

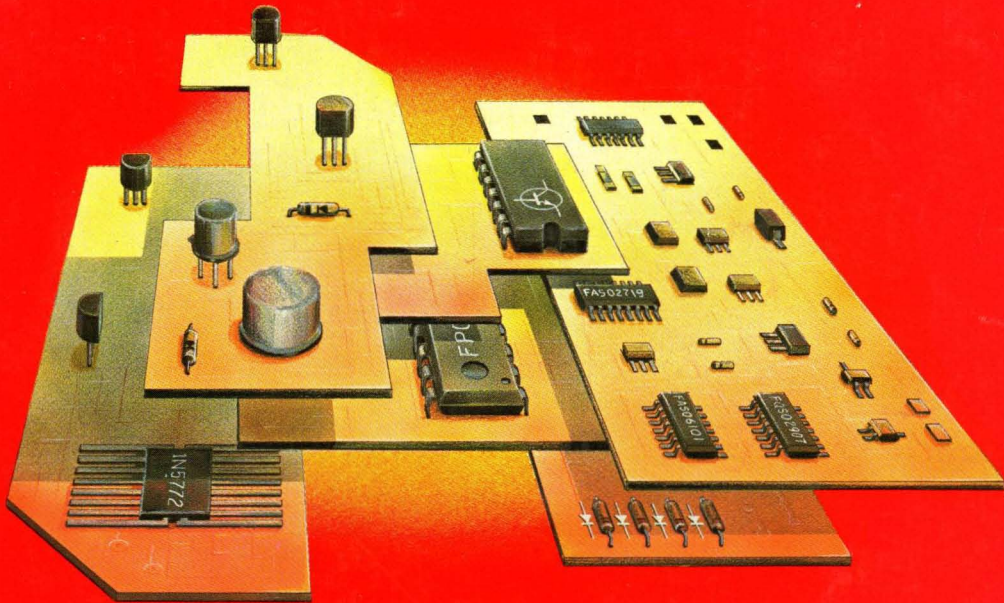
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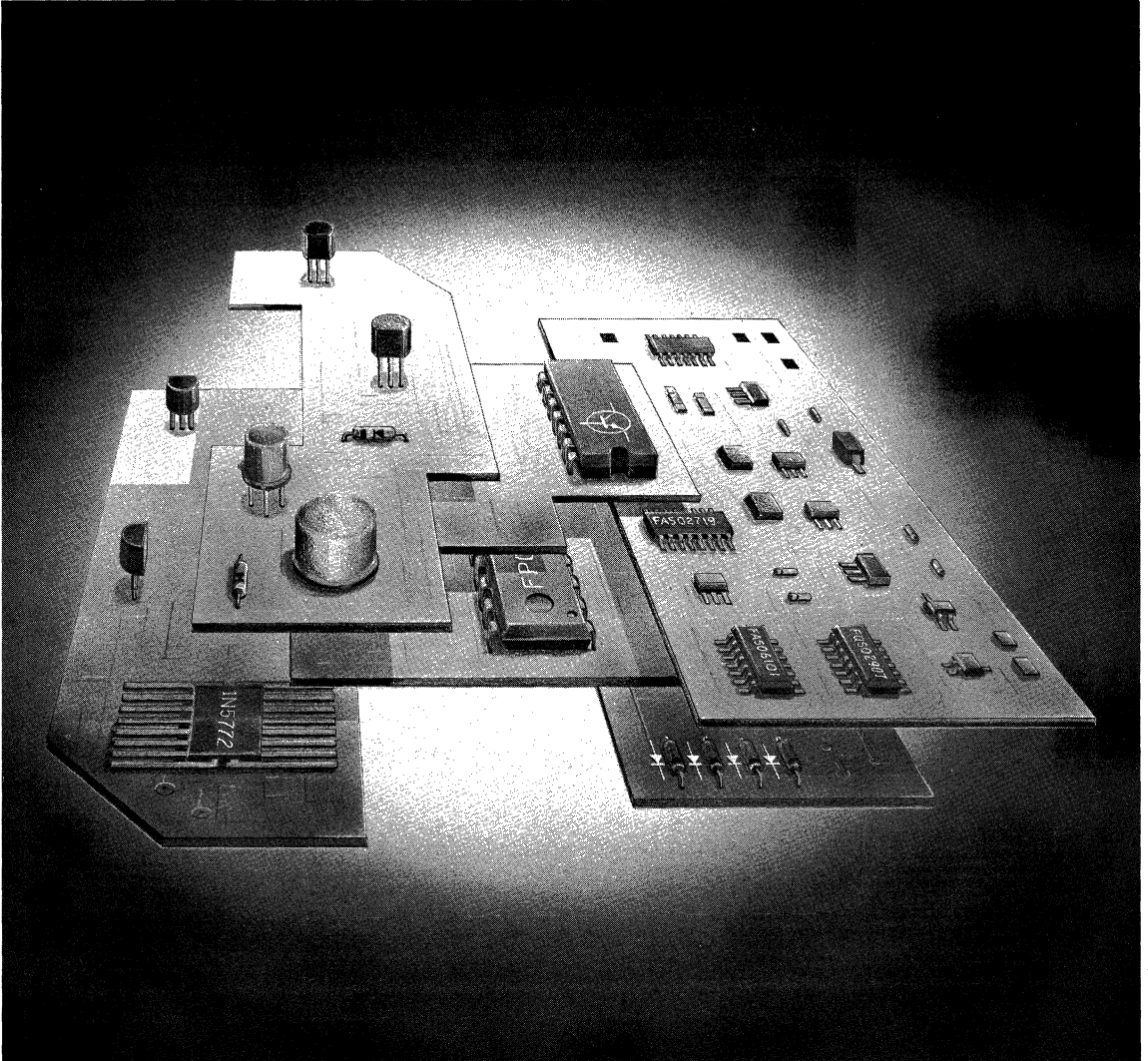
A Schlumberger Company

Discrete Data Book

1985

Analog Division





Introduction

The Discrete Small Signal Division, located in San Rafael, manufactures a broad line of discrete semiconductor products.

They include:

- Small signal and computer diodes in hermetic glass packages.
- General purpose, switching and power transistors in both plastic and hermetic metal can packages.
- Monolithic diode arrays in plastic and ceramic packages.
- Plastic quad transistor arrays.
- Plastic phototransistors.
- Many of the above devices are also available in surface mount packages.
 - Leadless glass diodes
 - SOT diodes and transistors
 - SOIC arrays
- Transistor, diode and monolithic array die
 - Hi-reliability qualified die (waffle pack)
 - Tested die in wafer form

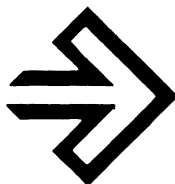
These products are designed to fill the needs of a wide range of consumer, industrial, computer and telecommunications applications. Also available are additionally processed high reliability and special selection devices.

The selection guides in this book are designed to provide an easy reference to the many standard device types currently offered by Fairchild. If your needs are not satisfied by any of the devices offered, please consult your local Fairchild sales representative or the factory, as special selections are available.

Fairchild has been a major supplier in this market for many years and the quality of product, high volume – on-time delivery and customer service is outstanding.

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If you need the electrical characteristics for any of the listed industry standards, they are available and guaranteed by four device families. Each of these families are available in five configurations including; single, series, common cathode and common anode. Please see the appropriate data sheet for details.

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1N916
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1N916B
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1N3600
1N4009
1N4148
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FDH666
MMBD2835
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FDSO1400 family

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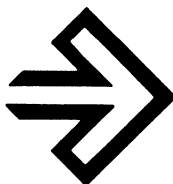
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Diode Shortform Data

Computer Diodes (By Ascending t_{rr})

Glass - Package

DEVICE NO.	t_{rr} ns Max	BV V Min	I_R nA Max	@	V_R V	V_F V Max	@	I_F mA	C pF Max	Package No.	Page No.
FD700	0.70	30	50		20	1.1		50	1.0	DO-7	3-55
1N4376	0.75	20	100		10	1.1		50	1.0	DO-7	3-18
1N4244	0.75	20	100		10	1.0		20	0.8	DO-7	3-18
BAY82	0.75	15	100		12	1.0		20	1.3	DO-7	3-18
FD777	0.75	15	100		8.0	1.0		20	1.3	DO-7	3-55
1N5282	2.0	80	100		55	1.3		500	2.5	DO-35	3-215
1N4153	2.0	75	50		50	0.88		20	4.0	DO-35	3-209
1N4151	2.0	75	50		50	1.0		50	4.0	DO-35	3-209
1N4305	2.0	75	100		50	0.85		10	2.0	DO-35	3-204
BAY71	2.0	50	100		35	1.0		20	2.0	DO-35	3-14
1N4152	2.0	40	50		30	0.88		20	4.0	DO-35	3-209
1N4154	2.0	35	100		25	1.0		30	4.0	DO-35	3-209
1N914	4.0	100	25		20	1.0		10	4.0	DO-35	3-201
1N914A	4.0	100	25		20	1.0		20	4.0	DO-35	3-201
1N914B	4.0	100	25		20	1.0		100	4.0	DO-35	3-201
1N916	4.0	100	25		20	1.0		10	2.0	DO-35	3-201
1N916A	4.0	100	25		20	1.0		20	2.0	DO-35	3-201
1N916B	4.0	100	25		20	1.0		30	2.0	DO-35	3-201
1N4148	4.0	100	25		20	1.0		10	4.0	DO-35	3-201
1N4149	4.0	100	25		20	1.0		10	2.0	DO-35	3-201
1N4446	4.0	100	25		20	1.0		20	4.0	DO-35	3-201
1N4447	4.0	100	25		20	1.0		20	4.0	DO-35	3-201
1N4448	4.0	100	25		20	1.0		100	2.0	DO-35	3-201
1N4449	4.0	100	25		20	1.0		30	2.0	DO-35	3-201
1N3600	4.0	75	100		50	1.0		200	2.5	DO-35	3-207
FDH600	4.0	75	100		50	1.0		200	2.5	DO-35	3-54
1N3064	4.0	75	100		50	1.0		10	2.0	DO-35	3-204
1N4150	4.0	75	100		50	1.0		200	2.5	DO-35	3-207
1N4454	4.0	75	100		50	1.0		10	2.0	DO-35	3-204
BAX13	4.0	50	200		50	1.0		20	3.0	DO-35	3-12

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Diode Shortform Data

Computer Diodes (By Ascending t_{rr}) continued
Glass Package

DEVICE NO.	t_{rr} ns Max	BV V Min	I_R nA Max	@	V_R V	V_F V Max	@	I_F mA	C pF Max	Package No.	Page No.
BAY74	4.0	50	100		35	1.1		300	3.0	DO-35	3-17
FDH900	4.0	45	500		40	1.1		100	3.0	DO-35	3-56
FDH666	4.0	40	100		25	1.0		100	3.5	DO-35	3-54
1N4450	4.0	40	50		30	1.0		200	4.0	DO-35	3-207
1N4009	4.0	35	100		25	1.0		30	4.0	DO-35	3-208
1N625	4.0	30	1000		20	1.5		4.0	—	DO-35	3-197
FDH999	5.0	35	1000		25	1.0		10	5.0	DO-35	3-56
FDH1000	100	75	50		20	1.0		500	5.0	DO-35	3-57

Computer Diodes (By Ascending t_{rr}) continued
Leadless Glass Package

Device No.	t_{rr} ns Max.	BV V Min.	I_R nA Max.	@	V_R V	V_F V Max.	@	I_F mA	C pF Max.	Pkg. No.	Page No.
FDLL4153	2.0	75	50		50	0.88		20	4.0	LL-34	3-209
FDLL4151	2.0	75	50		50	1.0		50	4.0	LL-34	3-209
FDLL4305	2.0	75	100		50	0.85		10	2.0	LL-34	3-204
FDLL4152	2.0	40	50		30	0.88		20	4.0	LL-34	3-209
FDLL4154	2.0	35	100		25	1.0		30	4.0	LL-34	3-209
FDLL914	4.0	100	25		20	1.0		10	4.0	LL-34	3-201
FDLL914A	4.0	100	25		20	1.0		20	4.0	LL-34	3-201
FDLL914B	4.0	100	25		20	1.0		100	4.0	LL-34	3-201
FDLL916	4.0	100	25		20	1.0		10	2.0	LL-34	3-201
FDLL916A	4.0	100	25		20	1.0		20	2.0	LL-34	3-201
FDLL916B	4.0	100	25		20	1.0		30	2.0	LL-34	3-201
FDLL4148	4.0	100	25		20	1.0		10	4.0	LL-34	3-201
FDLL4149	4.0	100	25		20	1.0		10	2.0	LL-34	3-201
FDLL4446	4.0	100	25		20	1.0		20	4.0	LL-34	3-201
FDLL4447	4.0	100	25		20	1.0		20	4.0	LL-34	3-201
FDLL4448	4.0	100	25		20	1.0		100	2.0	LL-34	3-201
FDLL4449	4.0	100	25		20	1.0		30	2.0	LL-34	3-201
FDLL3600	4.0	75	100		50	1.0		200	2.5	LL-34	3-207
FDLL600	4.0	75	100		50	1.0		200	2.5	LL-34	3-54
FDLL3064	4.0	75	100		50	1.0		10	2.0	LL-34	3-204

Diode Shortform Data

Computer Diodes (By Ascending t_{rr}) continued

Leadless Glass Package

Device No.	t_{rr} ns Max.	B_V V Min.	I_R nA Max.	@ V	V_R V	V_F V Max.	@ mA	I_F mA	C pF Max.	Pkg. No.	Page No.
FDLL4150	4.0	75	100		50	1.0		200	2.5	LL-34	3-207
FDLL4454	4.0	75	100		50	1.0		10	2.0	LL-34	3-204
FDLL666	4.0	40	100		25	1.0		100	3.5	LL-34	3-54
FDLL4450	4.0	40	50		30	1.0		200	4.0	LL-34	3-207
FDLL4009	4.0	35	100		25	1.0		30	4.0	LL-34	3-208
FDLL625	50	30	1000	20		1.5		4.0		LL-34	3-197

Low Leakage Diodes (By Descending B_V)

Glass Package

DEVICE NO.	B_V V Min	I_R nA Max	@ V	V_R V	V_F V Max	@ mA	I_F mA	C pF Max	Package No.	Page No.
1N485B	200	25		180	1.0		100	—	DO-35	3-196
1N459	200	25		175	1.0		3.0	—	DO-35	3-194
1N459A	200	25		175	1.0		100	—	DO-35	3-194
FDH300	150	1.0		125	1.0		200	6.0	DO-35	3-52
1N3595	150	1.0		125	1.0		200	8.0	DO-35	3-206
1N6099	150	1.0		125	1.0		200	8.0	DO-35	3-206
FDH333	150	3.0		125	1.05		200	6.0	DO-35	3-52
1N458A	150	5.0		125	1.0		100	—	DO-35	3-194
1N484B	150	25		130	1.0		100	—	DO-35	3-196
1N458	150	25		125	1.0		7.0	6.0	DO-35	3-194
BAY73	125	5.0		100	1.0		200	8.0	DO-35	3-16
1N483B	80	25		70	1.0		100	—	DO-35	3-196
1N457	70	25		60	1.0		20	8.0	DO-35	3-194
1N457A	70	25		60	1.0		100	—	DO-35	3-194
1N482B	40	25		36	1.0		100	—	DO-35	3-196
FJT1100	30	0.001		5.0	1.05		10	1.5	DO-7	3-62
1N456A	30	25		25	1.0		100	—	DO-35	3-194
1N456	30	25		25	1.0		40	10	DO-35	3-194

Diode Shortform Data

Low Leakage Diodes (by Descending B_V)

Leadless Glass Package

Device No.	B_V V Min.	I_R nA Max.	@ V	V_R V	V_F V Max.	@ mA	C pF Max.	Pkg. No.	Page No.
FDLL485B	200	25		180	1.0	100		LL-34	3-196
FDLL459	200	25		175	1.0	3.0		LL-34	3-194
FDLL459A	200	25		175	1.0	100		LL-34	3-194
FDLL300	150	1.0		125	1.0	200	6.0	LL-34	3-52
FDLL3595	150	1.0		125	1.0	200	8.0	LL-34	3-206
FDLL6099	150	1.0		125	1.0	200	8.0	LL-34	3-206
FDLL333	150	3.0		125	1.05	200	6.0	LL-34	3-52
FDLL458A	150	5.0		125	1.0	100		LL-34	3-194
FDLL484B	150	25		130	1.0	100		LL-34	3-196
FDLL458	150	25		125	1.0	7.0	6.0	LL-34	3-194
FDLL483B	80	25		70	1.0	100		LL-34	3-196
FDLL457	70	25		60	1.0	20	8.0	LL-34	3-194
FDLL457A	70	25		60	1.0	100		LL-34	3-194
FDLL482B	40	25		36	1.0	100		LL-34	3-196
FDLL456A	30	25		25	1.0	100		LL-34	3-194
FDLL456	30	25		25	1.0	40	10	LL-34	3-194

High Voltage Diodes (By Descending B_V)

Glass Package

DEVICE NO.	B_V V Min	I_R nA Max	@ V	V_R V	V_F V Max	@ mA	C pF Max	t_{rr} ns Max	Package No.	Page No.
BAV21	250	100		200	1.0	100	—	50	DO-35	3-6
1N661	240	10000		200	1.0	6.0	—	300	DO-35	3-199
FDH400	200	100		150	1.0	200	2.0	50	DO-35	3-53
1N3070	200	100		175	1.0	100	5.0	50	DO-35	3-205
1N4938	200	100		175	1.0	100	5.0	50	DO-35	3-205
BAV20	200	100		150	1.0	100	—	50	DO-35	3-6
1N629	200	1000		175	1.5	4.0	—	1000	DO-35	3-197
FDH444	150	50		100	1.1	200	2.5	60	DO-35	3-53
1N628	150	1000		125	1.5	4.0	—	1000	DO-35	3-197

Diode Shortform Data

High Voltage Diodes (By Descending B_v) Glass Package

DEVICE NO.	B _V V Min	I _R nA Max	@	V _R V	V _F V Max	@	I _F mA	C pF Max	t _{rr} ns Max	Package No.	Page No.
BAY72	125	100		100	1.0		100	5.0	50	DO-35	3-15
BAY80	120	100		120	1.0		150	6.0	—	DO-35	3-15
BAV19	120	100		100	1.0		100	—	50	DO-35	3-6
1N658	120	50		50	1.0		100	—	300	DO-35	3-198
1N660	120	5000		100	1.0		6.0	—	300	DO-35	3-199
1N627	100	1000		75	1.5		4.0	—	1000	DO-35	3-197
1N626	50	1000		35	1.5		4.0	—	1000	DO-35	3-197

High Voltage Diodes (By Descending B_v) Leadless Glass Package

Device No.	B _V V Min.	I _R nA Max.	@	V _R V	V _F V Max.	@	I _F mA	C pF Max.	t _{rr} ns Max.	Pkg. No.	Page No.
FDLL400	200	100		150	1.0		200	2.0	50	LL-34	3-53
FDLL3070	200	100		175	1.0		100	5.0	50	LL-34	3-205
FDLL629	200	1000		175	1.5		4.0		1000	LL-34	3-197
FDLL444	150	50		100	1.1		200	2.5	60	LL-34	3-53
FDLL628	150	1000		125	1.5		4.0		1000	LL-34	3-197
FDLL658	120	50		50	1.0		100		300	LL-34	3-198
FDLL660	120	5000		100	1.0		6.0		300	LL-34	3-199
FDLL627	100	1000		75	1.5		4.0		1000	LL-34	3-197
FDLL626	50	1000		35	1.5		4.0		1000	LL-34	3-197

Diode Shortform Data

General Purpose Diodes (By Descending B_V)

Glass Package

DEVICE NO.	B_V V Min	I_R nA Max	@	V_R V	V_F V Max	@	I_F mA	C pF Max	t_{rr} ns Max	Package No.	Page No.
BA128	75	100		50	1.0		50	5.0	—	DO-35	3-3
1N462A	70	500		60	1.0		100	—	—	DO-35	3-195
BAV18	60	100		50	1.0		100	—	50	DO-35	3-6
1N659	60	5000		50	1.0		6.0	—	—	DO-35	3-199
1S920	50	100		50	1.2		200	—	—	DO-35	3-220
BA218	50	50		25	1.0		10	5.0	—	DO-35	3-4
1S44	50	50		10	1.15		10	6.0	—	DO-35	3-219
FDH900	45	500		40	1.1		100	3.0	4.0	DO-35	3-56
FDH999	35	1000		25	1.0		10	5.0	5.0	DO-35	3-56
1N461A	30	500		25	1.0		100	10	—	DO-35	3-195
BA217	30	50		10	1.0		10	5.0	—	DO-35	3-4
BA130	30	100		25	1.0		10	2.0	—	DO-35	3-3
BAV17	25	100		20	1.0		100	—	50	DO-35	3-6
1N661	240	10000		200	1.0		6.0	—	300	DO-35	3-199
1S923	200	100		200	1.2		200	—	—	DO-35	3-220
1N463A	200	500		175	1.0		100	—	—	DO-35	3-195
1S922	150	100		150	1.2		200	—	—	DO-35	3-220
BAX16	150	100		150	1.0		1.0	10	120	DO-35	3-13
1N660	120	5000		100	1.0		6.0	—	—	DO-35	3-199
1S921	100	100		100	1.2		200	—	—	DO-35	3-220

General Purpose Diodes (By Descending B_V)

Leadless Glass Package

Device No.	B_V V Min.	I_R nA Max.	@	V_R V	V_F V Max.	@	I_F mA	C pF Max.	Pkg. No.	Page No.
FDLL661	240	10000		200	1.0		6.0		LL-34	3-199
FDLL923	200	100		200	1.2		200		LL-34	3-220
FDLL463A	200	500		175	1.0		100		LL-34	3-195
FDLL922	150	100		150	1.2		200		LL-34	3-220
FDLL921	100	100		100	1.2		200		LL-34	3-220

Diode Shortform Data

General Purpose Diodes (By Descending B_V) Leadless Glass Package

Device No.	B_V V Min.	I_R nA Max.	@	V_R V	V_F V Max.	@	I_F mA	C pF Max.	Pkg. No.	Page No.
FDLL462A	70	500		60	1.0		100		LL-34	3-195
FDLL659	60	5000		50	1.0		6.0		LL-34	3-199
FDLL920	50	100		50	1.2		200		LL-34	3-220
FDLL44	50	50		10	.15		10	6.0	LL-34	3-219
FDLL461A	30	500		25	1.0		100	10	LL-34	3-195

Surface Mount Diodes Plastic Package

Device	Description	t_{rr} ns Max.	B_V V Min.	I_R nA Max.	@	V_R V	V_F V Max.	@	I_F mA	C pF Max.	Pkg. No.	Page No.
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FD SO 1200 FAMILY

FD SO1201	Single	4.0	100	25	20	1.0	200	2.0	TO-236	3-58
FD SO1202	Single	4.0	100	25	20	1.0	200	2.0	TO-236	3-58
FD SO1203	Series	4.0	100	25	20	1.0	200	2.0	TO-236	3-58
FD SO1204	Common Cathode	4.0	100	25	20	1.0	200	2.0	TO-236	3-58
FD SO1205	Common Anode	4.0	100	25	20	1.0	200	2.0	TO-236	3-58

FD SO 1400 FAMILY

FD SO1401	Single	50	200	100	175	1.0	200	2.0	TO-236	3-59
FD SO1402	Single	50	200	100	175	1.0	200	2.0	TO-236	3-59
FD SO1403	Series	50	200	100	175	1.0	200	2.0	TO-236	3-59
FD SO1404	Common Cathode	50	200	100	175	1.0	200	2.0	TO-236	3-59
FD SO1405	Common Anode	50	200	100	175	1.0	200	2.0	TO-236	3-59

FD SO 1500 FAMILY

FD SO1501	Single	—	200	1.0	125	1.0	200	4.0	TO-236	3-60
FD SO1502	Single	—	200	1.0	125	1.0	200	4.0	TO-236	3-60
FD SO1503	Series	—	200	1.0	125	1.0	200	4.0	TO-236	3-60
FD SO1504	Common Cathode	—	200	1.0	125	1.0	200	4.0	TO-236	3-60
FD SO1505	Common Anode	—	200	1.0	125	1.0	200	4.0	TO-236	3-60

Diode Shortform Data

Surface Mount Diodes

Plastic Package

Device	Description	t _{rr} ns Max.	B _V V Min.	I _R nA Max.	@ V _R V	V _F V Max.	@ I _F mA	C pF Max.	Pkg. No.	Page No.
FSDO 1700 FAMILY										
FDSO1701	Single	0.7	30	50	20	1.1	50	1.0	TO-236	3-61
FDSO1702	Single	0.7	30	50	20	1.1	50	1.0	TO-236	3-61
FDSO1703	Series	0.7	30	50	20	1.1	50	1.0	TO-236	3-61
FDSO1704	Common Cathode	0.7	30	50	20	1.1	50	1.0	TO-236	3-61
FDSO1705	Common Anode	0.7	30	50	20	1.1	50	1.0	TO-236	3-61
BAS16	Single	6.0	75	1000	75	1.1	50	2.0	TO-236	3-5
BAV70	Common Cathode	6.0	70	5000	70	1.1	50	1.5	TO-236	3-7
BAV74	Common Cathode	4.0	50	100	50	1.0	100	2.0	TO-236	3-8
BAV99	Series	6.0	70	2500	70	1.1	50	1.5	TO-236	3-9
BAW56	Common Anode	6.0	70	2500	70	1.1	50	2.5	TO-236	3-10

Military Qualified Diodes (Numeric Order)

Metal Packages

DEVICE NO.	B _V V Min	I _R nA Max	@ V _R V	V _F V Max	@ I _F mA	C pF Max	t _{rr} ns Max	Package No.
1N457JAN	70	25	60	1.0	20	6.0	—	DO-35
1N458JAN	150	25	125	1.0	7.0	6.0	—	DO-35
1N459JAN	200	25	175	1.0	3.0	6.0	—	DO-35
1N483BJAN	80	25	70	1.0	100	—	—	DO-35
1N483BJANTX	80	25	70	1.0	100	—	—	DO-35
1N485BJAN	200	25	180	1.0	100	—	—	DO-35
1N485BJANTX	200	25	180	1.0	100	—	—	DO-35
1N486BJAN	250	25	225	1.0	100	—	—	DO-35
1N486BJANTX	250	25	225	1.0	100	—	—	DO-35

Diode Shortform Data

Military Qualified Diodes (Numeric Order) continued
Metal Packages

DEVICE NO.	BV V Min	IR nA Max	@ V	VR V	VF V Max	@ mA	IF mA	C pF Max	t _{rr} ns Max	Package No.
1N914JAN	100	25		20	1.0		10	4.0	4.0	DO-35
1N914JANTX	100	25		20	1.0		10	4.0	4.0	DO-35
1N3064JAN	75	100		50	1.0		10	2.0	4.0	DO-7
1N3064JANTX	75	100		50	1.0		10	2.0	4.0	DO-7
1N3595JAN	150	1.0		125	1.0		200	8.0	3000	DO-7
1N3595JANTX	150	1.0		125	1.0		200	8.0	3000	DO-7
1N3595JANTXV	150	1.0		125	1.0		200	8.0	3000	DO-7
1N3600JAN	75	100		50	1.0		200	2.5	4.0	DO-7
1N3600JANTX	75	100		50	1.0		200	2.5	4.0	DO-7
1N3600JANTXV	75	100		50	1.0		200	2.5	4.0	DO-7
1N4148JAN	100	25		20	1.0		10	4.0	4.0	DO-35
1N4148JANTX	100	25		20	1.0		10	4.0	4.0	DO-35
1N4148JANTXV	100	25		20	1.0		10	4.0	4.0	DO-35
1N4148-1JAN	100	25		20	1.0		10	4.0	4.0	DO-35
1N4148-1JANTX	100	25		20	1.0		10	4.0	4.0	DO-35
1N4148-1JANTXV	100	25		20	1.0		10	4.0	4.0	DO-35
1N4150JAN	75	100		50	1.0		200	2.5	4.0	DO-35
1N4150JANTX	75	100		50	1.0		200	2.5	4.0	DO-35
1N4150JANTXV	75	100		50	1.0		200	2.5	4.0	DO-35
1N4150-1JAN	75	100		50	1.0		200	2.5	4.0	DO-35
1N4150-1JANTX	75	100		50	1.0		200	2.5	4.0	DO-35
1N4150-1JANTXV	75	100		50	1.0		200	2.5	4.0	DO-35
1N4376JAN	20	100		10	1.1		50	1.0	0.75	DO-7
1N4376JANTX	20	100		10	1.1		50	1.0	0.75	DO-7
1N4454JAN	75	100		50	1.0		10	2.0	4.0	DO-35
1N4454JANTX	75	100		50	1.0		10	2.0	4.0	DO-35
1N4454JANTXV	75	100		50	1.0		10	2.0	4.0	DO-35
1N4454-1JAN	75	100		50	1.0		10	2.0	4.0	DO-35
1N4454-JANTX	75	100		50	1.0		10	2.0	4.0	DO-35
1N4454-1JANTXV	75	100		50	1.0		10	2.0	4.0	DO-35

2

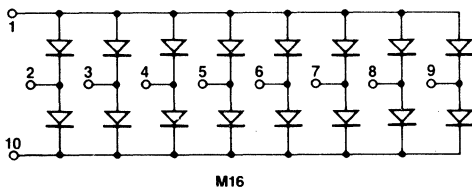
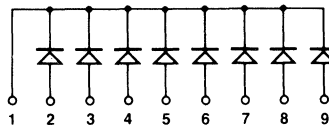
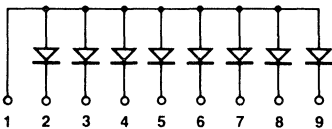
Diode Shortform Data

Military Qualified Diode Arrays (Numeric Listing)

Ceramic Package

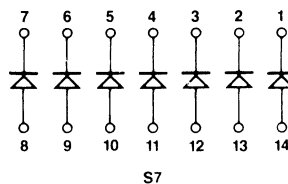
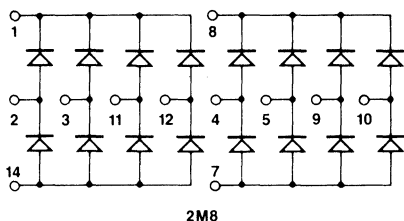
DEVICE NO.	BV V Min	V _F V Max	@	I _F mA	t _{fr} ns Max	t _{rr} ns Max	Configuration	Package No.
1N5768JAN	60	1.0		100	40	20	CC8	TO-85
1N5768JANTX	60	1.0		100	40	20	CC8	TO-85
1N5768JANTXV	60	1.0		100	40	20	CC8	TO-85
1N5770JAN	60	1.0		100	40	20	CA8	TO-85
1N5770JANTX	60	1.0		100	40	20	CA8	TO-85
1N5770JANTXV	60	1.0		100	40	20	CA8	TO-85
1N5772JAN	60	1.0		100	40	20	M16	TO-85
1N5772JANTX	60	1.0		100	40	20	M16	TO-85
1N5772JANTXV	60	1.0		100	40	20	M16	TO-85
1N5774JAN	60	1.0		100	40	20	2M8	TO-86
1N5774JANTX	60	1.0		100	40	20	2M8	TO-86
1N5774JANTXV	60	1.0		100	40	20	2M8	TO-86
1N6100JAN	75	1.0		100	15	5.0	S7	TO-86
1N6100JANTX	75	1.0		100	15	5.0	S7	TO-86
1N6100JANTXV	75	1.0		100	15	5.0	S7	TO-86
1N6101JAN	75	1.0		100	15	5.0	S7	TO-116-2
1N6101JANTX	75	1.0		100	15	5.0	S7	TO-116-2
1N6101JANTXV	75	1.0		100	15	5.0	S7	TO-116-2

Configurations



Diode Shortform Data

Configurations



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Military Qualified Diode Assemblies Unencapsulated Package

DEVICE NO.	BV V Min	I _R nA Max	@	V _R V	V _F V Max	@	I _F mA	C pF Max	t _{rr} ns Max	Package No.
1N4306JAN	75	50		50	1.0		50	2.0	4.0	DO-7
1N4306JANTX	75	50		50	1.0		50	2.0	4.0	DO-7
1N4306JANTXV	75	50		50	1.0		50	2.0	4.0	DO-7
1N4307JAN	75	50		50	1.0		50	2.0	4.0	DO-7
1N4307JANTX	75	50		50	1.0		50	2.0	4.0	DO-7
1N4307JANTXV	75	50		50	1.0		50	2.0	4.0	DO-7

Monolithic Diode Arrays (Numeric Listing) continued Plastic - Ceramic - Metal Packages

DEVICE NO.	BV V Min	V _F V Max	@	I _F mA	ΔV _F mV Max	t _{rr} ns Max	Configuration	Package No.	Page No.
FSA1410M	60	1.0		100	15	10	CA8	TO-96	3-82
FSA1411M	60	1.0		100	15	10	CC8	TO-96	3-82
FSA2002M	60	1.0		100	15	10	CC8	TO-85	3-82
FSA2003M	60	1.0		100	15	10	CA8	TO-85	3-82
FSA2500M	60	1.0		100	15	10	M16	TO-85	3-84
FSA2501M	60	1.0		100	15	10	M16	TO-116-2	3-84
FSA2501P	60	1.0		100	15	10	M16	TO-116	3-84
FSA2502M	60	1.0		100	15	10	M16	TO-96	3-84

Diode Shortform Data

Monolithic Diode Arrays (Numeric Listing)

Plastic - Ceramic - Metal Packages

DEVICE NO.	BV V Min	V _F V Max	@	I _F mA	ΔV _F mV Max	t _{rr} ns Max	Configuration	Package No.	Page No.
FSA2503M	60	1.0		100	15	10	2M8	TO-116-2	3-86
FSA2503P	60	1.0		100	15	10	2M8	TO-116	3-86
FSA2504M	60	1.0		100	15	10	2M8	TO-86	3-86
FSA2509M	60	1.3		500	15	10	2M8	TO-116-2	3-87
FSA2509P	60	1.3		500	15	10	2M8	TO-116	3-87
FSA2510M	60	1.3		500	15	10	M16	TO-116-2	3-87
FSA2510P	60	1.3		500	15	10	M16	TO-116	3-87
FSA2563M	60	1.3		500	15	10	CC8	TO-116-2	3-89
FSA2563P	60	1.3		500	15	10	CC8	TO-116	3-89
FSA2564M	60	1.3		500	15	10	CA8	TO-116-2	3-89
FSA2564P	60	1.3		500	15	10	CA8	TO-116	3-89
FSA2565M	60	1.3		500	15	10	CC13	TO-116-2	3-89
FSA2565P	60	1.3		500	15	10	CC13	TO-116	3-89
FSA2566M	60	1.3		500	15	10	CA13	TO-116-2	3-89
FSA2566P	60	1.3		500	15	10	CA13	TO-116	3-89
FSA2619M	100	1.0		10	15	5	S8	6B	3-91
FSA2619P	100	1.0		10	15	5	S8	9B	3-91
FSA2620M	100	1.0		10	15	5	S7	TO-116-2	3-91
FSA2620P	100	1.0		10	15	5	S7	TO-116	3-91
FSA2621M	100	1.0		10	15	5	S7	TO-86	3-91
FSA2621M	100	1.0		10	15	5	S7	TO-116	3-91
FSA2702M	60	1.0		200	3	5	R4	TO-33	3-93
FSA2703M	60	1.0		200	3	6	R4	TO-72	3-93
FSA2704M	60	1.0		200	—	6	R4	TO-33	3-93
FSA2705M	60	1.0		200	—	6	R4	TO-72	3-93
FSA2719M	75	1.0		10	15	6	S8	6B	3-91
FSA2719P	75	1.0		10	15	6	S8	9B	3-91
FSA2720M	75	1.0		10	15	6	S7	TO-116-2	3-91
FSA2720P	75	1.0		10	15	6	S7	TO-116	3-91
FSA2721M	75	1.0		10	15	6	S7	TO-86	3-91

Diode Shortform Data

Monolithic Diode Arrays (Numeric Listing) cont.

Plastic - Ceramic - Metal Packages

DEVICE NO.	B _V V Min	V _F V Max	@	I _F mA	ΔV _F mV Max	t _{rr} ns Max	Configuration	Package No.	Page No.
FSA2721M	75	1.0		10	15	6	S7	TO-86	3-91
1N5768	60	1.0		100	—	20	CC8	TO-85	3-216
1N5770	60	1.0		100	—	20	CA8	TO-85	3-216
1N5772	60	1.0		100	—	20	M16	TO-85	3-216
1N5774	60	1.0		100	—	20	2M8	TO-86	3-216
1N6100	75	1.0		100	—	5	S7	TO-86	3-218
1N6101	75	1.0		100	—	5	S7	TO-116-2	3-218

Surface Mount Monolithic Diode Arrays

Plastic Packages

Device No.	B _V V Min.	V _F V Max.	@	I _F mA	ΔV _F mV Max.	t _{rr} ns Max.	Config.	Pkg. No.	Page No.
FASO2501	60	1.0		100	15	10	M16	14-SOIC	3-84
FASO2503	60	1.0		100	15	10	2M8	14-SOIC	3-86
FASO2509	60	1.3		500	15	10	2M8	14-SOIC	3-87
FASO2510	60	1.3		500	15	10	M16	14-SOIC	3-87
FASO2563	60	1.3		500	15	10	CC8	14-SOIC	3-89
FASO2564	60	1.3		500	15	10	CA8	14-SOIC	3-89
FASO2565	60	1.3		500	15	10	CC13	16-SOIC	3-89
FASO2566	60	1.3		500	15	10	CA13	16-SOIC	3-89
FASO2618	75	1.0		10	50	5.0	S4	8-SOIC	3-50
FASO2718	100	1.0		10	50	6.0	S4	8-SOIC	3-50
FASO2619	100	1.0		10	15	5.0	S8	16-SOIC	3-91
FASO2620	100	1.0		10	15	5.0	S7	14-SOIC	3-91
FASO2719	75	1.0		10	15	6.0	S8	16-SOIC	3-91
FASO2720	75	1.0		10	15	6.0	S7	14-SOIC	3-91
FASO5768	60	1.0		100		20	CC8	8-SOIC	3-216
FASO5770	60	1.0		100		20	CA8	8-SOIC	3-216
FASO5772	60	1.0		100		20	M16	8-SOIC	3-216
FASO5774	60	1.0		100		20	2M8	14-SOIC	3-216
FASO6101	75	1.0		100		5.0	S7	14-SOIC	3-218

Diode Shortform Data

Zener Diodes (By Ascending V_Z) Glass Package

Device No.	V_Z V Nom.	Tol.* $\pm V_Z$ %	Z_Z Ω Max.	@ I_Z mA	I_R μA Max.	@ V	V_R V	T.C. %/°C Typ (Max)	P_D mW $T_A=25^\circ C$	Pkg. No.	Page No.
1N746A	3.3	5.0	28	20	10	1.0		-.070	500	DO-35	3-200
1N5226B	3.3	5.0	28	20	25	1.0		(-.070)	500	DO-35	3-213
1N4728A	3.3	5.0	10	76	100	1.0			1000	DO-41	3-211
1N747A	3.6	5.0	24	20	10	1.0		-0.65	500	DO-35	3-200
1N5227B	3.6	5.0	24	20	15	1.0		(-.065)	500	DO-35	3-213
1N4729A	3.6	5.0	10	69	100	1.0			1000	DO-41	3-211
1N748A	3.9	5.0	23	20	10	1.0		-0.60	500	DO-35	3-200
1N5228B	3.9	5.0	23	20	10	1.0		(-.060)	500	DO-35	3-213
1N4730A	3.9	5.0	9.0	64	50	1.0			1000	DO-41	3-211
1N749A	4.3	5.0	22	20	2.0	1.0		$\pm .055$	500	DO-35	3-200
1N5229B	4.3	5.0	22	20	5.0	1.0		($\pm .055$)	500	DO-35	3-213
1N4731A	4.3	5.0	9.0	58	10	1.0			1000	DO-41	3-211
1N750A	4.7	5.0	19	20	2.0	1.0		$\pm .043$	500	DO-35	3-200
1N5230B	4.7	5.0	19	20	5.0	2.0		($\pm .030$)	500	DO-35	3-213
1N4732A	4.7	5.0	8.0	53	10	1.0			1000	DO-41	3-211
1N751A	5.1	5.0	17	20	1.0	1.0		$\pm .030$	500	DO-35	3-200
1N5231B	5.1	5.0	17	20	5.0	2.0		($\pm .030$)	500	DO-35	3-213
1N4733A	5.1	5.0	7.0	49	10	1.0			1000	DO-41	3-211
1N752A	5.6	5.0	11	20	1.0	1.0		+0.028	500	DO-35	3-200
1N5232B	5.6	5.0	11	20	5.0	3.0		($\pm .038$)	500	DO-35	3-213
1N4734A	5.6	5.0	5.0	45	10	2.0			1000	DO-41	3-211
1N5233B	6.0	5.0	7.0	20	5.0	3.5		($\pm .038$)	500	DO-35	3-213
1N753A	6.2	5.0	7.0	20	0.1	1.0		+0.045	500	DO-35	3-200
1N5234B	6.2	5.0	7.0	20	5.0	4.0		(+0.045)	500	DO-35	3-213
1N4735A	6.2	5.0	2.0	41	10	3.0			1000	DO-41	3-211
1N754A	6.8	5.0	5.0	20	0.1	1.0		+0.050	500	DO-35	3-200
1N957B	6.8	5.0	4.5	18.5	150	5.2		+0.050	500	DO-35	3-203
1N5235B	6.8	5.0	5.0	20	3.0	5.0		(+0.050)	500	DO-35	3-213
1N4736A	6.8	5.0	3.5	37	10	4.0			1000	DO-41	3-211
1N755A	7.5	5.0	6.0	20	0.1	1.0		+0.058	500	DO-35	3-200
1N958B	7.5	5.0	5.5	16.5	75	5.7		+0.058	500	DO-35	3-203

Tolerance: All zener diodes are also available in $\pm 1\%$, $\pm 2\%$, $\pm 10\%$ and $\pm 20\%$ tolerances.

Diode Shortform Data

Zener Diodes (By Ascending V_Z) continued
Glass Package

DEVICE NO.	V_Z V Nom	Tol. $\pm V_Z$ %	Z_Z Ω Max	@ I_Z mA	I_R μA Max	@ V _R V	T.C. %/°C Typ (Max)	P_D mW $T_A=25^\circ C$	Package No.	Page No.
1N5236B	7.5	5.0	6.0	20	3.0	6.0	(+.058)	500	DO-35	3-213
1N4737A	7.5	5.0	4.0	34	10	5.0		1000	DO-41	3-211
1N756A	8.2	5.0	8.0	20	0.1	1.0	+.062	500	DO-35	3-200
1N959B	8.2	5.0	6.5	15	50	6.2	+.062	500	DO-35	3-203
1N5237B	8.2	5.0	8.0	20	3.0	6.5	(+.062)	500	DO-35	3-213
1N4738A	8.2	5.0	4.5	34	10	6.0		1000	DO-41	3-211
1N5238B	8.7	5.0	8.0	20	3.0	6.5	(+.065)	500	DO-35	3-213
1N757A	9.1	5.0	10	20	0.1	1.0	+.068	500	DO-35	3-200
1N960B	9.1	5.0	7.5	14	25	6.9	+.068	500	DO-35	3-203
1N5239B	9.1	5.0	10	20	3.0	7.0	(+.068)	500	DO-35	3-213
1N4739A	9.1	5.0	5.0	8	10	7.0		1000	DO-41	3-211
1N758A	10	5.0	17	20	0.1	1.0	+.075	500	DO-35	3-200
1N961B	10	5.0	8.5	12.5	10	7.6	+.072	500	DO-35	3-203
1N5240B	10	5.0	17	20	3.0	8.0	(+.075)	500	DO-35	3-213
1N4740A	10	5.0	7.0	25	10	7.6		1000	DO-41	3-211
1N962B	11	5.0	9.5	11.5	5.0	8.4	+.073	500	DO-35	3-203
1N5241B	11	5.0	22	20	2.0	8.4	(+.076)	500	DO-35	3-213
1N4741A	11	5.0	8.0	23	5.0	8.4		1000	DO-41	3-211
1N759A	12	5.0	30	20	0.1	1.0	+.077	500	DO-35	3-200
1N963B	12	5.0	11.5	10.5	5.0	9.1	+.076	500	DO-35	3-203
1N5242B	12	5.0	30	20	1.0	9.1	(+.077)	500	DO-35	3-213
1N4742A	12	5.0	9.0	21	5.0	9.1		1000	DO-41	3-211
1N964B	13	5.0	13	9.5	5.0	9.9	+.079	500	DO-35	3-203
1N5243B	13	5.0	13	9.5	0.5	9.9	(+.079)	500	DO-35	3-213
1N4743A	13	5.0	10	19	5.0	9.9		1000	DO-41	3-211
1N5244B	14	5.0	15	9.0	0.1	10	(+.082)	500	DO-35	3-213
1N965B	15	5.0	16	8.5	5.0	11.4	+.082	500	DO-35	3-203
1N5245B	15	5.0	16	8.5	0.1	11	(+.082)	500	DO-35	3-213
1N4744A	15	5.0	14	17	5.0	11.4		1000	DO-41	3-211
1N966B	16	5.0	17	7.8	5.0	12.2	+.083	500	DO-35	3-203
1N5246B	16	5.0	17	7.8	0.1	12	(+.083)	500	DO-35	3-213
1N4745A	16	5.0	16	15.5	5.0	12.2		1000	DO-41	3-211
1N5247B	17	5.0	19	7.4	0.1	13	(+.084)	500	DO-35	3-213

Diode Shortform Data

Zener Diodes (By Ascending Vz) cont.
Glass Package

DEVICE NO.	V _Z V Nom	Tol. ±V _Z %	Z _Z Ω Max	@I _Z mA	I _R μA Max	V _R @ V	T.C. %/°C Typ (Max)	P _D mW T _A =25°C	Package No.	Page No.
1N967B	18	5.0	21	7.0	5.0	13.7	+ .085	500	DO-35	3-203
1N5248B	18	5.0	21	7.0	0.1	14	(+.085)	500	DO-35	3-213
1N4746A	18	5.0	20	14	5.0	13.7		1000	DO-41	3-211
1N5249B	19	5.0	23	6.6	0.1	14	(+.086)	500	DO-35	3-213
1N968B	20	5.0	25	6.2	5.0	15.2	+ .086	500	DO-35	3-203
1N5250B	20	5.0	25	6.2	0.1	15	(+.086)	500	DO-35	3-213
1N4747A	20	5.0	22	12.5	5.0	15.2		1000	DO-41	3-211
1N969B	22	5.0	29	5.6	5.0	16.7	+ .087	500	DO-35	3-203
1N5251B	22	5.0	29	5.6	0.1	17	(+.087)	500	DO-35	3-213
1N4748A	22	5.0	23	11.5	5.0	16.7		1000	DO-41	3-211
1N970B	24	5.0	33	5.2	5.0	18.2	+ .088	500	DO-35	3-203
1N5252B	24	5.0	33	5.2	0.1	18	(+.088)	500	DO-35	3-213
1N4749A	24	5.0	25	10.5	5.0	18.2		1000	DO-41	3-211
1N5253B	25	5.0	5	5.0	0.1	19	(+.089)	500	DO-35	3-213
1N971B	27	5.0	41	4.6	5.0	20.6	+ .090	500	DO-35	3-203
1N5254B	27	5.0	41	4.6	0.1	21	(+.090)	500	DO-35	3-213
1N4750A	27	5.0	35	9.5	5.0	20.6		1000	DO-41	3-211
1N5255B	28	5.0	44	4.5	0.1	21	(+.091)	500	DO-35	3-213
1N972B	30	5.0	49	4.2	5.0	22.8	+ .091	500	DO-35	3-203
1N5256B	30	5.0	49	4.2	0.1	23	(+.091)	500	DO-35	3-213
1N4751A	30	5.0	40	8.5	5.0	22.8		1000	DO-41	3-211
1N973B	33	5.0	58	3.8	5.0	25.1	+ .092	500	DO-35	3-203
1N5257B	33	5.0	58	3.8	0.1	25	(+.092)	500	DO-35	3-213
1N4752A	33	5.0	45	7.5	5.0	25.1		1000	DO-41	3-211

Tolerance: All zener diodes are also available in ±1%, ±2%, ±10%, and ±20% tolerances.

Transistor Shortform Data

Military Qualified Transistors (Numeric Order)
Metal Packages

Device No.	BV_{CEO}	$h_{FE} @ I_C \setminus V_{CE}$		$V_{CE(sat)} @ I_C \setminus I_C$		I_C	Pkg.	Mil Std.
NPN	V	mA/V		V	mA/mA	Max. mA	No.	19500 Slash No.
PNP	V	mA/V		V	mA/mA	Max. mA	No.	19500 Slash No.
2N718AJAN	30	40-120	150/10	1.5	150/15	500	TO-18	181
2N718AJANTX	30	40-120	150/10	1.5	150/15	500	TO-18	181
2N718AJANTXV	30	40-120	150/10	1.5	150/15	500	TO-18	181
2N930JAN	45	100-300	10/5.0	1.0	10/0.5	30	TO-18	253
2N930JANTX	45	100-300	10/5.0	1.0	10/0.5	30	TO-18	253
2N1613JAN	30	40-120	150/10	1.5	150/15	500	TO-39	181
2N1613JANTX	30	40-120	150/10	1.5	150/15	500	TO-39	181
2N1613JANTXV	30	40-120	150/10	1.5	150/15	500	TO-39	181
2N2218AJAN	50	40-120	150/10	0.3	150/15	800	TO-39	251
2N2218AJANTX	50	40-120	150/10	0.3	150/15	800	TO-39	251
2N2218AJANTXV	50	40-120	150/10	0.3	150/15	800	TO-39	251
2N2219AJAN	50	100-300	150/10	0.3	150/15	800	TO-39	251
2N2219AJANTX	50	100-300	150/10	0.3	150/15	800	TO-39	251
2N2219AJANTXV	50	100-300	150/10	0.3	150/15	800	TO-39	251
2N2060JAN	60	50-150	10/5.0	0.3	50/5	500	TO-78	270
2N2060JANTX	60	50-150	10/5.0	0.3	50/5	500	TO-78	270
2N2221AJAN	50	40-120	150/10	0.3	150/15	800	TO-18	255
2N2221AJANTX	50	40-120	150/10	0.3	150/15	800	TO-18	255
2N2221AJANTXV	50	40-120	150/10	0.3	150/15	800	TO-18	255
2N2222AJAN	50	100-300	150/10	0.3	150/15	800	TO-18	255
2N2222AJANTX	50	100-300	150/10	0.3	150/15	800	TO-18	255
2N2222AJANTXV	50	100-300	150/10	0.3	150/15	800	TO-18	255
2N2369AJAN	15	40-120	10/0.35	0.2	10/1.0		TO-18	317
2N2369AJANTX	15	40-120	10/0.35	0.2	10/1.0		TO-18	317
2N2369AJANTXV	15	40-120	10/0.35	0.2	10/1.0		TO-18	317
2N2484JAN	60	200-500	10 μ A/1.0	0.3	1.0/0.1	50	TO-18	376
2N2484JANTX	60	200-500	10 μ A/1.0	0.3	1.0/0.1	50	TO-18	376
2N2484JANTXV	60	200-500	10 μ A/1.0	0.3	1.0/0.1	50	TO-18	376
2N2904AJAN	60	40-120	150/10	0.4	150/15	600	TO-39	290
2N2904JANTX	60	40-120	150/10	0.4	150/15	600	TO-39	290
2N2904AJANTXV	60	40-120	150/10	0.4	150/15	600	TO-39	290
2N2905AJAN	60	100-300	150/10	0.4	150/15	600	TO-39	290
2N2905AJANTX	60	100-300	150/10	0.4	150/15	600	TO-39	290

Transistor Shortform Data

Military Qualified Transistors (Numeric Order)
Metal Packages

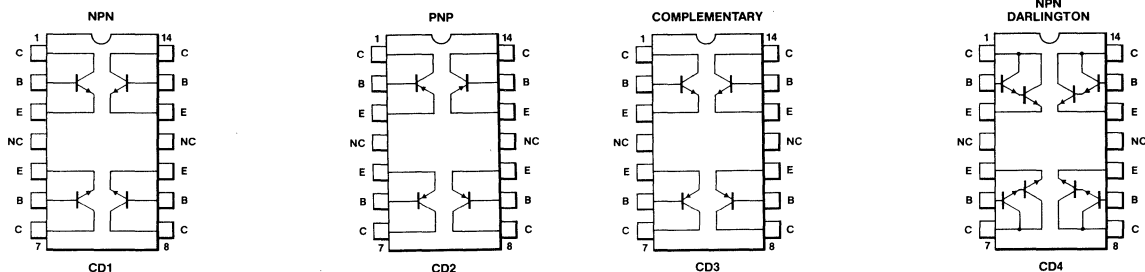
Device No.		BV_{CEO}	$h_{FE} @ I_C \setminus V_{CE}$		$V_{CE(sat)} @ I_C \setminus I_C$		I_C Max. mA	Pkg. No.	Mil Std. 19500 Slash No.
NPN	PNP	V	mA/V		V	mA/mA			
	2N2905AJANTX	60	100-300	150/10	0.4	150/15	600	TO-39	290
	2N2905AJANTXV	60	100-300	150/10	0.4	150/15	600	TO-39	290
	2N2906AJAN	60	40-120	150/10	0.4	150/15		TO-18	291
	2N2906AJANTX	60	40-120	150/10	0.4	150/15		TO-18	291
	2N2906AJANTXV	60	40-120	150/10	0.4	150/15		TO-18	291
	2N2907AJAN	60	100-300	150/10	0.4	150/15	600	TO-18	291
	2N2907AJANTX	60	100-300	150/10	0.4	150/15	600	TO-18	291
	2N2907AJANTXV	60	100-300	150/10	0.4	150/15	600	TO-18	291
	2N2920JAN	60	300-1000	1.0/5.0	0.3	1.0/0.1	30	TO-78	355
	2N2920JANTX	60	300-1000	1.0/5.0	0.3	1.0/0.1	30	TO-78	355
	2N2920JANTXV	60	300-1000	1.0/5.0	0.3	1.0/0.1	30	TO-78	355
	2N3019JAN	80	100-300	150/10	0.2	150/15		TO-39	391
	2N3019JANTX	80	100-300	150/10	0.2	150/15		TO-39	391
	2N3019JANTXV	80	100-300	150/10	0.2	150/15		TO-39	391
	2N3700JAN	80	100-300	150/10	0.2	150/15		TO-18	391
	2N3700JANTX	80	100-300	150/10	0.2	150/15		TO-18	391
	2N3700JANTXV	80	100-300	150/10	0.2	150/15		TO-18	391

Transistor Shortform Data

Special Quad Transistors Plastic Package

Device No.	BV_{CEO} V	h_{FE} Min.	@ I _C /V _{CE} mA/V	$V_{CE(sat)}$ Max V	@ I _C /I _B mA/mA	I _C Max mA	Pkg.	Page No.
NPN	PNP	Min.		Max				
UNMATCHED								
FPQ2222		40	100	150/10	0.4	150/15	500	TO-116 3-63
	FPQ2907	40	100	150/10	0.4	150/15	500	TO-116 3-64
FPQ3724		40	30	500/1.0	0.5	500/50	1.0 A	TO-116 3-65
FPQ3725		50	20	500/1.0	0.5	500/50	1.0 A	TO-116 3-65
MPQ3725		40	200	500/1.0	0.5	500/50	1.0 A	TO-116 3-65
SWITCHING								
FPQ3904		40	100	10/1.0	0.2	10/1.0	200	TO-116 3-67
MPQ3904		40	75	10/1.0	0.2	10/1.0	200	TO-116 3-67
	FPQ3906	40	100	10/1.0	0.25	10/1.0	200	TO-116 3-69
	MPQ3906	40	75	10/1.0	0.25	10/1.0	200	TO-116 3-69
NPN DARLINGTON								
FPQ6426		30	10,000	100/5.0	1.5	100/0.1	500	TO-116 3-71
MPQ6426		30	10,000	100/5.0	1.5	100/0.1	500	TO-116 3-71
COMPLEMENTARY								
FPQ6502		40	100	150/10	0.4	150/15	500	TO-116 3-73
MPQ6502		30	100	150/10	0.4	150/15	500	TO-116 3-73
FPQ6700		40	100	10/1.0	0.25	10/1.0	200	TO-116 3-75
MPQ6700		40	70	10/1.0	0.25	10/1.0	200	TO-116 3-75

Connection Diagrams (Top View)



NPN RF Transistors (By Descending B_V) cont.
Plastic Package

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE} @	mA/V I_C/V_{CE}	V Max.	$V_{CE(sat)}$ @	mA I_C/I_B
FTSO3563	TO-236	12	30	20-200	8.0/10			
FTSO5130	TO-236	12	30	15-250	8.0/10	0.6		10/1.0
MPS3563	TO-92	12	30	20-200	8.0/10			
PN3563	TO-92	12	30	20-200	8.0/10			
PN5130	TO-92	12	30	15-250	8.0/10	0.6		10/1.0
FTSO918	TO-236	15	30	20	3.0/1.0	0.4		10/1.0
MPS918	TO-92	15	30	20	10/1.0	0.4		3.0/1.0
PN918	TO-92	15	30	20	3.0/1.0	0.4		10/1.0

NPN Switches and Core Drivers (By Descending B_V)
Metal - Plastic - Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}	mA/V I_C/V_{CE}	V Max.	$V_{CE(sat)}$	mA I_C/I_B
2N3725	TO-39	50	80	60-150	100/1.0	0.26		100/10
2N4014	TO-18	50	80	60-150	100/1.0	0.26		100/10
2N3253	TO-39	40	75	25-75	500/1.0	0.6		500/50
2N3724	TO-39	30	50	60-150	100/1.0	0.20		100/10
2N4013	TO-18	30	50	60-150	100/1.0	0.2		100/10
FTSO2710	TO-236	20	40	40	10/1.0	0.25		10/1.0
FTSO3014	TO-236	20	40	30-120	30/0.4	0.18		30/3.0
2N2710	TO-18	20	40	40	10/1.0	0.25		10/1.0
2N3014	TO-52	20	40	30-120	30/0.4	0.18		30/3.0
FTSO706	TO-236	15	25	25	10/1.0	0.6		10/1.0
FTSO706A	TO-236	15	25	20-60	10/1.0	0.6		10/1.0
FTSO2369	TO-236	15	40	40-120	10/1.0	0.25		10/1.0
FTSO2369A	TO-236	15	40	40-120	10/0.35	0.2		10/1.0
FTSO3013	TO-236	15	40	30-120	30/0.4	0.18		30/3.0
FTSO3646	TO-236	15	40	30-120	30/0.4	0.20		30/3.0
FTSO4275	TO-236	15	40	35-120	10/1.0	0.20		10/1.0
FTSO5769	TO-236	15	40	40-120	10/0.35	0.2		10/1.0
FTSO5772	TO-236	15	40	30-120	30/0.4	0.2		30/3.0

Transistor Shortform Data

V Max.	V _{BE(sat)} @	mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB	Page No.
			1.7	600	14-26			3-134
1.0		10/1.0	1.7	450				3-174
0.95		10/5.0	1.7	600	14			3-134
			1.7	600	14-26			3-134
1.0		10/1.0	1.7	450				3-174
1.0		10/1.0	1.7	600	15	30	6.0	3-134
1.0		10/1.0	1.7	600	15	30	6.0	3-134
1.0		10/1.0	1.7	600	15	30	6.0	3-134

V Max.	V _{BE(sat)}	mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
0.8		10/1.0	4.0	300	25	35		3-276
0.86		100/10	10	300	35	60		3-276
1.3		500/50	12	175	50	70		3-270
0.8		10/1.0	4.0	300	25	35		3-276
0.86		100/10	10	300	35	60		3-276
0.9		10/1.0	4.0	500	20	35		3-256
0.95		30/3.0	5.0	350	16	25		3-262
0.9		10/1.0	4.0	500	20	35		3-256
0.95		30/3.0	5.0	350	16	25		3-262
0.9		10/1.0	6.0	200	40	75		3-222
0.9		10/1.0	6.0	200	40	75		3-222
0.85		10/1.0	4.0	400	12	18		3-246
0.85		10/1.0	4.0	500	12	18		3-246
0.95		30/3.0	5.0	350	15	25		3-262
0.95		30/3.0	5.0	350	18	28		3-152
0.95		30/3.0	5.0	350	18	28		3-163
0.85		10/1.0	4.0	500	12	18		3-246
0.95		30/3.0	5.0	350	18	28		3-152

NPN Switches and Core Drivers (By Descending B_V)
Metal - Plastic Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
					mA/V I_C/V_{CE}	V Max.	mA I_C/I_B
MPS706	TO-92	15	25	20	10/1.0	0.6	10/1.0
MPS706A	TO-92	15	25	20-60	10/1.0	0.6	10/1.0
MPS2369	TO-92	15	40	40-120	10/1.0	0.25	10/1.0
MPS3646	TO-92	15	40	30-120	30/0.4	0.20	30/3.0
PN2369	TO-92	15	40	40-120	10/1.0	0.25	10/1.0
PN2369A	TO-92	15	40	40-120	10/0.35	0.20	10/1.0
PN3646	TO-92	15	40	30-120	30/0.4	0.20	30/3.0
PN4275	TO-92	15	40	35-120	10/1.0	0.20	10/1.0
2N706	TO-18	15	25	20	10/1.0	0.6	10/1.0
2N2369	TO-18	15	40	40-120	10/1.0	0.25	10/1.0
2N2369A	TO-18	15	40	40-120	10/0.35	0.2	10/1.0
2N3013	TO-52	15	40	30-120	30/0.4	0.18	30/3.0
2N5769	TO-92	15	40	40-120	10/0.35	0.2	10/1.0
2N5772	TO-92	15	40	30-120	30/0.4	0.2	30/3.0
BSX39	TO-236	14		40-200	10/1.0	0.25	10/1.0
BSV52	TO-236	12		40-120	10/1.0	0.25	10/1.0
FTSO4274	TO-236	12	30	35-120	10/1.0	0.20	10/1.0
FTSO5224	TO-236	12	25	40-400	10/1.0	0.35	10/3.0
PN4274	TO-92	12	30	35-120	10/1.0	0.20	10/1.0
2N5224	TO-92	12	25	40-400	10/1.0	0.35	10/3.0
FTSO5134	TO-236	10	20	20-150	10/1.0	0.25	10/1.0
PN5134	TO-92	10	20	20-150	10/1.0	0.25	10/1.0

Transistor Shortform Data

V Max.	V_{BE(sat)} mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
0.9	10/1.0	6.0	200	40	75		3-222
0.9	10/1.0	6.0	200	40	75		3-222
0.85	10/1.0	4.0	500	12	18		3-246
0.95	30/3.0	5.0	350	18	28		3-152
0.85	10/1.0	4.0	400	12	12		3-246
0.85	10/1.0	4.0	400	12	12		3-246
0.85	10/1.0	4.0	500	12	18		3-152
0.95	30/3.0	5.0	350	18	28		3-163
0.9	10/1.0	6.0	200				3-222
0.85	10/1.0	4.0	400	12	18		3-246
0.85	10/1.0	4.0	500	12	18		3-246
0.95	30/3.0	5.0	350	15	25		3-261
0.85	10/1.0	4.0	500	12	18		3-246
0.95	30/3.0	5.0	350	18	25		3-152
0.85	10/1.0			12	18		3-47
0.85	10/1.0	4.0	400	12	18		3-46
0.95	30/3.0	5.0	350	16	25		3-163
0.9	10/3.0	4.0	250	45	60		3-318
0.95	30/3.0	5.0	350	16	25		3-163
0.9	10/3.0	4.0	250	45	60		3-318
0.9	10/1.0	4.0	250	18	18		3-177
0.9	10/1.0	4.0	250	18	18		3-177

2

PNP Switches and Core Drivers (By Descending B_V)

Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
FTSO5228	TO-236	-5.0	-5.0	30	10/0.3	-0.4	10/3.0
2N5228	TO-92	-5.0	-5.0	30	10/0.3	-0.4	10/3.0
FTSO3639	TO-236	-6.0	-6.0	30-120	10/0.3	-0.16	10/1.0
MPS3639	TO-92	-6.0	-6.0	30-120	10/0.3	-0.16	10/1.0
PN3639	TO-92	-6.0	-6.0	30-120	10/0.3	-0.16	10/1.0
FTSO3640	TO-236	-12	-12	30-120	10/0.3	-0.2	10/1.0
FTSO4208	TO-236	-12	-12	30-120	10/0.3	-0.15	10/1.0
FTSO4258	TO-236	-12	-12	30-120	10/3.0	-0.15	10/1.0
MPS3640	TO-92	-12	-12	30-120	10/0.3	-0.2	10/1.0
PN3640	TO-92	-12	-12	30-120	10/0.3	-0.2	10/1.0
PN4258	TO-92	-12	-12	30-120	10/3.0	-0.15	10/1.0
2N4208	TO-18	-12	-12	30-120	10/0.3	-0.15	10/1.0
FTSO5771	TO-236	-15	-15	50-120	10/0.3	-0.18	10/1.0
2N4209	TO-18	-15	-15	50-120	10/0.3	-0.18	10/1.0
2N5771	TO-92	-15	-15	50-120	10/0.3	-0.18	10/1.0

NPN General Purpose Amplifiers (By Descending B_V)

Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
FTSOA42	TO-236	300	300	40	30/10	0.5	20/2.0
MPSA42	TO-92	300	300	40	30/10	0.5	20/2.0
PE7059	TO-92	300	300	40	30/20	1.0	20/2.0
PE7058	TO-92	220	220	40	30/20	1.0	20/2.0
FTSOA43	TO-236	200	200	50-200	30/10	0.4	20/2.0
MPSA43	TO-92	200	200	50-200	30/10	0.4	20/2.0
FTSO5965	TO-236	180	200	50-250	10/5.0	0.2	10/1.0
FTSO5833	TO-236	180	200	50-250	10/5.0	0.2	10/1.0
PN5965	TO-92	180	200	50-250	10/5.0	0.2	10/1.0
2N5833	TO-92	180	200	50-250	10/5.0	0.2	10/1.0
2N5550	TO-92	140	160	60-250	10/5.0	0.15	10/1.0

Transistor Shortform Data

V Max.	V_{BE(sat)} mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
-1.25	10/3.0	5.0	300	75	140		3-323
-1.25	10/3.0	5.0	300	75	140		3-323
-1.0	10/1.0	3.5	500	60	60		3-144
-1.0	10/1.0	3.5	500	60	60		3-144
-1.0	10/1.0	3.5	500	60	60		3-144
-1.0	10/1.0	3.5	500	60	75		3-144
-0.95	10/1.0	3.0	700	15	20		3-295
-0.95	10/1.0	3.0	700	15	20		3-161
-1.0	10/1.0	3.5	500	60	75		3-144
-1.0	10/1.0	3.5	500	60	75		3-144
-0.95	10/1.0	3.0	700	15	20		3-161
-0.95	10/1.0	3.0	700	15	20		3-295
-0.95	10/1.0	3.0	850	15	20		3-338
-0.95	10/1.0	3.0	850	15	20		3-295
-0.95	10/1.0	3.0	850	15	20		3-338

V Max.	V_{BE(sat)} mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} MHz Min.	t_{off} ns Max.	NF ns Max.	Page No.
0.9	20/2.0	3.0	50				3-119
0.9	20/2.0	3.0	50				3-119
0.85	20/2.0	4.0	40				3-130
0.85	20/2.0	4.0	40				3-130
0.9	20/2.0	4.0	50				3-119
0.9	20/2.0	4.0	50				3-119
1.0	10/1.0	4.0	100				3-192
1.0	10/1.0	4.0	100				3-340
1.0	10/1.0	4.0	100				3-192
1.0	10/1.0	4.0	100				3-340
1.0	10/1.0	6.0	100			10	3-333

NPN General Purpose Amplifiers (By Descending B_V) continued

Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
					mA/V I_C/V_{CE}	V Max.	mA I_C/I_B
2N5831	TO-92	140	160	80-250	10/5.0	0.2	10/1.0
FTSO5551	TO-236	160	180	80-250	10/5.0	0.15	10/1.0
MPS5551	TO-92	160	180	80-250	10/5.0	0.15	10/1.0
FTSO5550	TO-236	140	160	60-250	10/5.0	0.15	10/1.0
FTSO5831	TO-236	140	160	80-250	10/5.0	0.2	10/1.0
FTSOL01	TO-236	120	140	50-300	10/5.0	0.2	10/1.0
MPSL01	TO-92	120	140	50-300	10/5.0	0.2	10/1.0
FTSO5830	TO-236	100	120	80-500	10/5.0	0.2	10/1.0
2N5830	TO-92	100	120	80-500	10/5.0	0.2	10/1.0
2N2405	TO-39	90	120	60-200	150/10	0.5	150/15
BSS64	TO-236	80	120	20	1.0/10	0.7	4.0/0.4
FTSO4410	TO-236	80	120	60-400	10/1.0	0.2	1.0/0.1
2N1893	TO-39	80	120	40-120	150/10	5.0	150/15
2N3019	TO-39	80	140	100-300	150/10	0.20	150/15
2N3020	TO-39	80	140	40-120	150/10	0.20	150/15
2N3700	TO-18	80	140	100-300	150/10	0.2	150/15
2N3701	TO-18	80	140	40-120	150/10	0.2	150/15
2N4410	TO-92	80	120	60-400	10/1.0	0.2	1.0/0.1
FTSO2484	TO-236	60	60	100-500	10 μ A/5.0	0.35	1.0/0.1
FTSO3117	TO-236	60	60	250-500	10 μ A/5.0	0.35	1.0/0.1
FTSO5961	TO-236	60	60	150-700	10/5.0	0.2	10/0.5
PE4020	TO-92	60	60	150-950	10/5.0	0.2	10/0.5
PN2484	TO-92	60	60	100-500	10 μ A/5.0	0.35	1.0/0.1
2N1890	TO-39	60	100	100-300	150/10	5.0	150/15
2N2484	TO-18	60	60	100-500	10 μ A/5.0	0.35	1.0/0.1
2N3107	TO-39	60	100	100-300	150/1.0	0.25	150/15
2N3108	TO-39	60	100	40-120	150/1.0	0.25	150/15
2N3117	TO-18	60	60	250-500	10 μ A/5.0	0.35	1.0/0.1
2N5961	TO-92	60	60	150-700	10/5.0	0.2	10/0.5
FTSO4409	TO-236	50	80	60-400	10/1.0	0.2	1.0/0.1
FTSO5209	TO-236	50	50	100-300	100 μ A/5.0	0.7	10/1.0
FTSO5210	TO-236	50	50	200-600	100 μ A/5.0	0.7	10/1.0
2N3053	TO-39	50	60	50-250	150/10	1.4	150/15

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
1.0	10/1.0	4.0	100				3-340
1.0	10/1.0	6.0	100			8.0	3-333
1.0	10/1.0	6.0	100			8.0	3-333
1.0	10/1.0	6.0	100			10	3-333
1.0	10/1.0	4.0	100				3-340
1.2	10/1.0	8.0	60				3-125
1.2	10/1.0	8.0	60				3-125
1.0	10/1.0	6.0	100				3-340
1.0	10/1.0	6.0	100				3-340
1.1	150/15	15					3-249
			50				3-43
0.8	1.0/0.1	12	60				3-305
1.3	150/15	15	50				3-234
1.1	150/15	12	100			4.0	3-264
1.1	150/15	12	80				3-264
1.1	150/15	12	100			4.0	3-274
1.1	150/15	12	80				3-274
0.8	1.0/0.1	12	60				3-301
		6.0	60			3.0	3-251
		4.5	60			4.0	3-251
		4.0	100				3-343
		4.0	100			6.0	3-128
		6.0	60			3.0	3-251
1.3	150/15	15	60				3-232
		6.0	60			3.0	3-251
1.1	150/15	20	70	200	1000	7.0	3-267
1.1	150/15	20	60	200	600	7.0	3-267
		4.5	60			4.0	3-251
		4.0	100				3-343
0.8	1.0/0.1	12	60				3-305
		4.0	30				3-313
		4.0	30				3-313
1.7	150/15	15	100				3-266

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NPN General Purpose Amplifiers (By Descending V_V) continued

Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
					mA/V I_C/V_{CE}	V Max.	mA I_C/I_B
2N4409	TO-92	50	80	60-400	10/1.0	0.2	1.0/0.1
2N5209	TO-92	50	50	100-300	100 μ A/5.0	0.7	10/1.0
2N5210	TO-92	50	50	200-600	100 μ A/5.0	0.7	10/1.0
FTSO3693	TO-236	45	45	40-160	10/10		
FTSO3694	TO-236	45	45	100-400	10/10		
FTSO5962	TO-236	45	45	600-1400	0/5.0	0.2	10/0.5
MPSA18	TO-92	45	45	500-1500	10/5.0	0.3	50/5.0
PN930	TO-92	45	45	100-300	10 μ A/5.0	1.0	10/0.5
PN3642	TO-92	45	60	40-120	150/10	0.22	150/15
PN3693	TO-92	45	45	40-160	10/10		
PN3694	TO-92	45	45	100-400	10/10		
2N930	TO-18	45	45	100-300	10 μ A/5.0	1.0	10/0.5
2N930A	TO-18	45	60	100-300	10 μ A/5.0	0.5	10/0.5
2N2270	TO-39	45	60	50-200	150/10	0.9	150/15
2N2586	TO-18	45	60	120-360	10 μ A/5.0	0.5	5.0/0.5
2N5962	TO-92	45	45	600-1400	10/5.0	0.2	10/0.5
BCW66F	TO-236	45	75	100-250	100/1.0		
BCW72	TO-236	45	50	200-450	2.0/5.0	0.25	10/0.5
BCX70G	TO-236	45	45	120-220	2.0/5.0	0.35	10/0.25
BCX70H	TO-236	45	45	180-310	2.0/5.0	0.35	10/0.25
BCX70J	TO-236	45	45	250-460	2.0/5.0	0.35	10/0.25
BCF81	TO-236	45	50	420-800	2.0/5.0	0.25	10/0.5
BCW81	TO-236	45	50	420-800	2.0/5.0	0.25	10/0.5
FTSO930	TO-236	45	45	100-300	10 μ A/5.0	1.0	10/0.5
FTSO930A	TO-236	45	60	100-300	10 μ A/5.0	0.5	10/0.5
FTSO3642	TO-236	45	60	40-120	150/10	0.22	150/15
BSR14	TO-236	40	75	100-300	150/10	0.3	150/15
BSR17	TO-236	40	60	50-150	10/1.0	0.2	10/1.0
BSS79B	TO-236	40	75	40-120	150/10	0.3	150/15
BSS79C	TO-236	40	75	100-300	150/10	0.3	150/15
FTSOA20	TO-236	40		40-400	5.0/10	0.25	10/1.0
FTSO2218A	TO-236	40	75	40-120	150/10	0.3	150/15
FTSO2219A	TO-236	40	75	100-300	150/10	0.3	150/15
FTSO2221A	TO-236	40	75	40-120	150/10	0.3	150/15

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _r MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
0.8	1.0/0.1	12	60				3-305
		4.0	30				3-313
		4.0	30				3-313
		3.5	200				3-154
		3.5	200				3-154
		4.0	100				3-343
		3.0	100				1.5 3-116
1.0	10/0.5	8.0	30				3-226
		8.0	150				3-147
		3.5	200				3-154
		3.5	200				3-154
1.0	10/0.5	8.0	30			3-226	
0.9	10/0.5	3.0	45			3-228	
1.2	150/15	15	100			3-244	
0.9	5.0/0.5	7.0	45			3.0	3-254
		4.0	100				3-343
2.0	500/50	12	100	100	400	10	3-28
		4.0				10	3-30
0.85	50/0.25	4.5	125	150	800	6.0	3-32
0.85	50/0.25	4.5	125	150	800	6.0	3-32
0.85	50/0.25	4.5	125	150	800	6.0	3-32
		4.0				4.0	3-21
		4.0				10	3-31
1.0	10/0.5	8.0	30			3-226	
0.9	10/0.5	3.0	45				3-228
		8.0	150				3-147
1.2	150/15	8.0	300	35	285		3-36
0.85	10/1.0		250				3-40
		8.0	250	20	285		3-44
		8.0	250	20	285		3-44
		4.0	125				3-118
1.2	150/15	8.0	250	35	285		3-238
1.2	150/15	8.0	300	35	285	4.0	3-242
1.2	150/15	8.0	250	3	285		3-238

NPN General Purpose Amplifiers (By Descending B_V) continued

Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
FTSO2222A	TO-236	40	75	100-300	150/10	0.3	150/15
FTSO3567	TO-236	40	80	40-120	150/1.0	0.25	150/15
FTSO3569	TO-236	40	80	100-300	150/1.0	0.25	150/15
FTSO3903	TO-236	40	60	50-150	10/1.0	0.2	10/1.0
FTSO3904	TO-236	40	60	100-300	10/1.0	0.2	10/1.0
FTSO3946	TO-236	40	60	59-150	10/1.0	0.2	10/1.0
FTSO4400	TO-236	40	60	50-150	150/1.0	0.4	150/15
FTSO4401	TO-236	40	60	100-300	150/1.0	0.4	150/15
MPSA10	TO-92	40		40-400	5.0/10		
MPSA20	TO-92	40		40-400	5.0/10	0.25	10/1.0
PN2218A	TO-92	40	75	40-120	150/10	0.3	150/15
PN2219A	TO-92	40	75	100-300	150/10	0.3	150/15
PN2221A	TO-92	40	75	40-120	150/10	0.3	150/15
PN2222A	TO-92	40	45	100-300	150/10	0.3	150/15
PN3567	TO-92	40	80	40-120	150/1.0	0.25	150/15
PN3569	TO-92	40	80	100-300	150/1.0	0.25	150/15
2N697	TO-39	40	60	40-120	150/10	1.5	150/15
2N2218A	TO-39	40	75	40-120	150/10	0.3	150/15
2N2219A	TO-39	40	75	100-300	150/10	0.3	150/15
2N2221A	TO-18	40	75	40-120	150/10	0.3	150/15
2N2222A	TO-18	40	75	100-300	150/10	0.3	150/15
2N3109	TO-39	40	80	100-300	150/1.0	0.25	150/15
2N3903	TO-92	40	60	50-150	10/1.0	0.2	10/1.0
2N3904	TO-92	40	60	100-300	10/1.0	0.2	10/1.0
2N3946	TO-18	40	60	59-150	10/1.0	0.2	10/1.0
2N4400	TO-92	40	60	50-150	150/1.0	0.4	150/15
2N4401	TO-92	40	60	100-300	150/1.0	0.4	150/15
BCW60A	TO-236	32	32	120-200	2.0/5.0	0.35	10/0.25
BCW65A	TO-236	32	60	100-250	100/1.0		
2N1613	TO-39	32	75	40-120	150/10	1.5	150/15
BSR13	TO-236	30	60	100-300	150/10	0.4	150/15
FTSO2218	TO-236	30	60	40-120	150/10	0.4	150/15
FTSO2219	TO-236	30	60	100-300	150/10	0.4	150/15

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
1.2	150/15	8.0	300	35	285		3-242
1.1	150/15	20	56				3-140
1.1	150/15	20	60				3-140
0.85	10/1.0	4.0	250	70	225	6.0	3-278
0.85	10/1.0	4.0	300	70	250	5.0	3-278
0.9	10/1.0	4.0	250	335	375	5.0	3-282
0.95	150/15	6.5	200	35	255		3-301
0.95	150/15	6.5	250	35	255		3-301
		4.0	50				3-112
		4.0	125				3-118
1.2	150/15	8.0	250	35	285		3-238
1.2	150/15	8.0	300	35	285	4.0	3-242
1.2	150/15	8.0	250	35	285		3-238
1.2	150/15	8.0	300	35	285		3-242
1.1	150/15	20	60				3-140
1.1	150/15	20	60				3-140
1.3	150/15	35	50				3-221
1.2	150/15	8.0	250				3-238
1.2	150/15	8.0	300	35	250		3-242
1.2	150/15	8.0	250	35	285		3-238
1.2	150/15	8.0	300	35	285		3-242
1.1	150/15	25	70	200	1000	7.0	3-267
0.85	10/1.0	4.0	250	70	225	6.0	3-278
0.85	10/1.0	4.0	300	70	250	5.0	3-278
0.9	10/1.0	4.0	250	335	375	5.0	3-282
0.95	150/15	6.5	200	35	255		3-301
0.95	150/15	6.5	250	35	2255		3-301
0.85	50/0.25	4.5	125	150	800	6.0	3-24
2.0	500/50	12	100	100	400	10	3-27
1.3	150/15	25	60			12	3-224
1.3	150/15	8.0	250				3-36
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240

2

NPN General Purpose Amplifiers (By Descending V_V)

Metal - Plastic Package

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
					mA/V I_C/V_{CE}	V Max.	mA I_C/I_B
FTSO2221	TO-236	30	60	40-120	150/10	0.4	150/15
FTSO2222	TO-236	30	60	100-300	150/10	0.4	150/15
FTSO3566	TO-236	30	40	150-600	10/10	1.0	100/10
FTSO3641	TO-236	30	60	40-120	150/10	0.22	150/15
FTSO3643	TO-236	30	60	100-300	150/10	0.22	150/15
FTSO3704	TO-236	30	50	100-300	50/2.0	0.6	100/5.0
FTSO3705	TO-236	30	50	50-150	50/2.0	0.8	100/5.0
FTSO4123	TO-236	30	40	5-150	2.0/1.0	0.3	50/5.0
FTSO5088	TO-236	30	35	300-900	100 μ A/5.0	0.5	10/1.0
MPS3704	TO-92	30	50	100-300	50/2.0	0.6	100/5.0
MPS3705	TO-92	30	50	50-150	50/2.0	0.8	100/5.0
PN2218	TO-92	30	60	40-120	150/10	0.4	150/15
PN2219	TO-92	30	60	100-300	150/10	0.4	150/15
PN2221	TO-92	30	60	40-120	150/10	0.4	150/15
PN2222	TO-92	30	60	100-300	150/10	0.4	150/15
PN3566	TO-92	30	40	150-600	10/10	1.0	100/10
PN3641	TO-92	30	60	40-120	150/10	0.22	150/15
PN3643	TO-92	30	60	100-300	150/10	0.22	150/15
2N2218	TO-39	30	60	40-120	150/10	0.4	150/15
2N2219	TO-39	30	60	100-300	150/10	0.4	150/15
2N2221	TO-18	30	60	40-120	150/10	0.4	150/15
2N2222	TO-18	30	60	100-300	150/10	0.4	150/5
2N4123	TO-92	30	40	50-150	2.0/1.0	0.3	50/5.0
2N5088	TO-92	30	35	300-900	100 μ A/5.0	0.5	10/1.0
FTSO2924	TO-236	25	25				
FTSO3392	TO-236	25	25	150-300	2.0/4.5		
FTSO3393	TO-236	25	25	90-180	2.0/4.5		
FTSO3565	TO-236	25	30	150-600	1.0/10	0.35	100/0.1
FTSO4124	TO-236	25	30	120-360	2.0/1.0	0.3	50/5.0
FTSO5089	TO-236	25	30	400-1200	100 μ A/5.0	0.5	10/1.0
FTSO5135	TO-236	25	30	50-600	10/10	1.0	100/10
FTSO5172	TO-236	25	25	100-500	10/10	0.25	10/1.0
FTSO5225	TO-236	25	25	30-600	50/10	0.8	100/10

Transistor Shortform Data

$V_{BE(sat)}$ V Max.	mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240
		25	40				3-138
		8.0	150				3-147
		8.0	250				3-147
		12	100				3-99
		12	100				3-99
0.95	50/5.0	4.0	250			6.0	3-291
		4.0	50				3-311
		12	100				3-99
		12	100				3-99
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240
		25	40				3-138
		8.0	150				3-147
		8.0	250				3-147
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240
1.3	150/15	8.0	250				3-236
1.3	150/15	8.0	250				3-240
0.95	50/5.0	4.0	250			6.0	3-291
		4.0	50				3-311
		12					3-94
		10					3-95
		10					3-95
		4.0	40				3-137
0.95	50/5.0	4.0	300			5.0	3-291
		4.0	50				3-311
1.0	100/10	25	40				3-179
		10					3-101
1.0	100/10	20	50				3-320

NPN General Purpose Amplifiers (By Descending V_V)

Metal - Plastic Package

Device No.	Pkg.	V_{CEO} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
FTSO6514	TO-236	25	40	150-200	2.0/10	0.5	50/5.0
FTSO6515	TO-236	25	40	250-500	2.0/10	0.5	50/5.0
FTSO6520	TO-236	25	40	200-400	2.0/10	0.5	50/5.0
FTSO6521	TO-236	25	40	300-600	2.0/10	0.5	50/5.0
FTSO6560	TO-236	25	25	50-200	500/1.0	0.5	500/50
MPS2924	TO-92	25	25				
MPS3392	TO-92	25	25	150-300	2.0/4.5		
MPS3393	TO-92	25	25	90-180	2.0/4.5		
MPS5172	TO-92	25	25	100-500	10/10	0.25	10/1.0
MPS6514	TO-92	25	40	150-300	2.0/10	0.5	50/5.0
MPS6515	TO-92	25	40	250-500	2.0/10	0.5	50/5.0
MPS6520	TO-92	25	40	200-400	2.0/10	0.5	50/5.0
MPS6521	TO-92	25	40	300-600	2.0/10	0.5	50/5.0
MPS6560	TO-92	25	25	50-200	500/1.0	0.5	500/50
PE4010	TO-92	25	30	200-1000	1.0/10	0.35	1.0/0.1
PE8050	TO-92	25	30	65-200	100/1.0	0.15	200/20
PN3565	TO-92	25	30	150-600	1.0/10	0.35	1.0/0.1
PN5135	TO-92	25	30	50-600	10/10	1.0	100/10
2N4124	TO-92	25	30	120-360	2.0/1.0	0.3	50/5.0
2N5089	TO-92	25	30	400-1200	100 μ A/5.0	0.5	10/1.0
2N5225	TO-92	25	25	30-600	50/10	0.8	100/10
BCW32	TO-236	20	30	200-450	2.0/5.0	0.25	10/0.5
BCW33	TO-236	20	30	420-800	2.0/5.0	0.25	10/0.5
FTSO5136	TO-236	20	30	20-400	150/1.0	0.25	150/15
FTSO5137	TO-236	20	30	20-400	150/1.0	0.25	150/15
FTSO5223	TO-236	20	25	50-800	2.0/10	0.7	10/1.0
FTSO6561	TO-236	20	20	50-200	350/1.0	0.5	350/35
FTSO6571	TO-236	20	25	250-1,000	0.1/5.0	0.5	10/1.0
MPS6561	TO-92	20	20	50-200	350/1.0	0.5	350/35
MPS6571	TO-92	20	25	250-1,000	0.1/5.0	0.5	10/1.0
PN5136	TO-92	20	30	20-400	150/1.0	0.25	150/15
PN5137	TO-92	20	30	20-400	150/1.0	0.25	150/15
2N5223	TO-92	20	25	50-800	2.0/10	0.7	10/1.0

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
		3.5					3-102
		3.5					3-102
		3.5				3.0	3-104
		3.5				3.0	3-104
		30	60				3-107
		12					3-94
		10					3-95
		10					3-95
		10					3-101
		3.5					3-102
		3.5					3-102
		3.5				3.0	3-104
		3.5				3.0	3-104
		30	60				3-107
	4.0	60					3-127
0.9	200/20	40	100				3-132
		4.0	40				3-137
1.0	100/10	25	40				3-179
0.95	50/5.0	4.0	300			5.0	3-291
		4.0	50				3-311
1.0	100/10	20	50				3-320
		4.0				10	3-23
		4.0				10	3-23
1.1	150/15	35	40				3-179
1.1	150/15	35	40				3-179
1.2	10/1.0	4.0	150				3-316
		30	60				3-107
		4.5	50				3-109
0.5	350/35			30	60		3-107
0.5	10/1.0			4.5	50		3-109
0.25	150/15	1.1	150/15	35	40		3-179
0.25	150/15	1.1	150/15	35	40		3-179
0.7	10/1.0	1.2	10/1.0	4.0	150		3-316

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NPN General Purpose Amplifiers (By Descending V_V)
Metal - Plastic Package

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
FTSO5133	TO-236	18	20	60-000	1.8/5.0	0.4	1.0/0.1
PN5133	TO-92	18	20	60-1000	1.8/5.0	0.4	1.0/0.1
FTSO5220	TO-236	15	15	30-600	50/10	0.5	150/15
2N5220	TO-92	15	15	30-600	50/10	0.5	150/15
FTSO4274	TO-236	12	30	35-120	10/1.0	0.20	10/1.0
FTSO5128	TO-236	12	15	35-350	50/10	0.25	150/15
PN5128	TO-92	12	15	35-350	50/10	0.25	150/15
FTSO5134	TO-236	10	20	20-150	10/1.0	0.25	10/1.0
FTSOA12	TO-236		20	20,000	10/5.0	1.0	10/0.01
FTSOA13	TO-236		30	10,000	100/5.0	1.5	100/0.1
FTSOA14	TO-236		30	20,000	100/5.0	1.5	100/0.1
MPSA12	TO-92		20	20,000	10/5.0	1.0	10/0.01
MPSA13	TO-92		30	10,000	100/5.0	1.5	100/0.1
MPSA14	TO-92		30	20,000	100/5.0	1.5	100/0.01
2N718A	TO-18		75	40-120	150/10	1.5	150/15

PNP General Purpose Amplifiers (By Ascending B_V)
Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
BCW29	TO-236	-20	-30	120-260	2.0/5.0	-0.3	10/0.5
BCW30	TO-236	-20	-30	215-500	2.0/5.0	-0.3	10/0.5
FTSO5139	TO-236	-20	-20	40	10/-1.0	-0.2	10/1.0
FTSO5142	TO-236	-20	-20	30	50/-1.0	-0.5	50/2.5
FTSO5143	TO-236	-20	-20	15	300/-10	-2.0	300/30
PN5139	TO-92	-20	-20	40	10/-1.0	-0.2	10/1.0
PN5142	TO-92	-20	-20	30	50/-1.0	-0.5	50/2.5
PN5143	TO-92	-20	-20	15	300/-10	-2.0	300/30
FTSO3638	TO-236	-25	-25	30	50/-1.0	-0.25	50/2.5
FTSO3638A	TO-236	-25	-25	100	50/-1.0	-0.25	50/2.5
FTSO3702	TO-236	-25	-40	60-300	50/-5.0	-0.25	50/5.0
FTSO4126	TO-236	-25	-25	120-360	2.0/-1.0	-0.4	50/5.0

Transistor Shortform Data

V Max.	V_{BE(sat)} mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
		5.0	40				3-176
		5.0	40				3-176
1.1	150/15	10	100				3-315
1.1	150/15	10	100				3-315
0.95	30/3.0	5.0	350	16	25		3-163
1.1	150/15	10	200				3-172
1.1	150/15	10	200				3-172
0.9	10/1.0	4.0	250	18	18		3-177
							3-113
			125				3-114
			125				3-114
							3-113
			125				3-114
			125				3-114
1.3	150/15	25	60			12	3-224

V_{BE(sat)} V Max.	C_{ob} mA I_C/I_B	f_T pF Max.	t_{on} MHz Min.	t_{off} ns Max.	NF ns Max.	dB Max.	Page No.
		7.0				10	3-22
		7.0				10	3-22
-1.0	10/1.0	5.0	300				3-184
-1.5	50/2.5	10	100	100	200		3-186
-2.5	300/30	10	100	100	200		3-186
-1.0	10/1.0	5.0	300				3-184
-1.5	50/2.5	10	100	100	200		3-186
-2.5	300/30	10	100	100	200		3-186
-1.1	50/2.5	20	100	75	170		3-142
-1.1	50/2.5	10	150	75	170		3-142
		12	100				3-97
-0.95	50/5.0	4.5	250			4.0	3-293

PNP General Purpose Amplifiers (By Ascending V_B) continued
Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$ V Max.	mA I_C/I_B
					mA/V I_C/V_{CE}		
FTSO5226	TO-236	-25	-25	0-600	50/-10	-0.8	100/10
FTSO6562	TO-236	-25	-25	50-200	500/-1.0	-0.5	500/50
PN3638	TO-92	-25	-25	30	50/-1.0	-0.25	50/2.5
PN3638A	TO-92	-25	-	100	50/-1.0	-0.25	50/2.5
2N4126	TO-92	-25	-25	120-360	2.0/-1.0	-0.4	50/5.0
2N5226	TO-92	-25	-25	30-600	50/-10	-0.8	100/10
FTSO3703	TO-236	-30	-50	30-150	50/-5.0	-0.25	50/5.0
FTSO3704	TO-236	-30	-50	100-300	50/2.0	-0.6	100/5.0
FTSO3705	TO-236	-30	-50	50-150	50/2.0	-0.8	100/5.0
FTSO4125	TO-236	-30	-30	50-150	2.0/-1.0	-0.4	50/5.0
FTSO4916	TO-236	-30	-30	70-200	10/-1.0	-0.14	10/1.0
FTSO4917	TO-236	-30	-30	150-300	10/-1.0	-0.14	10/1.0
FTSO5138	TO-236	-30	-30	50-800	0.1/-10	-0.3	10/0.5
FTSO5227	TO-236	-30	-30	50-700	2.0/-10	-0.4	10/1.0
PN4916	TO-92	-30	-30	70-200	10/-1.0	-0.14	10/1.0
PN4917	TO-92	-30	-30	150-300	10/-1.0	-0.14	10/1.0
PN5138	TO-92	-30	-30	50-800	0.1/-10	-0.3	10/0.5
2N4125	TO-92	-30	-30	50-150	2.0/-1.0	-0.4	50/5.0
2N5227	TO-92	-30	-90	50-700	2.0/-10	-0.4	10/1.0
BCW61A	TO-236	-32	-32	120-220	2.0/5.0	-0.25	10/0.25
BCF29	TO-236	-32	-32	120-260	2.0/5.0	-0.3	10/0.50
BCF30	TO-236	-32	-32	215-500	2.0/5.0	-0.3	10/0.50
BSR15	TO-236	-40	-60	100-300	150/10	-0.4	150/15
BSS80B	TO-236	-40	-75	40-120	150/10	-0.3	150/15
BSS80C	TO-236	-40	-60	100-300	150/10	-0.4	150/15
FTSO2904	TO-236	-40	-60	40-120	150/-10	-0.4	150/15
FTSO2905	TO-236	-40	-60	100-300	150/-10	-0.4	150/15
FTSO2906	TO-236	-40	-60	40-120	150/-10	-0.4	150/15
FTSO2907	TO-236	-40	-60	100-300	150/-10	-0.4	150/15
FTSO3251	TO-236	-40	-50	100-300	10/-1.0	-0.25	10/1.0
FTSO3905	TO-236	-40	-40	50-150	10/-1.0	-0.25	10/1.0

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _r MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
-1.0	100/10	20	50				3-320
		30	60				3-107
-1.1	50/2.5	20	100	75	170		3-142
-1.1	50/2.5	10	150	75	170		3-142
-0.95	50/5.0	4.5	250			4.0	3-292
-1.0	100/10	20	50				3-320
-0.9	150/15	30	100	100	400	3.0	3-97
		12	100				3-99
		12	100				3-99
-0.95	50/5.0	4.5	200			5.0	3-293
-0.9	10/1.0	4.5	400	40	150	6.0	3-170
-0.9	10/1.0	4.5	450	40	150	6.0	3-170
-1.0	10/0.5	7.0	30				3-182
-1.0	10/1.0	5.0	100				3-322
-0.9	10/1.0	4.5	400	40	150	6.0	3-170
-0.9	10/1.0	4.5	450	40	150	6.0	3-170
-1.0	10/0.5	7.0	30				3-182
-0.95	50/5.0	4.5	200			5.0	3-293
-1.0	10/1.0	5.0	100				3-322
-0.85	10/0.25	6.0		150	800	6.0	3-26
		7.0					3-19
		7.0					3-19
-1.3	150/15	8.0	200	45	100		3-38
		8.0	250	20	285		3-45
		8.0	210	50	110		3-45
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-0.6-0.9	10/1.0	6.0	300	70	225	6.0	3-269
-0.85	10/1.0	4.5	200	70	260	5.0	3-280

PNP General Purpose Amplifiers (By Ascending B_V) continued
Metal - Glass Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$ V Max.	mA I_C/I_B
					mA/V I_C/V_{CE}		
FTSO3906	TO-236	-40	-40	100-300	10/-1.0	-0.25	10/1.0
FTSO4121	TO-236	-40	-40	70-200	10/-1.0	-0.14	10/1.0
FTSO4122	TO-236	-40	-40	150-300	10/-1.0	-0.14	10/1.0
FTSO4248	TO-236	-40	-40	50	0.1/-5.0	-0.25	10/0.5
FTSO4250	TO-236	-40	-40	250-700	0.1/-5.0	-0.25	10/0.5
FTSO4402	TO-236	-40	-40	50-150	150/-2.0	-0.4	150/15
FTSO4403	TO-236	-40	-40	100-300	150/-2.0	-0.4	150/15
FTSOA70	TO-236	-40		40-400	5.0/-10	-0.25	10/1.0
FTSO6518	TO-236	-40	-40	150-300	2.0/-10	-0.5	50/5.0
PN2904	TO-92	-40	-60	40-120	150/-10	-0.4	150/15
PN2905	TO-92	-40	-60	100-300	150/-10	-0.4	150/15
PN2906	TO-92	-40	-60	40-120	150/-10	-0.4	150/15
PN2907	TO-92	-40	-60	100-300	150/-10	-0.4	150/15
PN3251	TO-92	-40	-50	100-300	10/-1.0	-0.25	10/1.0
PN4121	TO-92	-40	-40	70-200	10/-1.0	-0.14	10/1.0
PN4122	TO-92	-40	-40	150-300	10/-1.0	-0.14	10/1.0
PN4248	TO-92	-40	-40	50	0.1/-5.0	-0.25	10/0.5
PN4250	TO-92	-40	-40	250-700	0.1/-5.0	-0.25	10/0.5
2N1132A	TO-39	-40	-60	30-90	150/-10	-1.5	150/15
2N2904	TO-39	-40	-60	40-120	150/-10	-0.4	150/15
2N2905	TO-39	-40	-60	100-300	150/-10	-0.4	150/15
2N2906	TO-18	-40	-60	40-120	150/-10	-0.4	150/15
2N2907	TO-18	-40	-60	100-300	150/-10	-0.4	150/15
2N3905	TO-92	-40	-40	50-150	10/-1.0	-0.25	10/1.0
2N3906	TO-92	-40	-40	100-300	10/-1.0	-0.25	10/1.0
2N4037	TO-39	-40	-60	50-250	150/-10	-1.4	150/15
2N4402	TO-92	-40	-40	50-150	150/-2.0	-0.4	150/15
2N4403	TO-92	-40	-40	100-300	150/-2.0	-0.4	150/15
BCF70	TO-236	-45	-50	215-500	2.0/5.0	-0.3	10/0.50
BCW69	TO-236	-45	-50	120-260	2.0/5.0	-0.3	10/0.5
BCW70	TO-236	-45	-50	215-500	2.0/5.0	-0.3	10/0.5
BCX71H	TO-236	-45	-45	180-310	2.0/5.0	-0.25	10/0.25
BCX71J	TO-236	-45	-45	250-460	2.0/5.0	-0.25	10/0.25

Transistor Shortform Data

V Max.	V_{BE(sat)} mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
-0.85	10/1.0	4.5	250	70	300	4.0	3-280
-0.9	10/1.0	4.5	400	40	150		3-156
-0.7-0.9	10/1.0	4.5	450	40	150		3-156
		6.0					3-158
		6.0				2.0	3-158
-0.95	150/15	8.5	150	35	255		3-303
-0.95	150/15	8.5	200	35	255		3-303
		4.0	125				3-118
		4.0					3-103
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-0.6-0.9	10/1.0	6.0	300	70	225	6.0	3-269
-0.9	10/1.0	4.5	400	40	150		3-156
-0.7-0.9	10/1.0	4.5	450	40	150	6.0	3-156
		6.0					3-158
		6.0				2.0	3-158
-1.3	150/15	30	60	45	35		3-230
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-1.3	150/15	8.0	200	45	100		3-258
-0.85	10/1.0	4.5	200	70	260	5.0	3-280
-0.85	10/1.0	4.5	250	70	300	4.0	3-280
		30	60				3-289
-0.95	150/15	8.5	150	35	255		3-303
-0.95	150/15	8.5	200	35	255		3-303
		7.0					3-20
		7.0				10	3-29
		7.0				10	3-29
		6.0		150	800	6.0	3-34
		6.0		150	800	6.0	3-34

2

PNP General Purpose Amplifiers (By Ascending V_B) continued
Metal - Plastic Packages

Device No.	Pkg.	V_{CE0} V Min.	V_{CBO} V Min.	h_{FE}		$V_{CE(sat)}$	
				mA/V I_C/V_{CE}	V Max.	mA I_C/I_B	
BCX71K	TO-236	-45	-45	380-630	2.0/5.0	-0.25	10/0.25
FTSO3644	TO-236	-45	-45	100-300	150/-10	-0.4	150/15
PN3644	TO-92	-45	-45	100-300	150/-10	-0.4	150/15
FTSO5086	TO-236	-50	-50	250-800	0.1/-5.0	-0.3	10/1.0
FTSO5087	TO-236	-50	-50	250-800	0.1/-5.0	-0.3	10/1.0
2N5086	TO-92	-50	-50	250-800	0.1/5.0	-0.3	10/1.0
2N5087	TO-92	-50	-50	250-800	0.1/-5.0	-0.3	10/1.0
BSR16	TO-236	-60	-60	100-300	150/10	-0.4	150/15
FTSO2904A	TO-236	-60	-60	40-120	150/-10	-0.4	150/15
FTSO2905A	TO-236	-60	-60	100-300	150/-10	-0.4	150/15
FTSO2906A	TO-236	-60	-60	40-120	150/-10	-0.4	150/15
FTSO2907A	TO-236	-60	-60	100-300	150/-10	-0.4	150/15
FTSO3645	TO-236	-60	-60	100-300	150/-10	-0.4	150/15
FTSO3962	TO-236	-60	-60	100-450	1.0/-5.0	-0.25	10/.5
FTSO4249	TO-236	-60	-60	100-300	0.1/-5.0	-0.25	10/0.5
FTSO4354	TO-236	-60	-60	50-500	10/-10	-0.15	150/15
FTSO4355	TO-236	-60	-60	100-400	10/-10	-0.15	150/15
FTSO5855	TO-236	-60	-60	50-300	150/-10	-0.4	150/15
FTSOA55	TO-236	-60	-60	50	100/-1.0	-0.25	100/10
PN2904A	TO-92	-60	-60	40-120	150/-10	-0.4	150/15
PN2905A	TO-92	-60	-60	100-300	150/-10	-0.4	150/15
PN2906A	TO-92	-60	-60	40-120	150/-10	-0.4	150/15
PN2907A	TO-92	-60	-60	100-300	150/-10	-0.4	150/15
PN3645	TO-92	-60	-60	100-300	150/-10	-0.4	150/15
PN4249	TO-92	60	-60	100-300	0.1/-5.0	-0.25	10/0.5
PN4250A	TO-92	-60	-60	250-700	0.1/-5.0	-0.25	10/0.5
PN4354	TO-92	-60	-60	50-500	10/-10	-0.15	150/15
PN4355	TO-92	-60	-60	100-400	10/-10	-0.15	150/15
PN5855	TO-92	-60	-60	50-300	150/-10	-0.4	150/15
2N2904A	TO-39	-60	-60	40-120	150/-10	-0.4	150/15
2N2905A	TO-39	-60	-60	100-300	150/-10	-0.4	150/15
2N2906A	TO-18	-60	-60	40-120	150/-10	-0.4	150/15
2N2907A	TO-18	-60	-60	100-300	150/-10	-0.4	150/15

Transistor Shortform Data

V Max.	V _{BE(sat)} mA I _C /I _B	C _{ob} pF Max.	f _T MHz Min.	t _{on} ns Max.	t _{off} ns Max.	NF dB Max.	Page No.
		6.0		150	800	6.0	3-34
-1.3	150/15	8.0	200	40	100		3-150
-1.3	150/15	8.0	200	40	100		3-150
		4.0	40			3.0	3-309
		4.0	40			2.0	3-309
		4.0	40			3.0	3-309
		4.0	40			2.0	3-309
1.3	150/15	8.0	200	45	100		3-38
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	40	100		3-150
-0.9	10/0.5	6.0	40			3.0	3-284
		6.0				3.0	3-158
-0.9	150/15	30	100	100	400	3.0	3-165
-0.9	150/15	30	100	100	400	3.0	3-165
-1.3	150/15	15	100				3-190
			100				3-121
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	40	100		3-150
		6.0				3.0	3-158
		6.0				2.0	3-158
-0.9	150/15	30	100	100	400	3.0	3-165
-0.9	150/15	30	100	100	400	3.0	3-165
-1.3	150/15	15	100				3-190
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260
-1.3	150/15	8.0	200	45	100		3-260

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PNP General Purpose Amplifiers (By Ascending V_V)
Metal - Plastic Packages

Device No.	Pkg.	V_{CEO}	V_{CBO}	h_{FE}	mA/V I_C/V_{CE}	$V_{CE(sat)}$	
		V Min.	V Min.			V Max.	mA I_C/I_B
2N3962	TO-18	-60	-60	100-450	1.0/-5.0	-0.25	10/5
2N4030	TO-39	-60	-60	40-120	100/-5.0	-0.15	150/15
2N4032	TO-39	-60	-60	100-300	100/-5.0	-0.15	150/15
2N4036	TO-39	-65	-90	20-200	150/-2.0	-0.65	150/15
FTSO4356	TO-236	-80	-80	50-250	10/-10	-0.15	150/15
FTSO5857	TO-236	-80	-80	50-300	150/-10	-0.4	150/15
FTSOA56	TO-236	-80	-80	50	100/-1.0	-0.25	100/10
PN4356	TO-92	-80	-80	50-250	10/-10	-0.15	150/15
2N4031	TO-39	-80	-80	40-120	100/-5.0	-0.15	150/15
2N4033	TO-39	-80	-80	100-300	100/-5.0	-0.15	150/5
BSS63	TO-236	-100	-110	30	10/1.0	-0.25	25/2.5
FTSOL51	TO-236	-100	-100	40-250	50/-5.0	-0.3	50/5.0
FTSO5400	TO-236	-120	-130	40-180	10/-5.0	-0.2	10/1.0
2N5400	TO-92	-120	-130	40-180	10/-5.0	-0.2	10/1.0
FTSO4888	TO-236	-150	-150	40-400	10/-10	-0.5	10/1.0
FTSO4889	TO-236	-150	-150	80-300	10/-10	-0.5	10/1.0
FTSO5401	TO-236	-150	-160	60-240	10/-5.0	-0.2	10/1.0
PN4888	TO-92	-150	-150	40-400	10/-10	-0.5	10/1.0
PN4889	TO-92	-150	-150	80-300	10/-10	-0.5	10/1.0
2N5401	TO-92	-150	-160	60-240	10/-5.0	-0.2	10/1.0
MPSA93	TO-92	-200	-200	30-150	30/-10	-0.4	20/2.0
MPSA92	TO-92	-300	-300	25	30/-10	-0.5	20/2.0

Transistor Shortform Data

$V_{BE(sat)}$ V Max.	mA I_C/I_B	C_{ob} pF Max.	f_T MHz Min.	t_{on} ns Max.	t_{off} ns Max.	NF dB Max.	Page No.
-0.9	10/0.5	6.0	40			3.0	3-284
-0.9	150/15	20	100	100	400		3-286
-0.9	150/15	20	150	100	400		3-286
-1.4	150/15		60	110	700		3-289
-0.9	150/15	30	100	100	400	3.0	3-165
-1.3	150/15	15	100				3-190
			100				3-121
-0.9	150/15	30	100	100	400	3.0	3-165
-0.9	150/15	20	100	100	400		3-286
-0.9	150/15	20	150	100	400		3-286
-0.9	25/2.5		50				3-42
-1.1	50/2.5	20	100	75	170		3-125
-1.0	10/1.0	60	100			8.0	3-329
-1.0	10/1.0	6.0	100			8.0	3-329
-0.9	10/1.0	4.0	30				3-168
-0.9	10/1.0	4.0	40			3.0	3-168
-1.0	10/1.0	6.0	100			8.0	3-329
-0.9	10/1.0	4.0	30				3-168
-0.9	10/1.0	4.0	40			3.0	3-168
-1.0	10/1.0	6.0	100			8.0	3-329
-0.9	20/2.0		50				3-123
-0.9	20/2.0		50				3-123

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Transistor Shortform Data

Phototransistors (Numeric Listing) cont.

Plastic Package

Device No.	Description	V_{CE0} $I_C = 1.0 \text{ mA}$ V		$I_{CE(II)}$ $V_{CE} = 5.0 \text{ V}$ mA			$V_{CE(sat)}$ H = 20 mW/cm ² V			t_r/t_f μs Typ	Package No.
		Min	Typ	Min	Typ	Max	Min	Typ	Max		
FPT100	Plastic, Dome Lens General Purpose	30	50	H = 5.0 mW/cm ² 0.2 1.4			$I_C = 500 \mu\text{A}$ 0.16 0.3			2.8	Opto-26
FPT100A	Plastic, Dome Lens 1:3 Sensitivity	30	50	H = 5.0 mW/cm ² 1.0 1.4 3.0			$I_C = 500 \mu\text{A}$ 0.16 0.3			2.8	Opto-26
FPT100B	Plastic, Dome Lens 1:2 Sensitivity	30	50	H = 5.0 mW/cm ² 1.3 1.4 2.6			$I_C = 500 \mu\text{A}$ 0.16 0.3			2.8	Opto-26
FPT110	Plastic, Flat Lens General Purpose	30	50	H = 5.0 mW/cm ² 0.2 0.88			$I_C = 500 \mu\text{A}$ 0.16 0.33			2.8	Opto-28
FPT110A	Plastic, Flat Lens 1:3 Sensitivity	30	50	H = 5.0 mW/cm ² 0.6 0.88 1.8			$I_C = 500 \mu\text{A}$ 0.16 0.33			2.8	Opto-28
FPT110B	Plastic, Flat Lens 1:2 Sensitivity	30	50	H = 5.0 mW/cm ² 0.8 0.88 1.6			$I_C = 500 \mu\text{A}$ 0.16 0.33			2.8	Opto-28
FPT120	Plastic, Dome Lens High Sensitivity	20	50	H = 1.0 mW/cm ² 0.4 1.5			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-26
FPT120A	Plastic, Dome Lens 1:3 Sensitivity	15	30	H = 1.0 mW/cm ² 1.5 4.5			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-26
FPT120B	Plastic, Dome Lens 1:1.5 Sensitivity	15	30	H = 1.0 mW/cm ² 2.0 4.0			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-26
FPT120C	Plastic, Dome Lens High Sensitivity	11	20	H = 5.0 mW/cm ² 16 25			$I_C = 1.0 \text{ mA}$ 0.35 0.55			18	Opto-26
FPT130	Plastic, Flat Lens High Sensitivity	20	50	H = 1.0 mW/cm ² 0.4 0.9			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-28
FPT130A	Plastic, Flat Lens 1:3 Sensitivity	15	30	H = 1.0 mW/cm ² 0.9 2.7			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-28
FPT130B	Plastic, Flat Lens 1:2 Sensitivity	15	30	H = 1.0 mW/cm ² 1.2 2.4			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-28
FPT320	Plastic, Dome Lens 1:3 Sensitivity	20	50	H = 1.0 mW/cm ² 0.75 1.5 2.25			$I_C = 1.0 \text{ mA}$ 0.25 0.55			18	Opto-26

Note Data Sheets:

FPT100, FPT100A, FPT100B, FPT110, FPT110A, FPT110B - page 3-77.

FPT120, FPT120A, FPT120B, FPT120C, FPT130, FPT130A, FPT130B - page 3-79.

FPT320 - page 3-81.

Power Shortform Data

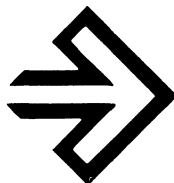
NPN Power Transistors (By Descending B_V) Metal Package

Device No.	V_{CE0} V Min.	I_C A Max.	h_{FE}		I_C mA	V_{CE} V V	$V_{CE(sat)}$ V V	I_C / I_B		P_D 25° C W	f_T MHz Min.	Pkg. No.	Page No.
			Min.	Max.									
2N3439	350	1.0	40	160	20	10	0.5	50	4.0	10	5.0	TO-39	3-273
2N3440	250	1.0	40	160	20	10	0.5	50	4.0	10	5.0	TO-39	3-273
2N5682	120	1.0	40	150	250	2.0	1.0	500	50	10		TO-39	3-335
2N5681	100	1.0	40	150	250	2.0	1.0	500	50	10		TO-39	3-335
2N5320	100	2.0	30	130	500	4.0	0.5	500	50	10	10	TO-39	3-325
2N5338	100	5.0	30	120	2000	2.0	1.2	5000	500	6.0		TO-39	3-327
2N5336	80	5.0	30	120	2000	2.0	1.2	5000	500	6.0		TO-39	3-327
2N4239	80	1.0	15		1000	1.0	0.6	1000	100	5.0	1.0	TO-39	3-299
2N5321	75	2.0	40	250	500	4.0	0.8	500	50	10	10	TO-39	3-325
2N4238	60	1.0	30		500	4.0	0.6	1000	100	5.0	1.0	TO-39	3-299
2N4896	60	5.0	100	300	2000	2.0	1.0	5000	500	4.0	20	TO-39	3-307
2N4237	40	1.0	30	150	250	1.0	0.6	1000	100	5.0	1.0	TO-39	3-299

PNP Power Transistors (By Descending B_V) Metal Package

Device No.	V_{CE0} V Min.	I_C A Max.	h_{FE}		I_C mA	V_{CE} V V	$V_{CE(sat)}$ V V	I_C / I_B		P_D 25° C W	f_T MHz Min.	Pkg. No.	Page No.
			Min.	Max.									
2N5416	-300	1.0	30	120	50	-10	-2.0	50	5.0	10		TO-39	3-331
2N5415	-200	1.0	30	150	50	-10	-2.5	50	5.0	10		TO-39	3-331
2N5680	-120	1.0	40	150	250	-2.0	-2.0	1000	200	10		TO-39	3-335
2N5679	-100	1.0	40	150	250	-2.0	-2.0	1000	200	10		TO-39	3-335
2N4236	-80	1.0	30	150	250	-1.0	-0.6	1000	125	6.0		TO-5	3-297
2N5322	-75	1.0	30	130	500	-4.0	-0.7	500	50	10		TO-39	3-325
2N4235	-60	1.0	30	150	250	-1.0	-0.6	1000	125	6.0		TO-5	3-297
2N5323	-50	1.0	40	250	500	-4.0	-1.2	500	50	10		TO-39	3-325
2N4234	-40	1.0	30	150	250	-1.0	-0.6	1000	125	6.0		TO-5	3-297

NOTES



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- WIV ... 50 V (BA128), 25 V (BA130)
- I_R ... 100 nA (MAX) @ WIV

PACKAGES	
BA128	DO-35
BA130	DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	175°C
Lead Temperature (10 seconds)	260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	BA128	50 V
		BA130	25 V
I _O	Average Rectified Current		200 mA
I _F	Continuous Forward Current		500 mA
i _f	Peak Repetitive Forward Current		600 mA
i _f (surge)	Peak Forward Surge Current		
	Pulse Width = 1 s		1.0 A
	Pulse Width = 1 μs		4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BA128		BA130		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _F	Forward Voltage	0.73	1.00			V	I _F = 50 mA
		0.63	0.79	0.69	1.00	V	I _F = 10 mA
		0.51	0.64	0.56	0.71	V	I _F = 1.0 mA
				0.45	0.58	V	I _F = 0.1 mA
				0.40	0.52	0.34	0.47
I _R	Reverse Current		100			nA	V _R = 50 V
			100		100	nA	V _R = 25 V
					100	μA	V _R = 50 V, T _A = 100°C
						μA	V _R = 25 V, T _A = 100°C
BV	Breakdown Voltage	75		30		V	I _R = 100 μA
						V	I _R = 5 μA
C	Capacitance		5.0		2.0	pf	V _R = 0, f = 1.0 MHz

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D4.

- WIV... 10 V to 100 V
- t_{rr} ... 4ns (MAX) BA216-218

PACKAGES

BA217 DO-35
BA218 DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range -65°C to +200°C
Maximum Junction Operating Temperature +175°C
Lead Temperature +260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient 500 mW
Linear Power Derating Factor (from 25°C) 3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	BA218	50 V	BA217	30 V
I_F	Continuous Forward Current				100 mA
I_f	Peak Repetitive Forward Current				300 mA
$i_f(\text{surge})$	Peak Forward Surge Current				400 mA
	Pulse Width = 1 s				1.0 A
	Pulse Width = 1 μ s				4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BA217 - BA218		UNITS	TEST CONDITIONS
		MIN	MAX		
V_F	Forward Voltage		1.50 1.00 0.70		$I_F = 100 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 15 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 3.0 \text{ mA}$ $I_F = 1.0 \text{ mA}$ $I_F = 0.2 \text{ mA}$
I_R	Reverse Current		50 50 200 200	nA nA nA nA nA nA	$V_R = 10 \text{ V}$ $V_R = 10 \text{ V}$ $V_R = 25 \text{ V}$ $V_R = 30 \text{ V}$ $V_R = 50 \text{ V}$ $V_R = 50 \text{ V}$ $V_R = 100 \text{ V}$
C	Capacitance		3.0	pF	$V_R = 0, f = 1 \text{ MHz}$
t_{rr}	Reverse Recovery Time		4.0	ns ns	$I_F = 10 \text{ mA}, I_R = 60 \text{ mA}$ $R_L = 100 \Omega$ (Note 3) $I_F = 30 \text{ mA}, I_R = 30 \text{ mA}$ $R_L = 100 \Omega$ (Note 4)

NOTES:

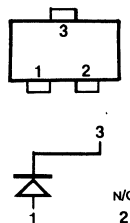
1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to $I_R = 1 \text{ mA}$.
4. Recovery to $I_R = 3 \text{ mA}$.
5. For product family characteristic curves, refer to Chapter 4, D4

BAS16

Switching Diode

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

Connection Diagram



ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

Power Dissipation (Note 2)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents

V_R Continuous Reverse Voltage 75 V
 I_F Peak Forward Current 200 mA
 I_{FM} Peak Forward Surge Current 500 mA

PACKAGE

BAS16

TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Voltage Leakage Current		1.0	μA	$V_R = 75 \text{ V}$
			50	μA	$V_R = 75 \text{ V}, T_J = 150^\circ \text{C}$
			30	μA	$V_R = 25 \text{ V}, T_J = 150^\circ \text{C}$
$V_{(BR)}$	Reverse Breakdown Voltage	75		V	$I_{BR} = 100 \mu\text{A}$
V_F	Forward Voltage		715	mV	$I_F = 1.0 \text{ mA}$
			855	mV	$I_F = 10 \text{ mA}$
			1100	mV	$I_F = 50 \text{ mA}$
			1300	mV	$I_F = 100 \text{ mA}$
C_D	Diode Capacitance		2.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
V_{FR}	Forward Recovery Voltage		1.75	V	$I_F = 10 \text{ mA}, t_r = 20 \text{ ns}$
t_{rr}	Reverse Recovery Time		6.0	ns	$I_F = I_R = 10 \text{ mA}, R_L = 100 \Omega$
Q_S	Stored Charge		45	pC	$I_F = 10 \text{ mA}$ to $V_R = 5.0 \text{ V}$, $R_L = 500 \Omega$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 - For product family characteristic curves, refer to Curve Set D-4.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

FAIRCHILD

A Schlumberger Company

BAV17/BAV18/BAV19 BAV20/BAV21

General Purpose Diodes

- V_F ... 1.0 V (Max) @ 100 mA
- I_R ... 100 nA @ WIV

PACKAGES

BAV17	DO-35
BAV18	DO-35
BAV19	DO-35
BAV20	DO-35
BAV21	DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage		
		BAV 17	20 V
		BAV 18	50 V
		BAV 19	100 V
		BAV 20	150 V
		BAV 21	200 V
I_O	Average Rectified Current		100 mA
I_F	Continuous Forward Current		300 mA
i_f	Peak Repetitive Forward Current		400 mA
$i_f(\text{surge})$	Peak Forward Surge Current		
	Pulse Width=1 μ sec.		4 A
	Pulse Width=1 sec.		1 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.00	V	$I_F=100$ mA
				1.25	V	$I_F=200$ mA
I_R	Reverse Current	BAV 21		100	nA	$V_R=200$ V
				15	μ A	$V_R=200$ V, $T_A=100^\circ$ C
		BAV 20		100	nA	$V_R=150$ V
				15	μ A	$V_R=150$ V, $T_A=100^\circ$ C
		BAV 19		100	nA	$V_R=100$ V
				15	μ A	$V_R=100$ V, $T_A=100^\circ$ C
BV	Breakdown Voltage	BAV 21	250		V	$I_R=100$ μ A
		BAV 20	200		V	$I_R=100$ μ A
		BAV 19	120		V	$I_R=100$ μ A
		BAV 18	60		V	$I_R=100$ μ A
		BAV 17	25		V	$I_R=100$ μ A
C	Capacitance		1.5	5.0	pF	$V_R=0, f=1$ MHz
t_{rr}	Reverse Recovery Time (Note 3)			50	ns	$I_F=30$ mA, $I_R=30$ mA, $R_L=100\Omega$
r_{diff}	Differential Resistance		5.0		Ω	$I_F=10$ mA

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to $I_R=3$ mA.
4. For product family characteristic curves, refer to Chapter 4 BAV 17/18 D4, BAV 19/20/21 D1.

BAV70

Switching Diode

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

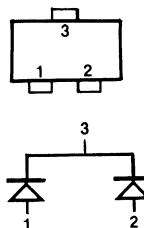
Power Dissipation (Note 2)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents

V_R Continuous Reverse Voltage 70 V
 I_F Peak Forward Current 200 mA
 I_{FM} Peak Forward Surge Current 500 mA

Connection Diagram



PACKAGE

BAV70 TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Voltage Leakage Current		60 5.0 100	μA μA μA	$V_R = 25 \text{ V}, T_J = 150^\circ \text{C}$ $V_R = 70 \text{ V},$ $V_R = 70 \text{ V}, T_J = 150^\circ \text{C}$
$V_{(BR)}$	Reverse Breakdown Voltage	70		V	$I_{(BR)} = 100 \mu\text{A}$
V_F	Forward Voltage		715 855 1100 1300	mV mV mV mV	$I_F = 1.0 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 100 \text{ mA}$
C_T	Diode Capacitance		1.5	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		6.0	ns	$I_F = I_R = 10 \text{ mA}, V_R = 5.0 \text{ V}$ $I_{R(REC)} = 1.0 \text{ mA}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}^\circ \text{C}$).
 - For product family characteristic curves, refer to Curve Set D-4.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BAV74

Switching Diode

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

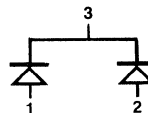
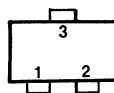
Power Dissipation (Note 2)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents

V_R Continuous Reverse Voltage 50 V
 I_F Peak Forward Current 200 mA
 I_{FM} Peak Forward Surge Current 500 mA

Connection Diagram



PACKAGE

BAV74 TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Voltage Leakage Current		100 0.1	μA μA	$V_R = 50 \text{ V}$, $T_J = 150^\circ \text{C}$ $V_R = 50 \text{ V}$
$V_{(BR)}$	Reverse Breakdown Voltage	50		V	$I_{BR} = 5.0 \mu\text{A}$
V_F	Forward Voltage		1.0	V	$I_F = 100 \text{ mA}$
C_T	Diode Capacitance		2.0	pF	$V_R = 0$, $f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		4.0	ns	$I_F = I_R = 10 \text{ mA}$, $R_L = 100 \Omega$ $I_{R(REC)} = 1.0 \text{ mA}$, measured at $I_R = 1.0 \text{ mA}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 - For product family characteristic curves, refer to Curve Set D-4.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

Connection Diagram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

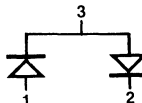
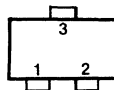
Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

Power Dissipation (Note 2)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Current

V_R Continuous Reverse Voltage 70 V
 I_F Peak Forward Current 100 mA
 I_{FM} Peak Forward Surge Current 500 mA



PACKAGE

BAV99 TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Voltage Leakage Current		30 2.5 50	μA μA μA	$V_R = 25 \text{ V}, T_J = 150^\circ \text{C}$ $V_R = 70 \text{ V}$ $V_R = 70 \text{ V}, T_J = 150^\circ \text{C}$
$V_{(BR)}$	Reverse Breakdown Voltage	70		V	$I_{BR} = 100 \mu\text{A}$
V_F	Forward Voltage		715 855 1100 1300	mV mV mV mV	$I_F = 1.0 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 100 \text{ mA}$
C_T	Diode Capacitance		1.5	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		6.0	ns	$I_F = I_R = 10 \text{ mA}, I_{R(REC)} = 1.0 \text{ mA}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}^\circ \text{C}$).
 - For product family characteristic curves, refer to Curve Set D-4.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BAW56

Dual Switching Diode

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° to 150°C
 Operating Junction Temperature 150°C

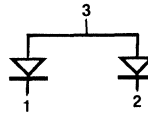
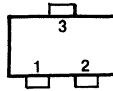
Power Dissipation (Note 2)

Total Dissipation at 25°C Ambient Temperature 0.350 W^*

Voltages & Current

V_R Continuous Reverse Voltage 70 V
 I_F Peak Forward Current 200 mA
 I_{FM} Peak Forward Surge Current 200 mA

Connection Diagram



PACKAGE

BAW56

TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Voltage Leakage Current		30 2.5 50	μA μA μA	$V_R = 25 \text{ V}, T_J = 150^\circ \text{C}$ $V_R = 70 \text{ V}$ $V_R = 70 \text{ V}, T_J = 150^\circ \text{C}$
$V_{(BR)}$	Reverse Breakdown Voltage	70		V	$I_{BR} = 100 \mu\text{A}$
V_F	Forward Voltage		715 855 1100 1300	mV mV mV mV	$I_F = 1.0 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 100 \text{ mA}$
C_T	Diode Capacitance		2.5	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		6.0	ns	$I_F = I_R = 10 \text{ mA}, I_{R(REC)} = 1.0 \text{ mA}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 - For product family characteristic curves, refer to Curve Set D-4.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BAW75/BAW76

High Speed Computer Diodes

- t_{rr} ... 4 ns (max)
- C ... 4 pf (max)

PACKAGES

BAW75	DO-35
BAW76	DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	BAW 75	25V
		BAW 76	50V
I_O	Average Rectified Current		100 mA
I_F	Continuous Forward Current		300 mA
i_f	Peak Repetitive Forward Current		400 mA
i_f (surge)	Peak Forward Surge Current		
	Pulse Width = 1 s		1.0 A
	Pulse Width = 1 μ s		4.0 A

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BAW 75		BAW 76		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V_F	Forward Voltage		1.0		1.0	V	$I_F = 30$ mA $I_F = 100$ mA
I_R	Reverse Current		100		100	nA μ A	$V_R = 25$ V $V_R = 50$ V $V_R = 25$ V, $T_A = 150^\circ$ C $V_R = 50$ V, $T_A = 150^\circ$ C
B_V	Breakdown Voltage	35		75		V	$I_R = 5.0$ μ A
C	Capacitance		4.0		2.0	pf	$V_R = 0$, $f = 1$ MHz
t_{rr}	Reverse Recovery Time		4.0		4.0	ns	$I_f = I_r = 10$ mA Recovery to 1 mA
			2.0		2.0	ns	$I_f = 10$ mA, $V_R = 6$ V, $R_L = 100$ Ω

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D4.

- C ... 3.0 pF (MAX)
- t_{rr} ... 4.0 ns (MAX)

PACKAGE

BAX13

DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Operating Junction Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltages and Currents

V _{RRM}	Repetitive Peak Reverse Voltage	50 V
V _R	Reverse Voltage	50 V
I _O	Average Rectified Current	100 mA
I _F	Forward Current	300 mA
i _f	Recurrent Peak Forward Current	400 mA
I _{FSM}	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V _F	Forward Voltage		0.7	V	I _F = 2.0 mA
			0.8	V	I _F = 10 mA, T _A = 100°C
			1.0	V	I _F = 20 mA.
			1.53	V	I _F = 75 mA.
I _R	Reverse Current		25	nA	V _R = 10 V
			10	μA	V _R = 10 V, T _A = 150°C
			50	nA	V _R = 25 V
			200	nA	V _R = 50 V
			25	μA	V _R = 50 V, T _A = 150°C
C	Capacitance		3.0	pF	V _R = 0, f = 1.0 MHz
t _{rr}	Reverse Recovery Time		4.0	ns	I _F = 10 mA, V _R = 6.0 V, R _L = 100Ω, I _r = 1.0 mA
Q _S	Recovered Charge		45	pC	I _F = 10 mA, V _R = 5.0 V, R _L = 500Ω

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For product family characteristic curves, refer to Chapter 4, D4.

- BV... 180 V (MIN) @ 100 μ A
- I_R... 100 nA (MAX) @ 150V

PACKAGE

BAX16

DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	150 V
I _O	Average Rectified Current	200 mA
I _F	Continuous Forward Current	500 mA
i _f	Peak Repetitive Forward Current	600 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1 s	1.0 A
	Pulse Width = 1 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V _F	Forward Voltage		1.5	V	I _F = 200 mA
			1.4	V	I _F = 200 mA, T _A = 175°C
			1.3	V	I _F = 100 mA
			0.85	V	I _F = 10 mA, T _A = 100°C
			0.65	V	I _F = 1 mA
I _R	Reverse Current		100	nA	V _R = 150 V
			100	μ A	V _R = 150 V, T _A = 150°C
			25	nA	V _R = 50 V
			25	μ A	V _R = 50 V, T _A = 150°C
BV	Breakdown Voltage	180		V	I _R = 100 μ A
C	Capacitance		10	pf	V _R = 0, f = 1 MHz
t _{rr}	Reverse Recovery Time (Note 3)		120	ns	I _F = 30 mA, I _R = 30 mA R _L = 100 Ω
Q _s	Stored Charge		700	pC	I _F = 10 mA, V _R = 5 V R _L = 500 Ω

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to I_R = 3 mA.
4. For product family characteristic curves, refer to Chapter 4, D1.

BAY71

Fast Switching Diode

- t_{rr} ... 4.0 ns (MAX)
- C ... 2.0 pF (MAX)

PACKAGE
BAY71

DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	35 V
I _O	Average Rectified Current	100 mA
I _F	Forward Current Steady State DC	300 mA
i _f	Recurrent Peak Forward Current	400 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V _F	Forward Voltage	0.76 0.69 0.57 0.46	1.00 0.88 0.69 0.56	V V V V	I _F = 20 mA I _F = 10 mA I _F = 1.0 mA I _F = 0.1 mA
I _R	Reverse Current		100 100	nA μA	V _R = 35 V V _R = 35 V, T _A = 125°C
BV	Breakdown Voltage	50		V	I _R = 5.0 μA
t _{rr}	Reverse Recovery Time (Note 5)		2.0	ns	I _F = 10 mA, I _R = 6.0 mA, R _L = 100 Ω, V _R = 6.0 V
V _{fr}	Forward Recovery Peak Voltage (Note 3)		3.0	V	I _F = 100 mA (pulsed)
t _{fr}	Forward Recovery Time (Note 3)		40	ns	I _F = 100 mA (pulsed)
Q _S	Stored Charge (Note 4)		65 50	pC pC	I _F = 20 mA, I _R = 2.0 mA I _F = 10 mA, I _R = 1.0 mA
RE	Rectification Efficiency (Note 6)	45		%	f = 100 MHz
C	Capacitance		2.0	pF	V _R = 0, f = 1.0 MHz

- NOTES:
- The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - The oscilloscope used as the response detector shall have a bandwidth of at least 10 MHz (3 dB down), and shall be calibrated using a deposited carbon resistor of 50 Ω in the diode test clips. t_{rr} is defined as the difference between the 10% point of the pulse and the point where V_F is to within 10% of the quiescent value.
 - Measured on the Tektronix "S" unit.
 - Recovery to 1.0 mA.
 - Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5.0 kΩ, load capacitance 20 pF.
 - For product family curves, refer to Chapter 4, D4.

BAY72/BAY80

General Purpose High Conductance Diodes

- $V_F \dots 1.0V$ (MAX) @ 100 mA (BAY72)
- $V_F \dots 1.0V$ (MAX) @ 150 mA (BAY80)

PACKAGES	
BAY72	DO-35
BAY80	DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW / °C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	BAY 72	100 V
		BAY 80	120 V
I_O	Average Rectified Current		200 mA
I_F	Continuous Forward Current		500 mA
i_f	Peak Repetitive Forward Current		600 mA
$i_f(\text{surge})$	Peak Forward Surge Current		
	Pulse Width = 1 s		1.0 A
	Pulse Width = 1 μ s		4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BAY 72		BAY 80		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V_F	Forward Voltage				1.00	V	$I_F = 150$ mA
		0.78	1.00			V	$I_F = 100$ mA
		0.73	0.92			V	$I_F = 50$ mA
		0.63	0.78			V	$I_F = 10$ mA
		0.51	0.64			V	$I_F = 1.0$ mA
I_R	Reverse Current				100	nA	$V_R = 120$ V
					150	μ A	$V_R = 120$ V, $T_A = 100^\circ$ C
			100			nA	$V_R = 100$ V
			100			μ A	$V_R = 100$ V, $T_A = 125^\circ$ C
BV	Breakdown Voltage	125		150		V	$I_R = 100$ μ A
C	Capacitance		5.0		6.0	pF	$V_R = 0$, $f = 1$ MHz
t_{rr}	Rev. Rec. Time (note 3) (note 4)		50		60	ns	$I_f = I_r = 30$ mA, $R_L = 75$ Ω
			400			ns	$I_f = 30$ mA, $V_R = 35$ V
V_{fr}	Fwd. Rec. Voltage (note 5)		2.5			v	$R_L = 2.0$ K Ω , $C_L = 10$ pF
V_{fr}	Fwd. Rec. Voltage (note 5)		2.5			V	$I_f = 100$ mA (pulsed)
t_{fr}	Fwd. Rec. Time (note 5)		50			ns	$I_f = 100$ mA (pulsed)
Q_s	Stored Charge (note 6)		250			pC	$I_f = 20$ mA, $I_r = 1.0$ mA
R_E	Rect. Efficiency (note 7)	35				%	$f = 100$ MHz

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 1.0 mA.
4. Recovery to 400 k Ω , Jan 256 Circuit.
5. The oscilloscope used as the response detector shall have a bandwidth of at least 10 MHz (3 dB down), and shall be calibrated using a deposited carbon resistor of 50 Ω in the diode test clips. t_{fr} is defined as the difference between the 10% point of the pulse and the point where V_F is to be within 10% of the quiescent value. Pulse conditions shall be 0.1 μ s wide at base, 20 ns maximum rise time, repetition rate = 100 kHz max.
6. Measured on the Tektronix "S" unit.
7. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input to the circuit. Load resistance of 5.0 k Ω , load capacitance 20 pF.
8. For product family characteristic curves, refer to Chapter 4, D1.

BAY73/BA129

High Voltage Low Leakage Diodes

- BV... 125 V (MIN) @ 100 μ A (BAY73)
- BV... 200 V (MIN) @ 100 μ A (BA129)

PACKAGES

BAY73 DO-35
BA129 DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range -65°C to +200°C
Maximum Junction Operating Temperature +175°C
Lead Temperature +260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient 500 mW
Linear Power Derating Factor (from 25°C) 3.33 mW / °C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	BAY73	100 V
		BA129	180 V
I _O	Average Rectified Current		200 mA
I _F	Continuous Forward Current		500 mA
i _f	Peak Repetitive Forward Current		600 mA
i _f (surge)	Peak Forward Surge Current		
	Pulse Width = 1 s		1.0 A
	Pulse Width = 1 μ s		4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BAY73		BA129		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _F	Forward Voltage	0.85	1.00			V	I _F = 200 mA
		0.81	0.94			V	I _F = 100 mA
		0.78	0.88	0.78	1.00	V	I _F = 50 mA
		0.69	0.80	0.69	0.83	V	I _F = 10 mA
		0.67	0.75			V	I _F = 5.0 mA
		0.60	0.68	0.60	0.71	V	I _F = 1.0 mA
I _R	Reverse Current		500			nA	V _R = 20 V, T _A = 125°C
			5.0			nA	V _R = 100 V
			1.0			μ A	V _R = 100 V, T _A = 125°C
					10	nA	V _R = 180 V
					5.0	μ A	V _R = 180 V, T _A = 100°C
BV	Breakdown Voltage	125		200		V	I _R = 100 μ A
C	Capacitance		8.0		6.0	pf	V _R = 0, f = 1.0 MHz
t _{rr}	Reverse Recovery Time		3.0			μ s	I _F = 10 mA, V _F = 35 V R _L = 1.0 to 100 K Ω C _L = 10 pf, JAN 256

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulses or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2

BAY74

High Conductance
Ultra Fast Diode

- t_{rr} ... 4.0 ns (MAX)
- C... 3.0 pF (MAX)

PACKAGE

BAY74

DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65° C to +200° C
Maximum Operating Junction Temperature	+175° C
Lead Temperature	+260° C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25° C Ambient	500 mW
Linear Deviation Factor (from 25° C)	3.33 mW

Maximum Voltage and Currents

WIV	Working Inverse Voltage	35 V
I_O	Average Rectified Current	100 mA
I_F	Continuous Forward Current	300 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	0.85	1.10	V	$I_F = 300$ mA
		0.82	1.00	V	$I_F = 200$ mA
		0.78	0.93	V	$I_F = 100$ mA
		0.73	0.88	V	$I_F = 50$ mA
		0.65	0.77	V	$I_F = 10$ mA
		0.54	0.65	V	$I_F = 1.0$ mA
I_R	Reverse Current		100	nA	$V_R = 35$ V
			100	μ A	$V_R = 35$ V, $T_A = 125^\circ$ C
BV	Breakdown Voltage	50		V	$I_R = 5.0$ μ A
C	Capacitance		3.0	pF	$V_R = 0$, $f = 1.0$ MHz
t_{rr}	Reverse Recovery Time (Note 4)		4.0	ns	$I_f = I_r = 10$ mA to 200 mA
			6.0	ns	$I_f = I_r = 200$ mA to 400 mA
t_{rr}	Reverse Recovery Time (Note 3)		6.0	ns	$I_f = 10$ mA, $I_r = 1.0$ mA

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady-state limits. The factory should be consulted on applications involving pulses or low duty-cycle operations.
3. Recovery to 0.1 mA.
4. Recovery to 10% of I_f .
5. For product family characteristic curves, refer to Chapter 4, D4.

BAY82/1N4244 1N4376

Ultra Fast Switching Diodes

- t_{rr} ... 750 ps (MAX)
- C ... 0.8 pF (MAX) 1N4244

PACKAGES

BAY82	DO-7
1N4244	DO-7
1N4376	DO-7

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	250 mW
Linear Power Derating Factor (from 25°C)	1.67 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	10 V (12 V BAY82)
I_O	Average Rectified Current	50 mA
I_F	Continuous Forward Current	150 mA
i_f	Peak Repetitive Forward Current	150 mA
$i_f(\text{surge})$	Peak Forward Surge Current	250 mA
	Pulse Width = 1 s	

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BAY82		1N4244		1N4376		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX	MIN	MAX		
V_F	Forward Voltage	0.90	1.35			0.89	1.10	V	$I_F = 50 \text{ mA}$ $I_F = 20 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 1.0 \text{ mA}$ $I_F = 0.1 \text{ mA}$ $I_F = 10 \mu\text{A}$
		0.80	1.00		1.00	0.81	0.95	V	
		0.77	0.94			0.76	0.88	V	
		0.64	0.79			0.64	0.74	V	
		0.53	0.66			0.52	0.61	V	
		0.41	0.53			0.42	0.50	V	
I_R	Reverse Current				100		100	nA	$V_R = 10 \text{ V}$ $V_R = 10 \text{ V}, T_A = 150^\circ\text{C}$ $V_R = 12 \text{ V}$ $V_R = 12 \text{ V}, T_A = 100^\circ\text{C}$ $V_R = 15 \text{ V}$
			100		100		100	μA	
			50		250			μA	
								nA	
BV	Breakdown Voltage	15		20		20		V	$I_R = 5.0 \mu\text{A}$
C	Capacitance		1.3		0.8		1.0	pF	$V_R = 0, f = 1 \text{ MHz}$
t_{rr}	Reverse Recovery Time (Note 3)		750		750		750	ps	$I_F = I_T = 10 \text{ mA}$ $R_L = 100 \Omega$

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to $I_T = 1.0 \text{ mA}$.
4. For product family characteristic curves, refer to Chapter 4, D3.

- h_{FE} ... **BCF29 120-260, BCF30 215-500**
- V_{CEO} ... **-32 V (Max)**
- **NF** ... **4.0 dB (Max)**

PACKAGE

BCF29	TO-236AA/AB
BCF30	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage	-32 V
V_{CBO} Collector to Base Voltage	-32 V
V_{CES} Collector to Emitter Voltage	-32 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	100 mA
I_{CM} Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	BCF29		BCF30		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		100 10		100 10	nA μ A	$V_{CB} = 32$ V, $I_E = 0$ $V_{CB} = 32$ V, $I_E = 0$, $T_J = 100^\circ$ C
h_{FE}	DC Current Gain (Note 5)	120	260	215	500		$I_C = 2.0$ mA, $V_{CE} = 5.0$ V
$V_{BE(ON)}$	Base to Emitter Voltage		-0.6		-0.75	V	$I_C = 2.0$ mA, $V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.3		0.3	V	$I_C = 10$ mA, $I_B = 0.5$ mA
C_C	Collector Capacitance		7.0		7.0	pF	$V_{CB} = 10$ V, $I_E = 0$
NF	Noise Figure		4.0		4.0	dB	$I_C = 200$ μ A, $V_{CE} = 5.0$ V, $f = 1.0$ kHz, BW = 200 Hz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle μ 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BCF70

PNP Low Noise Transistor

- h_{FE} ... 215-500 @ 10 mA
- V_{CEO} ... -45 V (Min)
- NF ... 4.0 dB (Max)

PACKAGES

BCF70

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage -45 V
 V_{CBO} Collector to Base Voltage -50 V
 V_{CES} Collector to Emitter Voltage -50 V
 V_{EBO} Emitter to Base Voltage -5.0 V
 I_C Collector Current 100 mA
 I_{CM} Collector Current 200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		100 10	nA μ A	$V_{CB} = -20$ V, $I_E = 0$ $V_{CB} = -20$ V, $I_E = 0$, $T_J = 100^\circ$ C
h_{FE}	DC Current Gain (Note 5)	215	500		$I_C = 2.0$ mA, $V_{CE} = -5.0$ V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		-0.3	V	$I_C = 10$ mA, $I_B = 0.5$ mA
V_{BE}	Base-to-Emitter Voltage	-0.6	-0.75	V	$I_C = 2.0$ mA, $V_{CE} = -5.0$ V
C_c	Collector Capacitance		7.0	pF	$V_{CB} = -10$ V, $I_E = 0$
NF	Noise Figure		4.0	dB	$I_C = 200$ μ A, $V_{CE} = -5.0$ V, $f = 1.0$ kHz, B = 200 Hz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BCF81

PNP Low Noise Transistor

- h_{FE} ... **420-800 @ 10 mA**
- V_{CEO} ... **-45 V (Min)**
- **NF ... 4.0 dB (Max)**

PACKAGES

BCF81 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage -45 V
 V_{CBO} Collector to Base Voltage -50 V
 V_{CES} Collector to Emitter Voltage -50 V
 V_{EBO} Emitter to Base Voltage -5.0 V
 I_C Collector Current 100 mA
 I_{CM} Collector Current 200 mA

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		100 10	nA μ A	$V_{CB} = -20$ V, $I_E = 0$ $V_{CB} = -20$ V, $I_E = 0$, $T_A = 100^\circ$ C
h_{FE}	DC Current Gain (Note 5)	420	800		$I_C = 2.0$ mA, $V_{CE} = -5.0$ V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		-0.25	V	$I_C = 10$ mA, $I_B = 0.5$ mA
V_{BE}	Base-to-Emitter Voltage	-0.55	-0.7	V	$I_C = 2.0$ mA, $V_{CE} = 5.0$ V
C_c	Collector Capacitance		4.0	pF	$V_{CB} = -10$ V, $I_E = 0$
NF	Noise Figure		4.0	dB	$I_C = 200$ μ A, $V_{CE} = -5.0$ V, $f = 1.0$ kHz, B = 200 Hz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

• $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature $-55^\circ \text{C to } 150^\circ \text{C}$
 Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 20 V
 V_{CBO} Collector to Base Voltage 30 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 100 mA

PACKAGE

BCW29 TO-236AA/AB
 BCW30 TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-20		V	$I_C = 2.0 \text{ mA}, I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-30		V	$I_C = 100 \mu\text{A}, V_{EB} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-30		V	$I_C = 10 \mu\text{A}, I_C = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100 10	nA μA	$V_{CB} = -20 \text{ V}, I_E = 0$ $V_{CB} = -20 \text{ V}, I_E = 0, T_A = 100^\circ \text{C}$
h_{FE}	DC Current Gain (BCW29) (Note 5) (BCW30)	120 215	260 500		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$ $I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.3	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	-0.6	-0.75	V	$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
C_{ob}	Output Capacitance		7.0	pF	$V_{CE} = -10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
NF	Noise Figure		10	dB	$I_C = 0.2 \text{ mA}, V_{CE} = -5.0 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 2.0 \text{ k}\Omega,$ $BW = 200 \text{ Hz}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 - Rating refers to a high current point where collector to emitter voltage is lowest.
 - Pulse conditions: length = 300 μs ; duty cycle = 1%.
 - For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BCW32/BCW33

General Purpose Transistor

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 20 V
 V_{CBO} Collector to Base Voltage 30 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 100 mA

PACKAGE

BCW32 TO-236AA/AB
 BCW33 TO-236AA/AB

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 2.0 \text{ mA}, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	$I_C = 10 \mu\text{A}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
h_{FE}	DC Current Gain (BCW32) (Note 5) (BCW33)	200 420	450 800		$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.25	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.55	0.70	V	$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
NF	Noise Figure		10	dB	$I_C = 0.2 \text{ mA}, V_{CE} = 5.0 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 2.0 \text{ k}\Omega,$ $BW = 200 \text{ Hz}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

- $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

PACKAGE

BCW60A

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

 Storage Temperature -55°C to 150°C

 Operating Junction Temperature 150°C
Power Dissipation (Notes 2 & 3)

Total Dissipation at

 25°C Ambient Temperature 0.350 W^*
Voltages & Currents (Note 4)

 V_{CEO} Collector to Emitter Voltage 32 V
 V_{CBO} Collector to Base Voltage 32 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 100 mA
ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	32		V	$I_C = 2.0 \text{ mA}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 1.0 \mu\text{A}, I_C = 0$
I_{CES}	Collector Reverse Current		20 20	nA μA	$V_{CE} = 32 \text{ V}$ $V_{CE} = 32 \text{ V}, T_A = 150^\circ \text{C}$
I_{EBO}	Emitter Cutoff Current		20	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	120 60 125	220 250		$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.55 0.35	V V	$I_C = 50 \text{ mA}, I_B = 1.25 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BCW60A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.7	1.05	V	$I_C = 50 \text{ mA}$, $I_B = 1.25 \text{ mA}$
		0.6	0.85	V	$I_C = 50 \text{ mA}$, $I_B = 0.25 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.55	0.75	V	$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
C_{ob}	Output Capacitance		4.5	pF	$V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ MHz}$
f_T	Current Gain Bandwidth Product		125	MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ MHz}$
t_{on}	Turn On Time		150	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 1.0 \text{ mA}$
t_{off}	Turn Off Time		800	ns	$I_{B2} = 1.0 \text{ mA}$, $V_{BB} = 3.6 \text{ V}$, $R_1 = R_2 = 5.0 \Omega$, $R_L = 990 \Omega$
NF	Noise Figure		6.0	dB	$I_C = 0.2 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 2.0 \text{ k}\Omega$, $BW = 200 \text{ Hz}$

3

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

BCW61A

TO-236AA/AB

Temperatures

 Storage Temperature -55°C to 150°C

 Operating Junction Temperature 150°C
Power Dissipation (Notes 2 & 3)

Total Dissipation at

 25°C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

 V_{CEO} Collector to Emitter Voltage 32 V

 V_{CBO} Collector to Base Voltage 32 V

 V_{EBO} Emitter to Base Voltage 5.0 V

 I_{C} Collector Current (Continuous) 100 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-32		V	$I_{\text{C}} = 2.0\text{ mA}$, $I_{\text{E}} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_{\text{E}} = 10\ \mu\text{A}$, $I_{\text{C}} = 0$
I_{CES}	Collector Reverse Current		20 20	nA μA	$V_{\text{CE}} = -32\text{ V}$, $V_{\text{BE}} = 0$ $V_{\text{CE}} = -32\text{ V}$, $V_{\text{BE}} = 0$, $T_{\text{A}} = 150^{\circ}\text{C}$
h_{FE}	DC Current Gain	120 60 125	220 250		$I_{\text{C}} = 2.0\text{ mA}$, $V_{\text{CE}} = -5.0\text{ V}$ $I_{\text{C}} = 50\text{ mA}$, $V_{\text{CE}} = -1.0\text{ V}$ $I_{\text{C}} = 2.0\text{ mA}$, $V_{\text{CE}} = -5.0\text{ V}$, $f = 1.0\text{ kHz}$
$V_{\text{CE(sat)}}$	Collector to Emitter Saturation Voltage		-0.55 -0.25	V V	$I_{\text{C}} = 50\text{ mA}$, $I_{\text{B}} = 1.25\text{ mA}$ $I_{\text{C}} = 10\text{ mA}$, $I_{\text{B}} = 0.25\text{ mA}$
$V_{\text{BE(sat)}}$	Base to Emitter Saturation Voltage	-0.68 -0.6	-1.05 -0.85	V V	$I_{\text{C}} = 50\text{ mA}$, $I_{\text{B}} = 1.25\text{ mA}$ $I_{\text{C}} = 10\text{ mA}$, $I_{\text{B}} = 0.25\text{ mA}$
$V_{\text{BE(ON)}}$	Base to Emitter "On" Voltage	-0.6	-0.75	V	$I_{\text{C}} = 2.0\text{ mA}$, $V_{\text{CE}} = -5.0\text{ V}$
C_{ob}	Output Capacitance		6.0	pF	$V_{\text{CE}} = -10\text{ V}$, $I_{\text{C}} = 0$, $f = 1.0\text{ MHz}$
t_{on}	Turn On Time		150	ns	$I_{\text{C}} = 10\text{ mA}$, $I_{\text{B1}} = 1.0\text{ mA}$
t_{off}	Turn Off Time		800	ns	$I_{\text{B2}} = 1.0\text{ mA}$, $V_{\text{BB}} = -3.6\text{ V}$, $R_1 = R_2 = 5.0\ \Omega$, $R_{\text{L}} = 990\ \Omega$
NF	Noise Figure		6.0	dB	$I_{\text{C}} = 0.2\text{ mA}$, $V_{\text{CE}} = -5.0\text{ V}$, $f = 1.0\text{ kHz}$, $R_{\text{S}} = 2.0\text{ k}\Omega$, $\text{BW} = 200\text{ Hz}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of $357^{\circ}\text{C}/\text{W}$ (derating factor of $2.8\text{ mW}/^{\circ}\text{C}$).
 - Rating refers to a high current point where collector to emitter voltage is lowest.
 - Pulse conditions: length = $300\ \mu\text{s}$; duty cycle = 1%.
 - For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina $8\text{ mm} \times 8\text{ mm} \times 0.6\text{ mm}$.

BCW65A

NPN Silicon General Purpose Transistor

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 32 V
 V_{CBO} Collector to Base Voltage 60 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 800 mA

PACKAGE

BCW65A TO-236AA/AB

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CEO}	Collector to Emitter Breakdown Voltage	32		V	I _C = 10 mA, I _B = 0
BV _{CES}	Collector to Emitter Breakdown Voltage	60		V	I _C = 10 μA, V _{EB} = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I _E = 10 μA, I _C = 0
I _{EBO}	Emitter Cutoff Current		20	nA	V _{EB} = 4.0 V, I _C = 0
I _{CES}	Collector Reverse Current		20 20	nA μA	V _{CE} = 32 V, I _E = 0 V _{CE} = 32 V, I _E = 0, T _A = 150° C
h _{FE}	DC Current Gain (Note 5)	35 75 100 35	220 250		I _C = 100 μA, V _{CE} = 10 V I _C = 10 mA, V _{CE} = 1.0 V I _C = 100 mA, V _{CE} = 1.0 V I _C = 500 mA, V _{CE} = 2.0 V
V _{BE(sat)}	Base to Emitter Saturation Voltage		2.0	V	I _C = 500 mA, I _B = 50 mA
C _{ob}	Output Capacitance		12	pF	V _{CB} = 10 V, I _E = 0, f = 1.0 MHz
C _{ib}	Input Capacitance		80	pF	V _{EB} = 0.5 V, I _C = 0, f = 1.0 MHz
f _T	Current Gain Bandwidth Product	100		MHz	V _{CE} = 10 V, I _C = 20 mA, f = 100 MHz
t _{on}	Turn On Time		100	ns	I _{B1} = I _{B2} = 15 mA
t _{off}	Turn Off Time		400	ns	I _C = 150 mA, R _L = 150 Ω
NF	Noise Figure		10	dB	I _C = 0.2 mA, V _{CE} = 5.0 V, f = 1.0 kHz, R _S = 1.0 kΩ, BW = 200 Hz

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs; duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

BCW66F

TO-236AA/AB

Temperatures

Storage Temperature -55° C to 150° C

Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at

25° C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 45 V

V_{CBO} Collector to Base Voltage 75 V

V_{EBO} Emitter to Base Voltage 5.0 V

I_C Collector Current (Continuous) 800 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CEO}	Collector to Emitter Breakdown Voltage	45		V	I _C = 10 mA, I _B = 0
BV _{CES}	Collector to Emitter Breakdown Voltage	75		V	I _C = 10 μA, V _{EB} = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I _E = 10 μA, I _C = 0
I _{EBO}	Emitter Cutoff Current		20	nA	V _{EB} = 4.0 V, I _C = 0
I _{CES}	Collector Reverse Current		20 20	nA μA	V _{CE} = 45 V, I _C = 0 V _{CE} = 45 V, I _C = 0, T _A = 150° C
h _{FE}	DC Current Gain (Note 5)	35 75 100 35	250		I _C = 100 μA, V _{CE} = 10 V I _C = 10 mA, V _{CE} = 1.0 V I _C = 100 mA, V _{CE} = 1.0 V I _C = 500 mA, V _{CE} = 2.0 V
V _{BE(sat)}	Base to Emitter Saturation Voltage		2.0	V	I _C = 500 mA, I _B = 50 mA
C _{ob}	Output Capacitance		12	pF	V _{CB} = 10 V, I _E = 0, f = 1.0 MHz
C _{ib}	Input Capacitance		80	pF	V _{EB} = 0.5 V, I _C = 0, f = 1.0 MHz
f _T	Current Gain Bandwidth Product	100		MHz	V _{CE} = 10 V, I _C = 20 mA, f = 100 MHz
t _{on}	Turn On Time		100	ns	I _{B1} = I _{B2} = 15 mA
t _{off}	Turn Off Time		400	ns	I _C = 150 mA, R _L = 150 Ω
NF	Noise Figure		10	dB	I _C = 0.2 mA, V _{CE} = 5.0 V, f = 1.0 kHz, R _S = 1.0 kΩ, BW = 200 Hz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

• $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{C}$

PACKAGE

BCW69	TO-236AA/AB
BCW70	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage	-45 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current (Continuous)	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-45		V	$I_C = 2.0 \text{ mA}, I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-50		V	$I_C = 100 \mu\text{A}, V_{EB} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100 10	nA μA	$V_{CB} = -20 \text{ V}, I_E = 0$ $V_{CB} = -20 \text{ V}, I_E = 0, T_A = 100^\circ \text{C}$
h_{FE}	DC Current Gain (BCW69) (Note 5) (BCW70)	120 215	260 500		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$ $I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.3	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	-0.6	-0.75	V	$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
C_{ob}	Output Capacitance		7.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
NF	Noise Figure		10	dB	$I_C = 0.2 \text{ mA}, V_{CE} = -5.0 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 20 \Omega$ $BW = 200 \text{ Hz}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs ; duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3

- $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

PACKAGE

BCW72

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25°C Ambient Temperature	0.350 W*

Voltages & Currents (Note 4)

V_{CE0} Collector to Emitter Voltage	45 V
V_{CB0} Collector to Base Voltage	50 V
V_{EB0} Emitter to Base Voltage	5.0 V
I_C Collector Current (Continuous)	100 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	45		V	$I_C = 2.0 \text{ mA}$, $V_{EB} = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	45		V	$I_C = 2.0 \text{ mA}$, $V_{EB} = 0$
BV_{CB0}	Collector to Base Breakdown Voltage	50		V	$I_C = 10 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EB0}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \text{ } \mu\text{A}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100 10	nA μA	$V_{CB} = 20 \text{ V}$, $I_E = 0$ $V_{CB} = 20 \text{ V}$, $I_E = 0$, $T_A = 100^\circ \text{C}$
h_{FE}	DC Current Gain (Note 5)	200	450		$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.25	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.6	0.75	V	$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
NF	Noise Figure		10	dB	$I_C = 0.2 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 2.0 \text{ } \Omega$ $BW = 200 \text{ Hz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BCW81

NPN Transistor

- h_{FE} ... 420-800
- V_{CEO} ... 45 V (Max)
- NF ... 10 dB (Max)

PACKAGE

BCW81

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage	45 V
V_{CBO} Collector to Base Voltage	50 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	100 mA
I_{CM} Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		100 10	nA μ A	$V_{CB} = 20$ V, $I_E = 0$ $V_{CB} = 20$ V, $I_E = 0$, $T_A = 100^\circ$ C
h_{FE}	DC Current Gain (Note 5)	420	800		$I_C = 2.0$ mA, $V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.25	V	$I_C = 10$ mA, $I_B = 0.5$ mA
V_{BE}	Base-to-Emitter Voltage	0.55	0.7	V	$I_C = 2.0$ mA, $V_{CE} = 5.0$ V
C_c	Collector Capacitance		4.0	pF	$V_{CB} = 10$ V, $I_E = 0$
NF	Noise Figure		4.0	dB	$I_C = 200$ μ A, $V_{CE} = -5.0$ V, $f = 1.0$ kHz, B = 200 Hz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

• $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{ C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature $-55^\circ \text{ C to } 150^\circ \text{ C}$
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 45 V
 V_{CBO} Collector to Base Voltage 45 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 100 mA

PACKAGE

BCX70G TO-236AA/AB
 BCX70H TO-236AA/AB
 BCX70J TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	45		V	$I_C = 2.0 \text{ mA}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		20	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
I_{CES}	Collector Cutoff Current		20 20	nA μA	$V_{CE} = 32 \text{ V}$ $V_{CE} = 32 \text{ V}, T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain (Note 5)				
	(BCX70H)	20			$I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}$
	(BCX70J)	40			$I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}$
	(BCX70G)	120	220		$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
	(BCX70H)	180	310		$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
	(BCX70J)	250	460		$I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
	(BCX70G)	60			$I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
	(BCX70H)	70			$I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
	(BCX70J)	90			$I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BCX70G/BCX70H/BCX70J

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.35	V	$I_C = 10 \text{ mA}$, $I_B = 0.25 \text{ mA}$
			0.55	V	$I_C = 50 \text{ mA}$, $I_B = 1.25 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.55	0.75	V	$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	0.6	0.85	V	$I_C = 50 \text{ mA}$, $I_B = 0.25 \text{ mA}$
		0.7	1.05	V	$I_C = 50 \text{ mA}$, $I_B = 1.25 \text{ mA}$
C_{ob}	Output Capacitance		4.5	pF	$V_{CE} = 10 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain (BCX70G) (BCX70H) (BCX70J)	125	250		$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ MHz}$
		175	350		$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ MHz}$
		250	500		$I_C = 2.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ MHz}$
f_T	Current Gain Bandwidth Product		125	MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ mA}$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time		150	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 1.0 \text{ mA}$
t_{off}	Turn Off Time		800	ns	$I_{B2} = 1.0 \text{ mA}$, $V_{BB} = 3.6 \text{ V}$, $R1 = R2 = 5.0 \text{ k}\Omega$, $R_L = 990 \Omega$
NF	Noise Figure		6.0	dB	$I_C = 0.2 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 2.0 \text{ k}\Omega$, $BW = 200 \text{ Hz}$

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CE0} Collector to Emitter Voltage -45 V
 V_{CB0} Collector to Base Voltage -45 V
 V_{EB0} Emitter to Base Voltage -5.0 V
 I_C Collector Current (Continuous) 100 mA

PACKAGE

BCX71H TO-236AA/AB
 BCX71J TO-236AA/AB
 BCX71K TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	-45		V	$I_C = 2.0 \text{ mA}, I_B = 0$
BV_{EB0}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 1.0 \mu\text{A}, I_C = 0$
I_{CES}	Collector Cutoff Current		20 20	nA μA	$V_{CE} = -32 \text{ V}$ $V_{CE} = -32 \text{ V}, T_A = 150^\circ \text{C}$
h_{FE}	DC Current Gain (Note 5)				
	(BCX71H)	30			$I_C = 10 \mu\text{A}, V_{CE} = -5.0 \text{ V}$
	(BCX71J)	40			$I_C = 10 \mu\text{A}, V_{CE} = -5.0 \text{ V}$
	(BCX71K)	100			$I_C = 10 \mu\text{A}, V_{CE} = -5.0 \text{ V}$
	(BCX71H)	180	310		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
	(BCX71J)	250	460		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
	(BCX71K)	380	630		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
	(BCX71H)	80			$I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$
	(BCX71J)	100			$I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$

NOTES

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length $\mu 300 \mu\text{s}$; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BCX71H/BCX71J/BCX71K

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
	(BCX71K)	110			$I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$
	(BCX71H)	175	350		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
	(BCX71J)	250	500		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
	(BCX71K)	350	700		$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.25 -0.55	V V	$I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 1.25 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	-0.6	-0.75	V	$I_C = 2.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	-0.6 -0.68	-0.85 -1.05	V V	$I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 1.25 \text{ mA}$
C_{ob}	Output Capacitance		6.0	pF	$V_{CE} = -10 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
t_{on}	Turn On Time		150	ns	$I_C = 10 \text{ mA}, I_{B1} = 1.0 \text{ mA}$
t_{off}	Turn Off Time		800	ns	$I_{B2} = 1.0 \text{ mA}, V_{BB} = -3.6 \text{ V},$ $R_1 = R_2 = 5.0 \text{ k}\Omega, R_L = 990 \Omega$
NF	Noise Figure		6.0	dB	$I_C = 0.2 \text{ mA}, V_{CE} = -5.0 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 2.0 \text{ k}\Omega,$ $BW = 200 \text{ Hz}$

BSR13/BSR14

NPN Switching Transistor

- V_{CE0} ... BSR13 30 V (Max), BSR14 40 V (Max)
- f_T ... BSR13 250 MHz (Min), BSR14 300 MHz (Min)

PACKAGE

BSR13	TO-236AA/AB
BSR14	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents

	BSR13	BSR14
V_{CE0} Collector to Emitter Voltage	30 V	40 V
V_{CB0} Collector to Base Voltage	60 V	75 V
V_{EB0} Emitter to Base Voltage	5.0 V	6.0 V
I_C Collector Current	800 mA	800 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	BSR13		BSR14		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		30			nA	$V_{CB} = 50 V, I_E = 0$ $V_{CB} = 60 V, I_E = 0$ $V_{CB} = 50 V, I_E = 0,$ $T_A = 150^\circ C$ $V_{CB} = 60 V, I_E = 0,$ $T_A = 150^\circ C$
			10		10	nA	
						μA	
					10	μA	
I_{CEX}	Collector Reverse Current				10	nA	$V_{CE} = 60 V, V_{EB} = 3.0 V$
I_{BEX}	Base Reverse Current				20	nA	$V_{CE} = 60 V, V_{EB} = 3.0 V$
I_{EBO}	Emitter Cutoff Current		30		15	nA	$V_{EB} = 3.0 V, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BSR13/BSR14

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	BSR13		BSR14		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	35	300	35	300		$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		50			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$
		75		75			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
		100		100			$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		50			$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		30		40			$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		400 1.6		300 1.0	mV V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		1.3			V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			0.6		1.2	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			2.6		2.0	V	$I_C = 500 \text{ mA}, I_B = 15 \text{ mA}$
C_c	Collector Capacitance		8.0		8.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
f_T	Current Gain Bandwidth Product	250		300		MHz	$V_{CE} = 20 \text{ mA}, I_C = 20 \text{ mA}$
h_{fe}	Small Signal Current Gain			50 75	300 375		$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
				2.0 0.25	8.0 1.25	k Ω k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
h_{oe}	Output Conductance			5.0 25	35 200	μmhos μmhos	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
					8.0 4.0	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
t_d	Turn On Delay Time				10	ns	$I_C = 150 \text{ mA}$
t_r	Rise Time				25	ns	$I_C = 150 \text{ mA}$
t_s	Storage Time				225	ns	$I_C = 150 \text{ mA}$
t_f	Fall Time				60	ns	$I_C = 150 \text{ mA}$

BSR15/BSR16

PNP Switching Transistor

- $V_{CE0} \dots$ BSR15 40 V (Max), BSR16 60 V (Max)
- $f_T \dots > 200$ MHz
- $t_{on} \dots < 45$ ns
- $t_{on} \dots < 100$ μ s

PACKAGE

BSR15	TO-236AA/AB
BSR16	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents

	BSR15	BSR16
V_{CE0} Collector to Emitter Voltage (Note 4)	-40 V	-60 V
V_{CBO} Collector to Base Voltage	-60 V	-60 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	BSR15		BSR16		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		20		10	nA	$V_{CB} = -50$ V, $I_E = 0$ $V_{CB} = -50$ V, $I_E = 0$, $T_A = 150^\circ$ C
			20		10	μ A	
I_{CEX}	Collector Cutoff Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = 0.5$ V
I_{BEX}	Base Reverse Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = 3.0$ V
h_{FE}	DC Current Gain (Note 5)	35		75			$I_C = 0.1$ mA, $V_{CE} = -10$ V $I_C = 1.0$ mA, $V_{CE} = -10$ V $I_C = 10$ mA, $V_{CE} = -10$ V $I_C = 150$ mA, $V_{CE} = -10$ V $I_C = 500$ mA, $V_{CE} = -10$ V
		50		100			
		75		100			
		100	300	100	300		
		30		50			

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle μ 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BSR15/BSR16

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	BSR15		BSR16		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4		-0.4	V	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$
			-1.6		-1.6	V	
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.3		-1.3	V	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$
			-2.6		-2.6	V	
C_c	Collector Capacitance		8.0		8.0	pF	$V_{CB} = -10\text{ mA}, I_E = I_o = 0$
C_e	Emitter Capacitance		30		30	pF	$V_{EB} = -2.0\text{ V}, I_C = 0$
f_T	Current Gain Bandwidth Product	200				MHz	$V_{CE} = 20\text{ mA}, I_C = 50\text{ mA}, T_A = 25^\circ\text{ C}$
t_d	Turn On Delay Time		10		10	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$
t_r	Rise Time		40		40	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$
t_s	Storage Time		80		80	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_{BM} = 15\text{ mA}$
t_f	Fall Time		30		30	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_{BM} = 15\text{ mA}$
t_{on}	Turn On Time		45		45	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$
t_{off}	Turn Off Time		100		100	ns	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_{BM} = 15\text{ mA}$

BSR17

NPN Switching Transistor

- V_{CE0} ... 40 V (Max)
- f_T ... 250 MHz (Min)

PACKAGES

BSR17

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation

Total Dissipation at
 25° C Ambient Temperature 0.350 W*

Voltages & Currents

V_{CE0} Collector to Emitter Voltage 40 V
 V_{CBO} Collector to Base Voltage 60 V
 V_{EBO} Emitter to Base Voltage 6.0 V
 I_C Collector Current 200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		5.0	μA	$V_{CB} = 50 V, I_E = 0, T_J = 150^\circ C$
I_{CEX}	Collector Cutoff Current		50	nA	$V_{CE} = 30 V, V_{EB} = 3.0 V$
I_{BX}	Base Current		50	nA	$V_{CE} = 30 V, V_{EB} = 3.0 V$
h_{FE}	DC Current Gain	20 35 50 30 15	150		$I_C = 0.1 mA, V_{CE} = 1.0 V$ $I_C = 1.0 mA, V_{CE} = 1.0 V$ $I_C = 10 mA, V_{CE} = 1.0 V$ $I_C = 50 mA, V_{CE} = 1.0 V$ $I_C = 100 mA, V_{CE} = 1.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		200 300	V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 50 mA, I_B = 5.0 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	650	850 950	V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 50 mA, I_B = 5.0 mA$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BSR17

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
f_T	Current Gain Bandwidth Product	250		MHz	$V_{CE} = 20 \text{ mA}, I_C = 10 \text{ mA}$
h_{fe}	Small Signal Current Gain	50	200		$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Impedance	1.0	8.0	$k\Omega$	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 1.0 \text{ kHz}$
		0.1	5.0	$k\Omega$	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance	1.0	40	μmhos	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 1.0 \text{ kHz}$
t_d	Turn On Delay Time		35	ns	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, V_{EB} = 0.5 \text{ V}$
t_r	Rise Time		35	ns	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, V_{EB} = 0.5 \text{ V}$
t_s	Storage Time		175	ns	$I_C = 10 \text{ mA}, I_{B\text{on}} = -I_{B\text{off}} = 1.0 \text{ mA}$
t_f	Fall Time		50	ns	$I_C = 10 \text{ mA}, I_{B\text{on}} = -I_{B\text{off}} = 1.0 \text{ mA}$

3

- $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

PACKAGE

BSS63

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents (Note 4)

V_{CE0} Collector to Emitter Voltage	-100 V
V_{CER} Collector to Emitter Voltage $R_{BE} = 10 \text{ k}\Omega$	-110 V
I_C Collector Current (Continuous)	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	-100		V	$I_C = 100 \mu\text{A}$
BV_{CBO}	Collector to Base Breakdown Voltage	-110		V	$I_C = 10 \mu\text{A}$
BV_{CER}	Collector to Emitter Breakdown Voltage	-110		V	$I_C = 10 \mu\text{A}, I_E = 0, R_{BE} = 10 \text{ k}\Omega$
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		V	$I_E = 10 \mu\text{A}$
I_{EBO}	Emitter Cutoff Current		200	nA	$V_{EB} = -6.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = -90 \text{ V}, I_E = 0$
I_{CER}	Collector Cutoff Current		10	μA	$V_{CE} = -110 \text{ V}, R_{BE} = 10 \Omega$
h_{FE}	DC Current Gain (Note 5)	30 30			$I_C = 10 \text{ mA}, V_{CE} = -1.0 \text{ V}$ $I_C = 25 \text{ mA}, V_{CE} = -1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-250	mV	$I_C = 25 \text{ mA}, I_B = 25 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-900	V	$I_C = 25 \text{ mA}, I_B = 2.5 \text{ mA}$
f_T	Current Gain Bandwidth Product	50		MHz	$V_{CE} = -5.0 \text{ V}, I_C = 25 \text{ mA}, f = 35 \text{ MHz}$
C_C	Case Capacitance		5.0	pF	$I_E = I_C = 0, V_{CB} = -10 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T232.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

BSS64
NPN Driver Transistor

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

PACKAGE

BSS64

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage 80 V
 V_{CBO} Collector to Base Voltage 120 V
 V_{EBO} Emitter to Base Voltage 5.0 V
 I_C Collector Current (Continuous) 100 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	80		V	$I_C = 4.0 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	120		V	$I_C = 100 \mu\text{A}$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 100 \mu\text{A}$
I_{EBO}	Emitter Cutoff Current		200	nA	$V_{EB} = 4.0 \text{ V}$
I_{CES}	Collector Cutoff Current		20	μA	$V_{CE} = 80 \text{ V}, T_A = 70^\circ \text{C}$
h_{FE}	DC Current Gain (Note 5)	20			$I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.7 3.0	V V	$I_C = 4.0 \text{ mA}, I_B = 400 \mu\text{A}$ $I_C = 50 \text{ mA}, I_B = 15 \text{ mA}$
f_T	Current Gain Bandwidth Product		50	MHz	$I_C = 4.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 35 \text{ MHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T149.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

BSS79B/BSS79C

PNP General Purpose Transistor

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.350 W*
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Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage	40 V
V_{CBO} Collector to Base Voltage	75 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current (Continuous)	100 mA

PACKAGE

BSS79B	TO-236AA/AB
BSS79C	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 2.0 \text{ mA}$
BV_{CBO}	Collector to Base Breakdown Voltage	75		V	$I_C = 10 \mu\text{A}$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_E = 10 \mu\text{A}$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{BE} = 3.0 \text{ V}$
I_{CBO}	Collector Cutoff Current		10 10	nA μA	$V_{CB} = 60 \text{ V}$ $V_{CB} = 60 \text{ V}, T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain (BSS79B) (Note 5) (BSS79C)	40 100	120 300		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.3 1.0	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10 \text{ V}, f = 1.0 \text{ MHz}$
f_T	Current Gain Bandwidth Product	250		MHz	$V_{CE} = 20 \text{ V}, I_C = 20 \text{ mA}, f = 100 \text{ MHz}$
t_d	Turn On Delay Time		10	ns	$I_C = 150 \text{ mA}, V_{CC} = 30 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$
t_r	Rise Time		10	ns	$I_C = 150 \text{ mA}, V_{CC} = 30 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$
t_s	Storage Time		225	ns	$I_C = 150 \text{ mA}, V_{CC} = 30 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$
t_f	Fall Time		60	ns	$I_C = 150 \text{ mA}, V_{CC} = 30 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 - Rating refers to a high current point where collector to emitter voltage is lowest.
 - Pulse conditions: length = 300 μs ; duty cycle = 1%.
 - For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.350 W*

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage -40 V
 V_{CBO} Collector to Base Voltage -60 V
 V_{EBO} Emitter to Base Voltage -5.0 V
 I_C Collector Current (Continuous) 800 mA

PACKAGE

BSS80B TO-236AA/AB
 BSS80C TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CEO}	Collector to Emitter Breakdown Voltage	-40		V	I _C = 10 mA
BV _{CBO}	Collector to Base Breakdown Voltage	-60		V	I _C = 10 μA
BV _{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	I _E = 10 μA
I _{EBO}	Emitter Cutoff Current		10	nA	V _{BE} = -3.0 V
I _{CBO}	Collector Cutoff Current		10 10	nA μA	V _{CB} = -50 V V _{CB} = -50 V, T _A = 150° C
h _{FE}	DC Current Gain (BSS80B) (Note 5) (BSS80C)	40 100	120 300		I _C = 150 mA, V _{CE} = -10 V I _C = 150 mA, V _{CE} = -10 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		-0.4 -1.6	V V	I _C = 150 mA, I _B = 15 mA I _C = 500 mA, I _B = 50 mA
C _{ob}	Output Capacitance		8.0	pF	V _{CB} = -10 V, f = 1.0 MHz
f _T	Current Gain Bandwidth Product	200		MHz	V _{CE} = -20 V, I _C = 50 mA, f = 100 MHz
t _d	Turn On Delay Time		10	ns	I _C = 150 mA, V _{CC} = -30 V, I _{B1} = I _{B2} = 15 mA
t _r	Rise Time		40	ns	I _C = 150 mA, V _{CC} = -30 V, I _{B1} = I _{B2} = 15 mA
t _s	Storage Time		80	ns	I _C = 150 mA, V _{CC} = -30 V, I _{B1} = I _{B2} = 15 mA
t _f	Fall Time		30	ns	I _C = 150 mA, V _{CC} = -30 V, I _{B1} = I _{B2} = 15 mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3

• $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$

PACKAGE

BSV52

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.350 W^*

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 12 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 20 V
 V_{EBO} Emitter to Base Voltage 20 V
 I_C Collector Current (Continuous) 200 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	12		V	$I_C = 1.0 \text{ mA}, I_B = 0$
I_{CBO}	Collector Cutoff Current		100 5.0	nA μA	$V_{CB} = 10 \text{ V}, I_E = 0$ $V_{CB} = 10 \text{ V}, I_E = 0, T_A = 125^\circ \text{C}$
h_{FE}	DC Current Gain	25 40 25	120		$I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		300 250 400	mV mV mV	$I_C = 10 \text{ mA}, I_B = 300 \mu\text{A}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	700	850 1200	mV mV	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		4.5	pF	$V_{EB} = 1.0 \text{ V}, I_C = 0$
f_T	Current Gain Bandwidth Product	400		MHz	$V_{CE} = 10 \text{ V}, I_C = 10 \text{ mA}$
t_s	Storage Time (test circuit no. 239)		13	ns	$I_C = 10 \text{ mA}, I_B = I_{BM} = 10 \text{ mA}$
t_{on}	Turn On Time		12	ns	$I_C = 10 \text{ mA}, V_{BE} = 1.5 \text{ V}, I_B = 3.0 \text{ mA}$
t_{off}	Turn Off Time		18	ns	$I_C = 10 \text{ mA}, I_B = 3.0 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ \text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T132.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

• $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{ C}$

PACKAGE

BSX39

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature $-55^\circ \text{ C to } 150^\circ \text{ C}$
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.350 W^*

Voltages & Currents (Note 4)

V_{CE0} Collector to Emitter Voltage 14 V
 I_C Collector Current (Continuous) 200 mA

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	14		V	$I_C = 2.0 \text{ mA}, I_B = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 12 \text{ V}, I_E = 0$
I_{CES}	Collector Cutoff Current		100 5.0	nA μA	$V_{CE} = 12 \text{ V}, I_E = 0$ $V_{CE} = 12 \text{ V}, I_E = 0, T_A = 125^\circ \text{ C}$
h_{FE}	DC Current Gain (Note 5)	25 40 25	200		$I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		250 400	mV mV	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.7	0.85 1.2	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
t_{on}	Turn On Time		12	ns	$I_C = 10 \text{ mA}, I_B = 3.0 \text{ mA}$
t_{off}	Turn Off Time		18	ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 3.0 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T132.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FA Series

Matched Pair and Quad Assemblies Diodes

The FA Series are individual glass diodes featuring very tightly matched characteristics over broad temperature and current ranges.

- ΔV_F ... Down to 3 mV (MAX)
- ΔI_R ... Down to 10 nA (MAX)

PACKAGE
All Devices DO-7

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	
Each Diode	250 mW

Linear Power Derating factor (from 25°C)	
Each Diode	1.67 mW/°C

Maximum Voltage and Currents

Basic Diode (See Specification below)	FD1389	FD2389	FD3389	FD6389
WIV Working Inverse Voltage	75 V	150 V	125 V	50 V
I_O Average Rectified Current	100 mA	100 mA	150 mA	200 mA
I_F Continuous Forward Current	150 mA	150 mA	225 mA	300 mA
i_f Recurrent Peak Forward Current	300 mA	300 mA	450 mA	600 mA
$i_{f(surge)}$ Peak Forward Surge Current				
Pulse width = 1.0 s	1.0 A	1.0 A	1.0 A	1.0 A
Pulse width = 1.0 μ s	4.0 A	4.0 A	4.0 A	4.0 A

MATCHING CHARACTERISTICS (Apply over temperature range of -55°C to +100°C)

Basic Diode (See Specification below)	Forward Current Matching Range (Notes 4 & 6)	Reverse Current Match (ΔI_R Maximum) (Note 3)	Forward Voltage Match (ΔV_F Maximum)	Assembly Type Number	
				Pair	Quad
FD1389	10 μ A to 1.0 mA		3.0 mV	FA2310U	FA4310U
FD1389	10 μ A to 1.0 mA		10 mV	FA2311U	FA4311U
FD1389	1.0 mA to 10 mA		5.0 mV	FA2312U	FA4312U
FD1389	1.0 mA to 10 mA		15 mV	FA2313U	FA4313U

NOTES:

- These are Limiting values above which life or satisfactory performance may be impaired
- These are steady state Limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- The Reverse Current Match (ΔI_R) is the difference in reverse current between the diode having the highest I_R and that having the lowest I_R in a given assembly. The reverse voltage (V_R) in the ΔI_R calculation can be any value up to 125 V. For example, the maximum ΔI_R for an FA2330U at V_R of 10 V is $(2.0 + 0.064 \times 10)$ nA or 2.64 nA.
- The Forward Current Matching Ranges between 10 μ A and 10 mA may be applied either as a dc current or a pulse current. Above 10 mA, however, the matching characteristics are guaranteed only for low duty cycle ($\leq 1\%$) pulse current. Conditions of test are shown in the characteristic curve and test circuit section of this book
- For product family characteristics curves for the basic diodes used in the assemblies, refer to the following parts of Section 4.

FD1389 D4
FD2389 D1
FD3389 D2
FD6389 D4

For test circuits, refer to Chapter 4, D18.

FA Series

Matched Pair and
Quad Assemblies Diodes

MATCHING CHARACTERISTICS (Apply over temperature range of -55°C to $+100^{\circ}\text{C}$)

Basic Diode (See Specification below)	Forward Current Matching Range (Notes 4 & 6)	Reverse Current Match (ΔI_R Maximum) (Note 3)	Forward Voltage Match (ΔV_F Maximum)	Assembly Type Number	
				Pair	Quad
FD2389	10 μA to 1.0 mA		3.0 mV	FA2320U	FA4320U
FD2389	10 μA to 1.0 mA		10 mV	FA4321U	FA4321U
FD2389	1.0 mA to 10 mA		5.0 mV	FA2322U	FA4322U
FD2389	1.0 mA to 10 mA		15 mV	FA2323U	FA4323U
FD2389	10 mA to 100 mA		10 mV	FA2324U	FA4324U
FD2389	10 mA to 100 mA		20 mV	FA2325U	FA4325U
FD3389	10 μA to 1.0 mA	($2.0 + 0.064 V_R$) nA	10 mV	FA2330U	FA4330U
FD3389	1.0 mA to 10 mA	($2.0 + 0.064 V_R$) nA	15 mV	FA2331U	FA4331U
FD3389	10 mA to 100 mA	($2.0 + 0.064 V_R$) nA	20 mV	FA2332U	FA4332U
FD3389	10 μA to 1.0 mA	($4.0 + 0.128 V_R$) nA	10 mV	FA2333U	FA4333U
FD3389	1.0 mA to 10 mA	($4.0 + 0.128 V_R$) nA	15 mV	FA2334U	FA4334U
FD3389	10 mA to 100 mA	($4.0 + 0.128 V_R$) nA	20 mV	FA2335U	FA4335U
FD6389	10 mA to 100 mA		10 mV	FA2360U	FA4360U
FD6389	10 mA to 100 mA		20 mV	FA2361U	FA4361U

BASIC DIODE ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FD1389		FD2389		FD3389		FD6389		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
BV	Breakdown Voltage	100		200		150		75		V	$I_R = 5.0 \mu\text{A}$
										V	$I_R = 100 \mu\text{A}$
I_R	Reverse Current		100 100		100 100		1.0 3.0		100 100	nA μA	$V_R = WIV$ $V_R = WIV, T_A = 150^{\circ}\text{C}$
V_F	Forward Voltage				1.000		1.000		1.000	V	$I_F = 200 \text{ mA}$
					0.925		0.930		0.920	V	$I_F = 100 \text{ mA}$
					0.860		0.880		0.860	V	$I_F = 50 \text{ mA}$
			1.000		0.790		0.840		0.790	V	$I_F = 20 \text{ mA}$
			0.875		0.740		0.810		0.750	V	$I_F = 10 \text{ mA}$
			0.800		0.700		0.770		0.710	V	$I_F = 5.0 \text{ mA}$
			0.725		0.620		0.730		0.670	V	$I_F = 2.0 \text{ mA}$
			0.670		0.610		0.710		0.630	V	$I_F = 1.0 \text{ mA}$
											V
C	Capacitance (Note 5)		2.0		5.0		6.0		3.0	pF	$V_R = 0, f = 1 \text{ MHz}$
t_{rr}	Reverse Recovery Time		4.0							ns	$I_f = I_r = 10 \text{ mA}$ Recover to 1.0 mA
					50					ns	$I_f = I_r = 30 \text{ mA}$ Recover to 1.0 mA
								4.0		ns	$I_f = I_r = 200 \text{ mA}$ Recover to 20 mA

- $\Delta V_F \dots 5 \text{ mV (Max) @ } 5 \text{ mA}$

ABSOLUTE MAXIMUM RATINGS (Notes 1 & 5)

Temperatures

Storage Temperature $-55^\circ\text{C to } 150^\circ\text{C}$
 Operating Junction Temperature 150°C

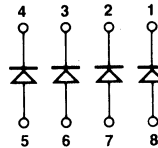
Power Dissipation (Note 2)

Total Dissipation
 per Junction at 25°C Ambient 300 mW^*
 per Package at 25°C Ambient 1.0 W
 Linear Derating Factor
 Junction $2.4 \text{ mW}/^\circ\text{C}$
 Package $8.0 \text{ mW}/^\circ\text{C}$

Voltages & Currents

W_{IV} Working Inverse Voltage
 FASA2618 75 V
 FASA2718 50 V
 I_F Continuous Forward Current 250 mA
 i_r Peak Forward Surge Current
 Pulse Width = 1.0 s 1.0 A
 Pulse Width = $1.0 \mu\text{s}$ 2.0 A

Connection Diagram



PACKAGE

FASO2618 8-SOIC
 FASO2718 8-SOIC

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage (Note 5) (FASO2718) (FASO2618)	75		V	$I_R = 5.0 \mu\text{A}$ $I_R = 100 \mu\text{A}$
		100		V	
I_R	Reverse Current (FASO2618) (FASO2718)		5.0	μA	$V_R = 75 \text{ V}$ $V_R = 20 \text{ V}$ $V_R = 20 \text{ V}, T_A = 150^\circ\text{C}$ $V_R = 50 \text{ V}$ $V_R = 50 \text{ V}, T_A = 150^\circ\text{C}$
			25	nA	
			50	μA	
			100	nA	
			100	μA	
V_F	Forward Voltage (Note 3)		1.0	V	$I_F = 10 \text{ mA}$
t_{rr}	Reverse Recovery Time (Note 6) (FASO2618) (FASO2718)		5.0	ns	$I_f = I_r = 10 \text{ mA}, I_{rr} = 1.0 \text{ mA}$ $I_f = I_r = 10 \text{ mA}, I_{rr} = 1.0 \text{ mA}$
			6.0	ns	

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. V_F is measured using an 8 ms pulse.
 4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
 5. For product family characteristic curves, refer to Curve Set D-15.
- * Package mounted on 99.5 alumina $12 \text{ mm} \times 18 \text{ mm}$ 0.6 mm .

FASO2618/FASO2718

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C	Capacitance (Note 6) (FASO2618) (FASO2718)		4.0 2.0	pF pF	$V_R = 0$ $V_R = 0$
ΔV_F	Forward Voltage Match (Note 6)		5.0	mV	$I_F = 5.0$ mA
t_{fr}	Forward Recovery Time (Note 6) (FASO2618)		20	ns	50 mA Peak Square wave, 0.1 μ s Pulse Width, 5.0 kHz - 100 kHz
V_{FM}	Peak Forward Voltage (Note 6) (FASO2618)		3.0	V	$I_F = 100$ mA, $t_r \leq 10$ ns
RE	Rectification Efficiency	45		%	$V_t = 2.0$ V rms, $f = 100$ MHz
I_{SO}	Isolation Current		50	nA	$V_R = 50$ V

3

FDH300/FDLL300 FDH333/FDLL333

High Conductance Low
Leakage Diodes

- BV... 150 V (MIN) @ 100 μ A
- I_R... 1.0 nA (MAX) @ 125 V (FDH300), 3.0 nA (MAX) @ 125 V (FDH333)

PACKAGES

FDH300	DO-35
FDH333	DO-35
FDLL300	LL-34
FDLL333	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltages and Currents

WIV	Working Inverse Voltage	125 V
I _O	Average Rectified Current	200 mA
I _F	Forward Current Steady State	500 mA
i _f	Recurrent Peak Forward Current	600 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FDH300		FDH333		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _F	Forward Voltage			0.9	1.15	V	I _F = 300 mA
				0.88	1.08	V	I _F = 250 mA
			1.0	0.87	1.05	V	I _F = 200 mA
				0.86	0.97	V	I _F = 150 mA
			0.92	0.83	0.94	V	I _F = 100 mA
			0.88	0.80	0.89	V	I _F = 50 mA
			0.8			V	I _F = 10 mA
			0.75			V	I _F = 5.0 mA
			0.68			V	I _F = 1.0 mA
		I _R	Reverse Current		1.0		3.0
	3.0					μ A	V _R = 125 V, T _A = 150°C
					500	nA	V _R = 125 V, T _A = 100°C
C	Capacitance		6.0		6.0	pF	V _R = 0, f = 1MHz
BV	Breakdown Voltage	150		150		V	I _R = 100 μ A

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For family characteristic curves, refer to Chapter 4, D2.

**FDH400/FDLL400
FDH444/FDLL444**

High Voltage General Purpose Diodes

- BV ... 200 V (MIN) FDH400
... 150 V (MIN) FDH444
- VF ... 1.1 V (MAX) @ 300 mA FDH400
@ 200 mA FDH444

PACKAGES

FDH400	DO-35
FDH444	DO-35
FDLL400	LL-34
FDLL444	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1400 family.

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	FDH400	FDH444
WIV Working Inverse Voltage	175 V	125 V
IO Average Rectified Current	200 mA	200 mA
IF Forward Current Steady State	500 mA	500 mA
if Recurrent Peak Forward Current	600 mA	600 mA
if(surge) Peak Forward Surge Current		
Pulse width = 1.0 s	1.0 A	1.0 A
Pulse width = 1.0 μs	4.0 A	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FDH400		FDH444		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
VF	Forward Voltage		1.1		1.2	V	IF = 300 mA IF = 200 mA
			1.0		1.1	V	
BV	Breakdown Voltage	200		150		V	IR = 100 μA
IR	Reverse Current		100		50	nA	VR = 150 V VR = 100 V VR = 150 V, TA = 150°C VR = 100 V, TA = 150°C
			100		100	μA	
						μA	
C	Capacitance		2.0		2.5	pF	VR = 0, f = 1.0 MHz
t _{rr}	Reverse Recovery Time		50		60	ns	IF = 30 mA, IR = 30 mA RL = 100 Ω, I _{rr} = 3.0 mA

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For product family characteristic curves, refer to Chapter 4, D1.

**FDH600/FDLL600
FDH666/FDLL666**

Ultra Fast Diodes

- C... 2.5 pF (MAX) FDH600, 3.5 pF (MAX) FDH666
- V_F... 1.0 V (MAX) @ 100 mA (FDH666)
... 1.0 V (MAX) @ 200 mA (FDH600)
- t_{rr}... 4.0 ns (MAX) @ I_f = I_r = 10 mA

PACKAGES

FDH600	DO-35
FDH666	DO-35
FDLL600	LL-34
FDLL666	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

		FDH 600	FDH 666
WIV	Working Inverse Voltage	50 V	25 V
I _O	Average Rectified Current	200 mA	200 mA
I _F	Continuous Forward Current	500 mA	500 mA
i _f	Recurrent Peak Forward Current	600 mA	600 mA
i _f (surge)	Peak Forward Surge Current		
	Pulse Width = 1.0 s	1.0 A	1.0 A
	Pulse Width = 1.0 μs	4.0 A	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FDH600		FDH666		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _F	Forward Voltage		1.0			V	I _F = 200 mA
			0.92		1.0	V	I _F = 100 mA
			0.86		0.86	V	I _F = 50 mA
			0.79		0.79	V	I _F = 10 mA
			0.65		0.65	V	I _F = 1.0 mA
I _R	Reverse Current		0.1			μA	V _R = 50 V
					0.1	μA	V _R = 25 V
			100			μA	V _R = 50 V, T _A = 150°C
					100	μA	V _R = 25 V, T _A = 150°C
BV	Breakdown Voltage	75		40		V	I _R = 5.0 μA
t _{rr}	Reverse Recovery Time (Note 3)		4.0		4.0	ns	I _f = I _r = 10 mA, R _L = 100 Ω
			6.0		6.0	ns	I _f = I _r = 200 mA, R _L = 100 Ω
C	Capacitance		2.5		3.5	pF	V _R = 0, f = 1.0 MHz

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 0.1 I_R.
4. For product family characteristic curves, refer to Chapter 4, D4.

- C... 1.0 pF (MAX) @ $V_R = 0$, $f = 1.0$ MHz (FD 700)
- t_{rr} ... 700 ps (MAX) @ $I_f = I_r = 10$ mA, $R_L = 100 \Omega$ (FD 700)
- CONTROLLED FORWARD CONDUCTANCE

PACKAGES	
FD700	DO-7
FD777	DO-7
FDLL700	LL-34
FDLL777	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	FD700	FD777	
Storage Temperature Range	-65°C to +200°C	-65°C to +200°C	
Max Junction Operating Temperature	+175°C	+175°C	
Lead Temperature	+260°C	+260°C	
Power Dissipation			
Maximum Total Dissipation at 25°C			
Ambient	250 mW	250 mW	
Linear Derating Factor (from 25°C)	1.67 mW/°C	1.67 mW/°C	
Maximum Voltages and Currents			
WIV	Working Inverse Voltage	20 V	8.0 V
I_O	Average Rectified Current	50 mA	50 mA
I_F	Forward Current Steady State dc	150 mA	150 mA
i_f	Recurrent Peak Forward Current	150 mA	150 mA
i_f (surge)	Peak Forward Surge Current		
	Pulse Width = 1.0 s	250 mA	250 mA

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1700 family.

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FD700		FD777		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V_F	Forward Voltage	0.89	1.10	0.89	1.35	V	$I_F = 50$ mA
		0.81	0.95	0.81	1.00	V	$I_F = 20$ mA
		0.76	0.88	0.76	0.94	V	$I_F = 10$ mA
		0.64	0.74	0.64	0.79	V	$I_F = 1.0$ mA
		0.52	0.61	0.52	0.64	V	$I_F = 0.1$ mA
		0.42	0.50	0.42	0.53	V	$I_F = 0.01$ mA
BV	Breakdown Voltage	30		15		V	$I_R = 5.0 \mu A$
I_R	Reverse Current		50			nA	$V_R = 20$ V
			50		100	nA	$V_R = 8.0$ V
					50	μA	$V_R = 20$ V, $T_A = 150^\circ C$
						μA	$V_R = 8.0$ V, $T_A = 150^\circ C$
τ	Minority Carrier Lifetime		450		450	ps	(see Note 2)
t_{rr}	Reverse Recovery Time (Note 3)		700		750	ps	$I_f = I_r = 10$ mA, $R_L = 100 \Omega$
C	Capacitance		1.0		1.3	pF	$V_R = 0$, $f = 1.0$ MHz

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Measured as suggested by S. M. Krakauer, IRE Proceedings, Volume 60, July 1962, pp. 1674 - 1675.
3. Recovery to 0.1 I_R .
4. For product family characteristic curves, refer to Chapter 4, D3.

**FDH900/FDLL900
FDH999/FDLL999**

High Speed Switching Diodes

- BV... 45V (FDH900), 35 V (FDH999)
- t_{rr} ... 4.0 ns (FDH900), 5.0 ns (FDH999)

PACKAGES

FDH900	DO-35
FDH999	DO-35
FDLL900	LL-34
FDLL999	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max. Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (From 25°C)	3.3 mW/°C.

Maximum Voltage and Currents

WIV	Working Inverse Voltage	FDH900	40 V
		FDH999	25 V
I_O	Average Rectified Current		200 mA
I_F	Continuous Forward Current		500 mA
i_f	Recurrent Peak Forward Current		600 mA
$i_f(\text{surge})$	Peak Forward Surge Current		
	Pulse Width = 1.0 s		1.0 A
	Pulse Width = 1.0 μ s		4.0 A

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FDH900		FDH999		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV	Breakdown Voltage	45		35		V	$I_R = 5.0 \mu A$
I_R	Reverse Current		500		1.0	μA nA	$V_R = 25 V$ $V_R = 40 V$
V_F	Forward Voltage		1.0		1.0	V V	$I_F = 10 mA$ $I_F = 100 mA$
C	Capacitance		3.0		5.0	pF	$V_R = 0, f = 1.0 MHz$
t_{rr}	Reverse Recovery Time		4.0		5.0	ns	$I_f = 10 mA, I_r = 10 mA,$ $R_L = 100 \Omega, I_{rr} = 1.0 mA$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D4.

- V_F ... 1 V (max) @ 500 mA
- Q_S ... 100 pC (max)

PACKAGES

FDH1000	DO-35
FDLL1000	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	50 V
I_O	Average Rectified Current	200 mA
I_F	Continuous Forward Current	500 mA
i_f	Peak Repetitive Forward Current	600 mA
$i_f(\text{surge})$	Peak Forward Surge Current	
	Pulse Width = 1 s	1.0 A
	Pulse Width = 1 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_f	Forward Voltage		1.0	V	$I_F = 500 \text{ mA}$
I_R	Reverse Current		5.0 50 50	μ A nA μ A	$V_R = 50 \text{ V}$ $V_R = 20 \text{ V}$ $V_R = 20 \text{ V}, T_A = 125^\circ\text{C}$
BV	Breakdown Voltage	75		V	$I_R = 100 \mu\text{A}$
C	Capacitance		5.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
Q_S	Stored Charge		100	pC	$I_f = 10 \text{ mA}, V_R = 10 \text{ V}$

NOTES:

1. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For family characteristic curves, refer to Chapter 4, D4.

FDSO1201 - 1205

High Conductance Ultra Fast Diode

- B_V ... 200 V (Min)
- I_r ... 1.0 ns (Max) @ 125 V

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Device Dissipation at $T_A = 25° C$	0.350 mW
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Voltages & Currents (Note 4)

W_{IV} Working Inverse Voltage	150 V
I_O Average Rectified Current	200 mA
I_f DC Forward Current	300 mA
i_f Recurrent Peak Forward Current	400 mA

Connection Diagram



1201



1202



1203



1204



1205

PACKAGE

FDSO1201	TO-236AA/AB
FDSO1202	TO-236AA/AB
FDSO1203	TO-236AA/AB
FDSO1204	TO-236AA/AB
FDSO1205	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	100		V	$I_R = 100 \mu A$
I_R	Reverse Current		25 50 5.0	nA nA nA	$V_R = 20 V$ $V_R = 50 V$ $V_R = 50 V, T_J = 150° C$
V_F	Forward Voltage	0.55 0.66 0.82 0.87	0.60 0.74 0.92 1.0 1.1	V V V V V	$I_F = 1.0 mA$ $I_F = 10 mA$ $I_F = 100 mA$ $I_F = 200 mA$ $I_F = 300 mA$
t_{rr}	Reverse Recovery Time		4.0	ns	$I_F = I_R = 10 mA, R_L = 100 \Omega,$ $I_{RR} = 1.0 mA$
C	Capacitance		2.0	pF	$V_R = 0, f = 1.0 MHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. For product family characteristic curves, refer to Curve Set D-1.

FDSO1401 - 1405

High Voltage General Purpose Diode

- $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{ C}$
- $B_V \dots 200 \text{ V (Min)}$
- $V_F \dots 1.1 \text{ V (Max) @ } 300 \text{ mA}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	150° C
Operating Junction Temperature	150° C

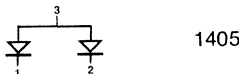
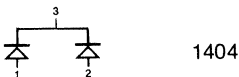
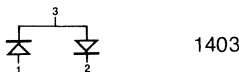
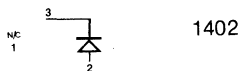
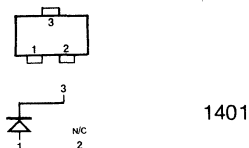
Power Dissipation (Notes 2 & 3)

Total Device Dissipation at $T_A = 25^\circ \text{ C}$	0.350 mW
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Voltages & Currents

W_{IV} Working Inverse Voltage	200 V
I_O Average Rectified Current	200 mA
I_F DC Forward Current	300 mA
i_F Recurrent Peak Forward Current	400 mA

Connection Diagram



PACKAGE

FDSO1401	TO-236AA/AB
FDSO1402	TO-236AA/AB
FDSO1403	TO-236AA/AB
FDSO1404	TO-236AA/AB
FDSO1405	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	200		V	$I_R = 100 \mu\text{A}$
I_R	Reverse Voltage Leakage Current		40 100	nA nA	$V_R = 120 \text{ V}$ $V_R = 175 \text{ V}$
V_F	Forward Voltage	0.76	0.80 0.92 1.0 1.1	V V V V	$I_F = 10 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 200 \text{ mA}$ $I_F = 300 \text{ mA}$
C	Capacitance		2.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		50	ns	$I_F = 30 \text{ mA}, I_{rr} = 1.0 \text{ mA}, R_L = 100 \Omega$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. For product family characteristic curves, refer to Curve Set D-2.

FDSO1501 - 1505

High Conductance Low Leakage Diode

- $P_D \dots 350 \text{ mW @ } T_A = 25^\circ \text{ C}$
- $B_V \dots 200 \text{ V (Min)}$
- $I_R \dots 1.0 \text{ nA (Max) @ } 125 \text{ V}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	150° C
Operating Junction Temperature	150° C

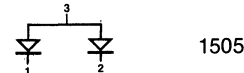
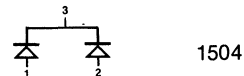
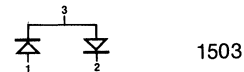
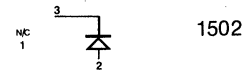
Power Dissipation (Notes 2 & 3)

Total Device Dissipation at $T_A = 25^\circ \text{ C}$	0.350 mW
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Voltages & Currents

W_{IV} Working Inverse Voltage	150 V
I_o Average Rectified Current	200 mA
I_f DC Forward Current	300 mA
I_r Recurrent Peak Forward Current	400 mA

Connection Diagram



PACKAGE

FDSO1501	TO-236AA/AB
FDSO1502	TO-236AA/AB
FDSO1503	TO-236AA/AB
FDSO1504	TO-236AA/AB
FDSO1505	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	200		V	$I_R = 5 \mu\text{A}$
I_R	Reverse Voltage Leakage Current		1.0 10 5.0 3.0	nA nA μA μA	$V_R = 125 \text{ V}$ $V_R = 180 \text{ V}$ $V_R = 180 \text{ V, } T_A = 150^\circ \text{ C}$ $V_R = 125 \text{ V, } T_A = 150^\circ \text{ C}$
V_F	Forward Voltage	0.60 0.69 0.80 0.83 0.87 0.90	0.68 0.80 0.88 0.92 1.0 1.15	V mV mV mV mV mV	$I_F = 1.0 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 100 \text{ mA}$ $I_F = 200 \text{ mA}$ $I_F = 300 \text{ mA}$
C_T	Diode Capacitance		4.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
4. For product family characteristic curves, refer to Curve Set D-2.

FDSO1701 - 1705

Picosecond Computer Diode

- $P_D \dots 350 \text{ mW} @ T_A = 25^\circ \text{C}$
- $C_T \dots 1.0 \text{ pf (Max)} @ V_R = 0, f = 1.0 \text{ MHz}$
- $t_{rr} \dots 700 \text{ ps (Max)} @ I_f = I_r = 10 \text{ mA}, R_L = 100 \Omega$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	150°C
Operating Junction Temperature	150°C

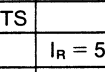
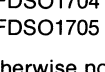
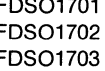
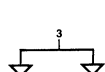
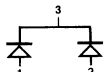
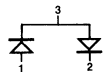
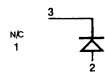
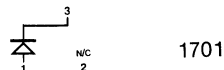
Power Dissipation (Notes 2 & 3)

Total Device Dissipation at $T_A = 25^\circ \text{C}$	0.350 mW
--	----------

Voltages & Currents

W_{IV} Working Inverse Voltage	20 V
I_o Average Rectified Current	50 mA
I_f DC Forward Current	150 mA
i_f Recurrent Peak Forward Current	150 mA

Connection Diagram



PACKAGE

FDSO1701	TO-236AA/AB
FDSO1702	TO-236AA/AB
FDSO1703	TO-236AA/AB
FDSO1704	TO-236AA/AB
FDSO1705	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	30		V	$I_R = 5.0 \mu\text{A}$
I_R	Reverse Voltage Leakage Current	50		nA	$V_R = 20 \text{ V}$
V_F	Forward Voltage	0.42	0.50	V	$I_F = 10 \mu\text{A}$
		0.52	0.61	V	$I_F = 100 \mu\text{A}$
		0.64	0.74	V	$I_F = 1.0 \text{ mA}$
		0.76	0.88	V	$I_F = 10 \text{ mA}$
		0.81	0.95	V	$I_F = 20 \text{ mA}$
		0.89	1.1	V	$I_F = 50 \text{ mA}$
C_T	Diode Capacitance		1.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{rr}	Reverse Recovery Time		700	ps	$I_F = I_R = 10 \text{ mA}, I_{RR} = 1.0 \text{ mA}, R_L = 100 \Omega$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
4. For product family characteristic curves, refer to Curve Set D-3.

FJT1100/FJT1101

Ultra Low Leakage Diodes

- I_R ... 1.0 pA (MAX) @ 5V (FJT1100)
- BV ... 20 V (MIN) (FJT1100)

PACKAGES

FJT1100	DO-7
FJT1101	DO-7

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperature

Storage Temperature Range	-55°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	250 mW
Linear Power Derating factor (from 25°C)	1.67 mW/°C

Maximum Voltage and Current

WIV	Working Inverse Voltage	FJT1100	25 V
		FJT1101	15 V
I_f	Continuous Forward Current		150 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	FJT1100	30		V	$I_R = 5.0 \mu A$
		FJT1101	20		V	
I_R	Reverse Current	FJT1100		1.0	pA	$V_R = 5.0 V$ $V_R = 15V$ $V_R = 5.0V$ $V_R = 15V$
				10	pA	
		FJT1101		5.0	pA	
				15	pA	
V_F	Forward Voltage	FJT1100		1.05	V	$I_F \approx 50 mA$ $I_F = 50 mA$
		FJT1101		1.10	V	
C	Capacitance	FJT1100		1.5	pF	$V_R = 0, f = 1MHz$ $V_R = 0, f = 1MHz$
		FJT1101		1.8	pF	

NOTES:

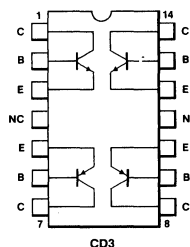
1. These are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves and applications information, refer to Chapter 4, D6.

FPQ2222/FQSO2222

NPN Quad General Purpose Amplifier

- **Compact Popular IC Package ... 4 Transistors per Package;**
14 Pin Plastic DIP Compatible with Automatic Insertion Equipment (FPQ2222)
- **High Breakdown Voltage ... 40 V $V_{CE(sus)}$**
- **DC Current Gain Specified ... 10 to 300 mA**
- **Similar to 2N2222 Series**
- **Gull Wing Surface Mount Package (FQSO)**

CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	FPQ	FQSO
25° C Ambient Temperature	0.65 W	
(Each Transistor)		
25° C Ambient Temperature	2.0 W	1.0 W

Voltages & Currents (Note 4)

V_{CEO} Collector to Emitter Voltage	40 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	600 mA

PACKAGE

FPQ2222	TO-116
FQSO2222	14SOIC

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB} = 3.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50	nA	$V_{CB} = 50 V, I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 4)	75 100 30			$I_C = 10 mA, V_{CE} = 10 V$ $I_C = 150 mA, V_{CE} = 10 V$ $I_C = 300 mA, V_{CE} = 10 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40		V	$I_C = 10 mA, I_B = 0$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 4)		1.3 2.6	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 300 mA, I_B = 30 mA$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.4 1.6	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 300 mA, I_B = 30 mA$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10 V, f = 100 kHz$
C_{ib}	Input Capacitance		30	pF	$V_{BE} = 0.5 V, f = 100 kHz$
f_T	Current Gain Bandwidth Product	200		MHz	$I_C = 20 mA, V_{CE} = -20 V, f = 100 MHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 62.5° C/W (derating factor of 16 mW/° C). FQSO power dissipation data is only an estimate, and may be subject to change without notice.
4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
5. For product family characteristic curves, refer to Curve Set T145.

FPQ2907/FQSO2907

PNP Quad General Purpose Amplifier

- High Breakdown Voltage ... 40 V $V_{CE(sus)}$
- DC Current Gain Specified ... 10 to 300 mA
- Similar to 2N2907 Series

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

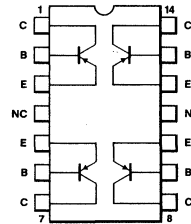
Total Dissipation at 25° C Ambient Temperature (Each Transistor)	0.65 W
25° C Ambient Temperature	2.0 W

Voltages & Currents (Notes 4 & 5)

V_{CEO} Collector to Emitter Voltage	-40 V
V_{CBO} Collector to Base Voltage	-60 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	600 mA

For SOIC power dissipation, consult factory.

Connection Diagram



PACKAGE

FPQ2907	TO-116
FQSO2907	14-SOIC

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB} = 3.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50	nA	$V_{CB} = -50 V, I_E = 0$
h_{FE}	DC Pulse Current Gain	75 100 50			$I_C = 10 mA, V_{CE} = -10 V$ $I_C = 150 mA, V_{CE} = -10 V$ $I_C = 300 mA, V_{CE} = -10 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	-40		V	$I_C = 10 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		-0.4 -1.6	V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 300 mA, I_B = 30 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 4)		-1.3 2.6	V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 300 mA, I_B = 30 mA$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = -10 V, f = 100 kHz$
C_{ib}	Input Capacitance		30	pF	$V_{BE} = 0.5 V, f = 100 kHz$
f_T	Current Gain Bandwidth Product	200		MHz	$I_C = 20 mA, V_{CE} = -20 V, f = 100 MHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 62.5° C/W (derating factor of 16 mW/° C).
4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
5. For product family characteristic curves, refer to Curve Set T212.

FPQ3724/FPQ3725
FQSO3724/FQSO3725

NPN Quad Core Driver

- $V_{CE(sus)}$... **50 V (Min) (FPQ3725)**
- t_{on} ... **25 ns (Typ)**
- t_{off} ... **45 ns (Typ)**
- **High Current ... 500 mA**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

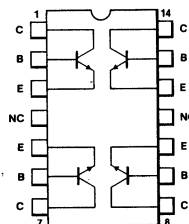
Storage Temperature -65° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 2.0 W
 25° C Ambient Temperature 0.65 W
 (Each Transistor)

For SOIC power dissipation, consult factory.

Connection Diagram



PACKAGES

FPQ3724 TO-116
 FPQ3725 TO-116
 FQSO3724 14-SOIC
 FQSO3725 14-SOIC

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3724		3725		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	70		80		V	$I_C = 10 \mu A, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	70		80		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CBO}	Collector Cutoff Current		1.7 120		1.7 120	μA	$V_{CB} = 40 V, I_E = 0$ $V_{CB} = 40 V, I_E = 0, T_A = 100^\circ C$
h_{FE}	DC Pulse Current Gain (Note 4)	50 30		50 20			$I_C = 100 mA, V_{CE} = 1.0 V$ $I_C = 500 mA, V_{CE} = 1.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.5 0.5 0.6		0.5 0.5 0.6	V	$I_C = 500 mA, I_B = 50 mA$ $I_C = 500 mA, I_B = 50 mA,$ $T_A = -55^\circ C$ $I_C = 500 mA, I_B = 50 mA,$ $T_A = 100^\circ C$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 62.5° C/W (derating factor of 16 mW/° C) for FPQ3724 and FPQ3725.
 4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 5. For product family characteristic curves, refer to Curve Set T139.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FPQ3724/FPQ3725
FQSO3724/FQSO3725

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3724		3725		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.2		1.2	V	$I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	40		50		V	$I_C = 10 \text{ mA}$, $I_B = 0$
C_{cb}	Collector to Base Capacitance		12		12	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$
C_{eb}	Emitter to Base Input Capacitance		60		60	pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$
h_{fe}	High Frequency Current Gain	2.0		2.0			$I_C = 50 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
t_s	Storage Time (test circuit no. 265)		50		50	ns	$I_C = 500 \text{ mA}$, $I_{B1} = I_{B2} = 50 \text{ mA}$
t_{on}	Turn On Time (test circuit no. 265)		35		35	ns	$I_C = 500 \text{ mA}$, $I_{B1} = 50 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 265)		60		60	ns	$I_C = 500 \text{ mA}$, $I_{B1} = I_{B2} = 50 \text{ mA}$

**FPQ3904/MPQ3904
FQSO3904**

Quad NPN Switching Transistor

The 3904 features four NPN silicon transistors in one package. The transistors are similar to 2N3904.

- **Fast Switching**
- **JEDEC (TO-116) 14-Pin Plastic DIP (FPQ/MPQ)**
- **Auto-Insertion Compatible**
- **Gull wing surface mount package (FQSO)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C
Lead Temperature (Soldering, 10 s)	275° C

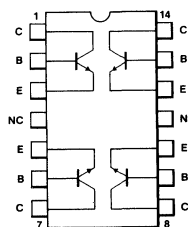
Power Dissipation (Notes 2, 3 & 5)

Total Dissipation at $T_A = 25^\circ\text{C}$	FPQ/MPQ 900 mW	FQSO* 1.0 W
Derate above 25° C	7.2 mW/° C	8.0 mW/° C
Power Dissipation at $T_A = 25^\circ\text{C}$ Each Transistor	500 mW	300 mW
Derate above 25° C	4.0 mW/° C	2.4 mW/° C

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	40 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	200 mA

Connection Diagram



PACKAGE

FPQ3904	TO-116
MPQ3904	TO-116
FQSO3904	14 SOIC

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	60			V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 40 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current			50	nA	$V_{EB} = 3.0 \text{ V}, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 139° C/W (derating factor of 7.2 mW/° C).
 4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 5. FQSO power dissipation data is only an estimate, and may be subject to change without notice.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**FPQ3904/MPQ3904
FQSO3904**

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
h_{FE}	DC Current Gain (Note 4)	40 70 100 50		300		$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 4)			0.2 0.3	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)	0.65		0.85 0.95	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 1.0 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	250			MHZ	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.0	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance			8.0	pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		30		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		125		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

SYMBOL	CHARACTERISTIC	MPQ			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	60			V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 40 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current			50	nA	$V_{EB} = 3.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 4)	30 50 75				$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation			0.2	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)			0.85	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 1.0 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	250			MHZ	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.0	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance			8.0	pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		30		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		125		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

**FPQ3906/MPQ3906
FQSO3906**

Quad PNP Switching Transistor

The 3906 features four PNP silicon transistors in one package. The transistors are similar to 2N3906.

- **Fast Switching**
- **JEDEC (TO-116) 14-Pin Plastic DIP (FPQ/MPQ)**
- **Auto-Insertion Compatible**
- **Gull wing surface mount package (FQSO)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C
Lead Temperature (Soldering, 10 s)	275° C

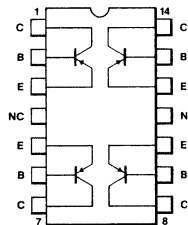
Power Dissipation (Notes 2, 3 & 5)

Total Dissipation at $T_A = 25^\circ\text{C}$	FPQ/MPQ 900 mW	FQSO* 1.0 W
Derate above 25° C	7.2 mW/° C	8.0 mW/° C
Power Dissipation at $T_A = 25^\circ\text{C}$ Each Transistor	500 mW	300 mW
Derate above 25° C	4.0 mW/° C	2.4 mW/° C

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	40 V
V_{CB0} Collector to Base Voltage	40 V
V_{EB0} Emitter to Base Voltage	5.0 V
I_C Collector Current	200 mA

Connection Diagram



PACKAGE

FPQ3906	TO-116
MPQ3906	TO-116
FQSO3906	14 SOIC

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
BV_{CB0}	Collector to Base Breakdown Voltage	40			V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EB0}	Emitter to Base Breakdown Voltage	5.0			V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CB0}	Collector Cutoff Current			20	nA	$V_{CB} = 30 \text{ V}, I_E = 0$
I_{EB0}	Emitter Cutoff Current			50	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 139° C/W (derating factor of 7.2 mW/° C).
 4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 5. FQSO power dissipation data is only an estimate, and may be subject to change without notice.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FPQ3906/MPQ3906
FQSO3906

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
h_{FE}	DC Current Gain (Note 4)	40 70 100 50		300		$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 4)			0.25 0.4	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)	0.65		0.85 0.95	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 1.0 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	300			MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V},$ $f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.5	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance			10	pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		40		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		200		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

SYMBOL	CHARACTERISTIC	MIN	MPQ		UNITS	TEST CONDITIONS
			TYP	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	40			V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 30 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current			50	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 4)	40 60 75				$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation			0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)			0.85	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 1.0 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	200			MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V},$ $f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.5	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance			10	pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		40		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		200		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

**FPQ6426/MPQ6426
FQSO6426**

Quad NPN Darlington Transistor

The 6502 features two NPN and two PNP complementary silicon transistors in one package. The transistors are similar to 2N2222 and 2N2907 devices.

- **High Breakdown Voltage**
- **JEDEC (TO-116) 14-Pin Plastic DIP (FPQ/MPQ)**
- **Auto-Insertion Compatible**
- **Gull wing surface mount package (FQSO)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C
Lead Temperature (Soldering, 10 s)	275° C

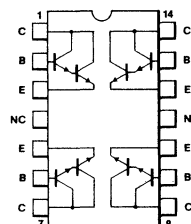
Power Dissipation (Notes 2, 3 & 5)

Total Dissipation at $T_A = 25^\circ\text{C}$	FPQ/MPQ 900 mW	FQSO* 1.0 W
Derate above 25° C	7.2 mW/° C	8.0 mW/° C
Power Dissipation at $T_A = 25^\circ\text{C}$ Each Transistor	500 mW	300 mW
Derate above 25° C	4.0 mW/° C	2.4 mW/° C

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	30 V
V_{CB0} Collector to Base Voltage	40 V
V_{EB0} Emitter to Base Voltage	12 V
I_C Collector Current	500 mA

Connection Diagram



PACKAGE

FPQ6426	TO-116
MPQ6426	TO-116
FQSO6426	14 SOIC

3

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO		MPQ		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CB0}	Collector to Base Breakdown Voltage	40		40		V	$I_E = 100 \mu\text{A}, I_C = 0$
BV_{EB0}	Emitter to Base Breakdown Voltage	12		12		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CB0}	Collector Cutoff Current		50		100	nA	$V_{CB} = 30 \text{ V}, I_E = 0$
I_{EB0}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 10 \text{ V}, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 139° C/W (derating factor of 7.2 mW/° C).
 4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 5. FQSO power dissipation data is only an estimate, and may be subject to change without notice.
 6. For product family characteristic curves, refer to Curve Set T164.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FPQ6426/MPQ6426
FQSO6426

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO		MPQ		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 4)	5000 10000		5000 10000			$I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 4)		1.5		1.5	V	$I_C = 100 \text{ mA}, I_B = 0.1 \text{ mA}$
$V_{BE(ON)}$	Pulsed Base-Emitter "On" Voltage (Note 4)		2.0		2.0	V	$I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	30		30		V	$I_C = 10 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	125		125		MHz	$I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V},$ $f = 100 \text{ MHz}$
C_{ob}	Output Capacitance		8.0		8.0	pF	$V_{CB} = 10 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		15		15	pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$

FPQ6502/MPQ6502 FQSO6502

Quad Complementary Pair Transistor

The 6426 features four NPN silicon darlington transistors in one package. The transistors are similar to MPSA13.

- $h_{FE} \dots 5000$ (Min.) @ 10 mA
- JEDEC (TO-116) 14-Pin Plastic DIP (FPQ/MPQ)
- Auto-Insertion Compatible
- Gull wing surface mount package (FQSO)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
 Operating Junction Temperature 150°C

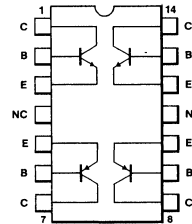
Power Dissipation (Notes 2, 3 & 5)

Total Dissipation at	FPQ/MPQ	FQSO*
$T_A = 25^{\circ}\text{C}$	1.25 W	1.0 W
Derate above 25°C	10 mW/ $^{\circ}\text{C}$	8.0 mW/ $^{\circ}\text{C}$
Power Dissipation at		
$T_A = 25^{\circ}\text{C}$ Each Transistor	0.65 W	300 mW
Derate above 25°C	5.2 mW/ $^{\circ}\text{C}$	2.4 mW/ $^{\circ}\text{C}$

Voltages & Currents

	FPQ/FQSO	MPQ
V_{CE0} Collector to Emitter Voltage	40 V	30 V
V_{CBO} Collector to Base Voltage	60 V	
V_{EBO} Emitter to Base Voltage	5.0 V	
I_C Collector Current	500 mA	

Connection Diagram



PACKAGE

FPQ6502	TO-116
MPQ6502	TO-116
FQSO6502	14 SOIC

Electrical Characteristics (25°C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO		MPQ		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 10 \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		20		30	nA	$V_{CB} = 50 \text{ V}$, $I_E = 0$
I_{EBO}	Emitter Cutoff Current		20		30	nA	$V_{EB} = 3.0 \text{ V}$, $I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and junction-to-ambient thermal resistance of 100°C/W (derating factor of $10 \text{ mW}/^{\circ}\text{C}$).
 4. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
 5. FQSO power dissipation data is only an estimate, and may be subject to change without notice.
 6. For product family characteristic curves, refer to Curve Set T145 for NPN and T212 for PNP.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

FPQ6502/MPQ6502
FQSO6502

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO		MPQ		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 4)	35 50 75 100 30		50 75 100 30			$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 300 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 4)		0.4 1.0		0.4 1.4	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40		30		V	$I_C = 10 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	200		200		MHz	$I_C = 50 \text{ mA}, V_{CE} = 20 \text{ V},$ $f = 100 \text{ MHz}$
C_{ob}	Output Capacitance		8.0		8.0	pF	$V_{CB} = 10 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		30		30	pF	$V_{EB} = 2.0 \text{ V}, f = 1.0 \text{ MHz}$

**FPQ6700/MPQ6700
FQSO6700**

Quad Complementary Pair Transistor

The 6700 features two NPN and two PNP silicon transistors in one package. The transistors are similar to 2N3904 and 2N3906 devices.

- **Fast Switching**
- **JEDEC (TO-116) 14-Pin Plastic DIP (FPQ/MPQ)**
- **Auto-Insertion Compatible**
- **Gull wing surface mount package (FQSO)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C
Lead Temperature (Soldering, 10 s)	275° C

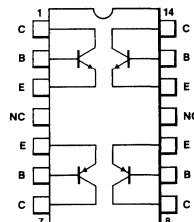
Power Dissipation (Notes 2, 3 & 5)

Total Dissipation at	FPQ/MPQ	FQSO*
T _A = 25° C	900 mW	1.0 W
Derate above 25° C	7.2 mW/° C	8.0 mW/° C
Power Dissipation at		
T _A = 25° C Each Transistor	500 mW	300 mW
Derate above 25° C	4.0 mW/° C	2.4 mW/° C

Voltages & Currents

V _{CEO}	Collector to Emitter Voltage	40 V
V _{CBO}	Collector to Base Voltage	40 V
V _{EBO}	Emitter to Base Voltage	5 V
I _c	Collector Current	200 mA

Connection Diagram



PACKAGE

FPQ6700	TO-116
MPQ6700	TO-116
FQSO6700	14 SOIC

3

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
BV _{CBO}	Collector to Base Breakdown Voltage	40			V	I _C = 10 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0			V	I _E = 10 μA, I _C = 0
I _{CBO}	Collector Cutoff Current			20	nA	V _{CB} = 30 V, I _E = 0
I _{EBO}	Emitter Cutoff Current			20	nA	V _{EB} = 4.0 V, I _C = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-ambient thermal resistance of 139° C/W (derating factor of 7.2 mW/° C).
 4. Pulse conditions: length = 300 μs; duty cycle = 1%.
 5. FQSO power dissipation data is only an estimate, and may be subject to change without notice.
 6. For product family characteristic curves, refer to Curve Set T144 for NPN and T215 for PNP.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FPQ6700/MPQ6700
FQSO6700

SYMBOL	CHARACTERISTIC	FPQ/FQSO			UNITS	TEST CONDITIONS
		MIN	TYP	MAX		
h_{FE}	DC Current Gain (Note 4)	40 70 100 60				$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 4)			0.25 0.5	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)			0.85 1.0	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 10 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	250			MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.5	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance NPN PNP			8.0 10	pF pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$ $V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		40		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		200		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

SYMBOL	CHARACTERISTIC	MIN	MPQ TYP	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	40			V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 30 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current			50	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 4)	30 50 70				$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector Saturation			0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 4)			0.9	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	40			V	$I_C = 10 \text{ mA}, I_B = 0$
f_T	Current Gain Bandwidth Product	200			MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
C_{ob}	Output Capacitance			4.5	pF	$V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance NPN PNP			8.0 10	pF pF	$V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$ $V_{EB} = 0.5 \text{ V}, f = 1.0 \text{ MHz}$
t_{on}	Turn-On Time		40		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$
t_{off}	Turn-Off Time		200		ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} 1.0 \text{ mA}$

FPT100/A/B FPT110/A/B

General Purpose Silicon Planar Phototransistor

General Description

The FPT100 and FPT110 are 3-terminal npn Planar phototransistors with exceptionally stable characteristics and high illumination-sensitivity. The availability of the base pin gives wide latitude for flexible circuit design. The case is made of a special plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions. The controlled sensitivities offered in the A and B versions give the circuit designer increased flexibility.

PACKAGE

FPT100	OPTO-26
FPT100A	OPTO-26
FPT100B	OPTO-26
FPT110	OPTO-28
FPT110A	OPTO-28
FPT110B	OPTO-28

Exceptionally Stable Characteristics Controlled Sensitivities

ABSOLUTE MAXIMUM RATINGS

Temperatures & Humidity

Storage Temperature	-55° C to 100° C
Operating Temperature	-55° C to 85° C
Relative Humidity at 65° C	85%

Power Dissipation (Notes 1 & 2)

Total Dissipation at	
$T_C = 25^\circ\text{C}$	200 mW
$T_A = 25^\circ\text{C}$	100 mW

Voltagess & Currents (Note 5)

V_{CB}	Collector-to-Base Voltage	50 V
V_{CES}	Collector-to-Emitter Sustaining Voltage (Note 3)	30 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 9)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 5)		7.0		V	$I_E = 100 \mu\text{A}$
BV_{CBO}	Collector-to-Base Breakdown Voltage (Note 5)	50	120		V	$I_C = 100 \mu\text{A}$

NOTES:

- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 85° C and junction-to-case thermal resistance of 300° C/W (derating factor of 3.33 mW/° C, and a junction-to-ambient thermal resistance of 600° C/W (derating factor of 1.67 mW/° C).
- Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854° K. The effective photosensitive area is typically 1.25 mm² (FPT100A/B) and 0.78 mm² (FPT110A/B).
- These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
- Measured with radiation flux intensity of less than 0.1 $\mu\text{W}/\text{cm}^2$ over the spectrum from 100-1500 nm.
- Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_C = 5.0\text{ V}$, $I_{CE} = 4.0\text{ mA}$, $R_L = 100\ \Omega$, GaAs source.
- No electrical connection to base lead.
- No electrical connection to emitter lead.
- For product family characteristic curves, refer to Curve Set FPT100.

FPT100/A/B
FPT110/A/B

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 9)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{CEO}	Collector Dark Current (Note 5)		2.0	100	nA	$V_{CE} = 5.0 \text{ V}$
I_{CBO}	Collector Dark Current (Note 5)		0.25 0.025	25 0.5	nA μA	$V_{CB} = 10 \text{ V}$ $V_{CB} = 10 \text{ V}, T_A = 65^\circ$
$I_{CE(II)}$	Photo Current, Tungsten Source (Notes 3 & 7) (FPT100/A/B) (FPT110/A/B)	0.2 0.2	1.4 0.88		mA	$V_{CE} = 5.0 \text{ V}, H = 5.0 \text{ mW/cm}^2$
$I_{CE(III)}$	Photo Current, GaAs Source (Notes 4 & 7) (FPT110/A/B) (FPT110/A/B)	0.6 0.6	4.2 2.7		mA	$V_{CE} = 5.0 \text{ V}, H = 5.0 \text{ mW/cm}^2$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage (FPT100/A/B) (FPT110/A/B)		0.16 0.16	0.3 0.33	V	$I_C = 500 \mu\text{A}, H = 20 \text{ mW/cm}^2$
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 5)	30	50		V	$I_C = 1.0 \text{ mA}$ (pulsed)
t_r	Light Current Rise Time (Note 6)		2.8		μs	
t_f	Light Current Fall Time (Note 6)		2.8		μs	
R_{CB}	Responsivity, Tungsten Source (Notes 3 and 8) (FPT100/A/B) (FPT110/A/B)	0.6 0.6	1.6 1.0		$\mu\text{A}/\text{mW/cm}^2$	$V_{CE} = 10 \text{ V}$
R_{CB}	Responsivity, GaAs Source (Notes 4 and 8) (FPT100/A/B) (FPT110/A/B)	1.8 1.8	4.8 3.0		$\mu\text{A}/\text{mW/cm}^2$	$V_{CE} = 10 \text{ V}$

**FPT120/A/B/C
FPT130/A/B**

High Sensitivity Silicon
Phototransistors

General Description

The FPT120/A/B/C and FPT130/A/B are silicon nitride protected NPN Planar phototransistors with exceptionally stable characteristics and high illumination-sensitivity. The case is made of a special plastic compound with transparent resin encapsulation. The controlled sensitivities offered in the A, B and C versions give the circuit designer increased flexibility.

PACKAGE

FPT120	OPTO-26
FPT120A	OPTO-26
FPT120B	OPTO-26
FPT120C	OPTO-26
FPT130	OPTO-28
FPT130A	OPTO-28
FPT130B	OPTO-28

High Illumination Sensitivity

Availability of Base Pins for Flexible Circuit Design

ABSOLUTE MAXIMUM RATINGS

Temperatures & Humidity

Storage Temperature	-55° C to 150° C
Operating Temperature	-55° C to 85° C
Pin Temperature (Soldering, 5 s)	260° C
Relative Humidity at 65° C	85%

Power Dissipation (Note 1)

Total Device Dissipation at T _c = 25° C	200 mW
Total Dissipation at T _A = 25° C	100 mW

Voltages & Currents

V _{CE(sus)} Collector-to-Emitter Sustaining Voltage (Note 4)	20 V
I _c Collector Current	25 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 9)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV _{Eco}	Emitter-to-Collector Breakdown Voltage (Note 5)		5.0		V	I _{EC} = 100 μA
I _{CEO}	Collector Dark Current (Note 5)		10	100	nA	V _{CE} = 5.0 V

NOTES:

- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 85° C and junction-to-case thermal resistance of 300° C/W (derating factor of 33.3 mW/° C). Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854° K. The effective photosensitive area is typically 1.25 mm² (FPT120A/B) and 0.78 mm² (FPT130A/B).
- These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
- Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
- Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: V_C = 5.0 V, I_{CC} = 4.0 mA, R_L = 100 Ω, GaAs source.
- Same electrical characteristics as FPT120 except for I_{CE(III)}.
- Same electrical characteristics as FPT130 except for I_{CE(III)}.
- For product family characteristic curves, refer to Curve Set FPT120.

FPT120/A/B/C
FPT130/A/B

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 9)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{CE(II)}$	Photo Current, Tungsten Source (Note 3)				mA	$V_{CE} = 5.0 \text{ V}$, $H = 5 \text{ mW/cm}^2$
	(FPT120)	2.0	7.5			
	(FPT120A) (Note 7)	7.5		22.5		
	(FPT120B) (Note 7)	10		20		
	(FPT120C) (Note 7)	16		25		
	(FPT130)	2.0	4.5			
	(FPT130A) (Note 8)	4.5		13.5		
(FPT130B) (Note 8)	6.0		12			
$I_{CE(III)}$	Photo Current, GaAs Source (Note 4)				mA	$V_{CE} = 5.0 \text{ V}$, $H = 1 \text{ mW/cm}^2$
	(FPT120)	0.7	4.5			
	(FPT130)	0.7	2.7			
$V_{CE(Stus)}$	Collector-to-Emitter Sustaining Voltage (Note 5)	20	50		V	$I_C = 1 \text{ mA}$ (pulsed)
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage, Tungsten Source (Note 3)	0.25	0.55		V	$I_C = 1 \text{ mA}$ (pulsed), $H = 20 \text{ mW/cm}^2$
t_r	Light Current Rise Time (Note 6)		18		μs	
t_f	Light Current Fall Time (Note 6)		18		μs	

Description

The FPT320 is a silicon nitride protected NPN Planar phototransistor with exceptionally stable characteristics and high illumination-sensitivity. The case is made of a special plastic compound with transparent resin encapsulation.

PACKAGE

FPT320 OPTO-26

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 100° C
 Operating Temperature -55° C to 85° C
 Pin Temperature (Soldering, 5 s) 260°
 Relative Humidity at 65° C 85%

Power Dissipation (Note 1)

Total Dissipation at T_c = 25° C 200 mW
 Derate Linearly from 25° C 3.33 mW/° C
 Total Dissipation at T_A = 25° 100 mW
 Derate Linearly from 25° C 1.67 mW/° C

Voltages & Current

V_{CE(sus)} Collector to Emitter Voltage 20 V
 I_c Collector Current 25 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I _{CE(ill)}	Photo Current, GaAs Source (Note 3)	0.7		mA	V _{CE} = 5.0 V, H = 1 mW/cm ²
I _{CEO}	Collector Dark Current (Note 4)		100	nA	V _{CE} = 5.0 V
V _{CEO(sus)}	Collector to Emitter Sustaining Voltage (Note 4)	20		V	I _c = 1.0 mA (pulsed)
V _{CE(sat)}	Collector to Emitter Saturation Voltage, Tungsten Source (Note 2)		0.55	V	I _c = 1.0 mA, H = 20 mW/cm ²

NOTES:

- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854° K.
- These are values obtained at noted irradiance as emitted from a GaAs source at 99 nm.
- Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
- Same electrical characteristics as FPT120 except for I_{CE(ill)}.
- Same electrical characteristics as FPT130 except for I_{CE(ill)}.
- For product family characteristic curves, refer to Curve Set FPT120.

**FSA1410M/FSA1411M
FSA2002M/FSA2003M**

**Monolithic Air Isolated
Diode Arrays**

- C... 5.0 pF MAX
- ΔV_F... 15 mV (MAX) @ 10 mA

PACKAGES

FSA1410M	TO-96
FSA1411M	TO-96
FSA2002M	TO-85
FSA2003M	TO-85

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-55°C to +200°C
Maximum Junction Operating Temperature	+150°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25°C Ambient	400 mW
per Package at 25°C Ambient	600 mW
Linear Derating Factor (from 25°C) Junction	3.2 mW/°C
Package	4.8 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	55 V
I _F	Continuous Forward Current	350 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width=1.0 s	1.0 A
	Pulse Width=1.0 μs	2.0 A

For SOIC power dissipation, consult factory.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

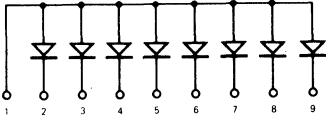
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
B _V	Breakdown Voltage	60		Volts	I _R = 10 μA
V _F	Forward Voltage (Note 3)		1.5 1.1 1.0	Volts Volts Volts	I _F = 500 mA I _F = 200 mA I _F = 100 mA
I _R	Reverse Current Reverse Current (T _A = 150°C)		100 100	nA μA	V _R = 40 V V _R = 40 V
C	Capacitance		5.0	pF	V _R = 0, f = 1 MHz
V _{FM}	Peak Forward Voltage		4.0	Volts	I _F = 500 mA, t _r < 10 ns
t _{fr}	Forward Recovery Time		40	ns	I _F = 500 mA, t _r < 10 ns
t _{rr}	Reverse Recovery Time		10 50	ns ns	I _F = I _r = 10–200 mA R _L = 100 Ω, Rec. to 0.1 I _r I _F = 500 mA, I _r = 50 mA R _L = 100 Ω, Rec. to 5 mA
ΔV _F	Forward Voltage Match		15	mV	I _F = 10 mA

NOTES:

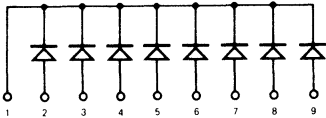
1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. V_F is measured using an 8 ms pulse.
4. For product family characteristic curves and test circuits, refer to Chapter 4, D15.

FSA1410M/FSA1411M
FSA2002M/FSA2003M

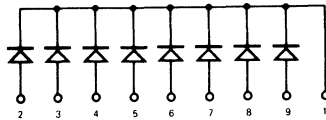
Connection Diagrams



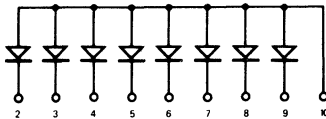
FSA1410M



FSA1411M



FSA2002M



FSA2003M

FAIRCHILD

A Schlumberger Company

**FSA2500M/FSA2501M
FSA2501P/FSA2502M
FASO2501**

Monolithic Air Isolated Diode Arrays

- C... 5.0 pf (MAX)
- V_F ... 15 mV (MAX) @ 10 mA

PACKAGES

FSA2500M	TO-85
FSA2501M	TO-116-2
FSA2501P	TO-116
FSA2502M	TO-96
FASO2501	14-SOIC

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature Range (M Suffix)	-55° C to +200° C
(P Suffix)	-55° C to +150° C
Maximum Junction Operating Temperature	+150° C
Lead Temperature	+260° C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25° C Ambient	400 mW
Maximum Dissipation per Package at 25° C Ambient	650 mW
Linear Derating Factor (from 25° C) Junction	3.2 mW/° C
Package	5.2 mW/° C

Maximum Voltage and Currents

WIV Working Inverse Voltage	50 V
I_F Continuous Forward Current	350 mA
I_F (surge) Peak Forward Surge Current	
Pulse Width = 1.0 s	1.0 A
Pulse width = 1.0 μ s	2.0 A

For SOIC power dissipation, consult factory.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted)

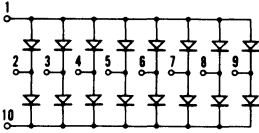
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	$I_R = 10 \mu A$
V_F	Forward Voltage (Note 3)		1.1 1.2 1.5	V V V	$I_F = 200 \text{ mA}$ $I_F = 300 \text{ mA}$ $I_F = 500 \text{ mA}$
ΔV_F	Forward Voltage Match (Note 6)		15	mV	$I_F = 10 \text{ mA}$
I_R	Reverse Current (Note 4)		100 200	nA μA	$V_R = 50 \text{ V}$ $V_R = 50 \text{ V}, T_A = 125^\circ \text{ C}$
C	Capacitance (Note 5)		5.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{fr}	Forward Recovery Time (Note 6)		40	ns	$I_F = 500 \text{ mA}$
t_{rr}	Reverse Recovery Time (Note 6)		10 50	ns ns	$I_F = I_r = 10 \text{ mA to } 200 \text{ mA}$ $R_L = 100 \Omega, I_{rr} = 0.1 I_R$ $I_F = 500 \text{ mA}, I_r = 50 \text{ mA}$ $R_L = 100 \Omega, I_{rr} = 5.0 \text{ mA}$

NOTES:

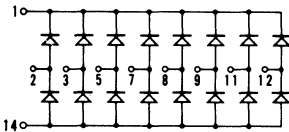
1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. The capacitance is measured from pin-to-pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
6. For product family characteristic curves and test circuits refer to Chapter 4, D15.

**FSA2500M/FSA2501M
FSA2501P/FSA2502M
FASO2501**

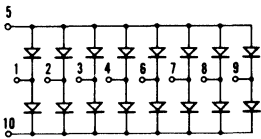
Connection Diagrams



FSA2500M



FSA2501M FSA2501P
FASO2501



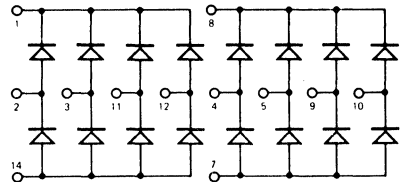
FSA2502P

**FSA2503M/FSA2503P
FSA2504M/FASO2503**

**Monolithic Air Isolated
Diode Arrays**

- C . . . 5.0 pF (MAX)
- ΔF . . . 15 mV (MAX) @ 10 mA

CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range (M Suffix)	-55°C to +200°C
(P Suffix)	-55°C to +150°C
Maximum Junction Operating Temperature	+150°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25°C Ambient	400 mW
Maximum Dissipation per Package at 25°C Ambient	650 mW
Linear Derating Factor (from 25°C) Junction	3.2 mW/°C
Package	5.2 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	50 V
I _F	Continuous Forward Current	350 mA
i _F (surge)	Peak Forward Surge Current	
	Pulse Width=1.0 s	1.0 A
	Pulse Width=1.0 μs	2.0 A

PACKAGES

FSA2503M	TO-116-2
FSA2503P	TO-116
FSA2504M	TO-86
FASO2503	14-SOIC

For SOIC power dissipation, consult factory.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	I _R = 10 μA
V _F	Forward Voltage (Note 3)		1.0 1.1 1.5	V	I _F = 100 mA I _F = 200 mA I _F = 500 mA
ΔV _F	Forward Voltage Match (Note 6)		15	mV	I _F = 10 mA
I _R	Reverse Current (Note 4)		100 200	nA μA	V _R = 50 V V _R = 50 V, T _A = 125°C
C	Capacitance (Note 5)		5.0	pF	V _R = 0, f = 1.0 MHz
t _{fr}	Forward Recovery Time (Note 6)		40	ns	I _F = 500 mA
t _{rr}	Reverse Recovery Time (Note 6)		10 50	ns	I _F = I _R = 10 mA to 200 mA R _L = 100 Ω, I _{rr} = 0.1 I _R I _F = 500 mA, I _r = 50 mA R _L = 100 Ω, I _{rr} = 5.0 mA

NOTES:

1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. The capacitance is measured from pin-to-pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
6. For product family characteristics and test circuits, refer to Chapter 4-D15.

FSA2509M/FSA2509P FSA2510M/FSA2510P FASO2509/FASO2510 Monolithic Air Isolated Diode Arrays

- C... 5.0 pF (MAX)
- ΔV_F ... 15 mV (MAX) @ 10 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range (M Suffix)	-55°C to +200°C
(P Suffix)	-55°C to +150°C
Maximum Junction Operating Temperature	+150°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25°C Ambient	400 mW
Maximum Dissipation per Package at 25°C Ambient	650 mW
Linear Derating factor (from 25°C) Junction	3.2 mW/°C
Package	5.2 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	40 V
I_F	Continuous Forward Current	350 mA
$I_{f(surge)}$	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	2.0 A

For SOIC power dissipation, consult factory.

PACKAGES

FSA2509M	TO-116-1
FSA2509P	TO-116
FSA2510M	TO-116-2
FSA2510P	TO-116
FASO2509	14-SOIC
FASO2510	14-SOIC

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

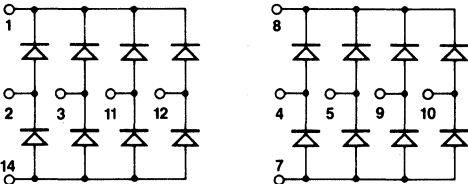
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	$I_R = 10 \mu A$
V_F	Forward Voltage (Note 3)		1.0 1.1 1.3	V V V	$I_F = 100 \text{ mA}$ $I_F = 200 \text{ mA}$ $I_F = 500 \text{ mA}$
ΔV_F	Forward Voltage Match (Note 6)		15	mV	$I_F = 10 \text{ mA}$
I_R	Reverse Current (Note 4)		100 200	nA μA	$V_R = 40 \text{ V}$ $V_R = 40 \text{ V}, T_A = 150^\circ \text{C}$
C	Capacitance (Note 5)		5.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
t_{fr}	Forward Recovery Time (Note 6)		40	ns	$I_f = 500 \text{ mA}$
t_{rr}	Reverse Recovery Time (Note 6)		10 50	ns ns	$I_f = I_r = 10 \text{ mA to } 200 \text{ mA}$ $R_L = 100 \Omega, I_{rr} = 0.1 I_R$ $I_f = 500 \text{ mA}, I_r = 50 \text{ mA}$ $R_L = 100 \Omega, I_{rr} = 5.0 \text{ mA}$

NOTES:

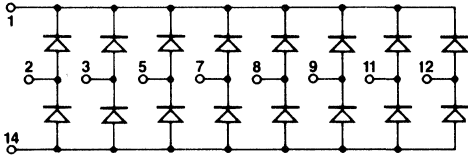
1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. The capacitance is measured from pin-to-pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
6. For product family characteristic curves and test circuits, refer to Chapter 4, D15.

FSA2509M/FSA2509P
FSA2510M/FSA2510P
FASO2509/FASO2510

Connection Diagrams



FSA2509M FSA2509P
FASO2509



FSA2510M FSA2510P
FASO2510

**FSA2563M/2564M/2565M
FSA2566M/FSA2563P
FSA2564P/2565P/2566P
FASO2563/2564 /2565/2566**
Monolithic Air Isolated Diode Arrays

- C ... 3.0 pf (max)
- V_F ... 15 mV (max) @ 10 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range (M Suffix)	-55°C to +200°C
(P Suffix)	-55°C to +150°C
Maximum Junction Operating Temperature	+150°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25°C Ambient	400 mW
Maximum Dissipation per Package at 25°C Ambient	650 mW
Linear Derating Factor (from 25°C) Junction	3.2 mW / °C
Package	5.2 mW / °C

Maximum Voltage and Currents

WIV Working Inverse Voltage	40 V
I _F Continuous Forward Current	350 mA
i _f (surge) Peak Forward Surge Current	
Pulse Width = 1.0 s	1.0 A
Pulse Width = 1.0 μs	2.0 A

For SOIC power dissipation, consult factory.

PACKAGES

FSA2563M	TO-116-2
FSA2564M	TO-116-2
FSA2565M	TO-6B
FSA2566M	TO-6B
FSA2563P	TO-116
FSA2564P	TO-116
FSA2565P	TO-9B
FSA2566P	TO-9B
FASO2563	14-SOIC
FASO2564	14-SOIC
FASO2565	16-SOIC
FASO2566	16-SOIC



ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

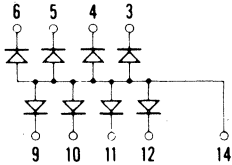
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	I _R = 10 μA
V _F	Forward Voltage (Note 3)		1.0 1.1 1.3	V V V	I _F = 100 mA I _F = 200 mA I _F = 500 mA
I _R	Reverse Current (Note 4)		100 100	nA μA	V _R = 40 V V _R = 40 V, T _A = 125°C
C	Capacitance (Note 5)		4	pF	V _R = 0 V, f = 1 MHz
V _{FM}	Peak Forward Voltage (Note 6)		4	V	I _F = 500 mA
t _{fr}	Forward Recovery Time (Note 6)		40	ns	I _F = 500 mA
t _{rr}	Reverse Recovery Time (Note 6)		10 50	ns ns	I _F = I _r = 10 mA to 200 mA R _L = 100Ω, I _{rr} = 0.1 I _F I _F = 500 mA, I _r = 50 mA R _L = 100Ω, I _{rr} = 5 mA
ΔV _F	Forward Voltage Match (Note 6)		15	mV	I _F = 10 mA

NOTES:

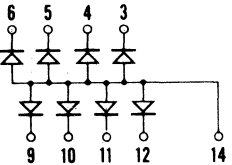
1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 μs pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. The capacitance is measured from pin-to-pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
6. For product family characteristic curves and test circuits, refer to Chapter 4, D15.

FSA2563M/2564M/2565M
FSA2566M/FSA2563P
FSA2564P/2565P/2566P
FASO2563/2564
FASO2565/2566

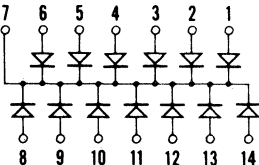
Connection Diagrams



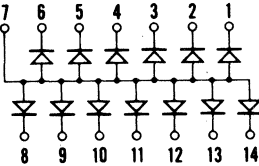
FSA2563M FSA2563P
 FASO2563



FSA2564M FSA2564P
 FASO2564



FSA2565M FSA2565P
 FASO2565



FSA2566M FSA2566P
 FASO2566

FAIRCHILD

A Schlumberger Company

FSA2619M/2620M/2621M
FSA2619P/2620P FASO2619/20
FSA2719M/2720M/2721M
FSA2719P/2720P FASO2719/20
 Monolithic Air Isolated Diode Arrays

- C... 2.0 pf (max) FSA2719 Series
- ΔV_F... 15 mV (max) @ 10 mA

ABSOLUTE MAXIMUM RATINGS (Notes 1 and 5)

Temperatures

Storage Temperature Range (M Suffix)	-55° C to +200° C
(P Suffix)	-55° C to +150° C
Maximum Junction Operating Temperature	+150° C
Lead Temperature	+260° C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25° C Ambient	400 mW
Maximum Dissipation per Package at 25° C Ambient	650 mW
Linear Derating factor (from 25° C) Junction	3.2 mW/°C
Package	5.2 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage FSA2619 (Note 5)	75 V
	FSA2719	50 V
I _F	Continuous Forward Current	350 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	2.0 A

For SOIC power dissipation, consult factory.

PACKAGES

FSA2619M	6B (Ceramic DIP)
FSA2719M	6B (Ceramic DIP)
FSA2619P	9B (Plastic DIP)
FSA2719P	9B (Plastic DIP)
FSA2620M	TO-116-2
FSA2720M	TO-116-2
FSA2620P	TO-116
FSA2720P	TO-116
FSA2621M	TO-86
FSA2721M	TO-86
FASO2619	16-SOIC
FASO2620	14-SOIC
FASO2719	16-SOIC
FASO2720	14-SOIC

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted)

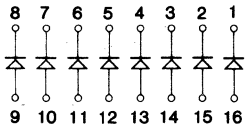
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage (Note 5)	FSA2719 75		V	I _R = 5.0 μA
		FSA2619 100		V	I _R = 100 μA
I _R	Reverse Current	FSA2619	5.0	μA	V _R = 75 V
			25	nA	V _R = 20 V
			50	μA	V _R = 20 V, T _A = 150° C
		FSA2719	100	nA	V _R = 50 V
			100	μA	V _R = 50 V, T _A = 150° C
V _F	Forward Voltage (Note 3)		1.0	V	I _F = 10 mA
t _{rr}	Reverse Recovery Time (Note 6)	FSA2619	5.0	ns	I _F = I _R = 10 mA, I _{rr} = 1.0 mA
		FSA2719	6.0	ns	I _F = I _R = 10 mA, I _{rr} = 1.0 mA
C	Capacitance (Note 6)	FSA2619	4.0	pF	V _R = 0
		FSA2719	4.0	pF	V _R = 0
ΔV _F	Forward Voltage Match (Note 6)		15	mV	I _F = 10 mA
t _{fr}	Forward Recovery Time (Note 6)	FSA2619	20	ns	50 mA Peak square wave, 0.1 μs Pulse Width, 5.0 kHz - 100 kHz
V _{FM}	Peak Forward Voltage (Note 6)	FSA2719	3.0	V	I _F = 100 mA, t _r ≤ 10 ns
RE	Rectification Efficiency		45	%	V _I = 2 V r.m.s. f = 100 MHz

NOTES:

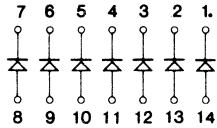
1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted or applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. FSA2619 denotes series FSA2619M/P, FSA2620M/P and FSA2621M; FSA2719 denotes series FSA2719M/P, FSA2720M/P and FSA2721M.
6. For product family characteristics curves and test circuits, refer to Chapter 4, D15.

FSA2619M/2620M/2621M
FSA2619P/2620P
FSA2719M/2720M/2721M
FSA2719P/2720P
FASO2619/2620 FASO2719/2720

Connection Diagrams



FSA2619 FSA2719
FASO2619 FASO2719



FSA2620 FSA2621
FSA2720 FSA2721
FASO2620 FASO2720

**FSA2702M/FSA2703M
FSA2704M/FSA2705M**

**Monolithic Air Isolated
Diode Arrays**

- $\Delta V_F \dots 3 \text{ mV (MAX) FSA2702M, FSA2703M}$
- $\Delta I_R \dots 1 \mu\text{A (MAX) FSA2702M, FSA2703M}$

CONNECTION DIAGRAM

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-55°C to +200°C
Maximum Junction Operating Temperature	175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

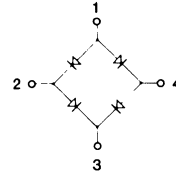
Maximum Dissipation	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	40 V
I_F	Continuous Forward Current	300 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

PACKAGE

FSA2702M	TO-33
FSA2703M	TO-33
FSA2704M	TO-72
FSA2705M	TO-72



3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	$I_R = 100 \mu\text{A}$
I_R	Reverse Current (Note 4)		100	nA μA	$V_R = 40 \text{ V}$ $V_R = 40 \text{ V}, T_A = 150^\circ\text{C}$
C	Capacitance (Note 5)		4.0	pF	$V_R = 0$
V_F	Forward Voltage (Note 3)		1.000 .920 .850 .780 .740 .700 .650 .620	V V V V V V V V	$I_F = 200 \text{ mA}$ $I_F = 100 \text{ mA}$ $I_F = 50 \text{ mA}$ $I_F = 20 \text{ mA}$ $I_F = 10 \text{ mA}$ $I_F = 5.0 \text{ mA}$ $I_F = 2.0 \text{ mA}$ $I_F = 1.0 \text{ mA}$
t_{rr}	Reverse Recovery Time (Note 6)		6.0 10	ns ns	$I_f = I_r = 10 \text{ mA}, I_{rr} = 1.0 \text{ mA}$ $I_f = I_r = 200 \text{ mA}, I_{rr} = 20 \text{ mA}$
ΔV_f	Forward Voltage Match (Note 6) FSA2702, FSA2703		3.0	mV	$I_F = 10 \mu\text{A to } 10 \text{ mA}$ $T_A = -55^\circ\text{C to } +100^\circ\text{C}$
ΔI_R	Reverse Current Match (Note 6) FSA2702, FSA2703		1.0	μA	$V_R = 10 \text{ V}, T_A = -55^\circ\text{C to } +100^\circ\text{C}$

NOTES:

1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See test circuits (Note 6) for measurement of reverse current of an individual diode.
5. The capacitance is measured from pin-to-pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
6. For product family characteristic curves and test circuits, refer to Chapter 4, D15.

MPS2924/FTSO2924

NPN Small Signal General Purpose Amplifier

- V_{CE0} . 25 V (Min)
- h_{FE} ... 150-300 @ 2.0 mA

PACKAGE

MPS2924
FTSO2924

TO-92
TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
70°C Ambient Temperature	0.400 W	
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	25 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		500 15	nA μA	$V_{CB} = 25 V, I_E = 0$ $V_{CB} = 25 V, I_E = 0, T_A = 100^\circ$
I_{EBO}	Emitter Cutoff Current		500	nA	$V_{EB} = 5.0 V, I_C = 0$
h_{fe}	Small Signal Current Gain	150	300		$V_{CE} = 10 V, I_C = 2.0 mA, f = 1.0 kHz$
C_{ob}	Output Capacitance		12	pF	$V_{CB} = 10 V, I_E = 0, f = 1.0 MHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS3392/FTSO3392
MPS3393/FTSO3393

NPN Small Signal General Purpose Amplifiers

- V_{CE0} ... **25 V (Min)**
- h_{FE} ... **150-300 (MPS/FTSO3392), 90-180 (MPS/FTSO3393)**
@ 2.0 mA
- **Complements ... 2N4125, 2N4126**

PACKAGE

MPS3392	TO-92
MPS3393	TO-92
FTSO3392	TO-236AA/AB
FTSO3393	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	25 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	100 mA

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3392		3393		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	25		25		V	$I_C = 1.0 \text{ mA}, I_B = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = 18 \text{ V}, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	150	300	90	180		$I_C = 2.0 \text{ mA}, V_{CE} = 4.5 \text{ V}$
C_{ob}	Output Capacitance		3.5		3.5	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
h_{ie}	Small Signal Current Gain	150	500	90	400		$I_C = 2.0 \text{ mA}, V_{CE} = 4.5 \text{ V}, f = 1.0 \text{ kHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T144.

**MPS3702/FTSO3702
MPS3703/FTSO3703**

PNP Small Signal General Purpose Amplifier

- V_{CE0} ... -30 V (Min) (MPS/FTSO3703)
- h_{FE} ... 60-300 @ 50 mA (MPS/FTSO3702)
- $V_{CE(sat)}$... -0.25 V (Max) @ 50 mA
- Complements ... MPS/FTSO3704, MPS/FTSO3705

PACKAGE

MPS3702	TO-92
MPS3703	TO-92
FTSO3702	TO-236AA/AB
FTSO3703	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (MPS3702, MPS3703) (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	3702	3703
V_{CE0} Collector to Emitter Voltage (Note 4)	-25 V	-30 V
V_{CBO} Collector to Base Voltage	-40 V	-50 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3702		3703		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	-25		-30		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-50		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = -20 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = -3.0 \text{ V}, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS3702/FTSO3702
MPS3703/FTSO3703

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3702		3703		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	60	300	30	150		$I_C = 50 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25		-0.25	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)	-0.6	-1.0	-0.6	-1.0	V	$I_C = 50 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$
f_T	Current Gain Bandwidth Product	100		100		MHz	$I_C = 50 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 20 \text{ MHz}$
C_{ob}	Output Capacitance		12		12	pF	$V_{CB} = -10 \text{ V}$, $f = 1.0 \text{ MHz}$

MPS3704/FTSO3704
MPS3705/FTSO3705

NPN Small Signal General Purpose Amplifiers

- V_{CEO} ... 30 V (Min)
- h_{FE} ... 100-300 @ 50 mA (MPS/FTSO3704)
- $V_{CE(sat)}$... -0.6 V (Max) @ 100 mA (MPS/FTSO3704)
- Complements ... MPS/FTSO3702, MPS/FTSO3703

PACKAGE	
MPS3704	TO-92
MPS3705	TO-92
FTSO3704	TO-236AA/AB
FTSO3705	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	30 V
(Note 4)	
V_{CBO} Collector to Base Voltage	50 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3704		3705		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	30		30		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	50		50		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = 20 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 3.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	100	300	50	150		$I_C = 50 \text{ mA}, V_{CE} = 2.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS3704/FTSO3704
MPS3705/FTSO3705

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3704		3705		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.6		0.8	V	$I_C = 100 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(on)}$	Base to Emitter "On" Voltage (Note 5)	0.5	1.0	0.5	1.0	V	$I_C = 100 \text{ mA}$, $V_{CE} = 2.0 \text{ V}$
f_T	Current Gain Bandwidth Product	100		100		MHz	$I_C = 50 \text{ mA}$, $V_{CE} = 2.0 \text{ V}$, $f = 20 \text{ MHz}$
C_{ob}	Output Capacitance		12		12	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$

MPS5172/FTSO5172

NPN Small Signal General Purpose Amplifier

- **h_{FE} ... 100-500 @ $I_C = 10$ mA**
- **$V_{CE(sat)}$... 0.25 V (Max) @ $I_C = 10$ mA**
- **Complements ... 2N4126, FTSO4126**

PACKAGE

MPS5172
FTSO5172

TO-92
TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	25 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	25		V	$I_C = 10$ mA, $I_B = 0$
I_{CES}	Collector Cutoff Current		100	nA	$V_{CE} = 25$ V, $V_{BE} = 0$
I_{CBO}	Collector Cutoff Current		100 10	nA μ A	$V_{CB} = 25$ V, $I_E = 0$ $V_{CB} = 25$ V, $I_E = 0.1$, $T_A = 100^\circ$ C
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{BE} = 5.0$ V, $I_C = 0$
h_{FE}	DC Current Gain (Note 5)	100	500		$I_C = 10$ mA, $V_{CE} = 10$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 10$ mA, $I_B = 1.0$ mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.5	1.2	V	$I_C = 10$ mA, $V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance	1.6	10	pF	$V_{CB} = 0$, $I_E = 0$, $f = 1.0$ MHz
h_{fe}	Small Signal Current Gain	100	750		$I_C = 10$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**MPS6514/FTSO6514
MPS6515/FTSO6515**

**NPN Small Signal General
Purpose Amplifiers**

- V_{CEO} ... 25 V (Min)
- h_{FE} ... 150-300 (MPS/FTSO6514), 250-500 (MPS/FTSO6515)
@ 2.0 mA
- h_{FE} ... 90 (Min) (MPS/FTSO6514), 150 (Min)
(MPS/FTSO6515) @ 100 mA

PACKAGE	
MPS6514	TO-92
MPS6515	TO-92
FTSO6514	TO-236AA/AB
FTSO6515	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	40 V
V_{EBO} Emitter to Base Voltage	4.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	6514		6515		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage	30		30		V	$I_C = 0.5$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		4.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 1.0		50 1.0	nA μ A	$V_{CB} = 30$ V, $I_E = 0$ $V_{CB} = 30$ V, $I_E = 0$, $T_A = 60^\circ$ C
h_{FE}	DC Current Gain (Note 5)	150 90	300	250 150	500		$I_C = 2.0$ mA, $V_{CE} = 10$ V $I_C = 100$ mA, $V_{CE} = 10$ V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5		0.5	V	$I_C = 50$ mA, $I_B = 5.0$ mA
C_{ob}	Output Capacitance		3.5		3.5	pF	$V_{CB} = 10$ V, $I_E = 0$, $f = 100$ kHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144 for MPS6514 & T-155 for MPS6515.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS6518/FTSO6518

PNP Small Signal General Purpose Amplifier

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 150-300 @ 2.0 mA, 90 (Min) @ 100 mA

PACKAGE

MPS6518
FTSO6518

TO-92

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-40 V
V_{CBO} Collector to Base Voltage	-40 V
V_{EBO} Emitter to Base Voltage	-4.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	-40		V	$I_C = 0.5$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 1.0	nA μ A	$V_{CB} = -30$ V, $I_E = 0$ $V_{CB} = -30$ V, $I_E = 0$, $T_A = 60^\circ$ C
h_{FE}	DC Current Gain (Note 5)	150 90	300		$I_C = 2.0$ mA, $V_{CE} = -10$ V $I_C = 100$ mA, $V_{CE} = -10$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.5	V	$I_C = 50$ mA, $I_B = 5.0$ mA
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = -10$ V, $I_E = 0$, $f = 100$ kHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**MPS6520/FTSO6520
MPS6521/FTSO6521**

NPN Small Signal General Purpose Amplifiers

- V_{CE0} ... 25 V (Min)
- h_{FE} ... 100 (Min) (MPS/FTSO6520), 150 (Min) (MPS/FTSO6521) @ 100 μ A
- h_{FE} ... 200-400 (MPS/FTSO6520), 300-600 (MPS/FTSO6521) @ 2.0 mA
- NF ... 3.0 dB (Max) @ $I_C = 10 \mu$ A, Wide Band

PACKAGE

MPS6520	TO-92
MPS6521	TO-92
FTSO6520	TO-236AA/AB
FTSO6521	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	40 V
V_{EBO} Emitter to Base Voltage	4.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	6520		6521		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	25		25		V	$I_C = 0.5 \text{ mA}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		4.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		50 1.0		50 1.0	nA μ A	$V_{CB} = 30 \text{ V}, I_E = 0$ $V_{CB} = 30 \text{ V}, I_E = 0,$ $T_A = 60^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS6520/FTSO6520
MPS6521/FTSO6521

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	6520		6521		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	100 200	400	150 300	600		$I_C = 100 \mu A, V_{CE} = 10 V$ $I_C = 2.0 mA, V_{CE} = 10 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5		0.5	V	$I_C = 50 mA, I_B = 5.0 mA$
C_{ob}	Output Capacitance		3.5		3.5	pF	$V_{CB} = 10 V, I_E = 0, f = 100 kHz$
NF	Noise Figure		3.0		3.0	dB	$V_{CE} = 5.0 V, I_C = 10 \mu A,$ $R_g = 10 k\Omega,$ Power Bandwidth $\pm 15.7 kHz,$ 3.0 dB pts @ 10 Hz & 10 kHz

3

- P_D 625 mW @ $T_A = 25^\circ C$
- V_{CEO} ... -30 V (Min)
- h_{FE} ... 30 (Min) @ 100 mA

PACKAGE

MPS6535M

TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.625 W
70° C Ambient Temperature	0.400 W
25° C Case Temperature	1.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	-30 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-30 V
V_{EBO} Emitter to Base Voltage	-4.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-30		V	$I_C = 10$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-30		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100 5.0	nA μ A	$V_{CB} = -20$ V, $I_E = 0$ $V_{CB} = -20$ V, $I_E = 0$, $T_A = 60^\circ C$
h_{FE}	DC Current Gain (Note 5)	30			$I_C = 100$ mA, $V_{CE} = -1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		-0.5	V	$I_C = 100$ mA, $I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		-1.2	V	$I_C = 100$ mA, $I_B = 10$ mA
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = -10$ V, $I_E = 0$, $f = 100$ kHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T202.

MPS6560/FTSO6560
MPS6561/FTSO6561
MPS6562/FTSO6562
 NPN-PNP Small Signal General
 Purpose Complementary Amplifiers

- | | | | | | | | | | | | | | |
|---|--|---------|-------|---------|-------|---------|-------|----------|-------------|----------|-------------|----------|-------------|
| <ul style="list-style-type: none"> • V_{CE0} ... MPS/FTSO6560/2),
20 V (MPS/FTSO6561) • h_{FE} ... 50-200 @ 500 mA (MPS/FTSO6560/2),
@ 350 mA (MPS/FTSO6561) • $V_{CE(sat)}$... 0.5 V (Max) @ 500 mA (MPS/FTSO6560/2),
@ 350 mA (MPS/FTSO6561) • Complements ... MPS/FTSO6560, MPS/FTSO6561 (NPN);
MPS/FTSO6562 (PNP) | <p>PACKAGE</p> <table border="0"> <tr><td>MPS6560</td><td>TO-92</td></tr> <tr><td>MPS6561</td><td>TO-92</td></tr> <tr><td>MPS6562</td><td>TO-92</td></tr> <tr><td>FTSO6560</td><td>TO-236AA/AB</td></tr> <tr><td>FTSO6561</td><td>TO-236AA/AB</td></tr> <tr><td>FTSO6562</td><td>TO-236AA/AB</td></tr> </table> | MPS6560 | TO-92 | MPS6561 | TO-92 | MPS6562 | TO-92 | FTSO6560 | TO-236AA/AB | FTSO6561 | TO-236AA/AB | FTSO6562 | TO-236AA/AB |
| MPS6560 | TO-92 | | | | | | | | | | | | |
| MPS6561 | TO-92 | | | | | | | | | | | | |
| MPS6562 | TO-92 | | | | | | | | | | | | |
| FTSO6560 | TO-236AA/AB | | | | | | | | | | | | |
| FTSO6561 | TO-236AA/AB | | | | | | | | | | | | |
| FTSO6562 | TO-236AA/AB | | | | | | | | | | | | |

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	6560/62	6561
V_{CE0} Collector to Emitter Voltage (Note 4)	25 V	20 V
V_{CBO} Collector to Base Voltage	25 V	20 V
V_{EBO} Emitter to Base Voltage	4.0 V	4.0 V
I_C Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	6560/62		6561		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		-5.0		V	$I_E = 100 \mu A, I_C = 0$
I_{CE0}	Collector Cutoff Current		100		100	nA	$V_{CE} = 25 V, I_B = 0$ $V_{CE} = 20 V, I_B = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = 20 V, I_E = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 4.0 V, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T124 for MPS6560, MPS6561 & T12 for MPS6562.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPS6560/FTSO6560
MPS6561/FTSO6561
MPS6562/FTSO6562

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	6560/62		6561		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	35 50 50	200	35 50 50	200		$I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 100 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 350 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5		-0.5	V V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$ $I_C = 350 \text{ mA}, I_B = 35 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.2		-1.2	V V	$I_C = 500 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 350 \text{ mA}, V_{CE} = 1.0 \text{ V}$
f_T	Current Gain Bandwidth Product	60		60		MHz	$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 30 \text{ MHz}$
C_{ob}	Output Capacitance		30		30	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$

MPS6571/FTSO6571
NPN Low Level High Gain Amplifier

- $V_{CEO} \dots -20 \text{ V (Min)}$
- $h_{FE} \dots 250-1000 @ 100 \mu\text{A}$

PACKAGE
MPS6571 TO-92
FTSO6571 TO236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
70°C Ambient Temperature	0.400 W	
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	20 V
(Note 4)	
V_{CBO} Collector to Base Voltage	20 V
V_{EBO} Emitter to Base Voltage	3.0 V
I_C Collector Current (Continuous)	50 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	$I_C = 100 \mu\text{A}, I_E = 0$
I_{CBO}	Collector Cutoff Current		50	nA	$V_{CB} = 20 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB(OFF)} = 3.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	250	1000		$I_C = 100 \mu\text{A}, V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		0.8	V	$I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$
f_T	Current Gain Bandwidth Product	50		MHz	$I_C = 500 \mu\text{A}, V_{CE} = 5.0 \text{ V}, f = 20 \text{ MHz}$
C_{ob}	Output Capacitance		4.5	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 100 \text{ kHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of $8.0 \text{ mW}/^\circ\text{C}$); junction-to-ambient thermal resistance of 200°C/W (derating factor of $5.0 \text{ mW}/^\circ\text{C}$); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}/^\circ\text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.

**MPSA05/FTSOA05
MPSA06/FTSOA06**

**NPN Small Signal General
Purpose Amplifiers**

- V_{CE0} ... 60 V (Min) (MPS/FTSOA05), 80 V (Min) (MPS/FTSOA06)
- h_{FE} ... 50 (Min) @ 10 mA and 100 mA
- $V_{CE(sat)}$... 0.25 V (Max) @ 100 mA
- Complements ... MPS/FTSOA55, MPS/FTSOA56, (PNP)

PACKAGE	
MPSA05	TO-92
MPSA06	TO-92
FTSOA05	TO-236AA/AB
FTSOA06	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	A05	A06
V_{CE0} Collector to Emitter Voltage (Note 4)	60 V	80 V
V_{CBO} Collector to Base Voltage	60 V	80 V
V_{EBO} Emitter to Base Voltage	4.0 V	4.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A05		A06		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	60		80		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA nA	$V_{CB} = 60 \text{ V}, I_E = 0$ $V_{CB} = 80 \text{ V}, I_E = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T149.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPSA05/FTSOA05
MPSA06/FTSOA06

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A05		A06		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	50		50			$I_C = 100 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25		0.25	V	$I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		1.2		1.2	V	$I_C = 100 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
f_T	Current Gain Bandwidth Product	50		50		MHz	$I_C = 100 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$, $f = 100 \text{ MHz}$

3

MPSA10
NPN Amplifier Transistor

• V_{CE0} . . . 40 V (Min)

PACKAGE
MPSA10 TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
25° C Ambient Temperature 0.625 W
25° C Case Temperature 1.0 W

Voltages & Currents

V_{CE0} Collector to Emitter Voltage 40 V
(Note 4)
 V_{EBO} Emitter to Base Voltage 4.0 V
 I_C Collector Current (Peak) 100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 30$ V, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	40	400		$I_C = 5.0$ μ A, $V_{CE} = 10$ V
f_T	Current Gain Bandwidth Product	125		MHz	$I_C = 5.0$ mA, $V_{CE} = 10$ V, $f = 100$ MHz
C_{obo}	Output Capacitance		4.0	pF	$V_{CB} = 10$ V, $I_E = 0$, $f = 100$ MHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T144.

MPSA12/FTSOA12

NPN Monolithic Darlington Amplifiers

- V_{CEO} ... 20 V (Min)
- h_{FE} ... 20,000 (Min) @ 10 mA

PACKAGE	
MPSA12	TO-92
FTSOA12	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
70°C Ambient Temperature	0.400 W	
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	20 V
(Note 4)	
V_{EBO} Emitter to Base Voltage	10 V

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 100 \mu A, I_B = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 15 V, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 10 V, I_C = 0$
I_{CES}	Collector Reverse Current		100	nA	$V_{CE} = 15 V, V_{BE} = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	20,000			$I_C = 10 mA, V_{CE} = 5.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		1.0	V	$I_C = 10 mA, I_B = 0.01 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		1.4	V	$I_C = 10 mA, V_{CE} = 5.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T164.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**MPSA13/FTSOA13
MPSA14/FTSOA14**

**NPN Monolithic Darlington
Amplifiers**

- V_{CEO} ... **30 V (Min)**
- h_{FE} ... **20,000 (Min) @ 10.0 mA (MPS/FTSOA14)**

PACKAGE

MPSA13	TO-92
MPSA14	TO-92
FTSOA13	TO-236AA/AB
FTSOA14	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	30 V
V_{CES} Collector to Emitter Voltage	30 V
V_{CBO} Collector to Base Voltage	50 V
V_{EBO} Emitter to Base Voltage	10 V
I_C Collector Current	300 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A13		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	30		V	$I_C = 100 \mu A, I_B = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 30 V, I_E = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 10 V, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	5,000 10,000			$I_C = 10 mA, V_{CE} = 5.0 V$ $I_C = 100 mA, V_{CE} = 5.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	$I_C = 100 mA, I_B = 0.1 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		2.0	V	$I_C = 100 mA, V_{CE} = 5.0 V$
f_T	Current Gain Bandwidth Product	125		MHz	$I_C = 10 mA, V_{CE} = 5.0 V,$ $f = 100 MHz$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs ; duty cycle = 2%.
- For product family characteristic curves, refer to Curve Set T164.
- Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPSA13/FTSOA13
MPSA14/FTSOA14

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A14		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	30		V	$I_C = 100 \mu A, I_B = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 30 V, I_E = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 10 V, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	10,000 20,000			$I_C = 10 mA, V_{CE} = 5.0 V$ $I_C = 100 mA, V_{CE} = 5.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	$I_C = 100 mA, I_B = 0.1 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		2.0	V	$I_C = 100 mA, V_{CE} = 5.0 V$
f_T	Current Gain Bandwidth Product	125		MHz	$I_C = 10 mA, V_{CE} = 5.0 V,$ $f = 100 MHz$

- V_{CEO} ... **45 V (Min)**
- h_{FE} ... **500 (Min) @ 100 μ A**
- **NF ... 0.5 dB (Typ) (Wideband)**

PACKAGE

MPSA18 TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.625 W
 25° C Case Temperature 1.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 45 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 45 V
 I_C Collector Current (Peak) 200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	45			V	$I_C = 10$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	45			V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.5			V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 30$ V, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	400 500 500 500		1500		$I_C = 10$ μ A, $V_{CE} = 5.0$ V $I_C = 100$ μ A, $V_{CE} = 5.0$ V $I_C = 1.0$ mA, $V_{CE} = 5.0$ V $I_C = 10$ mA, $V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)			0.2 0.3	V V	$I_C = 10$ mA, $I_B = 0.5$ mA $I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)			0.7	V	$I_C = 1.0$ mA, $V_{CE} = 5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T107.

MPSA18

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
f_T	Current Gain Bandwidth Product	100			MHz	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 100 \text{ kHz}$
C_{cb}	Collector to Base Capacitance			3.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance			6.5	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
NF	Noise Figure		0.5	1.5	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $R_S = 10 \text{ k}\Omega$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$
			4.0		dB	

3

**MPSA20/FTSOA20
MPSA70/FTSOA70**

**NPN-PNP Small Signal General
Purpose Complementary Amplifiers**

- V_{CEO} ... **40 V (Min)**
- h_{FE} ... **40-400 @ 5.0 mA**
- $V_{CE(sat)}$... **0.25 V (Max) @ 10 mA**
- C_{ob} ... **4.0 pF (Max) 10 V**
- Complements ... **MPS/FTSOA20 (NPN), MPS/FTSOA70 (PNP)**

PACKAGE

MPSA20	TO-92
MPSA70	TO-92
FTSOA20	TO-236AA/AB
FTSOA70	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	40 V
V_{EBO} Emitter to Base Voltage	4.0 V
I_C Collector Current (Continuous)	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 30 \text{ V}, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	40	400		$I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
f_T	Current Gain Bandwidth Product	125		MHz	$I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T144 for MPSA20 & T215 for MPSA70.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**MPSA42/FTSOA42
MPSA43/FTSOA43**

**NPN Small Signal High Voltage
General Purpose Amplifiers**

- V_{CE0} ... **300 V (Min) (MPS/FTSOA42), 200 V (Min) MPS/FTSOA43)**
- h_{FE} ... **40 (Min) @ 10 mA**
- f_T ... **50 MHz (Min)**
- **Complements ... MPSA92, MPSA93**

PACKAGE	
MPSA42	TO-92
MPSA43	TO-92
FTSOA42	TO-236AA/AB
FTSOA43	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	A42	A43
V_{CE0} Collector to Emitter Voltage (Note 4)	300 V	200 V
V_{CBO} Collector to Base Voltage	300 V	200 V
V_{EBO} Emitter to Base Voltage	8.0 V	6.0 V
I_C Collector Current (Continuous)	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A42		A43		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	300		200		V	$I_C = 1.0 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	300		200		V	$I_C = 100 \text{ }\mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0		6.0		V	$I_E = 100 \text{ }\mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		0.1		0.1	μA μA	$V_{CB} = 200 \text{ V}, I_E = 0$ $V_{CB} = 160 \text{ V}, I_E = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%
6. For product family characteristic curves, refer to Curve Set T176.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPSA42/FTSOA42
MPSA43/FTSOA43

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A42		A43		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		0.1		0.1	μA μA	$V_{EB} = 6.0 V, I_C = 0$ $V_{EB} = 4.0 V, I_C = 0$
h_{FE}	DC Current Gain	25 40 40		25 40 50	200		$I_C = 1.0 mA, V_{CE} = 10 V$ $I_C = 10 mA, V_{CE} = 10 V$ $I_C = 30 mA, V_{CE} = 10 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.5		0.4	V	$I_C = 20 mA, I_B = 2.0 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.9		0.9	V	$I_C = 20 mA, I_B = 2.0 V$
f_T	Current Gain Bandwidth Product	50		50		MHz	$I_C = 10 mA, V_{CE} = 20 V,$ $f = 100 MHz$
C_{cb}	Collector to Base Capacitance		3.0		4.0	pF	$V_{CB} = 20 V, I_E = 0,$ $f = 1.0 MHz$

**MPSA55/FTSOA55
MPSA56/FTSOA56**

**PNP Small Signal General Purpose
Complementary Amplifiers**

- V_{CEO} . . . **-60 V (Min) (MPS/FTSOA55),
-80 V (Min) (MPS/FTSOA56)**
- h_{FE} . . . **50 (Min) @ 100 mA**
- $V_{CE(sat)}$. . . **-0.25 V (Max) @ 100 mA**
- **Complements . . . MPS/FTSOA05, MPS/FTSOA06 (NPN)**

PACKAGE

MPSA55	TO-92
MPSA56	TO-92
FTSOA55	TO-236AA/AB
FTSOA56	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	A55	A56
V_{CEO} Collector to Emitter Voltage (Note 4)	-60 V	-80 V
V_{CBO} Collector to Base Voltage	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-4.0 V	-4.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A55		A56		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage	-60		-80		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		-4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = -60 \text{ V}, I_E = 0$ $V_{CB} = -80 \text{ V}, I_E = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T224.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPSA55/FTSOA55
MPSA56/FTSOA56

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A55		A56		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	50 50		50 50			$I_C = 10 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25		-0.25	V	$I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$
$V_{BE(on)}$	Base to Emitter "On" Voltage		-1.2		-1.2	V	$I_C = 100 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$
f_T	Current Gain Bandwidth Product	50		50		MHz	$I_C = 100 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$, $f = 100 \text{ MHz}$

MPSA92/MPSA93

PNP Small Signal High Voltage
General Purpose Amplifiers

- $V_{CEO} \dots -300 \text{ V (Min) (MPSA92), } -200 \text{ V (Min) (MPSOA93)}$
- $h_{FE} \dots 40 \text{ (Min) @ } 10 \text{ mA}$
- $f_T \dots 50 \text{ MHz (Min)}$
- **Complements ... MPSA42, MPSA43**

PACKAGE

MPSA92	TO-92
MPSA93	TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.625 W
25° C Case Temperature	1.0 W

Voltages & Currents

	A92	A93
V_{CEO} Collector to Emitter Voltage	-300 V	-200 V
V_{CBO} Collector to Base Voltage	-300 V	-200 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current (Continuous)	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A92		A93		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	-300		-200		V	$I_C = 1.0 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-300		-200		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CBO}	Collector Cutoff Current		0.25		0.25	μA	$V_{CB} = -200 \text{ V}, I_E = 0$ $V_{CB} = -160 \text{ V}, I_E = 0$
I_{EBO}	Emitter Cutoff Current		0.1		0.1	μA	$V_{EB} = -3.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain	25 40 25		25 40 30	150		$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 30 \text{ mA}, V_{CE} = -10 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T139.

MPSA92/MPSA93

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	A92		A93		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.5		-0.4	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-0.9		-0.9	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
f_T	Current Gain Bandwidth Product	50		50		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$
C_{cb}	Collector to Base Capacitance		6.0		8.0	pF	$V_{CB} = -20 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$

MPSL01/FTSOL01
MPSL51/FTSOL51
 NPN-PNP High Voltage
 Complementary Small Signal
 General Purpose Amplifiers

- V_{CEO} ... 120 V (Min) (MPS/FTSOL01),
 -100 V (Min) (MPS/FTSOL51)
- $V_{CE(sat)}$... 0.30 V (Max) @ 50 mA
- Complements ... MPS/FTSOL01 (NPN),
 MPS/FTSOL51 (PNP)

PACKAGE

MPSL01	TO-92
MPSL51	TO-92
FTSOL01	TO-236AA/AB
FTSOL51	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	L01	L51
V_{CEO} Collector to Emitter Voltage (Note 4)	120 V	-100 V
V_{CBO} Collector to Base Voltage	140 V	-100 V
V_{EBO} Emitter to Base Voltage	5.0 V	-4.0 V
I_C Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	L01		L51		UNITS	TEST CONDITIONS (Reverse Voltage Polarity for PNP)
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	120		-100		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	140		-100		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		-4.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		1.0		1.0	μ A	$V_{CB} = 75$ V, $I_E = 0$ $V_{CB} = 50$ V, $I_E = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 4.0$ V, $I_C = 0$ $V_{EB} = 3.0$ V, $I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T147 for MPSL01 & T232 for MPSL51.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

MPSL01/FTSOL01
MPSL51/FTSOL51

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	L01		L51		UNITS	TEST CONDITIONS (Reverse Voltage Polarity for PNP)
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	50	300	40	250		$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.20 0.30		-0.25 -0.30	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.2 1.4		-1.2 -1.2	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
f_T	Current Gain Bandwidth Product	60		60		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
C_{ob}	Output Capacitance		8.0		8.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	30		20			$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$



A Schlumberger Company

PE4010

NPN High Gain Low Noise Type

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
25°C Ambient Temperature 0.625 W
70°C Case Temperature 0.400 W
25°C Case Temperature 1.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 25 V
V_{CBO} Collector to Base Voltage 30 V
V_{EBO} Emitter to Base Voltage 6.0 V

PACKAGE

PE4010 TO-92

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV _{CBO}	Collector to Base Breakdown Voltage	30			V	I _C = 100 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	6.0			V	I _E = 100 μA, I _C = 0
I _{CBO}	Collector Cutoff Current (65°)			200 3.0	nA μA	V _{CB} = 5.0 V, I _E = 0 V _{CB} = 5.0 V, I _E = 0
h _{FE}	DC Current Gain	200	350 100	1000		I _C = 1.0 mA, V _{CE} = 10 V I _C = 50 μA, V _{CE} = 10 V
h _{fe}	High Frequency Current Gain	1.0 3.0	1.3			I _C = 50 μA, V _{CE} = 5.0 V, f = 20 MHz I _C = 1.0 mA, V _{CE} = 5.0 V, f = 20 MHz
V _{CEO(sus)}	Collector to Emitter Sustaining Voltage (Notes 3 & 4)	25			V	I _C = 10 mA, I _B = 0
V _{CE(sat)}	Collector to Emitter Saturation Voltage			0.35	V	I _C = 1.0 mA, I _B = 0.1 mA
C _{ob}	Output Capacitance			4.0	pF	V _{CB} = 5.0 V, I _E = 0
NF	Narrow Band Noise Frequency (Note 5)		1.5	3.0	dB	I _C = 30 μA, V _{CB} = 5.0 V

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs; duty cycle = 1%. R_S = 10 kΩ; f = 1.0 kHz; Power Bandwidth of 200 Hz.
- For product family characteristic curves, refer to Curve Set T107.

- h_{FE} ... **100 (Min) @ 10 μ A, 150 (Min) @ 10 mA**
- $V_{CE(sat)}$... **0.2 V (Max) @ 10 mA/0.5 mA**
- I_{CBO} ... **2.0 nA (Max) @ 45 V, 50 nA (Max) @ 45 V, $T_A = 65^\circ C$**
- **NF ... 2.5 dB (Typ) @ 100 Hz; 1.0 k Ω**

PACKAGE

PE4020

TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature $-55^\circ C$ to $150^\circ C$
 Operating Junction Temperature $150^\circ C$

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 $25^\circ C$ Ambient Temperature 0.625 W
 $25^\circ C$ Case Temperature 1.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 60 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 60 V
 V_{EBO} Emitter to Base Voltage 8.0 V
 I_C Collector Current (Continuous) 50 mA

ELECTRICAL CHARACTERISTICS ($25^\circ C$ Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0		V	$I_E = 10 \mu A, I_C = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60		V	$I_C = 10 \mu A, I_B = 0$
I_{CBO}	Collector Cutoff Current		2.0	nA	$V_{CB} = 45 V, I_E = 0$
			50	nA	$V_{CB} = 45 V, I_E = 0, T_A = 65^\circ C$
I_{EBO}	Emitter Cutoff Current		1.0	nA	$V_{EB} = 5.0 V, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of $150^\circ C$ and a maximum junction temperature of $125^\circ C$ and junction-to-case thermal resistance of $200^\circ C/W$ (derating factor of $5.0 mW/^\circ C$); junction-to-ambient thermal resistance of $500^\circ C/W$ (derating factor of $2.0 mW/^\circ C$).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = $300 \mu s$; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T107.

PE4020

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	150	950		$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
h_{FE}	DC Current Gain	135 120 100 25			$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
h_{fe}	High Frequency Current Gain	1.0	2.0		$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 100 \text{ MHz}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60		V	$I_C = 5.0 \text{ mA}$, $I_B = 0$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.7	V	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.3 0.2	V V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$ $I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$
C_{eb}	Emitter to Base Capacitance		6.0	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$
NF	Narrow Band Noise Figure		6.0 3.0	dB dB	$I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $R_S = 1.0 \text{ k}\Omega$, $BW = 400 \text{ Hz}$ $I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $R_S = 10 \text{ k}\Omega$, $BW = 400 \text{ Hz}$
NF	Wide Band Noise Figure		3.0	dB	$I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 10 \text{ Hz to } 10 \text{ kHz}$ $R_S = 10 \text{ k}\Omega$, $BW = 15.7 \text{ kHz}$

- V_{CEO} ... 220 V to 300 V (Min) @ 10 mA
- C_{cb} ... 4.0 pF (Max) @ 20 V
- f_T ... 40 to 50 MHz (Min)
- h_{FE} ... Outstanding Beta Linearity to 100 mA

PACKAGE

PE7058	TO-92
PE7059	TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2, 3 & 6)

Total Dissipation at	
25°C Ambient Temperature	0.625 W
25°C Case Temperature	1.0 W

Voltages & Currents

	7058	7059
BV_{CEO} Collector to Emitter Voltage (Note 4)	220 V	300 V
BV_{CBO} Collector to Base Voltage	220 V	300 V
BV_{EBO} Emitter to Base Voltage	7.0 V	7.0 V
I_C Collector Current (Continuous)	500 mA	500 mA
I_C Collector Current (Pulsed)	2.0 A	2.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	PE7058		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	220		V	$I_C = 10 \text{ mA}$, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage (Note 5)	220		V	$I_C = 100 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage (Note 5)	7.0		V	$I_E = 10 \text{ } \mu\text{A}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current (Note 5)		100	nA	$V_{CB} = 200 \text{ V}$, $I_E = 0$
I_{CES}	Collector Reverse Current (Note 5)		100	nA	$V_{CE} = 100 \text{ V}$, $V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 6.0 \text{ V}$, $I_C = 0$
h_{FE}	DC Current Gain (Note 5)	20 40 40 15			$I_C = 1.0 \text{ mA}$, $V_{CE} = 20 \text{ V}$ $I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ V}$ $I_C = 30 \text{ mA}$, $V_{CE} = 20 \text{ V}$ $I_C = 150 \text{ mA}$, $V_{CE} = 20 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and (TO92) junction-to-case thermal resistance of 125°C/W (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T176.

PE7058/PE7059

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	PE7058		UNITS	TEST CONDITIONS
		MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.0	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.65	0.85	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
f_T	High Frequency Current Gain	40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 40 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 15 \text{ mA}$, $V_{CE} = 100 \text{ V}$, $f = 20 \text{ MHz}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 20 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		70	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$

SYMBOL	CHARACTERISTIC	PE7059		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	300		V	$I_C = 10 \text{ mA}$, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage (Note 5)	300		V	$I_C = 100 \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage (Note 5)	7.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current (Note 5)		100	nA	$V_{CB} = 200 \text{ V}$, $I_E = 0$
I_{CES}	Collector Reverse Current (Note 5)		100	nA	$V_{CE} = 100 \text{ V}$, $V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 6.0 \text{ V}$, $I_C = 0$
h_{FE}	DC Current Gain (Note 5)	20			$I_C = 1.0 \text{ mA}$, $V_{CE} = 20 \text{ V}$
		40			$I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ V}$
		40			$I_C = 30 \text{ mA}$, $V_{CE} = 20 \text{ V}$
		10			$I_C = 150 \text{ mA}$, $V_{CE} = 20 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.0	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.65	0.85	V	$I_C = 20 \text{ mA}$, $I_B = 2.0 \text{ mA}$
f_T	High Frequency Current Gain	40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 30 \text{ mA}$, $V_{CE} = 40 \text{ V}$, $f = 20 \text{ MHz}$
		40		MHz	$I_C = 15 \text{ mA}$, $V_{CE} = 100 \text{ V}$, $f = 20 \text{ MHz}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 20 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		70	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$

PE8050/PE8550

**NPN-PNP General Purpose
Complementary Amplifiers & Output
Drivers**

- **V_{CEO} ... 25 V (Min)**
- **h_{FE} ... Outstanding Beta Linearity to 1.0 A**
- **Three h_{FE} Groups**
- **Guaranteed SOA**
- **Complements ... PE8050, (NPN), PE8550, (PNP)**

PACKAGE

PE8050	TO-92
PE8550	TO-92

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (V_{CE} = 8.0 V) (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.625 W
25° C Case Temperature	1.0 W

Voltages & Currents

V _{CEO} Collector to Emitter Voltage	25 V
(Note 4)	
V _{CBO} Collector to Base Voltage	30 V
V _{EBO} Emitter to Base Voltage	6.0 V
I _C Collector Current (Continuous)	1.5 A
I _c Collector Current (Pulsed)	1.5 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V _{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	25		V	I _C = 10 mA, I _B = 0
V _{CBO}	Collector to Base Breakdown Voltage	30		V	I _C = 100 μA, I _E = 0
V _{EBO}	Emitter to Base Breakdown Voltage	6.0		V	I _E = 100 μA, I _C = 0
I _{CBO}	Collector Cutoff Current		100	nA	V _{CB} = 20 V, I _E = 0
h _{FE}	DC Current Gain (Note 5)	50	200		I _C = 10 mA, V _{CE} = 1.0 V
		65	200		I _C = 100 mA, V _{CE} = 1.0 V
		65	200		I _C = 500 mA, V _{CE} = 1.0 V
		40	200		I _C = 1.0 A, V _{CE} = 1.0 V
	Gain Grouping A	65	130		I _C = 100 mA, V _{CE} = 1.0 V
	Gain Grouping B	85	160		
	Gain Grouping C	120	200		

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 5.0 mW/° C); junction-to-ambient thermal resistance of 125° C/W (derating factor of 8.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T124 for PE8050 & T202 for PE8550.

PE8050/PE8550

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE1}/h_{FE2}	Beta Ratio at Two Currents	0.8	1.8		$I_{C1} = 100 \text{ mA}, I_{C2} = 800 \text{ mA}, V_{CE} = 1.0 \text{ V}$
h_{FE3}/h_{FE4}	Beta Ratio at Two Currents	0.8	1.5		$I_{C1} = 150 \text{ mA}, I_{C4} = 500 \text{ mA}, V_{CE} = 1.0 \text{ V}$
h_{fe}	High Frequency Current Gain	1.0			$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.15 0.5	V V	$I_C = 200 \text{ mA}, I_B = 20 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9 1.2	V V	$I_C = 200 \text{ mA}, I_B = 20 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
C_{cb}	Collector to Base Capacitance		40	pF	$V_{CB} = 10 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$

**PN918/MPS918/FTSO918
PN3563/MPS3563/FTSO3563**

NPN Small Signal High Frequency
Amplifiers & Oscillators

- $G_{PE} \dots 15 \text{ dB (Min) @ 200 MHz (PN/FTSO918)}$
- $C_{OB} \dots 1.7 \text{ pF (Max) @ 10 V}$
- $NF \dots 6.0 \text{ dB (Max) @ 60 MHz}$

PACKAGE

PN918	TO-92
PN3563	TO-92
MPS918	TO-92
MPS3563	TO-92
FTSO918	TO-236AA/AB
FTSO3563	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN/MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
65° C Ambient Temperature	0.300 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	3563	918
V_{CEO} Collector to Emitter Voltage (Note 4)	12 V	12 V
V_{CBO} Collector to Base Voltage	30 V	30 V
V_{EBO} Emitter to Base Voltage	2.0 V	3.0 V
I_C Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3563		MPS918		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	30		30		V	$I_C = 100 \mu A, I_E = 0$ $I_C = 10 \mu A, I_E = 0$
						V	
BV_{EBO}	Emitter to Base Breakdown Voltage	2.0		3.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CBO}	Collector Cutoff Current		50		10	nA	$V_{CB} = 15 V, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	20	200	20			$I_C = 3.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 8.0 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	12		15		V	$I_C = 3.0 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)				0.4	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage				1.0	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle \leq 1%.
 6. For product family characteristic curves, refer to Curve Set T121.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**PN918/MPS918/FTSO918
PN3563/MPS3563/FTSO3563**

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3563		MPS918		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
C _{ob}	Output Capacitance		1.7		1.7 3.0	pF pF	V _{CB} = 10 V, I _E = 0, f = 1.0 MHz V _{CB} = 0, I _E = 0, f = 1.0 MHz
C _{ib}	Input Capacitance				2.0	pF	V _{EB} = 0.5 V, I _C = 0, f = 1.0 MHz
h _{fe}	High Frequency Current Gain	6.0	15	6.0			I _C = 4.0 mA, V _{CE} = 10 V, f = 100 MHz I _C = 8.0 mA, V _{CE} = 10 V, f = 100 MHz
h _{ie}	Small Signal Current Gain	20	250				I _C = 8.0 mA, V _{CE} = 10 V, f = 1.0 kHz
G _{pe}	Available Power Gain (neutralized) (test circuit 254 for MPS918, PN/MPS3563)	14	26	15		dB dB	I _C = 6.0 mA, V _{CB} = 12 V, f = 200 MHz I _C = 8.0 mA, V _{CE} = 10 V, f = 200 MHz
P _o	Power Output (test circuit no. 264)			30		mW	I _C = 8.0 mA, V _{CB} = 15 V, f = 500 MHz
η	Collector Efficiency			25		%	I _C = 8.0 mA, V _{CB} = 15 V, f = 500 MHz
r _b 'C _c	Collector to Base Time Constant	8.0	25			pF	I _C = 8.0 mA, V _{CB} = 10 V, f = 79.8 MHz
NF	Noise Figure				6.0	dB	I _C = 1.0 mA, V _{CE} = 6.0 V, f = 60 kHz, R _G = 400 Ω

SYMBOL	CHARACTERISTIC	PN918		UNITS	TEST CONDITIONS
		MIN	MAX		
BV _{CB0}	Collector to Base Breakdown Voltage	30		V	I _C = 10 μA, I _E = 0
BV _{EB0}	Emitter to Base Breakdown Voltage	3.0		V	I _E = 10 μA, I _C = 0
I _{CB0}	Collector Cutoff Current		10 1.0	nA μA	V _{CB} = 15 V, I _E = 0 V _{CB} = 15 V, I _E = 0, T _A = 150° C
h _{FE}	DC Current Gain (Note 5)	20			I _C = 3.0 mA, V _{CE} = 1.0 V
V _{CE0(sus)}	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		V	I _C = 3.0 mA, I _B = 0
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		0.4	V	I _C = 10 mA, I _B = 1.0 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage		1.0	V	I _C = 10 mA, I _B = 1.0 mA
C _{ob}	Output Capacitance		1.7 3.0	pF pF	V _{CB} = 10 V, I _E = 0, f = 1.0 MHz V _{CB} = 0, I _E = 0, f = 1.0 MHz
C _{ib}	Input Capacitance		1.6	pF	V _{EB} = 0.5 V, I _C = 0, f = 1.0 MHz

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PN918/MPS918/FTSO918
PN3563/MPS3563/FTSO3563

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	PN918		UNITS	TEST CONDITIONS
		MIN	MAX		
h_{fe}	High Frequency Current Gain	6.0			$I_C = 4.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
G_{pe}	Available Power Gain (neutralized) (test circuit 254 for PN918)	15		dB	$I_C = 6.0 \text{ mA}$, $V_{CB} = 12 \text{ V}$, $f = 200 \text{ MHz}$
P_o	Power Output (test circuit no. 264)	30		mW	$I_C = 8.0 \text{ mA}$, $V_{CB} = 15 \text{ V}$, $f = 500 \text{ MHz}$
η	Collector Efficiency	25		%	$I_C = 8.0 \text{ mA}$, $V_{CB} = 15 \text{ V}$, $f = 500 \text{ MHz}$
NF	Noise Figure		6.0	dB	$I_C = 1.0 \text{ mA}$, $V_{CE} = 6.0 \text{ V}$, $f = 60 \text{ kHz}$, $R_G = 400 \Omega$

PN3565/FTSO3565

NPN Low Level High Gain Amplifiers

- V_{CEO} ... 25 V (Min)
- h_{FE} ... 150-600 @ 1.0 mA

PACKAGE

PN3565 TO-92
FTSO3565 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Note 2)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	25 V
(Note 3)	
V_{CBO} Collector to Base Voltage	30 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_C = 0, I_E = 10 \mu A$
I_{CBO}	Collector Cutoff Current		50	nA	$V_{CB} = 25 V, I_E = 0$
I_{CBO}	Collector Cutoff Current		3.0	μA	$V_{CB} = 25 V, I_E = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	150 70	600		$I_C = 1.0 mA, V_{CE} = 10 V$ $I_C = 100 \mu A, V_{CE} = 10 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	25		V	$I_C = 2.0 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.35	V	$I_C = 1.0 mA, I_B = 0.1 mA$
C_{ob}	Open Circuit Output Capacitance		40	pF	$I_E = 0, V_{CB} = 5.0 V, f = 140 kHz$
h_{fe}	High Frequency Current Gain	2.0	12		$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 20 MHz$
h_{ie}	Input Resistance	2.0	20	k Ω	$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz$
h_{oe}	Output Conductance	0.5	100	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz$
h_{fe}	Small Signal Current Gain	120	750		$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These ratings give a maximum junction temperature of 150° C and (TO92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 - Rating refers to a high current point where collector to emitter voltage is lowest.
 - For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

- **V_{CEO} ... 30 V (Min)**
- **h_{FE} ... 150-600 @ 10 mA**
- **Complement ... MPS3638A**

PACKAGE

PN3566	TO-92
FTSO3566	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V _{CEO} Collector to Emitter Voltage	30 V
(Note 4)	
V _{CBO} Collector to Base Voltage	40 V
V _{EBO} Emitter to Base Voltage	5.0 V
I _C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CBO}	Collector to Base Breakdown Voltage	40		V	I _C = 100 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I _E = 10 μA, I _C = 0
I _{CBO}	Collector Cutoff Current		50	nA	V _{CB} = 20 V, I _E = 0
I _{CBO}	Collector Cutoff Current		5.0	μA	V _{CB} = 20 V, I _E = 0, T _A = 75° C
I _{EBO}	Emitter Cutoff Current		10	μA	V _{EB} = 5.0 V, I _C = 0
h _{FE}	DC Pulse Current Gain (Note 5)	150 80	600		I _C = 10 mA, V _{CE} = 10 V I _C = 2.0 mA, V _{CE} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs; duty cycle ≤ 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN3566/FTSO3566

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		1.0	V	$I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	30		V	$I_C = 30 \text{ mA}$, $I_B = 0$ (pulsed)
$V_{BE(ON)}$	Base to Emitter "On" Voltage (pulsed) (Note 5)		0.9	V	$I_C = 100 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
C_{ob}	Output Capacitance		25	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0	35		$I_C = 30 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$

FAIRCHILD

A Schlumberger Company

**PN3567/FTSO3567
PN3569/FTSO3569**NPN Small Signal General Purpose
Amplifiers

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 100-300 @ 10 mA (3569); 40-120 @ 150 mA (3567)
- Complement ... MPS4355

PACKAGE

PN3567	TO-92
PN3569	TO-92
FTSO3567	TO-236AA/AB
FTSO3569	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	40 V
(Notes 4 & 6)	
V_{CBO} Collector to Base Voltage	80 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	500 mA
I_B Base Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	3567		3569		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	40		40		V	$I_C = 30$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	80		80		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = 40$ V, $I_E = 0$
			5.0		5.0	μ A	$V_{CB} = 40$ V, $I_E = 0$, $T_A = 75^\circ$ C
I_{EBO}	Emitter Cutoff Current		25		25	nA	$V_{EB} = 4.0$ V, $I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. Applicable 0 to 30 mA.
 7. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN3567/FTSO3567
PN3569/FTSO3569

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	3567		3569		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	40 40	120	100 100	300		$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 30 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25		0.25	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.1		1.1	V	$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{eb}	Emitter to Base Capacitance		80		80	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	3.0	30	3.0	30		$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 20 \text{ MHz}$

3

**PN/MPS/FTSO3638
PN/MPS/FTSO3638A**

**PNP Small Signal General Purpose
Amplifiers & Switches**

- $V_{CE0} \dots -25 \text{ V (Min)}$
- $h_{FE} \dots 30 \text{ (Min) (PN/MPS/FTSO3638)}$,
 $100 \text{ (Min) (PN/MPS/FTSO3638A) @ } 50 \text{ mA}$
- $t_{on} \dots 75 \text{ ns (Max) @ } 300 \text{ mA}$; $t_{off} \dots 170 \text{ ns (Max) @ } 300 \text{ mA}$
- Complements ... PN3641, PN3643

PACKAGE

PN3638	TO-92
PN3638A	TO-92
MPS3638	TO-92
MPS3638A	TO-92
FTSO3638	TO-236AA/AB
FTSO3638A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN/MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-25 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-25 V
V_{CES} Collector to Emitter Voltage	-25 V
V_{EBO} Emitter to Base Voltage	-4.0 V
I_C Collector Current (Note 2)	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3638		3638A		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-25		-25		V	$I_C = 100 \mu\text{A}$, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-25		-25		V	$I_C = 100 \mu\text{A}$, $V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		-4.0		V	$I_E = 100 \mu\text{A}$, $I_C = 0$
I_{CES}	Collector Reverse Current		35 2.0		35 2.0	nA μA	$V_{CE} = -15 \text{ V}$, $V_{BE} = 0$ $V_{CE} = -15 \text{ V}$, $V_{BE} = 0$, $T_A = 65^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN/MPS/FTSO3638
PN/MPS/FTSO3638A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3638		3638A		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5) (MPS3638)	20		100			$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$ $I_C = 300 \text{ mA}, V_{CE} = -2.0 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-25		-25		V	$I_C = 10 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		-0.25 -1.0		-0.25 -1.0	V V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$ $I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.8	-1.1 -2.0	-0.8	-1.1 -2.0	V V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$ $I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
C_{ob}	Common Base Open Circuit, Output Capacitance		20		10	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{ib}	Common Base Open Circuit, Input Capacitance (PN3638A) (MPS3638A)		65		35 25	pF pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$ $V_{EB} = -0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
h_{re}	Magnitude of Small Signal Current Gain	1.0		1.5			$I_C = 50 \text{ mA}, V_{CE} = -3.0 \text{ V}, f = 100 \text{ MHz}$
h_{re}	Small Signal Current Gain (PN3638) (MPS3638)	25 25	180	100			$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance (MPS3638)		2000 1500		2000	Ω Ω	$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance		1200		1200	μmhos	$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		2600		1500	$\times 10^{-6}$	$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
t_{on}	Turn On Time (test circuit no. 536)		75		75	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx 30 \text{ mA}, V_{CC} = 10 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 536)		170		170	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx I_{B2} \approx 30 \text{ mA}, V_{CC} = 10 \text{ V}$

PN/MPS/FTSO3639 PN/MPS/FTSO3640

PNP High Speed Saturated Logic Switches

- V_{CE0} ... 12 V (Min) (PN/MPS3640)
- t_{on} ... 25 ns (Max) @ 50 mA, 60 ns (Max) @ 10 mA;
 t_{off} ... 35 ns (Max) @ 50 mA, 75 ns (Max) @ 10 mA
- Complements ... PN4274, 2N5769

PACKAGE

PN3639	TO-92
PN3640	TO-92
MPS3639	TO-92
MPS3640	TO-92
FTSO3639	TO-236AA/AB
FTSO3640	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN/MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	3639	3640
V_{CE0} Collector to Emitter Voltage (Note 4)	-6 V	-12 V
V_{CBO} Collector to Base Voltage	-6 V	-12 V
V_{EBO} Emitter to Base Voltage	-4.0 V	-4.0 V
I_C Collector Current	80 mA	80 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	PN3639		PN3640		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-6.0		-12.0		V	$I_C = 100 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-6.0		-12.0		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		-4.0		V	$I_E = 100 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current		50		50	nA	$V_{CE} = -3.0 V, V_{BE} = 0$ $V_{CE} = -6.0 V, V_{BE} = 0$ $V_{CE} = -3.0 V, V_{BE} = 0, T_A = 65^\circ C$ $V_{CE} = -6.0 V, V_{BE} = 0, T_A = 65^\circ C$
			1.0		1.0	nA	
						μA	
						μA	
h_{FE}	DC Pulse Current Gain (Note 5)	30 20	120	30 20	120		$I_C = 10 mA, V_{CE} = -0.3 V$ $I_C = 50 mA, V_{CE} = -1.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T292.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN/MPS/FTSO3639
PN/MPS/FTSO3640

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	PN3639		PN3640		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-6.0		-12		V	$I_C = 10 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		-0.16		-0.2	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			-0.5		-0.6	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
			-0.25		-0.3	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
			-0.23		-0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = 65^\circ \text{ C}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.75	-0.95	-0.75	-0.95	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
		-0.8	-1.0	-0.8	-1.0	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			1.5		1.5	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		3.5		3.5	pF	$V_{CB} = -5.0 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
			5.5		5.5	pF	$V_{CB} = 0, I_E = 0, f = 140 \text{ kHz}$
C_{ib}	Input Capacitance		3.5		3.5	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	3.0		3.0			$I_C = 10 \text{ mA}, V_{CB} = 0, f = 100 \text{ MHz}$
		5.0		5.0			$I_C = 10 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 100 \text{ MHz}$
τ_s	Storage Time (test circuit no. 234)		30		50	ns	$I_C \approx 10 \text{ mA}, I_{B1} \approx I_{B2} \approx 10 \text{ mA}, V_{CC} = 3.0 \text{ V}$
t_{on}	Turn On Time (test circuit no. 235) (test circuit no. 219)		25		25	ns	$I_C \approx 50 \text{ mA}, I_{B1} \approx 5.0 \text{ mA}, V_{CC} = 6.0 \text{ V}$
			60		60	ns	$I_C \approx 10 \text{ mA}, I_{B1} \approx 0.5 \text{ mA}, V_{CC} = -1.5 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 235) (test circuit no. 219)		25		35	ns	$I_C \approx 50 \text{ mA}, I_{B1} \approx I_{B2} \approx 5.0 \text{ mA}, V_{CC} = 6.0 \text{ V}$
			60		75	ns	$I_C \approx 10 \text{ mA}, I_{B1} \approx I_{B2} \approx 0.5 \text{ mA}, V_{CC} = 1.5 \text{ V}$

SYMBOL	CHARACTERISTIC	MPS3639		MPS3640		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-6.0		-12.0		V	$I_C = 100 \mu\text{A}, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-6.0		-12.0		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		-4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CES}	Collector Reverse Current		10			nA	$V_{CE} = -3.0 \text{ V}, V_{BE} = 0$
			1.0		10	nA	$V_{CE} = -6.0 \text{ V}, V_{BE} = 0$
					1.0	μA	$V_{CE} = -3.0 \text{ V}, V_{BE} = 0, T_A = 65^\circ \text{ C}$
					1.0	μA	$V_{CE} = -6.0 \text{ V}, V_{BE} = 0, T_A = 65^\circ \text{ C}$

PN/MPS/FTSO3639
PN/MPS/FTSO3640

SYMBOL	CHARACTERISTIC	MPS3639		MPS3640		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	30 20	120	30 20	120		$I_C = 10 \text{ mA}$, $V_{CE} = -0.3 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-6.0		-12		V	$I_C = 10 \text{ mA}$, $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.16 -0.5 -0.23		-0.2 -0.6 -0.25	V V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$ $I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$, $T_A = 65^\circ \text{ C}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.75 -0.8	-0.95 -1.0 1.5	-0.75 -0.8	-0.95 -1.0 1.5	V V V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$ $I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		3.5		3.5	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz}$
C_{ib}	Input Capacitance		3.5		3.5	pF	$V_{EB} = -0.5 \text{ V}$, $I_C = 0$, $f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	3.0 5.0		5.0			$I_C = 10 \text{ mA}$, $V_{CB} = 0$, $f = 100 \text{ MHz}$ $I_C = 10 \text{ mA}$, $V_{CE} = -5.0$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 235) (test circuit no. 219)		25 60		25 60	ns ns	$I_C \approx 50 \text{ mA}$, $I_{B1} \approx 5.0 \text{ mA}$, $V_{CC} = 6.0 \text{ V}$ $I_C \approx 10 \text{ mA}$, $I_{B1} \approx 0.5 \text{ mA}$, $V_{CC} = -1.5 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 235) (test circuit no. 219)		25 60		35 75	ns ns	$I_C \approx 50 \text{ mA}$, $I_{B1} \approx I_{B2} \approx 5.0 \text{ mA}$, $V_{CC} = -6.0 \text{ V}$ $I_C \approx 10 \text{ mA}$, $I_{B1} \approx I_{B2} \approx 0.5 \text{ mA}$, $V_{CC} = 1.5 \text{ V}$

PN3641/FTSO3641
PN3642/FTSO3642
PN3643/FTSO3643
 NPN General Purpose Small Signal Amplifiers

- V_{CE0} ... 30 V (Min) (PN/FTSO3641, PN/FTSO3643), 45 V (Min) (PN/FTSO3642)
- h_{FE} ... 100 (Min) @ 150 mA, 25 (Min) @ 500 mA (PN/FTSO3643)
- P_G ... 400 mW RF Power Out at 30 MHz
- f_T ... 250 MHz (Min) (PN3643)
- t_{on} ... 60 ns (Max) @ 300 mA, t_{off} ... 150 ns (Max) @ 300 mA
- Complements ... MPS3638/A, PN3644

PACKAGE

PN3641	TO-92
PN3642	TO-92
PN3643	TO-92
FTSO3641	TO-236AA/AB
FTSO3642	TO-236AA/AB
FTSO3643	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	3641/3	3642
V_{CE0} Collector to Emitter Voltage (Note 4)	30 V	45 V
V_{CBO} Collector to Base Voltage	60 V	60 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3641		3642		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sus)}$	Collector to Emitter Breakdown Voltage (Notes 4 & 5)	30		45		V	$I_C = 10$ mA, $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60		60		V	$I_C = 10$ μ A, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10$ μ A, $I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN3641/FTSO3641
PN3642/FTSO3642
PN3643/FTSO3643

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3641		3642		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CES}	Collector Cutoff Current (Note 5)		50 1.0		50 1.0	nA μA	$V_{CE} = 50\text{ V}$, $V_{BE} = 0$ $V_{CE} = 50\text{ V}$, $V_{BE} = 0$, $T_A = 65^\circ\text{ C}$
h_{FE}	DC Pulse Current Gain (Note 5)	40 15	120	40 15	120		$I_C = 150\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}$, $V_{CE} = 10\text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.22		0.22	V	$I_C = 150\text{ mA}$, $I_B = 15\text{ mA}$
C_{ob}	Output Capacitance		8.0		8.0	pF	$V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 140\text{ kHz}$
h_{fe}	Magnitude of Common Emitter, Short Circuit Small Signal Current Gain	1.5		1.5			$I_C = 50\text{ mA}$, $V_{CE} = 5.0\text{ V}$, $f = 100\text{ MHz}$
G_{PE}	Amplifier Power Gain (test circuit no. 238)	10		10		dB	(Zero Signal) $V_{CE} = 15\text{ V}$, $I_C = 0$, $R_G = 140\ \Omega$, $R_L = 260\ \Omega$, $f = 30\text{ MHz}$, $P_{IN} = 40\text{ mW}$
η	Collector Efficiency (test circuit no. 238)	60		60		%	(Zero Signal) $V_{CE} = 15\text{ V}$, $I_C = 0$, $R_G = 140\ \Omega$, $R_L = 260\ \Omega$, $f = 30\text{ MHz}$, $P_{IN} = 40\text{ mW}$
t_{on}	Turn On Time (test circuit no. 241)		60		60	ns	$I_C \approx 300\text{ mA}$, $I_{B1} \approx 30\text{ mA}$,
t_{off}	Turn Off Time (test circuit no. 242)		150		150	ns	$I_C \approx 300\text{ mA}$, $I_{B1} \approx I_{B2} = 30\text{ mA}$

SYMBOL	CHARACTERISTIC	3643		UNITS	TEST CONDITIONS
		MIN	MAX		
$BV_{CEO(sus)}$	Collector to Emitter Breakdown Voltage (Notes 4 & 5)	30		V	$I_C = 10\text{ mA}$, $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60		V	$I_C = 10\ \mu\text{A}$, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10\ \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10\ \mu\text{A}$, $I_C = 0$
I_{CES}	Collector Cutoff Current (Note 5)		50 1.0	nA μA	$V_{CE} = 50\text{ V}$, $V_{BE} = 0$ $V_{CE} = 50\text{ V}$, $V_{BE} = 0$, $T_A = 65^\circ\text{ C}$
h_{FE}	DC Pulse Current Gain (Note 5)	100 25	300		$I_C = 150\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}$, $V_{CE} = 10\text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.22	V	$I_C = 150\text{ mA}$, $I_B = 15\text{ mA}$

PN3641/FTSO3641
PN3642/FTSO3642
PN3643/FTSO3643

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3643		UNITS	TEST CONDITIONS
		MIN	MAX		
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz}$
h_{fe}	Magnitude of Common Emitter, Short Circuit Small Signal Current Gain	2.5			$I_C = 50 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 100 \text{ MHz}$
G_{PE}	Amplifier Power Gain (test circuit no. 238)	10		dB	(Zero Signal) $V_{CE} = 15 \text{ V}$, $I_C = 0$, $R_G = 140 \Omega$, $R_L = 260 \Omega$, $f = 30 \text{ MHz}$, $P_{IN} = 40 \text{ mW}$
η	Collector Efficiency (test circuit no. 238)	60		%	(Zero Signal) $V_{CE} = 15 \text{ V}$, $I_C = 0$, $R_G = 140 \Omega$, $R_L = 260 \Omega$, $f = 30 \text{ MHz}$, $P_{IN} = 40 \text{ mW}$
t_{on}	Turn On Time (test circuit no. 241)		60	ns	$I_C \approx 300 \text{ mA}$, $I_{B1} \approx 30 \text{ mA}$,
t_{off}	Turn Off Time (test circuit no. 242)		150	ns	$I_C \approx 300 \text{ mA}$, $I_{B1} \approx I_{B2} = 30 \text{ mA}$

3

**PN3644/FTSO3644
PN3645/FTSO3645**

**PNP Small Signal General Purpose
Amplifiers & Switches**

- V_{CEO} ... -45 V (Min) (PN/FTSO3644), 60 V (Min) (PN/FTSO3645)
- h_{FE} ... 80-240 @ 50 mA
- t_{on} ... 40 ns (Max) @ 300 mA
- t_{off} ... 100 ns (Max) @ 300 mA
- Complements ... PN3569

PACKAGE

PN3644	TO-92
PN3645	TO-92
FTSO3644	TO-236AA/AB
FTSO3645	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	3645	3644
V_{CEO} Collector to Emitter Voltage (Note 4)	-60 V	-45 V
V_{CBO} Collector to Base Voltage	-60 V	-45 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3644		3645		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-45		-60		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current (Note 5)		35		35	nA nA μA μA	$V_{CE} = -30 V, V_{BE} = 0$ $V_{CE} = -50 V, V_{BE} = 0$ $V_{CE} = -30 V, V_{BE} = 0, T_A = 65^\circ C$ $V_{CE} = -50 V, V_{BE} = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	40 80		40 80			$I_C = 100 \mu A, V_{CE} = -10 V$ $I_C = 1.0 mA, V_{CE} = -10 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN3644/FTSO3644
PN3645/FTSO3645

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3644		3645		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	100 80 100 20	240 300	100 80 100 20	240 300		$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 300 \text{ mA}, V_{CE} = -2.0 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Pulsed) (Notes 4 & 5)	-45		-60		V	$I_C = 10 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		-0.25 -0.4 -1.0		-0.25 -0.4 -1.0	V V V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 5)		-1.0 -1.3 -2.0		-1.0 -1.3 -2.0	V V V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
C_{ob}	Output Capacitance		8.0		8.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{ib}	Input Capacitance		35		35	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0		2.0			$I_C = 20 \text{ mA}, V_{CE} = -20 \text{ V},$ $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 246)		40		40	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx 30 \text{ mA},$ $V_{CC} = -30 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 246)		100		100	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx I_{B2} \approx 30 \text{ mA},$ $V_{CC} = -30 \text{ V}$

**PN/MPS/FTSO3646
2N/FTSO5772**

**NPN High Speed Saturated Logic
Switches**

- V_{CE0} ... 15 V (Min)
- T_s ... 18 ns (Max) @ 10 mA
- t_{on} ... 18 ns (Max) @ 300 mA
- t_{off} ... 28 ns (Max) @ 300 mA

PACKAGE

PN3646	TO-92
MPS3646	TO-92
2N5772	TO-92
FTSO3646	TO-236AA/AB
FTSO5772	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	15 V
(Note 4)	
V_{CES} Collector to Emitter Voltage	40 V
V_{CBO} Collector to Base Voltage	40 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	200 mA
Pulse = 10 μ s	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_C = 0, I_E = 100 \mu A$
BV_{CBO}	Collector to Base Breakdown Voltage	40		V	$I_C = 100 \mu A, I_E = 0$
I_{CES}	Collector Reverse Current		0.5	μA	$V_{CE} = 20 V, V_{BE} = 0$
h_{FE}	DC Current Gain (Note 5)	30 25 15	120		$I_C = 30 mA, V_{CE} = 0.4 V$ $I_C = 100 mA, V_{CE} = 0.5 V$ $I_C = 300 mA, V_{CE} = 1.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T162.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**PN/MPS/FTSO3646
2N/FTSO5772**

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		V	$I_C = 10 \text{ mA}$, $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.20 0.28 0.5 0.3	V V V V	$I_C = 30 \text{ mA}$, $I_B = 3.0 \text{ mA}$ $I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$ $I_C = 300 \text{ mA}$, $I_B = 30 \text{ mA}$ $I_C = 30 \text{ mA}$, $I_B = 3.0 \text{ mA}$, $T_A = 65^\circ \text{ C}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.75	0.95 1.2 1.7	V V V	$I_C = 30 \text{ mA}$, $I_B = 3.0 \text{ mA}$ $I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$ $I_C = 300 \text{ mA}$, $I_B = 30 \text{ mA}$
C_{ob}	Output Capacitance		5.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz}$
C_{TE}	Emitter Transition Capacitance		8.0	pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	3.5			$I_C = 30 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		18	ns	$I_C \approx I_{B1} \approx -I_{B2} \approx 10 \text{ mA}$, $V_{CC} = 10 \text{ V}$
t_{on}	Turn On Time (test circuit no. 233)		18	ns	$I_C \approx 300 \text{ mA}$, $I_{B1} \approx 30 \text{ mA}$, $V_{CC} = 10 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 233)		28	ns	$I_C \approx 300 \text{ mA}$, $I_{B1} \approx -I_{B2} = 30 \text{ mA}$, $V_{CC} = 10 \text{ V}$

3

- V_{CE0} ... 45 V (Min)
- h_{FE} ... 100-400 (PN/FTSO3694)
- A_{PG} ... 55 dB (Typ) @ 455 kHz
- G_C ... 20 dB (Typ) from 108 MHz to 10.7 MHz
- NF ... 4.0 dB (Typ) @ 1.0 MHz
- Complements ... PN4121, PN4122

PACKAGE

PN3693	TO-92
PN3694	TO-92
FTSO3693	TO-236AA/AB
FTSO3694	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	45 V
(Note 4)	
V_{CBO} Collector to Base Voltage	45 V
V_{EBO} Emitter to Base Voltage	4.0 V
I_C Collector Current	30 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3693		3694		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	45		45		V	$I_C = 0.1$ mA, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		4.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		100		100	μ A	$V_{EB} = 4.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 5.0		50 5.0	nA μ A	$V_{CB} = 30$ V, $I_E = 0$ $V_{CB} = 30$ V, $I_E = 0$, $T_A = 65^\circ$ C
h_{FE}	DC Pulse Current Gain (Note 5)	40	160	100	400		$I_C = 10$ mA, $V_{CE} = 10$ V
$V_{CE0(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	45		45		V	$I_C = 10$ mA (pulsed), $I_B = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN3693/FTSO3693
PN3694/FTSO3694

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3693		3694		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
C _{ob}	Output Capacitance	0.5	6.0	0.5	6.0	pF	V _{CB} = 10 V, I _E = 0, f = 1.0 MHz
h _{fe}	High Frequency Current Gain	2.0	5.0	2.0	5.0		I _C = 10 mA, V _{CE} = 15 V, f = 100 MHz
r _b 'C _c	Collector Base Time Constant		55		55	ps	I _C = 10 mA, V _{CE} = 15 V, f = 80 MHz

3

**PN4121/FTSO4121
PN4122/FTSO4122**

**PNP Small Signal General Purpose
Amplifiers & Switches**

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 150-300 @ 10 mA (PN/FTSO4122)
- f_T ... 450 MHz (Min) @ 10 mA (PN/FTSO4122)
- $r_b' C_c$... 50 ps (Max)
- C_{cb} ... 4.5 pF (Max)
- NF ... 6.0 dB (Max) @ 100 MHz

PACKAGE

PN4121	TO-92
PN4122	TO-92
FTSO4121	TO-236AA/AB
FTSO4122	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	PN	FTSO
Total Dissipation at		0.350 W*
25° C Ambient Temperature	0.625 W	
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-40 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4121		4122		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-40		-40		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-40		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-50.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current		25 25		25 25	nA μA	$V_{CE} = -30 V, V_{BE} = 0$ $V_{CE} = -30 V, V_{BE} = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	40 60		100 150			$I_C = 100 \mu A, V_{CE} = -1.0 V$ $I_C = 1.0 mA, V_{CE} = -1.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN4121/FTSO4121
PN4122/FTSO4122

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4121		4122		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	70 15	200	150 30	300		$I_C = 10 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-40		-40		V	$I_C = 10 \text{ mA}$, $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.13		-0.13	V	$I_C = 1.0 \text{ mA}$, $I_B = 0.1 \text{ mA}$
			-0.14		-0.14	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
			-0.3		-0.3	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.75		-0.75	V	$I_C = 1.0 \text{ mA}$, $I_B = 0.1 \text{ mA}$
			-0.9		-0.9	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
		-0.7	-1.1	-0.7	-1.1	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.5		4.5	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$
C_{ib}	Open Circuit Input Capacitance		8.0		8.0	pF	$V_{EB} = -0.5 \text{ V}$, $I_C = 0$
$ h_{fe} $	Magnitude of Small Signal Current Gain	4.0		4.5			$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$
h_{fe}	Forward Current Transfer Ratio	50	300	150	450		$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	1.0	8.0	4.0	12	k Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance	2.0	24	8.0	40	μmho	$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		3.0		4.0	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
$r_b' C_c$	Collector to Base Time Constant		50		50	ps	$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 80 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 342)		40		40	ns	$I_C = 50 \text{ mA}$, $I_{B1} = 5.0 \text{ mA}$,
t_{off}	Turn Off Time (see test circuit no. 342)		150		150	ns	$I_C = 50 \text{ mA}$, $I_{B1} = 5.0 \text{ mA}$, $I_{B2} = 5.0 \text{ mA}$
NF	Noise Figure		6.0		6.0	dB	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 100 \text{ MHz}$, $BW = 15 \text{ MHz}$, $R_S = 100 \Omega$
			4.0		4.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $BW = 15 \text{ MHz}$, $R_S = 1.0 \text{ k}\Omega$, $f = 10 \text{ Hz to } 10 \text{ kHz}$

3

FAIRCHILD

A Schlumberger Company

PN4248/FTSO4248 PN4249/FTSO4249 PN4250/FTSO4250 PN4250A/FTSO4250A

PNP Low Level Low Noise Amplifiers

- V_{CE0} ... 40 V (Min) (PN4248/50); 60 V (Min) (PN4249/50A)
- h_{FE} ... 250-700 @ 100 μ A (PN4250/50A)
- NF ... 2.0 dB (Max) @ 1.0 kHz (PN4250/50A)
- Excellent Beta Linearity from 1.0 μ A to 50 mA

PACKAGE

PN4248	TO-92
PN4249	TO-92
PN4250	TO-92
PN4250A	TO-92
FTSO4248	TO-236AA/AB
FTSO4249	TO-236AA/AB
FTSO4250	TO-236AA/AB
FTSO4250A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	4248/50	4249/50A
V_{CE0} Collector to Emitter Voltage (Note 4)	-40 V	-60 V
V_{CBO} Collector to Base Voltage	-40 V	-60 V
V_{CES} Collector to Emitter Voltage	-40 V	-60 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4248		4249		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-40		-60		V	$I_E = 10 \mu$ A, $I_C = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-60		V	$I_C = 10 \mu$ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu$ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		20		20	nA	$V_{EB} = -3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10 3.0		10 3.0	nA μ A	$V_{CB} = -40$ V, $I_E = 0$ $V_{CB} = -40$ V, $I_E = 0$, $T_A = 65^\circ$ C
h_{FE}	DC Current Gain	50 50		100 100	300		$I_C = 100 \mu$ A, $V_{CE} = -5.0$ V $I_C = 1.0$ mA, $V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	50		100			$I_C = 10$ mA, $V_{CE} = -5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**PN4248/FTSO4248/PN4249/FTSO4249
PN4250/FTSO4250
PN4250A/FTSO4250A**

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4248		4249		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _{CE(sus)}	Collector to Emitter Sustaining Voltage (Note 5)	-40		-60		V	I _C = 5.0 mA (pulsed), I _B = 0
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		-0.25		-0.25	V	I _C = 10 mA, I _B = 0.5 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	I _C = 10 mA, I _B = 0.5 mA
C _{ob}	Output Capacitance		6.0		6.0	pF	V _{CB} = -5.0 V, I _E = 0, f = 1.0 MHz
C _{ib}	Input Capacitance		16		16	pF	V _{BE} = -0.5 V, I _C = 0, f = 1.0 MHz
h _{fe}	High Frequency Current Gain	2.0		2.0			I _C = 0.5 mA, V _{CE} = -5.0 V, f = 20 MHz
h _{fe}	Small Signal Current Gain	50	1000	100	550		I _C = 1.0 mA, V _{CE} = -5.0 V, f = 1.0 kHz
h _{ie}	Input Resistance			2.5	17	kΩ	I _C = 1.0 mA, V _{CE} = -5.0 V, f = 1.0 kHz
h _{oe}	Output Conductance			5.0	40	μmhos	I _C = 1.0 mA, V _{CE} = -5.0 V, f = 1.0 kHz
h _{re}	Voltage Feedback Ratio				10	x10 ⁻⁴	I _C = 1.0 mA, V _{CE} = -5.0 V, f = 1.0 kHz
NF	Wide Band Noise Figure				3.0	dB	I _C = 20 μA, V _{CE} = -5.0 V, f = 10 Hz to 10 kHz, R _S = 10 kΩ, PBW = 15.7 kHz
NF	Narrow Band Noise Figure				3.0	dB	I _C = 20 μA, V _{CE} = -5.0 V, f = 1.0 kHz, R _S = 10 kΩ, PBW = 150 Hz I _C = 250 μA, V _{CE} = -5.0 V, f = 1.0 kHz, R _S = 1.0 Ω, PBW = 150 Hz

3

PN4248/FTSO4248/PN4249/FTSO4249
PN4250/FTSO4250
PN4250A/FTSO4250A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4250		4250A		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-40		-60		V	$I_C = 5.0 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25		-0.25	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9			V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
C_{ob}	Output Capacitance		6.0		6.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		16			pF	$V_{BE} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	2.5					$I_C = 0.5 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	250	800	250	800		$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	6.0	20	6.0	20	k Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance	5.0	50	5.0	50	μmhos	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		10		10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Wide Band Noise Figure		2.0		2.0	dB	$I_C = 20 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 10 \text{ Hz to } 10 \text{ kHz}$, $R_S = 10 \text{ k}\Omega$, $PBW = 15.7 \text{ kHz}$
NF	Narrow Band Noise Figure		2.0		2.0	dB	$I_C = 20 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 10 \text{ k}\Omega$, $PBW = 150 \text{ Hz}$
			2.0		2.0	dB	$I_C = 250 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 1.0 \text{ k}\Omega$, $PBW = 150 \text{ Hz}$
BV_{CES}	Collector to Emitter Breakdown Voltage	-40		-60		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-60		V	$I_C = 10 \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		20		20	nA	$V_{EB} = -3.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	nA	$V_{CB} = -40 \text{ V}$, $I_E = 0$
			3.0			nA	$V_{CB} = -50 \text{ V}$, $I_E = 0$
						μA	$V_{CB} = -40 \text{ V}$, $I_E = 0$, $T_A = 65^\circ \text{ C}$
h_{FE}	DC Current Gain	250	700	250	700		$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$
		250					$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$
h_{FE}	DC Pulse Current Gain (Note 5)	250					$I_C = 10 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$

PN4258/FTSO4258

PNP Small Signal Ultra High Speed Logic Switch

- V_{CE0} ... 12 V (Min)
- h_{FE} ... 30-120 @ 10 mA
- t_{on} ... 15 ns (Max) @ 10 mA
- Complement ... 2N/FTSO5769

PACKAGE

PN4258 TO-92
 FTSO4258 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-12 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-12 V
V_{EBO} Emitter to Base Voltage	-4.5 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-12		V	$I_E = 100 \mu A, I_C = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.5		V	$I_E = 100 \mu A, I_C = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-12		V	$I_C = 100 \mu A, V_{CE} = 0$
I_{CES}	Collector Reverse Current		10 5.0	nA μA	$V_{CE} = -6.0 V, V_{BE} = 0$ $V_{CE} = -6.0 V, V_{BE} = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain (Note 5)	30 15 30	120		$I_C = 10 mA, V_{CE} = -3.0 V$ $I_C = 1.0 mA, V_{CE} = -0.5 V$ $I_C = 50 mA, V_{CE} = -1.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T292.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN4258/FTSO4258

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
			-0.5	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-12		V	$I_C = 3.0 \text{ mA}$, $I_B = 0$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.75	-0.95	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
			-1.5	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		3.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$
C_{ib}	Input Capacitance		3.5	pF	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$
$ h_{fe} $	Magnitude of Small Signal Current Gain	7.0			$I_C = 10 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$
		5.0			$I_C = 10 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 348)		15	ns	$I_C \approx 10 \text{ mA}$, $I_{B1} \approx 1.0 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 348)		20	ns	$I_C \approx 10 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 1.0 \text{ mA}$
τ_s	Charge Storage Time (test circuit no. 234)		20	ns	$I_C \approx 10 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 10 \text{ mA}$

**PN4274/FTSO4274
PN4275/FTSO4275**

**NPN Small Signal High Speed
Saturated Switches**

- V_{CE0} ... **12 V (Min) (PN/FTSO4274), 15 V (Min) (PN/FTSO4275)**
- $V_{CE(sat)}$... **0.2 V (Max) @ 10 mA**
- f_T ... **400 MHz (Min)**
- C_{cb} ... **4.0 pF (Max) @ 5.0 V**
- τ_s ... **13 ns (Max) @ 10 mA**
- t_{on} and t_{off} ... **12 ns (Max) @ 10 mA**
- **Complement ... PN3640**

PACKAGE

PN4274	TO-92
PN4275	TO-92
FTSO4274	TO-236AA/AB
FTSO4275	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	4274	4275
V_{CE0} Collector to Emitter Voltage (Note 4)	12 V	15 V
V_{CBO} Collector to Base Voltage	30 V	40 V
V_{CES} Collector to Emitter Voltage	30 V	40 V
V_{EBO} Emitter to Base Voltage	4.5 V	4.5 V
I_C Collector Current (10 μ s pulse)	500 mA	500 mA
I_C Collector Current	100 mA	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4274		4275		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	30		40		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30		40		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5		4.5		V	$I_E = 10 \mu A, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T162.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN4274/FTSO4274
PN4275/FTSO4275

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4274		4275		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		10		10	μA	$V_{CB} = 20 V, I_E = 0, T_A = 65^\circ C$
I_{CES}	Collector Reverse Current		400		400	nA	$V_{CE} = 20 V, V_{BE} = 0$
h_{FE}	DC Pulse Current Gain	35 30 18	120	35 30 18	120		$I_C = 10 mA, V_{CE} = 1.0 V$ $I_C = 30 mA, V_{CE} = 0.4 V$ $I_C = 100 mA, V_{CE} = 1.0 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	12		15		V	$I_C = 10 mA$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.20 0.18 0.25 0.50 0.30		0.20 0.18 0.25 0.50 0.30	V V V V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 10 mA, I_B = 3.3 mA$ $I_C = 30 mA, I_B = 3.0 mA$ $I_C = 100 mA, I_B = 10 mA$ $I_C = 10 mA, I_B = 1.0 mA, T_A = 65^\circ C$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.72 0.74	0.85 1.00 1.15 1.60	0.72 0.74	0.85 1.00 1.15 1.60	V V V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 10 mA, I_B = 3.3 mA$ $I_C = 30 mA, I_B = 3.0 mA$ $I_C = 100 mA, I_B = 10 mA$
C_{cb}	Collector to Base Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 V, I_E = 0$
h_{fe}	High Frequency Current Gain	4.0		4.0			$I_C = 10 mA, V_{CE} = 10 V, f = 100 MHz$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		13		13	ns	$I_C = I_{B1} = -I_{B2} = 10 mA,$
t_{on}	Turn On Time (test circuit no. 381)		12		12	ns	$I_C = 10 mA, I_{B1} = 3.3 mA$
t_{off}	Turn Off Time (test circuit no. 381)		12		12	ns	$I_C = 10 mA, I_{B1} = I_{B2} = 3.3 mA$

**PN4354/FTSO4354
PN4355/MPS4355/FTSO4355
PN4356/MPS4356/FTSO4356**
PNP General Purpose Amplifiers

- V_{CEO} ... -60 V (Min) (PN4354, PN/MPS4355),
-80 V (Min) (PN/MPS4356)
- $V_{CE(sat)}$... -1.0 V (Max) @ $I_C = 1.0$ A (PN/MPS4355)
- NF ... 3.0 dB (Max) at 1.0 kHz
- Complements ... PN3567, PN3569

PACKAGE

PN4354	TO-92
PN4355	TO-92
PN4356	TO-92
MPS4355	TO-92
MPS4356	TO-92
FTSO4354	TO-236AA/AB
FTSO4355	TO-236AA/AB
FTSO4356	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN/MPS	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	4354/5	4356
V_{CEO} Collector to Emitter Voltage (Note 4)	-60 V	-80 V
V_{CBO} Collector to Base Voltage	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4354		4355		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-60		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = -4.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50 5.0		50 5.0	nA μA	$V_{CB} = -50 V, I_E = 0$ $V_{CB} = -50 V, I_E = 0,$ $T_A = 75^\circ C$
h_{FE}	DC Pulse Current Gain (Note 5)	25 40 50 40 30	500	60 75 100 75 75	400		$I_C = 100 \mu A, V_{CE} = -10 V$ $I_C = 1.0 mA, V_{CE} = -10 V$ $I_C = 10 mA, V_{CE} = -10 V$ $I_C = 100 mA, V_{CE} = -10 V$ $I_C = 500 mA, V_{CE} = -10 V$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs ; duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T224.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN4354/FTSO4354
PN4355/MPS4355/FTSO4355
PN4356/MPS4356/FTSO4356

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4354		4355		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-60		-60		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15		-0.15	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
			-0.5		-0.5	V	$I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$
					-1.0	V	$I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 3)		-1.1		-1.1	V	$I_C = 500 \text{ mA}$, $V_{CE} = -0.5 \text{ V}$
					-1.2	V	$I_C = 1.0 \text{ A}$, $V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ V}$
			-1.1		-1.1	V	$I_C = 500 \text{ mA}$, $I_B = 500 \text{ mA}$
					-1.2	V	$I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$
C_{cb}	Collector to Base Capacitance		30		30	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		110		110	pF	$V_{BE} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0	5.0	1.0	5.0		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 341)		100		100	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx 50 \text{ mA}$, $V_{CC} = -30 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 341)		400		400	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx I_{B2} = 50 \text{ mA}$, $V_{CC} = -30 \text{ V}$
NF	Noise Figure		3.0		3.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$, $BW = 1.0 \text{ Hz}$, $R_S = 1.0 \text{ k}\Omega$

SYMBOL	CHARACTERISTIC	4356		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = -4.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50	nA	$V_{CB} = -50 \text{ V}$, $I_E = 0$
			5.0	μA	$V_{CB} = -50 \text{ V}$, $I_E = 0$, $T_A = 75^\circ \text{ C}$
h_{FE}	DC Pulse Current Gain (Note 5)	25	250		$I_C = 100 \mu\text{A}$, $V_{CE} = -10 \text{ V}$
		40			$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$
		50			$I_C = 10 \text{ mA}$, $V_{CE} = -10 \text{ V}$
		40			$I_C = 100 \text{ mA}$, $V_{CE} = -10 \text{ V}$
		30			$I_C = 500 \text{ mA}$, $V_{CE} = -10 \text{ V}$

PN4354/FTSO4354
PN4355/MPS4355/FTSO4355
PN4356/MPS4356/FTSO4356

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4356		UNITS	TEST CONDITIONS
		MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-80		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
			-0.5	V	$I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 3)		-1.1	V	$I_C = 500 \text{ mA}$, $V_{CE} = -0.5 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ V}$
			1.1	V	$I_C = 500 \text{ mA}$, $I_B = 500 \text{ mA}$
C_{cb}	Collector to Base Capacitance		30	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		110	pF	$V_{BE} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0	5.0		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 341)		100	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx 50 \text{ mA}$, $V_{CC} = -30 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 341)		400	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx I_{B2} = 50 \text{ mA}$, $V_{CC} = -30 \text{ V}$
NF	Noise Figure		3.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$, $BW = 1.0 \text{ Hz}$, $R_S = 1.0 \text{ k}\Omega$

- V_{CE0} ... 150 V (Min)
- h_{FE} ... 80-300 @ 10 mA (PN/FTSO4889)
- C_{ob} ... 4.0 pF (Max)
- NF ... 3.0 dB (Max) @ 1.0 kHz (PN/FTSO4889)
- Excellent Beta Linearity from 10 μ A to 50 mA

PACKAGE

PN4888	TO-92
PN4889	TO-92
FTSO4888	TO-236AA/AB
FTSO4889	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-150 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-150 V
V_{EBO} Emitter to Base Voltage	-6.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4888		4889		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-150		-150		V	$I_C = 100 \mu A, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-150		-150		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-0.6		-0.6		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		10	nA	$V_{EB} = -4.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50 2.5		10 0.5	nA μA	$V_{CB} = -100 V, I_E = 0$ $V_{CB} = -100 V, I_E = 0, T_A = 65^\circ C$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T232.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN4888/FTSO4888

PN4889/FTSO4889

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4888		4889		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	30 40	400	60 70 80	300		$I_C = 100 \mu A, V_{CE} = -10 V$ $I_C = 1.0 mA, V_{CE} = -10 V$ $I_C = 10 mA, V_{CE} = -10 V$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage	-150		-150		V	$I_C = 2.0 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		-0.5		-0.5	V	$I_C = 10 mA, I_B = 1.0 mA$
$V_{BE(on)}$	Base to Emitter "On" Voltage (Pulsed) (Note 5)		-0.8		-0.7	V	$I_C = 1.0 mA, V_{CE} = -10 V$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 5)		-0.9		-0.9	V	$I_C = 10 mA, I_B = 1.0 mA$
C_{ob}	Output Capacitance		4.0		4.0	pF	$V_{CB} = -20 V, I_E = 0, f = 1.0 MHz$
C_{ib}	Input Capacitance		30		25	pF	$V_{BE} = -0.5 V, I_C = 0, f = 1.0 MHz$
h_{fe}	High Frequency Current Gain	1.5	8.0	2.0	8.0		$I_C = 1.0 mA, V_{CE} = -10 V, f = 20 MHz$
h_{fe}	Common Emmitter Small Signal Current Gain Forward Current Transfer Ratio	30	500	65	400		$I_C = 1.0 mA, V_{CE} = -10 V, f = 1.0 kHz$
h_{ie}	Small Signal Short Circuit Input Resistance	0.75	20	1.7	12	k Ω	$I_C = 1.0 mA, V_{CE} = -10 V, f = 1.0 kHz$
h_{oe}	Small Signal Open Circuit Output Conductance	1.4	40	3.0	25	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = -10 V, f = 1.0 kHz$
h_{re}	Small Signal Open Circuit Reverse Voltage Feedback Ratio				5	$\times 10^{-4}$	$I_C = 1.0 mA, V_{CE} = -10 V, f = 1.0 kHz$
NF	Wide Band Noise Figure				4.0	dB	$I_C = 250 \mu A, V_{CE} = -5.0 V, f = 10 Hz \text{ to } 10 kHz, R_S = 1.0 k\Omega, BW = 15.7 kHz$
NF	Narrow Band Noise Figure				10	dB	$I_C = 250 \mu A, V_{CE} = -5.0 V, R_S = 1.0 k\Omega, f = 100 Hz, BW = 15 Hz$
					3.0	dB	$I_C = 30 \mu A, V_{CE} = -5.0 V, R_S = 1.0 k\Omega, f = 1.0 kHz, BW = 150 Hz$
					3.0	dB	$I_C = 250 \mu A, V_{CE} = -5.0 V, R_S = 1.0 k\Omega, f = 10 kHz, BW = 1.5 kHz$
					4.0	dB	$I_C = 1.0 mA, V_{CE} = -10 V, R_S = 1.0 k\Omega, f = 1.0 MHz, BW = 2.0 kHz$

3

- V_{CEO} ... 30 V (Min)
- h_{FE} ... 150-300 @ 10 mA
- f_T ... 450 MHz (Min) @ 10 mA
- C_{cb} ... 4.5 pF (Max)
- $r_b' C_c$... 50 ps (Max)
- Complements ... 2N3903, 2N3904

PACKAGE

PN4916	TO-92
PN4917	TO-92
FTSO4916	TO-236AA/AB
FTSO4917	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	-30 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-30 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4916		4917		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-30		-30		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-30		-30		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current		25 25		25 25	nA μA	$V_{CE} = -15 V, V_{EB} = 0$ $V_{CE} = -15 V, V_{EB} = 0, T_A = 65^\circ C$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**PN4916/FTSO4916
PN4917/FTSO4917**

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4916		4917		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	40 60		100 150			$I_C = 100 \mu A, V_{CE} = -1.0 V$ $I_C = 1.0 mA, V_{CE} = -1.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	70 15	200	150 30	300		$I_C = 10 mA, V_{CE} = -1.0 V$ $I_C = 50 mA, V_{CE} = -1.0 V$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-30		-30		V	$I_C = 10 mA, I_B = 0$ (pulsed)
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.13		-0.13	V	$I_C = 1.0 mA, I_B = 0.1 mA$
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		-0.14 -0.3		-0.14 -0.3	V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 50 mA, I_B = 5.0 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-0.75		-0.75	V	$I_C = 1.0 mA, I_B = 0.1 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 5)	-0.7 -0.75	-0.9 -1.1	-0.7 -0.75	-0.9 -1.1	V V	$I_C = 10 mA, I_B = 1.0 mA$ $I_C = 50 mA, I_B = 5.0 mA$
C_{cb}	Collector to Base Capacitance		4.5		4.5	pF	$V_{CE} = -10 V, I_E = 0$
C_{eb}	Emitter to Base Capacitance		8.0		8.0	pF	$V_{EB} = -0.5 V, I_C = 0$
$ h_{fe} $	Magnitude of Small Signal Current Gain	4.0		4.5			$I_C = 10 mA, V_{CE} = -20 V,$ $f = 100 MHz$
$r_b'C_c$	Collector to Base Time Constant		50		50	ps	$I_C = 10 mA, V_{CE} = -20 V,$ $f = 80 MHz$
t_{on}	Turn On Time (test circuit no. 407)		40		40	ns	$I_C = 50 mA, I_{B1} = 5.0 mA,$
t_{off}	Turn Off Time (test circuit no. 407)		150		150	ns	$I_C = 50 mA, I_{B1} = 5.0 mA,$
NF	Noise Figure		6.0 4.0		6.0 4.0	dB dB	$I_C = 1.0 mA, V_{CE} = -5.0 V,$ $R_S = 100 k\Omega, BW = 15 MHz,$ $f = 100 MHz$ $I_C = 100 \mu A, V_{CE} = -5.0 V,$ $R_S = 1.0 k\Omega, BW = 15.7 kHz,$ 3.0 dB Pts A 10 Hz & 10 kHz

- h_{FE} ... **35 (Min) @ 50 mA, 20 (Min) @ 10 mA**
- f_T ... **150 MHz (Min) @ 50 mA**
- t_{on} ... **14 ns (Typ) @ 300 mA, t_{off} ... 80 ns (Typ) @ 300 mA**
- $V_{CE(sat)}$... **-0.25 V (Max) @ 150 mA, -0.35 V (Typ) @ 500 mA**

PACKAGE

PN5128 TO-92
FTSO5128 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 12 V
(Note 4)
 V_{CBO} Collector to Base Voltage 15 V
 V_{EBO} Emitter to Base Voltage 3.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	15		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	$I_E = 10 \mu A, I_C = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	15		V	$I_C = 10 \mu A, I_B = 0$
I_{CBO}	Collector Cutoff Current		50 1.0	nA μA	$V_{CE} = 10 V, I_E = 0$ $V_{CE} = 10 V, I_E = 0, T_A = 65^\circ C$
I_{EBO}	Emitter Cutoff Current		10	μA	$V_{EB} = 3.0 V, I_C = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	20 35	350		$I_C = 10 mA, V_{CE} = 10 V$ $I_C = 50 mA, V_{CE} = 10 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5128/FTSO5128

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	12		V	$I_C = 10 \text{ mA}$, $I_B = 0$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 5)		1.10	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.1	V	$I_C = 150 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
C_{cb}	Collector to Base Capacitance		10	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	1.5	8.0		$I_C = 50 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 100 \text{ MHz}$

3

- G_{pe} ... 15 dB (Typ) @ 200 MHz
- P_o ... 7.0 mW (Typ) @ 930 MHz
- NF ... 4.0 dB (Typ) @ 60 MHz

PACKAGE

PN5130	TO-92
FTSO5130	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	12 V
V_{CBO} Collector to Base Voltage	30 V
V_{EBO} Emitter to Base Voltage	1.0 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	12		V	$I_C = 3.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	1.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 5.0	nA μ A	$V_{CB} = 10$ V, $I_C = 0$ $V_{CB} = 10$ V, $I_E = 0$, $T_A = 65^\circ$ C
h_{FE}	DC Pulse Current Gain (Note 5)	15	250		$I_C = 8.0$ mA, $V_{CE} = 10$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T121.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5130/FTSO5130

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.6	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.0	V	$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$
C_{cb}	Collector to Base Capacitance		1.7	pF	$V_{EB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Forward Current Transfer Ratio	12	300		$I_C = 8.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
$ h_{fe} $	Magnitude of Small Signal Current Gain	4.5			$I_C = 8.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$

3

PN5133/FTSO5133
NPN Low Level Amplifiers

- h_{FE} ... 60 (Min), 220 (Typ) @ 1.0 mA
- BV_{CEO} ... 18 V (Min) @ 3.0 mA

PACKAGE

PN5133 TO-92
FTSO5133 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents (Notes 4 & 5)

V_{CEO} Collector to Emitter Voltage	18 V
V_{CBO} Collector to Base Voltage	20 V
V_{EBO} Emitter to Base Voltage	3.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	20		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB} = 2.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50 5.0	nA μA	$V_{CB} = 15 V, I_E = 0$ $V_{CB} = 15 V, I_E = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	60	1000		$I_C = 1.0 mA, V_{CE} = 5.0 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 3 & 4)		18	V	$I_C = 3.0 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.4	V	$I_C = 1.0 mA, I_B = 0.1 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.75	V	$I_C = 100 \mu A, V_{CE} = 5.0 V$
C_{cb}	Collector to Base Capacitance		5.0	pF	$V_{CB} = 5.0 V, I_E = 0$
h_{fe}	High Frequency Current Gain	2.0	20		$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 20 MHz$
h_{fe}	Small Signal Current Gain	50	1100		$I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T107.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5134/FTSO5134

NPN Small Signal High Speed Saturated Switch

- f_T ... **250 MHz (Min)**
- C_{cb} ... **4.0 pF (Max) @ 5.0 V**
- T_s ... **18 ns (Max) @ 10 mA**
- t_{on} ... **18 ns (Max) @ 10 mA**, t_{off} ... **18 ns (Max) @ 10 mA**
- **Complement ... MPS3639**

PACKAGE

PN5134
FTSO5134

TO-92
TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	10 V
(Note 4)	
V_{CES} Collector to Emitter Voltage	20 V
V_{CBO} Collector to Base Voltage	20 V
V_{EBO} Emitter to Base Voltage	3.5 V
I_C Collector Current	100 mA
Pulse = 10 μ s	500 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	20		V	$I_C = 10 \mu A, I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 10 \mu A, V_{EB} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.5		V	$I_E = 10 \mu A, I_C = 0$
I_{CBO}	Collector Cutoff Current		10	μA	$V_{CB} = 15 V, I_E = 0, T_A = 65^\circ C$
I_{CES}	Collector Reverse Current		0.40	μA	$V_{CE} = 15 V, V_{EB} = 0$
h_{FE}	DC Current Gain (Note 5)	20 15	150		$I_C = 10 mA, V_{CE} = 1.0 V$ $I_C = 30 mA, V_{CE} = 0.4 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T132.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5134/FTSO5134

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			0.20	V	$I_C = 10 \text{ mA}, I_B = 3.3 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.70	0.90	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
		0.72	1.10	V	$I_C = 10 \text{ mA}, I_B = 3.3 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0$
h_{fe}	High Frequency Current Gain	2.5			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		18	ns	$I_C = 10 \text{ mA}, I_{B1} \approx -I_{B2} \approx 10 \text{ mA}, V_{CC} = 10 \text{ V}$
t_{on}	Turn On Time (test circuit no. 381)		18	ns	$I_C \approx 10 \text{ mA}, I_{B1} \approx 3.3 \text{ mA}, V_{CC} = 3.0 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 381)		7.0	18	ns $I_C \approx 10 \text{ mA}, I_{B1} \approx 3.3 \text{ mA}, I_{B2} \approx -3.3 \text{ mA}, V_{CC} = 2.0 \text{ V}$

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137
 NPN Small Signal General Purpose Amplifiers

- **P_D ... 625 mW @ T_A = 25° C**
- **V_{CEO} ... 25 V (Min) (PN/FTSO5135)**
- **h_{FE} ... 50-600 @ 10 mA (PN/FTSO5135), 20-400 @ 150 mA (PN/FTSO5136/7)**
- **f_T ... 40 MHz (Min)**
- **Complements ... PN5142, PN5143**

PACKAGE

PN5135	TO-92
PN5136	TO-92
PN5137	TO-92
FTSO5135	TO-236AA/AB
FTSO5136	TO-236AA/AB
FTSO5137	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5135	5136/7
V _{CEO} Collector to Emitter Voltage	25 V	20 V
(Note 4)		
V _{CBO} Collector to Base Voltage	30 V	30 V
V _{CES} Collector to Emitter Voltage	30 V	30 V
V _{EBO} Emitter to Base Voltage	4.0 V	3.0 V
I _c Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5135		5136		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV _{CES}	Collector to Emitter Breakdown Voltage	30		30		V	I _c = 100 μA, V _{BE} = 0
BV _{CBO}	Collector to Base Breakdown Voltage	30		30		V	I _c = 100 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	4.0		3.0		V	I _E = 10 μA, I _c = 0
I _{EBO}	Emitter Cutoff Current		10		100	nA μA	V _{EB} = 2.0 V, I _c = 0 V _{EB} = 4.0 V, I _c = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5135		5136		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current	300	10		100	nA	$V_{CB} = 15\text{ V}, I_E = 0$ $V_{CB} = 20\text{ V}, I_E = 0$ $V_{CB} = 15\text{ V}, I_E = 0$ $T_A = 65^\circ\text{ C}$ $V_{CB} = 20\text{ V}, I_E = 0,$ $T_A = 65^\circ\text{ C}$
						nA	
						μA	
						μA	
h_{FE}	DC Pulse Current Gain (Note 5)	50 15	600		20 20	400	$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 2.0\text{ mA}, V_{CE} = 1.0\text{ V}$ $I_C = 150\text{ mA}, V_{CE} = 1.0\text{ V}$ $I_C = 30\text{ mA}, V_{CE} = 1.0\text{ V}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	25		20		V	$I_C = 1.0\text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.0		0.25	V	$I_C = 100\text{ mA}, I_B = 10\text{ mA}$ $I_C = 150\text{ mA}, I_B = 15\text{ mA}$
						V	
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.0		1.1	V	$I_C = 100\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}, V_{CE} = 1.0\text{ V}$
						V	
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0		1.1	V	$I_C = 100\text{ mA}, I_B = 10\text{ V}$ $I_C = 150\text{ mA}, I_B = 15\text{ V}$
						V	
C_{cb}	Collector to Base Capacitance		25		35	pF	$V_{CB} = 10\text{ V}, I_E = 0, f = 1.0\text{ MHz}$
C_{eb}	Emitter to Base Capacitance				85	pF	$V_{EB} = 0.5\text{ V}, I_C = 0, f = 1.0\text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	2.0	15		2.0 20		$I_C = 30\text{ mA}, V_{CE} = 10\text{ V},$ $f = 20\text{ MHz}$ $I_C = 50\text{ mA}, V_{CE} = 5.0\text{ V},$ $f = 20\text{ MHz}$

SYMBOL	CHARACTERISTIC	5137		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	30		V	$I_C = 100\text{ }\mu\text{A}, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	$I_C = 100\text{ }\mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	$I_E = 10\text{ }\mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 2.0\text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100 10	nA	$V_{CB} = 20\text{ V}, I_E = 0$ $V_{CB} = 20\text{ V}, I_E = 0,$ $T_A = 65^\circ\text{ C}$
				μA	
				μA	
h_{FE}	DC Pulse Current Gain (Note 5)	20 20	400		$I_C = 150\text{ mA}, V_{CE} = 1.0\text{ V}$ $I_C = 30\text{ mA}, V_{CE} = 1.0\text{ V}$

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5137		UNITS	TEST CONDITIONS
		MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	20		V	$I_C = 1.0 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.1	V	$I_C = 150 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.1	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ V}$
C_{cb}	Collector to Base Capacitance		35	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		85	pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	2.0	20		$I_C = 50 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 20 \text{ MHz}$

- h_{FE} ... 50 (Min) @ 100 μ A & 10 mA
- V_{CEO} ... -30 V (Min)

PACKAGE

PN5138
FTSO5138

TO-92
TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55°C to 150°C
Operating Junction Temperature 150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	-30 V
V_{CBO} Collector to Base Voltage	-30 V
V_{EBO} Emitter to Base Voltage	-5.0 V

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-30		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 100 \mu A, I_C = 0$
I_{CBO}	Collector Cutoff Current		50 3.0	nA μA	$V_{CB} = -20 V, I_E = 0$ $V_{CB} = -20 V, I_E = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	50 50	800		$I_C = 100 \mu A, V_{CE} = -10 V$ $I_C = 1.0 mA, V_{CE} = -10 V$
h_{FE}	DC Pulse Current Gain (Note 5)	50			$I_C = 10 mA, V_{CE} = -10 V$
$V_{CEO(SUS)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-30		V	$I_C = 10 mA$ (pulsed), $I_B = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.3	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		-1.0	V	$I_C = 10 \text{ mA}$, $V_{CE} = -10 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.0	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
C_{cb}	Collector to Base Capacitance		7.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		30	pF	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	1.5			$I_C = 0.5 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	40	1000		$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$

FAIRCHILD

A Schlumberger Company

PN5139/FTSO5139PNP Small Signal General Purpose
Amplifier & Switch

- V_{CE0} ... -20 V (Min)
- h_{FE} ... 40 (Min) @ 10 mA
- f_T ... 300 MHz (Min)
- C_{cb} ... 5.0 pF (Max) @ -10 V

PACKAGE

PN5139

TO-92

FTSO5139

TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-20 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-20 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-20		V	$I_C = 100 \mu A, I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-20		V	$I_C = 100 \mu A, V_{EB} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 100 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current		50 25	nA μA	$V_{CE} = -15 V, V_{EB} = 0$ $V_{CE} = -15 V, V_{EB} = 0, T_A = 65^\circ C$
h_{FE}	DC Current Gain	30 40			$I_C = 100 \mu A, V_{CE} = -10 V$ $I_C = 1.0 mA, V_{CE} = -10 V$
h_{FE}	DC Pulse Current Gain (Note 5)	40 15			$I_C = 10 mA, V_{CE} = -1.0 V$ $I_C = 50 mA, V_{CE} = -10 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5139/FTSO5139

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.15	V	$I_C = 1.0 \text{ mA}$, $I_B = 0.1 \text{ mA}$
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		-0.20 -0.5	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Pulsed Base to Emitter Saturation Voltage (Note 5)	-0.7 -0.75	-1.0 -1.25	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-20		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
C_{cb}	Collector to Base Capacitance		5.0	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		8.0	pF	$V_{EB} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Small Signal Current Gain	3.0			$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 407)		50	ns	$I_C \approx 50 \text{ mA}$, $I_{B1} \approx 5.0 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 407)		200	ns	$I_C \approx 50 \text{ mA}$, $I_{B1} \approx 5.0 \text{ mA}$, $I_{B2} \approx -5.0 \text{ mA}$

FAIRCHILD

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**PN5142/FTSO5142
PN5143/FTSO5143**PNP Small Signal General Purpose
Amplifiers & Switches

- $V_{CE0} \dots 20 \text{ V @ } 10 \text{ mA}$
- $h_{FE} \dots 30 \text{ (Min) @ } 50 \text{ mA, } 15 \text{ (Min) @ } 300 \text{ mA}$
- $t_{on} \dots 100 \text{ ns (Max) @ } 300 \text{ mA, } t_{off} \dots 200 \text{ ns (Max) @ } 300 \text{ mA}$

PACKAGE

PN5142	TO-92
PN5143	TO-92
FTSO5142	TO-236AA/AB
FTSO5143	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-20 V
V_{CBO} Collector to Base Voltage	-20 V
V_{EBO} Emitter to Base Voltage	-4.0 V
I_C Collector Current	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-20		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CES}	Collector Reverse Current		50 2.0	nA μA	$V_{CE} = -12 \text{ V}, V_{BE} = 0$ $V_{CE} = -12 \text{ V}, V_{BE} = 0, T_A = 65^\circ\text{C}$
h_{FE}	DC Pulse Current Gain (Note 5)	30 15			$I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 300 \text{ mA}, V_{CE} = -10 \text{ V}$
$V_{CE0(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-20		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5142/FTSO5142
PN5143/FTSO5143

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (pulsed) (Note 5)		-0.5	V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$
			-2.0	V	$I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (pulsed) (Note 5)	-0.8	-1.5	V	$I_C = 50 \text{ mA}, I_B = 2.5 \text{ mA}$
			-2.5	V	$I_C = 300 \text{ mA}, I_B = 30 \text{ mA}$
C_{cb}	Collector to Base Capacitance		10	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{eb}	Emitter to Base Capacitance		30	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	1.0			$I_C = 50 \text{ mA}, V_{CE} = -3.0 \text{ V}, f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no. 245)		100	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx 30 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 245)		200	ns	$I_C \approx 300 \text{ mA}, I_{B1} \approx 30 \text{ mA}, I_{B2} \approx -30 \text{ mA}$

PN5770/FTSO5770

NPN Small Signal High Frequency Amplifier & Oscillator

- $P_D \dots 30 \text{ mW @ } 500 \text{ MHz}$
- $f_c \dots 800 \text{ (Min)}$

PACKAGE	
PN5770	TO-92
FTSO5770	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector-to-Emitter Voltage	15 V
(Note 4)	
V_{CBO} Collector-to-Base Voltage	30 V
V_{EBO} Emitter-to-Base Voltage	4.5 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		10 1.0	nA μA	$V_{CB} = 15 \text{ V}, I_E = 0$ $V_{CB} = 15 \text{ V}, I_E = 0,$ $T_A = 125^\circ \text{ C}$
h_{FE}	DC Current Gain (Note 5)	20 50	200		$I_C = 3.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 8.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.4	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Collector to Base Saturation Voltage		1.0	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T121.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5770/FTSO5770

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{cb}	Collector-to-Base Capacitance	0.7	1.1	pF	$V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ MHz}$
h_{fe}	Low Frequency Current Gain	40	240		$I_C = 8.0 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{fe}	High Frequency Current Gain	8.0	18		$I_C = 8.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
$r_b'C_c$	Collector Base Time Constant	3.0	20	ps	$I_E = 8.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 79.8 \text{ MHz}$
n	Collector Efficiency	25		%	$I_C = 8.0 \text{ mA}$, $V_{CB} = 15 \text{ V}$, $f = 500 \text{ MHz}$
P_o	Power Output	30		mW	$I_C = 8.0 \text{ mA}$, $V_{CB} = 15 \text{ V}$, $f = 500 \text{ MHz}$

PN5855/FTSO5855 PN5857/FTSO5857

PNP Small Signal General Purpose Transistor

- V_{CE0} ... -60 V and -80 V (Min)
- h_{FE} ... 50 (Min) from 10 mA to 500 mA

PACKAGE

PN5855	TO-92
PN5857	TO-92
FTSO5855	TO-236AA/AB
FTSO5857	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*

Voltages & Currents

(Reverse Voltage Polarity for PNP)	5855	5857
V_{CE0} Collector to Emitter Voltage	-60 V	-80 V
V_{CB0} Collector to Base Voltage	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	1.0 A	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	5855		5857		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CB0}	Collector to Base Breakdown Voltage	-60		-80		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = -4.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = -40 V, I_E = 0$ $V_{CB} = -60 V, I_E = 0$
h_{FE}	DC Current Gain (Note 4)	50	300	50	300		$I_C = 10 mA, V_{CE} = -10 V$ $I_C = 150 mA, V_{CE} = -10 V$ $I_C = 500 mA, V_{CE} = -10 V$ $I_C = 1.0 A, V_{CE} = -10 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN5855 and PN5857. These ratings give a maximum junction temperature of 135° C and junction-to-ambient thermal resistance of 150° C/W (derating factor of 6.8 mW/° C) for 2N5855 and 2N5857.
 4. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 5. For product family characteristic curves, refer to Curve Set T224.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5855/FTSO5855
PN5857/FTSO5857

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	5855		5857		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	-60		-80		V	$I_C = 10 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		-0.4		-0.4	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		-1.3		-1.3	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		15		15	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	1.0		1.0			$I_C = 50 \text{ mA}, V_{CE} = -10 \text{ V}, f = 100 \text{ MHz}$

- V_{CE0} ... 180 V (Min)
- h_{FE} ... 50-250 @ 10 mA, 50 (Min) @ 1.0 mA and 50 mA
- C_{cb} ... 4.0 pF (Max) @ 10 V
- Complements ... PN4888

PACKAGE
PN5965 TO-92
FTSO5965 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	180 V
(Notes 4 & 5)	
V_{CBO} Collector to Base Voltage	200 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C DC Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	180		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_C = 0, I_E = 10 \text{ } \mu\text{A}$
BV_{CBO}	Collector to Base Breakdown Voltage	200		V	$I_C = 100 \text{ } \mu\text{A}, I_E = 0$
I_{CBO}	Collector Cutoff Current		50 25	nA μA	$V_{CB} = 160 \text{ V}, I_E = 0$ $V_{CB} = 160 \text{ V}, I_E = 0, T_A = 100^\circ \text{ C}$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 5)	50 50 50	250		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 5.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. C_{cb} measurement employs a three terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal of the bridge.
 7. For product family characteristic curves, refer to Curve Set T147.
- * Package mounted on 99.5% alumina 8mm x 8mm x 0.6mm.

PN5965/FTSO5965

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.15 0.20 0.25	V V V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.8	V	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.8 1.0 1.0	V V V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ V}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ V}$
C_{cb}	Collector to Base Capacitance (Note 6)		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0	5.0		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Small Signal Short Circuit Input Impedance		6.0	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Small Signal Open Circuit Open Conductance		40	μmho	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$

FAIRCHILD

A Schlumberger Company

1N456/457/458/459
FDLL456/457/458/459
1N456A/457A/458A/459A
FDLL456A/457A/458A/459A
Low Leakage Diodes

- I_R ... 25 nA (MAX) @ WIV
- C ... 6.0 pf (MAX)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (From 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	1N456/A	1N457/A	1N458/A	1N459/A
WIV Working Inverse Voltage	25 V	60 V	125 V	175 V
I_O Average Rectified Current				200 mA
I_F Continuous Forward Current				500 mA
i_f Peak Repetitive Forward Current				600 mA
$i_f(\text{surge})$ Peak Forward Surge Current				
				Pulse Width = 1 μ s
				4.0 A
				Pulse Width = 1 s
				1.0 A

PACKAGES

1N456	DO-35
1N457	DO-35
1N458	DO-35
1N459	DO-35
1N456A	DO-35
1N457A	DO-35
1N458A	DO-35
1N459A	DO-35
FDLL456	LL-34
FDLL457	LL-34
FDLL458	LL-34
FDLL459	LL-34
FDLL456A	LL-34
FDLL457A	LL-34
FDLL458A	LL-34
FDLL459A	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage 1N456A/7A/8A/9A		1.0	V	$I_F = 100$ mA
		1N456	1.0	V	$I_F = 40$ mA
		1N457	1.0	V	$I_F = 20$ mA
		1N458	1.0	V	$I_F = 7$ mA
		1N459	1.0	V	$I_F = 3$ mA
I_R	Reverse Current		25	nA	$V_R = \text{Rated WIV}$
			5.0	μ A	$V_R = \text{Rated WIV}, T_A = 150^\circ\text{C}$
BV	Breakdown Voltage	1N456/A	30	V	$I_R = 100$ μ A
		1N457/A	70	V	$I_R = 100$ μ A
		1N458/A	150	V	$I_R = 100$ μ A
		1N459/A	200	V	$I_R = 100$ μ A
C	Capacitance		6.0	pF	$V_R = 0, f = 1$ MHz

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2:

1N461A/462A/463A FDLL461A/462A/463A

General Purpose High
Conductance Diodes

- $V_F \dots 1.0 \text{ V (MAX) @ } 100 \text{ mA}$
- $I_R \dots 500 \text{ nA (MAX) @ WIV}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	IN461A	IN462A	IN463A	IN464A
WIV Working Inverse Voltage	25 V	60 V	175 V	125 V
I_O Average Rectified Current	200 mA	200 mA	200 mA	200 mA
I_F Continuous Forward Current	500 mA	500 mA	500 mA	500 mA
i_f Peak Repetitive Forward Current	600 mA	600 mA	600 mA	600 mA
$i_f(\text{surge})$ Peak Forward Surge Current				
Pulse Width = 1 s	1.0 A	1.0 A	1.0 A	1.0 A
Pulse Width = 1 μ s	4.0 A	4.0 A	4.0 A	4.0 A

PACKAGES

1N461A	DO-35
1N462A	DO-35
1N463A	DO-35
FDLL461A	LL-34
FDLL462A	LL-34
FDLL463A	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1500 family.

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_f = 100 \text{ mA}$
I_R	Reverse Current		500 30	nA μ A	$V_R = \text{Rated WIV}$ $V_R = \text{Rated WIV}, T_A = 150^\circ\text{C}$
BV	Breakdown Voltage	IN461A IN462A IN463A IN464A	30 70 200 150	V V V V	$I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2.

**1N482B/483B/484B/485B
FDLL482B/483B/484B/485B**

**General Purpose Low
Leakage Diodes**

- V_F ... 1.0 V (MAX) @ 100 mA
- I_R ... 25 nA (MAX) @ WIV

PACKAGES

1N482B	DO-35
1N483B	DO-35
1N484B	DO-35
1N485B	DO-35
FDLL482B	LL-34
FDLL483B	LL-34
FDLL484B	LL-34
FDLL485B	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature (from 25°C)	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	1N482B	1N483B	1N484B	1N485B	1N486B
WIV Working Inverse Voltage	36 V	70 V	130 V	180 V	225 V
I_O Average Rectified Current					200 mA
I_F Continuous Forward Current					500 mA
i_f Peak Repetitive Forward Current					600 mA
$i_f(\text{surge})$ Peak Forward Surge Current					
Pulse Width = 1 s					1.0
Pulse Width = 1 μ s					4.0

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 100$ mA
I_R	Reverse Current	1N482B - 1N485B 1N486B	25 5.0 50 10	nA μ A nA μ A	$V_R =$ Rated WIV $V_R =$ Rated WIV, $T_A = 150^\circ\text{C}$ $V_R = 225$ V $V_R = 225$ V, $T_A = 150^\circ\text{C}$
BV	Breakdown Voltage	1N482B 1N483B 1N484B 1N485B 1N486B	40 80 150 200 250	V V V V V	$I_R = 100$ μ A $I_R = 100$ μ A $I_R = 100$ μ A $I_R = 100$ μ A $I_R = 100$ μ A

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2.

1N625/626/627/628/629 FDLL625/626/627/628/629

General Purpose Diodes

- $V_F \dots 1.5 \text{ V (MAX) @ } 4.0 \text{ mA}$
- $I_R \dots 1.0 \mu\text{A (MAX) @ WIV}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Operating Junction Temperature	175°C
Lead Temperatures	260°C

Power Dissipation (Notes 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	1N625	1N626	1N627	1N628	1N629
WIV Working Inverse Voltage	20 V	35 V	75 V	125 V	175 V
I_O Average Rectified Current	175 mA	175 mA	175 mA	175 mA	175 mA
I_F Forward Current Steady State	400 mA	400 mA	400 mA	400 mA	400 mA
$i_{f(\text{surge})}$ Peak Forward Surge Current					
Pulse Width = 1.0 s	1.0 A	1.0 A	1.0 A	1.0 A	1.0 A
Pulse Width = 1.0 μs	4.0 A	4.0 A	4.0 A	4.0 A	4.0 A

PACKAGES

1N625	DO-35
1N626	DO-35
1N627	DO-35
1N628	DO-35
1N629	DO-35
FDLL625	LL-34
FDLL626	LL-34
FDLL627	LL-34
FDLL628	LL-34
FDLL629	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDS01400 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.5	V	$I_F = 4.0 \text{ mA}$
I_R	Reverse Current		1.0 30	μA μA	$V_R = \text{rated WIV}$ $V_R = \text{rated WIV, } T_A = 100^\circ\text{C}$
BV	Breakdown Voltage	1N625 1N626 1N627 1N628 1N629	30 50 100 150 200	V V V V V	$I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$ $I_R = 100 \mu\text{A}$
t_{rr}	Reverse Recovery Time		1.0	μs	$I_f = 30 \text{ mA, } V_r = 35 \text{ V,}$ Recovery to 400 k Ω

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For product family characteristic curves, refer to Chapter 4, D1.

1N658/FDLL658

General Purpose Diodes

- BV... 120 V (MIN) @ 100 μ A
- V_F... 1.0 V (MAX) @ 100 mA

PACKAGES

1N658	DO-35
FDLL658	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Operating Junction Temperature	+175°C
Lead Temperature	+200°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	100 V
I _O	Average Rectified Current	200 mA
I _F	Forward Current Steady State	500 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1400 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V _F	Forward Voltage		1.0	V	I _F = 100 mA
I _R	Reverse Current		50 25	nA μ A	V _R = 50 V V _R = 50 V, T _A = 150°C
BV	Breakdown Voltage	120		V	I _R = 100 μ A
t _{rr}	Reverse Recovery Time		300	ns	V _R = 40 V, I _F = 5.0 mA, R _L = 2.0 k Ω , C _L = 10 pF, Recovery to 80 k Ω

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For product family characteristic curves, refer to Chapter 4, D1.

1N659/660/661 FDLL659/660/661

General Purpose Diodes

- $V_F \dots 1.0 \text{ V (MAX) @ } 6.0 \text{ mA}$
- $t_{rr} \dots 300 \text{ ns (MAX)}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-85°C to +200°C
Maximum Operating Junction Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Notes 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

	1N659	1N660	1N661
WIV Working Inverse Voltage	50 V	100 V	200 V
I_O Average Rectified Current	200 mA	200 mA	200 mA
I_F Forward Current Steady State	500 mA	500 mA	500 mA
$i_f(\text{surge})$ Peak Forward Surge Current	Pulse Width = 1.0s	1.0 A	1.0 A
	Pulse Width = 1.0 μs	4.0 A	4.0 A
		4.0 A	4.0 A

PACKAGES

1N659	DO-35
1N660	DO-35
1N661	DO-35
FDLL659	LL-34
FDLL660	LL-34
FDLL661	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	1N659		1N660		1N661		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX	MIN	MAX		
V_F	Forward Voltage		1.0		1.0		1.0	V	$I_F = 6.0 \text{ mA}$
I_R	Reverse Current		5.0		5.0		10	μA	$V_R = 50 \text{ V}$ $V_R = 100 \text{ V}$ $V_R = 200 \text{ V}$ $V_R = 50 \text{ V}, T_A = 100^\circ\text{C}$ $V_R = 100 \text{ V}, T_A = 100^\circ\text{C}$ $V_R = 200 \text{ V}, T_A = 100^\circ\text{C}$
			25		50		100	μA	
								μA	
								μA	
BV	Breakdown Voltage	60		120		240		V	$I_R = 100 \text{ μA}$
t_{rr}	Reverse Recovery Time		300		300		300	ns	$V_r = 35 \text{ V}, I_f = 30 \text{ mA}, R_L = 2.0 \text{ k}\Omega,$ $C_L = 10 \text{ pF}, \text{Recovery to } 400 \text{ k}\Omega$

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. For product family characteristic curves, refer to Chapter 4, D4 for 1N659, 4, D1 for 1N660 and 1N661.

1N746 through 1N759

500 mW Silicon Linear Diodes

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

PACKAGES

All Devices DO-35

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW / °C

ELECTRICAL CHARACTERISTICS (25°C Ambient unless otherwise noted)

SYMBOL	Z _Z	V _Z	I _R		TC
			Maximum Reverse Current (V _R = 1.0V)		
			@25°C	@150°C	
Characteristic	Maximum Zener Impedance (Note 4) (I _Z = 20 mA)	Nominal Zener Voltage (Note 3) (I _Z = 20 mA)			Typical Temperature Coefficient of V _Z
UNIT	Ω	V	μA	μA	% / °C
1N746	28.0	3.3	10.0	30.0	-0.070
1N747	24.0	3.6	10.0	30.0	-0.065
1N748	23.0	3.9	10.0	30.0	-0.060
1N749	22.0	4.3	2.0	30.0	-0.055
1N750	19.0	4.7	2.0	30.0	-0.043
1N751	17.0	5.1	1.0	20.0	±0.030
1N752	11.0	5.6	1.0	20.0	±0.028
1N753	7.0	6.2	0.1	20.0	+0.045
1N754	5.0	6.8	0.1	20.0	+0.050
1N755	6.0	7.5	0.1	20.0	+0.058
1N756	8.0	8.2	0.1	20.0	+0.062
1N757	10.0	9.1	0.1	20.0	+0.068
1N758	17.0	10.0	0.1	20.0	+0.075
1N759	30.0	12.0	0.1	20.0	+0.077

NOTES:

- These ratings are limiting values above which the serviceability of the diode may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- Type numbers without suffix have ± 10% tolerance on nominal V_Z.
Type numbers with suffix A have ± 5% tolerance on nominal V_Z.
- The Zener impedance Z_Z is derived by superimposing a 60 Hz 2 mA (RMS) signal on the 20 mA I_Z test current.
- For product family characteristic curves, refer to Chapter 4, D13.

1N/FDLL914/A/B/916/A/B
1N/FDLL4148/4149/4446
1N/FDLL4447/4448/4449
 High Conductance Ultra Fast
 Switching Diodes

- t_{rr} ... 4.0 ns (MAX)
- BV... 100 V (MIN)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65° to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C	500 mW
Linear Derating Factor (from 25°C)	3.33 mW / °C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	75 V
IO	Average Rectified Current	200 mA
I _f	DC Forward Current	300 mA
i _f	Recurrent Peak Forward Current	400 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

PACKAGES

1N914	DO-35
1N916	DO-35
1N914A	DO-35
1N914B	DO-35
1N916A	DO-35
1N916B	DO-35
1N4148	DO-35
1N4149	DO-35
1N4446	DO-35
1N4447	DO-35
1N4448	DO-35
1N4449	DO-35
FDLL914	LL-34
FDLL916	LL-34
FDLL914A	LL-34
FDLL914B	LL-34
FDLL916A	LL-34
FDLL916B	LL-34
FDLL4148	LL-34
FDLL4149	LL-34
FDLL4446	LL-34
FDLL4447	LL-34
FDLL4448	LL-34
FDLL4449	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	100 75		V V	I _R = 100 μA I _R = 5.0 μA
I _R	Reverse Current		25 50 5.0	nA μA μA	V _R = 20 V V _R = 20 V, T _A = 150°C V _R = 75 V
V _F	Forward Voltage	0.62 0.63	0.72 0.73 1.0 1.0 1.0 1.0	V V V V V V	I _F = 5.0 mA I _F = 5.0 mA I _F = 10 mA I _F = 20 mA I _F = 30 mA I _F = 100 mA
t _{rr}	Reverse Recovery Time		4.0	ns	I _F = 10 mA, V _r = 6.0 V, R _L = 100 Ω Rec. to 1.0 mA

NOTES:

1. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For family characteristic curves, refer to Chapter 4, D4.

1N/FDLL914/A/B/916/A/B
1N/FDLL4148/4149/4446
1N/FDLL4447/44448/4449

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX	UNITS	TEST CONDITIONS
C	Capacitance	1N914, 1N914A 1N914B, 1N4148 1N4446, 1N4447		4.0	pF	$V_R = 0, f = 1 \text{ MHz}$
		1N916, 1N916A 1N916B, 1N4149 1N4448, 1N4449		2.0	pF	$V_R = 0, f = 1 \text{ MHz}$
V_{fr}	Peak Forward Recovery Voltage	1N914, 1N916 1N914B, 1N916B 1N4448, 1N4449		2.5	V	50 mA Peak Square Wave, 0.1 μs pulse width, 5 kHz - 100 kHz rep. rate
RE	Rectification Efficiency	1N914A, 1N914B 1N916A, 1N916B	45		%	2.0 V rms, $f = 100 \text{ MHz}$

1N957 through 1N973

500 mW Silicon Planar
Zener Diodes

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

PACKAGES

All Devices DO-35

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

3

ELECTRICAL CHARACTERISTICS (25°C Ambient)

SYMBOL	V _Z	Z _Z	I _{ZT}	Z _{ZK}	I _{ZK}	I _R	V _{RT}			TC	I _{ZM}
	Nominal Zener Voltage (Note 3) @I _{ZT}	Maximum Zener Impedance (Note 4) @I _{ZT}	Test Current	Maximum Zener Knee Impedance (Note 4) @I _{ZK}	Test Current	Maximum Reverse Current @V _{RT}	Test Voltage			Typical Temperature Coefficient of V _Z	Maximum Zener Current (Note 5)
							±20% V _Z Tolerance	±10% V _Z Tolerance	±5% V _Z Tolerance		
UNIT	V	Ω	mA	Ω	mA	μA	V	V	V	%/°C	mA
1N957	6.8	4.5	18.5	700	1.0	150	4.4	4.9	5.2	+0.050	47
1N958	7.5	5.5	16.5	700	0.5	75	4.8	5.4	5.7	+0.058	42
1N959	8.2	6.5	15.0	700	0.5	50	5.2	5.9	6.2	+0.062	38
1N960	9.1	7.5	14.0	700	0.5	25	5.8	6.6	6.9	+0.068	35
1N961	10.0	8.5	12.5	700	0.25	10	6.4	7.2	7.6	+0.072	32
1N962	11.0	9.5	11.5	700	0.25	5.0	7.0	8.0	8.4	+0.073	28
1N963	12.0	11.5	10.5	700	0.25	5.0	7.6	8.6	9.1	+0.076	26
1N964	13.0	13.0	9.5	700	0.25	5.0	8.3	9.4	9.9	+0.079	24
1N965	15.0	16.0	8.5	700	0.25	5.0	9.6	10.8	11.4	+0.082	21
1N966	16.0	17.0	7.8	700	0.25	5.0	10.2	11.5	12.2	+0.083	19
1N967	18.0	21.0	7.0	750	0.25	5.0	11.5	13.0	13.7	+0.085	17
1N968	20.0	25.0	6.2	750	0.25	5.0	12.8	14.4	15.2	+0.086	15
1N969	22.0	29.0	5.6	750	0.25	5.0	14.0	15.8	16.7	+0.087	14
1N970	24.0	33.0	5.2	750	0.25	5.0	15.4	17.3	18.2	+0.088	13
1N971	27.0	41.0	4.6	750	0.25	5.0	17.2	19.4	20.6	+0.090	11
1N972	30.0	49.0	4.2	1000	0.25	5.0	19.2	21.6	22.8	+0.091	10
1N973	33.0	58.0	3.8	1000	0.25	5.0	21.1	23.8	25.1	±0.092	9.2

NOTES:

- These ratings are limiting values above which the serviceability of the diode may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- Type numbers without suffix have ±20% tolerance on nominal V_Z.
Type numbers with suffix A have ±10% tolerance on nominal V_Z.
Type numbers with suffix B have ±5% tolerance on nominal V_Z.
- The Zener impedances Z_Z and Z_{ZK} are derived by superimposing a 60 Hz signal on test currents I_{ZT} and I_{ZK}, having an RMS value of 10% of the d.c. value of I_{ZT} and I_{ZK} respectively.
- Maximum Zener Current (I_{ZM}) is based on the maximum Zener voltage of a 20% tolerance unit.
- For product family characteristic curves, refer to Chapter 4, D13.

FAIRCHILD

A Schlumberger Company

**1N3064/4305/4454
FDLL3064/4305/4454**Ultra Fast Low
Capacitance Diodes

- C... 2.0 pF @ $V_R = 0$, $f = 1.0$ MHz
- t_{rr} ... 4.0 ns @ $I_f = 10$ mA, $I_r = 10$ mA, $V_r = 1.0$ V
- BV... 75 V (MIN)

PACKAGES

1N3064	DO-35
1N4305	DO-35
1N4454	DO-35
FDLL3064	LL-34
FDLL4305	LL-34
FDLL4454	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltages and Currents

WIV	Working Inverse Voltage	50 V
I_O	Average Rectified Current	100 mA
I_F	Forward Current Steady State	300 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	0.610	0.710	V	$I_F = 2.0$ mA $I_F = 1.0$ mA $I_F = 250$ μ A $I_F = 10$ mA $I_F = 10$ mA
		0.550	0.650	V	
		0.505	0.575	V	
		1N3064 } 1N4454 } 1N4305 }	1.0	V	
		0.70	0.85	V	
I_R	Reverse Current		0.1 100	μ A μ A	$V_R = 50$ V $V_R = 50$ V, $T_A = 150^\circ$ C
BV	Breakdown Voltage	75		V	$I_R = 5.0$ μ A
t_{rr}	Reverse Recovery Time (Note 3)	1N4305	2.0	ns	$I_f = 10$ mA, $V_r = 6.0$ V, $R_L = 100$ Ω $I_f = I_r = 10$ mA, $R_L = 100$ Ω , $V_r = 1.0$ V
		1N3064 } 1N4305 } 1N4454 }	4.0	ns	
C	Capacitance		2.0	pF	$V_R = 0$, $f = 1.0$ MHz
RE	Rectification Efficiency (Note 4)	45		%	$f = 1.0$ MHz
$\Delta V_F / ^\circ$ C	Forward Voltage Temperature Coefficient (Note 5)		3.0	mV/°C	

NOTES:

- The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- Recovery to 1.0 mA.
- Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5.0 Ω , load capacitance 20 pF.
- This value for $\Delta V_F / ^\circ$ C is a typical value not a minimum or maximum.
- For product family characteristic curves, refer to Chapter 4, D4.

**1N3070/4938
FDLL3070/4938**

**High Speed High
Conductance Diodes**

- BV ... 200 V (MIN)
- IR ... 100 nA (MAX)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	175 V
IO	Average Rectified Current	200 mA
IF	Forward Current Steady State DC	500 mA
if	Recurrent Peak Forward Current	600 mA
if (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

PACKAGES

1N3070	DO-35
1N4938	DO-35
FDLL3070	LL-34
FDLL4938	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1400 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
IR	Reverse Current		100 100	nA μA	VR = 175 V VR = 175 V, TA = 150°C
BV	Breakdown Voltage	200		V	IR = 100 μA
VF	Forward Voltage		1.0	V	IF = 100 mA
C	Capacitance		5.0	pF	VR = 0, f = 1.0 MHz
trr	Reverse Recovery Time (Note 3)		50	ns	IF = IR = 30 mA, RL = 100Ω
RE	Rectification Efficiency (Note 4)	35		%	f = 100 MHz

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 1.0 mA.
4. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance: 5.0 kΩ, load capacitance 20 pF.
5. 1N3070 and 1N4938 are electrically and mechanically identical.
6. For product family characteristic curves, refer to Chapter 4, D1.

1N3595/6099
FDLL3595/6099
 High Conductance Low
 Leakage Diodes

- $V_B \dots 150 \text{ V (MIN) @ } 100 \mu\text{A}$
- $V_F \dots 1.0 \text{ V @ } 200 \text{ mA}$

PACKAGES

1N3595	DO-35
1N6099	DO-35
FDLL3595	LL-34
FDLL6099	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (From 25°C)	3.33 mW / °C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	125 V
I_O	Average Rectified Current	200 mA
I_F	Forward Current Steady State	500 mA
i_f	Peak Repetitive Forward Current	600 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	0.83	1.0	V	$I_F = 200 \text{ mA}$
		0.79	0.92	V	$I_F = 100 \text{ mA}$
		0.75	0.88	V	$I_F = 50 \text{ mA}$
		0.65	0.80	V	$I_F = 10 \text{ mA}$
		0.60	0.75	V	$I_F = 5.0 \text{ mA}$
		0.52	0.68	V	$I_F = 1.0 \text{ mA}$
I_R	Reverse Current		1.0	nA	$V_R = 125 \text{ V}$
			300	nA	$V_R = 30 \text{ V, } T_A = 125^\circ\text{C}$
			500	nA	$V_R = 125 \text{ V, } T_A = 125^\circ\text{C}$
			3.0	μA	$V_R = 125 \text{ V, } T_A = 150^\circ\text{C}$
t_{rr}	Reverse Recovery Time		3.0	μs	$I_F = 10 \text{ mA, } V_R = 3.5 \text{ V, } R_L = 1.0 \text{ k}\Omega$
C	Capacitance		8.0	pF	$V_R = 0, f = 1.0 \text{ MHz}$
BV	Breakdown Voltage	150		V	$I_R = 100 \mu\text{A}$

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. 1N3595 and 1N6099 are electrically and mechanically identical.
4. For product family characteristic curves, refer to Chapter 4, D2.

1N3600/FDLL3600 1N4150/FDLL4150 1N4450/FDLL4450

High Conductance Ultra Fast Diodes

- t_{rr} ... 4.0 ns (MAX)
- V_F ... 1.0 V (MAX) @ 200 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Max Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Max Total Power Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltages and Currents

	1N3600	1N4150	1N4450
WIV Working Inverse Voltage	50 V	50 V	30 V
I_O Average Rectified Current	200 mA	200 mA	200 mA
I_F DC Forward Current	400 mA	400 mA	400 mA
i_f Recurrent Peak Forward Current	600 mA	600 mA	600 mA
$i_f(\text{surge})$ Peak Forward Surge Current			
Pulse Width = 1.0 s	1.0 A	1.0 A	1.0 A
Pulse Width = 1.0 μ s	4.0 A	4.0 A	4.0 A

PACKAGES

1N3600	DO-35
1N4150	DO-35
1N4450	DO-35
FDLL3600	LL-34
FDLL4150	LL-34
FDLL4450	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	1N3600 1N4150		1N4450		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV	Breakdown Voltage	75		40		V V	$I_R = 5.0 \mu A$ $I_R = 5.0 \mu A$
I_R	Reverse Current		100		50	nA nA μA μA	$V_R = 50 V$ $V_R = 30 V$ $V_R = 50 V, T_A = 150^\circ C$ $V_R = 30 V, T_A = 150^\circ C$
V_F	Forward Voltage	0.54 0.66 0.76 0.82 0.87	0.62 0.74 0.86 0.92 1.0	0.42 0.52 0.64 0.80	0.54 0.64 0.76 0.92 1.0	V V V V V	$I_F = 0.1 mA$ $I_F = 1.0 mA$ $I_F = 10 mA$ $I_F = 50 mA$ $I_F = 100 mA$ $I_F = 200 mA$
C	Capacitance		2.5		4.0	pF	$V_R = 0, f = 1.0 MHz$
t_{rr}	Reverse Recovery Time (Note 3)		4.0 6.0		4.0	ns ns ns	$I_f = I_r = 10 mA$ to 200 mA, $R_L = 100 \Omega$ $I_f = I_r = 10 mA, R_L = 100 \Omega$ $I_f = I_r = 200 mA$ to 400 mA, $R_L = 100 \Omega$
t_{fr}	Forward Recovery Time		10			ns	$I_f = 200 mA, t_r = 0.4 ns,$ $V_{fr} = 1.0 V$

NOTES:

1. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 0.1 I_f .
4. For family characteristic curves, refer to Chapter 4, D4.

- t_{rr} ... 2 ns (MAX)
- BV... 35 V (MIN) @ 5 μ A

PACKAGES

1N4009	DO-35
FDLL4009	LL-34

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor	3.33 mW/°C

Maximum Voltage and Current

WIV	Working Inverse Voltage	25 V
I_O	Average Rectified Current	100 mA
I_F	Continuous Forward Current	300 mA
i_f	Peak Repetitive Forward Current	400 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1 s	1.0 A
	Pulse Width = 1 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 30$ mA
I_R	Reverse Current		0.1 100	μ A μ A	$V_R = 25$ V $V_R = 25$ V, $T_A = 150^\circ$ C
BV	Breakdown Voltage	35		V	$I_R = 5.0$ μ A
t_{rr}	Reverse Recovery Time		4.0 2.0	ns ns	$I_f = I_r = 10$ mA (Note 3) $I_f = 10$ mA, $V_r = 6.0$ V, $R_L = 100$ Ω
C	Capacitance		4.0	pF	$V_R = 0, f = 1.0$ MHz

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 1.0 mA.
4. For product family characteristic curves, refer to Chapter 4, D4



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1N/FDLL4151/4152 1N/FDLL4153/4154

High Speed Diodes

- C...4 pF (MAX)
- t_{rr} ...2 nS (MAX) @ 10 mA, -6 V, 100 Ω .

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	1N4151 50 V	1N4153 50 V
		1N4152 30 V	1N4154 25 V
I_O	Average Rectified Current		100 mA
I_F	Continuous Forward Current		300 mA
i_f	Peak Repetitive Forward Current		400 mA
i_f (surge)	Peak Forward Surge Current		
	Pulse Width = 1 s		1.0 A
	Pulse Width = 1 μ s		4.0 A

PACKAGES

1N4151	DO-35
1N4152	DO-35
1N4153	DO-35
1N4154	DO-35
FDLL4151	LL-34
FDLL4152	LL-34
FDLL4153	LL-34
FDLL4154	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1200 family.

3

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS	
V_F	Forward Voltage	1N4154	1.0	V	$I_F = 30$ mA	
		1N4151	1.0	V	$I_F = 50$ mA	
		1N4152 & 1N4153	0.49	0.55	V	$I_F = 0.1$ mA
			0.53	0.59	V	$I_F = 0.25$ mA
			0.59	0.67	V	$I_F = 1.0$ mA
			0.62	0.70	V	$I_F = 2.0$ mA
			0.70	0.81	V	$I_F = 10$ mA
	0.74	0.88	V	$I_F = 20$ mA		
I_R	Reverse Current	1N4154	0.1	μ A	$V_R = 25$ V	
		1N4153 } 1N4151 }	100	μ A	$V_R = 25$ V, $T_A = 150^\circ$ C	
			0.05	μ A	$V_R = 50$ V	
		1N4152	50	μ A	$V_R = 50$ V, $T_A = 150^\circ$ C	
			0.05	μ A	$V_R = 30$ V	
		50	μ A	$V_R = 30$ V, $T_A = 150^\circ$ C		
B_V	Breakdown Voltage	1N4154	35	V	$I_R = 5.0$ μ A	
		1N4153 } 1N4151 }	75	V	$I_R = 5.0$ μ A	
		1N4152	40	V	$I_R = 5.0$ μ A	
t_{rr}	Reverse Recovery Time		4.0	ns	$I_f = 10$ mA, $I_r = 10$ mA (Note 3)	
			2.0	ns	$I_f = 10$ mA, $V_r = -6.0$ V, $R_L = 100 \Omega$	
C	Capacitance		4.0	pF	$V_R = 0$, $f = 1.0$ MHz	

NOTES:

1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
3. Recovery to 1.0 mA.
4. For product family characteristic curves, refer to Chapter 4, D4.

The 1N4306 and 1N4307 are JAN assemblies of two and four glass diodes respectively. They feature tightly matched forward voltages over broad current and temperature ranges.

PACKAGES

1N4306	DO-7
1N4307	DO-8

- ΔV_F ... 10 mV (MAX)
- C... 2.0 pF (MAX)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +150°C
Maximum Junction Operating Temperature	+150°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	
Each Diode	250 mW

Linear Derating Factor (from 25°C)	
Each Diode	2.0 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	50 V
I _O	Average Rectified Current	200 mA
I _F	Continuous Forward Current	300 mA
i _f	Recurrent Peak Forward Current	600 mA
i _f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μs	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	75		V	I _R = 5.0 mA
I _R	Reverse Current		50	nA	V _R = 50 V
			50	nA	V _R = 50 V, T _A = 150°C
V _F	Forward Voltage	0.75	1.00	V	I _F = 50 mA
		0.67	0.81	V	I _F = 10 mA
		0.56	0.67	V	I _F = 1.0 mA
		0.44	0.55	V	I _F = 100 μA
C	Capacitance		2.0	pF	V _R = 0, f = 1 MHz
t _{rr}	Reverse Recovery Time		4.0	ns	I _F = I _r = 10 mA, R _L = 100Ω Recovery to 1 mA
ΔV _F	Forward Voltage Match (Note 4)		10	mV	I _F = 0.1 to 10 mA T _A = -55°C to +125°C
			20	mV	I _F = 10 to 50 mA T _A = -55°C to +125°C

NOTES:

1. These are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D4.
4. For test circuits, refer to Chapter 4, D18.

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGES

All Devices

DO-41

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+200°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 50°C Ambient	1 W
Linear Power Derating Factor (from 50°C)	6.67 mW/°C
Maximum Surge Power (Note 8)	10 W

3

ELECTRICAL CHARACTERISTICS (25°C Ambient)

SYMBOL	V _Z	Z _Z	I _{ZT}	Z _{ZK}	I _{ZK}	I _R	V _{RT}	I _{ZM}	i _Z (surge)
Characteristic	Nominal Zener Voltage (Note 4) @I _{ZT}	Maximum Zener Impedance (Note 5) @I _{ZT}	Test Current	Maximum Zener Knee Impedance (Note 5) @I _{ZK}	Test Current	Maximum Reverse Current @V _{RT}	Test Voltage	Maximum Zener Current (Note 6)	Maximum Zener Surge Current (Note 3)
UNIT	V	Ω	mA	Ω	mA	μA	V	mA	mA
1N4728	3.3	10.0	76.0	400	1.0	100	1.0	276	1380
1N4729	3.6	10.0	69.0	400	1.0	100	1.0	252	1260
1N4730	3.9	9.0	64.0	400	1.0	50	1.0	234	1190
1N4731	4.3	9.0	58.0	400	1.0	10	1.0	217	1070
1N4732	4.7	8.0	53.0	500	1.0	10	1.0	193	970
1N4733	5.1	7.0	49.0	550	1.0	10	1.0	178	890
1N4734	5.6	5.0	45.0	600	1.0	10	2.0	162	810
1N4735	6.2	2.0	41.0	700	1.0	10	3.0	146	730
1N4736	6.8	3.5	37.0	700	1.0	10	4.0	133	660
1N4737	7.5	4.0	34.0	700	0.5	10	5.0	121	605
1N4738	8.2	4.5	31.0	700	0.5	10	6.0	110	550
1N4739	9.1	5.0	28.0	700	0.5	10	7.0	100	500
1N4740	10.0	7.0	25.0	700	0.25	10	7.6	91	454

NOTES:

- These ratings are limiting values above which the serviceability of the diode may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- Non-recurrent square wave, PW = 8.3 ms, superimposed on Zener test current, I_{ZT}.
- Type numbers without suffix have ± 10% tolerance on nominal V_Z. Type numbers with suffix A have ± 5% tolerance on nominal V_Z.
- The Zener impedances Z_Z and Z_{ZK} are derived by superimposing a 60 Hz signal on test currents I_{ZT} and I_{ZK}, having an RMS value of 10% of the d.c. value of I_{ZT} and I_{ZK} respectively.
- Maximum Zener Current (I_{ZM}) is based on the maximum Zener voltage of a 10% tolerance unit.
- V_F = 1.2 V (max) @ I_F = 200 mA for all types. Non-recurrent square wave, PW = 8.3 ms, T_A = 55°C.
- Non-recurrent square wave, PW = 8.3 ms, T_A = 55°C
- For product family characteristic curves, refer to Chapter 4, D14.

1N4728 through 1N4752

ELECTRICAL CHARACTERISTICS (25°C Ambient)

SYMBOL	V _Z	Z _Z	I _{ZT}	Z _{ZK}	I _{ZK}	I _R	V _{RT}	I _{ZM}	i _z (surge)
Characteristic	Nominal Zener Voltage (Note 4) @I _{ZT}	Maximum Zener Impedance (Note 5) @I _{ZT}	Test Current	Maximum Zener Knee Impedance (Note 5) @I _{ZK}	Test Current	Maximum Reverse Current @V _{RT}	Test Voltage	Maximum Zener Current (Note 6)	Maximum Zener Surge Current (Note 3)
UNIT	V	Ω	mA	Ω	mA	μA	V	mA	mA
1N4741	11.0	8.0	23.0	700	0.25	5.0	8.4	83	414
1N4742	12.0	9.0	21.0	700	0.25	5.0	9.1	76	380
1N4743	13.0	10.0	19.0	700	0.25	5.0	9.9	69	344
1N4744	15.0	14.0	17.0	700	0.25	5.0	11.4	61	304
1N4745	16.0	16.0	15.5	700	0.25	5.0	12.2	57	285
1N4746	18.0	20.0	14.0	750	0.25	5.0	13.7	50	250
1N4747	20.0	22.0	12.5	750	0.25	5.0	15.2	45	225
1N4748	22.0	23.0	11.5	750	0.25	5.0	16.7	41	205
1N4749	24.0	25.0	10.5	750	0.25	5.0	18.2	38	190
1N4750	27.0	35.0	9.5	750	0.25	5.0	20.6	34	170
1N4751	30.0	40.0	8.5	1000	0.25	5.0	22.8	30	150
1N4752	33.0	45.0	7.5	1000	0.25	5.0	25.1	27	135

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+200°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 75°C Ambient	500 mW
Linear Power Derating Factor (from 75°C)	4.0 mW / °C
Maximum Surge Power (Note 3)	10 W

PACKAGES

All Devices DO-35

3

ELECTRICAL CHARACTERISTICS (25°C Ambient unless otherwise noted)

SYMBOL	V _Z		Z _Z	I _{ZT}	Z _{ZK}	I _R		V _{RT}		TC
	Nominal Zener Voltage (Note 4) @I _{ZT}	Maximum Zener Impedance (Note 5) @I _{ZT}	Test Current	Maximum Zener Knee Impedance (Note 5) @ I _{ZK} = 0.25 mA	Maximum Reverse Current @ V _{RT}		Test Voltage		Maximum Temperature Coefficient of V _Z (Note 6)	
					±20% V _Z Tolerance	±10, 5, 2, 1% V _Z Tolerance	±20, 10% V _Z Tolerance	±5, 2, 1% V _Z Tolerance		
UNIT	V	Ω	mA	Ω	μA	μA	V	V	% / °C	
1N5226	3.3	28	20	1600	100	25	0.95	1.0	-0.070	
1N5227	3.6	24	20	1700	100	15	0.95	1.0	-0.065	
1N5228	3.9	23	20	1900	75	10	0.95	1.0	-0.060	
1N5229	4.3	22	20	2000	50	5.0	0.95	1.0	±0.055	
1N5230	4.7	19	20	1900	50	5.0	1.9	2.0	±0.030	
1N5231	5.1	17	20	1600	50	5.0	1.9	2.0	±0.030	
1N5232	5.6	11	20	1600	50	5.0	2.9	3.0	+0.038	
1N5233	6.0	7.0	20	1600	50	5.0	3.3	3.5	+0.038	
1N5234	6.2	7.0	20	1000	50	5.0	3.8	4.0	+0.045	
1N5235	6.8	5.0	20	750	30	3.0	4.8	5.0	+0.050	
1N5236	7.5	6.0	20	500	30	3.0	5.7	6.0	+0.058	
1N5237	8.2	8.0	20	500	30	3.0	6.2	6.5	+0.062	
1N5238	8.7	8.0	20	600	30	3.0	6.2	6.5	+0.065	
1N5239	9.1	10	20	600	30	3.0	6.7	7.0	+0.068	
1N5240	10.0	17	20	600	30	3.0	7.6	8.0	+0.075	
1N5241	11.0	22	20	600	30	2.0	8.0	8.4	+0.076	

NOTES:

- These ratings are limiting values above which the serviceability of the diode may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
- Non-recurrent square wave, PW = 8.3 ms, T_A = 55°C.
- Type numbers without suffix have ±20% tolerance on nominal V_Z.
Type numbers with suffix A have ±10% tolerance on nominal V_Z.
Type numbers with suffix B have ±5% tolerance on nominal V_Z.
Type numbers with suffix C have ±2% tolerance on nominal V_Z.
Type numbers with suffix D have ±1% tolerance on nominal V_Z.
- The Zener impedances Z_Z and Z_{ZK} are derived by superimposing a 60 Hz signal on test currents I_{ZT} and I_{ZK}, having an RMS value of 10% of the d.c. value of I_{ZT} and I_{ZK} respectively.
- Maximum temperature coefficients apply to 10, 5, 2 and 1% tolerance types only and are measured under the following conditions:
1N5226A, B, C, D through 1N5242A, B, C, D: I_Z = 7.5 mA, T₁ = 25°C, T₂ = 125°C.
1N5242A, B, C, D through 1N5257A, B, C, D: I_Z = I_{ZT}, T₁ = 25°C, T₂ = 125°C.
- V_F = 1.1V (maximum) @ I_F = 200 mA for all types.
- For product family characteristic curves, refer to Chapter 4, D13.

1N5226 through 1N5257

ELECTRICAL CHARACTERISTICS (25°C Ambient unless otherwise noted)

SYMBOL	V _Z	Z _Z	I _{ZT}	Z _{ZK}	I _R		V _{RT}		TC	
	Nominal Zener Voltage (Note 4) @I _{ZT}	Maximum Zener Impedance (Note 5) @I _{ZT}	Test Current	Maximum Zener Knee Impedance (Note 5) @ I _{ZK} = 0.25 mA	Maximum Reverse Current @ V _{RT}		Test Voltage			Maximum Temperature Coefficient of V _Z (Note 6)
					± 20% V _Z Tolerance	± 10, 5, 2, 1% V _Z Tolerance	± 20, 10% V _Z Tolerance	± 5, 2, 1% V _Z Tolerance		
UNIT	V	Ω	mA	Ω	μA	μA	V	V	% / °C	
1N5242	12.0	30	20	600	10	1.0	8.7	9.1	+0.077	
1N5243	13.0	13	9.5	600	10	0.5	9.4	9.9	+0.079	
1N5244	14.0	15	9.0	600	10	0.1	9.5	10.0	+0.082	
1N5245	15.0	16	8.5	600	10	0.1	10.5	11.0	+0.082	
1N5246	16.0	17	7.8	600	10	0.1	11.4	12.0	+0.083	
1N5247	17.0	19	7.4	600	10	0.1	12.4	13.0	+0.084	
1N5248	18.0	21	7.0	600	10	0.1	13.3	14.0	+0.085	
1N5249	19.0	23	6.6	600	10	0.1	13.3	14.0	+0.086	
1N5250	20.0	25	6.2	600	10	0.1	14.3	15.0	+0.086	
1N5251	22.0	29	5.6	600	10	0.1	16.2	17.0	+0.087	
1N5252	24.0	33	5.2	600	10	0.1	17.1	18.0	+0.088	
1N5253	25.0	35	5.0	600	10	0.1	18.1	19.0	+0.089	
1N5254	27.0	41	4.6	600	10	0.1	20.0	21.0	+0.090	
1N5255	28.0	44	4.5	600	10	0.1	20.0	21.0	+0.091	
1N5256	30.0	49	4.2	600	10	0.1	22.0	23.0	+0.091	
1N5257	33.0	58	3.8	700	10	0.1	24.0	25.0	+0.092	

- BV... 80 V (MIN) @ 5.0 μ A
- C... 2.5 pF @ $V_R = 0$ V, $f = 1.0$ MHz
- t_{rr} ... 4.0 ns @ $I_f = I_r = 10$ mA to 200 mA

PACKAGES

1N5282

DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25° Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	55 V
I_O	Average Rectified Current	200 mA
I_F	Continuous Forward Current	300 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1.0 s	1.0 A
	Pulse Width = 1.0 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.05	1.30	V	$I_F = 500$ mA
		0.92	1.10	V	$I_F = 300$ mA
		0.80	0.90	V	$I_F = 100$ mA
		0.67	0.725	V	$I_F = 10$ mA
		0.55	0.60	V	$I_F = 1.0$ mA
		0.45	0.49	V	$I_F = 0.1$ mA
I_R	Reverse Current		100	nA	$V_R = 55$ V
			100	μ A	$V_R = 55$ V, $T_A = 150^\circ$ C
BV	Breakdown Voltage	80		V	$I_R = 5.0$ μ A
t_{rr}	Reverse Recovery Time (Note 3)		4.0	ns	$I_f = I_r = 10$ mA to 200 mA $R_L = 100$ Ω
t_{rr}	Reverse Recovery Time		2.0	ns	$I_f = 10$ mA, $V_R = 6.0$ V
t_{fr}	Forward Recovery Time		10	ns	$I_f = 200$ mA (Note 4)
V_{pk}	Peak Forward Voltage		2.0	V	$I_f = 500$ mA (Note 5)
C	Capacitance		2.5	pF	$V_R = 0$, $f = 1.0$ MHz

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. Recovery to 0.1 I_r .
4. $t_r = 0.4$ ns, $V_R = 1.0$ V, pulse width = 100 ns; duty cycle $\leq 1\%$.
5. $t_f = 8.0$ ns, pulse width = 1.0 μ s; duty cycle $\leq 1\%$.
6. For product family characteristics curves, refer to Chapter 4, D4.

FAIRCHILD

A Schlumberger Company

1N5768/1N5770/1N5772 1N5774/FASO5768/FASO5770 FASO5772/FASO5774

Monolithic Air Isolated Diode Arrays

- BV... 60 V @ 10 μ A
- I_R... 100 nA @ 40 V
- V_R... 1 V @ 100 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature Range	-65°C to +200°C
Junction Operating Temperature Range	-65°C to +200°C

Maximum Power Dissipation

Maximum Total Dissipation at T _A = 25°C	500 mW
Linear Derating Factor	4.0 mW/°C above 25°C

Maximum Currents

I _O	Average Rectified Current (each diode)	300 mA
	Linear Derating Factor	2.4 mA/°C above 25°C
I _{FSM}	Peak Forward Surge Current Pulse Width = 8.3 ms	500 mA

For SOIC power dissipation, consult factory.

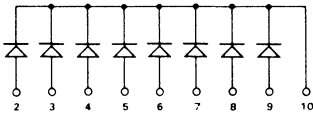
ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	60		V	I _R = 10 μ A, Pulse Width = 100 μ s, Duty Cycle \leq 20%
V _F	Forward Voltage		1.0 1.5	V V	I _F = 100 mA I _F = 500 mA, Pulse Width = 300 ns, Duty Cycle = 2%
V _{FX}	Forward Voltage		1.0	V	I _F = 25 mA; I _F = 25 mA for each of the other Diodes in the Test Section (Note 3)
V _{FM}	Peak Forward Voltage		5.0	V	I _F = 500 mA, Pulse Width = 150 ns, Duty Cycle \leq 2%
I _R	Reverse Current		100 50	nA μ A	V _R = 40 V V _R = 40 V, T _A = +150°C
I _{RX}	Reverse Current		10	μ A	V _R = 40 V, I _F = 25 mA for each of the other Diodes in the Test Section (Note 3)
I _{Ri}	Isolation Current 1N5772, 1N5774		0.8	μ A	V _R = 40 V (Note 4)
C	Pin-to-Pin Capacitance (Note 2) 1N5768 1N5770, 1N5772, 1N5774		4.0 8.0	pF pF	V _R = 0 V, f = 1.0 MHz V _R = 0 V, f = 1.0 MHz
t _{fr}	Forward Recovery Time (Note 5)		40	ns	I _F = 500 mA, R _S = 10 Ω , V _{fr} = 1.8 V, t _r = 15 ns Max
t _{rr}	Reverse Recovery Time (Note 5)		20	ns	I _F = 200 mA, I _r = 200 mA, R _L = 100 Ω , I _{rr} = 20 mA

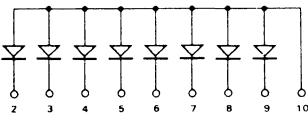
- NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
 2. This parameter is the total pin-to-pin capacitance measured across each diode. This does not necessarily represent actual diode capacitance since other diode interconnections can contribute additional capacitance.
 3. Each common anode section and/or common cathode section tested separately.
 4. The isolation current shall be measured between any two interconnect pins of adjacent parallel sets of diodes with all other pins open circuited.
 5. For Product Family characteristic curves and Test Circuits, refer to Chapter 4, D15.

**1N5768/1N5770/1N5772
1N5774/FASO5768/FASO5770
FASO5772/FASO5774**

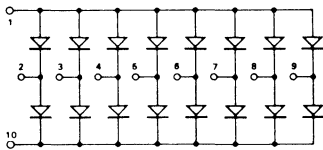
Connection Diagrams



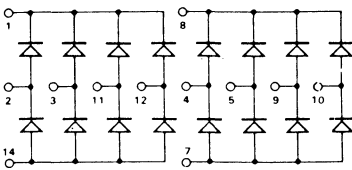
1N5768 FASO5768



1N5770 FASO5770



1N5771 FASO5772



1N5774 FASO5774

1N6100/1N6101

FASO6101

Monolithic Air Isolated Diode Arrays

- C... 3.0 pF (MAX)
- ΔV_F ... 10 mV (MAX) @ 10 μ A

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range
Maximum Junction Operating Temperature
Lead Temperature

-55°C to +200°C
+175°C
+260°C

Power Dissipation (Note 2)

Maximum Dissipation per Junction at 25°C Ambient
Maximum Dissipation per Package at 25°C Ambient
Linear Derating Factor (from 25°C) Junction
Package

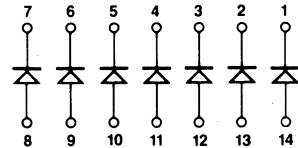
400 mW
600 mW
2.67 mW/°C
4.0 mW/°C

Maximum Voltage and Currents

WIV Working Inverse Voltage 65 V
 I_F Continuous Forward Current 350 mA
 i_f (surge) Peak Forward Surge Current
Pulse Width = 1.0 s 1.0 A
Pulse Width = 1.0 μ s 2.0 A

For SOIC power dissipation, consult factory.

Connection Diagrams



PACKAGES

1N6100	TO-86
1N6101	TO-116-2
FASO6101	14-SOIC

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	75		V	$I_R = 5.0 \mu$ A
I_R	Reverse Current (Note 4)		25 50	nA μ A	$V_R = 20$ V $V_R = 20$ V, $T_A = 150^\circ$ C
V_F	Forward Voltage (Note 3)		1.0	V	$I_F = 100$ mA
V_{FM}	Peak Forward Voltage		5.0	V	$I_F = 100 \mu$ A, PW = 100 ns Duty Cycle $\leq 2\%$
I_{RX}	Reverse Current (Note 5)		10	μ A	$V_R = 40$ V
V_{FX}	Forward Voltage (Note 5)		1.0	V	$I_F = 25$ mA
C	Capacitance		3.0	pF	$V_R = 0$, $f = 1$ MHz
t_{fr}	Forward Recovery Time (Note 6)		15	ns	$I_f = 100$ mA, $R_S = 50 \Omega$ $V_{fr} = 1.1$ V, $t_r \leq 10$ ns
t_{rr}	Reverse Recovery Time (Note 6)		5.0	ns	$I_f = I_r = 10$ mA $I_{rr} = 1.0$ mA, $R_L = 100 \Omega$
ΔV_F	Forward Voltage Match (Note 6)		10	mV	$I_F = 10$ mA

NOTES:

1. These ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. V_F is measured using an 8 ms pulse.
4. See Test circuits (Note 6) for measurement of reverse current of an individual diode.
5. $I_F = 25$ mA for each of the other diodes in the array.
6. For product family characteristic curves and test circuits, refer to Chapter 4, D15.

- BV... 50 V (MIN) @ 100 μ A
- t_{rr} ... 8.0 ns (MAX)

PACKAGES
1S44 DO-35

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

WIV	Working Inverse Voltage	40 V
I_O	Average Rectified Current	100 mA
I_F	Continuous Forward Current	300 mA
i_f	Peak Repetitive Forward Current	400 mA
i_f (surge)	Peak Forward Surge Current	
	Pulse Width = 1 s	1.0 A
	Pulse Width = 1 μ s	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	0.65	1.00	V	$I_F = 10$ mA
		0.70	1.20	V	$I_F = 30$ mA
I_R	Reverse Current		50	nA	$V_R = 10$ V
BV	Breakdown Voltage	50		V	$I_R = 100$ μ A
C	Capacitance		4.0	pF	$V_R = 0$, $f = 1$ MHz
Q_s	Stored Charge		120	pC	$I_F = 10$ mA, $V_R = 10$ V
t_{rr}	Reverse Recovery Time		8.0	ns	$I_f = I_r = 10$ mA Recovery to 1 mA

NOTES:

1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D4

1S920/921/922/923
FDLL920/921/922/923

General Purpose Diodes

- V_F ... 1.2 (MAX) @ 200 mA
- I_R ... 100 nA (MAX) @ RATED WIV

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	-65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Dissipation at 25°C Ambient	500 mW
Linear Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents

		1S920	1S921	1S922	1S923
WIV	Working Inverse Voltage (-65°C to +100°C)	50 V	100 V	150 V	200 V
I_O	Average Forward Current	200 mA	200 mA	200 mA	200 mA
i_f	Recurrent Peak Forward Current	600 mA	600 mA	600 mA	600 mA
I_f (surge)	Peak Forward Surge Current				
	Pulse Width = 1 s	1.0 A	1.0 A	1.0 A	1.0 A
	Pulse Width = 1 μ s	4.0 A	4.0 A	4.0 A	4.0 A

PACKAGES

1S920	DO-35
1S921	DO-35
1S922	DO-35
1S923	DO-35
FDLL920	LL-34
FDLL921	LL-34
FDLL922	LL-34
FDLL923	LL-34

If you need this device in the SOT package, an electrical equivalent is available. See FDSO1400 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Inverse Current		100 10	nA μ A	V_R = rated WIV V_R = rated WIV, T_A = 100°C
V_F	Forward Voltage		1.2	V	I_F = 200 mA
C	Capacitance		6.5	pF	V_R = 0, f = 1 MHz
Q_S	Stored Charge		12	nC	I_F = 10 mA, V_R = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D1.

These transistors are designed for high-performance amplifier, oscillator and some switching applications. They perform at frequencies from dc to VHF and over more than 3 decades of current. Superior replacements offering PLANAR reliability and performance are available as the 2N1613, 2N1711 and 2N718A.

PACKAGE

2N697

TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -65° C to 200° C
 Operating Junction Temperature 175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.8 W
 25° C Case Temperature 3.0 W

Voltages & Currents

V_{CB0} Collector to Base Voltage 60 V
 V_{CER} Collector to Emitter Voltage 40 V
 (R_{BE} ≤ 10 Ω) (Note 4)
 V_{EBO} Emitter to Base Voltage 5.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I _{CBO}	Collector Cutoff Current		1.0 100	μA μA	V _{CB} = 30 V, I _E = 0 V _{CB} = 30 V, I _E = 0 T _A = 150° C
h _{FE}	DC Current Gain (Note 5)	40	120		I _C = 150 mA, V _{CE} = 10 V
h _{fe}	High Frequency Current Gain	2.5			I _C = 50 mA, V _{CE} = 10 V, f = 20 mc
V _{CE(sat)}	Collector to Emitter Saturation Voltage		1.5	V	I _C = 150 mA, I _B = 15 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage		1.3	V	I _C = 150 mA, I _B = 15 mA
C _{ob}	Output Capacitance		35	pF	V _{CB} = 10 V, I _E = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175° C and junction-to-case thermal resistance of 75° C/W (derating factor of 13.3 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T145.

**2N/MPS/FTSO706
MPS/FTSO706A**

NPN High Speed Logic Switches

- V_{CER} ... 20 V (Min) @ 10 mA
- h_{FE} ... 20 (Min) @ 10 mA
- τ_s ... 60 ns (Max) 2N/MPS/FTSO706), 25 ns (Max) (MPS/FTSO706A)
- Complements ... MPS3640 (TO-92)

PACKAGE

2N706	TO-118A
MPS706	TO-92
MPS706A	TO-92
FTSO706	TO-236AA/AB
FTSO706A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	MPS/FTSO
Storage Temperature	-65° C to 175° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	MPS	FTSO
25° C Ambient Temperature	0.3 mW	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	1.0 W	

Voltages & Currents

	706	706A
V_{CBO} Collector to Base Voltage	25 V	25V
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10 \Omega$) (Note 4)	20 V	20 V
V_{EBO} Emitter to Base Voltage	3.0 V	5.0 V

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MPS706		706A		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage	15		15		V	$I_C = 10 \text{ mA}, I_B = 0$
BV_{CER}	Collector to Emitter Breakdown Voltage	20		20		V	$I_C = 10 \text{ mA}, R_{BE} = 10 \Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	25		25		V	$I_C = 10 \mu\text{A}, I_E = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$V_{EB} = 3.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		500		500	nA	$V_{CB} = 15 \text{ V}, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	20		20	60		$I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C and junction-to-case thermal resistance of 150° C/W (derating factor of 6.7 mW/°C) for 2N706. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/°C) for MPS706 and MPS706A; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length $\leq 12 \mu\text{s}$; duty cycle = 1% for MPS706, MPS706A; length = 300 μs ; duty cycle = 1% for 2N706.
 6. For product family characteristic curves, refer to Curve Set T132 for 2N706; T162 for MPS706 and MPS706A.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/MPS/FTSO706
MPS/FTSO706A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MPS706		706A		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.6		0.6	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9	0.7	0.9	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
C_{ob}	Output Capacitance		6.0		6.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0		2.0			$I_C = 10 \text{ mA}$, $V_{CE} = 15 \text{ V}$, $f = 100 \text{ MHz}$
r_b'	Base Resistance		50		50	Ω	$I_E = 10 \text{ mA}$, $V_{CE} = 15 \text{ V}$, $f = 300 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		60		25	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 10 \text{ V}$, $I_{B1} = I_{B2} = 10 \text{ mA}$
t_{on}	Turn On Time (test circuit no. 589)		40		40	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 3.0 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 589)		75		75	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 3.0 \text{ mA}$, $I_{B2} = 1.5 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$

SYMBOL	CHARACTERISTIC	2N706		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CER}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 10 \text{ mA}$, $R_{BE} = 10 \Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	$I_C = 10 \mu\text{A}$, $I_E = 0$
I_{CBO}	Collector Cutoff Current		300	nA	$V_{CB} = 15 \text{ V}$, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	20			$I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.6	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.6	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
C_{ob}	Output Capacitance		6.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0			$I_C = 10 \text{ mA}$, $V_{CE} = 15 \text{ V}$, $f = 100 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		60	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 10 \text{ V}$, $I_{B1} = I_{B2} = 10 \text{ mA}$

- V_{CE0} ... 32 V (Min)
- h_{FE} ... 40-120 @ 150 mA, 20 (Min) @ 500 mA

PACKAGE

2N718A	TO-18
2N1613	TO-5

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	718A	1613
25° C Ambient Temperature	0.5 mW	0.8 W
100° C Ambient Temperature	1.0 mW	1.7 W
25° C Case Temperature	1.8 W	3.0 W

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	32 V
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10 \Omega$) (Note 4)	50 V
V_{CBO} Collector to Base Voltage	75 V
V_{EBO} Emitter to Base Voltage	7.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	75		V	$I_C = 0.1 \text{ mA}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		V	$I_E = 0.1 \text{ mA}$, $I_C = 0$
I_{EBO}	Emitter Current		10	nA	$V_{EB} = 5.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10	nA	$V_{CB} = 60 \text{ V}$, $I_E = 0$
			10	μA	$V_{CB} = 60 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain	20			$I_C = 0.1 \text{ mA}$, $V_{CE} = 10 \text{ V}$
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		$I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$
		35			$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$
		20			$I_C = 500 \text{ mA}$, $V_{CE} = 10 \text{ V}$
		20			$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $T_A = -55^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 97.2° C (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 350° C/W (derating factor of 2.86 mW/° C) for 2N718A; junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C) junction-to-ambient thermal resistance of 219° C (derating factor of 4.56 mW/° C) for 2N1613.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle $\leq 1\%$.
6. For product family characteristic curves, refer to Curve Set T145.

2N718A/2N1613

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	50		V	$I_C = 100 \text{ mA}$ (pulsed), $R_{BE} \leq 10 \Omega$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		25	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$
C_{TE}	Input Capacitance		80	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$
h_{fe}	High Frequency Current Gain	3.0			$I_C = 50 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	30 35	100 150		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ib}	Input Resistance	24 4.0	34 8.0	Ω Ω	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance	0.05 0.1	0.5 1.0	μmho μmho	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ratio		3.0 3.0	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
$t_d + t_r + t_f$	(test circuit no. 287)		30	ns	$I_C = 50 \text{ mA}$, $V_{CC} = 20 \text{ V}$
NF	Noise Figure		12	dB	$I_C = 0.3 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 510 \Omega$ $BW = 1.0 \text{ Hz}$

- V_{CEO} ... 45 V (Min)
- h_{FE} ... 100-300 @ 10 mA
- NF ... 3.0 dB (Max) @ 1.0 kHz

PACKAGE

2N930	TO-18
PN930	TO-92
FTSO930	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	PN/FTSO	2N
Storage Temperature	-55° C to 150° C	-65° C to 200° C
Operating Junction Temperature	150° C	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	2N	FTSO
25° C Ambient Temperature	0.625 W	0.3 W	0.350 W*
25° C Case Temperature	1.0 W	0.6 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	45 V
(Note 4)	
V_{CBO} Collector to Base Voltage	45 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	30 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_C = 0, I_E = 10 \text{ nA}$
I_{CEO}	Collector to Emitter Cutoff Current		2.0	nA	$V_{CE} = 5.0 \text{ V}, I_B = 0$
I_{CBO}	Collector Cutoff Current		10	nA	$V_{CB} = 45 \text{ V}, I_E = 0$
I_{EBO}	Emitter to Base Cutoff Current		10	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
I_{CES}	Collector to Emitter Cutoff Current		10 10	nA μA	$V_{CE} = 45 \text{ V}, V_{EB} = 0$ $V_{CE} = 45 \text{ V}, V_{EB} = 0, T_A = 170^\circ \text{ C}$
h_{FE}	DC Pulse Current Gain (Note 5)		600		$I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$
h_{FE}	DC Current Gain	150 100 20	300		$I_C = 500 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}, T_A = -55^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C and junction-to-case thermal resistance of 250° C/W (derating factor of 4.0 mW/° C); junction-to-ambient thermal resistance of 500° C/W (derating factor of 2.0 mW/° C) for 2N930; (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C). (TO-236) junction-to-ambient thermal resistance of 35.7° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length $\leq 300 \mu\text{s}$; duty cycle $\leq 2\%$.
 6. For product family characteristic curves, refer to Curve Set T107.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N930/PN930/FTSO930

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	45		V	$I_C = 10 \text{ mA}$, $I_B = 0$ (pulsed)
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.0	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.6	1.0	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$
h_{fe}	Small Signal Current Gain	150	600		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{fe}	High Frequency Current Gain	1.0			$I_C = 500 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 30 \text{ MHz}$
h_{ib}	Input Resistance	25	32	Ω	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance		1.0	μmho	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ratio		600	$\times 10^{-6}$	$I_C = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Noise Figure		3.0	dB	$I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $R_S = 10 \text{ k}\Omega$, $BW = 15.7 \text{ kHz}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -65°C to 200°C
 Operating Junction Temperature 175°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at **2N** **FTSO**
 25°C Ambient Temperature 0.5 W 0.350*
 25°C Case Temperature 1.8 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 45 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 60 V
 V_{EBO} Emitter to Base Voltage 6.0 V
 I_C Collector Current 30 mA

PACKAGE

2N930A TO-18
 FTSO930A TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CEO}	Collector to Emitter Breakdown Voltage (Notes 4 & 5)	45		V	I _C = 10 mA (pulse)
BV _{CBO}	Collector to Base Breakdown Voltage	60		V	I _C = 10 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	6.0		V	I _E = 10 μA, I _C = 0
I _{EBO}	Emitter Cutoff Current		2.0	nA	V _{EB} = 5.0 V, I _C = 0
I _{CBO}	Collector Cutoff Current		2.0	nA	V _{CE} = 45 V, I _E = 0
I _{CEO}	Collector Cutoff Current		2.0	nA	V _{CE} = 5.0 V, I _B = 0
I _{CES}	Collector Cutoff Current		2.0	nA	V _{CE} = 45 V, V _{EB} = 0
h _{FE}	DC Current Gain	150 100 60 30	300		I _C = 500 μA, V _{CE} = 5.0 V I _C = 10 μA, V _{CE} = 5.0 V I _C = 1.0 μA, V _{CE} = 5.0 V I _C = 10 μA, V _{CE} = 5.0 V, T _A = -55°C
h _{FE}	DC Pulse Current Gain (Note 5)		600		I _C = 10 mA, V _{CE} = 5.0 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		0.5	V	I _C = 10 mA, I _B = 0.5 mA

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 250°C/W (derating factor of 4.0 mW/°C); junction-to-ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.
- For product family characteristic curves, refer to Curve Set T107.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N930A/FTSO930A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{BE(sat)}$	Base to Emitter Saturation Voltage) (Note 5)	0.7	0.9	V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$
C_{ob}	Output Capacitance		6.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$
h_{fe}	Small Signal Current Gain	150	600		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{fe}	High Frequency Current Gain	1.5			$I_C = 50 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 30 \text{ MHz}$
h_{ib}	Input Resistance	25	32	Ω	$I_E = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance		1.0	μmhos	$I_E = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ratio		600	$\times 10^{-6}$	$I_E = 1.0 \text{ mA}$, $V_{CB} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Noise Figure		3.0	dB	$I_C = 10 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $BW = 10 \text{ cps to } 10 \text{ kHz}$, $R_G = 10 \text{ k}\Omega$

2N1132A

PNP Transistor Medium Power Voltage Speed Switch & Frequency Amplifier

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N1132A

TO-39

Temperatures

Storage Temperature	-65° to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.6 mW
25° C Case Temperature	2.0 W
100° C Case Temperature	1.0 W
Derating Factor above 25° C	40 mW/° C min.

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	40 V
V_{CER} Collector to Emitter Voltage $R \leq 10 \text{ } \Omega$	50 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 10 \text{ mA}$, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 100 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 1.0 \text{ mA}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	μA	$V_{EB} = 4.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		0.5 50	μA	$V_{CB} = 45 \text{ V}$, $I_E = 0$ $V_{CB} = 45 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$
I_{CER}	Collector Cutoff Current		10	mA	$V_{CE} = 50 \text{ V}$, $R_{BE} < 10 \text{ } \Omega$, $V_{CE} = 30 \text{ V}$, $V_{BE} = 1.5 \text{ V}$ (reverse bias) $T_C = 150^\circ \text{ C}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length \leq 2% duty cycle, and \leq 1.2 ms pulse duration.
- For product family characteristic curves, refer to Curve Set T212.

2N1132A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	30 25	90		$I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ $I_C = 5 \text{ mA}$, $V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3	V	$I_C = 150 \text{ mA}$, $V_{CE} = 15 \text{ V}$
C_{ob}	Output Capacitance		30	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		80	pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	AC Current Gain	25 30	75		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{fe}	High Frequency Current Gain		3.0		$I_C = 50 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$
h_{ib}	Input Impedance	25	35 10	Ω Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance		1.0 5	μmhos μmhos	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ration		8.0 8.0	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
t_{on}	Turn On Time ($t_d + t_r$)		45	ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$ (see figure 1)
t_{off}	Turn Off Time		50	ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$

2N1890

NPN High Voltage Amplifier & Oscillator Type

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N1890

TO-39

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	3.0 W

Voltages & Currents

V _{CEO} Collector to Emitter Voltage (Note 4)	60 V
V _{CER} Collector to Emitter Voltage (R _{BE} ≤ 10Ω) (Note 4)	80 V
V _{CBO} Collector to Base Voltage	100 V
V _{EBO} Emitter to Base Voltage	7.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CBO}	Collector to Base Breakdown Voltage	100		V	I _C = 0, I _E = 0.1 mA
BV _{EBO}	Emitter to Base Breakdown Voltage	7.0		V	I _C = 0, I _E = 0.1 mA
I _{CBO}	Collector Cutoff Current		10 15	nA μA	V _{CB} = 75 V, I _E = 0 V _{CB} = 75 V, I _E = 0, T _A = 150° C
I _{EBO}	Emitter Cutoff Current		10	nA	V _{EB} = 5.0 V, I _C = 0
h _{FE}	DC Pulse Current Gain (Note 5)	100	300		I _C = 150 mA, V _{CE} = 10 V
h _{fe}	High Frequency Current Gain (Note 5)	3.0			I _C = 50 mA, V _{CE} = 10 V, f = 20 MHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T149.

2N1890

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{fe}	Small Signal Current Gain	50 70	200 300		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}$
h_{ib}	Input Resistance	2.0 4.0	3.0 8.0	Ω	$I_C = 1.0 \text{ mA}, V_{CB} = 5.0 \text{ V}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}$
h_{ie}	Input Resistance	4.0	8.0	$k\Omega$ Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}$
h_{ob}	Output Conductance		0.3 0.3	μmho μmho	$I_C = 1.0 \text{ mA}, V_{CB} = 5.0 \text{ V}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}$
h_{rb}	Voltage Feedback Ratio		1.50 1.50	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CB} = 5.0 \text{ V}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		1.2 5.0	V V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9 1.3	V V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{CER(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	80		V	$I_C = 100 \text{ mA}$ (pulsed), $R_{BE} \leq 10 \Omega$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	60		V	$I_C = 30 \text{ mA}$ (pulsed), $I_B = 0$
C_{obc}	Output Capacitance		15	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
C_{TE}	Emitter Transition Capacitance		85	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0$

- P_D ... 800 mW @ $T_A = 25^\circ\text{C}$
- V_{CE0} ... 80 V (Min)
- h_{FE} ... 40-120 @ 150 mA
- Complements ... 2N4013 (TO-39), MPSA56 (TO-92)

PACKAGE

2N1893

TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
100° C Case Temperature	1.7 W
25° C Case Temperature	3.0 W

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	80 V
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$) (Note 4)	100 V
V_{CBO} Collector to Base Voltage	120 V
V_{EBO} Emitter to Base Voltage	7.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		V	$I_C = 0$, $I_E = 100 \mu\text{A}$
BV_{CBO}	Collector to Base Breakdown Voltage	120		V	$I_C = 100 \mu\text{A}$, $I_E = 0$
I_{CBO}	Collector Cutoff Current		10 15	nA μA	$V_{CB} = 90\text{ V}$, $I_E = 0$ $V_{CB} = 90\text{ V}$, $I_E = 0$, $T_A = 150^\circ\text{C}$
I_{EBO}	Emitter to Base Cutoff Current		10	nA	$V_{EB} = 5.0\text{ V}$, $I_C = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	40 35 20	120		$I_C = 150\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$, $V_{CE} = 10\text{ V}$, $T_A = -55^\circ\text{C}$
h_{FE}	DC Current Gain	20			$I_C = 0.1\text{ mA}$, $V_{CE} = 10\text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.56 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T149.

2N1893

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	80		V	$I_C = 30 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.2 5.0	V V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9 1.3	V V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$ $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{CER(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)		100	V	$I_C = 100 \text{ mA (pulsed)}, (R_{BE} \leq 10 \Omega)$
C_{ob}	Output Capacitance		15	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
C_{ib}	Input Capacitance		85	pF	$V_{EB} = 0.5 \text{ V}, I_E = 0$
h_{fe}	High Frequency Current Gain	2.5			$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	30 45	100		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ib}	Input Resistance	20 4.0	30 8.0	Ω Ω	$I_C = 1.0 \text{ mA}, V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance		0.5 0.5	μmho μmho	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ratio		1.25 1.50	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CB} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}, V_{CB} = 10 \text{ V}, f = 1.0 \text{ kHz}$

FAIRCHILD

A Schlumberger Company

2N/PN/FTSO2218**2N/PN/FTSO2221****NPN Small Signal General Purpose
Amplifiers & Switches**

- $V_{CEO} \dots 30 \text{ V (Min)}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2218	2N2221
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	PN2218	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	30 V
(Note 4)	
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	800 mA

PACKAGE

2N2218	TO-39
2N2221	TO-18
PN2218	TO-92
PN2221	TO-92
FTSO2218	TO-236AA/AB
FTSO2221	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{EB} = 3.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		10	nA	$V_{CB} = 50 \text{ V}, I_E = 01$
			10	μA	$V_{CB} = 50 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C; junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2218; for 2N2221, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C); junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C; junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2218 and PN2221; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle $\leq 2\%$.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/PN/FTSO2218
2N/PN/FTSO2221

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	40 20 35 25 20 20	120		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	30		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 1.6	V V	$I_C = 150 \text{ mA}, I_B = 50 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3 2.6	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
h_{fe}	High Frequency Current Gain	2.5			$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
$R_o(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	Ω	$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 300 \text{ MHz}$

2N/PN/FTSO2218A
2N/PN/FTSO2221A

NPN Small Signal General Purpose Amplifiers & Switches

- V_{CE0} ... **40 V (Min) @ 10 mA**
- h_{FE} ... **40-120 @ 150 mA**
- t_{on} ... **35 ns (Max) @ 150 mA**, t_{off} ... **285 ns (Max) @ 150 mA**
- **Complements ... 2N/PN/FTSO2904A Series**

PACKAGE

2N2218A	TO-39
2N2221A	TO-18
PN2218A	TO-92
PN2221A	TO-92
FTSO2218A	TO-236AA/AB
FTSO2221A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

	2218A	2221A
Total Dissipation at		
25° C Ambient Temperature (Note 7)	0.8 W	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN	FTSO
Total Dissipation at		
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	40 V
V_{CBO} Collector to Base Voltage	75 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	800 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	40		V	$I_C = 10$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_C = 0$, $I_E = 10$ μ A
BV_{CBO}	Collector to Base Breakdown Voltage	75		V	$I_C = 10$ μ A, $I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C, junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C) and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2218A. For the 2N2221A, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C), junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C, junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); and junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2218A and PN2221A. For FTSO2218A and FTSO2221A junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/PN/FTSO2218A
2N/PN/FTSO2221A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I _C EX	Collector Reverse Current		10	nA	V _{CE} = 60 V, V _{EB} = 3.0 V
I _C BO	Collector Reverse Current		10 10	nA μA	V _{CB} = 60 V, I _E = 0 V _{CB} = 60 V, I _E = 0, T _A = 150° C
I _E BO	Emitter to Base Cutoff Current		10	nA	V _{EB} = 3.0 V, I _C = 0
I _{BL}	Base Current		20	nA	V _{EB} = 3.0 V, V _{CE} = 60 V
h _{FE}	DC Current Gain (Note 5) (Note 5) (Note 5) (Note 5) (Note 5)	20 25 35 40 25 15 20	120		I _C = 100 μA, V _{CE} = 10 V I _C = 1.0 mA, V _{CE} = 10 V I _C = 10 mA, V _{CE} = 10 V I _C = 150 mA, V _{CE} = 10 V I _C = 500 mA, V _{CE} = 10 V I _C = 10 mA, V _{CE} = 10 V, T _A = -55° C I _C = 150 mA, V _{CE} = 1.0 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		0.3 1.0	V V	I _C = 150 mA, I _B = 15 mA I _C = 500 mA, I _B = 50 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage (Note 5)	0.6	1.2 2.0	V V	I _C = 150 mA, I _B = 15 mA I _C = 500 mA, I _B = 50 mA
C _{ob}	Output Capacitance		8.0	pF	V _{CB} = 10 V, I _E = 0, f = 100 kHz
C _{ib}	Input Capacitance		25	pF	V _{EB} = 0.5 V, I _C = 0, f = 100 kHz
h _{fe}	High Frequency Current Gain	2.5			I _C = 20 mA, V _{CE} = 5.0 V, f = 100 MHz
h _{fe}	Small Signal Current Gain	30 50	150 300		I _C = 1.0 mA, V _{CB} = 10 V, f = 1.0 kHz I _C = 10 mA, V _{CB} = 10 V, f = 1.0 kHz
h _{ie}	Input Resistance	1.0 0.2	3.5 1.0	kΩ kΩ	I _C = 1.0 mA, V _{CB} = 10 V, f = 1.0 kHz I _C = 10 mA, V _{CB} = 10 V, f = 1.0 kHz
h _{oe}	Output Conductance	3.0 10	15 100	μmho μmho	I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz I _C = 10 mA, V _{CB} = 10 V, f = 1.0 kHz
h _{re}	Voltage Feedback Ratio		500 250	×10 ⁻⁶ ×10 ⁻⁶	I _C = 1.0 mA, V _{CB} = 10 V, f = 1.0 kHz I _C = 10 mA, V _{CB} = 10 V, f = 1.0 kHz
R _E (h _{ie})	Real Part of Common Emitter High Frequency Input Impedance	60		Ω	I _C = 20 mA, V _{CE} = 20 V f = 300 MHz
t _d	Turn On Delay Time (test circuit no. 231)		10	ns	I _{CS} = 150 mA, V _{CC} = 30 V, I _{B1} = 15 mA
t _r	Rise Time (test circuit no. 231)		25	ns	I _{CS} = 150 mA, V _{CC} = 30 V, I _{B1} = 15 mA
t _s	Storage Time (test circuit no. 232)		225	ns	I _C = 150 mA, V _{CC} = 30 V, I _{B1} = I _{B2} = 15 mA
t _f	Fall Time (test circuit no. 232)		60	ns	I _{CS} = 150 mA, V _{CC} = 30 V, I _{B1} = I _{B2} = 15 mA
T _A	Active Region Time Constant		2.5	ns	I _C = 150 mA, V _{CE} = 30 V
r _b 'C _C	Collector to Base Time Constant		150	ps	I _C = 20 mA, V _{CE} = 20 V, f = 31.8 MHz

FAIRCHILD

A Schlumberger Company

**2N2219/PN2219/FTSO2219
2N2222/PN2222/FTSO2222**NPN Small Signal General Purpose
Amplifiers & Switches

- V_{CE0} ... 30 V (Min)
- h_{FE} ... 100-300 @ 150 mA, 30 (Min) @ 500 mA

PACKAGE

2N2219	TO-39
2N2222	TO-18
PN2219	TO-92
PN2222	TO-92
FTSO2219	TO-236AA/AB
FTSO2222	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2219	2N2222
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	PN2219	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	30 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current	800 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{EB} = 3.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		10	nA	$V_{CB} = 50 V, I_E = 0$
			10	μA	$V_{CB} = 50 V, I_E = 0, T_A = 150^\circ C$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C; junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2219; for 2N2222, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C); junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C; junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2219 and PN2222; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle \leq 2%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N2219/PN2219/FTSO2219
2N2222/PN2222/FTSO2222

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	100 50 75 50 35 30	300		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	30		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 1.6	V V	$I_C = 150 \text{ mA}, I_B = 50 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3 2.6	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
h_{fe}	High Frequency Current Gain	2.5			$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
$R_e(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	Ω	$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 300 \text{ MHz}$

2N/PN/FTSO/2219A 2N/PN/FTSO2222A

NPN Small Signal General Purpose Amplifiers & Switches

- V_{CEO} ... 40 V (Min) @ 10 mA
- h_{FE} ... 100-300 (2N/PN/FTSO2219A, 2N/PN/FTSO2222A) @ 150 mA
- t_{on} ... 35 ns (Max) @ 150 mA, t_{off} ... 285 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2904A Series

PACKAGE

2N2219A	TO-39
2N2222A	TO-39
PN2219A	TO-92
PN2222A	TO-92
FTSO2219A	TO-236AA/AB
FTSO2222A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2219A	2N2222A
25° C Ambient Temperature (Note 7)	0.8 W	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	40 V
V_{CBO} Collector to Base Voltage	75 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	800 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	40		V	$I_C = 10$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_C = 0$, $I_E = 10$ μ A
BV_{CBO}	Collector to Base Breakdown Voltage	75			$I_C = 10$ μ A, $I_C = 0$
I_{CEX}	Collector Reverse Current		10	nA	$V_{CE} = 60$ V, $V_{EB} = 3.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 175° C, junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2219A. For the 2N2222A, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C), junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C, junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2219A, PN2222A. For the FTSO2219A/2222A, these ratings give a maximum junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/PN/FTSO2219A
2N/PN/FTSO2222A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Reverse Current		10 10	nA μ A	$V_{CB} = 60$ V, $I_E = 0$ $V_{CB} = 60$ V, $I_E = 0$, $T_A = 150^\circ$ C
I_{EBO}	Emitter to Base Cutoff Current		10	nA	$V_{EB} = 3.0$ V, $I_C = 0$
I_{BL}	Base Current		20	nA	$V_{EB} = 3.0$ V, $V_{CE} = 60$ V
h_{FE}	DC Current Gain (Note 5) (Note 5) (Note 5) (Note 5) (Note 5)	35 50 75 100 40 35 50	300		$I_C = 100$ μ A, $V_{CE} = 10$ V $I_C = 1.0$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V $I_C = 500$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V, $T_A = -55^\circ$ C $I_C = 150$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.3 1.0	V V	$I_C = 150$ mA, $I_B = 15$ mA $I_C = 500$ mA, $I_B = 50$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.6	1.2 2.0	V V	$I_C = 150$ mA, $I_B = 15$ mA $I_C = 500$ mA, $I_B = 50$ mA
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = 10$ V, $I_E = 0$, $f = 100$ kHz
C_{ib}	Input Capacitance		25	pF	$V_{EB} = 0.5$ V, $I_C = 0$, $f = 100$ kHz
h_{fe}	High Frequency Current Gain	3.0			$I_C = 20$ mA, $V_{CE} = 5.0$ V, $f = 100$ MHz
h_{fe}	Small Signal Current Gain	50 75	300 375		$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
h_{ie}	Input Resistance	2.0 0.25	8.0 1.25	k Ω k Ω	$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
h_{oe}	Output Conductance	5.0 25	35 200	μ mho μ mho	$I_C = 1.0$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz
h_{re}	Voltage Feedback Ratio		800 400	$\times 10^{-6}$ $\times 10^{-6}$	$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
$R_E (h_{ie})$	Real Part of Common Emitter Frequency Input Impedance	60		Ω	$I_C = 20$ mA, $V_{CE} = 20$ V $f = 300$ MHz
t_d	Turn On Delay Time (test circuit no. 231)		10	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA
t_r	Rise Time (test circuit no. 231)		25	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA
t_s	Storage Time (test circuit no. 232)		225	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = I_{B2} = 15$ mA
t_f	Fall Time (test circuit no. 232)		60	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = I_{B2} = 15$ mA
T_A	Active Region Time Constant		2.5	ns	$I_C = 150$ mA, $V_{CE} = 30$ V
$r_b' C_c$	Collector to Base Time Constant		150	ps	$I_C = 20$ mA, $V_{CE} = 20$ V, $f = 31.8$ MHz
NF	Noise Figure		4.0	dB	$I_C = 100$ μ A, $V_{CE} = 10$ V, $R_G = 1.0$ k Ω , BW = 1.0 Hz, $f = 1.0$ kHz

3

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N2270

TO-39

Temperatures

Storage Temperature -65° C to 200° C

Operating Junction Temperature -65° C to 200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at

25° C Ambient Temperature 1.0 W

25° C Case Temperature 5.0 W

Voltages & Currents
 V_{CEO} Collector to Emitter Voltage 45 V
(Note 4)

 V_{CBO} Collector to Base Voltage 60 V
(with Emitter Open)

 V_{CER} Collector to Base Voltage 60 V
($R_{BE} \leq 10 \Omega$)

 V_{EBO} Emitter to Base Voltage 7.0 V

 I_C Collector Current 1 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 0.05 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7		V	$I_E = 100 \mu A, I_C = 0$
LV_{CEO}	Collector to Emitter Sustaining Voltage (Note 1)	45		V	$I_C = 100 \text{ mA}, I_B = 0$ (pulsed)
LV_{CER}	Collector to Emitter Sustaining Voltage	60		V	$I_C = 100 \text{ mA}, R_{BE} = 10 \Omega$ (pulsed)
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current (150° C)		50 50	nA μA	$V_{CB} = 60 \text{ V}, I_E = 0$ $V_{CB} = 60 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
h_{FE}	DC Pulse Current Gain (Note 2)	5 30	200		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- Pulse conditions: length = 300 μs ; duty cycle = 1.8%.
- These ratings give a maximum junction temperature of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- For product family characteristic curves, refer to Curve Set T145.

2N2270

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.9	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		1.2	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		15	pF	$V_{CB} = 10 \text{ V}, I_E = 0$
C_{ib}	Input Capacitance		80	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0$
h_{fe}	Small Signal Current Gain	50 5	275		$I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kc}$ $I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 20 \text{ mc}$
f_T	Current Gain Bandwidth Product		100	MHz	$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}$
$t_d+t_s+t_r$	Switching Time		30	ns	
NF	Broad Band Noise Figure		10	dB	$I_C = 300 \mu\text{A}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 1000 \Omega,$ $BW = 15 \text{ kHz}$

**2N/PN/MPS/FTSO2369
2N/PN/MPS/FTSO2369A
2N/FTSO5769**

NPN High Speed Saturated Switches

- V_{CE0} ... 15 V (Min)
- t_s ... 13 ns (Max) @ 10 mA
- t_{on} ... 12 ns (Max) @ 10 mA, t_{off} ... 18 ns (Max) @ 10 mA
- Complements ... 2N4209 (TO18), 2N5771 (TO92)

PACKAGE

2N2369	TO-18
2N2369A	TO-18
2N5769	TO-92
PN2369	TO-92
PN2369A	TO-92
MPS2369	TO-92
MPS2369A	TO-92
FTSO2369	TO-236AA/AB
FTSO2369A	TO-236AA/AB
FTSO5769	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

**MPS/PN2369/A
FTSO2369/69A**

Temperatures	2N2369/69A	2N/FTSO5769
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	200° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2369/A	2N5769	FTSO
25° C Ambient Temperature	0.36 W	0.625 W	0.350 W*
100° C Case Temperature	0.68 W	0.260 W	
25° C Case Temperature	1.2 W	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	15 V
V_{CBO} Collector to Base Voltage	40 V
V_{CES} Collector to Emitter Voltage	40 V
V_{EBO} Emitter to Base Voltage	4.5 V
I_C Collector Current (Pulse = 10 μ s)	200 mA 500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2369		2369A 5769		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	40		40		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		40		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5		4.5		V	$I_E = 10 \mu A, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 146° C/W (derating factor of 6.85 mW/° C); junction-to-ambient thermal resistance of 486° C/W (derating factor of 2.06 mW/° C) for 2N2369, 2N2369A, PN2369 and PN2369A. These ratings give a maximum junction temperature of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for MPS2369 and 2N5769; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle \leq 2%.
 6. For product family characteristic curves, refer to Curve Set T132.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/PN/MPS/FTSO2369
2N/PN/MPS/FTSO2369A
2N/FTSO5769

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2369		2369A 5769		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		400 30		400 30	nA μ A	$V_{CB} = 20$ V, $I_E = 0$ $V_{CB} = 20$ V, $I_E = 0$, $T_A = 150^\circ$ C
h_{FE}	DC Pulse Current Gain (Note 5)	40 20	120	40 30 20	120		$I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 100$ mA, $V_{CE} = 2.0$ V $I_C = 10$ mA, $V_{CE} = 0.35$ V $I_C = 30$ mA, $V_{CE} = 0.4$ V $I_C = 100$ mA, $V_{CE} = 1.0$ V $I_C = 10$ mA, $V_{CE} = 1.0$ V, $T_A = -55^\circ$ C $I_C = 10$ mA, $V_{CE} = 0.35$ V, $T_A = -55^\circ$ C
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		15		V	$I_C = 10$ mA (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25		0.2 0.25 0.5 0.3	V V V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 30$ mA, $I_B = 3.0$ mA $I_C = 100$ mA, $I_B = 10$ mA $I_C = 10$ mA, $I_B = 10$ mA, $T_A = 125^\circ$ C
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.70	0.85	0.70	0.85	V	$I_C = 10$ mA, $I_B = 1.0$ mA
C_{ob}	Output Capacitance		4.0		4.0	pF	$V_{CB} = 5.0$ V, $I_E = 0$, $f = 140$ kHz
h_{fe}	High Frequency Current Gain	5.0		5.0			$I_C = 10$ mA, $V_{CE} = 10$ V, $f = 100$ MHz
τ_s	Charge Storage Time Constant (test circuit no. 3111)		13		13	ns	$I_C = 10$ mA, $I_{B1} = I_{B2} = 10$ mA, $V_{CC} = 10$ V
t_{on}	Turn On Time (test circuit no. 210)		12		12	ns	$I_C = 10$ mA, $I_{B1} = 3.0$ mA, $V_{CC} = 3.0$ V
t_{off}	Turn Off Time (test circuit no. 210)		18		18	ns	$I_C = 10$ mA, $I_{B1} = 3.0$ mA, $I_{B2} = -1.5$ mA, $V_{CC} = 3.0$ V

SYMBOL	CHARACTERISTIC	MPS2369		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 10$ μ A, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		V	$I_C = 10$ μ A, $V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5		V	$I_E = 10$ μ A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		400	nA	$V_{CB} = 20$ V, $I_E = 0$, $T_A = 150^\circ$ C
I_{CES}	Collector Cutoff Current		30	μ A	$V_{CB} = 20$ V, $I_E = 0$, $T_A = 125^\circ$ C

2N/PN/MPS/FTSO2369
2N/PN/MPS/FTSO2369A
2N/FTSO5769

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MPS2369		UNITS	TEST CONDITIONS
		MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	40 20 20	120		$I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = 2.0 \text{ V}$ $I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.70	0.85	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	5.0			$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		13	ns	$I_C = 10 \text{ mA}$, $I_{B1} = I_{B2} = 10 \text{ mA}$, $V_{CC} = 10 \text{ V}$
t_{on}	Turn On Time (test circuit no. 210)		12	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 3.0 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$
t_{off}	Turn Off Time (test circuit no. 210)		18	ns	$I_C = 10 \text{ mA}$, $I_{B1} = 3.0 \text{ mA}$, $I_{B2} = -1.5 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N2405

TO-39

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	1.0 W
25° C Case Temperature	5.0 W

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	90 V
V_{CBO} Collector to Base Voltage	140 V
V_{EBO} Emitter to Base Voltage	7.0 V
I_C Collector Current	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CER}	Collector to Emitter Breakdown Voltage	140		V	$I_C = 100 \text{ mA}$, $R_{BE} = 10 \ \Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	120		V	$I_C = 100 \ \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		V	$I_E = 100 \ \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{EB} = 5.0 \text{ V}$
I_{CBO}	Collector Cutoff Current		10 10	nA μA	$V_{CB} = 90 \text{ V}$ $V_{CB} = 90 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$
LV_{CE0}	Collector to Emitter Sustain Voltage	90 90		V V	$I_C = 30 \text{ mA}$ $I_C = 100 \text{ mA}$
h_{FE}	DC Pulse Current Gain (Note 5)	60	200		$I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$
h_{FE}	DC Current Gain (Note 5)	35			$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 175° C and junction-to-case thermal resistance of 30° C/W (derating factor of 3.33 mW/° C); junction-to-ambient thermal resistance of 150° C/W (derating factor of 6.6 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs ; duty cycle = 1.8%.
- For product family characteristic curves, refer to Curve Set T149.

2N2405

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.5	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		1.1	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		15	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		80	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$
h_{fe}	Current Gain	50	275		$I_C = 5.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ib}	Input Resistance	4	8	Ω	$I_C = 5.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ob}	Output Conductance		0.5	μmhos	$I_C = 5.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{rb}	Voltage Feedback Ratio		3	$\times 10^{-4}$	$I_C = 5.0 \text{ mA}$, $V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$

**2N2484/FTSO2484
PN2484
2N3117/FTSO3117**

NPN Low Level Low Noise Amplifiers

- V_{CE0} ... 60 V (Min)
- I_{FE} ... 100-500 (2N/PN/FTSO2484), 250-500 (2N/FTSO3117) @ 10 μ A
- NF ... 3.0 dB (Max) (2N/PN/FTSO2484), 1.0 dB (Max) (2N/FTSO3117) @ 1.0 kHz, 2.0 dB (Max) (2N/PN/FTSO2484), 1.0 dB (Max) (2N/FTSO3117) @ 10 kHz

PACKAGE

2N2484	TO-18
2N3117	TO-18
PN2484	TO-92
FTSO2484	TO-236AA/AB
FTSO3117	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N3117	PN/FTSO	2N2484
Storage Temperature	-65° C to 200° C	-55° C to 150° C	-65° C to 300° C
Operating Junction Temperature	200° C	150° C	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	PN
25° C Ambient Temperature	0.36 mW	0.625 W
25° C Case Temperature	1.2 W	1.0 W
Total Dissipation at	FTSO	
25° C Ambient Temperature	0.350 W*	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	60 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2484		3117		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10 \mu A, I_C = 0$
I_{CE0}	Collector to Emitter Cutoff Current		2.0			nA	$V_{CE} = 5.0 V, I_B = 0$
I_{EBO}	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	nA	$V_{CB} = 45 V, I_E = 0$
			10		10	μA	$V_{CB} = 45 V, I_E = 0, T_A = 150^\circ C$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 147° C/W (derating factor of 6.85 mW/° C); junction-to-ambient thermal resistance of 485° C/W (derating factor of 2.06 mW/° C) for 2N2484 and 2N3117. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T107.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N2484/FTSO2484
PN2484
2N3117/FTSO3117

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2484		3117		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	250 200 175 100 30 20	800 500	400 300 250 100 50	 500		$I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 500 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 100 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 1.0 \mu\text{A}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}, T_A = -55^\circ\text{C}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60		60		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$

SYMBOL	CHARACTERISTIC	2484		3117		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.35		0.35	V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.5	0.7		0.7	V	$I_C = 100 \mu\text{A}, V_{CE} = 5.0 \text{ V}$
C_{ob}	Output Capacitance		6.0		4.5	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{ib}	Input Capacitance		6.0		6.0	pF	$V_{BE} = 0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0 3.0 150	 900	2.0 400	 900		$I_C = 0.5 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 30 \text{ MHz}$ $I_C = 50 \mu\text{A}, V_{CE} = 5.0 \text{ V}, f = 5.0 \text{ MHz}$ $I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	3.5	24	10	24	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance		40		40	μmhos	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{re}	Reverse Voltage Feedback Ratio		800		800	$\times 10^{-6}$	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f \div 1.0 \text{ kHz}$
NF	Wide Band Noise Figure		3.0			dB	$I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V}, R_S = 10 \text{ k}\Omega$, Power Bandwidth of 15.7 kHz with 3.0 dB pts at 10 Hz and 10 kHz

2N2484/FTSO2484
PN2484
2N3117/FTSO3117

Electrical Characteristics (25° C Ambient Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
NF	Narrow Band Noise Figure	3.0		dB	$I_C = 10 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega$ Power Bandwidth of 200 Hz
		2.0		dB	$I_C = 10 \mu A, V_{CE} = 5.0 V,$ $f = 10 \text{ kHz}, R_S = 10 \text{ k}\Omega,$ Power Bandwidth of 2.0 kHz
		10		dB	$I_C = 10 \mu A, V_{CE} = 5.0 V,$ $f = 100 \text{ Hz}, R_S = 10 \text{ k}\Omega,$ Power Bandwidth of 20 Hz
			1.0	dB	$I_C = 5.0 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 \text{ kHz}, R_S = 50 \text{ k}\Omega,$ Power Bandwidth of 200 Hz
			1.0	dB	$I_C = 5.0 \mu A, V_{CE} = 5.0 V,$ $f = 10 \text{ kHz}, R_S = 50 \text{ k}\Omega,$ Power Bandwidth of 1.0 kHz
			4.0	dB	$I_C = 30 \mu A, V_{CE} = 5.0 V,$ $f = 100 \text{ kHz}, R_S = 10 \text{ k}\Omega,$ Power Bandwidth of 20 Hz
		1.5	dB	$I_C = 30 \mu A, V_{CE} = 5.0 V,$ $f = 10 \text{ Hz}, R_S = 10 \text{ k}\Omega,$ Power Bandwidth of 2.0 Hz	

3

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N2586

TO-18

Temperatures

Storage Temperature -65° C to 200° C
 Operating Junction Temperature 175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25° C Ambient Temperature 0.4 W
 25° C Case Temperature 1.8 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 45 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 60 V
 V_{EBO} Emitter to Base Voltage 6.0 V
 I_C Collector Current 30 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CBO}	Collector to Base Breakdown Voltage	60		V	I _C = 10 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	6.0		V	I _E = 10 μA, I _C = 0
I _{CEO}	Collector to Emitter Cutoff Current		2.0	nA	V _{CE} = 5.0 V, I _B = 0
I _{CES}	Collector to Emitter Cutoff Current		2.0 10	nA μA	V _{CE} = 45 V, V _{BE} = 0 V _{CE} = 45 V, V _{BE} = 0, T _A = 170° C
I _{CBO}	Collector Cutoff Current		2.0	nA	V _{CB} = 45 V, I _E = 0
I _{EBO}	Emitter Cutoff Current		2.0	nA	V _{EB} = 5.0 V, I _C = 0
h _{FE}	DC Pulse Current Gain (Note 5)		600		I _C = 10 mA, V _{CE} = 5.0 V
h _{FE}	DC Current Gain	150 120 80 40	360		I _C = 500 μA, V _{CE} = 5.0 V I _C = 10 μA, V _{CE} = 5.0 V I _C = 1.0 μA, V _{CE} = 5.0 V I _C = 10 μA, V _{CE} = 5.0 V, T _A = 55° C

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175° C and junction-to-case thermal resistance of 250° C/W (derating factor of 4.0 mW/° C); junction-to-ambient thermal resistance of 500° C/W (derating factor of 2.0 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
6. For product family characteristic curves, refer to Curve Set T107.

2N2586

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	45		V	$I_C = 10 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.5	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
V_{BE}	Base to Emitter Voltage	0.7	0.9	V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$
C_{obo}	Common Base Open Circuit Output Capacitance		7.0	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	1.5			$I_C = 500 \mu\text{A}, V_{CE} = 5.0 \text{ V}, f = 30 \text{ MHz}$
h_{fe}	Small Signal Current Gain	150	600		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	4.5	18	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Admittance		100	μmhos	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
NF	Spot Noise Figure		2.0	dB	$I_C = 1.0 \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $R_G = 1.0 \text{ M}\Omega, f = 10 \text{ kHz}$
			2.0	dB	$I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $R_G = 10 \text{ k}\Omega, f = 10 \text{ kHz}$
			3.0	dB	$I_C = 10 \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $R_G = 10 \text{ k}\Omega, f = 1.0 \text{ kHz}$
			3.5	dB	$I_C = 1.0 \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $R_G = 1 \text{ M}\Omega, f = 1.0 \text{ kHz}$

2N2710/FTSO2710

NPN Small Signal High Speed Low Power Saturating Switch Transistor

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.5 W	0.350 W*
25° C Case Temperature	1.2 W	

Voltages & Currents

V _{CEO} Collector to Emitter Voltage (Note 4)	20 V
V _{CES} Collector to Emitter Voltage	30 V
V _{CBO} Collector to Base Voltage	40 V
V _{EBO} Emitter to Base Voltage	5.0 V
I _C Collector Current	500 mA

PACKAGE

2N2710	TO-18
FTSO2710	TO-236AA/AB

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CEO}	Collector to Emitter Breakdown Voltage	20		V	I _C = 10 mA, I _B = 0
BV _{CES}	Collector to Emitter Breakdown Voltage	30		V	I _C = 10 μA, I _B = 0
BV _{CBO}	Collector to Base Breakdown Voltage	40		V	I _C = 10 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I _E = 10 μA, I _C = 0
I _{EBO}	Emitter Cutoff Current		1.0	μA	V _{EB} = 3.0 V, I _C = 0
I _{CBO}	Collector Cutoff Current (150° C)		30 30	nA μA	V _{CB} = 20 V, I _E = 0 V _{CB} = 20 V, T _A = 150° C
h _{FE}	DC Current Gain (Note 5)	40 40			I _C = 10 mA, V _{CE} = 1.0 V I _C = 50 mA, V _{CE} = 1.0 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage		0.25 0.40	V V	I _C = 10 mA, I _B = 1.0 mA I _C = 50 mA, I _B = 5.0 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage		0.90 1.30	V V	I _C = 10 mA, I _B = 1.0 mA I _C = 50 mA, I _B = 5.0 mA

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 146° C/W (derating factor of 6.8 mW/°C); junction-to-ambient thermal resistance of 350° C/W (derating factor 2.8 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%, and ≤ 1.2 ms pulse duration.
- For product family characteristic curves, refer to Curve Set T162.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N2710/FTSO2710

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 4.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	5.0			$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
τ_s	Charge Storage Time Constant (test circuit no. 3111)		15	ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 10 \text{ mA}$
t_{on}	Turn On Time		20	ns	$I_C = 10 \text{ mA}, I_{B1} = 3.0 \text{ mA}$
t_{off}	Turn Off Time		35	ns	$I_C = 10 \text{ mA}, I_{B1} = 3.0 \text{ mA}$ $I_{B2} = 1.0 \text{ mA}$

2N2904/5/6/7

PN2904/5/6/7

FTSO2904/5/6/7

PNP Small Signal General Purpose Amplifiers & Switches

- V_{CE0} ... -40 V (Min)
- h_{FE} ... 40-120 (2N/PN/FTSO2904/6), 100-300 (2N/PN/FTSO2905/7)
- t_{on} ... 45 ns (Max) @ 150 mA, t_{off} ... 100 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2218 Series, 2N/PN/FTSO2218A Series

PACKAGE

2N2904	TO-39
2N2905	TO-39
2N2906	TO-18
2N2907	TO-18
PN2904	TO-92
PN2905	TO-92
PN2906	TO-92
PN2907	TO-92
FTSO2904	TO-236AA/AB
FTSO2905	TO-236AA/AB
FTSO2906	TO-236AA/AB
FTSO2907	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2904/5	2N2906/7
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

2N/PN2904

V_{CE0} Collector to Emitter Voltage	-40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-60 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N/PN2904/6		TEST CONDITIONS
		MIN	MAX	
h_{FE}	DC Current Gain (Note 5)	40	120	$I_C = 150$ mA, $V_{CE} = -10$ V
		20		$I_C = 500$ mA, $V_{CE} = -10$ V
		35		$I_C = 10$ mA, $V_{CE} = -10$ V
		25		$I_C = 1.0$ mA, $V_{CE} = -10$ V
		20		$I_C = 0.1$ mA, $V_{CE} = -10$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C) for 2N2904 and 2N2905; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906 and 2N2907. These ratings give a maximum junction resistance of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2904, PN2905, PN2906, and PN2907; (TO236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T212.

* Package mounted on 99.5% alumina 8mm x 8mm x 0.6mm.

2N2904/5/6/7
PN2904/5/6/7
FTSO2904/5/6/7

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N/PN2905/7		UNITS	TEST CONDITIONS
		MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	100 30 75 50 35	300		$I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = -10 \text{ V}$
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_C = 0, I_E = 10 \mu\text{A}$
BV_{CBO}	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}, I_E = 0$
I_{CEX}	Collector Reverse Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
I_{CBO}	Collector Cutoff Current		20 20	nA μA	$V_{CB} = -50 \text{ V}, I_E = 0$ $V_{CB} = -50 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
I_B	Base Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-60		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4 -1.6	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.3 -2.6	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
C_{ib}	Emitter Transition Capacitance		30	pF	$V_{EB} = -2.0 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0			$I_C = 50 \text{ mA}, V_{CE} = -20 \text{ V}, f = 100 \text{ MHz}$
t_d	Turn On Delay Time (test circuit no. 224)		10	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = 15 \text{ mA}$
t_r	Rise Time (test circuit no. 224)		40	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$
t_s	Storage Time (test circuit no. 225)		80	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = 15 \text{ mA}$
t_f	Fall Time (test circuit no. 225)		30	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$

3

FAIRCHILD

A Schlumberger Company

2N2904A/5A/6A/7A PN2904A/5A/6A/7A FTSO2904A/5A/6A/7A

PNP Small Signal General Purpose
Amplifiers & Switches

- P_D ... 625 mW @ $T_A = 25^\circ\text{C}$ (PN Series)
- V_{CE0} ... -60 V (Min)
- h_{FE} ... 40-120 (2N/PN/FTSO2904A/6A), 100-300 (2N/PN/FTSO2905A/7A)
- t_{on} ... 45 ns (Max) @ 150 mA, t_{off} ... 100 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2218 Series, 2N/PN/FTSO2218A Series

PACKAGE

2N2904A	TO-39
2N2905A	TO-39
2N2906A	TO-18
2N2907A	TO-18
PN2904A	TO-92
PN2905A	TO-92
PN2906A	TO-92
PN2907A	TO-92
FTSO2904A	TO-236AA/AB
FTSO2905A	TO-236AA/AB
FTSO2906A	TO-236AA/AB
FTSO2907A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N2904/5A	2N2906/7A
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	2N/PN
V_{CE0} Collector to Emitter Voltage (Note 4)	-40 V
V_{CBO} Collector to Base Voltage	-60 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2904A/2906A		UNITS	TEST CONDITIONS
		MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	40	120		$I_C = 150\text{ mA}, V_{CE} = -10\text{ V}$ $I_C = 500\text{ mA}, V_{CE} = -10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = -10\text{ V}$ $I_C = 1.0\text{ mA}, V_{CE} = -10\text{ V}$ $I_C = 0.1\text{ mA}, V_{CE} = -10\text{ V}$

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C) for 2N2904A and 2N2905A; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906A and 2N2907A. These ratings give a maximum junction resistance of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2904A, PN2905A, PN2906A, and PN2907A; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μ s; duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N2904A/5A/6A/7A
PN2904A/5A/6A/7A
FTSO2904A/5A/6A/7A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2905A/2907A		UNITS	TEST CONDITIONS
		MIN	MAX		
h_{FE}	DC Current Gain (Note 5)	100 50 100 100 75	300		$I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = -10 \text{ V}$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_C = 0, I_E = 10 \mu\text{A}$
BV_{CBO}	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}, I_E = 0$
I_{CEX}	Collector Reverse Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
I_{CBO}	Collector Cutoff Current		10 10	nA μA	$V_{CB} = -50 \text{ V}, I_E = 0$ $V_{CB} = -50 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
I_B	Base Current		50	nA	$V_{CE} = -0 \text{ V}, V_{EB} = -0.5 \text{ V}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-40		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-1.6	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.3	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-2.6	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
C_{ob}	Output Capacitance		8.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
C_{ib}	Emitter Transition Capacitance		30	pF	$V_{EB} = -2.0 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	2.0			$I_C = 50 \text{ mA}, V_{CE} = -20 \text{ V}, f = 100 \text{ MHz}$
t_d	Turn On Delay Time (test circuit no. 224)		10	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = 15 \text{ mA}$
t_r	Rise Time (test circuit no. 224)		40	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$
t_s	Storage Time (test circuit no. 225)		80	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = 15 \text{ mA}$
t_f	Fall Time (test circuit no. 225)		30	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$
t_{on}	Turn On Time (test circuit no. 224)		45	ns	$I_C = 150 \text{ mA}, V_{CC} = -3.0 \text{ V}, I_{B1} = 15 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 225)		100	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$

2N3013/FTSO3013
2N3014/FTSO3014

NPN High Speed Saturated Logic Switches

- V_{CE0} ... 20 V (Min) (2N/FTSO3014), 15 V (Min) (2N/FTSO3013)
- τ_s ... 18 ns (Max) @ 10 mA
- t_{on} ... 15 ns (Max) @ 300 mA (2N/FTSO3013), 16 ns (Max) @ 30 mA (2N/FTSO3014)
- t_{off} ... 25 ns (Max) @ 300 mA (2N/FTSO3013), @ 30 mA (2N/FTSO3014)

PACKAGE

2N3013	TO-52
2N3014	TO-52
FTSO3013	TO-236AA/AB
FTSO3014	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	FTSO
Storage Temperature	-55° C to 200° C	-55° C to 150° C
Operating Junction Temperature	200° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.36 mW	0.350 W*
25° C Case Temperature	1.2 W	

Voltages & Currents

	3013	3014
V_{CE0} Collector to Emitter Voltage (Note 4)	15 V	20 V
V_{CBO} Collector to Base Voltage	40 V	40 V
V_{CES} Collector to Emitter Voltage	40 V	40 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V
I_C Collector Current (Pulse = 10 μ s)	200 mA 500 mA	200 mA 500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3013		3014		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	40		40		V	$I_C = 100 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		40		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 100 \mu A, I_C = 0$
I_{CES}	Collector Reverse Current (Note 5)		0.3		0.3	μA	$V_{CE} = 20 V, V_{BE} = 0$ $V_{CE} = 20 V, V_{BE} = 0, T_A = 125^\circ C$
			40		40	μA	

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 200° C and (TO-18) junction-to-case thermal resistance of 146° C/W (derating factor of 6.85 mW/° C); junction-to-ambient thermal resistance of 486° C/W (derating factor of 2.06 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T162.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3013/FTSO3013

2N3014/FTSO3014

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3013		3014		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h _{FE}	DC Current Gain (Note 5)	30	120	30	120		I _C = 30 mA, V _{CE} = 0.4 V I _C = 10 mA, V _{CE} = 0.4 V I _C = 100 mA, V _{CE} = 0.5 V I _C = 100 mA, V _{CE} = 1.0 V I _C = 300 mA, V _{CE} = 1.0 V I _C = 30 mA, V _{CE} = 0.4 V, T _A = -55° C
		25		25			
		15		25			
		12		12			
V _{CE(sus)}	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		20		V	I _C = 10 mA, I _B = 0
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		0.18		0.18	V	I _C = 10 mA, I _B = 1.0 mA
			0.28		0.35	V	I _C = 30 mA, I _B = 3.0 mA
			0.5			V	I _C = 100 mA, I _B = 10 mA
			0.25		0.25	V	I _C = 300 mA, I _B = 30 mA
						V	I _C = 30 mA, I _B = 3.0 mA, T _A = 125° C
V _{BE(sat)}	Base to Emitter Saturation Voltage (Note 5)	0.75	0.95	0.75	0.95	V	I _C = 30 mA, I _B = 3.0 mA
			1.2		1.2	V	I _C = 100 mA, I _B = 10 mA
			1.7			V	I _C = 300 mA, I _B = 30 mA
				0.7	0.8	V	I _C = 10 mA, I _B = 1.0 mA
C _{ob}	Output Capacitance		5.0		5.0	pF	V _{CB} = 5.0 V, I _E = 0
C _{ib}	Input Capacitance		8.0		8.0	pF	V _{BE} = 0.5 V, I _C = 0
h _{fe}	High Frequency Current Gain	3.5		3.5			I _C = 30 mA, V _{CE} = 10 V, f = 100 MHz
τ _s	Charge Storage Time Constant (test circuit no. 3111)		18		18	ns	I _C ≈ I _{B1} ≈ -I _{B2} ≈ 10 mA
t _{on}	Turn On Time (test circuit no. 233) (test circuit no. 286)		15			ns	I _C ≈ 300 mA, I _{B1} ≈ 30 mA
					16	ns	I _C ≈ 30 mA, I _{B1} ≈ 3.0 mA
t _{off}	Turn Off Time (test circuit no. 233) (test circuit no. 286)		25			ns	I _C ≈ 300 mA, I _{B1} ≈ -I _{B2} = 3.0 mA
					25	ns	I _C ≈ 30 mA, I _{B1} ≈ -I _{B2} = 3.0 mA

3

2N3019/2N3020

NPN Small Signal General Purpose Amplifiers

- V_{CEO} ... 80 V (Min)
- $V_{CE(sat)}$... 0.5 V (Max) @ 500 mA
- h_{FE} ... 100-300 @ 150 mA (2N3019), 50 (Min) @ 100 μ A & 500 mA (2N3019)
- Complements ... 2N4031, 2N4033

PACKAGE

2N3019 TO-5
2N3020 TO-5

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -65° to 200° C
Operating Junction Temperature 200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
25° C Ambient Temperature 0.8 W
25° C Case Temperature 5.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 80 V
 V_{CB} Collector to Base Voltage 140 V
 V_{EB} Emitter to Base Voltage 7.0 V
 I_C Collector Current 1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3019		3020		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	80		80		V	$I_C = 30$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	140		140		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	nA μ A	$V_{CB} = 90$ V, $I_E = 0$ $V_{CB} = 90$ V, $I_E = 0$, $T_A = 150^\circ$ C
h_{FE}	DC Current Gain (Note 4)	50 90 100 40 50 15	300	30 40 40 30 15	100 120 120 100		$I_C = 0.1$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V, $T_A = -55^\circ$ C $I_C = 500$ mA, $V_{CE} = 10$ V $I_C = 1.0$ A, $V_{CE} = 10$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 217° C/W (derating factor of 4.6 mW/° C).
4. Pulse conditions: length \leq 300 μ s; duty cycle \leq 1%.
5. For product family characteristic curves, refer to Curve Set T149.

2N3019/2N3020

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3019		3020		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.2 0.5		0.2 0.5	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.1		1.1	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		12		12	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		60		60	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	80	400	30	200		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V},$ $f = 1.0 \text{ kHz}$
h_{fe}	Current Gain Bandwidth Product	5.0		5.0			$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 20 \text{ MHz}$
$r_b'C_c$	Collector Base Time Constant		400		400	ps	$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 4.0 \text{ MHz}$
NF	Noise Figure		4.0			dB	$I_C = 100 \mu\text{A}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega$

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 50-250 @ 150 mA
- f_T ... 100 MHz (Min) @ 50 mA

PACKAGE

2N3053

TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Case Temperature	5.0 W
Linear Derating Factor	28.6 mW/° C

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	40 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C Collector Current (Continuous)	700 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{ECO}	Collector to Emitter Breakdown Voltage	40		V	$I_C = 100 \mu A, I_E = 0$
BV_{CER}	Collector to Emitter Breakdown Voltage	50		V	$I_C = 100 \mu A, R_{BE} = 10 \Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_C = 0, I_E = 100 \mu A$
I_{CEX}	Collector Cutoff Current		0.25	μA	$V_{CE} = 30 V, V_{EB(OFF)} = 1.5 V$
I_{EBO}	Emitter to Base Cutoff Current		0.25	μA	$V_{EB} = 4.0 V, I_C = 0$
h_{FE}	DC Pulse Current Gain (Note 4)	25 50	250		$I_C = 150 mA, V_{CE} = 2.5 V$ $I_C = 150 mA, V_{CE} = 10 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		1.4	V	$I_C = 150 mA, I_B = 1.5 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.7	V	$I_C = 150 mA, I_B = 15 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		1.7	V	$I_C = 150 mA, V_{CE} = 2.5 V$
C_{ob}	Output Capacitance		15	pF	$V_{CB} = 10 V, I_E = 0, f = 140 kHz$
C_{ib}	Input Capacitance		80	pF	$V_{EB} = 0.5 V, I_C = 0, f = 140 kHz$
h_{fe}	Current Gain Bandwidth Product	5.0			$I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C).
4. Pulse conditions: length = 300 μs ; duty cycle = 2%.
5. For product family characteristic curves, refer to Curve Set T149.

**2N3107/2N3108
2N3109**

**NPN Small Signal General Purpose
Amplifiers & Saturated Switches**

- V_{CEO} ... 40 V (Min) (2N3109), 60 V (Min) (2N3107/8)
- $V_{CE(sat)}$... 1.0 V (Max) @ 1.0 A
- h_{FE} ... 100-300 @ 150 mA (2N3107/9), 40 (Min) @ 500 mA (2N3107/9, 40 (Min) @ 500 mA (2N3107/9)
- t_{on} ... 200 ns (Max) @ 150 mA
- t_{off} ... 600 ns (Max) (2N3108), 1.0 μ s (Max) (2N3107/9) @ 150 mA
- NF ... 7.0 dB (Max) @ 1.0 kHz

PACKAGE	
2N3107	TO-39
2N3108	TO-39
2N3109	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	0.8 W
25° C Case Temperature	5.0 W

Voltages & Currents

	3107/8	3109
V_{CEO} Collector to Emitter Voltage (Note 4)	60 V	40 V
V_{CBO} Collector to Base Voltage	100 V	80 V
V_{EBO} Emitter to Base Voltage	7.0 V	7.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	3107/9		3108		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage (2N3107 only)	100				V	$I_C = 100 \mu A, I_E = 0$
				100		V	$I_C = 100 \mu A, I_E = 0$
		80				V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	μA	$V_{CB} = 60 V, I_E = 0, T_A = 150^\circ C$
I_{CES}	Collector Reverse Current		10		10	nA	$V_{CE} = 60 V, V_{EB} = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 218° C/W (derating factor of 4.5 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
6. Saturation voltage measured with 1/4" lead length.
7. For product family characteristic curves, refer to Curve Set T149.

2N3107/2N3108/2N3109

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3107/9		3108		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	100 40 35 30	300	40 25 20 15	120		$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V},$ $T_A = -55^\circ \text{ C}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5) (2N3107) (2N3108) (2N3109)	60 40		60		V V V	$I_C = 30 \text{ mA}, I_B = 0$ $I_C = 30 \text{ mA}, I_B = 0$ $I_C = 30 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		0.25 1.0		0.25 1.0	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		1.1 2.0		1.1 2.0	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
C_{ob}	Open Circuit Output Capacitance (2N3107) (2N3108) (2N3109)		20 25		20	pF pF pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$ $V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$ $V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{ib}	Open Circuit Input Capacitance		80		80	pF	$V_{EB} = 0.5 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
t_{on}	Turn On Time (test circuit no. 288)		200		200	ns	$I_C \approx 150 \text{ mA}, I_{B1} \approx 7.5 \text{ mA},$ $I_{B2} \approx 7.5 \text{ mA}$
t_{off}	Turn Off Time (test circuit no. 289)		1000		600	ns	$I_C \approx 150 \text{ mA}, I_{B1} \approx 7.5 \text{ mA},$ $I_{B2} \approx 7.5 \text{ mA}$

2N3251/PN3251 FTSO3251

PNP Small Signal General Purpose
Amplifiers & Switches

- $V_{CE0} \dots -40 \text{ V (Min) (2N/PN/FTSO3251)}$
- $h_{FE} \dots 100-300 @ 10 \text{ mA}$
- $NF \dots 6.0 \text{ dB @ } I_C = 100 \mu\text{A}, V_{CE} = -5.0 \text{ V}$
- **Complements ... 2N3946 (40 V); 2N870, 2N871 (60 V) — (TO-18); 2N3903, 2N3904 (40 V)**

PACKAGE

2N3251	TO-18
PN3251	TO-92
FTSO3251	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	PN/FTSO	2N
Storage Temperature	-55° C to 150° C	-65° C to 200° C
Operating Junction Temperature	150° C	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	2N	FTSO
25° C Ambient Temperature	0.625 W	0.36 W	0.350 W*
25° C Case Temperature	1.0 W	1.2 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-40 V
V_{CBO} Collector to Base Voltage	-50 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage (Notes 4 & 5)	-40		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-50		V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{CEX}	Collector Reverse Current (Note 5)		20	nA	$V_{CE} = -40 \text{ V}, V_{EB} = -3.0 \text{ V}$
I_{BL}	Base Current		50	nA	$V_{CE} = -40 \text{ V}, V_{EB} = -3.0 \text{ V}$
h_{FE}	DC Current Gain	80 90			$I_C = 100 \mu\text{A}, V_{CE} = -1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -1.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 200° C and (TO-18) junction-to-case thermal resistance of 145° C/W (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486° C/W (derating factor of 2.1 mW/°C) for 2N series. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/°C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3251/PN3251
FTSO3251

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	100 30	300		$I_C = 10 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25 -0.50	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.6	-0.9 -1.2	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{ob}	Output Admittance		6.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		8.0	pF	$V_{EB} = 1.0 \text{ V}$, $I_C = 0$, $f = 100 \text{ kHz}$
h_{fe}	High Frequency Current Gain	3.0			$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	100	400		$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ie}	Input Impedance	2.0	12	k Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{oe}	Output Admittance	10	60	μmhos	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		20	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
t_d	Turn On Delay Time (test circuit no. 333)		35	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 1.0 \text{ mA}$
t_r	Rise Time (test circuit no. 333)		35	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 1.0 \text{ mA}$
t_s	Storage Time (test circuit no. 239)		200	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 1.0 \text{ mA}$
t_f	Fall Time (test circuit no. 239)		50	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 1.0 \text{ mA}$
$r_b'C_c$	Collector Base Time Constant		250	ps	$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 31.8 \text{ MHz}$
NF	Noise Figure		6.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 100 \text{ Hz}$, $R_E = 1.0 \text{ k}\Omega$

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

PACKAGE

2N3253	TO-39
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Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	3.0 W

Voltages & Currents

V _{CEO} Collector to Emitter Voltage	40 V
(Note 4)	
V _{CBO} Collector to Base Voltage	75 V
V _{EBO} Emitter to Base Voltage	5.0 V
I _c Collector Current	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV _{CBO}	Collector to Base Breakdown Voltage	75		V	I _c = 10 μA, I _E = 0
BV _{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I _E = 10 μA, I _c = 0
I _{EBO}	Emitter Cutoff Current		50	nA	V _{EB} = 4.0 V, I _c = 0
I _{cBO}	Collector Reverse Current (100° C)		500 75	nA μA	V _{CB} = 60 V, I _E = 0 V _{CB} = 60 V, I _E = 0
I _{CEX}	Collector Reverse Current		500	nA	V _{CE} = 60 V, V _{EB} = 4.0 V
I _{BL}	Base Current		500	nA	V _{CE} = 60 V, V _{OB} = 4.0 V
h _{FE}	DC Pulse Current Gain (Note 5)	25 25 20	75		I _c = 150 mA, V _{CE} = 1.0 V I _c = 375 mA, V _{CE} = 1.0 V I _c = 750 mA, V _{CE} = 5.0 V
V _{CEO(sus)}	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	40		V	I _c = 10 mA, I _B = 0
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		0.35 0.6 1.2	V V V	I _c = 150 mA, I _B = 15 mA I _c = 500 mA, I _B = 50 mA I _c = 1.0 A, I _B = 100 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage (Pulsed) (Note 5)	0.7	1.0 1.3 1.8	V V V	I _c = 150 mA, I _B = 15 mA I _c = 500 mA, I _B = 50 mA I _c = 1.0 A, I _B = 100 mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle ≤ 1%.
6. For product family characteristic curves, refer to Curve Set T139.

2N3253

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		12	pF	$V_{CB} = 20 \text{ V}, I_E = 0$
C_{ib}	Input Capacitance		80	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0$
h_{fe}	High Frequency Current Gain	1.75			$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
t_d	Turn On Delay Time (test circuit no. 3164)		15	ns	$I_C = 500 \text{ mA}, I_{B1} = 50 \text{ mA}$
t_r	Rise Time (test circuit no. 3164)		35	ns	$I_C = 500 \text{ mA}, I_{B1} = 50 \text{ mA}$
t_s	Storage Time (test circuit no. 3165)		40	ns	$I_C = 500 \text{ mA}, I_{B1} = I_{B2} = 50 \text{ mA}$
t_f	Fall Time (test circuit no. 3165)		30	ns	$I_C = 500 \text{ mA}, I_{B1} = I_{B2} = 50 \text{ mA}$
Q_T	Total Control Charge (test circuit no. 3163)		5.0	ncoul	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$

- $P_D \dots 10 \text{ W @ } T_C = 25^\circ \text{ C}$
- $V_{CEO} \dots 250\text{-}350 \text{ V (Min)}$

PACKAGE

2N3439	TO-39
2N3440	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	-65° C to 200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	1.0 W
25° C Case Temperature	10 W

Voltages & Currents

	3439	3440
V_{CEO} Collector to Emitter Voltage (Applicable from 0 to 50 mA)	350 V	250 V
V_{CBO} Collector to Base Voltage	450 V	300 V
V_{EBO} Emitter to Base Voltage	7.0 V	7.0 V
I_C Collector Current (Continuous)	1.0 A	1.0 A
I_B Base Current (Continuous)	0.5 A	0.5 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		20	μA	$V_{EB} = 6.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current (2N3439) (2N3440)		20 20	μA μA	$V_{CB} = 360 \text{ V}, I_E = 0$ $V_{CB} = 250 \text{ V}, I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 2)	40	160		$I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 2)		0.5	V	$I_C = 50 \text{ mA}, I_B = 4.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 2)		1.3	V	$I_C = 50 \text{ mA}, I_B = 4.0 \text{ mA}$
C_{ob}	Output Capacitance		10	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		75	pF	$V_{EB} = 5.0 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	3.0			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 5.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	25			$I_C = 5.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction operating temperature of 200° C and junction-to-case thermal resistance of 17.5° C/W (derating factor of 5.0 mW/° C); junction-to-ambient thermal resistance of 175° C/W (derating factor of 5.7 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T333.

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2N3700/2N3701NPN Small Signal General Purpose
Amplifiers

- $V_{CEO} \dots 80 \text{ V (Min) @ } 30 \text{ mA}$
- $V_{CE(sat)} \dots 0.5 \text{ V (Max) @ } 500 \text{ mA}$

PACKAGE

2N3700	TO-18
2N3701	TO-18

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.5 W
100° C Case Temperature	1.0 W
25° C Case Temperature	1.8 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	80 V
(Note 4)	
V_{CBO} Collector to Base Voltage	140 V
V_{EBO} Emitter to Base Voltage	7.0 V
I_C Collector Current	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3700		3701		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	140		140		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	nA	$V_{CB} = 90 \text{ V}, I_E = 0$
			10		10	μA	$V_{CB} = 90 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
h_{FE}	DC Pulse Current Gain (Note 5)	100	300	40	120		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		90		40	120		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		30	100		$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		30	100		$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
		15		15			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$
		40					$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
							$T_A = -55^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 97° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 350° C/W (derating factor of 2.85 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle $\leq 1\%$.
6. For product family characteristic curves, refer to Curve Set T149.

2N3700/2N3701

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3700		3701		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	80		80		V	$I_C = 30 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.2 0.5		0.2 0.5	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed)		1.1		1.1	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{ob}	Output Capacitance		12		12	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		60		60	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	5.0	10	4.0	10		$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	80	400	30	200		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
$r_b' C_c$	Collector to Base Time Constant	25	400	25	400	ps	$I_C = 10 \text{ mA}, V_{CB} = 10 \text{ V}, f = 4.0 \text{ MHz}$
NF	Noise Figure		4.0			dB	$I_C = 100 \mu\text{A}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}, R_G = 1.0 \text{ k}\Omega$

**2N3724/2N3725
2N4013/2N4014**

NPN Small Signal High Current High Speed Switches

- V_{CE0} ... 30 V (Min) (2N3724, 2N4013), 50 V (Min) (2N3725, 2N4014)
- $V_{CE(sat)}$... 0.65 V (Max) @ 800 mA, 0.75 V (Max) @ 1.0 A (2N3724, 2N4013)
- h_{FE} ... 60-150 @ 1.0 A (2N3724, 2N4013)
- t_{on} ... 35 ns (Max), t_{off} ... 60 ns (Max) @ 500 mA

PACKAGE	
2N3724	TO-5
2N3725	TO-5
2N4013	TO-18
2N4014	TO-18

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	4013/4	3724/5
25° C Ambient Temperature	0.36 W	0.8 W
25° C Case Temperature	1.2 W	3.5 W

Voltages & Currents

	3724/4013	3725/4014
V_{CE0} Collector to Emitter Voltage (Note 4)	30 V	50 V
V_{CBO} Collector to Base Voltage	50 V	80 V
V_{CES} Collector to Emitter Voltage	50 V	80 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V
I_C Collector Current (Note 5)	1.0 A	1.0 A
I_C DC Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3724/4013		3725/4014		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	50		80		V	$I_C = 10 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	50		50		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10 \mu A, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C) for 2N3724 and 2N3725; and 146° C/W (derating factor of 6.85 mW/° C) for the 2N4013 and 2N4014; junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.56 mW/° C) for the 2N3724, 2N3725, and 485° C/W (derating factor of 2.06 mW/° C) for the 2N4013 and 2N4014.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T162 for 2N3724/5 and T139 for 2N4013/4

2N3724/2N3725
2N4013/2N4014

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3724/4013		3725/4014		UNITS	TEST CONDITIONS	
		MIN	MAX	MIN	MAX			
I_{CBO}	Collector Cutoff Current		1.7		1.7	μA	$V_{CB} = 40 V, I_E = 0$	
			120		120	μA	$V_{CB} = 60 V, I_E = 0$	
						μA	$V_{CB} = 40 V, I_E = 0, T_A = 100^\circ C$	
						μA	$V_{CB} = 60 V, I_E = 0, T_A = 100^\circ C$	
I_{CES}	Collector Reverse Current		10		10	μA	$V_{CE} = 50 V, I_E = 0$	
						μA	$V_{CE} = 80 V, I_E = 0$	
h_{FE}	DC Pulse Current Gain (Note 5)	60	150	60	150		$I_C = 100 mA, V_{CE} = 1.0 V$	
		35		35			$I_C = 500 mA, V_{CE} = 1.0 V$	
		40		40			$I_C = 300 mA, V_{CE} = 1.0 V$	
		30		25			$I_C = 1.0 A, V_{CE} = 5.0 V$	
		30		30			$I_C = 10 mA, V_{CE} = 1.0 V$	
		25		20			$I_C = 800 mA, V_{CE} = 2.0 V$	
		30		30			$I_C = 100 mA, V_{CE} = 1.0 V,$ $T_A = -55^\circ C$	
		20		20			$I_C = 500 mA, V_{CE} = 1.0 V,$ $T_A = -55^\circ C$	
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	30		50		V	$I_C = 10 mA, I_B = 0$	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25		0.25	V	$I_C = 10 mA, I_B = 1.0 mA$	
			0.2		0.26	V	$I_C = 100 mA, I_B = 10 mA$	
			0.32		0.4	V	$I_C = 300 mA, I_B = 30 mA$	
			0.42		0.52	V	$I_C = 500 mA, I_B = 50 mA$	
			0.65		0.8	V	$I_C = 800 mA, I_B = 80 mA$	
			0.75		0.95	V	$I_C = 1.0 A, I_B = 100 mA$	
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.76		0.76	V	$I_C = 10 mA, I_B = 1.0 mA$	
			0.86		0.86	V	$I_C = 100 mA, I_B = 10 mA$	
			1.1		1.1	V	$I_C = 300 mA, I_B = 30 mA$	
			1.5		1.5	V	$I_C = 800 mA, I_B = 80 mA$	
			1.7		1.7	V	$I_C = 1.0 A, I_B = 100 mA$	
		0.8	1.1	0.8	1.1	V	$I_C = 500 mA, I_B = 50 mA$	
C_{ob}	Output Capacitance		12		10	pF	$V_{CB} = 10 V, I_E = 0$	
C_{ib}	Input Capacitance		55		55	pF	$V_{BE} = 0.5 V, I_C = 0$	
h_{fe}	High Frequency Current Gain	3.0		3.0			$I_C = 50 mA, V_{CE} = 10 V,$ $f = 100 MHz$	
t_{on}	Turn On Time (test circuit no. 265)		35		35	ns	$I_C = 500 mA, I_{B1} = 50 mA$	
t_{off}	Turn Off Time (test circuit no. 265)		60		60	ns	$I_C = 500 mA, I_{B1} = 50 mA,$ $I_{B2} = -50 mA$	

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**2N3903/FTSO3903
2N3904/FTSO3904****NPN Small Signal General Purpose
Amplifiers & Switches**

- V_{CEO} ... 40 V (Min)
- h_{FE} ... 100-300 @ 10 mA (2N/FTSO3904)
- NF ... 5.0 dB (Max) Wide Band (2N/FTSO3904)
- Complements ... 2N3905, 2N3906

PACKAGE

2N3903	TO-92
2N3904	TO-92
FTSO3903	TO-236AA/AB
FTSO3904	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	40 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3903		3904		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	40		40		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CEX}	Collector Cutoff Current		50		50	nA	$V_{CE} = 30$ V, $V_{EB} = 3.0$ V
I_{BL}	Base Cutoff Current		50		50	nA	$V_{CE} = 30$ V, $V_{EB} = 3.0$ V
h_{FE}	DC Current Gain (Note 4)	20 35 50 30 15	150	40 70 100 60 30	300		$I_C = 0.1$ mA, $V_{CE} = 1.0$ V $I_C = 1.0$ mA, $V_{CE} = 1.0$ V $I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 50$ mA, $V_{CE} = 1.0$ V $I_C = 100$ mA, $V_{CE} = 1.0$ V

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 - Pulse conditions: length = 300 μ s; duty cycle = 2%.
 - For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3903/FTSO3903
2N3904/FTSO3904

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3903		3904		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.2 0.3		0.2 0.3	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)	0.65	0.85 0.95	0.65	0.85 0.95	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		8.0		8.0	pF	$V_{BE} = 0.5 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
h_{fe}	Small Signal Current Gain	50	200	100	400		$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$
h_{ie}	Input Impedance	1.0	8.0	1.0	10	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$
h_{oe}	Output Admittance	1.0	40	1.0	40	μmho	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio	0.1	5.0	0.5	8.0	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	250		300		MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V},$ $f = 100 \text{ MHz}$
t_d	Turn On Delay Time (test circuit no. 526)		35		35	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V},$ $I_{B1} = 10 \text{ mA}, V_{BE(OFF)} = 0.5 \text{ V}$
t_r	Rise Time (test circuit no. 526)		35		35	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V},$ $I_{B1} = 10 \text{ mA}, V_{BE(OFF)} = 0.5 \text{ V}$
t_s	Storage Time (test circuit no. 527)		175		200	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V},$ $I_{B1} = I_{B2} = 1.0 \text{ mA}$
t_f	Fall Time (test circuit no. 527)		50		50	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V},$ $I_{B1} = I_{B2} = 1.0 \text{ mA}$
NF	Noise Figure		6.0		5.0	dB	$I_C = 100 \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $f = 10 \text{ Hz to } 15.7 \text{ kHz},$ $R_G = 1.0 \text{ k}\Omega$

3

**2N3905/FTSO3905
2N3906/FTSO3906**

**PNP Small Signal General Purpose
Amplifiers & Switches**

- V_{CEO} ... -40 V (Min)
- h_{FE} ... 100-300 @ 10 mA (2N3906)
- NF ... 4.0 dB (Max) Wide Band (2N3906)
- Complements ... 2N3903, 2N3904

PACKAGE

2N3905	TO-92
2N3906	TO-92
FTSO3905	TO-236AA/AB
FTSO3906	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	-40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-40 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3905		3906		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	-40		-40		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-40		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CEX}	Collector Cutoff Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = -3.0$ V
I_{BL}	Base Cutoff Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = -3.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30 40 50 30 15	150	60 80 100 60 30	300		$I_C = 0.1$ mA, $V_{CE} = -1.0$ V $I_C = 1.0$ mA, $V_{CE} = -1.0$ V $I_C = 10$ mA, $V_{CE} = -1.0$ V $I_C = 50$ mA, $V_{CE} = -1.0$ V $I_C = 100$ mA, $V_{CE} = -1.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle \leq 2%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3905/FTSO3905
2N3906/FTSO3906

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3905		3906		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25		-0.25	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			-0.4		-0.4	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.65	-0.85	-0.65	-0.85	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			-0.95		-0.95	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		4.5		4.5	pF	$V_{CB} = -5.0 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		10		10	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
h_{re}	Small Signal Current Gain	50	200	100	400		$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Impedance	0.5	8.0	2.0	10	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Admittance	1.0	40	3.0	60	μmho	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio	0.1	5.0	0.1	10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	200		250		MHz	$I_C = 10 \text{ mA}, V_{CE} = -20 \text{ V}, f = 100 \text{ MHz}$
t_d	Turn On Delay Time (test circuit no. 333)		35		35	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
t_r	Rise Time (test circuit no. 333)		35		35	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
t_s	Storage Time (test circuit no. 239)		200		225	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA}, I_{B2} \cong -1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
t_f	Fall Time (test circuit no. 239)		60		75	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA}, I_{B2} \cong -1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
NF	Wide Band Noise Figure		5.0		4.0	dB	$I_C = 100 \mu\text{A}, V_{CE} = -5.0 \text{ V}, R_S = 1.0 \text{ k}\Omega, f = 10 \text{ Hz to } 15.7 \text{ kHz}$

FAIRCHILD

A Schlumberger Company

2N3946/FTSO3946NPN Small Signal General
Purpose Amplifier & Switch• V_{CEO} ... 40 V (Min)**PACKAGE**

2N3946

TO18

FTSO3946

TO236AA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	FTSO
Storage Temperature	-65°C to 200°C	-55°C to 150°C
Operating Junction Temperature	175°C	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25°C Ambient Temperature	0.36 mW	0.350 W*
25°C Case Temperature	1.2 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	40 V	40 V
V_{CBO} Collector to Base Voltage	60 V	60 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V
I_C Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	40		V	$I_C = 10$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{CEX}	Collector Cutoff Current		10 15	nA μ A	$V_{CE} = 40$ V, $V_{EB} = 3.0$ V $V_{CE} = 40$ V, $V_{EB} = 3.0$ V, $T_A = 150^\circ$ C
I_{BL}	Base Cutoff Current		25	nA	$V_{CE} = 40$ V, $V_{EB} = 3.0$ V
h_{FE}	DC Current Gain (Note 5)	30 45 50 20	150		$I_C = 0.1$ mA, $V_{CE} = 1.0$ V $I_C = 1.0$ mA, $V_{CE} = 1.0$ V $I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 50$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.2 0.3	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.6	0.9 1.0	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 - These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 - Rating refers to a high current point where collector to emitter voltage is lowest.
 - Pulse conditions: length = 300 μ s; duty cycle = 2%.
 - For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3946/FTSO3946

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 100\text{ kHz}$
C_{ib}	Input Capacitance		8.0	pF	$V_{EB} = 1.0\text{ V}$, $I_C = 0$, $f = 100\text{ kHz}$
h_{fe}	Current Gain Bandwidth Product	2.5			$I_C = 10\text{ mA}$, $V_{CE} = 20\text{ V}$, $f = 100\text{ MHz}$
h_{ie}	Input Impedance	0.5	6.0	$k\Omega$	$I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ kHz}$
h_{oe}	Output Admittance	1.0	30	μmhos	$I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ kHz}$
h_{re}	Voltage Feedback Ratio		10	$\times 10^{-4}$	$I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ kHz}$
t_d	Delay Time (test circuit no. 526)		35	ns	$I_C = 10\text{ mA}$, $V_{CC} = 3.0\text{ V}$, $I_{B1} = 1.0\text{ mA}$, $V_{BE(OFF)} = 0.5\text{ V}$
t_r	Rise Time (test circuit no. 526)		300	ns	$I_C = 10\text{ mA}$, $V_{CC} = 3.0\text{ V}$, $I_{B1} = 1.0\text{ mA}$, $V_{BE(OFF)} = 0.5\text{ V}$
t_s	Storage Time (test circuit no. 527)		300	ns	$I_C = 10\text{ mA}$, $V_{CC} = 3.0\text{ V}$, $I_{B1} = I_{B2} = 1.0\text{ mA}$
t_f	Fall Time (test circuit no. 527)		75	ns	$I_C = 10\text{ mA}$, $V_{CC} = 3.0\text{ V}$, $I_{B1} = I_{B2} = 1.0\text{ mA}$
$r_b'C_c$	Collector to Base Time Constant		200	ps	$I_C = 10\text{ mA}$, $V_{CE} = 20\text{ V}$, $f = 31.8\text{ MHz}$
NF	Noise Figure		5.0	dB	$I_C = 100\ \mu\text{A}$, $V_{CE} = 5.0\text{ V}$, $R_G = 1.0\text{ k}\Omega$, $f = 10\text{ Hz to }15.7\text{ kHz}$

**2N3962/PN3962
FTSO3962**

**PNP Low Level Low Noise
Amplifiers**

- $V_{CE0} \dots -60 \text{ V (Min)}$
- **Excellent Beta Linearity from 1.0 μA to 50 mA**

PACKAGE	
2N3962	TO-18
PN3962	TO-92
FTSO3962	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	PN/FTSO	2N
Storage Temperature	-55° C to 150° C	-65° C to 200° C
Operating Junction Temperature	150° C	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	PN	FTSO
25° C Ambient Temperature	0.36 W	0.625 W	0.350 W*
25° C Case Temperature	1.2 W	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-60 V
V_{CBO} Collector to Base Voltage	-60 V
V_{EBO} Emitter to Base Voltage	-6.0 V
I_C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-60		V	$I_E = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}, I_B = 0$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{EB} = -4.0 \text{ V}, I_C = 0$
I_{CES}	Collector Reverse Current		10	nA	$V_{CE} = -50 \text{ V}, V_{EB} = 0$ $V_{CE} = -50 \text{ V}, V_{EB} = 0, T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain	60 100 100 100 40	300 450		$I_C = 1.0 \mu\text{A}, V_{CE} = -5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = -5.0 \text{ V}$ $I_C = 100 \mu\text{A}, V_{CE} = -5.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -5.0 \text{ V}$ $I_C = 10 \mu\text{A}, V_{CE} = -5.0 \text{ V}, T_A = -55^\circ \text{ C}$ $I_C = 1.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, T_A = 100^\circ \text{ C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	100 90 45			$I_C = 10 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
$V_{CE(sat)}$ $V_{CE(sat)}$	Collector to Emitter Saturation Voltage Collector to Emitter Saturation Voltage (Note 5)		-0.25 -0.4	V V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$ $V_{BE(sat)}$	Base to Emitter Saturation Voltage Base to Emitter Saturation Voltage (Note 5)		-0.9 -0.95	V V	$I_C = 10 \text{ mA}$, $I_B = 0.5 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)		-60	V	$I_C = 5.0 \text{ mA}$, $I_B = 0$
C_{ob}	Open Circuit Output Capacitance		6.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Open Circuit Input Capacitance		15	pF	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	2.0	8.0		$I_C = 0.5 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	100	500		$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	2.5	17	k Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance	5.0	40	μmhos	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Wide Band Noise Figure		3.0	dB	$I_C = 20 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $R_s = 10 \text{ k}\Omega$, BW = 15.7 Hz, $f = 10 \text{ Hz}$ to 10 kHz

2N4030/2N4031 2N4032/2N4033

PNP Small Signal General Purpose Amplifiers

- V_{CE0} ... 60 V (Min) (2N4030/2), 80 V (Min) 2N4031/3)
- h_{FE} ... 100-300 @ 10 mA (2N4032/3), 40 (Min) 2N4032), 25 (Min) (2N4033) @ 1.0 A
- Complements ... 2N3107, 2N3108, 2N3109, 2N3020

PACKAGES

2N4030	TO-39
2N4031	TO-39
2N4032	TO-39
2N4033	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	4.0 W

Voltages & Currents

	4030/2	4031/3
V_{CE0} Collector to Emitter Voltage (Note 4)	-60 V	-80 V
V_{CBO} Collector to Base Voltage	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	1.0 A	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4030		4031		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-80		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$V_{EB} = -5.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = -50 V, I_E = 0$
			50		50	nA	$V_{CB} = -60 V, I_E = 0$
					50	μA	$V_{CB} = -50 V, I_E = 0,$ $T_A = 150^\circ C$
					50	μA	$V_{CB} = -60 V, I_E = 0,$ $T_A = 150^\circ C$
h_{FE}	DC Current Gain	30		30			$I_C = 100 \mu A, V_{CE} = -5.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 43.7° C/W (derating factor of 22.8 mW/° C); junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.56 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T224.

2N4030/2N4031
2N4032/2N4033

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4030		4031		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	40 25 15 15	120	40 25 10 15	120		$I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 500 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
V_{CEO}	Collector to Emitter Sustaining Voltage (Note 5)	-60		-80		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15 -0.5 1.0		-0.15 -0.5	V V V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$ $I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		-1.1 -1.2		-1.1	V V	$I_C = 500 \text{ mA}$, $V_{CE} = -0.5 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		110		110	pF	$V_{BE} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{re} $	Magnitude of Common Emitter Small Signal Current Gain	1.0	4.0	1.0	4.0		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$
t_s	Storage Time (test circuit no. 341)		350		350	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 50 \text{ mA}$
t_f	Fall Time (test circuit no. 341)		50		50	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 50 \text{ mA}$
t_{on}	Turn On Time (test circuit no. 341)		100		100	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx 50 \text{ mA}$

SYMBOL	CHARACTERISTIC	4032		4033		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-80		V	$I_C = 10 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \text{ } \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 50		50 50	nA nA μA μA	$V_{CB} = -50 \text{ V}$, $I_E = 0$ $V_{CB} = -60 \text{ V}$, $I_E = 0$ $V_{CB} = -50 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$ $V_{CB} = -60 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain	75		75			$I_C = 100 \text{ } \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$
h_{FE}	DC Pulse Current Gain (Note 5)	100 70 40 40	300	100 70 25 40	300		$I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 500 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
V_{CEO}	Collector to Emitter Sustaining Voltage (Note 5)	-60		-80		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$

2N4030/2N4031
2N4032/2N4033

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4032		4033		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15		-0.15	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-0.5		-0.5	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
					-1.0	V	$I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		-1.1		-1.1	V	$I_C = 500 \text{ mA}, V_{CE} = -0.5 \text{ V}$
			1.2			V	$I_C = 1.0 \text{ A}, V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		110		110	pF	$V_{BE} = -0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.5	5.0	1.5	5.0		$I_C = 50 \text{ mA}, V_{CE} = -10 \text{ V}, f = 100 \text{ MHz}$
t_s	Storage Time (test circuit no. 341)		350		350	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx I_{B2} \approx 50 \text{ mA}$
t_f	Fall Time (test circuit no. 341)		50		50	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx I_{B2} \approx 50 \text{ mA}$
t_{on}	Turn On Time (see test circuit no. 341)		100		100	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx 50 \text{ mA}$

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N4036	TO-39
2N4037	TO-39

Temperatures

Storage Temperature	-65°C to 200°C
Operating Junction Temperature	-65°C to 200°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	4036	4037
25°C Ambient Temperature	5.0 W	1.0 W

Voltages & Currents (Note 4)

	4036	4037
V _{CEO} Collector to Emitter Voltage	-65 V	-40 V
V _{CBO} Collector to Base Voltage	-90 V	-60 V
V _{EBO} Emitter to Base Voltage	-7.0 V	-7.0 V
I _C Collector Current (Continuous)	1.0 A	1.0 A
I _B Base Current (Continuous)	0.5 A	0.5 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N4036		2N4037		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV _{CEO}	Collector to Emitter Sustaining Voltage	-65		-40		V	I _C = 100 mA, I _B = 0
BV _{CBO}	Collector to Base Breakdown Voltage			-60		V	I _C = 0.1 mA
I _{EBO}	Emitter Cutoff Current		10		1.0	μA	V _{EB} = -7.0 V V _{EB} = -5.0 V
I _{CBO}	Collector Cutoff Current		100		0.25	μA	V _{CB} = -90 V, I _E = 0 V _{CB} = -60 V, I _E = 0
I _{CEX}	Collector Cutoff Current		100 0.1			mA	V _{CE} = -85 V, V _{BE} = -1.5 V V _{CE} = -30 V, V _{BE} = -1.5 V T _C = 150°C
h _{FE}	DC Current Gain (Note 5)	20 20	200	15 50	250		I _C = 150 mA, V _{CE} = 2.0 V I _C = 100 μA, V _{CE} = 10 V I _C = 1.0 mA, V _{CE} = 10 V I _C = 150 mA, V _{CE} = 10 V I _C = 500 mA, V _{CE} = 10 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage		-0.65		-1.4	V	I _C = 150 mA, I _B = 15 mA
V _{BE(sat)}	Base to Emitter Saturation Voltage (Note 5)		-1.4			V	I _C = 150 mA, I _B = 15 mA
V _{BE(ON)}	Base to Emitter On Voltage			-1.4		V	I _C = 150 mA, V _{CE} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and (2N4036) junction-to-case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); (2N4037) junction-to-case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs, duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T224.

2N4036/2N4037

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N4036		2N4037		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$ h_{fe} $	High Frequency Current Gain	3.0		3.0	10		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 20 \text{ MHz}$
C_{cb}	Collector to Base Capacitance				30	pF	$V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ MHz}$
t_r	Rise Time		70			ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$
t_s	Storage Time		600			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$
t_f	Fall Time		100			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$
t_{on}	Turn On Time		110			ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$
t_{off}	Turn Off Time		700			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$

**2N4123/FTSO4123
2N4124/FTSO4124**

**NPN Small Signal General Purpose
Amplifiers & Switches**

- V_{CE0} ... 25 V (Min) (2N/FTSO4124)
- h_{FE} ... 120-360 @ 2.0 mA (2N/FTSO4124)
- NF ... 5.0 dB (Max) Wide Band (2N/FTSO4124)
- Complements ... 2N4125, 2N4126

PACKAGE

2N4123	TO-92
2N4124	TO-92
FTSO4123	TO-236AA/AB
FTSO4124	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	4123	4124
V_{CE0} Collector to Emitter Voltage (Note 4)	30 V	25 V
V_{CBO} Collector to Base Voltage	40 V	30 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V
I_C Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4123		4124		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	30		25		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		30		V	$I_C = 10$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = 3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = 20$ V, $I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	50 25	150	120 60	360		$I_C = 2.0$ mA, $V_{CE} = 1.0$ V $I_C = 50$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.3		0.3	V	$I_C = 50$ mA, $I_B = 5.0$ mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 2%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4123/FTSO4123 2N4124/FTSO4124

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4123		4124		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.95		0.95	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		8.0		8.0	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 100 \text{ kHz}$
$ h_{fe} $	Magnitude of Small Signal Current Gain	2.5		3.0			$I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50	200	120	480		$I_C = 2.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Noise Figure		6.0		5.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$, $R_S = 1.0 \text{ k}\Omega$

2N4125/FTSO4125
2N4126/FTSO4126

PNP Small Signal General Purpose
 Amplifiers & Switches

- V_{CEO} ... -25 V (Min) (2N/FTSO4126)
- h_{FE} ... 120-360 @ 2.0 mA (2N/FTSO4126)
- NF ... 4.0 dB (Max) Wide Band (2N/FTSO4126)
- Complements ... 2N4123, 2N4124

PACKAGE

2N4125	TO-92
2N4126	TO-92
FTSO4125	TO-236AA/AB
FTSO4126	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	4125	4126
V_{CEO} Collector to Emitter Voltage (Note 4)	-30 V	-25 V
V_{CBO} Collector to Base Voltage	-30 V	-25 V
V_{EBO} Emitter to Base Voltage	-4.0 V	-4.0 V
I_C Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4125		4126		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	-30		-25		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-30		-25		V	$I_C = 10 \text{ } \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		-4.0		V	$I_E = 10 \text{ } \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = -3.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = -20 \text{ V}, I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 5)		150	120	360		$I_C = 2.0 \text{ mA}, V_{CE} = -1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4		-0.4	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.95		-0.95	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 2%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4125/FTSO4125 2N4126/FTSO4126

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4125		4126		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
C_{cb}	Collector to Base Capacitance		4.5		4.5	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		10		10	pF	$V_{EB} = -0.5 \text{ V}$, $I_C = 0$, $f = 100 \text{ kHz}$
$ h_{fe} $	Magnitude of Small Signal Current Gain	2.0		2.0			$I_C = 10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50	200	120	480		$I_C = 2.0 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$, $f = 1.0 \text{ kHz}$
NF	Noise Figure		5.0		4.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$, $R_G = 1.0 \text{ k}\Omega$

2N4208/FTSO4208
2N4209/FTSO4209

PNP Small Signal Ultra High Speed
 Saturated Switches

- V_{CE0} ... 15 V (Min) (2N/FTSO4209)
- V_{CE} ... 0.18 V (Max) @ $I_C = 10$ mA (2N/FTSO4209)
- τ_s ... 20 ns (Max)
- t_{on} ... 15 ns (Max), t_{off} ... 20 ns (Max)
- C_{ob} ... 3.0 pF (Max)
- C_{ib} ... 3.5 pF (Max)
- f_T ... 850 MHz (Min) (2N/FTSO4209)
- Complement ... 2N2369A

PACKAGE

2N4208	TO-18
2N4209	TO-18
FTSO4208	TO-236AA/AB
FTSO4209	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	200° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.3 W	0.350 W*
25° C Case Temperature	0.7 W	

Voltages & Currents

	4208	4209
V_{CE0} Collector to Emitter Voltage (Note 4)	-12 V	-15 V
V_{CBO} Collector to Base Voltage	-12 V	-15 V
V_{EBO} Emitter to Base Voltage	-4.5 V	-4.5 V
I_C Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4208		4209		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CES}	Collector to Emitter Breakdown Voltage	-12		-15		V	$I_C = 100 \mu A, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-12		-15		V	$I_C = 100 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.5		-4.5		V	$I_E = 100 \mu A, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 200° C and (TO-92) junction-to-case thermal resistance of 250° C/W (derating factor of 4.0 mW/° C); junction-to-ambient thermal resistance of 583° C/W (derating factor of 1.72 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T292.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4208/FTSO4208
2N4209/FTSO4209

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4208		4209		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CES}	Collector Reverse Current (Note 5)		10 5.0		10 5.0	nA nA μ A μ A	$V_{CE} = -6.0$ V, $V_{BE} = 0$ $V_{CE} = -8.0$ V, $V_{BE} = 0$ $V_{CE} = -6.0$ V, $V_{BE} = 0$, $T_A = 125^\circ$ C $V_{CE} = -8.0$ V, $V_{BE} = 0$, $T_A = 125^\circ$ C
h_{FE}	DC Current Gain	15		35			$I_C = 1.0$ mA, $V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30 30 12	120	50 40 20	120		$I_C = 10$ mA, $V_{CE} = -0.3$ V $I_C = 50$ mA, $V_{CE} = -1.0$ V $I_C = 10$ mA, $V_{CE} = -0.3$ V, $T_A = -55^\circ$ C
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-12		-15		V	$I_C = 3.0$ mA, $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.13		-0.15	V	$I_C = 1.0$ mA, $I_B = 0.1$ mA
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		-0.15 -0.5		-0.18 -0.6	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-0.8		-0.8	V	$I_C = 1.0$ mA, $I_B = 0.1$ mA
$V_{BE(sat)}$	Pulsed Base to Emitter Saturation Voltage (Note 5)	-0.8	-0.95 -1.5	-0.8	-0.95 -1.5	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA
C_{ob}	Output Capacitance		3.0		3.0	pF	$V_{CB} = -5.0$ V, $I_E = 0$
C_{ib}	Input Capacitance		3.5		3.5	pF	$V_{BE} = -0.5$ V, $I_C = 0$
h_{fe}	High Frequency Current Gain		7.0		8.5		$I_C = 10$ mA, $V_{CE} = -10$ V, $f = 100$ MHz
τ_s	Charge Storage Time Constant (test circuit no. 234)		20		20	ns	$I_C = 10$ mA, $I_{B1} = I_{B2} \approx 10$ mA, $V_{CC} = -3.0$ V
t_{on}	Turn On Time (test circuit no. 348)		15		15	ns	$I_C = 10$ mA, $I_{B1} \approx 1.0$ mA, $V_{CC} = -1.5$ V
t_{off}	Turn Off Time (test circuit no. 348)		20		20	ns	$I_C = 10$ mA, $I_{B1} = I_{B2} \approx 1.0$ mA, $V_{CC} = -1.5$ V

2N4234/2N4235

2N4236

6 Watt PNP Power

- $V_{CE(sat)} \dots 0.6 \text{ V @ } I_C = 1.0 \text{ A}$
- **Complements ... 2N4237 through 2N4239**

PACKAGE

2N4234	TO-39
2N4235	TO-39
2N4236	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Case Temperature	6.0 W
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Voltages & Currents (Note 4)

	4234	4235	4236
V_{CEO} Collector to Emitter Voltage	-40 V	-60 V	-80 V
V_{CBO} Collector to Base Voltage	-40 V	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-7.0 V	-7.0 V	-7.0 V
I_C Collector Current (Continuous)	1.0 A	1.0 A	1.0 A
I_B Base Current (Continuous)	0.2 A	0.2 A	0.2 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 3)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		500	μA	$V_{EB} = -7.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current (2N4234) (2N4235) (2N4236)		100 100 100	μA μA μA	$V_{CB} = -40 \text{ V}, I_E = 0$ $V_{CB} = -60 \text{ V}, I_E = 0$ $V_{CB} = -80 \text{ V}, I_E = 0$
I_{CEO}	Collector Cutoff Current (2N4235) (2N4235) (2N4236)		1.0 1.0 1.0	mA mA mA	$V_{CE} = -30 \text{ V}, I_B = 0$ $V_{CE} = -40 \text{ V}, I_B = 0$ $V_{CE} = -60 \text{ V}, I_B = 0$
I_{CEX}	Collector Cutoff Current (2N4234) (2N4234) (2N4235) (2N4235) (2N4236) (2N4236) (2N4237)		100 1.0 100 1.0 100 1.0	μA mA μA μA μA mA	$V_{CE} = -40 \text{ V}, V_{EB} = -1.5 \text{ V}$ $V_{CE} = -30 \text{ V}, V_{EB} = -1.5 \text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = -60 \text{ V}, V_{EB} = -1.5 \text{ V}$ $V_{CE} = -40 \text{ V}, V_{EB} = -1.5 \text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = -80 \text{ V}, V_{EB} = -1.5 \text{ V}$ $V_{CE} = -60 \text{ V}, V_{EB} = -1.5 \text{ V}, T_C = 150^\circ\text{C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 33.3° C/W (derating factor of 34 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T414.

2N4234/2N4235
2N4236

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 3)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	40 30 20 10	150		$I_C = 100 \text{ mA}, V_{CE} = -1.0 \text{ V}$ $I_C = 250 \text{ mA}, V_{CE} = -1.0 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -1.0 \text{ V}$ $I_C = 1.0 \text{ A}, V_{CE} = -1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.6	V	$I_C = 1.0 \text{ A}, I_B = 125 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		-1.0	V	$I_C = 250 \text{ mA}, V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.5	V	$I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
C_{ob}	Output Capacitance		100	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
$ h_{re} $	Magnitude of Common Emitter Small Signal Current Gain	3.0			$I_C = 100 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ MHz}$
h_{re}	Small Signal Current Gain	25			$I_C = 50 \text{ mA}, V_{CE} = -10 \text{ V}, f = 1.0 \text{ kHz}$

2N4237/2N4238 2N4239

5 Watt NPN Power

- $V_{CE(sat)}$... 0.6 V @ $I_C = 1.0$ A
- Complements ... 2N4234 through 2N4236

PACKAGE

2N4237	TO-39
2N4238	TO-39
2N4239	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55°C to 200°C
Operating Junction Temperature	200°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25°C Ambient Temperature	0.8 W
25°C Case Temperature	5.0 W

Voltages & Currents

	4237	4238	4239
V_{CEO} Collector to Emitter Voltage (Note 4)	40 V	60 V	80 V
V_{CBO} Collector to Base Voltage	50 V	80 V	100 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V	6.0 V
I_C Collector Current	1.0 A	1.0 A	1.0 A
I_B Base Current (Note 2)	0.5 A	0.5 A	0.5 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		0.5	mA	$V_{EB} = 6.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current (4237) (4238) (4239)		0.1	mA	$V_{CB} = 50$ V, $I_E = 0$
			0.1	mA	$V_{CB} = 80$ V, $I_E = 0$
			0.1	mA	$V_{CB} = 100$ V, $I_E = 0$
I_{CEO}	Collector Cutoff Current (4237) (4238) (4239)		1.0	mA	$V_{CE} = 30$ V, $I_B = 0$
			1.0	mA	$V_{CE} = 40$ V, $I_B = 0$
			1.0	mA	$V_{CE} = 60$ V, $I_B = 0$
I_{CEX}	Collector Cutoff Current (4237) (4237) (4238) (4238) (4239) (4239)		0.1	mA	$V_{CE} = 50$ V, $V_{EB} = 1.5$ V
			1.0	mA	$V_{CE} = 30$ V, $V_{EB} = 1.5$ V, $T_C = 150^\circ$ C
			0.1	mA	$V_{CE} = 80$ V, $V_{EB} = 1.5$ V
			0.1	mA	$V_{CE} = 50$ V, $V_{EB} = 1.5$ V, $T_C = 150^\circ$ C
			0.1	mA	$V_{CE} = 100$ V, $V_{EB} = 1.5$ V
			0.1	mA	$V_{CE} = 70$ V, $V_{EB} = 1.5$ V, $T_C = 150^\circ$ C
h_{FE}	DC Pulse Current Gain (Note 5) (4237) (4238) (4239)	30	150		$I_C = 250$ mA, $V_{CE} = 1.0$ V
		30			$I_C = 500$ mA, $V_{CE} = 4.0$ V
		15			$I_C = 1.0$ A, $V_{CE} = 1.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/W (derating factor of 28.5 mW/°C); junction-to-ambient thermal resistance of 218.8°C/W (derating factor of 4.5 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μ s; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T315,

2N4237/2N4238
2N4239

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 4)		0.6 0.3	V V	$I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$ $I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Pulsed) (Note 4)		1.0	V	$I_C = 250 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed) (Note 4)		1.5	V	$I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$
C_{ob}	Output Capacitance		100	pF	$V_{CB} = 10 \text{ V}$, $I_C = 0$, $f = 0.1 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0			$I_C = 100 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{fe}	Small Signal Current Gain	30			$I_C = 100 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$

**2N4400/FTSO4400
2N4401/FTSO4401**

Small Signal General Purpose
Amplifiers & Switches

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 100-300 @ 150 mA (2N/FTSO4401);
40 (Min) @ 500 mA (2N/FTSO4401)
- t_{on} ... 35 ns (Max) @ 150 mA
- t_{off} ... 255 ns (Max) @ 150 mA
- Complements ... 2N4402, 2N4403

PACKAGE

2N4400	TO-92
2N4401	TO-92
FTSO4400	TO-236AA/AB
FTSO4401	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4400		4401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(US)}$	Collector to Emitter Sustaining Voltage (Note 5)	40		40		V	$I_C = 1.0 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CEX}	Collector Cutoff Current		100		100	nA	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$
I_{BL}	Base Reverse Current		100		100	nA	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle \leq 2%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4400/FTSO4400
2N4401/FTSO4401

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4400		4401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	20 40		20 40 80			$I_C = 100 \mu A, V_{CE} = 1.0 V$ $I_C = 1.0 mA, V_{CE} = 1.0 V$ $I_C = 10 mA, V_{CE} = 1.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 40	300		$I_C = 150 mA, V_{CE} = 1.0 V$ $I_C = 500 mA, V_{CE} = 2.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 0.75		0.4 0.75	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.75	0.95 1.2	0.75	0.95 1.2	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
C_{cb}	Collector to Base Capacitance		6.5		6.5	pF	$V_{CB} = 5.0 V, I_E = 0, f = 100 kHz$
C_{eb}	Emitter to Base Capacitance		30		30	pF	$V_{BE} = 0.5 V, I_C = 0, f = 100 kHz$
h_{fe}	Small Signal Current Gain	20	250	40	500		$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{ie}	Input Impedance	0.5	7.5	1.0	15	k Ω	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{oe}	Output Admittance	1.0	30	1.0	30	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	$\times 10^{-4}$	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
f_T	Current Gain Bandwidth Product	200		250		MHz	$I_C = 20 mA, V_{CE} = 10 V,$ $f = 100 MHz$
t_d	Turn On Delay Time (test circuit no. 559)		15		15	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = 15 mA$
t_r	Rise Time (test circuit no. 559)		20		20	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = 15 mA$
t_s	Storage Time (test circuit no. 560)		225		225	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = I_{B2} = 15 mA$
t_f	Fall Time (test circuit no. 560)		30		30	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = I_{B2} = 15 mA$

**2N4402/FTSO4402
2N4403/FTSO4403**

**PNP Small Signal General Purpose
Amplifiers & Switches**

- V_{CE0} ... -40 V (Min)
- h_{FE} ... 100-300 @ 150 mA (2N/FTSO4403),
20 (Min) @ 500 mA (2N/FTSO4403)
- t_{on} ... 35 ns (Max) @ 150 mA
- t_{off} ... 255 ns (Max) @ 150 mA
- Complements ... 2N4400, 2N4401

PACKAGE

2N4402	TO-92
2N4403	TO-92
FTSO4402	TO-236AA/AB
FTSO4403	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-40 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4402		4403		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-40		-40		V	$I_C = 1.0$ mA, $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-40		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{CEX}	Collector Reverse Current		100		100	nA	$V_{CE} = -35$ V, $V_{EB} = -0.4$ V
I_{BL}	Base Reverse Current		100		100	nA	$V_{CE} = -35$ V, $V_{EB} = -0.4$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle < 2%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4402/FTSO4402
2N4403/FTSO4403

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4402		4403		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	30 50		30 60 100			$I_C = 100 \mu A, V_{CE} = 1.0 V$ $I_C = 1.0 mA, V_{CE} = -1.0 V$ $I_C = 10 mA, V_{CE} = -1.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 20	300		$I_C = 150 mA, V_{CE} = -2.0 V$ $I_C = 500 mA, V_{CE} = -2.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4 -0.75		-0.4 -0.75	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.75	-0.95 -1.3	-0.75	-0.95 -1.3	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
C_{cb}	Collector to Base Capacitance		8.5		8.5	pF	$V_{CB} = -10 V, I_E = 0, f = 140 kHz$
C_{eb}	Emitter to Base Capacitance		30		30	pF	$V_{EB} = -0.5 V, I_C = 0, f = 140 kHz$
h_{fe}	Small Signal Current Gain	30	250	60	500		$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{ie}	Input Impedance	0.75	7.5	1.5	15	k Ω	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{oe}	Output Admittance	1.0	100	1.0	100	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	$\times 10^{-4}$	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
f_T	Current Gain Bandwidth Product	150		200		MHz	$I_C = 20 mA, V_{CE} = -10 V,$ $f = 100 MHz$
t_d	Turn On Delay Time (test circuit no. 557)		15		15	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = 15 mA$
t_r	Rise Time (test circuit no. 557)		20		20	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = 15 mA$
t_s	Storage Time (test circuit no. 558)		225		225	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = I_{B2} = 15 mA$
t_f	Fall Time (test circuit no. 558)		30		30	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = I_{B2} = 15 mA$

**2N4409/FTSO4409
2N4410/FTSO4410**

NPN Neon Display Tube Drivers

- V_{CE0} ... **80 V (Min) (2N/FTSO4410)**
- h_{FE} ... **60 V (Min) @ 1.0 and 10 mA**
- **Complements ... MPSA55, MPSA56**

PACKAGE

2N4409	TO-92
2N4410	TO-92
FTSO4409	TO-236AA/AB
FTSO4410	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	4409	4410
V_{CE0} Collector to Emitter Voltage (Note 4)	50 V	80 V
V_{CBO} Collector to Base Voltage	80 V	120 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V
I_C Collector Current	250 mA	250 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4409		4410		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	50		80		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{CEX}	Collector to Emitter Breakdown Voltage	80		120		V	$I_C = 500 \mu\text{A}, V_{BB} = -5.0 \text{ V}, R_{BE} = 8.2 \text{ k}\Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	80		120		V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T147.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N4409/FTSO4409
2N4410/FTSO4410

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	4409		4410		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I _{CBO}	Collector Cutoff Current		10		10	nA	V _{CB} = 60 V, I _E = 0
			1.0		1.0	μA	V _{CB} = 100 V, I _E = 0 V _{CB} = 60 V, I _E = 0, T _A = 100° C V _{CB} = 100 V, I _E = 0, T _A = 100° C
h _{FE}	DC Current Gain	60		60			I _C = 1.0 mA, V _{CE} = 1.0 V
h _{FE}	DC Pulse Current Gain (Note 5)	60	400	60	400		I _C = 10 mA, V _{CE} = 1.0 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage		0.2		0.2	V	I _C = 1.0 mA, I _B = 0.1 mA
V _{BE(ON)}	Base to Emitter "On" Voltage		0.8		0.8	V	I _C = 1.0 mA, V _{CE} = 5.0 V
V _{BE(sat)}	Base to Emitter Saturation Voltage		0.8		0.8	V	I _C = 1.0 mA, I _B = 0.1 mA
C _{cb}	Collector to Base Capacitance		12		12	pF	V _{CB} = 10 V, I _E = 0, f = 140 kHz
C _{eb}	Emitter to Base Capacitance		50		50	pF	V _{EB} = 0.5 V, I _C = 0, f = 100 kHz
h _{fe}	Magnitude of Common Emitter Small Signal Current Gain	2.0	10	2.0	10		I _C = 10 mA, V _{CE} = 10 V, f = 30 MHz

- $V_{CE(sat)} \dots 0.7 \text{ V @ } I_C = 2.0 \text{ A}$
- **Low Leakage** ... $I_{CES}^{(Max)} \mu^{100} \mu\text{A @ } T_C = 150^\circ \text{C}$

PACKAGE
2N4896 TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -65°C to 200°C
Operating Junction Temperature 200°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
25°C Ambient Temperature 0.8 W
25°C Case Temperature
100°C Case Temperature 4.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 60 V
(Note 4)
 V_{CBO} Collector to Base Voltage 120 V
 V_{EBO} Emitter to Base Voltage 6.0 V
 I_C Collector Current 5.0 A
 I_B Base Current 1.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		1.0 1.0	μA mA	$V_{EB} = 4.0 \text{ V}, I_E = 0$ $V_{EB} = 6.0 \text{ V}, I_C = 0$
I_{CES}	Collector Cutoff Current		0.1 1.0 1.0	mA mA μA	$V_{CE} = 60 \text{ V}, V_{BE} = 0, T_A = 150^\circ \text{C}$ $V_{CE} = 120 \text{ V}, V_{BE} = 0$ $V_{CE} = 60 \text{ V}, V_{BE} = 0$
h_{FE}	DC Current Gain (Note 5)	100 35	300		$I_C = 2.0 \text{ A}, V_{CE} = 2.0 \text{ V}$ $I_C = 2.0 \text{ A}, V_{CE} = 2.0 \text{ V}, T_A = -55^\circ \text{C}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60		V	$I_C = 50 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Notes 5 & 6))		1.0	V	$I_C = 5.0 \text{ mA}, I_B = 0.5 \text{ A}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Notes 5 & 6)		1.6	V	$I_C = 5.0 \text{ mA}, I_B = 0.5 \text{ A}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.57 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. Point of measurement: 1/4" from header.
7. For product family characteristic curves, refer to Curve Set T145.

2N4896

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		80	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 0.14 \text{ MHz}$
C_{ib}	Input Capacitance		500	pF	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 0.14 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	4.0			$I_C = 0.5 \text{ A}$, $V_{CE} = 5.0 \text{ V}$, $f = 20 \text{ MHz}$
t_d	Turn On Delay Time		50	ns	$I_C = 5.0 \text{ A}$, $I_{B1} = 0.5 \text{ A}$
t_r	Rise Time		300	ns	$I_C = 5.0 \text{ A}$, $I_{B1} = 0.5 \text{ A}$
t_s	Storage Time		350	ns	$I_C = 5.0 \text{ A}$, $I_{B1} = I_{B2} = 0.5 \text{ A}$
t_f	Fall Time		300	ns	$I_C = 5.0 \text{ A}$, $I_{B1} = I_{B2} = 0.5 \text{ A}$

2N5086/FTSO5086 2N5087/FTSO5087

PNP Low Level Low Noise High Gain Amplifiers

- V_{CE0} ... -50 V (Min)
- h_{FE} ... 250 (Min) from 100 μ A to 10 mA (2N/FTSO5087)
- NF ... 2.0 dB (Max) Wide Band and 1.0 kHz (2N/FTSO5087)
- Complements ... 2N5209, 2N5210

PACKAGE

2N5086	TO-92
2N5087	TO-92
FTSO5086	TO-236AA/AB
FTSO5087	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	1.0 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	0.625 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-50 V
V_{CBO} Collector to Base Voltage	-50 V
V_{EBO} Emitter to Base Voltage	-3.0 V
I_C Collector Current (Peak)	100 mA
I_C Collector Current (Continuous)	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5086		5087		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sat)}$	Collector to Emitter Breakdown Voltage	-50		-50		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-50		-50		V	$I_C = 100$ μ A, $I_E = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = -3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10 50		10 50	nA nA	$V_{CB} = -10$ V, $I_E = 0$ $V_{CB} = -35$ V, $I_E = 0$
h_{FE}	DC Current Gain	150 150	500	250 250	800		$I_C = 100$ μ A, $V_{CE} = -5.0$ V $I_C = 1.0$ mA, $V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	150		250			$I_C = 10$ mA, $V_{CE} = -5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5086/FTSO5086
2N5087/FTSO5087

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5086		5087		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.3		-0.3	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(on)}$	Base to Emitter "On" Voltage (Note 5)		-0.85		-0.85	V	$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$
C_{cb}	Output Capacitance		4.0		4.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
h_{fe}	Small Signal Current Gain	150	600	250	900		$I_C = 1.0 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	40		40		MHz	$I_C = 500 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 20 \text{ MHz}$
NF	Noise Figure		3.0		2.0	dB	$I_C = 20 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 10 \text{ to } 15.7 \text{ kHz}$, $R_S = 10 \text{ k}\Omega$
			3.0		2.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $f = 1.0 \text{ kHz}$, $R_S = 3.0 \text{ k}\Omega$

2N5088/FTSO5088
2N5089/FTSO5089

NPN Low Level Low Noise High Gain Amplifiers

- V_{CE0} ... **25 V (Min) (2N/FTSO5089)**
- h_{FE} ... **400 (Min) from 100 μ A to 10 mA (2N/FTSO5089)**
- **NF ... 2.0 dB (Max) Wide Band**
- **Complements ... 2N5086, 2N5087**

PACKAGE

2N5088	TO-92
2N5089	TO-92
FTSO5088	TO-236AA/AB
FTSO5089	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5088	5089
V_{CE0} Collector to Emitter Voltage (Note 4)	30 V	25 V
V_{CBO} Collector to Base Voltage	35 V	30 V
V_{EBO} Emitter to Base Voltage	4.5 V	4.5 V
I_C Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5086		5087		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sus)}$	Collector to Emitter Sustaining Voltage	30		25		V	$I_C = 1.0$ mA, $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	35		30		V	$I_C = 100$ μ A, $I_E = 0$
I_{EBO}	Emitter Cutoff Current		50 100		50 100	nA nA	$V_{EB} = 3.0$ V, $I_C = 0$ $V_{EB} = 4.5$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA nA	$V_{CB} = 20$ V, $I_E = 0$ $V_{CB} = 15$ V, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	300 350 300	900	400 450 400	1200		$I_C = 100$ μ A, $V_{CE} = 5.0$ V $I_C = 1.0$ mA, $V_{CE} = 5.0$ V $I_C = 10$ mA, $V_{CE} = 5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3

2N5088/FTSO5088
2N5089/FTSO5089

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5086		5087		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5		0.5	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		0.8		0.8	V	$I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
C_{cb}	Collector to Base Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
C_{eb}	Emitter to Base Capacitance		10		10	pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 100 \text{ kHz}$
h_{re}	Small Signal Current Gain	350	1400	450	1800		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	50		50		MHz	$I_C = 500 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 20 \text{ MHz}$
NF	Noise Figure		3.0		2.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $R_S = 10 \text{ k}\Omega$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$

**2N5209/FTSO5209
2N5210/FTOS5210**

**NPN Low Level Low Noise High
Gain Amplifiers**

- V_{CE0} ... 50 V (Min)
- h_{FE} ... 200 (Min) @ 100 μ A, 250 (Min) @ 1.0 mA and 10 mA (2N5210)
- NF ... 2.0 dB (Max) Wide Band (2N5210)
- Complement ... 2N5086, 2N5087

PACKAGE

2N5209	TO-92
2N5210	TO-92
FTSO5209	TO-236AA/AB
FTSO5210	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	50 V
(Note 4)	
V_{CBO} Collector to Base Voltage	50 V
V_{EBO} Emitter to Base Voltage	4.5 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5209		5210		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	50		50		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	50		50		V	$I_C = 100$ μ A, $I_E = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = 3.0$ V, $I_C = 0$ $V_{EB} = 4.5$ V, $I_C = 0$
			100		100	nA	

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle < 2%.
 6. For product family characteristic curves, refer to Curve Set T155.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5209/FTSO5209
2N5210/FTOS5210

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5209		5210		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I _{CBO}	Collector Cutoff Current		50		50	nA	V _{CB} = 35 V, I _E = 0
			10		10	nA	V _{CB} = 10 V, I _E = 0
h _{FE}	DC Current Gain (Note 5)	100	300	200	600		I _C = 100 μA, V _{CE} = 5.0 V
		150		250			I _C = 1.0 mA, V _{CE} = 5.0 V
		150		250			I _C = 10 mA, V _{CE} = 5.0 V
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		0.7		0.7	V	I _C = 10 mA, I _B = 1.0 mA
V _{BE(ON)}	Base to Emitter "On" Voltage		0.85		0.85	V	I _C = 1.0 mA, V _{CE} = 5.0 V
C _{cb}	Collector to Base Capacitance		4.0		4.0	pF	V _{CB} = 5.0 V, I _E = 0, f = 100 kHz
h _{fe}	Small Signal Current Gain	150	600	250	900		I _C = 1.0 mA, V _{CE} = 5.0 V, f = 1.0 kHz
f _T	Current Gain Bandwidth Product	30		30		MHz	I _C = 500 μA, V _{CE} = 5.0 V, f = 20 MHz
NF	Noise Figure		3.0		2.0	dB	I _C = 20 μA, V _{CE} = 5.0 V, R _S = 22 kΩ, f = 10Hz to 15.7 kHz
			4.0		3.0	dB	I _C = 20 μA, V _{CE} = 5.0 V, R _S = 10 kΩ, f = 1.0 kHz

2N5220/FTSO5220

NPN Small Signal General Purpose Complementary Amplifiers

- V_{CE0} ... 15 V (Min)
- h_{FE} ... 30-600 @ 50 mA
- $V_{CE(sat)}$... 0.5 V (max) @ 150 mA

PACKAGE

2N5220
FTSO5220

TO92-1
TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage 15 V
(Note 4)
 V_{CBO} Collector to Base Voltage 15 V
 V_{EBO} Emitter to Base Voltage 3.0 V
 I_C Collector Current 500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	15		V	$I_C = 10$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	15		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 10$ V, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	25 30	600		$I_C = 10$ mA, $V_{CE} = 10$ V $I_C = 50$ mA, $V_{CE} = 10$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5	V	$I_C = 150$ mA, $I_B = 15$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.1	V	$I_C = 150$ mA, $I_B = 15$ mA
C_{cb}	Collector to Base Capacitance		10	pF	$V_{CB} = 5.0$ V, $I_E = 0$, $f = 1.0$ MHz
h_{fe}	Small Signal Current Gain	30	1800		$I_C = 50$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz
f_T	Current Gain Bandwidth Product	100		MHz	$I_C = 20$ mA, $V_{CE} = 10$ V

NOTES:

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μ s; duty cycle < 2%.
- For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5223/FTSO5223

NPN Small Signal General Purpose Amplifier & Oscillator

- P_D ... 625 mW @ $T_A = 25^\circ C$
- V_{CE0} ... 20 V (Min)
- h_{FE} ... 50-800 @ 2.0 mA
- f_T ... 150 MHz (Min) @ 10 mA
- C_{cb} ... 4.0 pF (Max)
- Complement ... 2N/FTSO5227

PACKAGE

2N5223	TO-92
FTSO5223	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	20 V
(Note 4)	
V_{CBO} Collector to Base Voltage	25 V
V_{EBO} Emitter to Base Voltage	3.0 V
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 1.0 \text{ mA}$, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	$I_C = 100 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	$I_E = 100 \text{ } \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		500	nA	$V_{EB} = 2.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 10 \text{ V}$, $I_E = 0$
h_{FE}	DC Current Gain	50	800		$I_C = 2.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle < 2%.
 6. For product family characteristic curves, refer to Curve Set T144.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.7	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.2	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50	1600		$I_C = 2.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	150		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$

- V_{CEO} ... 12 V (Min)
- t_{on} ... 45 ns (Max) @ 10 mA
- t_{off} ... 60 ns (Max) @ 10 mA
- f_T ... 250 MHz (Min) @ 10 mA
- C_{cb} ... 4.0 pF (Max)
- Complement ... MPSL08

PACKAGE

2N5224 TO-92
 FTSO5224 TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° C to 150° C
 Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	12 V
(Note 4)	
V_{CBO} Collector to Base Voltage	25 V
V_{EBO} Emitter to Base Voltage	5.0 V
I_C DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	12		V	$I_C = 10$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		100	μ A	$V_{EB} = 4.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		500	nA	$V_{CB} = 15$ V, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	40 15	400		$I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 100$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.35	V	$I_C = 10$ mA, $I_B = 3.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9	V	$I_C = 10$ mA, $I_B = 3.0$ mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle < 2%.
 6. For product family characteristic curves, refer to Curve Set T162.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5224/FTSO5224

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{ce} = 5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
f_T	Current Gain Bandwidth Product	250		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
t_d	Delay Time (test circuit no. 531)		25	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 3.0 \text{ mA}$
t_r	Rise Time (test circuit no. 531)		20	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 3.0 \text{ mA}$
t_s	Storage Time (test circuit no. 531)		35	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 3.0 \text{ mA}$
t_f	Fall Time (test circuit no. 531)		25	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 3.0 \text{ mA}$

FAIRCHILD

A Schlumberger Company

**2N5225/FTSO5225
2N5226/FTOS5226****NPN-PNP Small Signal General
Purpose Complementary Amplifiers**

- $V_{CE0} \dots 25 \text{ V (Min)}$
- $h_{FE} \dots 30\text{-}600 \text{ @ } 50 \text{ mA}$
- $V_{CE(sat)} \dots 0.8 \text{ V (Max) @ } 100 \text{ mA}$
- **Complement ... 2N5225 (NPN), 2N5226 (PNP)**

PACKAGE

2N5225	TO-92
2N5226	TO-92
FTSO5225	TO-236AA/AB
FTSO5226	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5225	5226
V_{CE0} Collector to Emitter Voltage (Note 4)	25 V	-25 V
V_{CBO} Collector to Base Voltage	25 V	-25 V
V_{EBO} Emitter to Base Voltage	4.0 V	-4.0 V
I_C Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N5225		2N5226		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	25		-25		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25		-25		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		-4.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		500		500	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		300		300	nA	$V_{CB} = 15 \text{ V}, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	25 30	600	25 30	600		$I_C = 10 \mu\text{A}, V_{CE} = 10 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 2%.
 6. For product family characteristic curves, refer to Curve Set T145 for 2N5225 and T212 for 2N5226.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5225/FTSO5225
2N5226/FTOS5226

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N5225		2N5226		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.8		-0.8	V	$I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0		-1.0	V	$I_C = 100 \text{ mA}$, $I_B = 10 \text{ mA}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = 5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	30	1800	30	1800		$I_C = 50 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product		50		50	MHz	$I_C = 20 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 20 \text{ MHz}$

- V_{CEO} ... 30 V (Min)
- h_{FE} ... 50-700 @ 2.0 mA
- f_T ... 100 MHz (Min) @ 10 mA
- C_{cb} ... 5.0 pF (Max)
- Complements ... 2N5223

PACKAGES

- | | |
|----------|-------------|
| 2N5227 | TO-92 |
| FTSO5227 | TO-236AA/AB |

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	-30 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-30 V
V_{EBO} Emitter to Base Voltage	-3.0 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-30		V	$I_C = 1.0 \text{ mA}$, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-30		V	$I_C = 100 \text{ } \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-3.0		V	$I_E = 100 \text{ } \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		500	nA	$V_{EB} = -2.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = -10 \text{ V}$, $I_E = 0$
h_{FE}	DC Current Gain (Note 5)	30 50	700		$I_C = 100 \text{ } \mu\text{A}$, $V_{CE} = -10 \text{ V}$ $I_C = 2.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.4	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-1.0	V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		5.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50	1500		$I_C = 2.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	100		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T215.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

- V_{CE0} ... -5.0 V (Min)
- t_{on} ... 75 ns (Max) @ 10 mA
- t_{off} ... 140 ns (Max) @ 10 mA
- f_T ... 300 MHz (Min) @ 10 mA
- C_{cb} ... 5.0 pF (Max)
- Complement ... 2N5224

PACKAGE

2N5228	TO-92
FTSO5228	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55°C to 150°C
Operating Junction Temperature	150°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CES}	Collector to Emitter Voltage	-6.0 V
V_{CE0}	Collector to Emitter Voltage	-5.0 V
V_{CBO}	Collector to Base Voltage	-5.0 V
V_{EBO}	Emitter to Base Voltage	-3.0 V
I_C	DC Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 4)	-5.0		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-6.0		V	$I_C = 100 \mu\text{A}, V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-5.0		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-3.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
I_{CES}	Collector Cutoff Current		100	nA	$V_{CE} = -4.0 \text{ V}, V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		100	μA	$V_{EB} = -2.5 \text{ V}, I_C = 0$
h_{FE}	DC Current Gain (Note 4)	30 15			$I_C = 10 \text{ mA}, V_{CE} = -0.3 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
 4. Pulse conditions: length = 300 μs ; duty cycle * 2%.
 5. For product family characteristic curves, refer to Curve Set T292.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5228/FTSO5228

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		-0.4	V	$I_C = 10 \text{ mA}$, $I_B = 3.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)	-0.65	-1.25	V	$I_C = 10 \text{ mA}$, $I_B = 3.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		5.0	pF	$V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
f_T	Current Gain Bandwidth Product	300		MHz	$I_C = 10 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $f = 100 \text{ MHz}$
t_d	Delay Time (test circuit no. 532)		25	ns	$I_C \approx 10 \text{ mA}$, $V_{CC} = -3.0 \text{ V}$, $I_{B1} \approx 3.0 \text{ mA}$
t_r	Rise Time (test circuit no. 532)		50	ns	$I_C \approx 10 \text{ mA}$, $V_{CC} = -3.0 \text{ V}$, $I_{B1} \approx 3.0 \text{ mA}$
t_s	Storage Time (test circuit no. 532)		90	ns	$I_C \approx 10 \text{ mA}$, $V_{CC} = -3.0 \text{ V}$, $I_{B1} \approx -I_{B2} = 3.0 \text{ mA}$
t_f	Fall Time (test circuit no. 532)		50	ns	$I_C \approx 10 \text{ mA}$, $V_{CC} = -3.0 \text{ V}$, $I_{B1} \approx -I_{B2} \approx 3.0 \text{ mA}$

**2N5320/2N5321
2N5322/2N5323**

10 Watt NPN-PNP Silicon Power

- $V_{CE(sat)}$. . . **-0.7 V**
- h_{FE} . . . **40-250 @ $V_{CE} = 4.0 V, I_C = 0.5 A$**
- **Complements . . . 2N5320, NPN (2N5322, PNP);
2N5321, NPN (2N5322, PNP)**

PACKAGE

2N5320	TO-39
2N5321	TO-39
2N5322	TO-39
2N5323	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Case Temperature	10 W
Linear Derating Factor	0.057W/° C

Voltages & Currents

	5320	5321
V_{CEO} Collector to Emitter Voltage	75 V	50 V
V_{CBO} Collector to Base Voltage	100 V	75 V
V_{EBO} Emitter to Base Voltage	7.0 V	5.0 V
I_C Collector Current	2.0 A	2.0 A
I_B Base Current	1.0 A	1.0 A

Voltages & Currents

	5322	5322
V_{CEO} Collector to Emitter Voltage	-75 V	-50 V
V_{CBO} Collector to Base Voltage	-100 V	-75 V
V_{EBO} Emitter to Base Voltage	-7.0 V	-5.0 V
I_C Collector Current	2.0 A	2.0 A
I_B Base Current	1.0 A	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5320		5321		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		0.1			mA	$V_{EB} = 7.0 V$
				0.1		mA	$V_{EB} = 5.0 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μ s; duty cycle \leq 10%.
3. Pulse Rep. Frequency = 1 kHz, pulse width = 20 μ s.
4. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 0.2° C/W (derating factor of 0.057 W/° C).
5. Emitter diode is reversed biased.
6. For product family characteristic curves, refer to Curve Set T314 (2N5320 and 2N5321) and Curve Set T414 (2N5322 and 2N5323).

2N5320/2N5321
2N5322/2N5323

SYMBOL	CHARACTERISTIC	5320		5321		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CEX}	Collector Cutoff Current (Note 3)		5.0			mA	$V_{CE} = 70\text{ V}, V_{BE} = 1.5\text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = 45\text{ V}, V_{BE} = 1.5\text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = 100\text{ V}, V_{BE} = 1.5\text{ V}, V_{CE} = 75\text{ V}, V_{BE} = 1.5\text{ V}$
			0.1		5.0	mA	
					0.1	mA	
						mA	
h_{FE}	DC Current Gain (Note 2)	10 30	130	40	250		$I_C = 1.0\text{ A}, V_{CE} = 2.0\text{ V}$ $I_C = 0.5\text{ A}, V_{CE} = 4.0\text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 2)	75		50		V	$I_C = 100\text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 2)		0.5		0.8	V	$I_C = 500\text{ mA}, I_B = 50\text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 2)		1.1		1.4	V	$I_C = 500\text{ mA}, V_{CE} = 4.0\text{ V}$
h_{fe}	Small Signal Current Gain	5.0		5.0			$I_C = 50\text{ mA}, V_{CE} = 4.0\text{ V}, f = 10\text{ MHz}$
t_{on}	Turn On Time (Note 3)		80		80	ns	$I_C = 500\text{ mA}, I_{B1} = 50\text{ mA}$
t_{off}	Turn Off Time (Note 3)		800		800	ns	$I_C = 500\text{ mA}, I_{B1} = 50\text{ mA}, I_{B2} = -50\text{ mA}$

SYMBOL	CHARACTERISTIC	5322		5323		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		0.1			mA	$V_{EB} = -7.0\text{ V}$ $V_{EB} = -5.0\text{ V}$
					0.1	mA	
I_{CEX}	Collector Cutoff Current		5.0			mA	$V_{CE} = -70\text{ V}, V_{BE} = -1.5\text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = -45\text{ V}, V_{BE} = -1.5\text{ V}, T_C = 150^\circ\text{C}$ $V_{CE} = -100\text{ V}, V_{BE} = -1.5\text{ V}, V_{CE} = -75\text{ V}, V_{BE} = -1.5\text{ V}$
			0.1		5.0	mA	
					0.1	mA	
						mA	
h_{FE}	DC Current Gain	10 30	130	40	250		$I_C = 1.0\text{ A}, V_{CE} = -2.0\text{ V}$ $I_C = 500\text{ mA}, V_{CE} = -4.0\text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 2)	-75		-50		V	$I_C = -100\text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 2)		-0.7		-1.20	V	$I_C = 50\text{ mA}, I_B = 50\text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 2)		-1.1		-1.4	V	$I_C = 500\text{ mA}, V_{CE} = -4.0\text{ V}$
h_{fe}	Small Signal Current Gain	5.0		5.0			$I_C = 50\text{ mA}, V_{CE} = 4.0\text{ V}, f = 10\text{ MHz}$
t_{on}	Turn On Time (Note 3)		100		100	ns	$I_C = 500\text{ mA}, I_{B1} = -50\text{ mA}$
t_{off}	Turn Off Time (Note 3)		1000		1000	ns	$I_C = 500\text{ mA}, I_{B1} = -50\text{ mA}, I_{B2} = 50\text{ mA}$

- $P_D \dots 6.0 \text{ W @ } T_C = 25^\circ \text{ C}$
- $V_{CEO} \dots 80 \text{ V and } 100 \text{ V (Min)}$
- $V_{CE(sat)} \dots 1.2 \text{ V (Max) @ } 5.0 \text{ A}$

PACKAGE

2N5336	TO-5
2N5338	TO-5

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation

Total Dissipation at 25° C Case Temperature	6.0 W
--	-------

Voltages & Currents

	5336	5338
V_{CEO} Collector to Emitter Voltage	80 V	100 V
V_{CBO} Collector to Base Voltage	80 V	100 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V
I_C Collector Current	5.0 A	5.0 A
I_B Base Current	1.0 A	1.0 A

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 4)

SYMBOL	CHARACTERISTIC	5336		5338		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		100		100	μA	$V_{EB} = 6.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10	μA	$V_{CE} = 80 \text{ V}, I_E = 0$ $V_{CE} = 100 \text{ V}, I_E = 0$
I_{CEX}	Collector Cutoff Current		10			μA	$V_{CE} = 75 \text{ V}, V_{BE} = 1.5 \text{ V}$ $V_{CE} = 75 \text{ V}, V_{BE} = 1.5 \text{ V},$ $T_C = 150^\circ \text{ C}$
			1.0		10	μA	
h_{FE}	DC Current Gain (Note 2)	30		30			$I_C = 500 \text{ mA}, V_{CE} = 2.0 \text{ V}$ $I_C = 2.0 \text{ A}, V_{CE} = 2.0 \text{ V}$ $I_C = 5.0 \text{ A}, V_{CE} = 2.0 \text{ V}$
		30	120	30	120		
		20		20			

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs ; duty cycle μ 2%.
3. These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 33.3°C/W (linear derating factor of 34 mW/°C).
4. For product family characteristic curves, refer to Curve Set T316.

2N5336/2N5338

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5336		5338		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 2)	80		100		V	$I_C = 50 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Pulsed) (Note 2)		0.7		0.7	V	$I_C = 2.0 \text{ A}, I_B = 200 \text{ mA}$
			1.2		1.2	V	$I_C = 5.0 \text{ A}, I_B = 500 \text{ mA}$
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed) (Note 2)		1.2		1.2	V	$I_C = 2.0 \text{ A}, I_B = 200 \text{ mA}$
			1.8		1.8	V	$I_C = 5.0 \text{ A}, I_B = 500 \text{ mA}$
t_d	Turn On Delay Time		100		100	ns	$I_C = 2.0 \text{ A}, V_{CC} = 4.0 \text{ V}, I_{B1} = 200 \text{ mA}$
t_r	Turn On Rise Time		100		100	ns	$I_C = 2.0 \text{ A}, V_{CC} = 40 \text{ V}, I_{B1} = 200 \text{ mA}$
t_s	Turn Off Storage Time		2.0		2.0	μs	$I_C = 2.0 \text{ A}, V_{CC} = 40 \text{ V}, I_{B1} = I_{B2} = 200 \text{ mA}$
t_f	Turn Off Fall Time		200		200	ns	$I_C = 2.0 \text{ A}, V_{CC} = 40 \text{ V}, I_{B1} = I_{B2} = 200 \text{ mA}$

**2N5400/FTSO5400
2N5401/FTSO5401**

PNP High Voltage Small Signal
General Purpose Amplifiers

- V_{CEO} ... -120 V (Min) (2N/FTSO5400), -150 V (Min) (2N/FTSO5401)
- h_{FE} ... 60-240 @ 10 mA (2N/FTSO5401)
- $V_{CE(sat)}$... -0.5 V (Max) @ 50 mA
- Complements ... 2N5550, MPS5551M

PACKAGE

2N5400	TO-92
2N5401	TO-92
FTSO5400	TO-236AA/AB
FTSO5401	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -55° to 150° C
Operating Junction Temperature 150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5400	5401
V_{CEO} Collector to Emitter Voltage (Note 4)	-120 V	-150 V
V_{CBO} Collector to Base Voltage	-130 V	-150 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5400		5401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	-120		-150		V	$I_C = 1.0$ mA, $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-130		-160		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = -3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		100		50	nA	$V_{CB} = -100$ V, $I_E = 0$
			100		50	nA	$V_{CB} = -120$ V, $I_E = 0$
					50	μ A	$V_{CB} = -100$ V, $I_E = 0$, $T_A = 100^\circ$ C
					50	μ A	$V_{CB} = -120$ V, $I_E = 0$, $T_A = 100^\circ$ C
h_{FE}	DC Pulse Current Gain (Note 5)	30		50			$I_C = 1.0$ mA, $V_{CE} = -5.0$ V
		40	180	60	240		$I_C = 10$ mA, $V_{CE} = -5.0$ V
		40		50			$I_C = 50$ mA, $V_{CE} = -5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 2%.
 6. For product family characteristic curves, refer to Curve Set T232.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5400/FTSO5400
2N5401/FTSO5401

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5400		5401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
V _{CE(sat)}	Collector to Emitter Saturation Voltage (Note 5)		-0.20		-0.20	V	I _C = 10 mA, I _B = 1.0 mA I _C = 50 mA, I _B = 5.0 mA
			-0.5		-0.5	V	
V _{BE(sat)}	Base to Emitter Saturation Voltage (Note 5)		-1.0		-1.0	V	I _C = 10 mA, I _B = 1.0 mA I _C = 50 mA, I _B = 5.0 mA
			-1.0		-1.0	V	
C _{ob}	Output Capacitance		6.0		6.0	pF	V _{CB} = -10 V, I _E = 0, f = 1.0 MHz
h _{fe}	Small Signal Current Gain	30	200	40	200		I _C = 1.0 mA, V _{CE} = -10 V, f = 1.0 kHz
f _T	Current Gain Bandwidth Product	100	400	100	300	mHz	I _C = 10 mA, V _{CE} = -10 V, f = 100 MHz
NF	Noise Figure		8.0		8.0	dB	I _C = 250 μA, V _{CE} = -5.0 V, f = 10 Hz to 15.7 kHz, R _S = 1.0 kΩ

- 10 W Dissipation at 25° C Case
- 1 A (Max) Continuous Collector Current
- Up to 350 V V_{CB0} Rating (2N5416)
- Complements ... 2N3439, 2N3440

PACKAGE

2N5415	TO-39
2N5416	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Case Temperature	10 W
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Voltages & Currents (Note 4)

	5415	5416
V_{CEO} Collector to Emitter Voltage	-200 V	-300 V
V_{CBO} Collector to Base Voltage	-200 V	-350 V
V_{EBO} Emitter to Base Voltage	-4.0 V	-4.0 V
I_C Collector Current (Continuous)	1.0 A	1.0 A
I_B Base Current (Continuous)	0.5 A	0.5 A

3

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5415		5416		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		20		20	μA	$V_{EB} = -4.0 V, I_C = 0$ $V_{EB} = -6.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	μA	$V_{CB} = -175 V, I_E = 0$ $V_{CB} = -280 V, I_E = 0$
I_{CEV}	Collector Cutoff Current		50		50	μA	$V_{CE} = -200 V, V_{BE} = 1.5 V$ $V_{CE} = -300 V, V_{BE} = 1.5 V$
I_{CEO}	Collector Cutoff Current		50		50	μA	$V_{CE} = -150 V, I_B = 0$ $V_{CE} = -250 V, I_B = 0$
h_{FE}	DC Current Gain (Note 5)	30	150	30	120		$I_C = 50 mA, V_{CE} = -10 V$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 0.2° C/W (derating factor of 0.057 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T443.

2N5415/2N5416

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5415		5416		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-200		-300		V	$I_C = 50 \text{ mA}$, $I_B = 0$
$V_{CER(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)			-350		V	$I_C = 50 \text{ mA}$, $R_{BE} = 50 \ \Omega$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-2.5		-2.0	V	$I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		-1.5		-1.5	V	$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$
C_{ob}	Output Capacitance		15		15	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$ $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		75		75	pF	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$ $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	3.0		3.0			$I_C = 10 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 5.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	25		25			$I_C = 5.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
$R_e(h_{ie})$	Real Part of Common Emitter Small Signal Short-Circuit Impedance		300		300	Ω	$I_C = 5.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ MHz}$
$I_{s/b}$	Second Breakdown Collector Current	100		100		mA	$V_{CE} = -100 \text{ V}$, $t = 1.0 \text{ s}$ (non repetitive)

2N5550/FTSO5550

2N5551/MPS5551

FTSO5551

**NPN Small Signal High Voltage
General Purpose Amplifiers**

- V_{CEO} ... **160 V (Min) (MPS/FTSO5551)**
- h_{FE} ... **80-250 @ 10 mA (MPS/FTSO5551)**
- $V_{CE(sat)}$... **0.2 V (max) @ 50 mA (MPS/FTSO5551)**
- **Complements ... 2N5400, 2N5401**

PACKAGE

2N5550	TO-92
2N5551	TO-92
MPS5551	TO-92
FTSO5550	TO-236AA/AB
FTSO5551	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5550	5551
V_{CEO} Collector to Emitter Voltage (Note 4)	140 V	160 V
V_{CBO} Collector to Base Voltage	160 V	180 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V
I_C Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5550		5551		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage	140		160		V	$I_C = 1.0 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	160		180		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100		50	nA	$V_{CB} = 100 \text{ V}, I_E = 0$
			100		50	nA	$V_{CB} = 120 \text{ V}, I_E = 0$
					50	μA	$V_{CB} = 100 \text{ V}, I_E = 0, T_A = 100^\circ \text{C}$
					50	μA	$V_{CB} = 120 \text{ V}, I_E = 0, T_A = 100^\circ \text{C}$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T147.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5550/FTSO5550
2N5551/MPS5551
FTSO5551

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5550		5551		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	60 60 20	250	80 80 30	250		$I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 10 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$ $I_C = 50 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.15 0.25		0.15 0.25	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0 1.2		1.0 1.0	V V	$I_C = 10 \text{ mA}$, $I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$
C_{ob}	Output Capacitance		6.0		6.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance (2N/FTSO5550) (MPS/FTSO5551) (2N5551)		30		30 20	pF pF pF	$V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$ $V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$ $V_{BE} = 0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50	200	50	200		$I_C = 1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	100	300	100	300	MHz	$I_C = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 100 \text{ MHz}$
NF	Noise Figure		10		8.0	dB	$I_C = 250 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$, $R_S = 1.0 \text{ k}\Omega$

2N5679/2N5680 2N5681/2N5682

1.0 Amp 10 Watt NPN-PNP
Complementary Power

- f_T ... 30 MHz @ $I_C = 100$ mA
- $V_{CE(sat)}$... 0.6 V @ $I_C = 0.25$ A
- Complements ... 2N5679, PNP (2N5681, NPN);
2N5680, PNP (2N5682, NPN)

PACKAGE:	
2N5679	TO-39
2N5680	TO-39
2N5681	TO-39
2N5682	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Continuous Dissipation at 25° C Ambient Temperature	1.0 W
Continuous Dissipation at 25° C Case Temperature	10 W

Voltages & Currents (Note 4)

	5679	5680
V_{CEO} Collector to Emitter Voltage	-100 V	-120 V
V_{CBO} Collector to Base Voltage	-100 V	-120 V
V_{EBO} Emitter to Base Voltage	-4.0 V	-4.0 V
I_C Collector Current	1.0 A	1.0 A
I_B Base Current	0.5 A	0.5 A

Voltages & Currents (Note 4)

	5681	5682
V_{CEO} Collector to Emitter Voltage	100 V	120 V
V_{CBO} Collector to Base Voltage	100 V	120 V
V_{EBO} Emitter to Base Voltage	4.0 V	4.0 V
I_C Collector Current	1.0 A	1.0 A
I_B Base Current	0.5 A	0.5 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5679		5680		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		1.0		1.0	μA	$V_{EB} = -4.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		1.0		1.0	μA	$V_{CB} = -100$ V, $I_E = 0$ $V_{CB} = -120$ V, $I_E = 0$

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 0.2° C/W (derating factor of 0.057 mW/° C); junction-to-ambient thermal resistance of 0.02° C/W (derating factor of 0.0057 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T415 (2N5679 and 2N5680) and Curve Set T315 (2N5681 and 2N5782).

2N5679/2N5680
2N5681/2N5682

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5679		5680		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CEO}	Collector Cutoff Current		10		10	μA μA	$V_{CB} = -70 V, I_B = 0$ $V_{CB} = -80 V, I_B = 0$
I_{CEX}	Collector Reverse Current (Note 3)		1.0			mA	$V_{CE} = -100 V, V_{BE} = -1.5 V,$ $T_C = 150^\circ C$
			1.0		1.0	mA	$V_{CE} = -120 V, V_{BE} = -1.5 V,$ $T_C = 150^\circ C$
			1.0		1.0	μA μA	$V_{CE} = -100 V, V_{BE} = -1.5 V$ $V_{CE} = -120 V, V_{BE} = -1.5 V$
h_{FE}	DC Current Gain (Note 5)	5.0 40	150	5.0 40	150		$I_C = 1.0 A, V_{CE} = -2.0 V$ $I_C = 250 mA, V_{CE} = -2.0 V$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-100		-120		V	$I_C = 10 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-2.0		-2.0	V	$I_C = 1.0 mA, I_B = 200 mA$
			-1.0		-1.0	V	$I_C = 500 mA, I_B = 50 mA$
			-0.6		-0.6	V	$I_C = 250 mA, I_B = 25 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		-1.0		-1.0	V	$I_C = 250 mA, V_{CE} = -2.0 V$
C_{ob}	Common Base Output Capacitance		50		50	pF	$V_{CB} = -20 mA, I_E = 0$ $f = 1.0 MHz$
h_{fe}	High Frequency Current Gain	3.0		3.0			$I_C = 100 mA, V_{CE} = -10 V,$ $f = 10 MHz$
h_{fe}	Small Signal Current Gain	40		40			$I_C = 200 mA, V_{CE} = -1.5 V,$ $f = 1.0 kHz$

2N5679/2N5680

2N5681/2N5682

SYMBOL	CHARACTERISTIC	5681		5682		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{EBO}	Emitter Cutoff Current		1.0		1.0	μA	$V_{EB} = 4.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		1.0		1.0	μA	$V_{CB} = 100 V, I_E = 0$ $V_{CB} = 120 V, I_E = 0$
I_{CEO}	Collector Cutoff Current		10		10	μA	$V_{CB} = 70 V, I_B = 0$ $V_{CB} = 80 V, I_B = 0$
I_{CEX}	Collector Cutoff Current		1.0		1.0	mA	$V_{CE} = 100 V, V_{BE} = 1.5 V,$ $T_C = 150^\circ C$
			1.0		1.0	μA	$V_{CE} = 120 V, V_{BE} = -1.5 V,$ $T_C = 150^\circ C$
			1.0		1.0	μA	$V_{CE} = -100 V, V_{BE} = 1.5 V$ $V_{CE} = -120 V, V_{BE} = 1.5 V$
h_{FE}	DC Current Gain (Note 5)	5.0 40	150	5.0 40	150		$I_C = 1.0 A, V_{CE} = 2.0 V$ $I_C = 250 mA, V_{CE} = 2.0 V$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	100		120		V	$I_C = 10 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		2.0		2.0	V	$I_C = 1.0 mA, I_B = 200 mA$
			1.0		1.0	V	$I_C = 500 mA, I_B = 50 mA$
			0.6		0.6	V	$I_C = 250 mA, I_B = 25 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 2)		1.0		1.0	V	$I_C = 250 mA, V_{CE} = 2.0 V$
C_{ob}	Output Capacitance		50		50	pF	$V_{CB} = 20 mA, I_E = 0$ $f = 1.0 MHz$
h_{fe}	High Frequency Current Gain	3.0		3.0			$I_C = 100 mA, V_{CE} = 10 V,$ $f = 10 MHz$
h_{fe}	Small Signal Current Gain	40		40			$I_C = 200 mA, V_{CE} = 1.5 V,$ $f = 1.0 kHz$

3

2N5771/FTSO5771

PNP Ultra High Speed Saturated Logic Switch

- V_{CEO} ... 15 V (Min)
- t_{on} ... 15 ns (Max) @ 10 mA, t_{off} ... 20 ns (Max) @ 10 mA
- τ_s ... 20 ns (Max) @ 10 mA
- Complements ... 2N5769, 2N5772

PACKAGE

2N5771	TO-92
FTSO5771	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Ambient Temperature	2N 0.625 W	FTSO 0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage (Note 4)	-15 V
V_{CBO} Collector to Base Voltage	-15 V
V_{EBO} Emitter to Base Voltage	-4.5 V
I_C Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	-15		V	$I_C = 3.0$ mA, $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-15		V	$I_C = 100$ μ A, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-15		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.5		V	$I_E = 100$ μ A, $I_C = 0$
I_{CBO}	Collector to Base Cutoff Current		10	nA	$V_{CB} = -8.0$ V, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		1.0	μ A	$V_{EB} = -4.5$ V, $I_C = 0$
I_{CES}	Collector Reverse Current		10 5.0	nA μ A	$V_{CE} = -8.0$ V, $V_{BE} = 0$ $V_{CE} = -8.0$ V, $V_{BE} = 0$, $T_A = 125^\circ$ C
h_{FE}	DC Current Gain (Note 5)	35 50 40 20	120		$I_C = 1.0$ mA, $V_{CE} = -0.5$ V $I_C = 10$ mA, $V_{CE} = -0.3$ V $I_C = 50$ mA, $V_{CE} = -1.0$ V $I_C = 10$ mA, $V_{CE} = -0.3$ V, $T_A = 55^\circ$ C

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T292.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5771/FTSO5771

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.18	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			-0.15	V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$
			-0.6	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.8	V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$
		-0.8	-0.95	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			-1.5	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		3.0	pF	$V_{CB} = -5.0 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
C_{eb}	Emitter to Base Capacitance		3.5	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 140 \text{ kHz}$
h_{fe}	High Frequency Current Gain	8.5			$I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}, f = 100 \text{ MHz}$
t_{on}	Turn On Time (test circuit no 348)		15	ns	$I_C = 10 \text{ mA}, I_{B1} = 1.0 \text{ mA}$
t_{off}	Turn Off Time (test circuit no 348)		20	ns	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 1.0 \text{ mA}$
τ_s	Charge Storage Time Constant (test circuit no. 234)		20	ns	$I_C = 10 \text{ mA}, I_{B1} \approx I_{B2} \approx 10 \text{ mA}$

FAIRCHILD

A Schlumberger Company

2N5830/FTSO5830

2N5831/FTSO5831

2N5833/FTSO5833

NPN Small Signal High Voltage
General Purpose Amplifiers

- V_{CE0} ... 100 V (Min) (2N5830), 140 V (Min) (2N/FTSO5831), 180 V (Min) (2N/FTSO5833)
- h_{FE} ... 80 (Min) (2N/FTSO5830/1), 50 (Min) (2N/FTSO5833)
- C_{cb} ... 4.0 pF (Max)

PACKAGE

2N5830	TO-92
2N5831	TO-92
2N5833	TO-92
FTSO5830	TO-236AA/AB
FTSO5831	TO-236AA/AB
FTSO5833	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)**Temperatures**

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

	5830	5831	5833
V_{CE0} Collector to Emitter Voltage (Note 4)	100 V	140 V	180 V
V_{CBO} Collector to Base Voltage	120 V	160 V	200 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V	6.0 V
I_C Collector Current	600 mA	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	5830		5831		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	100		140		V	$I_C = 1.0$ mA, $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	120		160		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10$ μ A, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		50		50	nA	$V_{EB} = 4.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = 100$ V, $I_E = 0$
			25		25	μ A	$V_{CB} = 120$ V, $I_E = 0$
						μ A	$V_{CB} = 100$ V, $I_E = 0$, $T_A = 100^\circ$ C
						μ A	$V_{CB} = 120$ V, $I_E = 0$, $T_A = 100^\circ$ C
h_{FE}	DC Current Gain (Note 4)	60	500	60	250		$I_C = 1.0$ mA, $V_{CE} = 5.0$ V
		80		80			$I_C = 10$ mA, $V_{CE} = 5.0$ V
		80		80			$I_C = 50$ mA, $V_{CE} = 5.0$ V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Pulse conditions: length \leq 300 μ s; duty cycle \leq 1%.
 5. For product family characteristic curves, refer to Curve Set T147.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5830/FTSO5830
2N5831/FTSO5831
2N5833/FTSO5833

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	5830		5831		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.15		0.15	V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$
			0.20		0.20	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			0.25		0.25	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.8		0.8	V	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		0.8		0.8	V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$
			1.0		1.0	V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$
			1.0		1.0	V	$I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter High Frequency Current Gain	1.0	5.0	1.0	5.0		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	60		60			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance		6.0		6.0	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance		40		40	μmho	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$

3

2N5830/FTSO5830
2N5831/FTSO5831
2N5833/FTSO5833

SYMBOL	CHARACTERISTIC	5833		UNITS	TEST CONDITIONS
		MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	180		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	200		V	$I_C = 100 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		50	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		10 25	nA μA	$V_{CB} = 160 \text{ V}, I_E = 0$ $V_{CB} = 160 \text{ V}, I_E = 0, T_A = 100^\circ \text{ C}$
h_{FE}	DC Current Gain (Note 4)	50 50 50	250		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.15 0.20 0.25	V V V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.8	V	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		0.8 1.0 1.0	V V V	$I_C = 1.0 \text{ mA}, I_B = 0.1 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
C_{cb}	Collector to Base Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter High Frequency Current Gain	1.0	5.0		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$
h_{fe}	Small Signal Current Gain	50			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance		6.0	$k\Omega$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance		40	μmho	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$

**2N5961/FTSO5961
2N5962/FTSO5962**

NPN Low Level Low Noise Amplifiers

- $I_{CBO} \dots 2.0 \text{ nA (Max) @ } V_{CB} = 45 \text{ V, } 50 \text{ nA (Max) @ } V_{CB} = 45 \text{ V, } T_A = 65^\circ \text{ C (2N/FTSO5961)}$
- $V_{CE(sat)} \dots 0.2 \text{ V (Max) @ } 10 \text{ mA/0.5 mA}$
- $h_{FE} \dots 900 \text{ (Min) @ } 10 \mu\text{A}$

PACKAGE

2N5961	TO-92
2N5962	TO-92
FTSO5961	TO-236AA/AB
FTSO5962	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
70° C Ambient Temperature	0.400 W	
25° C Case Temperature	1.0 W	

Voltages & Currents

	5961	5962
V_{CEO} Collector to Emitter Voltage	60 V	45 V
(Note 4)		
V_{CBO} Collector to Base Voltage	60 V	45 V
V_{EBO} Emitter to Base Voltage	8.0 V	8.0 V
I_C Collector Current (Continuous)	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5961		5962		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CEO}	Collector to Emitter Breakdown Voltage	60		45		V	$I_C = 5.0 \text{ mA, } I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		45		V	$I_C = 10 \mu\text{A, } I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0		8.0		V	$I_E = 10 \mu\text{A, } I_C = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	nA	$V_{EB} = 5.0 \text{ V, } I_C = 0$
I_{CBO}	Collector Cutoff Current		2.0		2.0	nA	$V_{CB} = 45 \text{ V, } I_E = 0$
			50		50	nA	$V_{CB} = 30 \text{ V, } I_E = 0$
						nA	$V_{CB} = 45 \text{ V, } I_E = 0, T_A = 65^\circ \text{ C}$
						nA	$V_{CB} = 30 \text{ V, } I_E = 0, T_A = 65^\circ \text{ C}$

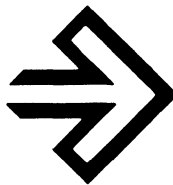
NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
 2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
 3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T107.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5961/FTSO5961
2N5962/FTSO5962

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

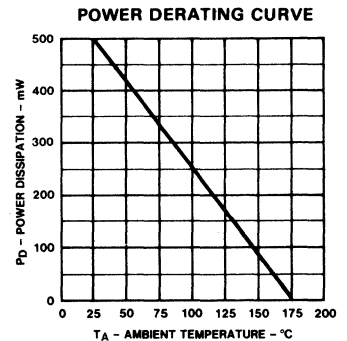
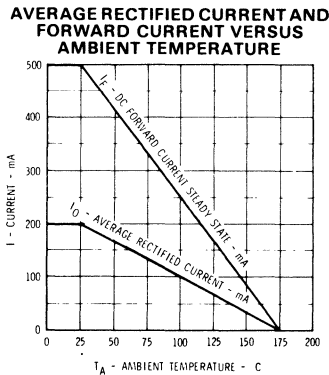
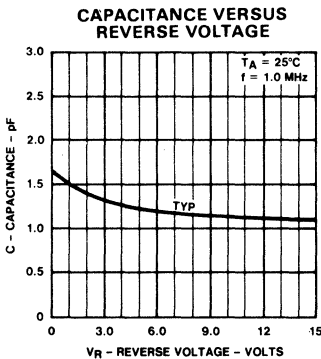
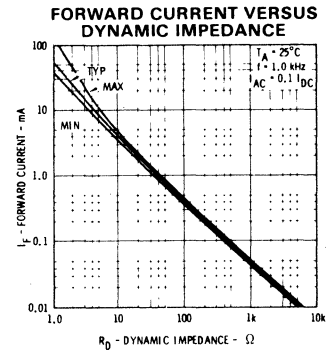
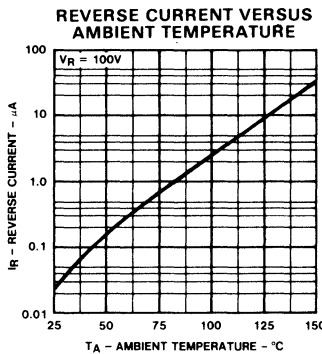
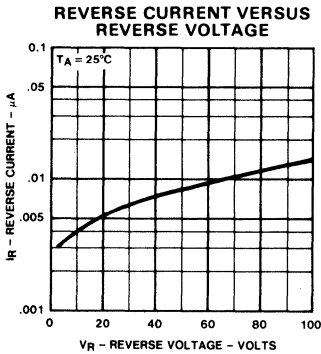
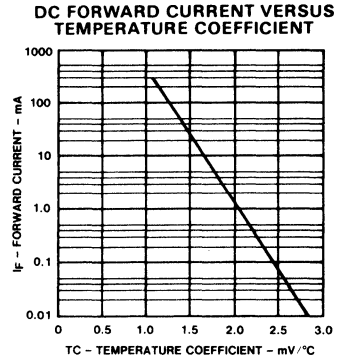
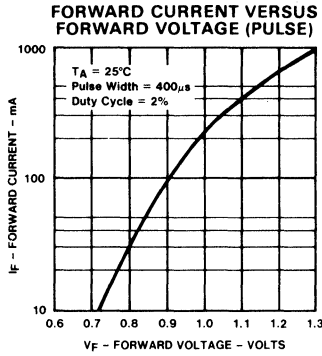
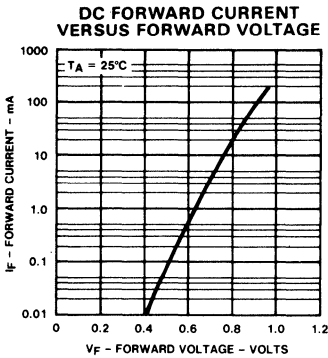
SYMBOL	CHARACTERISTIC	5961		5962		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	100 120 135		450 500 550			$I_C = 10 \mu A, V_{CE} = 5.0 V$ $I_C = 100 \mu A, V_{CE} = 5.0 V$ $I_C = 1.0 mA, V_{CE} = 5.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	150	700	600	1400		$I_C = 10 mA, V_{CE} = 5.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.2		0.2	V	$I_C = 10 mA, I_B = 0.5 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage	0.5	0.7	0.5	0.7	V	$I_C = 1.0 mA, V_{CE} = 5.0 V$
C_{cb}	Collector to Base Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 V, I_E = 0$
C_{eb}	Emitter to Base Capacitance		6.0		6.0	pF	$V_{BE} = 0.5 V, I_C = 0$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0		1.0			$I_C = 10 mA, V_{CE} = 5.0 V,$ $f = 100 MHz$
h_{fe}	Small Signal Current Gain	150	1000	650	2000		$I_C = 10 mA, V_{CE} = 5.0 V,$ $f = 1.0 kHz$
NF	Narrow Band Noise Figure		6.0		6.0	dB	$I_C = 100 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 kHz, R_S = 1.0 k\Omega,$ $BW = 400 Hz$
						dB	$I_C = 100 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 kHz, R_S = 10 k\Omega,$ $BW = 400 Hz$
						dB	$I_C = 100 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 kHz, R_S = 100 k\Omega,$ $BW = 400 Hz$
						dB	$I_C = 10 \mu A, V_{CE} = 5.0 V,$ $f = 1.0 kHz, R_S = 10 k\Omega,$ $BW = 400 Hz$
NF	Wide Band Noise Figure		3.0		3.0	dB	$I_C = 10 \mu A, V_{CE} = 5.0 V,$ $R_S = 10 k\Omega, BW = 15.7 kHz,$ $f = 10 Hz to 10 kHz$



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Field Sales Offices	9

Typical Electrical Characteristic Curves

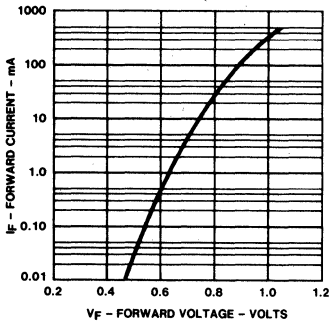
25°C Ambient Temperature unless otherwise noted



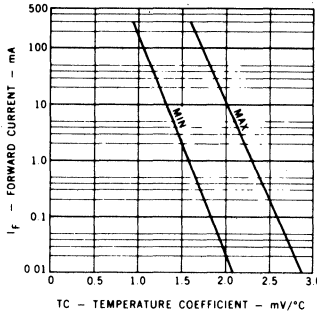
4

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

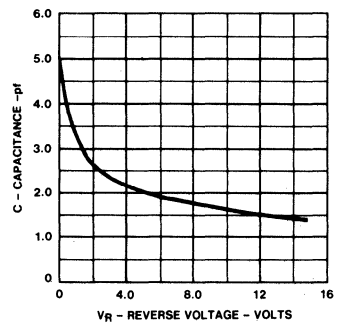
FORWARD VOLTAGE VERSUS FORWARD CURRENT



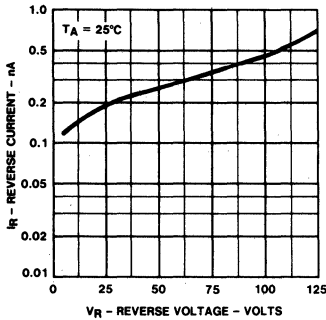
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



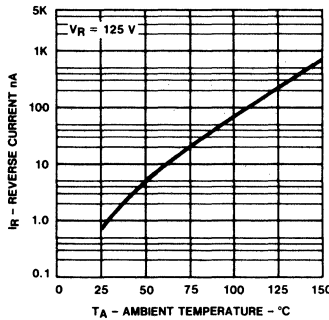
CAPACITANCE VERSUS REVERSE VOLTAGE



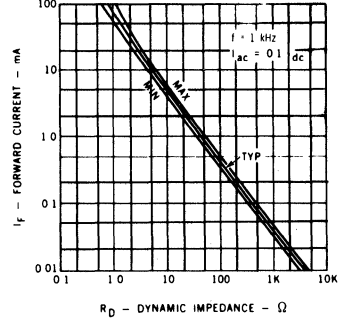
REVERSE VOLTAGE VERSUS REVERSE CURRENT



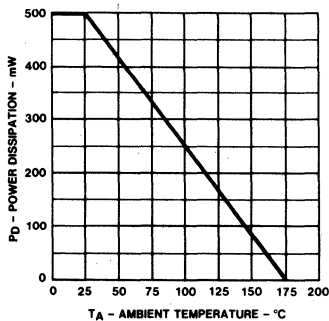
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



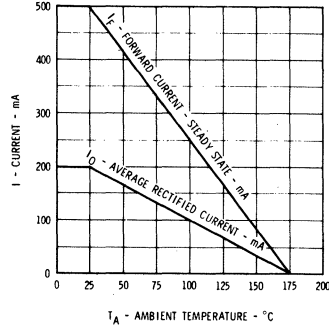
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



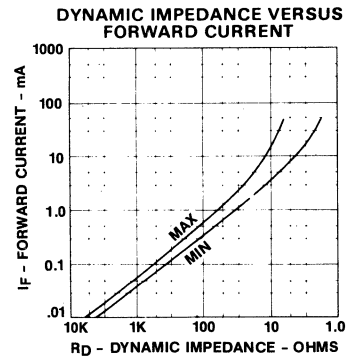
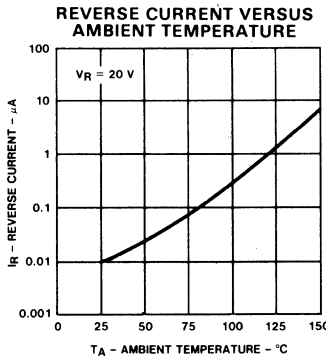
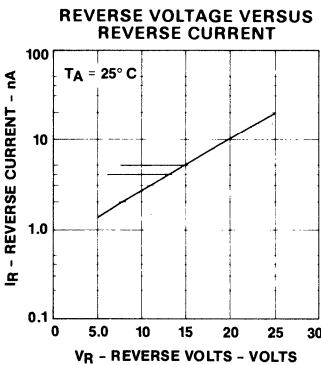
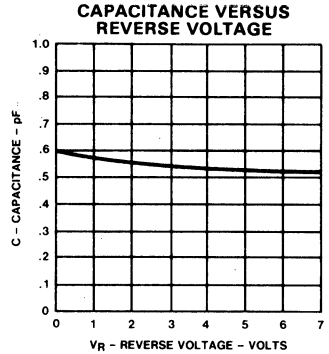
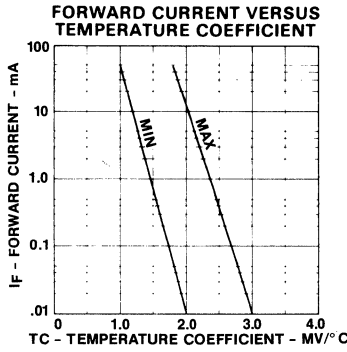
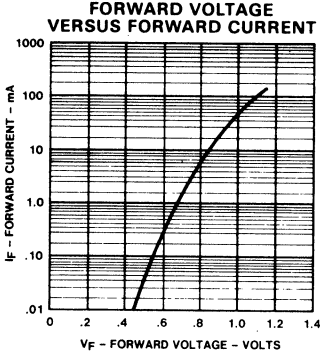
POWER DERATING CURVE



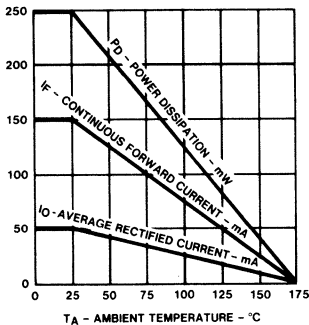
AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



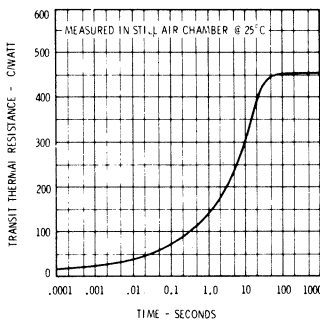
Typical Electrical Characteristic Curves 25° C Ambient Temperature unless otherwise noted



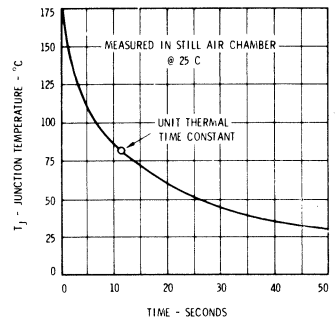
POWER DISSIPATION, AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



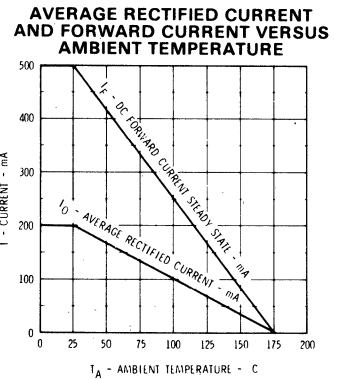
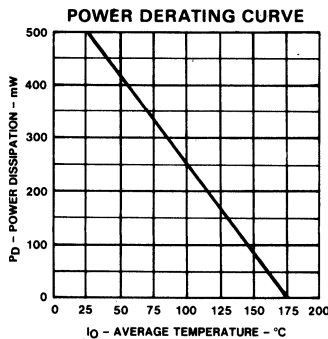
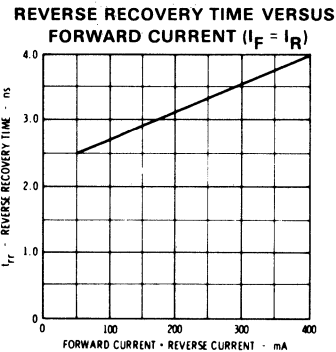
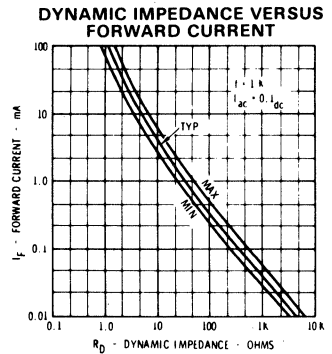
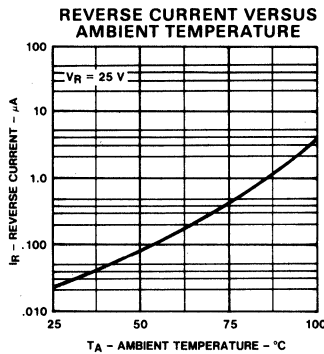
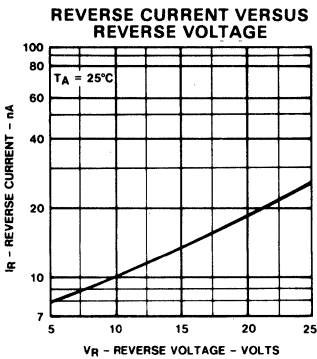
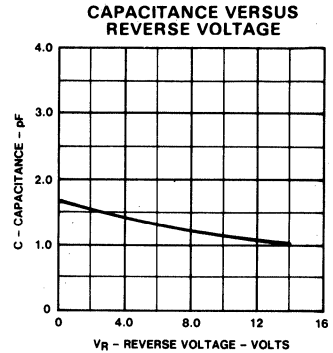
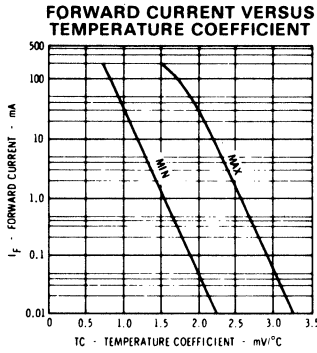
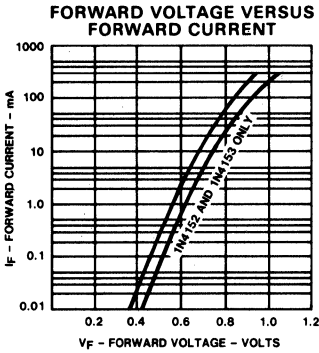
TRANSIENT THERMAL RESISTANCE VERSUS TIME



JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)

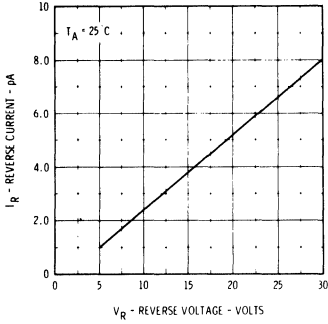


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

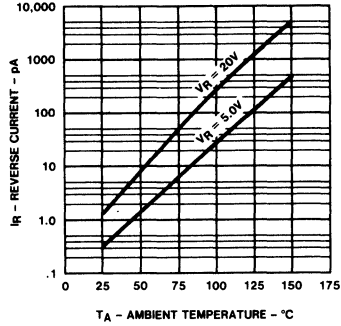


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

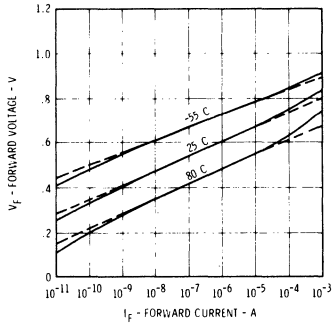
REVERSE CURRENT VERSUS REVERSE VOLTAGE



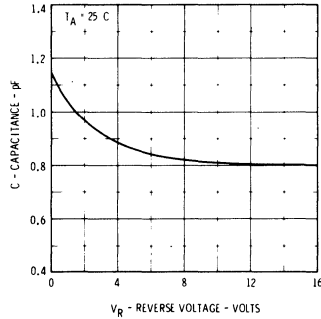
REVERSE CURRENT VERSUS TEMPERATURE



FORWARD VOLTAGE VERSUS FORWARD CURRENT



CAPACITANCE VERSUS REVERSE VOLTAGE

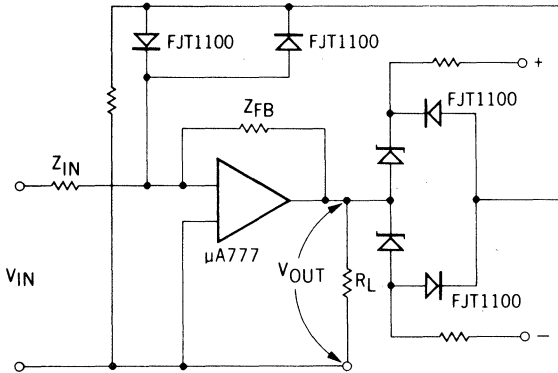


4

Curve Set number D6

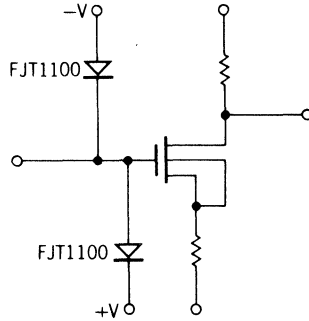
Test Circuits

A BOUND CIRCUIT FOR OPERATIONAL AMPLIFIERS



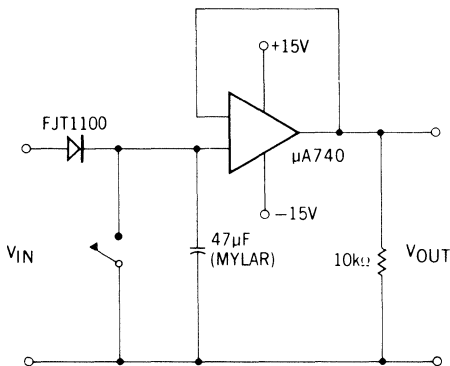
The bound circuit prevents overloading and saturation of operational amplifiers. The circuit has negligible effect on the operational amplifier until overload conditions occur. The use of the low leakage picoampere diode permits realization of extremely high input impedance for normal input voltages.

MOS FET PROTECTION CIRCUIT

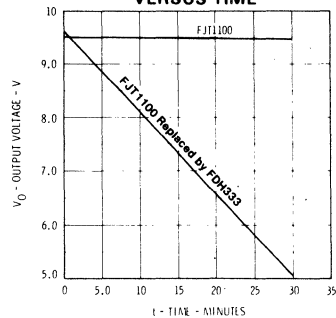


The picoampere diode affords excellent gate voltage protection while maintaining the DC input impedance at about one million megohms. In addition the very low capacity of the FJT1100 will have a relatively small effect on the circuit input capacity.

PEAK FOLLOWER CIRCUIT



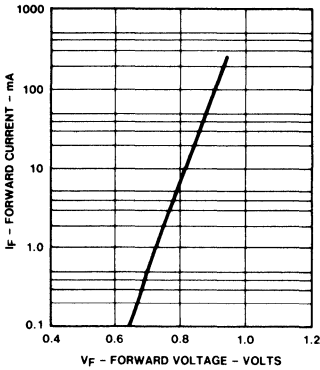
OUTPUT VOLTAGE OF THE PEAK FOLLOWER CIRCUIT VERSUS TIME



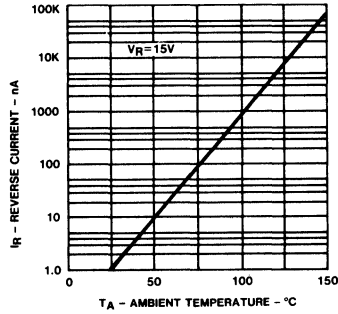
A nearly constant voltage peak follower circuit is available by using a picoampere diode. A comparison between the use of the FJT1100 and a "low leakage" FDH333 diode in the circuit is shown in the curves of V_{OUT} vs Time.

Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

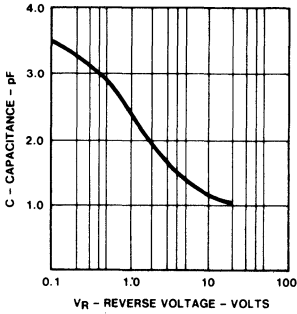
FORWARD CURRENT VERSUS FORWARD VOLTAGE



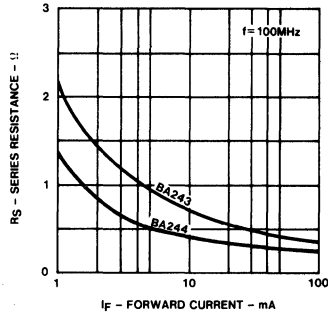
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



CAPACITANCE VERSUS REVERSE VOLTAGE



SERIES RESISTANCE VERSUS FORWARD CURRENT

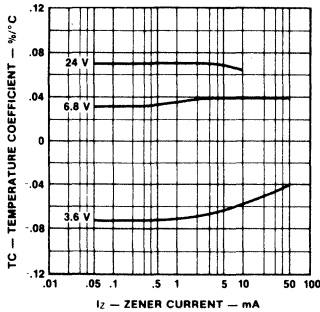


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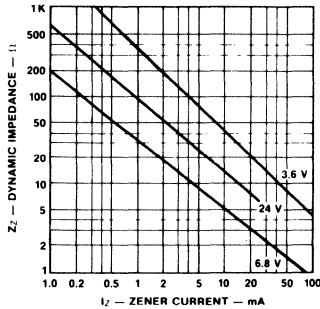
Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

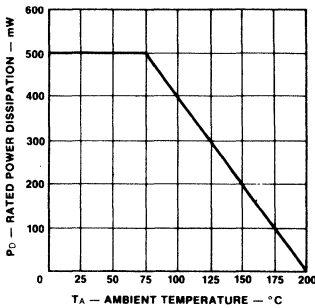
**TEMPERATURE COEFFICIENT
VERSUS ZENER CURRENT**



**DYNAMIC IMPEDANCE
VERSUS ZENER CURRENT**



**POWER DERATING VERSUS
AMBIENT TEMPERATURE**

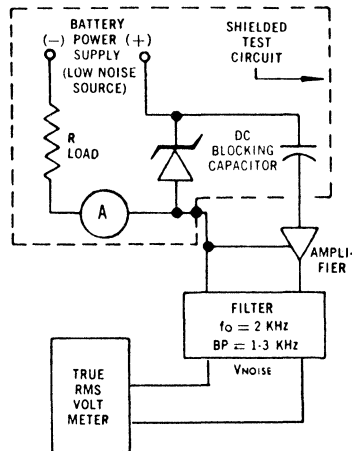


Test Circuit

NOISE DENSITY MEASUREMENT CIRCUIT

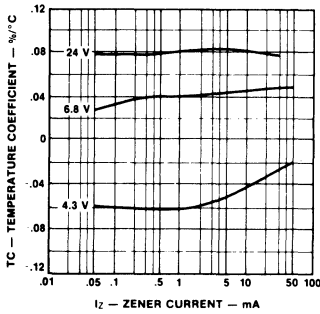
1N4099 - 1N4121

1N4620 - 1N4627

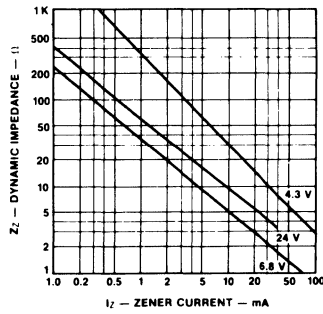


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

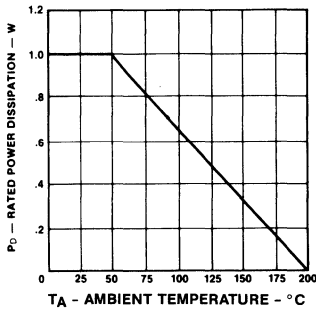
**TEMPERATURE COEFFICIENT
 VERSUS ZENER CURRENT**



**DYNAMIC IMPEDANCE
 VERSUS ZENER CURRENT.**

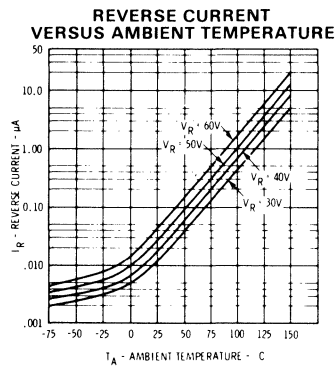
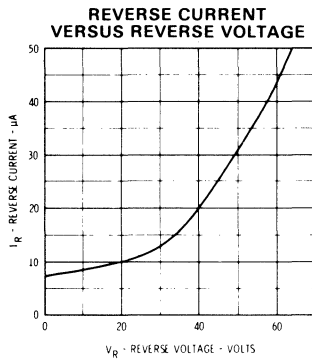
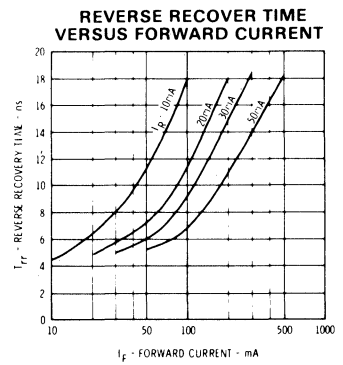
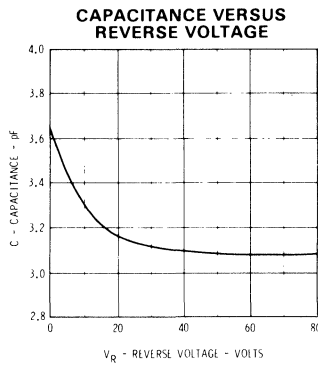
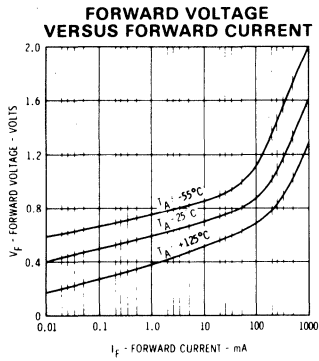


**POWER DERATING VERSUS
 AMBIENT TEMPERATURE**



4

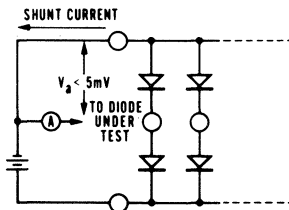
Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted



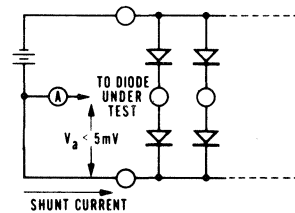
TEST CIRCUITS

To measure reverse current of an individual diode, the following test circuits are used:

COMMON CATHODE DIODES



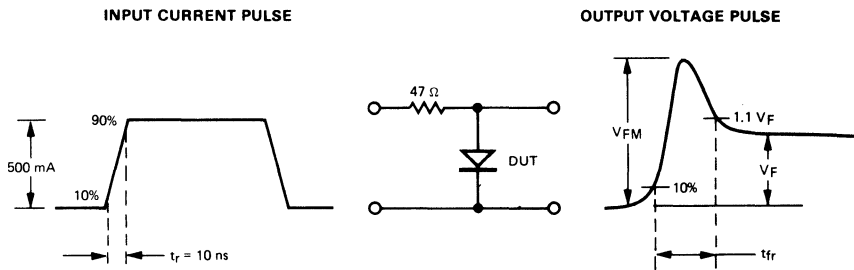
COMMON ANODE DIODES



Curve Set number D15

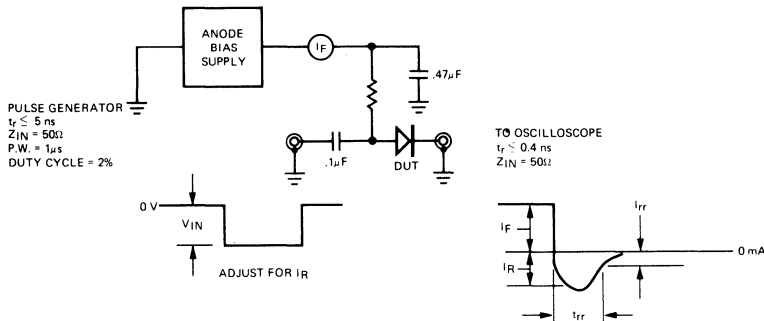
TEST CIRCUITS continued

Test requirement for V_{FM} and t_{fr} is as shown below; all leads should be as short as possible.

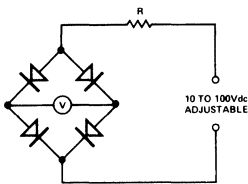


t_{rr} - REVERSE RECOVERY TIME TEST CIRCUIT

$$I_f = I_r, I_{rr} = 0.1 I_r$$



ΔV_F BRIDGE MATCHING CIRCUIT



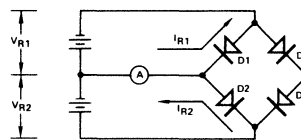
NOTES:

1. R Varies depending on the current range. For the most often used current ranges, R is as follows:

Current Range (amperes)	R (ohms)
10^{-5} to 10^{-4}	10^6
10^{-4} to 10^{-3}	10^5
10^{-3} to 10^{-2}	10^4
or 10^{-n} to 10^{-n+1}	10^{n+1}

2. V indicates mismatch of assembly.

ΔI_R BRIDGE MATCHING CIRCUIT

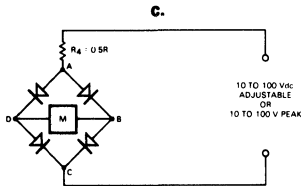
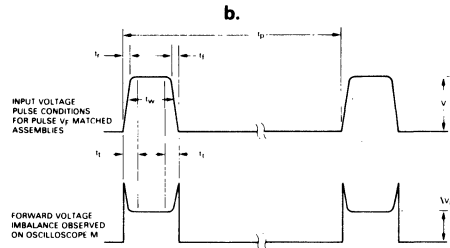
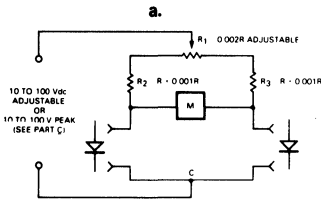


NOTES:

1. $V_{R2} = V_{R1} \pm 1\%$.
2. $I_{R2} - I_{R1} = \Delta I_R$ (difference in I_R between diodes D1 & D2). To measure diodes D3 & D4, reverse cathode-anode terminal connections.
3. A is a center reading pico ammeter. ΔI_R indicated directly on A.

Test Circuits

ΔV_F DIODE MATCHING CIRCUITS.



t_r	Pulse Rise Time (10 to 90% Amplitude)	= 1.0 μ s Max.
t_f	Pulse Fall Time (90 to 10% Amplitude)	= 1.0 μ s Max.
t_w	Pulse Width (50% Amplitude)	= 10 \pm 2.0 μ s
t_t	Transient Time	= 1.0 μ s Min.
t_p	Period	= 1.0 ms
V	Voltage Input to Circuit "A or B"	= 10 to 100 V Adjustable
ΔV_F	Forward Voltage Difference Between Diodes (Measured Between Transient Times)	= As Specified

NOTES:

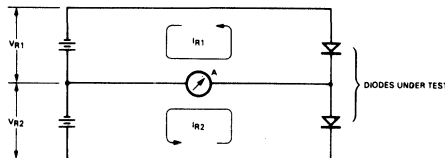
1. R varies depending on the current range. For the most often used current ranges, R is as follows:

Current Range (amperes)	R (ohms)
10 ⁻⁵ to 10 ⁻⁴	10 ⁶
10 ⁻⁴ to 10 ⁻³	10 ⁵
10 ⁻³ to 10 ⁻²	10 ⁴
or 10 ⁻ⁿ to 10 ⁻ⁿ⁺¹	10 ⁿ⁺¹

2. The input voltage pulse conditions shown above are employed at Fairchild in testing. The user may deviate from the specific conditions above with no variation in results providing the following general conditions are met:

- $\frac{t_w}{t_p} < 0.01$
- $t_w < 10$ ms
- Transients occurring during pulse rise and fall times are ignored in observing ΔV_F .

ΔI_R DIODE MATCHING CIRCUIT

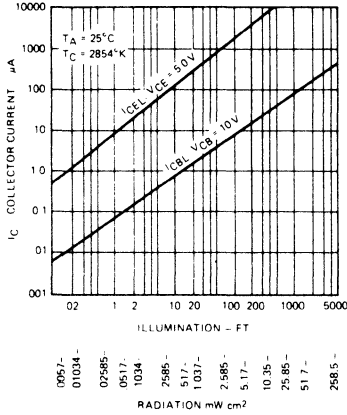


NOTES:

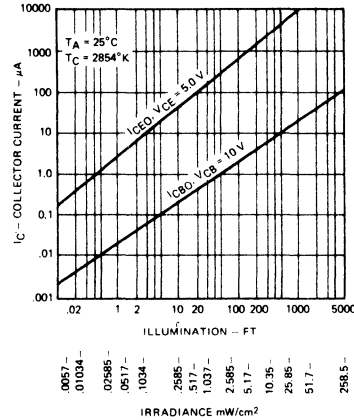
- $V_{R2} = -V_{R1} \pm 1\%$.
- $I_{R2} - I_{R1} = \Delta I_R$ (difference in I_R between two diodes under test).
- A is a center reading pico ammeter.

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

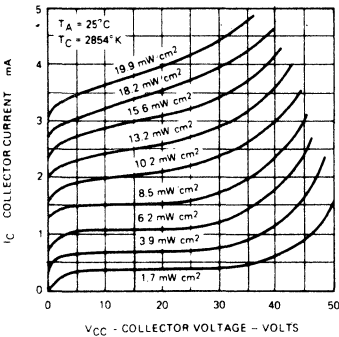
FPT100/A/B Photo Current Characteristics



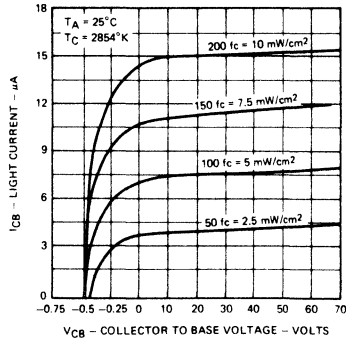
FPT110/A/B Photo Current Characteristics



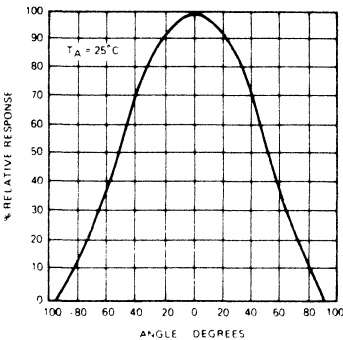
Collector Current vs Collector Voltage



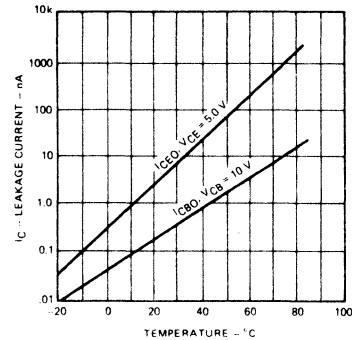
Collector Base Characteristics



Angular Response



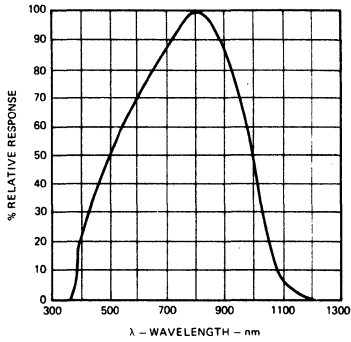
Collector Dark Current vs Temperature



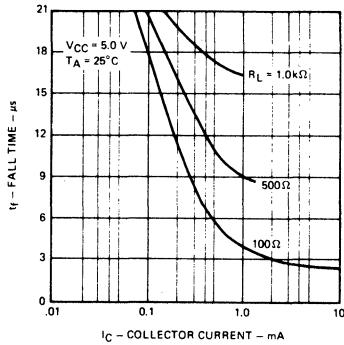
FPT100 Curve Set

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

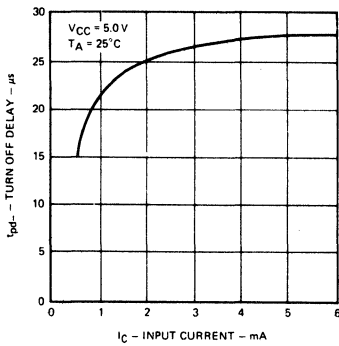
Spectral Characteristics



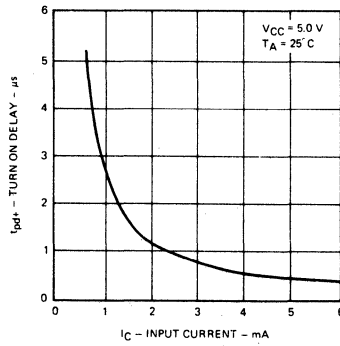
Rise And Fall Time vs Collector Current



Turn-Off Delay Times For Circuit

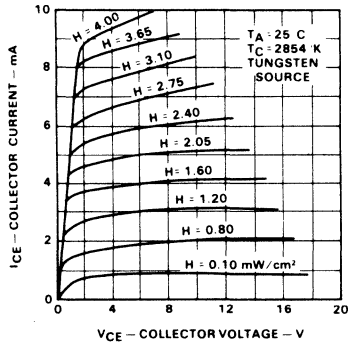


Turn-On Delay Times For Circuit

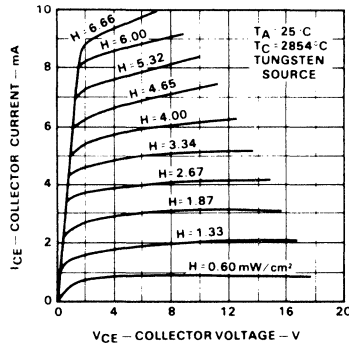


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

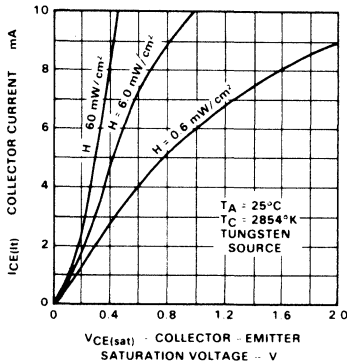
FPT120/A/B/C Collector Current vs Collector Voltage



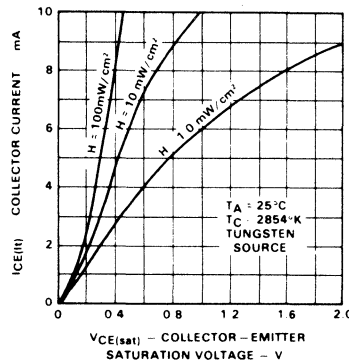
FPT130/A/B/C Collector Current vs Collector Voltage



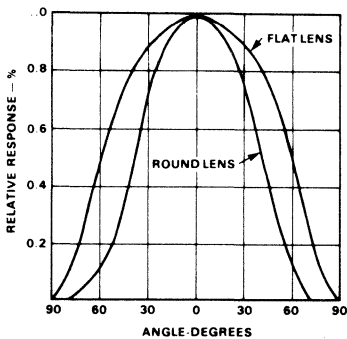
Collector-Emitter Saturation Voltage vs Collector Current



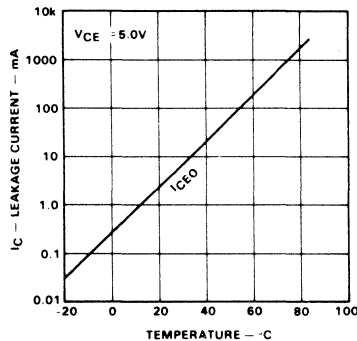
Collector-Emitter Saturation Voltage vs Collector Current



Angular Response



Collector Dark Current vs Temperature



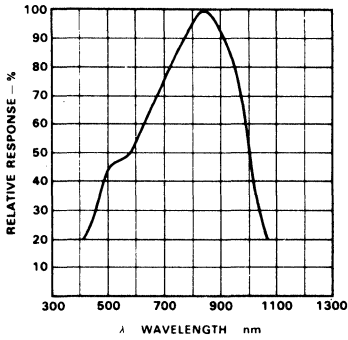
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FPT120 Curve Set

Typical Electrical Characteristic Curves

25° C Ambient Temperature unless otherwise noted

Relative Spectral Response



Rise And Fall Time vs Collector Current

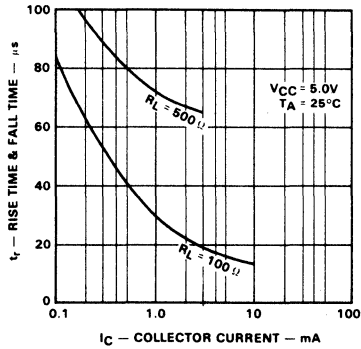
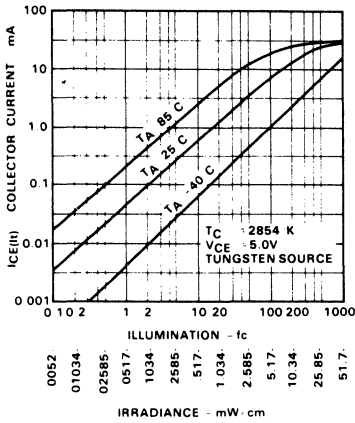
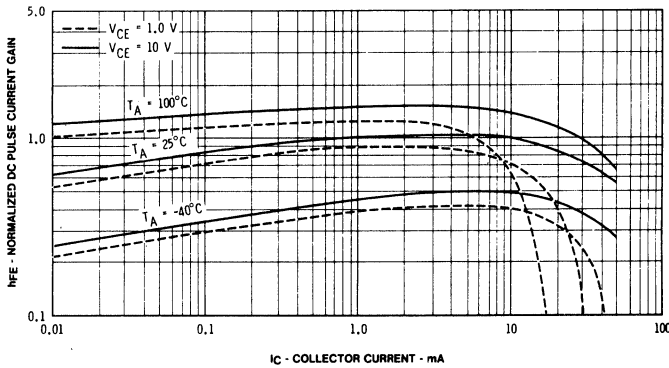


Photo Current Characteristics

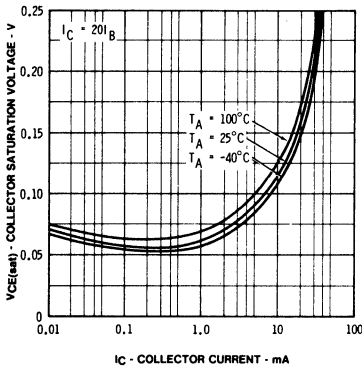


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

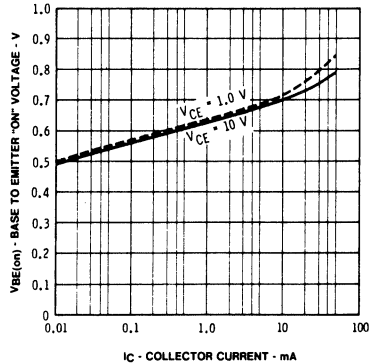
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



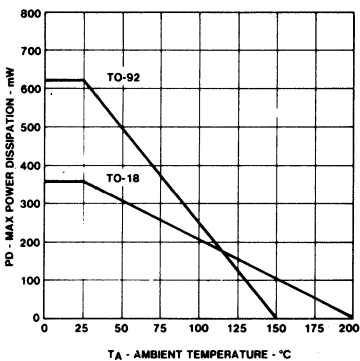
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



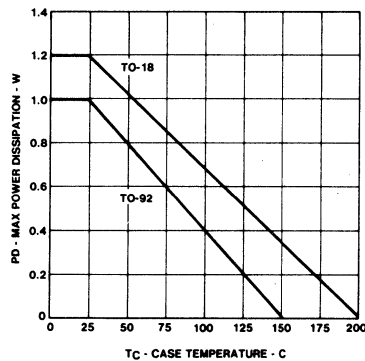
BASE TO EMITTER "ON" VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE

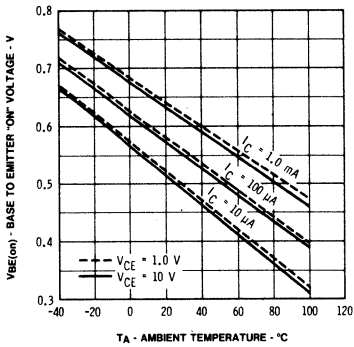


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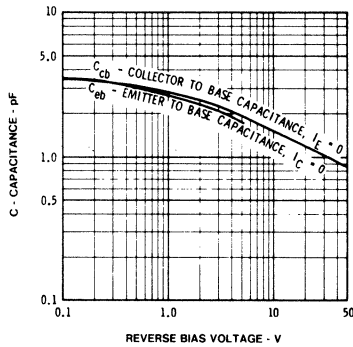
Curve Set number T107

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

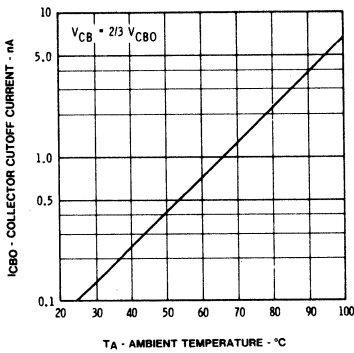
BASE TO EMITTER "ON" VOLTAGE vs AMBIENT TEMPERATURE



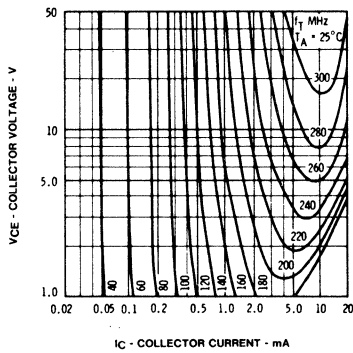
CAPACITANCE vs REVERSE BIAS VOLTAGE



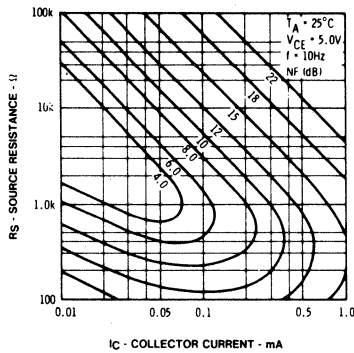
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



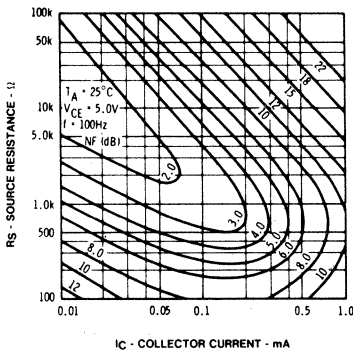
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



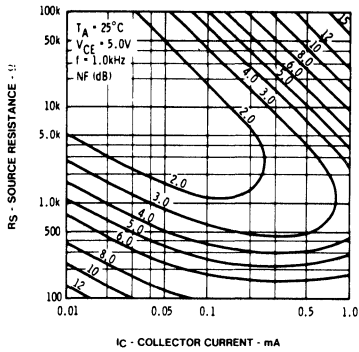
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



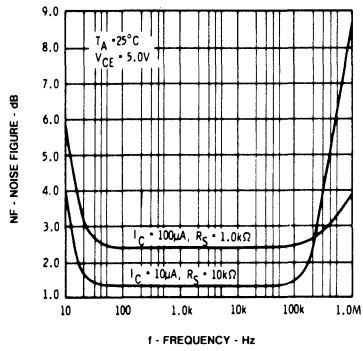
Typical Electrical Characteristic Curves

25° C Ambient Temperature unless otherwise noted

**CONTOURS OF CONSTANT
NARROW BAND NOISE FIGURE**



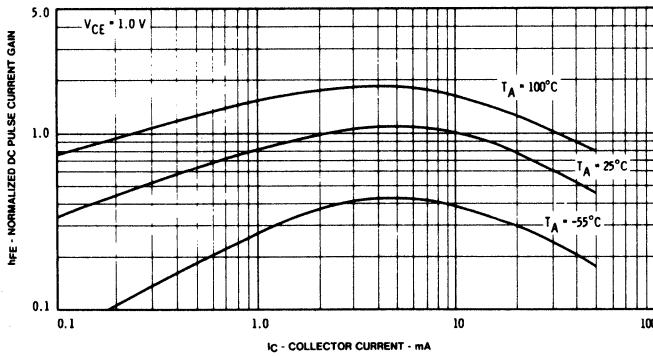
**NOISE FIGURE vs
FREQUENCY**



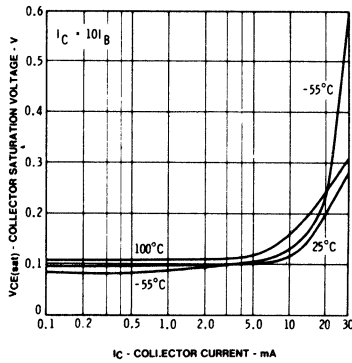
4

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

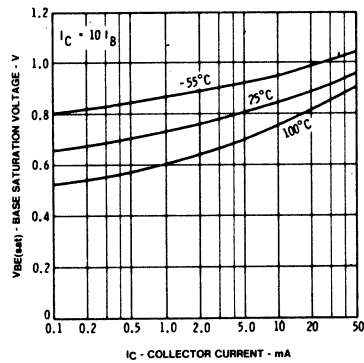
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



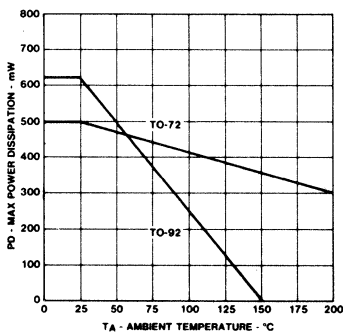
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



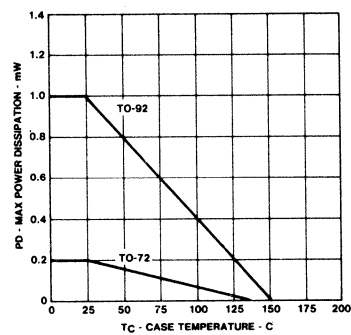
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



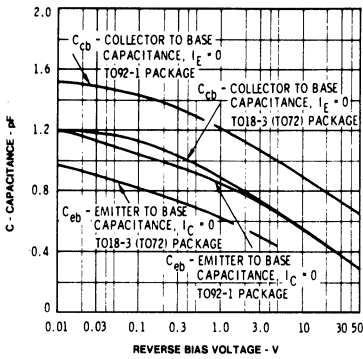
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



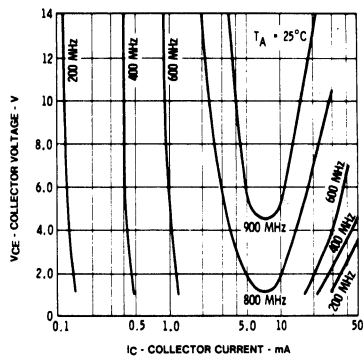
Curve Set number T121

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

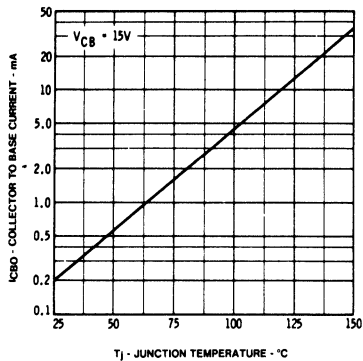
CAPACITANCE vs REVERSE BIAS VOLTAGE



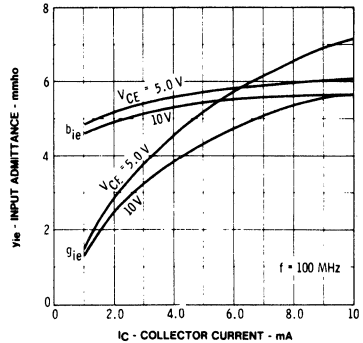
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



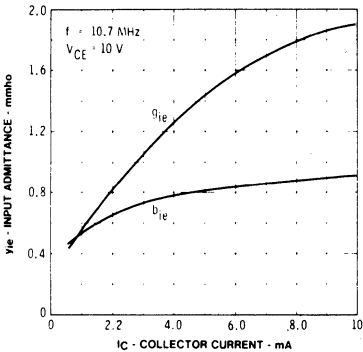
COLLECTOR TO BASE DIODE REVERSE CURRENT vs TEMPERATURE



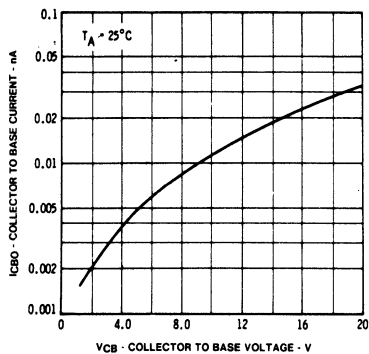
100 MHz INPUT ADMITTANCE vs COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



10.7 MHz INPUT ADMITTANCE OUTPUT SHORT CIRCUIT



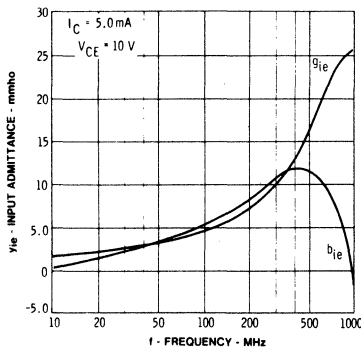
COLLECTOR CUTOFF CURRENT vs REVERSE BIAS VOLTAGE



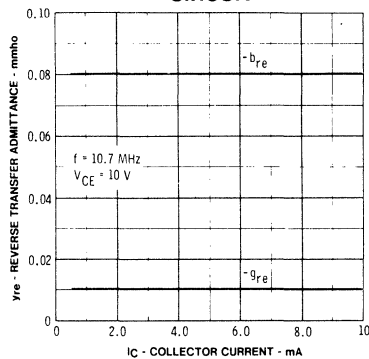
Curve Set number T121

Typical Electrical Characteristic Curves 25° C Ambient Temperature unless otherwise noted

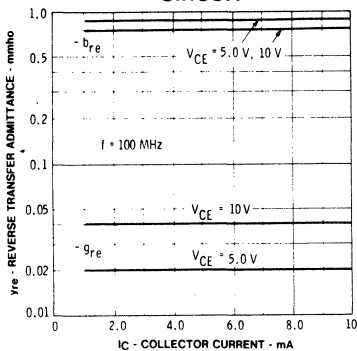
**INPUT ADMITTANCE vs
FREQUENCY OUTPUT SHORT
CIRCUIT**



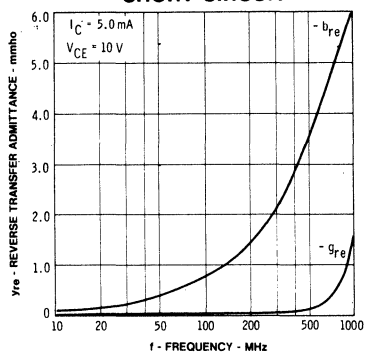
**10.7 MHz REVERSE TRANSFER
ADMITTANCE INPUT SHORT
CIRCUIT**



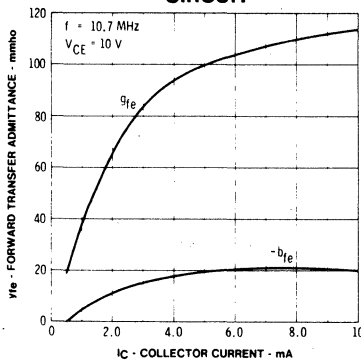
**100 MHz REVERSE TRANSFER
ADMITTANCE INPUT SHORT
CIRCUIT**



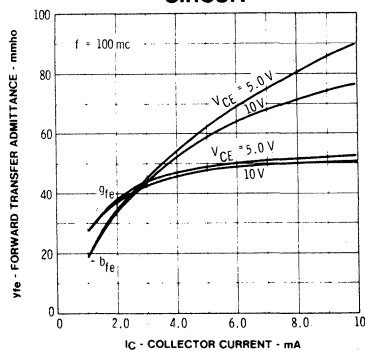
**REVERSE TRANSFER ADMITTANCE
vs FREQUENCY INPUT
SHORT CIRCUIT**



**10.7 MHz FORWARD TRANSFER
ADMITTANCE OUTPUT SHORT
CIRCUIT**



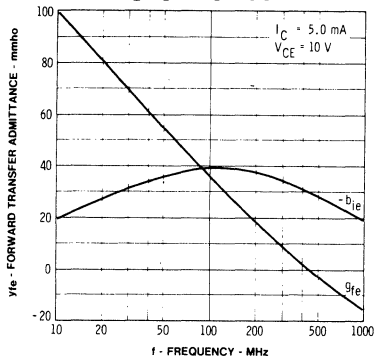
**100 MHz FORWARD TRANSFER
ADMITTANCE OUTPUT SHORT
CIRCUIT**



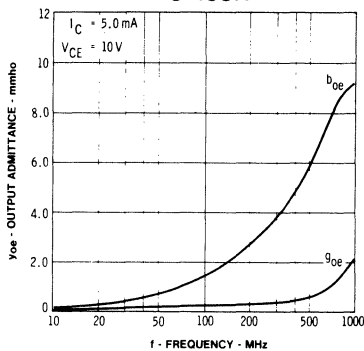
Curve Set number T121

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

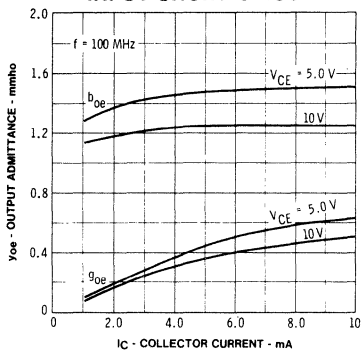
FORWARD TRANSFER ADMITTANCE vs FREQUENCY OUTPUT SHORT CIRCUIT



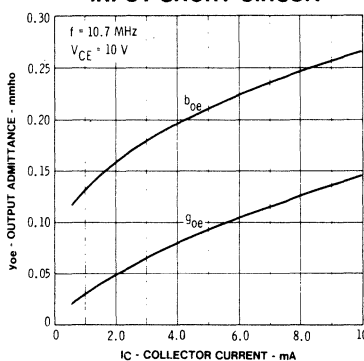
OUTPUT ADMITTANCE vs FREQUENCY INPUT SHORT CIRCUIT



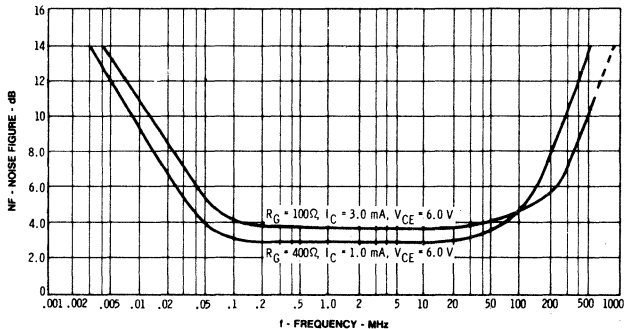
100 MHz OUTPUT ADMITTANCE INPUT SHORT CIRCUIT



10.7 MHz OUTPUT ADMITTANCE INPUT SHORT CIRCUIT



NOISE FIGURE vs FREQUENCY

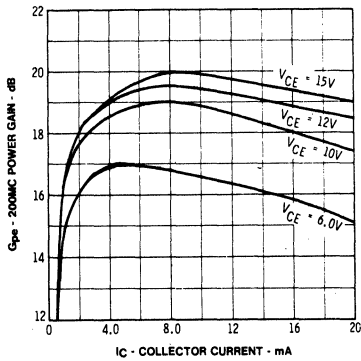


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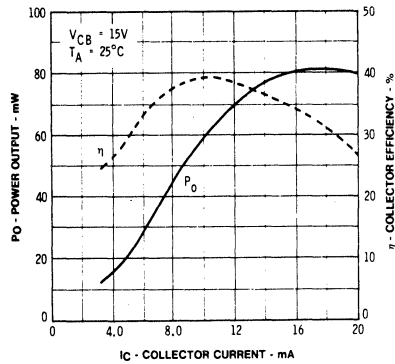
Curve Set number T121

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER PERFORMANCE

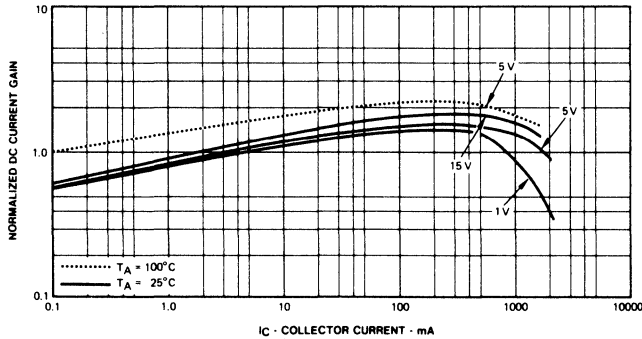


500 MHz OSCILLATOR TYPICAL PERFORMANCE

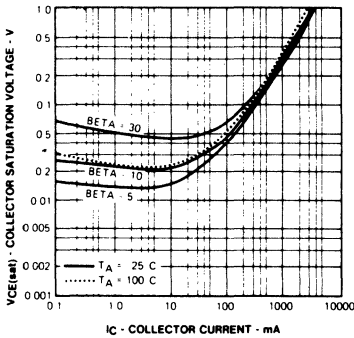


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

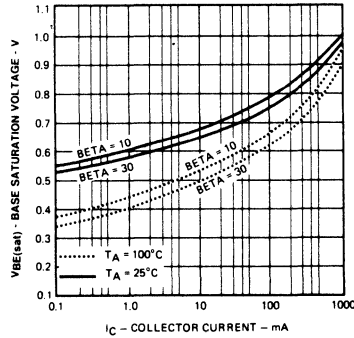
NORMALIZED DC CURRENT GAIN vs COLLECTOR CURRENT



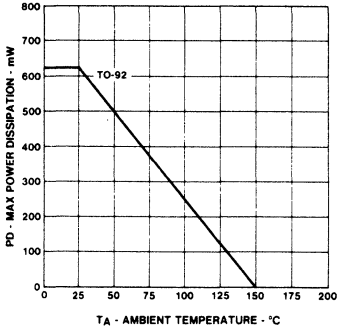
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



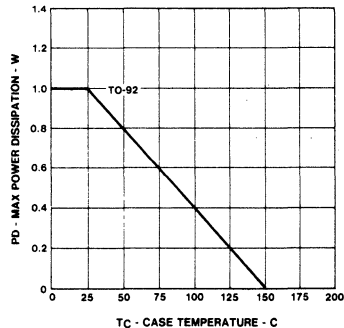
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



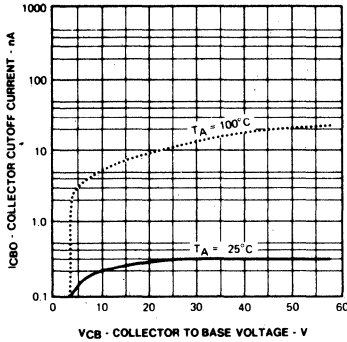
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



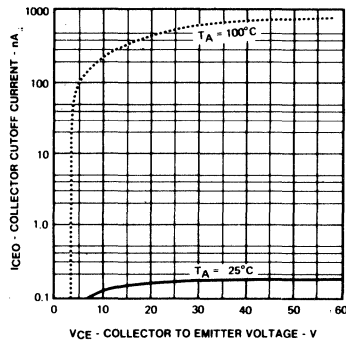
Curve Set number T124

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

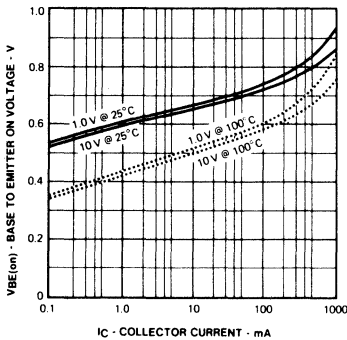
COLLECTOR CUTOFF CURRENT vs COLLECTOR TO EMITTER VOLTAGE



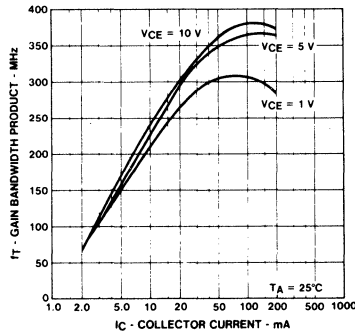
COLLECTOR CUTOFF CURRENT vs COLLECTOR TO EMITTER VOLTAGE



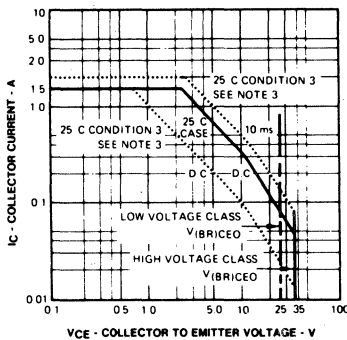
BASE TO EMITTER ON VOLTAGE vs COLLECTOR CURRENT



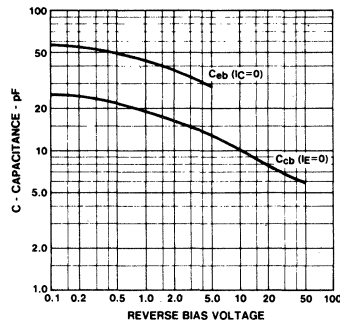
GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT



SAFE OPERATING AREA

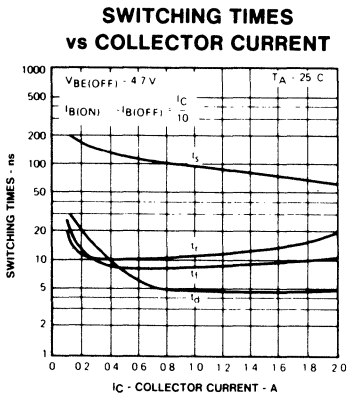


CAPACITANCE vs REVERSE BIAS VOLTAGE



Curve Set number T124

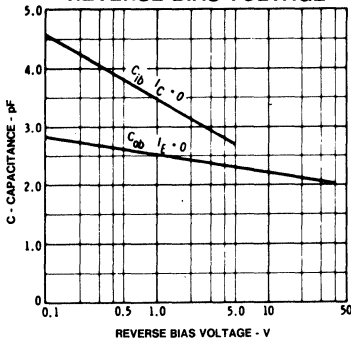
Typical Electrical Characteristic Curves 25° C Ambient Temperature unless otherwise noted



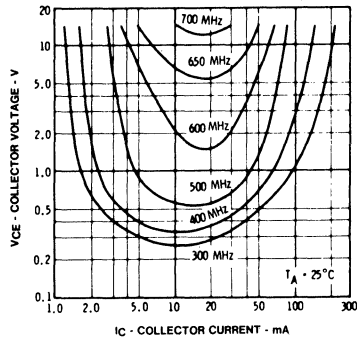
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

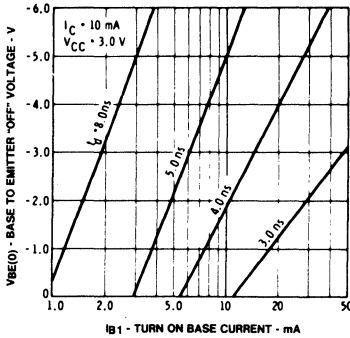
EMITTER TRANSITION AND OUTPUT CAPACITANCES vs REVERSE BIAS VOLTAGE



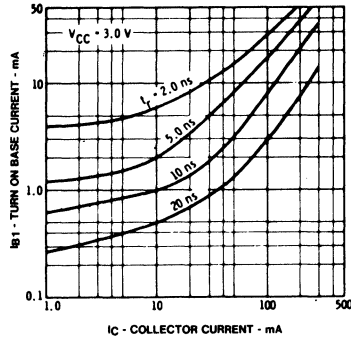
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



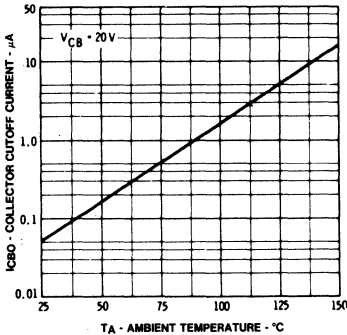
DELAY TIME vs BASE TO EMITTER "OFF" VOLTAGE AND TURN ON BASE CURRENT



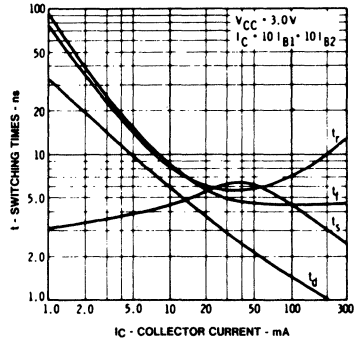
RISE TIME vs TURN ON BASE CURRENT AND COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



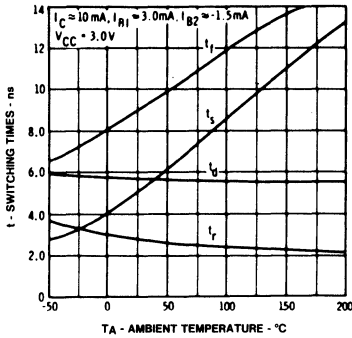
SWITCHING TIMES vs COLLECTOR CURRENT



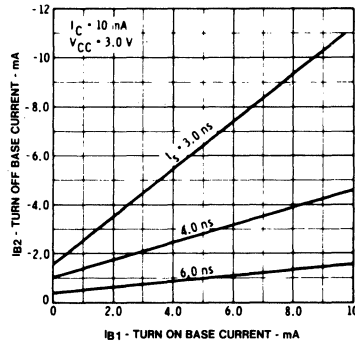
Curve Set number T132

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

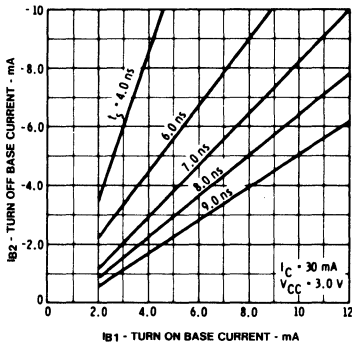
SWITCHING TIMES vs AMBIENT TEMPERATURE



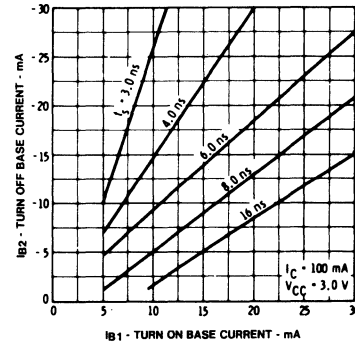
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



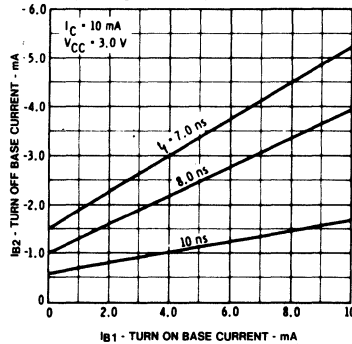
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



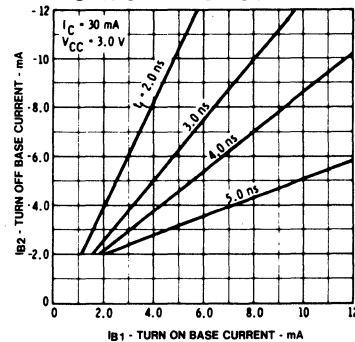
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS

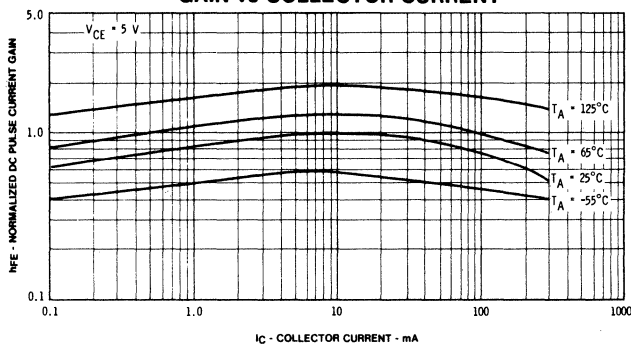


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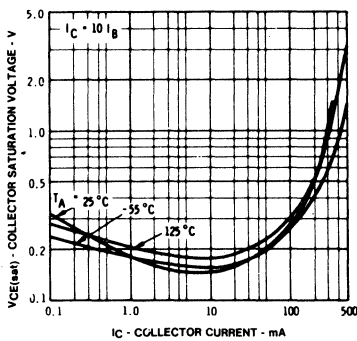
Curve Set number T132

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

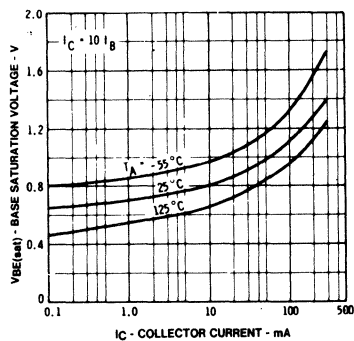
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



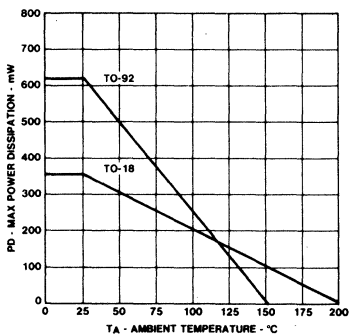
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



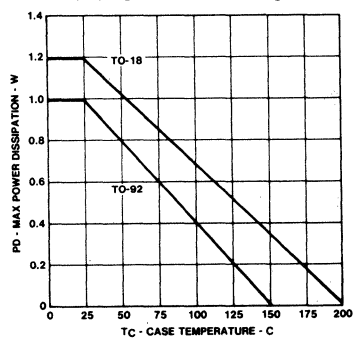
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



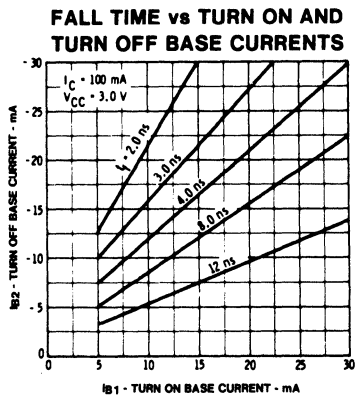
MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



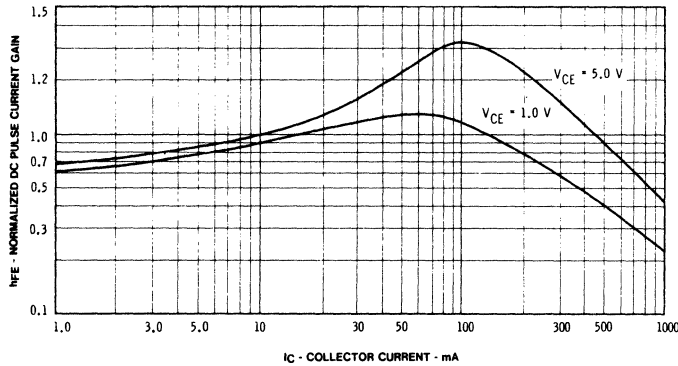
Typical Electrical Characteristic Curves
25°C Ambient Temperature unless otherwise noted



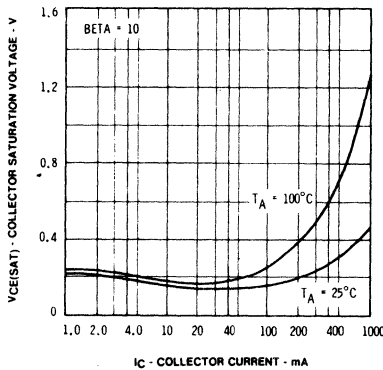
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

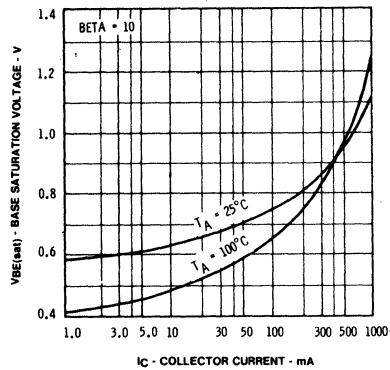
NORMALIZED DC PULSED CURRENT GAIN vs COLLECTOR CURRENT



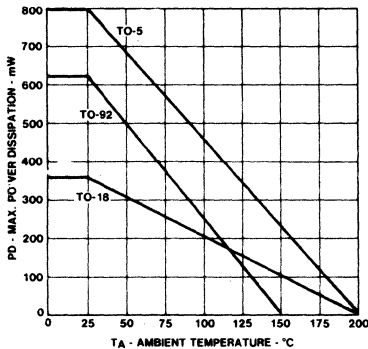
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



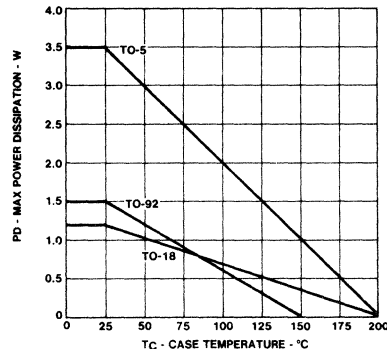
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



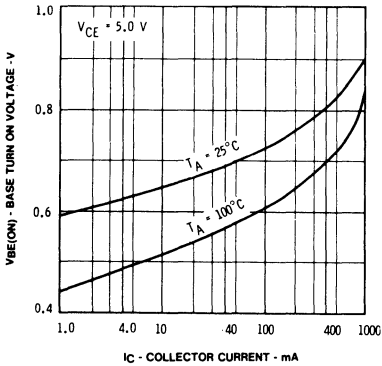
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



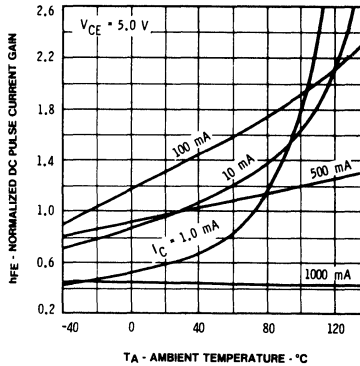
Curve Set number T139

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

BASE TURN ON VOLTAGE vs COLLECTOR CURRENT

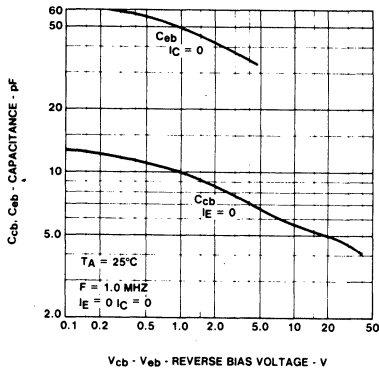


NORMALIZED DC PULSED CURRENT GAIN vs TEMPERATURE

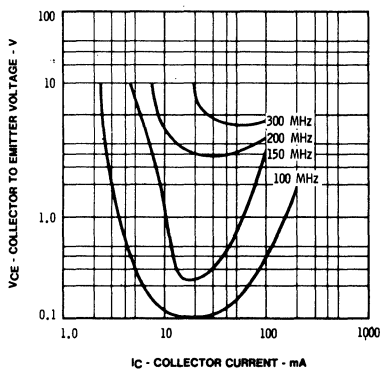


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C_{cb} AND C_{eb} vs COLLECTOR TO BASE REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT

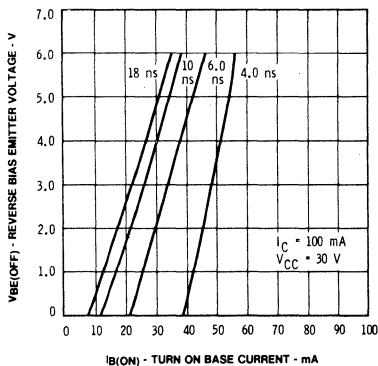


Curve Set number T139

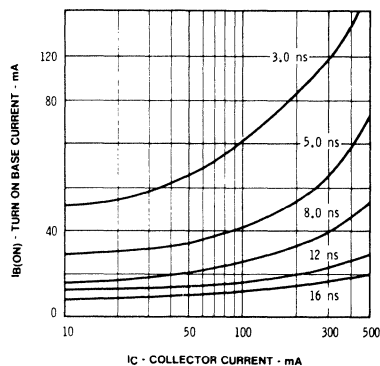
Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

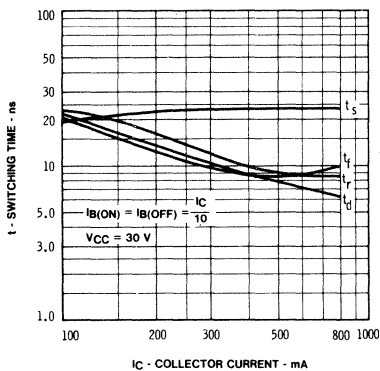
**DELAY TIME vs TURN ON
BASE CURRENT AND REVERSE BASE
TO EMITTER VOLTAGE**



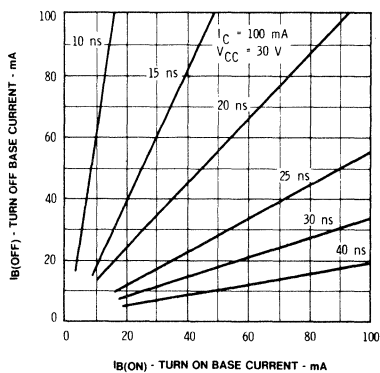
**RISE TIME vs COLLECTOR
CURRENT AND TURN ON BASE
CURRENT**



**SWITCHING TIME vs
COLLECTOR CURRENT**

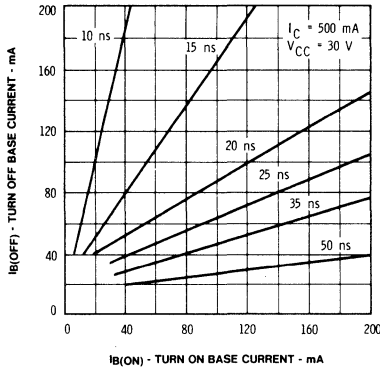


**STORAGE TIME vs TURN ON
AND TURN OFF BASE CURRENTS**

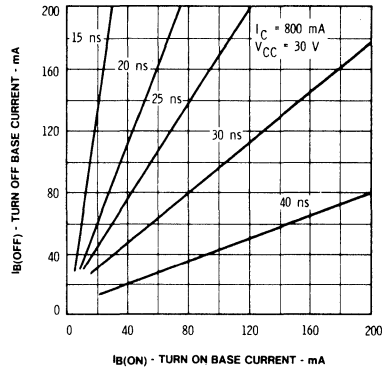


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

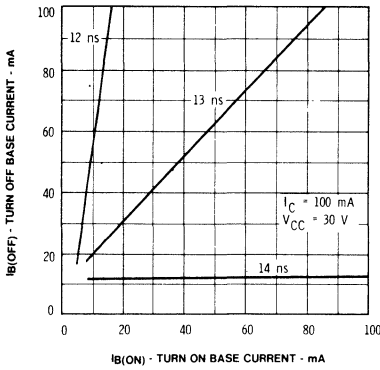
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



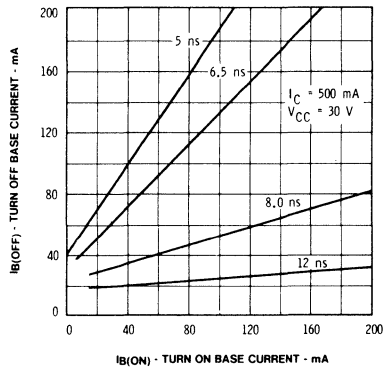
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



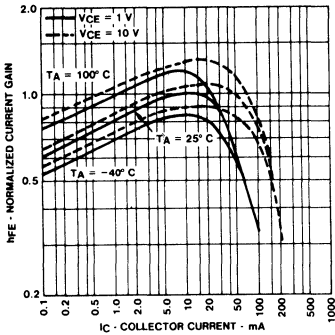
FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



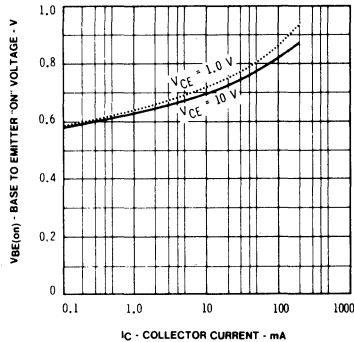
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

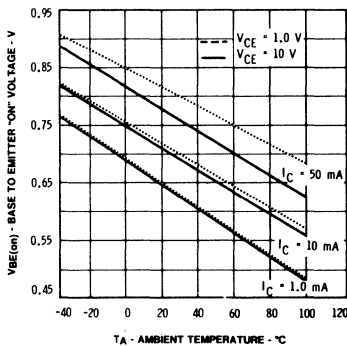
NORMALIZED CURRENT GAIN vs COLLECTOR CURRENT



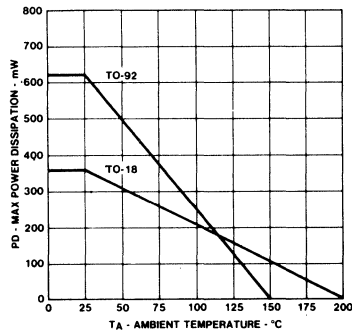
BASE TO EMITTER "ON" VOLTAGE vs COLLECTOR CURRENT



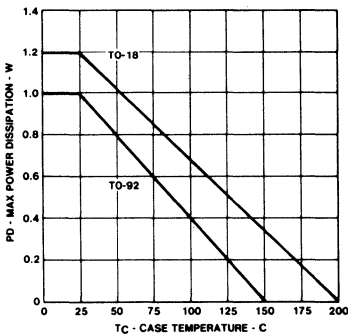
BASE TO EMITTER "ON" VOLTAGE vs AMBIENT TEMPERATURE



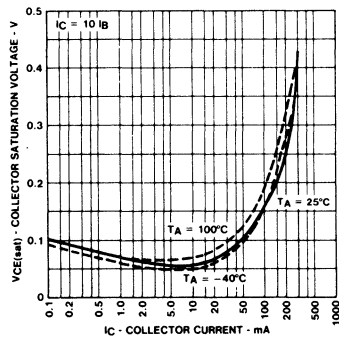
MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT

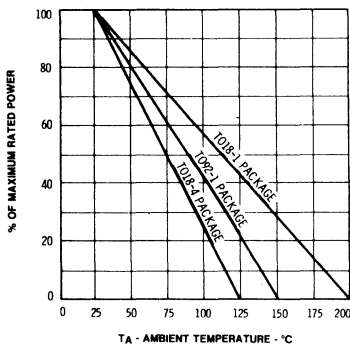


Curve Set number T144

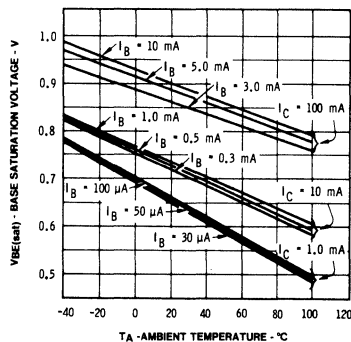
Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

4

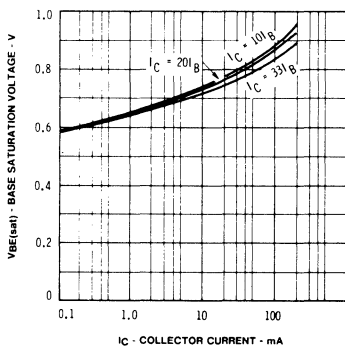
ALLOWABLE POWER DISSIPATION vs AMBIENT TEMPERATURE



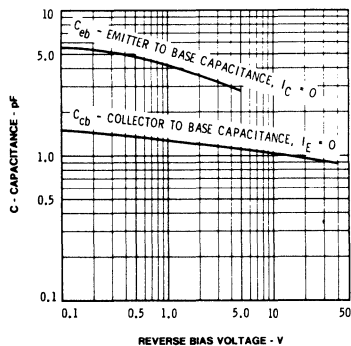
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



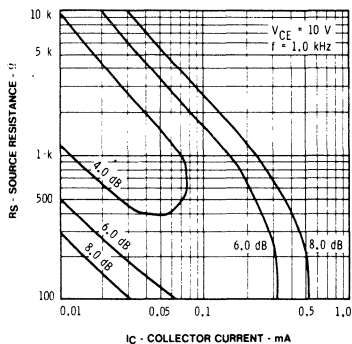
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



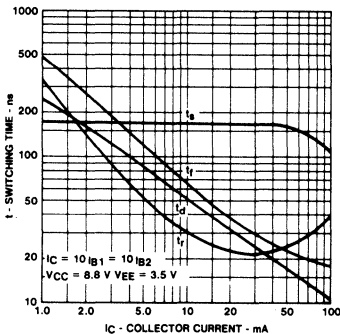
CAPACITANCE vs REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

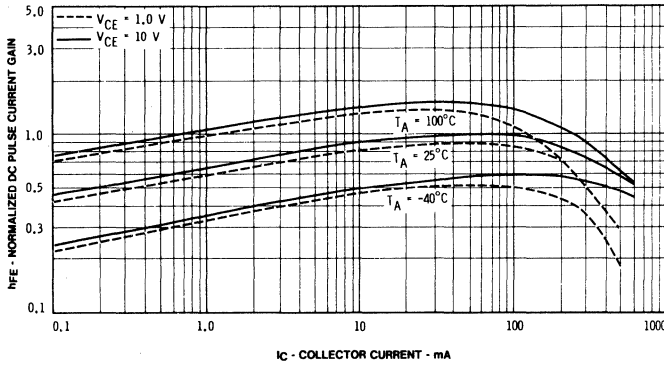


SWITCHING TIME vs COLLECTOR CURRENT

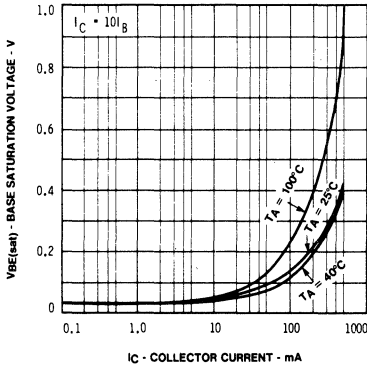


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

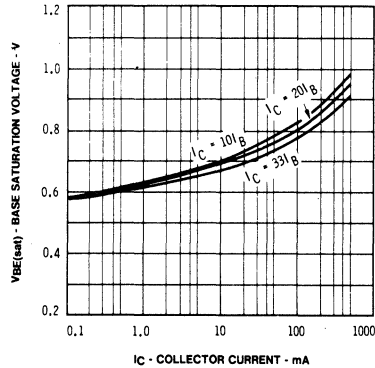
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



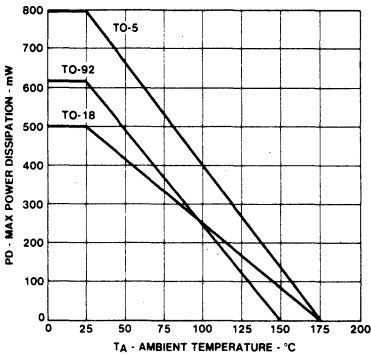
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



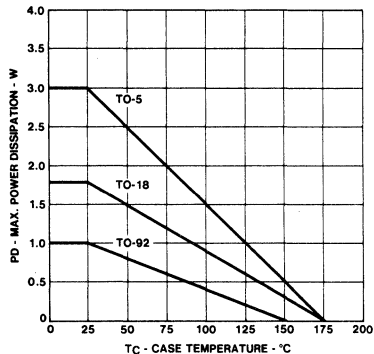
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



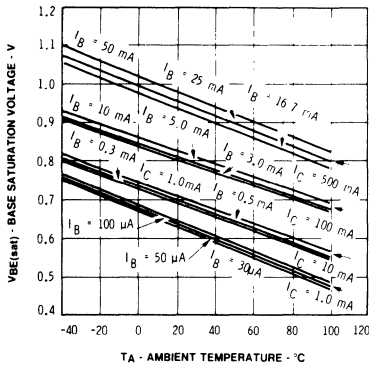
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



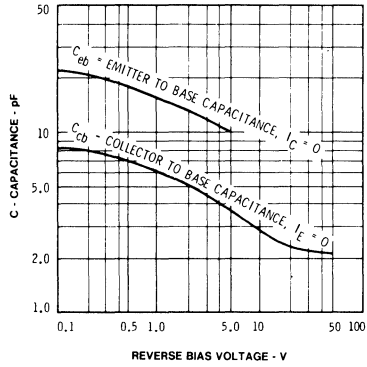
Curve Set number T145

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

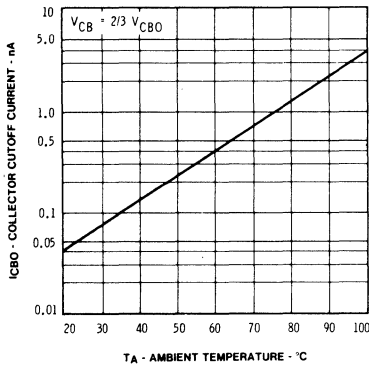
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



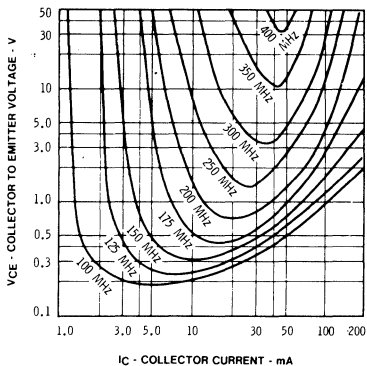
CAPACITANCE vs REVERSE BIAS VOLTAGE



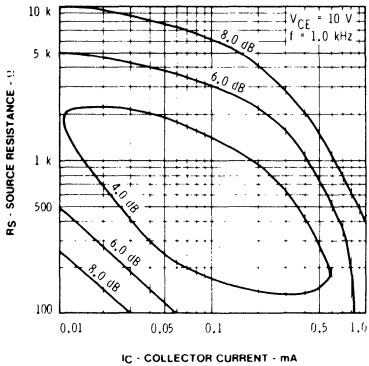
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



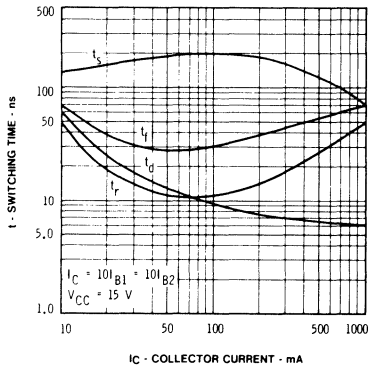
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



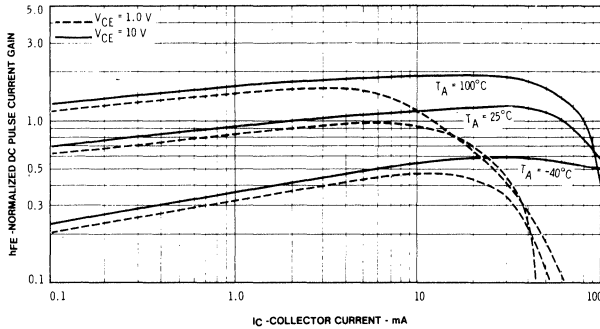
SWITCHING TIME VS COLLECTOR CURRENT



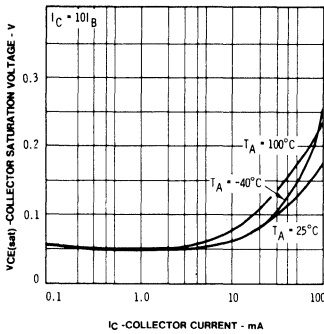
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

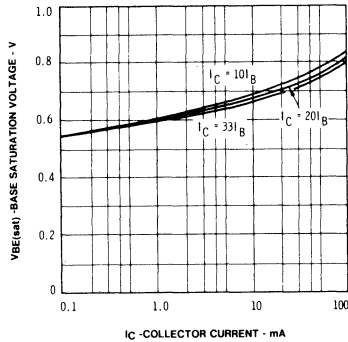
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



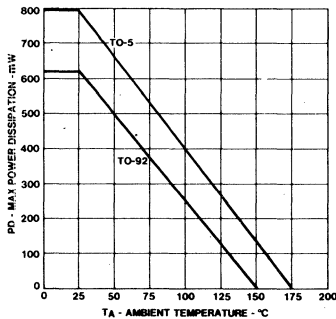
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



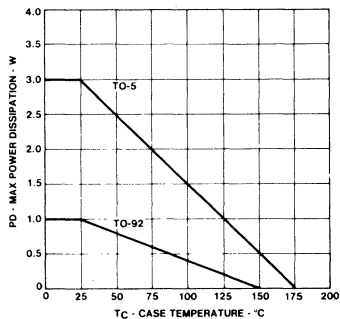
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



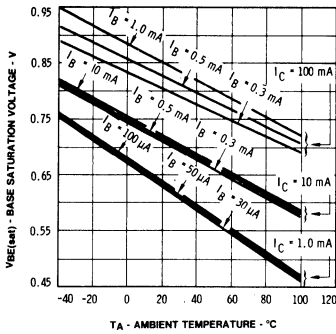
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



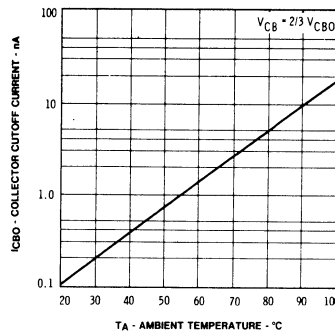
Curve Set number T147

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

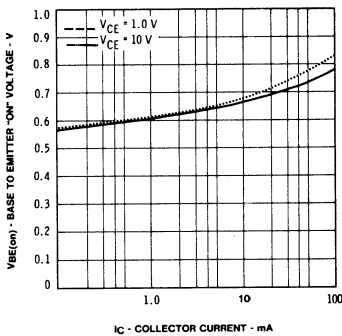
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



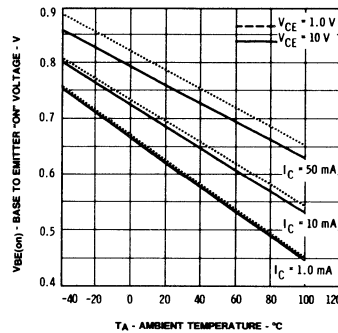
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



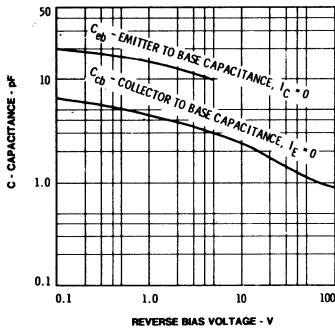
BASE TO EMITTER "ON" VOLTAGE vs COLLECTOR CURRENT



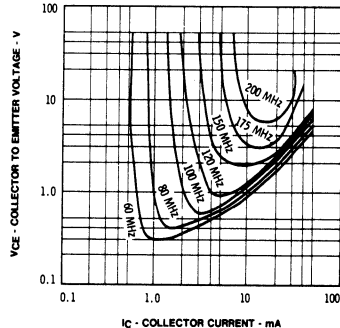
BASE TO EMITTER "ON" VOLTAGE vs AMBIENT TEMPERATURE



CAPACITANCE VS REVERSE BIAS VOLTAGE



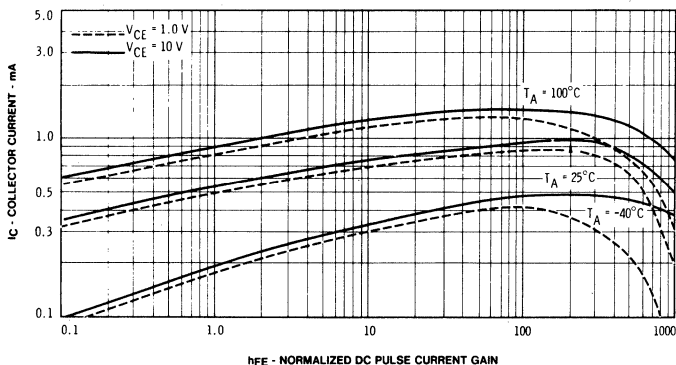
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



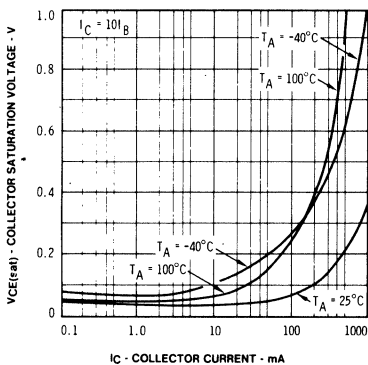
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

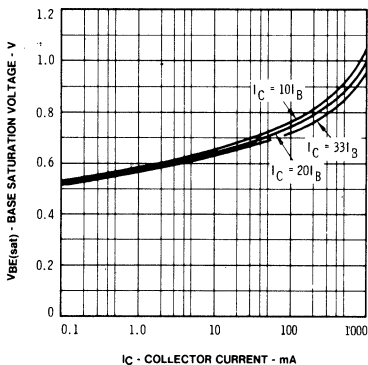
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



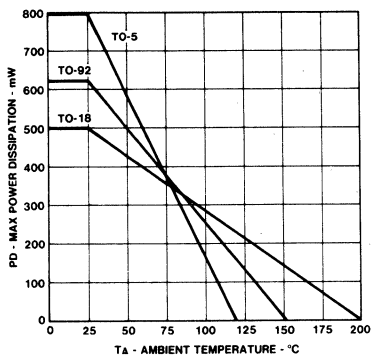
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



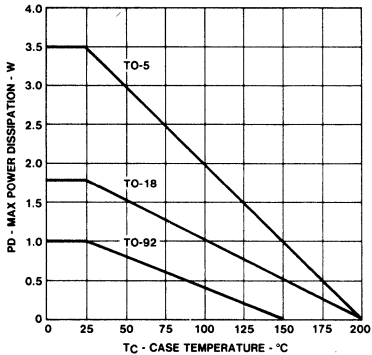
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE

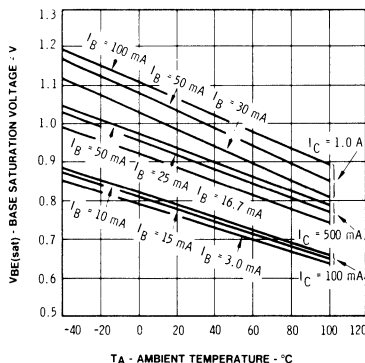


MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE

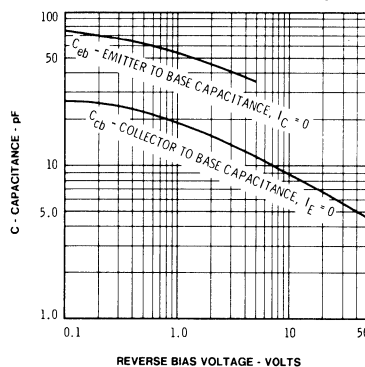


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

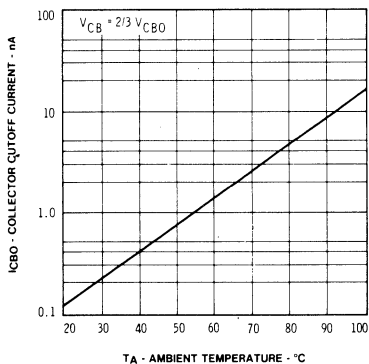
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



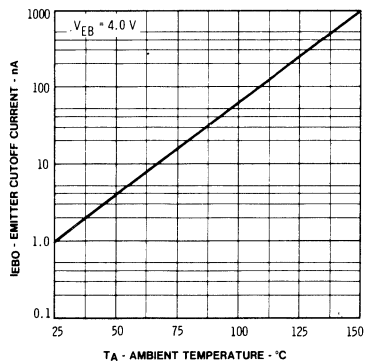
CAPACITANCE vs REVERSE BIAS VOLTAGE



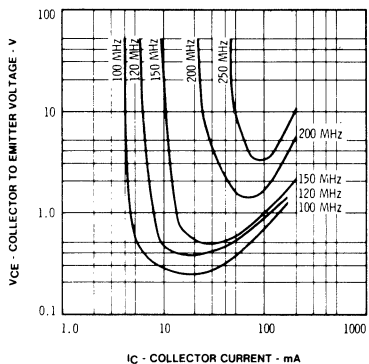
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



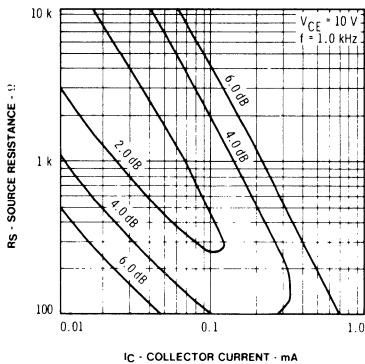
EMITTER CUTOFF CURRENT vs AMBIENT TEMPERATURE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



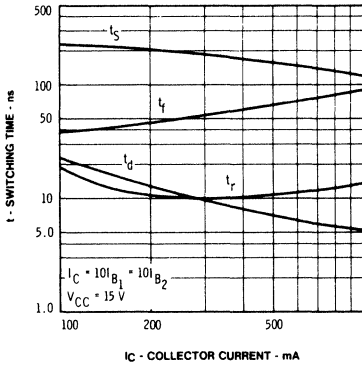
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Curve Set number T149

Typical Electrical Characteristic Curves

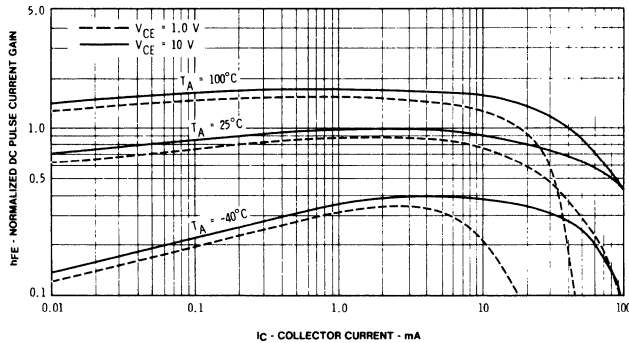
25°C Ambient Temperature unless otherwise noted

**SWITCHING TIME vs
COLLECTOR CURRENT**



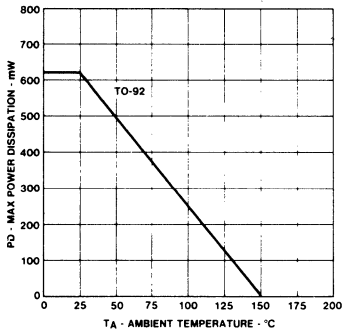
Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT

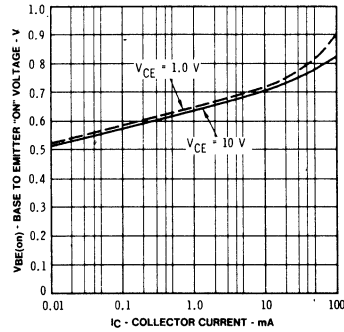


4

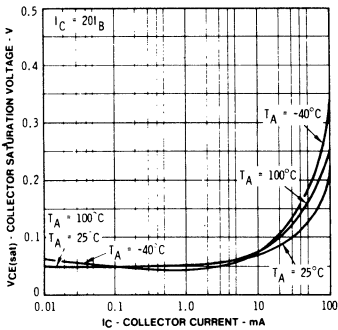
MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



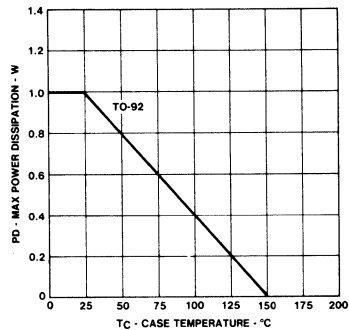
BASE EMITTER "ON" VOLTAGE vs COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



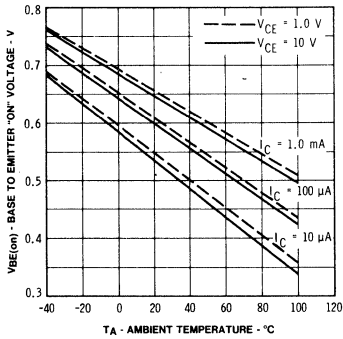
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



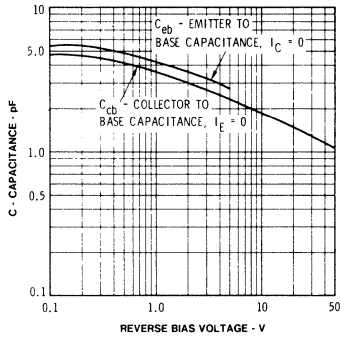
Curve Set number T155

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

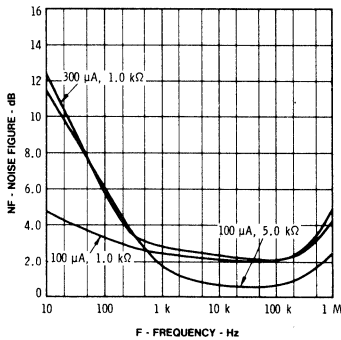
**BASE TO EMITTER 'ON' VOLTAGE
vs AMBIENT TEMPERATURE**



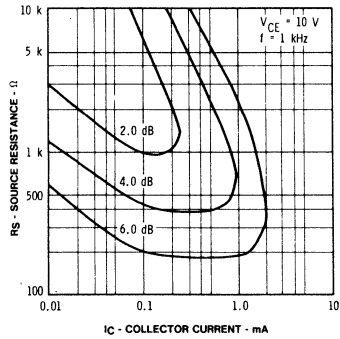
**CAPACITANCE vs REVERSE
BIAS VOLTAGE**



**NOISE FIGURE vs
FREQUENCY**

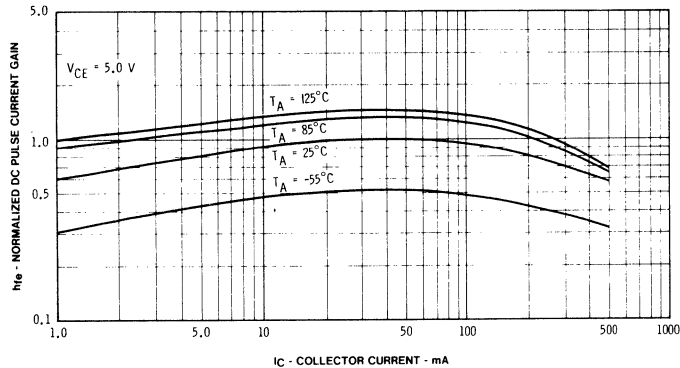


**CONTOURS OF CONSTANT
NARROW BAND NOISE FIGURE**

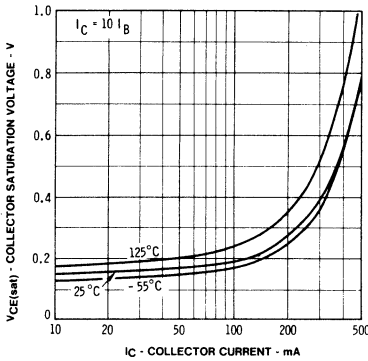


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

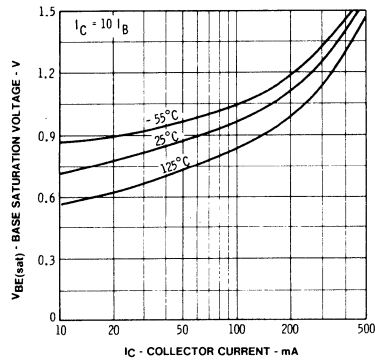
**NORMALIZED CURRENT GAIN
vs COLLECTOR CURRENT**



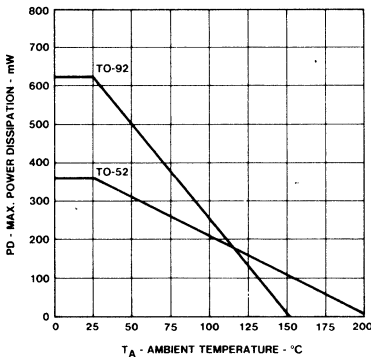
**COLLECTOR SATURATION VOLTAGE
vs COLLECTOR CURRENT**



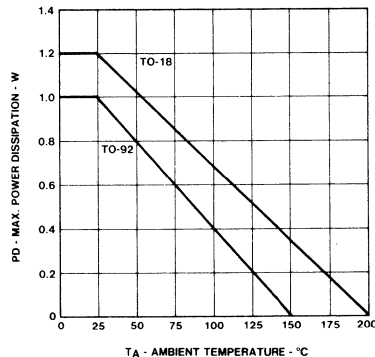
**BASE SATURATION VOLTAGE
vs COLLECTOR CURRENT**



**MAXIMUM POWER DISSIPATION
vs CASE TEMPERATURE**



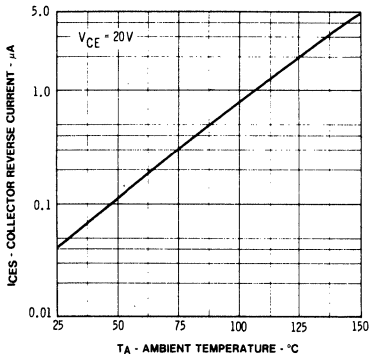
**MAXIMUM POWER DISSIPATION
vs AMBIENT TEMPERATURE**



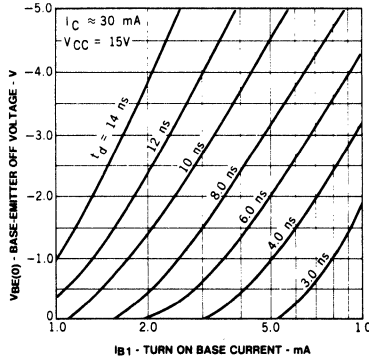
Curve Set number T162

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

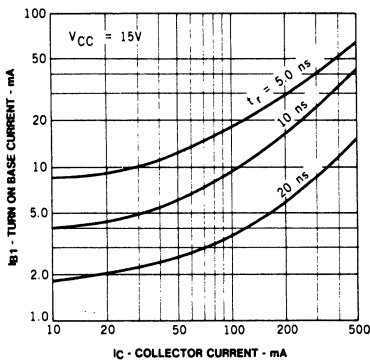
COLLECTOR REVERSE CURRENT vs AMBIENT TEMPERATURE



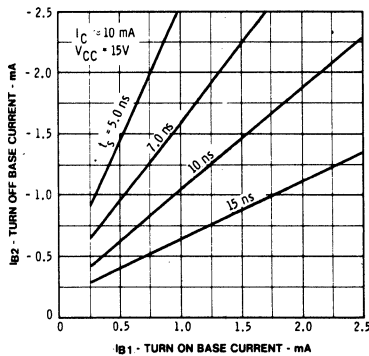
DELAY TIME vs BASE EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



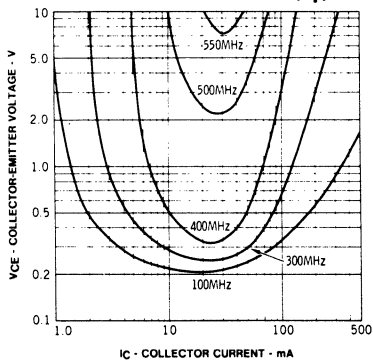
RISE TIME vs COLLECTOR AND TURN ON BASE CURRENTS



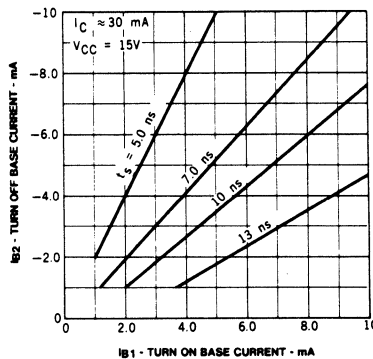
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



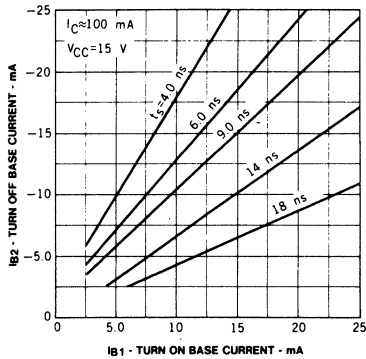
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



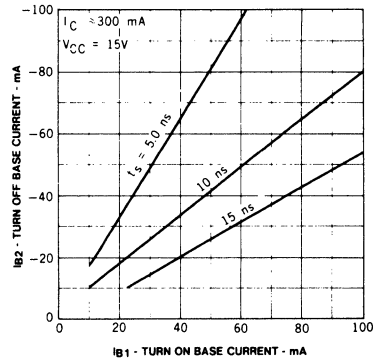
Curve Set number T162

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

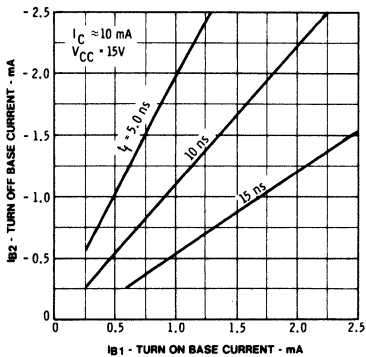
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



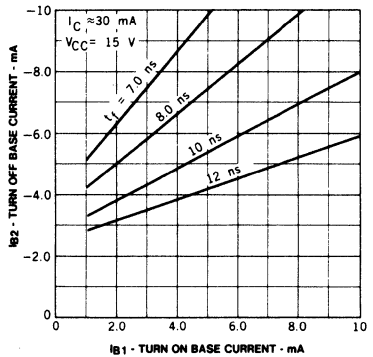
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



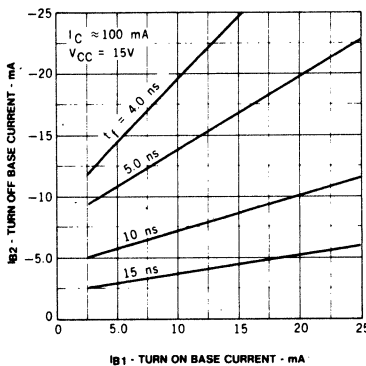
FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



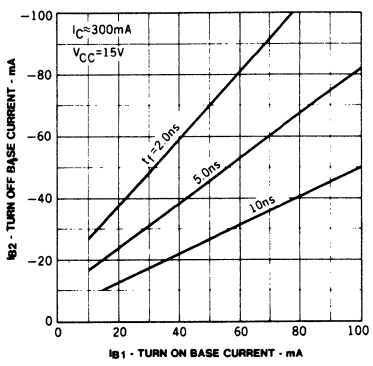
FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS

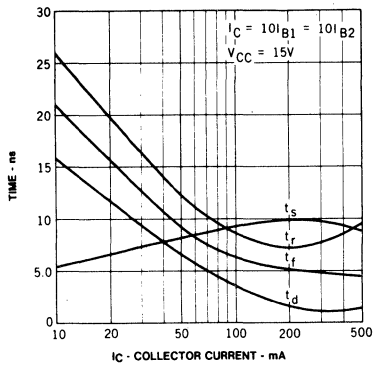


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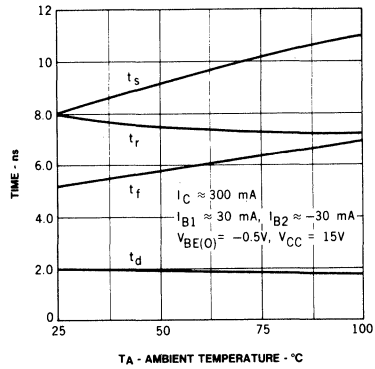
Curve Set number T162

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

**SWITCHING TIMES
vs COLLECTOR CURRENT**

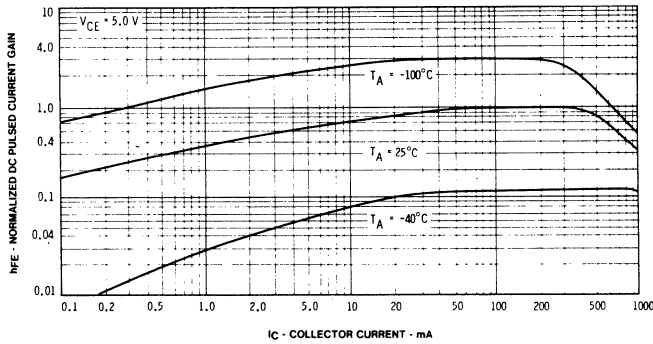


**SWITCHING TIMES
vs AMBIENT TEMPERATURE**

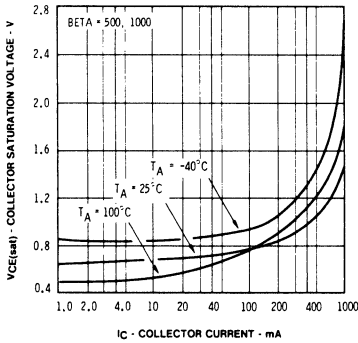


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

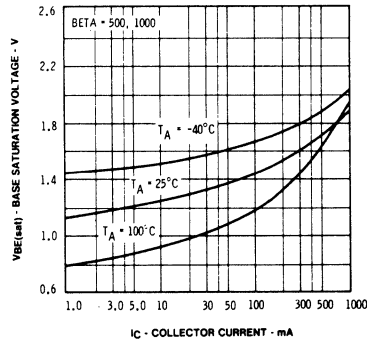
NORMALIZED DC PULSED CURRENT GAIN vs COLLECTOR CURRENT



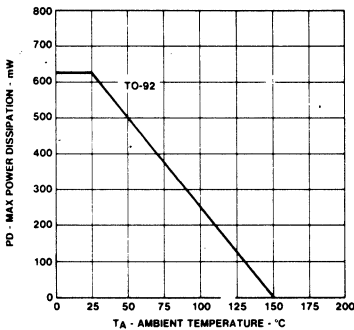
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



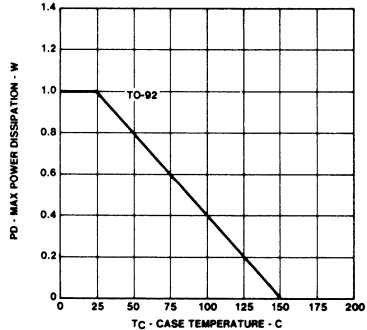
BASE SATURATION VOLTAGE vs COLLECTION CURRENT



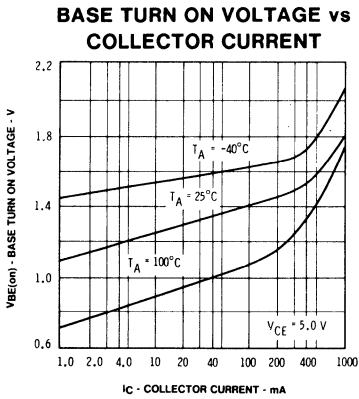
MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE

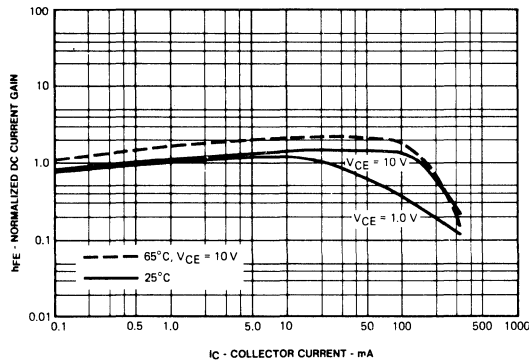


Typical Electrical Characteristic Curves
25°C Ambient Temperature unless otherwise noted

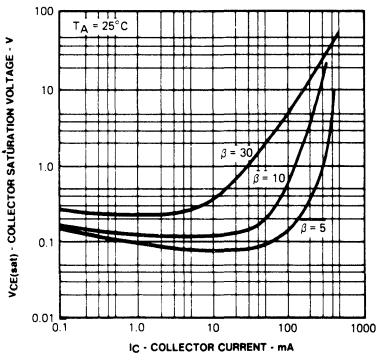


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

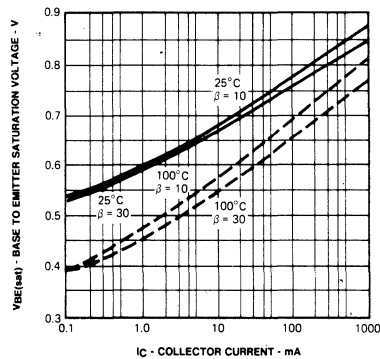
NORMALIZED DC CURRENT GAIN vs COLLECTOR CURRENT



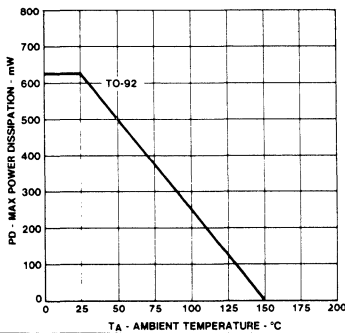
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



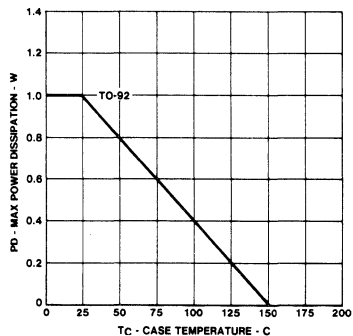
BASE TO EMITTER SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



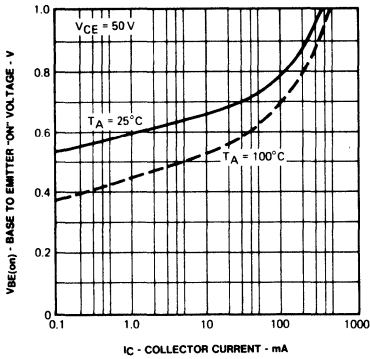
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



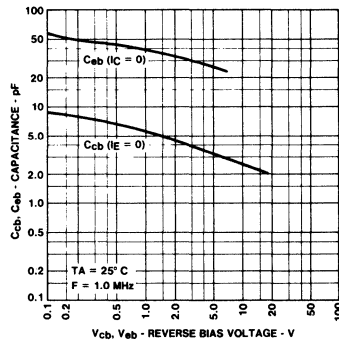
Curve Set number T176

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

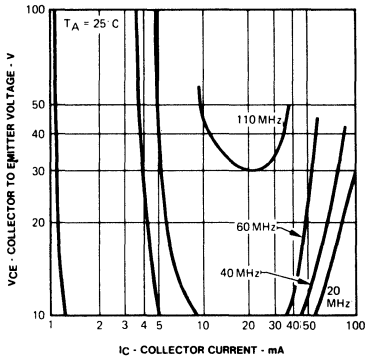
**BASE TO EMITTER
"ON" VOLTAGE
vs COLLECTOR CURRENT**



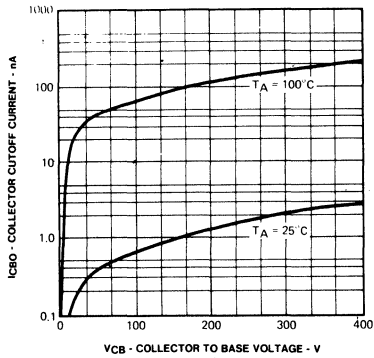
**C_{CB} AND C_{EB} vs COLLECTOR
TO BASE REVERSE BIAS VOLTAGE**



**CONTOURS OF CONSTANT
GAIN-BANDWIDTH PRODUCT**

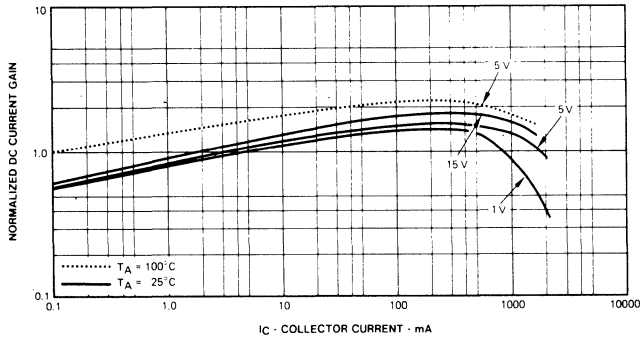


**COLLECTOR CUTOFF CURRENT
vs
COLLECTOR TO BASE VOLTAGE**

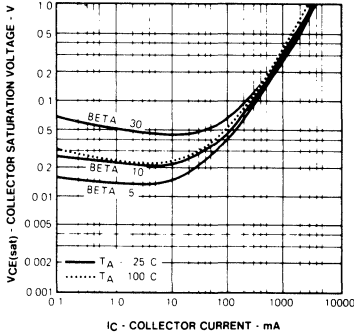


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

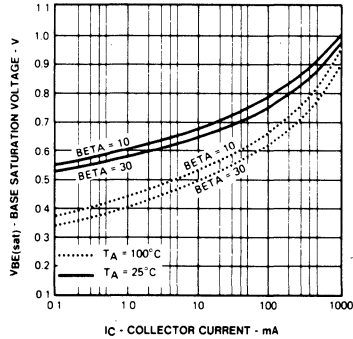
**NORMALIZED DC CURRENT GAIN
vs COLLECTOR CURRENT**



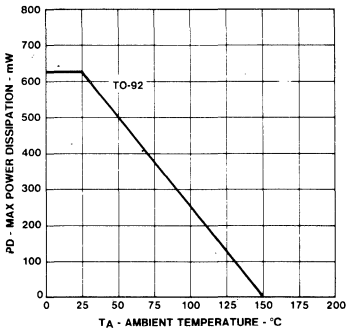
**COLLECTOR SATURATION VOLTAGE
vs COLLECTOR CURRENT**



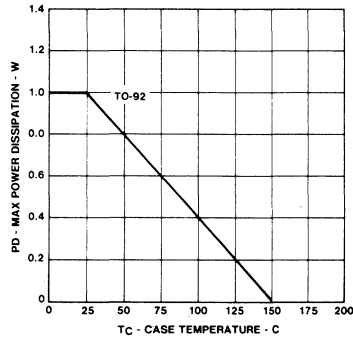
**BASE SATURATION VOLTAGE
vs COLLECTOR CURRENT**



**MAXIMUM POWER DISSIPATION
vs AMBIENT TEMPERATURE**



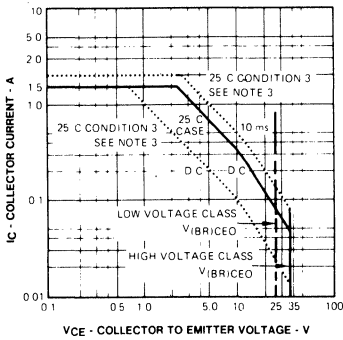
**MAXIMUM POWER DISSIPATION
vs CASE TEMPERATURE**



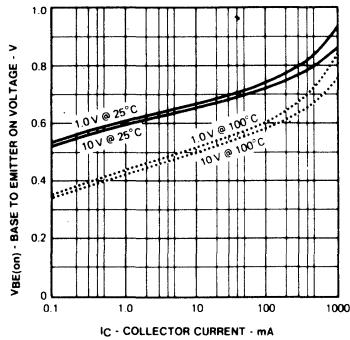
Curve Set number T202

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

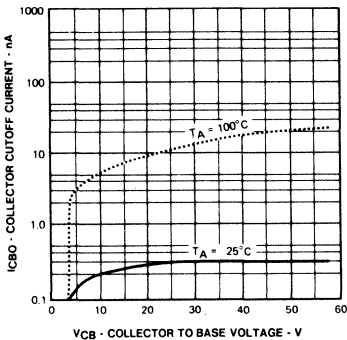
SAFE OPERATING AREA



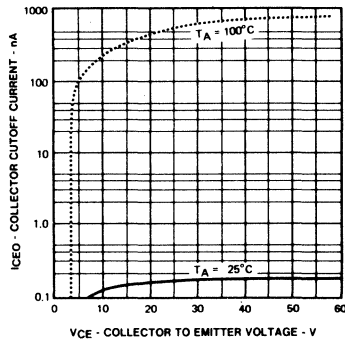
BASE TO EMITTER ON VOLTAGE vs COLLECTOR CURRENT



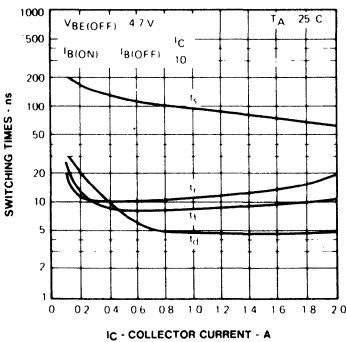
COLLECTOR CUTOFF CURRENT vs COLLECTOR TO EMITTER VOLTAGE



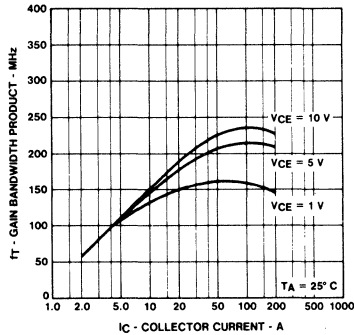
COLLECTOR CUTOFF CURRENT vs COLLECTOR TO EMITTER VOLTAGE



SWITCHING TIMES vs COLLECTOR CURRENT



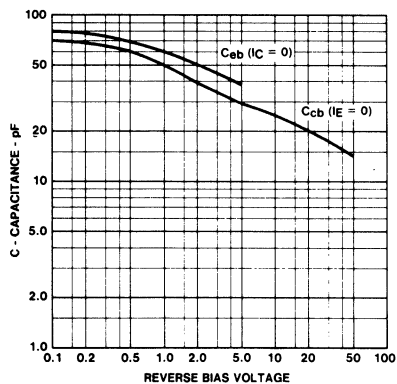
GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT



Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

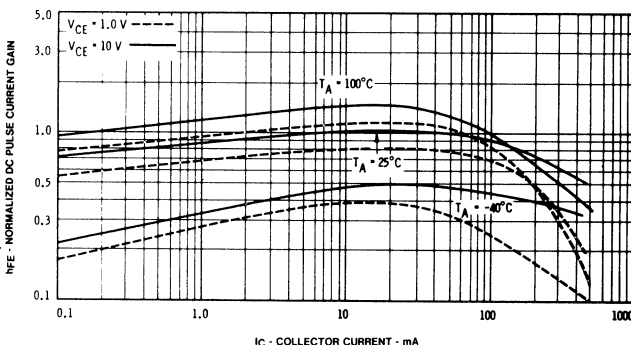
**CAPACITANCE vs REVERSE
BIAS VOLTAGE**



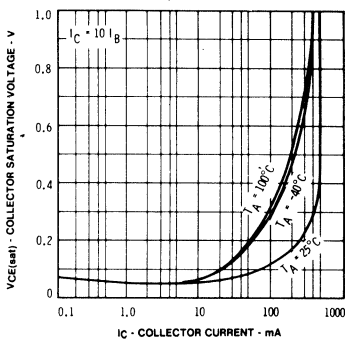
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Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

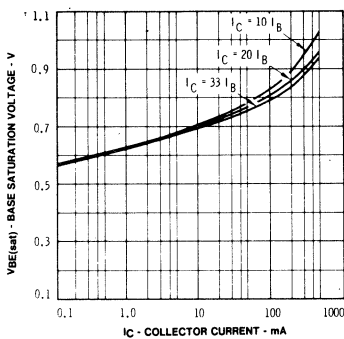
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



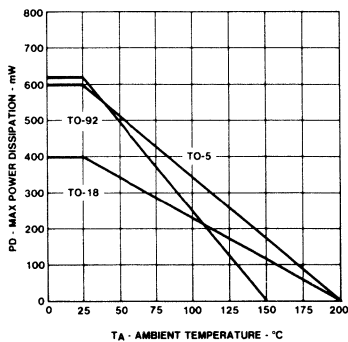
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



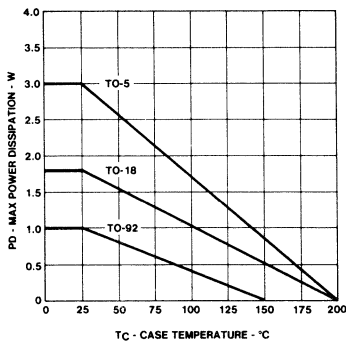
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



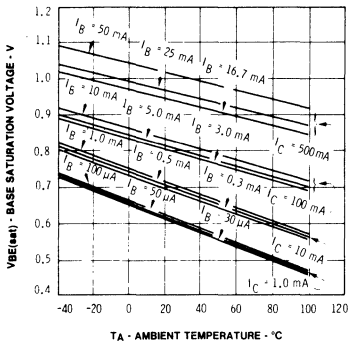
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



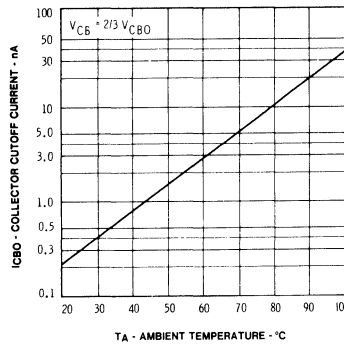
Curve Set number T212

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

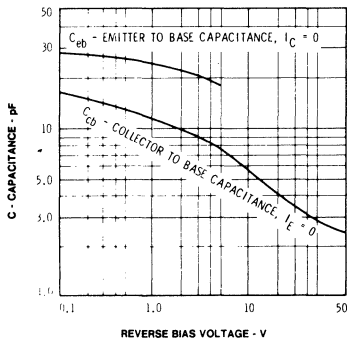
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



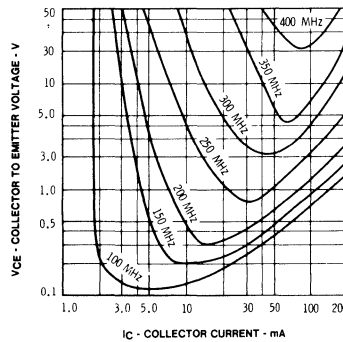
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



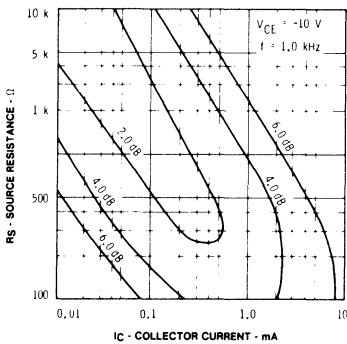
CAPACITANCE vs REVERSE BIAS VOLTAGE



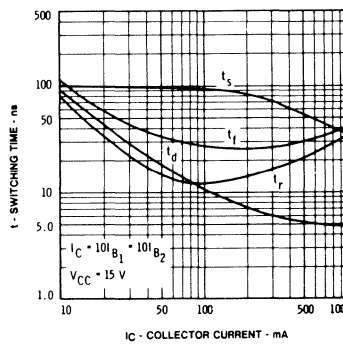
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

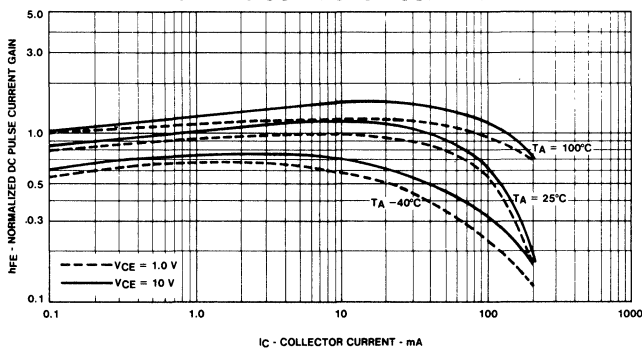


SWITCHING TIME vs COLLECTOR CURRENT

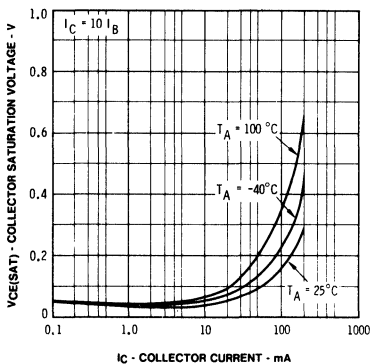


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

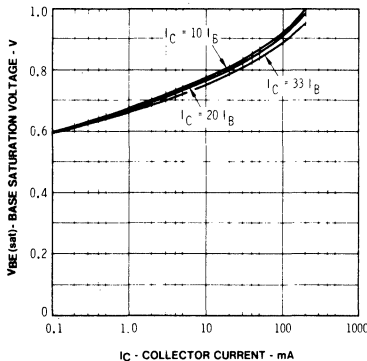
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



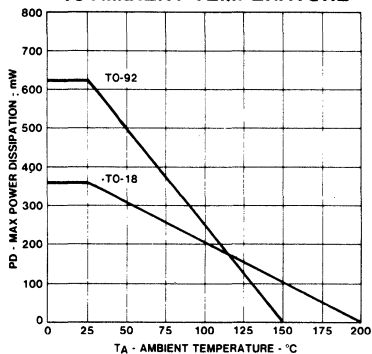
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



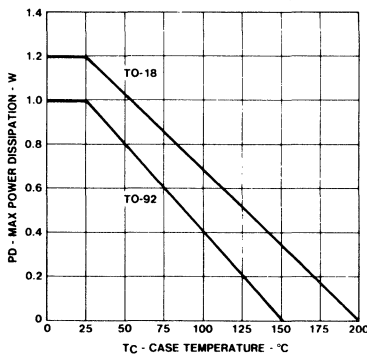
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



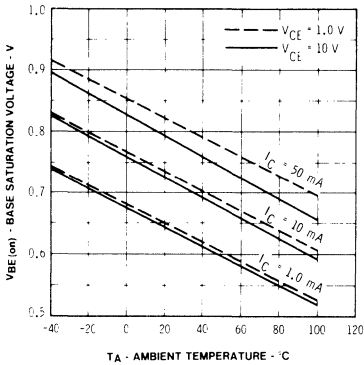
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



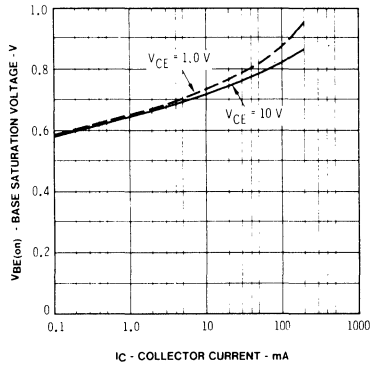
Curve Set number T215

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

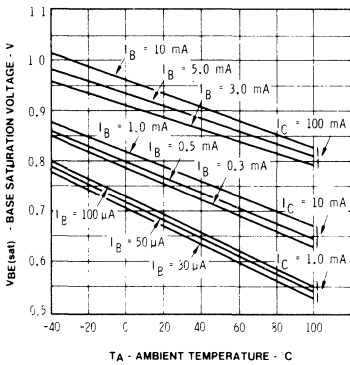
BASE TO EMITTER 'ON' VOLTAGE vs AMBIENT TEMPERATURE



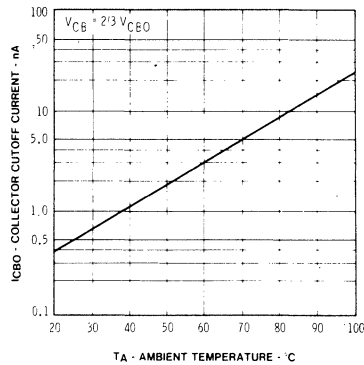
BASE TO EMITTER 'ON' VOLTAGE vs COLLECTOR CURRENT



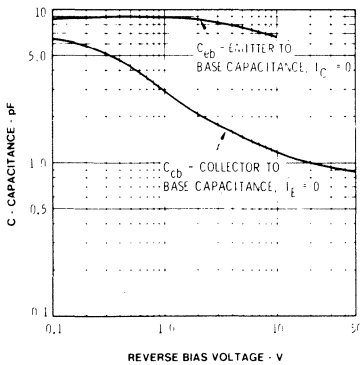
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



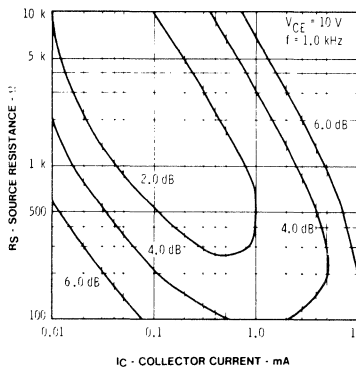
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



CAPACITANCE vs REVERSE BIAS VOLTAGE



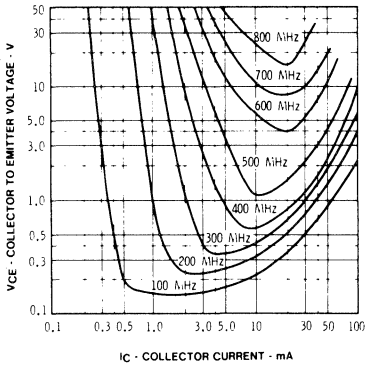
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



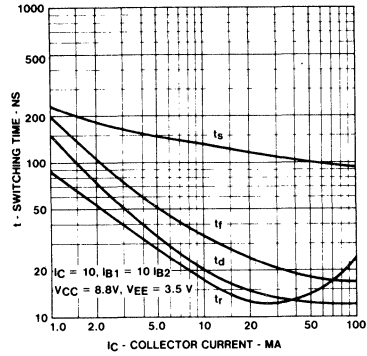
Typical Electrical Characteristic Curves

25° C Ambient Temperature unless otherwise noted

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT

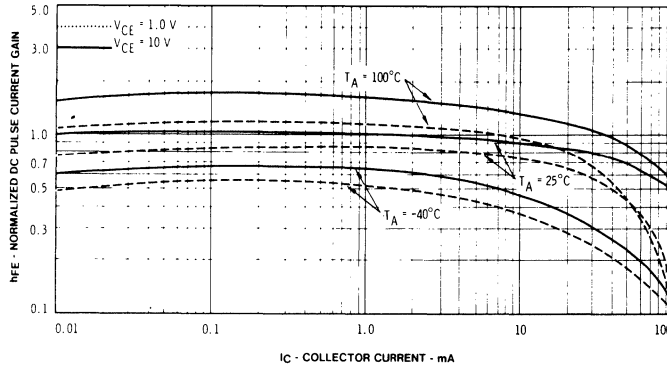


SWITCHING TIME vs COLLECTOR CURRENT

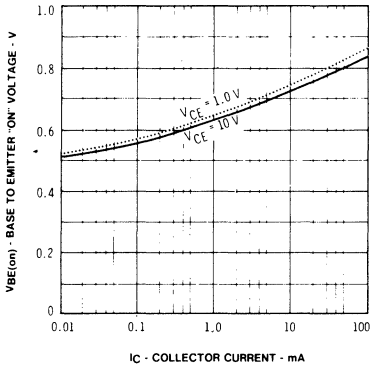


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

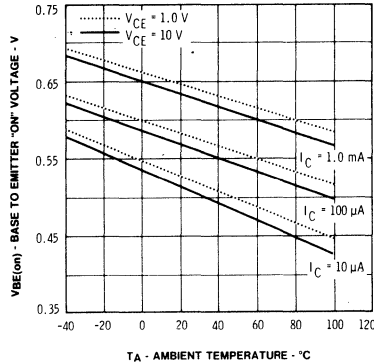
DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



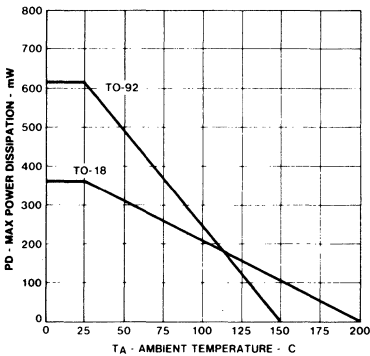
BASE TO EMITTER 'ON' VOLTAGE vs COLLECTOR CURRENT



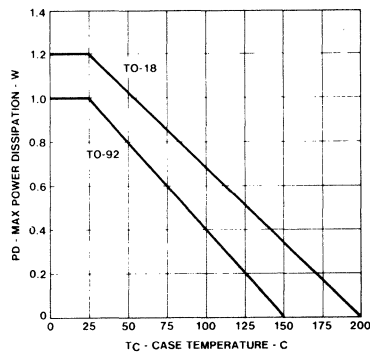
BASE TO EMITTER 'ON' VOLTAGE vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



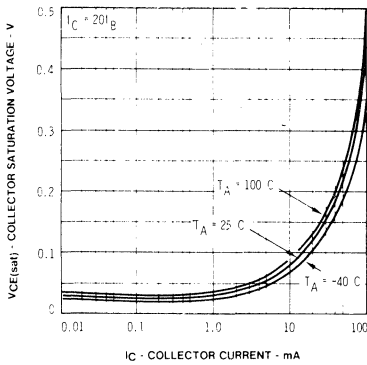
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



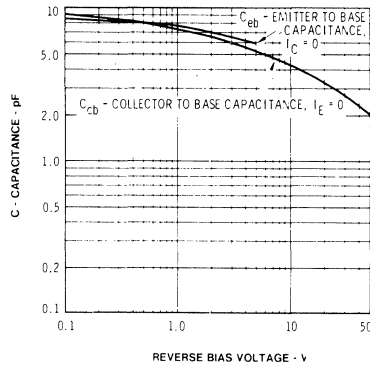
Curve Set number T219

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

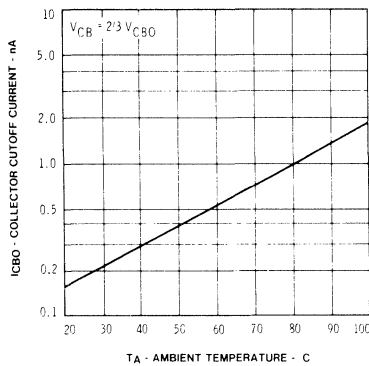
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



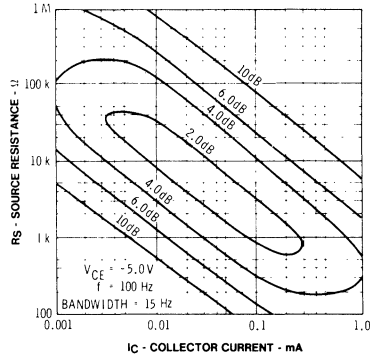
CAPACITANCE vs REVERSE BIAS VOLTAGE



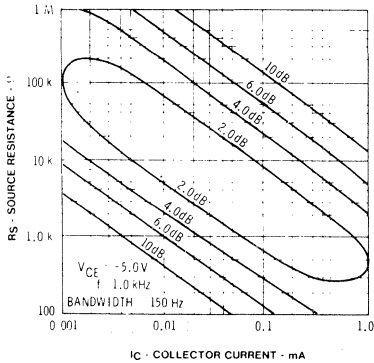
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



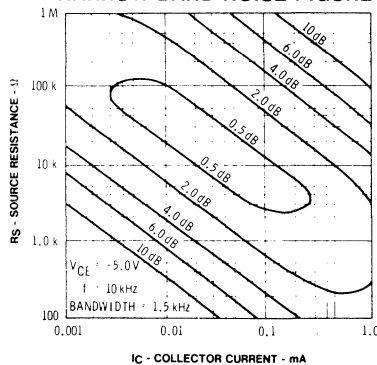
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



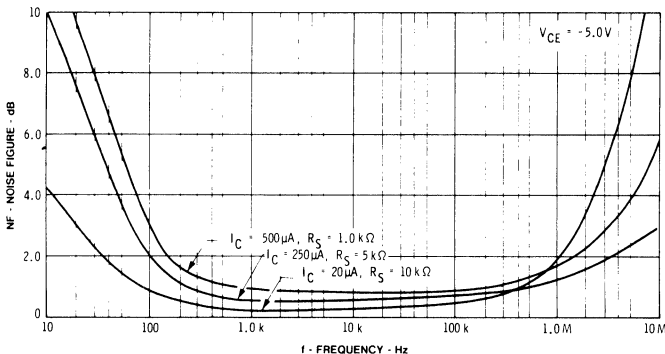
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



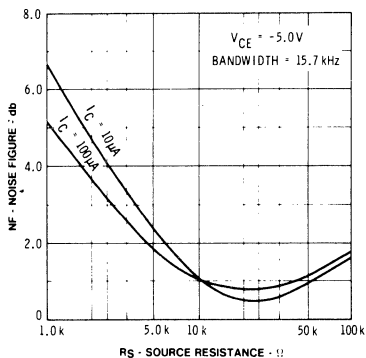
Curve Set number T219

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

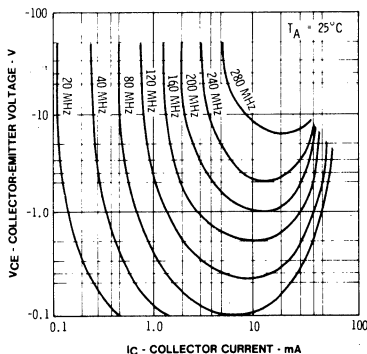
NOISE FIGURE vs FREQUENCY



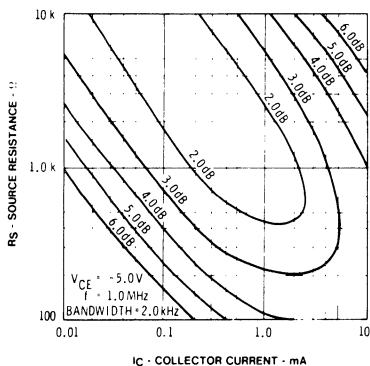
WIDE BAND NOISE FIGURE vs SOURCE RESISTANCE



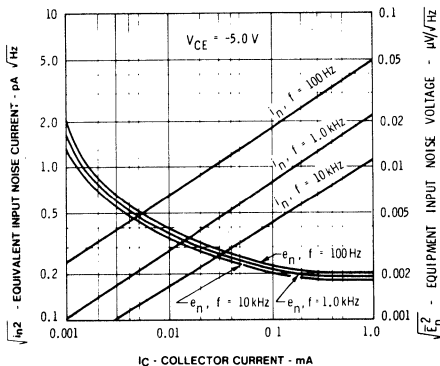
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

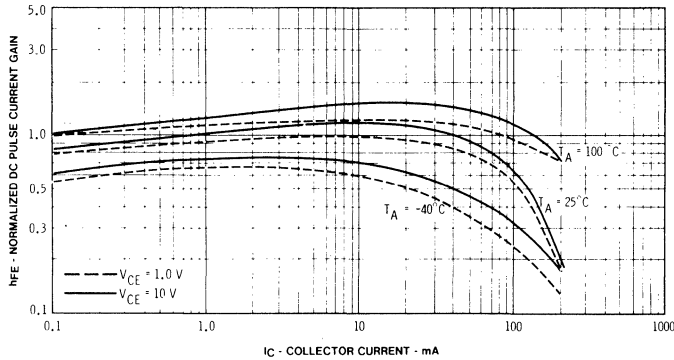


EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT vs COLLECTOR CURRENT

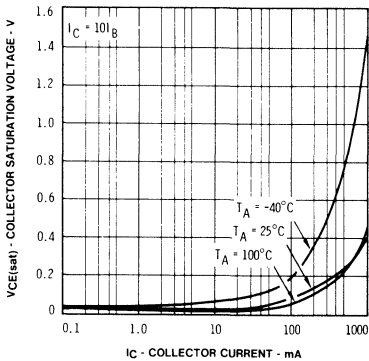


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

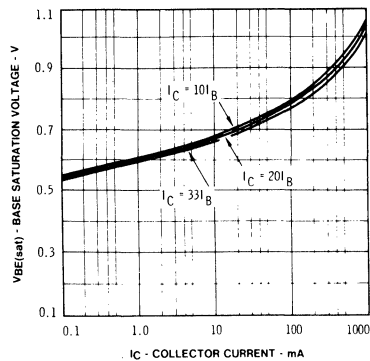
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



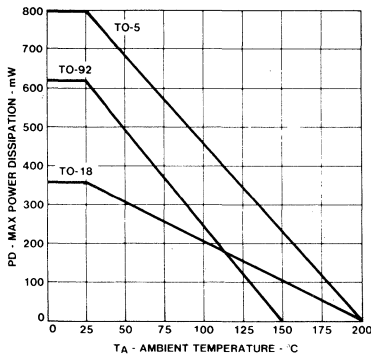
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



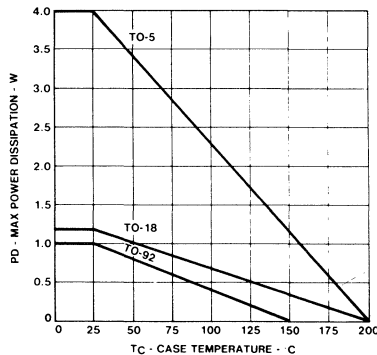
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



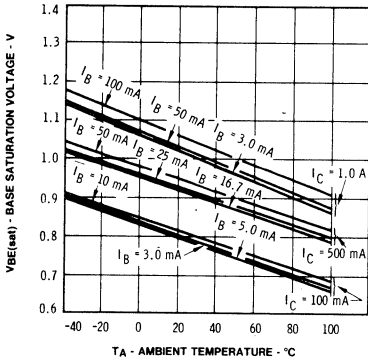
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



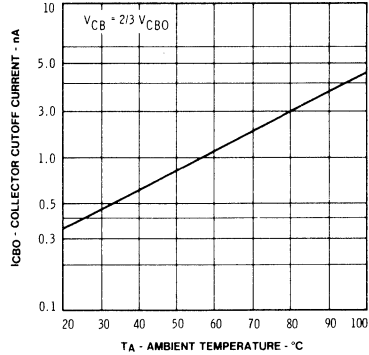
Curve Set number T224

Typical Electrical Characteristic Curves 25° C Ambient Temperature unless otherwise noted

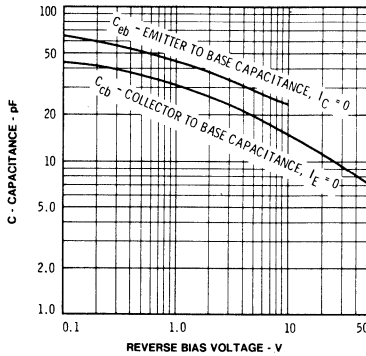
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



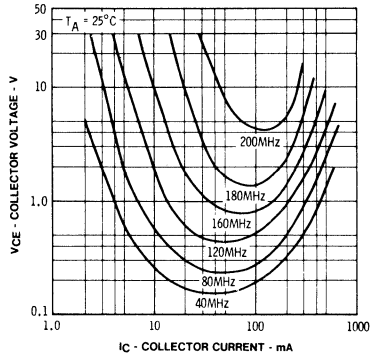
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



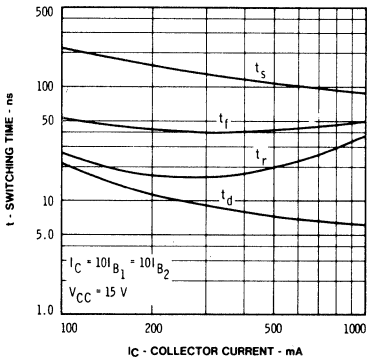
CAPACITANCE vs REVERSE BIAS VOLTAGE



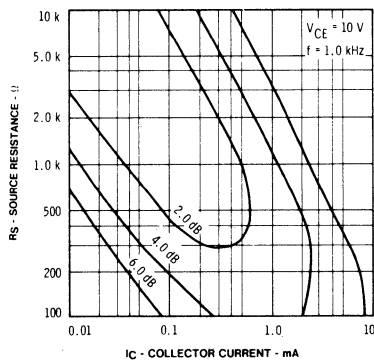
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



SWITCHING TIME vs COLLECTOR CURRENT

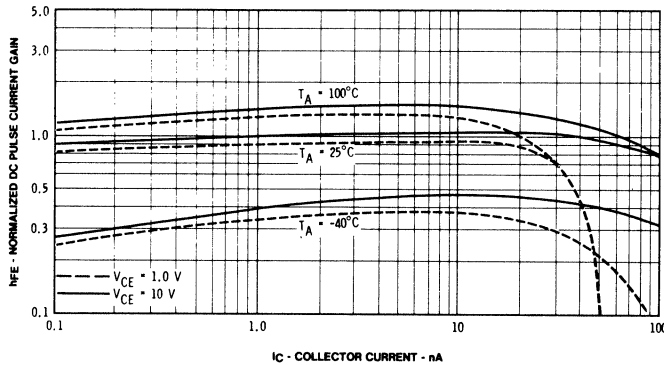


CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

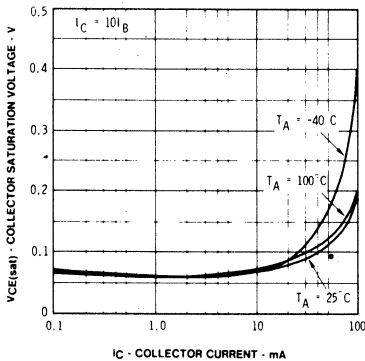


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

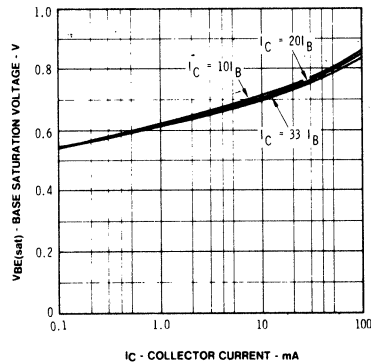
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



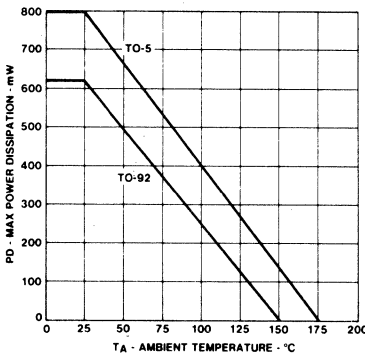
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



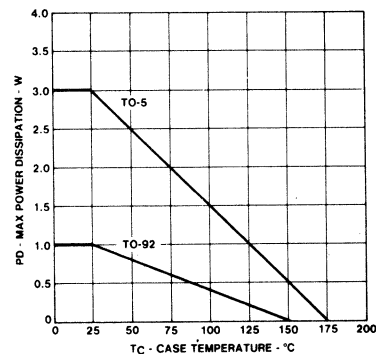
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



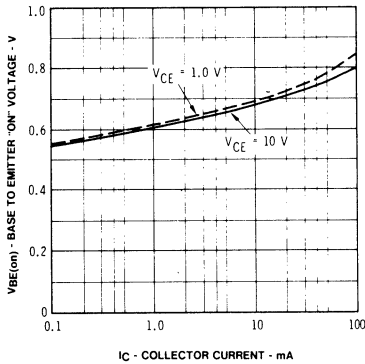
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



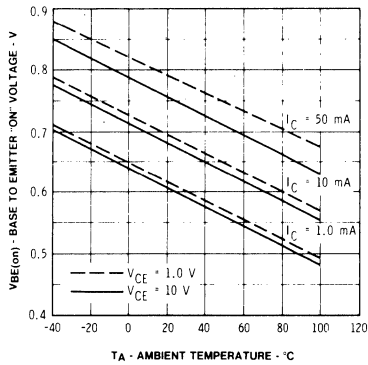
Curve Set number T232

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

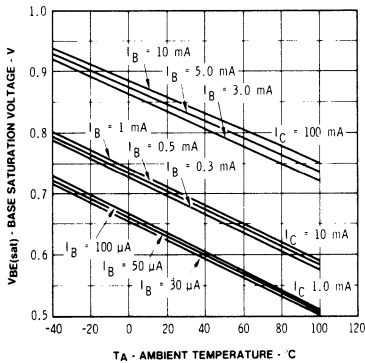
BASE TO EMITTER 'ON' VOLTAGE vs COLLECTOR CURRENT



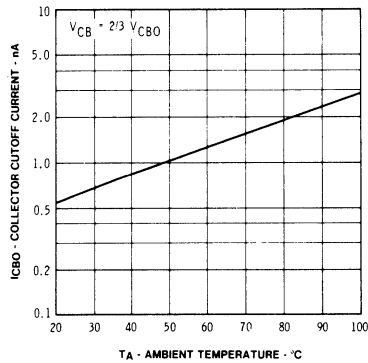
BASE TO EMITTER 'ON' VOLTAGE vs AMBIENT TEMPERATURE



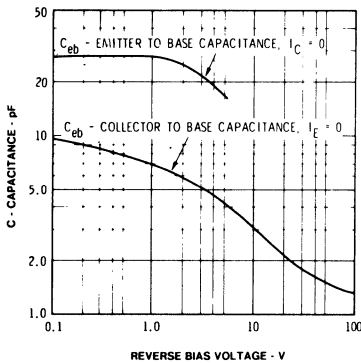
BASE SATURATION VOLTAGE vs AMBIENT TEMPERATURE



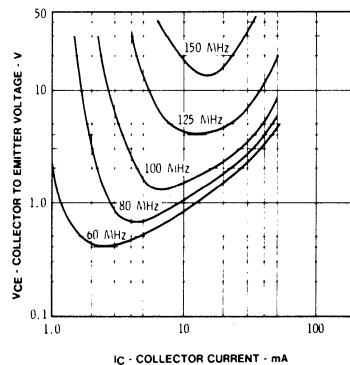
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



CAPACITANCE vs REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT

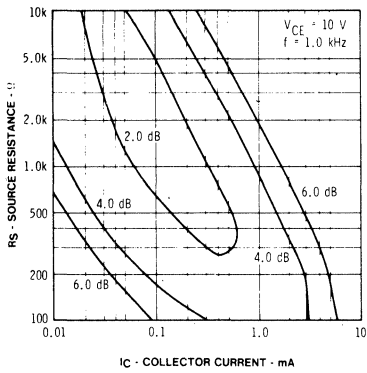


Curve Set number T232

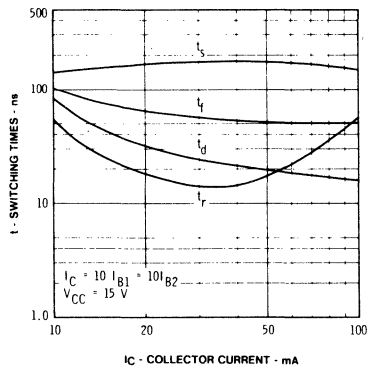
Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

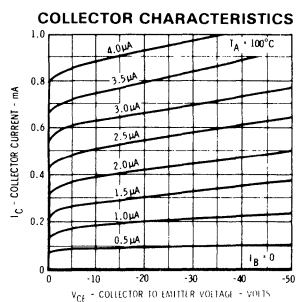
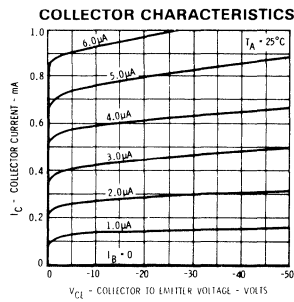
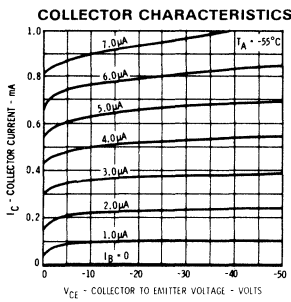
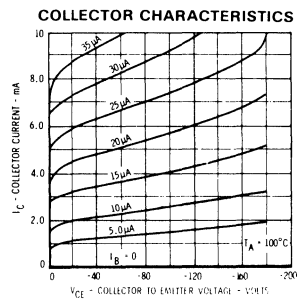
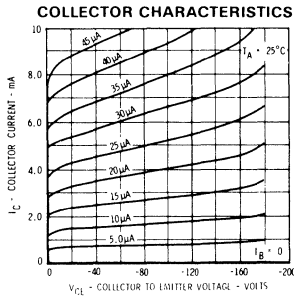
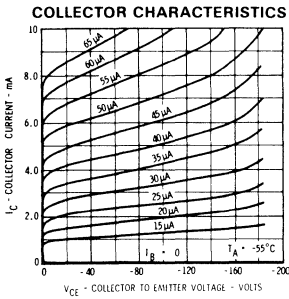
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



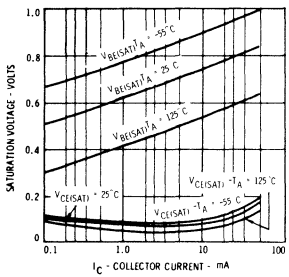
SWITCHING TIME vs COLLECTOR CURRENT



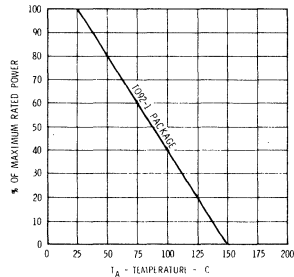
Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted



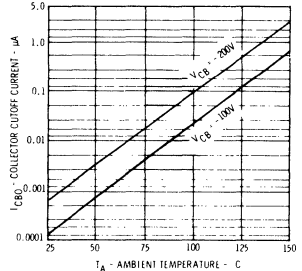
COLLECTOR AND BASE SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



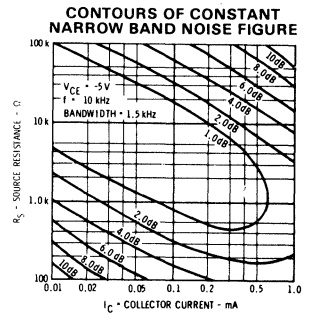
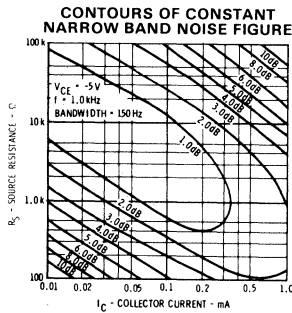
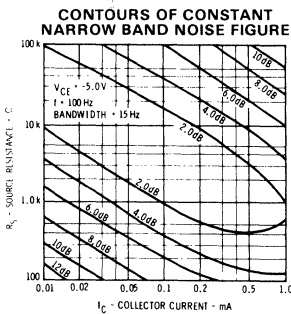
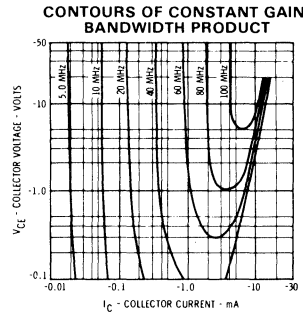
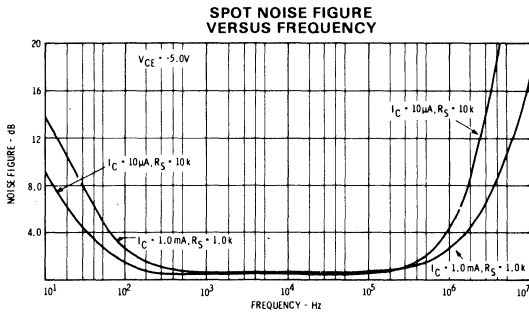
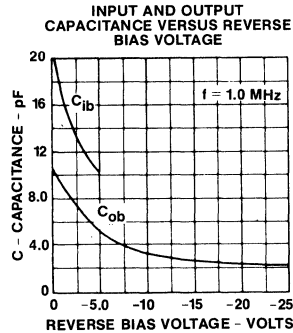
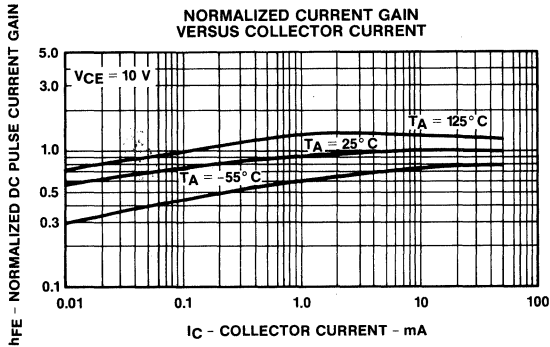
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



Curve Set number T276

Typical Electrical Characteristic Curves

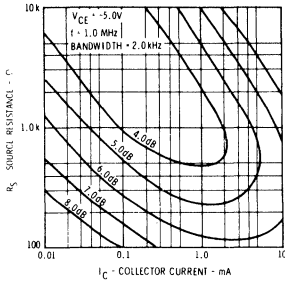
25°C Ambient Temperature unless otherwise noted



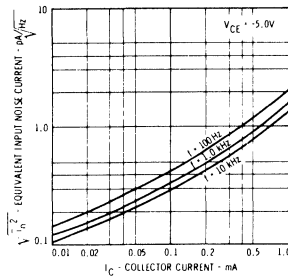
Curve Set number T276

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

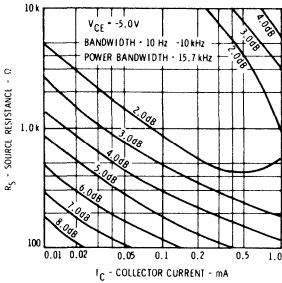
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



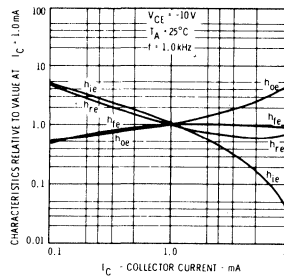
EQUIVALENT INPUT NOISE CURRENT VERSUS COLLECTOR CURRENT



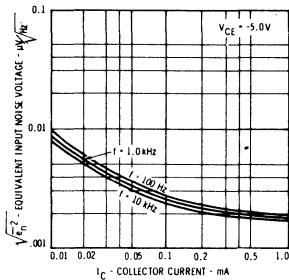
CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



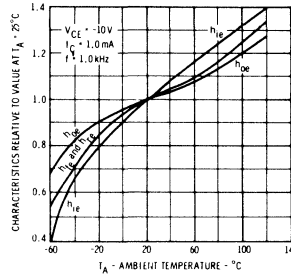
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



EQUIVALENT INPUT NOISE VOLTAGE VERSUS COLLECTOR CURRENT

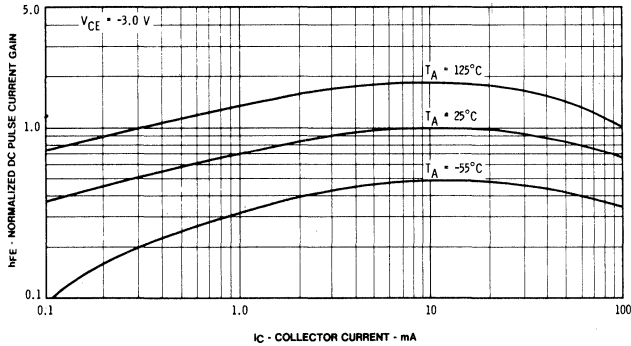


COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE

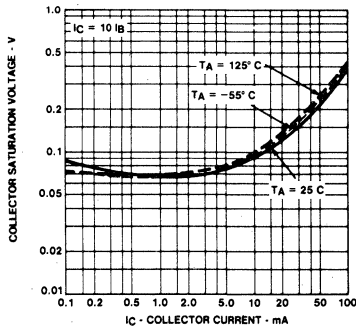


Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

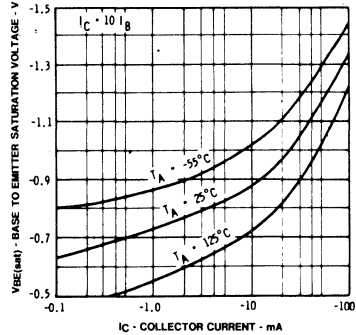
NORMALIZED DC PULSE CURRENT GAIN vs COLLECTOR CURRENT



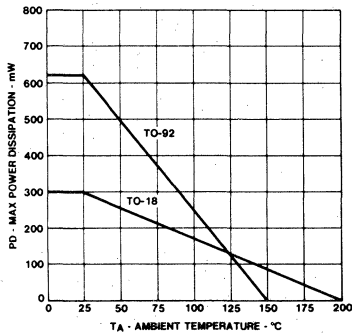
COLLECTOR SATURATION VOLTAGE vs COLLECTOR CURRENT



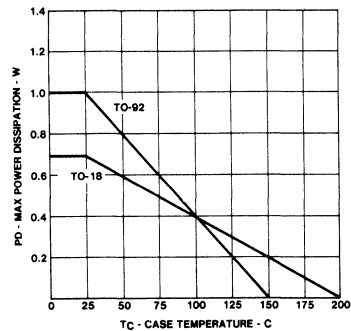
BASE SATURATION VOLTAGE vs COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



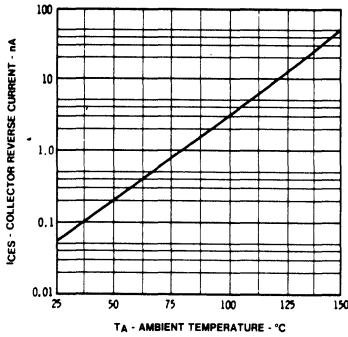
MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE



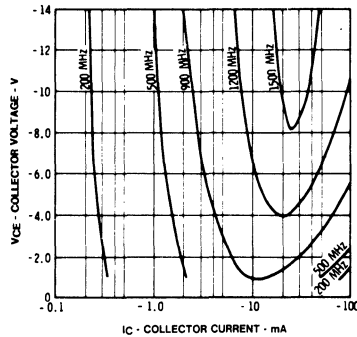
Curve Set number T292

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

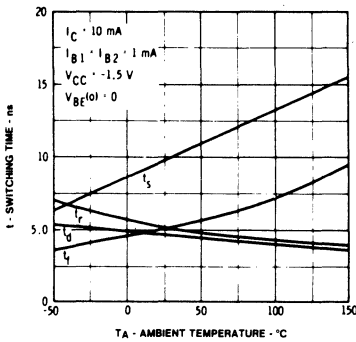
COLLECTOR REVERSE CURRENT vs AMBIENT TEMPERATURE



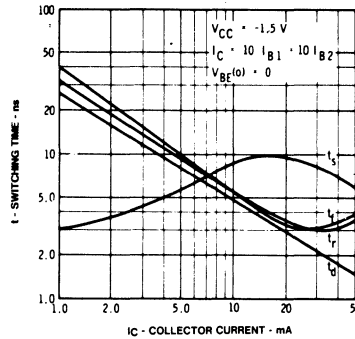
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



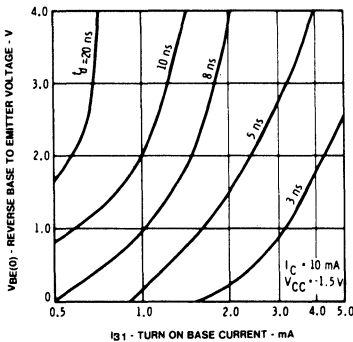
SWITCHING TIMES vs AMBIENT TEMPERATURE



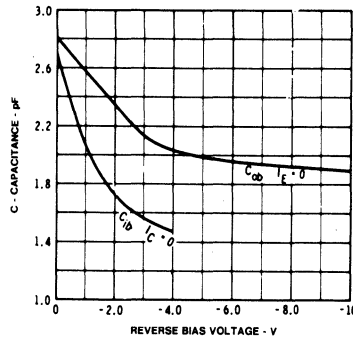
SWITCHING TIMES vs COLLECTOR CURRENT



DELAY TIME vs TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



INPUT AND OUTPUT CAPACITANCES vs REVERSE BIAS VOLTAGE

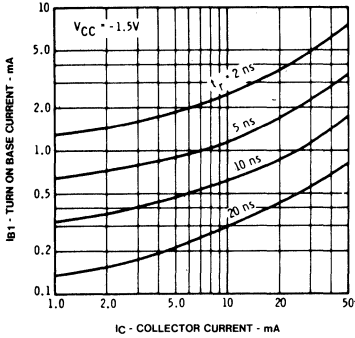


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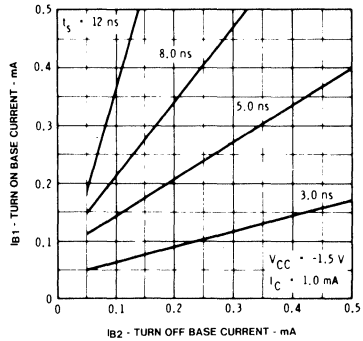
T292 Curve Set

Typical Electrical Characteristic Curves 25°C Ambient Temperature unless otherwise noted

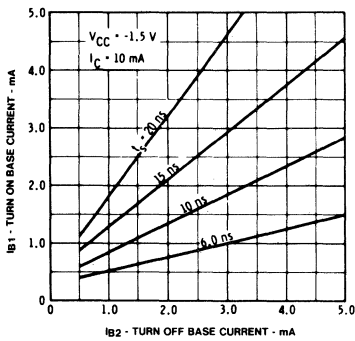
RISE TIME vs COLLECTOR AND TURN ON BASE CURRENTS



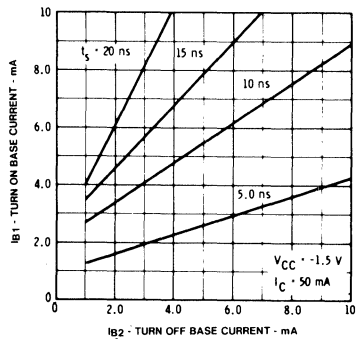
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



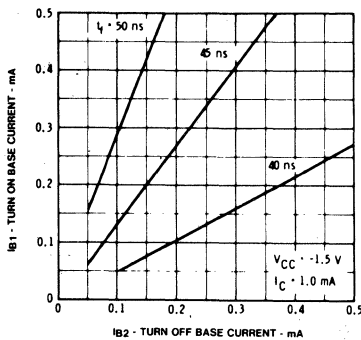
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



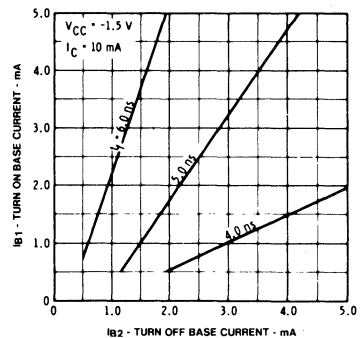
STORAGE TIME vs TURN ON AND TURN OFF BASE CURRENTS



FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



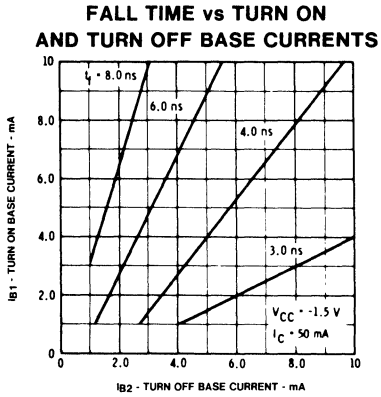
FALL TIME vs TURN ON AND TURN OFF BASE CURRENTS



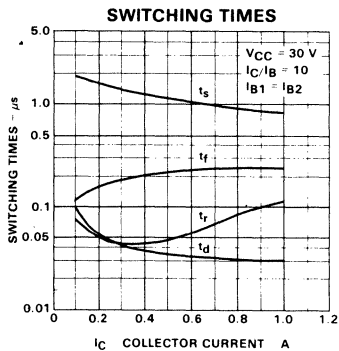
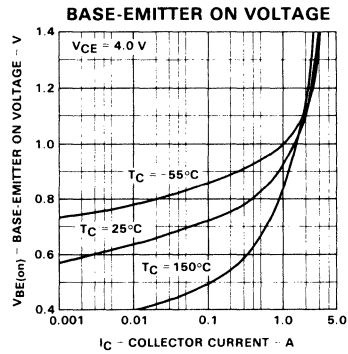
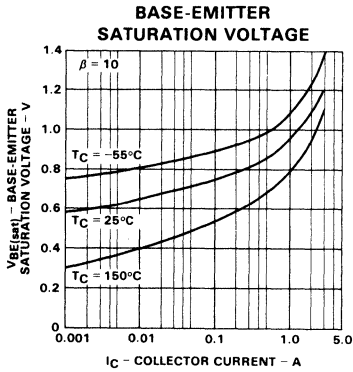
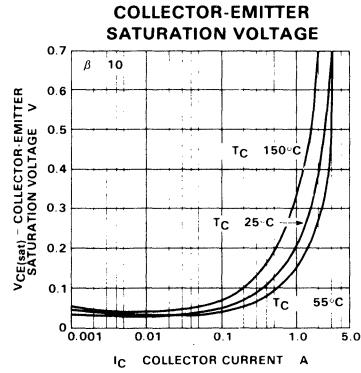
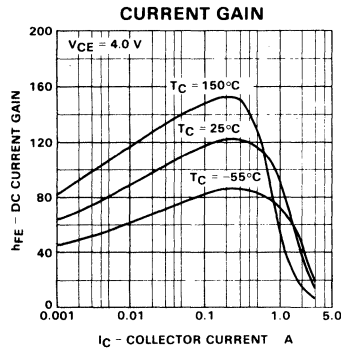
T292 Curve Set

Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

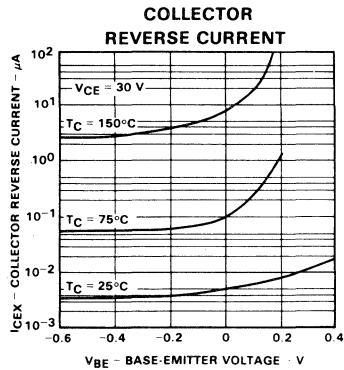
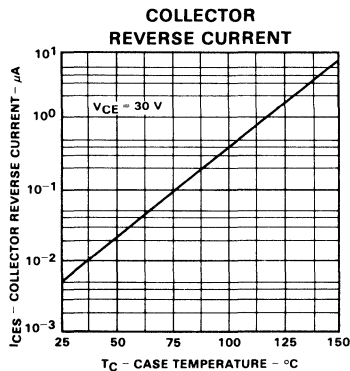
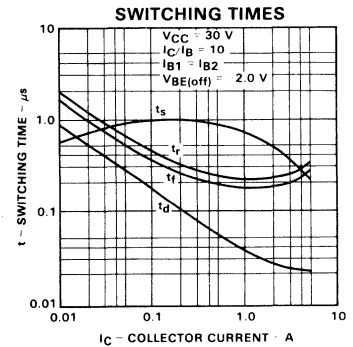
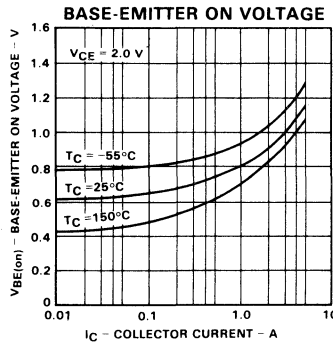
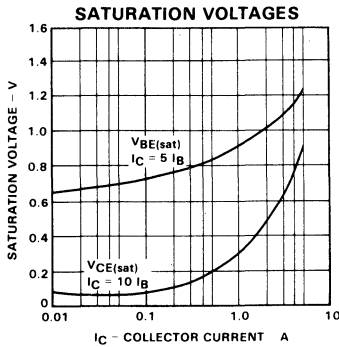
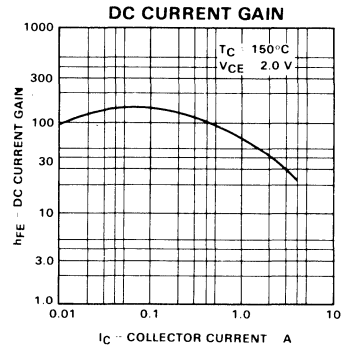
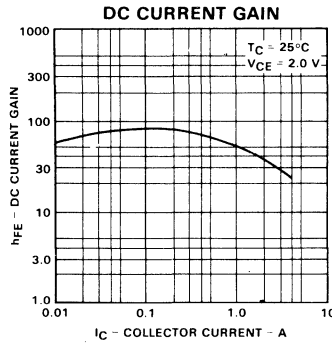
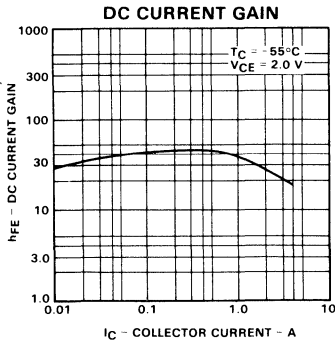


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted



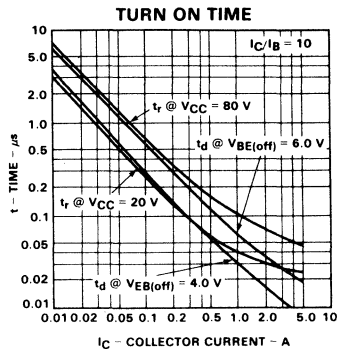
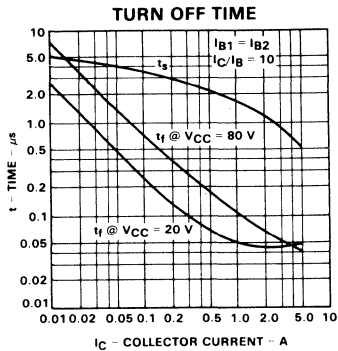
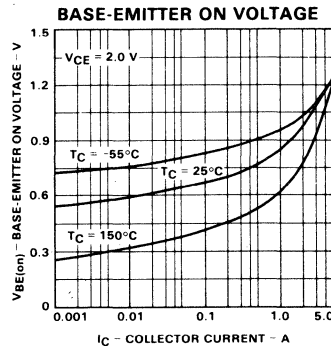
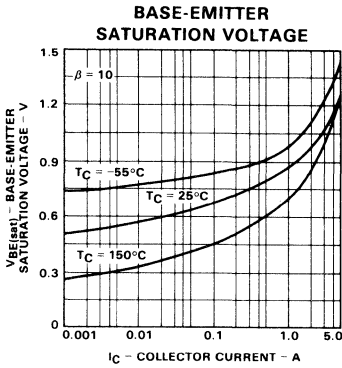
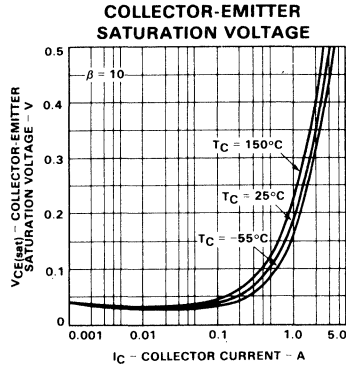
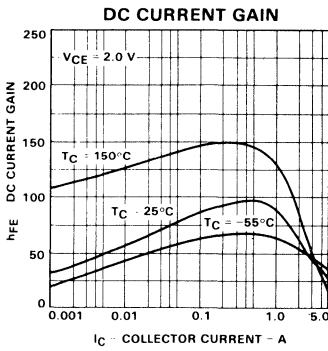
Typical Electrical Characteristic Curves

25°C Ambient Temperature unless otherwise noted

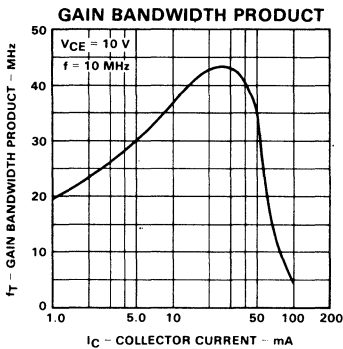
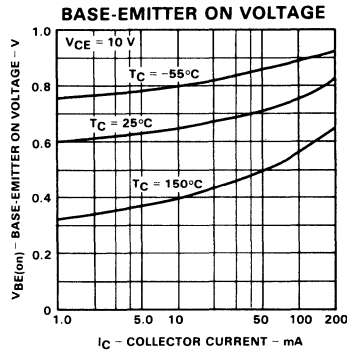
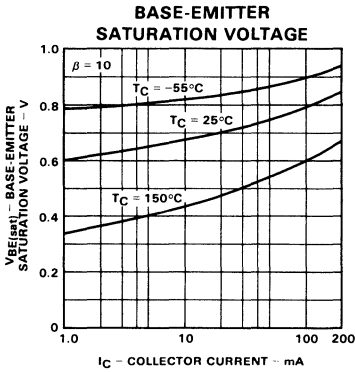
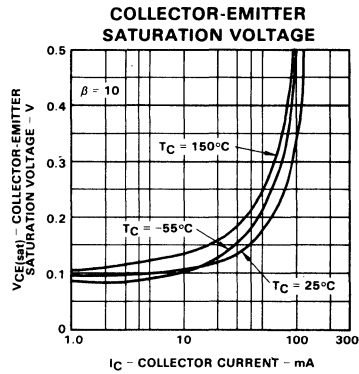
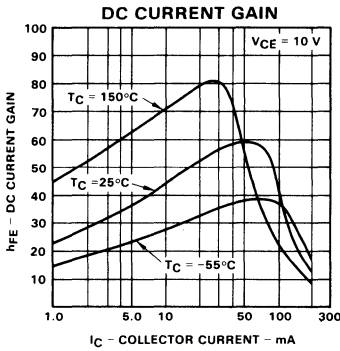


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Typical Electrical Characteristic Curves
 25° C Ambient Temperature unless otherwise noted

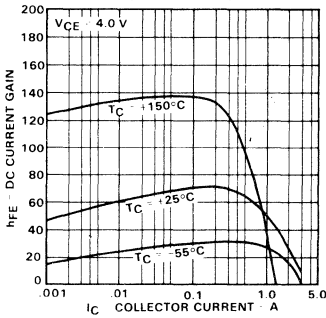


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

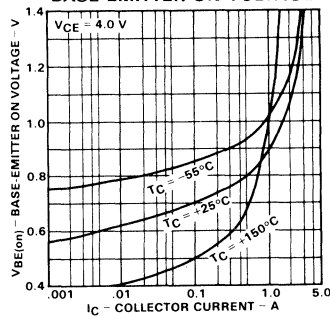


Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

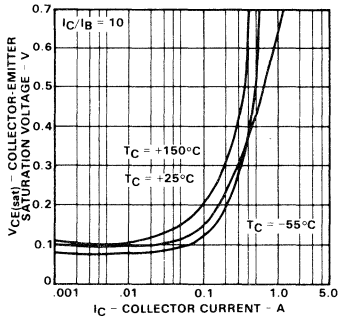
DC CURRENT GAIN



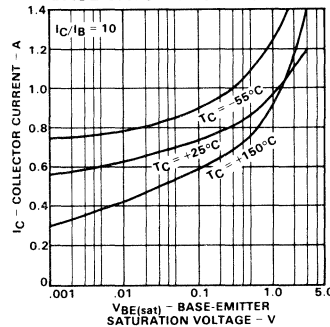
BASE-EMITTER ON VOLTAGE



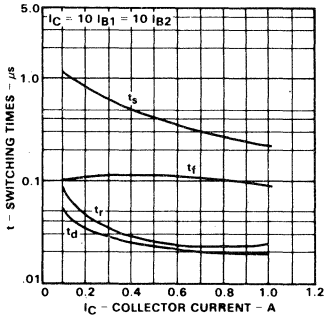
COLLECTOR-SATURATION VOLTAGE



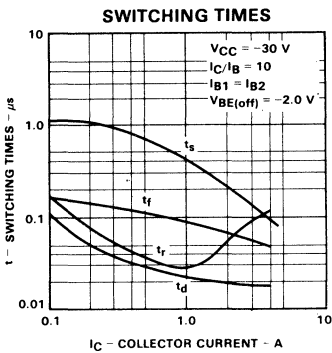
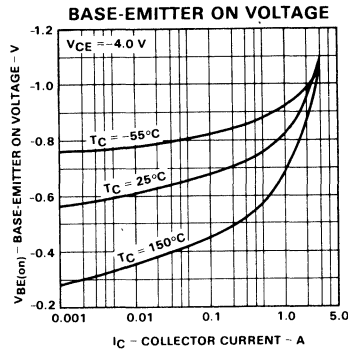
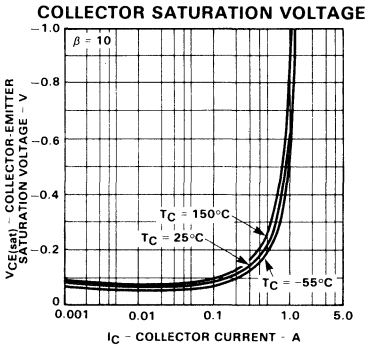
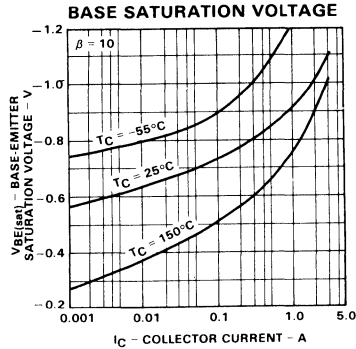
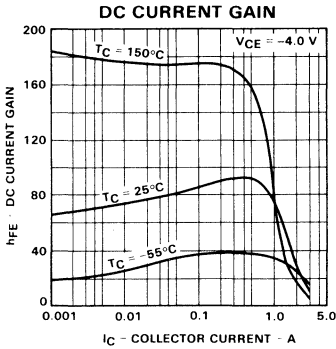
BASE SATURATION VOLTAGE



SWITCHING CHARACTERISTICS



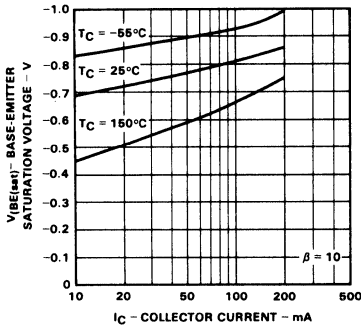
Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted



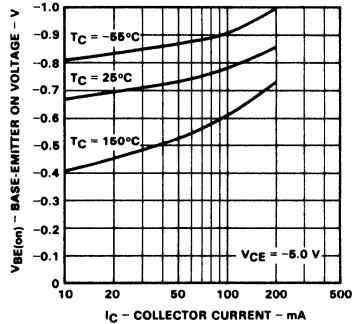
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Typical Electrical Characteristic Curves
 25°C Ambient Temperature unless otherwise noted

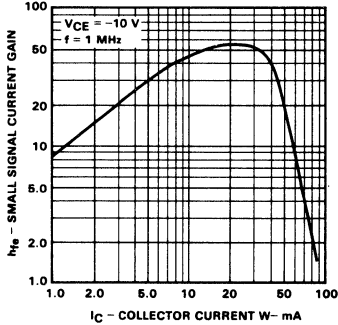
BASE-EMITTER SATURATION VOLTAGE



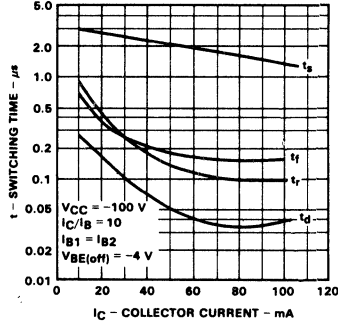
BASE-EMITTER ON VOLTAGE



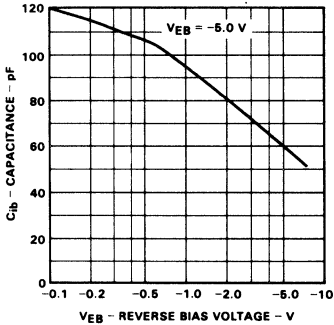
SMALL SIGNAL CURRENT GAIN



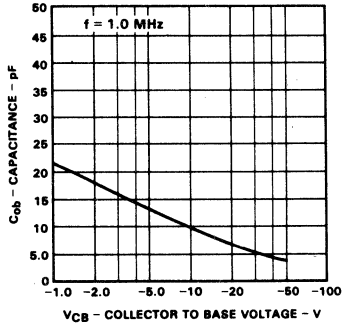
SWITCHING TIMES



INPUT CAPACITANCE



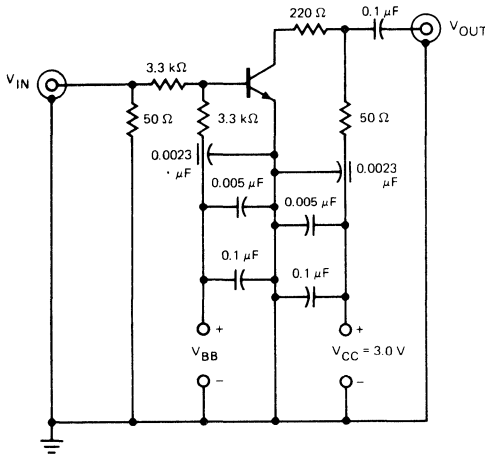
OUTPUT CAPACITANCE





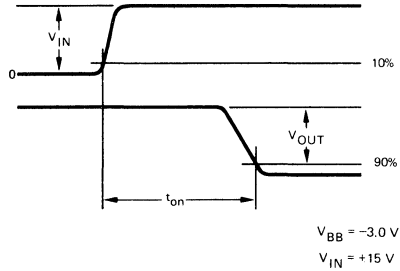
Index and Device Crossreference	1
Device Selection Guides	2
Product Information	3
Product Family Curves	4
Test Circuits	5
Ordering Information and Package Outlines	6
High Reliability Information	7
Dice and Wafer Information	8
Field Sales Offices	9

210 $t_{on} - t_{off}$ SWITCHING



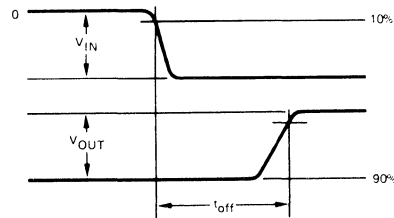
t_{off}
 $V_{BB} = +12\text{ V}$
 $V_{IN} = -15\text{ V}$

TO OSCILLOSCOPE
 INPUT IMPEDANCE = 50 Ω
 $t_r \leq 1.0\text{ ns}$

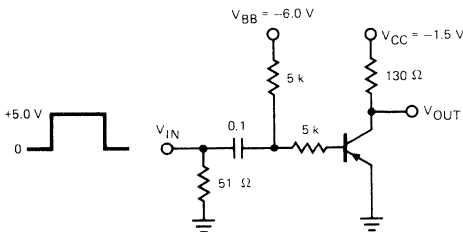


PULSE GENERATOR

$V_{IN} t_r < 1.0\text{ ns}$
 SOURCE IMPEDANCE = 50 Ω
 $PW \geq 300\text{ ns}$
 $DC < 2\%$



219 $t_{on} - t_{off}$ SWITCHING

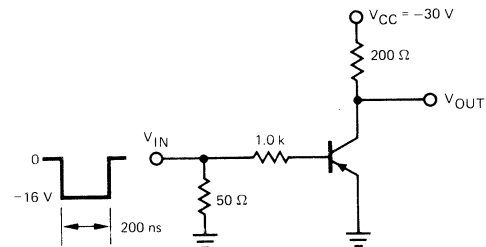


$PW = 100\text{ ns}$
 $Z_{IN} = 50\ \Omega$
 $t_r, t_f < 1.0\text{ ns}$

TO OSCILLOSCOPE
 $Z_{IN} \geq 100\text{ k}\Omega$
 $t_r < 1.0\text{ ns}$

$I_C \approx 10\text{ mA}$, $I_{B1} \approx 0.5\text{ mA}$, $I_{B2} \approx -0.5\text{ mA}$

224 $t_d - t_r$ SWITCHING

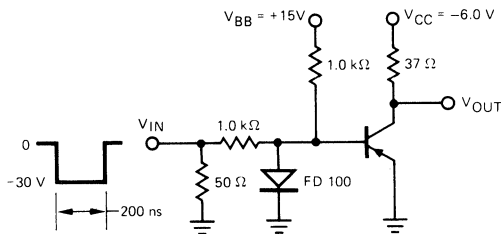


$Z_O = 50\ \Omega$
 $PRF = 150\text{ PPS}$
 $t_r \leq 2.0\text{ ns}$

TO OSCILLOSCOPE
 $t_r \leq 5.0\text{ ns}$
 $Z_{IN} = 10\text{ M}\Omega$

Test Circuits

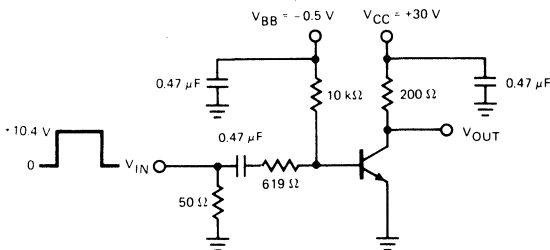
225 $t_s - t_f$ SWITCHING



$Z_O = 50 \Omega$
 $PRF = 150 \text{ PPS}$
 $t_r \leq 2.0 \text{ ns}$

TO OSCILLOSCOPE
 $t_r \leq 5.0 \text{ ns}$
 $Z_{IN} = 10 \text{ M}\Omega$

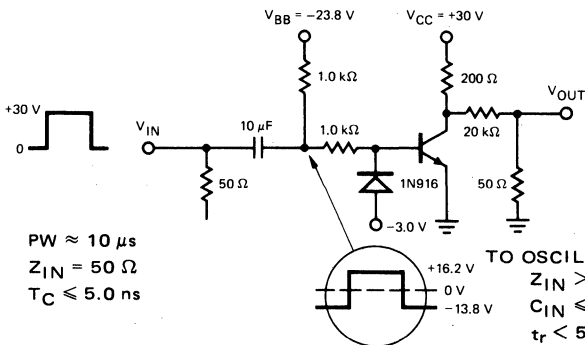
231 t_{on} SWITCHING



$PW \leq 200 \text{ ns}$
 $t_r \leq 2.0 \text{ ns}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE
 $Z_{IN} < 100 \text{ k}\Omega$
 $C_{IN} \leq 12 \text{ pF}$
 $t_r \leq 5.0 \text{ ns}$

232 t_{off} SWITCHING



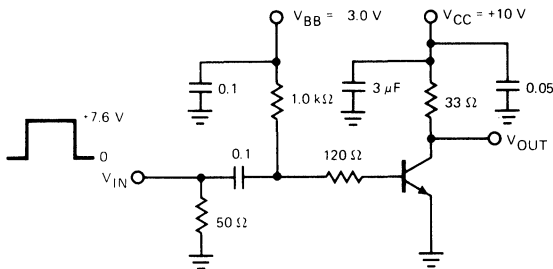
$PW \approx 10 \mu\text{s}$
 $Z_{IN} = 50 \Omega$
 $T_C \leq 5.0 \text{ ns}$

TO OSCILLOSCOPE
 $Z_{IN} > 100 \text{ k}\Omega$
 $C_{IN} \leq 12 \text{ pF}$
 $t_r < 5.0 \text{ ns}$

The $20 \text{ k}\Omega$ and 50Ω resistors on the output of the test circuit are normally omitted, due to the excessive attenuation of the collector waveform. The collector voltage is monitored directly with a high impedance oscilloscope probe.

Test Circuits

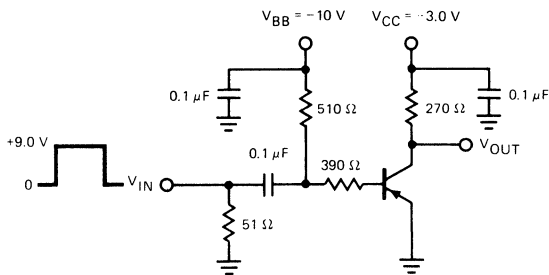
233 $t_{on} - t_{off}$ SWITCHING



$PW \geq 240 \text{ ns}$
 $t_r, t_f < 1.0 \text{ ns}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE
 $t_r < 1.0 \text{ ns}$
 $Z_{IN} \approx 100 \text{ k}\Omega$

234 CHARGE STORAGE TIME

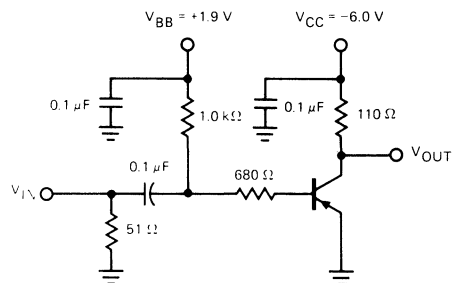


$PW = 240 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $t_r \leq 1.0 \text{ ns}$

TO OSCILLOSCOPE
 $Z_{IN} \geq 100 \text{ k}\Omega$
 $t_r < 1.0 \text{ ns}$

$I_C \approx 10 \text{ mA}, I_{B1} \approx 10 \text{ mA}, I_{B2} \approx 10 \text{ mA}$

235 SWITCHING TIME



PULSE SOURCE

$t_r \leq 1.0 \text{ ns}$
 $PW \geq 100 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $t_r \leq 1.0 \text{ ns}$

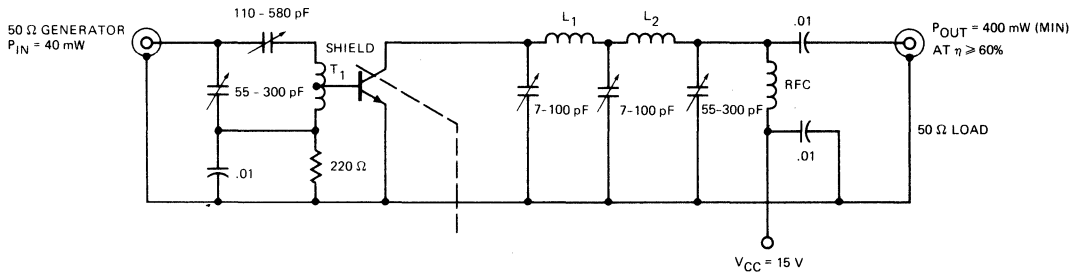
TO OSCILLOSCOPE

$Z_{IN} \geq 100 \text{ k}\Omega$
 $t_r \leq 1.0 \text{ ns}$

COLLECTOR CURRENT = 50 mA, t_{on} AND t_{off}
BASE CURRENTS = 5.0 mA

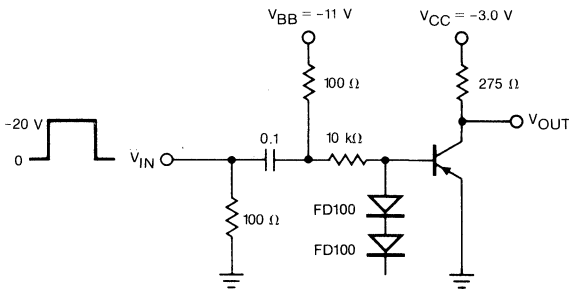
Test Circuits

238 30 MHz AMPLIFIER



T_1 - 4 TURNS NO. 20 WIRE, 3/4" DIA. X 1/4" LONG, MIDTAPPED.
 L_1 AND L_2 - 4 TURNS NO. 20 WIRE, 1/2" DIA. X 1/4" LONG.
 VARIABLE CAPACITORS ARE COMPRESSION MICA.

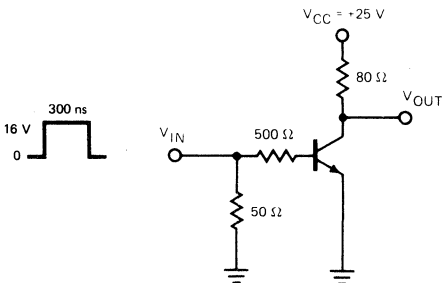
239 t_{off} SWITCHING



$PW \approx 300$ ns
 $t_r \leq 1.0$ ns
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE
 $t_r \leq 1.0$ ns
 $Z_{IN} = 100$ k Ω

241 t_{on} SWITCHING

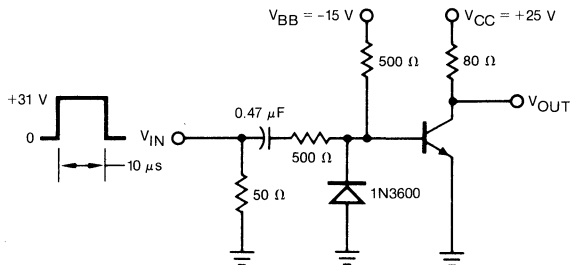


PULSE SOURCE
 $t_r \leq 1.0$ ns
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE
 $t_r \leq 1.0$ ns
 $Z_{IN} \approx 100$ k Ω

Test Circuits

242 t_{off} SWITCHING



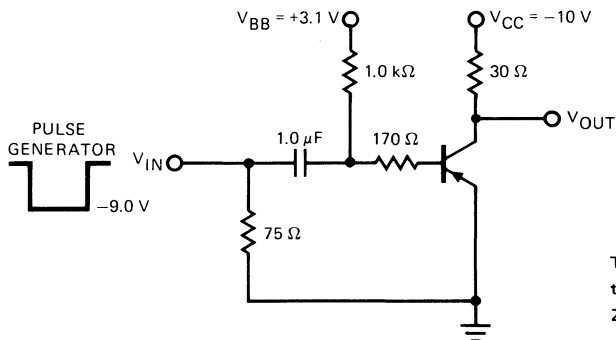
PULSE SOURCE

$t_r \leq 20 \text{ ns}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE

$t_r \leq 1.0 \text{ ns}$
 $Z_{IN} \approx 100 \text{ k}\Omega$

245 $t_{on} - t_{off}$ SWITCHING

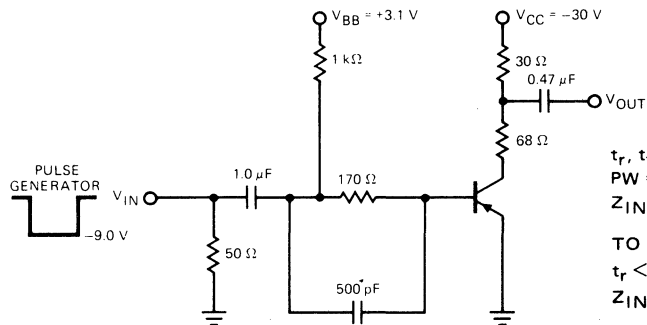


$t_r, t_f \leq 15 \text{ ns}$
 $PW = 0.5 \mu\text{s}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE

$t_r \leq 1.0 \text{ ns}$
 $Z_{IN} \geq 0.1 \text{ m}\Omega$

246 $t_{on} - t_{off}$



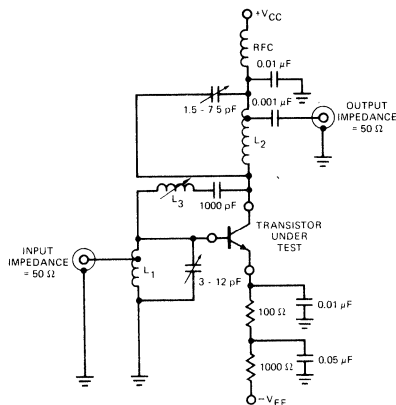
$t_r, t_f \leq 6 \text{ ns}$
 $PW = 0.5 \mu\text{s}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE

$t_r < 1.0 \text{ ns}$
 $Z_{IN} \geq 0.1 \text{ M}\Omega$

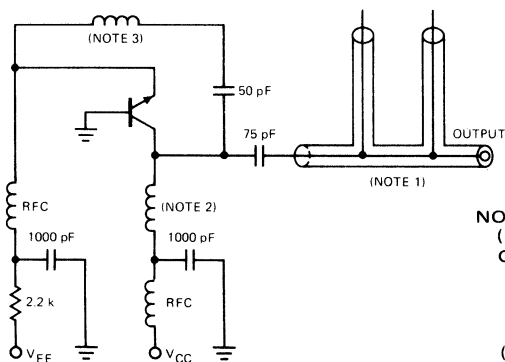
Test Circuits

254 GAIN AMPLIFIER



- L_1 - 3.5 TURNS #16 WIRE; 5/16" DIA.; 7/16" LONG.
 TURNS RATIO 4 TO 2
 L_2 - 8 TURNS #16 WIRE; 1/8" DIA.; 7/8" LONG.
 TURNS RATIO 8 TO 1
 L_3 - 0.4-0.65 μ H, ADJUSTABLE CORE

264 500 MHz OSCILLATOR

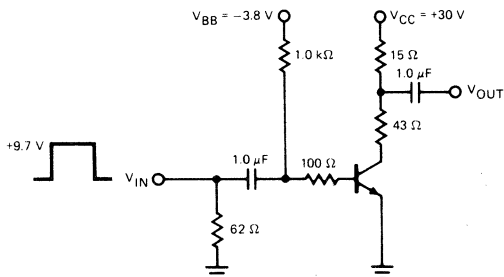


NOTES:

- (1) COAX PLUMBING CONSISTS OF THE FOLLOWING
 GR AIR LINES:

- 2 TYPE 874 TEE
 1 TYPE 874 - D20 ADJUSTABLE STUB
 1 TYPE 874 - LA ADJUSTABLE LINE
 1 TYPE 874 - WN3 SHORT - CIRCUIT TERMINATION
 (2) 2 TURNS #16 AWG WIRE, 3/8 INCH OD, 1-1/4 INCH LONG
 (3) 9 TURNS #22 AWG WIRE, 3/16 INCH OD, 1/2 INCH LONG

265 SWITCHING TIME



$$t_r \text{ AND } t_f \leq 1.0 \text{ ns}$$

$$PW \approx 1.0 \mu\text{s}$$

$$Z_{IN} = 50 \Omega$$

$$DC < 2\%$$

TO OSCILLOSCOPE

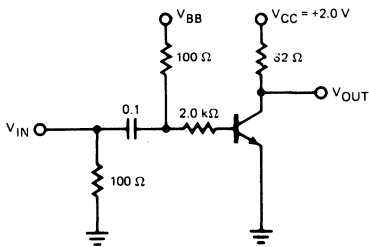
$$t_r < 1.0 \text{ ns}$$

$$Z_{IN} \geq 100 \text{ k}\Omega$$

$$I_C \approx 500 \text{ mA}, I_{B1} \approx 50 \text{ mA}, I_{B2} \approx 50 \text{ mA}$$

Test Circuits

286 $t_{on} - t_{off}$ SWITCHING



$$t_{off}: \begin{aligned} V_{CC} &= 2.0 \text{ V} \\ V_{BB} &= 7.0 \text{ V} \\ V_{IN} &= -13 \text{ V} \end{aligned}$$

$$t_{on}: \begin{aligned} V_{CC} &= 2.0 \text{ V} \\ V_{BB} &\text{ GROUNDED} \\ V_{IN} &= 7.0 \text{ V} \end{aligned}$$

PULSE SOURCE

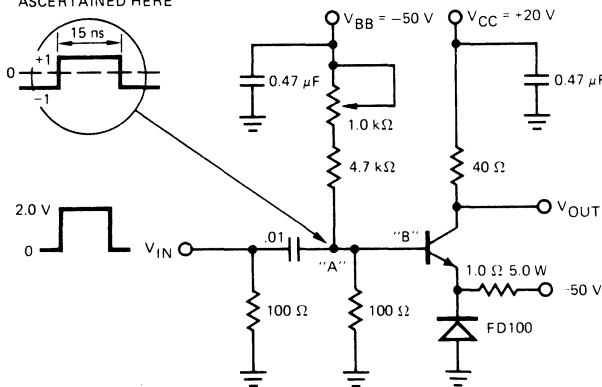
$$\begin{aligned} t_r &< 1.0 \text{ ns} \\ PW &> 200 \text{ ns} \\ Z_{IN} &\approx 50 \Omega \end{aligned}$$

TO OSCILLOSCOPE

$$\begin{aligned} t_r &< 1.0 \text{ ns} \\ Z_{IN} &\approx 100 \text{ k}\Omega \end{aligned}$$

287 $t_{on} - t_{off}$ SWITCHING

THIS WAVE FORM ASCERTAINED HERE

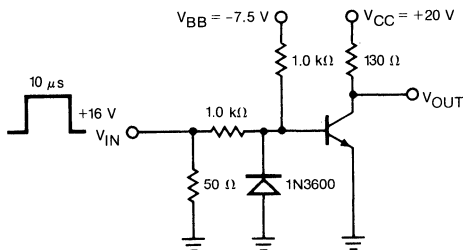


$$\begin{aligned} PW &= 15 \text{ ns} \\ t_r &\leq 1.0 \text{ ns} \\ Z_{IN} &= 50 \Omega \end{aligned}$$

TO OSCILLOSCOPE

$$\begin{aligned} t_r &< 1.0 \text{ ns} \\ Z_{IN} &= 10 \text{ M}\Omega \end{aligned}$$

288A $t_{on} - t_{off}$ SWITCHING



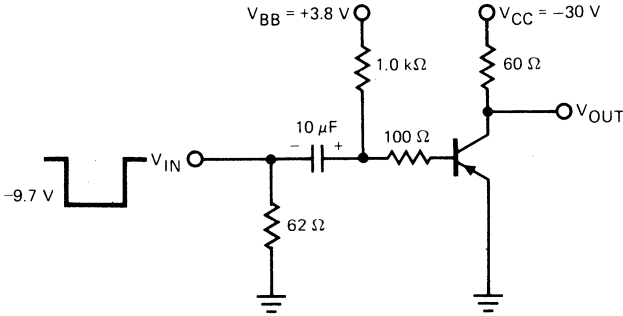
$$\begin{aligned} t_r \text{ OF INPUT PULSE} &< 15 \text{ ns} \\ t_f \text{ OF INPUT PULSE} &< 15 \text{ ns} \end{aligned}$$

TO OSCILLOSCOPE

$$\begin{aligned} t_r &> 15 \text{ ns} \\ Z_{IN} &\approx 100 \text{ k}\Omega \end{aligned}$$

Test Circuits

341 $t_{on} - t_{off}$ SWITCHING



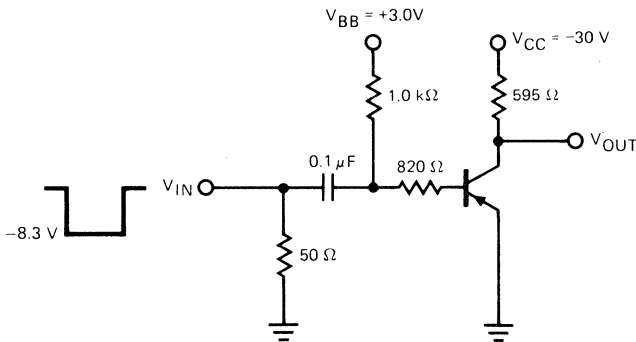
PULSE SOURCE

$t_r, t_f < 20 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $PW = 10 \mu\text{s}$
 $DC < 2\%$

TO OSCILLOSCOPE

$Z_{IN} > 100 \text{ k}\Omega$
 $t_r \approx 10 \text{ ns}$

342 SWITCHING TIME

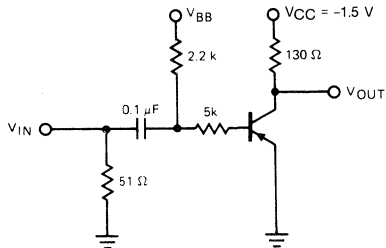


$PW = 500 \text{ ns}$
 $t_r \text{ AND } t_f = 1.0 \text{ ns}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE

$t_r < 1.0 \text{ ns}$
 $Z_{IN} \approx 100 \text{ k}\Omega$

348 $t_{on} - t_{off}$ SWITCHING



$I_C \approx 10 \text{ mA}, I_{B1} \approx 1.0 \text{ mA}, I_{B2} \approx 1.0 \text{ mA}$

t_{on}
 $V_{BB} = \text{GROUND}$
 $V_{IN} = -5.8 \text{ V}$

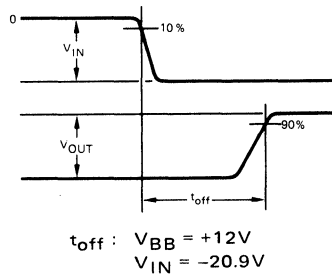
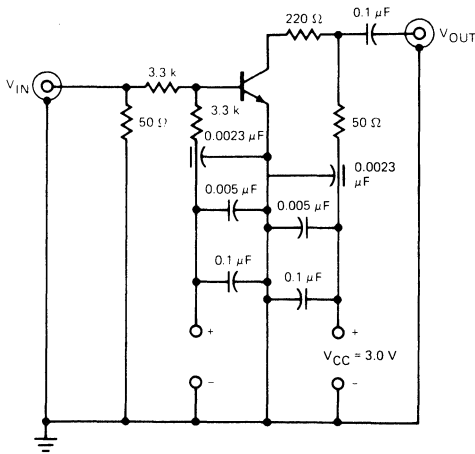
V_{IN}
 $PW = 240 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $t_r \leq 1.0 \text{ ns}$

t_{off}
 $V_{BB} = -8.0 \text{ V}$
 $V_{IN} = +9.8 \text{ V}$

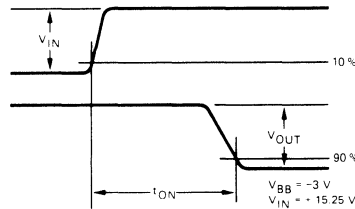
TO OSCILLOSCOPE
 $Z_{IN} \geq 100 \text{ k}\Omega$
 $t_r < 1.0 \text{ ns}$

Test Circuits

381 $t_{on} - t_{off}$ SWITCHING



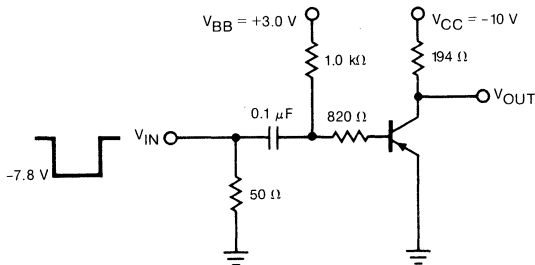
TO OSCILLOSCOPE
 $Z_{IN} = 50 \Omega$
 $t_r \leq 1.0 \text{ ns}$



PULSE GENERATOR
 $V_{IN} = t_r < 1.0 \text{ ns}$
SOURCE IMPEDANCE
 $= 50 \Omega$
 $PW \geq 300 \text{ ns}$
 $DC < 2\%$

5

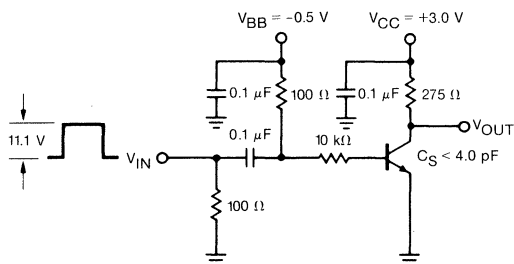
407 SWITCHING TIME



$PW = 500 \text{ ns}$
 $t_r \text{ AND } t_f = 1.0 \text{ ns}$
 $Z_{IN} = 50 \Omega$

TO OSCILLOSCOPE
 $t_r < 1.0 \text{ ns}$
 $Z_{IN} = 100 \text{ k}\Omega$

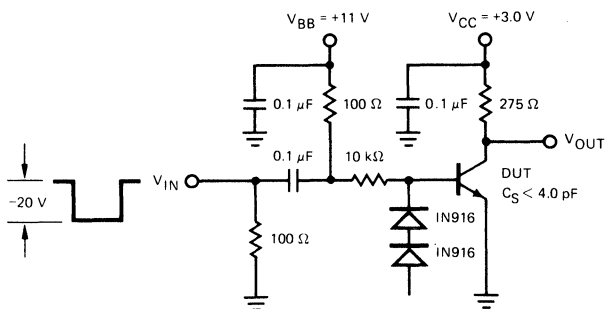
526 t_{on} SWITCHING



$t_r < 1.0 \text{ ns}$
 $PW \geq 300 \text{ ns}$
 $DC = 2\%$

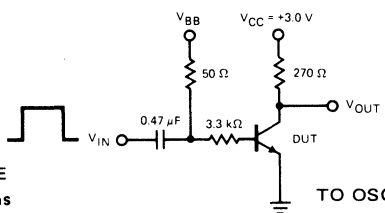
Test Circuits

527 t_{off} SWITCHING



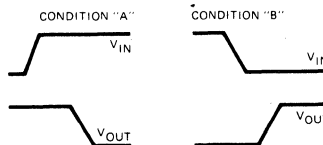
$t_r = < 9.0 \text{ ns}$
 $PW \geq 300 \text{ ns}$
 $DC = 2\%$

531 $t_{on} - t_{off}$ SWITCHING



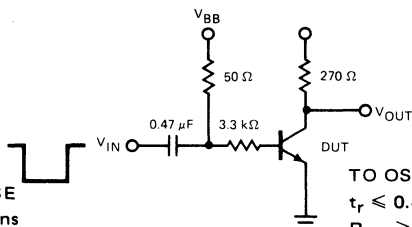
INPUT PULSE
 $t_r = t_f \leq 2.0 \text{ ns}$
 $PW \approx 300 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $DC \approx 2\%$

TO OSCILLOSCOPE
 $t_r \leq 0.4 \text{ ns}$
 $R_{IN} \geq 100 \text{ k}\Omega$
 $C_{IN} \leq 4.0 \text{ pF}$



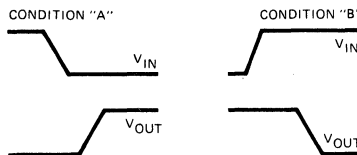
CONDITION "A" = t_d, t_r, t_{on}	10/3 mA
$V_{BB} = -1.5 \text{ V}$	$V_{IN} = +12.05 \text{ V}$
CONDITION "B" = t_s, t_f, t_{off}	10/3/1.5 mA
$V_{BB} = -4.15 \text{ V}$	$V_{IN} = +14.85 \text{ V}$
CONDITION "C" = t_s, t_f, t_{off}	10/3/3 mA
$V_{BB} = -9.1 \text{ V}$	$V_{IN} = +19.8 \text{ V}$

532 $t_{on} - t_{off}$ SWITCHING



INPUT PULSE
 $t_r = t_f \leq 2.0 \text{ ns}$
 $PW \approx 300 \text{ ns}$
 $Z_{IN} = 50 \Omega$
 $DC \approx 2\%$

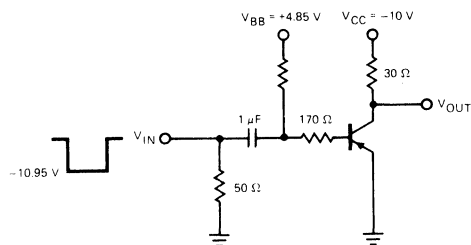
TO OSCILLOSCOPE
 $t_r \leq 0.4 \text{ ns}$
 $R_{IN} \geq 100 \text{ k}\Omega$
 $C_{IN} \leq 4.0 \text{ pF}$



CONDITION "A" = t_d, t_r, t_{on}	
$V_{BB} = +1.5 \text{ V}$	$V_{IN} = -12.05 \text{ V}$
CONDITION "B" = t_s, t_f, t_{off}	
$V_{BB} = +9.1 \text{ V}$	$V_{IN} = -19.8 \text{ V}$

Test Circuits

536 $t_{on} - t_{off}$ SWITCHING



300/30/30 mA

INPUT PULSE

$t_r, t_f < 6.0$ ns

$Z_{IN} = 50 \Omega$

PW = 0.5 μ s

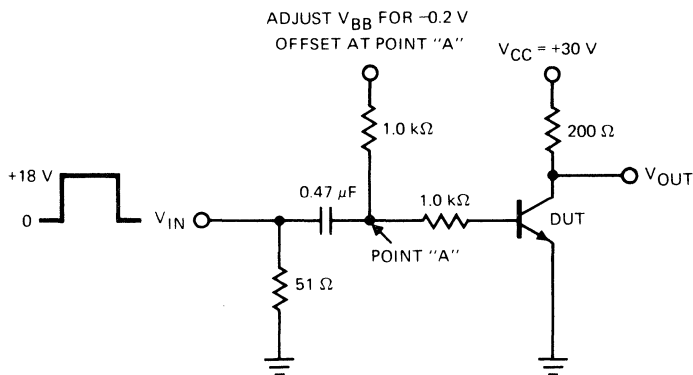
TO OSCILLOSCOPE

$t_r < 1.0$ ns

$Z_{IN} \geq 100$ k Ω

BASE CURRENTS WILL BE EXACT WHEN THE ABOVE VOLTAGES ARE USED. THESE VOLTAGES TAKE THE TERMINATING RESISTOR AND GENERATOR IMPEDANCE INTO ACCOUNT WHEN THE CURRENTS ARE CALCULATED. $V_{BE(sat)}$ IS A NOMINAL 1.0 V.

559 t_{on} SWITCHING

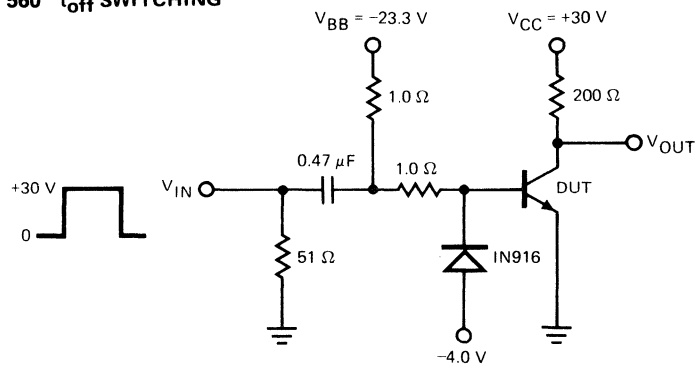


$t_r < 2.0$ ns

PW = 1.0 μ s

DC = 2%

560 t_{off} SWITCHING



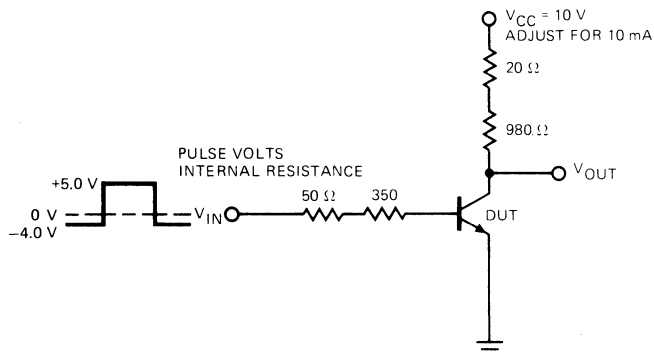
$t_r \leq 2.0$ ns

PW = 1.0 μ s

DC = 2%

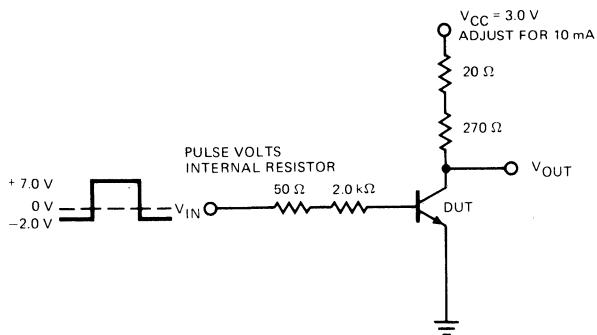
Test Circuits

588 τ_s SWITCHING



TYPE R SAMPLING RESISTOR
 $I_C = 10\text{ mA}$, $I_{B1} = I_{B2} = 10\text{ mA}$

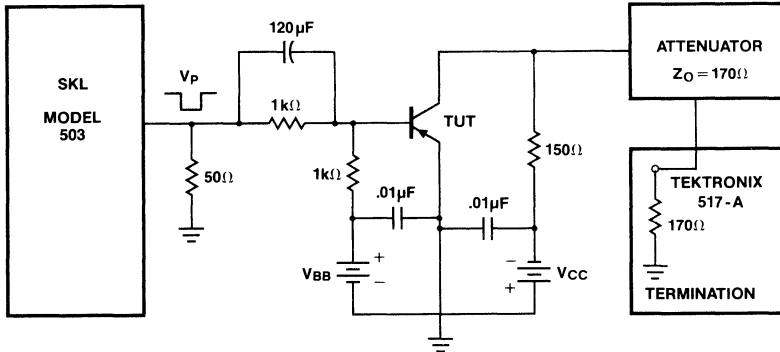
589 $t_{on} - t_{off}$ SWITCHING



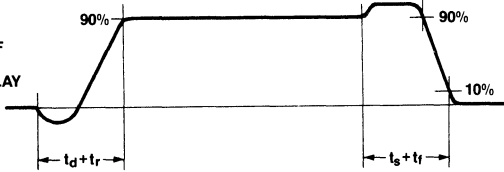
TYPE R SAMPLING RESISTOR
 $I_C = 10\text{ mA}$, $I_{B1} = 3.0\text{ mA}$, $I_{B2} = 1.5\text{ mA}$

Test Circuits

1132A SWITCHING CIRCUIT AND SWITCHING TIMES



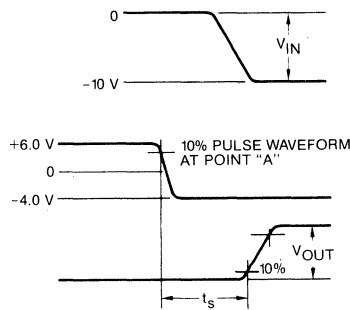
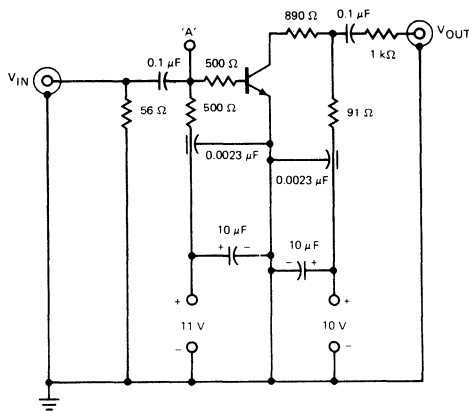
DETERMINATION OF SWITCHING TIMES FROM SCOPE DISPLAY



CONDITIONS: $V_{CC} = -15$ Volts, $V_B = 1.5$ Volts, $V_P = -7.5$ Volts, Pulse Length = 150 nSec

5

3111 CHARGE STORAGE TIME



TO OSCILLOSCOPE

$Z_{IN} = 50 \Omega$

$t_r \leq 1.0$ ns

PULSE GENERATOR

$V_{IN} t_r < 1.0$ ns

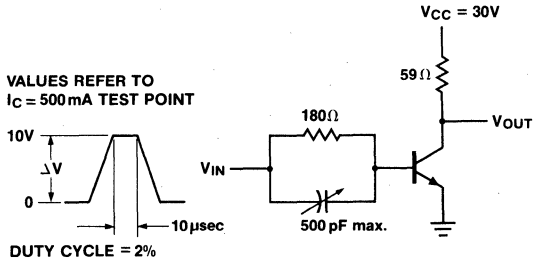
SOURCE IMPEDANCE = 50 Ω

PW ≥ 300 ns

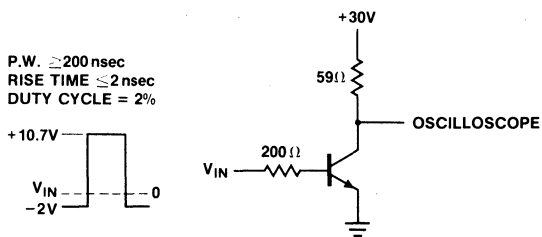
DC < 2.0%

Test Circuits

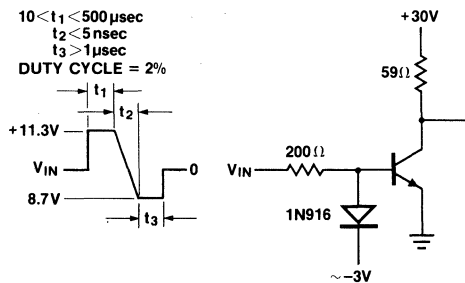
3163 Q_t TEST CIRCUIT



3164 t_d AND t_r SWITCHING CIRCUIT



3165 t_s AND t_f SWITCHING CIRCUIT





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I Case Outlines

- A. Diode Physical Dimensions (DO-7, DO-35, DO-41)
- B. Transistor Physical Dimensions (TO-39, TO-18, TO-92)
- C. Surface mount
 - 1. Leadless diode (LL-34)
 - 2. SOT 23 (TO-236 AA & AB)
 - 3. SOIC 8, 14, 16 lead package
- D. Diode and Transistor Arrays (4L, TO-85, TO-86, TO-96, TO-116, TO-116-2, TO-33)
- E. Photo Transistors (OPTO-26, OPTO-28)

II Packaging Options

- A. Diode
 - 1. Bulk
 - 2. Tape and reel
 - a. axial (fig. 1)
 - b. radial (fig. 2)
- B. Transistor
 - 1. Bulk
 - 2. Tape and reel (fig. 3)
- C. Surface Mount
 - 1. Bulk
 - 2. Tape and reel (fig. 4)
- D. Monolithic arrays
 - 1. Tubes

III Ordering Information

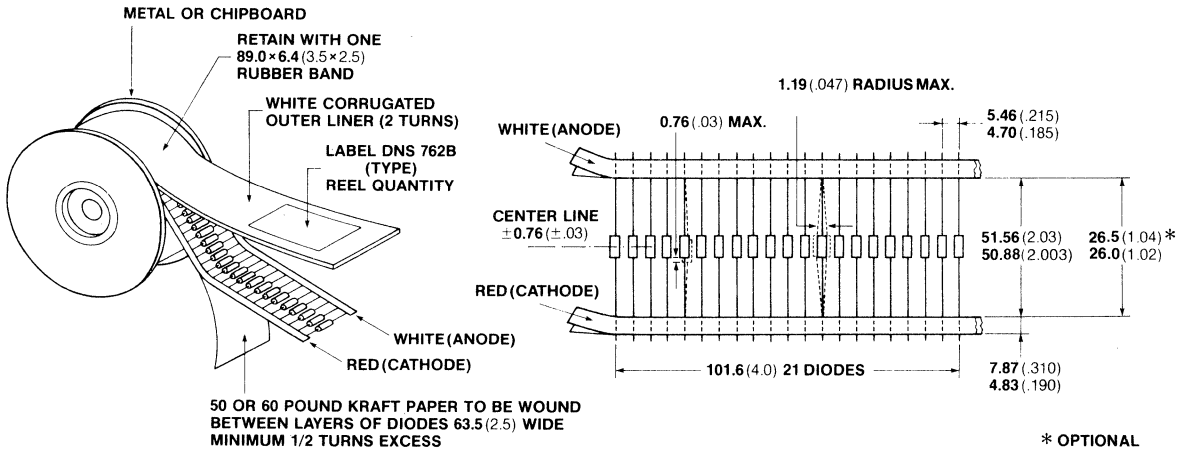
- A. Axial Lead Diodes
 - No suffix indicates bulk packaging
package quantity = 4,000
 - TR suffix indicates axial tape and reel
(50 mm tape spacing) package
 - PS suffix indicates axial tape and reel
(26 mm tape spacing)
quantity signal diodes -
DO-35 = 10,000
DO-41 = 7,000
 - package quantity zener diodes
DO-35 = 5,000
DO-41 = 3,000
 - RT suffix indicates radial tape and reel
package quantity
DO-7 = 2,000
DO-35 = 2,500
DO-41 = 2,000

B. Transistors

- No suffix indicates bulk packaging
package quantity
TO-5 = 400
TO-18 = 500
TO-92 = 1,000
- RT suffix indicates radial tape and reel style A
styles B, C, or D must be special ordered
package quantity = 2,000
- 05 suffix indicates TO-5 lead form
18 suffix indicates TO-18 lead form
- C. Surface Mount Diodes and Transistors
(SOT-23)
1st suffix letter indicates lead form profile
S = standard profile (TO-236/AA)
L = low profile (TO-236/AB)
2nd suffix letter indicates packaging style
O = bulk
A = tape and reel style A
B = tape and reel style B
package quantity
bulk = 1,000
tape and reel = 3,000
- D. Leadless Diodes
D is the first suffix letter for all leadless diodes
2nd suffix letter indicates packaging style
O = bulk
A = tape and reel style A
B = tape and reel style B
package quantity
bulk = 3,000
tape and reel = 3,000
- E. Examples
PN2222A, radial T&R style A
order as: PN2222A.RT
PN2222A with TO-5 lead form
order as: PN2222A.05
1N4148 tape & reel
order as: 1N4148.TR
FTSO2222A, low profile, T&R style A
order as: FTSO2222A.LA
FDLL4148 T&R style B
order as: FDLL4148.DB

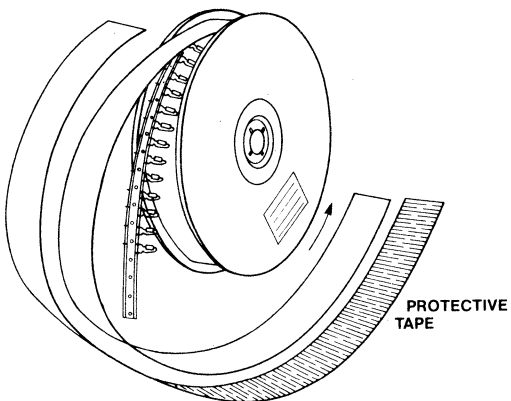
Packaging And Order Information

Figure 1



Note: All dimensions in millimeters (bold) and inches (parenthesis)

Figure 2



Packaging And Order Information

Figure 2 continued

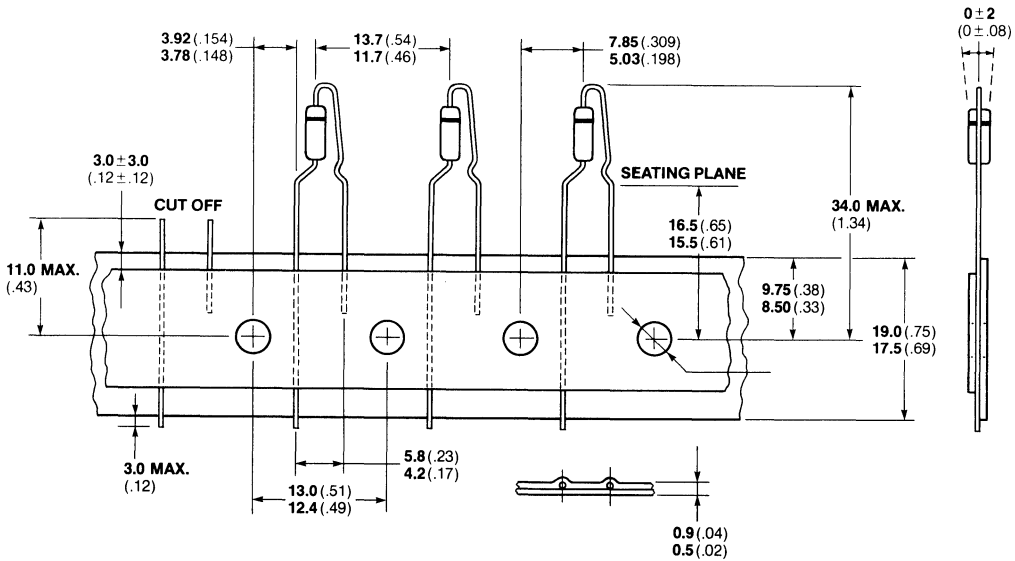
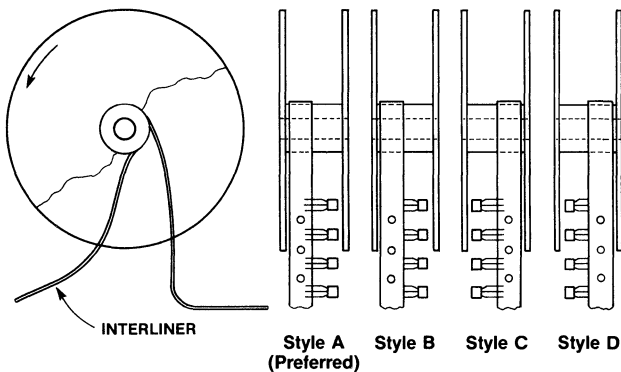


Figure 3



Style A: FSC STD (Preferred) Transistor flat side down, carrier tapes to the left. Emitter leads when unreeling.

Style B: Transistor flat side up, carrier tapes to the left. Collector leads when unreeling.

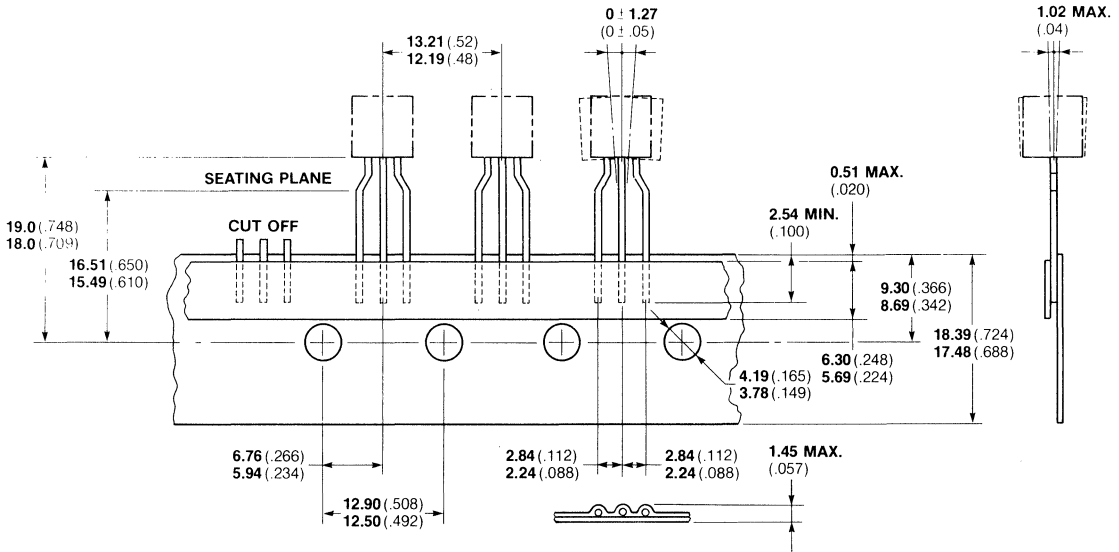
Style C: Transistor flat side down, carrier tapes to the right. Collector leads when unreeling.

Style D: Transistor flat side up, carrier tapes to the right. Emitter leads when unreeling.

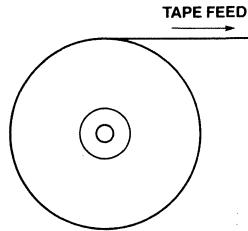
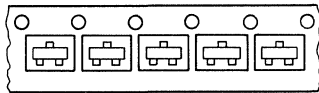
Note: All dimensions in millimeters (bold) and inches (parenthesis)

Packaging And Order Information

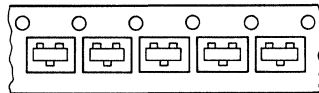
Figure 3 continued



SOT-23 Style A

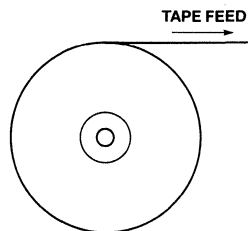
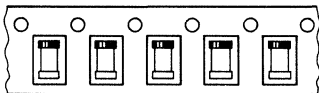


Style B

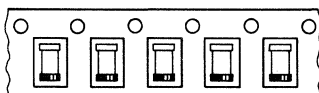


EIA Std RS481

LL-34 Style A



Style B

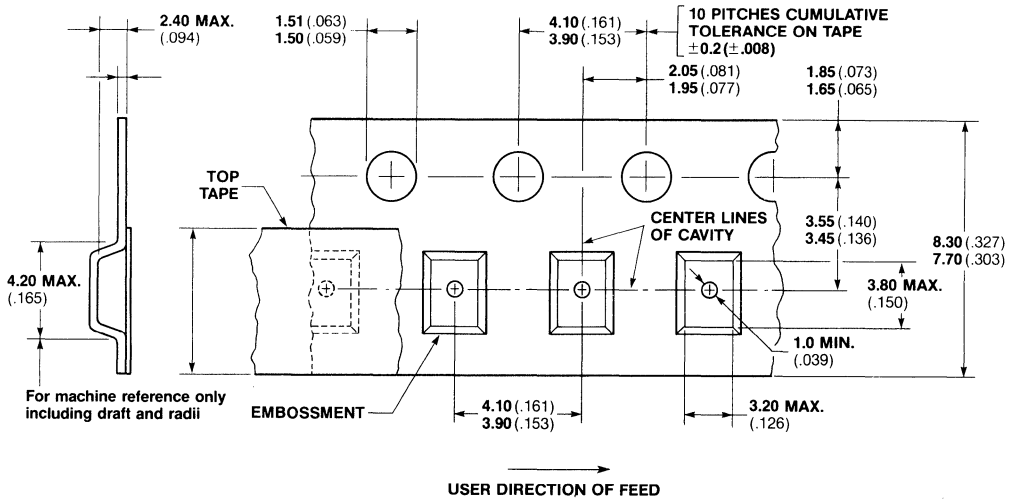


NOTE: Polarity band indicates cathode

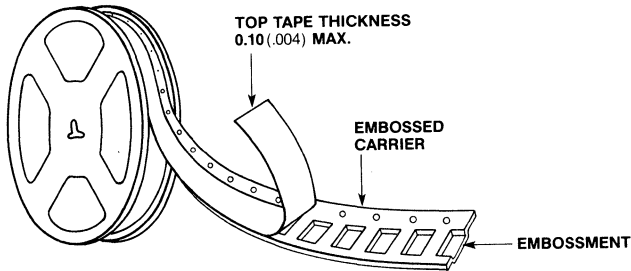
Note: All dimensions in millimeters (bold) and inches (parenthesis)

Packaging And Order Information

Figure 4



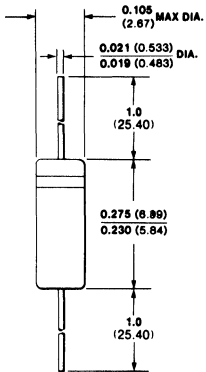
6



Note: All dimensions in millimeters (bold) and inches (parenthesis)

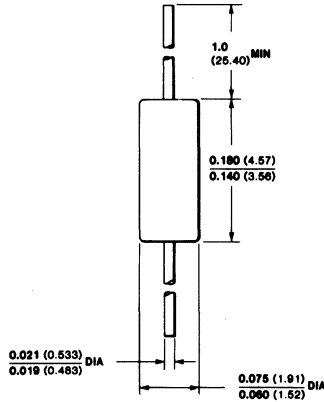
Packaging And Order Information

DO-7



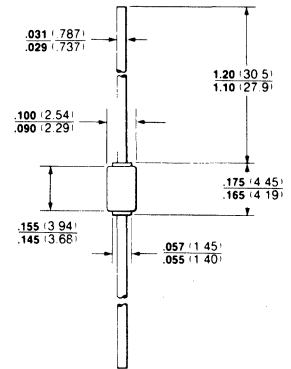
NOTES:
 Dumet leads, tin plated
 Gold plated leads available
 Hermetically sealed glass package
 Package weight is 0.19 gram

DO-35



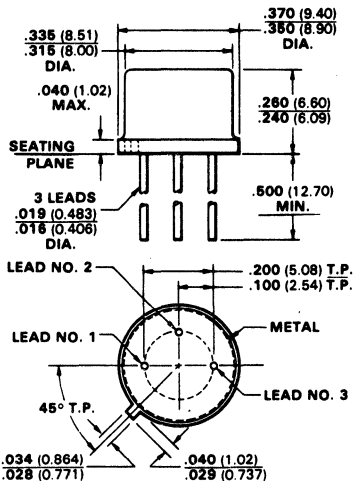
NOTES:
 Copper clad steel leads, tin plated
 Gold plated leads available
 Hermetically sealed glass package
 Package weight is 0.14 gram

DO-41



NOTES:
 Copper clad steel leads, tin plated
 Gold plated leads available
 Hermetically sealed glass package
 Package weight is 0.30 gram

TO-39

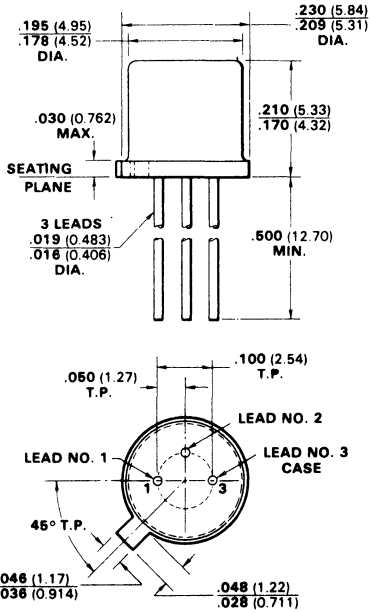


NOTES:
 Leads are solder dipped kovar
 Lead 3 connected to case
 This is a standard package and does not fall into the "special" classification
 Package weight is 0.76 gram

Note: All dimensions in inches (bold) and millimeters (parenthesis).

Packaging And Order Information

TO-18

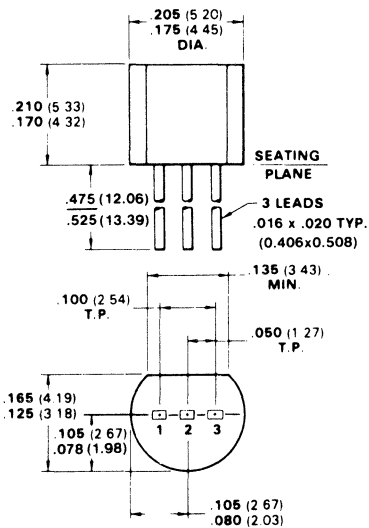


NOTES:

- Leads are gold-plated kovar
- Lead 3 connected to case
- 8 mil kovar header
- Package weight is 0.44 gram

6

TO-92



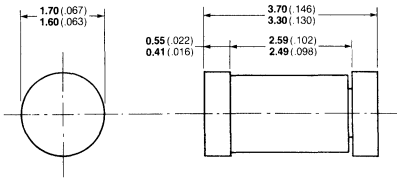
NOTES:

- Package material is transfer molded thermosetting plastic
- Package weight is 0.25 gram
- Leads are solder dipped.

TO-92 PIN CONFIGURATION		
PIN 1	PIN 2	PIN 3
E	B	C

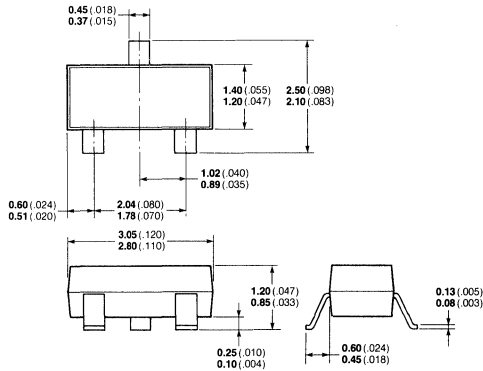
Packaging And Order Information

LL-34



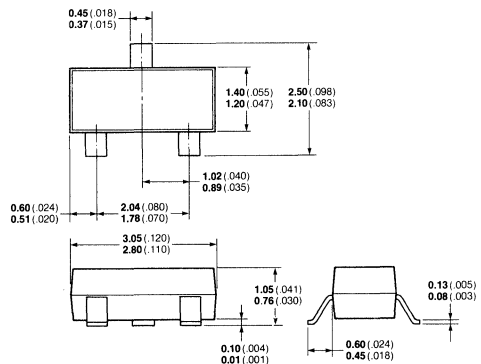
Note: All dimensions in millimeters (bold) and inches (parenthesis)

TO-236AA



NOTES: 1. Meets all JEDEC dimensional requirements for TO-236AA
2. Controlling dimension: millimeters

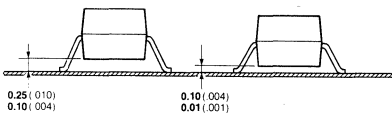
TO-236AB



NOTES: 1. Dimensioning and tolerancing per ANSI Y14.5, 1982
2. Controlling dimension: millimeters

SOT-23
TO-236AA
Standard

SOT-23
TO-236AB
Low Profile

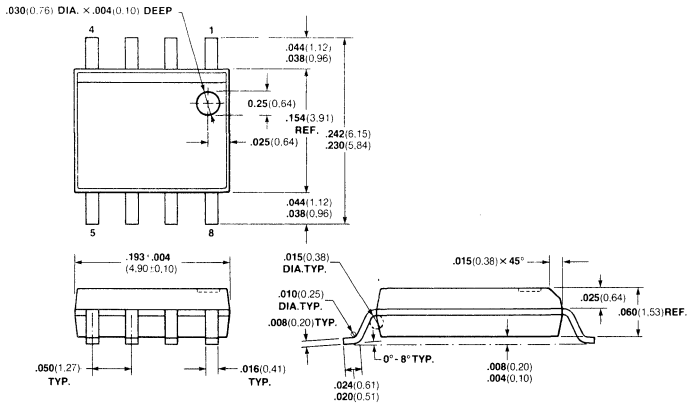


NOTE: Footprint is the same for standard and low profile package

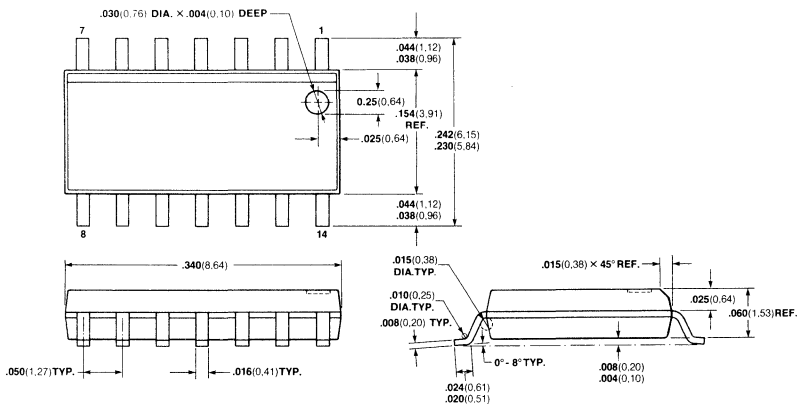
Note: All dimensions in millimeters (bold) and inches (parenthesis)

Packaging And Order Information

8-SOIC



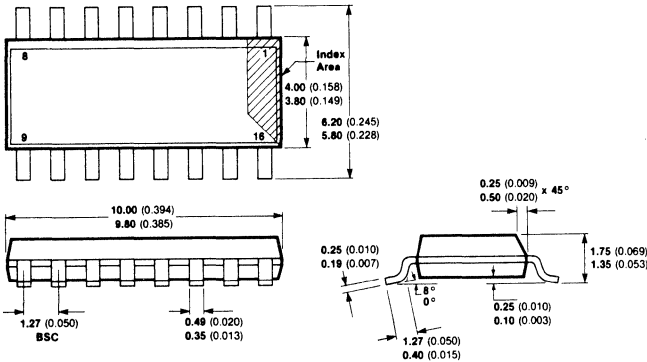
14-SOIC



Note: All dimensions in millimeters (bold) and inches (parenthesis)

Packaging And Order Information

16-SOIC



Notes

Index area: a notch or Lead One identification mark shall be located adjacent to Lead One and shall be located within the shaded area shown.

Leads are copper alloy, either tin plated or solder coated.

Package plastic material is nonvolac epoxy.

Total flash not to exceed 0.15 (0.006) over body dimensions.

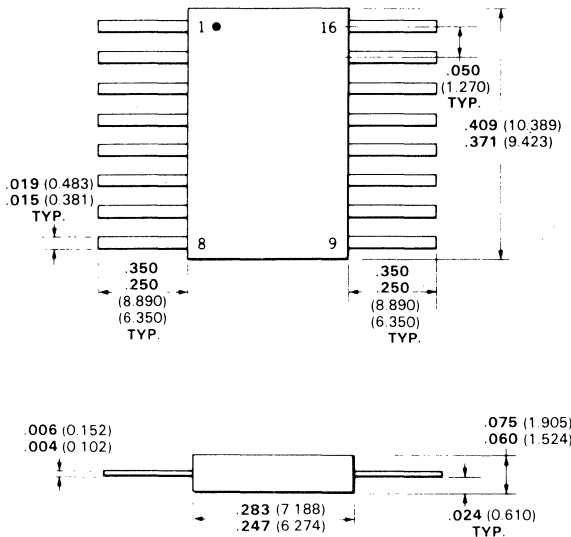
Conforms to variation AC of proposed JEDEC outline for 3.75 (0.150) wide body small outline (SO) family.

All dimensions are typical unless otherwise specified.

Controlling dimensions are metric dimensions.

Note: All dimensions in millimeters (bold) and inches (parenthesis)

4L



NOTES:

Pins are alloy 42

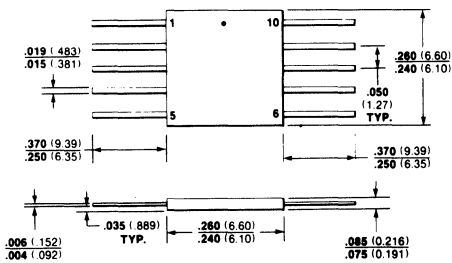
Package weight is 0.4 gram

Hermetically sealed beryllia package

Note: All dimensions in inches (bold) and millimeters (parenthesis).

Packaging And Order Information

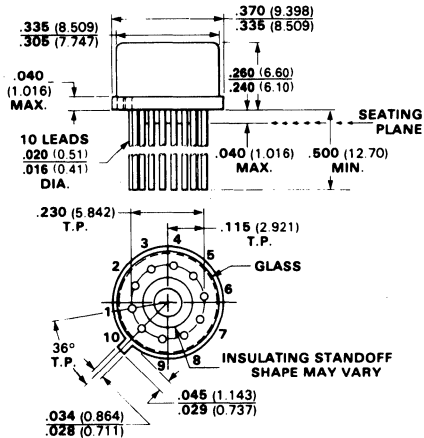
TO-85



NOTES:

- Alloy 42 leads, tin plated
- Gold plated leads available
- Hermetically sealed ceramic package
- Dot or tab indicates lead 1
- Package weight is 0.26 gram

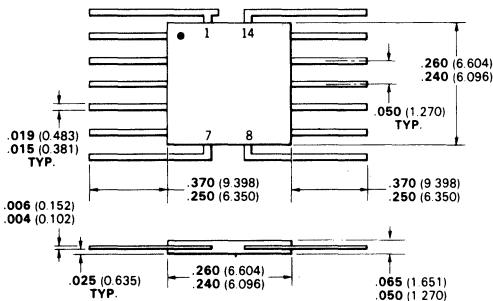
TO-96



NOTES:

- Kovar leads, gold plated
- Hermetically sealed package
- Package weight is 1.32 grams

TO-86



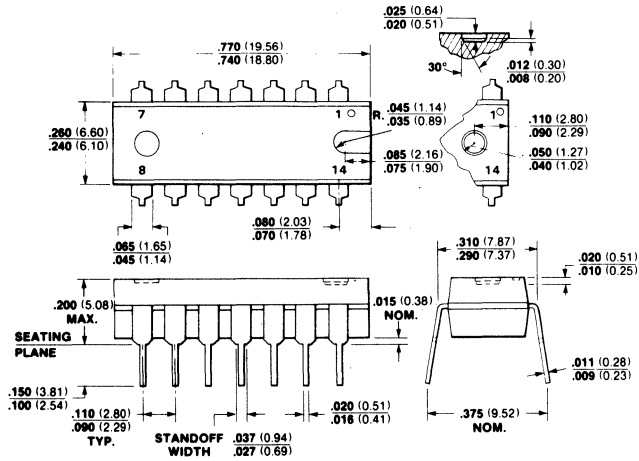
NOTES:

- Alloy 42 leads, tin plated
- Gold plated leads available
- Hermetically sealed ceramic package
- Dot or tab indicates lead 1
- Package weight is 0.27 gram

Note: All dimensions in inches (bold) and millimeters (parenthesis).

Packaging And Order Information

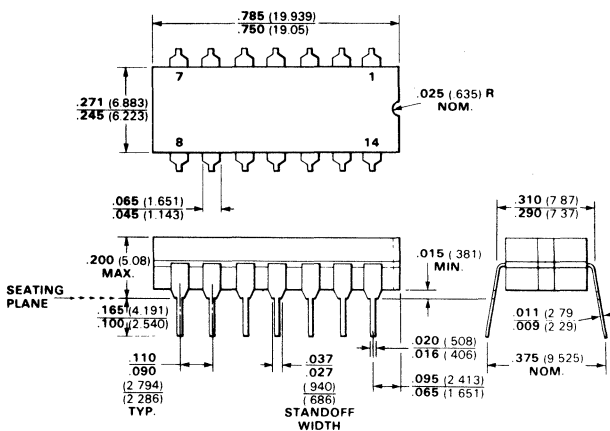
TO-116



NOTES:

- Alloy 42 pins, tin plated
- Gold plated pins available
- Transfer moulded DM-6B plastic package
- Pins are intended for insertion in hole rows on .300" (7.62) centers
- They are purposely shipped with "positive" misalignment to facilitate insertion
- Board drilling dimensions should equal your practice for .020" (0.508) inch diameter pin
- Package weight is 0.9 gram

TO-116-2



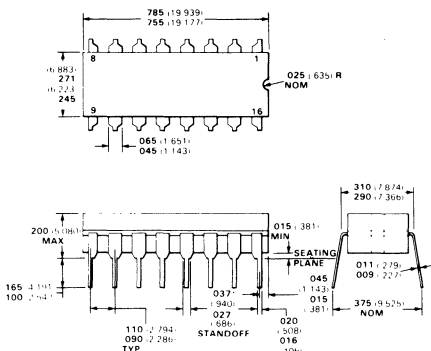
NOTES:

- Alloy 42 pins, tin plated
- Gold plated pins available
- Hermetically sealed ceramic package
- Pins are intended for insertion in hole rows on .300" (7.620) centers
- They are purposely shipped with "positive" misalignment to facilitate insertion
- Board-drilling dimensions should equal your practice for .020" (0.508) diameter pin
- Package weight is 2.0 grams

Note: All dimensions in inches (bold) and millimeters (parenthesis).

Packaging And Order Information

6B

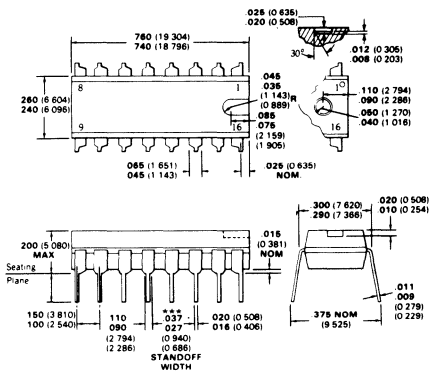


NOTES:

- Alloy 42 pins, tin plated
- Gold plated pins available
- Hermetically sealed ceramic package
- Pins are intended for insertion in hole rows on .300" centers (7.62)
- They are purposely shipped with "positive" misalignment to facilitate insertion
- Board-drilling dimensions should equal your practice for .020 inch diameter pin (0.51)
- Package weight is 2.0 grams
- *The .037-.027 dimension does not apply to the corner pins

6

9B



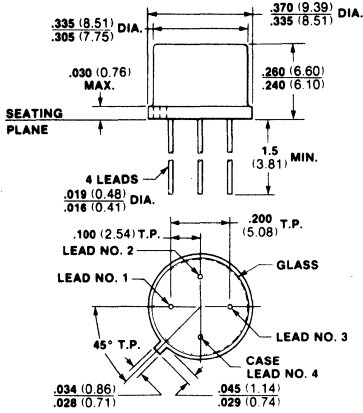
NOTES:

- Alloy 42 pins, tin plated
- Gold plated pins available
- Transfer moulded DM-6B plastic package
- Pins are intended for insertion in hole rows on .300" (7.62) centers
- Leads purposely have a "positive" misalignment to facilitate insertion
- Board-drilling dimensions should equal your practice for .020 inch (0.51) diameter pin
- **The .037-.027 (0.94-0.69) dimension does not apply to the corner pins

Note: All dimensions in inches (bold) and millimeters (parenthesis).

Packaging And Order Information

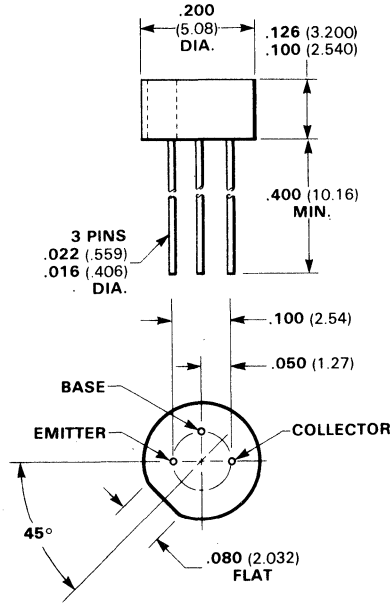
TO-33



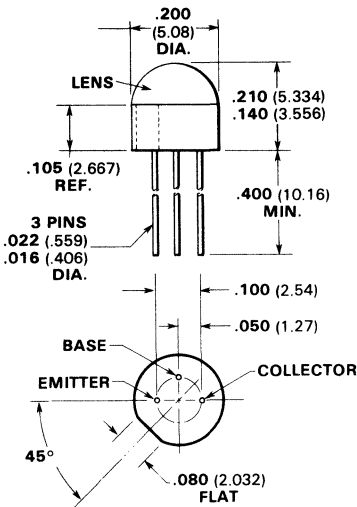
NOTES:

- Kovar leads, gold plated
- Hermetically sealed package
- Package weight is 0.36 gram
- Package weight is 1.22 grams

OPTO-28



OPTO-26



Note: All dimensions in inches (bold) and millimeters (parenthesis).



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Discrete Small Signal Hi-Reliability Devices

Fairchild Discrete Small Signal Division offers a complete line of Hi-Reliability devices produced in modern production facilities at San Rafael, California and Cebu, the Phillipines. Although emphasis is placed on designing and built-in quality and reliability, a complete reliability screening program has been established. Most products offered in this data book are available in all of the following Hi-Rel configurations:

- Hi-Rel Wafers and Die
- Military Qualified Diodes & Transistors
- Source Controlled Devices (SCD)
- Custom "Level S" Processing

Hi-Rel Wafers and Die

Refer to the DICE section of this data book for information on WAFER and DIE available in four standard configurations.

Military Qualified Diodes and Transistors

Fairchild maintains qualified status for all the devices listed in Tables 1 & 2. Most devices are available in three standard quality levels, JAN, JANTX, and JAN TXV, as defined by Mil-Std-19500. For short form information, Refer to Section 2, pages 10, 11, 12, 13, 19 and 20.

Source Controlled Devices (SCD)

Many devices listed in this data book are available with processing defined and controlled by customer documents, commonly referred to as SCD's. Using the Fairchild-developed MODULAR PROCESSING table in this section, along with the standard test methods and conditions outlined in this section, complete custom processing can be designed. Fairchild will conform to the requirements of furnished documents, however, reference to modules within the MODULAR PROCESSING sequence (see example) in the SCD as equal to or exceeding the requirements specified will expedite quote response and product delivery.

Custom "Level S" Processing

Top of the line custom built and processed devices, requiring baseline documentation, wafer lot acceptance and traceability, clean room assembly and Level S process controls and screening are available. Consult the factory for details.

Military Qualified Transistors

Qualified Products List

Device No.	Jan	TX	TXV
2N718A	X	X	X
2N930	X	X	
2N1613	X	X	X
2N2218A	X	X	X
2N2219A	X	X	X
2N2221A	X	X	X
2N2222A	X	X	X
2N2369A	X	X	X
2N2484	X	X	X
2N2904A	X	X	X
2N2905A	X	X	X
2N2906A	X	X	X
2N2907A	X	X	X
2N2920	X	X	X
2N3019	X	X	X
2N3700	X	X	X
2N2060	X	X	
1N457	X		
1N458	X		
1N459	X		
1N483B	X	X	X
1N485B	X	X	X
1N486B	X	X	X
1N914	X	X	X
1N3064	X	X	
1N3070	X	X	
1N3595	X	X	X
1N3600	X	X	X
1N4148-1	X	X	X
1N4150-1	X	X	X
1N4306	X	X	X
1N4307	X	X	X
1N4376	X	X	
1N4454-1	X	X	X
1N4938-1	X	X	
1N5768	X	X	X
1N5770	X	X	X
1N5772	X	X	X
1N5774	X	X	X
1N6100	X	X	X
1N6101	X	X	X

Discrete Small Signal Hi-Reliability Devices

Fairchild Standard Test Methods & Conditions

TEST	MIL-STD-750 METHOD	TEST CONDITION	COMMENTS
Internal Visual	2072, 2073, 2074		
High Temp Storage	1032		200° C, 48 hrs.
Temp Cycle	1051	C	-65° C to +200° C, 20 cyc, 15 min. at extremes
Constant Acceleration	2006		30 Kg, Y1, one minute does not apply. (Not applicable to DO-35 pkg.)
Fine Leak	1071	G	5x10 ⁻⁸ atmos cc/sec. (Not applicable to DO-35 pkg.)
Gross Leak	1071	C	Test cond. E for glass diodes
HTRB Burn-In	1038 & 1039		150° C, 48 hrs, 80% V _{CB} (transistor), 80% V _R (Diode) min. (use 72 hrs if not followed by Power Burn-In)
Power Burn-In	1038 & 1039	B	Transistors - 160 hrs Diodes - 96 hrs
X-Ray	2076		2 views
External Visual	2071		
Group A	—	—	Mil-Std-19500 Table III, JAN TXV
Group B	—	—	Mil-Std-19500 Table IVb
Group C	—	—	Mil-Std-19500 Table V
Solderability	2026		LTPD = 15, Electrical rejects may be used.
Resistance to Solvents	1022		LTPD = 15, Electrical rejects may be used.

Modular Processing
(Using standard test methods and conditions)

<p>ASSEMBLY LOCATION SELECT ONE</p>	<p>1</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">USA BUILD</div>	<p>2</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">OFFSHORE BUILD</div>																		
<p>ASSEMBLY FLOW SELECT ONE</p>	<p>10</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">INTERNAL VISUAL HIGH TEMP STORAGE TEMPERATURE CYCLE CONSTANT ACCELERATION FINE LEAK GROSS LEAK</div>	<p>11</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">INTERNAL VISUAL</div>	<p>12</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">NO INTERNAL VISUAL</div>	<p>13</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">NO INTERNAL VISUAL HIGH TEMP STORAGE TEMP CYCLE CONSTANT ACCELERATION FINE LEAK GROSS LEAK</div>																
<p>ELECTRICAL SELECTION SELECT ONE</p>	<p>20</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">STANDARD (refer to DEVICE)</div>	<p>21</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">SPECIAL SELECTION (specify in SCD)</div>																		
<p>SCREENING SELECT ONE</p>	<p>30</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">25°C D.C. TEST HTRB BURN-IN 25°C D.C. TEST POWER BURN-IN 25°C D.C. TEST DRIFT CRITERIA CUSTOM MARK GROUP A SAMPLE</div>	<p>31</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">25°C D.C. TEST HTRB BURN-IN 25°C D.C. TEST 10% P.D.A. CUSTOM MARK GROUP A SAMPLE</div>	<p>32</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">25°C D.C. R&R HTRB BURN-IN 25°C D.C. R&R POWER BURN-IN 25°C D.C. R&R CUSTOM MARK GROUP A SAMPLE</div>	<p>33</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CUSTOM MARK GROUP A SAMPLE</div>																
<p>SPECIAL TESTS SELECT ONE OR MORE</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">40</td><td>NONE</td></tr> <tr><td style="text-align: center;">41</td><td>X-RAY PIND</td></tr> <tr><td style="text-align: center;">42</td><td>100% TEMP TESTS</td></tr> <tr><td style="text-align: center;">43</td><td>100% A.C.</td></tr> <tr><td style="text-align: center;">44</td><td>GROUP B</td></tr> <tr><td style="text-align: center;">45</td><td>GROUP C</td></tr> </table>				40	NONE	41	X-RAY PIND	42	100% TEMP TESTS	43	100% A.C.	44	GROUP B	45	GROUP C				
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41	X-RAY PIND																			
42	100% TEMP TESTS																			
43	100% A.C.																			
44	GROUP B																			
45	GROUP C																			
<p>DATA/SPECIAL INSTRUCTIONS SELECT ONE OR MORE</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">50</td><td>NONE</td></tr> <tr><td style="text-align: center;">51</td><td>ATTRIBUTES DATA</td></tr> <tr><td style="text-align: center;">52</td><td>VARIABLES DATA</td></tr> <tr><td style="text-align: center;">53</td><td>CORRELATION UNITS</td></tr> <tr><td style="text-align: center;">54</td><td>IN-PROCESS SOURCE INSP.</td></tr> <tr><td style="text-align: center;">55</td><td>OUTGOING SOURCE INSP.</td></tr> <tr><td style="text-align: center;">56</td><td>GENERIC GROUP B&C</td></tr> <tr><td style="text-align: center;">57</td><td>RADIATION SAMPLES</td></tr> </table>				50	NONE	51	ATTRIBUTES DATA	52	VARIABLES DATA	53	CORRELATION UNITS	54	IN-PROCESS SOURCE INSP.	55	OUTGOING SOURCE INSP.	56	GENERIC GROUP B&C	57	RADIATION SAMPLES
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54	IN-PROCESS SOURCE INSP.																			
55	OUTGOING SOURCE INSP.																			
56	GENERIC GROUP B&C																			
57	RADIATION SAMPLES																			

Discrete Small Signal Hi-Reliability Devices

Modular Processing Examples

2N2222, 1, 10 21, 32, 41, 44, 45, 51, 52, 55

2N2222

U.S.A. assy.

Internal visual

High temp storage

Temp cycle

Fine leak

Gross leak

Select electrical screen

25° C DC R&R

HTRB burn-in

25° C DC R&R

Power burn-in

25° C DC R&R

Custom Mark

Group A Sample

X-Ray

PIND

Group B

Group C

Attributes data

Variables data

Outgoing source inspection

1N4148, 2, 13, 21, 30, 40, 56

1N4148

Offshore assy.

No internal visual

High temp storage

Temp cycle

Gross leak

Select electrical screen

HTRB burn-in

25° C DC R&R

Power burn-in

25° C DC test

Drift criteria

Custom mark

Group A sample

Generic Gp B & C

2N2222, 2, 12, 21, 33, 40, 56

2N2222

Offshore assy.

No internal visual

Select electrical screen

Custom mark

Group A

Generic Gp B & C

Index and Device Crossreference 1

Device Selection Guides 2

Product Information 3

Product Family Curves 4

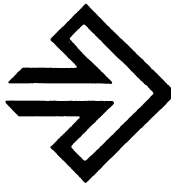
Test Circuits 5

**Ordering Information and
Package Outlines** 6

High Reliability Information 7

Dice and Wafer Information 8

Field Sales Offices 9



Wafer And Dice Information

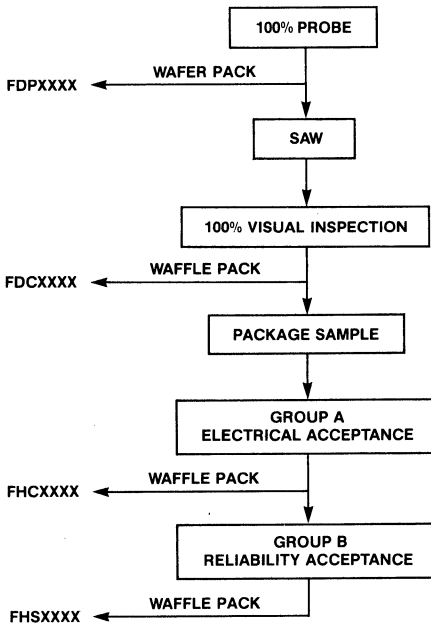
Fairchild's Small Signal Discrete Division is now servicing the hybrid applications of Commercial, Aerospace & Defense marketplaces with diode and transistor chips.

All die types from diode and transistor packaged devices are offered in levels ranging from electrically probed wafers for volume commercial applications to individually processed die for ultra high reliability applications specifying Mil-Std-883, Method 5008 Requirements.

Standard Manufacturing Flows

A standard processing die flow compatible with manufacturing capabilities satisfies commercial and high reliability requirements. Variations of the standard flow may be available to satisfy specific Source Control Drawing requirements.

Standard Wafer and Die Flow



Die Description

Physical properties:

- Topside metallization is aluminum, approximately 1 micron thick, excellent for all wire bonding techniques.
- Backside metalization of gold approximately 8000 Angstroms offers ease of die bonding for eutectic or epoxy with good thermal characteristics.
- Nitride passivation surface protection.
- Die size per die pictorial diagrams.

Product Selection

- **Product electrical** performance may be selected in one of two ways:

- 1) Using the Product Selection guide in this section, select the electrical characteristics meeting or exceeding your requirements. The corresponding die type (4 digit number) should then be added to the prefix designating the level of product required.
- 2) Knowing the JEDEC device designation, select the corresponding die type using the Device Cross Reference guide in this section. Add the prefix designation for complete product description.

- **Processing Level** may be determined from the Die Flow diagram in this section. Four levels of product are available as standard.

Prefix	Description
FDP,	Probed Wafers
FDC,	Probed, Visualed DICE
FHC,	Probed, Visualed, Group A Sampled DICE
FHS,	Probed, Visualed, Group A & B Sampled DICE

In addition, custom devices are available including special probe parameters, wafer lot acceptance, custom packaging, and radiation sample testing. Consult factory for details.

Wafer And Dice Information

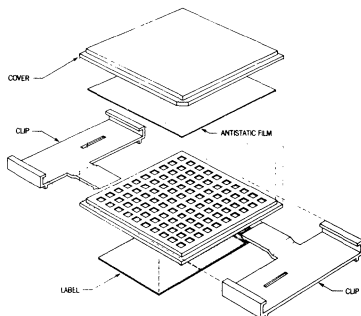
Additional Specifications

- 1) 100% Probe - 25° C DC parameters only.
- 2) 100% Visual - Mil-Std-883 Method 2010.
- 3) Group A - 25° C DC parameters - LTPD = 10%.
25° C AC parameters - LTPD = 15%.
- 4) Group B - Mil-Std-883 Method 5008.
- 5) Packaging - Per figure 1.
- 6) Data - Attributes data supplied with FHC (Group A) and FHS (Group A and B).

Ordering Information

- 1) Specify prefix from flow chart.
- 2) Add Die Type from cross reference chart or selection guide.
- 3) Specify quantity of electrically good die (EGD) required. This applies to both wafers and dice.

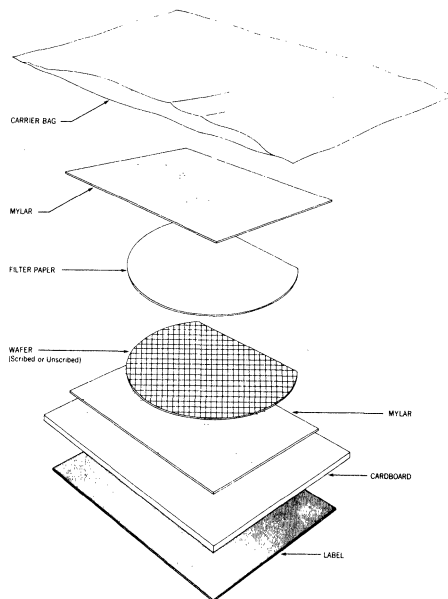
Figure 1



CAVITY PACK - Dice are Placed in Individual Compartments. The Plastic Snap Clips Permit Inspection and Resealing.



VIAL PACK - The Vial is Filled with FREON TF and a Plastic Cap Seals the Vial. The Freon Acts as a Motion Retarder and Cleansing Agent.



WAFER PACK - Entire Wafer is Sandwiched Between Two Pieces of Mylar and Vacuum Sealed in a Plastic Envelope.

Wafer And Dice Information

Die Sales Cross Reference Transistors

2N1893	149B	2N3251	215A	2N5089	155A
2N1974	149B	2N3304	292B	2N5209	155B
2N1984	149B	2N3439	333A	2N5210	155B
2N1986	149B	2N3440	333A	2N5220	145B
2N1988	149B	2N3700	149A	2N5223	144A
2N1990	149B	2N3701	149B	2N5224	162A
2N2192	149A	2N3724	139B	2N5225	145B
2N2192A	149A	2N3725	139A	2N5226	212B
2N2205	162A	2N3903	144B	2N5227	215A
2N2219	145A	2N3904	144A	2N5228	292B
2N2219A	145A	2N3905	215B	2N5270	145B
2N2221	145B	2N3906	215A	2N5320	314B
2N2221A	145B	2N3946	144B	2N5321	314B
2N2222	145C	2N3947	144A	2N5322	414B
2N2222A	145C	2N3962	219B	2N5323	414B
2N2242	161A	2N3964	219A	2N5400	232A
2N2270	145B	2N4013	139B	2N5401	232A
2N2297	149B	2N4014	139A	2N5415	443A
2N2369	132A	2N4030	224B	2N5416	443A
2N2369A	132A	2N4031	224B	2N5550	147A
2N2484	107B	2N4032	224A	2N5679	414A
2N2651	162A	2N4033	224A	2N5680	414A
2N2696	212B	2N4036	224B	2N5681	314A
2N2710	162A	2N4037	224B	2N5682	314A
2N2904	212B	2N4123	144B	2N5769	132A
2N2904A	212B	2N4124	144A	2N5771	292A
2N2905	212A	2N4125	215B	2N5772	162A
2N2905A	212A	2N4126	215A	2N5830	147A
2N2906	212B	2N4137	132A	2N5831	147A
2N2906A	212B	2N4208	292B	2N5833	147A
2N2907	212A	2N4209	292A	2N5961	107B
2N2907A	212A	2N4234	414B	2N5962	107A
2N2927	212B	2N4235	414B	2N699	149B
2N3013	162A	2N4236	414B	2N699B	149B
2N3019	149A	2N4237	314B	2N706	162A
2N3020	149B	2N4238	314B	2N708	162A
2N3072	212B	2N4239	314B	2N720	149B
2N3073	212B	2N4400	145B	2N720A	149B
2N3107	149A	2N4401	145A	2N744	132A
2N3108	149B	2N4402	212B	2N870	149B
2N3109	149A	2N4403	212A	2N914	162A
2N3120	212B	2N4409	147A	2N916	144B
2N3133	212B	2N4410	147A	2N930	107C
2N3134	212A	2N4896	340A	2N930A	107C
2N3135	212B	2N5042	224B	2N947	162A
2N3136	212A	2N5087	219A	2N957	144A

Wafer And Dice Information

Die Sales Cross Reference cont.

Transistors

MPS3563	212A	PE8550	202A	1N4009	1225
MPS3638	212A	PE8552	202A	1N4148	1225
MPS3639	292B	PN3565	155B	1N4149	1225
MPS3640	292B	PN3567	145B	1N4150	1225
MPS3646	162A	PN3569	145A	1N4151	1225
MPS3702	212B	PN3638A	212A	1N4154	1225
MPS3703	212B	PN3643	145A	1N4376	1725
MPS3704	145A	PN4121	215B	1N4446	1225
MPS4355	224A	PN4248	219B	1N4447	1225
MPS4356	224B	PN4249	219B	1N4448	1225
MPS5172	144A	PN4250	219A	1N4454	1225
MPS5551	147A	PN4258	292B	1N456A	1525
MPS6515	155B	PN4274	132A	1N457	1525
MPS6521	155A	PN4275	132A	1N457A	1525
MPS6535	212B	PN4354	224A	1N458	1525
MPS6560	124A	PN4355	224A	1N458A	1525
MPS6562	202A	PN4356	224B	1N459	1525
MPS6571	155A	PN4888	232A	1N459A	1525
MPS6590	147A	PN4889	232A	1N4606	1225
MPS6591	147A	PN4916	215B	1N482B	1525
MPS918	121A	PN4946	145A	1N483B	1525
MPSA05	150A	PN4965	219B	1N485B	1525
MPSA06	150A	PN5128	145B	1N493B	1425
MPSA10	144A	PN5130	121A	1N628	1425
MPSA12	164A	PN5133	107B	1N659	1225
MPSA13	164A	PN5134	132A	1N660	1425
MPSA14	164A	PN5135	145A	1N661	1425
MPSA18	107A	PN5136	145B	1N914	1225
MPSA20	144A	PN5137	145B	1N914A	1225
MPSA42	176A	PN5138	219B	1N914B	1225
MPSA43	176A	PN5139	215B	1N916	1225
MPSA55	224A	PN5142	212B	1N916A	1225
MPSA56	224A	PN5143	212A	1N916B	1225
MPSA70	215A	PN5770	121A	FDH325	1525
MPSA92	276A	PN5855	224B	FDH333	1525
MPSA93	276A	PN5857	224B	FDH425	1425
MPSL01	147A	PN5965	147A	FDH444	1425
MPSL51	232A	PN6076	215A	FDH625	1225
PE4002	107B			FDH666	1225
PE4010	107B	Diodes		FD725	1725
PE4020	107B			FD777	1725
PE7058	176A	1N3064	1225	FJT1100	1325
PE7059	176A	1N3070	1425	FJT1101	1325
PE8050	124A	1N3595	1525		
PE8052	124A	1N3600	1225		

Wafer And Dice Information

Diode Dice Selection Guide

Device	B _V	V _F	I _R	T _{RR}	CAP
1425	100 μ A >200 V	100 mA <1.0 V	150 V <100 nA	10 mA <50 ns	C _o < 2.5 pF
1525	100 μ A >200 V	100 mA <1.0 V	175 V <25 nA	–	C _o < 5.0 pF
1225	5.0 μ A >75 V	100 mA <1.0 V	50 V <100 nA	10 mA <4.0 ns	C _o < 2.5 pF
1725	5.0 μ A >20 V	50 mA <1.1 V	10 V <100 nA	10 mA <0.8 ns	C _o < 1.2 pF
1325	5.0 μ A >30 V	50 mA <1.1 V	5.0 V <10 pA	–	C _o < 2.0 pF

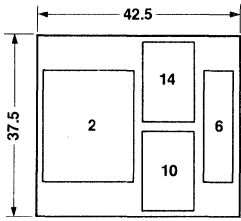
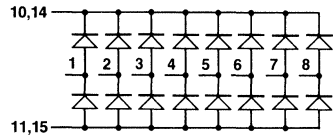
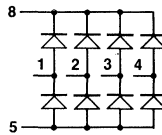
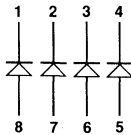
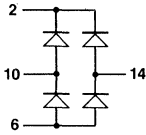
Diode Array Die Selection Guide

Product*	B _V (Min) @ I _R	I _R (Max) @ V _R	V _F (Max) @ I _F	V _F (Max) @ I _F	T _{RR} (Typ) I _F = I _R	CAP (Typ) @ V _R
02MO	60 V 100 μ A	100 nA 50 V	1.0 V 100 mA	–	20 nS 200 mA	4.0 pF 0 V
04MO	75 V 5.0 μ A	25 nA 20 V	1.0 V 100 mA	–	6.0 ns 10 mA	4.0 pF 0 V
08MO	60 V 10 μ A	100 nA 50 V	1.0 V 100 mA	1.5 V 500 mA	20 ns 200 mA	4.0 pF 0 V
16MO	60 V 10 μ A	100 nA 50 V	1.0 V 100 mA	1.5 V 500 mA	20 ns 200 mA	4.0 pF 0 V
18MO	60 V 10 μ A	100 nA 50 V	1.0 V 100 mA	1.5 V 500 mA	20 ns 200 mA	4.0 pF 0 V
19MO	60 V 10 μ A	100 nA 50 V	1.0 V 100 mA	1.5 V 500 mA	20 ns 200 mA	4.0 pF 0 V
28MO	60 V 10 μ A	100 nA 50 V	1.0 V 100 mA	1.5 V 500 mA	20 ns 200 mA	4.0 pF 0 V

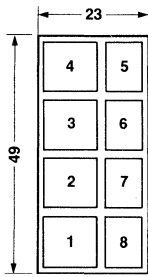
* Refer to schematic diagrams and topography for chip configuration.

Wafer And Dice Information

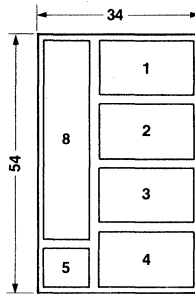
Diode Array Schematics and Topography



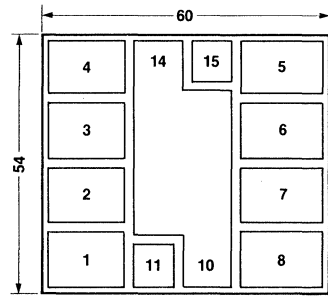
02M0



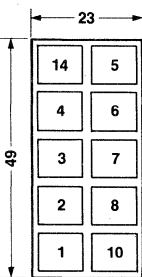
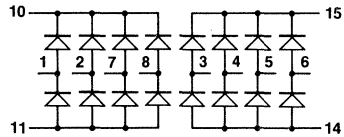
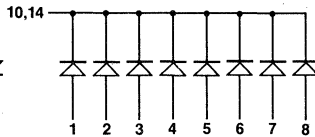
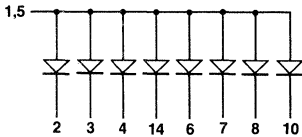
04M0



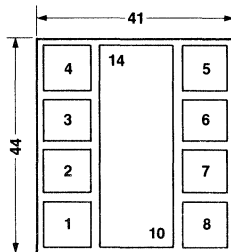
08M0



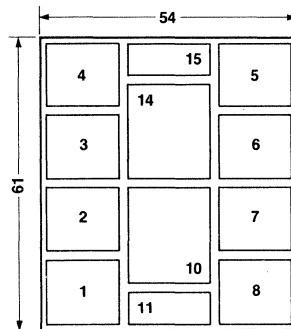
16M0



18M0



19M0



28M0

Wafer And Dice Information

Die Sales Cross Reference Diode Arrays

FSA1410	18MO
FSA1411	19MO
FSA2002	19MO
FSA2500	16MO
FSA2501	16MO
FSA2502	16MO
FSA2503	28MO
FSA2504	28MO
FSA2509	28MO
FSA2510	16MO
FSA2563	19MO
FSA2564	18MO
FSA2565	19MO
FSA2566	18MO
FSA2619	04MO
FSA2620	04MO
FSA2621	04MO
FSA2702	02MO
FSA2703	02MO
FSA2704	02MO
FSA2705	04MO
FSA2719	04MO
FSA2721	04MO

Wafer And Dice Information

Transistor Dice Selection Guide

Product	I _{CS}	I _{EBO}	H _{FE}	H _{FE}	H _{FE}	V _{CE(S)}
107A	45 V <10 nA	5.0 V <10 nA	10 μA/5.0 V >450	100 μA/5.0 V 500 - 1200	10 mA/5.0 V 700 - 1400	10 mA/0.5 mA <0.2 V
107B	45 V <10 nA	nA <10 nA	5.0 V 200 - 500	10 μA/5.0 V 225 - 500	100 μA/5.0 V 250 - 700	10 mA/5.0 V <0.2 V
107C	45 V <10 nA	5.0 V <10 nA	10 μA/5.0 V 100 - 300	100 μA/5.0 V 125 - 400	10 mA/5.0 V 200 - 600	10 mA/0.5 mA <0.2 V
121A	25 V <10 nA	3.0 V <10 nA	2.0 mA/6.0 V >75	8.0 mA/10 V >60	8.0 mA/10 V <190	10 mA/1.0 mA <0.2 V
124A	20 V <75 nA	4.0 V <50 nA	10 mA/1.0 V 50 - 180	100 mA/1.0 V 65 - 180	1.0 A/1.0 V 40 - 180	1.0 A/100 mA <0.5 V
132A	20 V <200 nA	4.0 V <500 nA	10 mA/0.35 V >40	10 mA/1.0 V <120	30 mA/0.4 V >30	100 mA/10 mA <0.5 V
139A	60 V <250 nA	4.0 V <250 nA	100 mA/1.0 V >60	100 mA/1.0 V <150	500 mA/1.0 V >35	500 mA/50 mA <0.5 V
139B	40 V <250 nA	4.0 V <250 nA	100 mA/1.0 V >60	100 mA/1.0 V <150	500 mA/1.0 V >35	500 mA/50 mA <0.42 V
144A	40 V <10 nA	5.0 V <10 nA	1.0 mA/1.0 V >90	10 mA/1.0 V 120 - 300	100 mA/1.0 V >30	50 mA/5.0 mA <0.3 V
144B	40 V <10 nA	5.0 V <10 nA	1.0 mA/1.0 V >35	10 mA/1.0 V 50 - 150	100 mA/1.0 V >15	50 mA/5.0 mA <0.3 V
145A	50 V <15 nA	5.0 V <10 nA	100 μA/10 V >40	150 mA/1.0 V >100	150 mA/10 V <300	150 mA/15 mA <0.22 V
145B	50 V <15 nA	5.0 V <10 nA	100 μA/1.0 V >20	150 mA/1.0 V 50 - 120	150 mA/10 V <150	150 mA/15 mA <0.22 V
147A	120 V <50 nA	5.0 V <50 nA	1.0 mA/5.0 V >80	10 mA/5.0 V >80	10 mA/5.0 V <250	50 mA/5.0 mA <0.2 V
149A	80 V <10 nA	5.0 V <10 nA	100 μA/10 V >50	150 mA/10 V >100	150 mA/10 V <300	150 mA/15 mA <0.2 V
149B	80 V <10 nA	5.0 V <10 nA	100 μA/10 V >30	100 μA/10 V <100	150 mA/10 V <120	150 mA/15 mA <0.2 V
150A	60 V <20 nA	5.0 V <10 nA	100 μA/5.0 V >25	100 μA/1.0 V 50 - 300	500 mA/10 V >20	150 mA/15 mA <0.4 V
155A	45 V <10 nA	6.0 V <10 nA	100 μA/5.0 V 400 - 800	1 mA/5.0 V >450	2.0 mA/10 V <800	50 mA/5.0 mA <0.3 V
155B	45 V <10 nA	6.0 V <10 nA	100 μA/5.0 V >100	100 μA/5.0 V <300	2.0 mA/10 V 250 - 300	50 mA/5.0 mA <0.3 V
162A	20 V <50 nA	4.0 V <80 nA	30 mA/0.4 V >40	30 mA/1.0 V <120	100 mA/0.5 V >25	100 mA/10 mA <0.28 V
164A	15 V <100 nA	10 V <50 nA	10 mA/5.0 V >20K	10 mA/5.0 V <100K	100 mA/5.0 V >20K	100 mA/100 μA <1.6 V
176A	200 V <100 nA	6.0 V <50 nA	30 mA/10 V >50	30 mA/10 V <200	150 mA/20 V >15	20 mA/2.0 mA <0.5 V

Wafer And Dice Information

$V_{BE(S)}$	F_T	LV_{CEO}	T_{off}
10 mA/0.5 mA 0.7 V - 0.9 V	>100 MHz	10 mA >60 V	-
10 mA/0.5 mA 0.7 V - 0.9 V	10 mA/0.5 mA	>100 MHz >60 V	10 mA
10 mA/0.5 mA 0.7 V - 0.9 V	>100 MHz	10 mA >60 V	-
10 mA/1.0 mA <0.9 V	>750 MHz	3.0 mA >15 V	-
1.0 A/100 mA <1.2 V	100 MHz	10 mA >25 V	-
10 mA/1.0 mA 0.7 V - 0.9 V	>500 MHz	10 mA >15 V	<18 ns
500 mA/50 mA <1.1 V	>300 MHz	10 mA >50 V	<60 ns
500 mA/50 mA 0.9 V - 1.1 V	>300 MHz	10 mA >40 V	<60 ns
50 mA/5.0 mA <0.9 V	>250 MHz	1.0 mA >40 V	<250 ns
50 mA/5.0 mA <0.9 V	>200 MHz	1.0 mA >40 V	<250 ns
150 mA/15 mA 0.75 V - 0.95 V	>300 MHz	10 mA >40 V	<250 ns
150 mA/15 mA 0.75 V - 0.95 V	>250 MHz	10 mA >50 V	<250 ns
50 mA/5.0 mA <1.0 V	100-300 MHz	10 mA >180 V	-
150 mA/15 mA <0.9 V	>100 MHz	10 mA >80 V	250 - 1000 ns
150 mA/15 mA <0.9 V	>100 MHz	10 mA >80 V	<600 ns
150 mA/15 mA <0.9 V	>100 MHz	10 mA >80 V	-
50 mA/5.0 mA <1.0 V	>300 MHz	1.0 mA >45 V	-
50 mA/5.0 mA <1.0 V	>300 MHz	1.0 mA >50 V	-
100 mA/10 mA <1.2 V	>350 MHz	10 mA >20 V	<25 ns
100 mA/100 μ A <1.6 V	>125 MHz	10 mA >30 V	-
20 mA/2.0 mA <0.9 V	>50 MHz	1.0 mA >300 V	-

Wafer And Dice Information

Transistor Dice Selection Guide

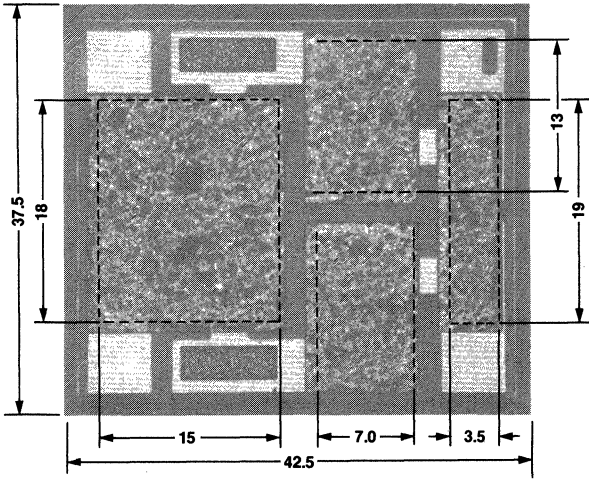
Product	I _{CS}	I _{EBO}	H _{FE}	H _{FE}	H _{FE}	V _{CE(S)}
202A	20 V <100 nA	4.0 V <100 nA	10 mA/1.0 V >50	100 mA/1.0 V >65	100 mA/1.0 V <200	200 mA/20 mA <0.15 V
212A	50 <35 nA	5.0 V <50 nA	100 μA/1.0 V >75	150 mA/2.0 V >100	150 mA/10 V <300	150 mA/15 mA <0.4 V
212B	50 V <35 nA	5.0 V <50 nA	100 μA/1.0 V >40	150 mA/2.0 V >50	150 mA/10 V <120	150 mA/15 mA <0.4 V
215A	30 V <25 nA	5.2 V <25 nA	100 μA/1.0 V >100	1.0 mA/5.0 V <300	10 mA/1.0 V >120	50 mA/5.0 mA <0.3 V
215B	30 V <25 nA	5.2 V <25 nA	100 μA/1.0 V >40	10 mA/1.0 V >70	10 mA/5.0 V <150	50 mA/5.0 mA <0.3 V
219A	40 V <10 nA	5.0 V <10 nA	10 μA/5.0 V 250 - 500	100 μA/5.0 V 250 - 700	10 mA/5.0 V >250	10 mA/0.5 mA <0.25 V
219B	50 V <10 nA	5.0 V <10 nA	100 μA/5.0 V >100	100 μA/5.0 V <300	500 μA/2.0 V >125	10 mA/0.5 mA <0.2 V
224A	75 V <50 nA	5.0 V <10 nA	100 μA/5.0 V >75	100 mA/1.0 V >100	100 mA/5.0 V <300	150 mA/15 mA <0.15 V
224B	75 V <50 nA	5.0 V <10 nA	1 mA/10 V >40	100 mA/1.0 V >50	100 mA/5.0 V <120	150 mA/15 mA <0.15 V
232A	120 V <50 nA	4.0 V <10 nA	10 mA/5.0 V >70	10 mA/5.0 V <180	50 mA/5.0 V >50	50 mA/5.0 mA <0.25 V
276A	200 V <50 nA	5.0 V <10 nA	1 mA/10 V >30	10 mA/10 V 40 - 400	30 mA/10 V 30 - 150	20 mA/2.0 mA <0.4 V
292A	10 V <10 nA	3.0 V <50 nA	10 mA/0.3 V >50	10 mA/0.3 V <120	50 mA/1.0 V >40	10 mA/1.0 mA <0.18 V
292B	10 V <10 nA	3.0 V <50 nA	10 mA/0.3 V >30	10 mA/3.0 V <120	50 mA/1.0 V >30	10 mA/1.0 mA <0.15 V
314A	120 V <1.0 μA	5.0 V <100 nA	250 mA/2.0 V >40	500 mA/3.0 V >30	500 mA/3.0 V <150	500 mA/50 mA <0.3 V
314B	100 V <100 μA	5.0 V <100 nA	500 mA/4.0 V >40	500 mA/4.0 V <130	1.0 A/1.0 V >15	1.0 A/0.1 A <0.6 V
316A	90 V <10 μA	6.0 V <100 μA	500 mA/2.0 V >30	2.0 A/2.0 V >30	2.0 A/2.0 V <375	2.0 A/0.1 A <0.5 V
333A	450 V <20 μA	6.0 V <20 μA	20 mA/10 V >40	20 mA/10 V <160	100 mA/2.0 V >10	50 mA/4.0 mA <0.5 V
340A	60 V <20 nA	4.0 V <1.0 μA	40 mA/1.0 V >50	2.0 A/2.0 V >100	2.0 A/2.0 V <300	5.0 A/0.5 A <1.0 V
414A	120 V <1 μA	7.0 V <1.0 μA	250 mA/2.0 V >40	250 mA/2.0 V <150	1.0 A/2.0 V >15	1.0 A/0.1 A <1.0 V
414B	100 V <100 μA	6.0 V <10 μA	10 mA/4.0 V >40	250 mA/1.0 V 30 - 150	500 mA/4.0 V 40 - 130	1.0 A/0.125 A <0.6 V
443A	300 V <50 μA	4.0 V <500 nA	5.0 mA/10 V >25	50 mA/10 V >30	50 mA/10 V <120	50 mA/5.0 mA <1.4 V

Wafer And Dice Information

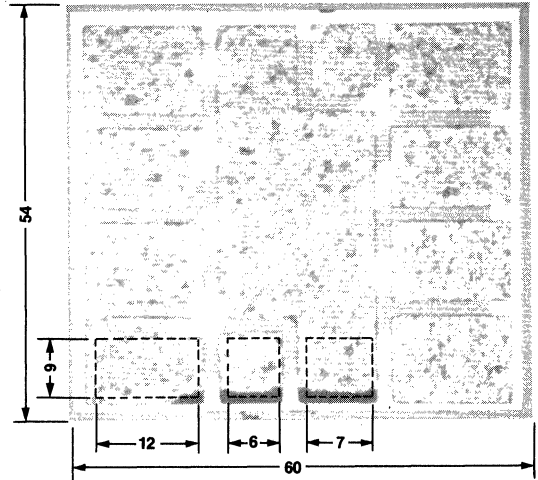
$V_{BE(S)}$	F_T	LV_{CEO}	T_{off}
200 mA/20 mA <0.9 V	>100 MHz	10 mA >25 V	–
150 mA/15 mA <0.95 V	>250 MHz	10 mA >60 V	<100 ns
150 mA/15 mA <0.4 V	>200 MHz	10 mA >60 V	<100 ns
50 mA/5.0 mA <0.95 V	>450 MHz	10 mA >45 V	<325 ns
50 mA/5.0 mA <0.95 V	>450 MHz	10 mA >45 V	<300 ns
10 mA/0.5 mA <0.9 V	>50 MHz	5.0 mA >50 V	–
100 mA/0.5 mA <0.9 V	>40 MHz	>60 V	–
150 mA/15 mA 0.95 V	150 - 500 MHz	5.0 mA >80 V	<400 ns
150 mA/15 mA 0.95 V	150 - 500 MHz	10 mA >80 V	<400 ns
50 mA/5.0 mA <1.0 V	>100 MHz	1.0 mA >150 V	–
20 mA/2.0 mA 0.9 V	>50 MHz	10 mA >300 V	–
10 mA/1.0 mA 0.95 V	>850 MHz	3.0 mA >15 V	<20 ns
10 mA/1.0 mA <0.95 V	>900 MHz	3.0 mA >12 V	<20 ns
500 mA/50 mA <1.2 V	>40 MHz	10 mA >60 V/120 V	–
1.0 A/0.1 A <1.5 V	>50 MHz	30 mA >80 V	<800 ns
2.0 A/0.1 A <1.5 V	>30 MHz	50 mA >75 V	<10 μ s
50 mA/4.0 mA <1.3 V	>15 MHz	15 mA >350 V	–
5.0 A/0.5 A <1.6 V	>80 MHz	50 mA >60 V	–
1.0 A/0.2 A <1.2 V	>30 MHz	10 mA >120 V	–
1.0 A/0.1 A <1.5 V	>50 MHz	10 mA >80 V	<1000 ns
50 mA/5.0 mA <1.5 V	>15 MHz	5.0 mA >350 V	–

Wafer And Dice Information

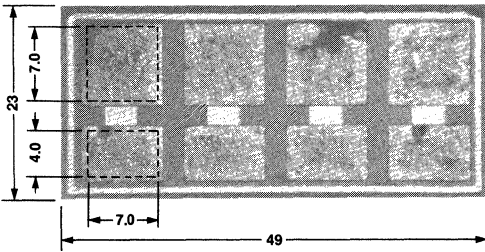
02MO DIE



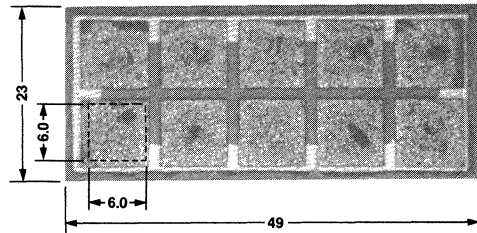
16MO DIE



04MO DIE

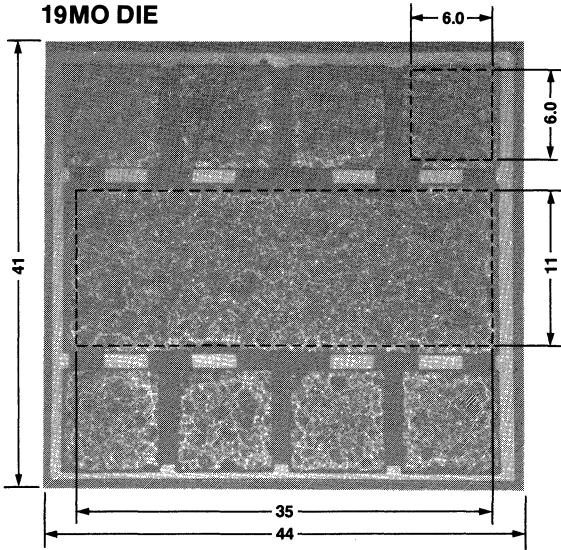


18MO DIE

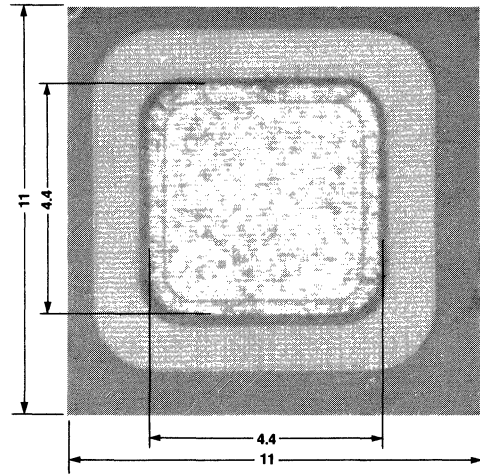


Wafer And Dice Information

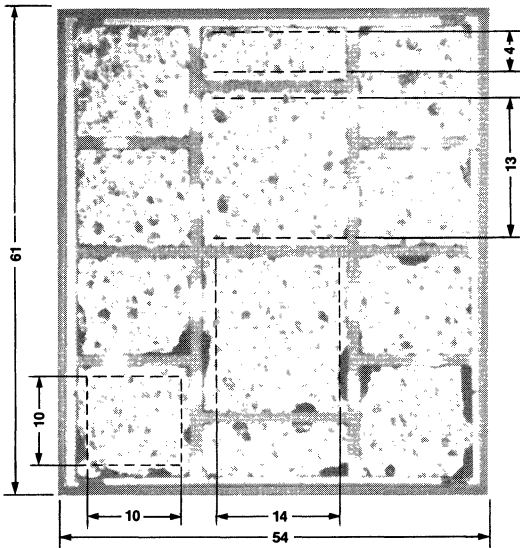
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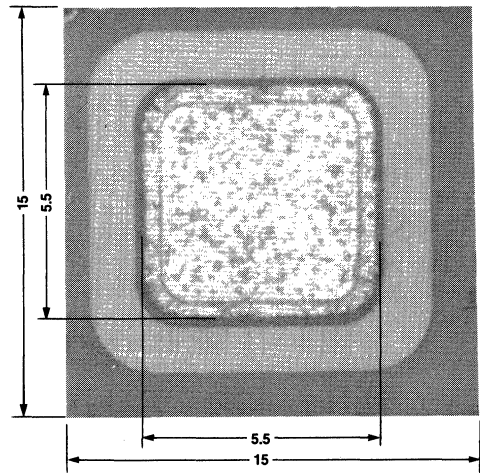
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28MO DIE

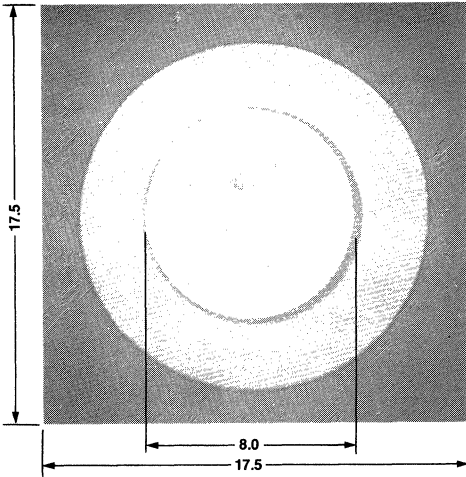


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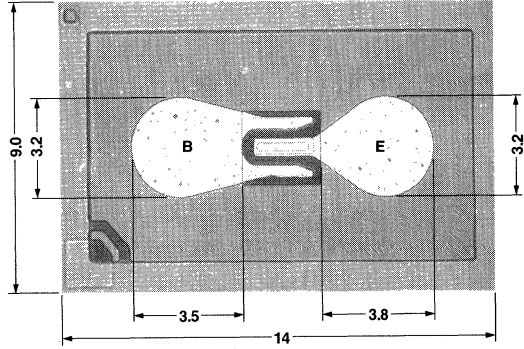


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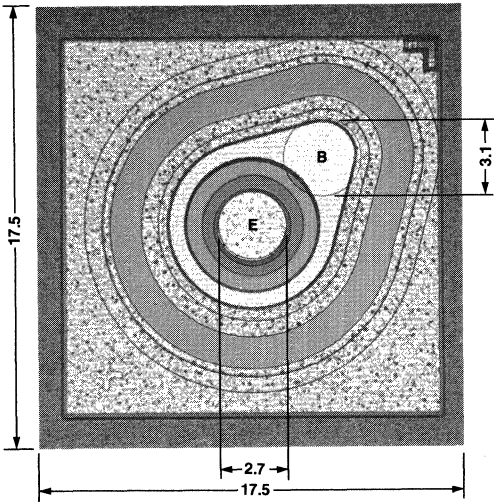
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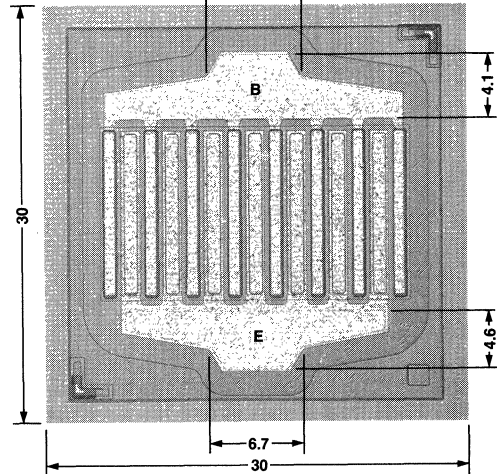
121 DIE



107 DIE

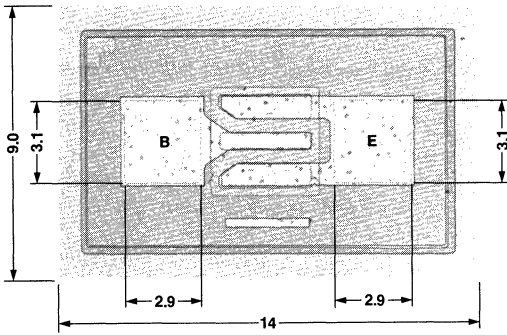


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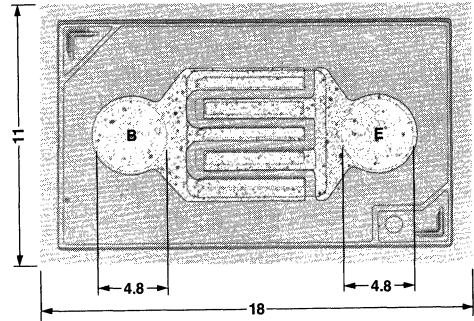


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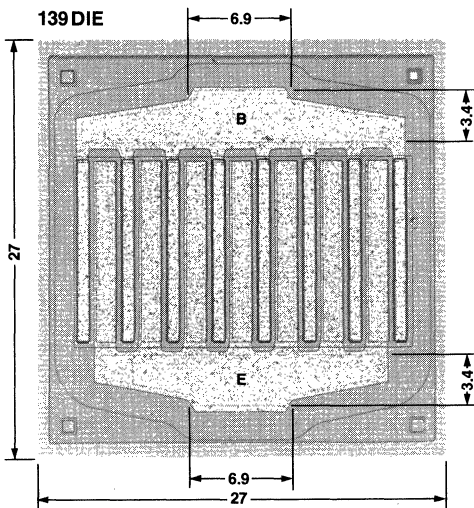
132 DIE



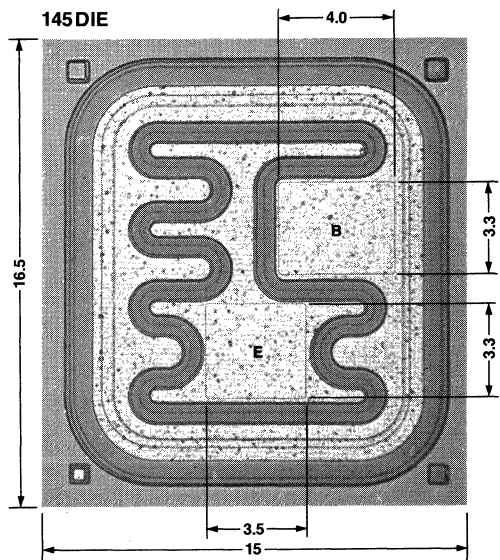
144 DIE



139 DIE

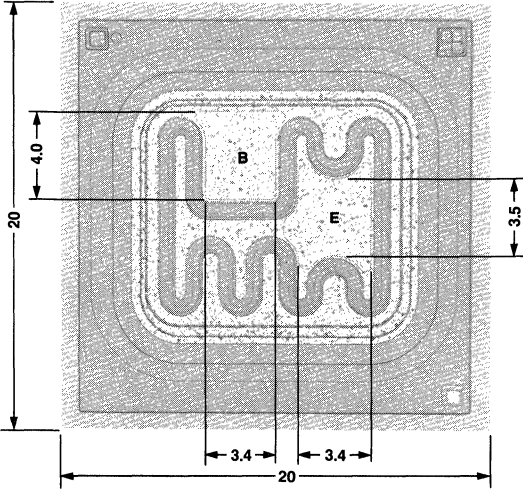


145 DIE

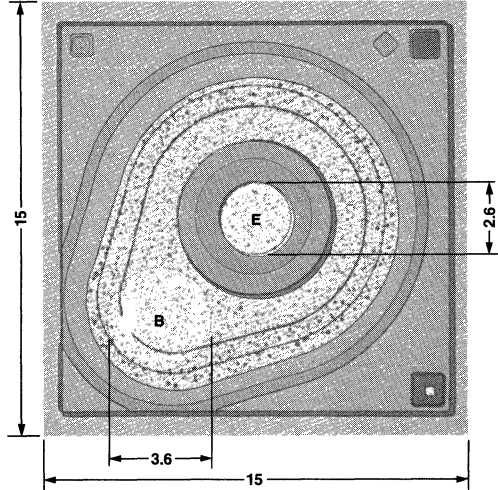


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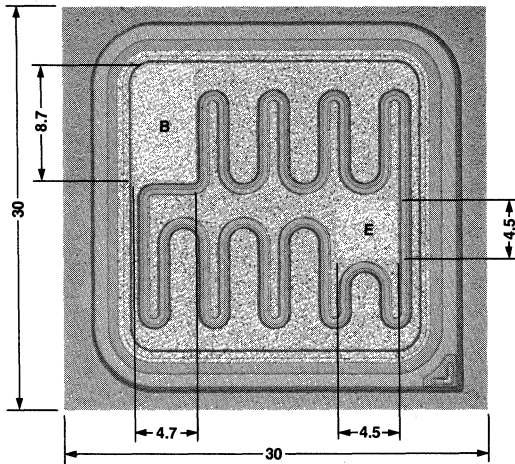
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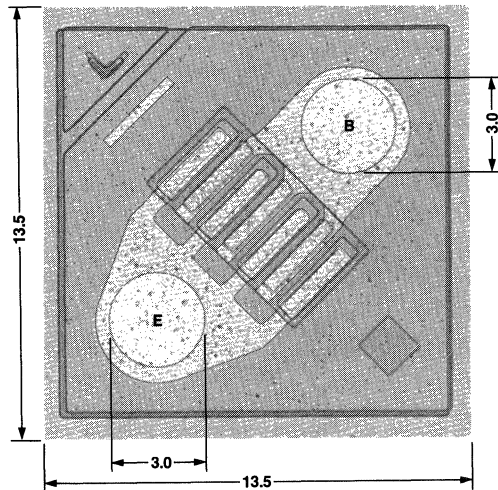
155DIE



149DIE

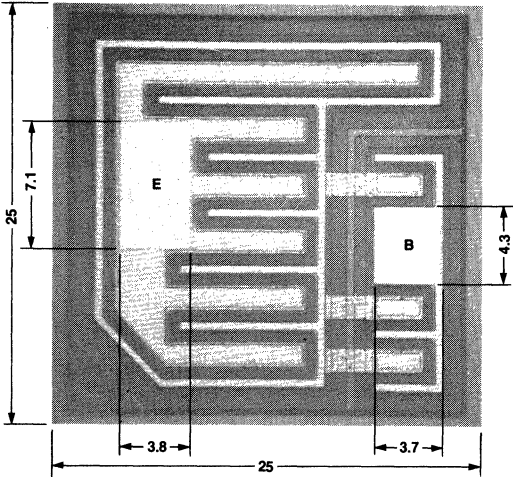


162DIE

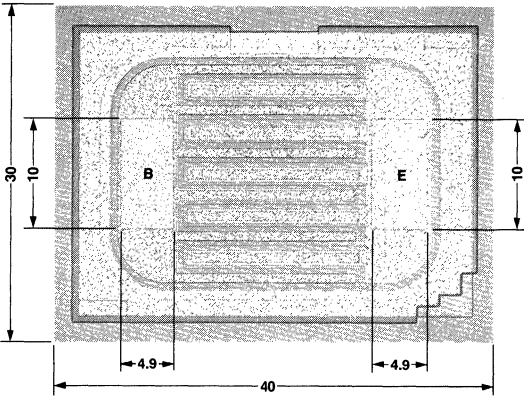


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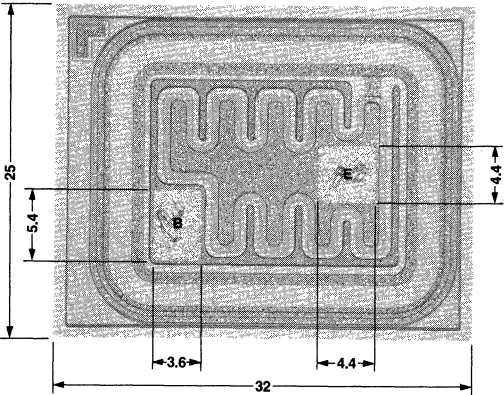
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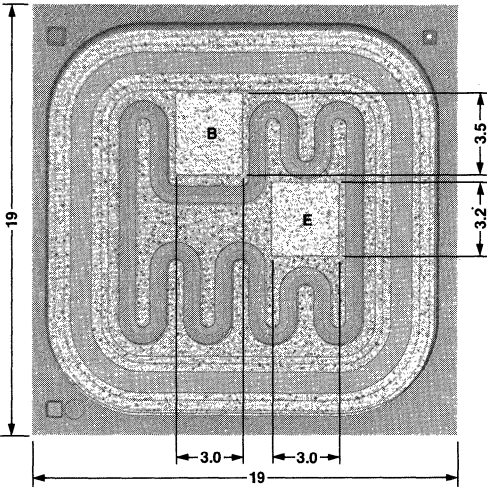
202 DIE



176 DIE

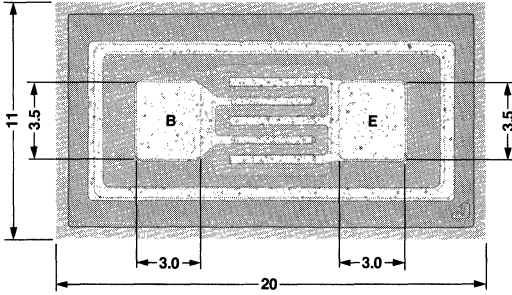


212 DIE

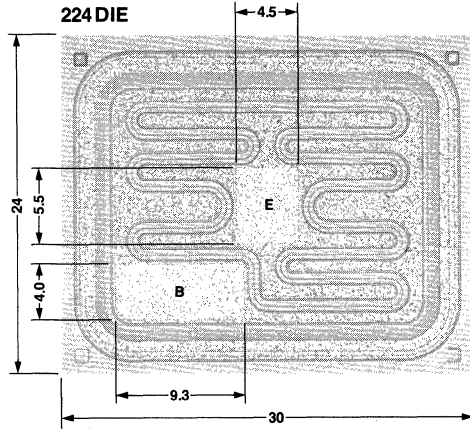


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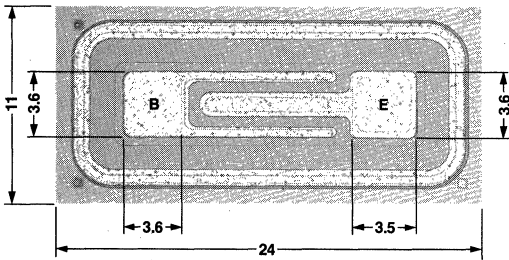
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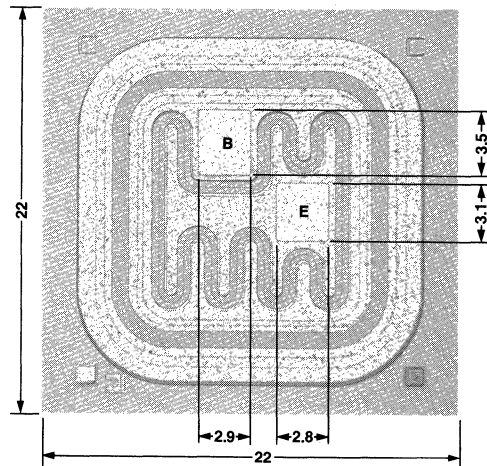
224 DIE



219 DIE

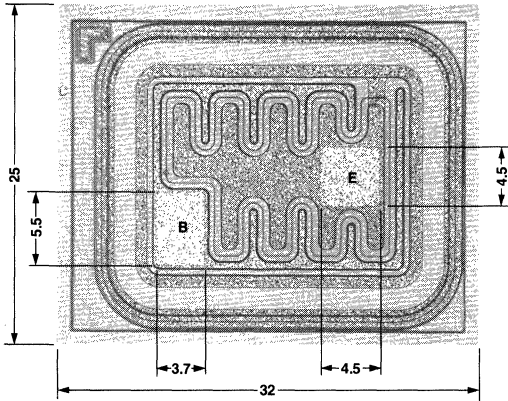


232 DIE

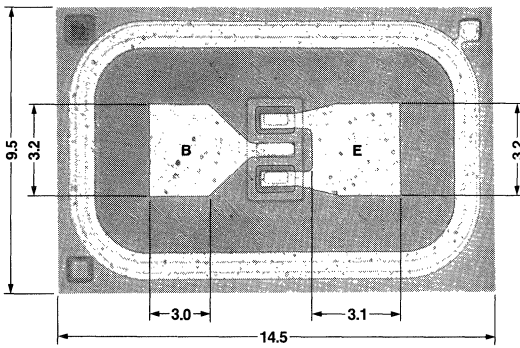


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276 DIE



292 DIE



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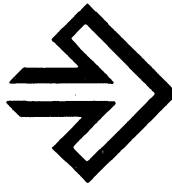
7

Dice and Wafer Information

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Field Sales Offices

9



Field Sales Offices United States and Canada

Alabama

Huntsville Office
555 Sparkman Drive, Suite 1030
Huntsville, Alabama 35805
Tel: 205-837-8960

Arizona

Phoenix Office
9201 N. 25th Ave., Suite 215
Phoenix, Arizona 95021
Tel: 602-943-2100 TWX: 910-950-0199

California

Auburn Office
320 Aeolia Drive
Auburn, California 95603
Tel: 916-823-6664

Costa Mesa Office
3505 Cadillac Avenue
Suite O-104
Costa Mesa, California 92626
Tel: 714-241-5600 TWX: 910-595-1109

Encino Office
Crocker Bank Bldg.
15760 Ventura Blvd., Suite 1027
Encino, California 91436
Tel: 818-990-9800 TWX: 910-495-1176

Mountain View Office
441 N. Whisman Road
Mountain View, California 94042
Tel: 415-962-8200 TWX: 910-338-0241

San Diego Office
4355 Ruffin Road, Suite 100
San Diego, California 92123
Tel: 619-560-1332

Colorado

Denver Office
10200 E. Girard, Suite 222, Bldg. B
Denver, Colorado 80231
Tel: 303-695-4927

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Woodbridge Office
131 Bradley Road
Woodbridge, Connecticut 06525
Tel: 203-397-5001

Florida

Altamonte Springs Office
Crane's Roost Office Park
399 Whooping Loop
Altamonte Springs, Florida 32701
Tel: 305-834-7000 TWX: 810-850-0152

Ft. Lauderdale Office
450 Fairway Dr., Suite 107
Deerfield Beach, Florida 33441
Tel: 305-485-7970 TWX: 510-995-4098

Georgia

Norcross Office
3220 Pointe Parkway, Suite 1200
Norcross, Georgia 30092
Tel: 404-441-2740 TWX: 810-766-4952

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500 Park Blvd., Suite 575
Itasca, Illinois 60143
Tel: 312-773-3133 TWX: 910-651-0120

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Indianapolis Office
7202 N. Shadeland, Room 205
Castle Point
Indianapolis, Indiana 46250
Tel: 317-849-5412 TWX: 810-260-1793

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Cedar Rapids Office
373 Collin Road N.E., Suite 200
Cedar Rapids, Iowa 52402
Tel: 319-395-0090

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Overland Park Office
8600 West 110th Street, Suite 209
Overland Park, Kansas 66210
Tel: 913-451-8374

Wichita Office
2400 Woodlawn, Suite 221
Wichita, Kansas 67220
Tel: 316-687-1111 TWX: 710-826-9654

Maryland

Columbia Office
2000 Century Plaza, Suite 114
Columbia, Maryland 21044
Tel: 301-730-1510 TWX: 710-826-9654

Massachusetts

Waltham Office
1432 Main Street
Waltham, Massachusetts 02154
Tel: 617-890-4000

Michigan

Farmington Hills Office
21999 Farmington Road
Farmington Hills, Michigan 48024
Tel: 313-478-7400 TWX: 810-242-2973

Minnesota

Minneapolis Office
3600 W. 80th Street, Suite 590
Bloomington, Minnesota 55431
Tel: 612-835-3322 TWX: 910-576-2944

New Jersey

New Jersey Office
Vreeland Plaza
41 Vreeland Avenue
Totowa, New Jersey 07512
Tel: 201-256-9011

New Mexico

Albuquerque Office
North Building
2900 Louisiana N.E., Suite D
Albuquerque, New Mexico 87110
Tel: 505-884-5601 TWX: 910-379-6435

New York

Endwell Office
3215 East Main Street
Endwell, New York 13760
Tel: 607-757-0200

Fairport Office
815 Ayrault Road
Fairport, New York 14450
Tel: 716-223-7700

Hauppauge Office
300 Wheeler Road, Suite 201
Hauppauge, New York 11788
Tel: 516-348-0900 TWX: 510-221-2183

Poughkeepsie Office
19 Davis Avenue
Poughkeepsie, New York 12603
Tel: 914-473-5730 TWX: 510-248-0030

North Carolina

Raleigh Office
5970-C Six Forks Road
Raleigh, North Carolina 27609
Tel: 919-848-2420

Ohio

Cleveland Office
6133 Rockside Road, Suite 407
Cleveland, Ohio 44131
Tel: 216-447-9700

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7250 Poe Avenue, Suite 260
Dayton, Ohio 45415
Tel: 216-890-5813

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Portland Office
6600 S.W. 92nd Ave., Suite 27
Portland, Oregon 97223
Tel: 503-244-6020 TWX: 910-467-7842

Pennsylvania

Willow Grove Office
Willow Wood Office Center
Suite 110
3901 Commerce Ave.
Willow Grove, Pennsylvania 19090
Tel: 215-657-2711

Texas

Austin Office
8240 Mopac Expressway, Suite 270
Austin, Texas 78759
Tel: 512-346-3990

Houston Office
9896 Bissonnet-2, Suite 470
Houston, Texas 77036
Tel: 713-771-3547 TWX: 910-881-8278

Richardson Office
1702 North Carolina Street, Suite 101
Richardson, Texas 75080
Tel: 214-234-3811 TWX: 910-867-4824

Sales Offices United States and Canada International

- Utah**
Salt Lake City Office
5282 S. 320 West, Suite D120
Salt Lake City, Utah 84107
Tel: 801-266-0773
- Washington**
Bellevue Office
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