LINEAR

INTEGRATED CIRCUITS

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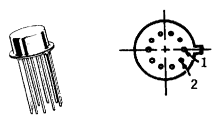
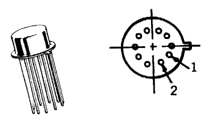
APPLICATION SELECTOR GUIDE

LINEAR integrated circuits offer the design engineer a variety of functions for analog applications. This line includes operational, differential, high frequency, power, and sense amplifiers with a broad selection of operating characteristics and packaging.

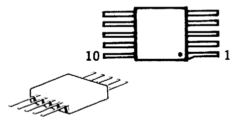
LINEAR IC PACKAGES



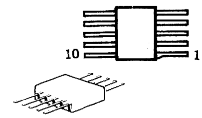
CASE 71 — 10 PIN
Suffix G after type number



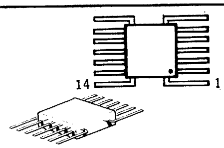
CASE 71A — 10 PIN
Suffix G after type number



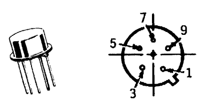
CASE 72 (TO-91)
Suffix F after type number



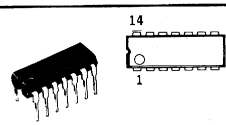
CASE 73
Suffix F after type number



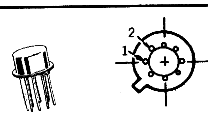
CASE 83 (TO-86)
Suffix F after type number



CASE 89 — 5 PIN
Suffix G after type number



CASE 93 (TO-116)
Suffix P after type number



CASE 96 — 8 PIN (TO-99)
Suffix G after type number

At a Glance

OPERATIONAL AMPLIFIERS

TYPE				Open Loop Voltage Gain (A_{VOL})	Output Voltage Swing (V_{out}, V_P)	Common Mode Rejection Ratio (CM_{rej}, dB)
Temperature Range						
−55 to +125°C	Case	0 to +75°C	Case			
MC1520	71A,72	–	–	1,500	± 4.0	−90
MC1530	71,72	MC1430	71,72,93	5,000	± 5.0	−75
MC1531	71,72	MC1431	71,72,93	3,500	± 5.0	−75
MC1533	71,72	MC1433	71,72,93	60,000*	± 12	−100
MC1535**	71,83	MC1435**	71,83,93	7,000	± 3.6	−90
–	–	MC1437**	93	45,000	± 14	−100
MC1539	96	MC1439	96	MC1539 120,000 MC1439 100,000	± 14	−100
MC1709	96,72	MC1709C	96,72,93	45,000	± 14	−90
MC1712	96,72	MC1712C	96,72,93	3,600	± 5.3	−100

*Adjustable **Dual

HIGH FREQUENCY AMPLIFIERS

TYPE	Temperature	Case	Small-Signal Voltage Gain (A_V, dB)	Bandwidth (MHz)	Noise Figure (dB)	Comments
MC1110	−55 to +125°C	89	26② @ 100 MHz	300②	4.0 @ 100 MHz	High stability through low internal feedback for RF-IF applications.
MC1509	−55 to +125°C	73	40	40	4.5μV(5Hz-10MHz)①	Ideal for wideband video applications.
MC1510	−55 to +125°C	73, 96	40	40	4.5μV(5Hz-10MHz)①	
MC1550	−55 to +125°C	71	26 @ 60 MHz	200②	5.0 @ 60 MHz	Constant input impedance over entire AGC range. RF-IF amplifier for communications equipment.
MC1552	−55 to +125°	71	34	40	5.0 @ 30 MHz	Three stage direct coupled common emitter cascade circuit with series feedback achieving extremely stable gain.
MC1553	−55 to +125°C	71	52	35	5.0 @ 30 MHz	Same as MC1552 except higher gain.

① Noise Voltage referred to input
② Useful transducer power gain

POWER AMPLIFIERS

TYPE	Temperature	Case	Output Power (W)	Voltage Gain (A_V, V/V)	Total Harmonic Distortion (%)	Comments
MC1524	−55 to +125°C	71	1.0	38	0.6	Complementary output, low standby current drain.
MC1554	−55 to +125°C	71	1.0	10,18,36	0.4	Capable of single or split supply operation.

DIFFERENTIAL AMPLIFIERS

TYPE	Temperature	Case	Differential Voltage Gain (A_{dd}, dB)	Output Voltage Swing (V_{out}, V_{p-p})	Common Mode Rejection (CM_{rej}, dB)	Differential Input Impedance (Z_{in}, kΩ)	Comments
MC1429	0 to +75°C	71	38	6.0	−75	40	Darlington inputs (high impedance).
MC1519	−55 to +125°C	71	73	14	−89	2.6	NPN inputs, PNP outputs, 1 MHz BW.
MC1525	−55 to +125°C	71	43	8.0	−85	3.0	Conventional differential inputs, high gain, built-in temperature compensated current source.
MC1526	−55 to +125°C	71	36	8.0	−85	70	Same as MC1525 except Darlington inputs.
MC1529	−55 to +125°C	71	38	6.0	−75	50	Same as MC1429—specified over full temperature range.

SENSE AMPLIFIERS

TYPE	Temperature	Case	Input Threshold (V_{th}, mVdc)	Voltage Gain (A_V, V/V)	Response Time (t_R, ns)	Comments
MC1440	0 to +75°C	71,72,93	17	85	50	Designed to detect bipolar differential signals derived by a core memory with cycle times as short as 0.5 µs.
MC1540	−55 to +125°C	71,72	17	85	30	
MC1541	−55 to +125°C	83	17	85	15	A dual-channel gated sense amplifier with separate wide band differential input amplifiers.
MC1710	−55 to +125°C	72,96	0	1700†	40	A differential comparator providing accuracy and fast response time.
MC1710C	0 to +75°C	72,96,93	0	1700†	40	Same as MC1710—specified over limited temperature range.
MC1711	−55 to +125°C	71A,72	0	1500†	40	A dual differential comparator providing accuracy and fast response time.
MC1711C	0 to +75°C	71A,72,93	0	1500†	40	Same as MC1711—specified over limited temperature range.

† Avol

STEREO PREAMPLIFIERS

TYPE	Temperature	Case	Open Loop Voltage Gain (A_{VOL})	Input Offset Voltage (mV)	Output Voltage Swing (V_{rms})	Channel Separation (dB)	Comments
MC1303	0 to +75°C	93	10,000	3.0	5.5	70	Two amplifiers on a single monolithic chip.

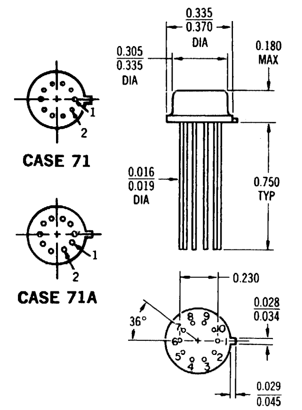
LINEAR IC SYMBOLS AND DEFINITIONS

A_{dd} Differential Voltage Gain (dB)
A_p Transducer Power Gain (dB)
A_V Voltage Gain (dB or V/V, as specified)
A_{VOL} Open Loop Voltage Gain (V/V)
$A_{V(s-s)}$ Single-Ended Voltage Gain (dB)
CM_{rej} Common Mode Rejection Ratio (dB)
CMV_{in} Input Common Mode Voltage Swing (V_{pk} or V_{p-p}, as specified)
TCV_{io} Temperature Coefficient of Input Offset Voltage (µV/°C)
TCV_{th} Threshold Voltage Temperature Coefficient (µV/°C)

THD Total Harmonic Distortion (%)
t_{pd} Propagation Delay Time (ns)
t_R Response Time (ns)
V_{io} Input Offset Voltage (mV)
V_{OH} Output Voltage, High (Vdc)
V_{OL} Output Voltage, Low (Vdc)
V_{out} Output Voltage Swing (V_{pk} or V_{p-p}, as specified)
V_{out} (CM) Common Mode Output Voltage (Vdc)
V_{out} (dc) DC Output Voltage (Vdc)
V_{th} Input Threshold Voltage (mVdc)

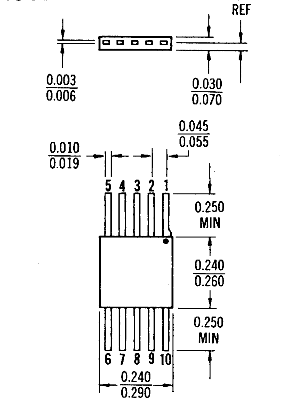
CASE 71, 71A

CASE 71A – PIN 10 UNDER TAB



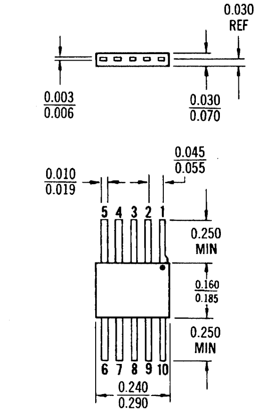
CASE 72 10-LEAD FLAT PACKAGE

TO-91



Lead 1 identified by color dot or by shoulder on lead. All leads electrically isolated from package.

CASE 73 10-LEAD FLAT PACKAGE

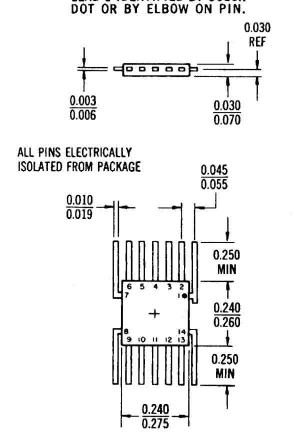


Lead 1 identified by color dot or by shoulder on lead. All leads electrically isolated from package.

CASE 83 14-LEAD FLAT PACKAGE

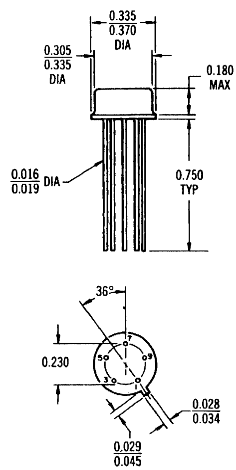
TO-86

LEAD 1 IDENTIFIED BY COLOR DOT OR BY ELBOW ON PIN.

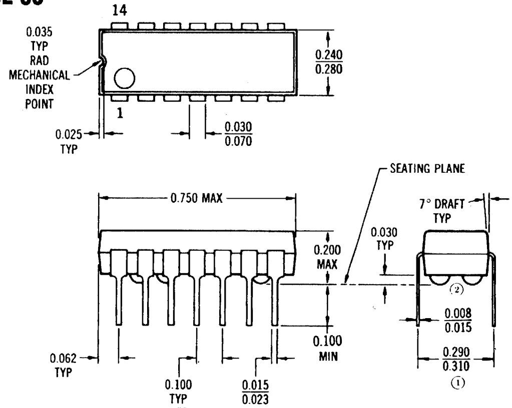


All dimensions are in inches

CASE 89

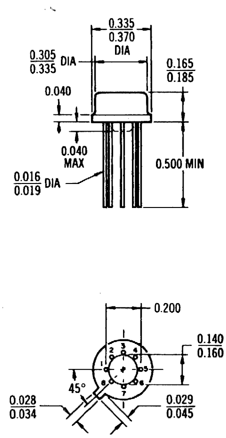


CASE 93 TO-116 PACKAGE



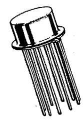
① This dimension is measured at the seating plane.
② 4 insulating stand-offs are provided.

CASE 96 TO-99 PACKAGE



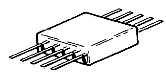
MC1430
MC1431

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

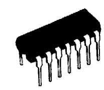


Lead 4 connected to case

CASE 71
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX



CASE 93
(TO-116)
"P" SUFFIX

Typical Amplifier Features:

- High Open Loop Gain — A_{VOL} = 74 dB typical
- Large Output Voltage Swing — Typically ±5.0 V @ ±6.0 V Supply
- Low Output Impedance — Z_{out} = 25 ohms typical
- High Slew Rate — Typically 4.5 V/μs

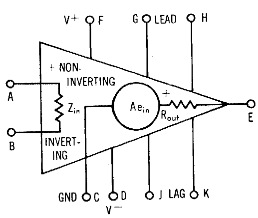


FIGURE 1 - EQUIVALENT CIRCUIT BOTH TYPES

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+	+8	Vdc
Power Supply Voltage	V^-	-8	Vdc
Differential Input Signal	V_{in}	±5	Volts
Load Current	I_L	10	mA
Power Dissipation (Package Limitation)	P_D		
Metal Can		680	mW
Derate above 25°C		4.6	mW/°C
Flat Package		500	mW
Derate above 25°C		3.3	mW/°C
Plastic Package		400	mW
Derate above 25°C		3.3	mW/°C
Operating Temperature Range*	T_A	0 to +75	°C
Storage Temperature Range	T_{stg}		°C
Metal Can and Flat Package		-55 to +150	
Plastic Package		-55 to +125	

*For full temperature range (-55°C to +125°C) see MC1530-MC1531 data sheet.

PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H	J	K
"F" & "G" Pkgs.	1	2	3	4	5	6	7	8	9	10
"P" Package	4	6	8	7	11	12	13	14	1	2

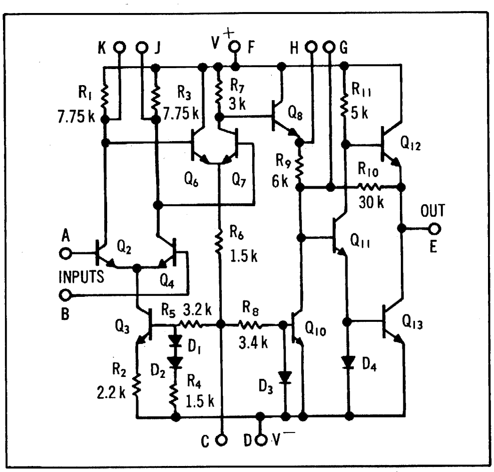


FIGURE 2 – MC1430 (STANDARD INPUT)

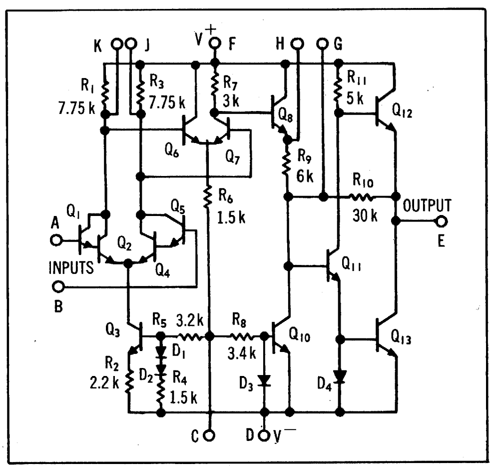
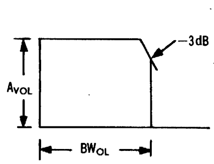
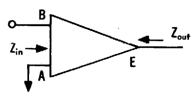
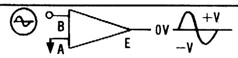
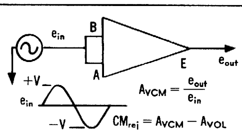
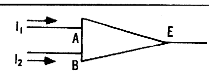
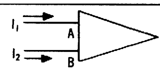
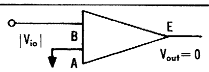


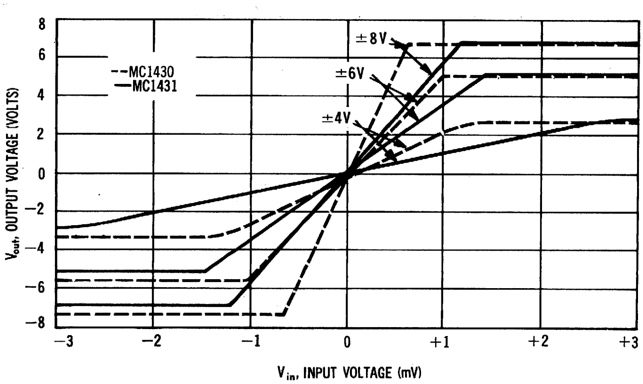
FIGURE 3 – MC1431 (DARLINGTON INPUT)

ELECTRICAL CHARACTERISTICS ($V^+ = +6$ Vdc, $V^- = -6$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions*	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain MC1430	A_{VOL}	69	74	—	dB
	MC1431		62	71	—	dB
	MC1430		3000	5000	—	V/V
	MC1431		1500	3500	—	V/V
	Open Loop Bandwidth (no roll-off capacitance) MC1430	BW_{OL}	1.0	1.2	—	MHz
	MC1431		0.15	0.4	—	
	Output Impedance (f = 20 Hz) MC1430, MC1431	Z_{out}	—	25	50	ohms
	Input Impedance (f = 20 Hz) MC1430	Z_{in}	5k	15k	—	ohms
	MC1431		300k	600k	—	
	Output Voltage Swing (1000 ohm Load) MC1430, MC1431	V_{out}	±4.0	±5.0	—	V_{peak}
	Input Common Mode Voltage Swing MC1430	CMV_{in}	±2.0	±2.5	—	V_{peak}
	MC1431		±2.0	±2.2	—	
	Common Mode Rejection Ratio MC1430	CM_{rej}	65	75	—	dB
	MC1431		60	75	—	
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$ MC1430	I_b	—	5	15	μA
	MC1431		—	0.1	0.3	
	Input Offset Current $I_{io} = I_1 - I_2$ MC1430	I_{io}	—	0.4	4	μA
	MC1431		—	0.01	0.1	
	Input Offset Voltage MC1430	$\|V_{io}\|$	—	2	10	mV
	MC1431		—	5	15	
	DC Power Dissipation (Power Supply = ±6 V, V_{out} = 0)	P_D	—	110	150	mW
	Input Offset Voltage +75°C MC1430	$\|V_{io}\|$	—	3.0	12.0	mV
	0°C		—	3.0	11.0	
	+75°C MC1431		—	6.0	18.0	
	0°C		—	6.0	16.5	

*All definitions imply linear operation (V_{io} = 0)

FIGURE 4 — NORMALIZED DC OPEN LOOP TRANSFER CHARACTERISTICS



RECOMMENDED OPERATING CONDITIONS

1. For High Slew Rate use Circuit A, Figure 9
2. For Minimum Noise use Circuit B, Figure 9
3. For operational stability Power Supply decoupling should be employed at all times.
4. Self Biasing network used to hold output voltage less than ±1 volt dc (quiescent)

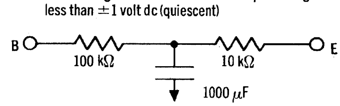


FIGURE 5 — VOLTAGE GAIN versus FREQUENCY

(Rolloff Applied To Output Amplifier) (Rolloff Applied To Input Differential Amplifier)

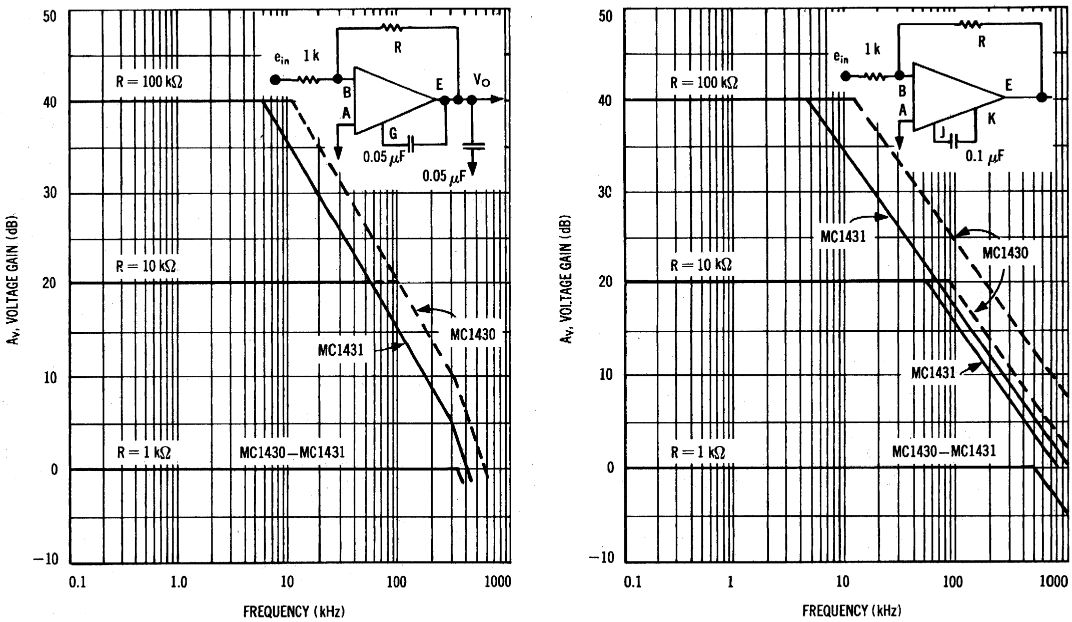


FIGURE 6 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY

(Rolloff Applied To Input Differential Amplifier)

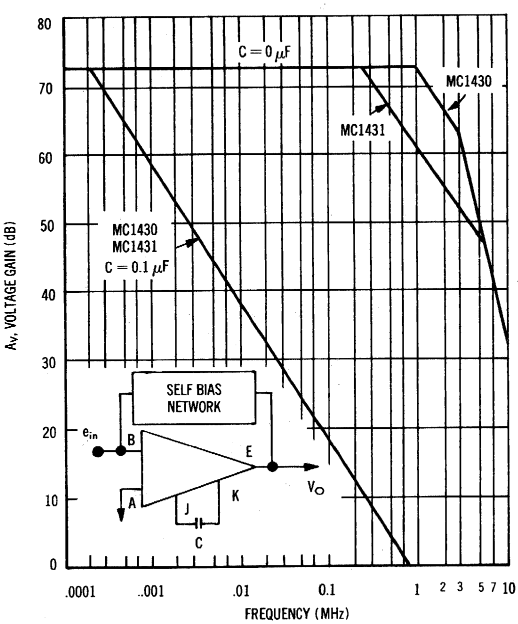


FIGURE 7 — VOLTAGE GAIN versus MINIMUM ROLLOFF CAPACITANCE

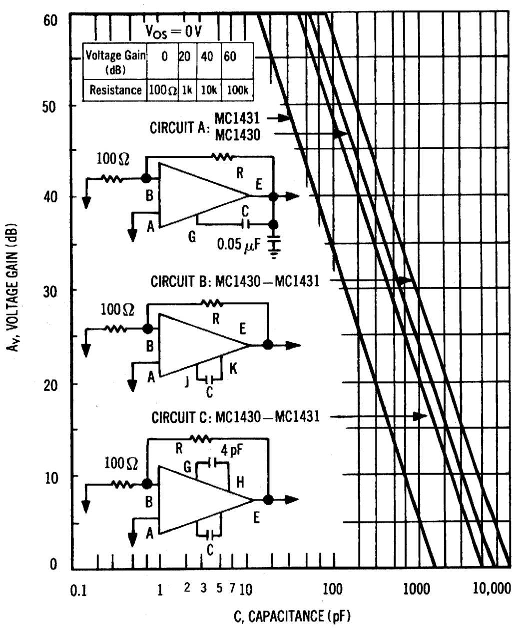


FIGURE 8 — MAXIMUM OUTPUT VOLTAGE SWING versus FREQUENCY

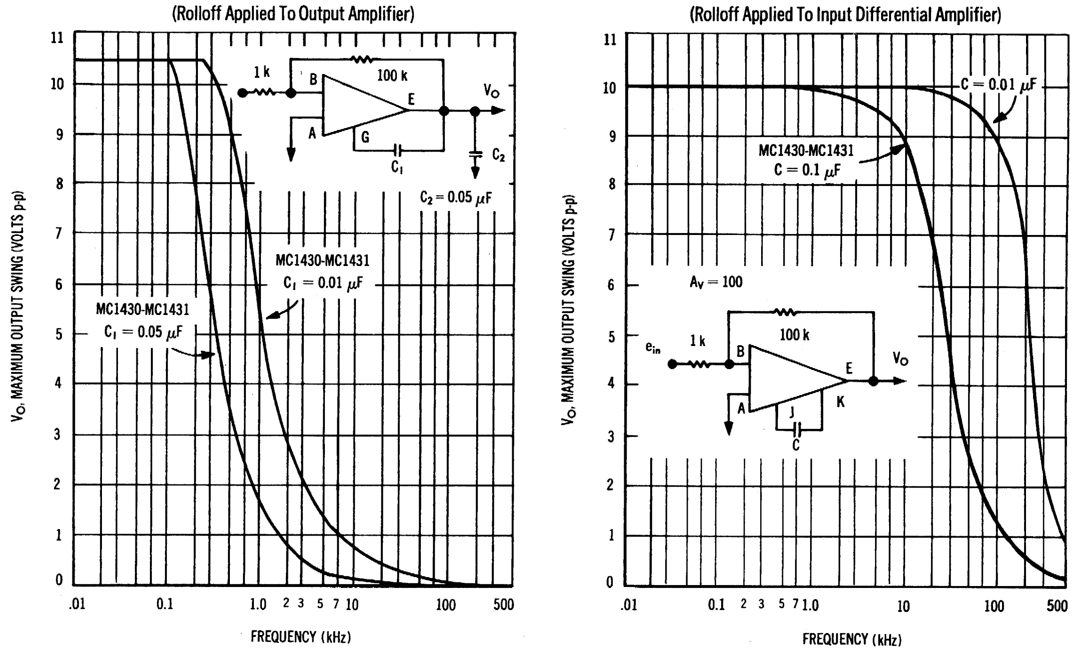


FIGURE 9 — SLEW RATE versus ROLLOFF CAPACITANCE

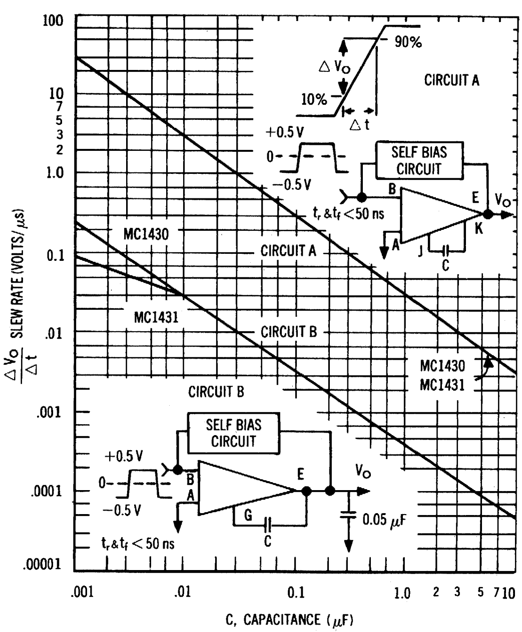
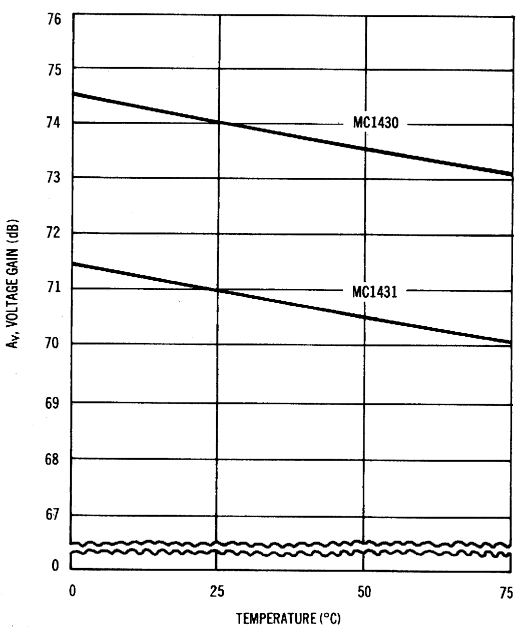
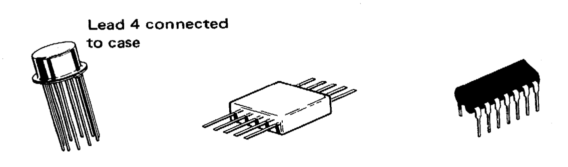


FIGURE 10 — OPEN LOOP VOLTAGE GAIN



MC1433



CASE 71 "G" SUFFIX	CASE 72 (TO-91) "F" SUFFIX	CASE 93 (TO-116) "P" SUFFIX

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

Typical Amplifier Features:

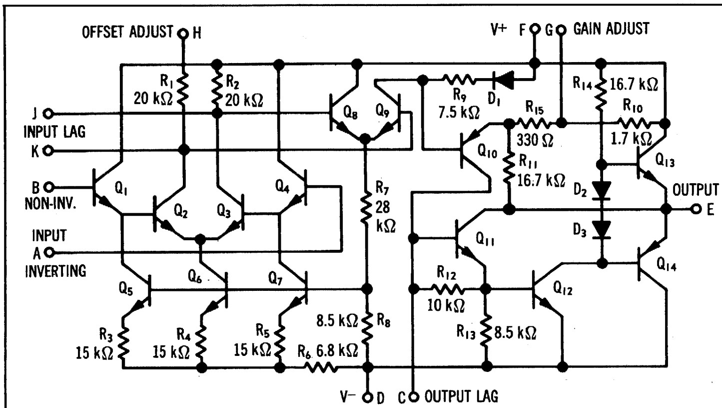
- High-Performance Open Loop Gain Characteristics
  A_{VOL} = 60,000 typical
- Low Temperature Drift — ±8.0 μV/°C
- Large Output Voltage Swing — ±13 V typical @ ±15 V Supply
- Low Output Impedance — Z_{out} = 100 ohms typical
- Input Offset Voltage Adjustable to Zero

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

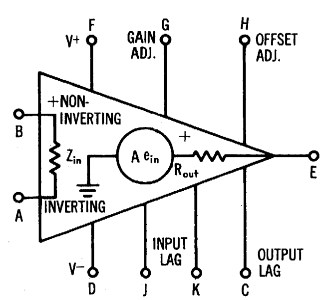
Rating	Symbol	Value	Unit
Power Supply Voltage	V+ V−	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	±10	Volts
Common Mode Input Swing	CMV_{in}	±V+	Volts
Load Current	I_L	10	mA
Output Short Circuit Duration	t_S	1.0	s
Power Dissipation (Package Limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range*	T_A	0 to +75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

*For full temperature range (-55°C to +125°C) and characteristic curves, see MC1533 data sheet.

CIRCUIT SCHEMATIC



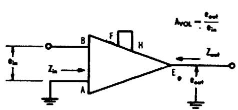
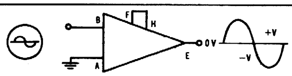
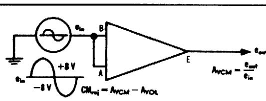
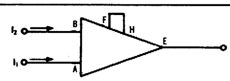
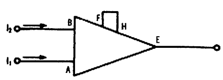
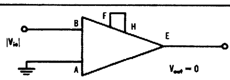
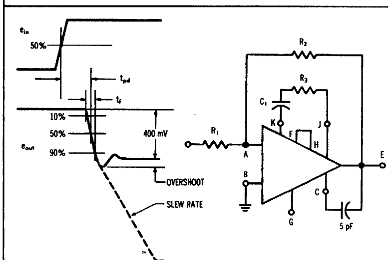
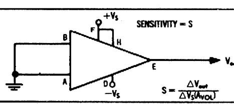
EQUIVALENT CIRCUIT



PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H	J	K
"G" Package	1	2	3	4	5	6	7	8	9	10
"F" Package	10	1	2	3	4	5	6	7	8	9
"P" Package	4	5	6	7	11	12	13	14	2	3

ELECTRICAL CHARACTERISTICS ($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions[1]	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (V @ Pin G = +15 Vdc) (Pin G open) (V @ Pin G = +15 Vdc, $T_A = 0^oC, +75^oC$) (Pin G open, $T_A = 0^oC, +75^oC$)	A_{VOL}	 30,000 10,000 20,000 5,000	 60,000 30,000 50,000 25,000	 - - - -	-
	Output Impedance (Pin G open, f = 20 Hz)	Z_{out}	-	100	150	Ω
	Input Impedance (Pin G open, f = 20 Hz)	Z_{in}	300	600	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ) (R_L = 2 kΩ)	V_{out}	 ±12 ±10	 ±13 ±12	 - -	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	±8	±9	-	V_{peak}
	Common Mode Rejection Ratio (V @ Pin G = +15 Vdc) (Pin G open)	CM_{rej}	 80 70	 100 94	 - -	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A = +25^oC$) ($T_A = 0^oC$)	I_b	 - -	 0.5 -	 2.0 4.0	µA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, $T_A = 0^oC$) ($I_{io} = I_1 - I_2$, $T_A = +75^oC$)	I_{io}	 - - -	 0.1 - -	 0.50 0.75 0.75	µA
	Input Offset Voltage [2] ($T_A = 25^oC$) ($T_A = 0^oC, +75^oC$)	V_{io}	 - -	 1.0 -	 7.5 10.0	mV
	Step Response Gain = 100, 15% overshoot, R_1 = 1 kΩ, R_2 = 100 kΩ, R_3 = 100 Ω, C_1 = 0.02 µF	 t_f t_{pd} dV_{out}/dt [3]	 - - -	 0.15 0.06 11.0	 - - -	 µs µs V/µs
	Gain = 10, no overshoot, R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 10 Ω, C_1 = 0.05 µF	t_f t_{pd} dV_{out}/dt [3]	- - -	0.3 0.1 1.5	- - -	µs µs V/µs
	Gain = 1, 20% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5 Ω, C_1 = 0.1 µF	t_f t_{pd} dV_{out}/dt [3]	- - -	0.2 0.3 0.8	- - -	µs µs V/µs
	Average Temperature Coefficient of Input Offset Voltage ($T_A = 0^oC$ to $+25^oC$) ($T_A = +25^oC$ to $+75^oC$)	TC_{Vio}	 - -	 10 8	 - -	$\mu V/^oC$
	Average Temperature Coefficient of Input Offset Current ($T_A = 0^oC$ to $+25^oC$) ($T_A = +25^oC$ to $+75^oC$)	TC_{Iio}	 - -	 0.1 0.05	 - -	$nA/^oC$
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	125	240	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	200	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	50	200	µV/V

① All definitions imply linear operation

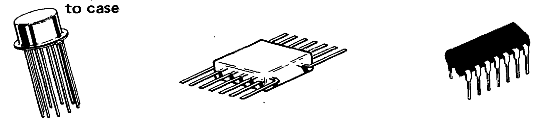
② Input offset voltage (V_{io}) may be adjusted to zero by varying the potential on pin H

③ dV_{out}/dt = Slew Rate

MC1435

. . . designed for use as summing amplifiers, integrators, or amplifiers with operating characteristics as a function of the external feedback components. Ideal for chopper stabilized applications where extremely high gain is required with excellent stability.

Lead 1 connected to case



CASE 71 "G" SUFFIX | CASE 83 (TO-86) "F" SUFFIX | CASE 93 (TO-116) "P" SUFFIX

Typical Amplifier Features:

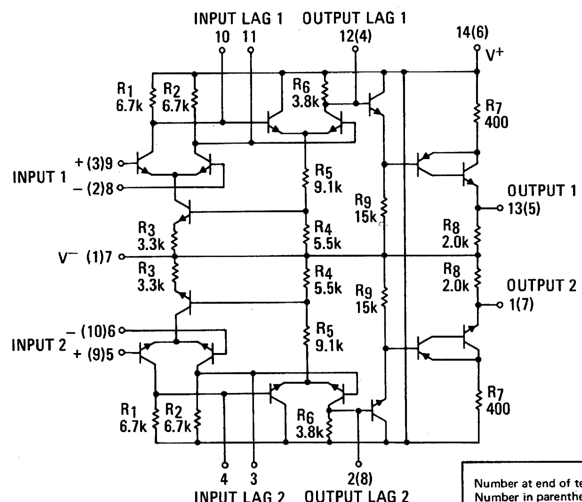
- High Open Loop Gain Characteristics — A_{VOL} = 7,000 typical
- Low Temperature Drift — ±10 μV/°C
- Large Output Voltage Swing — ±3.6 V typ @ ±6.0 V supply
- Low Input Offset Voltage — 1.0 mV
- Low Input Noise Voltage — 0.5 μV

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

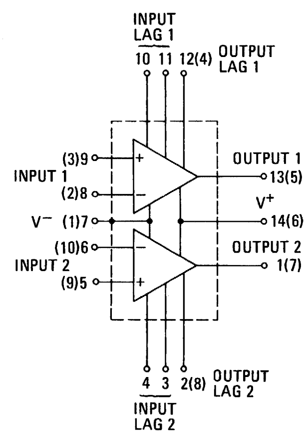
Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+9.0 -9.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	+5.0 -4.0	Volts
Output Short Circuit Duration	t_S	Continuous	
Power Dissipation (package limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range*	T_A	0 to + 75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

*For full temperature range (-55°C to +125°C) and characteristic curves, see MC1535 data sheet.

CIRCUIT SCHEMATIC

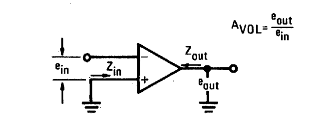
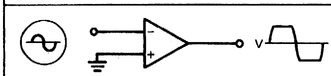
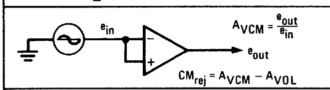
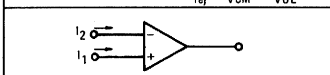
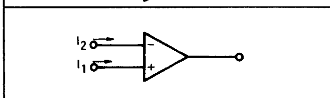
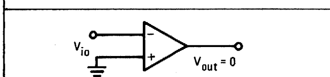
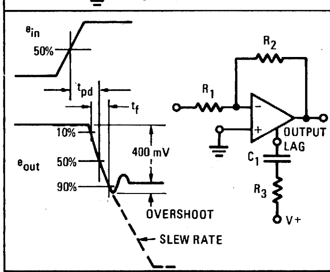
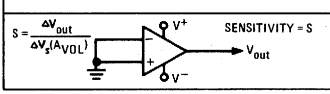


EQUIVALENT CIRCUIT



Number at end of terminal is pin number for both flat and plastic packages. Number in parenthesis is pin number for metal can package. Input lag available in flat and plastic packages.

ELECTRICAL CHARACTERISTICS (Each Amplifier) (V^+ = +6.0Vdc, V^- = −6.0Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operations)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (T_A = 0°C to +75°C)	A_{VOL}	3,500	7,000	-	V/V
			71	77	-	dB
	Output Impedance (f = 20 Hz)	Z_{out}	-	1.7	-	kΩ
	Input Impedance (f = 20 Hz)	Z_{in}	10	45	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	5.0	7.0	-	V_{p-p}
	Input Common Mode Voltage Swing	CMV_{in}	+3.0	+3.9	-	V_{peak}
			-2.0	-2.7	-	
	Common Mode Rejection Ratio	CM_{rej}	60	90	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C)	I_b	-	1.2	5.0	µA
	(T_A = 0°C)		-	3.6	10	
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}	-	0.05	0.5	µA
	($I_{io} = I_1 - I_2$, T_A = 0°C)		-	-	1.5	
	($I_{io} = I_1 - I_2$, T_A = +75°C)		-	-	1.5	
	Input Offset Voltage (T_A = 25°C) R_S = 50Ω	V_{io}	-	1.0	5.0	mV
	(T_A = 0°C to + 75°C)		-	-	7.5	
	Step Response: Gain = 100, 30% overshoot, R_1 = 4.7 kΩ, R_2 = 470 kΩ, R_3 = 150 Ω, C_1 = 1,000 pF	t_f	-	0.8	-	µs
		t_{pd}	-	0.1	-	µs
		dV_{out}/dt ①	-	7.0	-	V/µs
	Gain = 10, 10% overshoot, R_1 = 47 kΩ, R_2 = 470 kΩ, R_3 = 47 Ω, C_1 = 0.01 µF	t_f	-	0.4	-	µs
		t_{pd}	-	0.3	-	µs
		dV_{out}/dt ①	-	4.0	-	V/µs
	Gain = 1, 5% overshoot, R_1 = 47 kΩ, R_2 = 47 kΩ, R_3 = 4.7 Ω, C_1 = 0.1 µF	t_f	-	0.5	-	µs
		t_{pd}	-	0.25	-	µs
		dV_{out}/dt ①	-	0.67	-	V/µs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = 0°C to +75°C)	TC_{Vio}	-	3.0	-	µV/°C
	Average Temperature Coefficient of Input Offset Current (T_A = 0°C to +75°C)	TC_{Iio}		2.0		nA/°C
	DC Power Dissipation (Power Supply = ± 6.0 V, V_{out} = 0)	P_D	-	100	180	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	-	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	100	-	µV/V

MATCHING CHARACTERISTICS

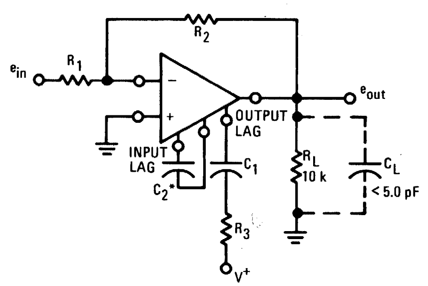
Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
Same characteristic definitions as shown for each amplifier above.	Open Loop Voltage Gain	$A_{VOL1}-A_{VOL2}$	-	±1.0	-	dB
	Input Bias Current	$I_{b1}-I_{b2}$	-	±0.15	-	µA
	Input Offset Current	$I_{io1}-I_{io2}$	-	±0.02	-	µA
	Average Temperature Coefficient	$TC_{Iio1}-TC_{Iio2}$		±0.1		nA/°C
	Input Offset Voltage	$V_{io1}-V_{io2}$	-	±0.1	-	mV
	Average Temperature Coefficient	$TC_{Vio1}-TC_{Io2}$		±0.5		µV/°C
	Channel Separation (See Fig. 10) (f = 10 kHz)	$\frac{e_{out\ 1}}{e_{out\ 2}}$	-	-60	-	dB

① dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

$V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, $T_A = 25°C$

FIGURE 1 – TEST CIRCUIT



*MC1435 F and P only.

FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS $R_1 (\Omega)$	$R_2 (\Omega)$	C_1 (pF)	$R_3 (\Omega)$	C_2 (pF)	OUTPUT NOISE (mV rms)
2	1	100	4.7 k	470 k	1,000	150	0	1.7
	1A	or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
	2A	or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
	3A	or 1	47 k	47 k	0	∞	50,000	0.46
3	1	100	4.7 k	470 k	1,000	150	0	1.7
		or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
		or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
		or 1	47 k	47 k	0	∞	50,000	0.46
4	1	A_{VOL}	100	∞	1,000	150	0	8.1
		or A_{VOL}	100	∞	0	∞	510	8.1
	2	A_{VOL}	100	∞	10,000	47	0	5.5
		or A_{VOL}	100	∞	0	∞	5,000	5.5
	3	A_{VOL}	100	∞	100,000	4.7	0	4.4
		or A_{VOL}	100	∞	0	∞	50,000	4.4

FIGURE 2 – LARGE SIGNAL SWING versus FREQUENCY

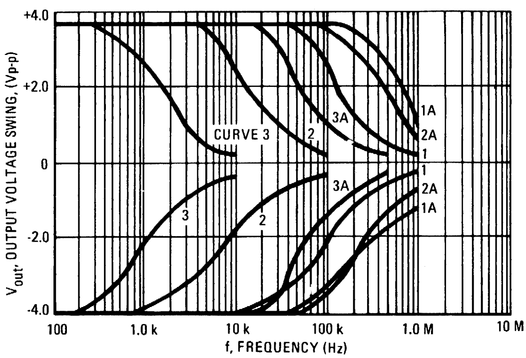


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

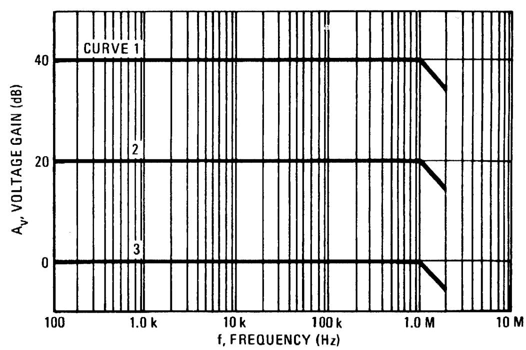


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

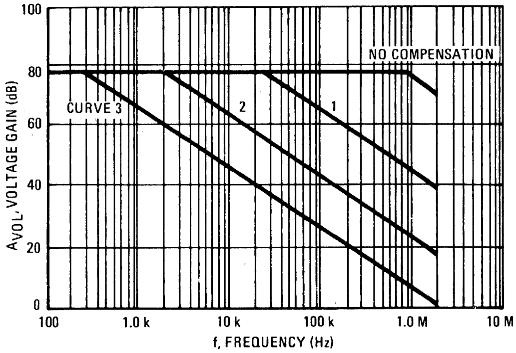


FIGURE 5 – INPUT OFFSET VOLTAGE versus TEMPERATURE

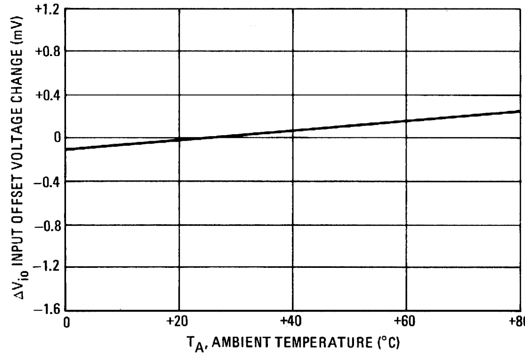


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

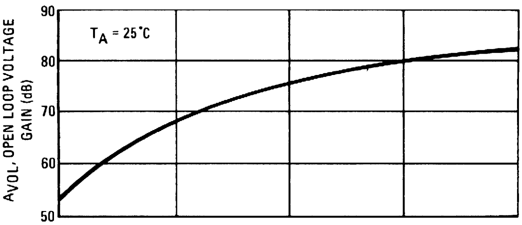


FIGURE 1 – COMMON MODE SWING versus POWER SUPPLY VOLTAGE

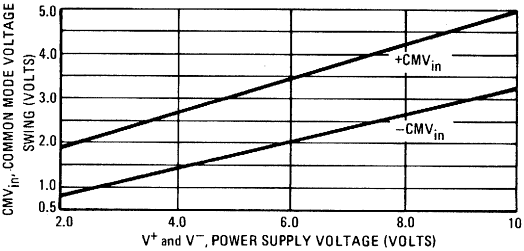


FIGURE 8 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

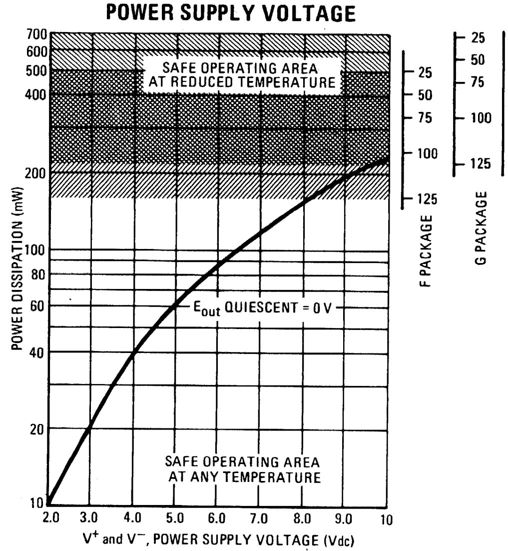


FIGURE 9 – OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE

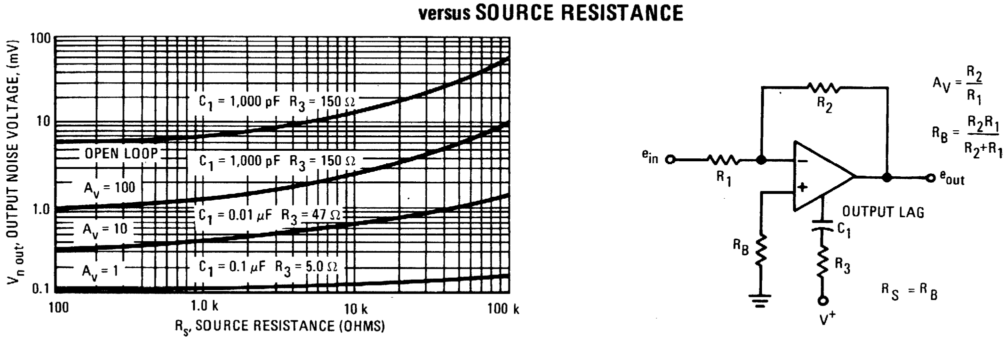
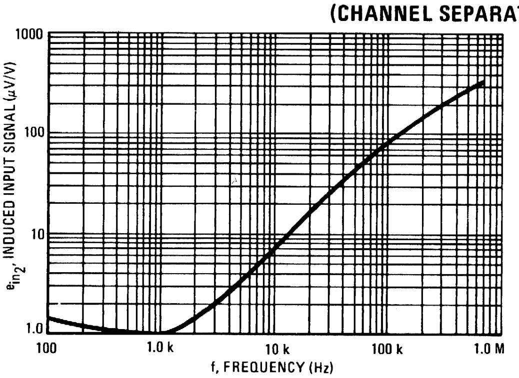
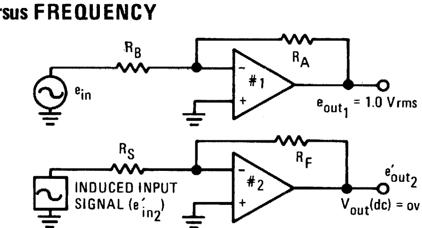


FIGURE 10 – INDUCED INPUT SIGNAL (CHANNEL SEPARATION) versus FREQUENCY





Induced input signal (μV of induced input signal in amplifier #2 per volt of output signal at amplifier #1)

$e'_{out_2} = e'_{in_2} \times \frac{R_F}{R_S}$, where e'_{out_2} is the component of e_{out_2} due only to lack of perfect separation between the two amplifiers.

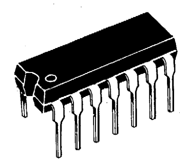
MC1437P

(DUAL MC1709CP)

. . . designed for use as summing amplifiers, integrators, or amplifiers with operating characteristics as a function of the external feedback components. Ideal for chopper stabilized applications where extremely high gain is required with excellent stability.

Typical Amplifier Features:

- High-Performance Open Loop Gain Characteristics A_{VOL} = 45,000 typical
- Low Temperature Drift – ±3.0 μV/°C
- Large Output Voltage Swing – ±14 V typical @ ±15 V Supply
- Low Output Impedance – Z_{out} = 30 ohms typical

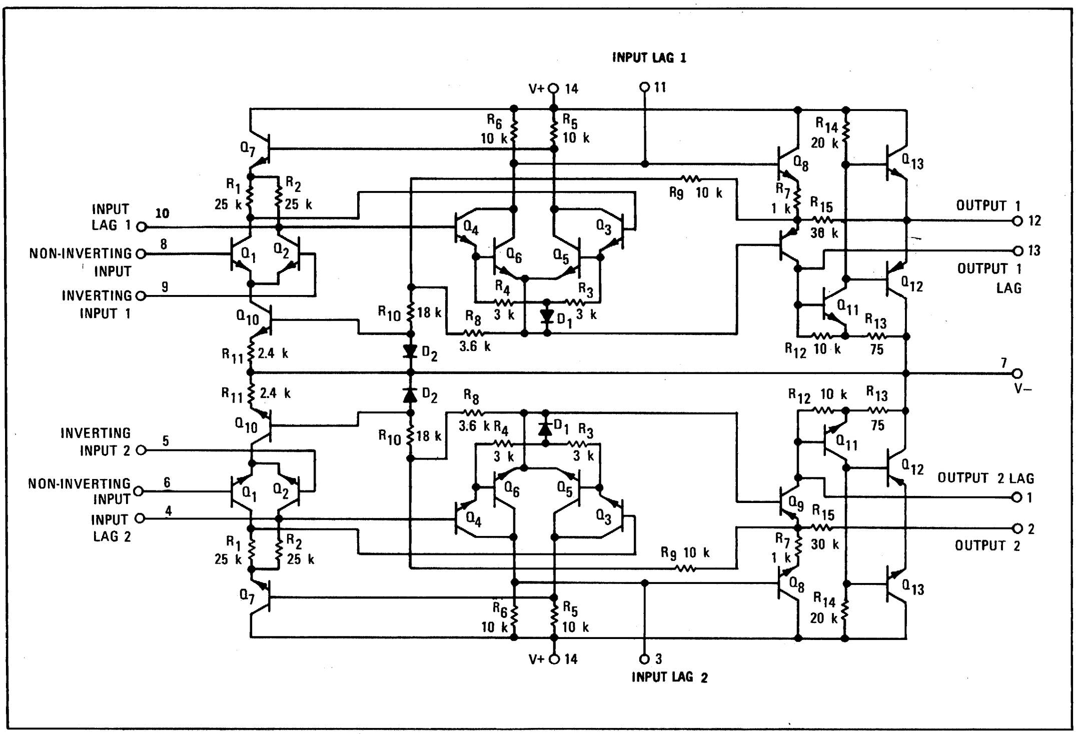


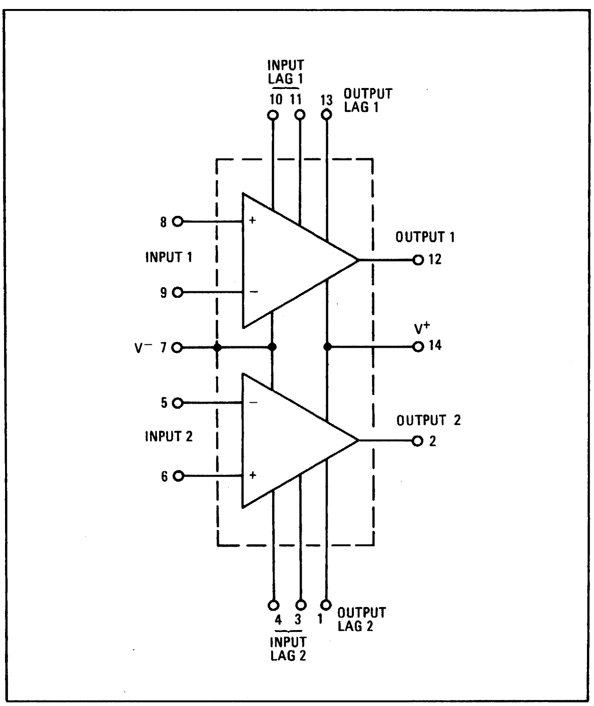
CASE 93
(TO-116)
"P" SUFFIX

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Output Short Circuit Duration	t_s	5.0	s
Power Dissipation (Package Limitation) Plastic Package Derate above 25° C	P_D	 415 3.3	 mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C
Storage Temperature Range Plastic Package	T_{stg}	 -65 to +125	°C

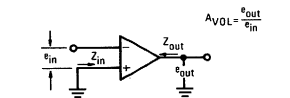
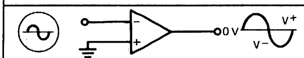
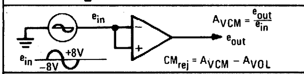
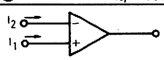
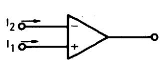
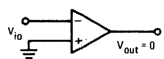
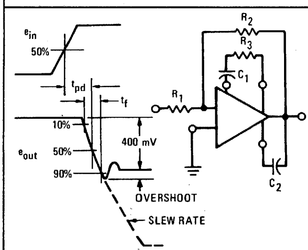
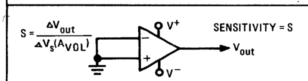
CIRCUIT SCHEMATIC





EQUIVALENT CIRCUIT

ELECTRICAL CHARACTERISTICS (each amplifier)
(V+ = +15 Vdc, V− = −15 Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operation)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (R_L = 5.0 kΩ, V_{out} = ±10 V, T_A = 0°C to +75°C)	A_{VOL}	15,000	45,000	-	-
	Output Impedance (f = 20 Hz)	Z_{out}	-	30	-	Ω
	Input Impedance (f = 20 Hz)	Z_{in}	50	150	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	±12	±14	-	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	±8.0	±10	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	65	100	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C)	I_b	-	0.4	1.5	μA
	(T_A = 0°C)		-	-	2.0	
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}	-	0.05	0.5	μA
	($I_{io} = I_1 - I_2$, T_A = 0°C)		-	-	0.75	
	($I_{io} = I_1 - I_2$, T_A = +75°C)		-	-	0.75	
	Input Offset Voltage (T_A = 25°C)	V_{io}	-	1.0	7.5	mV
	(T_A = 0°C, +75°C)		-	-	10	
	Step Response (Gain = 100, 5% overshoot, R_1 = 1 kΩ, R_2 = 100 kΩ, R_3 = 1.5 kΩ, C_1 = 100 pF, C_2 = 3.0 pF)	t_f	-	0.8	-	μs
		t_{pd}	-	0.38	-	μs
		dV_{out}/dt ①	-	12	-	V/μs
	(Gain = 10, 10% overshoot, R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 500 pF, C_2 = 20 pF)	t_f	-	0.6	-	μs
		t_{pd}	-	0.34	-	μs
		dV_{out}/dt ①	-	1.7	-	V/μs
	(Gain = 1, 5% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 5000 pF, C_2 = 200 pF)	t_f	-	2.2	-	μs
		t_{pd}	-	1.3	-	μs
		dV_{out}/dt ①	-	0.25	-	V/μs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = 0°C to +75°C)	TC_{Vio}	-	1.5	-	μV/°C
	(R_S ≦ 10 kΩ, T_A = 0°C to +75°C)		-	3.0	-	
	Average Temperature Coefficient of Input Offset Current (T_A = 0° to +25°C)	TC_{Iio}	-	0.7	-	nA/°C
	(T_A = +25°C to +75°C)		-	0.7	-	
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	150	225	mW
	Positive Supply Sensitivity (V− constant)	S^+	-	10	200	μV/V
	Negative Supply Sensitivity (V+ constant)	S^-	-	10	200	μV/V

① dV_{out}/dt = Slew Rate

MATCHING CHARACTERISTICS

	Characteristic	Symbol	Min	Typ	Max	Unit
Same characteristic definitions as shown for each amplifier above.	Open Loop Voltage Gain	$A_{VOL1}-A_{VOL2}$	-	±1.0	-	dB
	Input Bias Current	$I_{b1}-I_{b2}$	-	±0.15	-	μA
	Input Offset Current	$I_{io1}-I_{io2}$	-	±0.02	-	μA
	Average Temperature Coefficient	$TC_{Iio1}-TC_{Iio2}$	-	±0.2		nA/°C
	Input Offset Voltage	$V_{io1}-V_{io2}$	-	±0.2	-	mV
	Average Temperature Coefficient	$TC_{Vio1}-TC_{Io2}$		±0.5		μV/°C
	Channel Separation (f = 10 kHz)	$\frac{e_{out\ 1}}{e_{out\ 2}}$	-	90	-	dB

TYPICAL OUTPUT CHARACTERISTICS

FIGURE 1–TEST CIRCUIT
$V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25^oC$

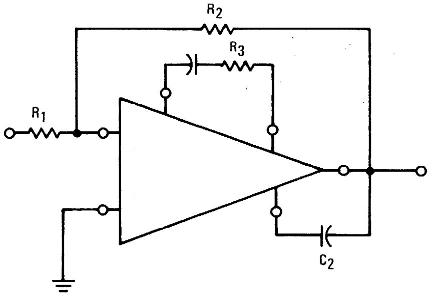


FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS $R_1(\Omega)$	$R_2(\Omega)$	$R_3(\Omega)$	C_1(pF)	C_2(pF)	OUTPUT NOISE (mV rms)
2	1	1	10 k	10 k	1.5 k	5.0 k	200	0.10
	2	10	10 k	100 k	1.5 k	500	20	0.14
	3	100	10 k	1.0 M	1.5 k	100	3.0	0.7
	4	1000	1.0 k	1.0 M	0	10	3.0	5.2
3	1	1	10 k	10 k	1.5 k	5.0 k	200	0.10
	2	10	10 k	100 k	1.5 k	500	20	0.14
	3	100	10 k	1.0 M	1.5 k	100	3.0	0.7
	4	1000	1.0 k	1.0 M	0	10	3.0	5.2
4	1	A_{VOL}	0	∞	1.5 k	5.0 k	200	5.5
	2	A_{VOL}	0	∞	1.5 k	500	20	10.5
	3	A_{VOL}	0	∞	1.5 k	100	3.0	21.0
	4	A_{VOL}	0	∞	0	10	3.0	39.0
	5	A_{VOL}	0	∞	∞	0	3.0	—

FIGURE 2–LARGE SIGNAL SWING versus FREQUENCY

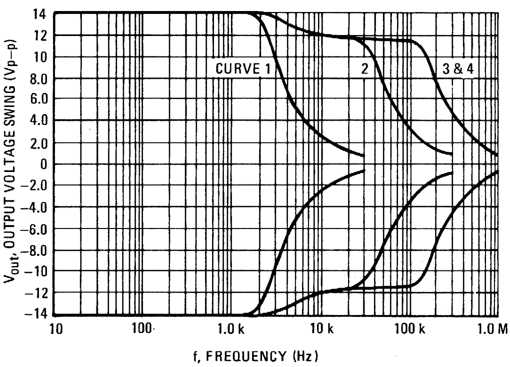


FIGURE 3–VOLTAGE GAIN versus FREQUENCY

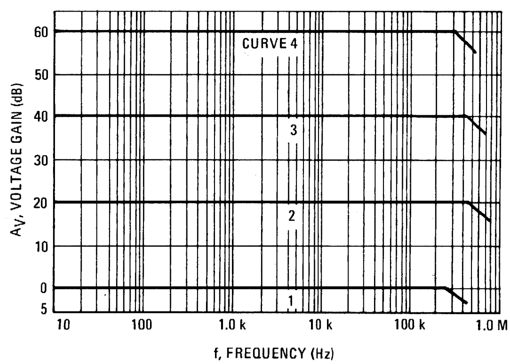


FIGURE 4–OPEN LOOP VOLTAGE GAIN versus FREQUENCY

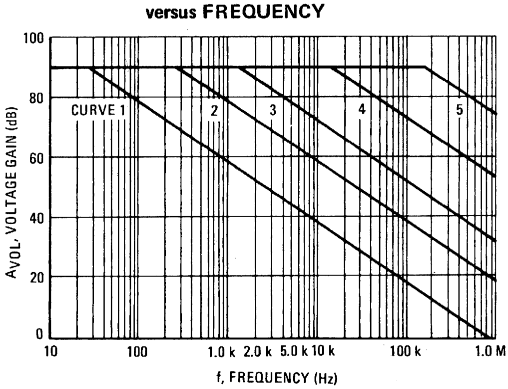


FIGURE 5–POWER DISSIPATION versus POWER SUPPLY VOLTAGE

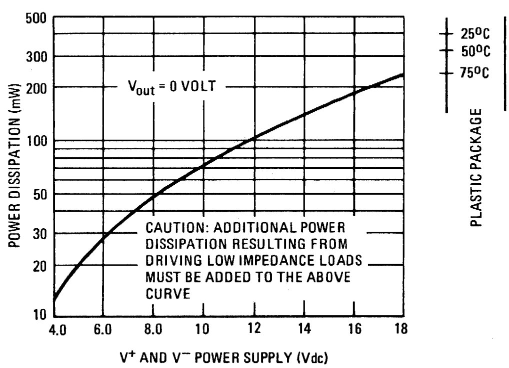


FIGURE 6—VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

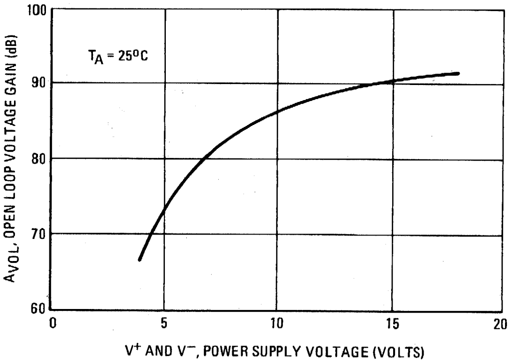


FIGURE 7—COMMON SWING versus POWER SUPPLY VOLTAGE

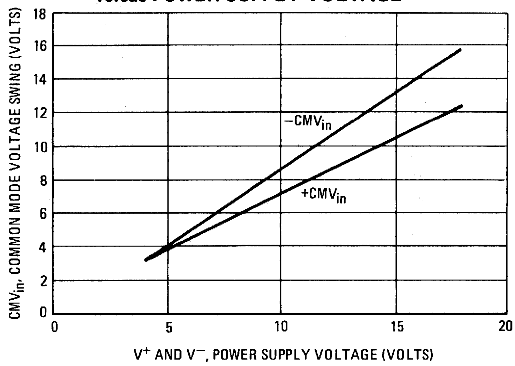


FIGURE 8—INPUT OFFSET VOLTAGE versus TEMPERATURE

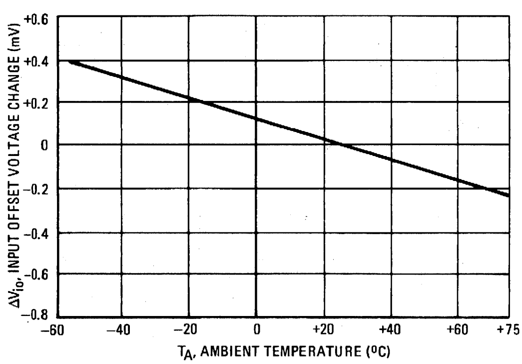


FIGURE 9—OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE

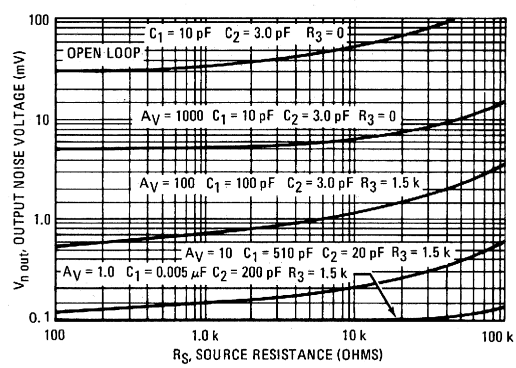
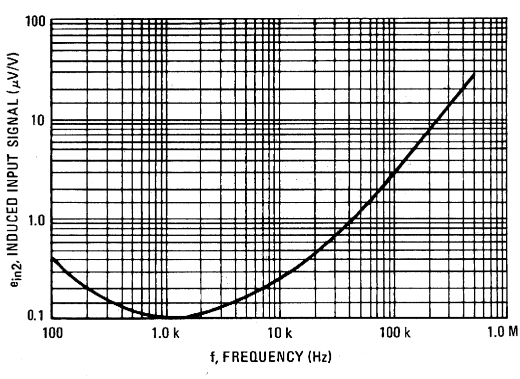
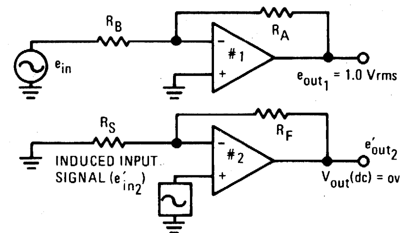


FIGURE 10—INDUCED INPUT SIGNAL (CHANNEL SEPARATION) versus FREQUENCY





Induced input signal (μV of induced input signal in amplifier #2 per volt of output signal at amplifier #1)

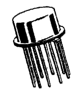
$e'_{out\,2} = e'_{in_2}\,(1 + \frac{R_F}{R_S})$, where e'_{out_2} is the component of e_{out_2} due only to lack of perfect separation between the two amplifiers.

MC1439G

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

Typical Amplifier Features:

- Low Input Offset Voltage — 2.0 mV typ
- Low Input Offset Current — 100 nA max
- Large Power-Bandwidth — 20 V_{p-p} Output Swing at 10 kHz min
- Output Short-Circuit Protection
- Input Over-Voltage Protection
- Class AB Output for Excellent Linearity
- Slew Rate — 34 V/μs typ



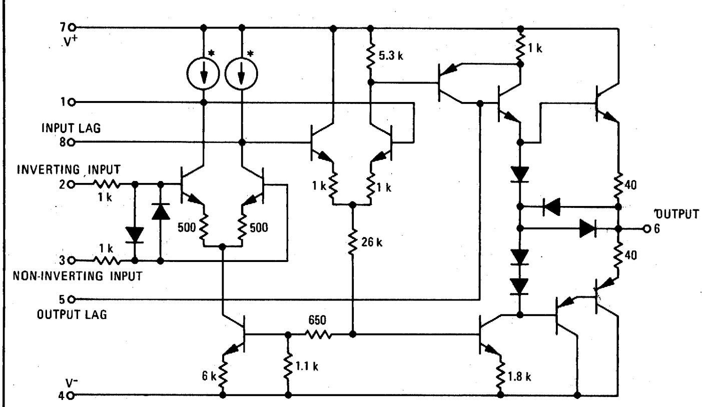
Lead 4 connected to case

CASE 96
(TO-99)
"G" SUFFIX

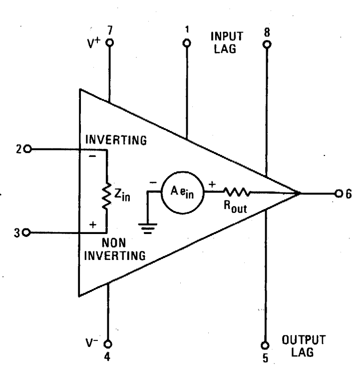
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	$\pm V^+$	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Load Current	I_L	15	mA
Output Short Circuit Duration	t_S	Continuous	
Power Dissipation (Package Limitation) Derate above 25°C	P_D	680 4.6	mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC

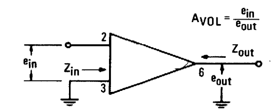
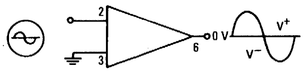
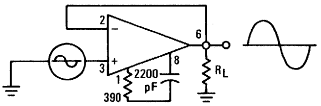
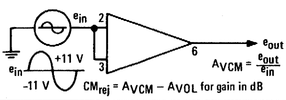
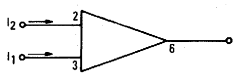
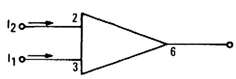
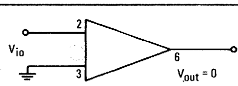
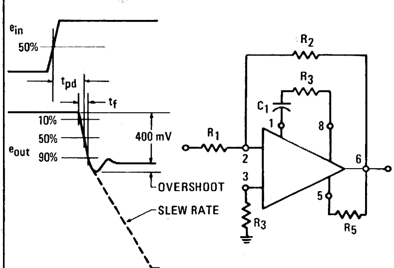
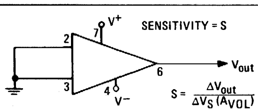


EQUIVALENT CIRCUIT



*PATENT PENDING

ELECTRICAL CHARACTERISTICS (V^+ = +15 Vdc, V^- = −15 Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operation)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (R_L = 2.0 kΩ, V_{out} = ±10 V, T_A = 0°C to +75°C)	A_{VOL}	15,000	100,000	-	-
	Output Impedance (f = 20 Hz)	Z_{out}	-	4.0	-	kΩ
	Input Impedance (f = 20 Hz)	Z_{in}	100	300	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	±12	±14	-	V_{peak}
	(R_L = 2.0 kΩ)		±10	±13	-	
	Power Bandwidth (A_v = 1, R_L = 2.0 kΩ, THD ≦ 5%, V_o = 20 V_{p-p})	P_{BW}	10	50	-	kHz
	Input Common Mode Voltage Swing	CMV_{in}	±11	±12	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	80	100	-	dB
	Input Bias Current $I_b = \frac{I_1 + I_2}{2}$, ($T_A$ = +25°C)	I_b	-	0.20	1.0	μA
	(T_A = 0°C)		-	0.23	1.5	
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}	-	20	100	nA
	($I_{io} = I_1 - I_2$, T_A = 0°C)		-	-	150	
	($I_{io} = I_1 - I_2$, T_A = +75°C)		-	-	150	
	Input Offset Voltage (T_A = 25°C)	V_{io}	-	2.0	7.5	mV
	(T_A = 0°C, +75°C)		-	-	10	
	Step Response (Gain = 100, no overshoot, R_1 = 1.0 kΩ, R_2 = 100 kΩ, R_3 = 1.0 kΩ, R_4 = 10 kΩ, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	700 100 34	- - -	ns ns V/μs
	(Gain = 100, no overshoot, R_1 = 1.0 kΩ, R_2 = 100 kΩ, R_3 = 1.0 kΩ, R_4 = 10 kΩ, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	700 100 1.7	- - -	ns ns V/μs
	(Gain = 10, 15% overshoot, R_1 = 1.0 kΩ, R_2 = 10 kΩ, R_3 = 1.0 kΩ, R_4 = 1.0 kΩ, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	600 80 6.25	- - -	ns ns V/μs
	(Gain = 10, 15% overshoot, R_1 = 1.0 kΩ, R_2 = 10 kΩ, R_3 = 1.0 kΩ, R_4 = 1.0 kΩ, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	600 80 1.7	- - -	ns ns V/μs
	(Gain = 1, 15% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5.0 kΩ, R_4 = 390 Ω, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	400 80 4.2	- - -	ns ns V/μs
	(Gain = 1, 15% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5.0 kΩ, R_4 = 390 Ω, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	400 80 1.4	- - -	ns ns V/μs
	Equivalent Input Noise Voltage (Open Loop) (R_S = 10 kΩ, Noise Bandwidth = 1.0 Hz, f = 1.0 kHz)	e_n	-	30	-	$nV/(Hz)^{1/2}$
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50Ω, T_A = 0°C to +75°C)	TC_{Vio}	-	3.0	-	μV/°C
	(R_S ≦ 10 kΩ, T_A = 0°C to +75°C)		-	5.0	-	
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	90	200	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	200	μV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	50	200	μV/V

*To improve performance, development is in process to include resistor R_5 ≈ 10 kΩ on the device chip. Available after September, 1968.
‡dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

(V^+ = +15 Vdc, V^- = -15 Vdc, T_A = 25°C)

FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS (FIGURE 1)					
			$R_1(\Omega)$	$R_2(\Omega)$	$R_3(\Omega)$	$R_4(\Omega)$	$R_5{}^*(\Omega)$	C_1(pF)
2	1	1.0	10 k	10 k	5.0 k	390	10 k	2200
	2	1.0	10 k	10 k	5.0 k	390	∞	2200
3	1	A_{VOL}	0	∞	0	∞	∞	0
	2	1000	1000	1.0 M	1000	0	∞	10
	3	100	1000	100 k	1000	10 k	∞	2200
	4	10	1000	10 k	1000	1.0 k	∞	2200
	5	1.0	10 k	10 k	5.0 k	390	∞	2200
4	1	A_{VOL}	0	∞	0	∞	∞	0
	2	A_{VOL}	0	∞	0	10 k	∞	2200
	3	A_{VOL}	0	∞	0	390	∞	2200

*To improve performance, development is in process to include resistor $R_5 \approx 10\ k\Omega$ on the device chip. Available after September 1968.

FIGURE 1 – TEST CIRCUIT

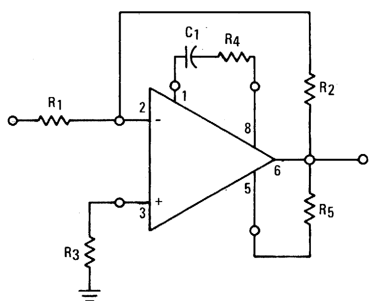


FIGURE 2 – POWER BANDWIDTH (LARGE SIGNAL SWING versus FREQUENCY)

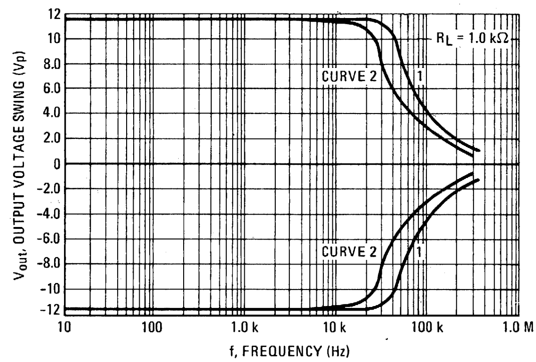


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

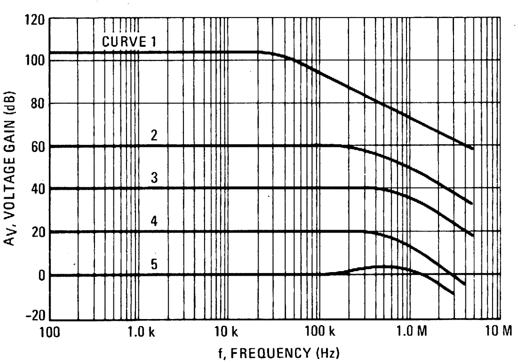


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

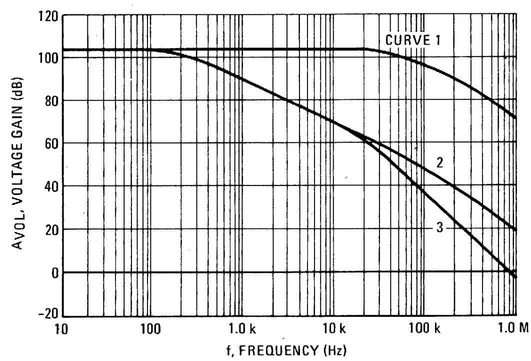


FIGURE 5 – INPUT OFFSET VOLTAGE versus TEMPERATURE

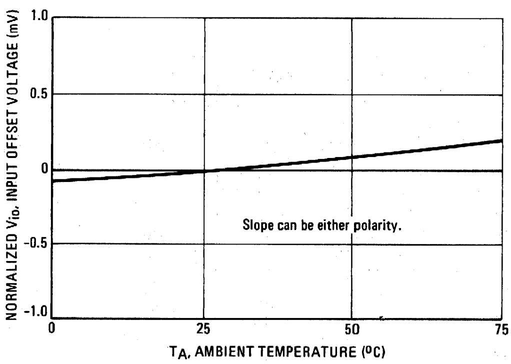


FIGURE 6 – INPUT OFFSET CURRENT versus TEMPERATURE

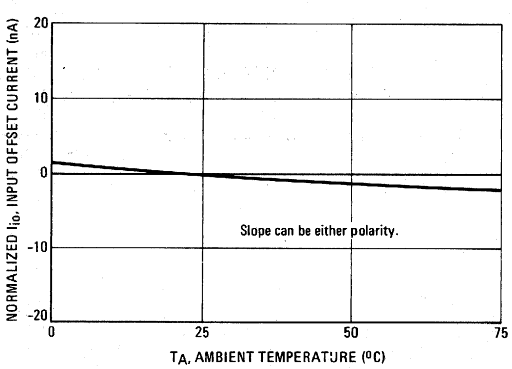


FIGURE 7 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

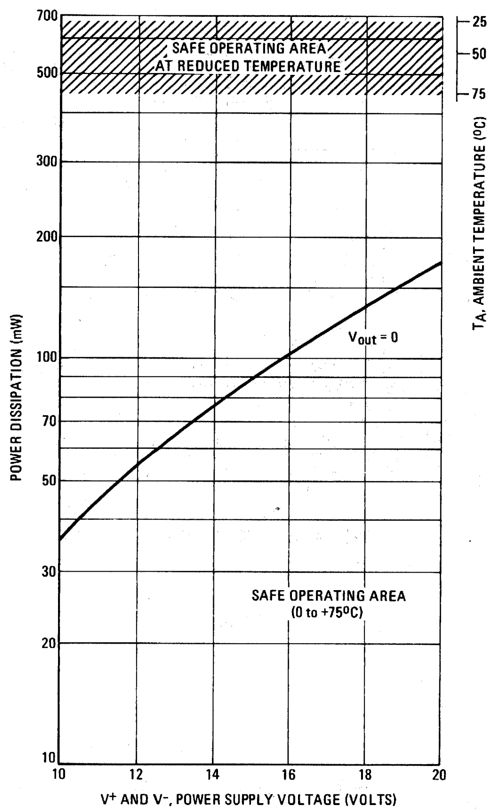


FIGURE 8 – INPUT BIAS CURRENT versus TEMPERATURE

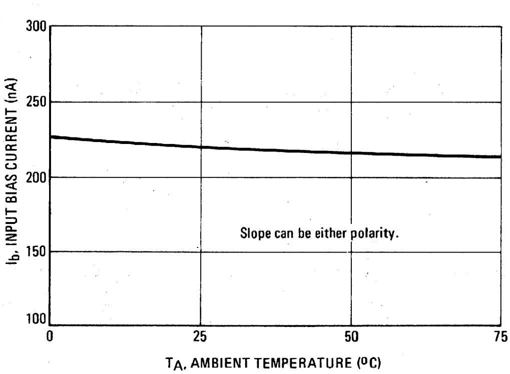
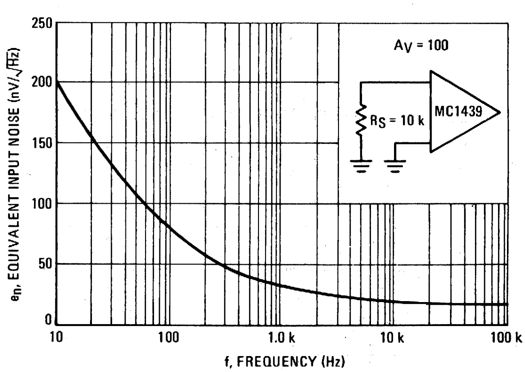
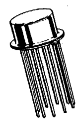


FIGURE 9 – SPECTRAL NOISE DENSITY



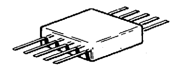
MC1520

. . . designed for use in general-purpose or wide band differential amplifier applications, especially those requiring differential outputs.



Lead 3 connected to case

CASE 71A
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

Typical Characteristics:

- Differential Input and Differential Output
- Wide Closed-Loop Bandwidth; 10 MHz
- Differential Gain; 70 dB
- High Input Impedance; 2.0 megohms
- Low Output Impedance; 50 ohms

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+8.0 -8.0	Vdc
Differential Input Signal	V_{in}	±8.0	Vdc
Load Current	I_{L1}, I_{L2}	15	mA
Power Dissipation (Package Limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

FIGURE 1 – CIRCUIT SCHEMATIC

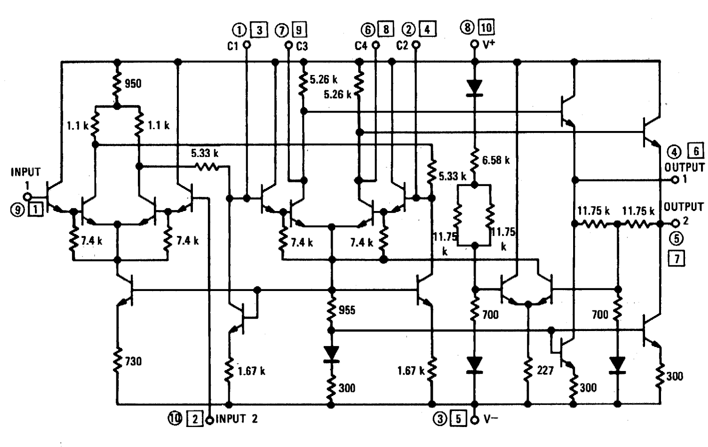
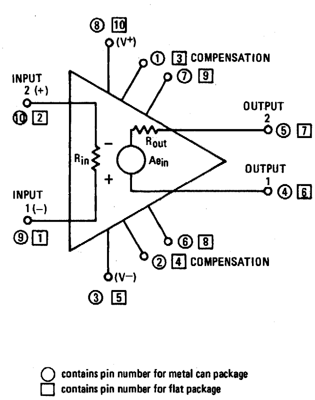
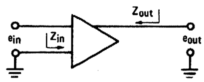
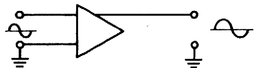
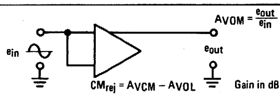
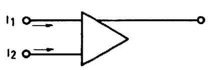
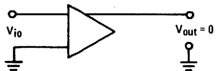
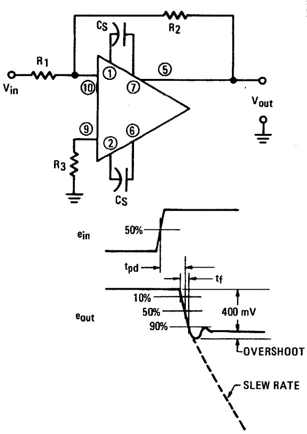
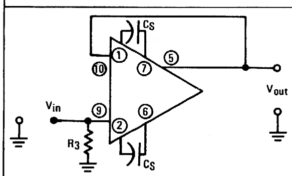
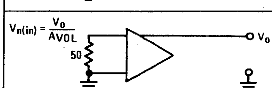


FIGURE 2 – EQUIVALENT CIRCUIT



SINGLE-ENDED ELECTRICAL CHARACTERISTICS

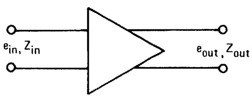
(V^+ = + 6.0 Vdc, V^- = –6.0 Vdc, T_A =25°C unless otherwise noted)

Characteristic Definitions ①	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (-55°C ≦ T_A ≦ +125°C)	A_{VOL}	1000 60	1500 64	2500 68	V/V dB
	Output Impedance (f = 20 Hz)	Z_{out}	-	50	100	ohms
	Input Impedance (f = 20 Hz)	Z_{in}	0.5	2.0	-	megohms
	Output Voltage Swing R_L = 7.0 kΩ (Figure 8)	V_{out}	±3.5	±4.0	-	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	±2.0	±3.0	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	75	90	-	dB
	Input Bias Current ($I_b = \frac{I_1 + I_2}{2}$), T_A = +25°C	I_b	-	0.8	2.0	µA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = -55°C) ($I_{io} = I_1 - I_2$, T_A = +125°C)	I_{io}	- - -	30 - -	100 200 200	nA
	Input Offset Voltage T_A = 25°C	V_{io}	-	5.0	10	mV
	Step Response Gain = 1.0, 10% Overshoot R_1 = 10 kΩ R_2 = 10 kΩ R_3 = 5.0 kΩ C_s = 39 pF	t_f t_{pd} dV_{out}/dt ②	-	80 70 5.0	-	ns ns V/µs
	Gain = 10, 10% Overshoot R_1 = 10 kΩ R_2 = 100 kΩ R_3 = 10 kΩ C_s = 10 pF	t_f t_{pd} dV_{out}/dt ②	-	80 70 15	-	ns ns V/µs
	Gain = 100, No Overshoot R_1 = 1.0 kΩ R_2 = 100 kΩ R_3 = 1.0 kΩ C_s = 1.0 pF	t_f t_{pd} dV_{out}/dt ②	-	80 70 30	-	ns ns V/µs
	Open Loop, No Overshoot R_1 = 50 Ω R_2 = ∞ R_3 = 50 Ω C_s = 0	t_f t_{pd} dV_{out}/dt ②	-	180 70 35	-	ns ns V/µs
	Bandwidth: Open Loop (Figure 4) Closed Loop (Unity Gain) (Figure 5)	-	- -	2.0 10	- -	MHz
	Input Noise Voltage (Open Loop) (5.0 Hz - 5.0 MHz)	$V_{n(in)}$	-	11	15	µV(rms)
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = -55°C to +125°C)	TCV_{io}	-	2.0	-	µV/°C
	DC Power Dissipation V_{out} = 0	P_D	-	120	240	mW
	Power Supply Sensitivity (V± Constant)	S±	-	250	450	µV/V

① All definitions imply linear operation. ② dV_{out}/dt = Slew Rate

DIFFERENTIAL ELECTRICAL CHARACTERISTICS

($V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, $T_A = 25^oC$ unless otherwise noted)

Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Gain (Open Loop)	A_{VOL}	2000 66	3000 70	5000 74	-
	Input Impedance (f = 20 Hz)	Z_{in}	0.5	2.0	-	megohms
	Output Impedance (f = 20 Hz)	Z_{out}	-	100	200	ohms
	Common Mode Output Voltage	$V_{out(CM)}$	-0.5	0	+0.5	Vdc
	Output Voltage Swing $R_L = 7.0\ k\Omega$	V_{out}	±7.0	±8.0	-	V_{peak}

TYPICAL OUTPUT CHARACTERISTICS ($V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, unless otherwise noted)

FIGURE 3 - LARGE SIGNAL SWING versus FREQUENCY

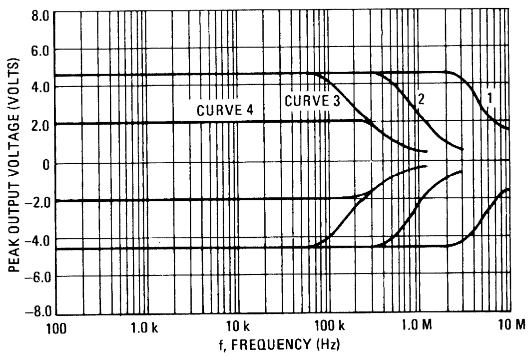
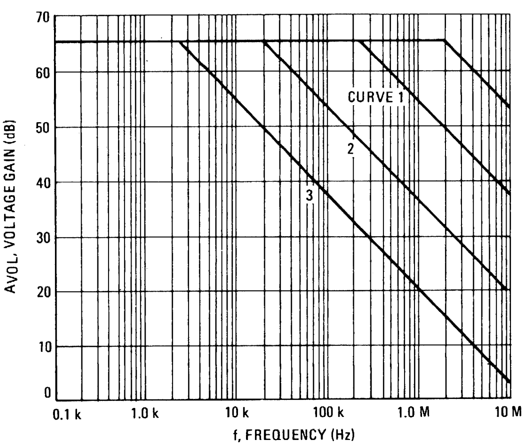


FIGURE 4 - OPEN LOOP VOLTAGE GAIN



TEST CIRCUIT

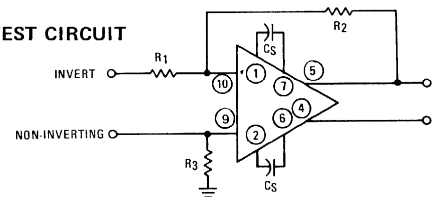
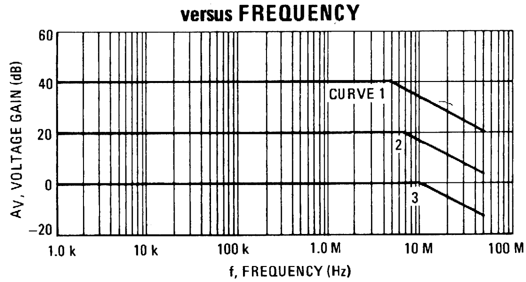


FIGURE NO.	CURVE NO.	MODE	VOLTAGE GAIN	TEST CONDITIONS R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	C_S (pF)	NOISE OUTPUT mV, rms
3	1	INVERTING	100	1.0 k	100 k	1.0 k	1.0	2.0
	2	INVERTING	10	10 k	100 k	10 k	10	0.55
	3	INVERTING	1.0	10 k	10 k	5.0 k	39	0.17
	4	NON-INVERTING	1.0	∞	10 k	10 k	39	0.17
4	1	NON-INVERTING	A_{VOL}	0	∞	50	1.0	1.0
	2	NON INVERTING	A_{VOL}	0	∞	50	10	2.0
	3	NON-INVERTING	A_{VOL}	0	∞	50	39	5.2
5	1	NON-INVERTING	100	100	10 k	100	1.0	2.0
	2	NON-INVERTING	10	1.0 k	9.1 k	910	10	0.55
	3	NON-INVERTING	1.0	∞	10 k	10 k	39	0.17

FIGURE 5 - CLOSED LOOP VOLTAGE GAIN versus FREQUENCY



TYPICAL CHARACTERISTICS

FIGURE 6 - POWER DISSIPATION versus POWER SUPPLY VOLTAGE

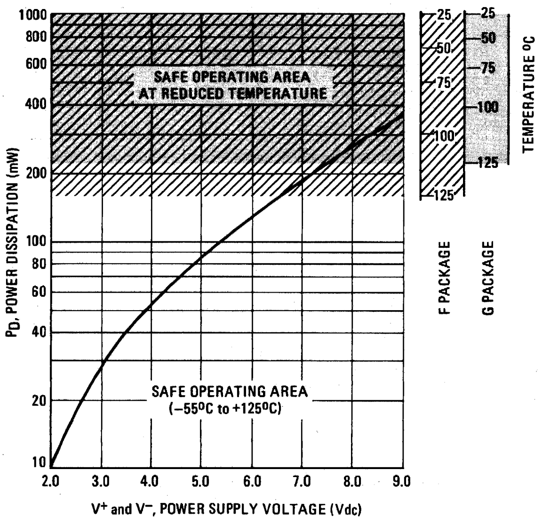


FIGURE 7 - OPEN LOOP VOLTAGE GAIN versus SUPPLY VOLTAGE

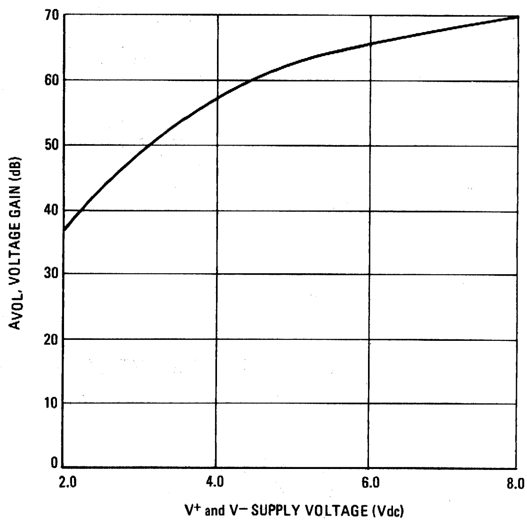


FIGURE 8 - SINGLE ENDED OUTPUT VOLTAGE versus LOAD RESISTANCE

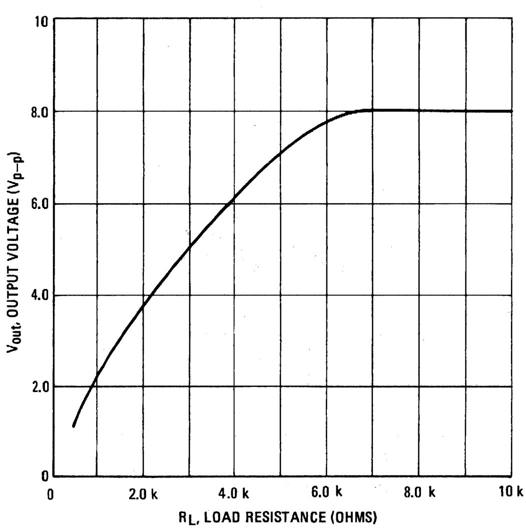
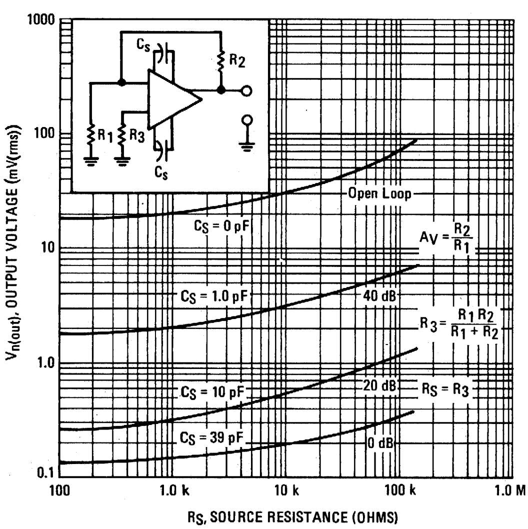
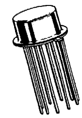


FIGURE 9 - OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE

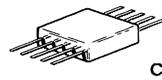


MC1530
MC1531

Lead 4 connected to case



CASE 71
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

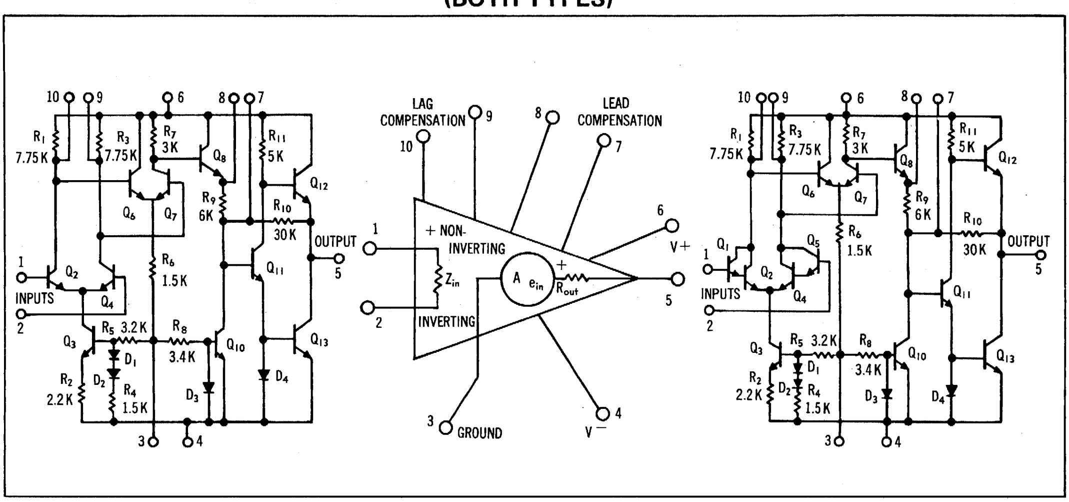
Typical Amplifier Features:

- Excellent Open Loop Gain Characteristics
  A_{VOL} = 74 dB typical
  A_{VOL} stability = ±1.5 dB from -55°C to +125°C
- Low Temperature Drift — ±3.0 μV/°C
- Large Output Voltage Swing — Typically ±5.0 V @ ±6.0 V Supply
- Low Output Impedance — Z_{out} = 25 ohms typical
- High Slew Rate — typically 4.5 V/μs @ A_V = 10

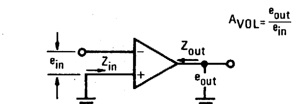
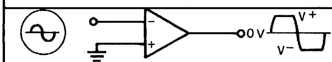
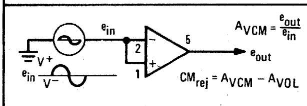
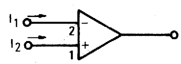
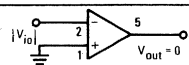
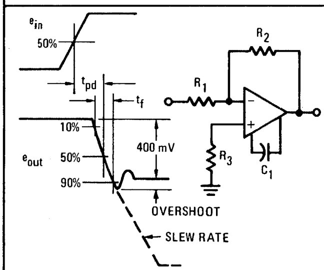
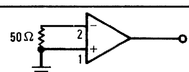
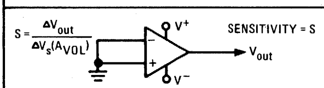
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V+	+9.0	Vdc
Power Supply Voltage	V-	-9.0	Vdc
Differential Input Signal	V_{in}	±5.0	Vdc
Load Current	I_L	10	mA
Power Dissipation (Package Limitation)	P_D		
Metal Can		680	mW
Derate above 25+ C		4.6	mW/°C
Flat Package		500	mW
Derate above 25° C		3.3	mW/°C
Operating Temperature Range	T_A	-55 to + 125	°C
Storage Temperature Range	T_{stg}	-65 to + 175	°C

MC1530 (STANDARD INPUT) — EQUIVALENT CIRCUIT (BOTH TYPES) — MC1531 (DARLINGTON INPUT)



ELECTRICAL CHARACTERISTICS ($V^+ = +6.0Vdc$, $V^- = -6.0Vdc$, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions (linear operations)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain	A_{VOL}				V/V
	(T_A = -55 to + 125° C) MC1530		4500	5000	12500	
	MC1531		2500	3500	7000	
	MC1530		73	74	82	dB
	MC1531		68	71	77	
	Output Impedance (f = 20 Hz) MC1530 MC1531	Z_{out}	-	25	50	ohms
	Input Impedance (f = 20 Hz) MC1530	Z_{in}	10k	20k	-	ohms
	MC1531		1.0M	2.0M	-	
	Output Voltage Swing (R_L = 1.0 k ohm) MC1530 MC1531	V_{out}	±4.5	±5.2	-	V_{peak}
	Input Common Mode Voltage Swing MC1530	CMV_{in}	±2.0	±2.7	-	V_{peak}
	MC1531		±2.0	±2.4	-	
	Common Mode Rejection Ratio MC1530	CM_{rej}	70	75	-	dB
	MC1531		65	65	-	
	Input Bias Current ($I_b = \frac{I_1 + I_2}{2}$) MC1530	I_b	-	3.0	10	µA
	MC1531		-	0.025	0.150	
	Input Offset Current MC1530	I_{io}	-	0.200	2.0	µA
	$I_{io} = I_1 - I_2$ MC1531		-	0.003	0.025	
	Input Offset Voltage MC1530	$\|V_{io}\|$	-	1.0	5.0	mV
	MC1531		-	3.0	10	
	Step Response					
	Gain = 100, 0% overshoot	t_f	-	0.60	-	µs
	R_1 = 1.0 k ohm R_2 = 100 k ohm	t_{pd}	-	0.30	-	µs
	R_3 = 1.0 k ohm C_1 = 1800 pF	dV_{out}/dt ①	-	17	-	V/µs
	Gain = 10, 10% overshoot	t_f	-	0.24	-	µs
	R_1 = 10 k ohm R_2 = 100 k ohm	t_{pd}	-	0.18	-	µs
	R_3 = 10 k ohm C_1 = 6800 pF	dV_{out}/dt ①	-	4.5	-	V/µs
	Gain = 1.0, 5.0% overshoot	t_f	-	0.20	-	µs
	R_1 = 10 k ohm R_2 = 10 k ohm	t_{pd}	-	0.16	-	µs
	R_3 = 5.0 k ohm C_1 = 33,000 pF	dV_{out}/dt ①	-	1.0	-	V/µs
	Input Noise Voltage (Open Loop, 50 ohm MC1530	$V_{n(in)}$	-	10	-	μV_{rms}
	source, BW_{OL} = 5.0 MHz) MC1531		-	20	-	
	Average Temperature Coefficient of Input Offset Voltage	TC_{Vio}				µV/°C
	25°C to + 125° C MC1530		-	3.8	-	
	-55° C to + 25° C		-	8.0	-	
	25°C to + 125° C MC1531		-	11	-	
	-55° C + 25° C		-	20	-	
	D. C. Power Dissipation (Power Supply = ±6.0 V, V_{out} = 0)	P_D	-	110	150	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	100	-	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	100	-	µV/V

① dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

$V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, $T_A = 25^oC$)

FIGURE 1 – TEST CIRCUIT

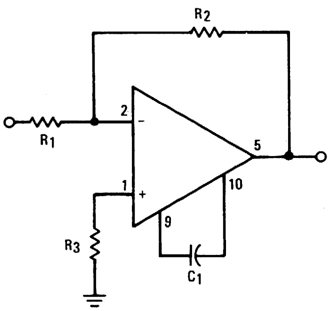


FIG. NO.	CURVE NO.	VOLTAGE GAIN	DEVICE	TEST CONDITIONS $R_1 (\Omega)$	$R_2 (\Omega)$	$R_3 (\Omega)$	C_1(pF)	OUTPUT NOISE (mV rms)
2	1	100	MC1530	1.0 k	100 k	1.0 k	1800	3.5
		100	MC1531	1.0 k	100 k	1.0 k	1800	3.4
	2	10	MC1530	10 k	100 k	10 k	6800	4.8
		10	MC1531	10 k	100 k	10 k	6800	4.8
	3	1.0	MC1530	10 k	10 k	5.0 k	33000	3.4
		1.0	MC1531	10 k	10 k	5.0 k	33000	7.0
3	1	100	MC1530	1.0 k	100 k	1.0 k	1800	3.5
		100	MC1531	1.0 k	100 k	1.0 k	1800	3.4
	2	10	MC1530	10 k	100 k	10 k	6800	4.8
		10	MC1531	10 k	100 k	10 k	6800	4.8
	3	1.0	MC1530	10 k	10 k	5.0 k	33000	3.4
		1.0	MC1531	10 k	10 k	5.0 k	33000	7.0
4	1	A_{VOL}	MC1530	0	∞	0	1800	7.6
		A_{VOL}	MC1531	0	∞	0	1800	19.0
	2	A_{VOL}	MC1530	0	∞	0	6800	5.5
		A_{VOL}	MC1531	0	∞	0	6800	15.0
	3	V_{VOL}	MC1530	0	∞	0	33000	5.0
		A_{VOL}	MC1531	0	∞	0	33000	11.0

FIGURE 2 – LARGE SIGNAL SWING versus FREQUENCY

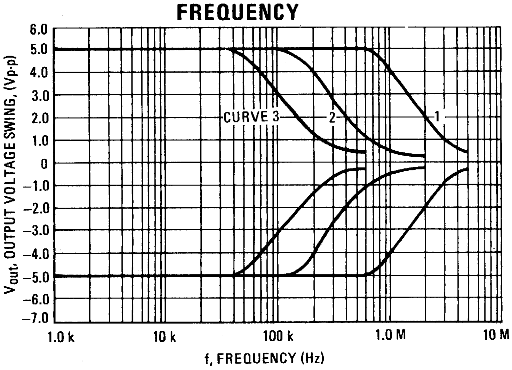


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

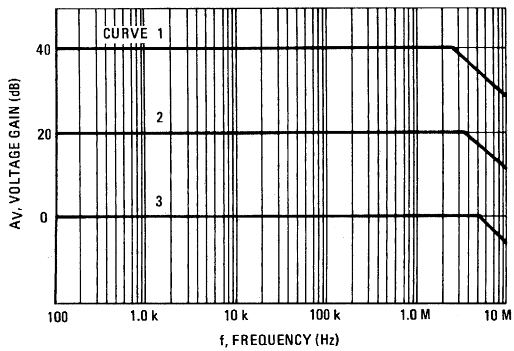


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

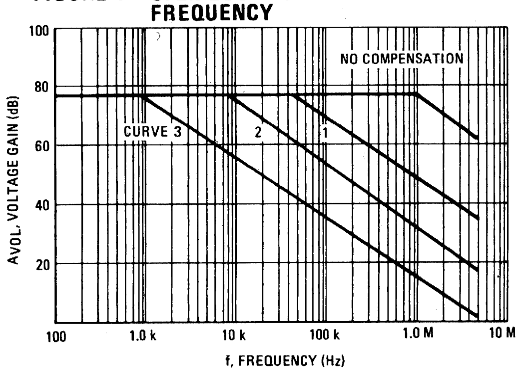


FIGURE 5 – SLEW RATE versus ROLLOFF CAPACITANCE

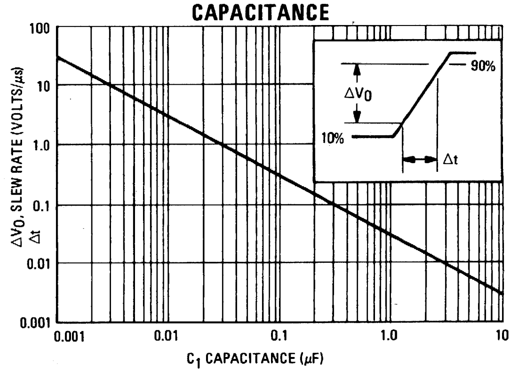


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

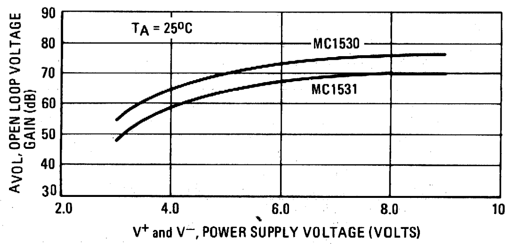


FIGURE 7 – COMMON MODE SWING versus POWER SUPPLY VOLTAGE

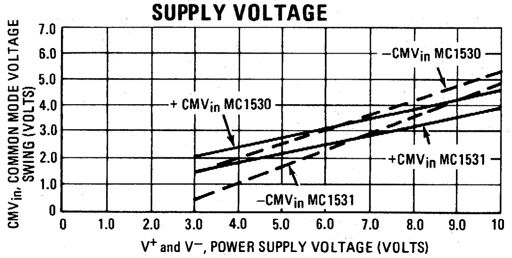


FIGURE 8 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

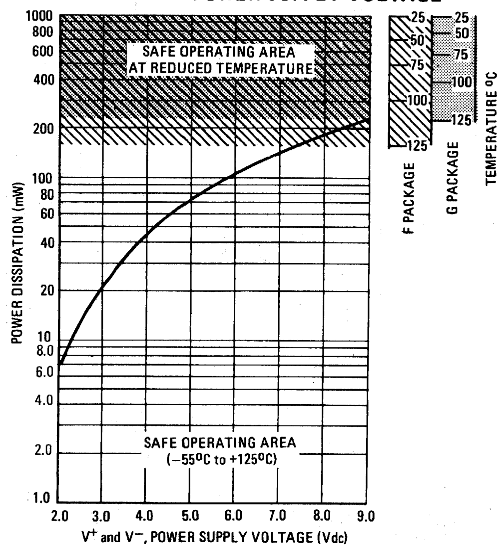


FIGURE 9 – OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE

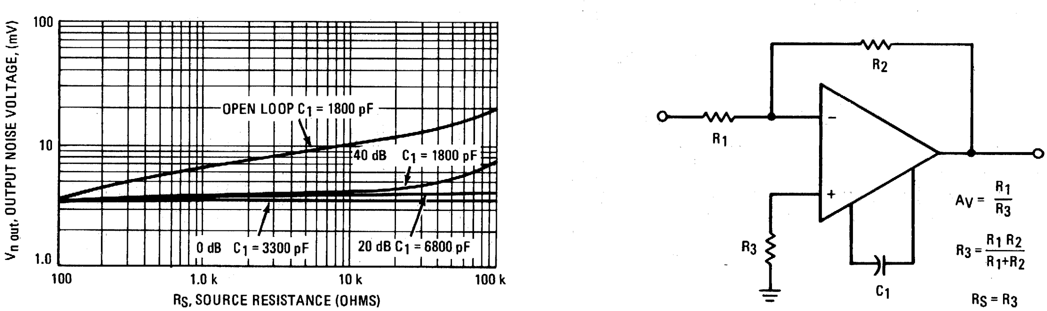
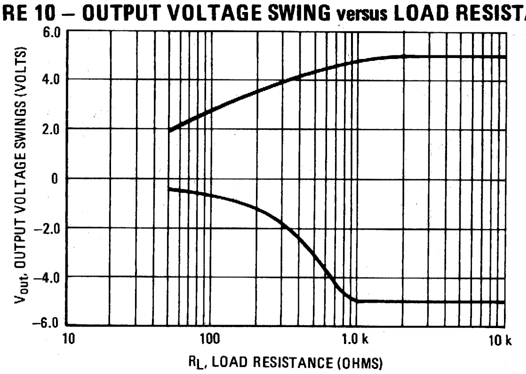
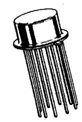


FIGURE 10 – OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

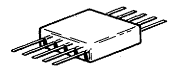


MC1533

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.



Lead 4 connected to case
CASE 71
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

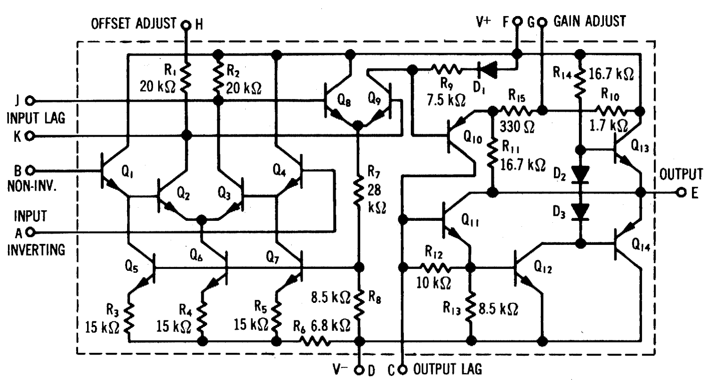
Typical Amplifier Features:

- High-Performance Open Loop Gain Characteristics
  A_{VOL} = 60,000 typical
- Low Temperature Drift — ±5.0 μV/^{o}C
- Large Output Voltage Swing — ±13 V Typical @ ±15 V Supply
- Low Output Impedance — Z_{out} = 100 ohms typical
- Input Offset Voltage Adjustable to Zero

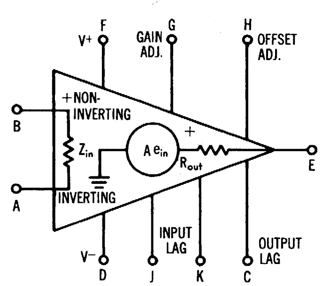
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+20 -20	Vdc Vdc
Differential Input Signal	V_{in}	±10	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Load Current	I_L	10	mA
Output Short Circuit Duration	t_S	1.0	s
Power Dissipation (Package Limitation) Metal Can Derate above T_A = 25^{o}C Flat Package Derate above T_A = 25^{o}C	P_D	 680 4.6 500 3.3	 mW mW/^{o}C mW mW/^{o}C
Operating Temperature Range	T_A	-55 to +125	^{o}C
Storage Temperature Range	T_{stg}	-65 to +150	^{o}C

CIRCUIT SCHEMATIC

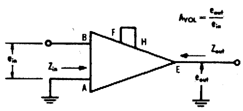
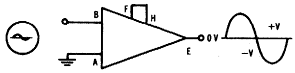
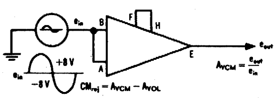
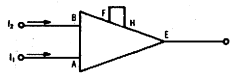
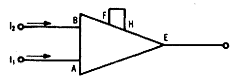
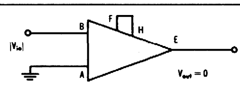
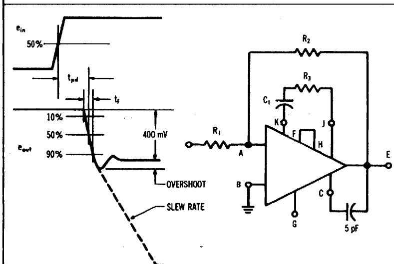
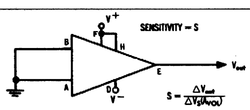


EQUIVALENT CIRCUIT



PIN CONNECTIONS										
Schematic	A	B	C	D	E	F	G	H	J	K
"G" Package	1	2	3	4	5	6	7	8	9	10
"F" Package	10	1	2	3	4	5	6	7	8	9

ELECTRICAL CHARACTERISTICS ($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions ①	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (V @ Pin G = +15 Vdc) (Pin G open) (V@Pin G = +15 Vdc, T_A = -55°C, +125°C) (Pin G open, T_A = -55°C, +125°C)	A_{VOL}	 40,000 15,000 35,000 12,000	 60,000 30,000 50,000 25,000	 150,000 60,000 150,000 60,000	-
	Output Impedance (Pin G open, f = 20 Hz)	Z_{out}	-	100	150	Ω
	Input Impedance (Pin G open, f = 20 Hz)	Z_{in}	500	1000	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ) (R_L = 2 kΩ)	V_{out}	 ±12 ±11	 ±13 ±12	 - -	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	+9 -8	+10 -9	- -	V_{peak}
	Common Mode Rejection Ratio (V @ Pin G = +15 Vdc) (Pin G open)	CM_{rej}	 90 80	 100 94	 - -	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C) (T_A = -55°C)	I_b	- -	0.5 -	1.0 3.0	μA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = -55°C) ($I_{io} = I_1 - I_2$, T_A = +125°C)	I_{io}	 - - -	 0.03 - -	 0.15 0.5 0.2	μA
	Input Offset Voltage ② (T_A = 25°C) (T_A = -55°C, + 125°C)	V_{io}	 - -	 1.0 -	 5.0 6.0	mV
	Step Response (Gain = 100, 15% overshoot, R_1 = 1 kΩ, R_2 = 100 kΩ, R_3 = 100 Ω, C_1 = 0.002 μF)	t_f t_{pd} dV_{out}/dt ③	- - -	0.15 0.06 11.0	- - -	μs μs V/μs
	(Gain = 10, no overshoot, R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 10 Ω, C_1 = 0.05 μF)	t_f t_{pd} dV_{out}/dt ③	- - -	0.3 0.1 1.5	- - -	μs μs V/μs
	(Gain = 1, 20% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5 Ω, C_1 = 0.1 μF)	t_f t_{pd} dV_{out}/dt ③	- - -	0.2 0.3 0.8	- - -	μs μs V/μs
	Average Temperature Coefficient of Input Offset Voltage (T_A = -55°C to +25°C) (T_A = +25°C to +125°C)	TC_{Vio}	 - -	 8.0 5.0	 - -	μV/°C
	Average Temperature Coefficient of Input Offset Current (T_A = -55°C to +125°C) (T_A = +25°C to +125°C)	TC_{Iio}	 - -	 0.1 0.05	 - -	nA/°C
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	120	170	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	150	μV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	50	150	μV/V

① All definitions imply linear operation

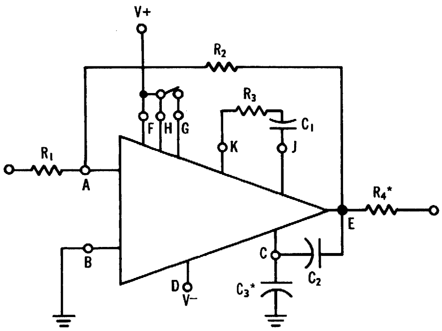
② Input offset voltage (V_{io}) may be adjusted to zero by varying the potential on pin H

③ dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

FIGURE 1 — TEST CIRCUIT

V+ = +15 Vdc, V− = −15 Vdc, T_A = 25°C



*FOR CAPACITIVE LOADS, R_4 = 47 Ω OR C_3 = 47 pF

Fig. No.	Curve No.	Test Conditions					
		R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	C_1	C_2 (pF)	C_3 (pF)
2	1	10k	10k	5	1 μF	10	47
	2	10k	100k	10	0.1 μF	10	47
	3	1k	1M	510	820 pF	10	47
	3	10k	1M	100	0.05 μF	10	47
	4	1k	1M	100	0.05 μF	3	47
	4	1k	1M	510	820 pF	3	47
3	1 (Low Gain)	1k	1M	10	1000 pF	10	47
	1 (High Gain)	1k	1M	510	820 pF	10	47
	2 (Low Gain)	10k	1M	10	0.01 μF	10	47
	2 (High Gain)	10k	1M	100	0.01 μF	10	47
	3 (Low Gain)	10k	100k	10	0.1 μF	10	47
	3 (High Gain)	10k	100k	10	0.1 μF	10	47
	4 (Low Gain)	10k	10k	10	1 μF	10	47
	4 (High Gain)	10k	10k	5	1 μF	10	47
4	1	0	∞	10	1 μF	10	47
	2	0	∞	10	0.1 μF	10	47
	3	0	∞	10	0.01 μF	10	47
	4	0	∞	10	1000 pF	10	47
	5	0	∞	10	100 pF	10	47
5	1	0	∞	10	1 μF	10	47
	2	0	∞	10	0.1 μF	10	47
	3	0	∞	10	0.01 μF	10	47
	4	0	∞	10	1000 pF	10	47
	5	0	∞	10	100 pF	10	47

FIGURE 2 — LARGE-SIGNAL SWING versus FREQUENCY

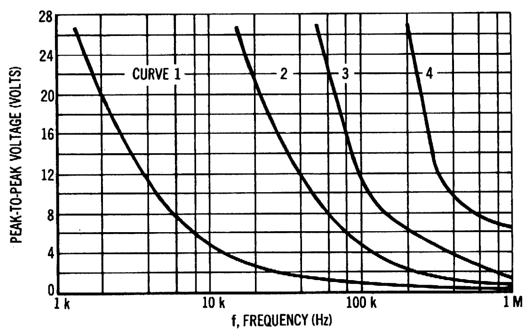


FIGURE 3 — VOLTAGE GAIN versus FREQUENCY

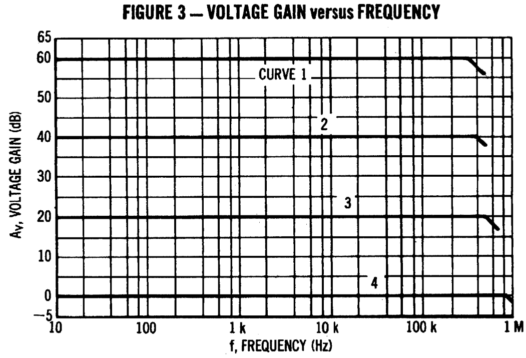


FIGURE 4 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY
(LOW GAIN CONFIGURATION)

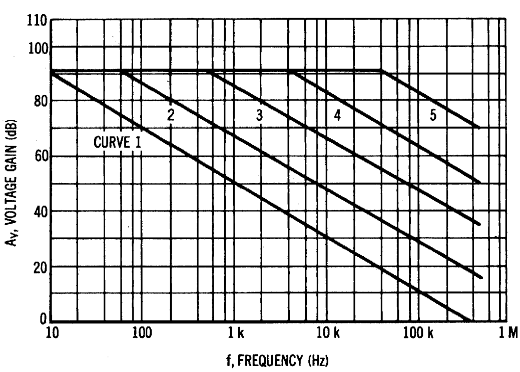
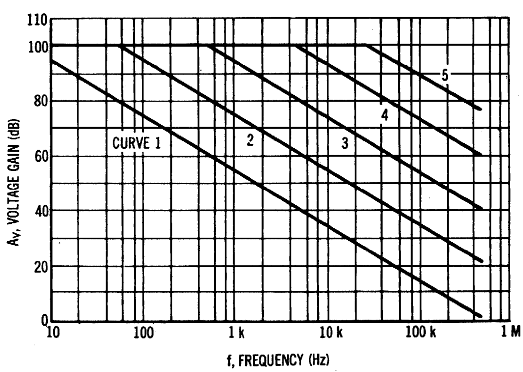


FIGURE 5 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY
(HIGH GAIN CONFIGURATION)



TYPICAL CHARACTERISTICS

FIGURE 6 — POWER DISSIPATION versus POWER SUPPLY VOLTAGE

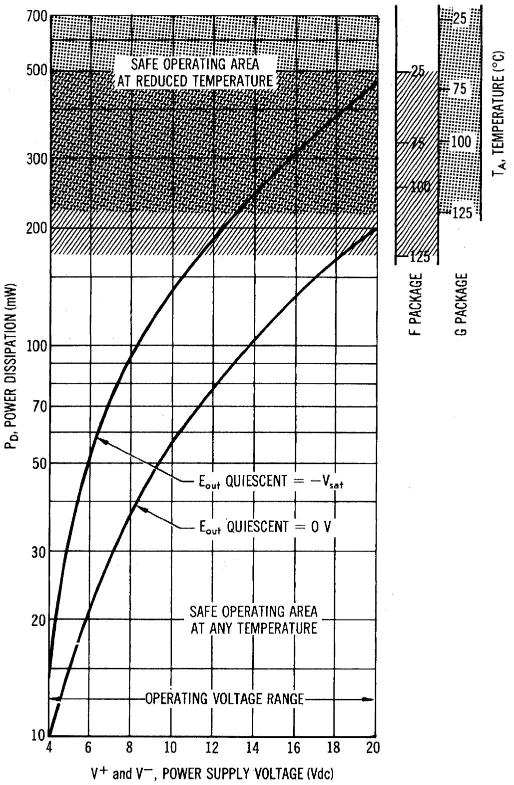


FIGURE 7 — VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

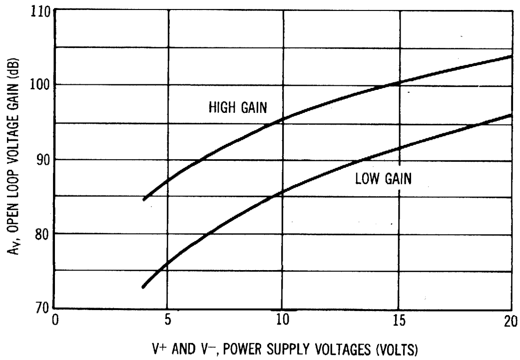


FIGURE 8 — COMMON MODE SWING versus POWER SUPPLY VOLTAGE

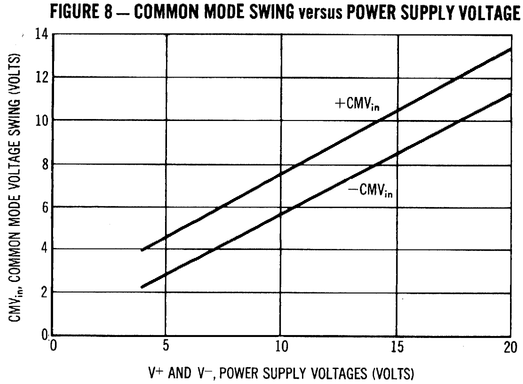


FIGURE 9 — INPUT OFFSET VOLTAGE versus TEMPERATURE

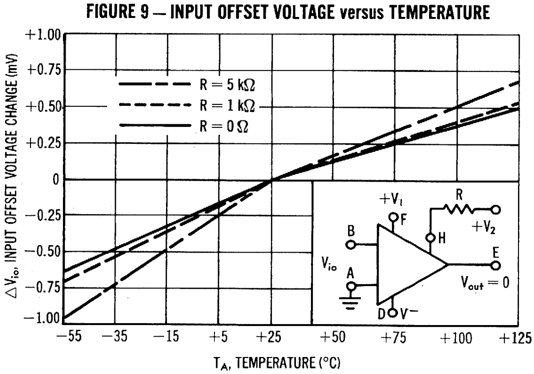
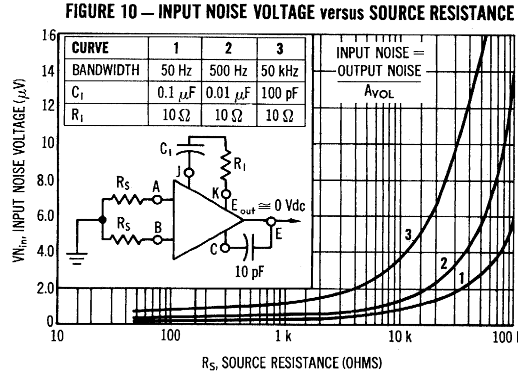
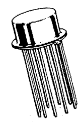


FIGURE 10 — INPUT NOISE VOLTAGE versus SOURCE RESISTANCE



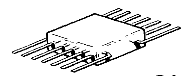
MC1535

. . . designed for use as summing amplifiers, integrators, or amplifiers with operating characteristics as a function of the external feedback components. Ideal for chopper stabilized applications where extremely high gain is required with excellent stability.



Lead 1 connected to case

CASE 71
"G" SUFFIX



CASE 83
(TO-86)
"F" SUFFIX

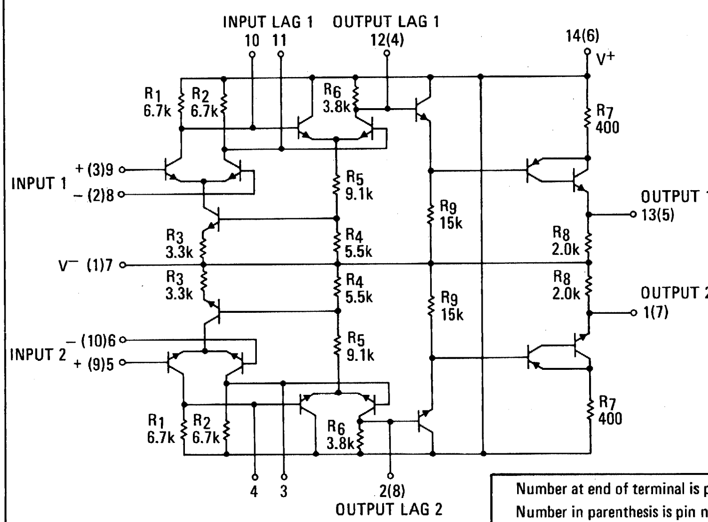
Typical Amplifier Features:

- High Open Loop Gain Characteristics — A_{VOL} = 7,000 typical
- Low Temperature Drift — ±10 μV/°C
- Large Output Voltage Swing — ±3.6 V Typ @ ±6.0 V supply
- Low Input Offset Voltage — 1.0 mV
- Low Input Noise Voltage — 0.5 μV

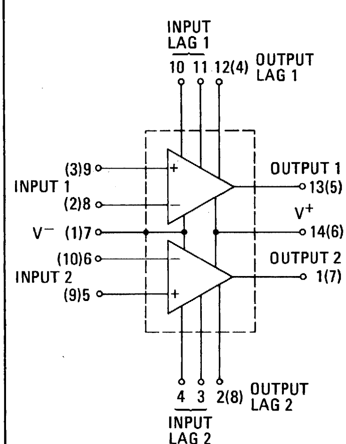
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+10 -10	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Output Short Circuit Duration	t_S	Continuous	
Power Dissipation (Package Limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC

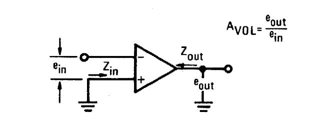
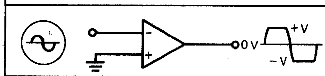
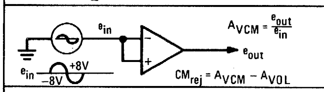
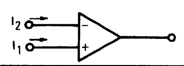
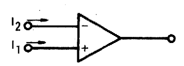
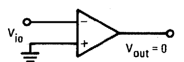
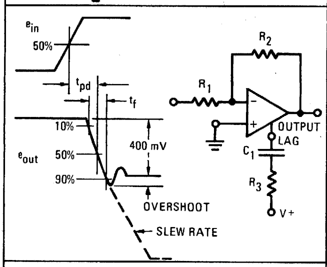
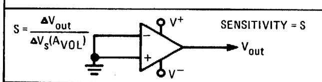


EQUIVALENT CIRCUIT



Number at end of terminal is pin number for flat package.
Number in parenthesis is pin number for metal can package.
Input Lag available only in flat package.

ELECTRICAL CHARACTERISTICS (Each Amplifier) (V^+ = +6.0Vdc, V^- = −6.0Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operations)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (T_A = -55°C to +125°C)	A_{VOL}	4,000 72	7,000 77	10,000 80	V/V dB
	Output Impedance (f = 20 Hz)	Z_{out}	-	1.7	-	kΩ
	Input Impedance (f = 20 Hz)	Z_{in}	10	45	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	±3.3	±3.6	-	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	+3.0 -2.0	+3.9 -2.7	- -	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	70	90	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C) (T_A = -55°C)	I_b	- -	1.2 3.6	3.0 6.0	µA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = -55°C) ($I_{io} = I_1 - I_2$, T_A = +125°C)	I_{io}	- - -	0.05 - -	0.3 0.9 0.3	µA
	Input Offset Voltage (T_A = 25°C) (T_A = -55°C + 125°C)	V_{io}	- -	1.0 -	3.0 5.0	mV
	Step Response Gain = 100, 30% overshoot, R_1 = 4.7 kΩ, R_2 = 470 kΩ, R_3 = 150 Ω, C_1 = 1,000 pF	t_f t_{pd} dV_{out}/dt ①	- - -	0.8 0.1 7.0	- - -	µs µs V/µs
	Gain = 10, 10% overshoot, R_1 = 47 kΩ, R_2 = 470 kΩ, R_3 = 47 Ω, C_1 = 0.01 µF	t_f t_{pd} dV_{out}/dt ①	- - -	0.4 0.3 4.0	- - -	µs µs V/µs
	Gain = 1, 5% overshoot, R_1 = 47 kΩ, R_2 = 47 kΩ, R_3 = 4.7 Ω, C_1 = 0.1 µF	t_f t_{pd} dV_{out}/dt ①	- - -	0.5 0.25 0.67	- - -	µs µs V/µs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = 55°C to +125°C)	TC_{Vio}	-	3.0	-	µV/°C
	Average Temperature Coefficient of Input Offset Current (T_A =-55°C to +125°C)	TC_{Iio}		2.0		nA/°C
	DC Power Dissipation (Power Supply = ± 6.0 V, V_{out} = 0)	P_D	-	100	150	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	-	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	100	-	µV/V

MATCHING CHARACTERISTICS

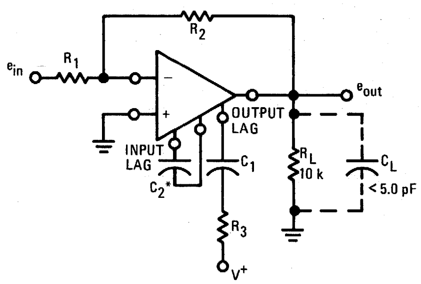
Same characteristic definitions as shown for each amplifier above.	Open Loop Voltage Gain	$A_{VOL1}-A_{VOL2}$	-	±1.0	-	dB
	Input Bias Current	$I_{b1}-I_{b2}$	-	±0.15	-	µA
	Input Offset Current	$I_{io1}-I_{io2}$	-	±0.02	-	µA
	Average Temperature Coefficient	$TC_{Iio1}-TC_{Iio2}$		±0.1		nA/°C
	Input Offset Voltage	$V_{io1}-V_{io2}$	-	±0.1	-	mV
	Average Temperature Coefficient	$TC_{Vio1}-TC_{Vio2}$		±0.5		mV/°C
	Channel Separation (See Fig. 10) (f = 10 kHz)	$\frac{e_{out\ 1}}{e_{out\ 2}}$	-	-60	-	dB

① dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

$V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, $T_A = 25°C$

FIGURE 1 – TEST CIRCUIT



*MC1535F only.

FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS $R_1(\Omega)$	$R_2(\Omega)$	C_1(pF)	$R_3(\Omega)$	C_2(pF)	OUTPUT NOISE (mV rms)
2	1	100	4.7 k	470 k	1,000	150	0	1.7
	1A	or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
	2A	or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
	3A	or 1	47 k	47 k	0	∞	50,000	0.46
3	1	100	4.7 k	470 k	1,000	150	0	1.7
		or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
		or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
		or 1	47 k	47 k	0	∞	50,000	0.46
4	1	A_{VOL}	100	∞	1,000	150	0	8.1
		or A_{VOL}	100	∞	0	∞	510	8.1
	2	A_{VOL}	100	∞	10,000	47	0	5.5
		or A_{VOL}	100	∞	0	∞	5,000	5.5
	3	A_{VOL}	100	∞	100,000	4.7	0	4.4
		or A_{VOL}	100	∞	0	∞	50,000	4.4

FIGURE 2 – LARGE SIGNAL SWING versus FREQUENCY

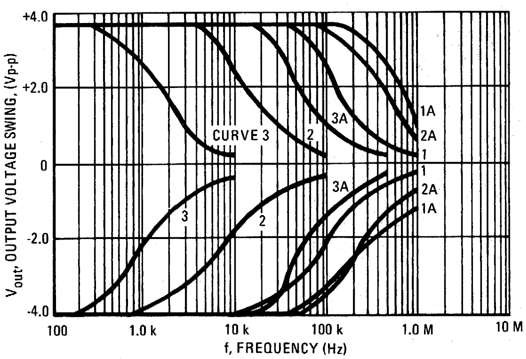


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

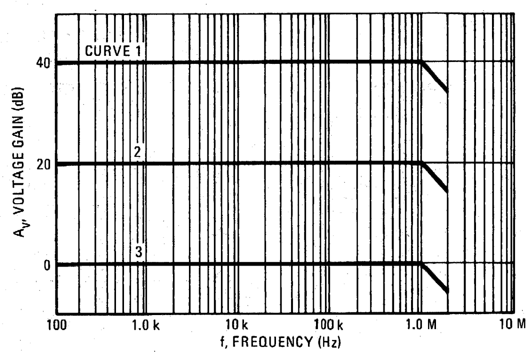


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

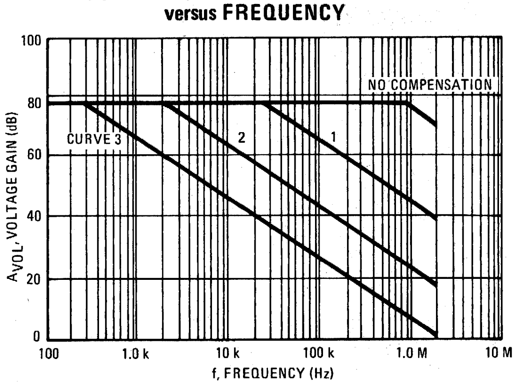


FIGURE 5 – INPUT OFFSET VOLTAGE versus TEMPERATURE

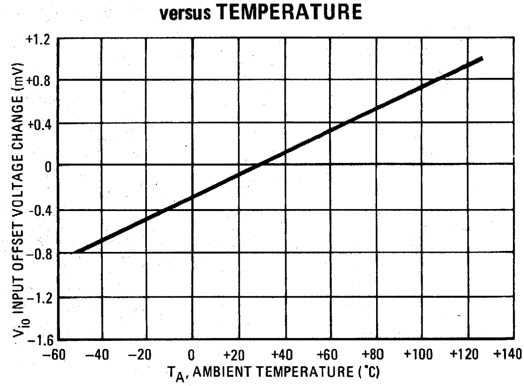


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

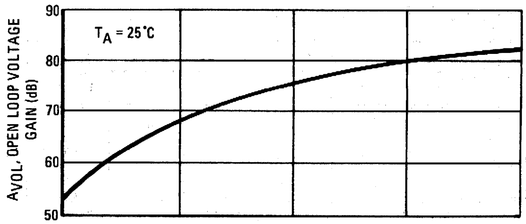


FIGURE 7 – COMMON MODE SWING versus POWER SUPPLY VOLTAGE

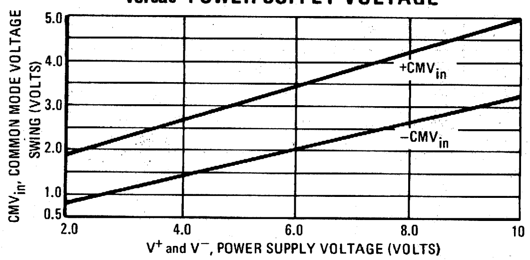


FIGURE 8 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

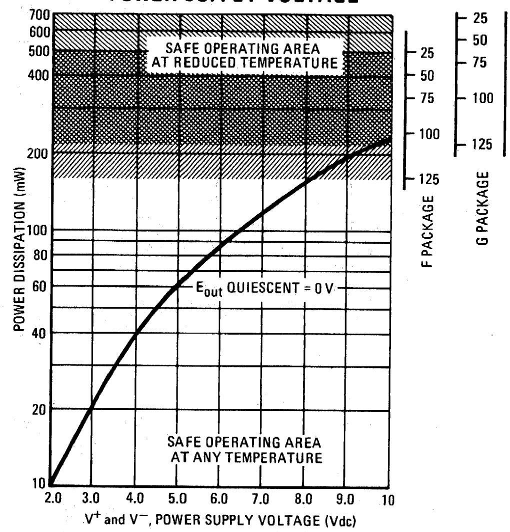
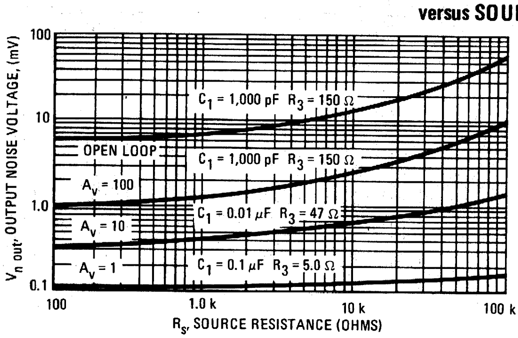


FIGURE 9 – OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE



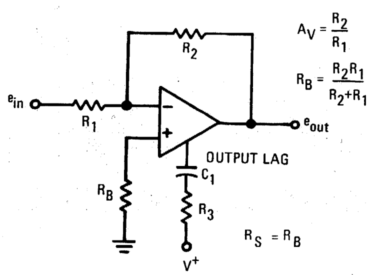
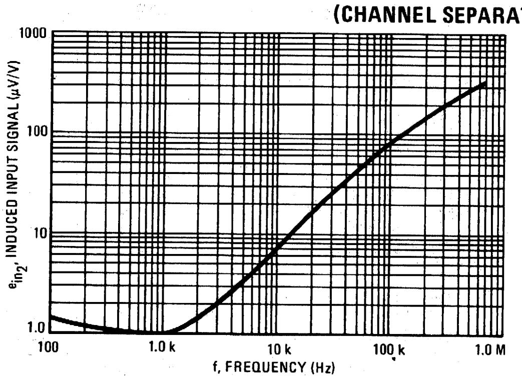
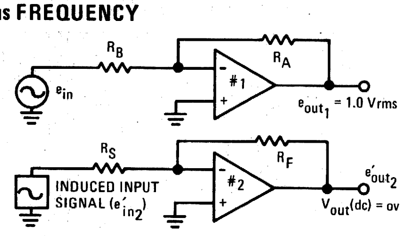


FIGURE 10 – INDUCED INPUT SIGNAL (CHANNEL SEPARATION) versus FREQUENCY



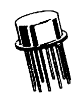


Induced input signal (μV of induced input signal in amplifier #2 per volt of output signal at amplifier #1)

$e'_{out_2} = e'_{in_2}\left(1 + \frac{R_F}{R_S}\right)$, where e'_{out_2} is the component of e_{out_2} due only to lack of perfect separation between the two amplifiers.

MC1539G

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.



Lead 4 connected to case

CASE 96
(TO-99)
"G" SUFFIX

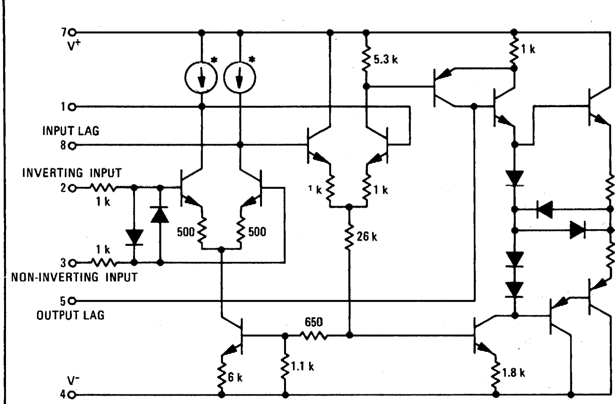
Typical Amplifier Features:

- Low Input Offset Voltage — 3.0 mV max
- Low Input Offset Current — 60 nA max
- Large Power-Bandwidth — 20 $V_{p\text{-}p}$ Output Swing at 20 kHz min
- Output Short-Circuit Protection
- Input Over-Voltage Protection
- Class AB Output for Excellent Linearity
- Slew Rate — 34 V/µs typ

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

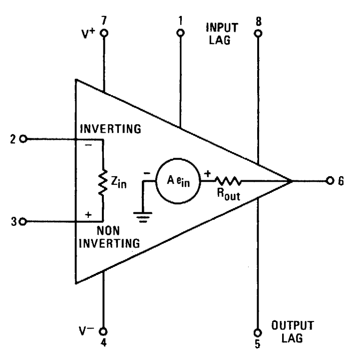
Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	$\pm V^+$	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Load Current	I_L	15	mA
Output Short Circuit Duration	t_S	Continuous	
Power Dissipation (Package Limitation) Derate above T_A = 25°C	P_D	680 4.6	mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC

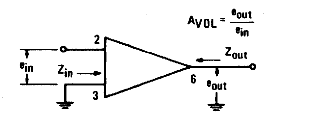
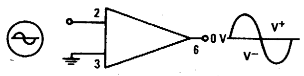
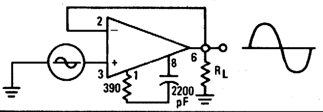
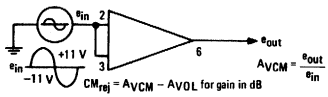
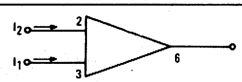
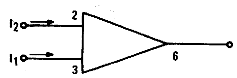
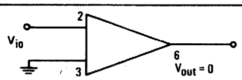
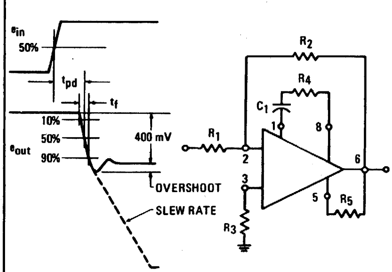
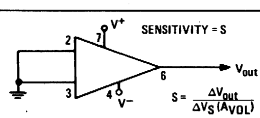


*PATENT PENDING

EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS ($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25^oC$ unless otherwise noted)

Characteristic Definitions (linear operation)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain ($V_{out} = \pm10$ V, T_A = -55°C to +125°C)	A_{VOL}	50,000	120,000	-	-
	Output Impedance (f = 20 Hz)	Z_{out}	-	4.0	-	kΩ
	Input Impedance (f = 20 Hz)	Z_{in}	150	300	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ) (R_L = 1.0 kΩ)	V_{out}	 ±12 ±10	 ±14 ±13	 - -	V_{peak}
	Power Bandwidth (A_v = 1, R_L = 1.0 kΩ, THD ≦ 5%, V_o = 20 V_{p-p})	P_{BW}	20	50	-	kHz
	Input Common Mode Voltage Swing	CMV_{in}	±11	±12	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	80	100	-	dB
	Input Bias Current $I_b = \frac{I_1 + I_2}{2}$, ($T_A$ = +25°C) (T_A = -55°C)	I_b	 - -	 200 230	 500 700	nA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = -55°C) ($I_{io} = I_1 - I_2$, T_A = +125°C)	I_{io}	 - - -	 20 - -	 60 75 75	nA
	Input Offset Voltage (T_A = 25°C) (T_A = -55°C + 125°C)	V_{io}	 - -	 1.0 -	 3.0 4.0	mV
	Step Response (Gain = 100, no overshoot, R_1 = 1.0 kΩ, R_2 = 100 kΩ, R_3 = 1.0 kΩ, R_4 = 10 kΩ, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	700 100 34	- - -	ns ns V/µs
	(Gain = 100, no overshoot, R_1 = 1.0 kΩ, R_2 = 100 kΩ, R_3 = 1.0 kΩ, R_4 = 10 kΩ, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	700 100 1.7	- - -	ns ns V/µs
	(Gain = 10, 15% overshoot, R_1 = 1.0 kΩ, R_2 = 10 kΩ, R_3 = 1.0 kΩ, R_4 = 1.0 kΩ, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	600 80 6.25	- - -	ns ns V/µs
	(Gain = 10, 15% overshoot, R_1 = 1.0 kΩ, R_2 = 10 kΩ, R_3 = 1.0 kΩ, R_4 = 1.0 kΩ, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	600 80 1.7	- - -	ns ns V/µs
	(Gain = 1, 15% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5.0 kΩ, R_4 = 390 Ω, R_5 = 10 kΩ,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	400 80 4.2	- - -	ns ns V/µs
	(Gain = 1, 15% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 5.0 kΩ, R_4 = 390 Ω, R_5 = ∞,* C_1 = 2200 pF)	t_f t_{pd} dV_{out}/dt‡	- - -	400 80 1.4	- - -	ns ns V/µs
	Equivalent Input Noise Voltage (Open Loop) (R_S = 10 kΩ Noise Bandwidth = 1.0 Hz, f = 1.0 kHz)	e_n	-	30	-	$nV/(Hz)^{1/2}$
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = -55°C to +125°C) (R_S = 10 kΩ, T_A = -55°C to +125°C)	TC_{Vio}	 - -	 3.0 5.0	 - -	µV/°C
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	90	150	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	150	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	50	150	µV/V

*To improve performance, development is in process to include resistor $R_5 \approx 10$ kΩ on the device chip. Available after September 1968.

‡dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25^oC$)

FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS (FIGURE 1)					
			$R_1(\Omega)$	$R_2(\Omega)$	$R_3(\Omega)$	$R_4(\Omega)$	$R_5^*(\Omega)$	C_1(pF)
2	1	1.0	10 k	10 k	5.0 k	390	10 k	2200
	2	1.0	10 k	10 k	5.0 k	390	∞	2200
3	1	A_{VOL}	0	∞	0	∞	∞	0
	2	1000	1000	1.0 M	1000	0	∞	10
	3	100	1000	100 k	1000	10 k	∞	2200
	4	10	1000	10 k	1000	1.0 k	∞	2200
	5	1.0	10 k	10 k	5.0 k	390	∞	2200
4	1	A_{VOL}	0	∞	0	∞	∞	0
	2	A_{VOL}	0	∞	0	10 k	∞	2200
	3	A_{VOL}	0	∞	0	390	∞	2200

*To improve performance, development is in process to include resistor $R_5 \approx 10$ kΩ on the device chip. Available after September 1968.

FIGURE 1 – TEST CIRCUIT

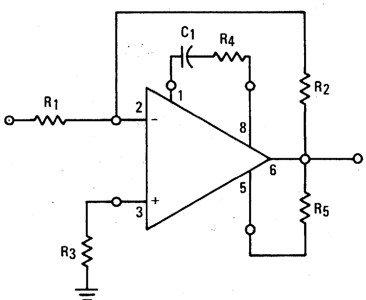


FIGURE 2 – POWER BANDWIDTH (LARGE SIGNAL SWING versus FREQUENCY)

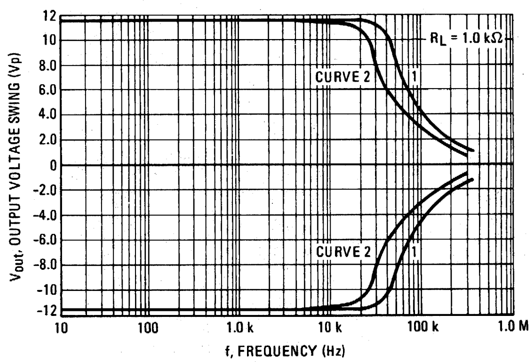


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

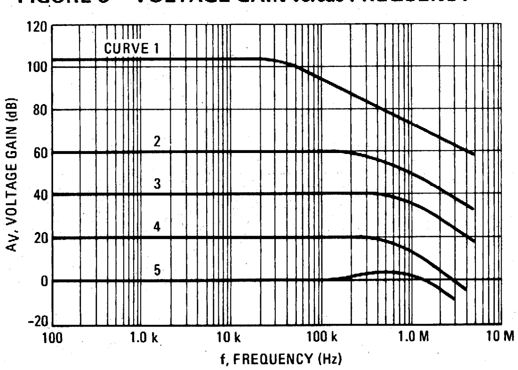


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

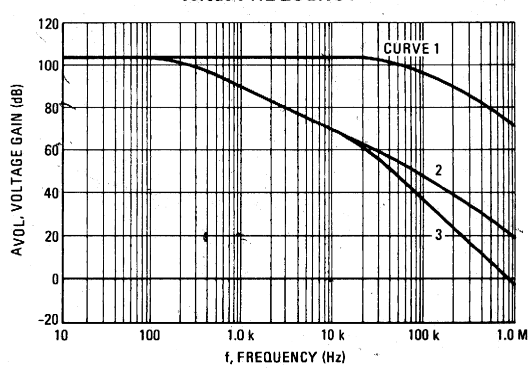


FIGURE 5 – INPUT OFFSET VOLTAGE versus TEMPERATURE

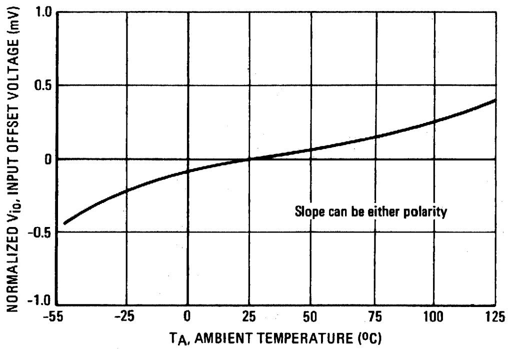


FIGURE 6 – INPUT OFFSET CURRENT versus TEMPERATURE

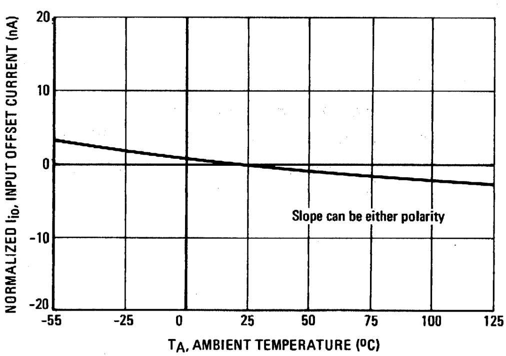


FIGURE 7 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

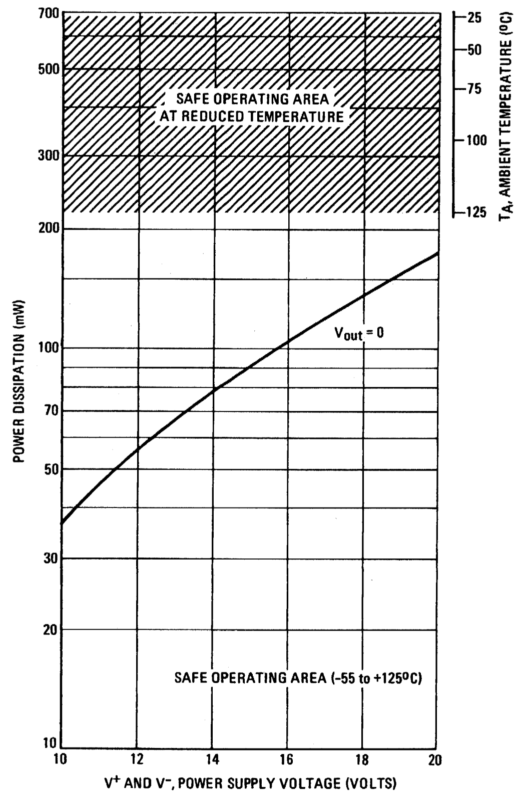


FIGURE 8 – INPUT BIAS CURRENT versus TEMPERATURE

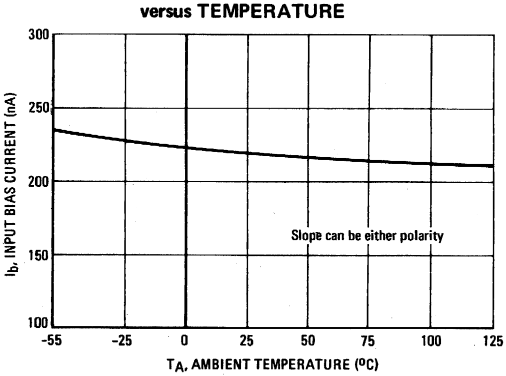
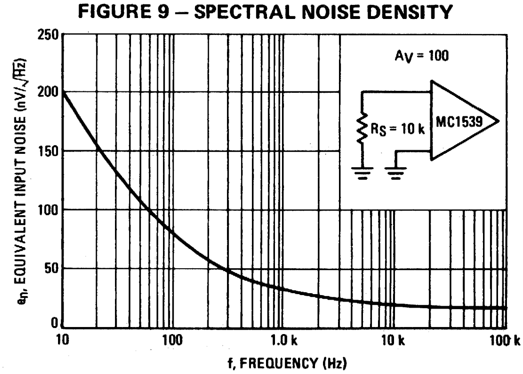


FIGURE 9 – SPECTRAL NOISE DENSITY

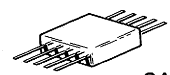


OPERATIONAL AMPLIFIER

MC1709

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

CASE 96
(TO-99)
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

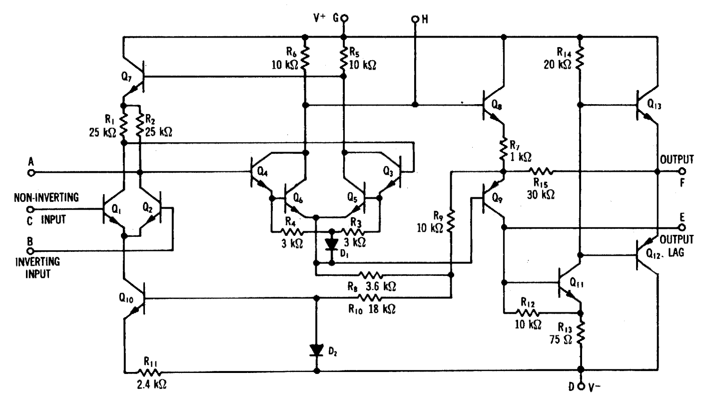
Typical Amplifier Features:

- High-Performance Open Loop Gain Characteristics
  A_{VOL} = 45,000 typical
- Low Temperature Drift – ±3.0 μV/°C
- Large Output Voltage Swing – ±14 V typical @ ±15 V Supply
- Low Output Impedance – Z_{out} = 150 ohms typical

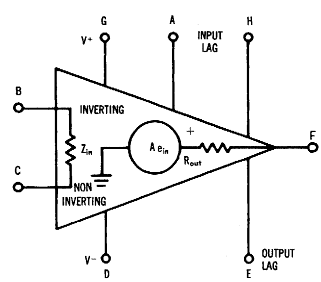
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Load Current	I_L	10	mA
Output Short Circuit Duration	t_S	5.0	s
Power Dissipation (Package Limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



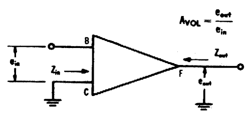
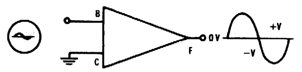
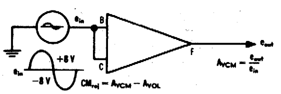
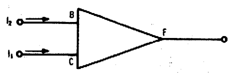
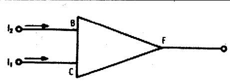
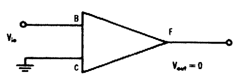
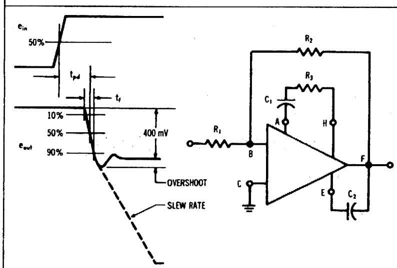
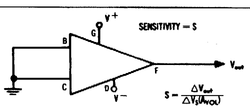
EQUIVALENT CIRCUIT



PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
"G" Package	1	2	3	4	5	6	7	8
"F" Package	2	3	4	5	6	7	8	9

ELECTRICAL CHARACTERISTICS ($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions①	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain ($V_{out} = \pm 10$ V, T_A = -55°C to +125°C)	A_{VOL}	25,000	45,000	70,000	-
	Output Impedance (f = 20 Hz)	Z_{out}	-	150	-	Ω
	Input Impedance (f = 20 Hz)	Z_{in}	150	400	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ) (R_L = 2 kΩ)	V_{out}	±12 ±10	±14 ±13	- -	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	±8	±10	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	70	90	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C) (T_A = -55°C)	I_b	- -	0.2 0.5	0.5 1.5	μA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = -55°C) ($I_{io} = I_1 - I_2$, T_A = +125°C)	I_{io}	- - -	0.05 - -	0.2 0.5 0.2	μA
	Input Offset Voltage (T_A = 25°C) (T_A = -55°C + 125°C)	V_{io}	- -	1.0 -	5.0 6.0	mV
	Step Response Gain = 100, 5% overshoot, R_1 = 1 kΩ, R_2 = 100 kΩ, R_3 = 1.5 kΩ, C_1 = 100 pF, C_2 = 3 pF	t_f t_{pd} dV_{out}/dt ②	- - -	0.8 0.38 12.0	- - -	μs μs V/μs
	Gain = 10, 10% overshoot, R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 500 pF, C_2 = 20 pF	t_f t_{pd} dV_{out}/dt ②	- - -	0.6 0.34 1.7	- - -	μs μs V/μs
	Gain = 1, 5% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 5000 pF, C_2 = 200 pF	t_f t_{pd} dV_{out}/dt ②	- - -	2.2 1.3 0.25	- - -	μs μs V/μs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = -55°C to +125°C) ($R_S \leq$ 10 kΩ, T_A = -55°C to +125°C)	TC_{Vio}	- -	3.0 6.0	- -	μV/°C
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	80	165	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	25	150	μV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	25	150	μV/V

① All definitions imply linear operation

② dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

FIGURE 1 — TEST CIRCUIT
V+ = +15 Vdc, V− = −15 Vdc, T_A = 25°C

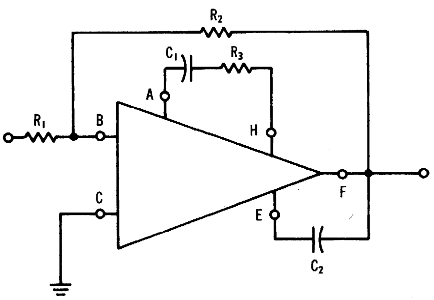


Fig. No.	Curve No.	Test Conditions				
		R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	C_1 (pF)	C_2 (pF)
2	1	10 k	10 k	1.5 k	5 k	200
	2	10 k	100 k	1.5 k	500	20
	3	10 k	1M	1.5 k	100	3
	4	1 k	1M	0	10	3
3	1	1 k	1M	0	10	3
	2	10 k	1M	1.5 k	100	3
	3	10 k	100 k	1.5 k	500	20
	4	10 k	10 k	1.5 k	5 k	200
4	1	0	∞	1.5 k	5 k	200
	2	0	∞	1.5 k	500	20
	3	0	∞	1.5 k	100	3
	4	0	∞	0	10	3

FIGURE 2 — LARGE SIGNAL SWING versus FREQUENCY

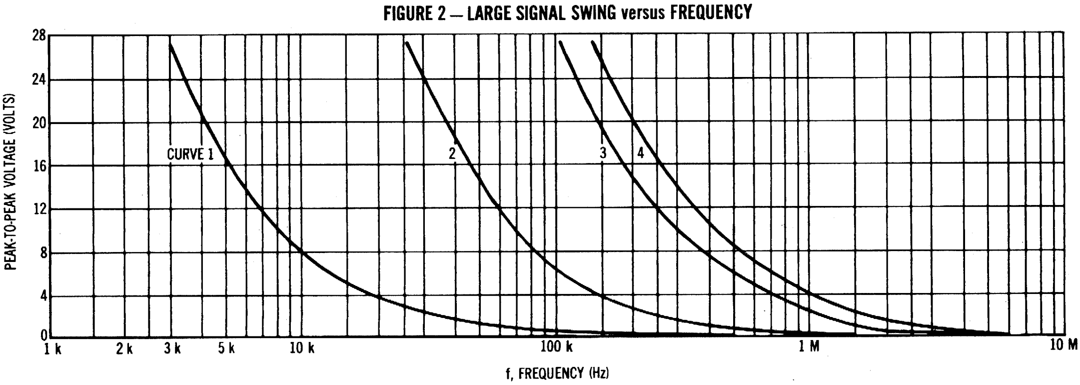


FIGURE 3 — VOLTAGE GAIN versus FREQUENCY

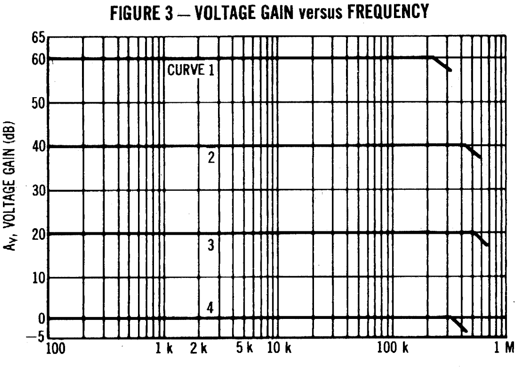


FIGURE 4 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY

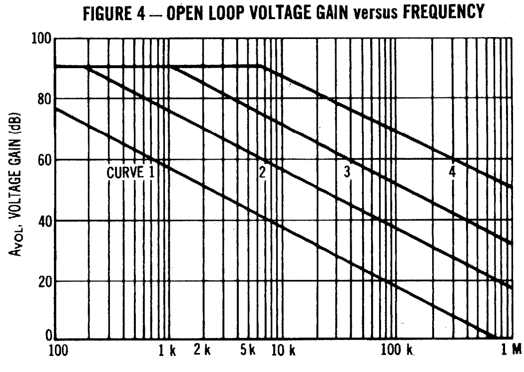


FIGURE 5 — POWER DISSIPATION versus POWER SUPPLY VOLTAGE

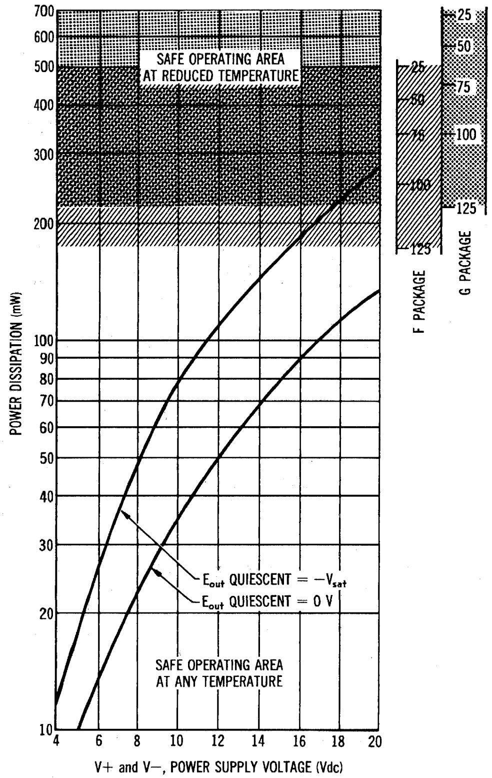


FIGURE 6 — VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

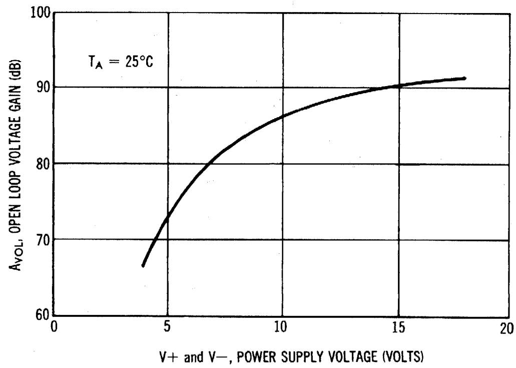


FIGURE 7 — COMMON SWING versus POWER SUPPLY VOLTAGE

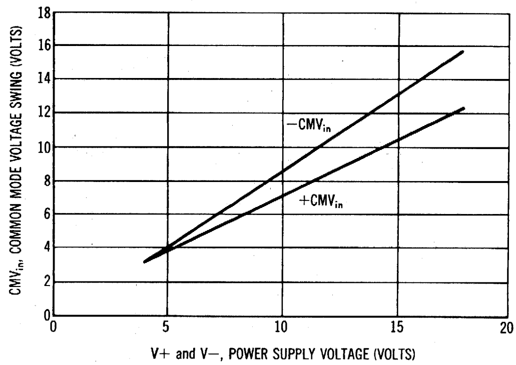


FIGURE 8 — INPUT OFFSET VOLTAGE versus TEMPERATURE

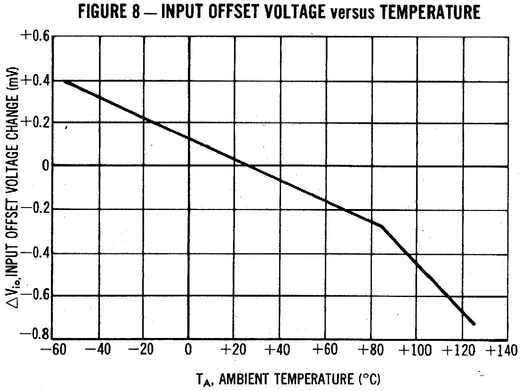
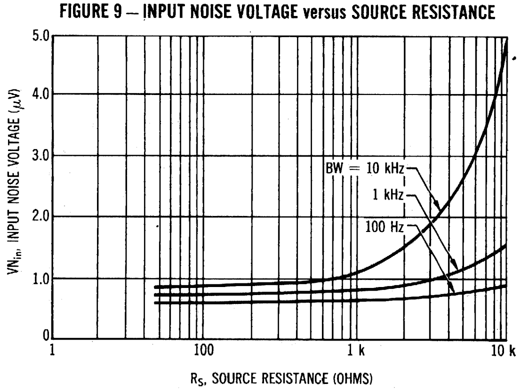
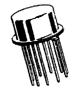


FIGURE 9 — INPUT NOISE VOLTAGE versus SOURCE RESISTANCE



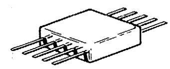
MC1709C

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

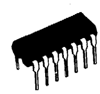


Lead 4 connected to case

CASE 96 (TO-99) "G" SUFFIX



CASE 72 (TO-91) "F" SUFFIX



CASE 93 (TO-116) "P" SUFFIX

Typical Amplifier Features:

- High-Performance Open Loop Gain Characteristics
  A_{VOL} = 45,000 typical
- Low Temperature Drift — ±3.0 μV/°C
- Large Output Voltage Swing — ±14 V typical @ ±15 V Supply
- Low Output Impedance — Z_{out} = 150 ohms typical

PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
"G" Package	1	2	3	4	5	6	7	8
"F" Package	2	3	4	5	6	7	8	9
"P" Package	3	4	5	6*	9	10	11	12

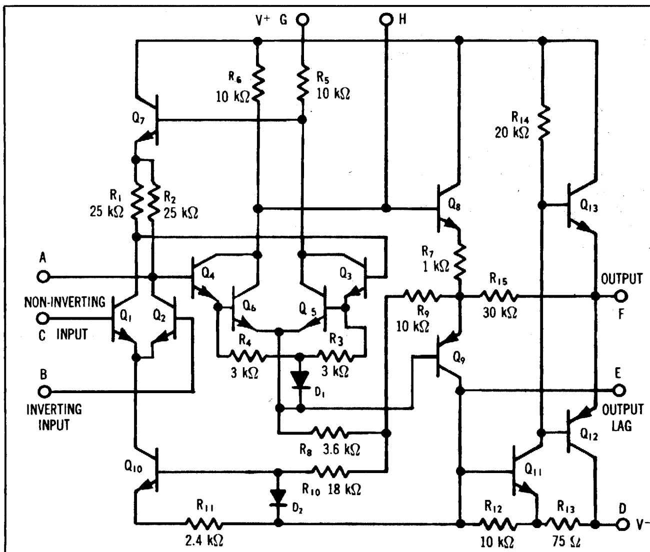
*Pin 7 is electrically connected to substrate and V^-

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

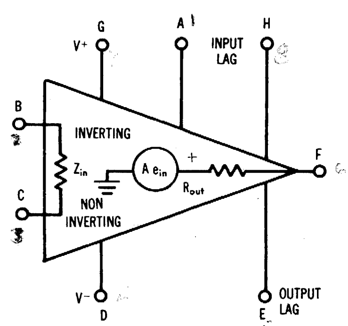
Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
Load Current	I_L	10	mA
Output Short Circuit Duration	t_S	5.0	s
Power Dissipation (Package Limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range*	T_A	0 to +75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

* For full temperature range (-55°C to +125°C) and characteristic curves, see MC1709 data sheet.

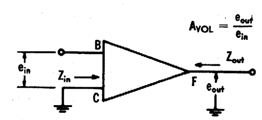
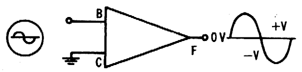
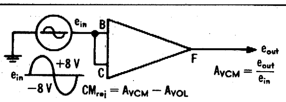
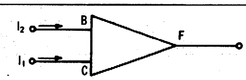
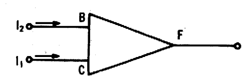
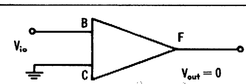
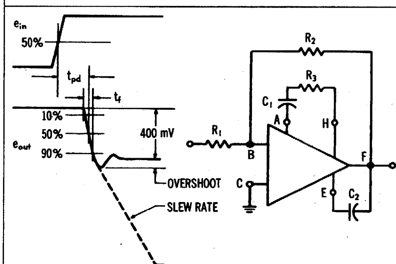
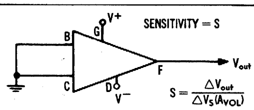
CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS (V^+ = +15 Vdc, V^- = −15 Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operation)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (R_L=2 kΩ, V_{out} = ± 10 V, T_A = 0°C to +75°C)	A_{VOL}	15,000	45,000	-	-
	Output Impedance (f = 20 Hz)	Z_{out}	-	150	-	Ω
	Input Impedance (f = 20 Hz)	Z_{in}	50	250	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ) (R_L = 2 kΩ)	V_{out}	±12 ±10	±14 ±13	- -	V_{peak}
	Input Common Mode Voltage Swing	CMV_{in}	±8.0	±10	-	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	65	90	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$ (T_A = +25°C) (T_A = 0°C)	I_b	- -	0.3 -	1.5 2.0	µA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = 0°C) ($I_{io} = I_1 - I_2$, T_A = +75°C)	I_{io}	- - -	0.1 - -	0.5 0.75 0.75	µA
	Input Offset Voltage (T_A = 25°C) (T_A = 0°C, +75°C)	V_{io}	- -	2.0 -	7.5 10	mV
	Step Response {Gain = 100, 5% overshoot, R_1 = 1 kΩ, R_2 = 100 kΩ, R_3 = 1.5 kΩ, C_1 = 100 pF, C_2 = 3 pF}	t_f t_{pd} dV_{out}/dt ①	- - -	0.8 0.38 12	- - -	µs µs V/µs
	{Gain = 10, 10% overshoot, R_1 = 1 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 500 pF, C_2 = 20 pF}	t_f t_{pd} dV_{out}/dt ①	- - -	0.6 0.34 1.7	- - -	µs µs V/µs
	{Gain = 1, 5% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1=5000 pF, C_2=200 pF}	t_f t_{pd} dV_{out}/dt ①	- - -	2.2 1.3 0.25	- - -	µs µs V/µs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = 0°C to +75°C) ($R_S \le$ 10 kΩ, T_A = 0°C to +75°C)	TC_{Vio}	- -	3.0 6.0	- -	µV/°C
	DC Power Dissipation (Power Supply = ±15 V, V_{out} = 0)	P_D	-	80	200	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	25	200	µV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	25	200	µV/V

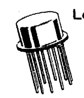
① dV_{out}/dt = Slew Rate

WIDEBAND DC AMPLIFIER

OPERATIONAL AMPLIFIERS

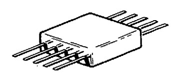
MC1712

. . . designed for use as an operational amplifier utilizing operating characteristics as a function of the external feedback components.



Lead 4 connected to case

CASE 96
(TO-99)
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

Typical Amplifier Features:

- Open Loop Gain A_{VOL} = 3600 typical
- Low Temperature Drift — ±2.5 μV/°C
- Output Swing — ±5.3 V typical @ +12 V and -6.0 V Supplies
- Low Output Impedance — Z_{out} = 200 ohms typical

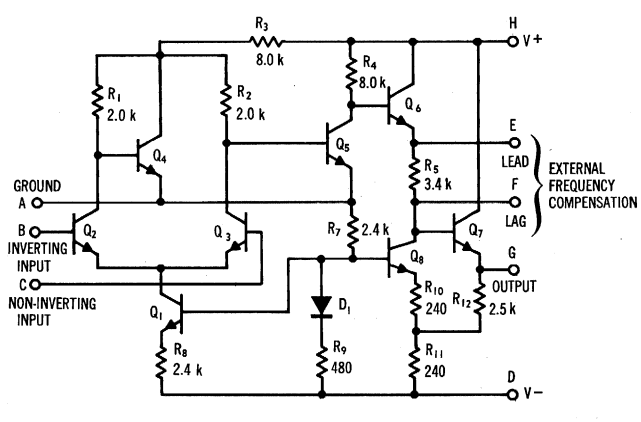
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage (Total between V^+ and V^- terminals)	$\|V^+\|+\|V^-\|$	21	Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	+1.5 -6.0	Volts
Peak Load Current	I_L	50	mA
Power Dissipation (Package Limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

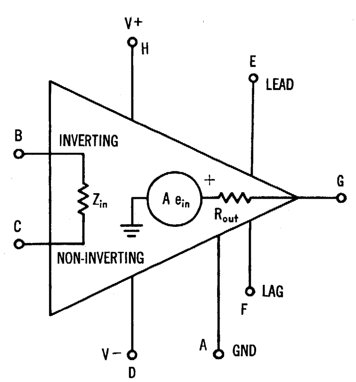
PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
"G" Package	1	2	3	4	5	6	7	8
"F" Package	2	3	4	5	6	7	8	10

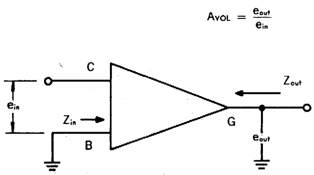
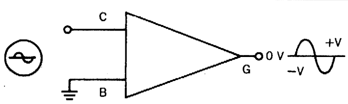
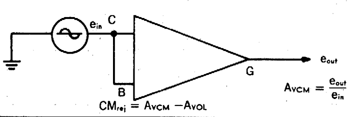
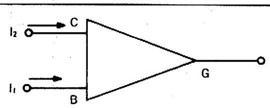
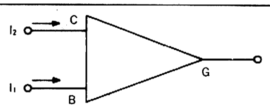
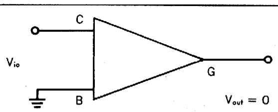
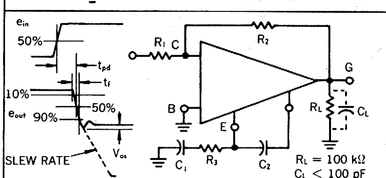
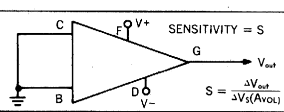
CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic Definitions ①	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain R_L = 100 kΩ	A_{VOL}				V/V
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, V_{out} = ± 2.5 V)		600	900	1500	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, V_{out} = ± 5.0 V)		2500	3600	6000	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, V_{out} = ± 5.0 Vdc, T_A = -55, +125°C)		2000		7000	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, V_{out} = ± 2.5 V, T_A = -55 to +125°C)		500		1750	
	Output Impedance	Z_{out}				ohms
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f = 20 Hz)		-	300	700	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f = 20 Hz)		-	200	500	
	Input Impedance	Z_{in}				k ohms
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f = 20 Hz)		22	70	-	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f = 20 Hz, T_A = -55°C, +125°C)		8.0	-	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f = 20 Hz)		16	40	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f = 20 Hz, T_A = -55°C, +125°C)		6.0	-	-	
	Output Voltage Swing	V_{out}				V_{peak}
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, R_L = 100 kΩ)		±2.5	±2.7	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, R_L = 100 kΩ)		±5.0	±5.3	-	
	(V^+ = +6.0 Vdc, V^- = -3.0 Vdc, R_L = 10 kΩ)		± 1.5	± 2.0		
	(V^+ = +12 Vdc, V^- = -6.0 Vdc, R_L = 10 kΩ)		± 3.5	± 4.0		
	Input Common Mode Voltage Swing	CMV_{in}				V_{peak}
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		+0.5	-	-	
			-1.5	-	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		+0.5	-	-	
			-4.0	-	-	
	Common Mode Rejection Ratio	CM_{rej}				dB
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f ≤ 1.0 kHz)		80	100	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f ≤ 1.0 kHz)		80	100	-	
	Input Bias Current $I_b = \frac{I_1 + I_2}{2}$, T_A = 25°C	I_b				μA
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	1.2	3.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	2.0	5.0	
	T_A = -55°C (V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	2.5	7.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	4.0	10	
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}				μA
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	0.1	0.5	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, T_A = -55 to +125°C)		-	-	1.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	0.2	0.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, T_A = -55 to +125°C)		-	-	1.5	
	Input Offset Voltage R_S = 2.0 kΩ	V_{io}				mV
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	1.3	3.0	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, T_A = -55°C, +125°C)		-	-	4.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	1.1	2.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, T_A = -55°C, +125°C)		-	-	3.0	
	Step Response					
	V^+ = 12 Vdc, V^- = -6.0 Vdc	V_{os}	-	20	40	%
	Gain = 100, V_{in} = 1.0 mV,	t_f	-	10	30	ns
	R_1 = 1.0 kΩ, R_2 = 100 kΩ,	t_{pd}	-	10	-	ns
	C_2 = 50 pF, R_3 = ∞, C_1 = open	dV_{out}/dt②	-	12	-	V/μs
	V^+ = 12 Vdc, V^- = -6.0 Vdc	V_{os}	-	10	50	%
	Gain = 1.0, V_{in} = 10 mV,	t_f	-	25	120	ns
	R_1 = 10 kΩ, R_2 = 10 kΩ,	t_{pd}	-	16	-	ns
	C_1 = 0.01 μF, R_3 = 20Ω, C_2 = open	dV_{out}/dt②	-	1.5	-	V/μs
	Average Temperature Coefficient of Input Offset Voltage R_S = 50 Ω	TC_{Vio}				μV/°C
	(T_A = +25 to +125°C)		-	2.5	-	
	(T_A = -55 to +25°C)		-	2.0	-	
	Average Temperature Coefficient Input Offset Current	TC_{Iio}				nA/°C
	(T_A = +25°C to +125°C)		-	0.05	-	
	(T_A = -55 to +25°C)		-	1.5	-	
	DC Power Dissipation	P_D				mW
	(V_{out} = 0, V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	17	30	
	(V_{out} = 0, V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	70	120	
	Positive Supply Sensitivity (V^- constant = -6.0 Vdc, V^+ = 12 Vdc to 6.0 Vdc)	S^+	-	60	200	μV/V
	Negative Supply Sensitivity (V^+ constant = 12 Vdc, V^- = -6.0 Vdc to -3.0 Vdc)	S^-	-	60	200	μV/V

① All definitions imply linear operation. ② dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

V+ = 12 Vdc, V− = −6.0 Vdc, T_A = 25°C

FIGURE 1 — OPEN LOOP GAIN versus POWER SUPPLY VARIATIONS

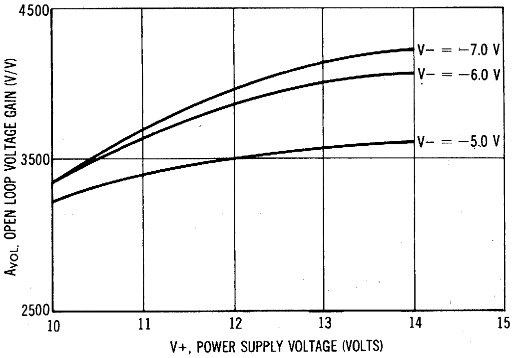


FIGURE 2 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY

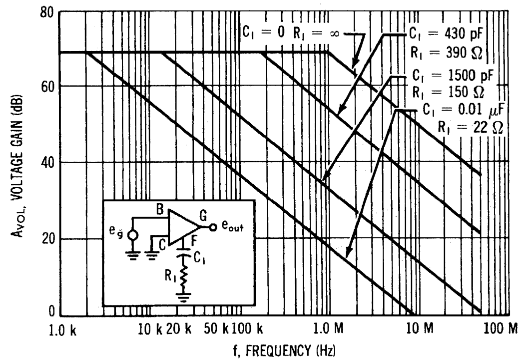


FIGURE 3 — VOLTAGE GAIN versus FREQUENCY

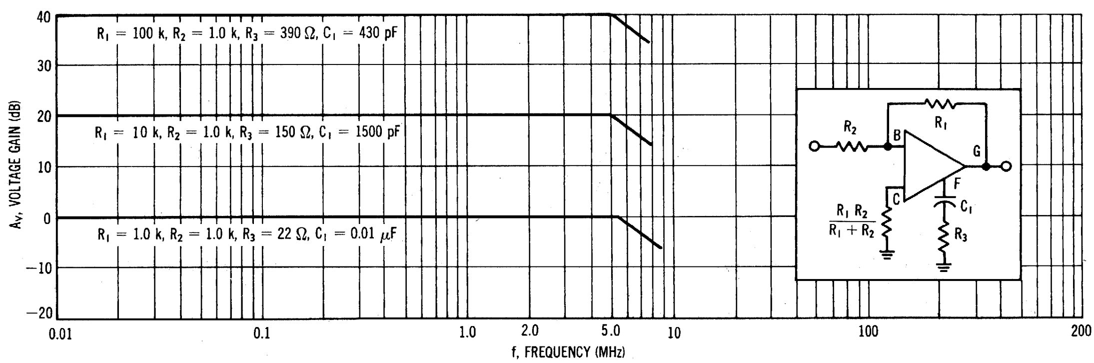


FIGURE 4 — MAXIMUM OUTPUT SWING versus FREQUENCY

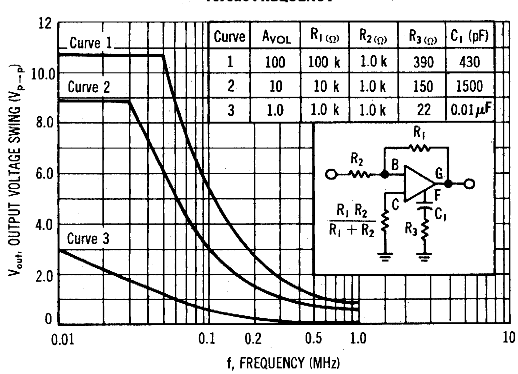


FIGURE 5 — OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

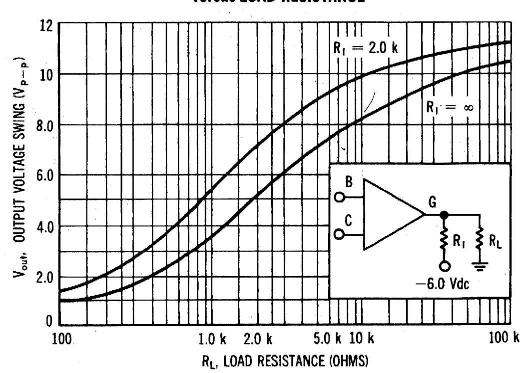


FIGURE 6 — INPUT BIAS CURRENT versus TEMPERATURE

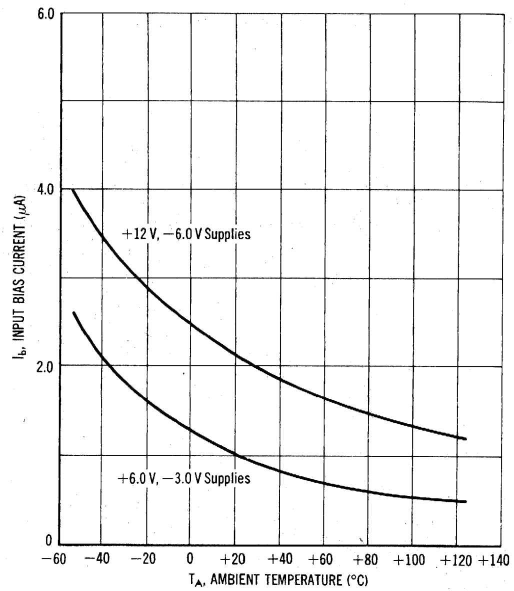


FIGURE 7 — INPUT OFFSET CURRENT versus TEMPERATURE

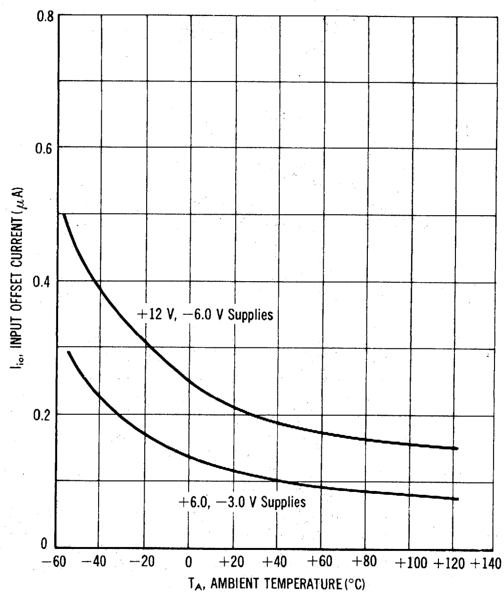


FIGURE 8 — INPUT OFFSET VOLTAGE versus TEMPERATURE

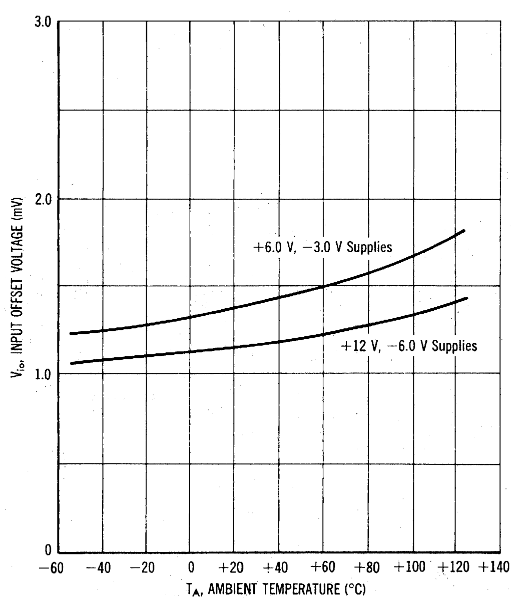
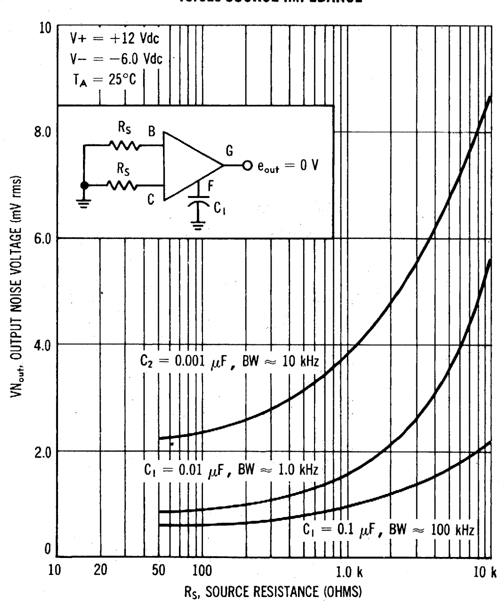


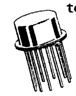
FIGURE 9 — OUTPUT NOISE VOLTAGE versus SOURCE IMPEDANCE



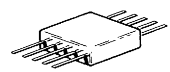
MC1712C

. . . designed for use as an operational amplifier utilizing operating characteristics as a function of the external feedback components.

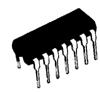
Lead 4 connected to case



CASE 96
(TO-99)
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX



CASE 93
(TO-116)
"P" SUFFIX

Typical Amplifier Features:

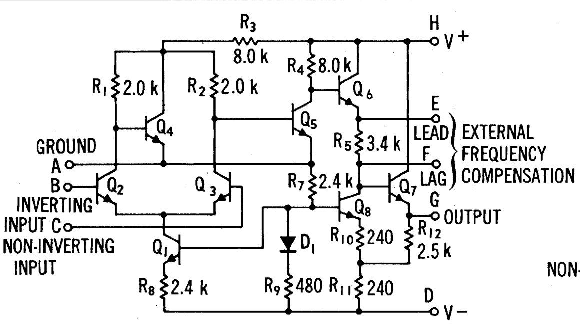
- Open Loop Gain A_{VOL} = 3400 typical
- Low Temperature Drift – ±5.0 µV/°C
- Output Voltage Swing – ±5.3 V typical @ +12 V and -6.0 V Supplies
- Low Output Impedance – Z_{out} = 200 ohms typical

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

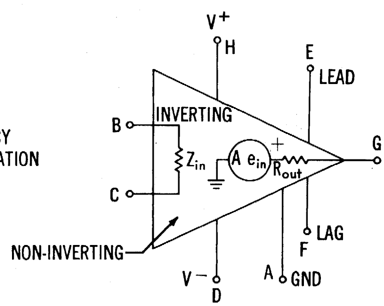
Rating	Symbol	Value	Unit
Power Supply Voltage (Total between V^+ and V^- terminals)	$\|V^+\|+\|V^-\|$	21	Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	+1.5 -6.0	Volts
Peak Load Current	I_L	50	mA
Power Dissipation (Package Limitation)	P_D		
Metal Can		680	mW
Derate above 25°C		4.6	mW/°C
Flat Package		500	mW
Derate above 25°C		3.3	mW/°C
Plastic Package		400	mW
Derate above 25°C		3.3	mW/°C
Operating Temperature Range*	T_A	0 to +75	°C
Storage Temperature Range	T_{stg}		°C
Metal Can and Flat Package		-65 to +150	
Plastic Package		-55 to +125	

* For full temperature range (-55°C to +125°C) and characteristic curves, see MC1712 data sheet.

CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT

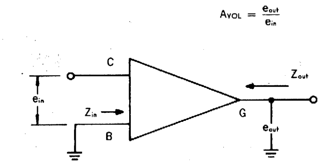
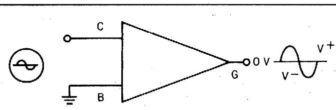
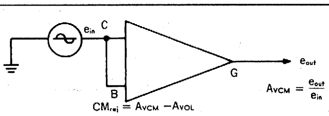
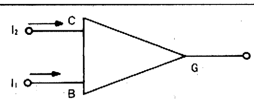
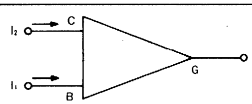
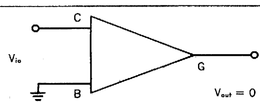
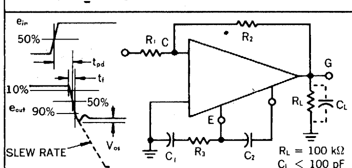
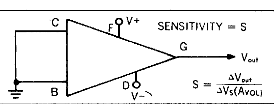


PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
"G" Package	1	2	3	4	5	6	7	8
"F" Package	2	3	4	5	6	7	8	10
"P" Package	3	4	5	6*	9	10	12	13

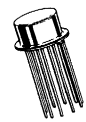
* Pin 7 is electrically connected to substrate and to V−

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic Definitions ①	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain R_L = 100 kΩ	A_{VOL}				V/V
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, V_{out} = ± 2.5 V)		500	800	1500	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, V_{out} = ± 5.0 V)		2000	3400	6000	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, V_{out} = ± 5.0 Vdc, T_A = 0, +75°C)		1500	-	7000	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, V_{out} = ± 2.5 V, T_A = 0, +75°C)		400	-	1750	
	Output Impedance	Z_{out}				ohms
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f = 20 Hz)		-	300	800	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f = 20 Hz)		-	200	600	
	Input Impedance	Z_{in}				k ohms
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f = 20 Hz)		16	55	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f = 20 Hz)		10	32	-	
	Output Voltage Swing	V_{out}				V_{peak}
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, R_L = 100 kΩ)		±2.5	±2.7	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, R_L = 100 kΩ)		±5.0	±5.3	-	
	(V^+ = +6.0 Vdc, V^- = -3.0 Vdc, R_L = 10 kΩ)		± 1.5	± 2.0	-	
	(V^+ = +12 Vdc, V^- = -6.0 Vdc, R_L = 10 kΩ)		± 3.5	± 4.0	-	
	Input Common Mode Voltage Swing	CMV_{in}				V_{peak}
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		+0.5 -1.5	- -	- -	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		+0.5 -4.0	- -	- -	
	Common Mode Rejection Ratio	CM_{rej}				dB
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, f ≤ 1.0 kHz)		70	95	-	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, f ≤ 1.0 kHz)		70	95	-	
	Input Bias Current $I_b = \frac{I_1 + I_2}{2}$, T_A = 25°C	I_b				µA
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	1.5	5.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	2.5	7.5	
	T_A = 0°C to +75°C: (V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	2.5	8.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc) T_A = 0°C to +75°C		-	4.0	12	
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}				µA
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	0.3	2.0	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, T_A = 0°C to +75°C)		-	-	2.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	0.5	2.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, T_A = 0°C to +75°C)		-	-	2.5	
	Input Offset Voltage R_S = 2.0 kΩ	V_{io}				mV
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	1.7	6.0	
	(V^+ = 6.0 Vdc, V^- = -3.0 Vdc, T_A = 0°C to +75°C)		-	-	7.5	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	1.5	5.0	
	(V^+ = 12 Vdc, V^- = -6.0 Vdc, T_A = 0°C to +75°C)		-	-	6.5	
	Step Response					
	V^+ = 12 Vdc, V^- = -6.0 Vdc, Gain = 100, V_{in} = 1.0 mV, R_1 = 1.0 kΩ, R_2 = 100 kΩ, C_2 = 50 pF, R_3 = ∞, C_1 = open	V_{os}	-	20	40	%
		t_f	-	10	30	ns
		t_{pd}	-	10	-	ns
		dV_{out}/dt②	-	12	-	V/µs
	V^+ = 12 Vdc, V^- = -6.0 Vdc, Gain = 1.0, V_{in} = 10 mV, R_1 = 10 kΩ, R_2 = 10 kΩ, C_1 = 0.01 µF, R_3 = 20Ω, C_2 = open	V_{os}	-	10	50	%
		t_f	-	25	120	ns
		t_{pd}	-	16	-	ns
		dV_{out}/dt②	-	1.5	-	V/µs
	Average Temperature Coefficient of Input Offset Voltage R_S = 50 Ω (T_A = 0, +75°C)	TC_{Vio}	-	5.0	-	µV/°C
	Average Temperature Coefficient Input Offset Current	TC_{Iio}				nA/°C
	(T_A = +25°C to +75°C)		-	4.0	-	
	(T_A = 0 to +25°C)		-	6.0	-	
	DC Power Dissipation	P_D				mW
	(V_{out} = 0, V^+ = 6.0 Vdc, V^- = -3.0 Vdc)		-	17	30	
	(V_{out} = 0, V^+ = 12 Vdc, V^- = -6.0 Vdc)		-	70	120	
	Positive Supply Sensitivity (V^- constant = -6.0 Vdc, V^+ = 12 Vdc to 6.0 Vdc)	S^+	-	60	300	µV/V
	Negative Supply Sensitivity (V^+ constant = 12 Vdc, V^- = -6.0 Vdc to -3.0 Vdc)	S^-	-	60	300	µV/V

① All definitions imply linear operation. ② dV_{out}/dt = Slew Rate

MC1110



CASE 89

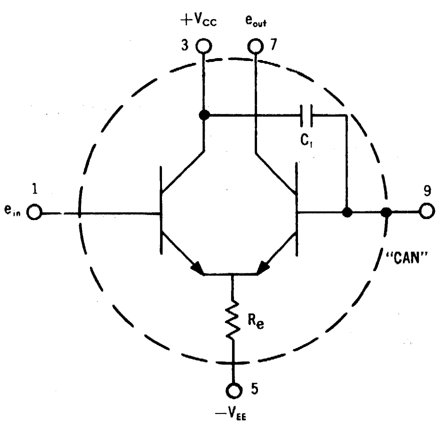
Typical Amplifier Features:

- DC – 300 MHz Performance
- Intended for IF and RF Applications
- 26 dB typ. Gain at 100 MHz
- High Stability Through Low Internal Feedback

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	10	Vdc
Power Supply Voltage	V_{EE}	14	Vdc
Total Power Dissipation (Derate 5 mW/°C above T_A = 25°C)	P_D	0.5	Watt
Operating Temperature Range	T_j	-55 to+125	°C
Storage Temperature Range	T_{stg}	-65 to+200	°C
Maximum Input Level (RMS)	V_{in}	2	V (RMS)

CIRCUIT SCHEMATIC



CIRCUIT DESCRIPTION

CIRCUIT OPERATION

The input terminal (Pin 1) of the device should be DC ground for optimum DC operating point. Pin 3 is to be supplied with a positive voltage (V_{CC}) for transistor collector and Pin 5 with a negative voltage (V_{EE}) to supply emitter bias current. AGC may be accomplished by variation of V_{EE}. The output of the circuit (Pin 7) should be operated at the same DC potential as is Pin 3. Pin 9 should be AC and DC grounded. Resistor R_e is a diffused silicon resistor, and C_1 is a silicon oxide capacitor.

ELECTRICAL CHARACTERISTICS (at T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
DC CHARACTERISTICS						
Input Leakage Current (V_3 = 5 Vdc; I_5, I_7, I_9 = 0)		I_1	---	---	10	nAdc
Output Leakage Current (V_7 = 5 Vdc; I_1, I_3, I_5 = 0)		I_9	---	---	10	nAdc
Operating Current (V_{CC} = 5 Vdc, V_{EE} = -4.7 Vdc, V_{in} = 0)	Figure 1	I_{CT}	3.8	4	4.2	mAdc
Input Operating Current V_{CC} = 5 Vdc, (V_{EE} = -10 Vdc, V_{in} = 0)	Figure 1	I_1	---	---	250	μAdc
Reference Operating Current V_{CC} = 5 Vdc, (V_{EE} = -10 Vdc, V_{in} = 0)	Figure 1	I_9	---	---	250	μAdc
Current Balance V_{CC} = 5 Vdc, (V_{EE} = -10 Vdc, V_{in} = 0) V_{CC} = 5 Vdc, V_{EE} = -4.7 Vdc, V_{in} = 0)	 Figure 1 Figure 1	I_3/I_7	 0.90 0.90	 --- ---	 1.10 1.10	---
Large Signal Transconductance (V_{CC} = 5 Vdc, V_{EE} = -4 Vdc, ΔV_{in} = 50 mV)		G_{21}	26	28	---	m-mhos
SMALL-SIGNAL CHARACTERISTICS						
Small Signal Current Gain (V_{CC} = 5 V, I_E = -4 mA, f = 100 MHz)		h_{21}	6.0	9.0	---	---
Short Circuit Admittances (V_{CC} = 5 V, V_{EE} = -4V, f = 100 MHz) Input Admittance Reverse Transfer Admittance Forward Transfer Admittance Output Admittance	Figure 2	--- $\lvert y_{11}\rvert$ $\lvert y_{12}\rvert$ $\lvert y_{21}\rvert$ $\lvert y_{22}\rvert$	 --- --- --- ---	 2.0 0.064 16.3 1.2	 --- --- --- ---	m-mhos
Transducer Power Gain (V_{CC} = 5V, V_{EE} = -4V, f = 100 MHz, BW = 3 MHz) (V_{CC} = 5V, V_{EE} = -4V, f = 200 MHz, BW = 6 MHz)	 Figure 20 Figure 21	G_T	 22 15	 26 18	 --- ---	dB
Noise Figure (V_{CC} = 5V, V_{EE} = -4V, f = 100 MHz, R_g = R_{SO})		NF	---	4	6	dB

FIGURE 1 — DC CHARACTERISTICS TEST CIRCUIT

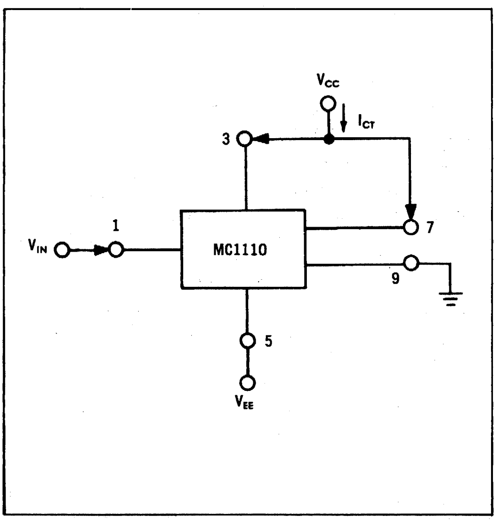
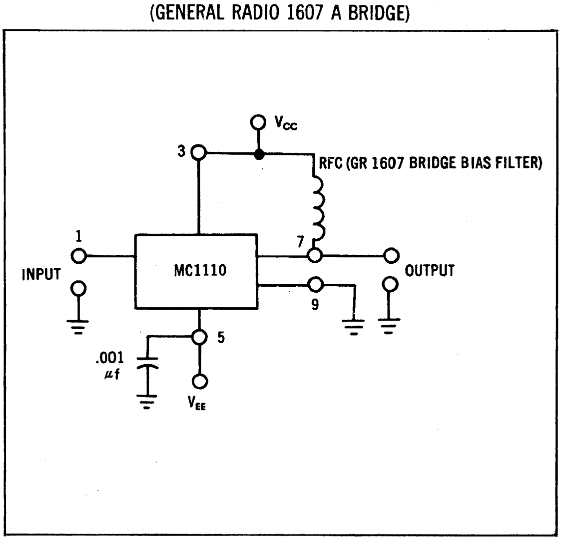
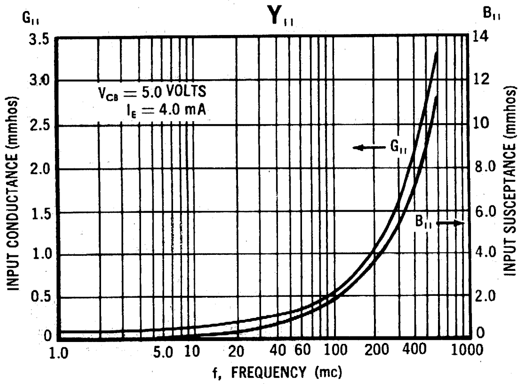


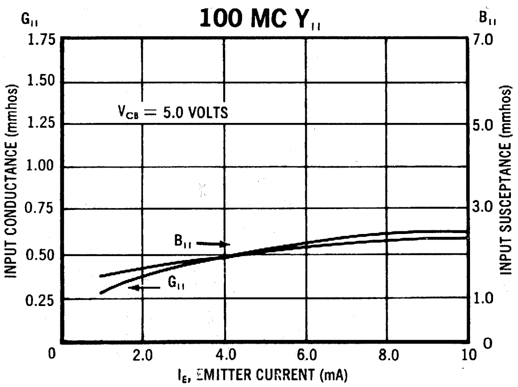
FIGURE 2 — SHORT CIRCUIT ADMITTANCE TEST CIRCUIT
(GENERAL RADIO 1607 A BRIDGE)





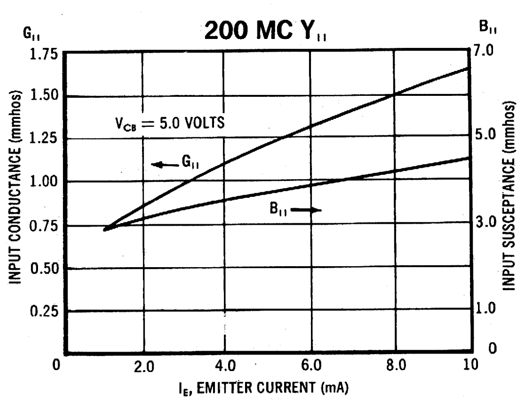
INPUT ADMITTANCE versus FREQUENCY

FIGURE 3



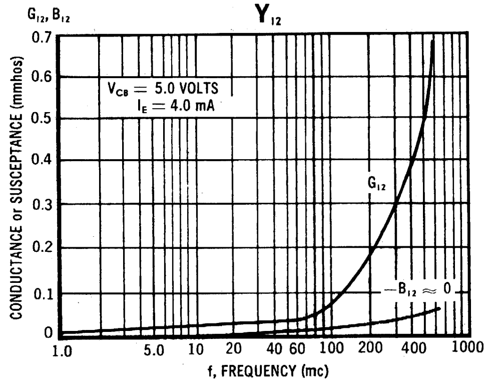
INPUT ADMITTANCE versus EMITTER CURRENT

FIGURE 4



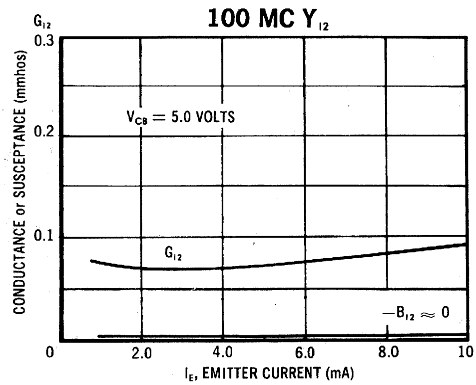
INPUT ADMITTANCE versus EMITTER CURRENT

FIGURE 5



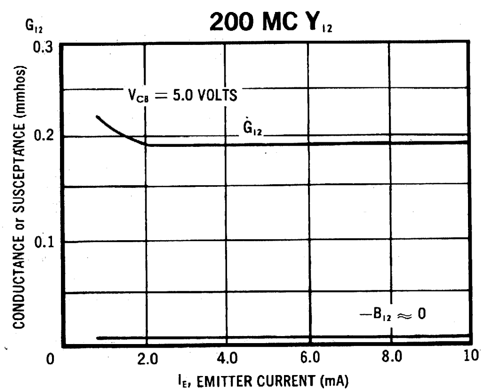
REVERSE TRANSFER ADMITTANCE versus FREQUENCY

FIGURE 6



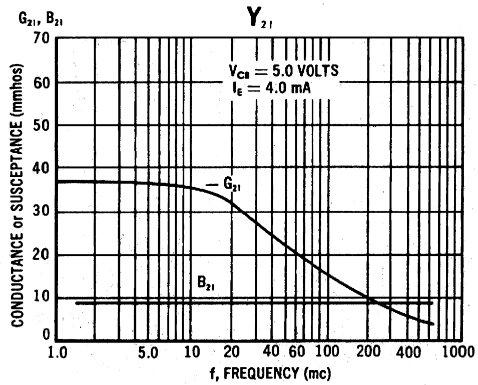
REVERSE TRANSFER ADMITTANCE versus EMITTER CURRENT

FIGURE 7



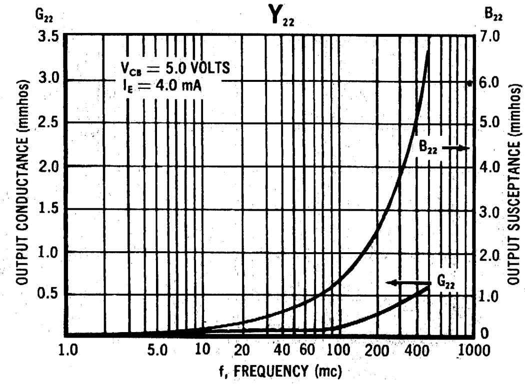
REVERSE TRANSFER ADMITTANCE versus EMITTER CURRENT

FIGURE 8



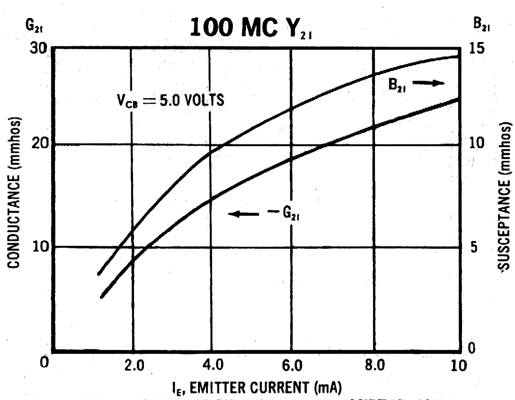
FORWARD TRANSFER ADMITTANCE versus FREQUENCY

FIGURE 9



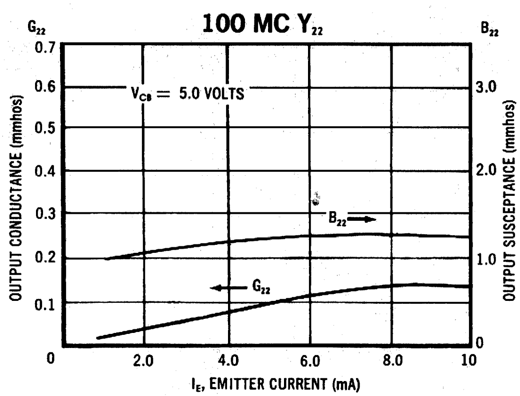
OUTPUT ADMITTANCE versus FREQUENCY,

FIGURE 12



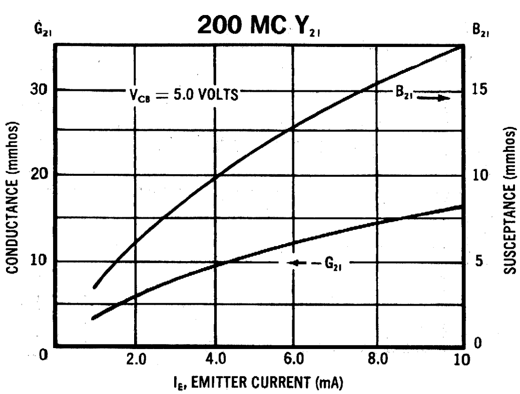
FORWARD TRANSFER ADMITTANCE versus EMITTER CURRENT

FIGURE 10



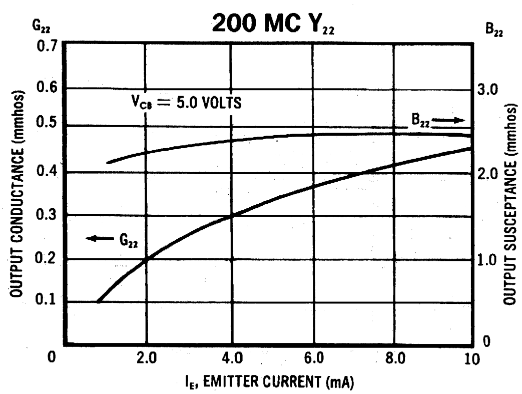
OUTPUT ADMITTANCE versus EMITTER CURRENT

FIGURE 13



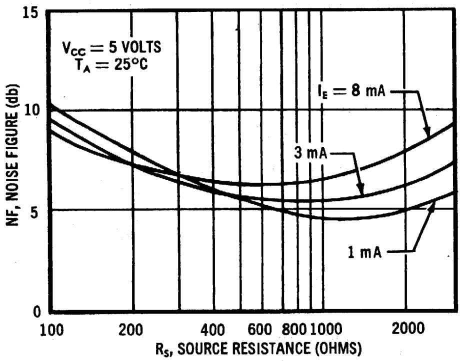
FORWARD TRANSFER ADMITTANCE versus EMITTER CURRENT

FIGURE 11



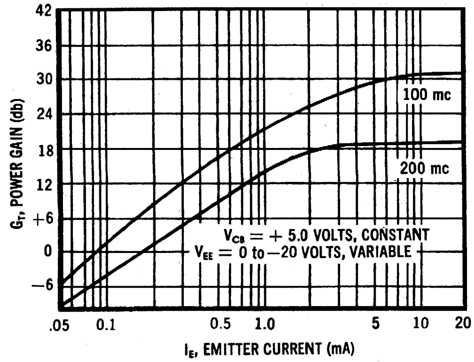
OUTPUT ADMITTANCE versus EMITTER CURRENT

FIGURE 14



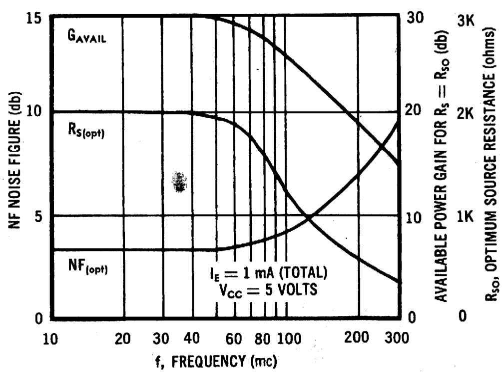
100 MC NOISE FIGURE vs. SOURCE RESISTANCE

FIGURE 15



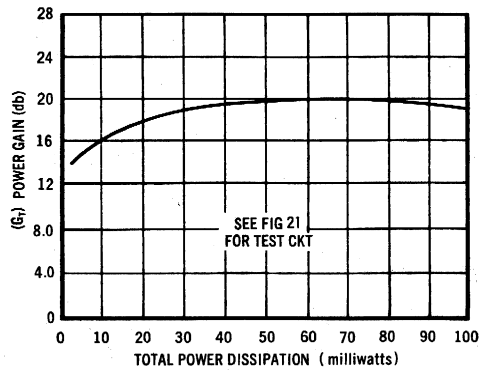
GAIN CONTROL CHARACTERISTICS

FIGURE 16



OPTIMUM NOISE FIGURE, OPTIMUM SOURCE RESISTANCE, AND AVAILABLE POWER GAIN vs. FREQUENCY

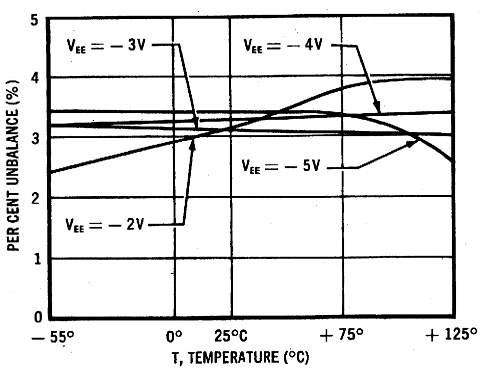
FIGURE 17



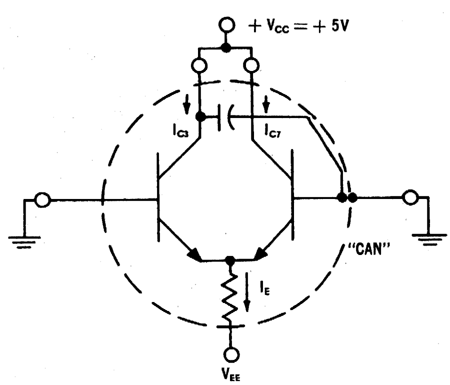
200 MC TRANSDUCER POWER GAIN (G_T) vs. POWER DISSIPATION

FIGURE 18

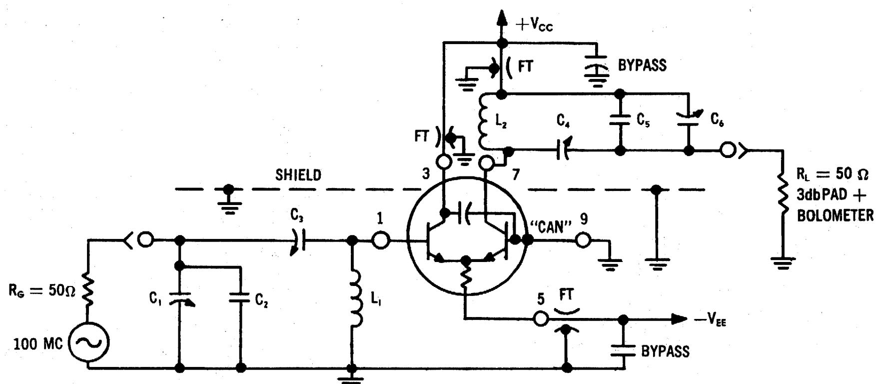
FIGURE 19



PERCENT UNBALANCE IN COLLECTOR CURRENTS (I_{C3}/I_{C7}) vs. TEMPERATURE



TEST CIRCUIT

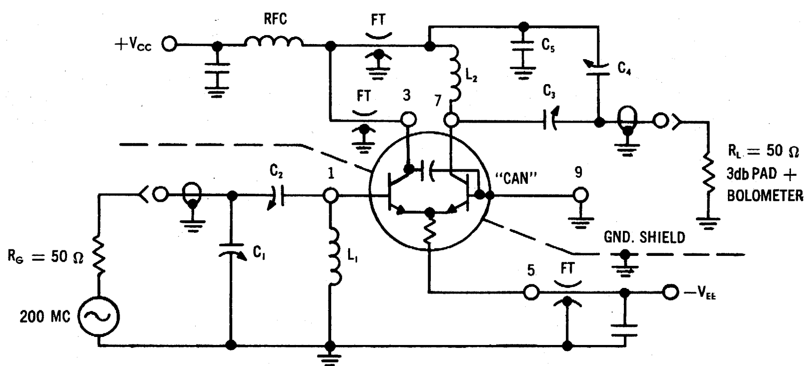


COMPONENT VALUES

C_1, C_6	VARIABLE CERAMIC CAPACITOR	9-35 μμf
C_3	VARIABLE CERAMIC CAPACITOR	5.5-18 μμf
C_4	VARIABLE CERAMIC CAPACITOR	2-8 μμf
C_2, C_5	FIXED MICA CAPACITOR	50 μμf
FT ALL	FEED THROUGH CAPACITORS	1200 μμf
Bypass	CAPACITORS, DISC CERAMIC	0.1 μf, 75 Vdc
L_1	INPUT INDUCTOR, 0.15 μh Q > 50	
L_2	OUTPUT INDUCTOR, 0.25 μh Q > 50	

V_{CC} = 5.0 Vdc
V_{EE} = −4 VOLTS

FIGURE 20 — 100 MC POWER GAIN TEST SET



COMPONENT VALUES

C_1, C_4	VARIABLE CERAMIC CAPACITOR	5.5-18 μμf
C_2, C_3	VARIABLE CERAMIC CAPACITOR	2-8 μμf
C_5	FIXED MICA CAPACITOR	300 μμf
FT ALL	FEED THROUGH CAPACITORS	1200 μμf
BYPASS	CAPACITORS, DISC CERAMIC	0.1 μf, 75 Vdc
L_1	INPUT INDUCTOR	30 nhy Q > 100, 2T #16 AWG ¼″ FORM
L_2	OUTPUT INDUCTOR	50 nhy Q > 100, 4T #16 AWG ¼″ FORM
RFC	JEFFERS MOLDED CHOKE	0.68 μh

V_{CC} = 5.0 Vdc
V_{EE} = −4 VOLTS

FIGURE 21 — 200 MC POWER GAIN TEST SET

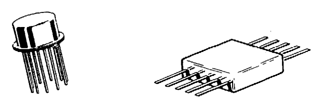
VIDEO AMPLIFIER

MC1510
MC1509

. . . designed for use as a high-frequency differential amplifier with operating characteristics that provide a flat frequency response from dc to 40 MHz.

Typical Amplifier Features:

- High Gain Characteristics
  A_V = 93 typical
- Wide Bandwidth — dc to 40 MHz
- Large Output Voltage Swing — 4.5 V p-p typical @ ±6.0 V Supply
- Low Output Distortion — THD ≦ 1.5%



Lead 4 connected to case

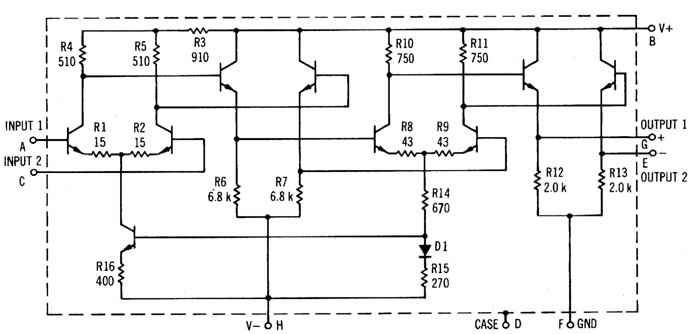
CASE 96
(TO-99)
MC1510G

CASE 73
(TO-90)
MC1510F
MC1509F

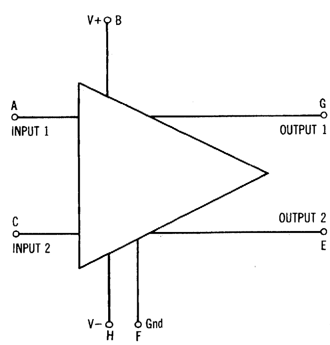
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+8.0 -8.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	±6.0	Volts
Load Current	I_L	10	mA
Output Short Circuit Duration	t_S	5.0	s
Power Dissipation (Package Limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT



PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
MC1510G	1	2	3	4	5	6	7	8
MC1510F	10	9	1	—	4	5	7	8
MC1509F	1	3	5	—	6	7	9	10

ELECTRICAL CHARACTERISTICS ($V+ = +6$ Vdc, $V- = -6$ Vdc, $T_A = 25°C$ unless otherwise noted)

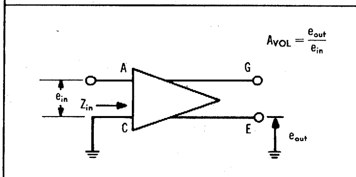
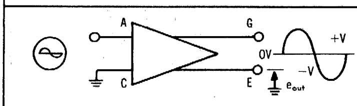
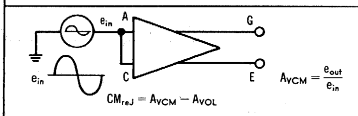
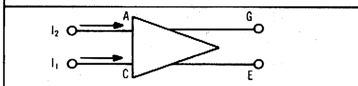
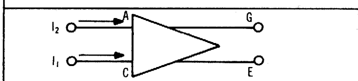
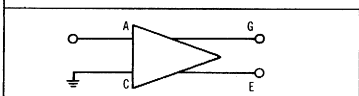
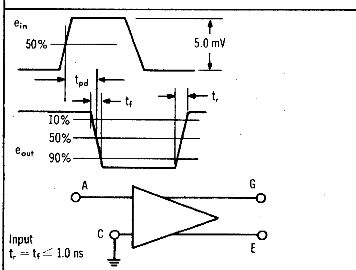
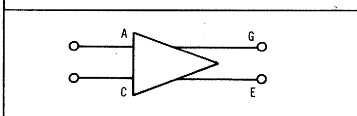
Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Single Ended Voltage Gain	$A_{V(se)}$	75	93	110	-
	Output Impedance (f = 20 kHz)	Z_{out}	-	35	-	Ω
	Input Impedance (f = 20 kHz)	Z_{in}	-	6.0	-	kΩ
	Bandwidth (-3.0 dB)	BW	-	40	-	MHz
	Output Voltage Swing (R_L = 5.0 kΩ, f = 100 kHz)	V_{out}	-	4.5	-	Vp-p
	Single Ended Output Distortion (e_{in} < 0.2% Distortion)	THD	-	1.5	5.0	%
	Input Common Mode Voltage Swing	CMV_{in}	-	±1.0	-	V_{peak}
	Common Mode Voltage Gain (R_L = 5 kΩ, e_{in} = 0.3 V rms, f = 100 kHz)	AVCM	-30	-45	-	dB
	Common Mode Rejection Ratio	CM_{rej}	-	-85	-	
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$ Differential Output = 0	I_b	-	20	80	μA
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}	-	3.0	20	μA
	Output Offset Voltage Differential Mode (V_{in} = 0)	$V_{out(DM)}$	-	0.5	1.3	Vdc
	Common Mode (Differential Output = 0)	$V_{out(CM)}$	2.6	3.1	3.5	
	Step Response	t_f	-	9.0	12	ns
		t_{pd}	-	9.0	-	
		t_r	-	9.0	12	
	Average Temperature Coefficient of Input Offset Voltage	TC_{Vio}				μV/°C
	(R_S = 50 Ω, T_A = -55°C to +125°C)		-	3.0	-	
	(R_S ≤ 10 kΩ, T_A = -55°C to +125°C)		-	6.0	-	
	DC Power Dissipation (Power Supply = ± 6.0 V)	P_D	-	150	220	mW
	Input Noise Voltage (f = 5.0 Hz to 10 MHz)	V_n	-	4.5	-	μV

FIGURE 1 — VOLTAGE GAIN versus FREQUENCY

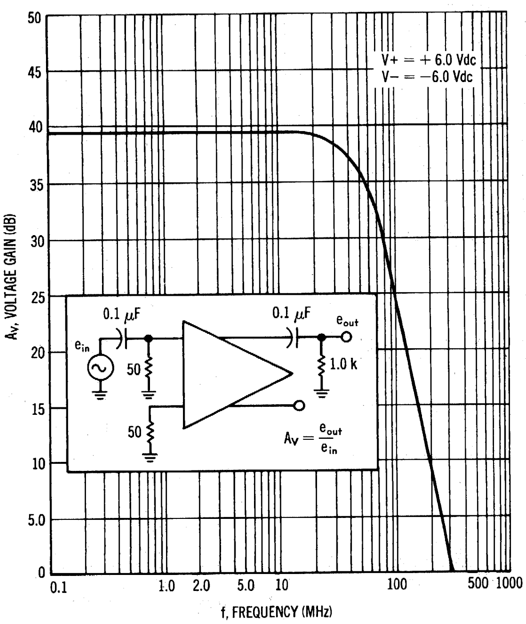


FIGURE 2 — VOLTAGE GAIN versus SUPPLY VOLTAGE

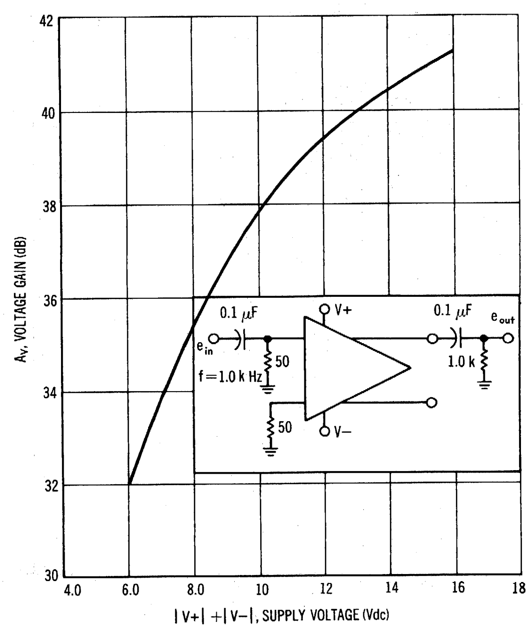


FIGURE 3 — VOLTAGE GAIN versus TEMPERATURE

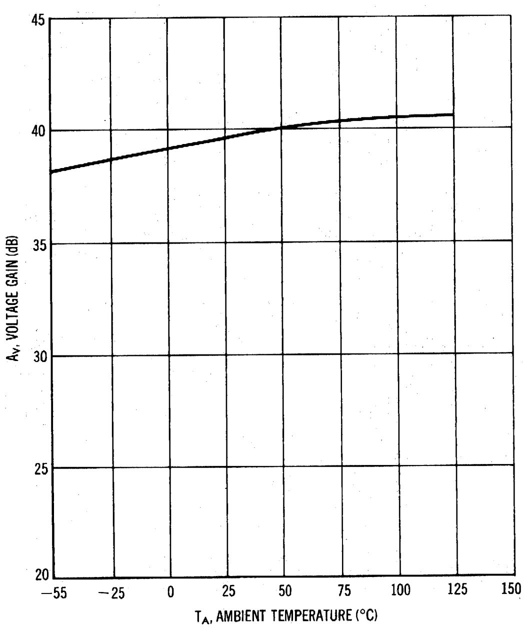


FIGURE 4 — LIMITING CHARACTERISTICS

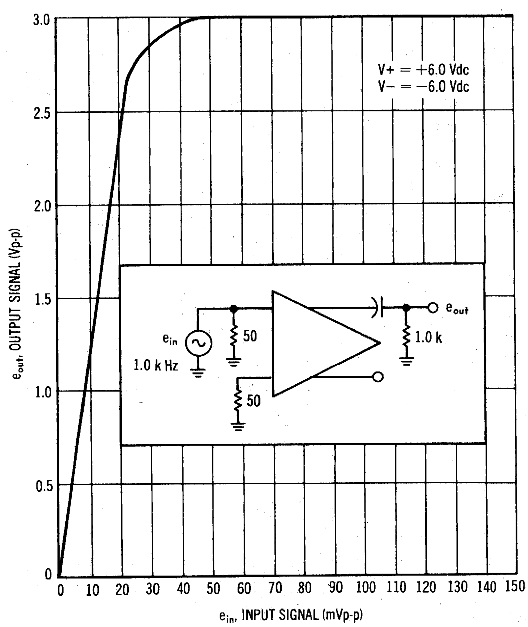


FIGURE 5 — DC OUTPUT VOLTAGE versus TEMPERATURE

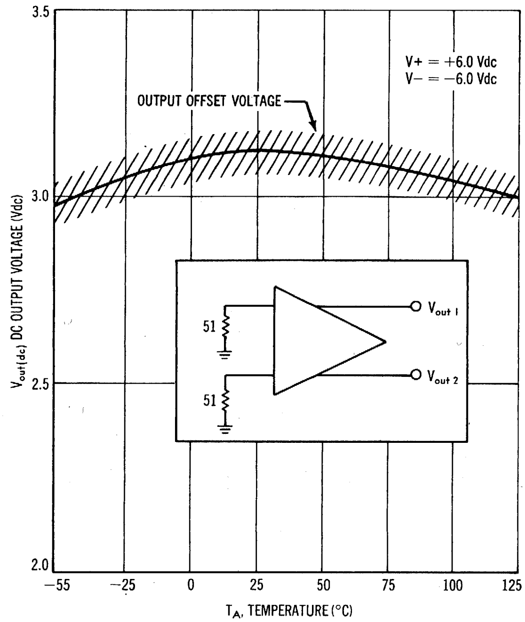


FIGURE 6 — INPUT BIAS CURRENT versus TEMPERATURE

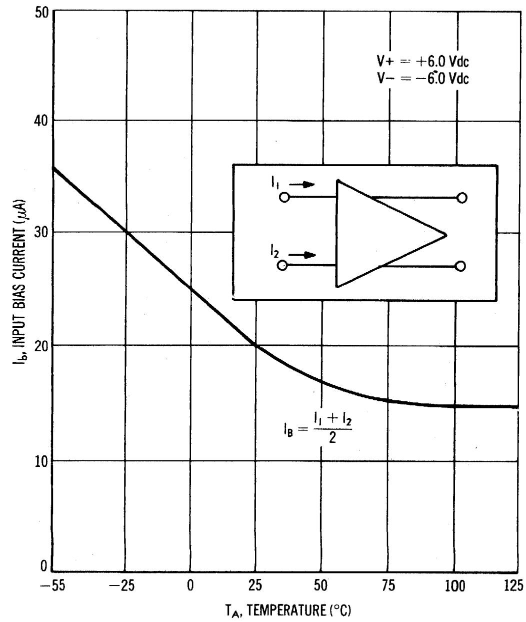


FIGURE 7 — POWER DISSIPATION versus SUPPLY VOLTAGE

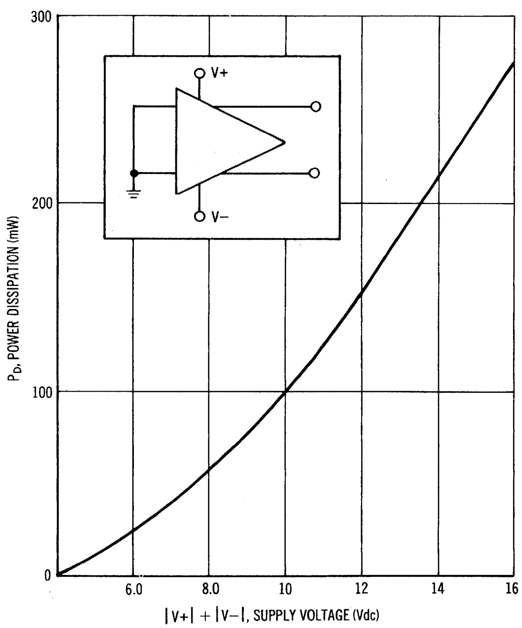
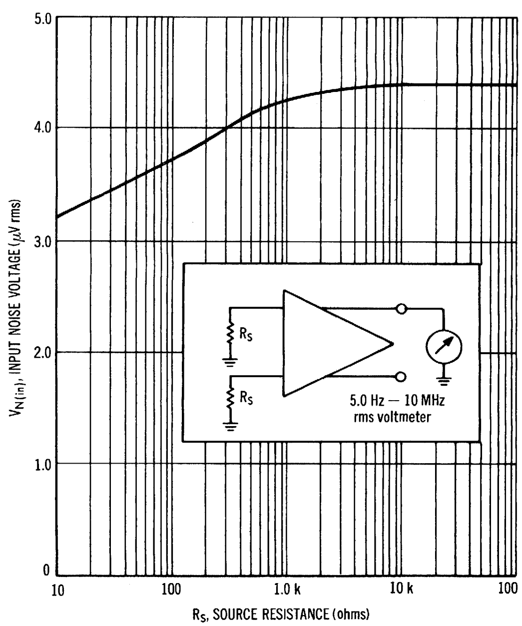


FIGURE 8 — INPUT NOISE VOLTAGE versus SOURCE IMPEDANCE

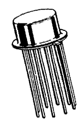


RF-IF AMPLIFIER

HIGH FREQUENCY AMPLIFIERS

MC1550G

. . . a versatile, common-emitter, common-base cascode circuit for use in communications applications.



Lead 7 connected to case

CASE 71

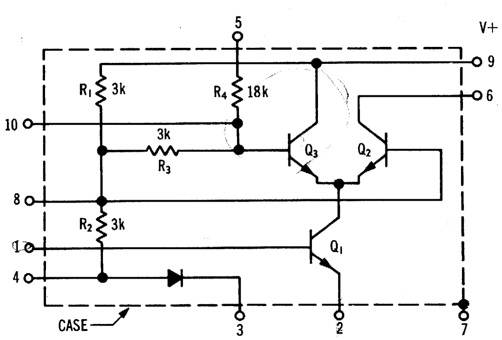
Typical Amplifier Features:

- Constant Input Impedance over entire AGC range
- Extremely Low y_{12} — 0.001 mmho
- High Power Gain — 30 dB @ 60 MHz (0.5 MHz BW)
- Good Noise Figure — 5.0 dB @ 60 MHz
- High Voltage-Gain—Bandwidth Product — 2.0 GHz

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage, Pin 9	V+	20	Vdc
AGC Supply Voltage	V_{AGC}	20	Vdc
Differential Input Voltage, Pin 1 to Pin 4 (R_S = 500 ohms)	V_{in}	±5	V (RMS)
Power Dissipation (Package Limitation) Derate above 25°C	P_D	680 4.6	mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



CIRCUIT DESCRIPTION

The MC1550 is built with monolithic fabrication techniques utilizing diffused resistors and small-geometry transistors. Excellent AGC performance is obtained by shunting the signal through the AGC transistor Q_3 maintaining the operating point of the input transistor Q_1. This keeps the input impedance constant over the entire AGC range.

The amplifier is intended to be used in a common-emitter, common-base configuration (Q_1 and Q_2) with Q_3 acting as an AGC transistor. The input signal is applied between pins 1 and 4, where pin 4 is ac-coupled to ground. DC source resistance between pins 1 and 4 should be small (less than 100 ohms). Pins 2 and 3 should be connected together and grounded. Pins 8 and 10 should be bypassed to ground. The positive supply voltage is applied at pin 9 and at higher frequencies, pin 9 should also be bypassed to ground. The output is taken between pins 6 and 9. The substrate is connected to pin 7 and should be grounded. AGC voltage is applied to pin 5.

ELECTRICAL CHARACTERISTICS (V+ = +6 Vdc, T_A = 25°C)

Characteristic	Conditions	Figure	Symbol	Min	Typ	Max	Unit
DC CHARACTERISTICS							
Output Voltage	V_{AGC} = 0 Vdc V_{AGC} = +6 Vdc	1	V_{out}	3.80 5.90	— —	4.65 6.00	Vdc
Test Voltage	V_{AGC} = 0 Vdc V_{AGC} = +6 Vdc	1	V_8	2.85 3.25	— —	3.40 3.80	Vdc
Supply Drain Current	V_{AGC} = 0 Vdc V_{AGC} = +6 Vdc	1	I_D	— —	— —	2.2 2.5	mAdc
AGC Supply Drain Current	V_{AGC} = 0 Vdc V_{AGC} = +6 Vdc	1	I_{AGC}	— —	— —	-0.2 0.18	mAdc
SMALL-SIGNAL CHARACTERISTICS							
Small-Signal Voltage Gain	f = 500 kHz	2	A_V	22	—	29	dB
Bandwidth	-3.0 dB	2	BW	22	—	—	MHz
Transducer Power Gain	f = 60 MHz, BW = 6 MHz f = 100 MHz, BW = 6 MHz	3	A_P	— —	25 21	— —	dB

FIGURE 1 — DC CHARACTERISTICS TEST CIRCUIT

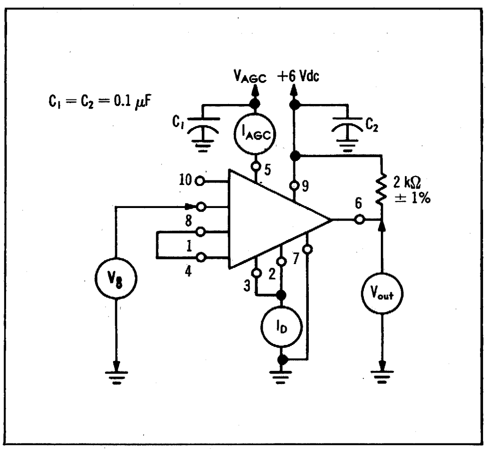


FIGURE 2 — VOLTAGE GAIN AND BANDWIDTH TEST CIRCUIT

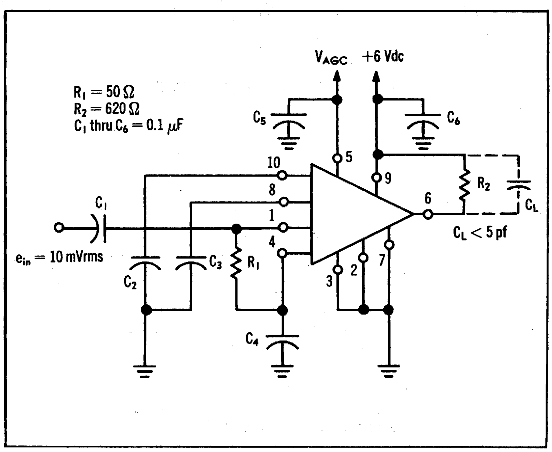


FIGURE 3 — POWER GAIN TEST CIRCUIT @ 60 MHz

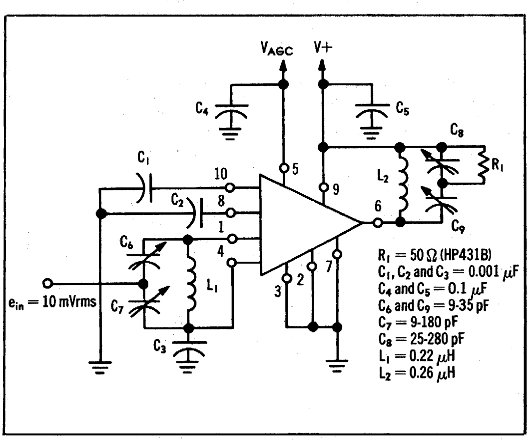


FIGURE 4 — DRAIN CURRENT TEMPERATURE CHARACTERISTICS

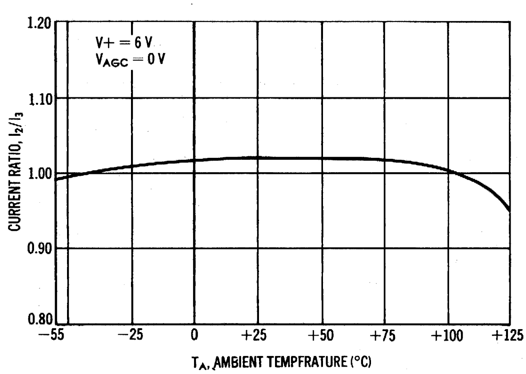


FIGURE 5 — INPUT RESISTANCE AND CAPACITANCE versus FREQUENCY

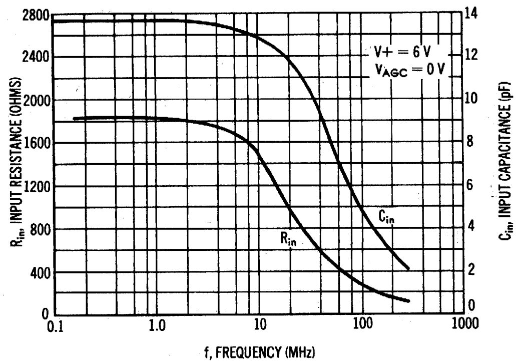


FIGURE 6 — INPUT RESISTANCE AND CAPACITANCE versus AGC VOLTAGE

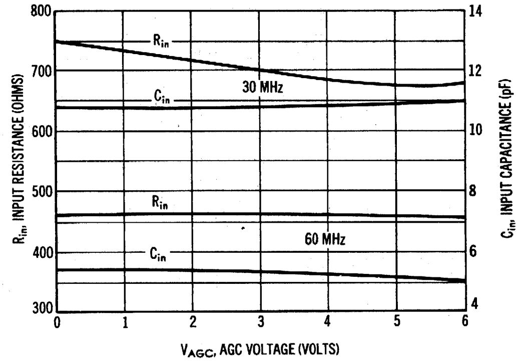


FIGURE 7 — OUTPUT RESISTANCE AND CAPACITANCE versus FREQUENCY

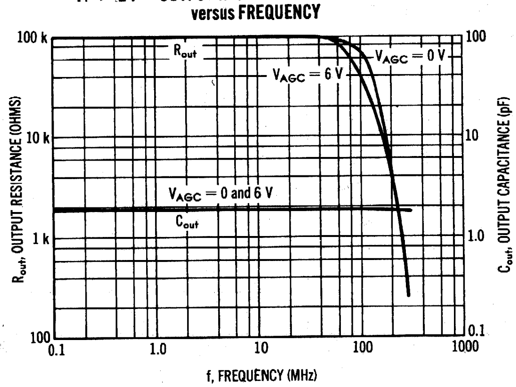


FIGURE 8 — OUTPUT RESISTANCE AND CAPACITANCE versus AGC VOLTAGE

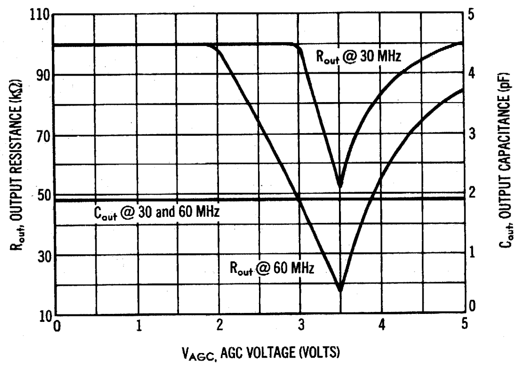


FIGURE 9 — FORWARD TRANSFER ADMITTANCE versus FREQUENCY

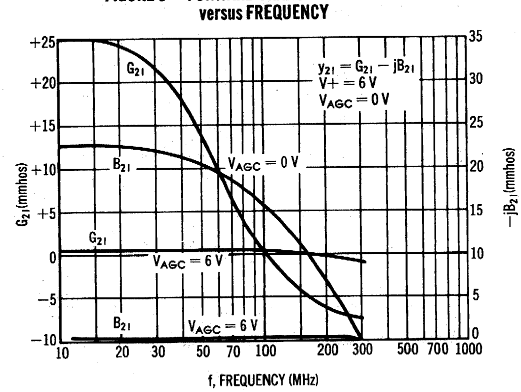


FIGURE 10 — FORWARD TRANSFER ADMITTANCE versus AGC VOLTAGE

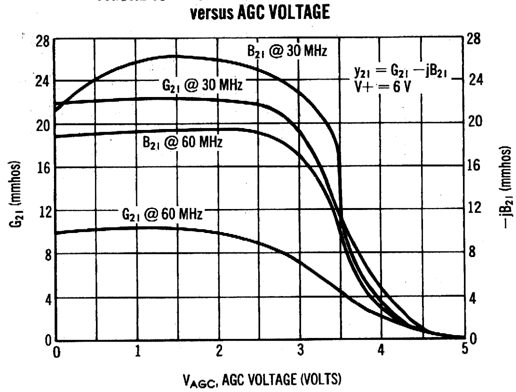


FIGURE 11 — MAXIMUM TRANSDUCER POWER GAIN versus FREQUENCY

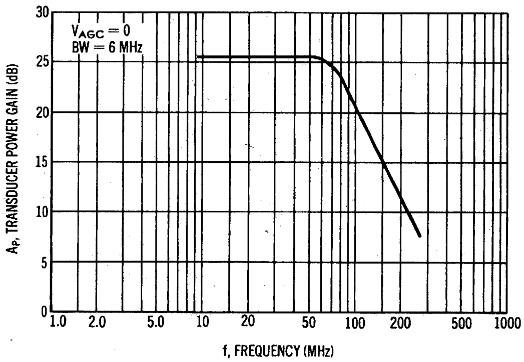


FIGURE 12 — TRANSDUCER POWER GAIN versus TEMPERATURE

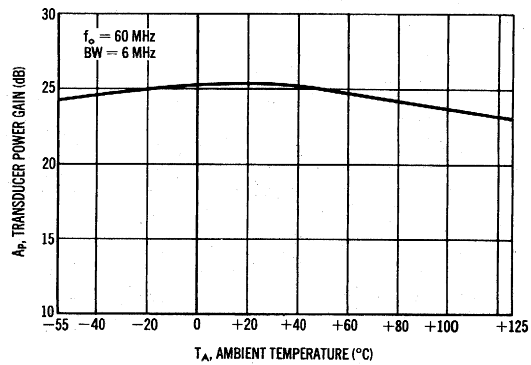


FIGURE 13 — TRANSDUCER POWER BANDWIDTH versus AGC VOLTAGE

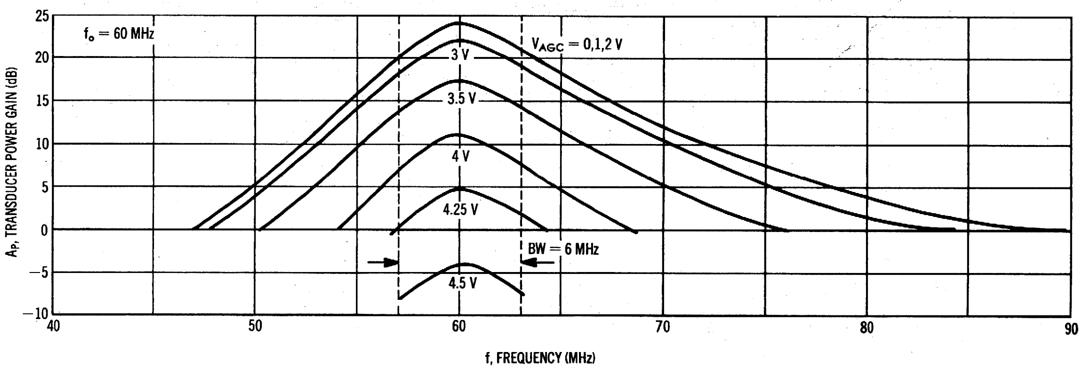


FIGURE 14 — NOISE FIGURE AND OPTIMUM SOURCE RESISTANCE versus FREQUENCY

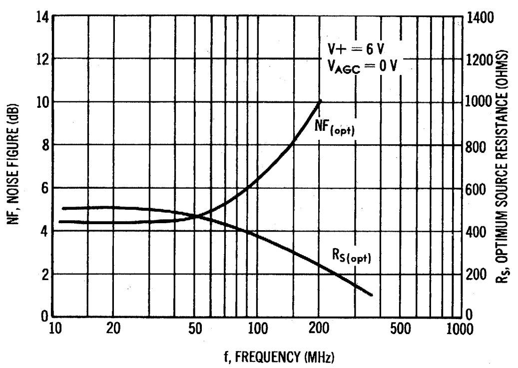
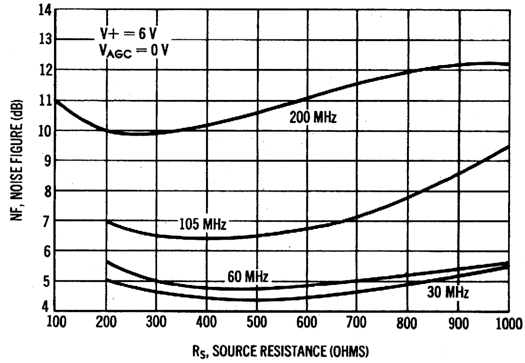
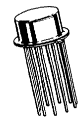


FIGURE 15 — NOISE FIGURE versus SOURCE RESISTANCE



MC1552G
MC1553G

. . . a three-stage, direct-coupled, common-emitter cascade incorporating series-series feedback to achieve stable voltage gain, low distortion, and wide bandwidth. Employs a temperature-compensated dc feedback loop to stabilize the operating point and a current-biased emitter follower output. Intended for use as either a wide-band linear amplifier or as a fast rise pulse amplifier.



Lead 6 connected to case

CASE 71

Typical Amplifier Features:

- High Gain — 34 dB ±1.0 dB (MC1552)
  52 dB ±1.0 dB (MC1553)
- Wide Bandwidth — 40 MHz (MC1552)
  35 MHz (MC1553)
- Low Distortion — 0.2% at 200 kHz
- Low Temperature Drift — ±0.002 dB/°C

MAXIMUM RATINGS ($T_A = 25°C$ unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage, Pin 9	V^+	9	Vdc
Input Voltage, Pin 1 to Pin 2 (R_S = 500 ohms)	V_{in}	1.0	V(RMS)
Power Dissipation (Package Limitation) Derate above 25°C	P_D	680 4.6	mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATICS

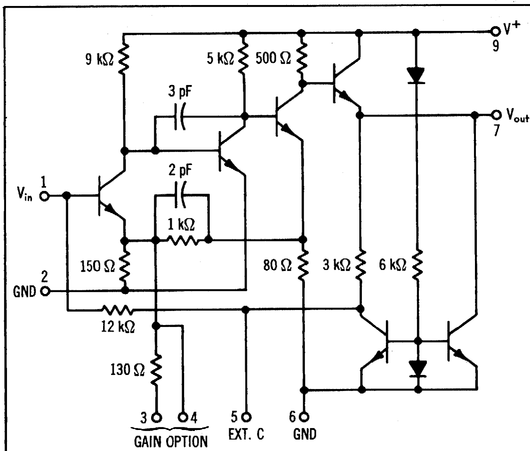


FIGURE 1 — MC1552 (LOW GAIN)

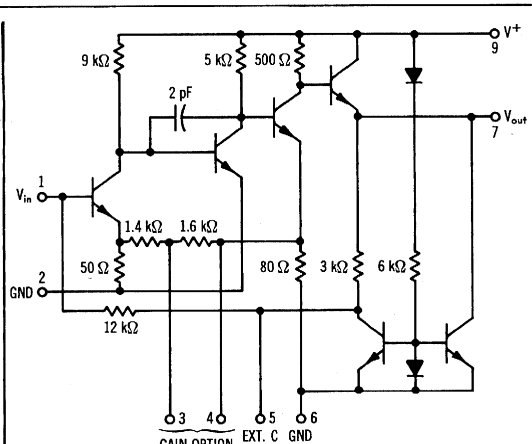


FIGURE 2 — MC1553 (HIGH GAIN)

ELECTRICAL CHARACTERISTICS ($V+ = +6$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic		Fig. No.	Gain Option*	Symbol	Min	Typ	Max	Unit
Voltage Gain	MC1552	3	50 100	V_{out}/V_{in}	44 87	50 100	56 113	V/V
	MC1553		200 400		175 350	200 400	225 450	
Voltage Gain Variation (T_A = -55°C to +125°C)		3	All	—	—	±0.2	—	dB
Bandwidth	MC1552	3, 6	50 100	BW	21 17	40 35	— —	MHz
	MC1553		200 400		17 7.5	35 15	— —	
Input Impedance (f = 100 kHz, R_L = 1 kΩ)		—	All	$\|Z_{in}\|$	7	10	—	kΩ
Output Impedance (f = 100 kHz, R_S = 50 Ω)		—	All	$\|Z_{out}\|$	—	16	50	Ω
DC Output Voltage		3	All	V_{out} (dc)	2.5	2.9	3.2	Vdc
DC Output Voltage Variation (T_A = -55°C to +125°C)		3	All	ΔV_{out} (dc)	—	±0.05	—	Vdc
Output Voltage Swing (Z_L ≥ 1 kΩ, V_{in} = 100 mV rms)		3	All	V_{out}	3.6	4.2	—	Vp-p
Power Dissipation		—	All	P_D	—	75	120	mW
Delay Time	MC1552	3, 4	50 100	t_{pd}	— —	8 9	— —	ns
	MC1553		200 400		— —	10 25	— —	
Rise Time	MC1552	3, 4	50 100	t_r	— —	9 12	16 20	ns
	MC1553		200 400		— —	11 30	20 45	
Overshoot		3, 4	All	$(V_{os}/V_p)100$	—	5	—	%
Noise Figure (R_S = 400 Ω, f_o = 30 MHz, BW = 3 MHz)		—	All	NF	—	5	—	dB
Total Harmonic Distortion (V_{out} = 2 Vp-p, f = 200 kHz, R_L = 1 kΩ)		—	All	THD	—	0.2	—	%

*To obtain the voltage-gain characteristic desired, use the following pin connections:

Type	Voltage Gain	Pin Connections
MC1552	50	Pin 3 Open
	100	Ground Pin 3
MC1553	200	Connect Pin 3 to Pin 4
	400	Pins 3 and 4 Open

NOTES

1. Ground Pin 6 as close to can as possible to minimize overshoot. Best results by directly grounding can.
2. If large input and output coupling capacitors are used, place shield between them to avoid input-output coupling.
3. A high-frequency capacitor must always be used to bypass the power supply. This capacitor should be as close to the circuit as possible.
4. Voltage gain can be adjusted to any value between 50 and 3000 by connecting an external resistor from Pin 4 to ground on MC1552, or from Pin 3 to ground on MC1553, as shown in Figure 8. Under these conditions, the following equations must be used to determine C_1 and C_2 rather than the circuits shown in Figure 5.

Fig. 5b $C_1 = \frac{1}{2\pi f_c(1.7 \times 10^4)}$ Farads; $C_2 = 8\,C_1 (V_{out}/V_{in})$ Farads

Fig. 5c $C_1 = \frac{V_{out}/V_{in}}{2\pi f_c(1.5 \times 10^4)}$ Farads

Fig. 5d $C_2 = \frac{V_{out}/V_{in}}{2\pi f_c(3 \times 10^3)}$ Farads

FIGURE 3 — TEST CIRCUIT

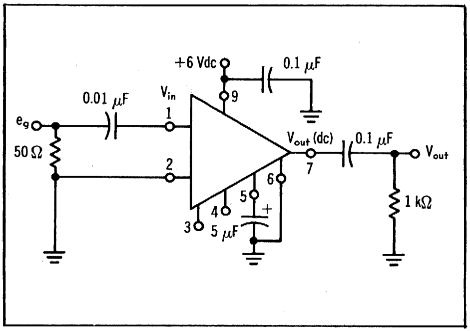
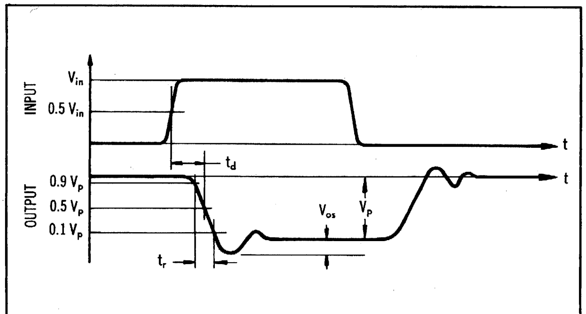


FIGURE 4 — PULSE RESPONSE DEFINITIONS



TYPICAL CHARACTERISTICS

$T_A = 25°C$

FIGURE 5a — FREQUENCY RESPONSE

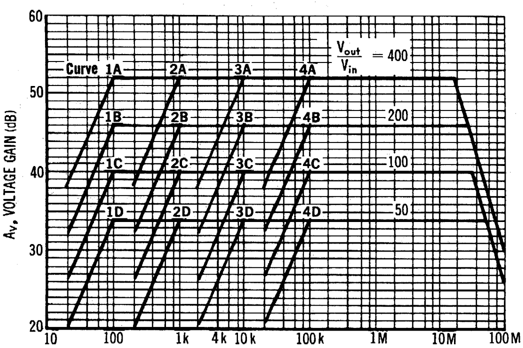
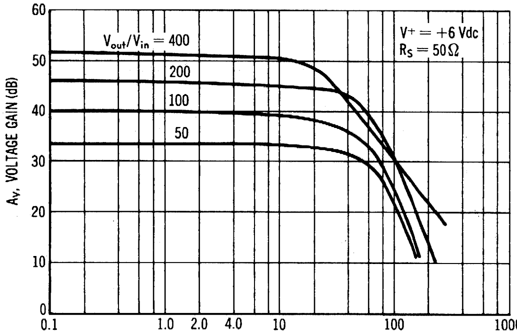
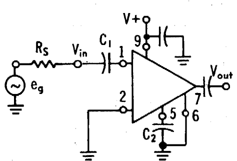


FIGURE 6 — VOLTAGE GAIN versus FREQUENCY



TEST CIRCUITS FOR FREQUENCY RESPONSE

FIGURE 5b — CAPACITIVE COUPLED INPUT (R_s < 5k Ω)



Curve No.	C_1 (μF)	C_2 (μF)
1A	0.1	250
1B	0.1	150
1C	0.1	70
1D	0.1	40

Curve No.	C_1 (μF)	C_2 (μF)
2A	0.01	30
2B	0.01	18
2C	0.01	8.0
2D	0.01	4.0
	(pF)	
3A	1000	3.0
3B	1000	1.8
3C	1000	0.8
3D	1000	0.4
4A	100	0.3
4B	100	0.18
4C	100	0.08
4D	100	0.04

FIGURE 7 — MAXIMUM NEGATIVE SWING SLEW RATE versus LOAD CAPACITANCE

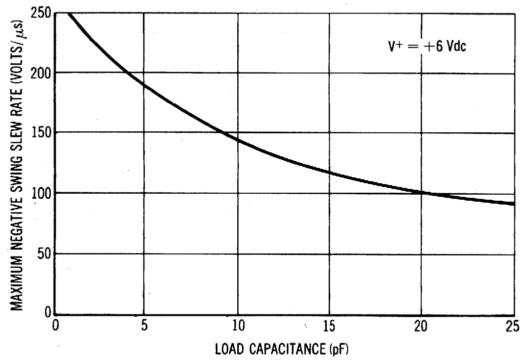
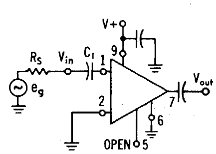


FIGURE 5c — CAPACITIVE COUPLED INPUT (R_s < 500 Ω)



Curve No.	C_1 (μF)	Curve No.	C_1 (μF)
1A	20	3A	0.4
1B	10	3B	0.2
1C	7.0	3C	0.1
1D	3.0	3D	0.06
2A	3.0	4A	0.04
2B	1.0	4B	0.02
2C	0.8	4C	0.01
2D	0.5	4D	0.007

FIGURE 8 — VOLTAGE GAIN ADJUSTMENT BY USE OF EXTERNAL RESISTOR

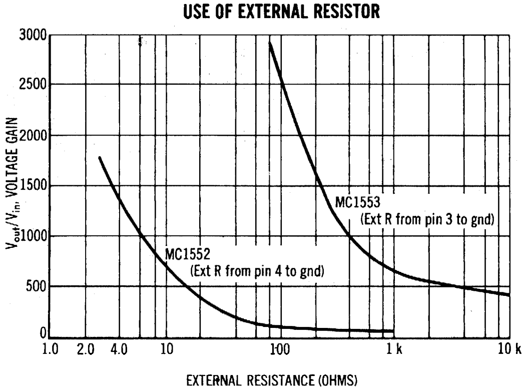
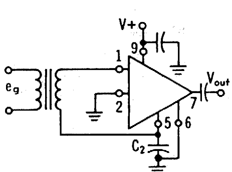


FIGURE 5d — TRANSFORMER COUPLED INPUT



Curve No.	C_2 (μF)	Curve No.	C_2 (μF)
1A	200	3A	2.0
1B	100	3B	1.0
1C	70	3C	0.7
1D	30	3D	0.3
2A	20	4A	0.2
2B	10	4B	0.1
2C	7.0	4C	0.07
2D	3.0	4D	0.03

INPUT ADMITTANCE

V+ = 6 Vdc, $R_L = 1\ k\Omega$, $T_A = 25°C$

FIGURE 9 — GAIN = 50

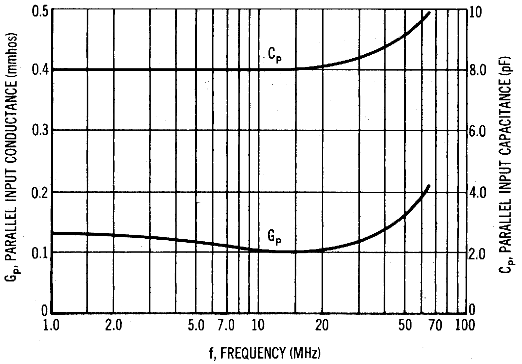


FIGURE 10 — GAIN = 100

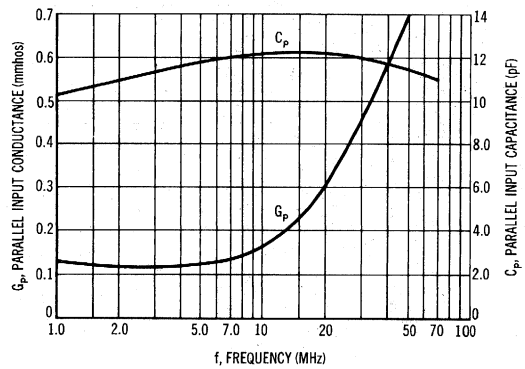


FIGURE 11 — GAIN = 200

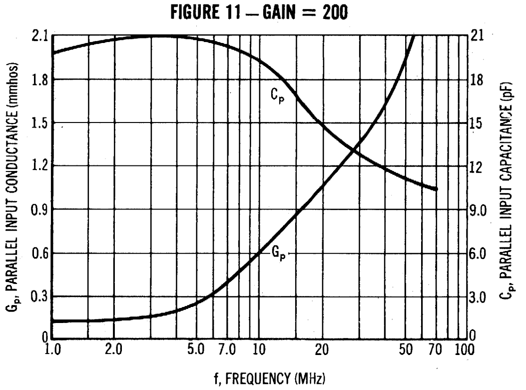


FIGURE 12 — GAIN = 400

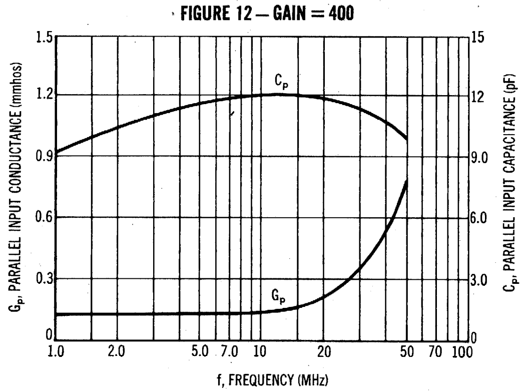


FIGURE 13 — OUTPUT IMPEDANCE versus FREQUENCY

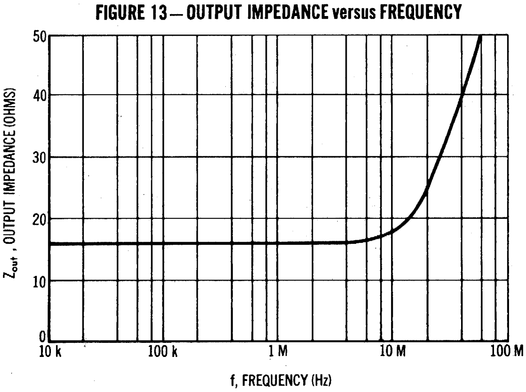
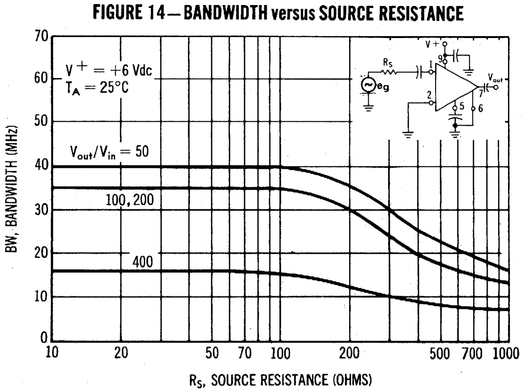


FIGURE 14 — BANDWIDTH versus SOURCE RESISTANCE

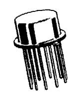


1-WATT POWER AMPLIFIER

MC1524

Typical Amplifier Features:

- Low Standby Current Drain – < 4 mA
- Low Total Harmonic Distortion
- 1-Watt Power Output
- Low Output Impedance
- Direct Coupling to Load
- Excellent Gain – Temperature Stability



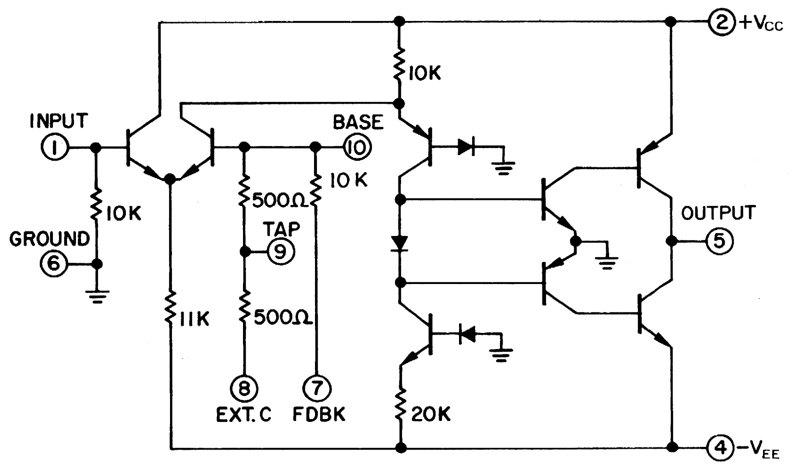
CASE 71

Lead 6 connected to case

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	12	Vdc
Power Supply Voltage	V_{EE}	-12	Vdc
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +175	°C
Maximum Audio Output Power (T_A = -55°C to +125°C)	Pout(max)	1.0	Watt

FIGURE 1 – CIRCUIT SCHEMATIC



LINEAR POWER AMPLIFIER

ELECTRICAL CHARACTERISTICS (V_{CC} = +6 V, V_{EE} = −6 V, T_A = 25°C. See Fig. 1)

Characteristic	Load Impedance ohms	Feedback Tap ohms	Symbol	Min	Typ	Max	Units
Maximum Peak-to-Peak Output Voltage for THD < 3% @ 1 kHz	16	1000	V_{Omax}	9.0	10.0	—	$V_{(P-P)}$
Voltage Gain @ 1 kHz	16	250	A_V	—	37.9	—	—
		500		—	20.0	—	
		1000		10.0	11.5	12.5	
	100	250		—	41.2	—	
		500		—	21.3	—	
		1000		11.0	12.3	13.5	
Input Impedance @ 1 kHz	—	1000	Z_{in}	6.0	8.5	—	kohms
Output Impedance @ 1 kHz	—	1000	Z_{out}	—	0.58	0.80	ohms
Bandwidth	16	250	BW	—	350	—	kHz
		500		—	480	—	
		1000		250	770	—	
	40	250		—	340	—	
		500		—	480	—	
		1000		—	790	—	
	100	250		—	320	—	
		500		—	480	—	
		1000		—	810	—	
Zero Signal Current Drain (Each Supply)	16	1000	I_S	—	1.5	4.0	mA
Low Level Total Harmonic Distortion @ 1 kHz (50 mVrms in)	16	1000	THD	—	0.6	2.0	%

FIGURE 1 — AC COUPLED CIRCUIT

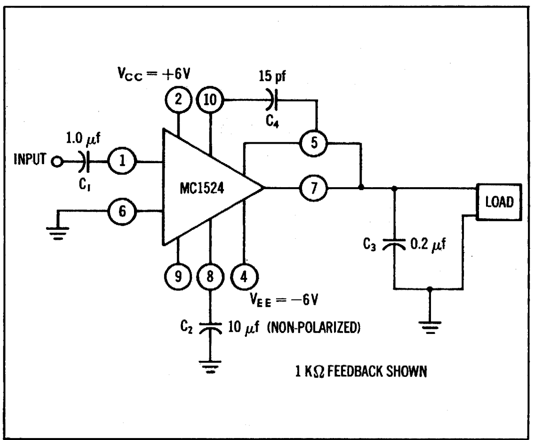
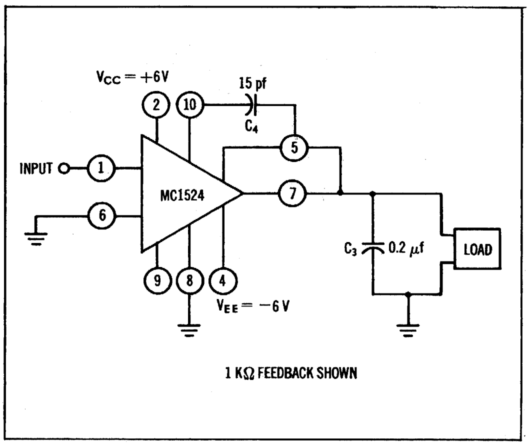


FIGURE 2 — DC COUPLED CIRCUIT



RECOMMENDED OPERATING CONDITIONS

1) DC load resistance (R_L) should be greater than 5 ohms for DC stability.

2) Power supplies should be balanced, have low source impedances, and should be turned on and off simultaneously. (See Fig. 6 for Standby Current vs. Supply Unbalance.)

3) Capacitors C_3 and C_4 provide high-frequency stability. For most loads, at temperatures below 70°C, C_4 may be omitted.

4) Low frequency rolloff of AC coupled circuit is determined by C_1 and C_2. Fig 1 is recommended for loudspeaker loads because of DC stability introduced by C_2.

5) Open loop operation is not recommended. Feedback taps are connected as follows:

Feedback Tap	Pin Connection
1 KΩ	8 to C_2 (AC) or ground (DC)
500Ω	9 to C_2 (AC) or ground (DC)
250Ω	8 to 10; 9 to C_2 (AC) or ground (DC)

FIGURE 3 — MAXIMUM AVAILABLE OUTPUT POWER
(BEFORE CLIPPING — RESISTIVE LOAD)

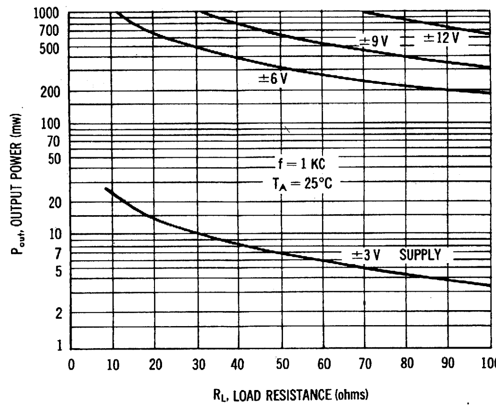


FIGURE 4 — TOTAL HARMONIC DISTORTION

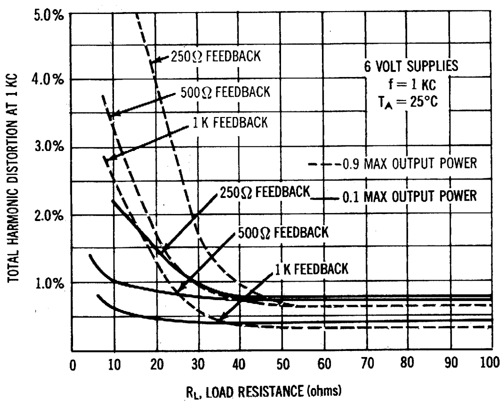


FIGURE 5 — AC COUPLED FREQUENCY RESPONSE

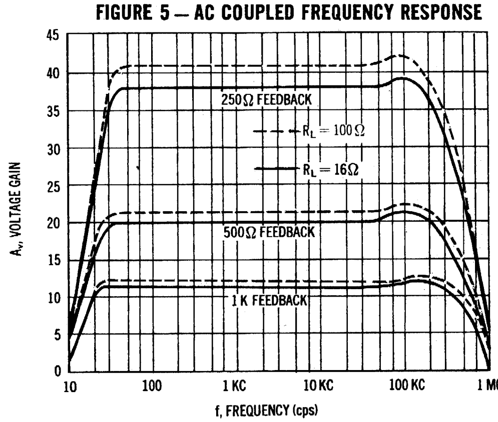


FIGURE 6 — STANDBY CURRENT VARIATION DUE TO SUPPLY UNBALANCE

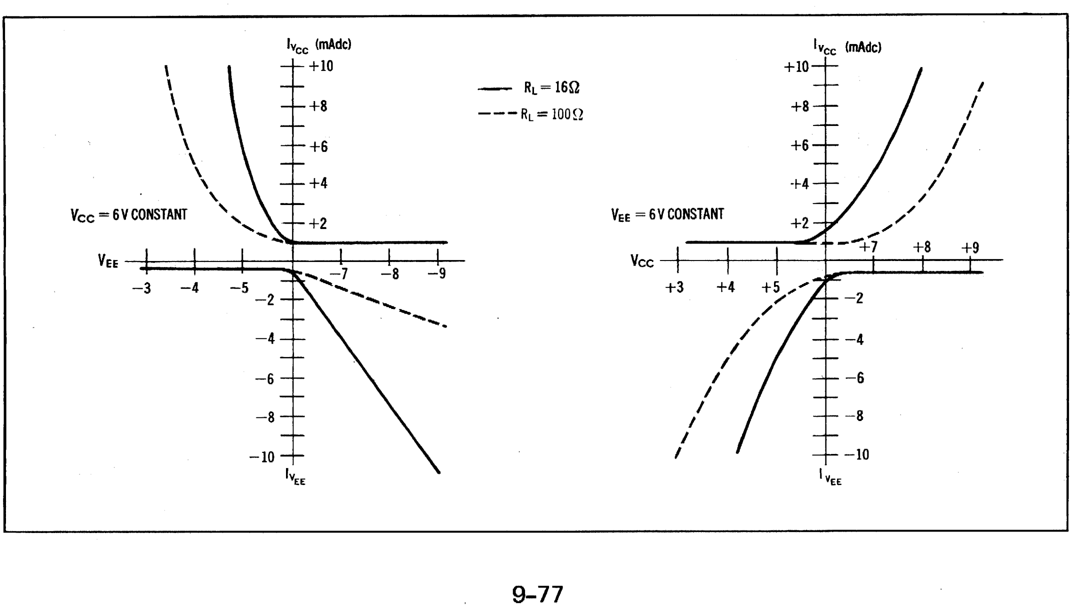
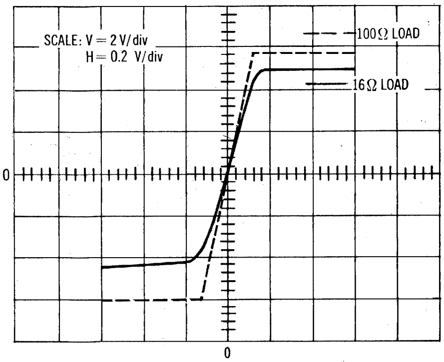
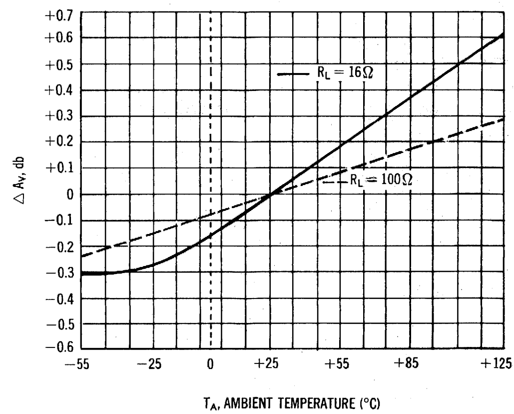


FIGURE 7 — DC TRANSFER CHARACTERISTICS

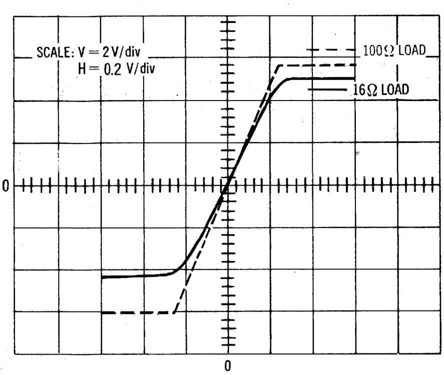
FIGURE 8 — VOLTAGE GAIN versus TEMPERATURE

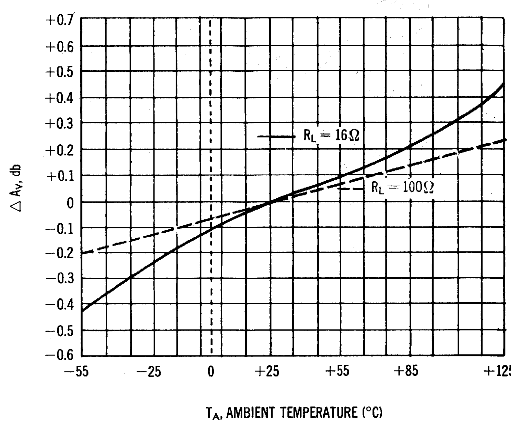
250Ω FEEDBACK TAP



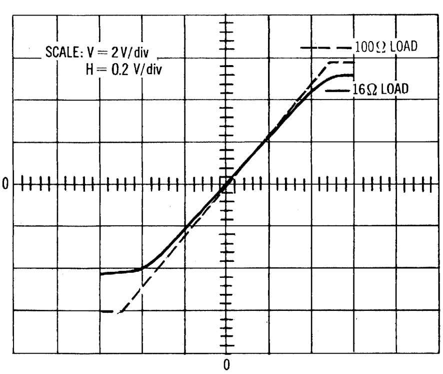


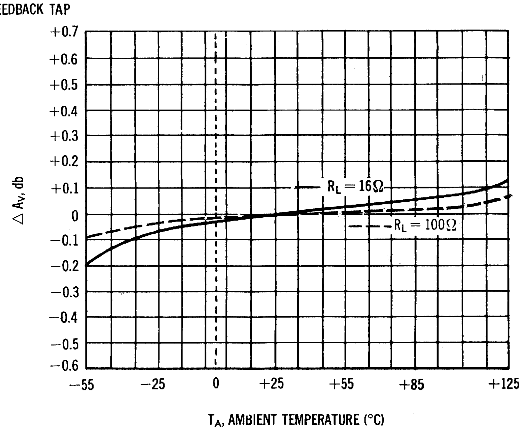
500Ω FEEDBACK TAP





1 KΩ FEEDBACK TAP



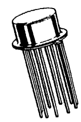


MC1554G

. . . designed to amplify signals to 300 kHz with one watt delivered to a direct or capacitively coupled load.

Typical Amplifier Features:

- Low Total Harmonic Distortion — 0.4% typical at 1.0 Watt
- Low Output Impedance — 0.2 ohm
- Excellent Gain — Temperature Stability



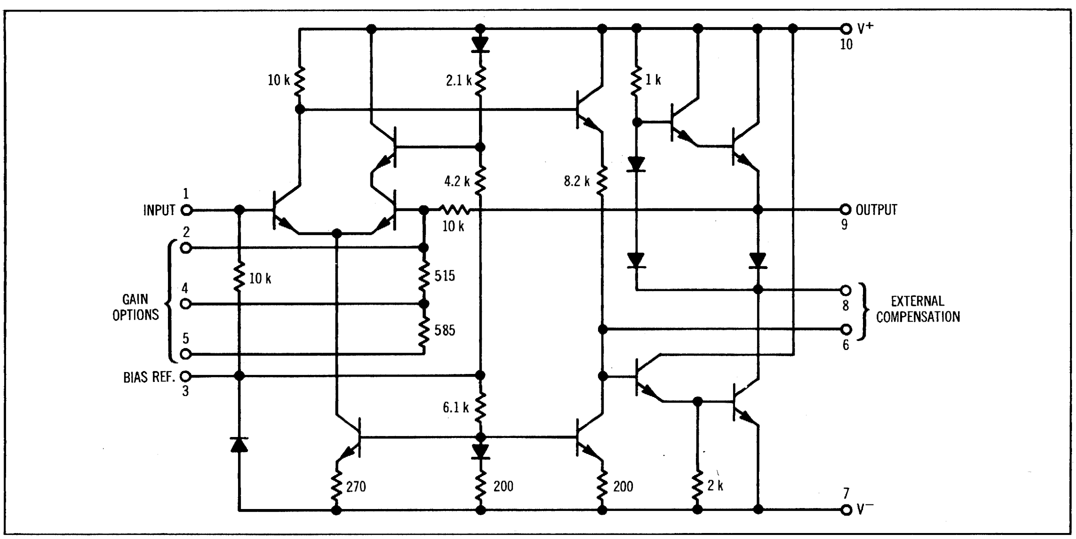
CASE 71

Lead 7 connected to case

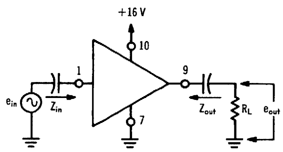
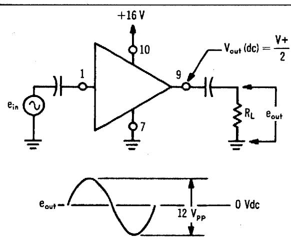
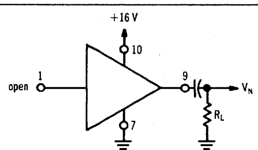
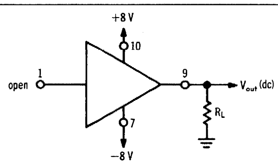
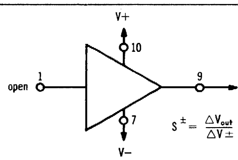
MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Total Power Supply Voltage	$\lvert V^+\rvert + \lvert V^-\rvert$	18	Vdc
Peak Load Current	I_{out}	0.5	Amp
Audio Output Power	P_{out}	1.8	Watt
Power Dissipation (package limitation)	P_D		
T_A = 25°C		600	mW
Derate above 25°C		4.8	mW/°C
T_C = 25°C		1.8	Watts
Derate above 25°C		14.4	mW/°C
Operating Temperature Range	T_C	-55 to +125	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C

CIRCUIT SCHEMATIC



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)
Frequency compensation shown in Figures 2 and 3.

Characteristic Definitions	Characteristic	R_L (ohms)	Gain Option*	Symbol	Min	Typ	Max	Unit
	Output Power	16	-	P_{out}	1.0	1.1	-	Watt
	Power Dissipation (@ P_{out} = 1.0 W)	16	-	P_D	-	0.9	1.2	Watt
	Voltage Gain	16	10	A_V	8.0	10	12	V/V
		16	18		-	18	-	
		16	36		-	36	-	
	Input Impedance	-	10	Z_{in}	7.0	10	-	kΩ
	Output Impedance	-	10	Z_{out}	-	0.2	-	Ω
	Power Bandwidth (for e_{out} < 5% THD)	16	10		-	270	-	kHz
		16	18		-	250	-	
		16	36		-	210	-	
	Total Harmonic Distortion (for e_{in} < 0.05% THD, f = 20 Hz to 20 kHz)			THD				%
	P_{out} = 1.0 Watt (sinewave)	16	10		-	0.4	-	
	P_{out} = 0.1 Watt (sinewave)	16	10		-	0.5	-	
	Zero Signal Current Drain	∞	-	I_D	-	11	15	mAdc
	Output Noise Voltage	16	10	V_n	-	0.3	-	mV RMS
	Output Quiescent Voltage (Split Supply Operation)	16	-	$V_{out}(dc)$	-	±10	±30	mVdc
	Positive Supply Sensitivity (V^- constant)	∞	-	S^+	-	-40	-	mV/V
	Negative Supply Sensitivity (V^+ constant)	∞	-	S^-	-	-40	-	mV/V

* To obtain the voltage gain characteristic desired, use the following pin connections:

Voltage Gain	Pin Connection
10	Pins 2 and 4 open, Pin 5 to ac ground
18	Pins 2 and 5 open, Pin 4 to ac ground
36	Pin 2 connected to Pin 5, Pin 4 to ac ground

TYPICAL CONNECTIONS

FIGURE 2—SPLIT SUPPLY OPERATION
VOLTAGE GAIN (A_V) = 10, $f_{LOW} \approx$ 25 Hz

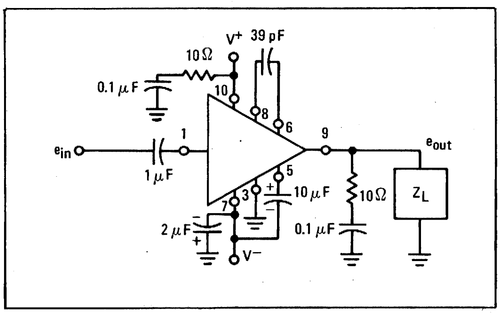
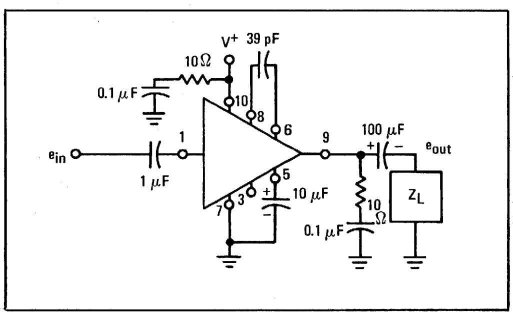


FIGURE 3—SINGLE SUPPLY OPERATION
VOLTAGE GAIN (A_V) = 10, $f_{LOW} \approx$ 100 Hz



RECOMMENDED OPERATING CONDITIONS

In order to avoid local VHF instability, the following set of rules must be adhered to:

1. An R-C stabilizing network (0.1 μF in series with 10 ohms) should be placed directly from pin 9 to ground, as shown in Figures 2 and 3, using short leads, to eliminate local VHF instability caused by lead inductance to the load.
2. Excessive lead inductance from the V+ supply to pin 10 can cause high frequency instability. To prevent this, the V+ by-pass capacitor should be connected with short leads from the V+ pin to ground. If this capacitor is remotely located a series R-C network (0.1 μF and 10 ohms) should be used directly from pin 10 to ground as shown in Figures 2 and 3.
3. Lead lengths from the external components to pins 7, 9, and 10 of the package should be as short as possible to insure good VHF grounding for these points.

Due to the large bandwidth of the amplifier, coupling must be avoided between the output and input leads. This can be assured by either (a) use of short leads which are well isolated, (b) narrow-banding the overall amplifier by placing a capacitor from pin 1 to ground to form a low-pass filter in combination with the source impedance, or (c) use of a shielded input cable. In applications which require upper band-edge control the input low-pass filter is recommended.

TYPICAL CHARACTERISTICS

FIGURE 4 — MAXIMUM AVAILABLE OUTPUT POWER (SINE WAVE)

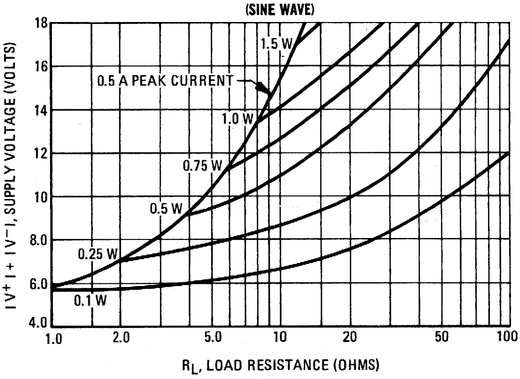


FIGURE 5 — MAXIMUM DEVICE DISSIPATION (SINE WAVE)

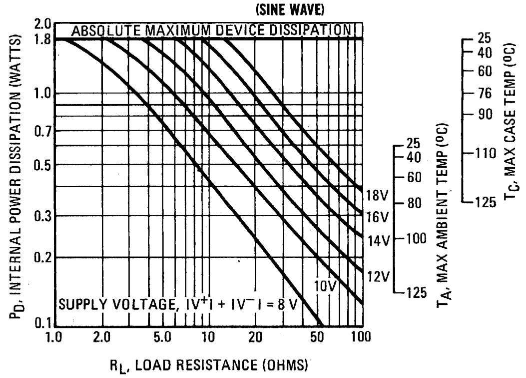


FIGURE 6 — TOTAL HARMONIC DISTORTION versus LOAD RESISTANCE

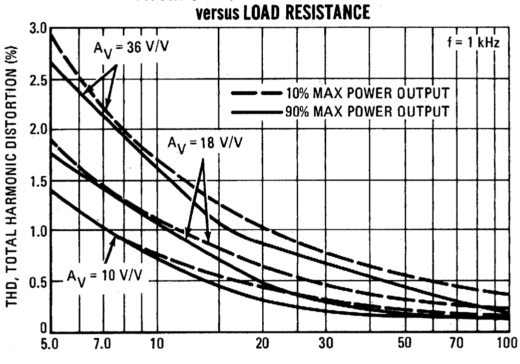
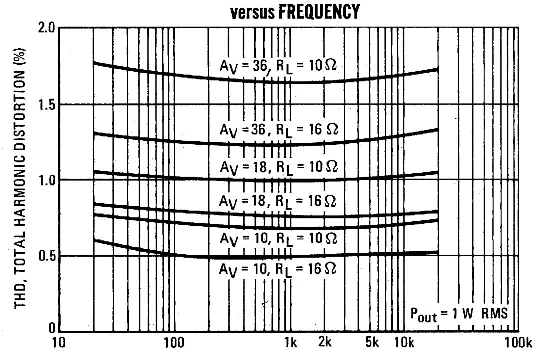


FIGURE 7 — TOTAL HARMONIC DISTORTION versus FREQUENCY



TYPICAL CHARACTERISTICS

FIGURE 8 — VOLTAGE GAIN versus TEMPERATURE

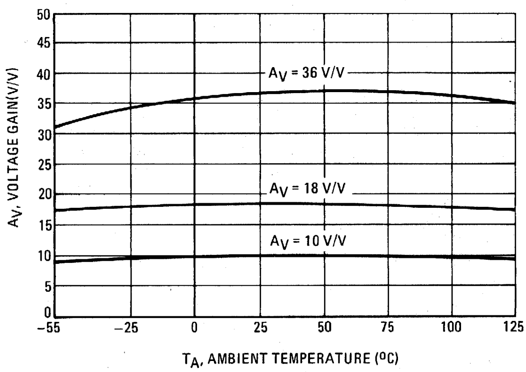


FIGURE 9 — OUTPUT VOLTAGE CHANGE

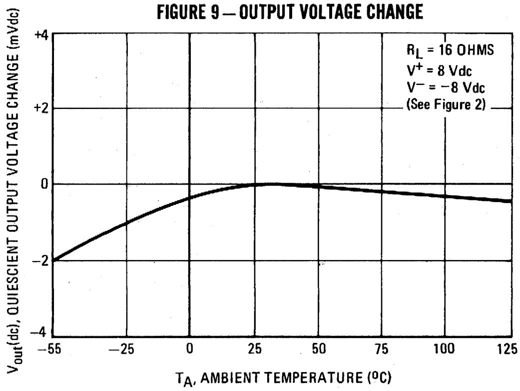


FIGURE 10 — VOLTAGE GAIN versus FREQUENCY (R_L = 16 OHMS)

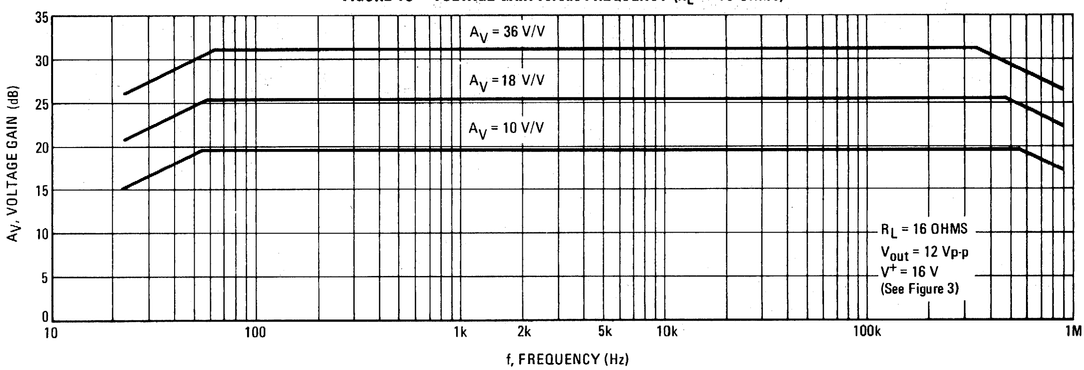
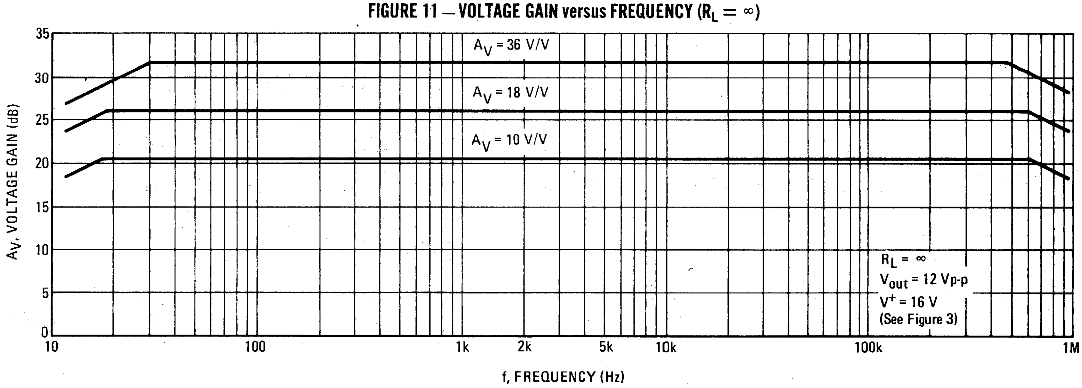


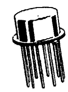
FIGURE 11 — VOLTAGE GAIN versus FREQUENCY ($R_L = \infty$)



MC1519

. . . featuring NPN inputs and PNP outputs. Two monolithic compatible* chips are used to provide a versatile and extremely stable amplifier.

*Compatible — a process utilizing thin film resistors deposited on a silicon monolithic integrated circuit.



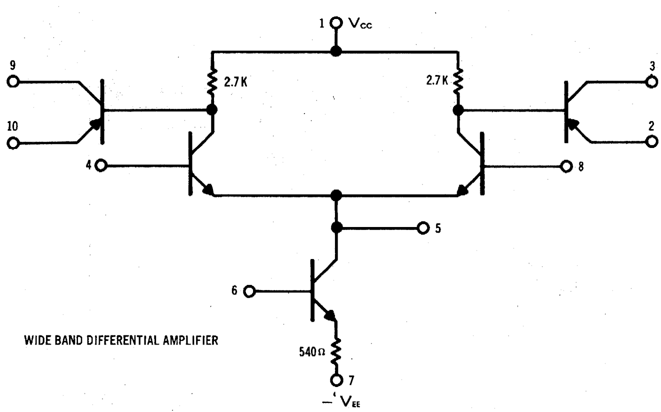
CASE 71

All pins electrically isolated from package

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+14	Vdc
Power Supply Voltage	V_{EE}	-14	Vdc
Differential Input Signal	V_{in}	±5	Vdc
Total Power Dissipation Derate above 25°C	P_D	300 2.0	mW mW/°C
Operating Temperature Range	T_J	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +175	°C

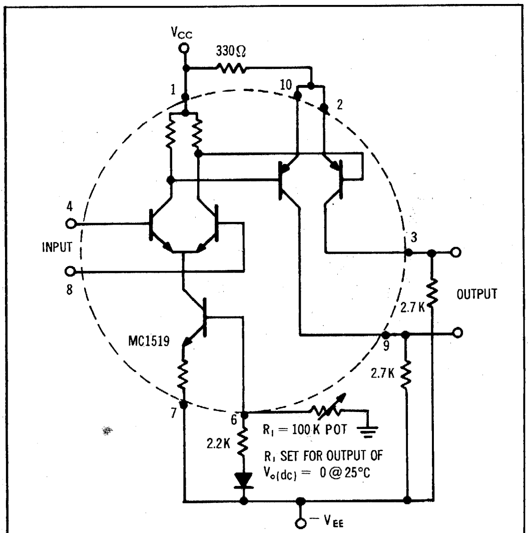
CIRCUIT SCHEMATIC



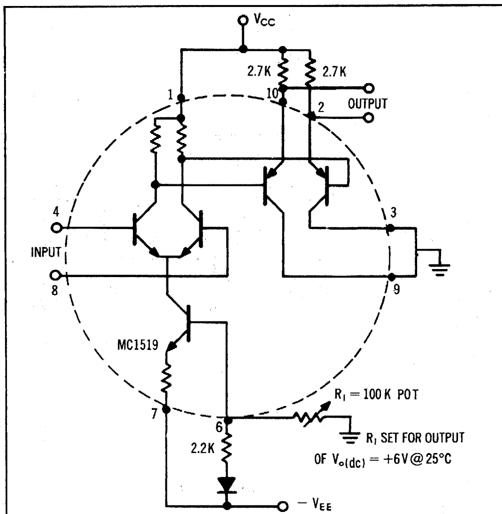
ELECTRICAL CHARACTERISTICS (V_{CC} = +12 Vdc, V_{EE} = −12 Vdc, T_A = 25°C unless otherwise noted)

Characteristic	Figure No.	Symbol	Min	Typ	Max	Unit
Differential Voltage Gain	3, 8	A_{dd}				db
Circuit A (CE)			67	73	79	
Circuit B (CC)			40	45	50	
Single Ended Voltage Gain	3	A_V				db
Circuit A (CE)			—	67	—	
Circuit B (CC)			—	38	—	
Maximum Output Swing	4	V_O				$V_{(p-p)}$
Circuit A (CE)			12.0	14.0	—	
Circuit B (CC)			8.0	10.0	—	
Input Offset Voltage	5, 9	V_{IO}				mVdc
Circuit A (CE)			—	2.0	6.0	
Circuit B (CC)			—	2.0	6.0	
Input Offset Voltage Drift	5, 9	V_{IOD}				μV/°C
Circuit A (CE)			—	5.0	—	
Circuit B (CC)			—	5.0	—	
Input Offset Current	6, 10	I_{IO}				μAdc
Circuit A (CE)			—	1.0	4.0	
Circuit B (CC)			—	2.0	8.0	
Input Current	6, 11	I_i				μAdc
Circuit A (CE)			—	40.0	70.0	
Circuit B (CC)			—	60.0	90.0	
Common Mode Rejection	7	CM_{Rej}				db
Circuit A (CE)			—	89.0	—	
Circuit B (CC)			—	86.0	—	
Bandwidth - 3 db	3, 12	BW				mc
Circuit A (CE)			0.70	1.0	—	
Circuit B (CC)			5.0	8.0	—	
Differential Input Impedance	2	Z_{in}				kohms
Circuit A (CE)			1.8	2.6	—	
Circuit B (CC)			—	1.2	—	
Single Ended Output Impedance	2	Z_{out}				kohms
Circuit A (CE)			—	2.7	—	
Circuit B (CC)			—	0.048	0.120	

FIGURE 1



CIRCUIT A — COMMON EMITTER OUTPUT



CIRCUIT B — COMMON COLLECTOR OUTPUT

TEST CIRCUITS

FIGURE 2 — DIFFERENTIAL INPUT IMPEDANCE AND SINGLE-ENDED OUTPUT IMPEDANCE

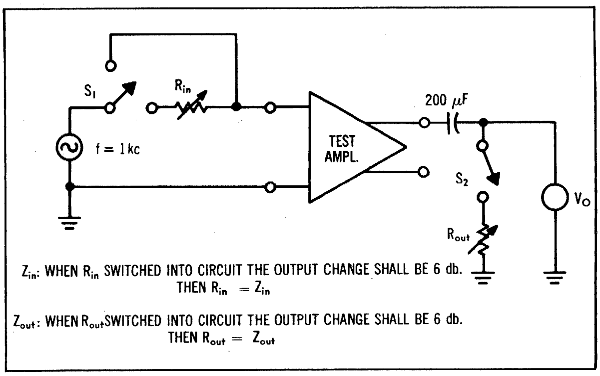


FIGURE 3 — DIFFERENTIAL VOLTAGE GAIN, SINGLE-ENDED VOLTAGE GAIN, and BANDWIDTH

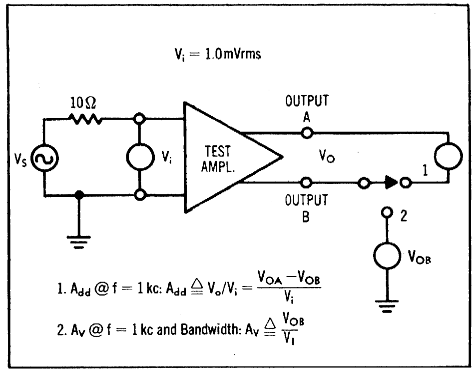


FIGURE 4 — MAXIMUM OUTPUT SWING

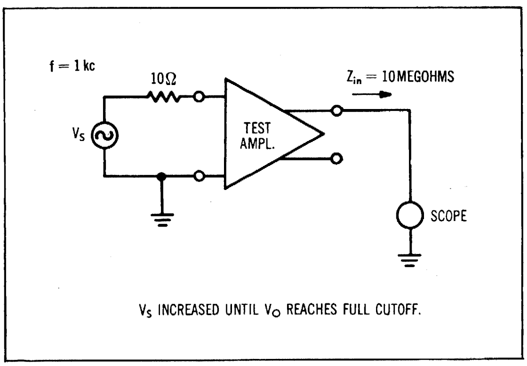


FIGURE 5 — INPUT OFFSET VOLTAGE

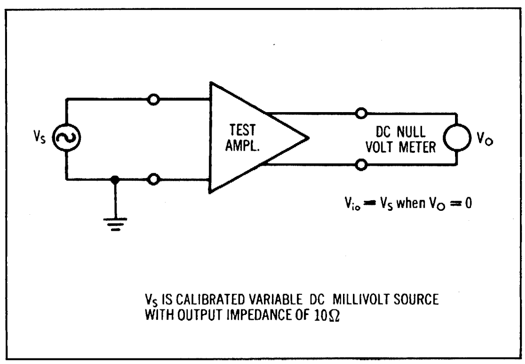


FIGURE 6 — INPUT OFFSET CURRENT and INPUT CURRENT

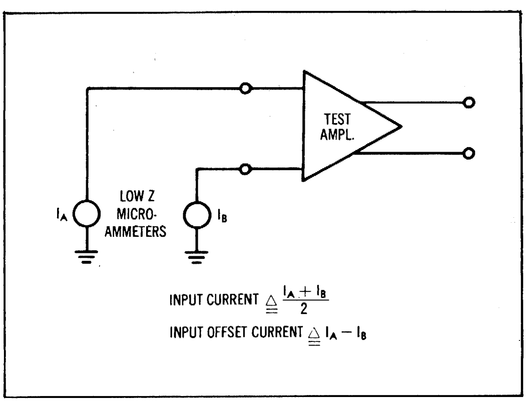
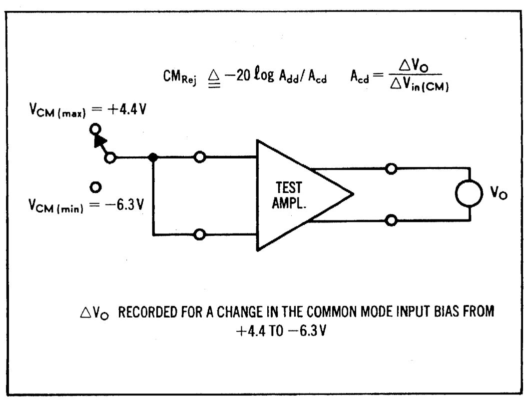


FIGURE 7 — COMMON MODE REJECTION



EFFECT OF TEMPERATURE ON CIRCUIT B CHARACTERISTICS

R_1 SET FOR $V_{O(CM)} = +6V$ AT $+25°C$

FIGURE 8 — DIFFERENTIAL MODE GAIN

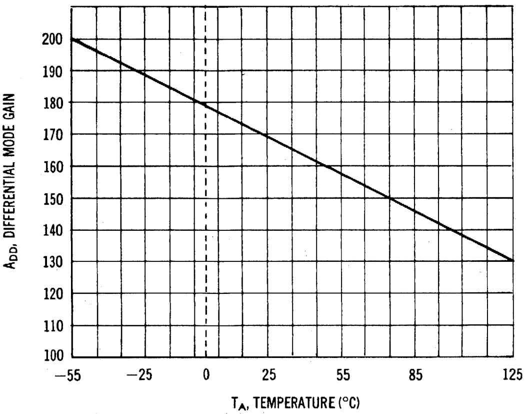


FIGURE 9 — INPUT OFFSET VOLTAGE

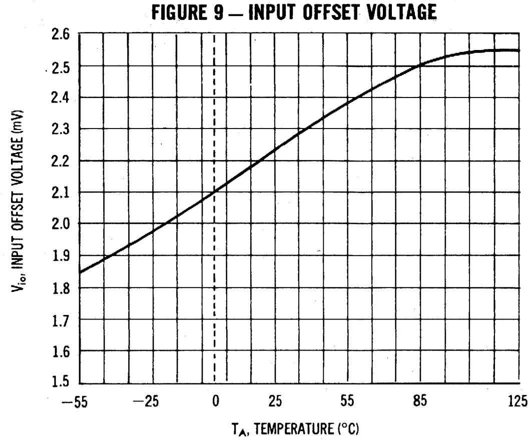


FIGURE 10 — INPUT OFFSET CURRENT

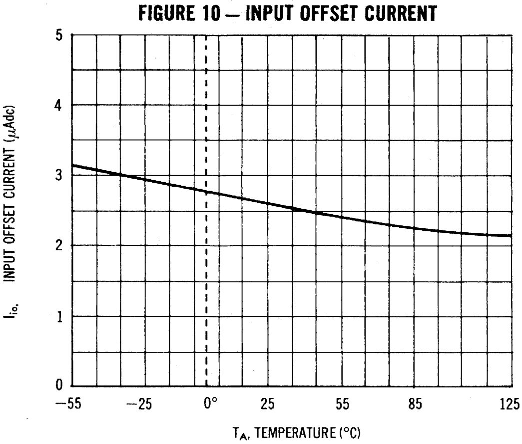


FIGURE 11 — INPUT CURRENT

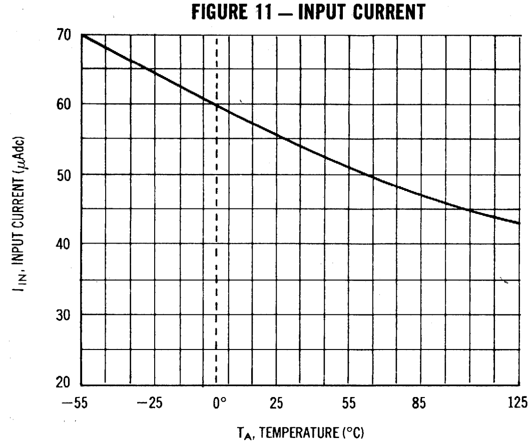


FIGURE 12 — CIRCUIT A BANDWIDTH

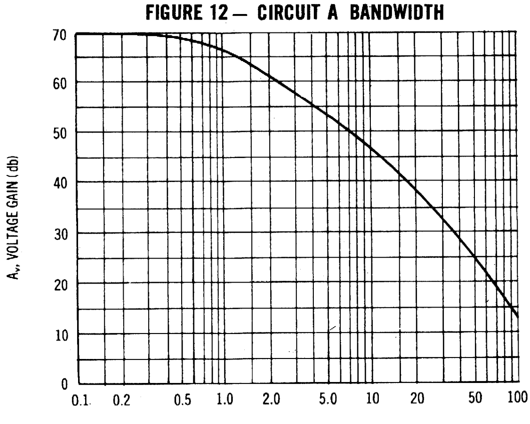
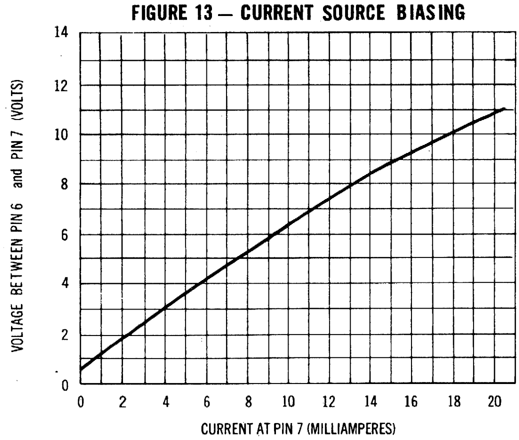


FIGURE 13 — CURRENT SOURCE BIASING



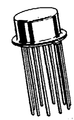
MC1525G
MC1526G

. . . designed for high gain applications. Features built-in temperature compensated current source for excellent temperature stability.

MONOLITHIC

MC1525G DIFFERENTIAL AMPLIFIER

MC1526G DARLINGTON INPUT DIFFERENTIAL AMPLIFIER



CASE 71

Lead 7 connected to case

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V+	+14	Vdc
Power Supply Voltage	V-	-14	Vdc
Differential Input Signal	V_{in}	±5	Vdc
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +175	°C
Total Power Dissipation, (Package Limitation) Derate above T_A = 25°C	P_D	680 4.6	mW mW/°C

CIRCUIT SCHEMATICS

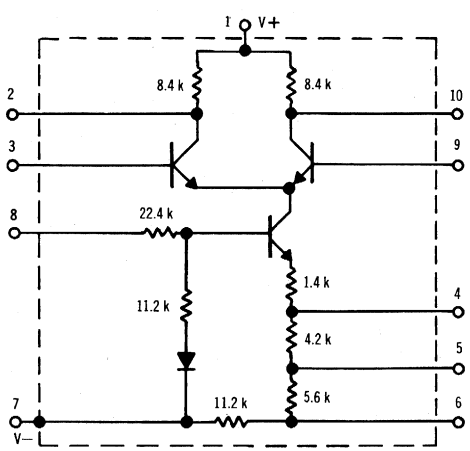


FIGURE 1 — MC1525

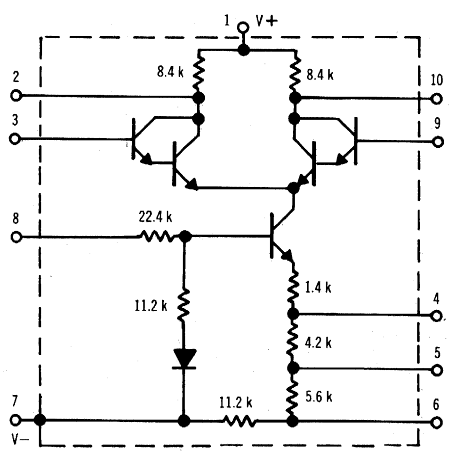


FIGURE 2 — MC1526

ELECTRICAL CHARACTERISTICS ($V+ = +12$ Vdc, $V- = -12$ Vdc, at $T_A = 25°C$ unless otherwise noted)

Characteristic	Fig No	Symbol	Min	Typ	Max	Unit
Differential Voltage Gain MC1525 MC1526	3, 13	A_{dd}	 120 50	 140 65	 160 75	—
Single Ended Voltage Gain MC1525 MC1526	4	A_v	 — —	 75 45	 — —	—
Output Voltage, Common Mode Both Types	5, 14	$V_{o(CM)}$	6.0	7.0	8.0	Vdc
Maximum Output Swing Both Types	6	V_{out}	7.0	—	—	$V_{(p-p)}$
AC Unbalance Both Types	6	U	—	—	300	$mV_{(p-p)}$
Input Offset Voltage MC1525 MC1526	7, 15	V_{io}	 — —	 — —	 5 7	mVdc
Input Offset Current MC1525 MC1526	8, 16	I_{io}	 — —	 — —	 4 2	µAdc
Input Current MC1525 MC1526	8, 18	I_{in}	 — —	 — —	 20 3.5	µAdc
Common Mode Rejection Both Types	9, 17	CM_{Rej}	80	—	—	dB
Bandwidth MC1525 MC1526	10	BW	 1400 500	 — —	 — —	kHz
Differential Input Impedance MC1525 MC1526	11	Z_{in}	 2.0 60	 — —	 — —	kΩ
Single Ended Output Impedance Both Types	12	Z_{out}	—	—	11	kΩ

DC Common Mode Input Voltage Set at: $V_{CM(min)}$ = 5.5 Vdc for MC1526G, $V_{CM(min)}$ = 6.2 Vdc for MC1525G

FIGURE 3 — DIFFERENTIAL VOLTAGE GAIN

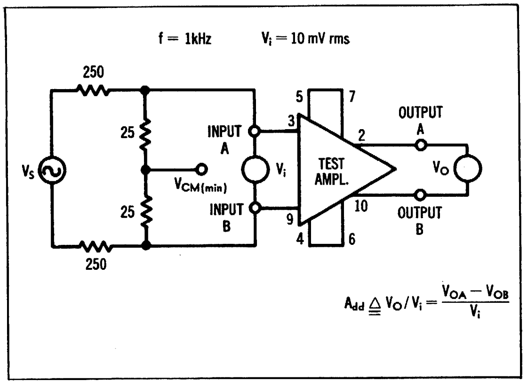


FIGURE 4 — SINGLE-ENDED VOLTAGE GAIN

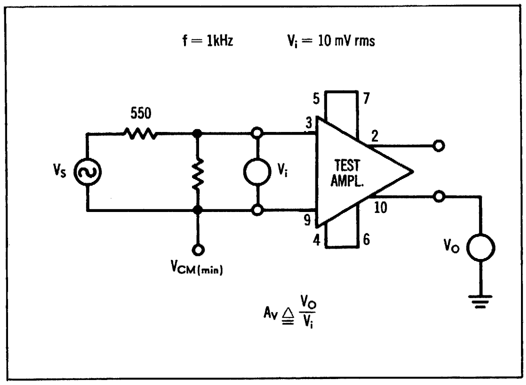


FIGURE 5 — OUTPUT VOLTAGE-COMMON MODE

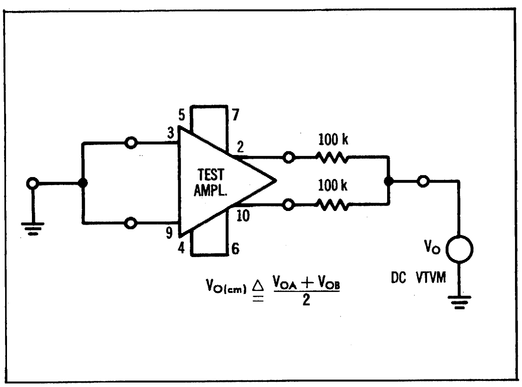


FIGURE 6 — MAXIMUM OUTPUT SWING

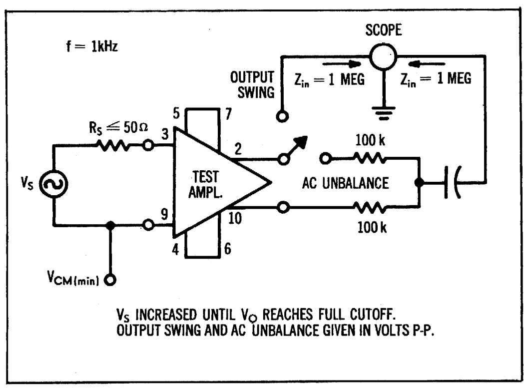


FIGURE 7 — INPUT OFFSET VOLTAGE

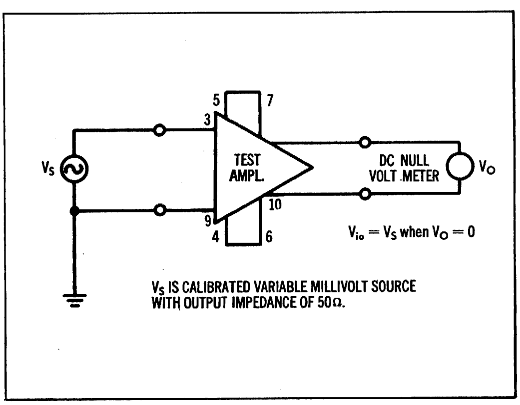
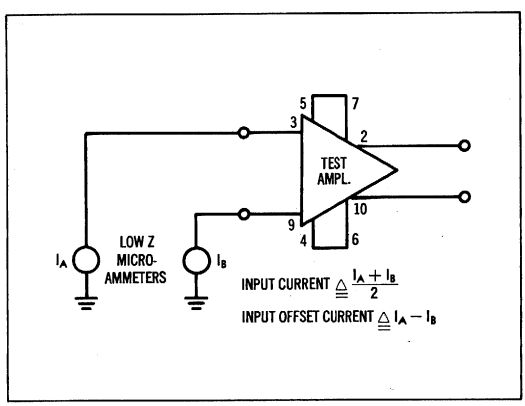


FIGURE 8 — INPUT OFFSET CURRENT and INPUT CURRENT



DC Common Mode Input Voltage Set at: $V_{CM(min)} = 5.5$ Vdc for MC1526G, $V_{CM(min)} = 6.2$ Vdc for MC1525G

FIGURE 9 — COMMON MODE REJECTION

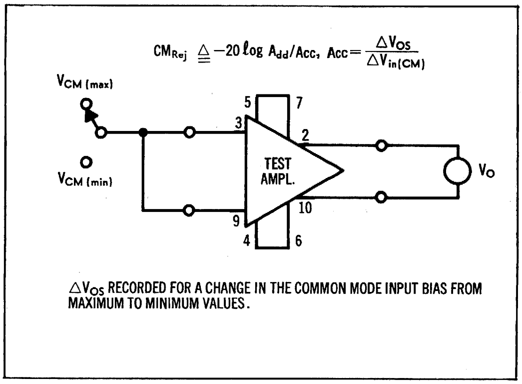


FIGURE 10 — BANDWIDTH

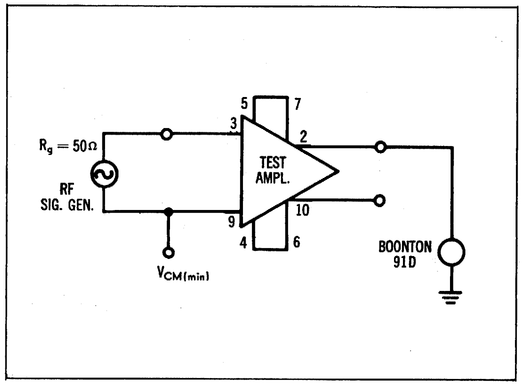


FIGURE 11 — DIFFERENTIAL INPUT IMPEDANCE

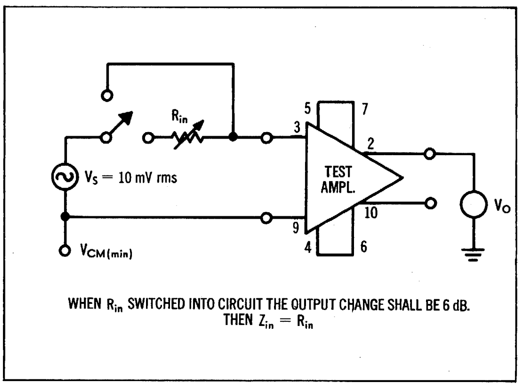
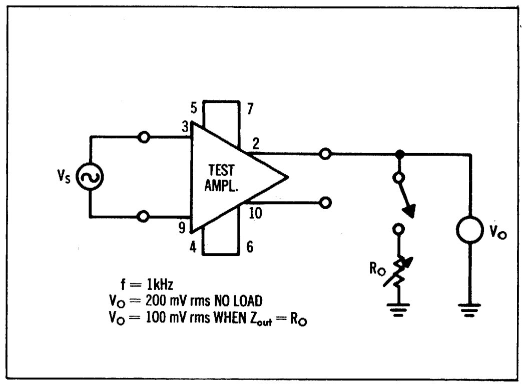
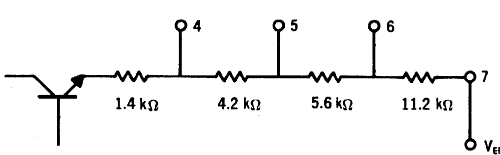


FIGURE 12 — SINGLE - ENDED OUTPUT IMPEDANCE



BIASING ARRANGEMENT

In the emitter of the current source transistor of each of the differential amplifiers, there are four resistors of different values which may be connected in seven ways. The resultant effective resistance in conjunction with a given V_{EE} makes provision for different current levels. For convenience, the seven methods together with their effective resistances are tabulated below.



*Pin 7 is connected to the substrate and must be connected to the V_{EE} supply for proper circuit operation.

METHOD	1	2	3	4	5	6	7
PIN CONNECTIONS	4-7	4-6, 5-7	4-5, 6-7	4-6	4-5	5-6	4,5,6 OPEN
EFFECTIVE RESISTANCE	1.4kΩ	3.37 kΩ	7.0 kΩ	12.6kΩ	18.2 kΩ	16.8kΩ	22.4 kΩ

EFFECT OF TEMPERATURE ON CHARACTERISTICS

FIGURE 13 — DIFFERENTIAL MODE GAIN

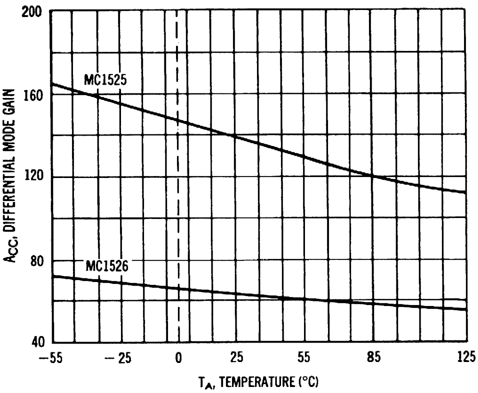


FIGURE 14 — OUTPUT VOLTAGE-COMMON MODE

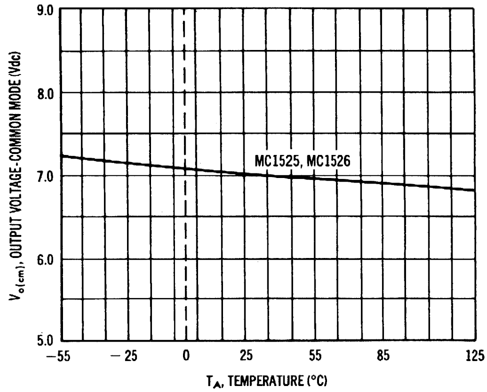


FIGURE 15 — INPUT OFFSET VOLTAGE

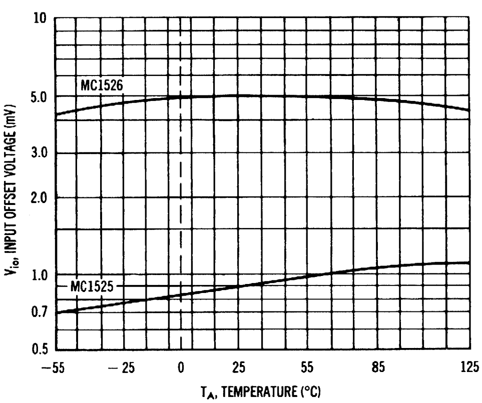


FIGURE 16 — INPUT OFFSET CURRENT

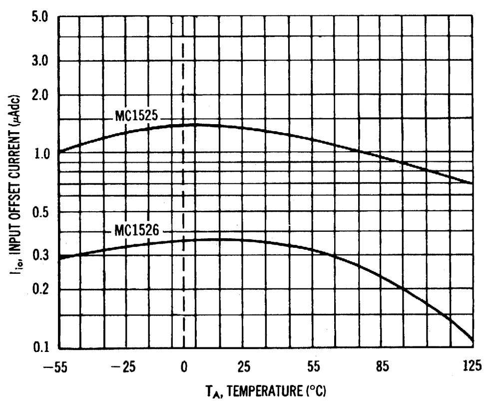


FIGURE 17 — COMMON MODE REJECTION

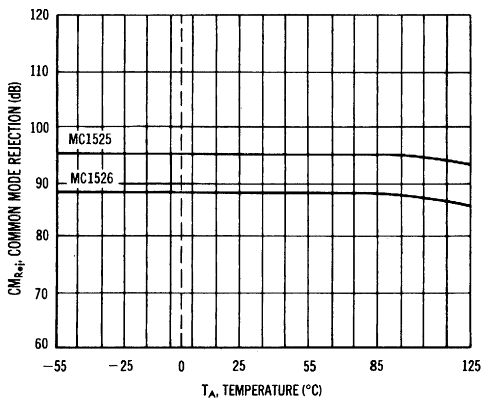
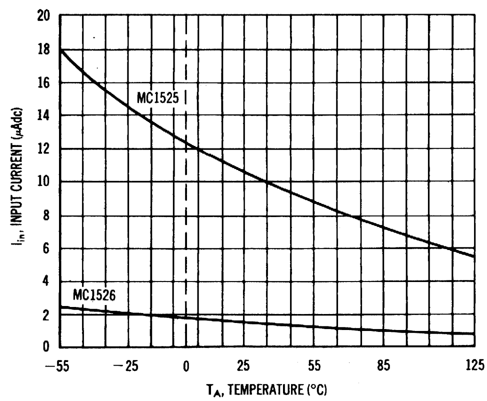
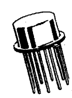


FIGURE 18 — INPUT CURRENT



MC1529G
MC1429G

. . . designed for high-gain applications. Features built-in temperature compensated current source for excellent temperature stability.



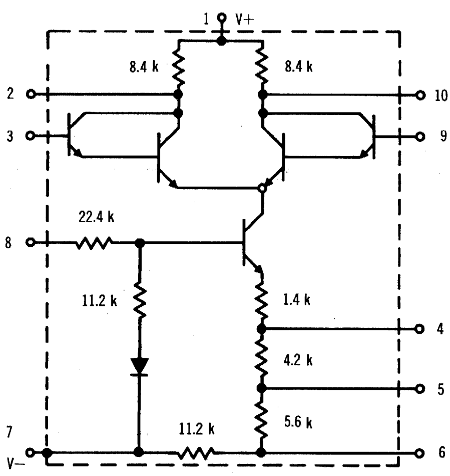
CASE 71

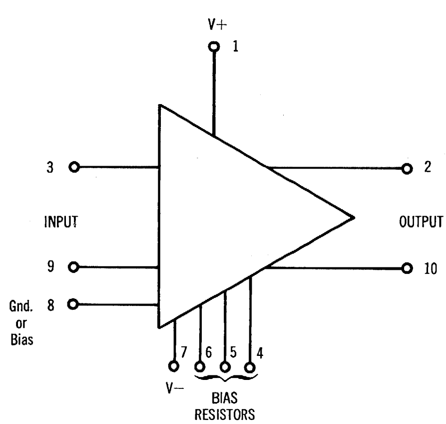
Lead 7 connected to case

MAXIMUM RATINGS ($T_A = 25°C$ unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V	+14	Vdc
Power Supply Voltage	V	-14	Vdc
Differential Input Signal	V_{in}	± 5	Vdc
Operating Temperature Range MC1529G MC1429G	T_A	 -55 to 125 0 to 75	°C
Storage Temperature Range	T_{stg}	-65 to 150	°C
Power Dissipation (Package Limitation) Derate above T_A = 25°C)	P_D	680 4.6	mW mW/°C

CIRCUIT SCHEMATICS

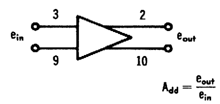
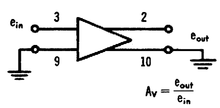
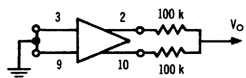
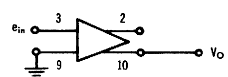
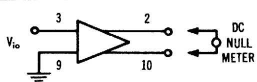
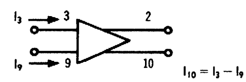
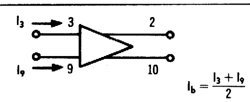
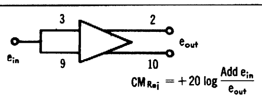
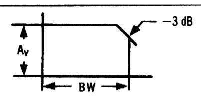
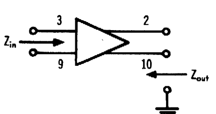




EQUIVALENT CIRCUIT

ELECTRICAL CHARACTERISTICS

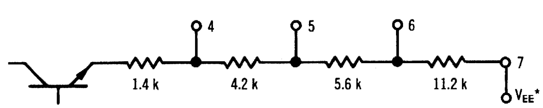
(V+ = +12 Vdc; V− = −12 Vdc; V_8 = 0 Vdc; T_A = 25°C unless otherwise noted)
Connect pin 4 to pin 6 and pin 5 to pin 7 for all tests.

Characteristic Definitions*	Characteristic	Symbol	Min	Typ	Max	Unit
	Differential Voltage Gain	A_{dd}				
	MC1529G		50 34	75 —	110 41	V/V dB
	MC1429G		45 33	75 —	— —	V/V dB
	Single Ended Voltage Gain	A_V				
	MC1529G		25 28	— —	55 35	V/V dB
	MC1429G		22 27	— —	— —	V/V dB
	Output Voltage, Common Mode	$V_{o(CM)}$				Vdc
	MC1529G		6.5	7.0	8.5	
	MC1429G		5.5	7.0	8.5	
	Maximum Output Swing Both Types	V_o	5.0	—	—	$V_{(p-p)}$
	Input Offset Voltage	V_{io}				mVdc
	MC1529G		—	—	9.0	
	MC1429G		—	—	12.0	
	Input Offset Current	I_{io}				µAdc
	MC1529G		—	—	2.0	
	MC1429G		—	—	3.0	
	Input Bias Current	I_{in}				µAdc
	MC1529G		—	—	4.0	
	MC1429G		—	—	4.0	
	Common Mode Rejection Both Types	CM_{Rej}	70	—	—	dB
	Bandwidth	BW				kHz
	MC1529G		200	300	—	
	MC1429G		150	250	—	
	Differential Input Impedance	Z_{in}				kΩ
	MC1529G		40	—	—	
	MC1429G		30	—	—	
	Single Ended Output Impedance	Z_{out}				kΩ
	MC1529G		—	—	12	
	MC1429G		—	—	15	

*All definitions imply linear operation.

BIASING ARRANGEMENT

In the emitter of the current source transistor of each of the differential amplifiers, there are four resistors of different values which may be connected in seven ways. The resultant effective resistance in conjunction with a given V_{EE} makes provision for different current levels. For convenience, the seven methods together with their effective resistances are tabulated below.



*Pin 7 is connected to the substrate and must be connected to the V_{EE} supply for proper circuit operation.

METHOD	1	2	3	4	5	6	7
PIN CONNECTIONS	4-7	4-6, 5-7	4-5, 6-7	4-6	4-5	5-6	4,5,6 OPEN
EFFECTIVE RESISTANCE	1.4 k	3.37 k	7.0 k	12.6 k	18.2 k	16.8 k	22.4 k

EFFECT OF TEMPERATURE ON CHARACTERISTICS

FIGURE 1 — DIFFERENTIAL MODE GAIN

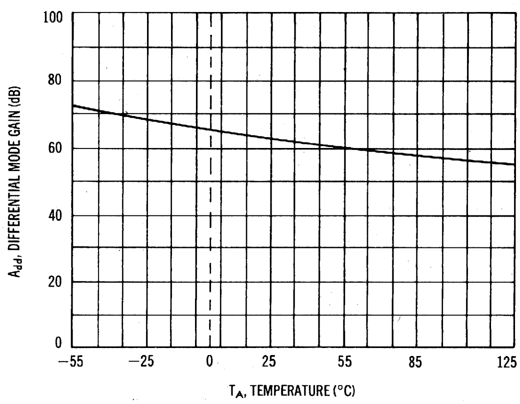


FIGURE 2 — OUTPUT VOLTAGE-COMMON MODE

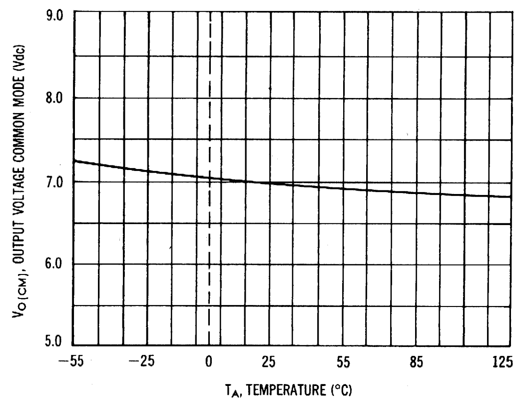


FIGURE 3 — INPUT OFFSET VOLTAGE

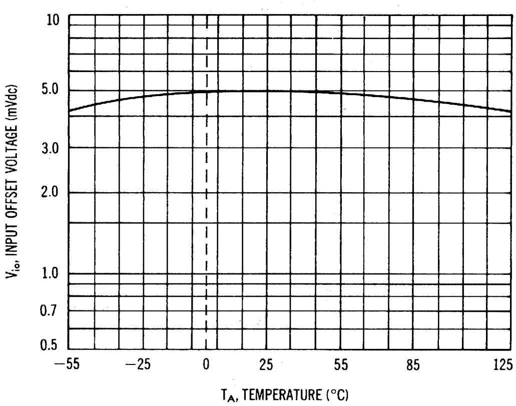


FIGURE 4 — INPUT OFFSET CURRENT

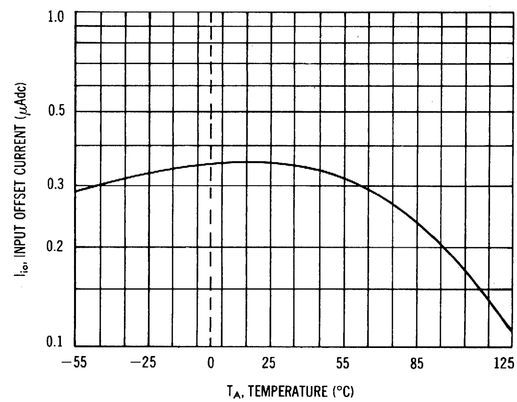


FIGURE 5 — COMMON MODE REJECTION

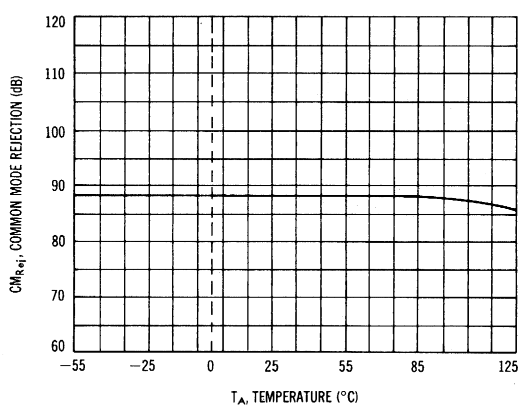
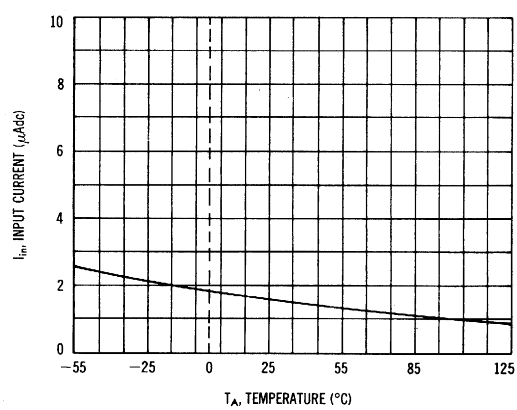
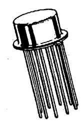


FIGURE 6 — INPUT CURRENT



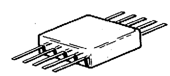
MC1440

. . . consisting of a wideband differential amplifier, a dc restoration circuit which also incorporates facilities to externally adjust the threshold, and an MDTL output gate which is strobed from saturated logic. It is designed to detect bipolar differential signals derived by a core memory with cycle times as low as 0.5 μs.

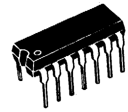


CASE 71
"G" SUFFIX

Lead 5 connected to case



CASE 72
(TO-91)
"F" SUFFIX



CASE 93
(TO-116)
"P" SUFFIX

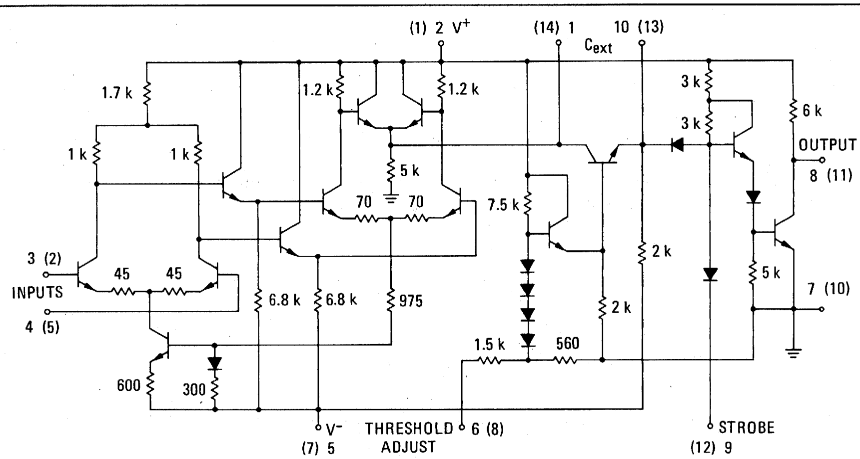
Typical Amplifier Features:

- Differential Threshold Characteristics:
  - Adjustable Threshold — 10-25 mV
  - Nominal Threshold — 17 mV @ V_6 = -6 V
  - Input Offset Voltage — 1.0 mV typical
  - Threshold Drift — -10 μV/°C typical
- Fast Response Time — 20 ns typical
- Short Recovery Time
  - 60 ns max @ e_{in} = 1.8 V Common Mode
  - 90 ns max @ e_{in} = 400 mV Differential Mode

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+10 -10	Vdc Vdc
Differential Input Signal	V_{in}	±5	Vdc
Common Mode Input Voltage	CMV_{in}	±5	Vdc
Load Current	I_L	25	mA
Power Dissipation (Package Limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 415 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



Number at end of terminal represents pin number for devices in flat package and metal can.

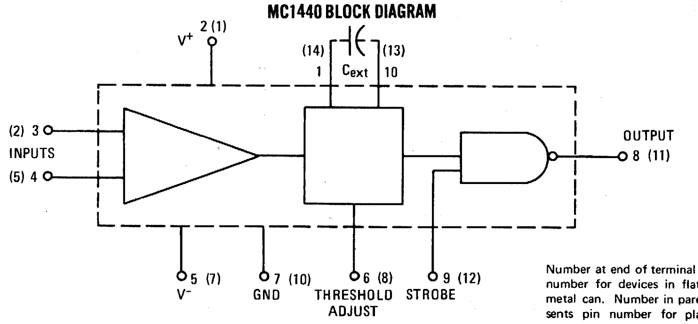
Number in parenthesis represents pin number for plastic package.

ELECTRICAL CHARACTERISTICS

(V^+ = +6 Vdc ±1%, V^- = -6 Vdc ±1%, C_{ext} = 0.01 μF, T_A = 25°C unless otherwise noted)
Pin numbers shown for devices in flat package and metal can. See block diagram for plastic pin numbers.

Characteristic	Fig. No.	Symbol	Min	Typ	Max	Unit
Input Threshold Voltage (V_6 = -6 Vdc)	1	V_{th}	12.0	17.0	22.0	mV
Input Offset Voltage	1	V_{io}	-	1.0	6.0	mV
Input Bias Current ($V_3 = V_4 = 0$)	2	I_b	-	7.5	75	μA
Input Offset Current	2	I_{io}	-	2.0	15.0	μA
Output Voltage, High ($V_3 = V_4 = 0$)	3	V_{OH}	5.8	-	-	Vdc
Output Voltage Low ($V_3 = V_4 = 0$, V_{10} = +6 Vdc, I_8 = 6 mAdc)	3	V_{OL}	-	-	400	mVdc
Amplifier Voltage Gain (V_3 = 15 mV peak)	4	A_V	-	85	-	-
Strobe Load Current (V_9 = 0)	-	I_S	-	-	1.5	mAdc
Strobe Reverse Current (V_9 = +5 Vdc)	-	I_R	-	-	5.0	μAdc
Power Dissipation	-	P_D	-	120	250	mW
Propagation Delay						ns
Input to Amplifier Output (V_3 = 25 mV pulse, V_9 = +2 Vdc)	5	t_{3+10+}	-	10	20	
Input to Gate Output (V_3 = 25 mV pulse, V_9 = +2 Vdc)	5	t_{3+8-}	-	20	50	
Strobe to Gate Output ($V_3 = V_4 = 0$, V_9 = +2 V pulse)	6	t_{9+8-}	-	10	30	
Recovery Time						ns
Differential Mode (V_3 = 300 mV pulse)	7	$t_{R(dm)}$	-	20	90	
Common Mode (V_3 = 1.5 V pulse)	7	$t_{R(cm)}$	-	20	60	
TESTS AT 0°C OR +75°C AS NOTED						
Input Threshold Voltage	1	V_{th}				mV
(V_6 = -6.0 V, T_A = 0°C)			10.0	17.0	30.0	
(V_6 = -6.0 V, T_A = +75°C)			10.0	17.0	30.0	
Input Bias Current ($V_3 = V_4 = 0$, T_A = 0°C)	2	I_b	-	-	100	μA
Output Voltage, Low (V_{10} = +6 Vdc, I_8 = 6 mAdc, T_A = +75°C)	3	V_{OL}	-	-	450	mVdc
Strobe Reverse Current (V_9 = +6 Vdc, T_A = +75°C)	-	I_R	-	-	30	μAdc

MC1440 BLOCK DIAGRAM



Number at end of terminal represents pin number for devices in flat package and metal can. Number in parenthesis represents pin number for plastic package.

FIGURE 1 — INPUT THRESHOLD AT OUTPUT VOLTAGE SWING FROM V_{OL} TO V_{OH}

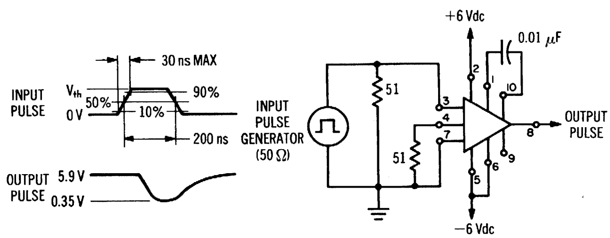


FIGURE 2 — INPUT BIAS CURRENT TEST CIRCUIT

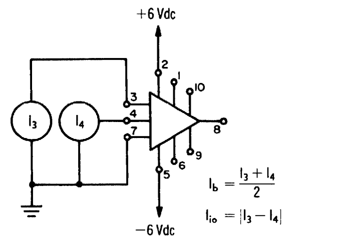


FIGURE 3 — OUTPUT VOLTAGE LEVELS

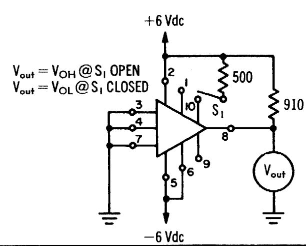


FIGURE 4 — AMPLIFIER VOLTAGE GAIN

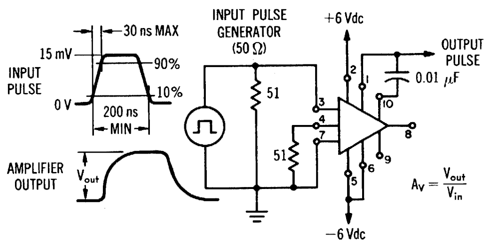


FIGURE 5 — PROPAGATION DELAY (STROBE HIGH)

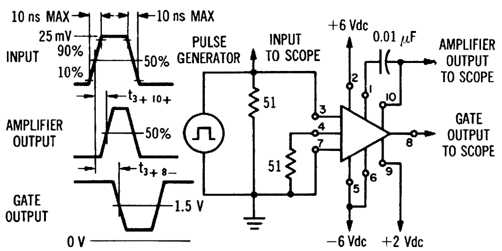


FIGURE 6 — PROPAGATION DELAY (STROBE INPUT)

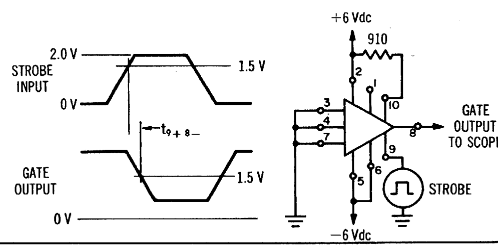


FIGURE 7 — DIFFERENTIAL MODE RECOVERY TIME TEST CIRCUIT

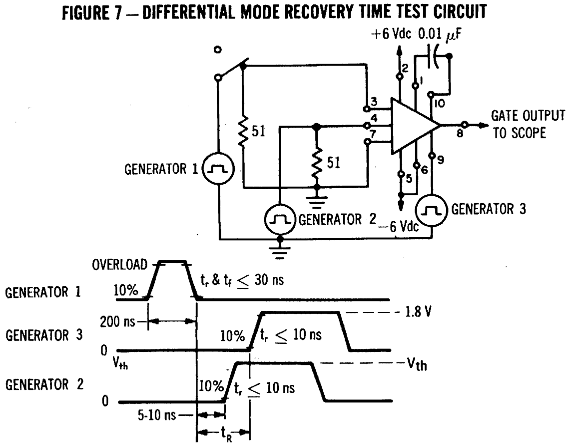
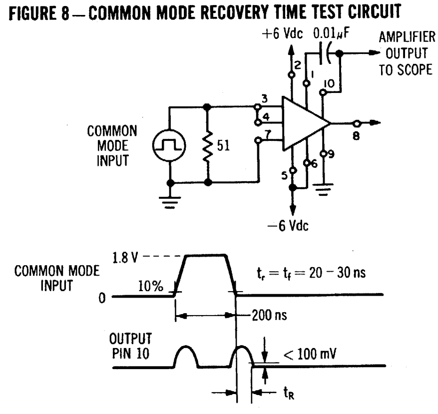


FIGURE 8 — COMMON MODE RECOVERY TIME TEST CIRCUIT



NOTE: The output shown is representative of that obtained. However, the two pulse amplitudes may not be equal or even present.

Pin numbers shown for devices in flat package and metal can. See block diagram for plastic package pin numbers.

FIGURE 9 — TYPICAL TRANSFER CHARACTERISTICS

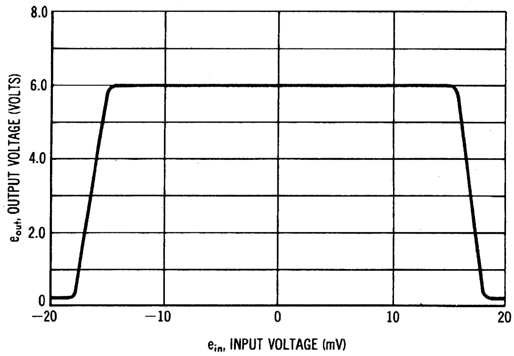


FIGURE 10 — TYPICAL THRESHOLD versus TEMPERATURE

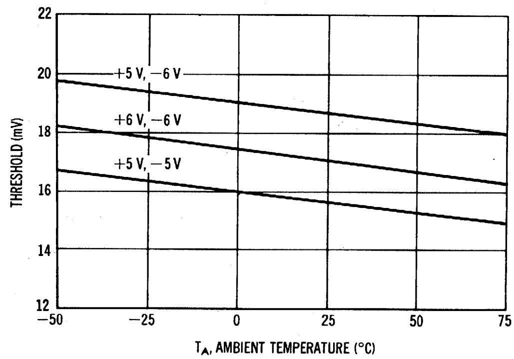


FIGURE 11 — TYPICAL THRESHOLD versus POWER SUPPLIES $T_A = +25°C$ (Threshold Adjust Attached to V^-)

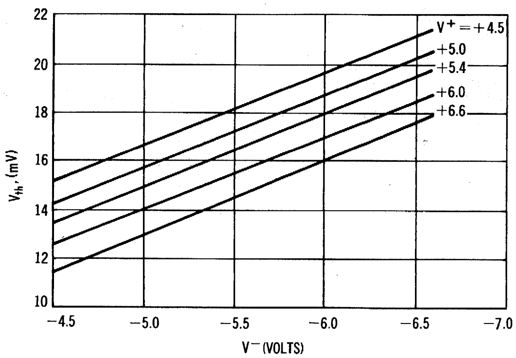
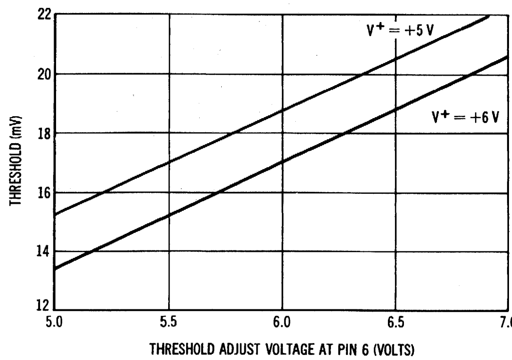


FIGURE 12 — TYPICAL THRESHOLD versus THRESHOLD VOLTAGE ADJUST FOR $V^- = -6.0$ V



DEFINITIONS

A_V — Amplifier Voltage Gain — The ratio of output voltage at pin 1 to the input voltage at pin 3 or 4.

I_b — Input Bias Current — The average input current defined as $(I_3 + I_4)/2$.

I_{io} — Input Offset Current — The difference between input current values, $|I_3 - I_4|$.

I_R — Strobe Reverse Current — The leakage current when the strobe input is high.

I_S — Strobe Load Current — The amount of current drain from the circuit when the strobe pin is grounded.

P_D — Power Dissipation — The amount of power dissipated in the unit as defined by $|I_2 \times V^+| + |I_5 \times V^-|$.

t_R — Recovery Time — The time required for the device to recover from the specified differential and common-mode overload inputs prior to strobe as referenced to the 10% point of the trailing edge of an input pulse. The device is considered recovered when the threshold after a differential overload disturbance is within 1.0 mV of the threshold value without the disturbance, or, for common-mode disturbance, when the level at pin 10 is within 100 mV of the quiescent value.

$t_{x\pm y\pm}$ — Propagation Delay — The time required for the output pulse at pin y to achieve 50% of its final value or the 1.5 V level referenced to 50% of the input pulse at pin x. (The + and − denote positive and negative-going pulse transition.)

V_{OH} — Output Voltage High — The high-level output voltage when the output gate is turned off.

V_{OL} — Output Voltage Low — The low-level output voltage when the output gate is turned on.

V_{th} — Input Threshold — Input pulse amplitude that causes the output to begin saturation.

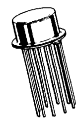
V_{io} — Input Offset Voltage — The difference in V_{th} at each input.

For a more detailed discussion regarding application of sense amplifiers, see Application Note AN-245A, "The MC1540 — An Integrated Core Memory Sense Amplifier."

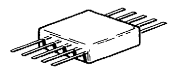
CORE MEMORY SENSE AMPLIFIER

MC1540

. . . consisting of a wideband differential amplifier, a dc restoration circuit which also incorporates facilities to externally adjust the threshold, and an MDTL output gate which is strobed from saturated logic. It is designed to detect bipolar differential signals derived by a core memory with cycle times as low as 0.5 μs.



CASE 71
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

Lead 5 connected to case

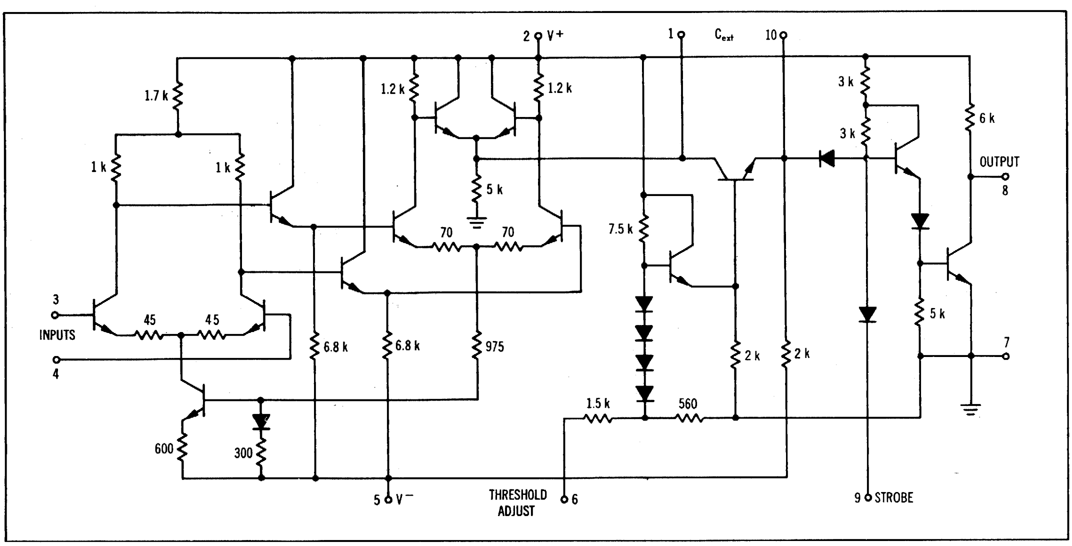
Typical Amplifier Features:

- Differential Threshold Characteristics:
  - Adjustable Threshold — 10-25 mV
  - Nominal Threshold — 17 mV @ V_6 = -6 V
  - Input Offset Voltage — 1.0 mV typical
  - Threshold Drift — -10 μV/°C
- Fast Response Time — 20 ns typical
- Short Recovery Time
  - 50 ns max @ e_{in} = 1.8 V Common Mode
  - 50 ns max @ e_{in} = 400 mV Differential Mode

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+	+10	Vdc
	V^-	-10	Vdc
Differential Input Signal	V_{in}	±5.0	Vdc
Common Mode Input Voltage	CMV_{in}	±5.0	Vdc
Load Current	I_L	25	mA
Power Dissipation (Package Limitation)	P_D		
Metal Can		680	mW
Derate above 25°C		4.6	mW/°C
Flat Package		500	mW
Derate above 25°C		3.3	mW/°C
Operating Temperature Range	T_A		°C
Metal Can		-55 to +125	
Flat Package		-55 to +100	
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



ELECTRICAL CHARACTERISTICS

($V^+ = +6$ Vdc ±1%, $V^- = -6$ Vdc ±1%, $C_{ext} = 0.01$ µF, $T_A = 25°C$ unless otherwise noted)

Characteristic	Figure	Symbol	Min	Typ	Max	Unit
Input Threshold Voltage ($V_6 = -6.0$ V)	1	V_{th}	14.0	17.0	20.0	mV
Input Offset Voltage	1	V_{io}	—	1.0	5.0	mV
Input Bias Current ($V_3 = V_4 = 0$)	2	I_b	—	7.5	50	µA
Input Offset Current	2	I_{io}	—	2.0	10.0	µA
Output Voltage, High ($V_3 = V_4 = 0$)	3	V_{OH}	5.9	—	—	Vdc
Output Voltage, Low ($V_3 = V_4 = 0$, $V_{10} = +6$ Vdc, $I_8 = 6$ mAdc)	3	V_{OL}	—	—	350	mVdc
Amplifier Voltage Gain ($V_3 = 15$ mV)	4	A_V	—	85	—	—
Strobe Load Current ($V_9 = 0$)	—	I_S	—	—	1.2	mAdc
Strobe Reverse Current ($V_9 = +5$ Vdc)	—	I_R	—	—	2.0	µAdc
Power Dissipation	—	P_D	—	120	180	mW
Propagation Delay						ns
Input to Amplifier Output ($V_3 = 25$ mV pulse, $V_9 = +2$ Vdc)	5	t_{3+10+}	—	10	15	
Input to Gate Output ($V_3 = 25$ mV pulse, $V_9 = +2$ Vdc)	5	t_{3+8-}	—	20	30	
Strobe to Gate Output ($V_3 = V_4 = 0$, $V_9 = +2$ V pulse)	6	t_{9+8-}	—	10	15	
Recovery Time						ns
Differential Mode ($V_3 = 400$ mV pulse)	7	$t_{R(dm)}$	—	20	50	
Common Mode ($V_3 = 1.8$ V pulse)	8	$t_{R(cm)}$	—	20	50	

TESTS AT −55°C OR +125°C AS NOTED

Characteristic	Figure	Symbol	Min	Typ	Max	Unit
Input Threshold Voltage ($V_6 = -6.0$ V, $T_A = -55°C$)	1	V_{th}	12.0	17.0	24.0	mV
($V_6 = -6.0$ V, $T_A = +125°C$)			12.0	17.0	22.0	
Input Bias Current ($V_3 = V_4 = 0$, $T_A = -55°C$)	2	I_b	—	—	100	µA
Output Voltage, Low ($V_{10} = +6$ Vdc, $I_8 = 6$ mAdc, $T_A = +125°C$)	3	V_{OL}	—	—	400	mVdc
Strobe Reverse Current ($V_9 = +6$ Vdc, $T_A = +125°C$)	—	I_R	—	—	25	µAdc

DEFINITIONS

A_V Amplifier Voltage Gain — The ratio of output voltage at pin 1 to the input voltage at pin 3 or 4.

I_b Input Bias Current — The average input current defined as $(I_3 + I_4)/2$.

I_{io} Input Offset Current — The difference between input current values, $|I_3 - I_4|$.

I_R Strobe Reverse Current — The leakage current when the strobe input is high.

I_S Strobe Load Current — The amount of current drain from the circuit when the strobe pin is grounded.

P_D Power Dissipation — The amount of power dissipated in the unit as defined by $|I_2 \times V^+| + |I_5 \times V^-|$.

t_R Recovery Time — The time required for the device to recover from the specified differential and common-mode overload inputs prior to strobe as referenced to the 10% point of the trailing edge of an input pulse. The device is considered recovered when the threshold after a differential overload disturbance is within 1.0 mV of the threshold value without the disturbance, or, for common-mode disturbance, when the level at pin 10 is within 100 mV of the quiescent value.

$t_{x\pm y\pm}$ Propagation Delay — The time required for the output pulse at pin y to achieve 50% of its final value or the 1.5 V level referenced to 50% of the input pulse at pin x. (The + and − denote positive and negative-going pulse transition.)

V_{OH} Output Voltage High — The high-level output voltage when the output gate is turned off.

V_{OL} Output Voltage Low — The low-level output voltage when the output gate is turned on.

V_{th} Input Threshold — Input pulse amplitude that causes the output to begin saturation.

V_{io} Input Offset Voltage — The difference in V_{th} at each input.

FIGURE 1 — INPUT THRESHOLD AT OUTPUT VOLTAGE SWING FROM V_{OL} TO V_{OH}

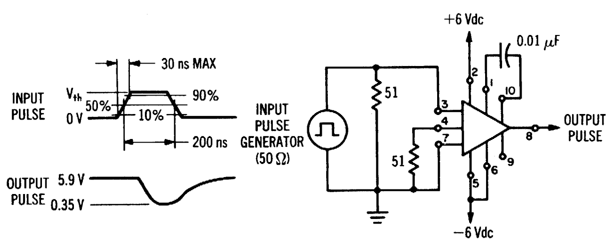


FIGURE 2 — INPUT BIAS CURRENT TEST CIRCUIT

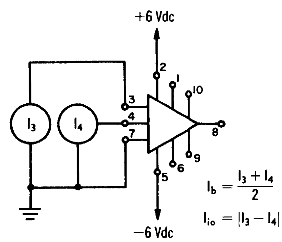


FIGURE 3 — OUTPUT VOLTAGE LEVELS

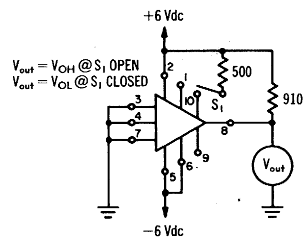


FIGURE 4 — AMPLIFIER VOLTAGE GAIN

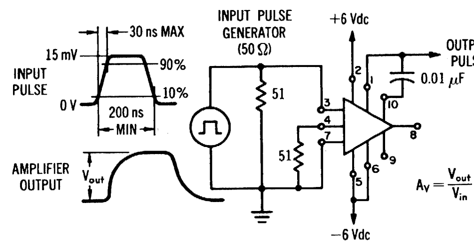


FIGURE 5 — PROPAGATION DELAY (STROBE HIGH)

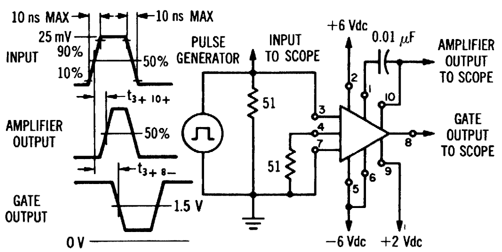


FIGURE 6 — PROPAGATION DELAY (STROBE INPUT)

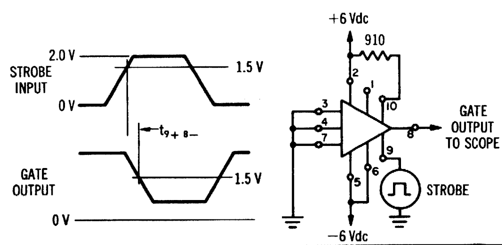


FIGURE 7 — DIFFERENTIAL MODE RECOVERY TIME TEST CIRCUIT

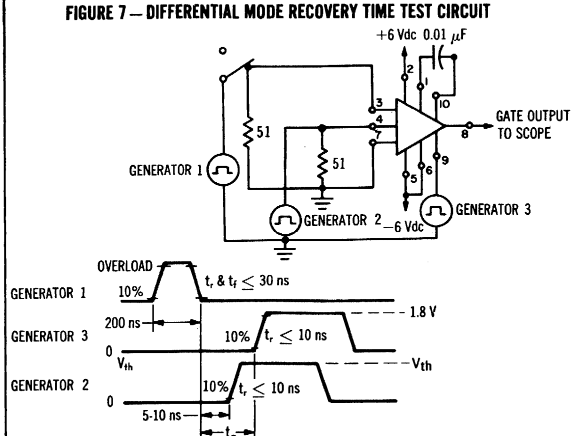
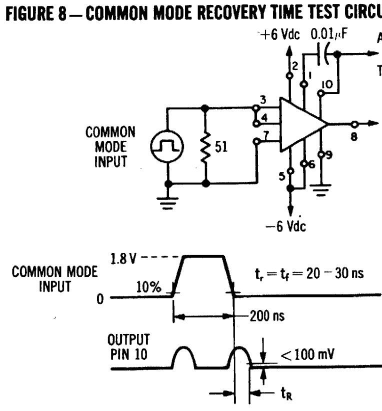


FIGURE 8 — COMMON MODE RECOVERY TIME TEST CIRCUIT



NOTE: The output shown is representative of that obtained. However, the two pulse amplitudes may not be equal or even present.

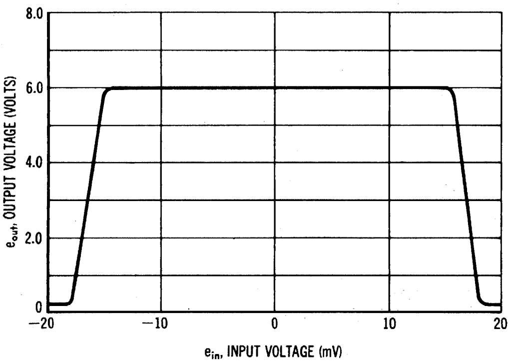


FIGURE 9 — TYPICAL TRANSFER CHARACTERISTICS

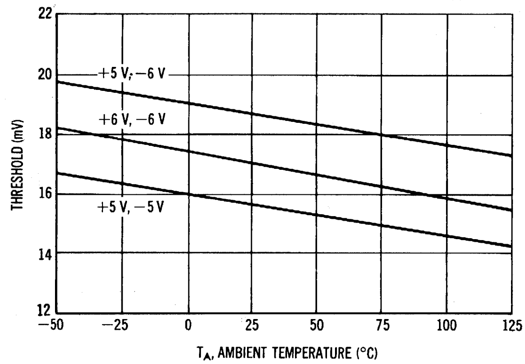


FIGURE 10 — TYPICAL THRESHOLD versus TEMPERATURE

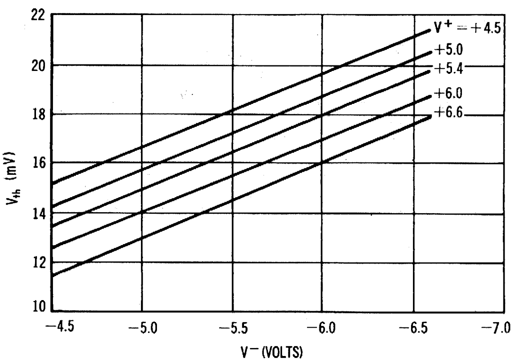


FIGURE 11 — TYPICAL THRESHOLD versus POWER SUPPLIES
$T_A = +25°C$ (Threshold Adjust Attached to V^-)

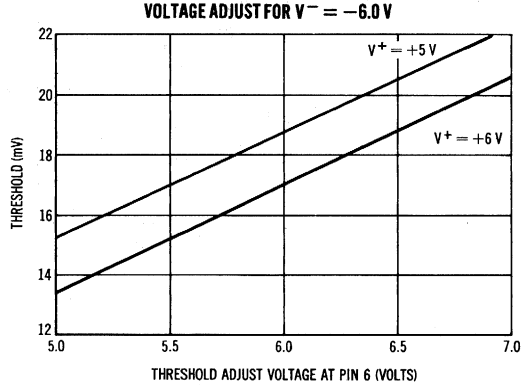


FIGURE 12 — TYPICAL THRESHOLD versus THRESHOLD VOLTAGE ADJUST FOR $V^- = -6.0\ V$

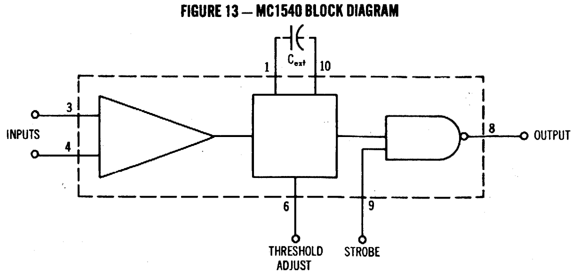


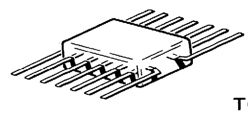
FIGURE 13 — MC1540 BLOCK DIAGRAM

For a more detailed discussion regarding application of sense amplifiers, see Application Note AN-245A, "The MC1540 — An Integrated Core Memory Sense Amplifier."

CORE MEMORY SENSE AMPLIFIER

MC1541F

Dual-channel gated sense amplifier with separate wideband differential input amplifiers. Either input can be gated on from saturated logic levels. The sense amplifier features adjustable threshold, saturated logic output levels, and a strobe input that accommodates saturated logic levels. Designed to detect bipolar signals from either of two sense lines. Operates with core memory cycle times less than 0.5 μs.



TO-86
CASE 83

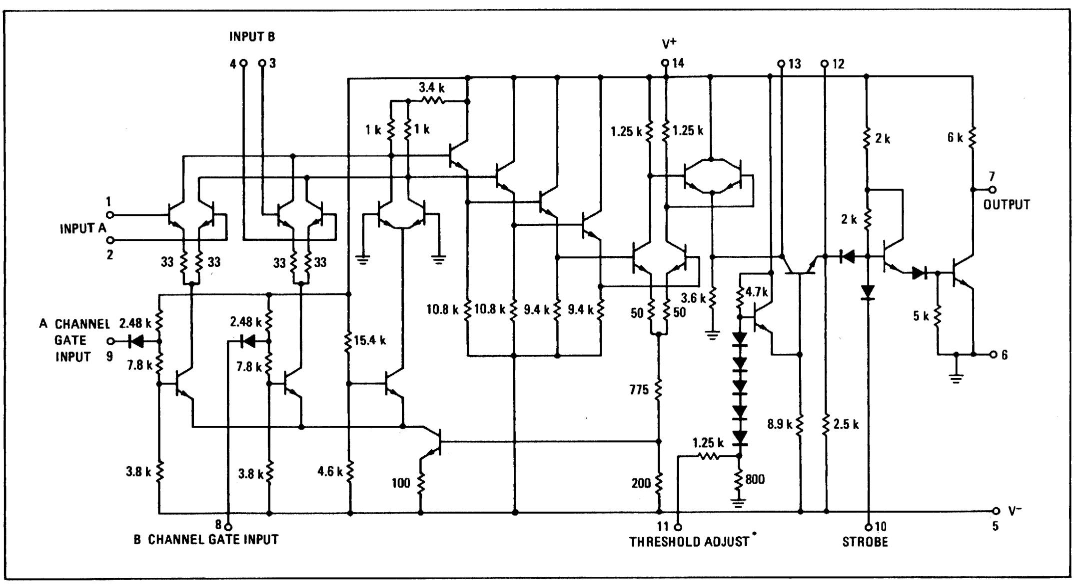
Typical Amplifier Features:

- Nominal Threshold — 17 mV
- Input Offset Voltage — 1.0 mV typical
- Propagation Delay
  Input to Gate-Output — 20 ns
  Input to Amplifier-Output — 10 ns
  Gate Response Time — 15 ns
  Strobe Response Time — 15 ns
- Common Mode Input Range — 1.5 Volts
- Differential Mode Input Range
  With Gate On — 600 mV
  With Gate Off — 1.5 Volts
- Power Dissipation — 140 mW typical

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V+ V-	+10 -10	Vdc Vdc
Differential Input Signal	V_{in}	±5	Vdc
Common Mode Input Voltage	CMV_{in}	±5	Vdc
Load Current	I_L	25	mA
Power Dissipation (Package Limitation) Derate above 25°C	P_D	500 3.3	mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



ELECTRICAL CHARACTERISTICS

(V^+ = +5.0 Vdc ± 1%, V^- = -5.0 Vdc ± 1%, $V_{th(pin\ 11)}$ = -5.0 Vdc ± 1%, C_{ext} = 0.01 μF, T_A = 25°C unless otherwise noted)

Characteristic	Fig. No.	Symbol	Min	Typ	Max	Unit
Input Threshold Voltage	8	V_{th}				mV
(T_A = +25°C)			14	17	20	
(-55°C ≤ T_A ≤ +125°C)			12	17	22	
Input Offset Voltage	8	V_{io}	-	1.0	6.0	mV
Input Bias Current	9	I_b				μA
($V_1 = V_2 = V_3 = V_4 = 0$)			-	5.0	25	
($V_1 = V_2 = V_3 = V_4 = 0$, T_A = -55°C)			-	-	50	
Input Offset Current	9	I_{io}	-	1.0	2.0	μA
Output Voltage High ($V_1 = V_2 = V_3 = V_4 = 0$)	10	V_{OH}	4.9	-	-	Vdc
Output Voltage Low	10	V_{OL}				mVdc
($V_1 = V_2 = V_3 = V_4 = 0$, V_{12} = +5.0 Vdc, I_7 = 10 mAdc)			-	-	350	
(V_{12} = +5.0 Vdc, I_7 = 10 mAdc, T_A = +125°C)			-	-	400	
Strobe Load Current (V_{10} = 0)		I_S	-	-	1.2	mAdc
Strobe Reverse Current		I_{SR}				μAdc
(V_{10} = +5.0 Vdc)			-	-	2.0	
(V_{10} = +5.0 Vdc, T_A = +125°C)			-	-	25	
Input Gate Voltage Low ($V_1 = V_3$ = 25 mVdc, $V_2 = V_4 = 0$)	11	V_{GL}	-	0.7	-	Vdc
Input Gate Voltage High ($V_1 = V_3$ = 25 mVdc, $V_2 = V_4 = 0$)	11	V_{GH}	-	1.6	-	Vdc
Input Gate Load Current (V_8 or V_9 = 0)		I_G	-	-	2.5	mAdc
Input Gate Reverse Current (V_8 or V_9 = 5.0 Vdc)		I_{GR}				μAdc
(T_A = 25°C)			-	-	2.0	
(T_A = +125°C)			-	-	25	
Common Mode Range	13	V_{CM}				Vdc
Input Gate High			-	±1.5	-	
Input Gate Low			-	±1.5	-	
Differential Mode Range	14					
Input Gate High		V_{DH}	-	±600	-	mV
Input Gate Low		V_{DL}	-	±1.5	-	Vdc
Power Dissipation		P_D	-	140	180	mW

SWITCHING CHARACTERISTICS

Characteristic	Fig. No.	Symbol	Min	Typ	Max	Unit
Propagation Delay						ns
Input to Amplifier Output (V_1 = 25 mV pulse, V_{10} = +2.0 Vdc)	8	t_{IA}	-	10	15	
Input to Output (V_1 = 25 mV pulse, V_{10} = +2.0 Vdc)	8	t_{IO}	-	20	30	
Strobe to Output ($V_1 = V_2 = V_3 = V_4 = 0$, V_{10} = +2.0 V pulse)	12	t_{SO}	-	15	20	
Gate Input to Amplifier Input (V_1 = 25 mV pulse, V_9 = 2.0 V pulse)	11	t_{GI}	-	10	15	
Gate Input to Amplifier Output (V_1 = 25 mVdc, V_9 = 2.0 V pulse)	11	t_{GA}	-	30	35	
Recovery Time						ns
Differential Mode	14	t_{DR}				
Input Gate High } V_1 or V_3 = 400 mV pulse			-	30	50	
Input Gate Low }			-	0	-	
Common Mode	13	t_{CMR}				
Input Gate High } V_1 or V_3 = 1.5 V pulse			-	15	30	
Input Gate Low }			-	15	30	

EQUIVALENT CIRCUIT

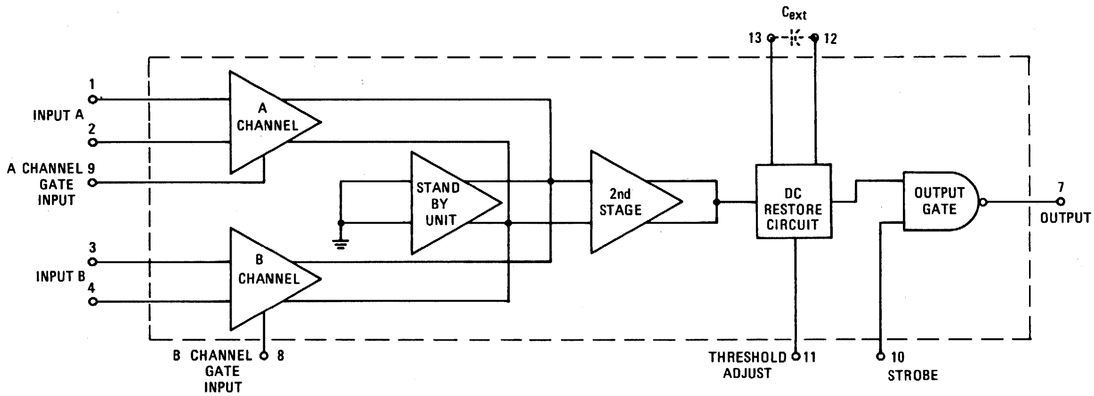


FIGURE 1 – TYPICAL OPERATION

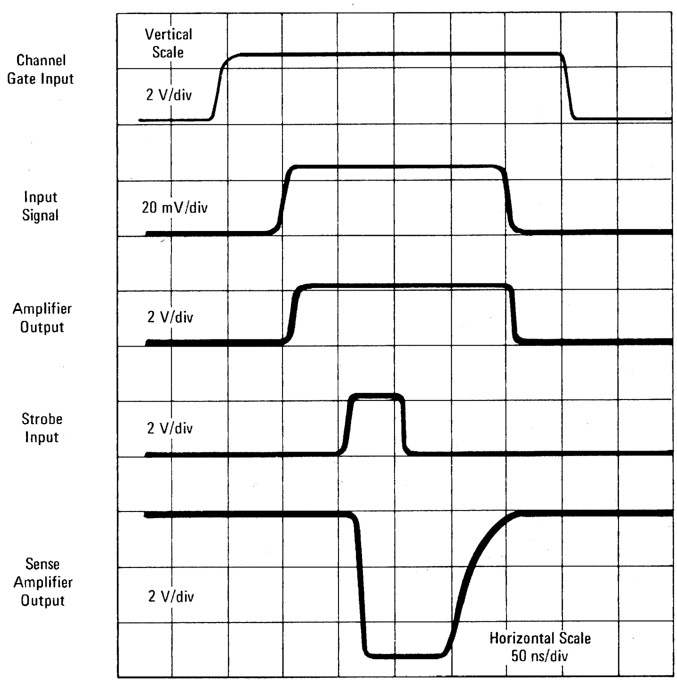


FIGURE 2 – TYPICAL INPUT THRESHOLD versus TEMPERATURE

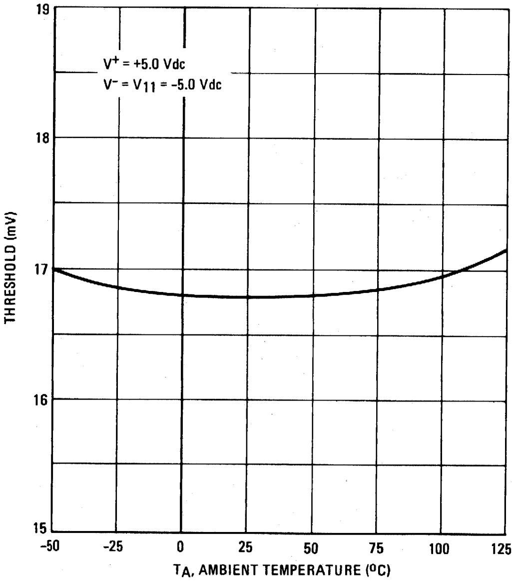


FIGURE 3 – TYPICAL THRESHOLD versus THRESHOLD VOLTAGE ADJUST

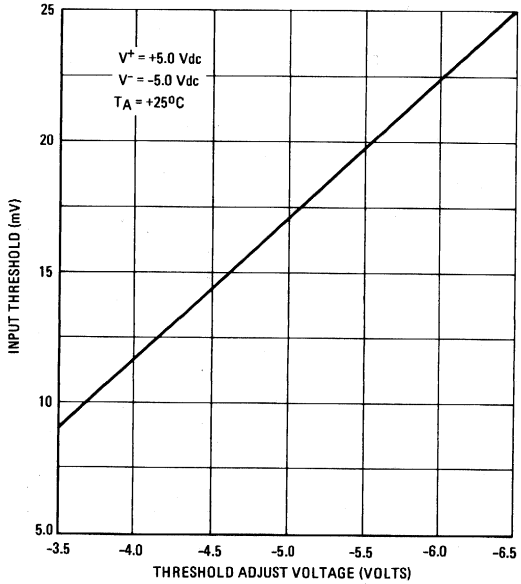


FIGURE 4 – TYPICAL INPUT THRESHOLD versus V−

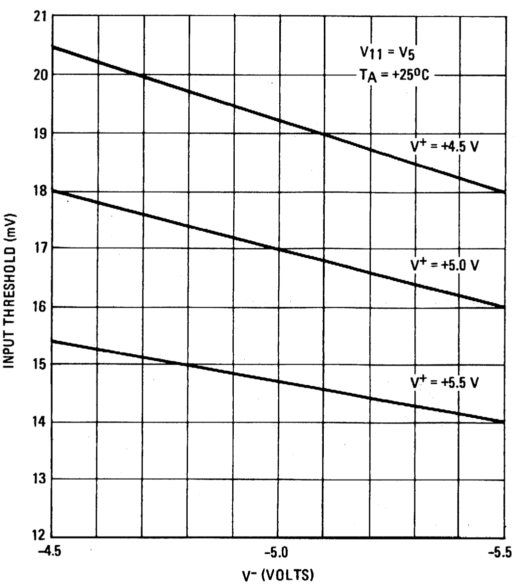


FIGURE 5 – TYPICAL INPUT THRESHOLD versus INPUT PULSE WIDTH

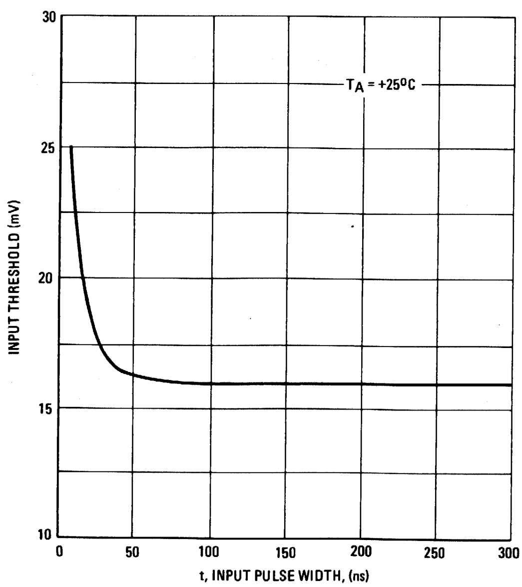


FIGURE 6 – INPUT-OUTPUT TRANSFER CHARACTERISTICS

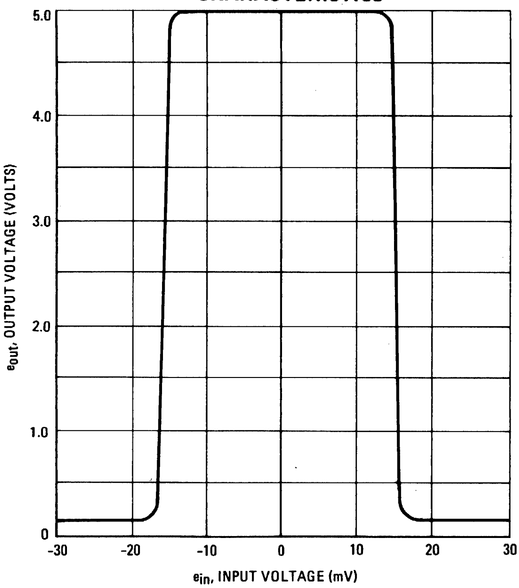


FIGURE 7 – CHANNEL GATE INPUT-AMPLIFIER OUTPUT TRANSFER CHARACTERISTICS

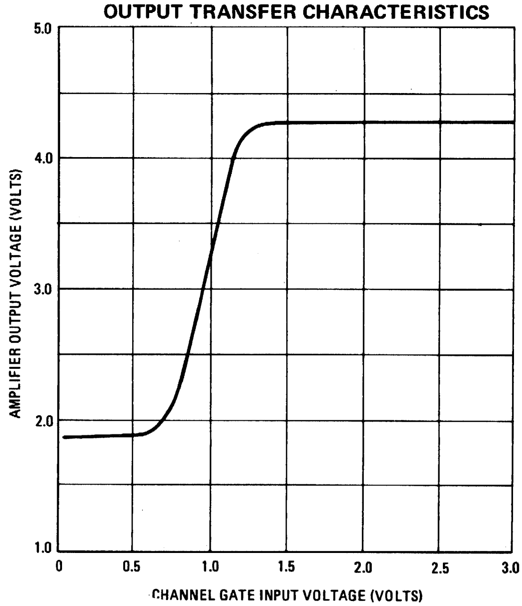


FIGURE 8 – INPUT THRESHOLD FOR OUTPUT VOLTAGE SWING FROM V_{OH} TO V_{OL} PROPAGATION DELAY FROM INPUT TO OUTPUT

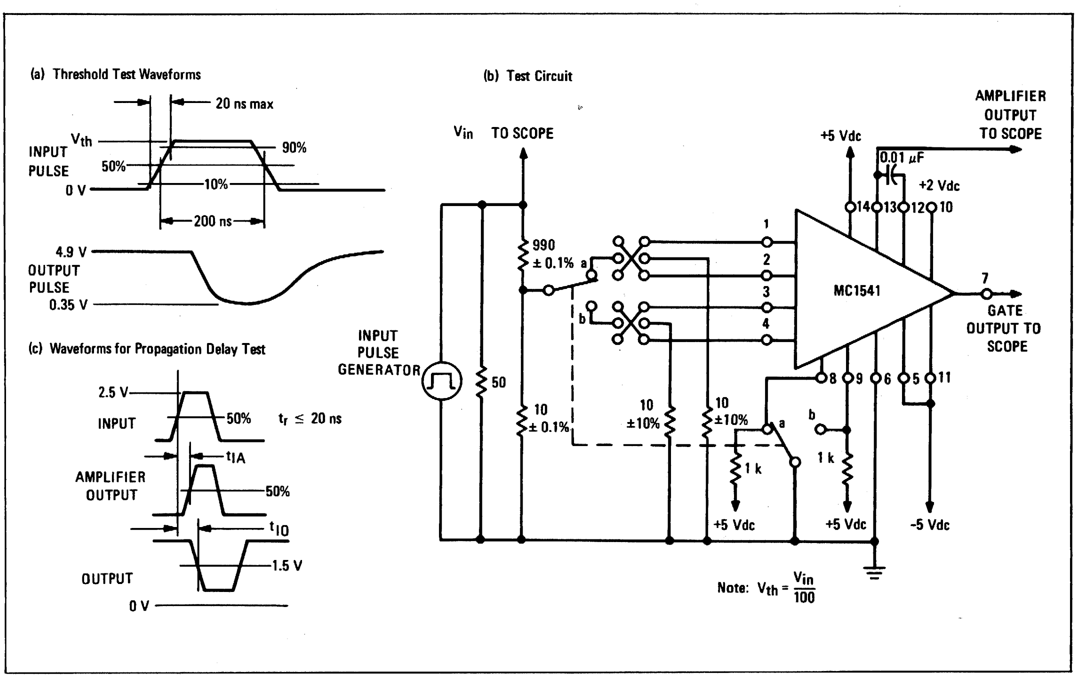
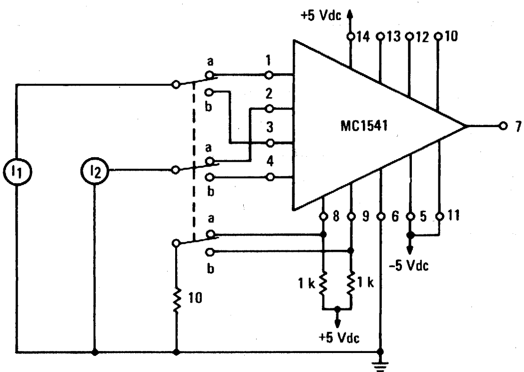


FIGURE 9 – INPUT BIAS CURRENT TEST CIRCUIT



$\frac{I_1 + I_2}{2} = I_b$ for "A" channel when switch is in "a" position

$= I_b$ for "B" channel when switch is in "b" position

$|I_1 - I_2| = I_{io}$

FIGURE 10 – OUTPUT VOLTAGE LEVELS

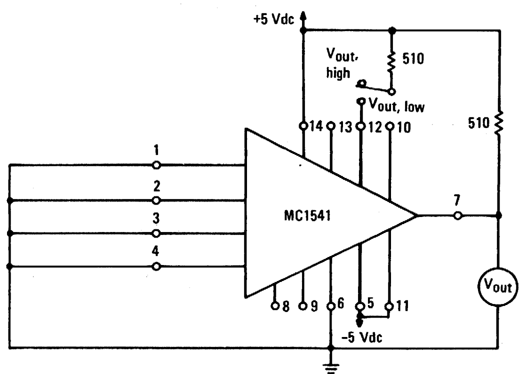


FIGURE 11 – MINIMUM TIME FROM CHANNEL GATE INPUT TO AMPLIFIER INPUT PROPAGATION DELAY FROM CHANNEL GATE INPUT TO AMPLIFIER OUTPUT

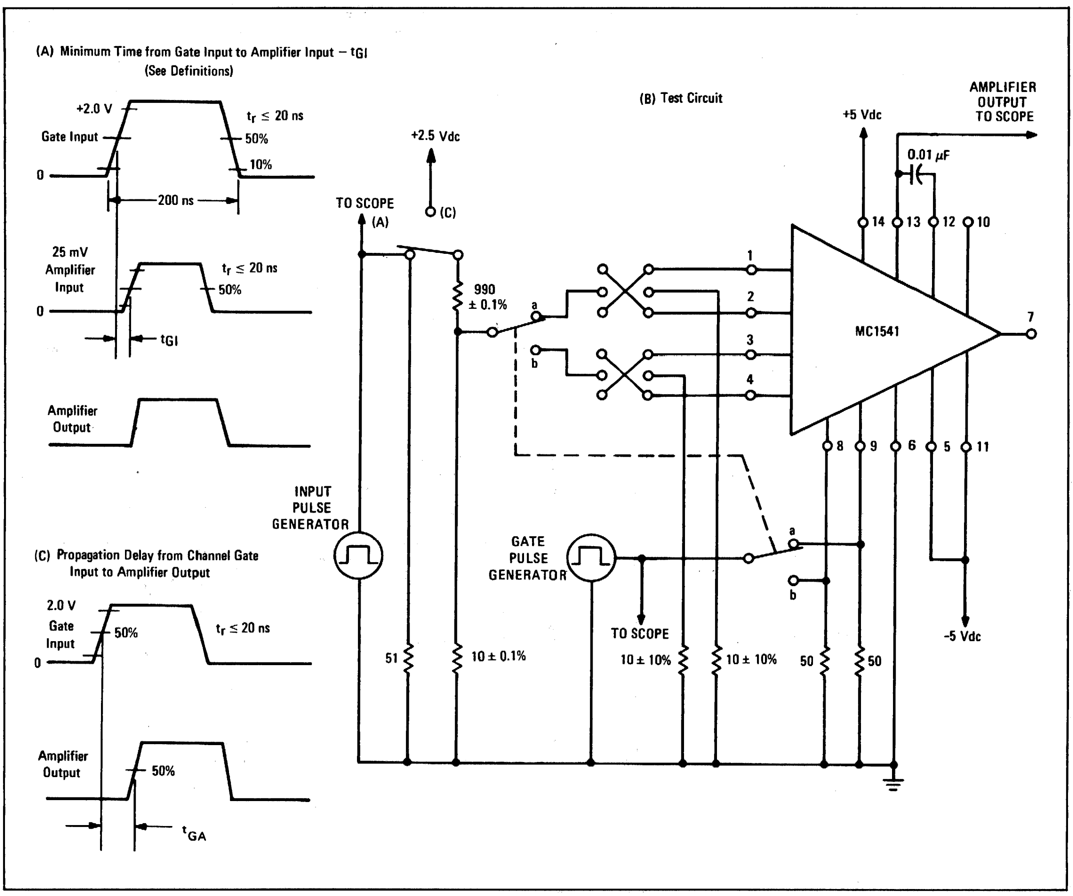


FIGURE 12 – PROPAGATION DELAY FROM STROBE INPUT TO OUTPUT

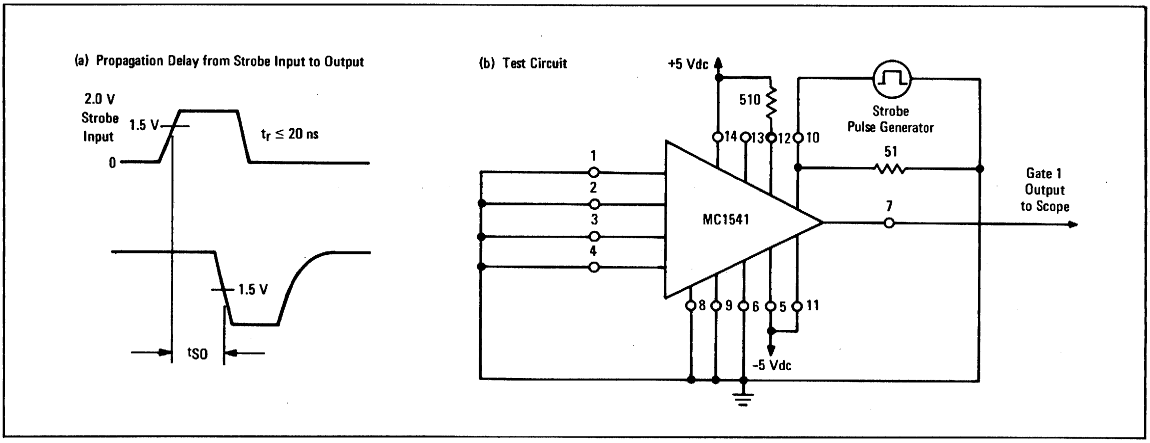


FIGURE 13 – COMMON MODE RECOVERY AND COMMON MODE RANGE

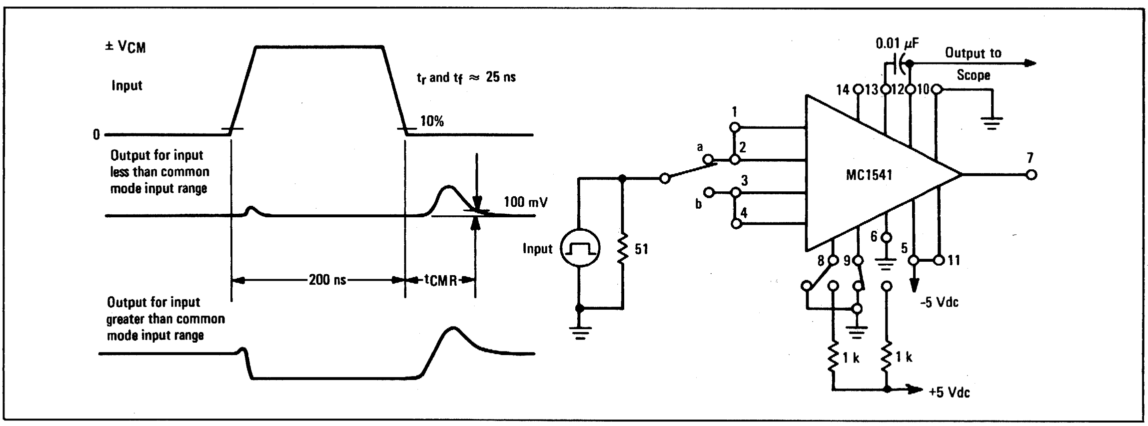
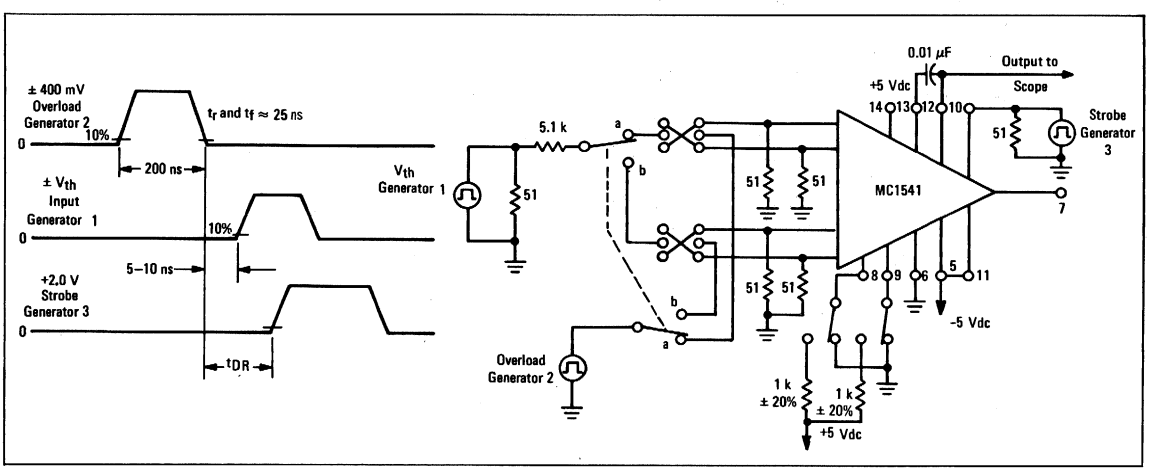


FIGURE 14 – DIFFERENTIAL RECOVERY AND DIFFERENTIAL RANGE



DEFINITIONS

I_B — Input Bias Current – The average input current defined as $(I_1 + I_2 + I_3 + I_4)/4$.

I_G — Channel Gate Load Current – The amount of current drain from the circuit when the channel gate input (Pin 8 or 9) is grounded.

I_{GR} — Channel Gate Reverse Current – The leakage current when the channel gate input (Pin 8 or 9) is high.

I_{io} — Input Offset Current – The difference between amplifier input current values $|I_1 - I_2|$ or $|I_3 - I_4|$.

I_S — Strobe Load Current – The amount of current drain from the circuit when the strobe pin is grounded.

I_{SR} — Strobe Reverse Current – The leakage current when the strobe input is high.

P_D — Power Dissipation – The amount of power dissipated in the unit.

t_{CMR} — Common Mode Recovery Time – The time required for the voltage at pin 12 to be within 100 mV of the dc value (after overshoot or ringing) as referenced to the 10% point of the trailing edge of a common mode overload signal.

t_{DR} — Differential Recovery Time – The time required for the device to recover from the specified differential input prior to strobe enable as referenced to the 10% point of the trailing edge of an input pulse. The device is considered recovered when the threshold with the overload signal applied is within 1.0 mV of the threshold with no overload input.

t_{GI} — Minimum Time Between Channel Gate Input and Signal Input – The minimum time between 50% point of channel gate input (Pin 8 or 9) and 50% point of signal input (Pins 1, 2, 3, or 4) that still allows a full width signal at amplifier output.

t_{GA} — Propagation Delay, Channel Gate Input to Amplifier Output – The time required for the amplifier output at pin 13 to reach 50% of its final value as referenced to 50% of the input gate pulse at pin 8 or 9 (Amplifier input = 25 mVdc).

t_{IA} — Propagation Delay, Input to Amplifier Output – The time required for the amplifier output pulse at pin 13 to achieve 50% of its final value referenced to 50% of the input pulse at pins 1 and 2 or 3 and 4.

t_{IO} — Propagation Delay, Input to Output – The time required for the gate output pulse at pin 7 to reach the 1.5 Volt level as referenced to 50% of the input pulse at pins 1 and 2 or 3 or 4.

t_{SO} — Strobe Propagation Delay to Output – The time required for the output pulse at pin 7 to reach the 1.5 Volt level as referenced to the 1.5 Volt level of the strobe input at pin 10.

V_{CM} — Maximum Common Mode Input Range – The common mode input voltage which causes the output voltage level of the amplifier to decrease by 100 mV. (This is independent of the channel gate input level.)

V_{DH} — Maximum Differential Input Range, Gate Input High – The differential input which causes the input stage to begin saturation.

V_{DL} — Maximum Differential Input Range, Gate Input Low – The differential input signal which causes the output voltage level of the amplifier to decrease by 100 mV.

V_{GH} — Channel Gate Input Voltage High – Gate pulse amplitude that allows the amplifier output pulse to just reach 100% of its final value. (Amplifier input is set at 25 mVdc).

V_{GL} — Channel Gate Input Voltage Low – Gate pulse amplitude that allows the amplifier output to just reach a 100 mV level. (Amplifier input is set at 25 mVdc).

V_{io} — Input Offset Voltage – The difference in V_{th} between inputs at pins 1 and 2 or 3 and 4.

V_{OH} — Output Voltage High – The high-level output voltage when the output gate is turned off.

V_{OL} — Output Voltage Low – The low-level output voltage when the output gate is saturated and the output sink current is 10 mA.

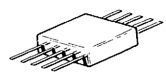
V_{th} — Input Threshold – Input pulse amplitude at pins 1, 2, 3 or 4 that causes the output gate to just reach V_{OL}.

MC1710

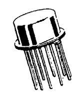
. . . designed for use in level detection, low-level sensing, and memory applications.

Typical Amplifier Features:

- Differential Input Characteristics:
  Input Offset Voltage = 1.0 mV
  Offset Voltage Drift = 3.0 μV/^{o}C
- Fast Response Time — 40 ns
- Output Compatible with All Saturating Logic Forms
  V_{out} = +3.2 V to -0.5 V typical
- Low Output Impedance — 200 ohms



CASE 72
(TO-91)
"F" SUFFIX



CASE 96
(TO-99)
"G" SUFFIX

Lead 4 connected to case

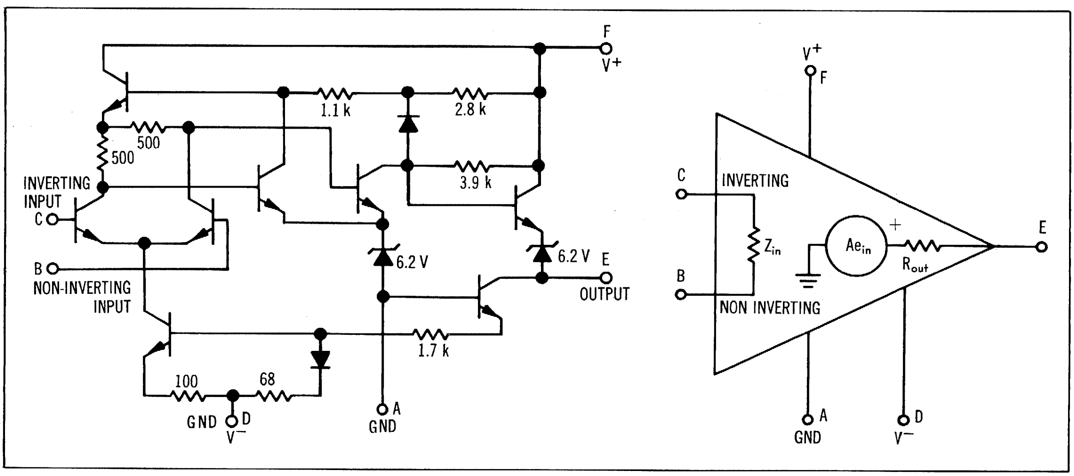
PIN CONNECTIONS

Schematic	A	B	C	D	E	F
"G" Package	1	2	3	4	7	8
"F" Package	1	2	3	5	6	8

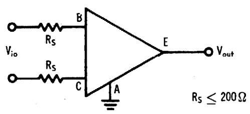
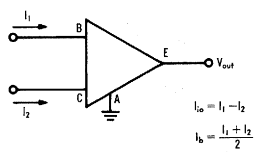
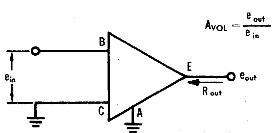
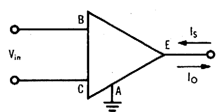
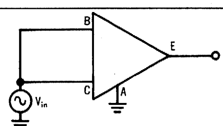
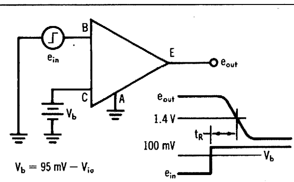
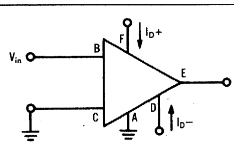
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+ 14 - 7.0	Vdc Vdc
Differential Input Signal	V_{in}	± 5.0	Volts
Common Mode Input Swing	CMV_{in}	± 7.0	Volts
Peak Load Current	I_L	10	mA
Power Dissipation (package limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC



ELECTRICAL CHARACTERISTICS ($V^+ = +12$ Vdc, $V^- = -6$ Vdc, $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Input Offset Voltage	V_{io}				mVdc
	$V_{out} = 1.4$ Vdc, $T_A = 25°C$		-	1.0	2.0	
	$V_{out} = 1.8$ Vdc, $T_A = -55°C$		-	-	3.0	
	$V_{out} = 1.0$ Vdc, $T_A = +125°C$		-	-	3.0	
	Temperature Coefficient of Input Offset Voltage	TC_{Vio}	-	3.0	-	µV/°C
	Input Offset Current	I_{io}				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = 25°C$		-	1.0	3.0	
	$V_{out} = 1.8$ Vdc, $T_A = -55°C$		-	-	7.0	
	$V_{out} = 1.0$ Vdc, $T_A = +125°C$		-	-	3.0	
	Input Bias Current	I_b				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = 25°C$		-	12	20	
	$V_{out} = 1.8$ Vdc, $T_A = -55°C$		-	-	45	
	$V_{out} = 1.0$ Vdc, $T_A = +125°C$		-	-	20	
	Open Loop Voltage Gain	A_{VOL}				V/V
	$T_A = 25°C$		1250	1700	-	
	$T_A = -55$ to $+125°C$		1000	-	-	
	Output Resistance	R_{out}	-	200	-	ohms
	Differential Voltage Range	V_{in}	±5.0	-	-	Vdc
	Positive Output Voltage $V_{in} \geqq 5.0$ mV, $0 \leqq I_O \leqq 0.5$ mA	V_{OH}	2.5	3.2	4.0	Vdc
	Negative Output Voltage $V_{in} \geqq -5.0$ mV	V_{OL}	-1.0	-0.5	0	Vdc
	Output Sink Current	I_S				mAdc
	$V_{in} \geqq -5.0$ mV, $V_{out} \geqq 0$, $T_A = 25°C$		2.0	2.5	-	
	$V_{in} \geqq -5.0$ mV, $V_{out} \geqq 0$, $T_A = -55°C$		1.0	2.0	-	
	Input Common Mode Range	CMV_{in}	±5.0	-	-	Volts
	Common Mode Rejection Ratio $V^- = -7.0$ Vdc, $R_S \leqq 200\Omega$	CM_{rej}	80	100	-	dB
	Response Time For Positive and Negative Going Input Pulse	t_R	-	40	-	ns
	Power Supply Current $V_{out} \leqq 0$ Vdc	I_D+	-	6.4	9.0	mAdc
		I_D-	-	5.5	7.0	
	Power Consumption					mW
	TO-99 Metal Can		-	115	150	
	TO-91 Flat Package		-	115	150	

TYPICAL CHARACTERISTICS

FIGURE 1 – VOLTAGE TRANSFER CHARACTERISTICS

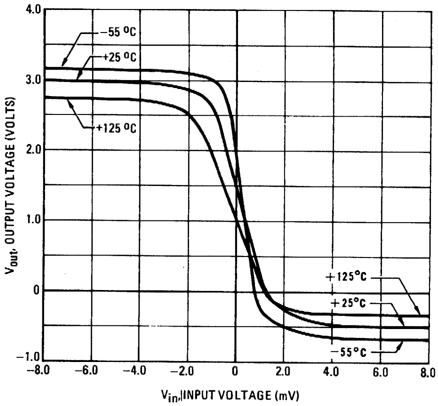


FIGURE 2 – INPUT OFFSET VOLTAGE versus TEMPERATURE

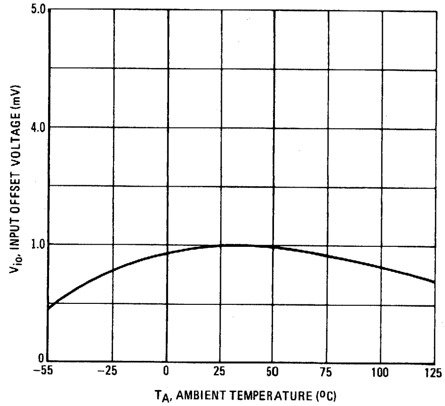


FIGURE 3 – INPUT OFFSET CURRENT versus TEMPERATURE

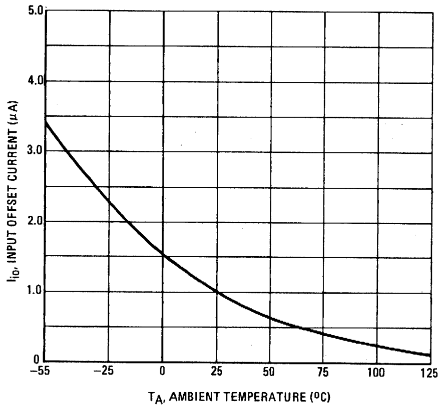


FIGURE 4 – INPUT BIAS CURRENT versus TEMPERATURE

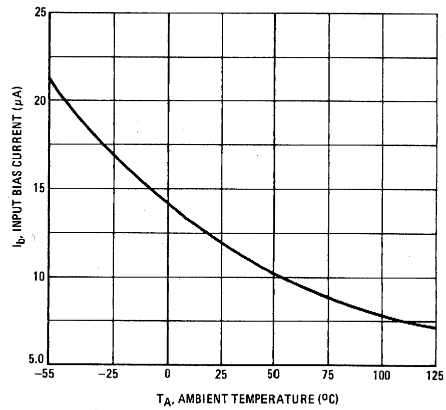


FIGURE 5 – GAIN VARIATION WITH POWER SUPPLY VOLTAGE

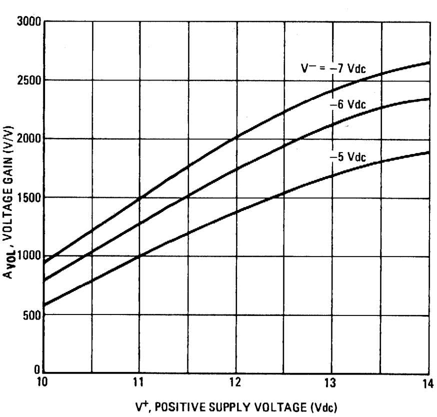


FIGURE 6 – VOLTAGE GAIN versus TEMPERATURE

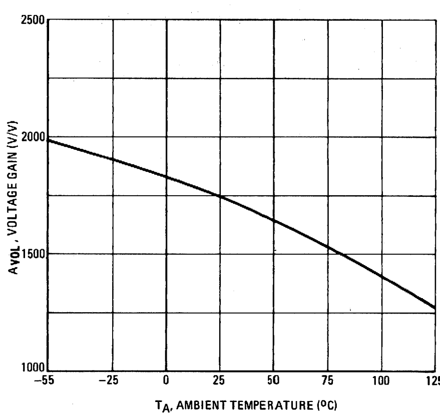


FIGURE 7 – RESPONSE TIME

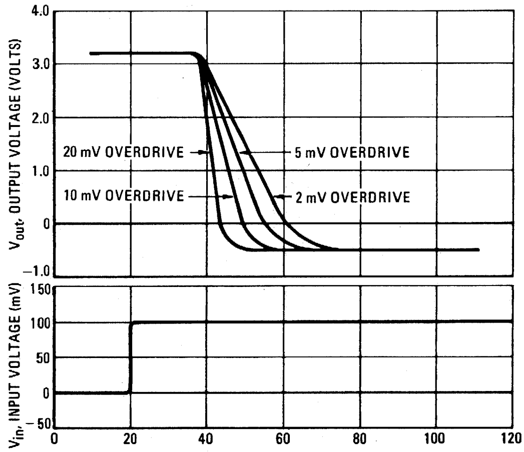


FIGURE 8 – POWER DISSIPATION versus TEMPERATURE

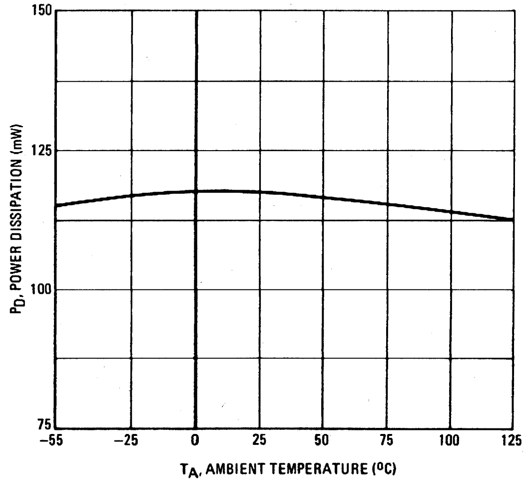


FIGURE 9 – SERIES RESISTANCE versus MRTL FAN-OUTS

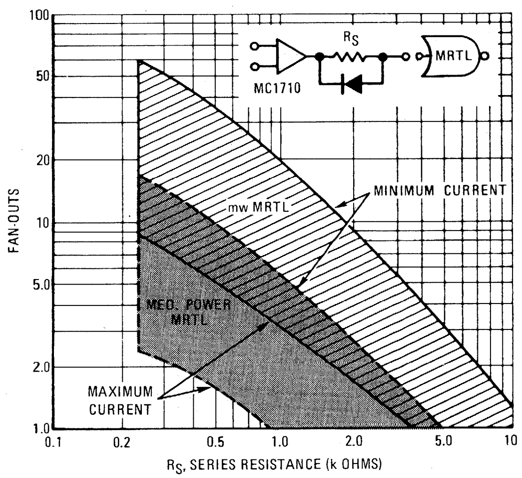
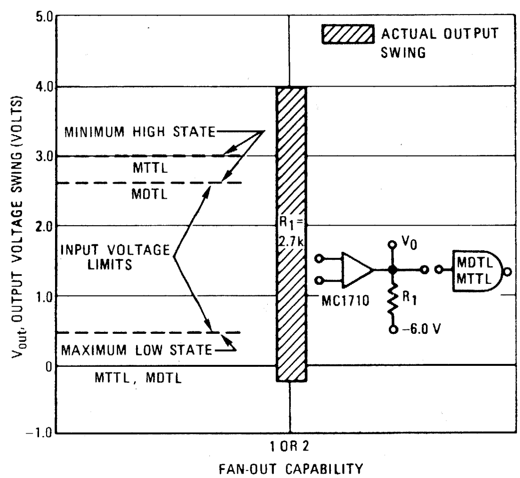


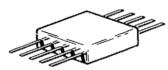
FIGURE 10 – FAN-OUT CAPABILITY WITH MDTL OR MTTL OUTPUT SWING



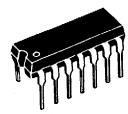
MC1710C

... designed for use in level detection, low-level sensing, and memory applications.

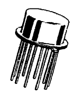
Lead 4 connected to case



CASE 72
(TO-91)
"F" SUFFIX



CASE 93
(TO-116)
"P" SUFFIX



CASE 96
(TO-99)
"G" SUFFIX

Typical Amplifier Features:

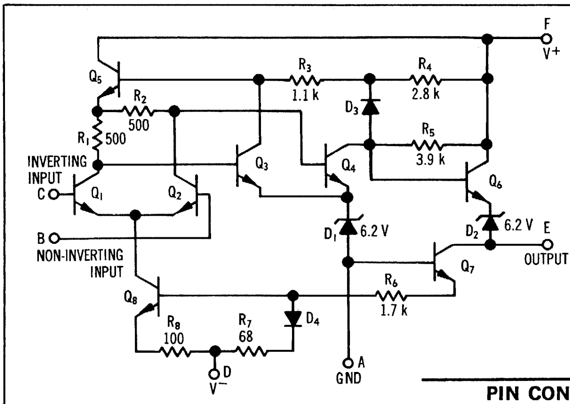
- Differential Input Characteristics:
  Input Offset Voltage = 1.5 mV
  Offset Voltage Drift = 5.0 μV/°C
- Fast Response Time — 40 ns
- Output Compatible with All Saturating Logic Forms
  V_{out} = +3.2 V to -0.5 V typical
- Low Output Impedance — 200 ohms

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

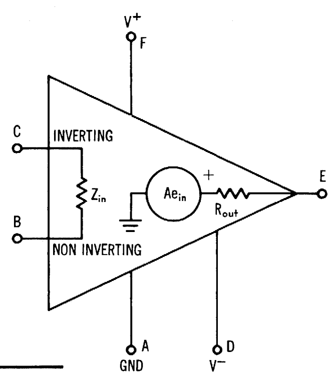
Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+14 -7.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	±7.0	Volts
Peak Load Current	I_L	10	mA
Power Dissipation (package limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range*	T_A	0 to +75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

*For full temperature range (-55°C to + 125°C) and characteristic curves, see MC1710 data sheet.

CIRCUIT SCHEMATIC



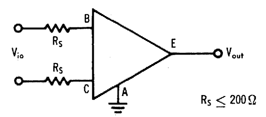
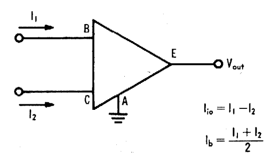
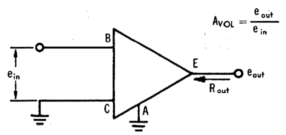
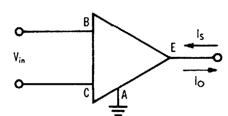
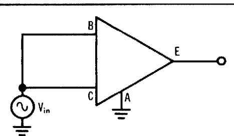
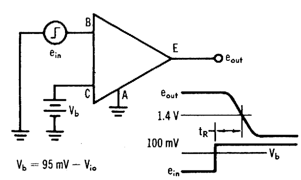
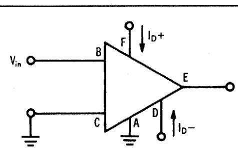
EQUIVALENT CIRCUIT



PIN CONNECTIONS

Schematic	A	B	C	D	E	F
"G" Package	1	2	3	4	7	8
"F" Package	1	2	3	5	6	8
"P" Package	2	3	4	6	9	11

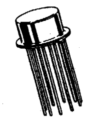
ELECTRICAL CHARACTERISTICS (V+ = +12 Vdc, V⁻ = −6 Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Input Offset Voltage V_{out} = 1.4 Vdc, T_A = 25°C V_{out} = 1.5 Vdc, T_A = 0°C V_{out} = 1.2 Vdc, T_A = +70°C	V_{io}	 - - -	 1.5 - -	 5.0 6.5 6.5	mVdc
	Temperature Coefficient of Input Offset Voltage	TC_{Vio}	-	5.0	-	μV/°C
	Input Offset Current V_{out} = 1.4 Vdc, T_A = 25°C V_{out} = 1.5 Vdc, T_A = 0°C V_{out} = 1.2 Vdc, T_A = +70°C	I_{io}	 - - -	 1.0 - -	 5.0 7.5 7.5	μAdc
	Input Bias Current V_{out} = 1.4 Vdc, T_A = 25°C V_{out} = 1.5 Vdc, T_A = 0°C V_{out} = 1.2 Vdc, T_A = +70°C	I_b	 - - -	 15 25 -	 25 40 40	μAdc
	Voltage Gain T_A = 25°C T_A = 0 to +70°C	A_{VOL}	 1000 800	 1500 -	 - -	V/V
	Output Resistance	R_{out}	-	200	-	ohms
	Differential Voltage Range	V_{in}	±5.0	-	-	Vdc
	Positive Output Voltage $V_{in} \geq 5.0$ mV, $0 \leq I_O \leq 0.5$ mA	V_{OH}	2.5	3.2	4.0	Vdc
	Negative Output Voltage $V_{in} \geq -5.0$ mV	V_{OL}	-1.0	-0.5	0	Vdc
	Output Sink Current $V_{in} \geq -5.0$ mV, $V_{out} \geq 0$ T_A = 25°C T_A = 0°C	I_s	 1.6 0.5	 2.5 -	 - -	mAdc
	Input Common Mode Range V⁻ = -7.0 Vdc	CMV_{in}	±5.0	-	-	Volts
	Common Mode Rejection Ratio $R_S \leq 200\ \Omega$	CM_{rej}	70	100	-	dB
	Propagation Delay Time For Positive and Negative Going Input Pulse	t_{pd}	-	40	-	ns
	Power Supply Current $V_{out} \leq 0$ Vdc	I_D+ I_D-	- -	6.4 5.5	9.0 7.0	mAdc
	Power Consumption		-	110	150	mW

DUAL DIFFERENTIAL COMPARATOR

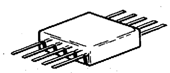
MC1711

. . . designed for use in level detection, low-level sensing, and memory applications.



Lead 5 connected to case

CASE 71A
"G" SUFFIX



CASE 72
(TO-91)
"F" SUFFIX

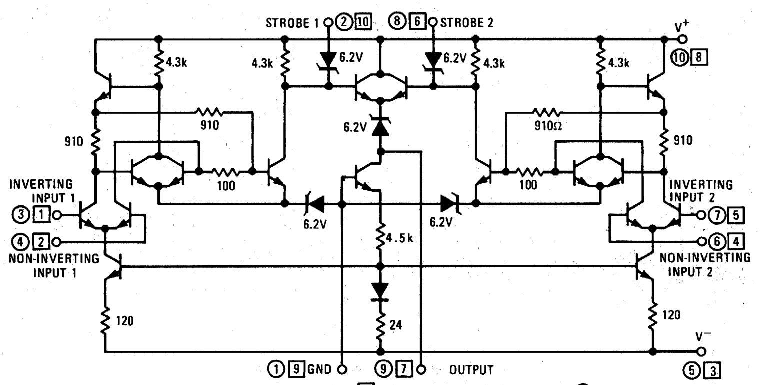
Typical Amplifier Features:

- Differential Input —
  Input Offset Voltage = 1.0 mV
  Offset Voltage Drift = 5.0 μV/^{o}C
- Fast Response Time — 40 ns
- Output Compatible with All Saturating Logic Forms
  V_{out} = +4.5 V to -0.5 V typical
- Low Output Impedance — 200 ohms

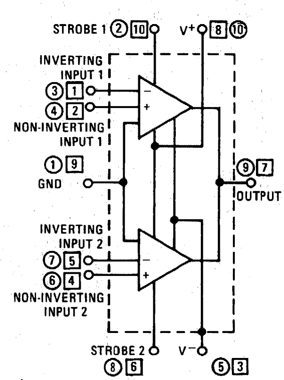
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+14 -7.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	±7.0	Volts
Peak Load Current	I_L	50	mA
Power Dissipation (package limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3	 mW mW/°C mW mW/°C
Operating Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

CIRCUIT SCHEMATIC

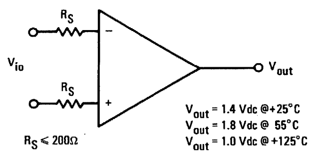
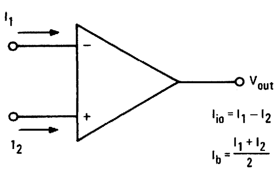
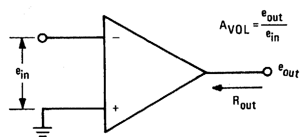
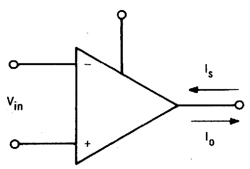
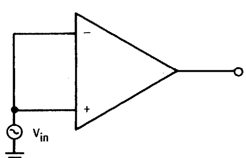
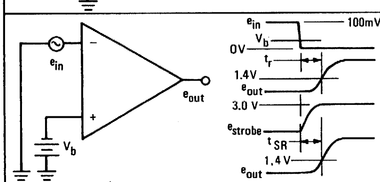
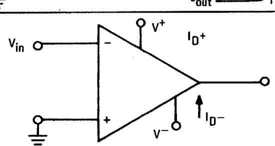


EQUIVALENT CIRCUIT



□ contains pin number for flat package. ○ contains pin number for metal can package.

ELECTRICAL CHARACTERISTICS (each comparator) $V^+ = +12$ Vdc. $V^- = -6.0$ Vdc. $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Input Offset Voltage	V_{io}				mVdc
	$CMV_{in} = 0$ Vdc, $T_A = +25°C$		-	1.0	3.5	
	$T_A = +25°C$		-	1.0	5.0	
	$CMV_{in} = 0$ Vdc, $T_A = -55$ to $+125°C$		-	-	4.5	
	$T_A = -55$ to $+125°C$		-	-	6.0	
	Temperature Coefficient of Input Offset Voltage	TC_{Vio}	-	5.0	-	µV/°C
	Input Offset Current	I_{io}				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = +25°C$		-	0.5	10	
	$V_{out} = 1.8$ Vdc, $T_A = -55°C$		-	-	20	
	$V_{out} = 1.0$ Vdc, $T_A = +125°C$		-	-	20	
	Input Bias Current	I_b				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = +25°C$		-	25	75	
	$V_{out} = 1.8$ Vdc, $T_A = -55°C$		-	-	150	
	$V_{out} = 1.0$ Vdc, $T_A = +125°C$		-	-	150	
	Voltage Gain	A_{VOL}				V/V
	$T_A = +25°C$		750	1500	-	
	$T_A = -55$ to $+125°C$		500	-	-	
	Output Resistance	R_{out}	-	200	-	ohms
	Differential Voltage Range	V_{in}	±5.0	-	-	Vdc
	Positive Output Voltage $V_{in} \geq 10$ mVdc, $0 \leq I_o \leq 0.5$ mA	V_{OH}	2.5	3.2	5.0	Vdc
	Negative Output Voltage $V_{in} \geq -10$ mVdc	V_{OL}	-1.0	-0.5	0	Vdc
	Strobed Output Level $V_{strobe} \leq 0.3$ Vdc	$V_{OL(st)}$	-1.0	-	0	Vdc
	Output Sink Current $V_{in} \geq -10$ mV, $V_{out} \geq 0$	I_S	0.5	0.8	-	mAdc
	Strobe Current $V_{strobe} = 100$ mVdc	I_{st}	-	1.2	2.5	mAdc
	Input Common Mode Range $V^- = -7.0$ Vdc	CM_{Vin}	±5.0	-	-	Volts
	Response Time $V_b = 5.0$ mV + V_{io}	t_R	-	40	-	ns
		t_R	-	40	-	ns
	Strobe Release Time	t_{SR}	-	12	-	ns
	Power Supply Current $V_{out} \leq 0$ Vdc	I_D^+	-	8.6	-	mAdc
		I_D^-	-	3.9	-	
	Power Consumption		-	130	200	mW

TYPICAL CHARACTERISTICS

FIGURE 1 – VOLTAGE TRANSFER CHARACTERISTICS

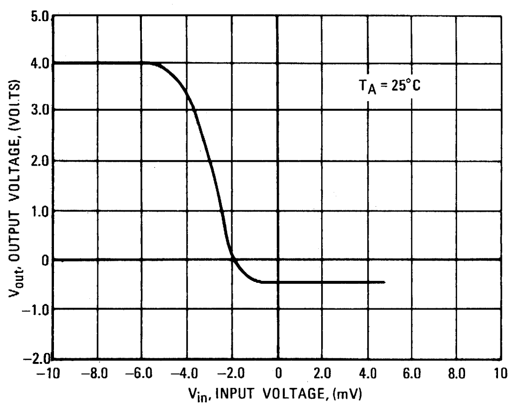


FIGURE 2 – INPUT BIAS CURRENT versus TEMPERATURE

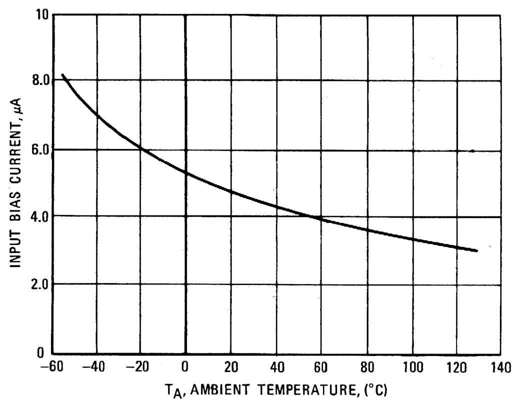


FIGURE 3 – VOLTAGE GAIN versus TEMPERATURE

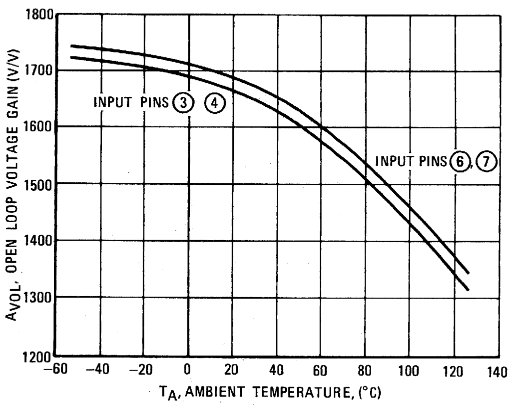


FIGURE 4 – RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES

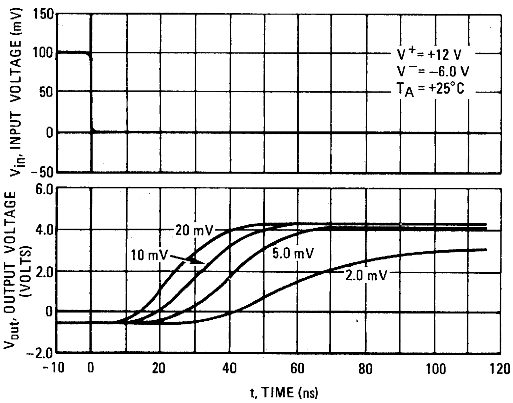


FIGURE 5 – VOLTAGE GAIN VARIATION WITH POWER SUPPLY VOLTAGE

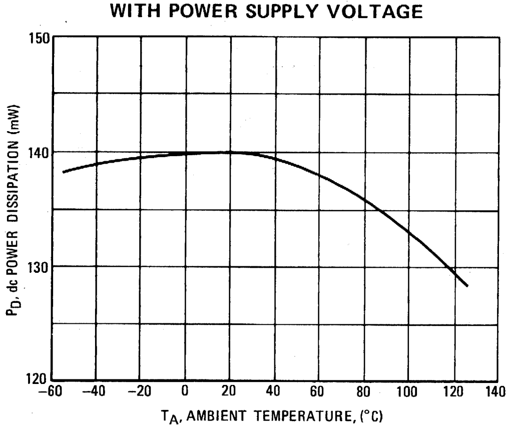


FIGURE 6 – STROBE RELEASE TIME FOR VARIOUS INPUT OVERDRIVES

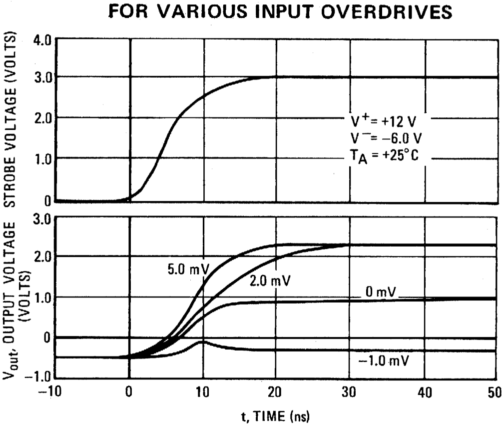


FIGURE 7 – COMMON MODE PULSE RESPONSE

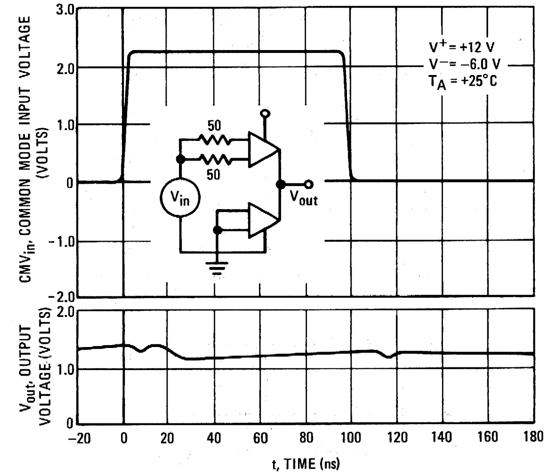


FIGURE 8 – OUTPUT PULSE STRETCHING WITH CAPACITIVE LOADING

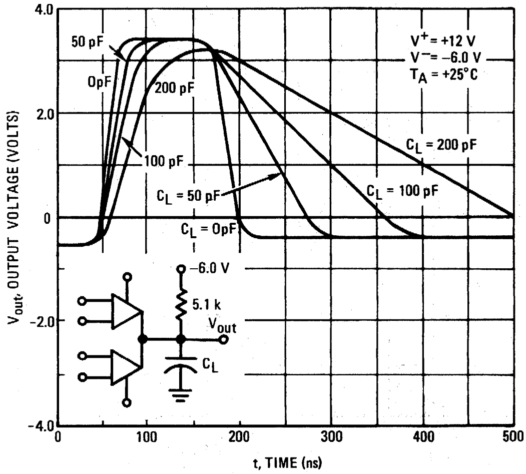


FIGURE 9 – SERIES RESISTANCE versus MRTL FAN-OUTS

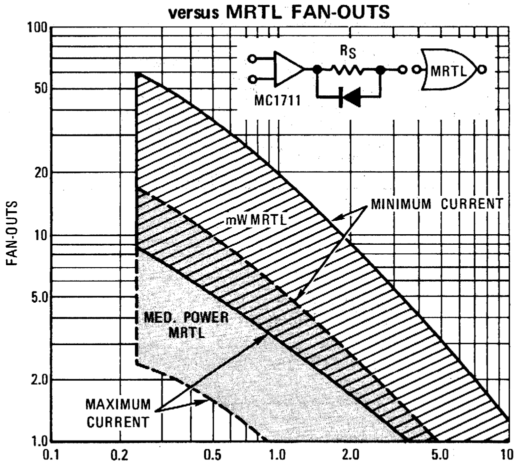
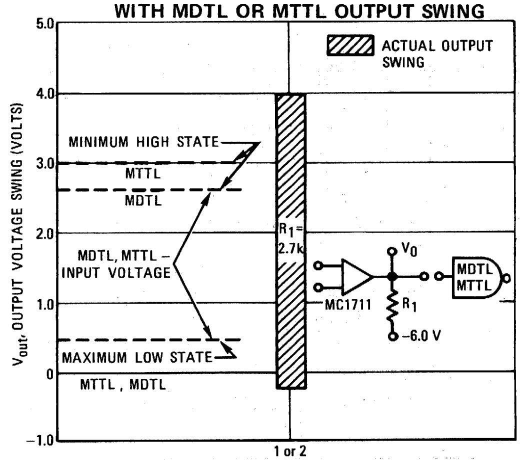


FIGURE 10 – FAN-OUT CAPABILITY WITH MDTL OR MTTL OUTPUT SWING

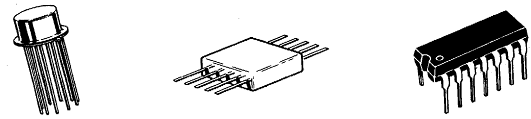


DUAL DIFFERENTIAL COMPARATOR

SENSE AMPLIFIERS

MC1711C

Lead 5 connected to case



CASE 71A "G" SUFFIX — CASE 72 (TO-91) "F" SUFFIX — CASE 93 (TO-116) "P" SUFFIX

. . . designed for use in level detection, low level sensing, and memory applications.

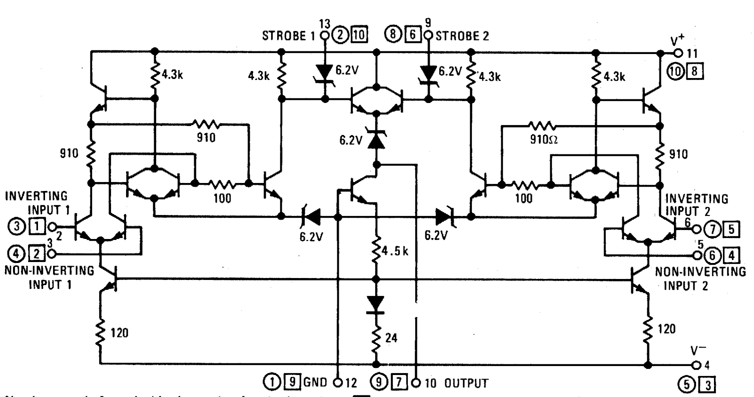
Typical Amplifier Features:

- Differential Input
  Input Offset Voltage = 1.0 mV
  Offset Voltage Drift = 5.0 μV/°C
- Fast Response Time — 40 ns
- Output Compatible with All Saturating Logic Forms
  V_{out} = +4.5 V to -0.5 V typical
- Low Output Impedance — 200 ohms

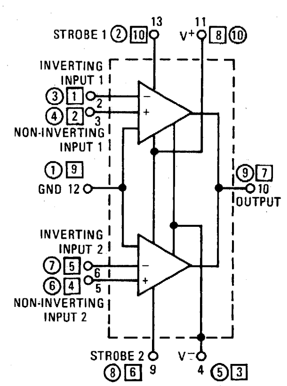
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+14 -7.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	±7.0	Volts
Peak Load Current	I_L	50	mA
Power Dissipation (package limitation) Metal Can Derate above T_A = 25°C Flat Package Derate above T_A = 25°C Plastic Package Derate above T_A = 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

CIRCUIT SCHEMATIC

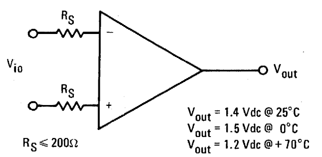
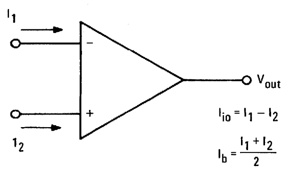
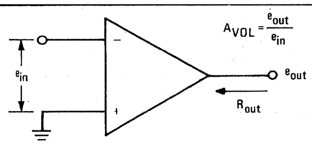
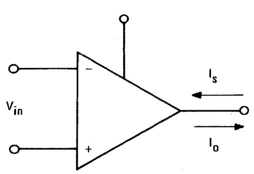
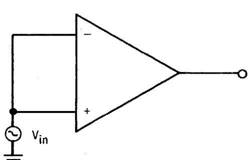
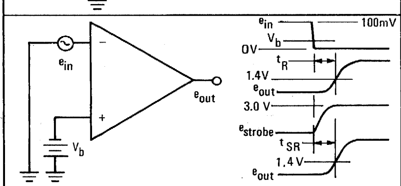
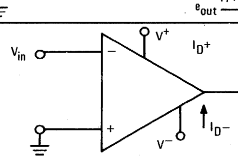


EQUIVALENT CIRCUIT



Number at end of terminal is pin number for plastic package. □ contains pin number for flat package. ○ contains pin number for metal can package.

ELECTRICAL CHARACTERISTICS (each comparator) $V^+ = +12$ Vdc. $V^- = -6.0$ Vdc. $T_A = 25°C$ unless otherwise noted)

Characteristic Definitions	Characteristic	Symbol	Min	Typ	Max	Unit
	Input Offset Voltage	V_{io}				mVdc
	$CMV_{in} = 0$ Vdc, $T_A = +25°C$		-	1.0	5.0	
	$CMV_{in} \neq 0$ Vdc, $T_A = +25°C$		-	1.0	7.5	
	$CMV_{in} = 0$ Vdc, $T_A = 0$ to $+70°C$		-	-	6.0	
	$CMV_{in} \neq 0$ Vdc, $T_A = 0$ to $+70°C$		-	-	10	
	Temperature Coefficient of Input Offset Voltage	TC_{Vio}	-	5.0	-	µV/°C
	Input Offset Current	I_{io}				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = +25°C$		-	0.5	15	
	$V_{out} = 1.5$ Vdc, $T_A = 0°C$		-	-	25	
	$V_{out} = 1.2$ Vdc, $T_A = +70°C$		-	-	25	
	Input Bias Current	I_b				µAdc
	$V_{out} = 1.4$ Vdc, $T_A = +25°C$		-	25	100	
	$V_{out} = 1.5$ Vdc, $T_A = 0°C$		-	-	150	
	$V_{out} = 1.2$ Vdc, $T_A = +70°C$		-	-	150	
	Voltage Gain	A_{VOL}				V/V
	$T_A = +25°C$		700	1500	-	
	$T_A = -55$ to $+125°C$		500	-	-	
	Output Resistance	R_{out}	-	200	-	ohms
	Differential Voltage Range	V_{in}	±5.0	-	-	Vdc
	Positive Output Voltage $V_{in} \geq 10$ mVdc, $0 \leq I_o \leq 0.5$ mA	V_{OH}	2.5	3.2	5.0	Vdc
	Negative Output Voltage $V_{in} \geq -10$ mVdc	V_{OL}	-1.0	-0.5	0	Vdc
	Strobed Output Level $V_{strobe} \leq 0.3$ Vdc	$V_{OL(st)}$	-1.0	-	0	Vdc
	Output Sink Current $V_{in} \geq -10$ mV, $V_{out} \geq 0$	I_S	0.5	0.8	-	mAdc
	Strobe Current $V_{strobe} = 100$ mVdc	I_{st}	-	1.2	2.5	mAdc
	Input Common Mode Range $V^- = -7.0$ Vdc	CM_{Vin}	±5.0	-	-	Volts
	Response Time $V_b = 5.0$ mV + V_{io}	t_R	-	40	-	ns
	Strobe Release Time	t_{SR}	-	12	-	ns
	Power Supply Current $V_{out} \leq 0$ Vdc	I_D^+	-	8.6	-	mAdc
		I_D^-	-	3.9	-	
	Power Consumption		-	130	200	mW

TYPICAL CHARACTERISTICS

FIGURE 1 – VOLTAGE TRANSFER CHARACTERISTICS

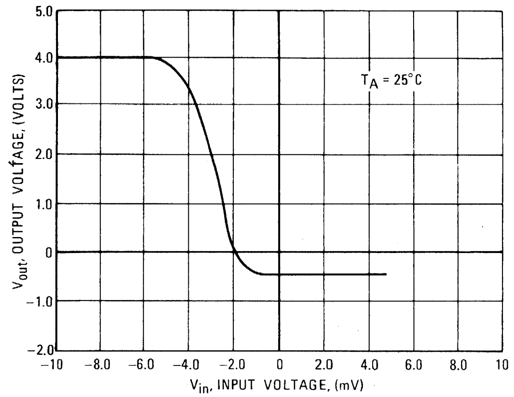


FIGURE 2 – INPUT BIAS CURRENT versus TEMPERATURE

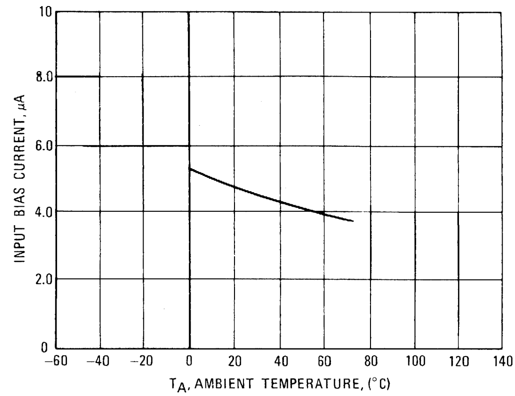


FIGURE 3 – VOLTAGE GAIN versus TEMPERATURE

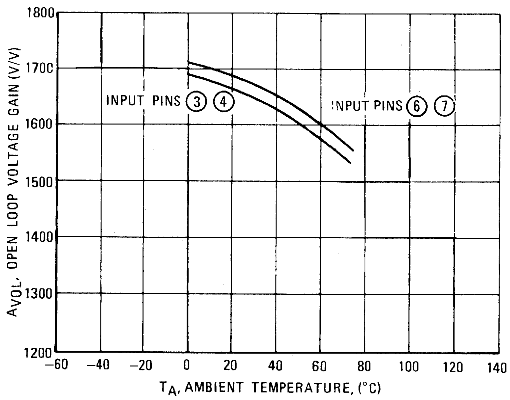


FIGURE 4 – RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES

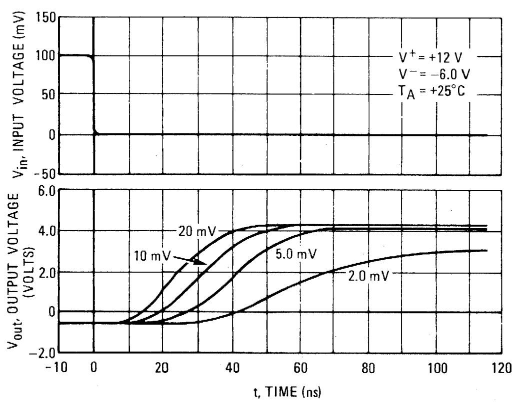


FIGURE 5 – VOLTAGE GAIN VARIATION WITH POWER SUPPLY VOLTAGE

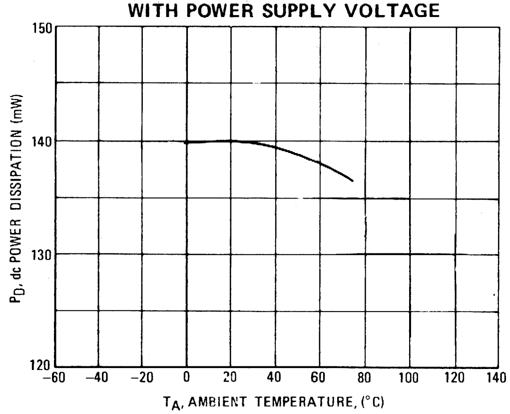


FIGURE 6 – STROBE RELEASE TIME FOR VARIOUS INPUT OVERDRIVES

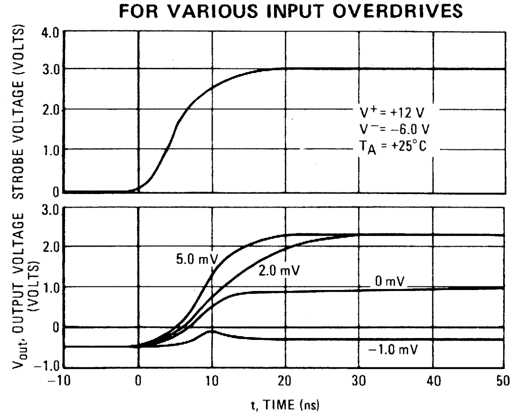


FIGURE 7 – COMMON MODE PULSE RESPONSE

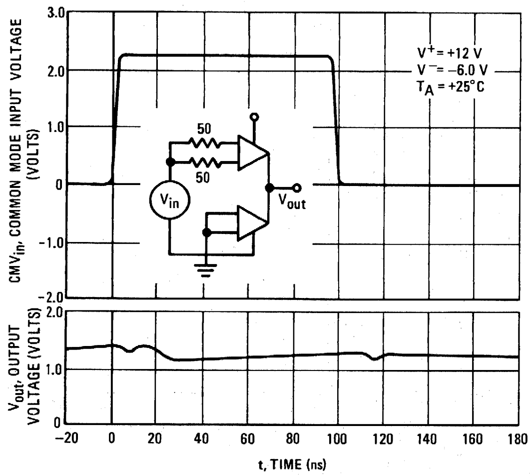


FIGURE 8 – OUTPUT PULSE STRETCHING WITH CAPACITIVE LOADING

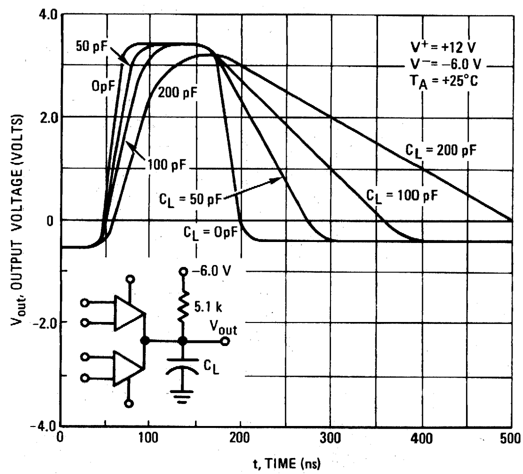


FIGURE 9 – SERIES RESISTANCE versus MRTL FAN-OUTS

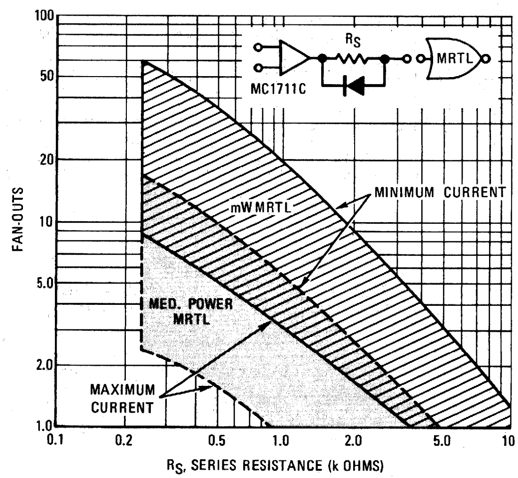
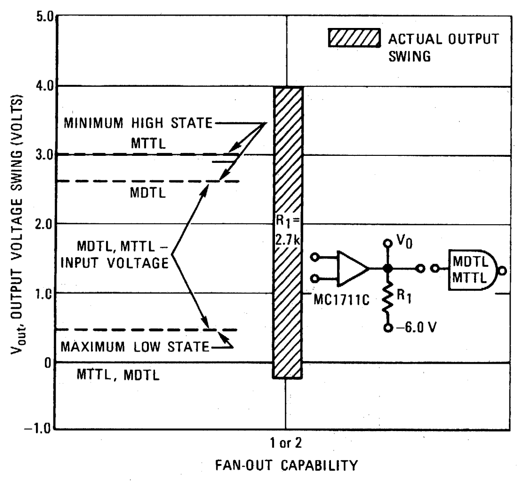
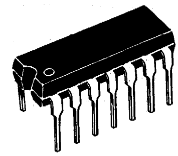


FIGURE 10 – FAN-OUT CAPABILITY WITH MDTL OR MTTL OUTPUT SWING



MC1303P

. . . designed for amplifying low-level stereo audio signals with two preamplifiers built into a single monolithic semiconductor.



CASE 93
(TO-116)
"P" SUFFIX

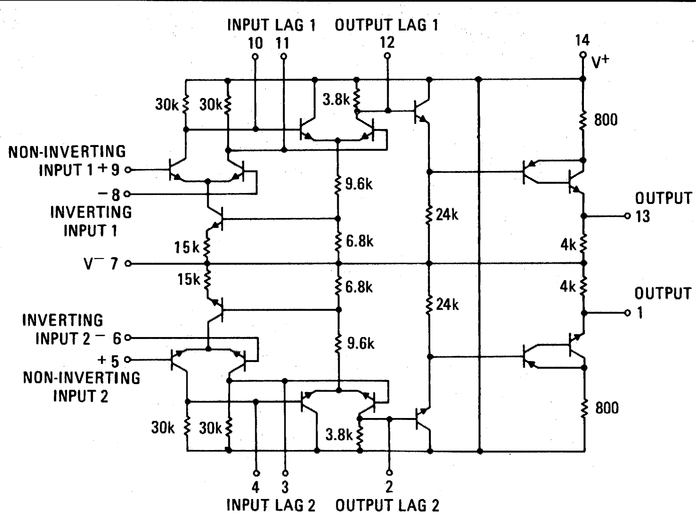
Each Preamplifier Features:

- Low Input Noise Voltage — 0.5 μV typical
- Large Output Voltage Swing — 4.5 V rms min
- High Open-Loop Voltage Gain = 8,000 min
- Channel Separation = 60 dB min at 10 kHz
- Short-Circuit-Proof Design

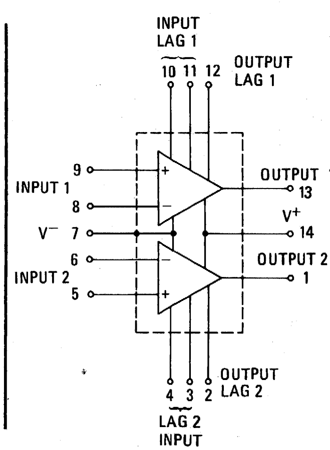
MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+15 -15	Vdc Vdc
Power Dissipation (Package Limitation) Derate above 25°C	P_D	415 3.3	mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C

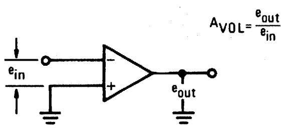
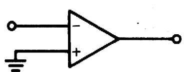
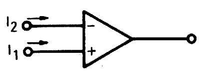
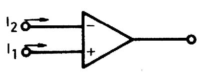
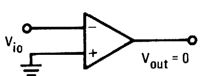
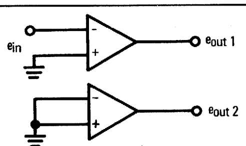
CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT

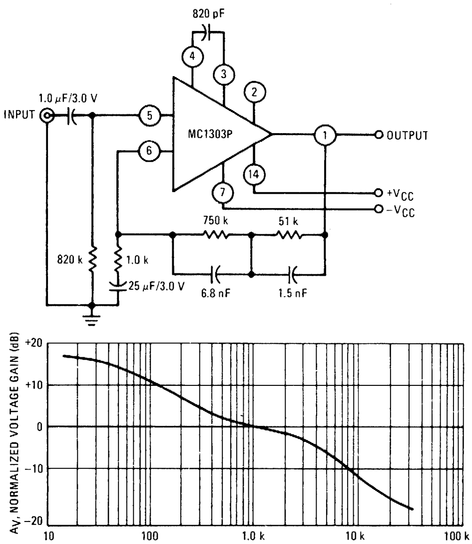


ELECTRICAL CHARACTERISTICS (Each Preamplifier) (V^+ = +13 Vdc, V^- = -13 Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operations)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain	A_{VOL}	8,000	10,000	12,000	V/V
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	4.5	5.5	-	V rms
	Input Bias Current $I_b = \frac{I_1 + I_2}{2}$	I_b	-	1.0	10	μA
	Input Offset Current ($I_{io} = I_1 - I_2$)	I_{io}	-	0.2	0.4	μA
	Input Offset Voltage	V_{io}	-	1.5	10	mV
	DC Power Dissipation (Power Supply = ±13 V, V_{out} = 0)	P_D	-	-	300	mW
	Channel Separation (f = 10 kHz)	$\frac{e_{out\ 1}}{e_{out\ 2}}$	60	70	-	dB

TYPICAL PREAMPLIFIER APPLICATIONS

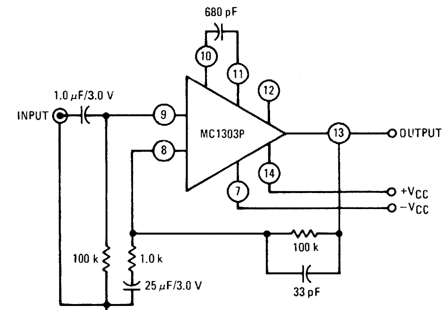
FIGURE 1 – MAGNETIC PHONO PLAYBACK PREAMPLIFIER/RIAA EQUALIZED



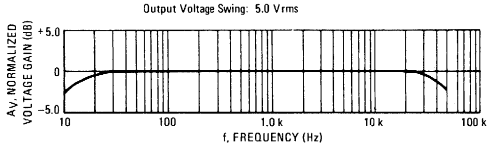
TYPICAL PERFORMANCE CHARACTERISTICS

Voltage Gain	: 34 dB (50) @ 1.0 kHz
Input Overload Point	: 100 mVrms @ 1.0 kHz
Output Voltage Swing	: 5.0 Vrms @ 1.0 kHz @ 0.1% THD.
Output Noise Level	: Better Than 70 dB Below 10 mV Phono Input (Input Shorted)

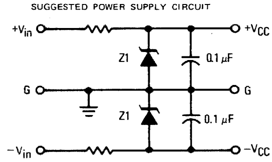
FIGURE 2 – BROADBAND AUDIO AMPLIFIER



Voltage Gain: 40 dB (100) @ 1.0 kHz reference
Output Voltage Swing: 5.0 Vrms

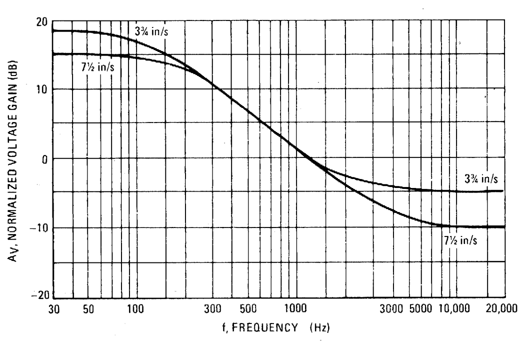


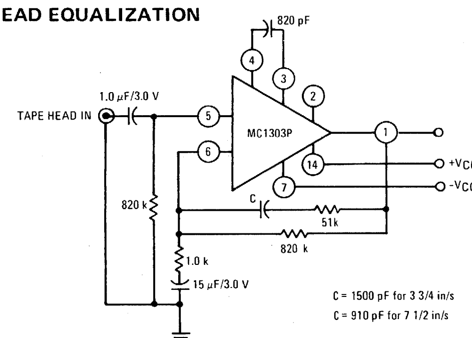
SUGGESTED POWER SUPPLY CIRCUIT



Z1 = MZ-500-19 (13 V nom.)
Select series R by allowing 11 mA for zener, and each dual I/C Preamplifier

FIGURE 3 – NAB TAPE HEAD EQUALIZATION





C = 1500 pF for 3 3/4 in/s
C = 910 pF for 7 1/2 in/s

Voltage Gain: 35 dB @ 1.0 kHz
Output Voltage Swing: 5.0 Vrms

FIGURE 4 – POWER DISSIPATION versus SUPPLY VOLTAGE

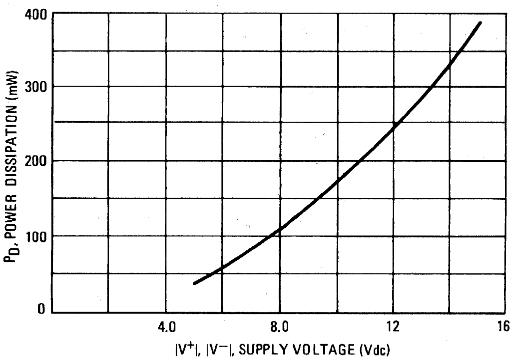


FIGURE 5 – OUTPUT LINEARITY

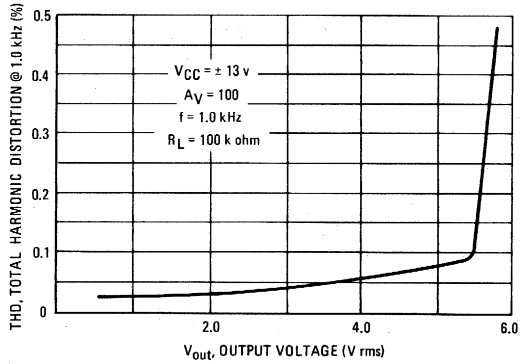
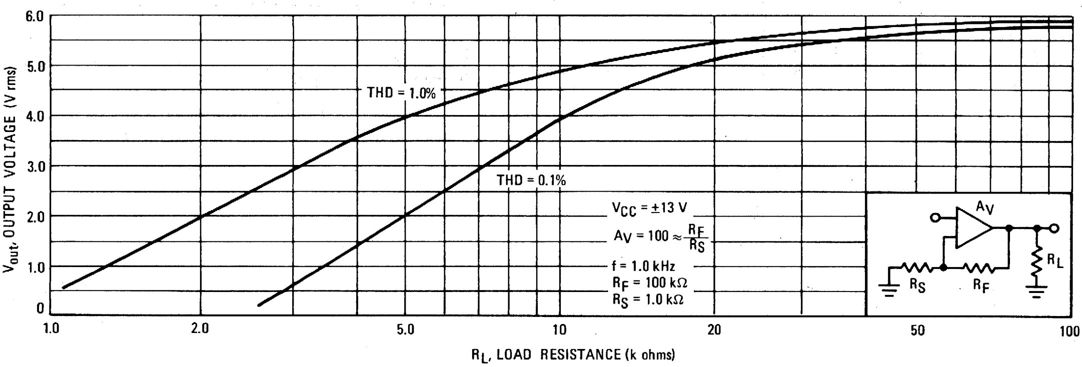


FIGURE 6 – INFLUENCE OF OUTPUT LOADING



NOISE CHARACTERISTICS

FIGURE 7A – INFLUENCE OF SOURCE RESISTANCE & BANDWIDTH

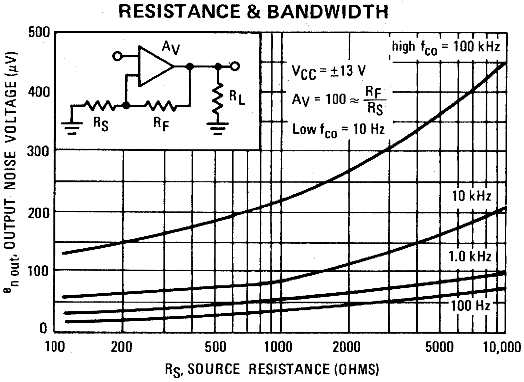


FIGURE 7B – INFLUENCE OF VOLTAGE GAIN & BANDWIDTH