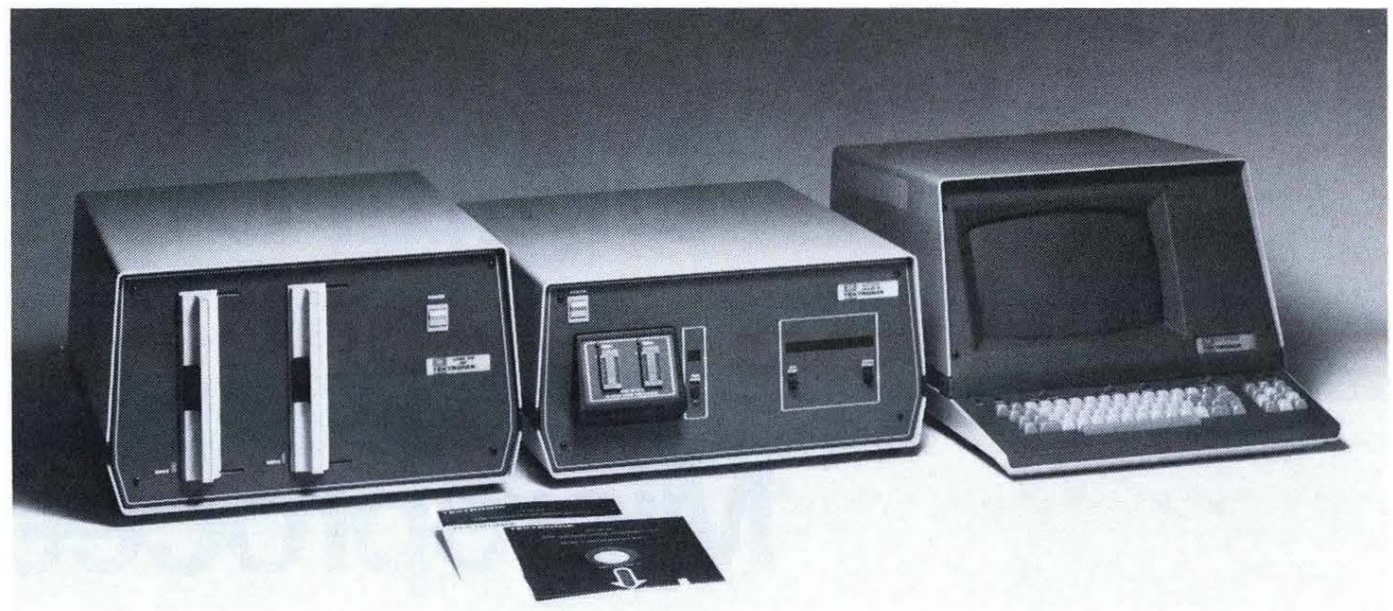
8002 Microprocessor Lab

A Complete Software Development System

Multiple Microprocessor Support

Real-Time Trace Option



The 8002 Microprocessor Lab consists of the 8002 mainframe; the dual flexible disc unit; an optional system terminal (TEKTRONIX CT8100 or CT8101 recommended); and two sets of assembler software for two different microprocessors, chosen from the microprocessors supported at time of purchase. An emulator processor module for each microprocessor the system supports, and its associated prototype control probe, are offered as options.

The 8002 Microprocessor Lab is a complete software development system for the design of microprocessor-based products. A key feature is its ability to support many microprocessor chips, including the Intel 8085A and 8080A, Motorola 6800, Texas Instruments TMS9900, and Zilog Z80A. In addition to multiple microprocessor support, the 8002 offers a superior operating system and powerful text editor, assembler, and debugging programs; three optional levels of emulation for software debugging, partial and full emulation; and a real-time prototype analyzer option offering all the capabilities of a microprocessor analyzer with eight channels of external input.

Software Development and Debugging

In a typical design sequence, software is developed using all the resources of TEKDOS, the disc-operating system software for the 8002 Microprocessor Lab. TEKDOS performs flexible disc and file utility functions, data transfer functions, and system/peripheral device control functions. In addition to relieving the user of these housekeeping chores, TEKDOS also supervises the text editor, assembler, and linker programs and the optional emulation support, debugging system, and PROM programming routines.

Program entry and editing may be accomplished module by module. The line-oriented text editor provides 150 60-character lines of buffer workspace, and offers several convenience features for preparing, correcting, and modifying the program quickly and easily. The macro assember allows a multiple-step routine to be defined by one new command. At the end of each work session, file space is allocated by TEKDOS; duplicate files of important material may be readily created. When program entry has been completed, all program files may be merged with a single TEKDOS command.

The assembler processor, with the appropriate disc inserted in the flexible disc drive, performs program assembly functions for each microprocessor supported by the 8002.

After an error-free assembly listing has been obtained, the resulting object code may be executed in system emulation (mode 0) on the optional emulator processor. The emulator processor is identical to the microprocessor that will finally be installed in the user's prototype. Execution is performed under control of the debugging system; during execution, program steps can be traced, software breakpoints can be set, and memory can be examined and changed as required. Should an error be discovered, that portion of the program can be corrected at the source level using the text editor. It can then be reassembled and executed again. This procedure continues until the program is correct.

Partial and Full Emulation

After the software has been debugged, it may be exercised on the prototype circuitry in the partial emulation mode (mode 1). During partial emulation, control may be released from the 8002 to the prototype in stages. The developmental software runs using 8002 memory space and prototype I/O and clock. The 8002 memory mapping feature allows memory to be gradually mapped over to the prototype in 128-byte address blocks. Throughout partial emulation, the user has access to prototype circuitry through the debugging system, which enables him, as before, to trace, set breakpoints, examine and change memory and register contents.

In full emulation (mode 2) the program is run on the prototype, but program execution is still under the complete control of the debugging system. All I/O and timing functions are directed by the prototype; all memory has been mapped over to the prototype; and only the prototype control probe is still in place, emulating the target microprocessor. Although the prototype is effectively free-standing, then, the user may still direct program activity from the 8002.

8002 CHARACTERISTICS

The 8002 Microprocessor Lab is a modular system whose mainframe houses up to 20 plug-in circuit boards. Two Assembler Software Support packages for the microprocessors of choice are selected at the time of purchase; their associated Emulator Support packages may be ordered as options. A terminal is necessary for system operation, and may be ordered as an optional peripheral.

The Real-Time Prototype Analyzer module, additional 16K byte Program Memory modules, and PROM Programmer modules for the 1702 or 2704/2708 are available as system options.

A system communications module provides three RS-232-C-compatible ports for interface with system peripherals. Two ports are designated for such peripherals as the optional TEKTRONIX CT8100 Crt Terminal, CT8101 Console Terminal, and LP8200 Line Printer. The remaining port is designated as a communications port for use with a modem. Baud rate is selectable for each port as 110, 300, 600, 1200, or 2400.

8002 PHYSICAL CHARACTERISTICS

Dimensions	cm	in
Height	24.7	9.6
Width	48.3	18.8
Length	57.3	22.3
Weight	**kg**	**lb**
Net	30	66

8002 ENVIRONMENTAL CHARACTERISTICS

Temperature	
Operating	0°C to +35°C (+32°F to 95°F).
Storage	Not available.
Humidity	To 90° relative noncondensing.
Altitude	
Operating	To 15,000 ft max.
Storage	To 50,000 ft max.

8002 ELECTRICAL CHARACTERISTICS

Ac Input Voltages	115 V ac ±10% or 230 V ac ±10%.
Frequency Range	60 Hz (50 Hz special order).

8002 DUAL FLEXIBLE DISC CHARACTERISTICS

Flexible Disc Unit — The Flexible Disc Unit consists of two disc drives, a controller, and power supplies. The two disc drives are designated as drive 0 and drive 1. Drive 0 is the default system drive. System programs are placed in this drive, including disc-operating system programs, the text editor, and the debugging routines peculiar to a specific emulator processor. Drive 1 may be used for storing user files, for modifying user files, or as a scratch data area. Drive 0 or drive 1 may be designated as the system drive.

Disc Organization — Each disc contains 77 concentric tracks. Each quarter track, or block, is split into eight sectors, and each sector can contain 128 bytes. Due to directory limitations, a maximum of 72 files

can be contained on one disc. The disc-operating system reserves track 0 for the disc directory; tracks one through four are normally automatically reserved for system programs.

Write Protection — Each disc has a write-protect slot. If the slot is covered, the disc is write-enabled; if the slot is not covered, the disc is write-protected. If an attempt is made to write to a write-protected disc, an error message will be displayed on the appropriate peripheral.

ENVIRONMENTAL CHARACTERISTICS

Temperature	
Operating	+10°C to 35°C (+50°F to 95°F).
Storage	Not available.
Humidity	
Operating	To 90% relative noncondensing.
Storage	Not available.
Altitude	
Operating	To 15,000 feet max.
Storage	To 50,000 feet max.

PHYSICAL CHARACTERISTICS

Size	cm	in
Height	27	10.5
Width	44	17.5
Length	60	23.6
Weight	**kg**	**lb**
Net	38.6	85

ELECTRICAL CHARACTERISTICS

Line Voltages	Voltage	Current
	115 V ac ±10%	3.5 A
	230 V ac ±10%	2.0 A
Line Frequency	60 Hz (50 Hz special order).	

DISC UNIT CHARACTERISTICS

Capacity		Bits	Bytes
Per Disc	77 x 32 x 128 x 8 bits =	2,523,136	315,392
Per Track	32 x 128 x 8 bits =	32,768	4,096
Per Sector	128 x 8 bits =	1,204	128
Access Time	10 ms/track		

ORDERING INFORMATION*

8002 Microprocessor Lab $9950

*The 8002 and 8001 may not be available in some areas of the world. Consult your Distributor or Representative.

The 8001 Microprocessor Lab consists of the 8001 mainframe; an optional system terminal (TEKTRONIX CT8100 or CT8101 recommended); and a Microprocessor Support Package for the microprocessor selected. A support package includes an emulator ROM, an emulator processor, and a prototype control probe.

Multiple Microprocessor Support

Real-Time Trace Option

The 8001 Microprocessor Lab is a total hardware debugging environment for the design of microprocessor-based products. A key feature is its ability to support many microprocessor chips, including the Intel 8085A and 8080A, Motorola 6800, Texas Instruments TMS9900 and Zilog Z80A. In addition to multiple microprocessor support, the 8001 offers three emulation modes for software debugging, partial and full emulation, as well as a real-time prototype analyzer option offering all the capabilities of a microprocessor analyzer with eight channels of external input.

Three Emulation Modes

In a typical design sequence, software is first developed independently using timesharing, a minicomputer, another development system, or some other means. It is then downloaded to the 8001. At this point the in-prototype emulation and software/hardware integration capabilities of the 8001 come into play.

In emulation mode 0, the software runs only on the emulator processor. This enables the program to be debugged on a microprocessor identical to the one that will ultimately be used in the completed product. In emulation modes 1 and 2, the prototype control probe is connected to the emulator processor at one end and plugged into the prototype's empty microprocessor socket at the other.

Partial emulation (mode 1) lets the user release control in methodical steps from the 8001 to the prototype. The developmental software runs using 8001 memory space and prototype I/O and clock. The 8001 memory mapping feature allows memory to be gradually mapped over to the prototype in address blocks. Throughout partial emulation, the user has access to prototype circuitry via the powerful 8001 debugging system, which enables him to trace, set breakpoints, examine and change memory and register contents.

Full emulation (mode 2) lets the user exercise the program on the prototype while still maintaining complete control through the Microprocessor Lab. All I/O and timing functions are directed by the prototype; all memory has been mapped over to the prototype; and only the prototype control probe is still in place, emulating the target microprocessor. Although the prototype is effectively free-standing, then, the user may still direct program activtity through the prototype control probe.

8001 CHARACTERISTICS

The 8001 Microprocessor Lab is a modular system whose mainframe houses up to 20 plug-in circuit boards. An emulator processor module for the microprocessor of choice, its associated prototype control probe, and a ROM-based software module are provided with the system. Additional Emulator Processor packages are available as options for each microprocessor the system supports. A terminal is necessary for system operation, and may be ordered as an optional peripheral.

The Real-Time Prototype Analyzer module, additional 16K byte Program Memory modules, and PROM Programmer modules for the 1702 or 2704/2708 are available as system options.

A system communications module provides three RS-232-C-compatible ports for interface with system peripherals. Two ports are designated for such peripherals as the optional TEKTRONIX CT8100 Crt Terminal, CT8101 Console Terminal, and LP8200 Line Printer. The remaining port is designated as a communications port for use with a modem. Baud rate is selectable for each port as 110, 300, 600, 1200, or 2400.

8001 PHYSICAL CHARACTERISTICS

Dimensions	cm	in
Height	24.7	9.6
Width	48.3	18.8
Length	57.3	22.3
Weight	**kg**	**lb**
Net	30	66

8001 ENVIRONMENTAL CHARACTERISTICS

Temperature	
Operating	0°C to +35°C (+32°F to 95°F).
Storage	Not available.
Humidity	To 90° relative noncondensing.
Altitude	
Operating	To 15,000 feet max.
Storage	To 50,000 feet max.

8001 ELECTRICAL CHARACTERISTICS

Ac Input Voltages	115 V ac ±10% or 230 V ac ±10%.
Frequency Range	60 Hz (50 Hz special order).

ORDERING INFORMATION*

8001 Microprocessor Lab $7650

Emulator Processor and Prototype Control Probe Support Packages

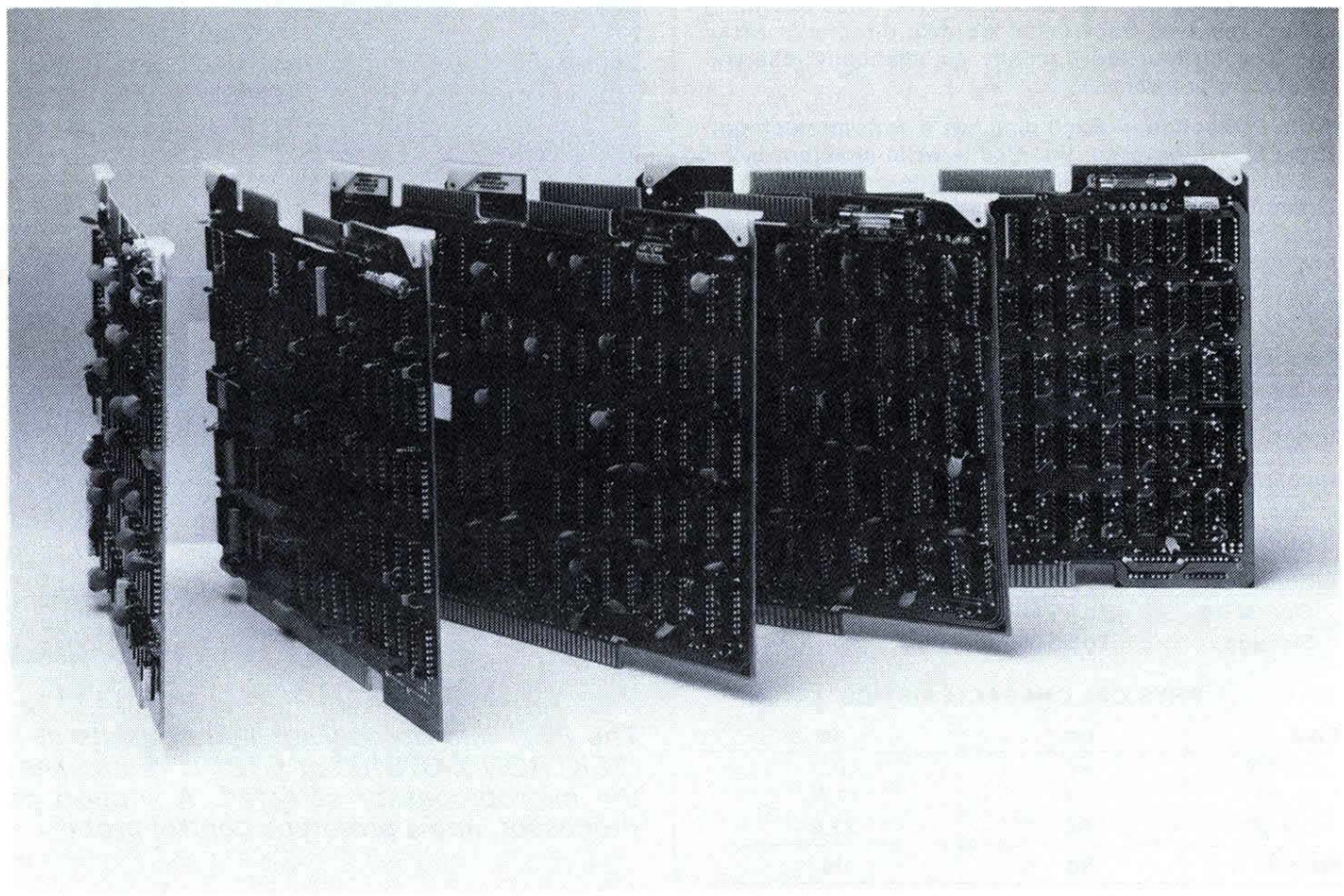
The 8002 and 8001 Microprocessor Labs currently support five different microprocessors: the Intel 8085A and 8080A, Motorola 6800, Texas Instruments TMS9900, and Zilog Z80A. Tektronix will continue to introduce support for selected microprocessors on a regular schedule.

Emulator packages for the 8002 and 8001 may be ordered as system options; one emulator package is provided at the time of purchase with the 8001. These options provide the capabilities necessary to fully emulate the target microprocessor in a user's prototype system.

The emulator processor, which resides on a plug-in circuit module along with controlling logic circuitry, enables the user to execute and debug the program on a microprocessor identical to the one which will be used in the prototype, while giving him access to the full 64K bytes of Microprocessor Lab program memory.

The prototype control probe, which links the emulator processor to the prototype system, allows partial and full in-circuit emulation.

All emulation operations are controlled by the powerful Microprocessor Lab system software. The user is able to monitor program execution, set software breakpoints, examine and change memory and register contents. Debug trace information is displayed in a format unique to the microprocessor, with instruction fetches disassembled into mnemonics for easy interpretation.



8080 EMULATOR SUPPORT PACKAGE CHARACTERISTICS

8080 and 8080A refer to microprocessors manufactured by Intel Corporation. Tektronix, Inc., does not guarantee that other vendors' versions of the 8080 will be compatible with the TEKTRONIX Microprocessor Labs.

PHYSICAL CHARACTERISTICS

Length 6 ft of cable from the emulator processor to the interface assembly.

1.5 ft of cable from the interface assembly to the 40 pin plug.

Cable Configuration

6 ft 2 40 conductor ribbon cables with alternating ground and signal paths.

1.5 ft 2 twisted pair 40 conductor cables.

Termination

6 ft The interface assembly contains resistive termination and receivers for data, address, and control from the emulator processor module.

1.5 ft Not terminated.

40 pin plug—40 pin spring plate protected plug. When used with a zero insertion force socket, an included 40 pin low profile DIP socket must be used between the zero insertion force socket and the 40 pin probe plug.

TIMING CHARACTERISTICS

Emulation Interface Delays*

To 8080 from Interface Assembly	Typ	Max (in ns)
ø1	44	60
ø2	44	60
HOLD	44	67
RESET	44	67
RDY**	35	40
INT	63	104
DATA	44	53

From 8080 to Interface Assembly	Typ	Max (in ns)
HOLDA***	39	55
SYNC	37	45
WAIT	37	45
$\overline{WR}$	37	45
DBIN	37	45
INTE	39	55
ADDRESS	27	35
DATA	50	63

Assumes 6 ft of cable at 1.5 ns/ft.

***RDY is ignored unless user memory or I/O is accessed in control mode 2 or special mode.*

****The equation for HOLDA to tristate timing is as follows: HOLDA • DBIN = FLOAT. Tristate of data and address follows the trailing edges of DBIN or $\overline{WR}$ by approximately 20 ns.*

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	**$7650**		
Option 01 8080 Microprocessor Support Package	**NC**	**8001F01**	**$2950**
8002 Microprocessor Lab	**$9950**		
Option 01 8080 Assembler Software Support	**NC**	**8002F01**	**$ 550**
Option 16 8080 Emulator Support	**+$1850**	**8002F16**	**$1950**
Option 31 8080 Prototype Control Probe	**+$ 850**	**8002F31**	**$ 950**

6800 EMULATOR SUPPORT PACKAGE CHARACTERISTICS

6800 refers to microprocessors manufactured by Motorola Corporation. Tektronix, Inc., does not guarantee that other vendors' versions of the 6800 will be compatible with the TEKTRONIX Microprocessor Labs.

PHYSICAL CHARACTERISTICS

Length 6 ft of cable from the emulator processor to the interface assembly.

1 ft of cable from the interface assembly to the 40-pin plug.

Cable Configuration

6 ft 2 40 conductor ribbon cables with alternating ground and signal paths.

1 ft 2 twisted pair 40 conductor cables made up of signal/ground pairs.

TIMING CHARACTERISTICS

Emulation Interface Delays*

To 6800 from Interface Assembly	Maximum	TPCS[1] (in ns)
ø1	26	—
ø2	26	—
NMI	30	200
IRQ	67	200
RESET	94	200
HALT**	72	—
DATA	28	114 (input setup)
DBE****	—	—
TSC***	not used	—

From 6800 to Interface Assembly	Maximum	TAD[2] (in ns)
ADDRESS	20	300
DATA****	28	460
VMA	45	300
R/W	63	300
BA	35	—

Assumes 6 ft of cable at 1.5 ns/ft.

***HALT must occur within 80 ns after the falling edge of ø1 to be recognized at the rising edge of the following ø2.*

****Delay to tristate, TSD=36 ns. Tristate is performed by the interface buffers, not by the 6800.*

*****Data from the 6800 will be available to the prototype 460 ns after the rising edge of ø1 or DBE + 36 ns, whichever is greater.*

[1]TPCS—Control signal setup time prior to ø2 falling edge.

[2]TAD—Output propagation delay from clock after ø1 rising edge.

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	**$7650**		
Option 02 6800 Microprocessor Support Package	**NC**	**8001F02**	**$2950**
8002 Microprocessor Lab	**$9950**		
Option 02 6800 Assembler Software Support	**NC**	**8002F02**	**$ 550**
Option 17 6800 Emulator Support	**+$1850**	**8002F17**	**$1950**
Option 32 6800 Prototype Control Probe	**+$ 850**	**8002F32**	**$ 950**

Z80 EMULATOR SUPPORT PACKAGE CHARACTERISTICS

Z80 and Z80A refer to microprocessors manufactured by Zilog Corporation. Tektronix, Inc., does not guarantee that other vendor's versions of the Z80 will be compatible with the TEKTRONIX Microprocessor Labs.

PHYSICAL CHARACTERISTICS

Length 6 ft of cable from the emulator processor to the interface assembly.

1 ft of cable from the interface assembly to the 40 pin plug.

Cable Configuration

6 ft 2 40 conductor ribbon cables with chassis ground plane and signal paths.

1 ft 2 40 conductor twisted pair cables.

Termination

6 ft The interface assembly contains receivers for data, address, and control from the Z80 emulator processor module.

1 ft Not terminated.

TIMING CHARACTERISTICS

The Z80 emulator processor was designed to match the ac characteristics of the Z80 microprocessor with two exceptions. Those exceptions are:

Prototype Clock

The prototype clock may not be stretched over a total of 10 μs during any one memory or I/0 request when a Microprocessor Lab memory access may occur in the next cycle. This exception is valid only if the prototype clock runs in excess of 1 MHz.

NMI

NMI (Non Maskable Interrupt) must occur one-half cycle earlier than in a standard Z80 configuration. This means the NMI must occur before the next to last trailing edge of the M cycle just prior to M1.

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	$7650		
Option 03 Z80 Microprocessor Support Package	NC	8001F03	$2950
8002 Microprocessor Lab	$9950		
Option 03 Z80 Assembler Software Support	NC	8002F03	$ 550
Option 18 Z80 Emulator Support	+$1850	8002F18	$1950
Option 33 Z80 Emulator Prototype Control Probe	+$ 850	8002F33	$ 950

TMS9900 EMULATOR SUPPORT PACKAGE CHARACTERISTICS

TMS9900 refers to microprocessors manufactured by Texas Instruments Corporation. Tektronix, Inc., does not guarantee that other vendor's versions of the TMS9900 will be compatible with the TEKTRONIX Microprocessor Labs.

PHYSICAL CHARACTERISTICS

Length 6 ft of cable from the emulator processor to the interface assembly.

9.5 in of cable from the interface assembly to the 64 pin plug.

Cable Configuration

6 ft 2 40 conductor ribbon cables with chassis ground plane and signal paths.

9.5 in 2 32 conductor twisted pair cables.

Termination

6 ft The interface assembly contains receivers for data, address, and control from the TMS 9900 emulator processor module.

9.5 in Not terminated.

TIMING CHARACTERISTICS

To TMS9900 from Interface Assembly	Emulation Interface Delays* Typical	Maximum (in ns)
ø1	41	59
ø2	41	59
ø3	41	59
ø4	41	59
CRUIN	12	23
INTREQ	12	18
1C0	12	23
IC1	12	23
IC2	12	23
$\overline{IC3}$	12	23
$\overline{HOLD}$	12	18
$\overline{READY}$	12	18
$\overline{LOAD}$	12	18
RESET	68	98
DATA	14	21

From TMS9900 to Interface Assembly	Typical	Maximum (in ns)
$\overline{DBIN}$	24	41
$\overline{MEMEN}$	12	18
$\overline{WE}$	12	18
CRUCK	12	23
CRUOUT	12	23
HOLDA	12	23
WAIT	12	23
IAQ	12	23
ADDRESS	14	21
DATA	14	21

**Assumes 1.5 ft of cable at 1.5 ns/ft.*

Note: All inputs and outputs of the 64 pin plug at the end of the prototype control probe are buffered by 74LSXXX type devices. In all cases, data and control should not change during clock ø1.

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	$7650		
Option 04 TMS9900 Microprocessor Support Package	+$ 400	8001F04	$3350
8002 Microprocessor Lab	$9950		
Option 04 TMS9900 Assembler Software Support	NC	8002F04	$ 550
Option 19 TMS9900 Emulator Support	+$2100	8002F19	$2200
Option 34 TMS9900 Prototype Control Probe	+$1000	8002F34	$1100
Option 49 16K Memory Module*	+$1100	8002F49	$1210

**One supplied with either Microprocessor Lab.*

8085 EMULATOR SUPPORT PACKAGE CHARACTERISTICS

8085 and 8085A refer to microprocessors manufactured by Intel Corporation. Tektronix, Inc., does not guarantee that other vendor's versions of the 8085 will be compatible with the TEKTRONIX Microprocessor Labs.

PHYSICAL CHARACTERISTICS

Length 6 ft of cable from the emulator processor to the interface assembly.

1 ft of cable from the interface assembly to the 40 pin plug.

Cable Configuration

6 ft 2 40 conductor ribbon cables with chassis ground plane and signal paths.

1 ft 2 40 conductor twisted pair cables.

Termination

6 ft The interface assembly contains receivers for data, address, and control from the 8085 emulator processor module.

1 ft Not terminated.

AC CHARACTERISTICS

Emulation Clock

Mode 1 or Mode 2 (user's clock), with 8085 Prototype Control Probe.	6.25 MHz max*; crystal, RC timing network or TTL input to X1.
Mode 0 (system clock)	6.25 MHz ±0.01%

Operational Speed

Full speed or 1 wait state per machine cycle during 8001/8002 program memory access selectable with jumper.

One wait state per machine cycle is inserted when using DEBUG breakpoints (BKPT) regardless of jumper position. When the Real-Time Prototype Analyzer option is installed, real-time operation with breakpoints automatically ensured during DEBUG by using the event triggers (EVT).

**A clock error detection circuit ensures that the user's clock is operational and basically within Intel max (1 μs) and min (160 ns) specifications.*

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	$7650		
Option 05 8085 Microprocessor Support Package	NC	8001F05	$2950
8002 Microprocessor Lab	$9950		
Option 05 8085 Assembler Software Support	NC	8002F05	$ 550
Option 20 8085 Emulator Support	+$1850	8002F20	$1950
Option 35 8085 Prototype Control Probe	+$ 850	8002F35	$ 950

8002 and 8001 Microprocessor Lab System Options

Real-Time Prototype Analyzer

The Real-Time Prototype Analyzer, Option 46 for the 8002 and 8001 Microprocessor Labs, is comprised of a real-time trace module, a data acquisition interface, and an 8-channel general logic probe. This option provides a real-time trace of the user program executing on the emulator processor, with 43 channels of data acquired simultaneously. The prototype address bus, data bus, control bus, and any eight external locations on the prototype circuit may be monitored without slowing up the operational speed of the processor. The Real-Time Prototype Analyzer is indispensable when isolating critical timing errors and hardware/software sequence discrepancies during the final integration phases of prototype development.

The analyzer module is a separate plug-in circuit card that may be inserted into either the 8002 or 8001 system mainframe. The P6451 Probe connects to the prototype circuitry and permits data transference from the prototype to the analyzer. Data from the prototype is buffered and driven by the probe to the data acquisition interface, and then loaded into the analyzer module's real-time trace buffer.

As the user program executes on the emulator processor, 48-bit data words are sequentially acquired from the prototype and loaded into the real-time trace buffer. Each data word contains 16-bit data from the address bus; 8-bit or 16-bit data from the data bus; 8-bit data from the test probe; 3-bit data identifying cycle type (read, write, I/0, memory, or instruction fetch); and 5-bit data used internally to identify last start/stop of the emulator processor. The analyzer will continue to acquire these sequential cycles of logic input until the processor is stopped or the real-time trace buffer is frozen by a specified trigger occurrence. The real-time trace buffer can retain up to 128 data words in pre-, variable center, or post-trigger modes; thus enabling the storage of pertinent program bus transactions.

The Real-Time Prototype Analyzer offers expanded breakpoints to aid in efficient location of prototype problems. Two event comparators located within the analyzer module can be utilized to halt program execution and stop real-time trace. A trigger may be generated on any specific data occurrence in the address bus, data bus, test probe input, and instruction cycle type. Triggering may be immediate; delayed by counting the number of passes; or delayed by counting the number of clock select outputs (clock select may be by microseconds, milliseconds, emulator clocks, etc.). In addition, an output pulse may be generated, via the data acquisition interface, to trigger a logic analyzer or an oscilloscope.

The two event comparators (triggers) may be set to designate a break or halt in the program execution. These comparators may be used as independent breakpoints; or they may be used together to enable a breakpoint on a specific event combination. The program execution can be halted when two trigger events occur simultaneously; when one trigger event precedes another; or when either trigger event occurs. When a break in the program execution takes place, program transactions stored in the real-time trace buffer may be displayed or printed.

Data stored in the real-time trace buffer is displayed sequentially in the order it was acquired from the prototype. Buffer content may be displayed in whole or in part. Optional command parameters are available to limit the storing of data to any specific transaction type, such as memory reads only. If the total buffer contents are displayed, a blank line will separate the data sequence associated with each program starting point.

The Real-Time Prototype Analyzer features a convenient and easy-to-understand display format. With this format, the address location, data, probe input, and control bus data of each acquired transaction are displayed. If the transaction was an instruction fetch, the instruction is also disassembled into the appropriate mnemonic readout unique to the emulator type being used.

The Real-Time Prototype Analyzer functions in all emulation modes and operates with all commercial microprocessors supported by the 8002 and 8001 Microprocessor Labs.

REAL-TIME PROTOTYPE ANALYZER CHARACTERISTICS

OPERATIONAL SPEED CHARACTERISTICS

Processor	Maximum Processor Clock Rate*
8085	3.125 MHz (internal clock)
8080	2.08 MHz
6800	1.00 MHz
Z80	4.00 MHz
TMS9900	3.33 MHz

**Maximum processor clock rate for Real-Time Prototype Analyzer operation.*

INPUT/OUTPUT CHARACTERISTICS

Variable Threshold

Range	$>+10$ V dc to <-10 V dc
Preset TTL Voltage	$+1.4$ V dc ± 200 mV
Event Trigger Out	High level voltage out (when Vcc=Min, Vi=0.5, Ro=50 Ω to GND) is >2 V dc.

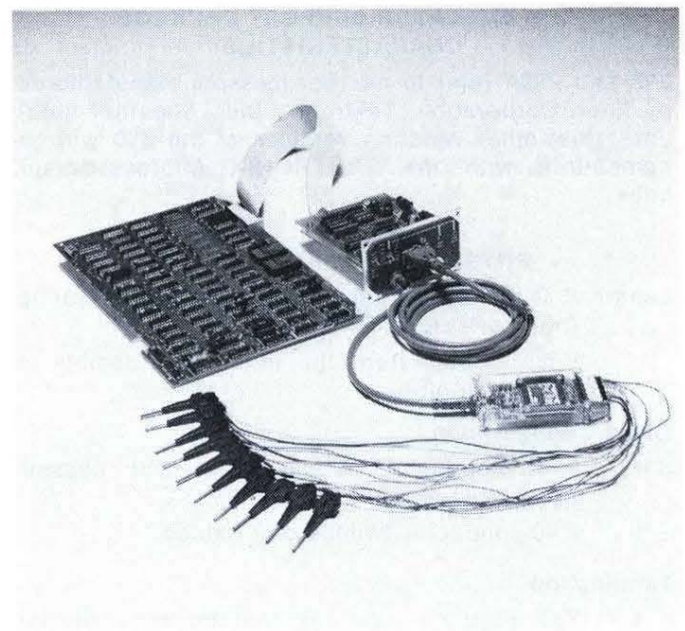
Adjustments—Variable Threshold may be adjusted from $>+10$ V dc to <-10 V dc with a screwdriver adjustment accessible at the rear panel of the Microprocessor Lab. This voltage must be monitored with a voltmeter having an input impedance of at least 10 MΩ.

Jumpers—With the internal jumper in position '0-3' the clock threshold is designated to be the same as channels 0-3. In position '4-7' the jumper designates the clock threshold to be the same as channels 4-7.

Cable Length — 50 cm (19.5 in).

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	$7650		
Option 46 Real-Time Prototype Analyzer	+$1950	8001F46	$2150
8002 Microprocessor Lab	$9950		
Option 46 Real-Time Prototype Analyzer	+$1950	8002F46	$2150



1702 and 2704/2708 PROM Programmer

The 1702 and 2704/2708 PROM Programmer, Options 47 and 48 for the 8002 and 8001 Microprocessor Labs, provide the ability to program either 1702 or 2704/2708 erasable PROM chips. When the module is installed in an 8002 or 8001 mainframe, the PROM Programmer software enables communication between 8002 or 8001 program memory and the PROM installed in the front-panel PROM programming porch.

1702 or 2704/2708 PROM Programmer software transfers one data byte at a time, and actual addresses are assigned. Data may be written from 8002 or 8001 program memory (WPROM); read from PROM into program memory (RPROM); or compared on the system terminal (CPROM).

The RPROM command allows the programmed PROM to be read into program memory and dumped to the system console. The CPROM compare function performs an address-by-address comparison between the PROM and the program under development. When an inequality between PROM bytes and memory bytes occurs, the memory address, memory byte content, and PROM byte content are displayed on the system console. A successful comparison between designated PROM and memory bytes is indicated by an End of Job message on the console.

ORDERING INFORMATION

Option Description	Factory Price	Field Number	Field Price
8001 Microprocessor Lab	$7650		
Option 47 1702 PROM Programmer	+$500	8001F47	$550
Option 48 2704/2708 PROM Programmer	+$500	8001F48	$550
8002 Microprocessor Lab	$9950		
Option 47 1702 PROM Programmer	+$500	8002F47	$550
Option 48 2704/2708 PROM Programmer	+$500	8002F48	$550

CT8100 Crt Terminal

The CT8100 Crt Terminal is an optional peripheral recommended for use with the 8002 and 8001 Microprocessor Labs.

The CT8100 is interfaced to the 8002 or the 8001 through an EIA standard RS-232-C port on the system communications module. Data formats and baud rate are switch-selectable for TTY or EIA operation.

The keyboard provides selection of the full ASCII set of 96 characters.

The console screen provides space for 24 lines of 80 characters each, allowing the 12-inch diagonal, refreshed crt to display up to 1920 characters.

ELECTRICAL CHARACTERISTICS

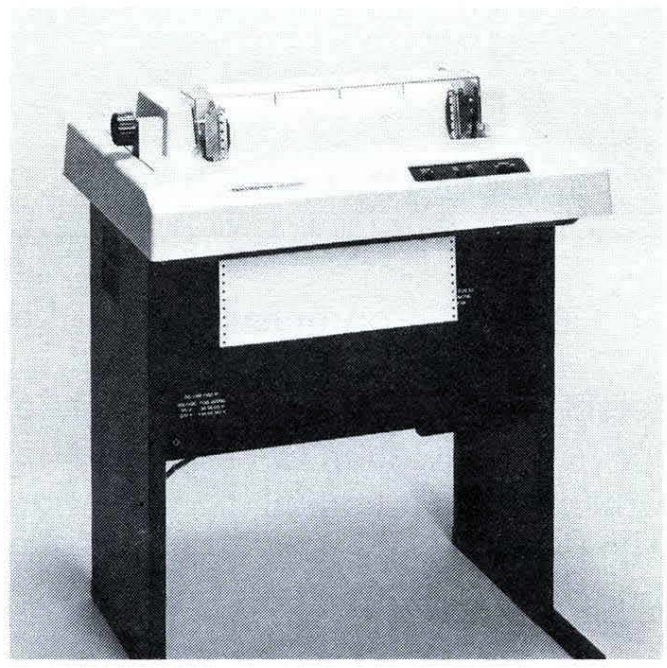
115/230 (Hi, Medium, Lo) V ac,
50 to 400 Hz; nominal 220 W.

PHYSICAL CHARACTERISTICS

Dimensions	cm	in
Height	33.02	13
Width	45.72	18
Length	68.58	27
Weight	**lb**	
Net	46	
Shipping	67	

ORDERING INFORMATION

CT8100 Crt Terminal **$3495**



LP8200 Line Printer

The LP8200 Line Printer is an optional system peripheral for the 8002 and 8001 Microprocesor Labs.

The LP8200 is serially interfaced to either Microprocessor Lab through an EIA standard RS-232-C port on the system communications module. Baud rates of 300 to 9600 are selectable.

The printout provides space for 132 characters/line, 6 lines/vertical inch. The full ASCII set of 96 upper/lower case characters is provided.

ELECTRICAL CHARACTERISTICS

Voltage	90 to 132 V ac or 180 to 264 V ac.
Frequency	50 or 60 Hz ±1 Hz.
Power	400 W max (printing); 200 W max (idle).

PHYSICAL CHARACTERISTICS

Dimensions	cm	in
Height	85.09	33.5
Width	69.85	27.5
Length	55.12	21.7
Weight	**lb**	
Net	102	

ORDERING INFORMATION

LP8200 Line Printer **$3765**

CT8101 Console Terminal

The CT8101 Console Terminal is an optional peripheral recommended for use with the 8002 and 8001 Microprocessor Labs.

The CT8101 is interfaced to the 8002 or 8001 through an EIA standard RS-232-C port on the system communications module. Data formats and baud rate are switch-selectable for TTY or EIA operation.

The keyboard provides selection of the full ASCII set of 96 characters. It also features character repeat when any key is pressed at the same time as the REPEAT key.

ELECTRICAL CHARACTERISTICS

Voltage	115 V RMS; +10%, −15%.
Frequency	47 through 63 Hz.
Power	75 W max.

PHYSICAL CHARACTERISTICS

Dimensions	cm	in
Height	10.79	4.25
Width	37.08	14.60
Length	38.73	15.25
Weight	**lb**	
Net	11.20 (including paper)	

ORDERING INFORMATION

CT8101 Console Terminal **$1395**

8001 and 8002 Microprocessor Lab
Ordering Information

	Option Description		Factory Price	Field Number	Field Price
8001 Microprocessor Lab			$7650		
Select one with initial order	Option 01	8080 Microprocessor Support Package	NC	8001F01	$2950
	Option 02	6800 Microprocessor Support Package	NC	8001F02	$2950
	Option 03	Z80 Microprocessor Support Package	NC	8001F03	$2950
	Option 04	TMS9900 Microprocessor Support Package	+$ 400	8001F04	$3350
	Option 05	8085 Microprocessor Support Package	NC	8001F05	$2950
	Option 46	Real-Time Prototype Analyzer	+$1950	8001F46	$2150
	Option 47	1702 PROM Programmer	+$ 500	8001F47	$ 550
	Option 48	2704/2708 PROM Programmer	+$ 500	8001F48	$ 550
	Option 49	16K Memory Module	+$1100	8001F49	$1210
8002 Microprocessor Lab			$9950		
Select two with initial order	Option 01	8080 Assembler Software Support	NC	8002F01	$ 550
	Option 02	6800 Assembler Software Support	NC	8002F02	$ 550
	Option 03	Z80 Assembler Software Support	NC	8002F03	$ 550
	Option 04	TMS9900 Assembler Software Support	NC	8002F04	$ 550
	Option 05	8085 Assembler Software Support	NC	8002F05	$ 550
	Option 16	8080 Emulator Support	+$1850	8002F16	$1950
	Option 17	6800 Emulator Support	+$1850	8002F17	$1950
	Option 18	Z80 Emulator Support	+$1850	8002F18	$1950
	Option 19	TMS9900 Emulator Support	+$2100	8002F19	$2200
	Option 20	8085 Emulator Support	+$1850	8002F20	$1950
	Option 31	8080 Prototype Control Probe	+$ 850	8002F31	$ 950
	Option 32	6800 Prototype Control Probe	+$ 850	8002F32	$ 950
	Option 33	Z80 Prototype Control Probe	+$ 850	8002F33	$ 950
	Option 34	TMS9900 Prototype Control Probe	+$1000	8002F34	$1100
	Option 35	8085 Prototype Control Probe	+$ 850	8002F35	$ 950
	Option 46	Real-Time Prototype Analyzer	+$1950	8002F46	$2150
	Option 47	1702 PROM Programmer	+$ 500	8002F47	$ 550
	Option 48	2704/2708 PROM Programmer	+$ 500	8002F48	$ 550
	Option 49	16K Memory Module	+$1100	8002F49	$1210

Peripherals

CT8100	Crt Terminal	$3495
CT8101	Console Terminal	$1395
LP8200	Line Printer	$3765

Alphanumeric Index

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Measurelec
144 Bd Salah Bouakouir
Algiers
Phone: 60.45.70 and 60.45.71 (Algiers)
Telex: (Private telex is not available today.)
Cable: (Address as above)

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Coasin S.A.
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Buenos Aires
Phone: 52-3185, 51-9363
Telex: 012-2284
Cable: COASIN, Buenos Aires

25 de Mayo N° 1930
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AUSTRALIA
Tektronix Australia Pty. Limited
80 Waterloo Road
North Ryde, N.S.W. 2113
Sydney
Phone: 888-7066
Telex: AA24269
Cable: TEKTRONIX Australia

128 Gilles Street
Adelaide, South Australia 5000
Phone: 223-2811

260 Auburn Road
Hawthorn, Vic. 3122
Melbourne
Phone: 81 0594

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Sonnleithnergasse 20
A-1100 **Wien**
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Mercure Centre
Rue De La Fusee NR100
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Tektronix Industria e Comercio Ltda.
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CEP 01454 **Sao Paulo**
Phone: 212-3608, 212-4874

Rua Barao de Lucena, 32
CEP 20000 **Rio de Janeiro**
Phone: 266-5364, 286-6946

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P.O. Box 6500 (Home Office)
Barrie, Ontario
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Phone: (705) 737-2700
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Pointe Claire, Quebec
H9R 3S3
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Telex: 05-821570
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Calgary, Alberta
T2R 0J2
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(Toronto)
P.O. Box 6500
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L4M 4V3
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Ottawa, Ontario
K2C 2B5
Phone: (613) 225-2850
Telex: 053-4119

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4519 Canada Way
Burnaby, B.C.
V5G 1K1
Phone: (604) 438-4321
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B3B 1J4
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K. 71 No. 55-98
Apartado Aereo 25124
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Herlev Hovedgade 119
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Fack
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S-414 59 **Gothenburg**
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THE NETHERLANDS
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Meidoornweg 2
"Postbus 164"
Badhoevedorp
Phone: 02968-6155
Telex: 18490

TURKEY
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatibey Caddesi 92/3
Karakoy, **Istanbul**
Phone: 44 15 46/44 76 51
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TUNISIA
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Societe Industrielle et Commerciale d' Equipements Electriques et Electroniques
3 Rue de Vesoul
Tunis
Phone: 244372
Telex: 13664 ESLEK TN

UNITED ARAB EMIRATES
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UNITED KINGDOM
Tektronix U.K. Limited
Beaverton House
36-38, Coldharbour Lane
(P.O. Box 69)
Harpenden, Herts
Phone: Harpenden 63141, 61251
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Burnage
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Phone: 061-224-0446
Telex: 668409

7 Shiel House, Shiel Walk
Scotland
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Phone: Livingston 32766/7

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Telex: 0 181 636
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(213) 778-5225, 26

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Phone: (213) 999-1711

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7827 Convoy Court
Suite 401
Phone: (714) 292-7330

***Santa Clara** 95051
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Englewood 80110
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Phone: (404) 449-4770

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EMC Corporation
2979 Ualena Street
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Farmington Hills 48018
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Phone: (505) 265-5541
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Latham 12110
Phone: (518) 785-3353

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100 Crossways Park West
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Phone: (516) 364-9060
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Phone: (914) 454-7540

Rochester 14623
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OHIO
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800 N.E. 63rd
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Suite 121
Tigard 97223
Phone: (503) 620-9100

†Factory Service Center
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Beaverton 97077
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TWX: 910-467-8708

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***(Philadelphia)**
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Phone: (215) 825-6400
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4455 Sigma Road
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***Houston** 77036
5755 Bonhomme
Suite 420
Phone: (713) 783-1910

San Antonio 78226
3311 Roselawn
Phone: (512) 434-4334

UTAH
***Salt Lake City** 84115
65 West 2950 South
Phone: (801) 484-8501

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1929 C Coliseum Dr.
Phone: (804) 826-4020

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641 Industry Drive
Phone: (206) 575-0180

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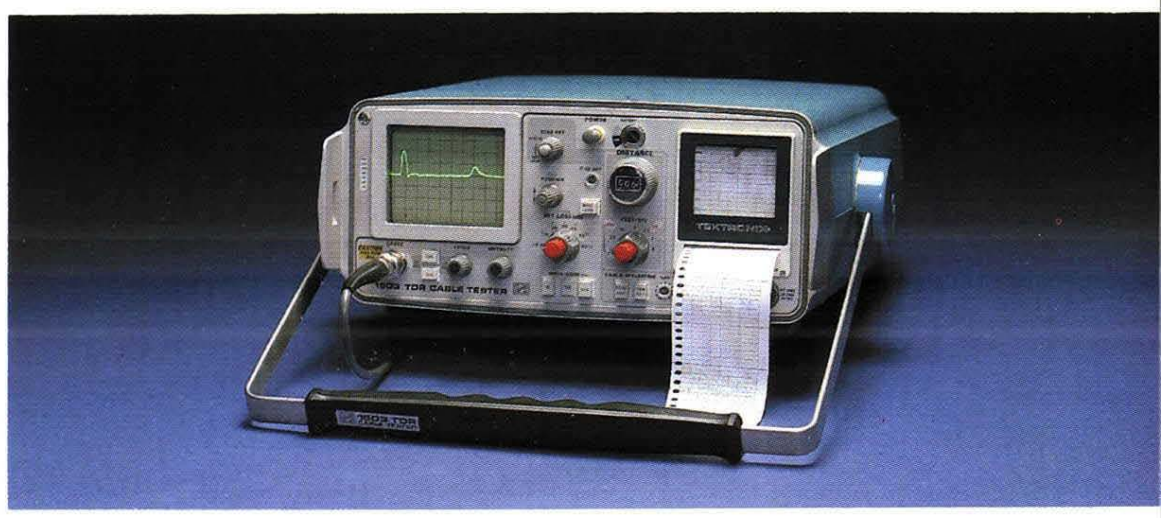
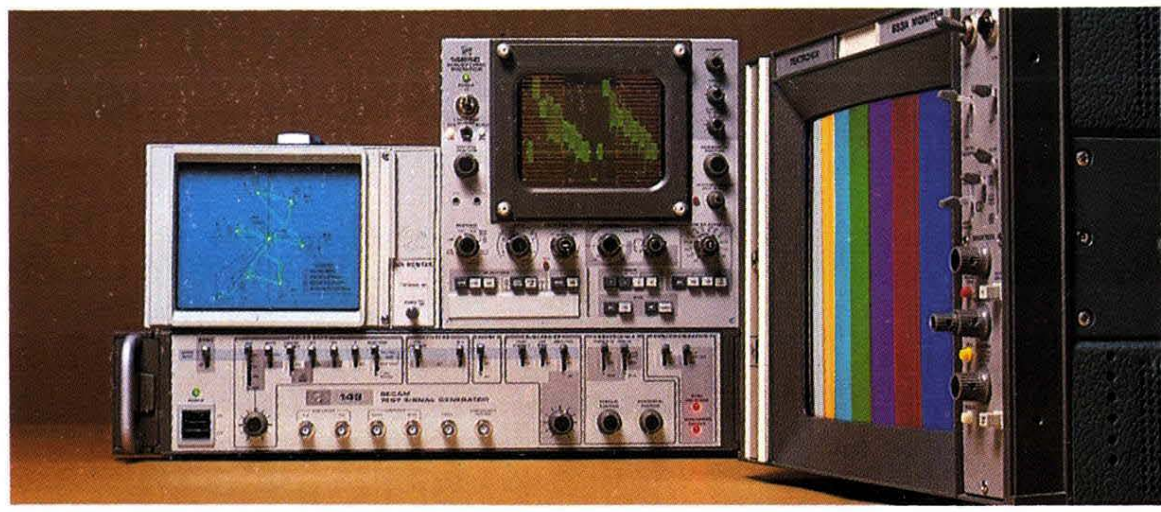
Technological innovation. Since the introduction of its first pioneering laboratory oscilloscope in 1947, Tektronix has been committed to advancing the state of technology. The 7834 was chosen by *Industrial Research* magazine as one of the top 100 technological innovations in 1977. It's the world's fastest storage oscilloscope. And the only scope that can retain waveforms of very fast, single-shot events (up to 1.4 nsec rise time) typical of nuclear research, laser fusion, and glitches in digital logic circuitry. The scope's biggest users are nuclear-energy researchers and computer people. See pages 56 and 57.

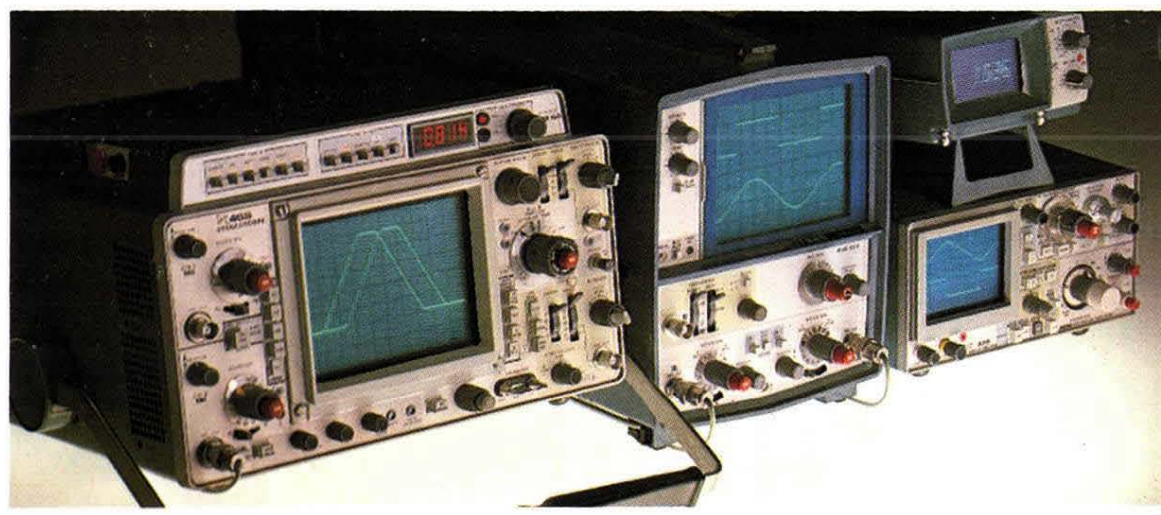
Our 1500-Series Cable Testers are valued by users including airlines and telephone companies. The 1500s provide maintenance people with a fast, accurate, portable tool for checking the internal condition of cables and pinpointing problems. Maintenance people can identify and locate opens and metallic shorts, as well as crimps, frays, and poor connections in coax. In telephone cables, they can also see splices, sheath damage, water, splits and resplits, load coils, bridged taps and other kinds of trouble. The 1500-Series Cable Testers are simple to operate and can be used on everything from coax to lamp cord. See pages 170 and 171.



The TV broadcasting industry around the world knows Tektronix for a wide range of instruments that help maintain the quality of television transmission from the camera to the home receiver. Applications of these instruments beyond the television broadcast industry are as varied as NASA Control's elaborate system that enabled us to see man take his first step on the moon to the production of video tapes that record what a physician sees through a bronchoscope. The Grass Valley Group subsidiary of Tektronix is also well known for television broadcast products – especially its production and routing switchers, which are used in program editing and for special effects. See pages 173 and 174.



The broadest line of portable scopes in the industry means you can pick and choose from 22 high-performance models. They can be found servicing computers, helping teach basic electronics to students, repairing business systems, and checking completed products on the production line. In integrated circuit manufacturing, TEKTRONIX Portable Oscilloscopes are used to maintain the ion implanters used in making ICs. Our business is supplying the model you need to go where you go. See pages 97 through 128.



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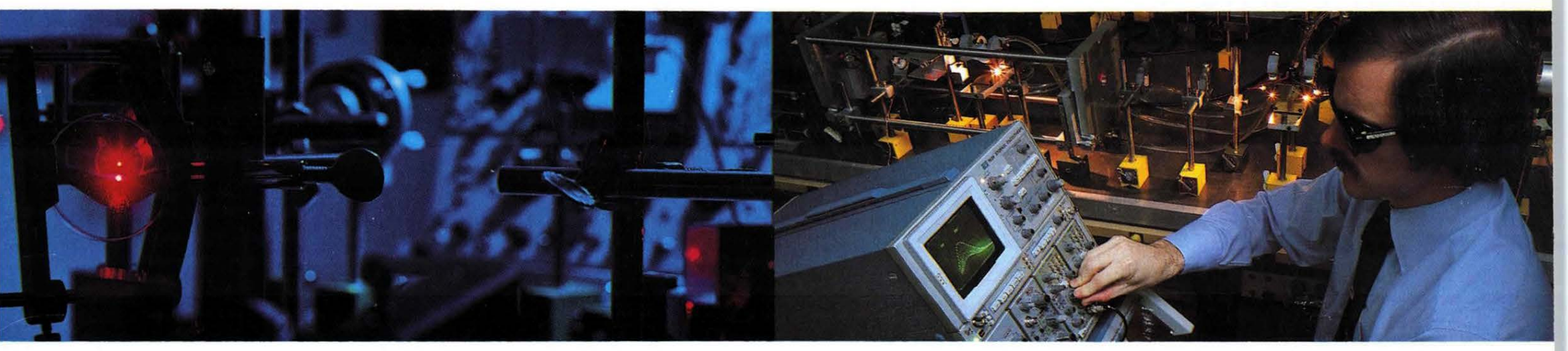
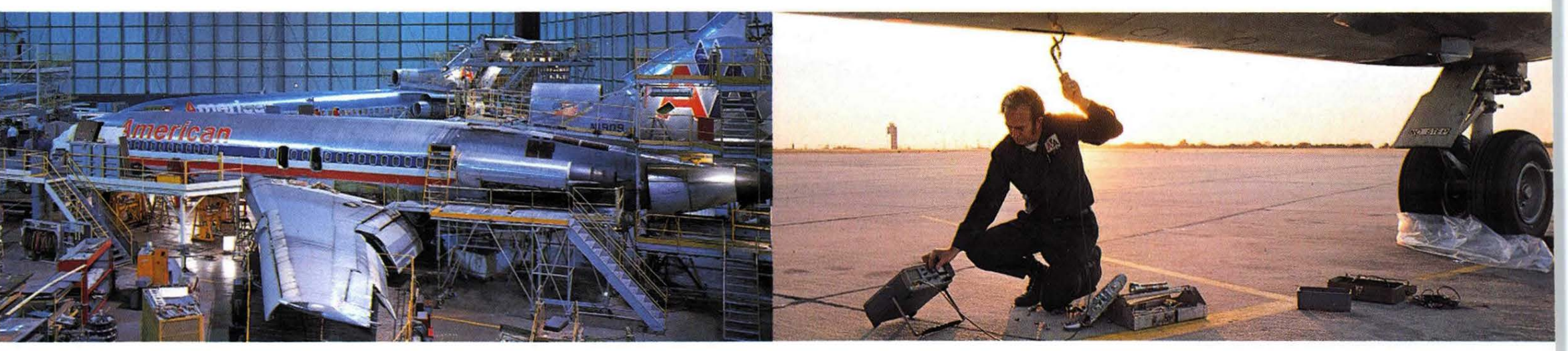
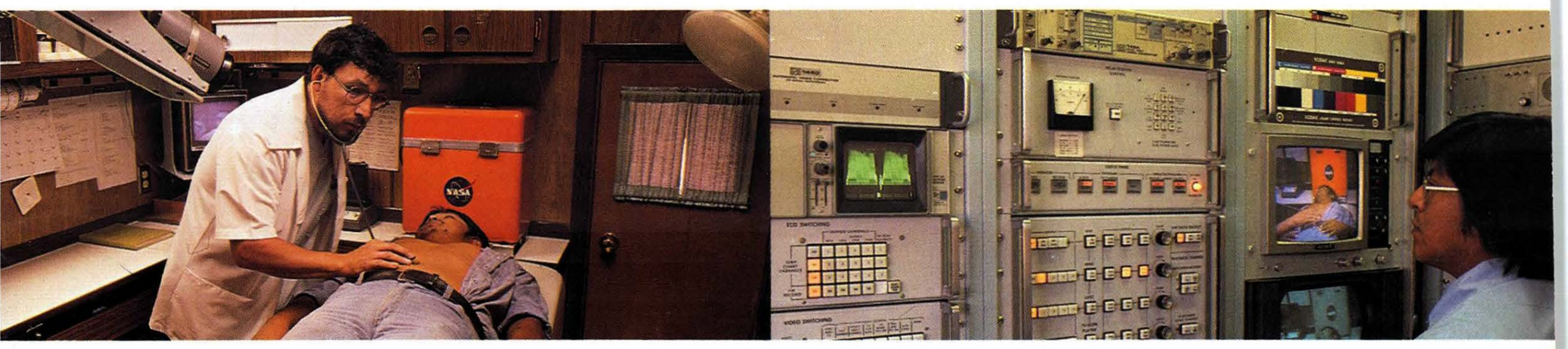


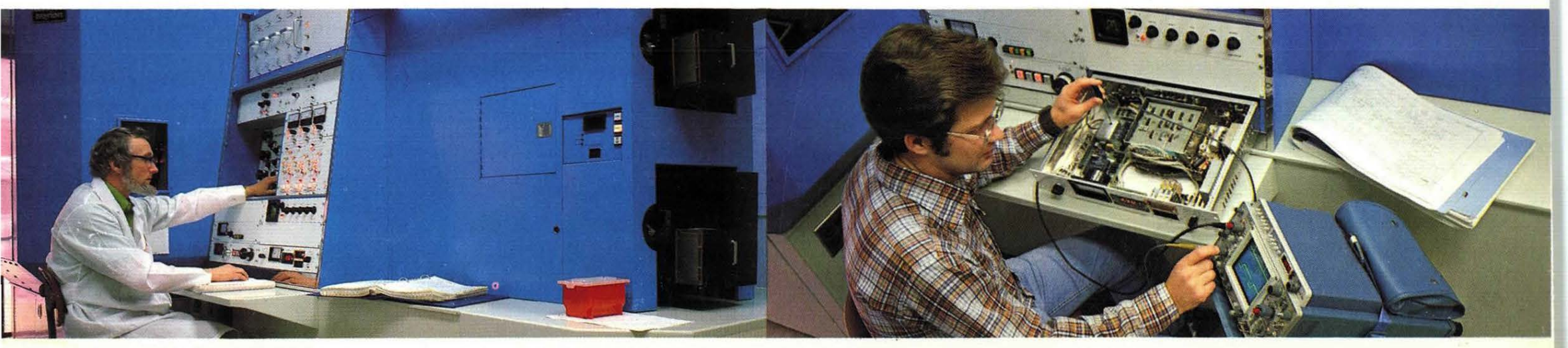
Fast scopes are needed to advance the state of technology



Cable testing means finding cable disturbances quickly



Video communications help provide health care to remote areas



Portable scopes meet on-the-spot servicing needs