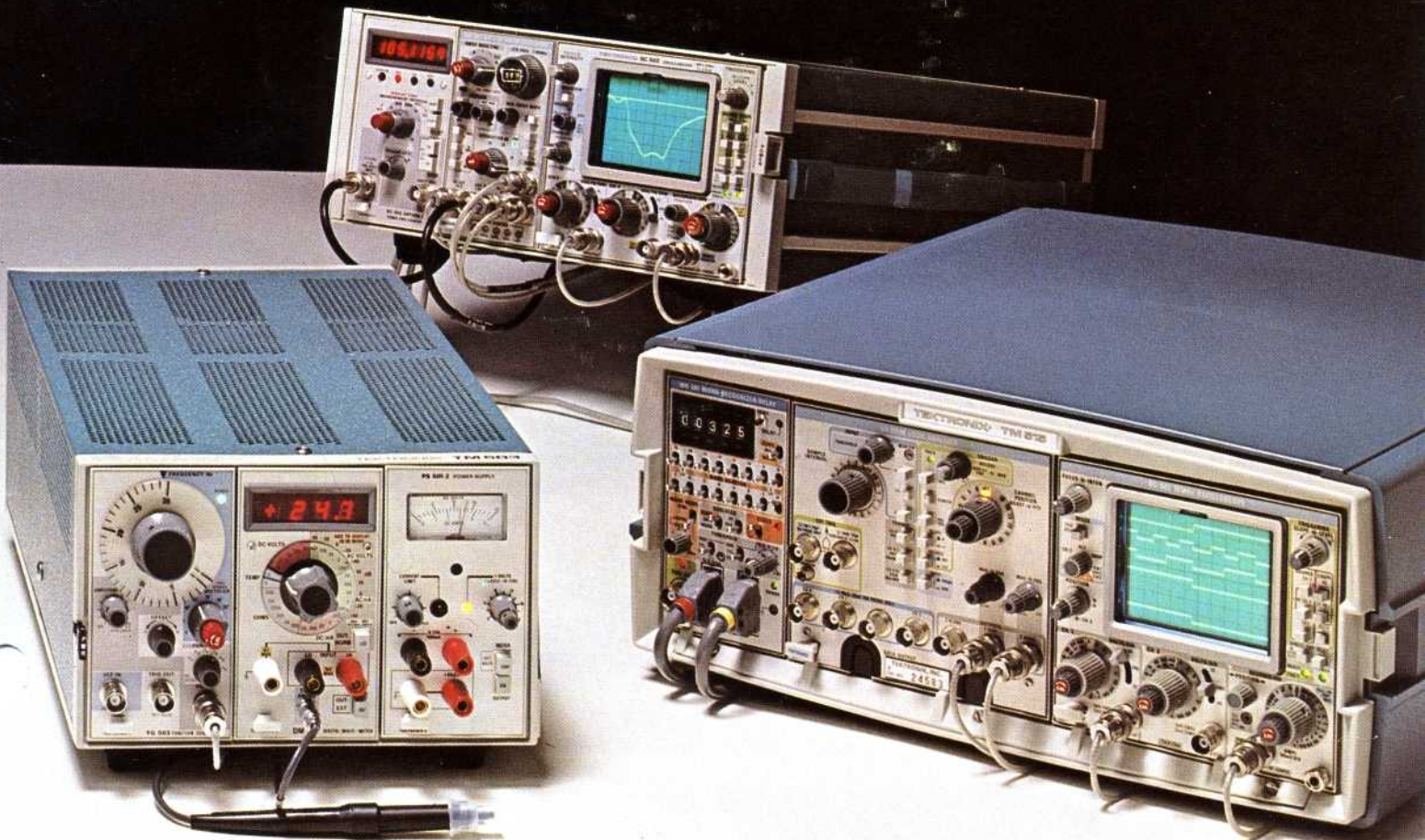


**Tektronix**  
COMMITTED TO EXCELLENCE

# TM 500 Modular test and measurement instruments

Counters  
Digital Multimeters  
Signal Sources  
Power Supplies  
Signal Processors  
Oscilloscopes  
Logic Analyzers



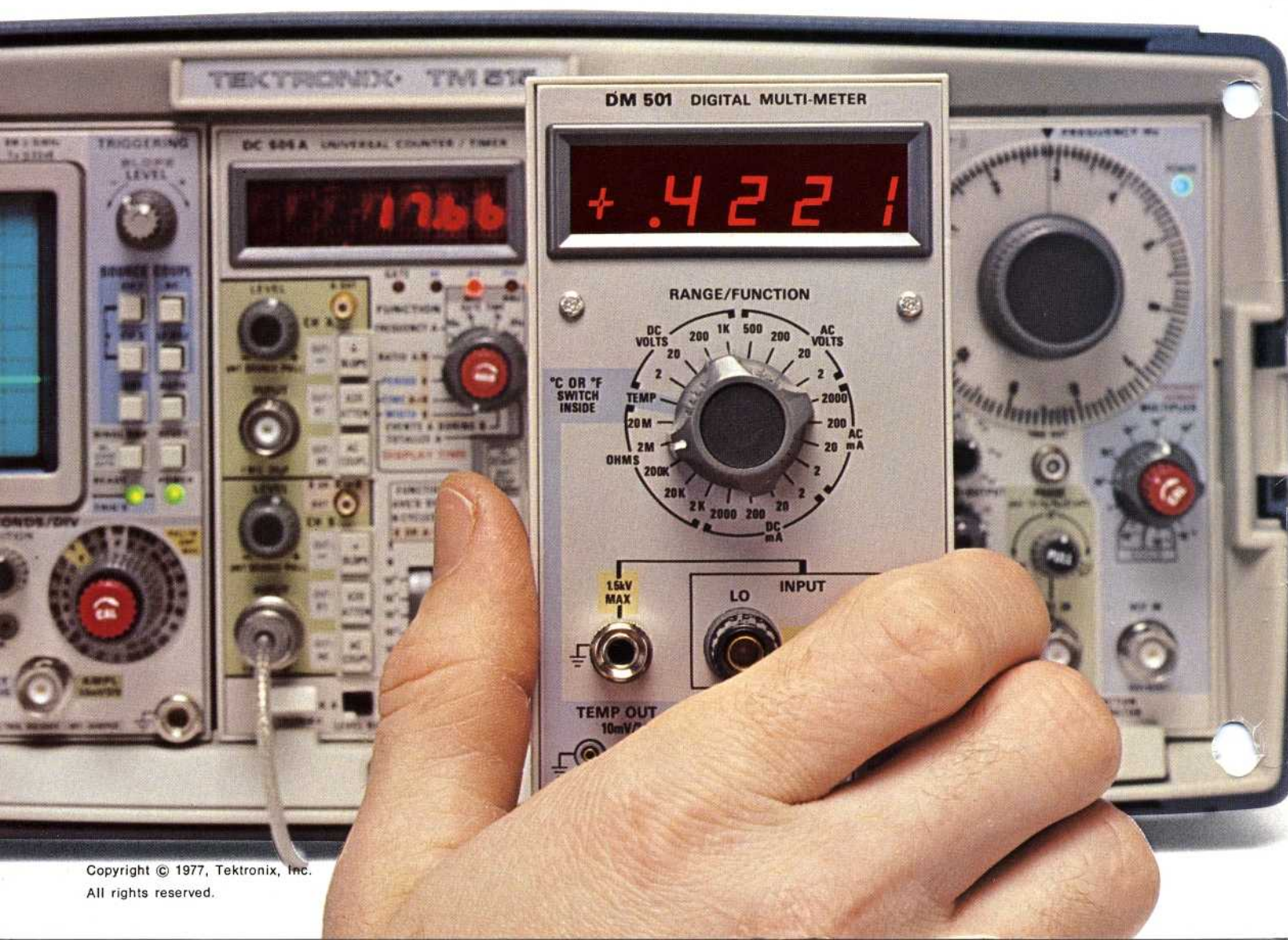
**TM 500...designed for configurability**

# TM 500...

## designed for configurability

Until you see TM 500 instrumentation, and discover its capabilities for yourself, you cannot fully appreciate how versatile yet compact it is. These instruments offer the quality and multiplicity of functions needed in modern electronics—and all within reach of your fingertips.

DM 501 is shown actual size.



# **TM 500**

## **Modular Test and Measurement Instruments**

### **Contents**

<b>TM 500 Modular Concepts and Features</b> . . . . .	<b>2-3</b>
<b>Digital Counters</b> . . . . .	<b>4-7</b>
<b>Digital Multimeters</b> . . . . .	<b>8-9</b>
<b>Pulse Generators</b> . . . . .	<b>10-12</b>
<b>Function Generators</b> . . . . .	<b>13-15</b>
<b>Audio/Miscellaneous Generators</b> . . . . .	<b>16-17</b>
<b>Oscilloscope Calibration Instruments</b> . . . . .	<b>18-19</b>
<b>Power Supplies</b> . . . . .	<b>20-21</b>
<b>Signal Processors</b> . . . . .	<b>22-24</b>
<b>Oscilloscopes and Monitors</b> . . . . .	<b>25-28</b>
<b>Digital Delay and Logic Analyzer</b> . . . . .	<b>29</b>
<b>Mainframes</b> . . . . .	<b>30-32</b>
<b>Optional Interface</b> . . . . .	<b>32</b>
<b>Accessories</b> . . . . .	<b>33-39</b>
<b>Lab Cart Model 3</b> . . . . .	<b>35</b>
<b>Mechanical Measurement Transducers</b> . . . . .	<b>38</b>

### Designed for Measurement Solutions

Over 30 compact plug-in test and measurement instruments which can work individually or be combined into powerful systems — that's TEKTRONIX TM 500.

TM 500 Plug-in Modular Instruments range from general-purpose devices like multimeters and power supplies to specialized units like oscilloscope calibration units and a digital delay trigger generator. The mainframes come in benchtop, rackmount, SCOPE-MOBILE® cartmounted and portable traveler models, with spaces for one to six plug-ins.

TM 500 allows you to assemble a specialized package of instruments to meet your individual measurement needs, or you can pick one of the standard combinations suggested in this catalog. You can also select an assortment of mainframes and an inventory of plug-in instruments, and then have the freedom to make one kind of measurement today and an entirely different one tomorrow.

### Modularity Means More than Plug-Ins

Each TM 500 instrument is *designed* as a plug-in unit, with standard and special connections available at a rear connector as well as on the front panel. Any instrument can be plugged into any TM 500 Mainframe slot. Two power supply modules (PS 503A and PS 505) perform to maximum ratings when operated in the high power compartment of the TM 504 or TM 506 Mainframes. Plug-ins can be rotated among mainframes or exchanged with supplementary units in seconds.

This add-on capability also means that your TM 500 system can keep up to date without the need to replace the complete investment. New TM 500 units can add the capability to keep up with new developments, while your existing units go on with day-to-day work. And both new and old units will work together, too.

### Your TM 500 Can Be A Measurement System

By connecting to the signal and control lines brought out at the rear of each plug-in, the optional mainframe interface board turns a TM 500 package into an integrated measurement system. Both standard and user-defined lines are available, and simple or complex systems can be assembled as the need arises.

Signals and inputs available at the rear connector of each plug-in include most front-panel connections, many internal values, and, on some units, bcd outputs. For automatic logging and calculating, you can connect a plug-in interface for TEKTRONIX Programmable Calculators. And, as the various industry interconnections standards develop, there will be TM 500 interfaces for many of these, too.

### Flexible TM 500 Works Anywhere

TM 500 is designed to serve a wide variety of uses. The mainframes come in benchtop, rackmount, and a protected portable travel case style unit. The three and four compartment versions can be fitted to TEKTRONIX SCOPE-MOBILE® carts. With the variety of plug-ins available, this means that TM 500 is at home almost anywhere.

Since you can take TM 500 right to the problem, you can be sure that the measurement you make in the field is the same as the one on the bench. The measurement setup you build in the lab can go into rackmounted TM 500 units on the production line. And, with your traveler mainframe, you can take your instruments along as carry-on luggage when the best choice is to carry your lab equipment right to the problem.

### Quality, Value, and Economy

TM 500 was designed to keep costs low and measurement value high. The mainframes include many of the more expensive components, such as the case and primary power supply, so they are shared by several plug-in instruments.

Extensive use has been made of the advanced technology and manufacturing techniques pioneered in TEKTRONIX Oscilloscopes — including the use of many Tektronix manufactured parts ranging from control knobs to integrated circuits.

Because of the wide selection of TM 500 instruments available, you can often tailor a TM 500 system to meet the needs of a special application at far less cost than that of a custom system or collection of the necessary separate instruments that would otherwise be required.

Since TM 500 is backed up by Tektronix, you save money in the long run as well. Worldwide customer assistance and service, quality engineering, and readily available parts are an important part of the value of TEKTRONIX TM 500 equipment.

### Production Engineers

Time savings are among the most important reasons to buy TM 500 for production line use: time savings at the design stage, where the interconnection capability of the TM 500 system allows the quick construction of sophisticated measuring systems; time savings at the training and measurement stage, where the easy-to-read digital outputs reduce operator error and fatigue, and where bcd output and a calculator interface make it possible to set up automatic testing and measurement logging; and time savings on repairs, where individual instruments can be unplugged for quick replacement to get the system back in operation immediately, eliminating possible production bottlenecks.

TM 500 rackmounting, portable, and mobile cart mounting options give you a whole range of configurations to choose from. Single-compartment and double-wide compartment plug-in kits with front panel and internal circuit board make it possible to construct compatible interfaces and custom circuits for further flexibility. And for complex systems and limited areas, the compact size of the TM 500 instruments is also an important factor to consider.

### Design Engineers

If you're expected to produce advanced circuit designs, then you need test instrumentation that can match your measurement requirements. That's why TM 500 state-of-the-art capability is a key benefit for design engineering use.

Modularity allows you to add units to keep up with advances in circuitry, while the compact size means that a full complement of instruments can be kept on a crowded workbench. Interconnection capability makes 30 input and output lines available, so you can build custom test systems for specialized design projects. And flexibility means that TM 500 will keep up with your imagination.

### Maintenance Engineers

With portable, cartmounted, rackmount, and desktop versions, TM 500 packages can do the work wherever it needs to be done. For specialized jobs, "solution" oriented instruments make those measurement problems easy to lick.

For example, the TG 501 Time Mark Generator not only provides exact pulses for calibration of oscilloscope and recorder time bases, but it also allows you to match a variable pulse with your existing calibration, and then read the error in percent on the TG 501 display. Since the TM 500 units can be brought to the job, oscilloscopes and recorders can be calibrated on site, eliminating the errors and added down time caused by moving them back to a calibration bench.

For general repair work, the flexibility of the TM 500 line means that any of the more than 30 units can be in place and running in seconds, covering far more of the possibilities than would be possible with a more limited system. You can set up your TM 500 instruments to have the ones you need at your fingertips, and still be able to switch to others in seconds when the problem requires an unexpected measurement.

### Educational Use

With TM 500, you can build student lab stations with the full capability of a complete range of instruments, yet assemble them within the stringent limitations of budgets and space that so often apply. You can supply basic TM 500 units to each student, with more specialized instruments rotated among groups as the curriculum requires. This saves the cost of duplicate purchases without limiting vital access to the measurements students need to make.

Although TM 500 equipment is quite sophisticated, it has been designed with human factors in mind. Color-coded front panels, standardization of connectors, and easy-to-read digital displays make TM 500 quite suitable for student use. In addition, the actual hands-on experience with commercial equipment is a valuable experience for students who will later be going on to further study or employment.

### Service Engineers

With TM 500's extreme portability, you can concentrate on electronics instead of on the logistics of getting test equipment to where you need it. The traveler five-compartment mainframe will go just about anywhere you might have to go, and the measurement power of the TM 500 instruments it carries assures you that you'll rarely have to make a second call because you couldn't make a vital reading.

With a choice of two oscilloscopes, five counter/timers, and close to a dozen signal generators, you can pick the level of performance you need. The systems capability of the TM 500 line means that you can also assemble a package for repetitive measurements, allowing you to make routine measurements quickly.

Special units, such as the DD 501 Digital Delay and temperature-measuring DM 502 Digital Multimeter, make service work easier and more productive. And the custom interface capability means that you can build that adapter you need right in a blank plug-in, keeping your total measurement package neat and easy to handle.

Digital integrated circuits and modern high-stability quartz crystals have combined to permit time and frequency measurements of a greater accuracy than for any other electrical parameters. The TEKTRONIX TM 500 line of digital counter/timers offers all the versatility, operating ease, compactness, and value available with present state-of-the-art techniques. Five models are available: the DC 501, DC 502, DC 503, DC 504, and DC 505A.

The counters, DC 501 and DC 502, measure frequencies and totalize events from low audio frequencies up through 110 or 550 MHz. The new low-cost DC 504 combines frequency counting and totalizing, plus an rpm capability, with the ability to measure period for higher resolution and accuracy at low frequencies. The DC 503 and DC 505A are fully Universal Counter/Timers which totalize and measure frequency, and also provide single period, period averaging, frequency ratio, and time interval capability. The DC 503 also includes a time-manual (electronic stopwatch) feature. The sophisticated DC 505A provides time-interval averaging, direct pulse width measurements, and a unique events-A-during-B mode.

Applications for the DC 501 and DC 502 Frequency Counters and the DC 504 Period and Frequency Counter cover many measurements needed in communications work. Typical measurements include carrier and sub-carrier frequencies, modulation frequen-

cies, pulse repetition rates in data communications, center frequency and corner frequencies of tuned filters, frequency of signaling tones, and verification of discriminator linearity. The totalize (event-counting) mode is also useful in industrial control applications or research environments.

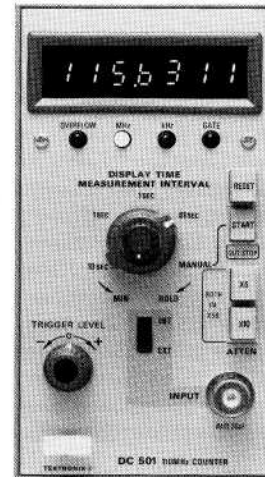
The second channel capabilities of the DC 503 and DC 505A Universal Counter/Timers permit measurement of frequency ratios and, more importantly, time intervals, in addition to the frequency and total events measures of single channel instruments. Time intervals are measured by counting the internal clock pulses which occur between a start event on channel A and a stop event on channel B. Resolution and accuracy are determined by the instrument's clock rate, and by whether time interval averaging is available.

The accuracy of counter/timer measurements is ultimately limited by the accuracy of the internal time base, although at some combinations of input frequency and counter operating controls, resolution may be the limiting factor. Two types of time bases are available in the TM 500 family of counters. The standard time base is quartz crystal providing a monthly aging rate and temperature stability of 1 part in  $10^5$  (0.001%). The option 01 time base is a high stability temperature-compensated quartz crystal which provides a one-hundred-times improvement in aging rate and a twenty-times improvement in temperature stability.

## DIGITAL COUNTERS — COMPARISON OF CHARACTERISTICS

The following is a comparison of the main characteristics of the DC 501 through the DC 505A. A complete list of specifications appears on the following pages.

	DC 501	DC 502	DC 503	DC 504	DC 505A
Number of Digits	7	7	7	5	7
Frequency Range	110 MHz	550 MHz	100 MHz	80 MHz	225 MHz
Totalize	Yes	Yes	Yes	Yes	Yes
Period	No	No	Yes	Yes	Yes
Period Average	No	No	Yes	No	Yes
Time Interval	No	No	Yes; 1 $\mu$ s maximum clock rate	No	Yes; 10 ns maximum clock rate
Time Interval Average	No	No	No	No	Yes
Ratio	No	No	Yes	No	Yes
Other	Option 01 FCC Type Approved	Option 01 FCC Type Approved	Time Manual	Rpm	Events A During B, single-jack pulse width, dc trigger level out



DC 501

### Direct Counting to 110 MHz

### 7-Digit LED Display

### Manual Start/Stop (Totalize)

### Auto Range and Time Base Options

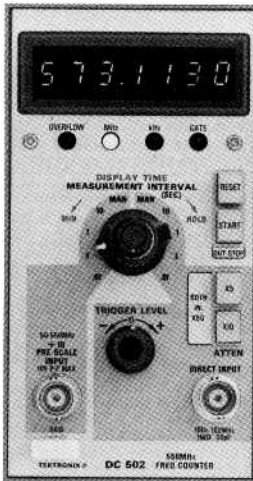
The DC 501 Digital Counter directly measures frequency from 10 Hz to 110 MHz and totalizes (counts number of events) from 0 to 9,999,999 at a maximum rate of 110 MHz. Measurement readout is provided by seven-segment LEDs in a seven digit display. The decimal point is automatically positioned and leading zeros (to the left of the most significant digit or decimal point) are blanked. Register overflow is indicated by a front-panel LED. Signals to be counted can be applied via a front-panel BNC connector into an impedance of 1 M $\Omega$  and 20 pF or via the rear connector into an impedance of 50  $\Omega$  and 20 pF. Four gate times of 0.01 s, 0.1 s, 1 s, and 10 s are provided. A standard internal 1 MHz time base is provided with  $1 \times 10^{-5}$  accuracy ( $0^\circ$  to  $50^\circ$  C) and an aging rate of  $1 \times 10^{-5}$  per month. An optional time base with  $5 \times 10^{-7}$  accuracy ( $0^\circ$  to  $50^\circ$  C) and an aging of  $1 \times 10^{-7}$  per month is available at extra cost. Input sensitivity is approximately 300 mV peak-to-peak (100 mV rms sine wave) below 110 MHz. An automatic measurement interval option, also at extra cost, automatically selects the gate time (up to 10 seconds) to obtain maximum resolution with any input signal.

### DC 501 Digital Counter

#### Option 01 (Time Base)

#### Option 02 (Auto Measurement)

See Accessory Section for suitable probes.



DC 502

Counts to 550 MHz with  $\div 10$  Prescale (50- $\Omega$  Input)

Direct Counting to 110 MHz

7-Digit LED Display

Manual Start/Stop (Totalize)

Time Base Option

The DC 502 Digital Counter measures frequencies from 10 Hz to 550 MHz or totalizes events up to the readout capacity of  $10^7-1$  at the max rate of 550 MHz. Frequency measurements are accomplished using one of two inputs. The DIRECT INPUT has a frequency range of 10 Hz to 110 MHz, a 1 megohm input impedance, 300 mV peak-to-peak sensitivity (100 mV rms sine wave) and an adjustable trigger level range. The  $\div 10$  PRESCALE INPUT has a frequency range from 50 MHz to 550 MHz with a 500 mV peak-to-peak sensitivity (170 mV rms sine wave) and a 50- $\Omega$  input impedance. The manual totalizing mode with front-panel start-stop control is available at both inputs; from the prescale input, 1 displayed count per 10 input events will result. Measurement display is accomplished with seven-segment LEDs in a seven-digit readout. The decimal point is automatically positioned by the measurement interval selected, and leading zeros (those to the left of the most significant digit or those to the left of the decimal point) are blanked. LEDs indicate when the gate is armed, and whether displayed numbers are in kHz or MHz, and when register overflow occurs. Four gate times of 0.01 s, 0.1 s, 1.0 s, and 10 s are provided. A standard internal 1 MHz clock is provided with  $1 \times 10^{-5}$  accuracy ( $0^\circ$  to  $50^\circ\text{C}$ ) and aging rate of  $1 \times 10^{-5}$  per month. An optional clock with  $5 \times 10^{-7}$  accuracy ( $0^\circ$  to  $50^\circ\text{C}$ ) and aging rate of  $1 \times 10^{-7}$  per month is available at extra cost.

**DC 502 Digital Counter**

**Option 01 (Time Base)**

**Option 07 (for use with TR 502 and SW 503)**

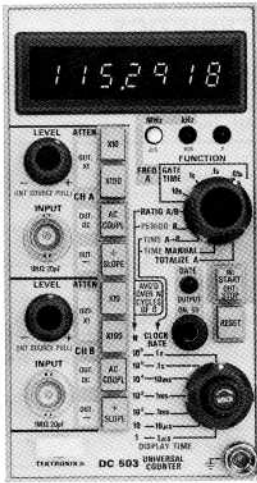
See Accessory Section for suitable probes.

**COMPARISON OF CHARACTERISTICS**

	DC 501	DC 502
<b>DISPLAY</b>	7 digits (7-segment LEDs) storage, leading zero blanked. Overflow, gate open and kHz or MHz indicators.	
<b>DIRECT INPUT</b>	10 Hz to 110 MHz	
Frequency Range	10 Hz to 110 MHz	
Sensitivity	300 mV p-p (100 mV rms sine wave)	
Impedance	1 M $\Omega$ , paralleled by 20 pF	
Triggering Level	Adjustable, $\pm 2$ V	
Max Safe Input (Sine waves, dc & peak ac)	X1 Atten: 500 V at 80 Hz or less; derate $-20$ dB/decade to 250 Hz. 150 V 250 Hz to 300 kHz; derate $-20$ dB/decade to 3 MHz. 15 V 3 MHz to 110 MHz. X5 Atten: 500 V at 600 kHz or less; derate $-20$ dB/decade to 4 MHz. 75 V 4 MHz to 110 MHz. X10 and X50 Atten: 500 V at 1.2 MHz or less; derate $-20$ dB/decade to 8 MHz. 75 V 8 MHz to 110 MHz.	
Attenuation	X1, X5, X10, or X50	
Resolution	0.1 Hz with 10 s gate, 1 Hz with 1 s gate, 10 Hz with 0.1 s gate, 100 Hz with 0.01 s gate	
<b><math>\div 10</math> PRESCALE INPUT</b>	Not Applicable	50 MHz to 550 MHz
Frequency Range		500 mV p-p (170 mV rms sine wave), or 1-2 mV rms (see special features below)
Sensitivity		50 ohms
Impedance		10 V p-p
Max Safe Input		1 Hz with 10 s gate 10 Hz with 1 s gate 100 Hz with 0.1 s gate 1 kHz with 0.01 s gate
Resolution		
<b>STANDARD TIME BASE ACCURACY</b>	Within 1 part in $10^5$ (0.001%)	
Temp Stability, $0^\circ$ to $50^\circ\text{C}$ after Warm-up		
Long Term Drift	Within 1 part in $10^5$ per month (0.001%)	
Setability	Adjustable within 1 part in $10^7$ (0.00001%)	
<b>OPTION 01 TIME BASE ACCURACY</b>	Within 5 parts in $10^7$ (0.00005%)	
Temp Stability, $0^\circ$ to $50^\circ\text{C}$ after Warm-up		
Long Term Drift	Within 1 part in $10^7$ per month (0.00001%)	
Setability	Adjustable within 5 parts in $10^9$ (0.0000005%)	
FCC Type Approval	Option 01 FCC Type approved for frequency monitoring in am and fm broadcast bands and on tv channels 2-6	Option 01 FCC Type approved for frequency monitoring in am and fm broadcast bands and on tv channels 2-26
Totalize	Counts events from 1 to 9,999,999 at a max rate 110 MHz. Start, stop, and reset commands via front-panel pushbuttons.	Same as DC 501 plus $\div 10$ totalize which counts events to 99,999,990 at a max rate of 550 MHz. Display is 1/10 the number of input events
<b>REAR INPUTS —</b> For routing from other compartments or from rear-panel connectors on Power Modules	Direct count input (50 ohms impedance, resistor may be removed for 1 megohm input), reset, external display scan clock, external time base	Reset, external display scan clock, external time base
<b>REAR OUTPUTS —</b> For routing from other compartments of Power Module or to rear-panel connectors on Power Modules	Bcd serial-by-digit, plus lines for MHz light, decimal point, internal display scan clock, time base out, data ready, etc	
<b>SPECIAL FEATURES</b>	Option 02—Automatically selects optimum measurement interval to fill the display, and displays appropriate kHz or MHz indication. Overflow is indicated for frequencies in excess of 99.99999 MHz.	A modification is available to provide 1-2 mV sensitivity from 50-550 MHz. See your Tektronix Field Engineer, Representative, or Distributor for more information.

DC 502 Option 07 Digital Counter (for use with the TR 502 Tracking Generator) has all usual characteristics of the DC 502 plus logic circuitry which allows the DC 502/TR 502/7L13 to select and determine unknown signal frequencies within the fre-

quency range of the counter and with the sensitivity of the analyzer; includes the High Stability Time Base. The spectrum display center frequency is indicated by a bright dot on the analyzer crt and is automatically counted by the DC 502 Option 07.



DC 503

**Direct Counting to 100 MHz**  
**Six Measurement Functions**  
**Period and Ratio Averaging**  
**Interval Measurement Capability**

The DC 503 Universal Counter offers counting to 100 MHz and provides the versatility of six measurement functions: frequency, period, ratio, time A→B, time manual, and totalize. The two channels (A and B) have individual BNC inputs and separate trigger level, attenuator, and coupling mode controls. Seven-digit readout is via seven-segment light emitting diodes (LEDs) with automatically positioned decimal point; leading zeros (to the left of the most significant digit or decimal point) are blanked. A flashing display indicates register overflow. The low-cost DC 503 offers high performance in a variety of applications. Its interval measurement capability with selectable clock rates is useful for digital equipment design and maintenance, particularly digital control and data communications work. The A-channel frequency range of dc to 100 MHz serves in communication and rf use. High resolution measurements of low frequencies are available quickly in the period mode with averaging up to 1 million periods available. TIME MANUAL provides an electronic stop watch function with selectable clock rates. TOTALIZE counts and displays the total number of input events at rates from dc to 100 MHz.

**DC 503**

**Option 01 (Time Base)**

See Accessory Section for suitable probes.

**NOTES:**

$$* = \left( \frac{0.01 \text{ V}}{dv/dt \text{ of triggering edge}} \right) / \sqrt{N}$$

$$** = \left( \frac{0.1 \text{ V}}{dv/dt \text{ stop edge}} \right) \pm \left( \frac{0.01 \text{ V}}{dv/dt \text{ start edge}} \right) / \sqrt{N}$$

\*\*\*Input amplifier slew rate of 10 ns/volt will produce additional error in

(1) Time A → B mode if A and B level controls are not set for corresponding points on waveforms.

(2) Width B and Events A during B modes if B level control is not set at 50% of input pulse height.

**COMPARISON OF CHARACTERISTICS**

	DC 503	DC 505A
<b>DISPLAY</b>	7 digits (7 segment LEDs)	Storage, leading zeros blanked
<b>FREQUENCY (A input) Range</b>	0 to 100 MHz, dc coupled 10 Hz to 100 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
<b>Gate Times</b>	0.01 s, 0.1 s, 1 s, 10 s	
<b>Accuracy</b>	±1 count ± time-base error	
<b>TIME INTERVAL (A → B) Resolution, Single event</b>	1 μs to 1 s, selectable	10 ns to 1 ms, selectable
<b>Resolution, averaging on repetitive events</b>	Not Applicable	≤ 100 picoseconds with 10 ns clock and 10 <sup>5</sup> averaging. Clock rate selectable, 10 ns to 1 ms. Averaging factor independently selectable from 1 to 10 <sup>5</sup> . 5 ns minimum pulse width in either channel.
<b>Accuracy</b>	±1 count ± time-base error; other contributions negligible	±1 count ± time-base error, ± trigger error CH A* ± trigger error CH B*. ± channel delay match error of 2 ns max ± slew rate error*** + 2 counts (10 ns clock rate only). Best absolute accuracy, 3 ns.
<b>WIDTH (B input) Resolution, single pulse</b>	Use "tee" connector and Time Interval A→B mode; see specifications above	10 ns to 1 ms, selectable
<b>Resolution, repetitive pulses</b>	Not Applicable	≤ 100 picoseconds with 10 ns clock and 10 <sup>5</sup> avg factor. Clock rate selectable 10 ns to 1 ms. Avg factor independently selectable from 1 to 10 <sup>5</sup> . 2 ns minimum pulse width.
<b>Accuracy</b>		±1 count ± time-base error + hysteresis error** ± slew rate error*** + 2 counts (10 ns clock rate only). Best absolute accuracy, 1.5 ns.
<b>PERIOD + PERIOD AVERAGING (B input) Resolution</b>	From 1 μs for single period to 1 picosecond with 10 <sup>5</sup> averaging	From 10 ns to 1 ms for single period; to 0.1 picosecond max with 10 ns clock and 10 <sup>5</sup> averaging
<b>Accuracy</b>	±1 count ± time-base error ± trigger error/N	±1 count ± time-base error ± trigger error ± 2 counts (10 ns clock rate only)
<b>RATIO (A/B)</b>	Averaged over 1 to 10 <sup>6</sup> cycles of signal at B	Averaged over 1 to 10 <sup>5</sup> cycles of signal at B. Accuracy: ±1 count FREQ A ± trigger jitter chan B†
<b>EVENTS A DURING B</b>	Not Applicable	Averaged over 1 to 10 <sup>5</sup> occurrences of signal at B. Accuracy: ±1 count FREQ A + hysteresis error** ± slew rate error***
<b>TOTALIZE (A)</b>	1 to 9,999,999 at max rate of 100 MHz. Front-panel start, stop, reset control.	1 to 9,999,999 at max rate of 225 MHz. Front-panel start, stop, reset control
<b>TIME MANUAL</b>	Electronic stop watch; accumulates and displays time following activation of front-panel start button. Clock rates selectable from 1 μs to 1 s.	Not Applicable
<b>INPUT Freq Range, A</b>	0 to 100 MHz, dc coupled 10 Hz to 100 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
<b>Freq Range, B</b>	0 to 10 MHz, dc coupled 10 Hz to 10 MHz, ac coupled	0 to 225 MHz, dc coupled 10 Hz to 225 MHz, ac coupled
<b>Sensitivity, A and B</b>	300 mV p-p (100 mV rms sine wave)	150 mV p-p (50 mV rms sine wave) below 150 MHz. 300 mV p-p (100 mV rms sine wave) from 150 to 225 MHz
<b>Impedance, A and B</b>	1 MΩ paralleled by 20 pF	1 MΩ paralleled by 24 pF
<b>A &amp; B Trig Lev</b>	Adjustable ±1.5 V at X1 attenuation	Adjustable ±2.0 V at X1 attenuation
<b>Max Safe Input, A and B (Sine waves, dc &amp; peak ac)</b>	CH A X1 Atten: 50 V at 2 kHz or less; derate -20 dB/decade to 10 kHz. 10 V, 10 kHz to 25 MHz; derate -20 dB/decade to 50 MHz. 5 V, 50 MHz to 100 MHz. CH B X1 Atten: 50 V at 2 kHz or less; derate -20 dB/decade to 10 kHz. 10 V, 10 kHz to 10 MHz (frequency limit). CH A X10 and X100 Atten: 500 V at 2 MHz or less; derate -20 dB/decade to 100 MHz. CH B X10 and X100 Atten: 500 V at 350 kHz or less; derate -20 dB/decade to 10 MHz.	X1 Atten: 50 V at 10 kHz or less; derate -20 dB/decade to 100 kHz.  CH A or CH B: 5 V 100 kHz to 225 MHz.  X20 Atten: 250 V at 1 MHz or less; derate -20 dB/decade to 50 MHz.  CH A or CH B: 5 V 50 MHz to 225 MHz.
<b>Attenuation, A and B</b>	X1, X10, X100	X1, X20
<b>STD AND OPTION 01 TIME BASE SPECS</b>	Same as DC 501/DC 502 (except, no FCC Type approval)	
<b>REAR INPUTS</b>	Same as DC 501	
<b>REAR OUTPUTS</b>	Same as DC 501/DC 502	

$$† = \left( \frac{0.01 \text{ V}}{dv/dt \text{ triggering edge}} \right) / N$$

NOTE 1: Accuracies with averaging are dependent on the laws of statistics in Time A → B, Width B, and Events A during B modes.

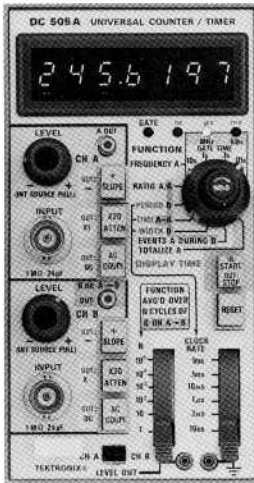
**SPECIAL FEATURES**

**A Out:** Shaped output, after LEVEL and SLOPE selection, of signal into CH A. This output represents what goes into the display of FREQ A, RATIO A/B, and

TOTALIZE A. Propagation delay from CH A INPUT to A OUT is ≈ 15 ns.

**B or A→B Out:** Shaped output, after LEVEL and SLOPE selection, of either CH B signal or A→B signal. This output represents the continuous signal used in generating the display gating for RATIO A/B, PERIOD B, TIME A→B, WIDTH B, and EVENTS A DURING B. Logic levels out are the same as for A OUT. Propagation delays from the channel INPUTS to B or A→B OUT are ≈ 15 ns.





DC 505A

**Dc Output for Accurate Trigger Level Setting with Companion DMM**

**Direct Counting to 225 MHz**

**10 Nanosecond Clock Rate**

**Time Interval Averaging with Resolution to 100 Picoseconds**

**Two Equal Bandwidth Channels for Time Measurements on Narrow Pulses**

**Events A During B**

The DC 505A is a high-performance universal counter featuring direct counting to 225 MHz. Both channels, A and B, have equal response for ratio, time interval, and other measurements requiring two channels. This new "A" version provides dc trigger level output both at the front-panel jack and rear interface connector. Any TM 500 Digital Multimeter may be connected via the rear interface to read the DC 505A trigger level setting when the DMM input switch is pushed to the INT position. Alternately, an external voltmeter or oscilloscope may be connected to the front-panel jack to perform this function. The DC 505A can perform virtually any counting-timing function below 225 MHz.

Various functions include conventional frequency operation on channel A, ratio of channel A to B frequency, period of signal B, time interval from channel A start to B stop, width B, events A during B, and totalize. An averaging feature allows measurements to be averaged from 1 to 10<sup>5</sup> times as selected

by front-panel controls with the resultant average displayed on the LED readout. Averaging factor and clock rate are independently selectable. Pulse width may be measured directly with single shot resolution to 10 ns. By use of maximum averaging on width or interval measurements of repetitive waveforms, resolution to better than 100 picoseconds is possible. Typical application of the DC 505A is in the design, development, or maintenance of logic circuitry in high speed digital computers. It is a high-performance counter for state-of-the-art design and measurements up to 225 MHz.

**DC 505A**

**Option 01 (Time Base)**

**Channel OUT to BNC cable adapter**

**Order (012-0532-00)**

**LEVEL OUT to BNC cable adapter**

**Order (175-1178-00)**

See Accessory Section for suitable probes.



DC 504

**Direct Frequency Counting to 80 MHz**

**Period Measurement for Resolution at Low Frequency**

**Rpm Counting**

**5-Digit LED Display**

**Low Cost**

The DC 504 Counter/Timer measures frequency from 0 Hz (with 0.1 Hz resolution) to 80 MHz, period from 1 microsecond to 999.99 seconds, and totalizes events from 0 to 99,999 at a maximum rate of at least 80 MHz. A resolution of 0.1 Hz can be obtained by allowing the more significant figures of the counter to overflow. Five 7-segment light-emitting diodes (LEDs) provide a visual numerical display. The decimal point is automatically positioned and leading zeros (to the left of the most significant digit or decimal point) are blanked. Digit overflow is indicated by a front-panel LED. Signals to be

counted/timed can be applied to either a front-panel BNC connector or to the rear interface connector. Internal switches select frequency or rpm operation, internal time base or external standard, and override display storage.

**Display** — 5 digits, LEDs.

**Display Accuracy** — ±1 count ± time-base accuracy (± trigger error in period mode only).

**Frequency (or rpm)** — Dc coupled: 0 Hz to at least 80 MHz. Ac coupled: 10 Hz to at least 80 MHz.

**Frequency/rpm (Max Resolution)** — kHz Positions: 0.1 Hz, 1 Hz, and 10 Hz (1 rpm, 10 rpm, and 100 rpm).\* MHz Positions: 0.1 kHz and 1 kHz (1000 rpm and 10 k rpm).\*

**Sensitivity** — 20 mV rms (56.6 mV p-p) below 15 MHz, 35 mV rms (99 mV p-p) at or below 50 MHz derating to typically <175 mV rms (495 mV p-p) at 80 MHz.

**Triggering Level** — Adjustable over at least -1.5 V to +1.5 V.

**Trigger Source** — Internal (rear connector interface) or external (front-panel BNC).

**Max Safe Input** — (Sine waves, dc & peak ac) ±250 V at 500 kHz or less; derate -20 dB/decade to 25 MHz. ±5 V 25 MHz to 80 MHz.

**Impedance** — 1 MΩ paralleled by approx 20 pF.

**Coupling** — Dc or ac.

\*Assuming transducer output is one pulse per revolution.

**Internal Time Base**

	Standard	Option 01
Crystal Frequency	1 MHz	5 MHz temperature compensated
Stability (0°C to 50°C) after ½ hour warm-up	Within 1 part in 10 <sup>5</sup>	Within 5 parts in 10 <sup>7</sup>
Long-term Drift	1 part or less in 10 <sup>5</sup> per month	1 part or less in 10 <sup>7</sup> per month
Setability	Adjustable to within 1 part in 10 <sup>7</sup>	Adjustable to within 5 parts in 10 <sup>9</sup>

**Totalize Events (Resolution)** — 1.

**Period (Resolution)** — mSec Position: 1 μs and 10 μs. Sec Position: 0.1 ms, 1 ms, and 10 ms.

**Display Time** — Variable from about 0.1 s to about 10 s. Detent position at cw position of DISPLAY TIME knob provides a HOLD mode.

**Data Inputs and Outputs** — Available at plug-in connector for intra-compartment routing in any TM 500 Power Module/Mainframe. Bcd serial-by-digit (parallel data for one digit at a time) plus timing and control functions.

**DC 504 Counter/Timer**

**Option 01 (Time Base)**

The digital multimeter, with the capability of measuring voltage, resistance, and current, is the most widely used electronic test instrument employed today, with the possible exception of the oscilloscope. Modern digital techniques have vastly improved the resolution and accuracy of the traditional volt-ohm-milliammeter, simplified instrument use, and reduced the possibilities of human error. The TM 500 Digital Multimeter line consists of two general-purpose instruments, the DM 501 and DM 502 Digital Multimeters. In addition to the usual dc and ac voltage, resistance, and dc and ac current functions, both meters offer an optional temperature measurement function. Applying the tip of the optional temperature probe to a power transistor, integrated circuit, mechanical component, or any other surface provides digital readout of the surface temperature in degrees Celsius or degrees Fahrenheit at the user's choice. The DM 502 further extends measurement capability by providing a standard decibel (dB) measurement feature across all ac ranges.

The DM 501 and DM 502 are similar instruments in many respects. Each measures dc voltage to 1000 volts (extendable to 40,000 volts with the addition of the optional high-voltage accessory probe), ac voltage to 500 volts, both dc and ac current to 2 amps, and resistance to 20 megohms. Optionally, both provide probe measurement of surface temperatures from  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . The most significant differences lie in the dB capability of the DM 502, the  $4\frac{1}{2}$  digits of the DM 501 versus  $3\frac{1}{2}$  in the DM 502, and the floating

bcd output of the DM 501 (for compatibility with the TEKTRONIX 31/53 Calculator Instrumentation System and other digital read-out systems).

Since the DM 501 is a  $4\frac{1}{2}$  digit instrument, it can provide significantly more precise values than  $3\frac{1}{2}$  digit instruments, including the DM 502. At a given signal level, the  $4\frac{1}{2}$  digit instrument can supply X10 better resolution and conversely it can also measure X10 as large a signal at any given resolution level.

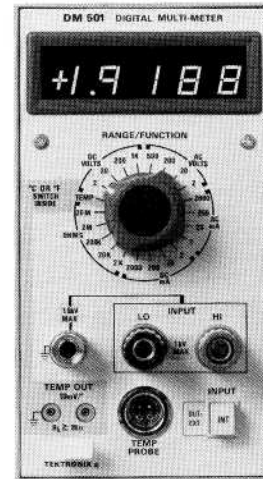
For example, an exact 2.000-volt signal must be measured on the 20-volt range on either instrument, since full scale on the nominal 2-volt range is actually 1.999 or 1.9999 volts. The specified possible error of the DM 502 (display 2.00) is  $\pm 0.1\%$  of reading  $\pm 1$  count, equal to  $\pm 12$  millivolts, or 0.6% of reading. The same input is displayed on the DM 501 as 2.000, and the possible error of  $\pm 0.1\%$  of reading  $\pm 2$  counts is 2.2 millivolts, or 0.11% — almost six times better.

The dB feature of the DM 502 is of great value in the general audio and communications industry: in mobile radio, microwave, telephone communication, computer time-sharing, and other applications of data transmission via voice links, broadcasting, high-fidelity and recording industries, sonar, acoustics, audiometrics, and many other fields. The absolute reference of the DM 502 may be selected, by internal jumper, as dBm (0 dB = 0.775 V or 1 mW in 600  $\Omega$ ) or dBV (0 dB = 1 V). With either reference, the dynamic range extends from  $-60$  dB to approximately  $+56$  dB.

**DIGITAL MULTIMETERS DM 501 AND DM 502  
COMPARISON OF CHARACTERISTICS**

The following is a comparison of the major characteristics of the DM 501 and DM 502. A complete set of specifications may be found on the following pages.

	<b>DM 501</b>	<b>DM 502</b>
Number of Digits	$4\frac{1}{2}$	$3\frac{1}{2}$
Dc Volts — full scale	2 V to 1 kV	0.2 V to 1 kV
Ac Volts — full scale	2 V to 500 V	0.2 V to 500 V
Dc Current — full scale	2 mA to 2 A	200 $\mu\text{A}$ to 2 A
Ac Current — full scale		
Resistance — full scale	2 k $\Omega$ to 20 M $\Omega$	200 $\Omega$ to 20 M $\Omega$
Temperature Probe	Optional	Optional
dB	No	$-60$ dB to $+56$ dB
Bcd Output	Full Floating	Nonfloating
Input Impedance	10 M $\Omega$	10 M $\Omega$ normal; FET input on 0.2 and 2 volt scales by internal jumper



**DM 501**

**0.1% Dc Voltage Accuracy**

**$4\frac{1}{2}$  Digit LED Display**

**Auto Polarity**

**Measures Volts, Current, Resistance, Temperature**

**Fully Isolated Serial Bcd Output**

The DM 501 Digital Multimeter measures dc and ac voltage and current, resistance, and temperature. Dc voltage measurement accuracy is 0.1%. The ac functions are average responding and rms calibrated. A single front-panel control selects all functions and ranges. A pushbutton selects front-panel input or optional rear interface connector input. Temperature measurements are made using a TEKTRONIX P6058 Probe or other suitable sensing devices. Front-panel pin jacks provide external temperature readout, at 10 mV per degree, regardless of the position of the function switch. An internal switch selects calibration in degrees Celsius or Fahrenheit. Readout is a  $4\frac{1}{2}$  digit stored display using seven segment LEDs. The decimal point is automatically positioned by the RANGE/FUNCTION switch and leading zeros (those to the left of the decimal point or most significant digit) are blanked. Polarity indication is automatic. A blinking display indicates overrange. Serial bcd output is available at the rear interface connector.

**DC VOLTAGE**

**Range** — 2 V, 20 V, 200 V, and 1 kV full scale (19999 max reading), accurate within 0.1% of reading  $\pm 2$  counts.

**Resolution** — 100  $\mu\text{V}$  on 2 V range.

**Common-Mode Rejection** —  $\geq 100$  dB at dc, 80 dB at 60 Hz with 1 k $\Omega$  imbalance.

**Step Response Time** —  $< 1$  s.

**Normal-Mode Rejection** —  $\geq 30$  dB at 60 Hz increasing 20 dB per decade.

**Input R** — 10 M $\Omega$ , constant.

**AC VOLTAGE**

**Range** — 2 V, 20 V, 200 V, and 500 V full scale (19999 max reading), average responding, rms calibrated.

**Accuracy** — Within 0.7% of reading  $\pm 2$  counts from 40 Hz to 10 kHz; 1.2% of reading  $\pm 2$  counts, 20 Hz to 20 kHz. Usable to 100 kHz. Typically  $< 5\%$  down between 0.4 V and 500 V at 100 kHz.

**Resolution** — 100  $\mu$ V on 2 V range.

**Response Time** —  $< 10$  s.

**Input R** — 10 M $\Omega$  paralleled by  $< 100$  pF.

**AC and DC CURRENT**

**Range** — 2 mA, 20 mA, 200 mA, 2 A full scale (19999 max reading), ac rms calibrated, average responding.

**Resolution** — 100 nA on 2 mA range.

**Accuracy** — Dc amps, 0.2% of reading  $\pm 10$  counts; ac amps, 0.6% of reading  $\pm 2$  counts from 40 Hz to 1 kHz  $\pm 0.6\%$  of reading,  $\pm 10$  counts, 1 kHz to 10 kHz. Usable to 100 kHz.

**Input R** —  $\frac{0.2 \text{ V}}{\text{Range Setting}} + 0.1 \Omega$

**RESISTANCE**

**Range** — 2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , 2 M $\Omega$ , 20 M $\Omega$  full scale (19999 max reading).

**Accuracy** — Within 0.3% of reading,  $\pm 2$  counts to 2 M $\Omega$ , 0.5% of reading,  $\pm 2$  counts on 20 M $\Omega$  scale.

**Resolution** — 0.1  $\Omega$  on 2 k $\Omega$  range.

**TEMPERATURE MEASUREMENT**

**Range** — 55°C to +150°C (–67°F to +302°F selected by internal switch), using included temperature probe. The temperature probe functions regardless of the DM 501 mode and provides a front-panel analog signal output of 10 mV/° (into 2 k $\Omega$  or greater); thus temperature may be measured simultaneously with any other function. If temperature probe is not desired, order Option 01. If temperature capability is not desired, order Option 02; note: capability cannot be restored at a later date.

**Accuracy** — Within 1.5°C (2.7°F) from –55°C to +125°C and within 2.5°C (4.5°F) from –55°C to +150°C.

**Resolution** — 0.1°.

**OTHER CHARACTERISTICS**

**Overrange Indication** — Blinking display.

**Measurement Rate** — 5 measurements/second.

**Max Input Voltage** — 1 kV. The front-panel HI and LO connectors may be floated 1.5 kV max above ground, the rear inputs 350 V max. Current measuring functions are fused at 3 A. Ohms ranges are fused at 1/16 A.

**Ambient Temperature** — Performance characteristics are valid over a temperature range of +15°C to +35°C.

**Standard Accessories** — 1 Pair Test Leads (003-0120-00), 1 P6058 Temp Probe (010-0259-00).

**ORDERING INFORMATION****DM 501 Digital Multimeter**

**Option 01 without Temp Probe (P6058)**

**Option 02 without Temp Capability and Probe**

**OPTIONAL ACCESSORIES**

Deluxe Test Lead with accessories including push-on spring-loaded hook tip and special IC package tip, high flexibility wire, red, 4 ft.

**Order (012-0426-00)**

As above except black.

**Order (012-0426-01)**

Test lead with alligator clip, 4 ft, black.

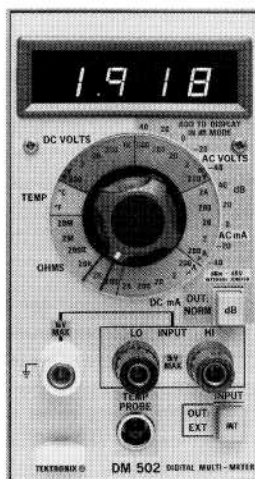
**Order (012-0425-00)**

High Voltage Probe to 40 kV

**Order (010-0277-00)**

P6420 Rf Probe for 10 kHz to 1 GHz.

**Order (010-6420-03)**

**DM 502****dB Readings from –60 dB to +56 dB****Six Functions Including Temperature and dB****0.1% Dc Voltage Accuracy****Autopolarity**

The DM 502 Digital Multimeter measures dc and ac voltage and current, dBm, dBV, resistance, and temperature. The ac functions are average responding and rms calibrated. A single front-panel control selects all ranges. Front-panel pushbuttons select dB readout of ac functions in lieu of ac voltage or current and front-panel or rear interface connector input. dB is obtained by adding the selected dB scale value to the display reading. Readout in dBm or dBV is chosen by an internal jumper. An internal jumper also permits selection of FET input ( $> 1000$  M $\Omega$ ) or 10 M $\Omega$  input impedance on the two lowest dc voltage ranges.

The readout is a 3½ digit display using seven-segment LEDs. The decimal point is automatically positioned by the RANGE/FUNCTION switch. Polarity indication is automatic. Maximum display at stated accuracy is 1999.

Nonfloating bcd output (referenced to the low input), is available at the rear interface connector if user wired.

**DC VOLTAGE**

**Range** — 0.2 V, 2 V, 20 V, 200 V, 1000 V.

**Accuracy** — Within  $\pm 0.1\%$  of reading,  $\pm 1$  count.

**Common-Mode Rejection** —  $\geq 100$  dB at dc,  $\geq 80$  dB at 50 or 60 Hz with 1 k $\Omega$  imbalance.

**Normal-Mode Rejection** —  $\geq 80$  dB at 50 or 60 Hz.

**Step Response Time** —  $\leq 0.5$  s.

**Input R** — 10 M $\Omega$  (jumper selectable for  $> 1000$  M $\Omega$  on 0.2 V and 2 V ranges).

**AC VOLTAGE**

**Voltage Range** — 0.2 V, 2 V, 20 V, 200 V, 500 V.

**Accuracy** — Within  $\pm 0.5\%$  of reading,  $\pm 1$  count, 40 Hz to 10 kHz.  $\pm 1.0\%$  of reading,  $\pm 1$  count, 20 Hz to 20 kHz. Usable to 100 kHz. Typically  $< 10\%$  down between 40 mV and 500 V at 100 kHz.

**Response Time** —  $\leq 5$  s.

**Common-Mode Rejection** —  $\geq 60$  dB at 50 or 60 Hz.

**Input R** — 10 M $\Omega$  paralleled by less than 60 pF.

**dB VOLTS AND CURRENT**

**Scales** — +40, +20, 0, –20, –40 dB. Reference is dBV (1 V) or dBm (1 mW dissipated in 600  $\Omega$ , 0.7746 V), selected by internal jumper.

**Display** —  $\pm 19.99$  dB on any scale, except that the total dynamic range is limited to the range –60 dB to approx +56 dB by a 500 V max input specification.

**Accuracy**

Display Reading	Frequency Range	Max Error
0 to +19.99	20 Hz to 20 kHz	0.5 dB
0 to –10.00	20 Hz to 2 kHz 2 kHz to 20 kHz	0.5 dB 1.0 dB
–10.00 to –19.99	20 Hz to 2 kHz 2 kHz to 7.5 kHz 7.5 kHz to 20 kHz	0.5 dB 1.0 dB 2.0 dB

**Response Time** —  $\leq 5$  s.

**Common-Mode Rejection** —  $\geq 60$  dB at 50 or 60 Hz.

**RESISTANCE**

**Ranges** — 200  $\Omega$ , 2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , 2 M $\Omega$ , 20 M $\Omega$ .

**Accuracy** — 200  $\Omega$  range, 0.5% of reading,  $\pm 1$  count,  $\pm 0.1 \Omega$ ; 2 k $\Omega$  through 2 M $\Omega$  range,  $\pm 0.5\%$  of reading,  $\pm 1$  count; 20 M $\Omega$  range, 1.0%,  $\pm 1$  count.

**Response Time** —  $\leq 0.5$  s; 20 M $\Omega$  range,  $\leq 5$  s.

**Max Output Current and Voltage** — 1 mA max; approx 12 V max.

**AC & DC CURRENT**

**Ranges** — 200  $\mu$ A, 2 mA, 20 mA, 200 mA, 2 A.

**Accuracy** — Dc current 0.2% of reading  $\pm 1$  count; ac current 0.6% of reading  $\pm 1$  count 40 Hz to 10 kHz.

**Response Time** — Dc  $\leq 0.5$  s; ac  $\leq 5$  s.

**Input Impedance** —  $\frac{0.2 \text{ V}}{\text{Range Setting}} + 0.1 \Omega$  ( $< 2$  k $\Omega$  with 200  $\mu$ A range)

**TEMPERATURE MEASUREMENT**

**Ranges** — Celsius: –55°C to +150°C. Fahrenheit: –67°F to +200°F.

**Accuracy** — With probe shipped with instrument  $\pm 2^\circ\text{C}$  ( $\pm 3.6^\circ\text{F}$ ). With any P6430 probe prior to calibration with instrument,  $\pm 8^\circ\text{C}$  ( $\pm 14.4^\circ\text{F}$ ).

The temperature probe functions in all other modes in °C with analog signal out of 10 mV/° at rear interconnect.

**OTHER CHARACTERISTICS**

**Overrange Indication** — Blinking display.

**Measurement Rate** — 3.33 per second.

**Inputs** — The max input voltage is 1 kV. The front-panel HI and LO connectors may be floated 1 kV max above ground, the rear inputs 350 V. Current measuring functions are fused at 2.5 A. Ohms functions protected to 120 V rms indefinitely, 250 V rms ½ hour.

**Ambient Temperature** — Performance characteristics are valid over a temperature range of +15°C to +40°C.

**Standard Accessories** — 1 pair Test Leads (003-0120-00), 1 P6430 Temp Probe (010-6430-00).

**ORDERING INFORMATION****DM 502 Digital Multimeter**

**Option 02 without Temp Capability and Probe**

**OPTIONAL ACCESSORIES**

Deluxe Test Lead with accessories including push-on spring-loaded hook tip and special IC package tip, high flexibility wire, red, 4 ft.

**Order (012-0426-00)**

As above except black.

**Order (012-0426-01)**

Test lead with alligator clip, 4 ft, black.

**Order (012-0425-00)**

High Voltage Probe to 40 kV

**Order (010-0277-00)**

P6420 Rf Probe for 10 kHz to 1 GHz.

**Order (010-6420-03)**

During the recent dynamic growth of digital logic and computers, the pulse generator, long a valuable signal source, has acquired added importance. Pulse generators are especially useful for testing response of wide-band systems and for simulating signals from a variety of devices. Pulse generators are also used to provide stimulus to living tissue in physiological and biological research. In addition they are used to drive lasers, simulate data transmission signals, test switching speeds of active devices or memory elements, and for a wide variety of other functions.

The TM 500 line consists of four general-purpose pulse generator modules and a specialized generator. The specialized generator, the PG 506, is intended primarily for oscilloscope calibration. The PG 501 and

PG 502 are designed for 50 ohm systems, and have repetition rates, amplitudes, and transition times compatible with the common digital integrated-circuit families such as TTL, DTL, and ECL. Furthermore, the PG 502, with 250 MHz repetition rate and independent control of the pulse top and bottom levels, is ideal for ECL design and testing.

The new PG 508 is designed for both 50  $\Omega$  and higher impedance circuits such as MOS, HTL, and CMOS logic. Its accurate 50  $\Omega$  output impedance allows you to deliver clean signals into reactive loads or at the end of an unterminated cable. The PG 508 sets a new standard in operator convenience with its control error light, trigger/gated light, selectable 1 M $\Omega$  or 50  $\Omega$  trigger input impedance, and an expanded trigger level range.

**PG 508 Pulse Generator**

- 5 Hz to 50 MHz Plus Custom Range**
- Independently Variable Rise and Fall Times**
- Delay and Double Pulse Capability**
- 20 V Output in a  $\pm 20$  V Window to HI Z, 10 V to 50  $\Omega$**
- Independent Pulse Top and Bottom Level Controls**
- True 50  $\Omega$  Output Impedance for Clean Waveforms**
- Control Error Light Warns of Improperly Set Switch or Variable Controls**
- 3-State Trigger Light Indicates Proper External Triggering**
- Selectable 1 M $\Omega$  Trigger Input Impedance for Optimum Match to Circuitry — Lets You Use Your Scope Probe**

The PG 508 is a high-performance 50 MHz pulse generator that occupies two compartments of the TM 500 Series Power Module/Mainframes. While it is primarily intended to be a highly versatile general-purpose pulse generator, it is ideally suited for logic circuit design in MOS, CMOS, TTL, and ECL within the 50 MHz range of the instrument. Its broad ranges of output period, delay, duration, transition times... and its output up to 20 V p-p offer you benefits equaled by few other pulse generators on the market. But when you consider its selectable 1 megohm/50  $\Omega$  trigger input impedance, control error light, 3-state trigger/gate light, preset or external control of output voltage levels, and capability of interfacing with other TM 500 Instruments, none surpass the PG 508.

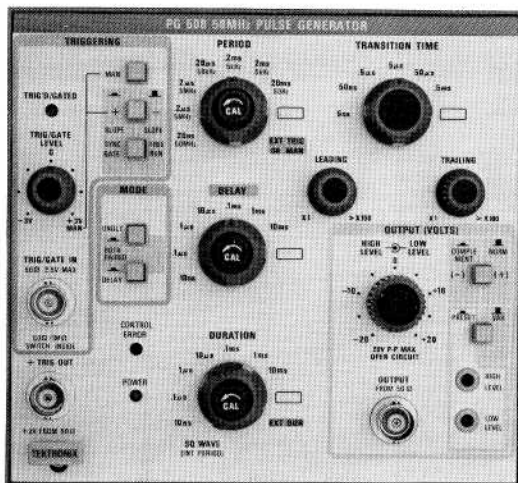
The PG 508 is the only pulse generator on the market with the convenience of preset or external tracking of the output voltage levels. A simple push of the preset button changes the output from variable top and bottom level controls to front panel screwdriver adjustments. Preset can also be used to track external supply voltages. This feature helps avoid the time spent in repeated setup of commonly used voltage levels and also avoids accidental changes in output. Most CMOS logic circuits, for example, can withstand only 0.3 V more input than the supply voltage. The PG 508 is truly designed to help you in your applications. A touch of a button complements the output voltage allowing an effective duty cycle range approaching 100%.

Although the PG 508 is a sophisticated instrument, the planning apparent in its selected control functions, and in the front panel itself, greatly simplifies its use and reduces the chance of error in setup. A control error light indicates improper switch or variable control settings, such as a pulse

**PULSE GENERATORS — COMPARISON OF CHARACTERISTICS**

The following is a comparison of the main characteristics of the PG 501, PG 502, PG 505, and PG 508. A complete list of specifications appears on the following pages.

	<b>PG 501</b>	<b>PG 502</b>	<b>PG 505</b>	<b>PG 508</b>
<b>Rep Rate Range</b>	5 Hz to 50 MHz	10 Hz to 250 MHz	1 Hz to 100 kHz	5 Hz to 50 MHz
<b>Pulse Width Range</b>	10 ns to 100 ms	2 ns to 50 ms	5 $\mu$ s to 0.5 s	10 ns to 100 ms
<b>Rise and Fall times</b>	Fixed, $\leq 3.5$ ns	Fixed, $\leq 1.0$ ns	$\leq 1 \mu$ s to $\geq 20$ ms, Independently variable up to 20:1	5 ns to $\geq 50$ ms, Independently variable up to 100:1
<b>Maximum Amplitude</b>	$\pm 5$ volts across 50 $\Omega$	5 volts in a $\pm 5$ V window across 50 $\Omega$	80 volts behind 4 k $\Omega$	20 volts in a $\pm 20$ volt window to HI Z, 10 volts in a $\pm 10$ V window to 50 $\Omega$
<b>Output Controls</b>	Independent Amplitude Controls for + and - outputs	Independent pulse top and pulse bottom, complement switch	Amplitude, inversion switch	Independent pulse top and pulse bottom, complement switch
<b>External Trigger and Ext Duration (width)</b>	+1 V, + Slope 50 $\Omega$ input Z	+1 V, + Slope 50 $\Omega$ input Z	+0.5 V to +10 V, + Slope, 10 k $\Omega$ input Z	-3 V to +3 V, + or - Slope, 1 M $\Omega$ or 50 $\Omega$ input Z
<b>Other</b>	Simultaneous Pos and neg outputs, output LOCKED ON mode	Manual trig, Square-wave Mode, selectable internal 50 $\Omega$ Reverse Termination	Delay anywhere along 10-volt input ramp, custom timing positions	10 ns to 100 ms delay, double pulse, three-state trigger/gate light, control error light, manual trigger, manual gate, true 50 $\Omega$ output Z, custom timing positions, counted pulse burst with DD 501.



DURATION setting greater than pulse PERIOD or excessive delay or transition times.

Independent rise and fall time controls allow the PG 508 user to have up to a 100:1 difference in rise and fall times. Rise and fall times are also not affected by changes in output amplitude levels. The square-wave mode reduces knob twisting when you want to vary the repetition rate over a wide range.

A unique arrangement of gating, slope, and manual controls allows you to gate the PG 508 on with a positive or negative going signal, or manually gate the instrument on or off by pressing the MAN button. In addition, with the DD 501 you can "dial up" a predetermined number of pulses in a burst from the PG 508. And the MANUAL button and MAN position in PERIOD let you add to that number, one by one. This is particularly valuable for simulating data of a given number of bits, or for checking logic circuitry where a suspected malfunction occurs at a specific number.

With the trigger input switched (internally) to 1 megohm impedance, you can "poke" into the circuitry under test using a 1X or 10X scope probe to trigger the PG 508 just as you would your favorite triggered sweep oscilloscope. In the external duration mode, the PG 508 can be used as a pulse regenerator, logic level translator, or sine wave to pulse converter. With the trigger level adjusted for the appropriate input signal, the output is set for the level of signal desired. The PG 508 provides the output to drive MOS, CMOS, DTL, HTL, I<sup>2</sup>L, T<sup>2</sup>L, or ECL. Its range of transition time control lets you create a signal accurately duplicating actual circuit drive observed in circuits under evaluation. Its high trigger input impedance makes it the only pulse generator on the market at this writing that can convert from

MOS or CMOS logic levels to other logic families.

While the PG 508 is particularly attractive to the logic world, the independent output level controls, external trigger, delay, and double pulse capability make it extremely useful in radar, laser, rf switching, and signal processing applications.

**Pulse Period** —  $\leq 20$  ns to  $\geq 200$  ms in seven decade steps plus variable, with overlap on all ranges. Periods longer than 200 ms can be obtained in custom range position. Jitter:  $< 0.1\% + 50$  ps.

**Pulse Delay** — (time between leading transitions in the paired pulse mode)  $\leq 10$  ns to  $\geq 10$  ms in seven decade steps plus variable, with overlap on all ranges. Delays longer than 100 ms can be obtained in custom range position. Duty Factor: delays to at least 70% of pulse periods for periods of 0.2  $\mu$ s or greater, decreasing to at least 50% for a 20 ns period. Jitter:  $\leq 0.1\% + 50$  ps.

**Pulse Duration** —  $\leq 10$  ns to  $\geq 100$  ms in seven decade steps plus variable, with overlap on all ranges. Durations longer than 100 ms can be obtained in custom range position. An additional position provides durations of approx 50% of the period setting for square wave output. Duty Factor: pulse durations to at least 70% of pulse periods for periods of  $\geq 0.2$   $\mu$ s, decreasing to at least 50% for a 20 ns period. Jitter:  $\leq 0.1\% + 50$  ps.

**Pulse Transition Times** — Independently adjustable leading and trailing transition times from  $< 5$  ns typical ( $< 7$  ns at some offset and amplitude levels) to  $\geq 50$  ms, measured from the 10% point to the 90% point in six decade steps plus variable. Variable controls with 100:1 range (50:1 on 5 ns) provide overlap on all ranges. Transition times longer than 50 ms are obtainable in the custom range position.

**Pulse-Transition Linearity** — Deviation from straight line  $\leq 5\%$  between the 10% and the 90% point for transition times greater than 10 ns.

**Pulse Amplitude** — Pulse high and low levels independently adjustable over a  $\pm 20$  V range from a 50  $\Omega$  low reactance source. Max pulse amplitude into a 50  $\Omega$  load is  $\geq 10$  V p-p; minimum is  $\leq 0.5$  V p-p. Max pulse amplitude into an open circuit is  $\geq 20$  V p-p; minimum is  $\leq 1.0$  V p-p. The preset level controls are adjustable over the same ranges.

**Pulse Aberrations** —  $\leq 5\%$ , + 50 mV p-p for pulse levels between + and - 5 volts into a 50  $\Omega$  load. May increase to  $\leq 10\%$ , +50 mV p-p for pulse levels outside this range.

**Trigger Output** — Amplitude  $\geq + 2$  V from 50  $\Omega$ . Source Impedance: 50  $\Omega$ . Duty Cycle: internal triggering,  $\approx 50\%$ ; external triggering: determined by duty cycle of triggering signal.

**Trigger/Gate Input** — Sensitivity: 80 mV p-p to 10 MHz; 250 mV p-p to 50 MHz. Input impedance: internally selected, 50  $\Omega$  or 1 M $\Omega$  paralleled by  $\approx 20$  pF. Max input:  $\pm 5$  V peak into 50  $\Omega$ ,  $\pm 20$  V peak into 1 M $\Omega$ . Minimum input pulse width: 10 ns. Trigger level range:  $\pm 3$  V. Polarity: front panel selectable, + or - slope.

**Trig'd Gated Light** — Flashing: input triggered at greater than approx a 10 Hz repetition rate or following the input signal at slower repetition rates. On: (Logic True) TRIG/GATE IN input potential above TRIG/GATE LEVEL setting with + SLOPE selected or below TRIG/GATE LEVEL setting with - SLOPE selected. Off: (Logic False) TRIG/GATE IN input potential below TRIG/GATE LEVEL with + SLOPE selected or above TRIG/GATE LEVEL with - SLOPE selected.

**Synchronous Gate** — Rate generator starts synchronously with the gating signal and completes the last output pulse in progress when the gating signal ends.

**Pulse Delay Modes** — Undelayed, delayed, and paired. Paired pulse mode limited to 25 MHz. Minimum pulse separation governed by duration duty factor specification.

**Fixed Delays** — Trig/Gate Input to Trigger Out:  $\approx 25$  ns. Trigger Out to Pulse Out:  $\approx 23$  ns in SQ WAVE or EXT DUR modes,  $\approx 35$  ns in other modes.

**Control Error Light** — Steady On: indicates invalid operating mode, output is undefined. Flashing: timing control settings selected do not properly define the output pulse because valid limits have been exceeded. Steady Off: indicates valid operation for most control settings.

**Counted Burst (with DD 501)** — Max PG 508 repetition rate for exact count: 20 MHz. Usable to 50 MHz. Minimum time between bursts: 100 ns.

## ORDERING INFORMATION

### PG 508 50 MHz Pulse Generator

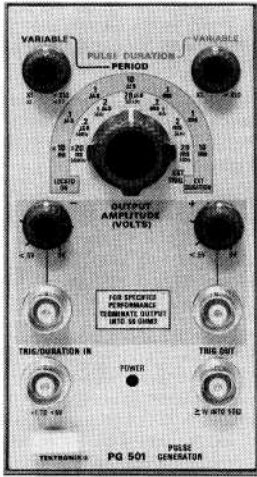
### PG 508T 50 MHz Pulse Generator

(includes PG 508, TM 503 Mainframe, and 016-0195-01 blank panel)

For Counted Burst, order the  
**DD 501 Digital Delay**

Suggested 10 in BNC 50  $\Omega$  cable (2 req) for interconnecting PG 508 and DD 501:  
**012-0208-00**

See Accessory Section for suitable probes. P6062B and P6105 are recommended.



PG 501

- 5 Hz to 50 MHz Triggered Mode
- Simultaneous Plus and Minus Outputs
- 5 V and 3.5 ns into 50  $\Omega$
- Independent Period and Duration Controls
- Trigger Out

**Pulse Period** — 20 ns or less to 20 ms (within 5% from 0.2  $\mu$ s to 2 ms and within 15% at 20 ms) in decade steps. Continuously variable between steps and to at least 0.2 s.

**Pulse Duration** — 10 ns or less to 10 ms (within 5% from 0.1  $\mu$ s to 10 ms) in decade steps. Continuously variable between steps and to at least 0.1 s.

**Duty Factor** — At least 70% for periods of 0.2  $\mu$ s or more. Duty factor decreases to 50% at 20 ns period. Minimum off time is 10 ns.

**Pulse Rise Time and Fall Time** — 3.5 ns or less.

**Aberrations** — With 3.5% at 5 V amplitude.

**Pulse Amplitude** — 0.5 V or less to at least 5 V into 50  $\Omega$  load.

**Pulse Coincidence (+ and - outputs)** — Leading edge of pulse outputs within 1 ns of each other (measured at 50% amplitude points).

**Trigger Output** — At least +1 V into 50  $\Omega$  load, occurring approx 8 ns prior to pulse output. Duty cycle  $\approx$  50% when using internal period.

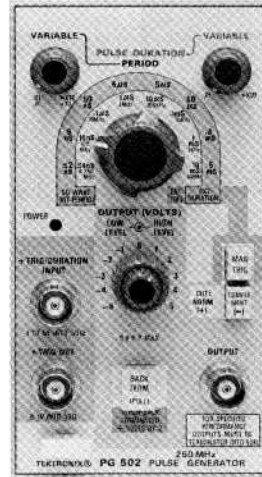
**External Trigger/Duration Input** — At least +1 not to exceed +5 V (dc + peak ac). Trigger/Duration recognition level, +1 V or less. Trigger/Duration reset level, +100 mV or less. Minimum on and off time is 10 ns. 50  $\Omega$  input impedance.

**PG 501 Pulse Generator**

**MANUAL (ONE-SHOT) TRIGGER GENERATOR**

The Manual (one-shot) Trigger Generator is used for manually initiating a pulse or complete train of events with instruments which do not have a manual trigger button or where a remote operation capability is desired, such as with some oscilloscopes and the PG 501, PG 505, and RG 501.

Order 016-0597-00



PG 502

- 10 Hz to 250 MHz
- 1 ns Rise Time
- 5 V Output,  $\pm 5$  V Window
- Independent Pulse Top and Bottom Level Controls
- Selectable Internal Reverse Termination
- Manual Trigger Button

The PG 502 (250 MHz Pulse Generator) features: fast rise and fall time; independent top and bottom pulse levels; and adjustable pulse duration. The fast rep rate makes the instrument ideal for design and testing of fast logic and switching circuits.

**Pulse Period** — 4 ns or less to 10 ms (within 5% in calibrated positions except 15% on 10 ms range) in decade steps. Continuously variable between steps and to at least 100 ms.

**Pulse Duration** — 2 ns or less to 5 ms (within 5% in calibrated positions except 15% on 5 ms range) in decade steps. Continuously variable between steps and to at least 50 ms. Square-wave mode approx 50% duty factor.

**Duty Factor** — At least 50% in normal mode, approx 100% in complement mode. Minimum off time is 2 ns.

**Pulse Rise Time and Fall Time** — Less than 1 ns.

**Aberrations** — Within  $\pm 5\%$  at 5 V p-p amplitude, except negative transition aberrations may exceed 5% for durations less than 5 ns.

**Pulse Top Flatness** — Within 2%, beginning 10 ns after transition.

**Pulse Amplitude** — Pulse high and low levels independently adjustable over a -5 to +5 V range, with pulse amplitude limited between  $\geq 0.5$  V and  $\leq 5$  V. Complement switch inverts pulse between same two selected voltage levels. Front-panel selectable 50  $\Omega$  internal back termination divides output levels by two.

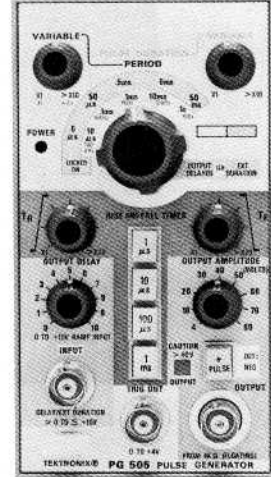
**Offset** —  $\pm 5$  V max, depends on amplitude setting.

**Trigger Output** — At least 1 V into 50  $\Omega$ , occurring approx 10 ns prior to pulse output. Duty cycle  $\approx$  50% when using internal period.

**External Trigger/Duration Input** — Trigger threshold less than 1 V; reset threshold greater than 0.1 V; max input 5 V. 50  $\Omega$  input impedance.

**Standard Accessory** — Precision 50  $\Omega$  cable 3 ft. long. (012-0482-00)

**PG 502 Pulse Generator**



PG 505

- 1 Hz to 100 kHz
- Independently Variable Duration and Period
- 80 V Output
- Variable Rise Time and Fall Time
- Delay Mode

The PG 505 Pulse Generator features: floating output; independently adjustable rise and fall times; external control of period or duration. A special position on the pulse period and pulse duration controls allows addition of an internal capacitor to custom-select pulse period and duration. When driven from an externally supplied 0 to 10 volt ramp, the delay control of the PG 505 permits the output pulse to occur at any selected voltage point on the ramp, thus providing controllable time delay to any set time along the ramp.

**Pulse Period** — 10  $\mu$ s or less to 100 ms (within 5%) in decade steps. Continuously variable between steps and to at least 1 s.

**Pulse Duration** — 5  $\mu$ s or less to 50 ms (5  $\mu$ s to 5 ms within 5%, 50 ms within 20%) in decade steps. Continuously variable between steps and to at least 0.5 s.

**Duty Factor** — (pulse duration/pulse period), 0 to 100%.

**Pulse Rise Time and Fall Time** — 1  $\mu$ s or less to 1 ms in decade steps with  $T_R$  or  $T_F$  controls set at (X1).  $T_R$  or  $T_F$  control extends time to at least 20 ms. Accurate within 5% with  $T_R$  or  $T_F$  set at (X1).

**Aberrations** — Within 5% at max p-p output into 4 k $\Omega$ , 20 pF load.

**Pulse Amplitude** — 4 V or less to at least 80 V from a 4 k $\Omega$  source. Polarity selectable for + or - output.

**Isolation of Pulse from Ground** — 200 V dc.

**Trigger Output** — 0 to +4 V into 50  $\Omega$ .

**External Trigger/Duration Input** — Accepts TTL level signals.

**Delay Mode** — Delay range (with respect to delay signal) 0 to 10 V within 5%.

**PG 505 Pulse Generator**

The function generator is one of the most rapidly growing types of signal sources due to its extreme versatility and reasonable cost. It provides a variety of waveshapes, including triangular, square, sine, and, in some cases, pulses and ramps. Triangular waveforms, used in conjunction with oscilloscopes, determine the overload (clipping) point of amplifiers. Square waveforms simultaneously reveal low frequency response (by sag), high frequency response (by rise time), and transient response (by ringing and other aberrations) of amplifiers. Sine waves, universal in the electronics industry, show the full frequency response of various devices. Further, pulses and square waves are used as clock and signal sources in logic circuitry. Ramps and triangles provide time bases for oscilloscopes and paper recorders, and test signals for voltage comparators. The high frequency coverage of modern function generators extends into the audio, video,

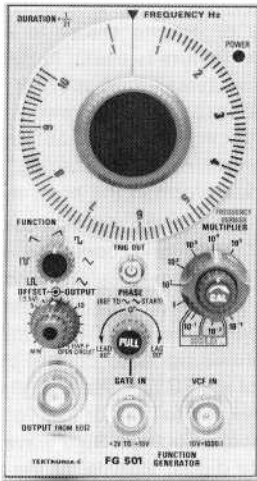
and radio spectra, and is useful in the telecommunications field as a modulation signal source. Their extreme low frequency range is useful in biological and geophysical simulations, servo systems, mechanical testing and simulations, and other applications. Built-in sweep in the FG 504 or an external ramp applied to the vcf (Voltage Controlled Frequency) input of any TEKTRONIX Function Generator permits the function generator to act as a sweep generator. A full 1000:1 sweep frequency range on TEKTRONIX Function Generators provides convenient testing of broadband amplifiers from sub-audio to 40 MHz. Also, the same vcf input, fed from a low-level modulating signal, provides a frequency-modulated carrier. Logarithmic sweep, available in the FG 504, is especially useful when sweeping wide (100:1 or greater) frequency ranges. It spreads out the lower octaves, reduces the time necessary to sweep the full range, and makes

Bode plots or graphs easier to read. The gate or burst feature is useful in testing tone-controlled systems, loud-speaker transient response characteristics, and Automatic Gain Control circuits. The FG 501 and FG 504 provide control over the starting phase of the output waveform in the burst mode.

External trigger in the FG 504 allows your signal to initiate one complete waveform from the FG 504, particularly useful when generating pulses or ramps. Phase lock, a powerful tool in the FG 504, permits an external repetitive signal to control the output frequency of the FG 504. Also, digital signals can be converted to high or low voltage sine waves, ramps, or pulses. Sine waves can be converted to digital signals, or the FG 504's output frequency can be referenced to your frequency standard. With the DD 501 Digital Delay in the "divide by n" mode the FG 504 can become a limited frequency synthesizer locked to your reference frequency.

	FG 501	FG 502	FG 503	FG 504
<b>Waveforms</b>	Sine, Square, Triangle, Pulse, Ramp		Sine, Square, Triangle	Sine, Square, Triangle, Ramps & pulses with variable symmetry
<b>Variable Symmetry</b>	no	no	no	7% to 93% duty cycle
<b>Frequency Range</b>	0.001 Hz to 1 MHz	0.1 Hz to 11 MHz (pulse, ramp 1.1 MHz max)	1.0 Hz to 3 MHz (usable 0.01 Hz to 5 MHz)	0.001 Hz to 40 MHz (usable 0.01 Hz to nominally 4 MHz with variable symmetry)
<b>Custom Frequency Range</b>	no	no	With user-installed capacitor	Shipped with capacitor for 20 Hz to 20 kHz range
<b>Dial Accuracy (% of Full Scale)</b>	Within 3%	Within 3% to 1 MHz Within 5% to 10 MHz	Within 5%	Within 3% to 4 MHz Within 6% to 40 MHz
<b>Amplitude Open Circuit</b>	15 V p-p max	10 V p-p max	20 V p-p max	30 V p-p max
<b>Into 50 Ω</b>	7.5 V p-p max	5 V p-p max	10 V p-p max	15 V p-p max
<b>Output Step Attenuator</b>	no	no	no	0 to -50 dB in 10 dB steps
<b>Offset</b>	±5 V dc open circuit, ±2.5 V dc into 50 Ω load			±7.5 V dc open circuit, ±3.75 V dc into 50 ohms
<b>Output Impedance</b>	50 ohms			
<b>Amplitude Flatness</b>	±1.5 dB, 0.001 Hz-1 MHz ±0.5 dB, 20 Hz to 20 kHz	±1.5 dB, 0.1 Hz-11 MHz ±0.5 dB, 20 Hz to 20 kHz	±2 dB, 0.1 Hz to 3 MHz ±0.5 dB, 20 Hz to 20 kHz	±0.5 dB, 0.001 Hz to 40 kHz ±2 dB, 40 kHz to 40 MHz Square wave ±0.5 dB to 20 MHz, ±2 dB to 40 MHz
<b>Sine Wave</b>	±1 dB ref sine	±3 dB ref sine	±1 dB ref sine	
<b>Frequency Stability (% of Full Scale)</b>	≤0.05% for 10 min, ≤0.1% for 1 hour, ≤0.5% for 24 hours			
<b>Sine Wave Distortion</b>	≤0.5% 1 Hz to 20 kHz ≤1.0% 20 kHz to 100 kHz ≤2.5% 100 kHz to 1 MHz	≤0.5% 10 Hz to 50 kHz Harmonics: ≤ -30 dB at all other frequencies	≤0.5% 1 Hz to 30 kHz ≤1.0% 30 kHz to 300 kHz ≤2.5% 300 kHz to 3 MHz	≤0.5% 20 Hz to 40 kHz Harmonics: ≤ -30 dB 40 kHz to 1 MHz ≤ -20 dB 1 MHz to 40 MHz
<b>Square Wave Response</b>	≤100 ns rise and fall ≤5% total aberrations	≤20 ns rise and fall ≤3% total aberrations	≤60 ns rise and fall ≤3% total aberrations	≤6 ns fixed 10 ns to 100 ms variable ≤5% + 30 mV aberrations
<b>Triangle Linearity (10% to 90%)</b>	Within 1% 0.001 Hz to 100 kHz Within 2% 100 kHz to 1 MHz	Within 1% 0.1 Hz to 100 kHz Within 3% 100 kHz to 1 MHz Within 5% 1 MHz to 11 MHz	Within 1% 1.0 Hz to 100 kHz Within 5% 100 kHz to 3.0 MHz	Within 1% 10 Hz to 400 kHz Within 5% 400 kHz to 40 MHz typ within 2% 0.001 Hz to 10 Hz
<b>Voltage Controlled Frequency</b>	Up to 1000:1 frequency change with 10 V external signal. Slew rate ≥0.3 V/μs, typically ≥0.5 V/μs.			
<b>Burst/Gate</b>	Input impedance, 1 kΩ. Control signal required +2 V; +15 V max. Bursts are synchronous with gate. Phase continuously variable from -90° to +90°.	Input impedance, 1 kΩ. Control signal required, +2 V; +15 V max. Bursts are synchronous with gate.	Not applicable	Input impedance ≥ 10 kΩ Trigger level +1 V to +10 V Sensitivity 1 V p-p Generator completes integral number of cycles ±80° phase control
<b>Triggered Mode</b>	no	no	no	Single waveform with external or manual trigger
<b>Trigger Output</b>	TTL compatible +2.5 V into 600 Ω	TTL compatible +2.5 V into 50 Ω	TTL compatible +2.5 V into 600 Ω	TTL compatible 0 to ≥ 2 V, 50 Ω Output Z
<b>Phase Lock</b>	no	no	no	100 Hz to 40 MHz
<b>Internal Sweep</b>	no	no	no	Logarithmic or linear 0.1 ms to 100 second duration Separate start-stop frequency dials
<b>Amplitude Modulation</b>	no	no	no	100% with 5 V p-p Input
<b>Output Hold Mode</b>	0.001 Hz to 10 Hz	no	no	0.001 Hz to 400 Hz

# FG 501, FG 502, FG 503, and FG 504 Function Generators



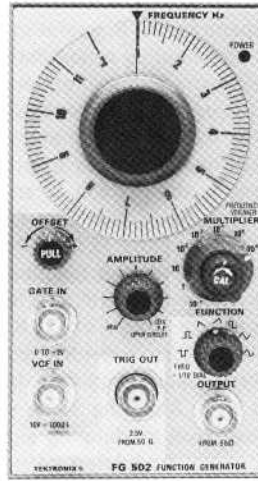
**FG 501**

- 0.001 Hz to 1 MHz
- Five Waveforms
- Vcf and Gated Burst
- Hold Mode

The FG 501 produces low-distortion sine, square, triangle, pulse, and ramp waveforms from 0.001 Hz to 1 MHz. An external vcf input permits control of the output frequency from an external voltage source. Frequency sweep up to 1000:1 ratio may be accomplished by applying a voltage ramp to the vcf input. A hold control allows the operation of the generator to be halted instantaneously at any point in its cycle. Release of the hold will then allow the operation to continue normally. A gate input is provided to allow "burst" or single cycle operation, with the phase of the generator output at the start of the burst controllable over a  $\pm 90^\circ$  range. Output signal voltage is adjustable to 7.5 V p-p into a 50-ohm load, with dc offset also adjustable up to  $\pm 2.5$  V.

**Standard Accessory** — Trig Out Cable (BSM to BNC) (012-0127.00).

## FG 501 Function Generator

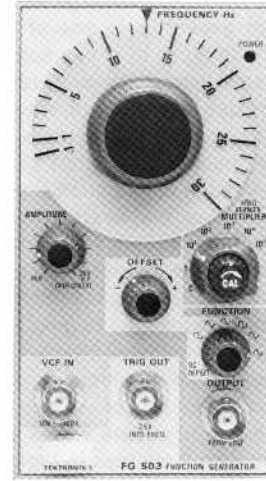


**FG 502**

- 0.1 Hz to 11 MHz
- Five Waveforms
- Vcf and Gated Burst

The FG 502 Function Generator provides low-distortion sine, square, and triangle waveforms, and positive or negative ramps and pulses. Output frequency is continuously variable from 0.1 Hz to 11 MHz. The high frequency range from 1 to 11 MHz permits the versatility of the function generator to be extended into the medium radio frequency range. Voltage controlled frequency input permits the FG 502 to be used as a sweep generator. The external gate input permits the FG 502 output in any of its modes to be controlled by an externally supplied pulse to generate bursts of various output waveforms. This feature has application in wireline or radio remote control equipment and in certain phases of the telephone industry.

## FG 502 Function Generator



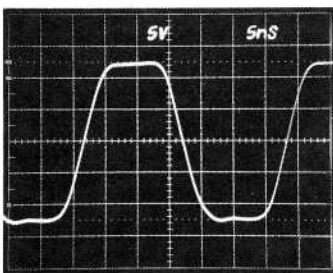
**FG 503**

- 1.0 Hz to 3 MHz
- Three Waveforms
- Vcf

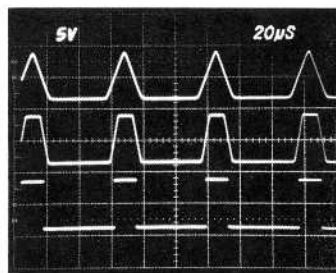
The FG 503 Function Generator provides high-quality low-distortion sine, square, and triangle waveforms. Six decade frequency multiplier steps, a custom position for user-determined frequency multiplication, a dial calibrated from 1.0 to 30 (uncalibrated from 0.1 to 1.0), and a frequency vernier control work together to select frequencies in overlapping ranges from 1 Hz to 3 MHz. The output frequency may be swept over a 1000:1 ratio by an external voltage. Output amplitude and offset controls are provided. A trigger output is available for controlling external devices or equipment. Amplitude up to 10 V p-p can be developed across a 50-ohm load (20 V p-p open circuit). Selectable offset up to 3.75 V dc across 50 ohms (7.5 V dc open circuit) is also featured.

## FG 503 Function Generator

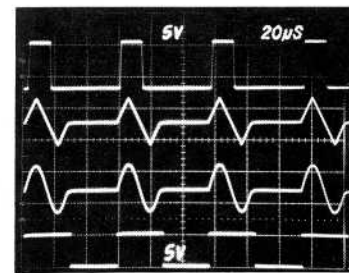
## FG 504 OUTPUT WAVEFORMS



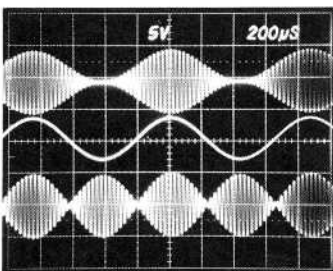
FG 504 30 volt output with 6 ns rise and fall times for superior pulse waveforms.



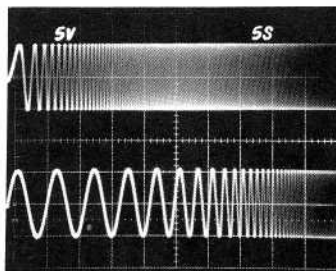
Variable rise and fall times increase pulse waveform flexibility.



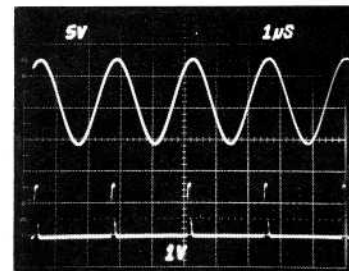
FG 504 completes one waveform when triggered from external signal on bottom trace.



True four quadrant multiplier permits normal am or double sideband suppressed carrier modulation.



FG 504 both linear or logarithmic sweep available for a wide range of sweep applications.



Phase lock allows the FG 504 output (top trace) to lock to virtually any periodic input waveform.



0.001 Hz to 40 MHz

Three Basic Waveforms,  
Plus a Wide Range of Shaping  
with Variable Rise and Fall  
and Symmetry Controls

Logarithmic or Linear Sweep

Separate Frequency Dials  
Set Lower (START) and  
Upper (STOP) Limits of Sweep

Up to 30 V p-p Output

Built-in Attenuator

Am and Fm

Phase Lock Mode

External and Manual Trigger  
or Gate

The output of the FG 504 may be phase locked, gated, or triggered by a reference signal, letting you convert from one waveform to another, such as pulses to sine waves, as well as adjust phase relationships. Post attenuator offset enables use of the full  $\pm 7.5$  V offset range with small signals. And the FG 504 output can be amplitude or frequency modulated by external signals.

The FG 504 also provides trigger output, external voltage control input, and sweep output. (Contact your Tektronix Field Engineer for a data sheet discussing FG 504 applications in detail.)

**Frequency Range** — Sine, Triangle and Square Waveforms: 0.001 Hz to 40 MHz calibrated range. Ramps, Pulses or waveforms requiring use of VARIABLE SYMMETRY control: 0.001 Hz to nominally 4 MHz. Multiplier switch has position for user-determined range by capacitor selection. Maximum frequency on this range is 400 kHz. A 5  $\mu$ F capacitor provides a full scale frequency of 400 Hz. Instrument shipped from factory with capacitor installed for 20 Hz to 20 KHz range in  $0.5 \times 10^3$  position.

**Frequency Resolution** — 1 part in  $10^4$  of full scale setting using the FREQUENCY VERNIER control.

**Frequency Stability** —  $\leq 0.05\%$  for 10 minutes,  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours. The FREQUENCY Hz dial must be on the calibrated portion. The instrument must be at a constant ambient temperature between 0°C and +50°C and checked after a 1 hour warmup.

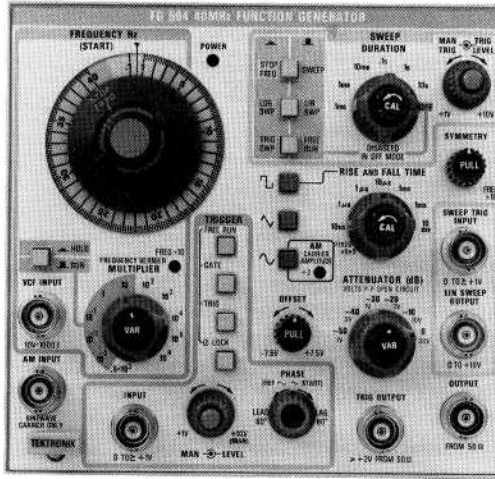
**Dial Calibration** — 1 to 40 calibrated, 0.1 to 1 uncalibrated.

**Dial Accuracy** — (+15°C to 35°C) Start Dial: Within  $\pm 3\%$  of full scale from 0.001 Hz to 4 MHz. Within  $\pm 6\%$  of full scale from 4 MHz to 40 MHz. Measurements made at +25°C  $\pm 10^\circ$ C. Stop Frequency Dial: 5% of the difference between the start and stop frequencies plus the FREQUENCY Hz (START) dial error. Stop Dial uncalibrated on the  $10^0$  MULTIPLIER range.

Maximum Dial, VCF, and Sweep Range —

MULTIPLIER	FREQUENCY RATIO
$10^6$	500:1
$10^5$ - $10^2$	1000:1
$10^1$ , $1$ , $10^{-1}$ , $10^{-2}$	100:1
$10^{-3}$	40:1

**Internal Sweep** — Linear or Logarithmic. Accuracy: Limited by Start and Stop Frequency dial specifications. Can be set more accurately using an external



frequency monitor. Sweep Duration: 100 s to 0.1 ms in six decades. Variable control overlaps decades. Stop Frequency to Swept Stop Frequency Error: Within 2% maximum from 100 s to 1 ms sweep duration. Within 10% maximum from 1 ms to 0.1 ms sweep duration. Linear Sweep Output: Amplitude: 0 V to +10 V from 1 k $\Omega$ . Amplitude Accuracy: Within  $\pm 5\%$  from 100 s to 1 ms, within  $\pm 10\%$  from 1 ms to 0.1 ms. Sweep Trigger Input: Input Sensitivity: 1 V p-p. Trigger Level: 1 V through 10 V. Maximum Input: +20 V. Manual Trigger: Front panel control.

**Voltage Controlled Frequency Input** — Nominal sensitivity (Hz/volt) = 4 x MULTIPLIER setting per volt. A positive-going voltage increases frequency. Maximum Frequency: 40 x MULTIPLIER setting. Minimum Frequency: Maximum frequency divided by vcf range of MULTIPLIER setting (see DIAL, VCF, and SWEEP RANGE). Slew Rate: 0.3 V/ $\mu$ s maximum. Input Impedance: 10 k $\Omega$ .

**Output Amplitude** — 30 V p-p into an open circuit, 15 V p-p into 50  $\Omega$ .

**Amplitude Flatness** — Sinewave (reference at 10 kHz): Within  $\pm 0.5$  dB from 0.001 Hz to 40 kHz. Within  $\pm 2$  dB from 40 kHz to 40 MHz. Typically within  $\pm 0.5$  dB to 40 MHz. Triangle (reference at 10 kHz): Within  $\pm 0.5$  dB from 0.001 Hz to 40 kHz. Within  $\pm 2$  dB from 40 kHz to 40 MHz. Squarewave (reference at 10 kHz): Within  $\pm 0.5$  dB from 0.001 Hz to 20 MHz. Within  $\pm 2$  dB from 20 MHz to 40 MHz. Sine, Triangle and Square-wave Amplitude Match: Within  $\pm 1$  dB at 10 kHz.

Output Attenuator — Open Circuit Voltages:

ATTENUATOR STEP	MAXIMUM OUTPUT VOLTAGE (p-p)
0 dB	30 V
-10 dB	9.5 V
-20 dB	3 V
-30 dB	950 mV
-40 dB	300 mV
-50 dB	95 mV

Variable -20 dB extends minimum signal amplitude to 10 mV. See square wave aberrations specification. Accuracy:  $\pm 0.5$  dB/decade.

**Offset Range** —  $\pm 7.5$  V into an open circuit,  $\pm 3.75$  V into 50  $\Omega$ . Maximum signal plus offset peak output amplitude of  $\pm 15$  V into an open circuit or  $\pm 7.5$  V into 50  $\Omega$ . Offset defeatable by front panel control.

**Waveforms** — Sine, Triangle and Square: Ramps and Pulses by use of the VARIABLE SYMMETRY control.

**Variable Symmetry** — Duty Cycle Range: 7% to 93%; 20% to 80% on triangle and sine waveforms above 1 MHz. Actuation of VARIABLE SYMMETRY control divides output frequency by approximately ten.

**Triangle Symmetry** — Within 1% from 10 Hz to 400 kHz, within 5% from 400 kHz to 40 MHz on calibrated portion of FREQUENCY Hz dial. Typically within 2% from 0.001 Hz to 10 Hz.

**Triangle Linearity** — Within 1% from 10 Hz to 400 kHz, within 2% from 400 kHz to 4 MHz, within 10% from 4 MHz to 40 MHz measured from the 20% to 80% points on the waveform. Typically within 2% from 0.001 Hz to 10 Hz.

**Sine-wave Distortion (Total Harmonic Distortion)** —  $\leq 0.5\%$  from 20 Hz to 40 kHz. Greatest harmonic at least 30 dB down from 40 kHz to 1 MHz and 20 dB down from 1 MHz to 40 MHz. Typically  $\leq 1\%$  from 0.001 Hz to 20 Hz. Measured under the following conditions: terminated in 50  $\Omega$ , at 25°C  $\pm 10^\circ$ C ambient, with zero offset,  $\leq 30$  dB attenuation and with FREQUENCY Hz (START) dial set between 4 and 40.

**Square wave** — Rise and fall time (FIXED):  $\leq 6$  ns. Aberrations:  $\leq 5\%$  p-p + 30 mV into a 50  $\Omega$  load.

**Variable Rise and Fall Time (Square and Pulse Waveforms)** — Range: 10 ns to 100 ms in 7 steps measured from 10% to 90% points on waveform. Variable control has  $\geq 10$  x range. Period of waveform must exceed combined rise and fall times by  $\geq 20\%$ .

**Amplitude Modulation Input** — a 5 V p-p signal produces 100% modulation of a sine wave carrier from dc to 4 MHz with  $< 5\%$  distortion at 70% modulation when driven from a source impedance of  $\leq 600$   $\Omega$ . From 4 MHz to 40 MHz there is  $< 10\%$  distortion at 65% modulation. Distortion specifications valid for modulating frequencies from 20 Hz to 20 kHz. Modulation frequency bandwidth is dc to 100 kHz. A modulating source impedance of  $\leq 10$  k $\Omega$  ensures proper modulation and divides the output amplitude by 2. Input Impedance:  $> 1$  M $\Omega$ .

**External Trigger/Gate/Phase Lock Input** — Input Impedance  $\geq 10$  k $\Omega$ . Sensitivity: 1 V p-p. Maximum input Amplitude: +20 V. Trigger Mode: (for triggering a single cycle of main generator waveform). Trigger Level: 1 to 10 V. Minimum Period: 75 ns. Maximum Triggered Frequency:  $\geq 20$  MHz. Gate Mode: (for gating multiple-cycle bursts of main generator waveform). Minimum Period: 75 ns. Maximum Gated Frequency:  $\geq 20$  MHz. Duration of gate determines number of output cycles with integral number of cycles completed. Phase Lock Mode: Frequency Range: 100 Hz to 40 MHz. Capture Range:  $\pm 10$  major dial divisions from 100 Hz to 4 MHz.  $\pm 8$  major dial divisions from 4 MHz to 40 MHz. Lock Range: Generator will lock to a changing external signal, without readjusting the PHASE control, within  $\pm 10$  major dial divisions from 100 Hz to 4 MHz and within  $\pm 1$  MHz from 4 MHz to 40 MHz Phase Adjustment Range:  $\pm 80^\circ$  from 100 Hz to 4 MHz.

**Gate and Trigger Phase Control** — Phase Adjustment Range: Triangle and sine waveforms only,  $\pm 80^\circ$  from 0.001 Hz to 4 MHz.

**Manual Trigger/Gate** — Available at front panel.

**Trigger Output** — 0 V to  $\geq +2$  V from 50  $\Omega$ .

**Hold Mode** — Drift:  $\leq 10\%$  of p-p output amplitude/hour. Range: 0.001 Hz to 400 Hz.

**Power Consumption** — 48 W from power line.

**Power Dissipation** — 24 W maximum in plug-in.

**Performance Conditions** — The electrical characteristics are valid if the FG 504 is calibrated at an ambient temperature between +20°C and +30°C, and operated between 0°C and +50°C, unless otherwise noted. Forced air circulation is required above +40°C (TM 515, TM 506, RTM 506 or equivalent).

FG 504 40 MHz Function Generator

FG 504T 40 MHz Function Generator

(includes FG 504, TM 503 Mainframe, and 016-0195-01 blank panel)

The Sweep, Audio, and Ramp Generators include the SG 502 Audio Oscillator, the SW 503 Sweep Generator, and the RG 501 Ramp Generator. The SG 502 Audio Oscillator features extremely low distortion and wide-range flat response for critical audio and communication systems and component testing. The RG 501 Ramp Generator provides single or repetitive ramps of controllable amplitude and duration, excellent linearity, and short retrace time.

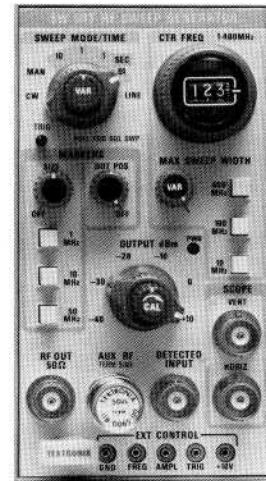
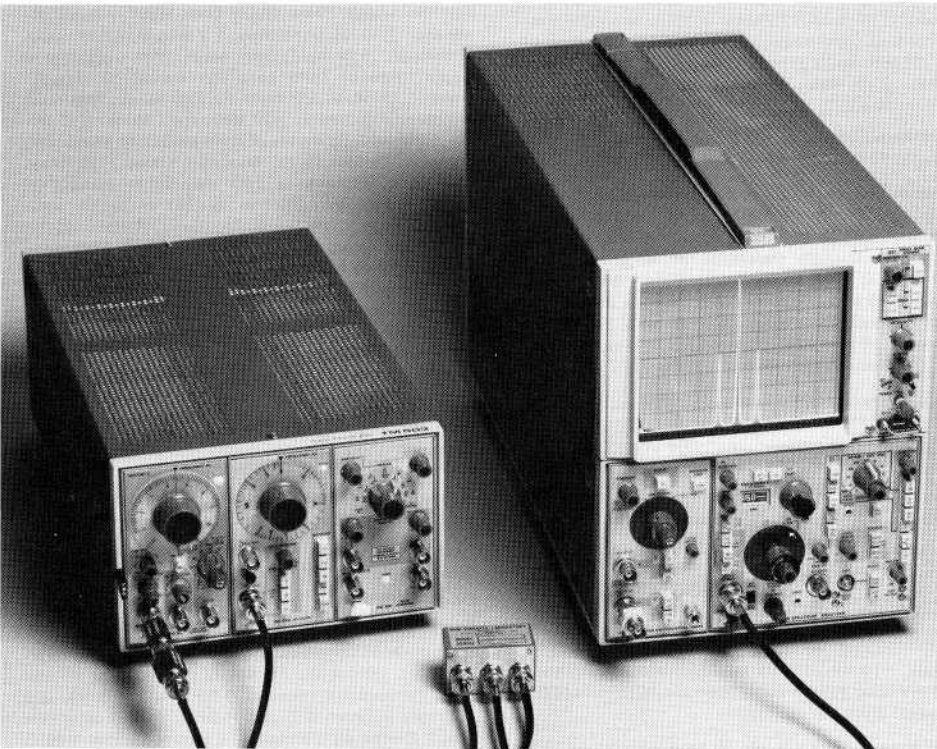
The SG 502 Oscillator is an RC design featuring distortion less than 0.035% over the entire audio range of 20 Hz to 50 kHz. Distortion does not exceed 0.1% over the balance of its 5 Hz to 500 kHz coverage. Output amplitude is flat with  $\pm 0.3$  dB over the entire range. The output impedance is the 600 ohm audio industry standard. Amplitude control of 70 dB is available in 10 dB steps plus a 40 dB variable attenuator. A fixed-amplitude square wave is present simultaneously.

The SG 502 is used in various applications in conjunction with several other TM 500 instruments. One of these is the Audio Frequency Communications package, as discussed, where it and the DM 502 and DC 504 find ready application in telephonic com-

munications, as well as in fields which use telephone lines for voice or low-speed data transmission, like the broadcasting industry and computer time-sharing industry.

The SW 503 Sweep Generator puts most of the features associated with larger laboratory-type sweep generators in a single compartment TM 500 Plug-in.

Frequently, the RG 501 Ramp Generator is used in conjunction with other TM 500 instruments; for instance, function generators, the PG 505 Pulse Generator, the MR 501 Monitor or other TEKTRONIX Crt Monitors, or an X-Y recorder. The ramp generator's output is an ideal time base for the monitor or recorder. Used with the PG 505 Pulse Generator, the RG 501 permits a pulse to be triggered at any selected point along a ramp: a single PG 505 and RG 501 can generate pulses delayed a controlled time following the RG 501 gate output and multiple PG 505s can be driven from one RG 501 to generate delayed pulse trains of almost any description. With any of the TM 500 Function Generators, where vcf (voltage controlled frequency) input is fed by the RG 501 output, a linear frequency sweep of up to 1000:1 width may be generated.



**SW 503 Sweep Generator**

- 1 to 400 MHz Range**
- 1, 10, and 50 MHz Markers Built-in**
- Continuously Variable Dot Marker System**
- +10 dBm (+50 dBmV) Output**
- Remote Programming Capability**

The SW 503 is a 1 to 400 MHz RF SWEEP GENERATOR with two marker systems built-in. Standard crystal comb markers at 1, 10, and 50 MHz intervals automatically adjust their width as the sweep width range is selected. Even more unique is the variable position dot marker whose frequency can be automatically displayed on a TEKTRONIX DC 502 Option 07 Counter. The counter will also monitor the frequency when using the SW 503 as a cw signal source.

The SW 503 can be amplitude modulated, frequency modulated, or remotely programmed with voltages to control amplitude, frequency, or sweep triggering.

The versatility and many features of the SW 503 make it an excellent choice for specialized sweep testing or for general laboratory use.

**CHARACTERISTICS**

**Center Frequency Range** — 1 to 400 MHz. Dial accuracy:  $\pm 8$  MHz (note 1). Drift: 100 kHz/5 min — 2 MHz/8 hrs (note 2).

**Swept Frequency Range** — 1 to 400 MHz. Sweep width: 200 kHz min, 400 MHz max. Display linearity:  $\leq 2\%$  @ 400 MHz position,  $\leq 3\%$  @ 100 MHz and 10 MHz positions.

**Signal Purity** — Residual fm:  $\leq 10$  KHz. Harmonic Spurious:  $\geq 30$  dB below output from 10 to 400 MHz,  $\geq 25$  dB below output from 3 to 10 MHz  $\geq 15$  dB below output from 1 to 3 MHz. Non-harmonic Spurious:  $\geq 40$  db below output.

**Output** — Impedance: Model SW 503 50  $\Omega$ , Model SW 503, Option 01 75  $\Omega$ . Level: 0.7 VRMS MAX, SW 503 CALIBRATED —40 to +10 dBm 50  $\Omega$ , SW 503, Option 01 CALIBRATED 0 to +50 dBmV 75  $\Omega$ . Attenuation:

Step 50 dB in 10 dB steps, absolute accuracy 0.2 dB/step referred to zero attenuation, vernier  $\geq 20$  dB. Flatness:  $\pm 0.25$  dB (measured at maximum output using precision detector  $\leq 1.15$  vswr).

**Blanking** — Retrace blanking of the rf output provided for sweep operation, removed for cw operation.

**Aux Rf Output** — -2 dBm min. into 50  $\Omega$ .

**Operating Modes** — Repetitive sweep, single sweep, externally triggered sweep, line-lock sweep, manual sweep, cw.

**Sweep Time** — Continuously variable from 10 ms to 100 s in 4 decade steps, plus vernier.

**Horizontal Output** — 0.5 volts p-p (output symmetrical to ground reference).

**Crystal Markers** — Type: birdie-by-pass, comb markers. Marker comb frequency: 1, 10, and 50 MHz. Marker accuracy: 0.005%. Marker width: automatically changes from approx 400 kHz to 50 kHz as the sweep width range is selected. Marker size: adjustable from 1 mV to 1 V p-p. Rectified marker: internal switch removes the negative portion of the birdie for use with x-y recorders. Size varies with detector's output impedance. Max marker size is over 0.5 V.

**Variable (Dot) Marker (use in line or 10 ms rate)** — When used in conjunction with the DC 502 Digital Counter with Option 7, the variable (dot) marker will stop the sweep wherever the marker is positioned. This in turn gates the counter on to read the frequency. At the end of the counter gate, the SW 503 resumes sweeping. The accuracy of the variable marker is limited to the counter accuracy and the display resolution, i.e.: reduced sweep width gives greater resolution.

**Remote Programming** — Front-panel jacks provide connections for the remote control of frequency, sweep width, and the 20 dB vernier output control. A jack is also provided to externally trigger the sweep circuit when the instrument is in a single sweep mode. Provisions are also available on the front panel for external frequency and amplitude modulation. External fm: the full frequency range can be modulated at rates up to 4 kHz. With reduced deviation and linearity, modulation rates to 100 kHz are possible. Modulation sensitivity is approx 50 MHz/V. Input impedance 10 k $\Omega$ . External am: 90% modulation can be obtained at modulation frequencies up to 25 kHz. Note: the output level must be reduced at least 6 dB by the vernier output control to obtain 90% modulation. Modulation sensitivity is 1 volt p-p/10% am. Input impedance 10 k $\Omega$ .

Note 1. Increased accuracy can be obtained using the crystal markers or the variable (dot) marker in conjunction with the DC 502, Opt 07.

Note 2. After 1/2 hour warm-up at a constant ambient, and allowing a 5 minute stabilization period after a frequency change.

**Included Accessory** — 50  $\Omega$  Termination 118-0065-00. Required for AUX RF output.

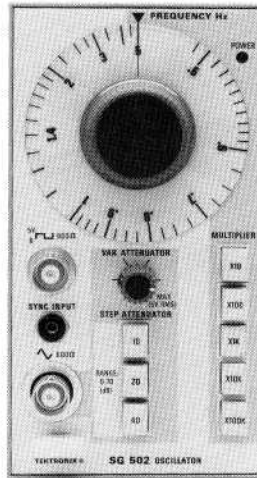
### ORDERING INFORMATION

**SW 503 RF Sweep Generator**  
(50  $\Omega$  Output)

**Option 01 (75  $\Omega$  Output)**  
Needs external detector.

### SUGGESTED ACCESSORIES

**Tm 515 Option 07 Power Module**  
**DC 502 Option 07 550 MHz Freq. Counter**  
**DM 502 Digital Multimeter**  
**SC 502 15 MHz Dual Trace Oscilloscope**  
**50  $\Omega$  Precision Detector for SW 503**  
(118-0070-00)  
**75  $\Omega$  Precision Detector for SW 503 Opt 01**  
(118-0071-00)



SG 502

**5 Hz to 500 kHz Sine and Square Waves**  
**Extremely Low Distortion Sine Wave**  
**5 V Rms Open Circuit—600  $\Omega$  Source**  
**0-40 dB Output Variable Plus 0-70 dB in 10 dB Steps**

### SINE WAVE

**Frequency Range** — 5 Hz to 500 kHz in 5 decade steps. Accurate within 5% of dial setting from 5 Hz to less than 50 kHz; within 10% of dial setting from 50 kHz to 500 kHz.

**Amplitude Response** — Flatness is 0.3 dB over entire range (1 kHz reference).

**Attenuation** — Selectable from 0 dB to 70 dB in 10, 20, and 40 dB steps with pushbuttons. Accurate within 2% for each step selected, additive. An uncalibrated control provides continuous variation from 0 dB to 40 dB.

**Harmonic Distortion** — Less than 0.035% from 20 Hz to 50 kHz. Less than 0.1% over the remaining frequency range.

**Hum and Noise** — Less than 0.1% of rated output.

**Max Output Voltage** — 5 V rms open circuit; 2.5 V rms into 600  $\Omega$ .

**Output Impedance** — 600  $\Omega$ , single ended.

### SQUARE WAVE

**Frequency Range** — Same as sine wave. The square wave switches on the 0° phase of sine out.

**Rise and Fall Time** — 50 ns or less.

**Amplitude** — +5 V, fixed, open circuit.

**Output Impedance** — 600  $\Omega$ , single ended.

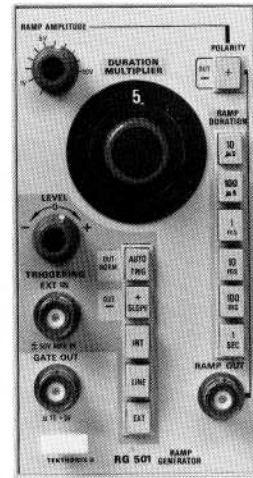
### SYNC INPUT

Oscillator can be synchronized to external signal. Sync range, the difference between sync frequency and set frequency, is a linear function of sync voltage.

**Input Impedance** — 10 k $\Omega$ .

Measurements made at rated output and terminated in 600  $\Omega$ .

**SG 502 Oscillator**



RG 501

**10  $\mu$ s to 10 s Ramp Duration**  
**Plus or Minus Output**  
**10-V Amplitude**  
**Scope-type Trigger Functions**  
**Gate Out, TTL Compatible**

### RAMP

**Ramp Duration** — Decade ranges of 10  $\mu$ s to 1 s, extends to 10 s with 1-10 duration multiplier. Accurate within 3% when multiplier is at X1 (multiplier not calibrated).

**Ramp Amplitude** — Continuously variable from 50 mV or less to at least 10 V, either polarity. Dc level between ramps, 0 V within 20 mV.

**Gate** — From a low state of 0 V, within 100 mV, the ramp gate rises to +3 V, within 0.6 V, in 100 ns or less. Fall time is 100 ns or less. Gate source impedance is nominally 160  $\Omega$ .

**Ramp Output Characteristics** — Minimum load resistance, 3 k $\Omega$ ; max load capacitance, 300 pF.

### TRIGGERING

**Auto Triggering** — Provides free-running signal in absence of trigger. Locks automatically to trigger with a frequency above 20 Hz and at least 200 mV amplitude.

**External Triggering** — Sensitivity is at least 200 mV p-p, dc to 100 kHz. Input impedance approx 9.5 k $\Omega$ . 50 V (dc + peak ac) max input.

**Internal Triggering** — Same as external except that the trigger source is via the rear interface.

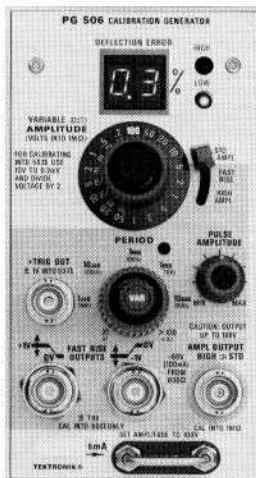
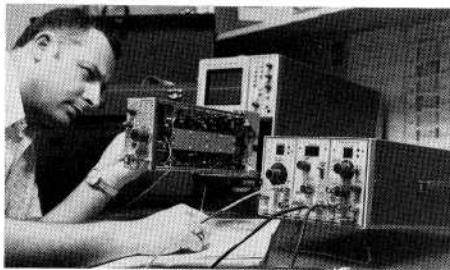
**Line Trigger** — Triggers at line frequency.

**Trigger Level Range** —  $\pm 1$  V.

### RG 501 Ramp Generator

**Optional Accessory** — Manual (One-Shot) Trigger Generator.

**Order 016-0597-00**



PG 506  
CALIBRATION GENERATOR

TEKTRONIX TM 500 Oscilloscope Calibration Instruments set the state-of-the-art in every respect in oscilloscope calibration. These instruments provide the widest range of standard amplitude square waves, fastest rise times, lowest aberrations, fastest time marks, and widest frequency range of leveled sine waves available from any calibration equipment.

Furthermore, the TM 500 Oscilloscope Calibration Instruments simplify and speed up verification procedures, assuring a high level of performance and minimum costs. For example, the TG 501 provides a variable mode in addition to its crystal-controlled mode. In the variable mode, the time mark spacing can be quickly adjusted to exactly align with the oscilloscope graticule marks. The resulting percentage timing error is then read directly off the TG 501 digital display. The superior multi-instrument portability of the TM 500 concept lets this rapid verification take place at the oscilloscope usage location, since the entire calibration facility now occupies one small package with a single handle. This on-site verification increases accuracy and time-savings still further.

### Three Square-Wave Output Modes

#### 10 Hz to 1 MHz

#### Direct Readout of Oscilloscope Deflection Error

The PG 506 is a calibration generator for oscilloscopes with three modes of square-wave output, selectable dc outputs, and a variable-amplitude output with front-panel digital indication of oscilloscope deflection error. For checking attenuator performance and transient response of oscilloscopes, simultaneous plus and minus low-level, fast-rise (1.0 ns) square waves or high amplitude (60 volt), extremely clean square waves are available at frequencies from 10 Hz through 1 MHz. A 5 milliamp calibration current loop is useful for current probe calibration. In the amplitude calibration mode, a 1 kHz square wave is generated whose amplitude may be varied around the calibrated level until the square wave aligns with the oscilloscope vertical graticule divisions; scope deflection error is then read directly off the PG 506 digital display in percentage high or low, permitting rapid verification of oscilloscope performance.

## OSCILLOSCOPE CALIBRATION INSTRUMENTS CHART

The following chart is a comparison of the four instruments making up the Oscilloscope Calibration Instruments.

A complete list of specifications appears on the following pages.

	PG 506 Calibration Generator	TG 501 Time Mark Generator	SG 503 Signal Generator	SG 504 Signal Generator
Primary functions	Amplitude calibration 200 $\mu$ V to 100 V	Time-base calibration 1 ns to 5 s	Bandwidth calibration 250 kHz to 250 MHz	Bandwidth calibration 245 MHz to 1050 MHz
Secondary functions	Rise time and transient response testing, attenuator compensation testing	Testing oscilloscope nonlinearity	General leveled rf signal source	General leveled rf signal source with frequency modulation capability

### AMPLITUDE CALIBRATOR MODE

**Period** — Fixed at approx one millisecond or dc.

**Amplitude** — From 100 V p-p to 200 microvolts p-p in 1-2-5 sequence, accurate within  $\pm 0.25\%$  into 1 M $\Omega$ . 5 V p-p to 100 microvolts p-p into 50  $\Omega$ .

**Error Readout Range** —  $\pm 7.5\%$ .

**Error Readout Resolution** — 0.1%.

### PULSE MODES

**Period** — One microsecond to 10 milliseconds (within 5%) in decade steps with the VARIABLE control in CAL position. VARIABLE extends period to at least 100 milliseconds.

**Symmetry** — Approx 50% duty cycle.

### HIGH AMPLITUDE OUTPUT

**Rise Time** — Unterminated: 100 ns or less. Terminated into 50  $\Omega$ : 10 ns or less.

**Amplitude Range** — Unterminated: 6 V or less to at least 60 V. Terminated into 50  $\Omega$ : 0.5 V or less to at least 5 V.

**Leading Edge Aberrations** — Within 2% or 50 mV p-p, whichever is greater, when terminated into 50  $\Omega$ .

**Polarity** — Positive going from a negative potential to ground.

**Output Resistance Source** — 600  $\Omega$  within 5%.

### FAST RISE OUTPUTS

**Rise Time (Terminated into 50  $\Omega$ )** — 1.0 ns or less.

**Amplitude Range (Terminated into 50  $\Omega$ )** — 100 mV or less to at least 1.0 V.

**Leading Edge Aberrations** — 2% or 10 mV p-p, whichever is greater, during first 10 ns.

**Flatness** — Within 0.5% after first 10 ns.

**Polarity** — Simultaneous positive and negative going. Positive going is from a negative rest potential to ground. Negative going is from a positive rest potential to ground.

**Output Resistance Source** — 50  $\Omega$  within 3% at + and — output connectors.

**Trigger Output (Terminated into 50  $\Omega$ )** — Positive-going signal of at least 1 V.

**Standard Accessory** — Precision 50  $\Omega$  cable 3 ft. long. (012-0482-00)

### PG 506 Calibration Generator

#### TUNNEL DIODE PULSER

The Tunnel Diode Pulser (067-0681-01) provides a clean, fast-rise pulse for adjusting the transient response of high-frequency oscilloscopes and other instruments. The Tunnel Diode Pulser can be driven by the PG 506 Calibration Generator at repetition rates exceeding 50 Hz. Output amplitude of the pulse is approximately 250 mV into 50 ohms, while rise time is  $\leq 125$  ps; aberrations are  $< 1\%$  in a 1 GHz system.

Order 067-0681-01

#### PRECISION VOLTAGE DIVIDER

Designed for use with the PG 506 in the STANDARD AMPLITUDE mode, this 0.4 divider allows your oscilloscope to display a constant 4 divisions when checking amplitude calibration from 20  $\mu$ V/div through 1 V/div. It also allows the PG 506 to be more conveniently used with oscilloscopes that cannot display 5 divisions of amplitude.

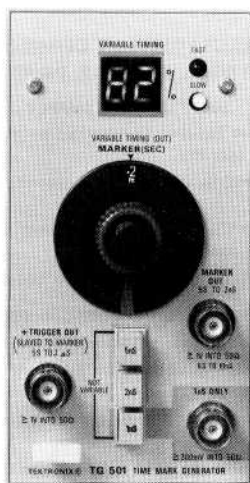
**Input Z** — 50  $\Omega$  with output load  $\geq 100$  k $\Omega$ .

**Max Input** —  $\leq 5$  V rms.

**Output** — 0.4 x PG 506 Amplitude.

**Voltage Accuracy** —  $\pm 0.4\%$ .

Order 015-0265-00



TG 501

**TIME MARK GENERATOR**

**Marker Outputs, 5 s to 1 ns**

**Direct Readout of Oscilloscope Timing Error**

**External Trigger Output**

The TG 501 Time Mark Generator provides marker outputs from five seconds to one nanosecond. A unique feature on the TG 501 is a variable timing output with a front-panel two-digit LED display which indicates percentage of timing error between the normal time interval and a variable interval set to line up the marker pulse with graticule or division mark on the display. This feature not only provides direct readout in terms of percent error, but also helps eliminate errors associated with visually estimating error from a display.

**Markers** — 1 ns through 5 s in a 1-2-5 sequence.

**Marker Amplitude** —  $\geq 1$  V peak into 50  $\Omega$  on 5 s through 10 ns markers.  $\geq 750$  mV p-p into 50  $\Omega$  on 5 ns and 2 ns markers.  $\geq 200$  mV p-p into 50  $\Omega$  on 1 ns markers.

**Trigger Output Signal** — Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

Internal Time Base	Standard	Option 1
Crystal Frequency	1 MHz	5 MHz
Stability (0° to 50° C) after ½ hour warm-up	within 1 part in 10 <sup>5</sup>	within 5 parts in 10 <sup>7</sup>
Long-term Drift	1 part or less in 10 <sup>5</sup> per month	1 part or less in 10 <sup>7</sup> per month
Settability	adjustable to within 1 part in 10 <sup>7</sup>	adjustable to within 5 parts in 10 <sup>9</sup>

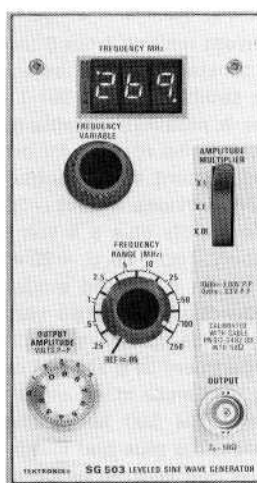
**External Reference Input** — Available with internal changes. Acceptable frequencies, 1 MHz, 5 MHz, or 10 MHz. Input amplitude must be TTL compatible.

**Timing Error Readout Range** — To  $\pm 7.5\%$ .

**Timing Error Measurement Accuracy** — Device under test error is indicated to within one least significant digit (to within one displayed count).

**TG 501 Time Mark Generator**

**Option 01, 5 MHz Time Base**



SG 503

**SIGNAL GENERATOR**

**Leveled, Variable Output**

**250 kHz to 250 MHz**

**Digital Readout of Frequency**

The SG 503 Signal Generator is a general-purpose leveled sine-wave oscillator. It provides a leveled output amplitude which is variable from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED read-out on the front panel. Accurately calibrated output voltage into 50 ohms is variable from 5 mV to 5.5 V peak-to-peak.

**Frequency Range** — 250 kHz to 250 MHz, plus 50 kHz reference frequency.

**Accuracy** — Within  $\pm 0.7$  of least significant digit of indicated frequency.

**Amplitude Range** — 5 mV to 5.5 V p-p into 50  $\Omega$  termination in three decade ranges.

**Amplitude Accuracy** — (50 kHz reference) Within 3% of indicated amplitude on (X1) range, 4% on (X0.1) range, and 5% on (X0.01) range.

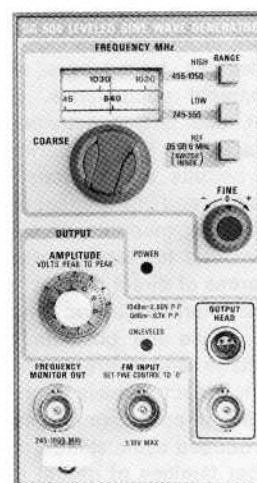
**Flatness** — (p-p) From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, -1% variation may occur between 50 MHz and 100 MHz on amplitude multiplier X0.1 and X0.01 ranges only. From 100 MHz to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

**Harmonic Content** — Second harmonic at least 35 dB down. Third and all higher harmonics at least 40 dB down.

**Other** — Rear edge card connection available to address the leveling circuit.

**Standard Accessory** — Precision 50  $\Omega$  cable 3 ft. long. (012-0482-00)

**SG 503 Signal Generator**



SG 504

**SIGNAL GENERATOR**

**Leveled, Variable Output**

**245 MHz to 1050 MHz**

**Frequency Modulation Capability**

The SG 504 Signal Generator provides a leveled output amplitude that is variable from 245 MHz to 1050 MHz in two bands. Frequency is indicated by a high-resolution tape dial that expands each band over 28 inches. The accurately calibrated output voltage is variable from 0.5 V to at least 4.0 V peak-to-peak into 50 ohms.

**Frequency Range** — Low band: 245 MHz to 550 MHz. Highband: 495 MHz to 1050 MHz, plus 50 kHz or 6 MHz reference frequency (internally selected).

**Frequency Accuracy** —  $\pm 2\%$  of dial indication.

**Amplitude Range** — 0.5 V to at least 4.0 V p-p.

**Amplitude Accuracy** — (at reference) Within 3% of indicated amplitude.

**Flatness** —  $\pm 4\%$  of amplitude at reference frequency.

**Harmonic Content** — 2nd harmonic at least 25 dB down; 3rd and all higher at least 40 dB down.

**Fm Input** — Frequency range: dc to 100 kHz. Deviation sensitivity:  $\pm 9$  V produces from  $\pm 0.05\%$  to  $\pm 0.4\%$  deviation of carrier, depending on output frequency.

**Frequency Monitor Output** —  $\geq 0.3$  V p-p into a 50  $\Omega$  load from 245 MHz to 1050 MHz.

**Rear Card Edge Connections** — Address fm input, frequency monitor output, and amplitude control.

**SG 504 Signal Generator (Includes Leveling Head)**

**Replacement Leveling Head, Order (015-0282-00)**



Direct current is almost invariably required for active devices, transducers, and many electromechanical components. Research, development, and design activities require supply voltages for the experimental or breadboard circuits and devices involved. Troubleshooting and maintenance, particularly when boards, modules, or sub-assemblies are removed for testing, also require versatile sources of direct current. Measurement systems often require dc for the basic transducers. While the possible combinations of voltage and current are infinite, modern semiconductors have decreased the typical maximum power requirements and have also produced some standardization of voltages. Most families of digital integrated circuits operate with a single 5 volt supply. Many operational amplifier ICs and other types of linear ICs operate with supply voltages in the 12 to 15 volt range, frequently requiring both positive and negative supplies. Complementary MOS (CMOS) logic typically can be powered by potentials ranging from a few volts to almost 20 volts.

The TM 500 line of power supplies features versatility and flexibility, with up to three independent voltages available from a single plug-in instrument. Three of the four power supplies feature a fixed 5-volt-at-1-amp supply for logic circuits or indicators plus one or two variable supplies. Two of these units — the PS 501-1 and PS 501-2 — are basically similar except for their means of voltage adjustment and indication. Each features a floating 0-to-20 volt output and ad-

justable current limiting from 0 to 400 milliamps with constant current operation above the limiting setting. The PS 501-1 precision supply uses a multiturn potentiometer with a mechanical digital readout for precise setting and adjustment of the output voltage. The PS 503A provides a dual -20, 0, +20 volt variable supply plus a 5 volt 1 A independent supply. The -20, 0, +20 volt supply can be varied in a tracked mode, or each part set individually. The two variable outputs each provide up to 1 amp in the high-power compartment of a TM 504 or TM 506, or 400 mA maximum in all other compartments of any TM 500 Mainframe. In the tracking mode, the plus and minus supplies are varied by one knob in proportion to the voltage ratio set on their individual controls. In the nontracking mode each can be set independently to any voltage from 0 to 20 V. Since all three of the variable supply terminals are floating, any one can be grounded or the two outside terminals used as a 0-to-40 volt supply. Both positive and negative variable supplies have their own current limiting.

In the high power slot (the far right-hand compartment of a TM 504 or TM 506) the PS 505 features a floating 3-to-5.5 volt output at up to 4 amperes with adjustable current limiting. In any other compartment, the maximum current available is 1 ampere and the output is nonfloating (negative grounded). A front-panel indicator light shows whether the PS 505 is in a standard or a high-power compartment. The PS 505 is particularly useful for powering TTL and ECL circuitry.

**CHARACTERISTICS COMMON TO  
PS 501-1, PS 501-2, PS 503A**

**20 V FLOATING SUPPLY**

**Primary Power Input** — Determined by power module (TM 501, TM 503, etc).

**Output** — Floating, isolated from ground, 350 V dc + peak ac.

**Stability** — (0.1% +5 mV) or less drift in 8 hours at constant line, load, and temperature.

**Indicator Lights** — Voltage variation and current limit.

**+5 V GROUND-REFERENCED SUPPLY**

**Output** — 5 V nominal, ±0.2 V at 1 A (20°C to 30°C).

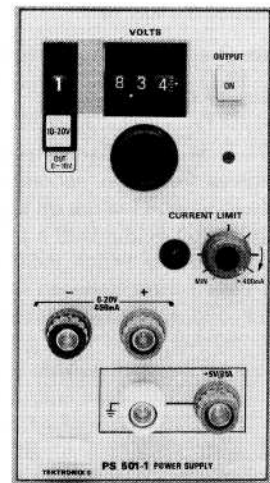
**Load Regulation** — Within 100 mV with a 1 A load change.

**Line Regulation** — Within 50 mV for a 10% line voltage change.

**Ripple and Noise (1A)** — 5 mV p-p or less; 100 μV rms or less.

**Stability** — 0.5% or less drift.

**Overload Protection** — Automatic current limiting and over-temperature shutdown.



**PS 501-1  
POWER SUPPLY**

**Floating Output, 0-20 V  
0 to 400 mA**

**Precise Regulation  
Low Ripple and Noise  
Fixed Output + 5 V**

**Output** — 0 to 20 V dc.

**Current Limit** — <40 to 400 mA.

**Line Regulation** — Within 5 mV for a ±10% line voltage change.

**Load Regulation** — Within 1 mV with a 400 mA load change.

**Ripple and Noise** — 0.5 mV p-p or less; 0.1 mV rms or less.

**Temperature Coefficient** — 0.01%/°C or less.

**Minimum Resolution** — 1.6 mV.

Voltage is selectable within 0.5% by a 10 turn potentiometer with a 3 digit in-line dial and range switch.

**Transient Recovery Time** — 20 μs or less for a constant voltage to recover within 20 mV of nominal output voltage after a 400 mA change in output current.

**PS 501-1 Power Supply**

**POWER SUPPLIES—COMPARISON OF CHARACTERISTICS**

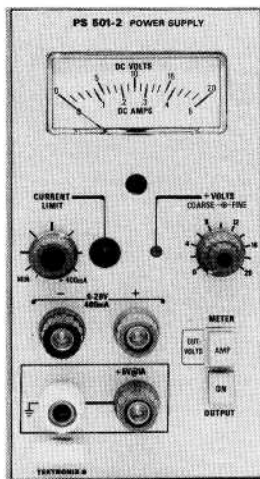
The following is a comparison of the major characteristics of the power supplies.

A complete list of specifications may be found on the following pages.

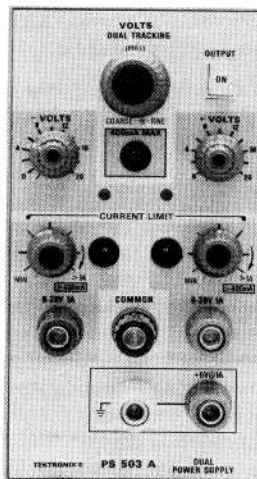
	PS 501-1	PS 501-2	PS 503A	PS 505
Voltage/Current #1	+5 V @ 1 A	+5 V @ 1 A	+5 V @ 1 A	+3 to 5.5 V 4 A*
Voltage/Current #2	0-20 V @ 400 mA	0-20 V @ 400 mA	0 to +20 V @ 1 A* / 400 mA**	No
Voltage/Current #3	No	No	0 to -20 V @ 1 A* / 400 mA**	No
Current limit	<40-400 mA	<40-400 mA	<100 mA-1 A* 400 mA**	<0.4-4.0 A
Min resolution	1.6 mV	10 mV	10 mV	—
Foldback current	No	No	No	Yes >4.0* A foldback to <1.5 and latches
Over voltage protection	No	No	Yes	Yes
Line regulation	<5 mV††	<5 mV††	<5 mV†††	<10 mV†
Ripple & noise p-p	0.5 mV††	0.5 mV††	0.5 mV†††	3 mV†
Others	Multiturn pot with digital readout	Meter for voltage or current	+ - outputs independent, or dual tracking at ratio set by individual knobs	

\*In high-power (right-hand) compartment of TM 504 or TM 506.  
\*\*In any standard mainframe compartment.

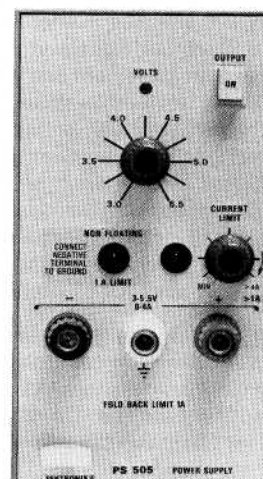
†Refers to output #1  
††Refers to output #2  
†††Refers to output #2 and #3



**PS 501-2  
POWER SUPPLY**



**PS 503A  
TRIPLE POWER SUPPLY**



**PS 505  
POWER SUPPLY**

**Floating Output, 0-20 V**

**0 to 400 mA**

**Precise Regulation**

**Low Ripple and Noise**

**Fixed Output + 5 V**

**Dual-Range Meter Readout**

**Output** — 0 to 20 V dc.

**Current Limit** — <40 mA to 400 mA.

**Minimum Resolution** — 10 mV.

**Line Regulation** — Within 5 mV for a  $\pm 10\%$  line voltage change.

**Load Regulation** — Within 1 mV with a 400 mA load change.

**Ripple and Noise** — 0.5 mV p-p or less; 0.1 mV rms or less.

**Temperature Coefficient** — 0.01%/°C or less.

**Transient Recovery Time** — 20  $\mu$ s or less for a constant voltage to recover within 20 mV of nominal output voltage after a 400-mA change in output current.

**Meter** — Dual range, 0 to 500 mA or 0 to 20 V dc. Accuracy,  $\pm 2\%$  of full scale.

**PS 501-2 Power Supply**

**Independent + and - Controls**

**Dual Tracking Voltage Control**

**0 to  $\pm 20$  V at 1 A (in high-power compartment)**

**Fixed 5 V at 1 A**

**Remote Resistance Programming**

**Overvoltage Protection Standard**

The PS 503A features superior dual tracking performance, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504 or TM 506 Mainframe, the PS 503A provides up to 1 amp from both + and -, 0 to 20 volt supplies.

**$\pm 20$  V FLOATING SUPPLIES**

**Output** — 0 to  $\pm 20$  V dc with respect to the common terminal or 0 to 40 V dc across the + and - terminals. Outputs can be varied independently or at a constant ratio.

**Tracking Mode Offset Error** — If the two supplies are set independently to any given voltage ratio and then varied by use of the VOLTS DUAL TRACKING control, the two supplies will maintain the same voltage ratio as initially set within  $\pm 50$  mV.

**Current Limit** — Adjustable from less than 100 mA to 1 A (high-power compartment) or less than 40 mA to 400 mA (standard compartment) on each supply.

**Load Regulation** — Within 3 mV for 1 A change (high-power compartment) or 1 mV for 400 mA change (standard compartment).

**Ripple and Noise** — 3 mV p-p or less at 1 A load (high-power compartment). 0.5 mV p-p or less at 400 mA load (standard compartment).

**Indicators** — Individual voltage indicators and current limiting indicators for both + and - supplies. Non-high-power compartment (400 mA) indicator.

**PS 503A Power Supply**

**Floating Output**

**3 to 5.5 V at 4 A**

**Overvoltage Protection Standard**

**Remote Resistance Programming of Voltage**

The PS 505 is a variable, low voltage, high current, dc power supply. It is designed to operate in the high-power compartment of a TM 504 or TM 506 Power Module. In the high-power compartment, it provides a floating 3.0 to 5.5 V dc at 4.0 A. Operating in a standard compartment of a TM 500-Series Power Module, the PS 505 will supply at least 1.0 A nonfloating (negative ground).

**Line Regulation** — Within 10 mV for a  $\pm 10\%$  line voltage change.

**Load Regulation** — Within 5 mV for 0.5 to 4.0 A load change.

**Ripple and Noise** — 3 mV p-p or less.

**Temperature Coefficient** — 0.01%/°C or less.

**Stability** — 0.1% +5 mV of drift in 8 hours at constant line, load, and temperature.

**Foldback Current** — When output current exceeds 4.1 A, current folds back to less than 1.5 A and latches.

**PS 505 Power Supply**

**OPTIONAL ACCESSORY**

**Terminal Access Adapter Kit** — For breadboarding and fixturing. Plugs directly onto front of PS 501-1, PS 503A, or PS 505. See accessory section for more details.

**Order 013-0152-00**

Signal processors are used to alter the characteristics of electrical signals in order to permit improved measurement and analysis. Typical examples include preamplification of low-level signals, addition or removal of dc offset, filtering to remove unwanted noise or signals outside the spectrum of interest, integration, differentiation, summing of multiple signals, impedance transformation, and post amplification to provide higher amplitude drive from low-amplitude signal sources.

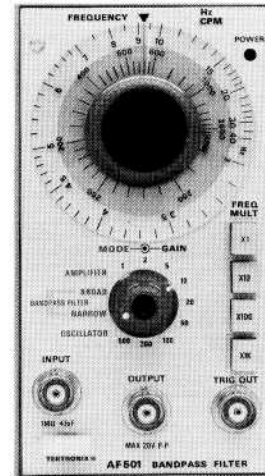
The TM 500 line of signal processors includes three versatile instruments, the AF 501 Bandpass Filter/Amplifier, the AM 501 Operational Amplifier, and the AM 502 Differential Amplifier. Each is capable of being used in a variety of applications.

The AF 501 Bandpass Filter/Amplifier is an active filter whose center frequency is one-knob tunable over the entire audio range from 3 Hz to 35 kHz. Broad (Q=5) and narrow (Q=15) bandwidths are switch selectable. Flat amplification to 50 kHz is also available. In both filter and flat modes, amplification from 1 to 500 may be selected in a 1-2-5 sequence. The AF 501 also features an oscillator mode where the output frequency is the same as the center-tuned frequency in the filter modes. A signal output pulse, used for driving counters or oscilloscopes or for triggering stroboscopic lamps in study of mechanical systems, is also provided. The AF 501 selectivity permits individual analysis of the fundamental and harmonic compo-

nents of complex waveforms, such as signals from vibration transducers.

The AM 501 Operational Amplifier is a high-output unit with front-panel jacks for quick and easy change of configurations by selection of feedback components. The output power available ( $\pm 40$  volts and  $\pm 50$  mA across loads of 800 ohms) is adequate for most electronic and many electromechanical applications. The AM 501 is ideal for classroom instruction and experimental use; it can be conveniently set up for various useful applications, such as differentiation, integration, summing, and impedance transformation. Where a more permanent use in a given configuration is desired, the feedback components may be hardwired inside the instrument.

The AM 502 Differential Amplifier is a highly flexible instrument giving control of gain, dc offset, low-frequency response, and high-frequency response. It may be used with single-ended input or in differential mode for maximum rejection of common-mode noise signals. High amplification may be used even with low-level signals having a dc component up to one volt, since the variable dc offset of the AM 502 can be used to cancel the signal's dc component. Full bandwidth of the amplifier is 1 MHz: switch-selectable high-pass and low-pass filters permit reducing the noise bandwidth when the full frequency range is not required.



**AF 501  
BANDPASS FILTER**

- Tunable Bandpass Filtering to 35 kHz**
- Signal Amplification to 50 kHz**
- Sine-wave Generation to 35 kHz**
- Strobe Trigger Synced to Oscillator or Filter Output**
- Dial Readings in Hz or Cycles per Minute**

The AF 501 is a bandpass filter/amplifier, ac-coupled amplifier and sine-wave generator combined in a single TM 500-Series module. Used alone or in conjunction with other TM 500-Series instruments, the AF 501 is a highly versatile and accurate signal analysis tool. Developed primarily for the mechanical

### SIGNAL PROCESSORS — COMPARISON CHART

The following is a comparison of the main characteristics of the AF 501, AM 501, and AM 502. A complete list of specifications appears on the following pages.

	<b>AF 501 Tunable Bandpass Filter/Amplifier</b>	<b>AM 501 Operational Amplifier</b>	<b>AM 502 Differential Amplifier</b>
Amplification range	1 to 500 in 1-2-5 steps	Depends on feedback components; open loop gain 10,000	1 to 100,000 in 1-2-5 steps
Input impedance	1 M $\Omega$	Depends on feedback components	1 M $\Omega$ normal; FET input by internal jumper
Bandwidth control	Center frequency tunable 3 Hz to 35 kHz; Q=5 or 15	Depends on feedback components; max gain-bandwidth product 5 MHz	Independent switch-selected high-frequency and low-frequency filters
Maximum output	20 V p-p (Bandpass filter)	$\pm 40$ V, $\pm 50$ mA with 800 $\Omega$ load	$\pm 5$ V, $\pm 20$ mA, output resistance 5 $\Omega$ or less
Other features	Functions as audio oscillator, narrow or wide bandwidth tunable filter and flat audio amplifier	Use as inverting or noninverting amplifier, follower, summing amplifier, integrator, differentiator, etc, by appropriate feedback R and C	Coarse and fine control of up to $\pm 1$ V of internal dc offset, ac or dc coupling, single-ended or differential input, 25 $\mu$ V equivalent input noise at full bandwidth



measurement domain, the AF 501 can be used as a manual-sweep spectrum analyzer for complex sound and vibration signals. Single-frequency tuning facilitates isolation of 1X rpm signals in dynamic balancing, or viewing higher order disturbances on a crt monitor. An output pulse, synced to the filter or oscillator output signal, is available for triggering a stroboscope or oscilloscope and for frequency counting. And, of course, the AF 501 can be used in any application calling for a conventional sine-wave generator, ac-coupled amplifier, or bandpass filter.

**BANDPASS FILTER**

**Center Frequency Range** — 3 Hz to 35 kHz in 4 decade steps.

**Frequency Dial Error** — <5% dial setting between 3-20, <10% dial setting between 20-30.

**Frequency Multiplier** — X1, X10, X100, X1 k.

**Phase Shift** — <10° at tuned frequency below 5 kHz.

**Dial Range** — 3 to 40 Hz/180-2400 cpm.

**Max Filter Attenuation** — >70 dB.

**Filter Selectivity** — Broad: Q = 5 ± 1.  
Narrow: Q = 15 ± 5.

**Bandwidth at Half-power Points** —

$$\Delta F_{-3\text{ dB}} = \frac{\text{center frequency}}{Q}$$

**Gain Range** — 1-500; 1-2-5 sequence.

**Gain Accuracy** — ± 3 dB (Broad), ± 5 dB (Narrow).

**Input Impedance** — 1 MΩ ± 1% paralleled by ≈ 47 pF.

**Max Nondestruct Dc Input Voltage** — ± 100 volts.

**Output Voltage** — 20 V p-p (max freq times amplitude = 400 V kHz).

**Output Current** — 20 mA p-p MAX (at 20 V p-p).

**Output Impedance** — < 1 Ω.

**AMPLIFIER**

**Gain** — 1 to 500; 1-2-5 sequence.

**Gain Accuracy** — ± 3%.

**Bandwidth** — < 0.5 Hz to > 50 kHz (at 3 dB point).

**Input Impedance** — 1 MΩ ± 1% paralleled by ≈ 47 pF.

**Noise** — < 25 mV rms (referred to output).

**Output Voltage** — 20 V p-p (max freq times amplitude = 400 V kHz).

**OSCILLATOR**

**Sine Wave Out Range** — 3 Hz to 35 kHz.

**Dial Range** — 3 to 40 Hz/180-2400 cpm.

**Output Amplitude** — 1, 2, or 5 V p-p ± 20%, depending on gain position.

**Waveform Distortion** — < 3%.

**Output Current** — Max 50 mA p-p.

**Output Impedance** — < 1 Ω (within 50 mA output current limit).

**TRIGGER OUTPUT**

**Pulse Amplitude** — > 10 volts.

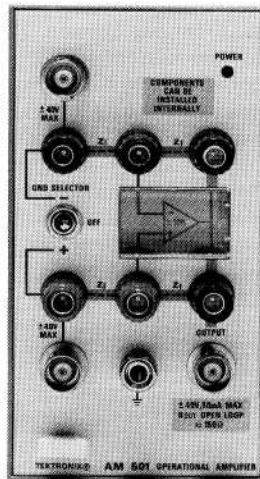
**Pulse Duration** — 10 ± 5 μs.

**Min Signal Required** — 500 mV, p-p

**Rise and Fall Time** — < 1 μs.

**Output Impedance** — ≈ 50 Ω.

**AF 501 Bandpass Filter/Amplifier**



**AM 501 OPERATIONAL AMPLIFIER**

± 40 V, 50 mA Output

Open Loop Gain 10,000

50 V/μs Slew Rate

Symmetrical Differential Design

The AM 501 Operational Amplifier features high input impedance (FET), high slew rate, a wide range of input and output voltage, and high output current. Applications include: amplification; impedance transformation; integration; differentiation and summing. It is well-suited as a post-amplifier or offset-generator for signal sources, including the TM 500 modules. Components may be added externally or internally making it ideal for teaching operational amplifier theory.

**OPERATIONAL AMPLIFIER**

**Open Loop Gain** — At least 10,000 into 800 Ω load.

**Unity Gain Bandwidth** — At least 5 MHz into 800 Ω load.

**Common-Mode Rejection Ratio** — At least 10,000 to 1 at 60 Hz.

**Slew Rate** — At least 50 V/μs into a 800 Ω load.

**INPUT**

**Common-Mode Input Voltage Range** — At least ± 40 V.

**Input Leakage Current** — Less than 500 pA at 20°C.

**Equivalent Input Drift** — Less than 100 μV/°C.

**Equivalent Input Noise** — Less than 10 μV rms.

**Max Safe Differential Input** — 80 V.

**OUTPUT**

**Voltage Range** — At least ± 40 V.

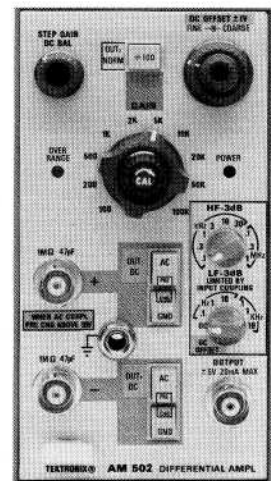
**Current Limit** — At least ± 50 mA.

**Open Loop Output R** — Approx 150 Ω.

**AM 501 Operational Amplifier**

**OPTIONAL ACCESSORY**

Terminal Accessory Adapter Kit  
(013-0146-00)



**AM 502 DIFFERENTIAL AMPLIFIER**

1-to-100,000 Gain

100 dB Cmrr

Selectable Upper and Lower — 3 dB Points

Dc-to-1 MHz Bandwidth

Adjustable Dc Offset

The AM 502 Differential Amplifier features: wide bandwidth; high cmrr; and selectable calibrated gain and filtering. Well-suited for general-purpose or laboratory work, it can drive oscilloscopes, monitors, chart recorders, display, or processing devices. In the unity gain mode, it can be used as a signal conditioner. Input dc offsetting to ± 1 V is provided.

**AMPLIFIER**

**Gain** — 1 to 100,000, 1-2-5 sequence, accurate within 2%.

**Frequency Response** — From dc (if ac coupled, 2 Hz or less at -3 dB point) to 1 MHz within +25%, -15% with GAIN set to 20 k or less. Upper -3 dB point reduces to 500 kHz at 50 k gain, 250 kHz at 100 k gain.

**HF -3 dB POINT** — Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz. (Also limited by frequency response at gains of 50 k and 100 k.)

**LF -3 dB POINT** — Selectable in 6 steps from 0.1 Hz to 10 kHz.

**Dc Offset** — At least + or - 1 V to offset signal dc component.

**Normal Mode Cmrr** — At least 100 dB, dc to 50 kHz, range, ± 5 V.

÷ **100 Mode Cmrr** — At least 50 dB, dc to 50 kHz, range, ± 50 V.

**Max Safe Inputs** — Normal mode dc coupled: 15 V (dc + peak ac). ÷ 100 Mode dc coupled: 350 V (dc + peak ac). Ac coupled: 350 V (dc + peak ac) with coupling capacitor precharged.

**Input R and C** — 1 MΩ paralleled by approx 47 pF. Input impedance can be increased to FET input via a simple internal jumper change.

**OUTPUT**

**Max Output** — ± 5 V, ± 20 mA, output resistance is 5 Ω or less.

**Min Load Impedance** — 250 Ω.

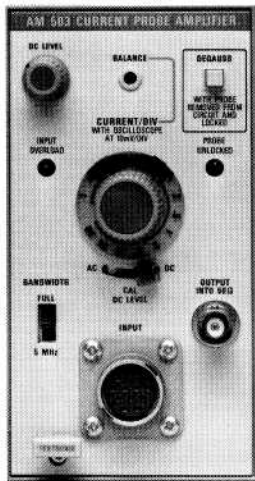
**Max Input Gate Current** — 50 pA at 25°C.

**Max Noise** — 25 μV or less (tangentially measured).

**Overrange** — Front-panel lamp indicates most over-range conditions.

**Max Voltage Drift** — 100 μV/°C.

**AM 502 Differential Amplifier**



**AM 503  
CURRENT-PROBE AMPLIFIER**

Displays current/div signals on an oscilloscope

Current range, maximum current, and bandwidth determined by the probe used

The AM 503 is a plug-in modular current-probe amplifier that operates in TM 500 Mainframes. It allows display of current/division on any oscilloscope with 10 mV/div sensitivity, 50 ohm or 1 megohm input, and (for performance to full specifications) at least 100 MHz bandpass. The amplifier attenuator is calibrated in 12 steps with a 1, 2, 5 sequence, and the knob-skirt is illuminated

to indicate current per division. The current range, maximum current rating, and bandwidth are determined by the particular probe in use. Bandwidth can be set to FULL (where it is limited by the probe in use) or to 5 MHz. Coupling may be switch selected to ac or dc. Ac coupling offers a convenient means of measuring low-amplitude ac signals on a high-level dc current. A front-panel indicator warns of input current overload.



**P6302  
CURRENT PROBE**

- 1 mA/div to 5 A/div
- 20A (dc + peak ac) max
- 50 A peak pulse max
- dc to 50 MHz

When a P6302 Current Probe is used with the AM 503 Current-Probe Amplifier, the current range is from 1 mA/div to 5 A/div. Maximum current is 20 A peak (dc + peak ac). Peak pulse maximum is 50 A not to exceed a

product of 100 A μs. And bandwidth is dc to 50 MHz. The probe operates through inductive coupling with no electrical contact. A flick of your forefinger operates the sliding jaw in the insulated probe tip. Just put the probe tip around the conductor under test for immediate current readings.

**ELECTRICAL CHARACTERISTICS  
(AM 503 Current Probe Amplifier with P6302 Probe)**

**Maximum Input Current** — Dc + peak ac: 20 A (derated with frequency). Peak pulse: 50 A (for pulse greater than 20 A, the pulse amp-sec product should not exceed 100 Aμs).

**Maximum Voltage for Current Under Test (Bare Conductor)** — 500 V (dc + peak ac).

**Bandwidth (−3dB)** — FULL: Dc to at least 50 MHz with P6302 Probe. 5 MHz: 5 MHz ± 1 MHz. Ac coupled, lower bandwidth limit: 7 Hz or less.

**Rise Time (FULL Bandwidth)** — 7 ns or less.

**Deflection Factor** — 1 mA/div to 5 A/div. in a 1, 2, 5 sequence.

**Attenuator Accuracy** — Within 3% of indicated CURRENT/DIV.

**Power Consumption (Full Load)** — AM 503 only: 17 W.

**INCLUDED ACCESSORIES**

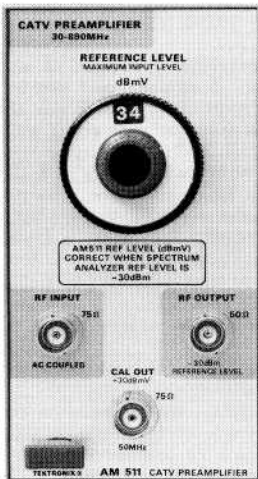
50 Ω cable w/bnc (012-0057-01), 50 Ω terminator (011-0049-01).

**AM 503 Probe Amplifier**

**INCLUDED ACCESSORIES**

7 cm ground lead (175-0263-01), 13 cm ground lead (175-0124-01), 2 alligator clips (344-0046-00).

**P6302 Current Probe  
Order 010-6302-01**



**AM 511  
PREAMPLIFIER**

For Use with 7L12 or 7L13 Spectrum Analyzers

Reference Level Selectable in 1 dB or 10 dB Steps

30 to 890 MHz Frequency Range

The AM 511 is a plug-in preamplifier for use with the 7L12 or 7L13 Spectrum Analyzers. It plugs into a TM 500 Power Module to meet the need of those who require a preamplifier for use with the 7L13.

The AM 511 applications include signal to noise, radiation, and field intensity measurements to FCC specifications on CATV, television, and fm installations. It is also useful in servicing and making measurements on radio systems and increasing sensitivity for emi measurements within the 30 to 890 MHz frequency range.

Concentric selectors select the reference level in either 1 dB or 10 dB steps and indicate this level in dBmV via a readout window. This level is also the maximum signal input level for linear operation. A +30 dBmV signal source at the input connector provides −30 dBm (from 50 Ω) signal at the OUTPUT connector. (Reference level readout uses an output of −30 dBm as a reference; therefore the 7L12 or 7L13 Reference Level must be set and calibrated for −30 dBm.) The CAL OUT Connector provides an accurate +30 dBmV, 50 MHz signal source from 75 Ω. This signal provides an absolute reference on the display of the 7L12 or 7L13 to check dBmV readings and calibrate the REFERENCE LEVEL. Harmonics of the 50 MHz provide picket fence markers across the frequency span for accurate frequency and span calibration.

**ELECTRICAL CHARACTERISTICS  
(with 7L12 or 7L13)**

**Frequency Range** — 30 MHz to 890 MHz.

**Display Flatness** — (AM 511/7L12) ±1.0 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB over the full frequency range. (AM 511/7L13) +1.0 dB, −1.5 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB, over the full frequency range.

**Sensitivity** — Signal + noise = 2X noise, in LIN mode. The following characteristics apply at 50 MHz.

Sensitivity	Resolution Bandwidth
−90 dBmV	30 Hz
−80 dBmV	300 Hz
−73 dBmV	3 kHz
−65 dBmV	30 kHz
−55 dBmV	300 kHz
−45 dBmV	3 MHz

Noise figure for the AM 511 is no greater than 5 dB.

**Intermodulation Distortion** — (AM 511/7L12 or AM511/7L13) 1md products and harmonics from two signals within the frequency span of the AM 511 are 70 dB or more down from the reference level for: 1) Third order intermodulation with two signals at the reference level (full screen), and 2) Second order intermodulation and harmonics, with two signals 10 dB below the reference level.

**Reference Level** — Calibrated level in 1 dB steps from +79 dBmV to 0 dBmV. Accuracy is referenced to the +30 dBmV Calibrator at 50 MHz. Max deviation from this reference is 0.2 dBmV +0.01 dBmV per dB deviation from the +30 dBmV AM 511 reference level. This is equivalent to: ± (0.2 dBmV ± 0.01 [dBmV Ref Lvl −30 dBmV]).

**Input Impedance** — 75 Ω with a vswr of 2:1 or better with 10 dB or more attenuation (between 50 MHz and 300 MHz).

**Calibrator** — 50 MHz ±0.01% with an absolute amplitude level of ±30 dBmV ±0.3 dB, from 75 Ω at 25°C.

**AM 511 CATV Preamplifier**

The ubiquitous cathode-ray oscilloscope is the world's most useful and versatile electronics test and measurement instrument. Tektronix, long identified with the oscilloscope, could hardly develop the TM 500 line of modular instrumentation without including crt display capability.

Three choices of performance level and display size are now available to add waveform display to the digital measurement capabilities of the TM 500 Multimeters and Counters.

The new SC 502 is a full-feature dual-trace 15 MHz oscilloscope packaged as a double-width TM 500 Plug-in. It features an exceptionally bright (12 kV) crt with an 8 x 10 division (0.25 in/div) graticule. A delay line allows observation of the full leading edge of waveforms. Vertical sensitivity is selectable from 1 mV/div to 20 V/div in 1-2-5 sequence, and sweep times can be chosen from 1.25 seconds/div to 20 nanoseconds/div. Sophisticated oscilloscope features include enhanced auto trigger for hands-off operation with a wide variety of signals, selectable trigger hold-off for digital circuit applications, trigger view, and an A minus B vertical mode for differential viewing of signals.

The SC 501 is a complete triggered-sweep calibrated time base single-trace oscilloscope. Y channel bandwidth is 5 MHz and sweep rates from 1 second per division to 200 nanoseconds per division are featured. In addition to display and measurement of external signals or waveforms generated by

TM 500 signal sources in the same power module, the SC 501 or SC 502 can also be integrated into more complex measurement packages. For example, the horizontal sweep on either oscilloscope also produces a ramp which is available on the rear interface connector, and this signal can be used to control other TM 500-Series instruments. The ramp can be used to sweep the function generator outputs of several TM 500 instruments, or as a delay source for the PG 505 Pulse Generator.

Both the MR 501 and SC 501 have miniature 2.5 inch crt's with an internal 6 x 10 division

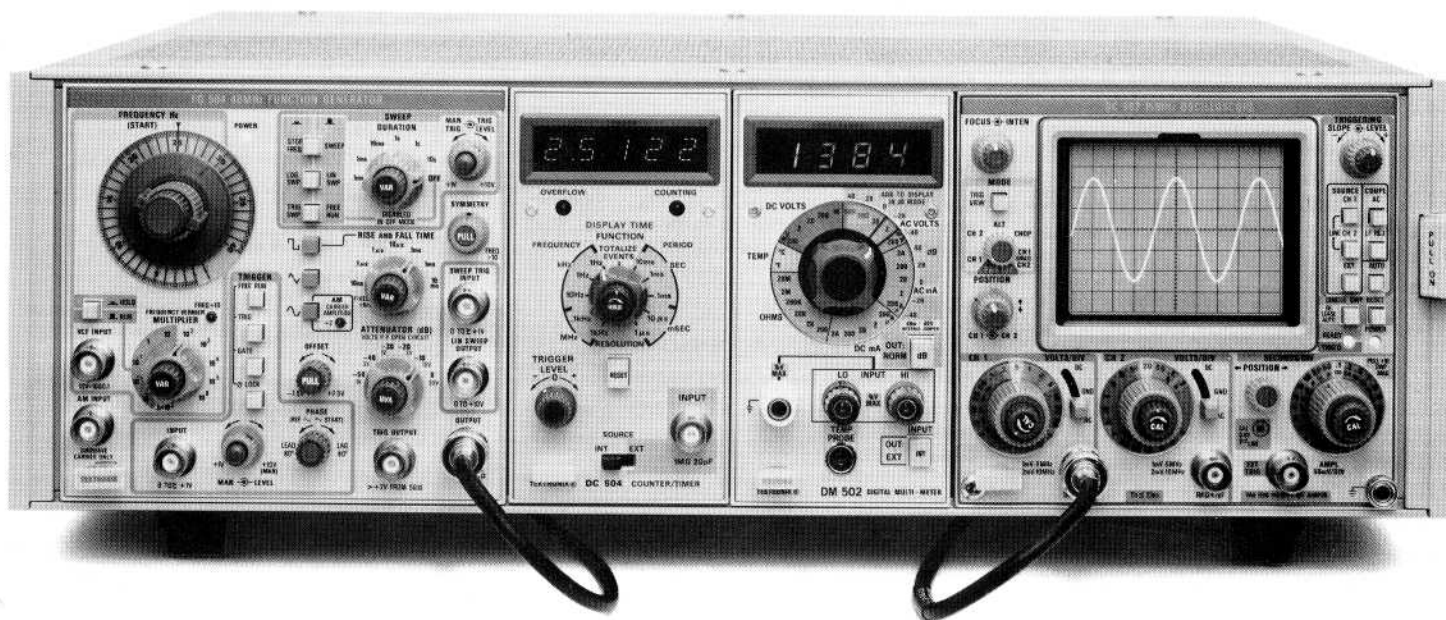
graticule of 0.203 inches per division. The MR 501 contains no time base and is optimized for X-Y displays. X and Y bandwidths are 2 MHz and the two channels are phase-matched. X, Y, and Z axis inputs all appear on the front panel.

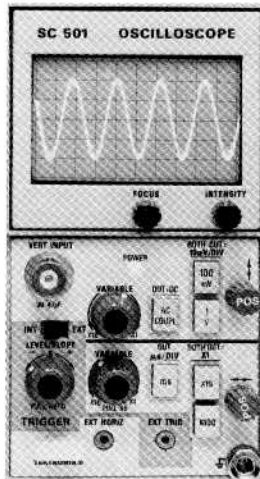
Where a time-calibrated display is required the RG 501 ramp output is compatible for use with the MR 501. Many useful functions, such as frequency sweeps, and delayed pulses or pulse trains, can be obtained by combining the MR 501 and RG 501 with a TM 500 Function Generator or the PG 505 Pulse Generator.

### OSCILLOSCOPE AND MONITOR COMPARISON CHART

The following is a comparison of the main characteristics of the SC 501, SC 502, and MR 501. A complete list of specifications appears on the following pages.

	SC 502	SC 501	MR 501
Crt	8 x 10 div, 0.25 in/div P31 phosphor	6 x 10 div, 0.203 in/div P31 phosphor	6 x 10 div, 0.203 in/div P31 phosphor
Vertical (Y) axis	Dual-trace, 15 MHz, 1 mV to 20 V/div (5 and 10 MHz bandwidth at 1 and 2 mV) alt, chop, and ch 1 minus ch 2 modes	5 MHz bandwidth, 10 mV/div to 10 V/div	2 MHz bandwidth, 10 mV/div to 10 V/div
Horizontal (X) axis	Triggered sweep 200 ns/div to 0.5 s/div with X10 magnifier, X2.5 variable, normal, enhanced auto, ext/int trig, single sweep, external horizontal input, variable trigger hold off	Triggered sweep 1 $\mu$ s/div to 1 s/div with X5 magnifier to 200 ns/div, normal/auto trigger, internal/external-trigger, external horizontal input	2 MHz bandwidth, 10 mV/div to 10 V/div, phase matched to Y axis within 1° from dc to 100 kHz.
Other features	Trigger view, 12 kV accelerating potential		





**SC 501  
OSCILLOSCOPE**

**5 MHz Bandwidth**

**Single Compartment Size**

**2½ in Crt**

**Versatile Operating Features**

The SC 501 is a single-channel 5 MHz plug-in unit oscilloscope with a 2.5 inch crt display which occupies a single TM 500-Series Plug-in compartment. Oscilloscope capability significantly enhances the application range of the multifunctional TM 500-Series Test and Measurement Instruments.

With the SC 501 a multitude of versatile test systems may be structured from the TM 500-Series to suit specific needs for time and frequency response, modulating waveforms, power for devices under test, stimulus and response studies and voltage, current, and temperature measurements. Since the SC 501 fits any TM 500 Mainframe, it can be used on the bench, in a rack, or on the road.

The single-channel SC 501 has a calibrated vertical deflection range from 10 mV/div to 1 V/div, selectable in decade steps. A variable control extends this range to at least 10 V/div.

Calibrated sweep rates are selected by pushbutton logic in decade steps from 1 μs/div to 100 μs/div (microsecond), and from 1 ms/div to 100 ms/div (millisecond range). A variable control extends the slowest sweep rate to at least 1 s/div and a fixed magnifier extends the fastest sweep rate to 200 ns/div.

A zero to 10 V ramp for all sweep rates (excluding the X5 magnification) is provided at a rear interface connector. This capability may be used for many auxiliary functions such as sweeping a voltage controlled frequency oscillator or obtaining variably delayed pulses from the PG 505 Pulse Generator.

The triggering circuits allow stable triggering from either internal or external sources. An AUTO triggering mode and manual LEVEL/SLOPE selection is combined in a single control. It is useful above 10 Hz and provides a bright baseline at all sweep rates.

An internal switch converts the horizontal deflection system of the SC 501 to an external horizontal amplifier which is internally calibrated for 100 mV/div deflection factor with a bandwidth of 100 kHz.

**VERTICAL DEFLECTION**

**Bandwidth** — Dc to >5 MHz.

**Deflection Factors** — 10 mV/div, 100 mV/div, and 1 V/div. Accuracy, within 3%. Uncalibrated (variable) range, continuously variable between steps (10:1) and to at least 10 V/div.

**Input Coupling** — Ac or dc.

**Input Impedance** — 1 MΩ paralleled by 47 pF.

**Max Safe Input Voltage** — 350 V (dc + peak ac).

**HORIZONTAL DEFLECTION**

**Time Base** — Calibrated sweep rates: 1 μs/div, 10 μs/div, 100 μs/div, 1 ms/div, 10 ms/div, 100 ms/div. Uncalibrated (variable) range: extends slowest calibrated rate to ≥1 s/div. X5 magnifier (fixed): extends fastest calibrated sweep rate to 200 ns/div. Accuracy (over center 8 div): ≥5% for all sweep rates. Linearity (any two div portion within center eight div): ≥5%.

**External Horizontal Amplifier** — Bandwidth: dc to 100 kHz. Input impedance: ≥100 kΩ paralleled by 25 pF. Max input voltage: ±3 V.

**TRIGGER**

**Normal Trigger Sensitivity (Trigger Level/Slope In)** — Internal: dc coupled, 0.4 major div of deflection at dc; increasing to 1.0 major div of deflection at 5 MHz. External: dc coupled, 1 V minimum to 5 V max from dc to 5 MHz. External trigger input impedance: 22 kΩ paralleled by approx 150 pF.

**Auto (Trigger Level/Slope Out)** — Sweep free-runs in absence of trigger signal or for trigger repetition rates below 10 Hz.

**CRT**

**Crt Type** — T2110.

**Graticule** — Type: internal black lines, nonilluminated. Area: six div vertical by 10 div horizontal. Each div equals 0.203 in. Phosphor: P31 standard.

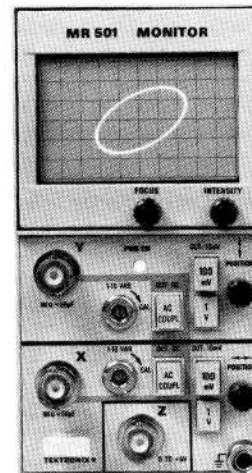
**SC 501 Oscilloscope**

**OPTIONAL ACCESSORIES**

**Passive Probes** — See Accessory Section.

**Pin Jack to BNC** — Adapter for EXT HORIZ and EXT TRIG

**Order (175-1178-00)**



**MR 501  
MONITOR**

**2 MHz X-Y Bandwidth**

**10 mV to 10 V Deflection Factors**

**Dc to 200 kHz Z-Axis Input**

**Compatible with RG 501**

Small size, 2 MHz X-Y bandwidth and selectable sensitivity make the MR 501 a highly desirable monitor oscilloscope. It may be used with the RG 501 to form a complete oscilloscope having a wide range of sweep rates and full triggering facilities. Six MR 501's will fit in a single RTM 506 Mainframe, allowing easy construction of large or small multiple displays.

**VERTICAL and HORIZONTAL AMPLIFIERS**

**Bandwidth** — Dc to at least 2 MHz.

**Deflection Factor** — 10 mV/div to 1 V/div in decade steps. Accurate within 3%, continuously variable between steps and to at least 10 V/div.

**Input R and C** — 1 MΩ paralleled by less than 50 pF.

**Input Coupling** — Ac or dc.

**Max Safe Input Voltage** — 350 V (dc + peak ac).

**X-Y Phase Shift** — Within 1° from dc to 100 kHz.

**Z-AXIS AMPLIFIER**

**Bandwidth** — Dc to at least 200 kHz.

**External Input Voltage** — Plus 5 volts turns crt beam on from an off condition (compatible with RG 501 gate output).

**Input Impedance** — 10 kΩ paralleled by less than 50 pF.

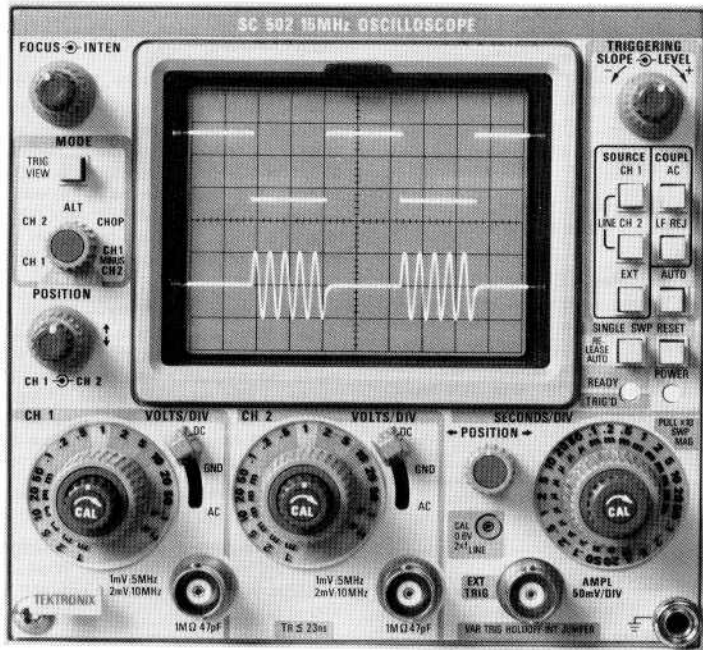
**Input Coupling** — Dc.

**CRT**

**Graticule** — Internal 6 x 10 div, 0.203 in/div.

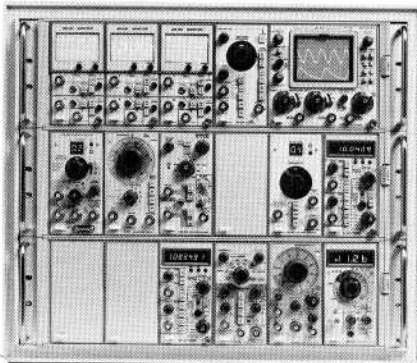
**Phosphor** — P31.

**MR 501 X-Y Monitor**

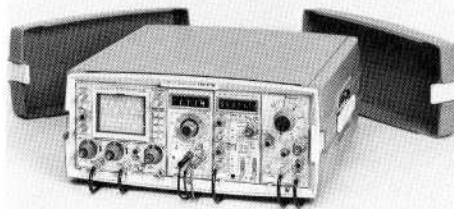


- A Full-Featured 15 MHz Dual-Trace Oscilloscope in a Two-wide Plug-in**
- 20 ns/div Max Calibrated Sweep Rate**
- 1 mV/div Max Sensitivity**
- Delay Line**
- Trigger View**
- Variable Trigger Hold-off**
- Enhanced Automatic Triggering**

The SC 502 is a general-purpose 15 MHz dual-trace oscilloscope designed to operate in any two adjacent compartments of TM 500 Power Module/Mainframes. It has a high writing speed, a wide range of sweep rates, a wide range of deflection factors, and versatile triggering, including trigger view and enhanced automatic triggering.

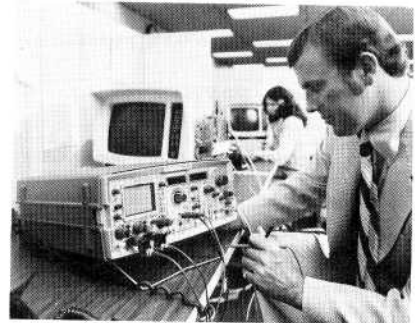


The SC 502 makes many new instrumentation systems feasible, especially in the areas of QA, production testing, maintenance, and field servicing. The rear interfacing capability of the SC 502 and all TM 500 instrumentation suggests exceptional applicability to systems of built-in test equipment or rack-mounted installations. And the TM 515 Traveler Mainframe with the SC 502 form a nucleus for sophisticated, compact field service "packages."

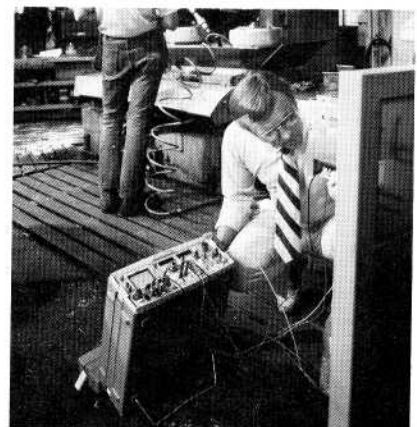


As with many TEKTRONIX Products, the SC 502 features circuits, sub-circuits, and components designed and built by Tektronix to fulfill the special design capabilities of the instrument. Among its many recommended uses, the SC 502 is intended to be a power-

ful tool in the field servicing of digital equipment, where it would be used in association with disc memories, key-to-tape, printers, plotters, punches, readers, and terminals. The crt of the SC 502, for example, is of new design, offering a high writing speed as an advantage in the display of digital information, while stable, clean triggering is assured by incorporating well-proven circuits. Thus, the SC 502 offers the engineer a unique combination of performance, compactness, and systems capability.



This instrument offers the features most often identified with more expensive monolithic or plug-in oscilloscopes, such as complete dual-trace modes, delay-line, trigger view, 1 mV sensitivity, sweep speeds from 0.5 s/div to 200 ns/div in 1-2-5 sequences, plus X10 sweep magnifier for calibrated sweep speeds to 20 ns/div, single sweep, external horizontal input, probe calibrator, variable trigger holdoff, and an exceptionally bright crt trace as a special advantage in field servicing and production areas where high ambient light levels are often encountered.



The probe recommended for use with the SC 502 is the P6062A, which has selectable 1X and 10X attenuation.

Here is an oscilloscope that allows industry to apply the same measurement system from product research and development, through production, to field servicing.

# SC 502 Oscilloscope

## VERTICAL DEFLECTION

**Bandwidth at -3 dB points** — 5 mV to 20 V/div, dc to at least 15 MHz; 2 mV/div, dc to at least 10 MHz; 1 mV/div, dc to at least 5 MHz.

**Rise Time** — 5 mV to 20 V/div, 23 ns or less.

**Ac Low-Frequency Response (Lower -3 dB point)** — Without probe, 10 Hz; with probe (10X), 1 Hz.

**Deflection Factors** — Calibrated range: 1 mV to 20 V/div, 14 steps in a 1-2-5 sequence. Accuracy: 5 mV to 20 V/div (+15°C to +35°C) within 2%, (0° to +50°C) within 3%; 1 mV and 2 mV/div within 5%. Uncalibrated (variable) range. At least 2.5:1 range. Continuously variable between calibrated steps. Extends max attenuator step to at least 50 V/div.

**Modes** — CH 1, CH 2, Alt, Chop, CH 1 minus CH 2. Chop rate at least 250 kHz.

**Input Impedance** — 1 M $\Omega$  within 0.5% paralleled by approx 47 pF.

**Max Safe Input Voltage** — 350 V (dc + peak ac).

**Aberrations** — Front corner  $\pm$  2% or 3% p-p.

**Common Mode Rejection Ratios (CH 1 minus CH 2 mode)** — At least 50:1 at 1 MHz when using same attenuator setting.

**Channel Isolation** — Input isolation: at least 80 dB up to 15 MHz; display related: at least 50:1 up to 15 MHz.

**Displayed Noise** — 200  $\mu$ V or less of noise tangentially measured.

**Position Range** —  $\pm$ 6 div.

**Calibrator** — Voltage, 0.6 V,  $\pm$ 1%. Frequency, twice the power line frequency.

## HORIZONTAL

**Sweep Generator** — Calibrated Sweep Rates: 0.5 s to 0.2  $\mu$ s/div, 20 steps in a 1-2-5 sequence, plus a X10 magnifier for sweep rates to 20 ns/div. Uncalibrated (variable) Range: the CAL (variable) control provides sweep rates that are continuously variable between the calibrated rates, and extends the slowest sweep rate to at least 1.25 s/div.

**Sweep Rate Accuracy** — Within 3% unmagnified and within 5% magnified.

**Trigger Holdoff** — CAL (variable) control, if selected by an internal jumper, increases trigger holdoff time by a factor of at least 20.

**External Horizontal Amplifier** — Bandwidth: dc coupled, dc to at least 2 MHz; ac coupled less than 50 Hz to at least 2 MHz. Deflection Factor, 50 mV/div within 5%. X and Y Amplifier Phase Difference, less than 3° at 50 kHz or less. Input Impedance, 1 M $\Omega$  within 2% paralleled by approx 47 pF. Max Safe Input Voltage, 350 V (dc + peak ac); 350 V p-p at 1 kHz or less.

### Enhanced Automatic Triggering

In the automatic mode, the trigger circuit automatically adjusts to spread the p-p signal over most of the range of the triggering level control. This provides more convenient triggering, especially on low amplitude signals.

## TRIGGER

**Trigger Modes** — AUTO (enhanced), NORMAL (auto button out), SINGL SWP.

**Trigger Sources** — CH 1, CH 2, LINE, EXT.

**Trigger Coupling** — Dc, ac, ac low freq reject.

**Internal Trigger Sensitivity** — Dc: 0.4 div of deflection, minimum, dc to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Ac: 0.4 div of deflection minimum, 50 Hz to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Will trigger below 50 Hz with increased deflection. LF REJ: 0.4 div of deflection, minimum, 5 kHz to 5 MHz; increasing to one div at 5 MHz to 15 MHz. Will trigger below 5 kHz with increased deflection.

**External Trigger Sensitivity** — Dc: 60 mV, minimum, dc to 5 MHz; increasing to 150 mV from 5 MHz to 15 MHz. Ac: 60 mV, minimum, 50 Hz to 5 MHz; increasing to 150 mV from 5 MHz to 15 MHz. Will trigger below 50 Hz with increased signal. LF REJ: 60 mV, minimum, 5 kHz to 5 MHz; increasing to 150 mV from 5 MHz to 15 MHz. Will trigger below 5 kHz with increased signal.

**Triggering Level Range** — Internal: at least + and -8 div. External: at least + and -1.2 V.

**External Triggering Input** — Input Impedance: 1 M $\Omega$  within 2% paralleled by approx 47 pF. Max Safe Input Voltage: 350 V (dc + peak ac); 350 V p-p ac at 1 kHz or less.

**Auto Mode** — Sweep free-runs in the absence of a triggering signal. TRIGGER LEVEL range is reduced to approx the p-p range of the triggering signal.

**Single Sweep** — Triggering requirements same as for normal sweep. When triggered, sweep generator produces one sweep only. AUTO pushbutton must be in the OUT position for operation and for setting triggering controls.

## CRT

**Phosphor** — P31.

**Deflection** — Electrostatic.

**Acceleration Potential** — 12 kV.

**Graticule** — Scale, 8 x 10 div with 0.25 in/div.

## ENVIRONMENTAL CAPABILITIES

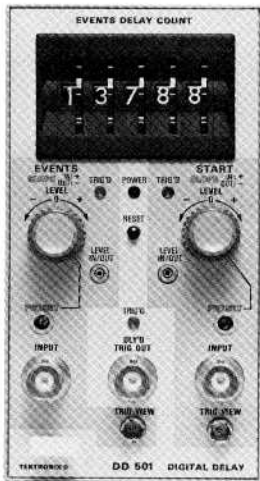
**Temperature** — Operating, 0°C to +50°C. Storage, -40°C to +75°C.

**Altitude** — Operating, to 15,000 ft. Storage, to 50,000 ft.

## SC 502 Oscilloscope

### OPTIONAL ACCESSORIES

**Passive Probes** — See Accessory Section.



**DD 501 DIGITAL DELAY**

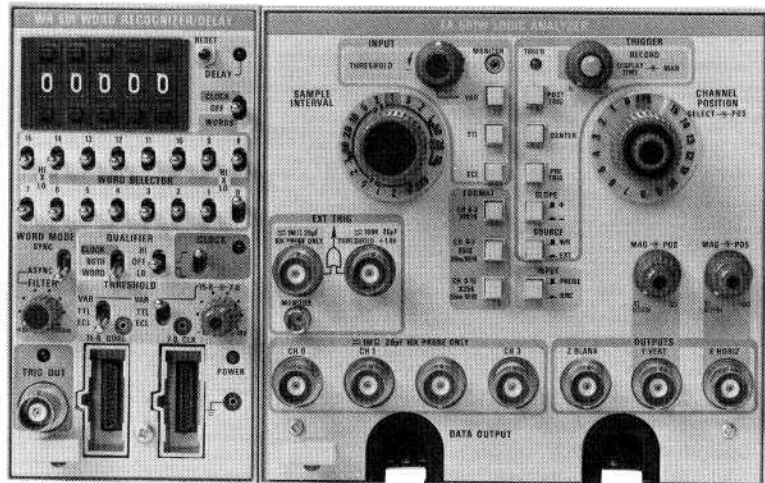
- Digital Events Delay for Scope Trigger**
- Delay to 99,999 Events**
- Divide by N up to 20 MHz**
- Pulse Counting to 65 MHz**
- Time Delay with Ext Clock**
- Compatible with Most Attenuator Probes**

The DD 501 is an events count plug-in unit. Separate external trigger signals connected to the EVENTS and START INPUT connectors allow up to 99,999 events to be counted. That is, the unit counts a predetermined number of events, from 0 to 99,999, selected by the front-panel thumb-wheel switches. The last event counted generates a trigger pulse to the DLY'D TRIG OUT connector on the front panel. Delay by event is particularly useful in troubleshooting asynchronous logic systems. The DD 501 can also function as a frequency divider when the same signal is applied to both inputs.

The DD 501 can be used in a "counted burst" mode with pulse or function generators that can be synchronously gated. This provides the ability to dial up the number of pulses you want in a burst for applications with shift registers, memories, data communications, process control, or any system requiring an exact number of pulses or waveforms. A jumper inside the DD 501 converts the DLY'D TRIG OUTPUT to a delay interval (gate) waveform for this application. TEKTRONIX generators capable of being gated by the DD 501 are the FG 501, FG 502, FG 504, and the PG 508.

Other DD 501 applications include ranging for radar, sonar, ultrasonics, or laser. By using the proper frequency clock, the numbers dialed up can represent miles, yards, kilometers, etc. In systems requiring precision timing, several DD 501s and a reference clock can provide precise thumbwheel-selectable repetition rates, delays, pulse widths, or timing intervals.

**DD 501 Digital Delay**



**LA 501W LOGIC ANALYZER**

- Acquires 16 Channels Simultaneously**
- Captures Single-Shot Data**
- Stores 4096 Bits in 4, 8, or 16 Channel Format**
- Displays Data Preceding Trigger**
- 16-Bit Parallel Word Recognizer with up to 99,999 Word Delay**
- Active Probes Minimize Circuit Loading**
- Samples Data Synchronously and Asynchronously**
- Selectable Trace Positioning**
- Tick Marks for Easy Timing Comparisons**

The LA 501W Logic Analyzer, made up of the LA 501 Logic Analyzer and WR 501 Word Recognizer plug-ins, operates in any 3, 4, 5, or 6-compartment TM 500-Series Power Module Mainframe. This combination complements virtually any oscilloscope or X-Y monitor to provide a versatile logic analysis system.

4096 bits of storage may be formatted as 4 channels x 1024 bits, 8 channels x 512 bits, or 16 channels x 256 bits to best fit your application. With a selectable asynchronous sampling rate of up to 100 MHz (4-channel operation only), the LA 501 provides timing resolution to 15 ns. Data can also be synchronously (externally) clocked to 50 MHz. Pre, center, or post-trigger data can be recorded at a sample rate from 10 ns to 5 ms.

Two active P6451 probes feature a high input impedance — 1 MΩ paralleled by 5 pF. They provide a total of 18 inputs to the WR 501 — 16 data input channels, one clock input, and one qualifier input. There are

separate threshold controls (TTL, ECL, and variable  $\pm 10$  V) for each probe.

The stored data is displayed as a timing diagram in groups of four. Each trace displays high and low logic states. Vertical and horizontal position and magnifier controls provide the capability to zoom in on any segment of the timing diagram. Biphasic timing tick marks on each channel provide excellent visual resolution and also indicate whether an inactive line is high or low. Channel-to-channel timing comparisons are easy because any trace can be moved vertically and thus positioned next to any other.

The WR 501 16-bit parallel word recognizer with digital delay produces triggers when it recognizes a preselected parallel word. This gives you fast access to almost any location in the data stream. The WR 501 can be operated as an independent trigger source or interfaced with the LA 501.

The LA 501W Logic Analysis System may be combined with counters, pulse generators, multimeters, and oscilloscopes into a compact package using TM 500 Series Power Module/Mainframes. The TM 500 Series also offers you a choice of benchtop, rackmount, rollabout, or portable configurations to match your application.

- LA501W Logic Analyzer**
- LA501 Logic Analyzer**
- WR501 Word Recognizer/Delay**

## The Mainframes

One of the major elements in the wide appeal of TEKTRONIX TM 500 is its extreme flexibility and versatility of configuration. Most test instrument manufacturers by now have taken advantage of integrated circuits, LED displays, and other aspects of miniaturization technology to make more compact instruments. Tektronix, however, also combined advanced technology with a modular plug-in system to provide highly flexible test instrument configurations for use almost anywhere.

The "classical" benchtop environment is served by 1, 3, 4, and 6 compartment mainframes with tilt bails and handles. These same mainframes can be easily carried about for portable use. The new TM 515 luggage-styled 5-compartment travel mainframe was designed especially for portable applications where ruggedness and resistance against moisture and dust are necessary. Two foam-padded carrying cases allow the 3- and 4-compartment mainframes to be shipped as luggage.

For mobility of an entire "benchfull" of instruments, Tektronix offers the new TEK LAB CART Model 3. This new cart allows you to configure your own rollabout test, maintenance, or calibration station. The TEK LAB CART Model 3 will mount virtually any TEKTRONIX Oscilloscope on the top of the cart and two TM 500 Mainframes, either 3 compartment or 4 compartment, on two under-mounted trays.

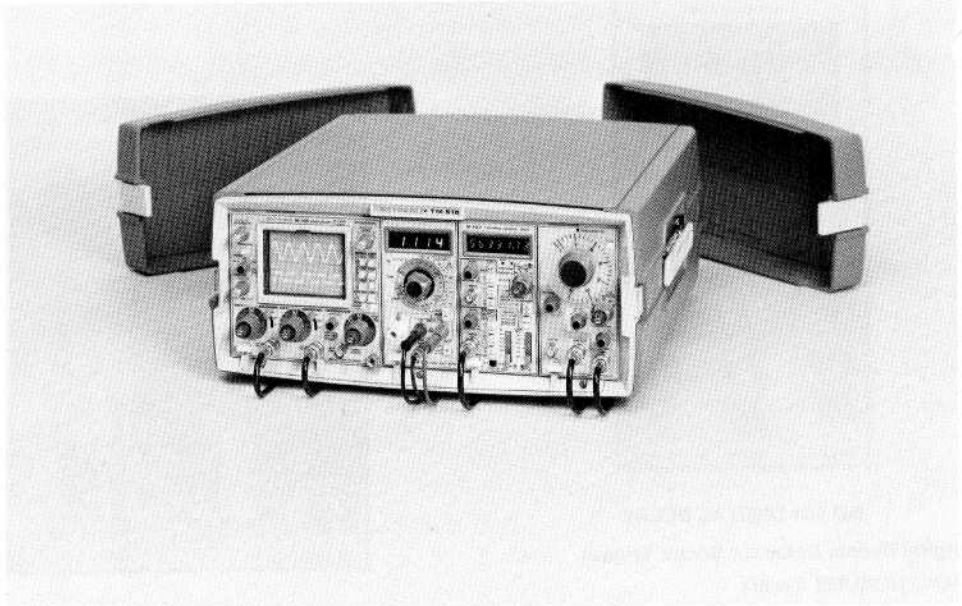
For rackmount applications, TM 500 fits up to six instruments into one standard rack width. Yet, the plug-in feature lets a rack installation be instantly re-configured or permits an instrument to be replaced to keep a critical test facility "on the air" even during maintenance or calibration of individual instruments.

In all configurations — bench, portable, rollabout, and rackmount — TM 500's internal interconnect feature lets commonly used connections between instruments be made only once and then stay hidden for simpler, uncluttered test setups. Then, at the touch of a switch, a counter can monitor the frequency of a signal source or a DMM can measure trigger level setting of a counter or voltage of a power supply.

## Benchtop

The four TM 500 benchtop mainframes are the TM 501, TM 503, TM 504, and TM 506.

The TM 500 system concept provides significant benefits when multiple instruments are involved, but the TM 501 was provided for cases when only a single instrument is needed. The TM 503 is the most compact of the multicompartment mainframes; it is only 15.3 inches deep, 6 inches high, and 8.7 inches wide.



The TM 504 and TM 506 are both heavy-duty units. Each features a high power compartment at the right-hand end to also supply greater current to TM 500 instruments that are designed for added performance or higher output power levels. The six-compartment TM 506 also incorporates a quiet fan for optimum cooling. The TM 504 and TM 506 are slightly deeper than the TM 503.

All four benchtop models have feet, tilt bails, handles, and front-panel power switches. All operate from normal 110 or 220 V ac.

## Portable

All of the benchtop models can be used for portable operation as well. Carry handles and sturdy rear cord-wrap feet, plus optional accessory protective front covers (available for all but the TM 501) permit them to be used in many moderate applications. However, the new TM 515 was designed from the ground up for superior multi-instrument portability. In its carrying configuration it is a handsome piece of luggage with molded-in feet on the bottom and a comfortable luggage-type carrying handle. It is extremely moisture and dust resistant, and designed to withstand the rigors of transport in car trunks and pickup trucks. Once at the destination, the rear cover pops off to give access to the power cord, power switch, and allow air flow from the built-in fan. The front cover is removed to uncover up to five operating instruments from the broad TM 500 line. The result, a total electronics superlab disguised as a mild-mannered suitcase.

A wire bail stowed in the cover can be snapped into the front feet as a conventional tilt bail for benchtop use, or into the rear feet to support the TM 515 in a nearly vertical attitude on the floor with all instruments visible to a standing operator. Test lead storage is also provided inside the rear

cover. The TM 515 operates from nominal 110 or 220 V, 48 - 60 Hz with the standard fan, and 48 - 440 Hz with optional universal fan.

## Rollabout

Rollabout test laboratories are combinations of TM 503 or TM 504 Mainframes, TM 500 Instruments, TEKTRONIX Plug-in or Monolithic Portable Oscilloscopes, and the TEK LAB CART Model 3. The TEK LAB CART Model 3 will hold a 5100, 5400, or 3 or 4 Plug-in 7000-Series, or a Portable Oscilloscope such as the 434, 464, 465, 466, 475, or 485. Two TM 503's or TM 504's can be mounted on two adjustable mounting trays beneath the cart. A large storage drawer, which can be padlocked, is provided at the bottom of the cart to hold accessories and plug-ins. In each case, the result is a highly mobile lab on wheels which can be rolled out onto a production floor, over to large installations needing maintenance or calibration, into narrow quarters like x-ray control booths, or down laboratory aisles to aid in conserving bench space.

## Rackmount

The RTM 506 Rackmounting Mainframe is electrically identical to the TM 506 benchtop model but features a slide-out assembly and handles, plus a higher power fan than the bench version in recognition of the high ambient temperatures often found in enclosed racks and consoles.

It is also possible to convert two TM 503's into a rackmount assembly with a kit; this kit has the advantage of requiring four inches less depth than the RTM 506 for space-critical applications, but lacks the fan and high power compartment, and requires assembly by the user. Other kits are available to rackmount a single TM 503, or a TM 503 with a 603, 604, or 605 monitor.



The TM 515 Traveler Mainframe accommodates up to five TM 500 Plug-in Modules, yet it is as attractive as quality, fashionable flight luggage. With a typical complement of TM 500 Plug-in Modules it weighs approximately 30 pounds. And it will go under the seat in most commercial aircraft. At last, the engineer on the go can take along a truly portable instrumentation package, one that goes as a unit, that is attractive, and that can be optimized for his instrumentation needs.

A typical application for the TM 515 could be digital field service, in which the likely plug-ins might be: an SC 502 dual-channel, 15 MHz (two-compartment wide) oscilloscope, a DD 501 Digital Delay, and a DC 505A/DM 502 combo, offering universal counter and full-function DMM capabilities plus readout of trigger level at the touch of the INT push-button, once interface connections are made.

All plug-ins in the TM 515 Mainframe can "talk" to each other and work together through a common interface circuit board. A factory-installed option (Option 5) allows TM 515 users to interconnect the plug-in instruments within the mainframe without making soldered junctions.

As in all TM 500 Power Module/Mainframes, the power transformer of the TM 515 Mainframe accommodates 100, 110, 120, 200, 220, and 240 V ac and 48 through 440 Hz. However, the range of line frequencies of the TM 515 (and TM 506) is limited to 48-60

Hz by the electrical characteristics of the ventilating fan. Operating the TM 515 at the various line voltages is accomplished with quick-change line-selector blocks, but operating it at line frequencies outside the 48-60 Hz range requires the optional ventilating fan, since "forced air" is required. An optional 48-440 Hz fan is available.

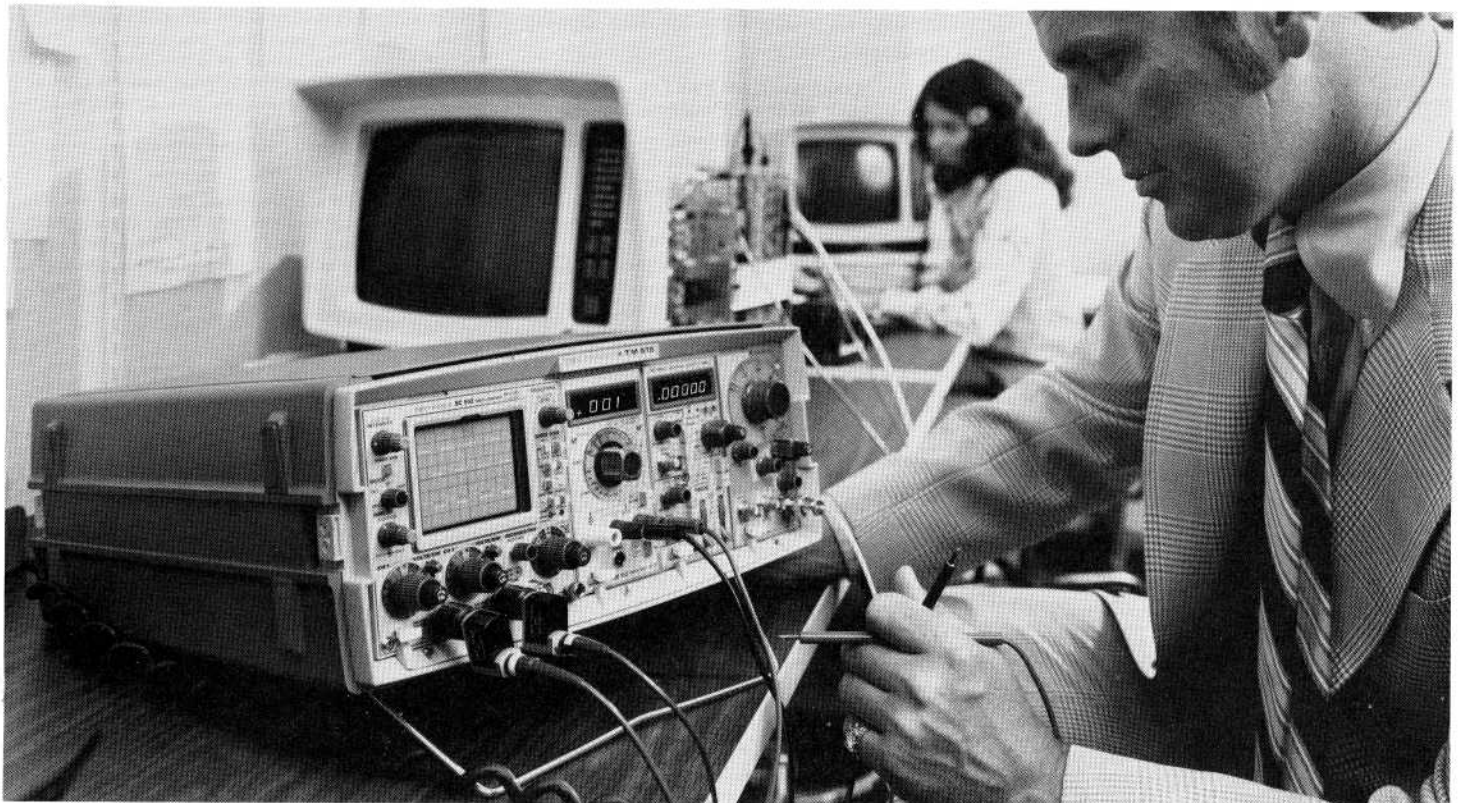
Significant cost savings are available through the use of TM 500 instrumentation systems in place of collections of monolithic instruments, mainly because TM 500 Plug-in instruments share a common power supply and enclosure.

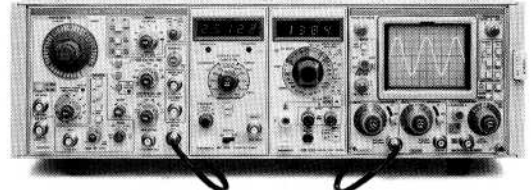
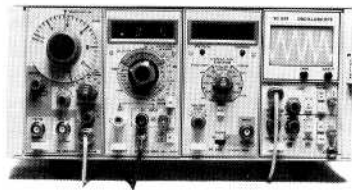
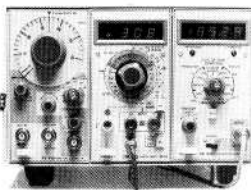
The TM 501 single-compartment, TM 503 three-compartment, TM 504 four-compartment, TM 515 five-compartment, and TM 506 six-compartment power module/mainframes provide the necessary power supply components (transformer, rectifier, and filter) to operate any of the TM 500 modular plug-ins. Low-level regulator circuitry is included in each individual instrument, with high-dissipation power transistors mounted on heat sinks in the rear of the power module, so each instrument is supplied with the exact voltage necessary for optimum performance. All plug-ins are connected in the power unit by a common interface board. A matrix of signal interconnection possibilities produces extensive multifunction capabilities to reduce cabling clutter.

The TM 504 and TM 506 provide one high-power compartment, which is located on the extreme right adjacent to the power switch.



(Typically it is used to accommodate a power supply plug-in, such as the PS 503A, which can provide 1 amp 0 to 40 V dc in the high-power compartment.) The TM 506 is available either for bench use with a carrying handle for convenience, or in a rack-mounting version with mounting ears and slide-out tracks. Factory-installed options add 25-mil square-pin connectors on the rear of the interface circuit board and supply a kit of jumpers with mating square-pin connectors. These allow TM 500 users to easily interconnect the plug-in instruments within the mainframe without making soldered junctions.





**POWER REQUIREMENTS**

**Line Voltage Ranges** — Universal Transformer: 100, 110, 120, 200, 220, 240 V ac, all within 10%. Range changing for transformer accomplished with quick-change line-selector block.

**Line Frequency Ranges** — Universal Transformer: 48 Hz to 440 Hz.

**NOTE:** The ventilating fans on the TM 506 and TM 515 operate on 48-60 Hz only.

**Power Consumption** — Max primary power approx: 35 W for TM 501, 120 W for TM 503, 200 W for TM 504, 320 W for TM 506, and 240 W for TM 515. Actual power consumption depends on plug-in selection and operating modes.

**SUPPLIES (UNREGULATED)**

**Shared by All Compartments** — +33.5 V dc and -33.5 V dc. TM 501 -500 mA max. TM 503 -1 A max. TM 504 -1.4 A max. TM 506 -2.1 A max. TM 515 -1.8 A max.

**Low Power Compartments** — Two 25 V ac windings, 500 mA each, supplied to each compartment, independently. 17.5 V ac and +11.5 V dc shared in any combination between these two supplies and among all low-power compartments. TM 501 -1 A max. TM 503 and TM 504 -3.6 A max. TM 506 -6.5 A max. TM 515 -6.5 A max.

**High Power Compartments** — (nearest to switch in TM 504 and TM 506): Two 25 V ac windings, 1 A each. 17.5 V ac and + 11.5 V dc, 4 A max, shared in any combination between these two supplies.

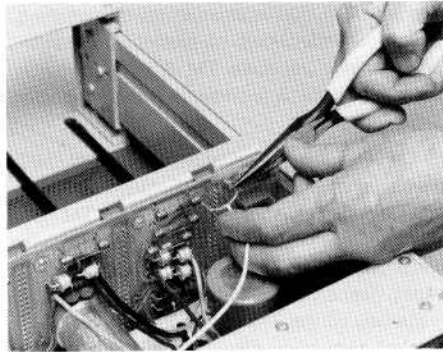
**TEMPERATURE RANGE**

**Operating** — 0°C to +50°C.  
**Nonoperating** — -40°C to +75°C.

**ALTITUDE RANGE**

**Operating** — To 15,000 ft.  
**Nonoperating** — To 50,000 ft.

**OPTIONAL INTERFACE**



The TM 500 line is designed so that connections between modules and/or external equipment can be made by the mainframe rear interface board and optional rear-panel connectors.

Each plug-in has selected lines brought to its interface, some parallel to front-panel connections, others present only at the interface. Normally, these lines are left open, but they may be connected by the user to reduce front-panel clutter or to perform functions not otherwise available. For example, digital counters have serial bcd outputs which may be brought out for data logging or processing.

**LINES AVAILABLE AT THE MODULE INTERFACE CONNECTOR**

**Digital Counters**

Bcd serial by digit	Reset
Range code (except DC 502)	Time slot zero
Scan clock out	Data good
Scan clock in and internal scan disable	Signal in (selected by front-panel switch) (except DC 502)

These lines allow for external data logging and processing via the bcd output and associated signals. They also allow the external system to initiate the taking of a measurement, and control the rate at which the bcd data is scanned.

**Digital Multimeters**

Scan clock out	Most significant digit
Decimal point	Data transfer
Bcd serial by digit	Polarity
Least significant digit	

**Power Supplies**

- Supply output through rear connection
- Remote sense
- Remote analog voltage control
- Remote analog current limit control

**Amplifiers**

Signal Out, Signal In

**Monitor**

X, Y, and Z inputs

**Oscilloscope**

Ramp out, Gate out

**NOTE:** The Option 02 power modules are shipped with a rear-panel multipin connector, a mating cable connector, and one rear-panel BNC connector for each plug-in compartment. The user may wire these to the interface board as required. Option 02 is also supplied with square pin connectors on the rear interface board, and a supply of jumper wires with square pin receptacles.

The Option 05 TM 515 is supplied with the square pin connectors on the rear interface board and the prepared jumper wires.

Pin assignments are common for each "family" of modules (DMMs, generators, counters, etc). Each family has its own pattern of circuit board notches at the interface. Interface terminal barriers may be inserted in the mainframe so that it accepts only plug-ins of one family. A supply of barriers (and square-pin jumpers) is shipped with the power module if Option 02 is ordered.

A typical example of interface connection between modules is to connect the ramp output of the RG 501 to the vcf input of the FG 502 for frequency sweep. The output of a power supply can be measured with the interface feature of the DM 501 for voltage monitoring.

**POWER MODULE DIMENSIONS & WEIGHTS (without Plug-ins)**

**CABINET**

	TM 501		TM 503		TM 504		TM 506		TM 515	
	in	cm	in	cm	in	cm	in	cm	in	cm
Height	6.0	15.2	6.0	15.2	6.0	15.2	6.0	15.2	6.8	17.3
Width	3.9	9.9	8.7	22.1	11.0	27.9	17.4	44.2	15.0	38.1
Length	15.3	38.9	15.3	38.9	20.0	50.8	20.0	50.8	20.0	50.8
Weight (approx)	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
Net	5.4	2.4	9.5	4.3	20.5	9.3	29.0	13.2	22.5	10.2
Domestic Ship	13	5.9	17	7.7	26.0	11.8	41.0	18.6	30.0	13.6

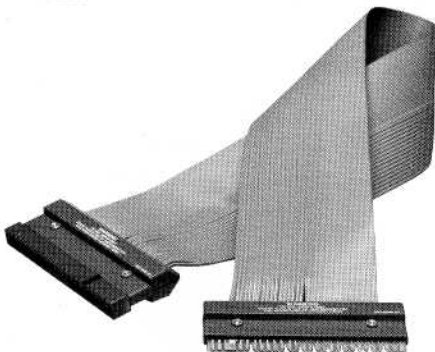
**ORDERING INFORMATION (Plug-ins not Included)**

- TM 501 Power Module with Option 02 Interface**
- TM 503 Power Module with Option 02 Interface**
- TM 504 Power Module with Option 02 Interface**
- TM 506 Power Module with Option 02 Interface**
- RTM 506 Power Module (rackmount version) with Option 02 Interface**
- TM 515 Traveler Mainframe with Option 05 Interface with Option 06 48-440 Hz fan**

**Option 07** — For operating TR 502 and DC 502 Option 07 in a TM 503, TM 504, TM 506, or TM 515

This group of accessories adds to the versatility and performance of the TM 500 test and measurement system. Convenient cases and covers offer mobility and protection. The provision for user options with special purpose hardware adds flexibility. Adapters and blank panels can be supplied, as well as extender cables, coaxial cables, special probes, and devices designed to operate with various plug-ins for specific applications.

**TM 500 FLEXIBLE EXTENDER CABLE**



Designed to couple a TM 500 Plug-in with the mainframe rear interface board connection. It provides a completely flexible connecting point outside the mainframe for plug-in operation during test or check-out.

**Extender Cable, Order 067-0645-02**

**RISE TIME LIMITER**



For use with the PG 502 Pulse Generator which has a pulse rise and fall time of less than one nanosecond. In some applications, such as TTL logic where slower rise time is needed, this fast pulse can be limited to six nanoseconds by using the rise time limiter.

**Rise Time Limiter, Order 015-0249-00**

**MANUAL (ONE SHOT) TRIGGER GENERATOR  
RG 501,  
PG 501,  
AND  
PG 505**



The Manual (one shot) Trigger Generator is a self-contained, battery-operated, handheld device for manually generating a single pulse. This adapter is used to start a pulse, ramp, sweep, or complete sequence of events on instruments which do not have a manual trigger button or where a remote operation capability is desired, such as some oscilloscopes and the PG 501, PG 505, and RG 501.

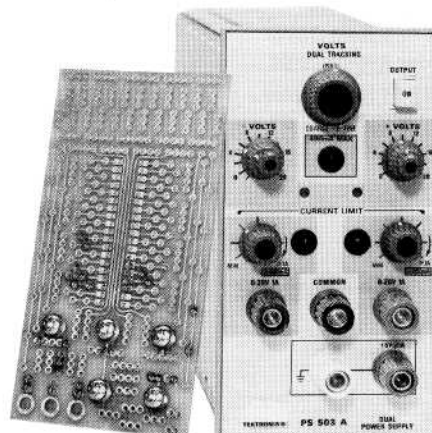
The internal trigger generator circuitry eliminates contact bounce, but will generate pulses as rapidly as the operator can manually cycle the pushbutton.

The output pulse is nominally two milliseconds in width and three volts in amplitude with a rapid rise and fall. Output impedance is low (50 Ω); the pulse amplitude drops from about 3.6 to 1.8 volts when changed from a high impedance to a 50 Ω termination. Both voltages decrease with battery aging. The battery is a 5.4 V dry cell.

Applications for the trigger generator also include stepping or sequencing of digital systems, analog control systems, mechanical devices, as well as obtaining "single shot" operation from many types and brands of instruments. Biological and physical experiments, where manual triggering is required as a part of the stimuli, are also common applications.

**Order Number 016-0597-00**

**FRONT-PANEL CIRCUIT BOARD ADAPTER KIT  
PS 501-1, PS 503A OR PS 505**



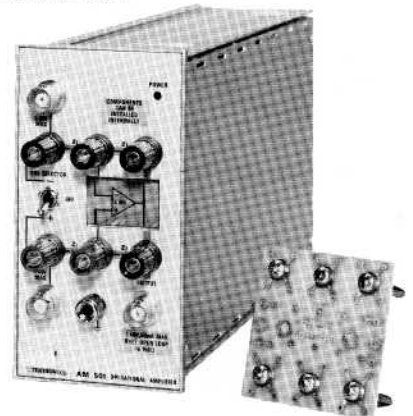
The front-panel circuit-board kit is a convenient way to mount small experimental circuits or fixtures right on the front of a TM 500 power supply.

Typical applications for the adapter are as a device tester (test fixture), educational demonstrator (especially IC's), and in temporary systems functions, e.g., OR'ing and AND'ing two signals. This adapter will supplement the blank plug-in kit for simple or temporary applications.

The adapter kit provides a convenient platform for building up circuits; its pin holes are pre-solder-flowed and some are interconnected. Discrete devices can be readily attached to the adapter kit board, stored, and easily reattached to the "banana jack" plugs on the face of the power supply. Circuit clips for interconnected pin holes are available from Tektronix. The adapter kit is 2½ inches wide.

**Order Number 013-0152-00**

**AM 501 AUXILIARY CIRCUIT BOARD KIT**



The AM 501 Auxiliary Circuit Board Kit attaches to the input and output terminal plugs on the front of the AM 501 Operational Amplifier. The kit is approximately 2½ inches square. The kit is a pc board which has six terminal studs for attachment to the amplifier's banana jacks. This permits the designer to build a circuit of resistors, capacitors, and other components for use in conjunction with the AM 501's input, output, or feedback circuits. With several boards, the AM 501 Op Amp circuit can be changed instantly in configuration from integrator to differentiator to amplifier.

An additional advantage of the kit is that it does not interfere with the other connectors on the face of the AM 501.

**Order Number 013-0146-00**

## TM 500-Series Accessories

### TM 500 CARRYING CASE



These luggage-type carrying cases for TM 500 equipment are molded of high strength glass-epoxy. The TM 503 model weighs 12 pounds empty and measures 23½ inches long by 8½ inches thick by 15½ inches high, including rubber feet, lockable latches, and handle. Inside, the resilient polyurethane foam insert is molded to accept a TM 503 (with or without the protective front cover) plus either a spare TM 500 family module or a 200-Series Miniscope. A third compartment in the foam accepts miscellaneous cables, accessories, or small tools.

The TM 504 case has a molded foam insert which will accept the TM 504 (with or without the protective front cover) but has no provisions for spare modules or tools. It is 24 inches long by 8½ inches thick by 17½ inches high and weighs approximately 14 pounds empty.

**TM 503 Carrying Case,**  
**Order 016-0565-00**

**TM 504 Carrying Case,**  
**Order 016-0608-00**

### PROTECTIVE FRONT COVER



A snap-on front cover, molded of high impact plastic, is available for the TM 503 (shown above), TM 504, and TM 506 Mainframes. While particularly valuable when the TM 503 or TM 504 (full of instruments) is carried into the field or in a vehicle, the cover is also good insurance against damage to instrument knobs and jacks during normal handling in the lab, or when a mainframe full of instruments is stored. The cover adds 1¼ inches to the length of the TM 503, TM 504, and TM 506 Mainframes, and clears the longest knob projections on any of the instruments.

**TM 503 Front Panel Cover,**  
**Order 200-1566-00**

**TM 504 Front Panel Cover,**  
**Order 200-1727-00**

**TM 506 Front Panel Cover,**  
**Order 200-1728-00**

### ACCESSORY POUCH



While the TM 501, TM 503, TM 504, and TM 506 Mainframes were optimized for bench use, they are frequently carried away for service elsewhere. Taking along the probes, cables, terminators, and other accessories usually required can then be a problem. The soft vinyl accessory pouch neatly solves this problem; sturdy snap-around straps let the pouch be secured to the carrying handle of any TM 500 Mainframe or TEKTRONIX Oscilloscope, or the straps may be snapped together to form a carrying handle for the pouch to be used independently. A convenient side zipper lets accessory items be removed or stored without removing the pouch from the mainframe handle. Dimensions approx 9¼ in L x 5¾ in W x 2 in D.

**Order Number 016-0351-00**

### RAIN COVERS



These soft, weather-proof, vinyl-coated Rain Covers come in sizes for TM 503 and TM 504 packages of instrumentation, and include adequate space for protective front covers, as well. They feature heavy-duty zippers that open from either end, and include their own carrying handles, offset to compensate for the off-center balancing point of TM 500 instrumentation packages. The color is Tek blue.

**TM 503 Rain Cover**  
**Order 016-0620-00**

**TM 504 Rain Cover**  
**Order 016-0621-00**

### TM 500 BLANK PANEL



When operating the TM 500 instruments with less than the full complement of plug-ins, the blank plug-in panel can be used to cover unused compartments.

**Blank Plug-in Panel,**  
**Order 016-0195-01**

### Type 1105 Battery Power Supply



TM 500 instruments may be operated with the Type 1105 when suitable ac line power is not available. The 1105 is rugged and portable, operating on internal batteries or an external dc source. Operating time is dependent on the number and type of plug-ins being powered, and their operating mode. The following table shows estimated operating time for a full power module in a typical situation.

TM 501	7.0 hours
TM 503	2.3 hours
TM 504	1.8 hours
TM 506	1.2 hours
TM 515	1.4 hours

### 1105 Battery Pack

**Option 01, 230 V operation**

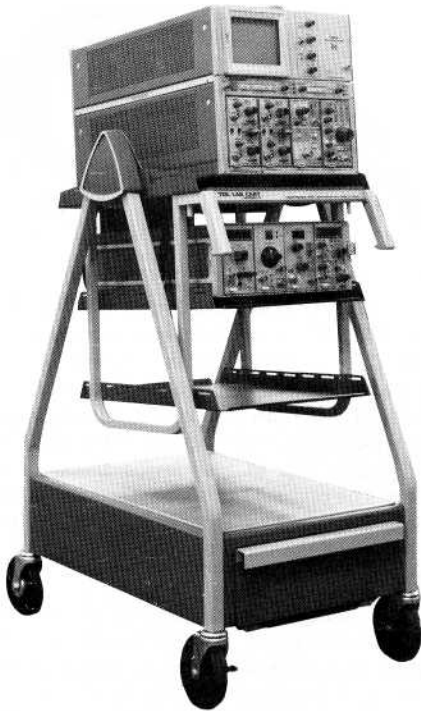
### 50 Ω PRECISION COAXIAL CABLE



For use with the PG 502, PG 506, and SG 503. These instruments are internally calibrated for use with this 3 ft 50 Ω coaxial cable into a 50 Ω load.

**50 Ω Cable, Order 012-0482-00**

**TEK LAB CART MODEL 3**



This Lab Cart is especially designed for roll-about configurations combining TM 500 instrumentation with the TEKTRONIX Oscilloscope of your choice. It features pistol-grip tilt control and a large accessory drawer in the base. The top tray accepts any TEKTRONIX 7000-Series, 5000-Series, or Portable Oscilloscope. The MODEL 3 comes standard with one lower shelf that will support either a TM 503 or TM 504 with plug-ins. Additional shelves are available as optional accessories. Max capacity of the lower shelf area is two TM 503's or TM 504's, stacked, or up to a TEKTRONIX 7000-Series Oscilloscope in size—with TM 500 packages placed on the tray at your option. The power distribution module at rear underside of the top tray provides four power outlets and a 15-foot line cord.

International modification (Option 01) deletes power distribution module.

**TEK Lab Cart Model 3**

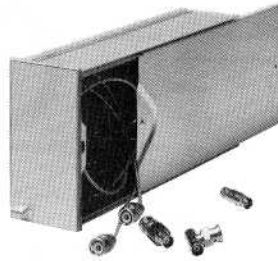
**with Option 01 (International Modification)**

**Additional Lower Shelf, Order 436-0132-01**

Safety Belt to secure oscilloscopes or TM 500 to top tray or lower shelves (not needed for 5000 or 7000 Series on top tray)

**Order 346-0136-01**

**PLUG-IN STORAGE COMPARTMENT**



An electronic engineer or technician away from his bench seldom has enough storage space for probes, cables, "tees" and accessories, and small tools. The Plug-in Storage Compartment is a useful adjunct to many rollabout and Travel Lab configurations. If all five compartments in your TM 515 Traveler Mainframe are not used for a particular field application, stuff in a plug-in storage compartment for extra convenience. Even a rackmount TM 500 installation might profit by readily-available terminators or attenuators in a presently unused compartment. Compatible with all TM 500 Mainframes, 5000-Series Oscilloscope Mainframes, and 203 and 204 SCOPE-MOBILE® Cart plug-in storage bins; inside dimensions 9 7/8 in L x 2 in W x 4 1/4 in D.

**Order Number 016-0362-00**



**ADAPTER KITS FOR EARLIER SCOPE-MOBILE® CARTS**

**TM 504 Adapter Kits** — Includes hardware to attach TM 504 to 203 or 204 SCOPE-MOBILE® Cart.

For 203, Order 016-0348-00

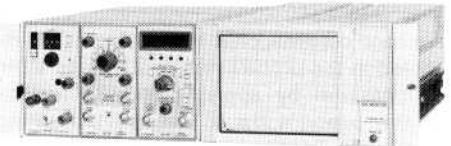
For 204, Order 016-0349-00

**TM 503 Adapter Kits** — Includes hardware to attach TM 503 to 203 or 204 SCOPE-MOBILE® Cart.

For 203, Order 016-0583-00

For 204, Order 016-0584-00

**CABINET-TO-RACKMOUNT CONVERSION KITS AND MONITORS**



Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount two TM 503's side-by-side in a standard rack width.

**Order 040-0616-01**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount a single TM 503 in a standard rack width. This includes securing hardware and a blank front panel when only one instrument is utilized.

**Order 040-0617-01**

Rackmount-to-cabinet conversion kit equipped to convert a rackmount TM 503 to a cabinet style.

**Order 040-0618-01**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to rackmount a TM 503 and a 603, 604, 605, 606, or 607 in a standard rack width.

**Order 040-0624-00**

Cabinet-to-rackmount conversion kit, equipped with slide-out assembly, required to convert a TM 506 (cabinet style) to an RTM 506.

**Order 040-0761-01**

Rackmount-to-cabinet conversion kit equipped to convert an RTM 506 to cabinet style TM 506.

**Order 040-0762-00**

**MONITOR ORDERING INFORMATION**

**603 Bistable Storage Monitor with Option 03 for rackmounting**

**604 Monitor with Option 03 for rackmounting**

**606 High Resolution Monitor with Option 03 (for rackmounting)**

**607 Variable Persistence Storage Monitor with Option 03 (for rackmounting)**

**P6058 TEMPERATURE PROBE**



The P6058 Temperature Probe is used with the DM 501 for sensing temperature from  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . The temperature sensing element consists of a transistor and is installed in the probe's nose tip. Temperature is measured by applying the flat surface of the probe's tip to the device being measured. P6058 probes are interchangeable among all DM 501's without requiring recalibration since probes and DM 501's are held to tight tolerances. Besides measuring temperature, the P6058 can function as an electrical probe for resistance, current, and voltage measurements to 500 V. To obtain the full probe kit with ground lead and push-on electrical contact tip, order 010-0260-00 below. A simple modification of the DM 501 is also required. For temperature-only measurements, order 010-0259-00.

The temperature probe consists of the temperature sensor, a four-foot, 4-wire coaxial cable, and a connector for attaching to the existing front-panel receptacle of the DM 501. The unit weighs approximately five ounces.

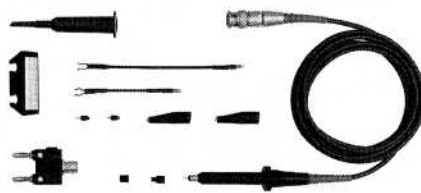
**P6058 Temperature Probe,**  
Order 010-0259-00

**P6058 Temperature Voltage Probe,**  
Order 010-0260-00

See TEKTRONIX General Catalog for detailed specifications and accessories for probes.

P6058 and P6430 temperature probes are not compatible with Option 02 DMMs.

**P6420 RF PROBE**



The P6420 conveniently converts dc voltmeters into high frequency ac voltmeters by producing a dc output voltage equal to the rms value of a sine wave input. 3 dB bandwidth is 10 kHz to 1 GHz.

Designed to be used with instruments that have 10 M $\Omega$  inputs, the P6420 is compatible with the TEKTRONIX DM 501 and DM 502 digital multimeters. When used with oscilloscopes which have 1 M $\Omega$  inputs and other types of dc-sensing instruments with input resistance other than 10 M $\Omega$ , the dc reading will be directly proportional to the sine wave input but not equal to the rms value.

The miniature probe-tip size allows the P6420 to use most of the standard TEKTRONIX miniature probe tip accessories such as the probe tips, adapters, and probe holders designed to fit on the TEKTRONIX Modular Probes.

**ELECTRICAL CHARACTERISTICS**

**Frequency Response** — 0 dB ref @ 1 MHz. 10 kHz to 1 GHz, within 3.0 dB.

**Input Capacitance** —  $\approx 3.7$  pF.

**Ac to dc Transfer Ratio Accuracy** — (DMM input resistance = 10 M $\Omega$  within 2%) 0.4 V to 30 V, within 10% ( $15^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ ); 1.0 V to 4 V within 5% ( $5^{\circ}\text{C}$  to  $45^{\circ}\text{C}$ ).

**Voltage Range** — 0.4 V to 30 V rms (84.8 V peak to peak).

**Maximum Input Voltage** — 42.4 V (peak ac + dc).

**Included Accessories:**

- 013-0097-01 1 TIP, retractable hook
- 344-0046-00 2 CLIPS, miniature alligator
- 175-0849-00 1 LEAD, ground, 8 cm
- 175-1017-00 1 LEAD, ground, 13 cm
- 166-0404-01 1 SLEEVE, insulating
- 352-0351-00 1 PROBE HOLDER
- 103-0090-00 ADAPTER, BNC to banana
- 206-0230-01 PROBE TIPS

**ORDERING INFORMATION**

**P6420, 1X Probe, 2 m**  
Order 010-6420-03

**For 1 meter length cable,**  
Order 175-1661-00

**For 3 meter length cable,**  
Order 175-1661-02

**P6430 TEMPERATURE PROBE**



The P6430 Temperature Probe is used with the DM 502 for sensing temperature from  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . The temperature sensing element consists of a transistor and is installed in the probe's nose tip. Temperature is measured by applying the flat surface of the probe's tip to the device being measured. The probe can be immersed vertically, approximately two inches in a liquid, for temperature sensing and still retain water tightness.

The temperature probe consists of the temperature sensor, a six-foot, 2-wire coaxial cable, and a connector for attaching to the existing front-panel receptacle of the DM 502. The unit weighs approximately five ounces.

To meet full accuracy specifications a specific P6430 and DM 502 multimeter must be calibrated as a pair.

**P6430 Temperature Probe,**  
Order 010-6430-00

**HIGH VOLTAGE PROBE FOR USE WITH DMMs**



The High Voltage Probe will measure dc voltages from 1 kV to 40,000 volts with an accuracy of 1% at 25,000 volts. The division ratio is 1000:1. Common uses include measuring anode voltages on monitors or oscilloscopes.

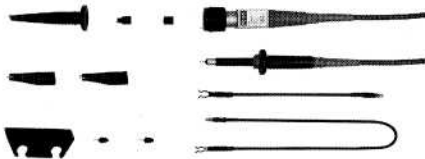
This probe plugs directly into the front end of either multimeter.

**CHARACTERISTICS**

Voltage range	1 kV to 40 kV dc
Input resistance	1000 MΩ
Division ratio	1000:1
Overall accuracy	20 kV to 30 kV 2%
Upper limit accuracy	Changes linear from 2% at 30 kV to 4% at 40 kV
Lower limit accuracy	Changes linear from 2% at 20 kV to 4% at 1 kV
Input Z at meter	10 MΩ required

Order 010-0277-00

**P6105 100 MHz 10X Modular Probe**



The P6105 is a miniature 10X modular probe for use with dc to 100 MHz oscilloscopes with an input capacitance range of 15-47 pF and an input resistance of 1 MΩ. A ground reference pushbutton on the probe body permits a ground reference or determination of a trace in a multi-trace display.

Modular construction of the probe simplifies repairs, as both the probe body and compensating box can be unplugged from the cable assembly. The P6105 comes in three lengths identified by the colored strain relief at each end of the cable. Blue for 1 meter, yellow for 2 meters, and red for 3 meters.

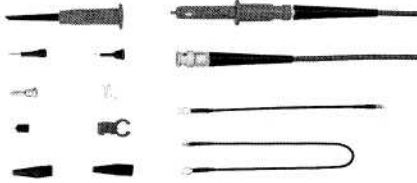
**Included Accessories:**

- 013-0107-03 1 TIP, retractable hook
- 344-0046-00 2 CLIPS, miniature alligator
- 175-0124-01 1 LEAD, ground, 13 cm
- 175-0125-01 1 LEAD, ground, 30 cm
- 166-0404-01 1 SLEEVE, insulating
- 352-0351-00 1 PROBE HOLDER
- 206-0191-01 2 TIPS, probe

**ORDERING INFORMATION**

- P6105, 10X Probe, 2 m,**  
Order 010-6105-03
- Opt 01, 1m, Order 010-6105-01
- Opt 02, 3m, Order 010-6105-05

**P6006 Dc to MHz 10X**



The P6006 is a general-purpose probe. It can be compensated to match all TEKTRONIX Plug-ins and Oscilloscopes with nominal input capacitances of 15 pF to 55 pF and input resistance of 1 MΩ. This probe is more rugged and has a higher voltage rating than the miniature probes.

Attenuation is 10X; Input Resistance is 10 MΩ; Input Capacitance for standard length probe is approx 7.5 pF when used with an instrument having a 20 pF input capacitance; 8.5 pF for the 6 ft version, 11 pF for the 9 ft version, 13 pF for the 12 ft version; Probe Rise Time is approx 5 ns; Voltage Rating is 600 V dc, ac peak, or dc and ac peak combined.\*

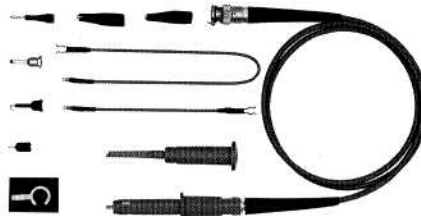
**ORDERING INFORMATION**

**P6006 10X Probe, Order 010-0160-00**

- Opt 01, 3.5 ft. BNC, Order 010-0127-00
- Opt 02, 9 ft. BNC, Order 010-0146-00
- Opt 03, 12 ft BNC, Order 010-0148-00

\*P-p voltage derating is necessary for cw frequencies higher than 5.7 MHz when working into a 20 pF input, or higher than 3.6 MHz when working into a 47 pF input.

**P6060 Dc to 35 MHz 10X**



The P6060 is a precision passive probe with 10X attenuation. The precise attenuation also provides greater accuracy for single-ended input applications, such as amplitude measurements with a differential comparator.

The BNC-type connector utilizes a special grounding clip to shift the deflection factor indicator to 10X normal reading in 5000-Series Oscilloscopes.

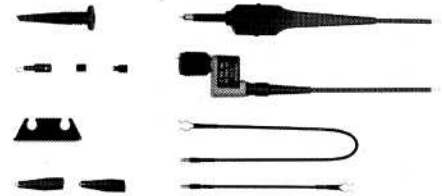
**Included Accessories:**

- 206-0060-00 1 TIP, probe, spring
- 344-0046-00 2 CLIPS, miniature alligator
- 134-0013-00 1 PLUG, banana, threaded
- 175-0125-01 1 CABLE, ground lead, 12 in
- 175-0124-01 1 CABLE, ground lead, 5 in
- 206-0105-00 1 TIP, probe, hook
- 206-0015-00 1 TIP, probe, BNC
- 352-0090-00 1 HOLDER, probe, plastic
- 013-0071-00 1 TIP, probe, retractable hook, screw-on

**ORDERING INFORMATION**

- P6060 10X Probe, 6 ft,**  
Order 010-6060-03
- Opt 01, 3.5 ft, Order 010-6060-01

**P6062B Dc to 100 MHz 1X, 10X Selectable Attenuation**



The P6062B is a passive dual attenuation probe designed for TEKTRONIX Oscilloscopes with bandwidths to 100 MHz. A sliding switch on the probe body selects 1X or 10X attenuation. The probe provides a push-button for actuating a ground reference in the 1X or 10X position. The 1X position of the probe allows the use of the full instrument sensitivity. This is valuable when evaluating small signals of 10 MHz or less. The 1X-10X switch allows the user to switch in and out a decade of sensitivity without returning to the oscilloscope. The user may also arbitrarily switch from 1X to 10X in order to evaluate the effects of loading by the oscilloscope.

**Included Accessories:**

- 352-0341-00 1 HOLDER, probe
- 206-0114-00 1 TIP, probe
- 013-0107-03 1 TIP, probe; ret hook assy
- 175-0124-01 1 LEAD, elec, probe ground, 5 in
- 175-0125-01 1 LEAD, elec, probe ground, 12 in
- 344-0046-00 2 CLIPS, miniature alligator with cover
- 166-0404-01 1 SLEEVE, insul for 0.188 dia probe bushing
- 016-0521-00 1 POUCH, accessory (not shown)

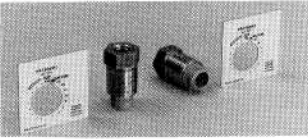
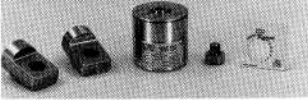

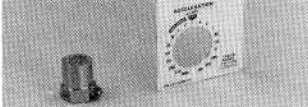
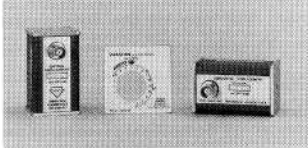
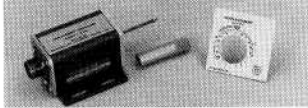
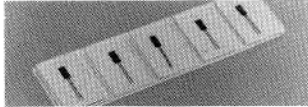
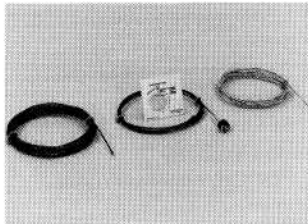
**ORDERING INFORMATION**

**P6062B Switchable Attenuation Probe, 6 ft, Order 010-6062-13**

- Opt 01, 3.5 ft, Order 010-6062-11
- Opt 02, 9 ft, Order 010-6062-15

The compensation of probes for use with counters requires special test procedures. If you require technical assistance contact your Tektronix Field Engineer.

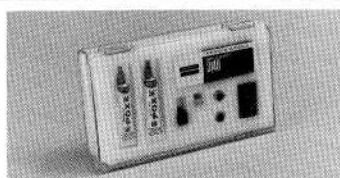
# Mechanical Measurement Transducers

TRANSDUCER PACKAGE	CONTENTS	DESCRIPTION	RECOMMENDED ACCESSORIES
	<b>PRESSURE</b> 015-0161-00*	TRDCR: 3000 psig. Scale: 1 to 1000 psi/DIV; 0.1 to 100 (kgf/cm <sup>2</sup> )/DIV.	Trdcr element: Bonded STRG 350 Ω; f <sub>n</sub> ≈ 65 kHz. Accuracy 2%. 20 ft cable 012-0209-00
	<b>PRESSURE</b> 015-0162-00*	TRDCR: 300 psig. Scale: 0.1 to 100 psi/DIV; 0.01 to 10 (kgf/cm <sup>2</sup> )/DIV.	Trdcr element: Bonded STRG 350 Ω; f <sub>n</sub> ≈ 24 kHz. Accuracy 2%. 20 ft cable 012-0209-00
	<b>FORCE</b> 015-0163-00*	TRDCR: 3000 lbs f. Load button. Eye bolt (2). Scale: 1 to 1000 lbs f/DIV; 0.5 to 500 kgf/DIV.	Trdcr element: Bonded STRG 350 Ω. Accuracy 1%. 20 ft cable 012-0209-00
	<b>FORCE</b> 015-0164-00*	TRDCR: 50 gram f; 50 lb f. Adapter. Scales: 0.01 to 20 lbs f/DIV; 5 (10 <sup>-3</sup> ) to 10 kgf/DIV. 0.01 to 20 gram f/DIV; 0.02 (10 <sup>-3</sup> ) to 40 (10 <sup>-3</sup> ) mm/DIV.	Trdcr element: Unbonded STRG 350 Ω. Accuracy 2%.
	<b>ACCELERATION</b> 015-0165-00	TRDCR: 10,000 g. Scale: 0.001 to 1000 g/DIV.	Trdcr 1.5 Hz to 15 kHz; f <sub>n</sub> ≈ 30 kHz. Element: Piezoelectric. Accuracy 5%. 20 ft cable 012-0211-00
	<b>VERTICAL VIBRATION</b> 015-0166-00 <b>HORIZONTAL VIBRATION</b> 015-0167-00	TRDCR: ±0.025 inch. Displacement Scale: 1 (10 <sup>-6</sup> ) to 10 (10 <sup>-3</sup> ) inch /DIV; 0.02 (10 <sup>-3</sup> ) to 0.2 mm/DIV. Velocity Scale: 20 (10 <sup>-6</sup> ) to 20 (inch/sec)/DIV; 0.5 (10 <sup>-6</sup> ) to 0.5 (10 <sup>-3</sup> ) (m/s)/DIV.	Trdcrs: Inductive self gen 10 Hz to 1 kHz; Damped f <sub>n</sub> ≈ 8 Hz. Outputs ≈ 600 mV/inch/s and ≈ 10 mV/0.001 inch. Accuracy 5%. 20 ft cable 012-0136-00
	<b>DISPLACEMENT</b> 015-0168-00	TRDCR: ±0.2 inch. Feeler gage 0.040-inch. Scale: 10 (10 <sup>-6</sup> ) to 0.1 inch/DIV; 0.2 (10 <sup>-3</sup> ) to 2 mm/DIV.	Element: DC to DC LVDT DC to >120 Hz. Accuracy 2% within ±0.1 inch. 20 ft cable 012-0209-00
	<b>STRAIN</b> 015-0171-00	Strain Gages: 30,000 μ strain. Package of five.	Elements: Foil STRG 120 Ω. Accuracy 1%. 0.125-inch long attached leads. Strain gage Adapter 015-0169-00 Cement kit 015-0172-00
<b>TEMPERATURE</b>	015-0173-00	Thermocouple:	
	+230°F	+105°C Max.	PVC Ripcord Insulation; #30 Iron Constantan.
	+1000°F	+480°C Max.	Fiberglass Insulation; #30 Iron Constantan.
	+900°F	+480°C Max with Magnet Mounting.	Fiberglass Insulation; #24 Iron Constantan.
		Adapter (2). Scale: 0.5 to 500°F/DIV; 0.2 to 200°C/DIV.	Accuracy 5% from +10°C to max °C.



### STRAIN GAGE ADAPTER (015-0169-00)\*

Provides means for connecting 1, 2, or 4 arms of a Wheatstone Bridge to the modified Transducer Power Supply. Has variable shunt resistor for gage factor calibration. The adapter has four binding post terminals and a six-foot cable with 6-pin connector. Scale included is 5 to 50,000 μ strain/DIV.



### CEMENT KIT (015-0172-00)

Provides means for mounting and connecting foil strain gages. Includes Room Temperature Curing Epoxy cement, RTV Clear Silicon Rubber coating, Neoprene pads and metal plates, cementable Wiring terminals, and clear Mylar film.

### CABLE (012-0136-00)

20 ft low-noise coaxial cable with BNC connectors on both ends.

### CABLE (012-0209-00)

20 ft low-noise six-conductor cable with 6-pin connector on each end.

### CABLE (012-0210-00)

20 ft six-conductor cable with 6-pin male connector on one end.

### CABLE (012-0211-00)

20 ft low-noise coaxial cable with miniature coaxial connector on one end and BNC connector on the other.

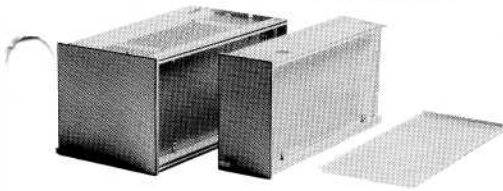
### CONNECTOR (131-0618-00)

Mates Type PS501-1 Transducer Power Supply INPUT 6-pin connector.

\*Requires PS501-1 custom modified Transducer Power Supply mounted in a TM 500-Series Mainframe. Consult a Tektronix Field Engineer for price and installation information on power supply and adapter.



## TM 500 CUSTOM PLUG-IN KITS



### Single and double compartment sizes

A complete test and measurement set-up for many typical jobs requires at least one non-standard item. Such items commonly include relay circuits or manual switches for routing signals; test oscillators at pre-set frequencies for alignment purposes and markers; digital logic circuits for sequencing, timing, and control; special processors or converters such as log amps, multipliers, and analog-to-digital converters; and a variety of other system elements which are usually not available or economical as complete commercial instruments. The construction and packaging of these special items is always a problem, and the sheet metal work and provision for necessary power supplies often far exceed the cost of the functional elements.

This is why the TM 500 line includes custom plug-in kits. The kits provide perforated main circuit boards which allow rapid construction and wiring of circuits using both discrete components and integrated circuits. Also included are top and bottom rails, side cover, front sub-panel, and a blank dress panel, and the latch mechanism. An instruction sheet details the voltages and currents available in the power module. Standard voltage regulator IC's can be used to provide exact voltages for most individual power supply requirements. The finished special-purpose circuitry or instrument is physically compatible with the other TM 500 instrumentation.

**Custom Plug-in Kit (single compartment)**  
Order 040-0652-03

**Custom Plug-in Kit (double compartment)**  
Order 040-0754-01

## General Terms of Sale and Warranty

Orders should be placed with your Tektronix Field Engineering Office listed on page 40.

### NET 30 DAYS

Tektronix, Inc., standard terms of sale are NET 30 days following the date of shipment. As with all credit terms, satisfactory credit accommodations must be arranged.

### EXTENDED TERMS OF SALE

Extended terms of 60 to 180 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended.

### WARRANTY

It is Tektronix' intent to provide unmatched value for our customers in products, services, and business practices. A part of this intent is expressed in our warranty practice. All TEKTRONIX products are warranted against defects in materials and workmanship. The period of coverage is specified in a warranty statement accompanying each product.

### SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified.

Unless otherwise specified, shipment will be made via most economical method. Surface and air shipments will be insured at full valuation unless your order instructs otherwise.

Specification and price change privileges reserved.

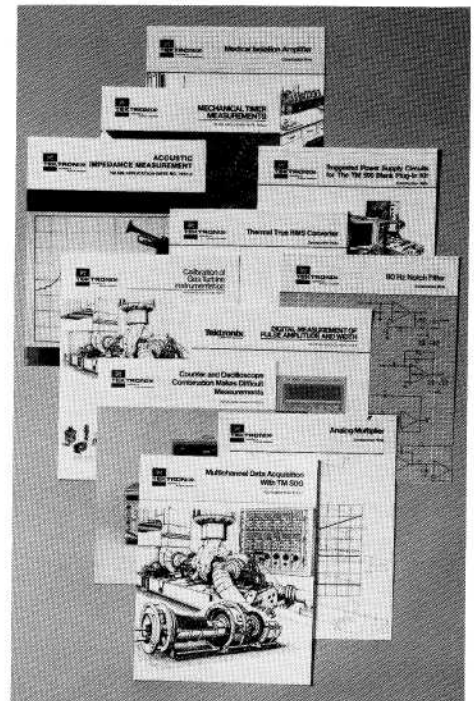
## TM 500 Application and Construction Notes

The TM 500 product line is supported by an on-going program to keep you informed of how to achieve optimal performance and versatility from your TM 500 instruments. Tektronix' goal of providing you with solutions to difficult measurement problems does not end with your purchase of TM 500 instruments.

The Application and Construction Notes augment your TM 500 instrument with valuable information. They tell you how to use your instruments more fully, and how to build a custom plug-in for your unusual measurement requirements.

Application Notes take you through the steps necessary to solve complex problems, or to make more useful measurements with your TM 500 instruments. Subjects include: Integration Through V to F Conversion, Generating Delayed Pulses, and Current Sinking with Power Supply Modules.

Construction Notes provide information necessary to build custom circuits using a TM 500 Blank Plug-in Kit and standard components. These notes are developed from the actual construction of more common special circuits; they include parts lists, schematics and other construction details. Some of the available notes include: Power Supply Circuits, Thermal True RMS Converter, and Analog Multipliers.





## GENERAL INFORMATION

To provide you with personal assistance in ordering as well as servicing TEKTRONIX Products, we have established Field Offices and technically qualified Tektronix Distributors in many countries throughout the world. The Tektronix office or distributor in your country will be pleased to help you select the instrument that best suits your requirements in performance, and provide you with prompt ordering service.

### SERVICE

If you require service, replacement parts, a warranty question resolved, or other help, please notify the Tektronix facility nearest you. They will process all orders for repair parts promptly, and provide emergency parts service when needed to restore an instrument to operating condition. They will also arrange for fast service with necessary recalibration or repair work on your instrument.

### WARRANTY

All TEKTRONIX Instruments are warranted against defective material and workmanship for one year.

**PLEASE DO NOT RETURN INSTRUMENTS OR PARTS BEFORE RECEIVING DIRECTIONS.**

## WHO TO CONTACT FOR QUOTATIONS, ORDERING INFORMATION, AND TECHNICAL ASSISTANCE

### COUNTRIES WITH TEKTRONIX FIELD OFFICES

AUSTRIA	JAPAN
AUSTRALIA	SWEDEN
BELGIUM	SWITZERLAND
CANADA	THE NETHERLANDS
DENMARK	UNITED KINGDOM
FRANCE	

Contact your local Field Office/Distributor.

### COUNTRIES WITH TEKTRONIX DISTRIBUTORS

Contact the distributor in your country as listed on the preceding page.

### COUNTRIES WITH NO TEKTRONIX DISTRIBUTOR OR TEKTRONIX FIELD ENGINEERING OFFICE

Please address your inquiries and orders to:

Tektronix, Inc.  
Export Marketing Dept.  
P.O. Box 500  
Beaverton, Oregon 97005 USA

## INFORMATION AND QUOTATIONS

Field Engineers will be pleased to provide you with information on TEKTRONIX Instruments and answer your technical questions. A pro forma invoice will be issued, if requested, indicating price and sales conditions. When pro forma invoice or purchase order acknowledgement is issued, we will indicate the documents needed to ship your order. We will be glad to prepare necessary export documentation for you and make all shipping arrangements.

### METHOD OF PAYMENT

We would like to make our products available to customers on open account terms, whenever conditions permit. Other credit terms are available for a customer's particular requirements. However, due to political, foreign exchange, and regulatory conditions in many areas of the world, credit terms are not always available. In those cases, advance payment or irrevocable letters of credit are required.

### SHIPMENTS

Unless otherwise requested, shipments will be made by the most economical method.



# Tektronix®

COMMITTED TO EXCELLENCE

Copyright © 1977, Tektronix, Inc.  
All rights reserved. Printed in  
U.S.A. Foreign and U.S.A. Products  
of Tektronix, Inc. are covered by  
Foreign and U.S.A. Patents and/or  
Patents Pending. Information in  
this publication supersedes all  
previously published material.  
Specification and price change  
privileges reserved. TEKTRONIX,  
TEK, SCOPE-MOBILE, TELEQUIP-  
MENT, and  are registered  
trademarks of Tektronix, Inc.  
P.O. Box 500, Beaverton, Oregon  
97077. Phone: (Area Code 503)  
644-0161, TWX: 910-467-8708,  
Cable: TEKTRONIX. Overseas  
Distributors in over 50 Countries.

