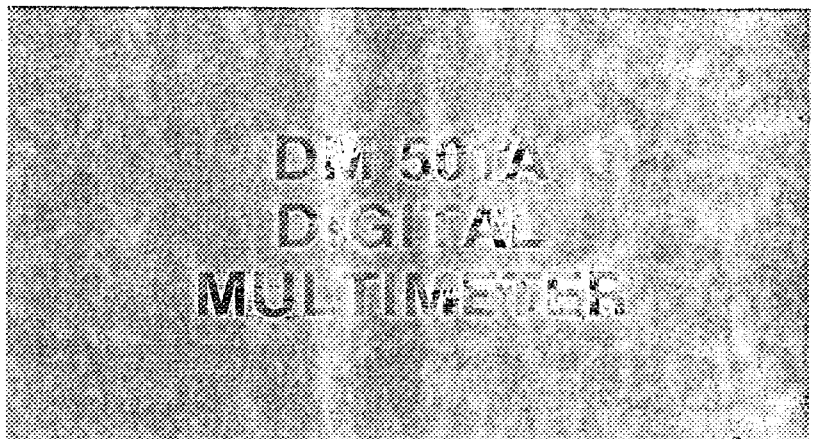


**Tektronix®**  
COMMITTED TO EXCELLENCE



INSTRUCTION MANUAL

Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97077

Serial Number \_\_\_\_\_

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Tektronix warrants that this product is free from defects in materials and workmanship. The warranty period is one (1) year from the date of shipment. Tektronix will, at its option, repair or replace the product if Tektronix determines it is defective within the warranty period and if it is returned, freight prepaid, to a service center designated by Tektronix.


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## WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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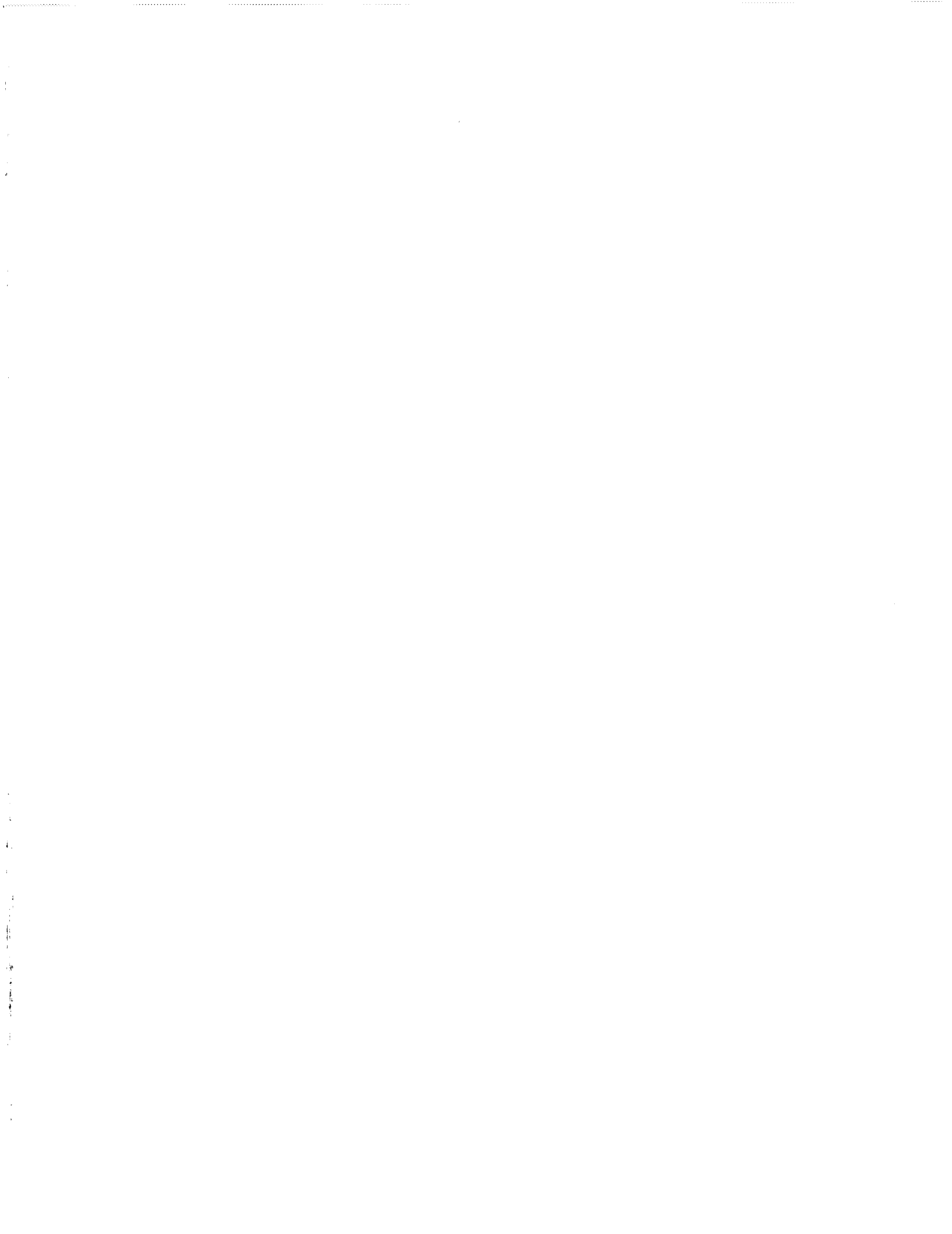
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# OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

## TERMS

### In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

### As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

## SYMBOLS

### In This Manual



This symbol indicates where applicable cautionary or other information is to be found.

### As Marked on Equipment



DANGER — High voltage.



Protective ground (earth) terminal.



ATTENTION — refer to manual.

### Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

### **Grounding the Product**

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

### **Danger Arising From Loss of Ground**

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

### **Use the Proper Power Cord**

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see (page/fig. ref.).

Refer cord and connector changes to qualified service personnel.

### **Use the Proper Fuse**

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

Refer fuse replacement to qualified service personnel.

### **Do Not Operate in Explosive Atmospheres**

To avoid explosion, do not operate this product in an atmosphere of explosive gases unless it has been specifically certified for such operation.

### **Do Not Remove Covers or Panels**

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

### **Do Not Operate Without Covers (for TM 500 plug-ins only)**

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

# **SERVICING SAFETY SUMMARY**

## **FOR QUALIFIED SERVICE PERSONNEL ONLY**

*Refer also to the preceding Operators Safety Summary.*

### **Do Not Service Alone**

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

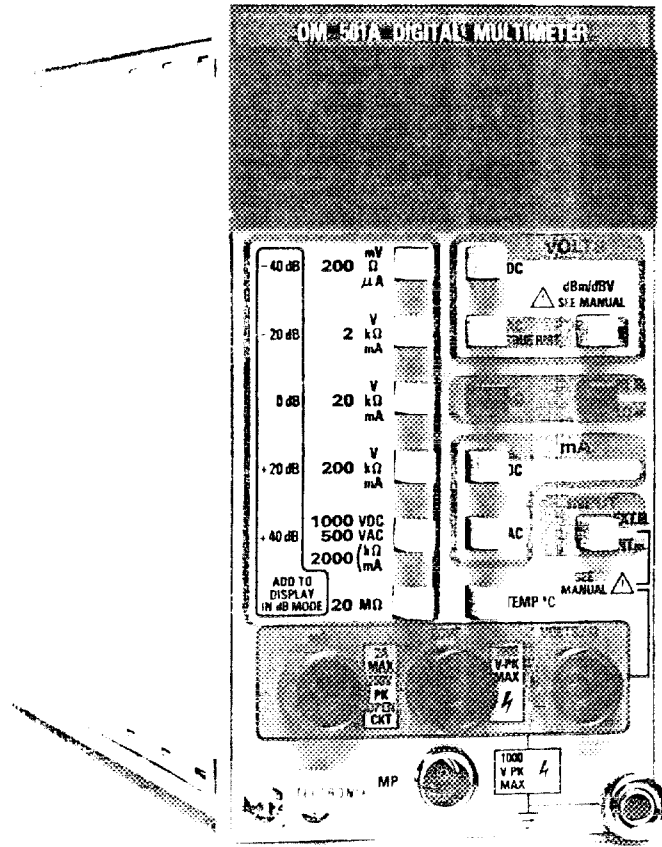
### **Use Care When Servicing With Power On**

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

### **Power Source**

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.



DM 501A Digital Multimeter.

# SPECIFICATION

## Introduction

The DM 501A Digital Multimeter measures dc voltage and current, ac voltage and current, dBm, dBV, resistance, and temperature. The ac functions are ac coupled only, true rms responding. All the functions and ranges are front panel push button selected, including the rear interface connector input.

Readout in dBm or dBV is selected by an internal jumper. The unit is shipped with the internal jumper in the dBm position.

The readout is a 0.4" high, 4 1/2 digit display using seven segment LED. The decimal point is automatically positioned depending on the selected operating range of the instrument. Polarity indication is automatic.

## Accessories

Standard accessories include this instruction manual, a set of test leads and the TEKTRONIX P6601 temperature probe with its instruction manual.

The P6601 temperature probe and temperature measurement capabilities are deleted for Option 2 instruments.

## Performance Conditions

The electrical characteristics are valid only if the DM 501A has been calibrated at an ambient temperature between  $-21^{\circ}\text{C}$  and  $+25^{\circ}\text{C}$  and is operating at an ambient temperature between  $0^{\circ}\text{C}$  and  $+50^{\circ}\text{C}$ , unless otherwise noted.

Items listed in the Performance Requirements column of the Electrical Characteristics are verified by comparing the Performance Check in the Calibration section of this manual. These items are either explanatory notes or performance characteristics for which no limits are specified.

Table 1-1

ELECTRICAL CHARACTERISTICS (Front Panel)

Characteristics	Performance Requirements	Supplemental Information
DC VOLTMETER		
Accuracy for 200 mV, 2 V, 20 V 200 V and 1000 V ranges +18°C to +28°C		
200 mV range	$\pm(0.05\%$ of reading $\pm 0.015\%$ of full scale)	
2 V to 200 V ranges	$\pm(0.05\%$ of reading $\pm 0.01\%$ of full scale)	
1000 V range	$\pm(0.05\%$ of reading $\pm 0.02\%$ of full scale)	
$0^{\circ}\text{C}$ to $+18^{\circ}\text{C}$ , $+28^{\circ}\text{C}$ to $+50^{\circ}\text{C}$		
200 mV to 200 V range	$\pm(0.1\%$ of reading $\pm 0.025\%$ of full scale)	
1000 V range	$\pm(0.1\%$ of reading $\pm 0.05\%$ of full scale)	

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
DC VOLTMETER (cont)		
Common Mode Rejection Ratio	100 dB at dc. 80 dB at 50 and 60 Hz.	With a 1 kΩ unbalance.
Normal Mode Rejection Ratio	60 dB at 50 or 60 Hz ±0.2 Hz.	
Maximum Resolution		10 μV.
Step Response Time		1 second.
Input Resistance		10 MΩ ±0.5%.
Maximum Input Voltage		
VOLTS/Ω to LOW		1000 V peak.
VOLTS/Ω to ground		1000 V peak.
LOW to ground		1000 V peak.
Input Connectors		Front panel (EXT) or rear interface (INT)
AC VOLTMETER (TRUE RMS)		
Accuracy for 200 mV, 2 V, 20 V 200 V and 500 V ranges ±18°C to ±28°C		Input signal must be between 5% and 100% of full scale. The 500 V range requires a dynamic input signal between 500 V and 100 V rms.
200 mV to 200 V ranges		
40 Hz to 10 kHz	±(0.6% of reading ± 0.05% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(1.0% of reading ± 0.05% of full scale)	
500 V range		
40 Hz to 10 kHz	±(0.6% of reading ± 0.2% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(1.0% of reading ± 0.2% of full scale)	
0°C to ±18°C, ±28°C to ±50°C		
200 mV to 200 V ranges		
40 Hz to 10 kHz	±(0.8% of reading ± 0.075% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(1.3% of reading ± 0.075% of full scale)	
500 V range		
40 Hz to 10 kHz	±(0.8% of reading ± 0.3% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(1.3% of reading ± 0.3% of full scale)	

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
AC VOLTMETER (TRUE RMS) (cont)		
Common Mode Rejection Ratio	60 dB at 50 and 60 Hz.	With a 1 k $\Omega$ unbalance.
Maximum Resolution		10 $\mu$ V.
Response Time		<2 seconds.
Input Impedance		10 M $\Omega$ $\pm$ 0.5% paralleled by 160 pF.
Input Connectors		Front panel (EXT) or rear interface (INT).
Maximum Input Voltage		500 V rms or 600 Vdc not to exceed 1000 V peak.
VOLTS/ $\Omega$ to LOW		
VOLTS/ $\Omega$ to ground		1000 V peak.
LOW to ground		1000 V peak.
Crest Factor		4 at full scale.
DECIBELS (dB)—TRUE RMS		
Accuracy for -40 dB, -20 dB, 0 dB, +20 dB and +40 dB ranges		
+18°C to +28°C		
+20 dB to -15 dB	$\pm$ 0.5 dB 20 Hz to 20 kHz	
-15 dB to -20 dB	$\pm$ 0.5 dB 20 Hz to 2 kHz $\pm$ 1.5 dB 2 kHz to 10 kHz	Typically < $\pm$ 2.5 dB 10 kHz to 20 kHz.
0°C to +18°C, +28°C to +50°C		
+20 dB to -15 dB	$\pm$ 1.1 dB 20 Hz to 20 kHz	
-15 dB to -20 dB	$\pm$ 1.1 dB 20 Hz to 2 kHz $\pm$ 2.1 dB 2 kHz to 10 kHz	Typically < $\pm$ 3.1 dB 10 kHz to 20 kHz.
Maximum Resolution		0.1 dB.
Response Time		<2 seconds.
Input Impedance		10 M $\Omega$ paralleled by 160 pF.
Maximum Input Voltage		500 v rms or 600 Vdc not to exceed 1000 V peak. <sup>a</sup>
VOLTS/ $\Omega$ to LOW		
VOLTS/ $\Omega$ to ground		1000 V peak.
LOW to ground		1000 V peak.

<sup>a</sup>Equivalent to 54 dBV or 56.2 dBm.

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information		
Crest Factor		4 at full scale.		
Ref Voltage		1 V.		
dBV		0.7746 V (1 mW dissipated into 600 Ω). Selected by internal jumper.		
dBm				
Input Connectors		Front panel (EXT) or rear interface (INT).		
<b>OHMMETER</b>				
Accuracy for 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ and 20 MΩ ranges.				
±18°C to ±28°C				
200 Ω to 200 kΩ LO Ω 2 kΩ to 2000 kΩ HI Ω	±(0.15% of reading ± 0.015% of full scale)			
2000 kΩ LO	±(0.3% of reading ± 0.015% of full scale)			
20 MΩ HI Ω	±(0.5% of reading ± 0.015% of full scale)			
0°C to ±18°C, ±28°C to ±50°C				
200 Ω to 200 kΩ LO Ω 2 kΩ to 2000 kΩ HI Ω	±(0.3% of reading ± 0.025% of full scale)			
2000 kΩ LO Ω 20 MΩ HI Ω	±(1.2% of reading ± 0.025% of full scale)			
Maximum Input Volts Any Range		250 V peak.		
Measuring Current and Full Scale Volts		Range	Source Current	V Max at Full Scale
HI Ω		200 Ω	1.0 mA	0.2 V
		2 kΩ	1.0 mA	2.0 V
		20 kΩ	0.1 mA	2.0 V
		200 kΩ	10.0 μA	2.0 V
		2000 kΩ	1.0 μA	2.0 V
		20 MΩ	0.1 μA	2.0 V
LO Ω		200 Ω	1.0 mA	0.2 V
		2 kΩ	0.1 mA	0.2 V
		20 kΩ	10.0 μA	0.2 V
		200 kΩ	1.0 μA	0.2 V
		2000 kΩ	0.1 μA	0.2 V
		20 MΩ	0.1 μA	2.0 V



Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental information
Maximum Resolution		10 mΩ.
Response Time		<2 seconds, 200 Ω to 2000 kΩ. <10 seconds, 20 MΩ scale.
Maximum Open Circuit Voltage		<6 V.
Input Connectors		Front panel (EXT) or rear interface (INT).

DC AMMETER

Accuracy for 200 μA, 2 mA, 20 mA, 200 mA and 2000 mA ranges.														
+18°C to +28°C	±(0.2% of reading + 0.015% of full scale)													
0°C to +18°C, +28°C to +50°C	±(0.3% of reading + 0.025% of full scale)													
Response Time		<1 second.												
Input Resistance		<table border="1"> <thead> <tr> <th>Range</th> <th>Approximate Resistance</th> </tr> </thead> <tbody> <tr> <td>200 μA</td> <td>1.0 kΩ</td> </tr> <tr> <td>2 mA</td> <td>100.0 Ω</td> </tr> <tr> <td>20 mA</td> <td>10.2 Ω</td> </tr> <tr> <td>200 mA</td> <td>1.2 Ω</td> </tr> <tr> <td>2000 mA</td> <td>0.4 Ω</td> </tr> </tbody> </table>	Range	Approximate Resistance	200 μA	1.0 kΩ	2 mA	100.0 Ω	20 mA	10.2 Ω	200 mA	1.2 Ω	2000 mA	0.4 Ω
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200 μA	1.0 kΩ													
2 mA	100.0 Ω													
20 mA	10.2 Ω													
200 mA	1.2 Ω													
2000 mA	0.4 Ω													
Maximum Input Current		2 A any range.												
Maximum Open Circuit Input Voltage (mA to LOW)		250 V peak.												
Maximum Floating Voltage mA to ground		1000 V peak.												
LOW to ground		1000 V peak.												
Input Connectors		Front panel only.												
Maximum Resolution		10 nA.												

AC AMMETER

Accuracy for 200 μA, 2 mA, 20 mA, 200 mA and 2000 mA ranges.														
20 Hz to 10 kHz (Sinewave)														
+18°C to +28°C	±(0.6% of reading + 0.05% of full scale)	Input current must be between 5% and 100% of full scale.												
0°C to +18°C, +28°C to +50°C	±(0.7% of reading + 0.075% of full scale)	Usable to 20 kHz.												
Response Time		<2 seconds.												
Input Resistance		<table border="1"> <thead> <tr> <th>Range</th> <th>Approximate Resistance</th> </tr> </thead> <tbody> <tr> <td>200 μA</td> <td>1.0 kΩ</td> </tr> <tr> <td>2 mA</td> <td>100.0 Ω</td> </tr> <tr> <td>20 mA</td> <td>10.2 Ω</td> </tr> <tr> <td>200 mA</td> <td>1.2 Ω</td> </tr> <tr> <td>2000 mA</td> <td>0.4 Ω</td> </tr> </tbody> </table>	Range	Approximate Resistance	200 μA	1.0 kΩ	2 mA	100.0 Ω	20 mA	10.2 Ω	200 mA	1.2 Ω	2000 mA	0.4 Ω
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200 μA	1.0 kΩ													
2 mA	100.0 Ω													
20 mA	10.2 Ω													
200 mA	1.2 Ω													
2000 mA	0.4 Ω													

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
AC AMMETER (cont)		
Maximum Input Current		2 A any range.
Maximum Open Circuit Input Voltage (mA to LOW)		250 V peak.
Maximum Floating Voltage mA to ground		1000 V peak.
LOW to ground		1000 V peak
Input Connectors		Front panel only.
Maximum Resolution		10 nA
TEMPERATURE		
Accuracy for the -62°C to +240°C range. +18°C to +28°C ambient Probe calibrated to instrument	±2°C from -62°C to +150°C. ±0°C to -6°C from +150°C to +240°C	
Any probe	±4°C from -62°C to +150°C. ±2°C to -8°C from +150°C to +240°C.	
0°C to +18°C, +28°C to +50°C	Add 1.5°C to the above tolerance in each direction.	
Input Connectors		Front panel (EXT) or rear interface (INT).

Table 1-1 (cont)

**ELECTRICAL CHARACTERISTICS (Rear Interface Inputs)**

Characteristics	Performance Requirements	Supplemental Information
Maximum Input Voltage (dc, ac, dB, and ohms) Pin 28B to 28A		200 V peak. Equivalent to 43 dBV or 45.2 dBm.
Pin 28B to ground		200 V peak.
Pin 28A to ground		200 V peak.

**DC VOLTMETER (REAR INTERFACE INPUTS)**

Accuracy for 200 mV, 2 V, 20 V, 200 V and 1000 V ranges. +18°C to +28°C		
200 mV range	$\pm(0.05\%$ of reading $\pm 0.015\%$ of full scale)	
2 V to 200 V range	$\pm(0.05\%$ of reading $\pm 0.01\%$ of full scale)	
1000 V range	$\pm(0.05\%$ of reading $\pm 0.02\%$ of full scale)	
0°C to +18°C, +28°C to +50°C		
200 mV to 200 V range	$\pm(0.1\%$ of reading $\pm 0.025\%$ of full scale)	
1000 V range	$\pm(0.1\%$ of reading $\pm 0.05\%$ of full scale)	

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
<b>AC VOLTMETER (REAR INTERFACE INPUTS)</b>		
Accuracy for 200 mV, 2 V, 20 V, 200 V and 500 V ranges.		Input signal must be between 5% and 100% of full scale input. The 500 V range is limited to between 200 V peak and 100 V rms.
±18°C to ±28°C		
200 mV to 200 V range		
40 Hz to 10 kHz	±(1.6% of reading + 0.05% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(2.0% of reading + 0.05% of full scale)	
500 V range		
40 Hz to 10 kHz	±(1.6% of reading + 0.2% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(2.0% of reading + 0.2% of full scale)	
0°C to ±18°C, ±28°C to ±50°C		
200 mV to 200 V range		
40 Hz to 10 kHz	±(1.8% of reading + 0.075% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(2.3% of reading + 0.075% of full scale)	
500 V range		
40 Hz to 10 kHz	±(1.8% of reading + 0.3% of full scale)	
20 Hz to 40 Hz and 10 kHz to 20 kHz	±(2.3% of reading + 0.3% of full scale)	
<b>DECIBELS (dB)—TRUE RMS (REAR INTERFACE INPUTS)</b>		
Accuracy for -40 dB, -20 dB, 0 dB, +20 dB and +40 dB ranges		
±18°C to ±28°C		
-20 dB to -15 dB	±0.6 dB 20 Hz to 20 kHz	
-15 dB to -20 dB	±0.6 dB 20 Hz to 2 kHz ±1.6 dB 2 kHz to 10 kHz	Typically ±2.6 dB 10 kHz to 20 kHz
0°C to ±18°C, ±28°C to ±50°C		
-20 dB to -15 dB	±1.2 dB 20 Hz to 20 kHz	
-15 dB to -20 dB	±1.2 dB 20 Hz to 2 kHz ±2.2 dB 2 kHz to 10 kHz	Typically ±3.2 dB 10 kHz to 20 kHz

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
OHMMETER (REAR INTERFACE INPUTS)		
Accuracy for 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, and 20 MΩ ranges +18°C to +28°C		
200 Ω to 200 kΩ LO Ω 2 kΩ to 2000 kΩ HI Ω	±(0.15% of reading + 0.015% of full scale) + 0.02 Ω	
2000 kΩ LO Ω	±(0.3% of reading + 0.015% of full scale) + 0.02 Ω	
20 MΩ HI Ω	±(0.5% of reading + 0.015% of full scale) + 0.02 Ω	
0°C to +18°C, +28°C to +50°C		
200 Ω to 200 kΩ LO Ω 2 kΩ to 2000 kΩ HI Ω	±(0.3% of reading + 0.025% of full scale) + 0.02 Ω	
2000 kΩ LO Ω 20 MΩ HI Ω	±(1.2% of reading + 0.025% of full scale) + 0.02 Ω	

Table 1-2  
MISCELLANEOUS

Characteristics	Description
Power Consumption	Approximately 9 watts.
Reading Rate	3 1/3 per second.
Over-range Indication	Flashing display except on 500 Vac and 1000 Vdc ranges.
Calibration Interval	1000 hours of operation or 6 months, whichever occurs first.
Warm-up Time	30 minutes (60 minutes after storage in high humidity environment).

Table 1-3  
ENVIRONMENTAL<sup>a</sup>

Characteristics	Description	
Temperature		
Operating	0°C to +50°C <sup>b</sup>	Meets or exceeds MIL-T-28800B, class 5 with exceptions. <sup>d</sup>
Non-operating	-55°C to +75°C	
Humidity	95% to 100% for 5 days (derated above 25°C)	Meets or exceeds MIL-T-28800B, class 5.
Altitude		
Operating	4.6 km (15,000 ft)	Meets or exceeds MIL-T-28800B, class 3.
Non-operating	15 km (50,000 ft)	
Vibration	0.64 mm (0.025") disp. 5-55-5 Hz <sup>a/c</sup> (sine wave). 75 min. total.	Meets or exceeds MIL-T-28800B, class 3.
Shock	30 g's (half sine) 11 ms 18 shocks <sup>a/c</sup>	Meets or exceeds MIL-T-28800B, class 3.
Bench Handling		
Operating	45° or 4" or equilibrium <sup>a/c</sup> , whichever occurs first.	Meets or exceeds MIL-T-28800B, class 3.
E.M.C.		
Operating	30 Hz to 1 GHz <sup>b</sup>	Meets or exceeds MIL-T-28800B, class 3.
Electrical Discharge		
Operating	20 kV max. <sup>b</sup>	No MIL-T-28800 equivalent. Charge applied to each protruding area of the front panel except the input connectors.
Transportation		
Vibration	25 mm (1 inch at 270 rpm for 1 hr) <sup>c</sup>	National Safe Transit Association Preshipment Test Procedures project: 1A-B-1 and 1A-B-2.
Package Drop	10 drops from 3 ft (91 cm) <sup>c</sup>	

<sup>a</sup>See Table 1-4 for system modifiers.

<sup>b</sup>With power module.

<sup>c</sup>Without power module.

<sup>d</sup>Temperature: During low temperature test MIL-T-28800B paragraph 4.5.5.1.3 (b) for class 5, steps 4 and 5 shall be performed before step 2. Also, the instrument shall not be operating during step 6, paragraph 4.5.5.1.3 (e), class 5. While operating, condensed moisture shall not be present on class 5 instruments. Drying of the instrument for this class may be performed in a suitable chamber, if necessary.

**Table 1-4**  
**TM 500 SYSTEMS**  
**ENVIRONMENTAL SPECIFICATION**

Characteristics	TM 501	TM 503	TM 504	TM 506	TM 515
Temperature Operating Non-operating	Meets same test standards as plug-in.				
Humidity Operating Non-operating	Meets same test standards as plug-in.				
Altitude Operating Non-operating	Meets same test standards as plug-in.				
Vibration Operating	0.26 mm (0.010 in.) disp., 10-55 Hz (sine wave), 75 min. total.			0.33 mm (0.015 in.) disp. 10-55 Hz (sine wave) 75 min.	
Shock Operating	20 g's (1/2 sine) 11 ms, 18 shocks			30 g's (1/2 sine) 11 ms, 18 shocks	
Bench Handling Operating	Meets same test standards as plug-in.				
Electric Discharge Operating	Meets same test standards as plug-in.				
Transportation Vibration Package Drop	Meets same test standards as plug-in.				

**Table 1-5**  
**PHYSICAL CHARACTERISTICS**

Characteristics	Description
Finish	Anodized aluminum panel and chassis.
Net Weight	≈2.5 lbs (1.13 kg).
Overall Dimensions	2.633 in. (66.8 mm) W x 11.240 in. (285.3 mm) D x 4.901 in. (125.9 mm) H.





# OPERATING INSTRUCTIONS

## Installation and Removal Instructions

The DM 501A is calibrated and ready to use when received. It operates in one compartment of a TM 500-Series power module. Refer to the power module instruction manual for line voltage requirements and power module operation.

### CAUTION

*Turn the power module off before inserting or removing the DM 501A; otherwise, arcing may occur at the rear interface connectors. Arcing reduces the connectors useful life and damage may be done to the plug-in circuitry.*

Check to see that the plastic barriers on the interconnecting jack of the selected power module compartment match the cut-outs in the DM 501A circuit board edge connector. If they don't match, do not insert the plug-in until proper identification is made. When the units are properly matched, align the DM 501A chassis with the upper and lower guides (see Fig. 2-1) of the selected compartment. Insert the DM 501A into the compartment and press firmly to seat the circuit board in the interconnecting jack. The LED display should be visible when the power module power switch is turned on.

To remove the DM 501A, pull the release latch (located on the lower left corner) until the interconnecting jack disengages. The DM 501A will now slide out.

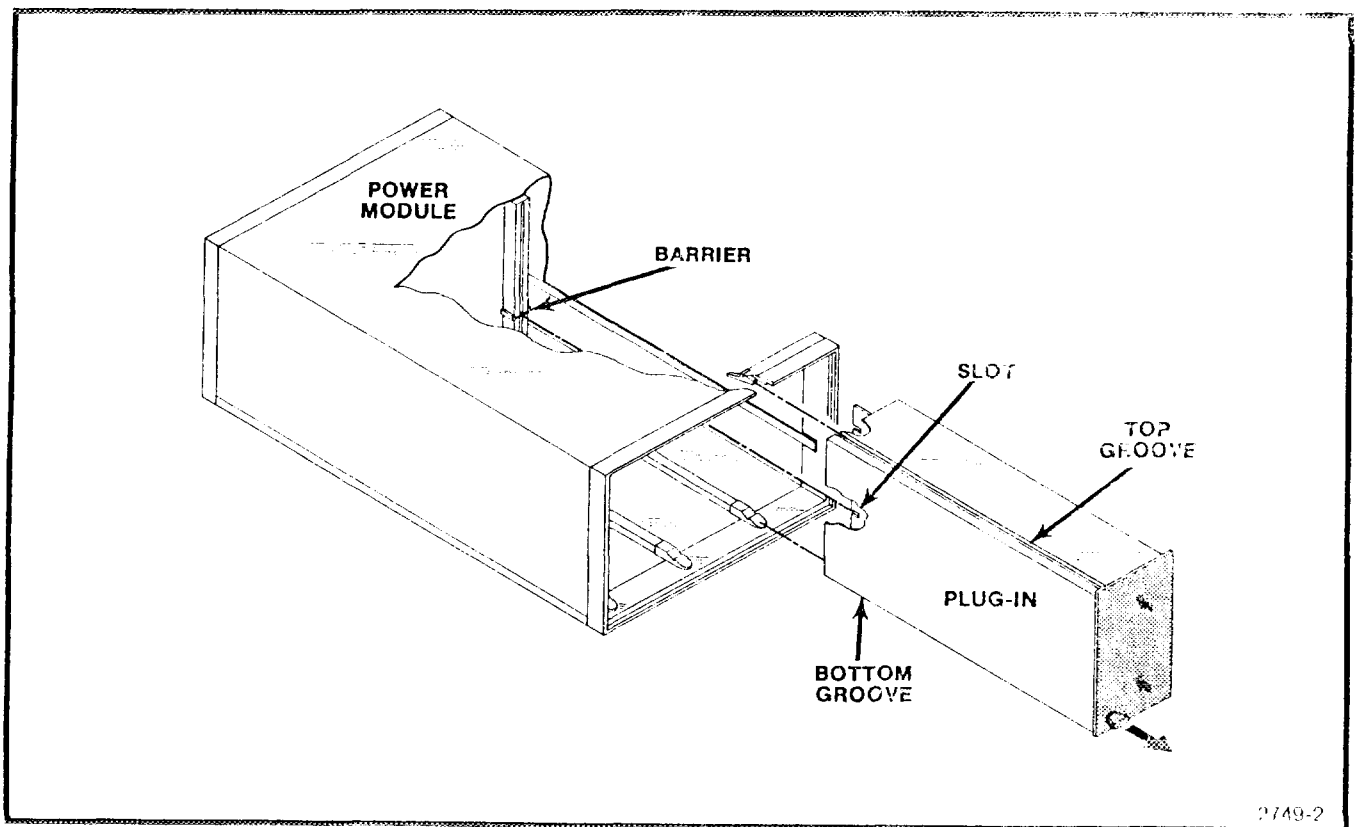




Fig. 2-1. Installation and removal.

## CONTROLS AND CONNECTORS

- ① 4-1/2 digit LED readout with decimal point positioned by the selected range push button switch.
- ② Range selector push button switches for volts, ohms, current or decibel measurement.
- ③ Front-panel mA input used in conjunction with the LOW input for current measurement.
- ④ Temperature probe input connector.
- ⑤ Chassis ground binding post.
- ⑥  Front-panel inputs for volts, ohms and decibel measurements.
- ⑦ Temperature input function push button.


### INPUT

- ⑧  Push button selects either rear interface inputs or front-panel inputs for measurement.

### mA

- ⑨ Ac current function push button.
- ⑩ Dc current function push button.
- ⑪ Push button selects HI or LO as probe tip voltage for measuring ohms.
- ⑫ Ohms function push button.

### VOLTS

- ⑬  Decibel function push button (used in conjunction with the AC volts push button).
- ⑭ Ac volts function push button.
- ⑮ Dc volts function push button.

- ⑯ Release latch. Pull to remove plug-in.



Refer to General Operating Information.

## General Operating Information

With the DM 501A properly installed in the power module and the power switch on, allow thirty minutes warm-up time for operation to specified accuracy. Select the desired measurement function and range. When the value of the quantity measured is unknown, select the highest range first. Decrease the range setting until the display reads between 10% and 100% of the full-scale reading. This particular range will give maximum resolution. When an input signal causes the display to read greater than 19999, an overrange blinking display occurs. This blinking indicates the input is greater than the full-scale reading on the particular range selected.

The 1000 Vdc and 500 Vac range will not cause a blinking display when the input signal exceeds the maximum allowable input on this range.



*Instrument damage may occur if maximum input potential is exceeded.*

## Input Connections



Four input connectors provide front-panel measurement connections. The VOLTS/Ω and LOW input connectors are used for dc voltage, ac voltage, dBV, dBm and ac and dc resistance measurements. The mA and LOW input connectors are used for ac or dc current measurements. The input EXT-INT push button selects front-panel or rear interface input. Rear interface pins 28A (LO) and 28B (HI) are used for rear interface voltage, dB and resistance measurements. The TEMP input connector is used for temperature measurements.



*To avoid equipment damage, do not apply a voltage exceeding 200 V peak between pins 28A and 28B of the rear interface connector.*

Normal measurement conditions are with the LOW connector referenced to the device-under-test common. A connection between the LOW input connector and the ground terminal may be made to reference the input to the DM 501A chassis ground. Use caution as the LOW connector is connected to earth ground through the power module three-wire power cord.

# CONTROLS AND CONNECTORS

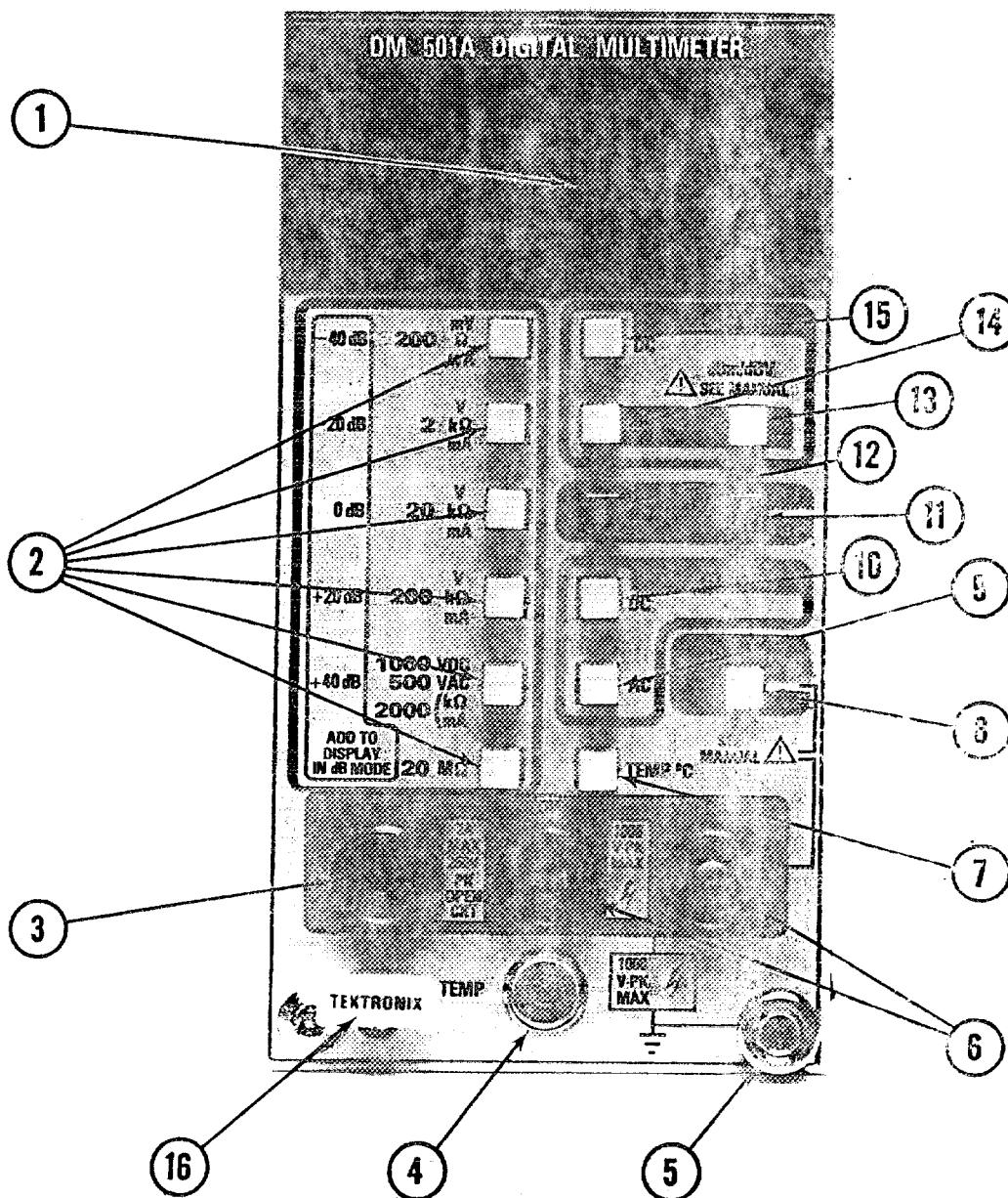


Fig. 2-2. Controls and connectors.

2740-3

**CAUTION**

To help eliminate shock hazard from voltages measured by the DM 501A:

1. If the measured voltage exceeds 42.5 V peak, avoid all contact with the voltage source.
2. Disconnect test probes from circuit-under-test before disconnecting probes from the DM 501A, or before removing the DM 501A from the power module.

**Dc Voltage Measurements**

Press the VOLTS DC push button and an appropriate range button. Apply the voltage to be measured to the LOW and VOLTS/Ω input connectors. Observe the maximum input voltage ratings as indicated on the front panel. The readout displays a  $\pm$  reading if the input to the VOLTS/Ω connector is positive with respect to the LOW input connector. A - reading is displayed if the input at the VOLTS/Ω connector is more negative. With the LOW and VOLTS/Ω input connectors shorted, the display reads zero as to the specifications.

**Dc Current Measurements**

Press the mA DC push button and appropriate range button. Connect the dc current to be measured to the LOW and mA input connectors. Conventional current flowing into the mA connector and out of the LOW connector indicates a  $\pm$  on the display. The current input is protected with an internal fuse located on the circuit board. Refer to qualified personnel when checking this fuse.

**Ac Voltage and dB Measurements**

For ac voltage measurements, press the VOLTS AC push button and an appropriate range button. Connect the unknown voltage between the LOW and VOLTS/Ω input connectors. The ac voltage and dB measurements are made with an ac only calculating true rms to dc converter. Voltages can be measured with a crest factor up to four. The crest factor is the ratio of the peak voltage to rms voltage.

Press the VOLTS AC and dB push buttons with an appropriate range button. A  $\pm 20$  dB dynamic range exists when any one range push button is pressed, except in the  $\pm 40$  dB range. The dB measurement is obtained by adding the displayed value to the selected range. For example, a  $-15.6$  displayed reading on the  $-20$  dB range corresponds to a  $-35.6$  dB signal. When in the  $\pm 40$  dB range, the maximum displayed value must be limited to  $\pm 16.2$  dBm or  $\pm 14$  dBV because of the 500 Vac maximum rating of the instrument.

When the DM 501A is shipped, the 0 dB reference is 1 mW into 600 Ω (0.7746 V). A 0 dB reference of 1 V is also available through an internal jumper (see the Calibration Procedure).

**WARNING**

*Refer jumper change to qualified personnel.*

**Ac Current Measurements**

To measure ac current, press the mA push button and an appropriate range button. Connect the unknown ac current to be measured between the mA and LOW input connectors. The ac current measurements are made using an ac only calculating true rms to dc converter.

**Resistance Measurements**

Press the kΩ function push button and the appropriate range button. The scaling factor is a function of the range push buttons only. Select the HI or LO function push button for the maximum desired voltage at full scale (see Table 2-1). The HI function advantage is it's non-susceptibility to noise or thermocouple (dissimilar metals) generated error signals. The LO function advantage is allowing in-circuit measurements without forward biasing most silicon type semiconductor components.

The kΩ function provides constant current at the LOW and VOLTS/Ω input connectors. The conventional current flows from the VOLTS/Ω connector into the LOW connector. Refer to Table 2-1 for the value of current and maximum voltages across the input connectors for full-scale display readings (instrument not over-ranged). The maximum (open circuit) voltage available from the VOLTS/Ω connector referenced to the LOW connector in the kΩ function is approximately  $\pm 6$  V.

Table 2-1

**OHMMETER SOURCE CURRENT AND VOLTAGE**

Range Scale	Source Current		V Max at Full Scale	
	HI	LO	HI	LO
200 Ω	1 mA	1 mA	0.2 V	0.2 V
2 kΩ	1 mA	100 μA	2.0 V	0.2 V
20 kΩ	100 μA	10 μA	2.0 V	0.2 V
200 kΩ	10 μA	1 μA	2.0 V	0.2 V
2000 kΩ	1 μA	0.1 μA	2.0 V	0.2 V
20 MΩ	0.1 mA	0.1 μA	2.0 V	2.0 V

### Temperature Measurements

Connect the P6601 temperature probe to the front-panel TEMP connector. Use care to align the connector pins. Press the TEMP °C push button. Apply the probe sensor tip to the device-under-test (DUT). Allow sufficient time for the probe tip to stabilize before taking a reading. The time to reach a stable reading is a function of the thermal mass of the probe and DUT, the thermal resistance of the probe and DUT, and the amount of heat being applied to the DUT.

Refer to the P6601 manual for more information on temperature measurements and probe use.

A list of standard accessories (and part numbers) is located in the Replaceable Mechanical Parts list.

### Repackaging Information

If this Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing owner (with address) and the name of an

individual at your firm that can be contacted. Include the complete instrument serial number and a description of the service required.

Save and re-use the package in which the instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than 6 inches more than the instrument dimensions. Cushion the instrument by tightly packing 3 inches of dunnage or urethane foam between carton and instrument on all sides. Seal the carton with shipping tape or an industrial stapler.

The carton test strength for this instrument is 200 pounds per square inch.



# THEORY OF OPERATION

## Introduction

This section of the manual describes the circuits necessary to display in digital form, the value of an input voltage, current, resistance or temperature. Refer to the block diagram and the schematic diagrams (indicated by a diamond) in the diagram section for an overall view of the DM 501A operation, including typical input and output signal levels.

## Voltage Input Circuits 1

The internal-external (INT-EXT) front-panel switch (S4-A and S4-B, see Fig. 3-1) is used to select either front-panel inputs or rear-interface inputs. In all functions except temperature, the LOW input connects to the main board floating ground (LO) through switches S4-A and S1-M.

A dc voltage applied to the VOLTAGE/Ω connector passes through switches S1-C and S1-E to the top of the attenuator resistor series network consisting of R1112A, R1104 (20 Vdc), R1112B, R1111J (200 Vdc), R1112C, R1114 (1000 Vdc), and R1112D. The bottom end (pin 8) of R1112D is connected to floating ground through switch S1-E and S1-M. The input signal attenuation is selected by pressing the desired range switch for either 200 mV, 2 V, 20 V, 200 V, or 1000 V. The attenuated signal couples through switches S1-F, S1-D, S1-J, S1-L, and S1-N. The signal flows through R1613 (located on Diagram 2) to the Analog Converter (U1601 pin 15). Resistor R1613 is a current limiting component that protects U1601 from overload.

In the ac voltage function (see Fig. 3-2), switch S1-C is open (depressed position) and capacitor C1100 ac couples the input signal to the attenuator. Capacitors

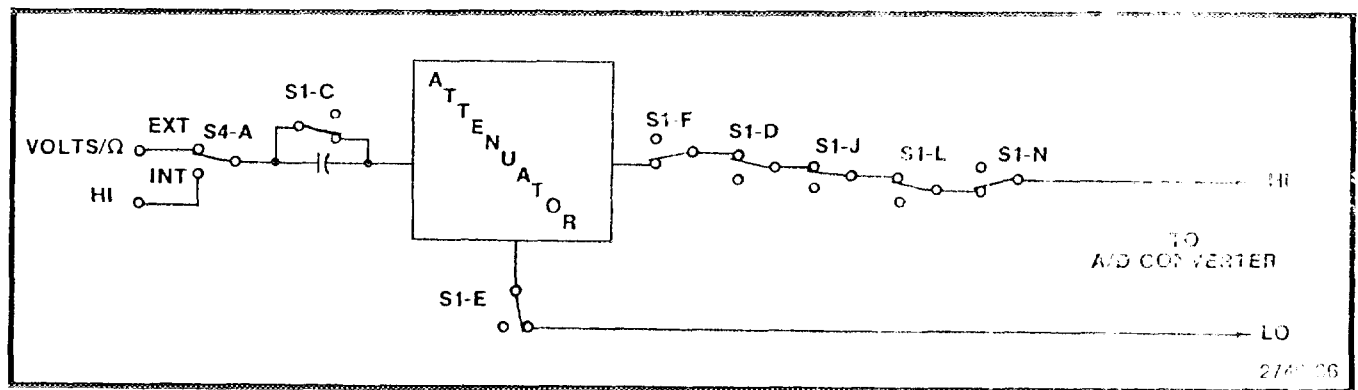


Fig. 3-1. Dc volts switching.

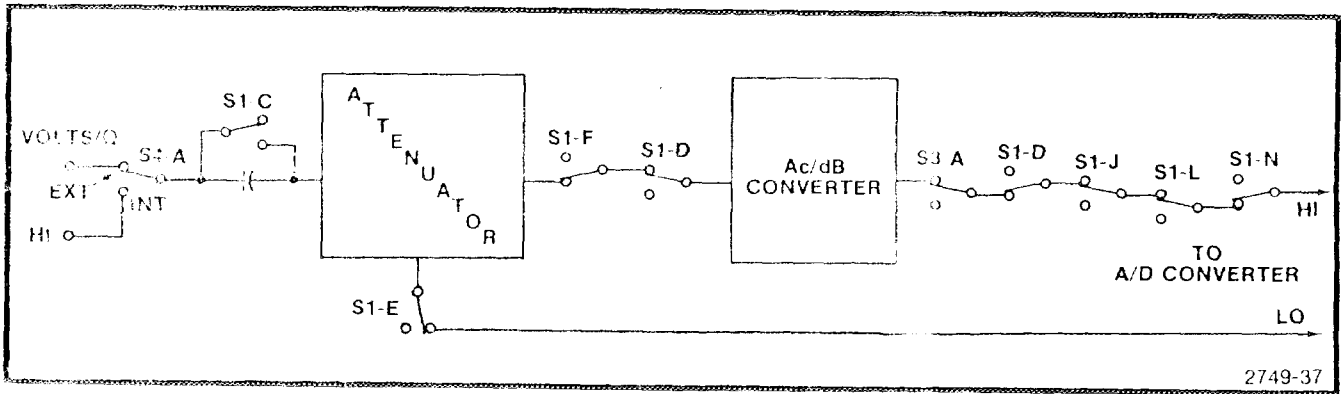


Fig. 3-2. Ac volts switching.

C1110, C1114 (20 Vac), and C1112 comprise the 20 Vac compensation. Capacitors C1120, C1128 (200 Vac), and C1122 comprise the 200 Vac compensation. The 500 Vac compensation consists of C1126, C1129 (500 Vac), and C1124. The attenuated signal passes through switches S1-F and S1-D (pin 3) and resistor RT1633 to the input of the AC Buffer (U1539). Simultaneously, the other half of switch S1-D (pin 5) couples the output of the dB Converter (U1429) through switch sections S3 and S1 to the Analog Converter, pin 15.

The resistor (RT1633) with diodes CR1631 and CR1632 protect U1539 from input voltage overloads. When an overload occurs, diodes CR1631 and CR1632 clamp the signal at 0.7 V above or below the power supply voltage causing RT1633 to heat. When reaching the trigger Temperature, RT1633 will effectively open or achieve a very high resistance, thus limiting the input current to U1539.

In the 200 mVac range position, switch S2-C activates relay K1528, which sets the AC Buffer (U1539) for X10 gain. Resistor R1539 and U1539 feedback resistor R1538 comprise the X1 and X10 gain setting network. The output of U1539 (pin 6) is coupled through capacitor C1539 and R1537 (2 Vac GAIN) to the input of U1429 (pin 1). The dB Converter (U1429) computes the rms level of the input ac signal and outputs the equivalent dc level on pin 8. This output signal (I!) is appropriately switch coupled through resistor R1613 (located on diagram 2) to the Analog Converter (U1601 pin 15).

**dB Input Circuitry 1 (Refer to Fig. 3-3)**

The dB Converter (U1429) also converts the ac signal input (pin 1) to a dc voltage proportional to dB at pin 5. This dc voltage is then coupled to pin 7, which has a resistor network to set the dB reference current and a jumper (J1435) that selects the dBm or dBV mode.

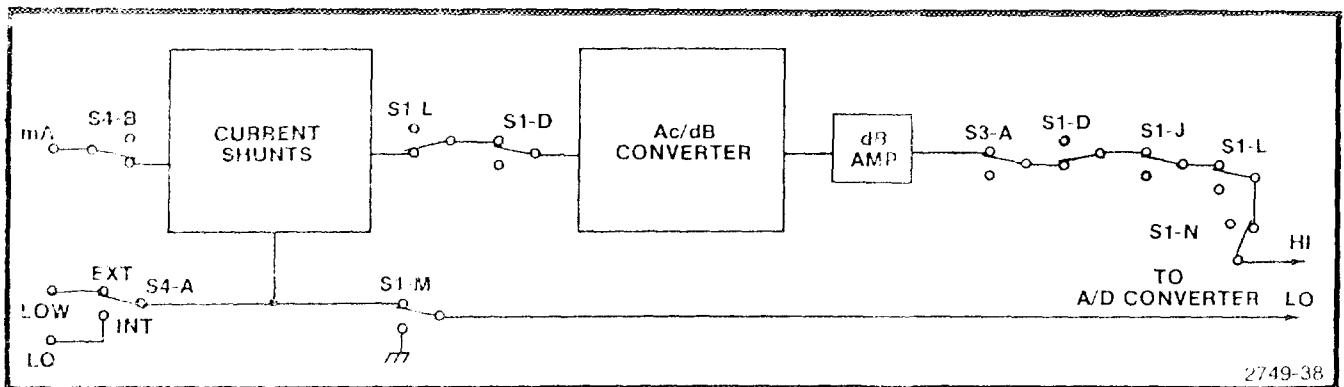


Fig. 3-3. dB switching



With the jumper in the dBm mode, R1535 (dB $\emptyset$ ) is adjusted for  $\emptyset$  dBm when the  $\emptyset$  dB range switch is depressed and 0.7746 Vac is connected between the VOLTS/ $\Omega$  and LOW front-panel connectors.

When the jumper is in the dBV mode and the input signal is 1.000 Vac, the display readout is also  $\emptyset$  dB. The signal at U1429 (pin 7) is internally buffered and applied to pin 6 (dB BUF OUT). This signal changes approximately -3 mV per 1 dB change. The positive temperature coefficient resistor (RT1525) is used to provide compensation for the 0.3% per degree C temperature drift in the dB converter of U1429.

Potentiometer R1528 (dB Gain) in combination with U1538 (dB AMP), RT1525, and feedback resistor R1536, is used to scale the dB buffer output signal to 100 mV per dB at the input of U1538 (pin 6). This output signal feeds through switch sections S3 and S1, to resistor R1613 (located on diagram 2), then into the Analog Converter (U1601 pin 15).

When dB is selected, the display is limited to 0.1 dB resolution. This reduced resolution occurs when dB switch S3-A (pin 3) connects +5 V to Digit Select Driver U1701 (pin 1). The output of U1701 (pin 16) turns on diodes CR1605 and CR1607, disabling the digit select lines for the two least significant digits in the display (DS1200 and DS1101). Simultaneously, +5 V is coupled through diode CR1711 turning on the SIGN (DS1000) in the display. This same high level disables integrated circuits U1703A, U1703B, and U1705B and enables U1705A. The decimal point is displayed at the second most significant digit ranges.

### Current Input Circuits 1 (Refer to Fig. 3-4 and Fig. 3-5)

The current input is only available through the front-panel mA and LOW connectors. Input current to the mA connector flows through fuse F1026 and the appropriate range switch and shunt resistors consisting of R1699A, B, and C and R1711 and R1713. In dc current function, with the mA dc front-panel switch (S1-J pin 4) closed, the voltage drop across the shunt resistors is directly coupled

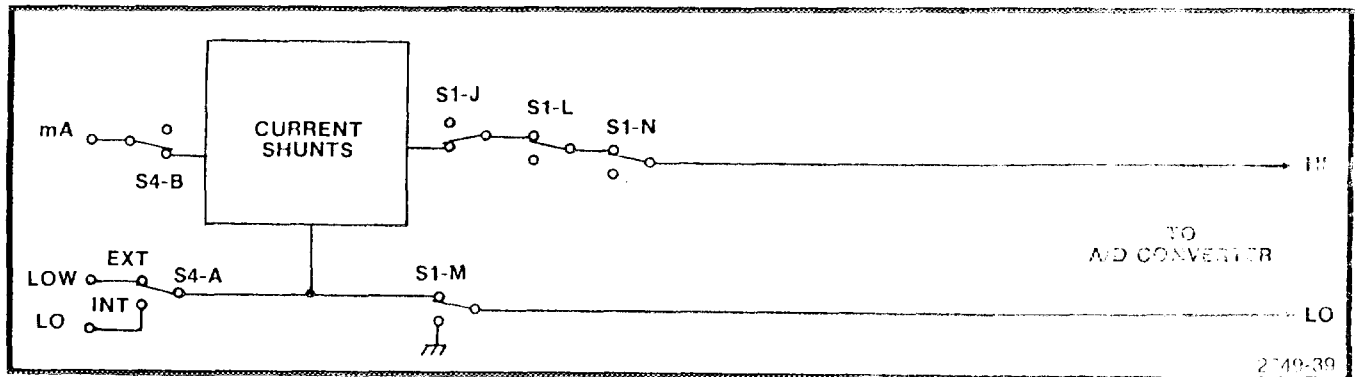


Fig. 3-4. Dc current switching.

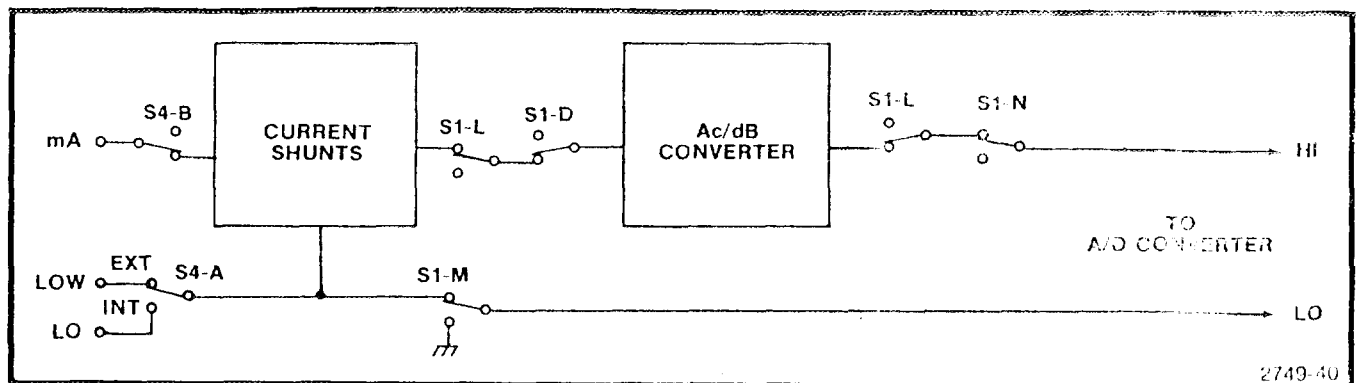


Fig. 3-5. Ac current switching.

to the Analog Converter (U1601 pin 15). In ac current function, the mA ac front-panel switch (S1-L pin 4) is closed. The voltage developed across the input current shunt is coupled to AC Buffer U1539, which is connected (by Relay K1528 energizer) as a X10 gain amplifier. The voltage at pin 6 of U1539 feed through R1537 to converter U1429 (pin 1) and outputs at pin 8 of U1429. Through appropriate switching, U1429 pin 8 output voltage couples to the Analog Converter, U1601 pin 15. Ac current is also measured as a true rms ac function.

**Ohms Converter 1** (Refer to Fig. 3-6)

The ohms converter circuitry generates a known current that flows out the front-panel VOLTS/Ω connector through the unknown resistance. The voltage developed at the input connectors is proportional to the unknown resistance. This voltage is sensed by the a/d converter and displayed as an ohms value.

The Ohms Reference Current Source, Q1415 and associated circuitry, generates a 100 μA reference current. This current either flows through R1516 or R1516 in parallel with the series combination of R1515 and R1412 (LOΩ) depending on which ohms function and range is selected. This reference current develops either 1 V or 10 V across R1516. The Ohms Converter (U1515 and Q1525) applies 1 V or 10 V across the attenuator section selected by the range switches. The attenuator current, determined by the range switches, flows through ohms protection resistor RT1102 and out the VOLTS/Ω front-panel connector or rear interface connector (pin 28B) through the unknown resistance to the LOW front-panel or rear interface connector (pin 28A). The output current from the VOLTS/Ω or rear interface connector varies between 100 μA and 1 mA in decade steps, depending on the selected range.

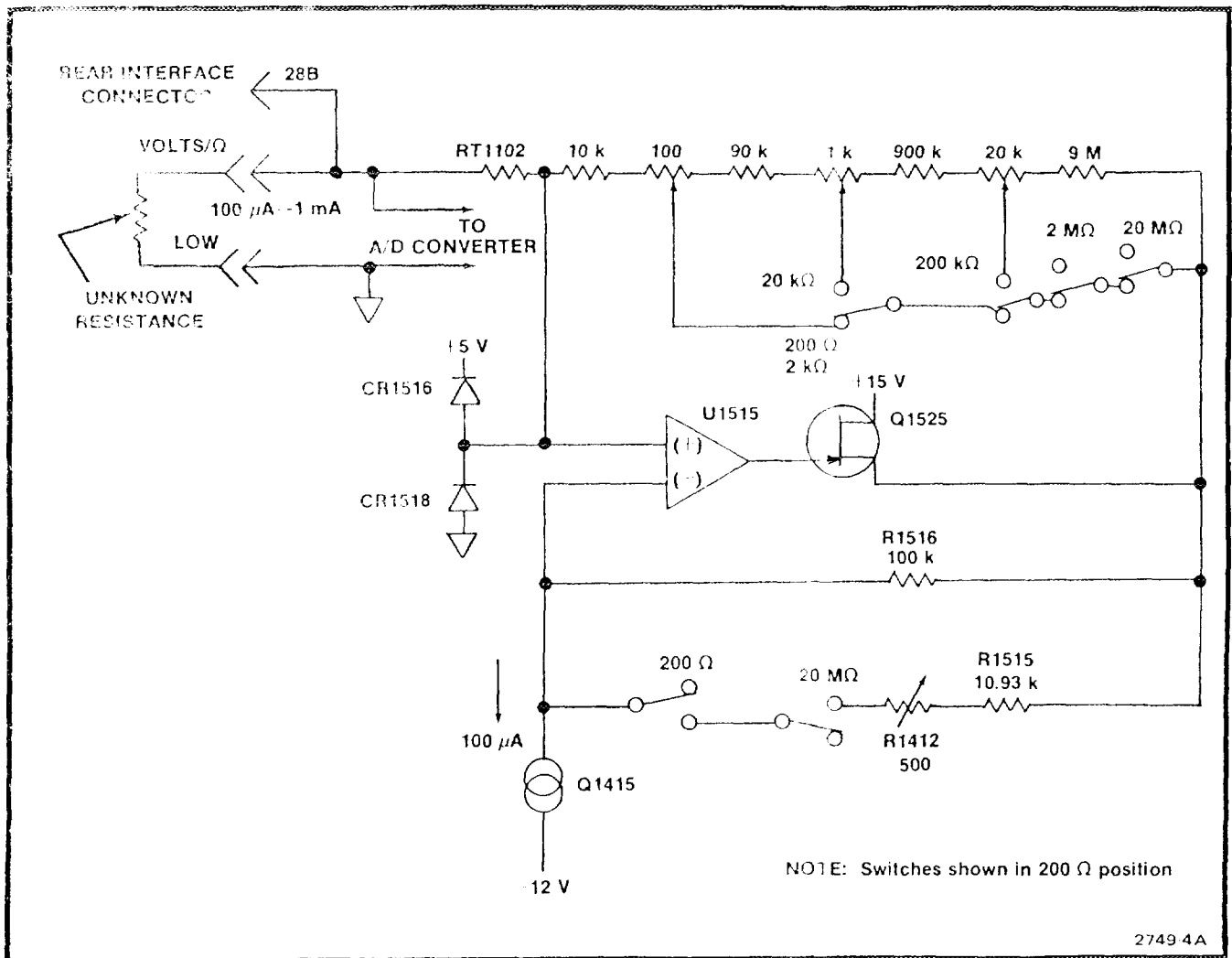


Fig. 3-6. Simplified ohms converter diagram.

Circuit protection to the ohmmeter function is provided by resistor RT1102 and clamping diodes CR1516 and CR1518. A voltage source inadvertently applied in the ohmmeter function will cause RT1102 to heat and effectively open.

### Temperature Measurement Circuitry 3

The temperature circuitry is designed to operate with the P6601 Temperature Probe. The temperature sensing element consists of a thin-film platinum resistor in the tip of the probe. The sensor resistance, which is a function of temperature, is:  $R = (R_0 + \alpha T + \beta T^2)$ , where  $R_0$  is 100  $\Omega$ ,  $\alpha$  is equal to 0.3738  $\Omega$  per degree C, and  $\beta$  is equal to  $-8.85 \times 10^{-5} \Omega/^\circ\text{C}^2$  (nominal coefficient). T is temperature in degrees Celsius.

A 1 mA current source from transistor Q1731, zener diode VR1636, and related circuitry flows through the temperature probe sensor. When the temperature changes, the sensor resistance changes, which causes the voltage developed across the sensor to change. This voltage is shifted and amplified by the Temperature Amplifier (U1737). The output of U1737 (pin 6) applies this temperature probe signal to a network consisting of components R1931, CR1935, R1935, R1932, R1933, CR1934, and R1934. This network helps compensate for the non-linear function of the temperature probe. With diode CR1935 setting a break point at an equivalent 75°C and diode CR1934 setting a break point at approximately 125°C, the output is somewhat linearized and equal to  $\approx 1 \text{ mV}/^\circ\text{C}$  times probe temperature.

When the front panel TEMP°C push button is depressed, switch S1-N couples this temperature output to Analog Converter U1601 (pin 15).

### Analog-to-Digital Converter 2

The analog-to-digital converter (a/d converter) in the DM 501A uses a Siliconix type LD120 analog converter (U1601) and a type LD121 digital converter (U1603) to convert the analog input voltage to a digital representation.

The Analog Converter (U1601) contains an input buffer-integrator-comparator and an auto-zero amplifier.

The Digital Converter (U1603) contains the necessary control logic for the analog converter as well as the buffers, multiplexers, latches, and counters needed to drive the display circuitry.

The basic sensitivity of the a/d converter is 2 V full scale indication, which is set by R1505 (2 Vdc). The 200 mV full scale input for the a/d converter is set by R1504 (200 mVdc) when the relay K1505 is energized through switches S1 and S2. The 2 Vdc  $\emptyset$  (R1405) is used to set the initial zero for the a/d converter when in the 2 V full scale mode. When the a/d converter input is set for 200 mV full scale mode, relays K1408 and K1505 are energized. The 200 mVdc  $\emptyset$  (R1415) is now in the circuit to adjust for the initial zero offset.

The a/d converter operates on a charge-balancing technique. The input voltage is converted to a current that charges integrator capacitor C1508. The converter counts the units of charge needed to keep the integrator output near zero. (See Fig. 8-2 in the Diagrams section.)

The conversion cycle is 49,152 clock pulses long of which 16,384 pulses are used in the AUTO-Zero (AZ) interval and 32,768 pulses are used in the measure interval.

#### Auto-Zero Period

The a/d converter system during the Auto-Zero period is represented by Fig. 3-7. In the AZ period, the input buffer is connected to reference ground and the A/Z buffer input is connected through R1507 to the integrator output. Note the M/Z line is low. The U/D line is being toggled at a 50% duty cycle, which results in a current through R1605 and R1505 at one-half of  $V_{ref} / R_1$ . The dynamics of the a/d converter system causes the voltage on capacitor C1505 ( $C_{strg}$ ) to attain the value required for the sum of the currents entering the integrator summing node to be zero. The A/Z voltage on C1505 is approximately 2 V, which is equivalent to the integrator output voltage.

#### Measure Interval

During the measure interval (see Fig. 3-8), the input buffer is connected to  $V_{in}$  and supplies the integrator with a current equal to  $V_{in} / R_2$ . Capacitor C1505 ( $C_{strg}$ ) is disconnected from the integrator output. The current developed from  $V_{in}$  causes the integrator output voltage to move from  $V_{AZ}$ . Digital converter U1603 attempts to keep the integrator output voltage close to  $V_{AZ}$  by adding or subtracting units of charge to integrator capacitor C1508 ( $C_{int}$ ). With a unit of charge equal to 14 counts, the net amount of charge for correction is totaled by the BCD counters. The measure interval can only resolve multiples of 14 counts.

#### Override Period

The override period immediately follows the measure interval and resolves the last of the measurement. The input buffer now connects to the high quality ground and the  $C_{AZ}$  switch is left open. The LD121 (U1603) allows the

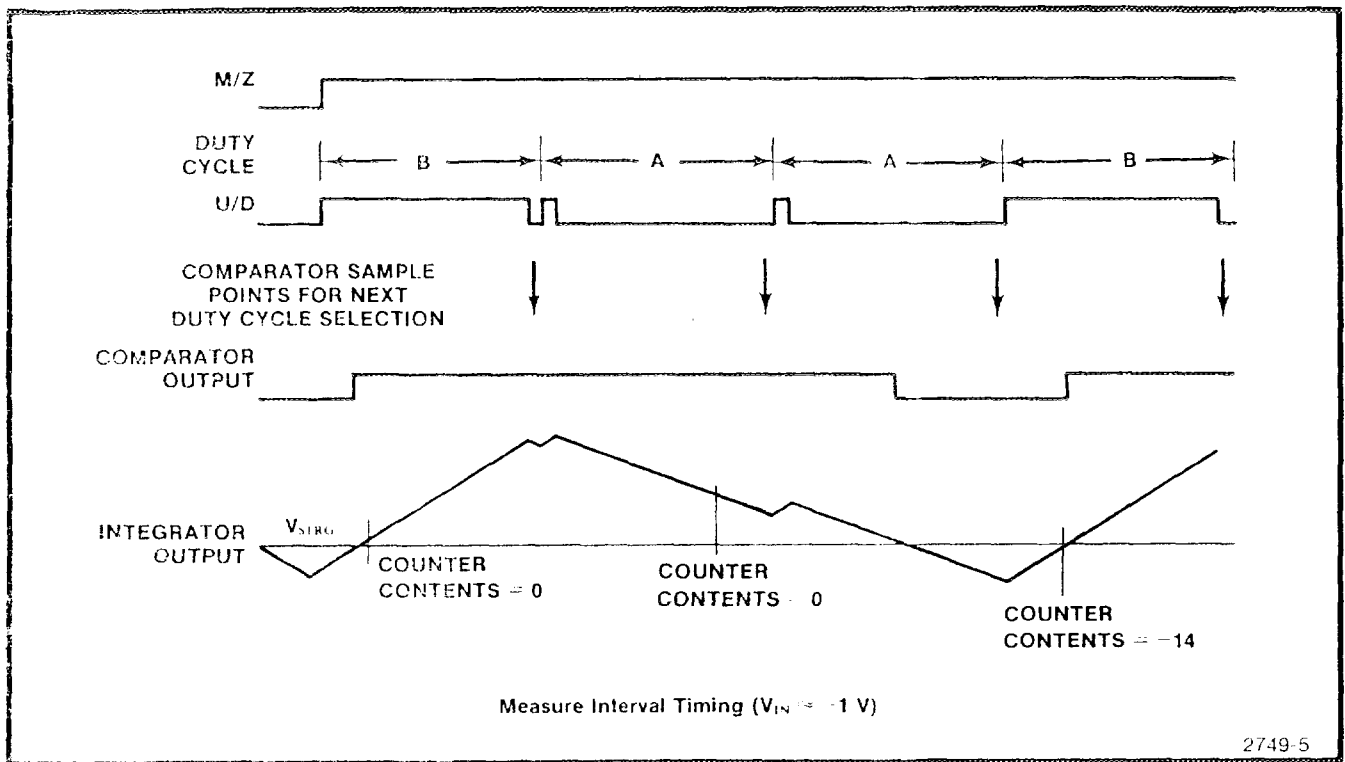


Fig. 3-7. Measure interval timing.

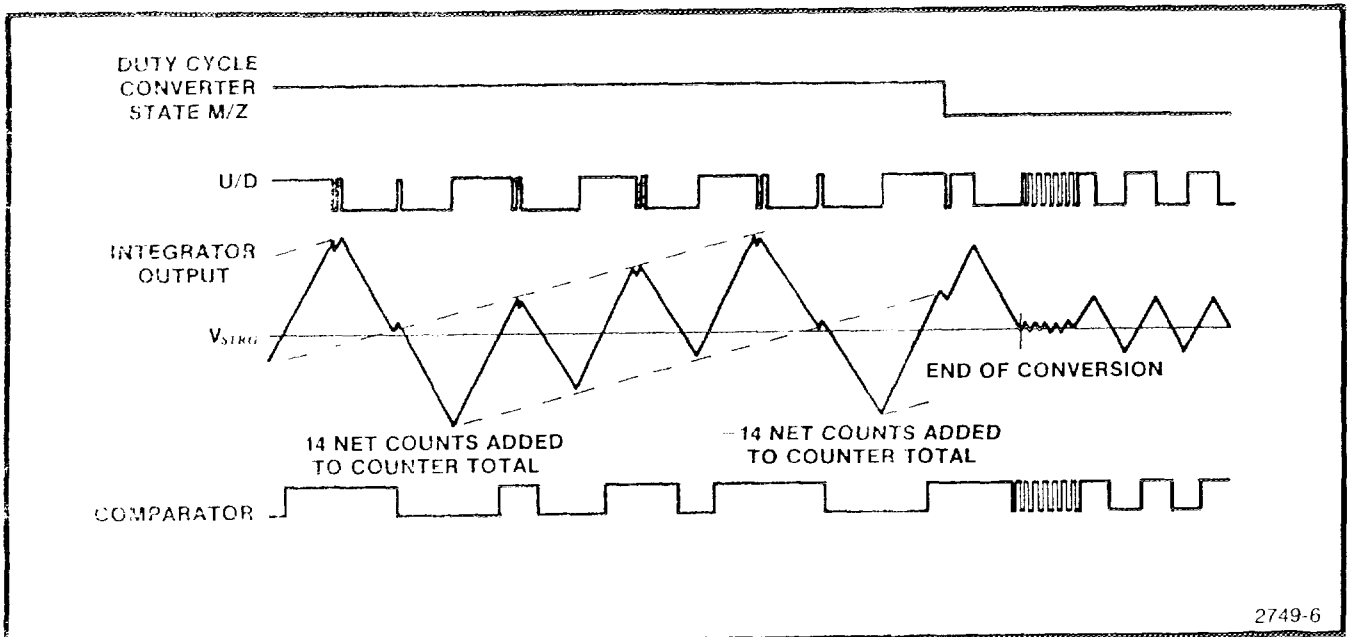


Fig. 3-8. Algorithm waveforms at end of measure interval.

integrator to go positive with respect to  $V_{AZ}$  (see Fig. 3-7), then returns it to  $V_{AZ}$  potential, stopping only when the LD120 (U1601) comparator changes state. The count is in single clock times.

The override period can exist a maximum of 56 clock times into the zero period, assuming the non-overload  $V_m$ . Since only 14 of the 16 counts in the U/D waveform (see Fig. 3-9) produce net counts, there are  $\pm 28,672$  counts maximum out of the measure period of 32,768 clock times available.

At the end of the measure period (after the last count cycle has accumulated its counts), the data in the counter is transferred to the data latches. The data is then multiplexed to the bcd outputs at the time the proper digit select line is enabled.

The digit select lines drive U1701, Digit Select Driver, which pulls down on the appropriate display common cathodes. During the time when each of the digit select lines on U1603 is enabled, the corresponding digit information is available at the bcd output.

### Display Driver 2

Display driver U1805 is a bcd to 7 segment decoder. The bcd digit information is decoded by U1805 and applied to the cathodes of 7-segment displays DS1000, DS1001, DS1100, DS1101, and DS1200. The output of U1805 is an active high that pulls up on the appropriate LED anodes. Figure 3-10 shows the waveforms available at the digit select lines and also the SIGN output. In addition to the sign information, the SIGN output also has the overrange and underrange information. The sign information is the only information used in this design.

### Clock 2

The clock for the LD121 (U1603) consists of Q1435, crystal Y1425, and associated circuitry. The clock circuit is a Pierce coupled oscillator that oscillates at 16.84 MHz.

### Decimal Point Circuitry 2

The decimal point circuit is composed of U1703, U1705, U1707, and associated circuitry. The decimal point line is only enabled when one of the range switches is selected and anded with a digit select line to turn on U1705. The anded signal pulls the decimal point line high, turning on the appropriate decimal point at the correct time.

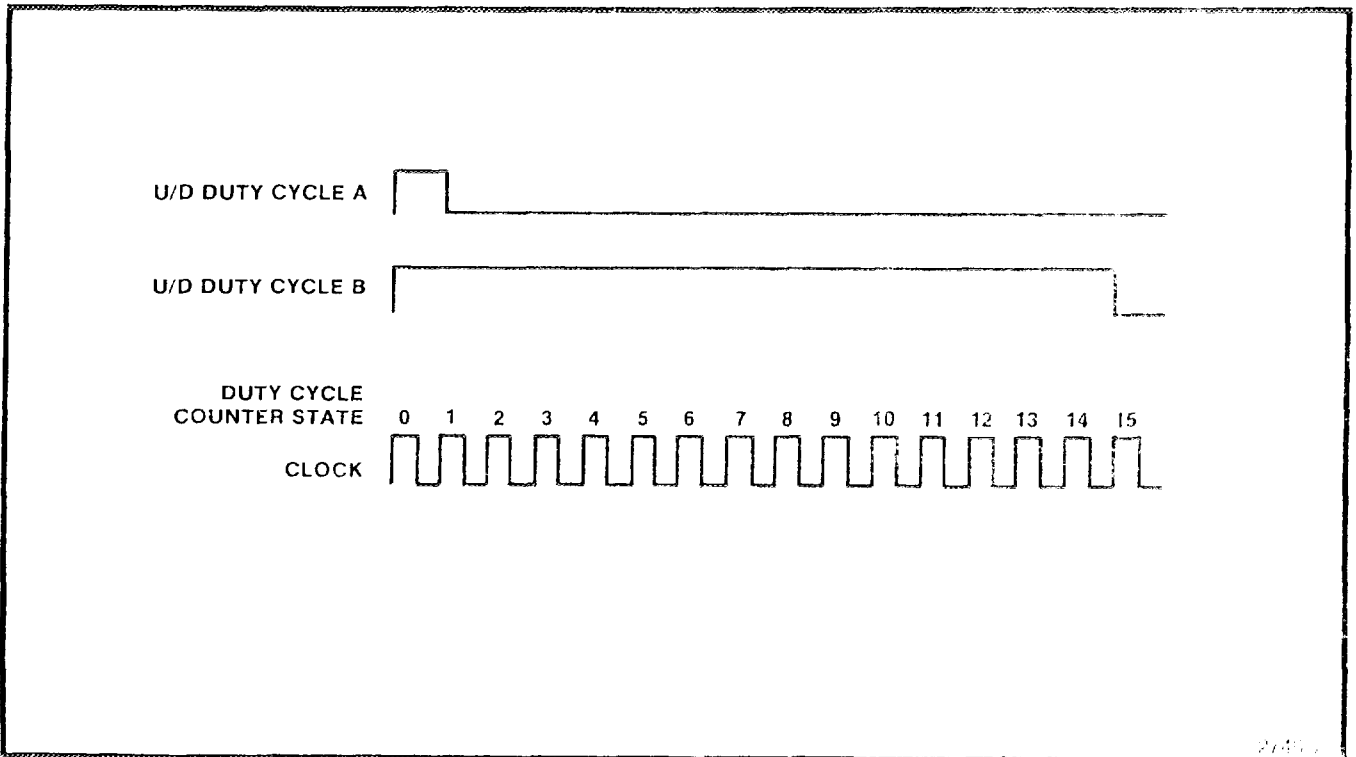


Fig. 3-9. Modulo 16 dual duty cycle counter waveforms.

Power Supply 3

The 25 Vac input to isolation transformer T1301 is supplied from the power module through rear interface pins 13A and 13B. The output voltage from pins 7 and 9 is rectified by CR1422 and applied to U1325 and U1335. These three-terminal regulators provide the +15 V source and +12 V source.

The output voltage from T1301, pins 10 and 12, is rectified by CR1424 and CR1426 and applied to U1431. This three-terminal regulator provides the +5 V source.

All three-terminal regulators are internally current limited.

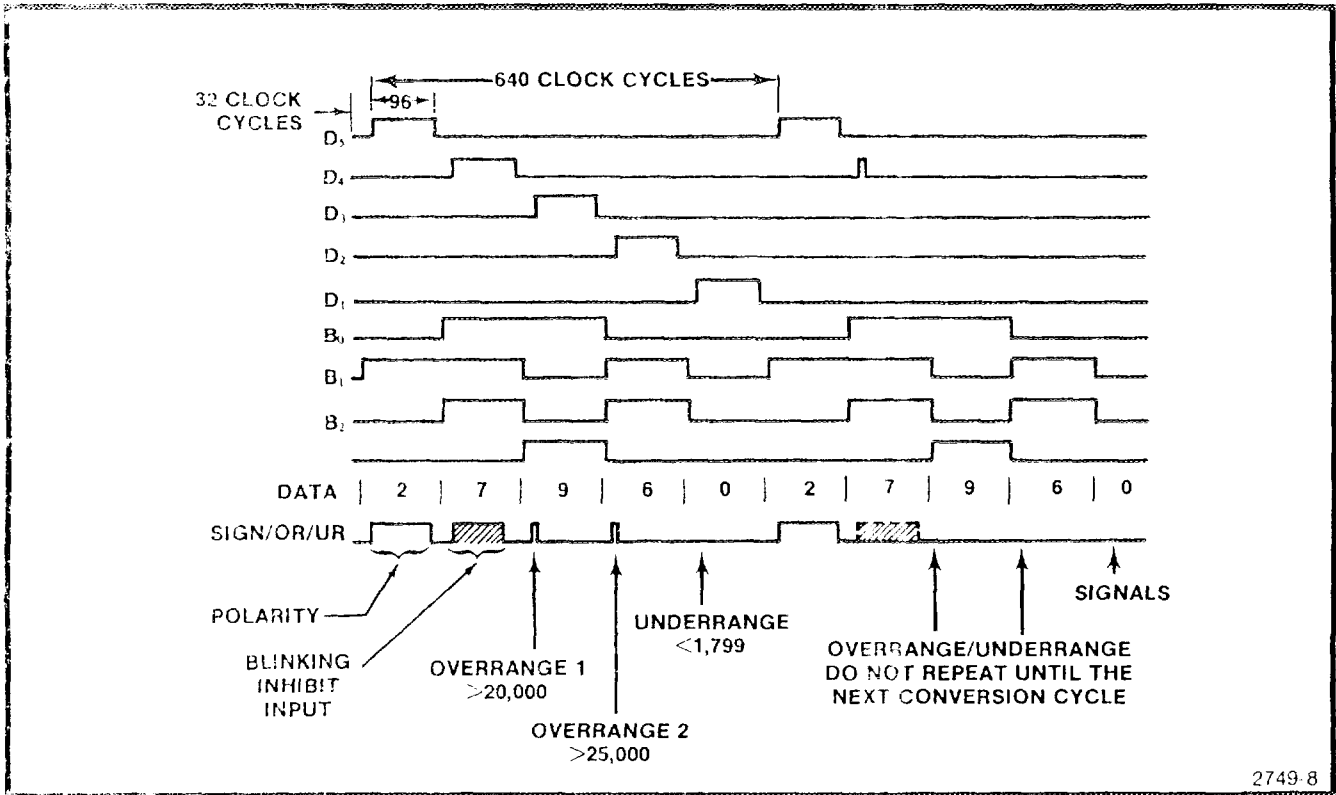


Fig. 3-10. LD121 data output waveforms.

# CALIBRATION PROCEDURE

## PERFORMANCE CHECK PROCEDURE

### Introduction

This procedure checks the electrical performance requirements as listed in the Specification section in this manual. Perform the Adjustment procedure if the instrument fails to meet these checks. In some cases, recalibration may not correct the discrepancy; circuit troubleshooting is then indicated. Also, use this procedure to determine acceptability of performance in an incoming inspection facility.

For convenience, many steps in this procedure check the performance of this instrument at only one value in the specified performance range. Any value within the specified range, within appropriate limits, may be substituted. Performance requirements for various temperature ranges are listed in this procedure; when performing the procedure, use only the Display Limits listed for the ambient temperature in which the instrument is operating.

To check the rear interface accuracy specifications, access the rear interface pins 28A (LO) and 28B (HI) with a TM 500-series Option 2 power module. Instructions and accuracy tables for rear interface performance checks are given following this procedure.

### Calibration Interval

To ensure instrument accuracy, check the calibration every 1000 hours of operation or at a minimum of every six months if used infrequently.

### Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local field service centers and at the factory service center. Contact your local Tektronix field office or representative for further information.

### Test Equipment Required

The following test equipment, or equivalent (refer to Table 4-1), is suggested to perform the Performance Check and Adjustment Procedure.

Table 4-1

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Applications	Example
Power Module		All tests.	TEKTRONIX TM 503 or TM 504
Digital Voltmeter	Range, 0 to 50 V; accuracy, $\pm 0.1\%$ .	Voltage measurement.	TEKTRONIX DM 501A <sup>1</sup> , DM 502A <sup>1</sup> , DM 505 <sup>1</sup> .
Ac-Dc Current Source	Range, 0 to 2 A, sine-wave from 20 Hz to 10 kHz; accuracy, $\pm 0.06\%$ . Range, 0 to 2 A, dc accuracy, $\pm 0.02\%$ .	Ac-Dc ammeter accuracy check.	Valhalla Scientific Inc. 2500 Ac Dc Current Calibrator.
Dc Voltage Source	Range, 0 to 1000 V; accuracy, $\pm 0.01\%$ .	Dc voltmeter accuracy check.	Fluke Model 343A or 341A Dc Voltage Calibrator.
Ac Voltage Source	Range, 0 to 500 V; accuracy, $\pm 0.05\%$ , 20 Hz to 20 kHz.	Ac voltmeter accuracy check.	Fluke Model 5200A Ac Calibrator and Fluke Model 5215A Power Amplifier.

Table 4-1 (cont)

Description	Performance Requirements	Applications	Example
Resistance Standard	Range, 0 to 20 M $\Omega$ ; accuracy, $\pm 0.05\%$ .	Ohmmeter accuracy check.	Electro Scientific Industries, Inc. Model DB 62 Dekabox.
Temperature Bath	Range, $-62^{\circ}\text{C}$ to $+240^{\circ}\text{C}$ ; accuracy, $\pm 0.25^{\circ}\text{C}$ .	Temperature probe check and adjustment.	Neslab Instruments Inc., Model ULT-80 Bath Circulator with denatured ethyl alcohol coolant, Model TX-9 <sup>b</sup> Circulator with Dow Corning 710 fluid and necessary hoses and adapters.

<sup>a</sup>Requires a TM 500 series power module.

<sup>b</sup>Connect the TX-9 cooling coil to the cooling pump in the ULT-80 to obtain temperatures between  $+10^{\circ}\text{C}$  and  $+40^{\circ}\text{C}$ .

**WARNING**

*Dangerous voltages may be encountered in the following steps. Caution must be exercised. Do not contact the output connectors of the voltage calibrator, the input terminals of the DM 501A, or the internal circuitry of the DM 501A.*

**FRONT PANEL INPUT ACCURACY CHECKS**

**1. Check Dc Voltage Accuracy**

- a. Set the dc voltage calibrator for a minimum output voltage.
- b. Press the VOLTS DC function push button switch.
- c. Connect the dc voltage calibrator to the VOLTS/ $\Omega$  and LOW connectors through appropriate cables and adapters.
- d. Press the range push buttons and set the calibrator voltages as listed in Table 4-2.
- e. Check—that the DM 501A display reads within the display limits for the ambient temperature as listed in Table 4-2.
- f. Set the calibrator for a minimum output voltage.
- g. Remove all connections.

**2. Check Dc and Ac Common Mode Rejection Ratios**

- a. Connect a bnc female-to-dual banana connector to the VOLTS/ $\Omega$  and LOW connectors.
- b. Connect a dual-binding post with bnc male connector to the bnc female connector of the dual banana connector.
- c. Connect a 1 k $\Omega$  resistor between the binding posts.
- d. Connect the red lead of a clip lead adapter to female bnc connector to the red binding post (one side of the resistor).
- e. Connect the black lead of the clip lead adapter to the ground binding post of the DM 501A.
- f. Connect the bnc female connector through a coaxial cable to the dc voltage calibrator.
- g. Press the VOLTS DC function push button.



- h. Press the 200 mV range push button.
- i. Set the dc voltage calibrator for 10.00 V output.
- j. Check—the display for a reading of  $\leq 00.13$ .
- k. Move the red lead of the clip lead adapter to black binding post and repeat part j.
- l. Replace the dc voltage calibrator with an ac voltage calibrator.
- m. Set the ac calibrator for a 10 V ac rms output at either 50 or 60 Hz  $\pm 0.2$  Hz.
- n. Check—the display for a reading of  $\leq 01.44$ .
- o. Press the VOLTS AC TRUE RMS function push button.
- p. Check—the display for a reading of  $\leq 14.33$ .
- q. Move the red lead of the clip lead adapter back to the side of the resistor connected to the red binding post.
- r. Check as per part p.
- s. Press the VOLTS DC function push button.
- t. Check as per part n.
- u. Remove the connections to the DM 501A.

### 3. Check Dc Normal Mode Rejection (60 dB)

- a. Connect a bnc female-to-dual banana connector to the VOLTS/ $\Omega$  and LOW connectors.
- b. Connect the bnc female connector through a coaxial cable to the ac voltage calibrator.
- c. Press the VOLTS DC function push button.

- d. Press the 200 mV range push button.
- e. Set the ac calibrator for 5 V ac rms output at either 50 or 60 Hz,  $\pm 0.2$  Hz.
- f. Check—the display for a reading of  $\leq 07.10$ .

### 4. Check Ac Voltage Accuracy

- a. Connect the ac voltage calibrator to the VOLTS/ $\Omega$  and LOW connectors through appropriate cables and connectors.
- b. Press the VOLTS AC TRUE RMS function push button.
- c. Press the range push button and set the calibrator voltage as listed in Table 4-3.
- d. Check—that the DM 501A display reads within the display limits for the ambient temperatures and frequencies as listed in Table 4-3.
- e. Set the ac calibrator to a minimum voltage.

### 5. Check dBm Accuracy (Factory Shipped with internal jumper set for dBm readout)

- a. Press the VOLTS AC TRUE RMS and dB push buttons.
- b. Connect the ac voltage calibrator to the VOLTS/ $\Omega$  and LOW connectors through appropriate cables and connectors.
- c. Press the range push button and set the calibrator voltage and frequency as listed in Table 4-4.
- d. Check—that the DM 501A display readout is within the display limits for the ambient temperatures and frequencies as listed in Table 4-4.

Check dBV Mode limits. The check procedure is identical to the setup for the dBm Accuracy check with the exception of using the range push buttons and calibrator voltages as listed in Table 4-5.

**Calibration Procedure—DM 501A  
Performance Check Procedure**

**6. Check Ohms Accuracy**

- a. Connect a resistance standard to the VOLTS/ $\Omega$  and LOW connectors.
- b. Press the  $k\Omega$  function push button and the appropriate HI or LO push button as indicated in Table 4-6.
- c. Press the range push button and set the resistance standard as listed in Table 4-6.
- d. Check— that the DM 501A display reads within the display limits for the ambient temperature as listed in Table 4-6.
- e. Remove all connections.

**7. Check Dc Current Accuracy**

- a. Connect the dc current source to the mA and LOW connectors through appropriate cables and connectors with the positive source to the mA connector.
- b. Press the mA DC function push button.
- c. Press the range push button and set the current source as listed in Table 4-7.
- d. Check— that the DM 501A display readout is within the display limits for the ambient temperature as shown in Table 4-7.
- e. Remove the dc current source and all connections.

**8. Check Ac Current Accuracy**

- a. Connect the precision ac current source to the mA and LOW connectors through appropriate cables and connectors.
- b. Press the mA AC function push button.
- c. Press the range push button and set the current source as listed in Table 4-8.
- d. Check— that the DM 501A display reads within the display limits for the ambient temperature as listed in Table 4-8.

- e. Remove the AC current source and all connections.

**9. Check Temperature Accuracy**

- a. Connect the temperature probe to the TEMP connector located on the front panel.
- b. Press the TEMP $^{\circ}$ C push button.
- c. Set the temperature bath for the first temperatures shown in the Temperature column in Table 4-9.
- d. Insert the probe in the bath and allow the probe to stabilize at the selected temperature.
- e. Check— that the display limits are as listed in Table 4-9.
- f. Repeat parts c, d, and e for the subsequent temperatures listed in Table 4-9.
- g. This completes the front panel performance check.

**Rear Interface Accuracy Checks**

To verify the accuracy of the dc voltage, ac voltage and resistance modes via the DM 501A rear interface, follow the steps outlined in the Performance Check Procedure for the front panel input connectors, but apply the voltages and resistances to rear interface pins 28B (HI) and 28A (LO). Access to the rear interface pins is most easily made using a TM 500 series, Option 2 power module.

Press the front panel EXT-INT push button to select rear interface input and use Table 4-10, Table 4-11, Table 4-12, Table 4-13, or Table 4-14 for the appropriate input voltages, frequencies, and display limits.

**NOTE**

*The output cable fixture from the calibrating sources to the rear interface pins may have to be modified to accommodate accuracy checks via the rear interface.*

Table 4-2

FRONT PANEL DC VOLTAGE ACCURACY

Range	Dc Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +10°C, +28°C to +50°C
200 mV	190.00 mV	190.13 to 189.87	190.24 to 189.76
2 V	1.9000 V	1.9012 to 1.8988	1.9024 to 1.8976
20 V	19.000 V	19.012 to 18.988	19.024 to 18.976
200 V	190.00 V	190.12 to 189.88	190.24 to 189.76
1000 V	1000.0 V	1000.7 to 999.3	1001.5 to 998.5

Table 4-3

FRONT PANEL AC VOLTAGE ACCURACY

Range	Ac Calibration Voltage	DISPLAY LIMITS			
		Ambient Temp. Range +18°C to +28°C		Ambient Temp. Range 0°C to +18°C, +28°C to +50°C	
		40 Hz to 10 kHz	20 to 40 Hz, 10 to 20 kHz	40 Hz to 10 kHz	20 to 40 Hz, 10 to 20 kHz
200 mV	190.00 mV	191.24 to 188.76	192.00 to 188.00	191.67 to 188.33	192.62 to 187.38
2 V	1.9000 V	1.9124 to 1.8876	1.9200 to 1.8800	1.9167 to 1.8833	1.9262 to 1.8738
20 V	19.000 V	19.124 to 18.876	19.200 to 18.800	19.167 to 18.833	19.262 to 18.738
200 V	190.00 V	191.24 to 188.76	192.00 to 188.00	191.67 to 188.33	192.62 to 187.38
500 V	500.00 V	504.0 to 496.0	506.0 to 494.0	505.5 to 494.5	508.0 to 492.0

Table 4-4

FRONT PANEL dBm ACCURACY

Calibration Frequency, 20 Hz to 20 kHz, +20 dB to -15 dB  
20 Hz to 10 kHz, -15 dB to -20 dB

Range	Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
-40 dB	7.746 mV	-5 to +5	-1.1 to +1.1
40 dB	77.46 mV	+19.5 to <sup>a</sup> +20.5	+18.9 to <sup>a</sup> +21.1
40 dB	0.7746 mV	-19.5 to <sup>a</sup> -20.5 20 Hz to 2 kHz -18.5 to <sup>a</sup> -21.5 2 kHz to 10 kHz	-18.9 to <sup>a</sup> -21.1 20 Hz to 2 kHz -17.9 to <sup>a</sup> -22.1 2 kHz to 10 kHz
-20 dB	7.746 mV	-19.5 to -20.5 20 Hz to 2 kHz -18.5 to -21.5 2 kHz to 10 kHz	-18.9 to -21.1 20 Hz to 2 kHz -17.9 to -22.1 2 kHz to 10 kHz
-20 dB	77.46 mV	-5 to +5	-1.1 to +1.1
20 dB	774.6 mV	+19.5 to <sup>a</sup> +20.5	+18.9 to <sup>a</sup> +21.1

<sup>a</sup>When a 2 is displayed, the DM 501A overranges (flashing display) and illuminates the upper segment of the 1 in the most significant digit.

Table 4-5

FRONT PANEL dBV ACCURACY

Calibration Frequency, 20 Hz to 20 kHz, +20 dB to -15 dB  
20 Hz to 10 kHz, -15 dB to -20 dB

Range	Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
-40 dB	10 mV	-5 to +5	-1.1 to +1.1
-40 dB	100 mV	+19.5 to <sup>a</sup> +20.5	+18.9 to <sup>a</sup> +21.1
-40 dB	1 mV	-19.5 to <sup>a</sup> -20.5 20 Hz to 2 kHz -18.5 to <sup>a</sup> -21.5 2 kHz to 10 kHz	-18.9 to <sup>a</sup> -21.1 20 Hz to 2 kHz -17.9 to <sup>a</sup> -22.1 2 kHz to 10 kHz
-20 dB	10 mV	-19.5 to -20.5 20 Hz to 2 kHz -18.5 to -21.5 2 kHz to 10 kHz	-18.9 to -21.1 20 Hz to 2 kHz -17.9 to -22.1 2 kHz to 10 kHz
-20 dB	100 mV	-5 to +5	-1.1 to +1.1
20 dB	1 V	+19.5 to <sup>a</sup> +20.5	+18.9 to <sup>a</sup> +21.1

<sup>a</sup>When a 2 is displayed, the DM 501A overranges (flashing display) and illuminates only the upper segment of the 1 in the most significant digit.

Table 4-6

FRONT PANEL RESISTANCE ACCURACY

Range	Resistance	DISPLAY LIMITS			
		Ambient Temp. Range +18°C to +28°C		Ambient Temp. Range 0°C to +18°C, +28°C to +50°C	
		HI	LO	HI	LO
200 Ω	190.00 Ω		190.32 to 189.68		190.62 to 189.38
2 kΩ	1.9000 kΩ	1.9032 to 1.8968	1.9032 to 1.8968	1.9062 to 1.8938	1.9062 to 1.8938
20 kΩ	19.000 kΩ	19.032 to 18.968	19.032 to 18.968	19.062 to 18.938	19.062 to 18.938
200 kΩ	190.00 kΩ	190.32 to 189.68	190.32 to 189.68	190.62 to 189.38	190.62 to 189.38
2000 kΩ	1900.0 kΩ	1903.2 to 1896.8	1900.0 to 1894.0	1906.2 to 1893.8	1923.3 to 1876.7
20 MΩ	19.000 MΩ	19.098 to 18.902		19.233 to 18.767	

Table 4-7

FRONT PANEL DC CURRENT ACCURACY

Range	Current	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
200 μA	190.00 μA	190.41 to 189.59	190.62 to 189.38
2 mA	1.9000 mA	1.9041 to 1.8959	1.9062 to 1.8938
20 mA	19.000 mA	19.041 to 18.959	19.062 to 18.938
200 mA	190.00 mA	190.41 to 189.59	190.62 to 189.38
2000 mA	1900.0 mA	1904.1 to 1895.9	1906.2 to 1893.8

Table 4-8

FRONT PANEL AC CURRENT ACCURACY

Range	Current	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
200 $\mu$ A	190.00 $\mu$ A	191.24 to 188.76	191.48 to 188.52
2 mA	1.9000 mA	1.9124 to 1.8876	1.9148 to 1.8852
20 mA	19.000 mA	19.124 to 18.876	19.148 to 18.852
200 mA	190.00 mA	191.24 to 188.76	191.48 to 188.52
2000 mA	1900.0 mA	1912.4 to 1887.6	1914.8 to 1885.2

Table 4-9

TEMPERATURE LIMITS

Temperature	DISPLAY LIMITS			
	Probe Calibrated To Instrument		Any Probe	
	Ambient Temp. Range		Ambient Temp. Range	
	+18°C to +28°C	0°C to +18°C +28°C to +50°C	+18°C to +28°C	0°C to +18°C +28°C to +50°C
62°C	60 to 64	58.5 to 65.5	58 to 66	-56.5 to 67.5
$\pm 125^\circ\text{C}$	$\pm 123$ to $\pm 127$	$\pm 121.5$ to $\pm 128.5$	$\pm 121$ to $\pm 129$	$\pm 119.5$ to $\pm 130.5$
$\pm 200^\circ\text{C}$	$\pm 194$ to $\pm 200$	$\pm 192.5$ to $\pm 201.5$	$\pm 192$ to $\pm 202$	$\pm 190.5$ to $\pm 203.5$

Table 4-10

REAR INTERFACE DC VOLTAGE ACCURACY

Range	Dc Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
200 mV	190.00 mV	190.13 to 189.87	190.24 to 189.76
2 V	1.9000 V	1.9012 to 1.8988	1.9024 to 1.8976
20 V	19.000 V	19.012 to 18.988	19.024 to 18.976
200 V	190.00 V	190.12 to 189.88	190.24 to 189.76
1000 V	190.00 V	190.3 to 189.7	190.7 to 189.3

Table 4-11

REAR INTERFACE AC VOLTAGE ACCURACY

Range	Ac Calibration Voltage	DISPLAY LIMITS			
		Ambient Temp. Range +18°C to +28°C		Ambient Temp. Range 0°C to +18°C, +28°C to +50°C	
		40 Hz to 10 kHz	20 to 40 Hz, 10 to 20 kHz	40 Hz to 10 kHz	20 to 40 Hz, 10 to 20 kHz
200 mV	190.00 mV	193.14 to 186.86	193.90 to 186.10	193.57 to 186.43	194.52 to 185.48
2 V	1.9000 V	1.9314 to 1.8686	1.9390 to 1.8610	1.9357 to 1.8643	1.9452 to 1.8548
20 V	19.000 V	19.314 to 18.686	19.390 to 18.610	19.357 to 18.643	19.452 to 18.548
200 mV	190.00 V	193.14 to 186.86	193.90 to 186.10	193.57 to 186.43	194.52 to 185.48
500 V	190.00 V	194.0 to 186.0	194.8 to 185.2	194.9 to 185.1	195.9 to 184.1

Table 4-12

REAR INTERFACE RESISTANCE ACCURACY

Range	Resistance	DISPLAY LIMITS			
		Ambient Temp. Range +18°C to +28°C		Ambient Temp. Range 0°C to +18°C, +28°C to +50°C	
		HI	LO	HI	LO
200 Ω	190.00 Ω		190.34 to 189.70		190.64 to 189.40
2 kΩ	1.9000 kΩ	1.9032 to 1.8968	1.9032 to 1.8968	1.9062 to 1.8938	1.9062 to 1.8938
20 kΩ	19.000 kΩ	19.032 to 18.968	19.032 to 18.968	19.062 to 18.938	19.062 to 18.838
200 kΩ	190.00 kΩ	190.32 to 189.68	190.32 to 189.68	190.62 to 189.38	190.62 to 189.38
2000 kΩ	1900.0 kΩ	1903.2 to 1896.8	1906.0 to 1894.0	1906.2 to 1893.8	1923.3 to 1876.7
20 MΩ	19.000 MΩ	19.098 to 18.902		19.233 to 18.767	

Table 4-13

REAR INTERFACE dBm ACCURACY

Calibration Frequency, 20 Hz to 20 kHz, +20 dB to -15 dB  
20 Hz to 10 kHz, -15 dB to -20 dB

Range	Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
-40 dB	7.746 mV	-0.6 to +0.6	-1.2 to +1.2
-40 dB	77.46 mV	+19.4 to <sup>a</sup> +20.6	+18.8 to <sup>a</sup> +21.2
-40 dB	0.7746 mV	-19.4 to -20.6 20 Hz to 2 kHz -18.4 to -21.6 2 kHz to 10 kHz	-18.8 to -21.2 20 Hz to 2 kHz -17.8 to -22.2 2 kHz to 10 kHz
-20 dB	7.746 mV	-19.4 to -20.6 20 Hz to 2 kHz -18.4 to -21.6 2 kHz to 10 kHz	-18.8 to -21.2 20 Hz to 2 kHz -17.8 to -22.2 2 kHz to 10 kHz
-20 dB	77.46 mV	-0.6 to +0.6	-1.2 to +1.2
-20 dB	774.6 mV	+19.4 to <sup>a</sup> +20.6	+18.8 to <sup>a</sup> +21.2

<sup>a</sup>When a 2 is displayed, the DM 501A overranges (flashing display) and illuminates only the upper segment of the 1 in the most significant digit.

Table 4-14

REAR INTERFACE dBV ACCURACY

Calibration Frequency, 20 Hz to 20 kHz, +20 dB to -15 dB  
20 Hz to 10 kHz, -15 dB to -20 dB

Range	Calibration Voltage	DISPLAY LIMITS	
		Ambient Temp. Range +18°C to +28°C	Ambient Temp. Range 0°C to +18°C, +28°C to +50°C
-40 dB	10 mV	-0.6 to +0.6	-1.3 to +1.3
-40 dB	100 mV	+19.4 to <sup>a</sup> +20.6	+18.7 to <sup>a</sup> +21.3
-40 dB	1 mV	-19.4 to -20.6 20 Hz to 2 kHz -18.4 to -21.6 2 kHz to 10 kHz	-18.8 to -21.2 20 Hz to 2 kHz -17.8 to -22.2 2 kHz to 10 kHz
-20 dB	10 mV	-19.4 to -20.6 20 Hz to 2 kHz -18.4 to -21.6 2 kHz to 10 kHz	-18.8 to -21.2 20 Hz to 2 kHz -17.8 to -22.2 2 kHz to 10 kHz
-20 dB	100 mV	-0.6 to +0.6	-1.3 to +1.3
-20 dB	1 V	+19.4 to <sup>a</sup> +20.6	+18.7 to <sup>a</sup> +21.3

<sup>a</sup>When a 2 is displayed, the DM 501A overranges (flashing display) and illuminates the upper segment of the 1 in the most significant digit.



# ADJUSTMENT PROCEDURE

## Introduction

Use this Adjustment Procedure to restore the DM 501A to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section, or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure ensures that the instrument will meet the Performance Requirements.

## Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the DM 501A. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is substituted, calibration setup may need to be altered to meet the requirements of the equipment used.

## Preparation

Access to the internal adjustments is achieved most easily when the DM 501A is connected to the power module with a flexible plug-in extender. Remove the left side cover of the DM 501A to access the adjustments on the main and attenuator boards. The electrical shield must be removed to make temperature adjustments. See Fig. 8-3 in the Diagram section at the rear of this manual.

Remove the power module cabinet to make adjustments to the DM 501A inside the power module. Install the DM 501A in the right side compartment of the power module with its unused compartments on the left side. Make adjustments at an ambient temperature between 21°C and 25°C (70°F and 77°F).

### 1. Check Power Supplies

- a. Set the test voltmeter to the 20 V range.
- b. Connect one lead of the voltmeter to the +15 V point located on the Main board, and the other lead to the LOW test point.

- c. Check—for a +15 V reading,  $\pm 0.6\%$  (between +14.1 V and +15.9 V).

- d. Disconnect the voltmeter lead from the +15 V point and reconnect this lead to the +12 V point of the Main board.

- e. Check—for a +12 V reading,  $\pm 0.6\%$  (between +11.28 V and +12.72 V).

- f. Disconnect the voltmeter lead from the +12 V point and reconnect this lead to the +5 V point on the Main board.

- g. Check—for a +5 V reading,  $\pm 0.6\%$  (between +4.70 V and +5.30 V).

### 2. Adjust 2 Vdc $\emptyset$ and 200 mVdc $\emptyset$

- a. Press the VOLTS DC push button.
- b. Connect a shorting strap from the LOW connector to the VOLTS/ $\Omega$  connector on the front panel of the DM 501A.
- c. Press the 2 V range push button switch.
- d. Adjust R1405 (2 Vdc  $\emptyset$ ) for a DM 501A display reading of 1.0000.
- e. Press the 200 mV range push button.
- f. Adjust R1415 (200 mVdc  $\emptyset$ ), located on the Main board, for a DM 501A display reading of 00.01 to 100.01.
- g. Remove the shorting strap between the LOW and VOLTS/ $\Omega$  front panel connectors.

### 3. Adjust Dc Voltage Ranges

- a. Select the range and required dc calibration voltage in the order listed in Table 4-15.

#### NOTE

*The adjustment of the 2 Vdc range interacts with the setting of the 200 mV range but not vice-versa.*

**Calibration Procedure—DM 501A**  
**Adjustment Procedure**

- b. Adjust the selected control for the required display.
- c. Return the calibrator to a minimum voltage.
- d. Remove connections.

**4. Adjust AC Converter and Attenuator Compensation**

- a. Press the VOLTS AC function push button.
- b. Press the 2 V range push button.
- c. Set the ac voltage source frequency to 10 kHz with an output of 0.1000 V rms.
- d. Connect the ac voltage source to the LOW connector and VOLTS/Ω connector on the front panel.
- e. Adjust R1525 (LO Vac) for a display reading of .0997–.1002.
- f. Set the ac calibrator for a voltage of 1.9000 V rms at 10 kHz.
- g. Adjust R1537 (2 Vac) for a display reading of 1.8995–1.9005.
- h. Interaction may occur in the adjustments of R1525 and R1537. Repeat step 2, part b through part g, as needed.
- i. Adjust 20 Vac, 200 Vac, and 500 Vac ranges.

**WARNING**

*Use an insulated shaft adjustment tool when adjusting capacitors C1114, C1128, and C1129. The input potential is connected to the metal top of these capacitors.*

- j. Using Table 4-16, set the range and the required ac calibration voltage. Adjust the selected control for the required display reading.
- k. Set the ac voltage calibrator to a minimum voltage.

- l. Remove connections.

**5. Adjust dBΩ and dB Gain**

- a. Press the VOLTS AC push button.
- b. Check and note the position of the dBm/dBV internal jumper. Set the ac calibrator for 77.46 mV (dBm) or 100.00 mV (dBV) at a frequency of 10 kHz.
- c. Press the dB function push button.
- d. Press the 20 dB range push button.
- e. Adjust R1535 (dBΩ) for a display reading of .1 to .2.
- f. Set the ac calibrator for 774.6 mV (dBm) or 1.0000 V (dBV).
- g. Adjust R1528 (dB Gain) for a flashing display positive reading with the upper segment of the 1 in the most significant digit followed by the numerals 0.0.
- h. Set the ac calibrator for 7.746 mV (dBm) or 10.00 mV (dBV).
- i. Check for a flashing display negative reading with the upper segment of the 1 in the most significant digit followed by the numerals 0.0.
- j. The settings of R1535 (dBΩ) and R1528 (dB Gain) may need to be compromised for optimum operation within the limits specified. Refer to Tables 4-4 or 4-5.
- k. Remove the ac calibrator connections from the DM 501A.

**6. Adjust HI Ohms and LO Ohms**

- a. Press the kΩ function push button.
- b. Press the 20 kΩ range push button.
- c. Set all other push buttons to the out position.

- d. Set the resistance standard for 19.000 k $\Omega$ .
- e. Connect the resistance standard between the VOLTS/ $\Omega$  and LOW input connectors.
- f. With the HI-LO push button in the out position, adjust R1426 (HI  $\Omega$ ) for a display reading of 18.994 to 19.006.
- g. Press the HI-LO push button.
- h. Adjust R1412 (LO  $\Omega$ ) for a display reading of 18.994 to 19.006.
- i. Remove the resistance standard connections from the DM 501A.
- b. Connect the temperature probe to the front panel TEMP connector.
- c. Press the TEMP $^{\circ}$ C function push button.
- d. Place the temperature probe in a 0.0 $^{\circ}$ C (ice-bath) environment. Allow enough time for the display reading to stabilize.
- e. Adjust R1731 (TEMP  $\emptyset$ ) for a display reading of -000.2 to +000.2.
- f. Place the temperature probe in a 100.0 $^{\circ}$ C environment. Allow enough time for the display reading to stabilize.
- g. Adjust R1831 (TEMP Set) for a display reading of 99.7 to 100.3.

### 7. Adjust TEMP $\emptyset$ and TEMP Set

- a. Remove left side shield.
- h. Interaction may occur in TEMP  $\emptyset$  and TEMP Set adjustments. Repeat step 7 parts d through g, as needed.

Table 4-15

#### DC VOLTAGE RANGE ADJUSTMENTS

Range	Calibration Voltage	Adjust	Component Location	Display Reading
2 V	1.9000 V	R1505 (2 Vdc)	Main	1.8997 - 1.9003
200 mV	190.00 mV	R1504 (200 mVdc)	Main	1.8996 - 1.9004
20 V	19.000 V	R1104 (20 Vdc)	Attenuator	18.997 - 19.003
200 V	190.00 V	R1110 (200 Vdc)	Attenuator	189.97 - 190.03
1000 V	1000.0 V	R1114 (1000 Vdc)	Attenuator	999.50 - 1000.2

Table 4-16

#### AC VOLTAGE RANGE ADJUSTMENTS

Range	Calibration Voltage at 10 kHz	Adjust	Component Location	Display Reading
20 V	19.000	C1114 (20 Vac)	Attenuator	18.990 - 19.010
200 V	190.00	C1128 (200 Vac)	Attenuator	189.90 - 190.10
500 V	500.00	C1129 (500 Vac)	Attenuator	499.50 - 500.50



# MAINTENANCE

## Recalibration

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or very six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Refer to the Adjustment Procedure in the Calibration section.

## Circuit Board Removal

To remove the circuit boards, remove the instrument snap-in side covers and electrical shield located under the side covers. To remove the Main board, carefully unsolder the connections to the front-panel connectors and remove the four screws that secure the Main board to the plug-in frame. Slide the Main board towards the rear of the instrument to clear the push button switch shafts.

The Display board, which attaches to the Main board through two connectors, can be removed with the Main board or through the front-panel display window. The display window is removed by pressing down on the two plastic tabs which are accessed through the rectangular holes at the top front of the plug-in frame.

The Attenuator board is removed by carefully unsoldering the connections from the range switch assembly and the wire strap located at the rear of the board.

## Switch Removal

The range switch assembly can be removed by carefully unsoldering the bottom connections from the Main board. Pull the switch assembly up and out until the push button switches clear the front panel.

The three switch assemblies comprising the function switches are located on the front and back sides of the Main board. All three switch assemblies are removed by carefully unsoldering the connections and pulling up and out on each assembly to clear the push buttons from the front panel.

## Heat Sink and Regulator Integrated Circuit Removal and Replacement

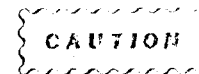
For heat sink removal, a special tool can be used to spread the heat sink tabs, releasing the heat sinks from the regulator integrated circuit. The special tool, assembly

No. 311, can be obtained from FAB TEK, INC. (17 Sugar Hollow Road; Danbury, CT 06810). If this tool is not available, a knife blade or thin-bladed tool can be used to spread the heat sink spring tabs. Use care not to spring the tabs beyond their elastic limit.

To remove the regulators, unsolder the three leads from each of the three regulator integrated circuits (U1325, U1335, and U1431), disconnecting them from the main board. Reverse this procedure to install the heat sink and regulator integrated circuit.

## Cleaning Instructions

This instrument should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation that can cause overheating and component breakdown.

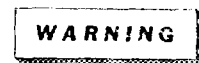


*Avoid the use of chemical cleaning agents that might leave a film or damage the plastic material used in this instrument. Use a non-residue type of cleaner, preferably, isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

## Exterior

Loose dust accumulated on the front panel can be removed with a soft cloth or a small brush. Dirt that remains can be removed with a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used.

## Interior



*To avoid electrical shock, disconnect the instrument test leads from the circuit under test and turn off the power module before removing the instrument.*

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low

## Maintenance—DM 501A

pressure air, then use a soft brush. If further cleaning is required, use a mild detergent and water solution, flushing well with clean water.

### CAUTION

*Variable capacitors C1114, C1128, and C1129 should not be cleaned, as their electrical performances will be degraded. If the Attenuator board requires washing, remove C1114, C1128, and C1129 by carefully unsoldering the appropriate connections.*

If the push button switches are washed, all switches should be in the out position; otherwise, there is a possibility of switch malfunction.

Drying can be accomplished with dry, low-pressure air or by placing in an oven at 40°C to 60°C for approximately four hours.

After making minor board repairs, cleaning is best accomplished by carefully flaking or chipping the solder flux from the repaired area.

Isopropyl alcohol can be used to clean major repairs to the circuit board; however, flush the board well with clean, isopropyl alcohol. Make certain that resin or dirt is carefully removed from board areas of high impedance circuitry.

## Obtaining Replacement Parts

Most electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, Inc., please check the Replaceable Electrical Parts list for the proper value, rating, tolerance, and description.

## Ordering Parts

When ordering replacement parts from Tektronix, Inc., it is important that all of the following information be included to ensure receiving the proper parts.

1. Instrument type (include modification or option numbers).
2. Instrument serial number.

3. A description of the part (if electrical, include the component number).

4. Tektronix part number.

## Troubleshooting Aids

**Troubleshooting Charts.** As an aid in locating problem areas, troubleshooting charts are provided for the DM 501A. They are located in the Diagram section in the rear of this manual.

## Static-Sensitive Components

### CAUTION

*Static discharge can damage any semiconductor component in this instrument.*

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 5-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.
3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only special antistatic suction type or wick type desoldering tools.

### Test Equipment

Before using any test equipment to make measurements on static-sensitive components or assemblies, be certain that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

**Table 5-1**  
**RELATIVE SUSCEPTIBILITY TO**  
**STATIC DISCHARGE DAMAGE**

Semiconductor Classes	Relative Susceptibility Levels <sup>a</sup>
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

<sup>a</sup>Voltage equivalent for levels:

1 = 100 to 500 V	4 = 500 V	7 = 400 to 1000 V (est.)
2 = 200 to 500 V	5 = 400 to 600 V	8 = 900 V
3 = 250 V	6 = 600 to 800 V	9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)





# OPTIONS

The standard instrument incorporates the temperature measuring capability using a TEKTRONIX P6601 probe or other suitable sensing device.

An Option 2 instrument deletes the temperature measurement function, P6601 temperature probe, and all internal circuits associated with this function.

Information concerning an Option 2 instrument can be found on schematic diagrams 1 and 2, in the Replaceable Electrical Parts list, and in the Calibration section of this manual. The factory will hardwire the deleted switch positions as shown on the diagrams. Information concerning the TEKTRONIX P6601 Temperature Probe can be found in the instruction manual for that accessory.



# REPLACEABLE ELECTRICAL PARTS

## PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

### LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

### CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

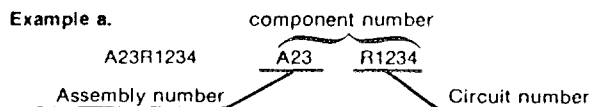
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

### ABBREVIATIONS

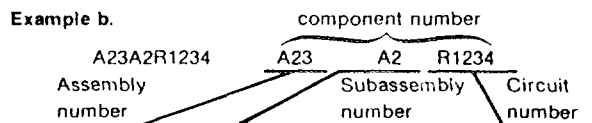
Abbreviations conform to American National Standard Y1.1.

### COMPONENT NUMBER (column one of the Electrical Parts List)

A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:



Read: Resistor 1234 of Assembly 23



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

### TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

### SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

### NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

### MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

### MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
53013	LEMO SA ELEKTROTECHNIQUE	RTE DE LAUSANNE MORGES	SWITZERLAND
00001	MATSHUSHITA ELECTRIC	200 PARK AVENUE, 54TH FLOOR	NEW YORK, NY 10017
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00815	NORTHERN ENG. LABS, INC.	357 BELIOT	BURLINGTON, WISCONSIN 59105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
19396	ILLINOIS TOOL WORKS, INC. PATRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
19647	CADDOCK ELECTRONICS INC.	3127 CHICAGO AVENUE	RIVERSIDE, CA 92507
21317	ELECTRONIC APPLICATIONS COMPANY	2213 EDWARDS AVENUE	SOUTH EL MONTE, CA 91733
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	RATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
50522	MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS	3400 HILLVIEW AVENUE	PALO ALTO, CA 94304
50558	ELECTRONIC CONCEPTS, INC.	526 INDUSTRIAL WAY WEST	EATONTOWN, NJ 07724
54673	MATSHUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	HESSMAN MFG., DIVISION OF MCGRAW- EDISON CO.	2536 W. UNIVERSITY ST. 644 W. 12TH ST.	ST. LOUIS, MO 63107 ERIE, PA 16512
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73156	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	P O BOX 500	BEAVERTON, OR 97077
80009	TEKTRONIX, INC.	3029 E. WASHINGTON STREET	
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	P. O. BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Replaceable Electrical Parts—DM 501A

Component No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A10	670-6136-00		CKT BOARD ASSY:MAIN	80009	670-6136-00
A10	670-6178-00		CKT BOARD ASSY:MAIN (OPTION 2 ONLY)	80009	670-6178-00
A12	670-6139-00		CKT BOARD ASSY:SWITCH	80009	670-6139-00
A14	670-6138-00		CKT BOARD ASSY:ATTENUATOR	80009	670-6138-00
A16	670-6137-00		CKT BOARD ASSY:DISPLAY	80009	670-6137-00
A10	-----		CKT BOARD ASSY:MAIN		
A10C1325	290-0804-00		CAP., FXD, ELCTLT:10UF, +50-10%, 25V	55680	250LA10-T
A10C1326	290-0804-00		CAP., FXD, ELCTLT:10UF, +50-10%, 25V	55680	250LA10-T
A10C1328	290-0844-00		CAP., FXD, ELCTLT:100UF, -10+75%, 35 WVDC	54473	ECF-A35V100L
A10C1422	290-0845-00		CAP., FXD, ELCTLT:330UF, 10+50%, 25 WVDC	55680	250LA330
A10C1423	281-0788-00		CAP., FXD, CER DI:470PF, 10%, 100V	72982	800509AADW5R471K
A10C1424	281-0775-00		CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	800509AABZ5U104M
A10C1431	290-0804-00		CAP., FXD, ELCTLT:10UF, +50-10%, 25V	55680	250LA10-T
A10C1432	290-0844-00		CAP., FXD, ELCTLT:100UF, -10+75%, 35 WVDC	54473	ECF-A35V100L
A10C1433	281-0772-00		CAP., FXD, CER DI:0.0047UF, 10%, 100V	72982	800509AABZ5R472K
A10C1435	281-0826-00		CAP., FXD, CER DI:2200PF, 5%, 100V	04222	GC101C222J
A10C1505	285-0809-00		CAP., FXD, PLSTC:1UF, 10%, 50V	56289	LP66A1A105K
A10C1508	283-0623-00		CAP., FXD, MICA D:1200PF, 1%, 100V	00853	D191E122F0
A10C1517	281-0773-00		CAP., FXD, CER DI:0.01UF, 10%, 100V	72982	800509AAW5R103K
A10C1521	290-0534-00		CAP., FXD, ELCTLT:1UF, 20%, 35V	56289	196D105E0635HA1
A10C1534	281-0812-00		CAP., FXD, CER DI:1000PF, 10%, 100V	72982	800509AABZ7R102K
A10C1539	290-0290-00		CAP., FXD, ELCTLT:10UF, 20%, 25V	56289	300472
A10C1601	290-0527-00		CAP., FXD, ELCTLT:15UF, 20%, 20V	50231	250L06M20FL
A10C1603	290-0536-00		CAP., FXD, ELCTLT:10UF, 20%, 25V	90201	700106M025FL
A10C1605	290-0776-00		CAP., FXD, ELCTLT:22UF, +50-10%, 10V	0080L	ECF-A10V22L
A10C1611	285-1119-00		CAP., FXD, PLSTC:0.082UF, 10%, 200V	19386	P2680CA23K
A10C1834	281-0786-00		CAP., FXD, CER DI:150PF, 10%, 100V	72982	100502AABZ5P151K
A10CR1422	152-0585-00		(REMOVE FOR OPTION 2) SEMICONV DEVICE:SILICON, BRIDGE, 200V, 1A	80009	152-0585-00
A10CR1424	152-0066-00		SEMICONV DEVICE:SILICON, 400V, 750MA	14433	LG4016
A10CR1426	152-0066-00		SEMICONV DEVICE:SILICON, 400V, 750MA	14433	LG4016
A10CR1516	153-0057-00		SEMICONV DVC, SE:SILICON, 40 PIV, 200MA, SEL	80009	153-0057-00
A10CR1518	153-0057-00		SEMICONV DVC, SE:SILICON, 40 PIV, 200MA, SEL	80009	153-0057-00
A10CR1605	152-0141-02		SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
A10CR1607	152-0141-02		SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
A10CR1624	152-0488-00		SEMICONV DEVICE:SILICON, 200V, 1500MA	80009	152-0488-00
A10CR1631	152-0246-00		SEMICONV DEVICE:SILICON, 40V, 200MA	80009	152-0246-00
A10CR1632	152-0246-00		SEMICONV DEVICE:SILICON, 40V, 200MA	80009	152-0246-00
A10CR1711	152-0141-02		SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
A10CR1934	152-0141-02		SEMICONV DEVICE:SILICON, 30V, 50NA (REMOVE FOR OPTION 2)	80009	152-0141-02
A10CR1935	152-0141-02		SEMICONV DEVICE:SILICON, 30V, 50NA (REMOVE FOR OPTION 2)	80009	152-0141-02
A10F1626	159-0021-00		FUSE, CARTRIDGE:3AG, 2A, 250V, FAST-BLOW	71400	AGC 2
A10J1435	131-0993-00		BUS, CONDUCTOR:2 WIRE BLACK	60779	530153-2
A10J1901	131-2371-00		CONN, RCPT, ELEC:CKT BD, 8 CONT, FEMALE	22526	65001-002
A10J1902	136-0632-00		SOCKET, PLUG-IN:8 PIN, FEMALE	60779	1-380949-F
A10K1408	148-0126-00		RELAY REED:5 VDC, 400 OHM COIL	21317	BEE 5
A10K1505	148-0126-00		RELAY REED:5 VDC, 400 OHM COIL	21317	BEE 5
A10K1528	148-0126-00		RELAY REED:5 VDC, 400 OHM COIL	21317	BEE 5
A10P1435	131-1857-00		TERM. SET, PIN:36/0.025 SQ PIN, ON 0.1 CTRS	22526	6500136
A10Q1415	151-0232-00		TRANSISTOR:SILICON, NPN, DBAL	80009	151-0232-00
A10Q1435	151-0341-00		TRANSISTOR:SILICON, NPN	80009	151-0341-00

Replaceable Electrical Parts—DM 501A

Component No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A10Q1525	151-1096-00		TRANSISTOR: SILICON, JFE, N-CHANNEL	80009	151-1006-00
A10Q1731	151-0232-00		TRANSISTOR: SILICON, NPN, DUAL (REMOVE FOR OPTION 2)	80009	151-0232-00
A10Q1905	151-0188-00		TRANSISTOR: SILICON, PNP	80009	151-0188-00
A10R1405	311-1557-00		RES., VAR, NONWIR: 25K OHM, 20%, 0.50W	73138	91A R24K
A10R1407	315-0331-00		RES., FXD, CMPSN: 330 OHM, 5%, 0.25W	01121	CB3315
A10R1408	321-0364-00		RES., FXD, FILM: 60.4K OHM, 1%, 0.125W	91637	MFF1816G60401F
A10R1412	311-1564-00		RES., VAR, NONWIR: TRMR, 500 OHM, 0.5W	73138	91A R500
A10R1415	311-1557-00		RES., VAR, NONWIR: 25K OHM, 20%, 0.50W	73138	91A R24K
A10R1416	321-1601-04		RES., FXD, FILM: 58.59K OHM, 0.1%, 0.125W	91637	MFF1816D58591B
A10R1425	315-0222-00		RES., FXD, CMPSN: 2.2K OHM, 5%, 0.25W	01121	CB2225
A10R1426	311-1559-00		RES., VAR, NONWIR: 10K OHM, 20%, 0.50W	73138	91A-10001M
A10R1435	321-0356-00		RES., FXD, FILM: 49.9K OHM, 1%, 0.125W	91637	MFF1816G49901F
A10R1501	321-0364-00		RES., FXD, FILM: 60.4K OHM, 1%, 0.125W	91637	MFF1816G60401F
A10R1502	321-0199-00		RES., FXD, FILM: 1.15K OHM, 1%, 0.125W	91637	MFF1816G11500F
A10R1503	315-0101-00		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
A10R1504	311-1564-00		RES., VAR, NONWIR: TRMR, 500 OHM, 0.5W	73138	91A R500
A10R1505	311-1943-00		RES., VAR, NONWIR: 10K OHM, 10%, 0.50W	73138	MODEL 68W
A10R1506	321-0292-07		RES., FXD, FILM: 10.7K OHM, 0.1%, 0.125W	24546	NE55E1182B
A10R1507	315-0473-00		RES., FXD, CMPSN: 47K OHM, 5%, 0.25W	01121	CB4735
A10R1508	321-0385-07		RES., FXD, FILM: 100K OHM, 0.1%, 0.125W	91637	MFF1816C10002B
A10R1509	315-0472-00		RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
A10R1511	307-0103-00		RES., FXD, CMPSN: 2.7 OHM, 5%, 0.25W	01121	CB27G5
A10R1512	321-0200-00		RES., FXD, FILM: 1.18K OHM, 1%, 0.125W	91637	MFF1816G11800F
A10R1514	321-0376-00		RES., FXD, FILM: 80.6K OHM, 1%, 0.125W	91637	MFF1816G80601F
A10R1515	321-1620-07		RES., FXD, FILM: 10.93K OHM, 0.1%, 0.125W	24546	NE55E 10.93KB
A10R1516	321-0385-07		RES., FXD, FILM: 100K OHM, 0.1%, 0.125W	91637	MFF1816C10002B
A10R1525	311-1556-00		RES., VAR, NONWIR: 50K OHM, 20%, 0.50W	73138	91A R50K
A10R1526	321-0450-00		RES., FXD, FILM: 475K OHM, 1%, 0.125W	91637	MFF1816G47502F
A10R1527	321-0135-00		RES., FXD, FILM: 249 OHM, 1%, 0.125W	91637	MFF1816G249R0F
A10R1528	311-1564-00		RES., VAR, NONWIR: TRMR, 500 OHM, 0.5W	73138	91A R500
A10R1531	321-1720-00		RES., FXD, FILM: 3.24M OHM, 1%, 0.125W	01121	CC3244FY
A10R1532	321-0807-00		RES., FXD, FILM: 900K OHM, 1%, 0.125W	91637	MFF1104F90002F
A10R1533	315-0364-00		RES., FXD, CMPSN: 360K OHM, 5%, 0.25W	01121	CB3645
A10R1535	311-1556-00		RES., VAR, NONWIR: 50K OHM, 20%, 0.50W	73138	91A R50K
A10R1536	321-0343-00		RES., FXD, FILM: 36.5K OHM, 1%, 0.125W	91637	MFF1816G36501F
A10R1537	311-1564-00		RES., VAR, NONWIR: TRMR, 500 OHM, 0.5W	73138	91A R500
A10R1538	321-1289-07		RES., FXD, FILM: 10.1K OHM, 0.1%, 0.125W	91637	MFF1816C10101B
A10R1539	321-0763-07		RES., FXD, FILM: 1.12K OHM, 0.1%, 0.125W	91637	MFF1816C11200B
A10R1601	321-0382-07		RES., FXD, FILM: 93.1K OHM, 0.1%, 0.125W	24546	NE55E9312B
A10R1602	315-0623-00		RES., FXD, CMPSN: 62K OHM, 5%, 0.25W	01121	CB6235
A10R1605	315-0752-00		RES., FXD, CMPSN: 7.5K OHM, 5%, 0.25W	01121	CB7525
A10R1613	304-0564-00		RES., FXD, CMPSN: 560K OHM, 10%, 1W	01121	CB5641
A10R1615	321-0382-00		RES., FXD, FILM: 93.1K OHM, 1%, 0.125W	91637	MFF1816C93101F
A10R1628A, B, C	307-0400-00		RES., FXD, FILM: 10 OHM, 0.1%	80009	307-0400-00
A10R1634	321-0318-00		RES., FXD, FILM: 20K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G20001F
A10R1636	321-0356-00		RES., FXD, FILM: 49.9K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G49901F
A10R1637	315-0152-00		RES., FXD, CMPSN: 1.5K OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB1525
A10R1638	321-0261-00		RES., FXD, FILM: 5.11K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G51100F
A10R1639	321-0269-00		RES., FXD, FILM: 6.19K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G61900F
A10R1711	321-0895-07		RES., FXD, FILM: 90 OHM, 0.1%, 0.125W	91637	MFF1816C90R00B
A10R1713	321-0754-07		RES., FXD, FILM: 900 OHM, 0.1%, 0.125W	91637	MFF1816C900R0B

Replaceable Electrical Parts—DM 501A

Component No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A10R1731	311-1560-00		RES., VAR, NONWIR: 5K OHM, 20%, 0.50W (REMOVE FOR OPTION 2)	73138	91A R5K
A10R1733	321-0983-00		RES., FXD, FILM: 4.5M OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G45003F
A10R1735	315-0104-00		RES., FXD, CMPSN: 100K OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB1045
A10R1801	315-0512-00		RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
A10R1803	315-0512-00		RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
A10R1805	315-0101-00		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
A10R1831	311-1552-00		RES., VAR, NONWIR: 500K OHM, 20%, 0.50W (REMOVE FOR OPTION 2)	73138	91-74-0
A10R1832	321-1516-01		RES., FXD, FILM: 2.34 OHM, 0.5%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G23403D
A10R1836	321-0385-00		RES., FXD, FILM: 100K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G10002F
A10R1901	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1902	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1903	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1904	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1906	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1907	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1908	315-0270-00		RES., FXD, CMPSN: 27 OHM, 5%, 0.25W	01121	CB2705
A10R1909	315-0103-00		RES., FXD, CMPSN: 10K OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB1035
A10R1931	315-0334-00		RES., FXD, CMPSN: 330K OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB3345
A10R1932	321-0256-00		RES., FXD, FILM: 4.53K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G45300F
A10R1933	315-0393-00		RES., FXD, CMPSN: 39K OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB3935
A10R1934	321-0251-00		RES., FXD, FILM: 4.02K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G40200F
A10R1935	321-0193-00		RES., FXD, FILM: 1K OHM, 1%, 0.125W (REMOVE FOR OPTION 2)	91637	MFF1816G10000F
A10R1936	315-0101-00		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W (REMOVE FOR OPTION 2)	01121	CB1015
A10R1937	315-0273-00		RES., FXD, CMPSN: 27K OHM, 5%, 0.25W	01121	CB2735
A10RT1525	308-0817-00		RES., FXD, WW: 1K OHM, 5%, 0.125W	91637	RS1A-154
A10RT1633	307-0645-00		RES., THERMAL: 5K OHM, 40%	50157	180050201
A10S1	260-1974-00		SWITCH, PUSH: 4 BUTTON, 4 POLE NO/TMP (OPTION 2 ONLY)	80009	260-1974-00
A10S1	260-1972-00		SWITCH, PUSH: 5 BUTTON, 4 POLE, FUNCTION (STANDARD ONLY)	80009	260-1972-00
A10S2	260-1971-00		SWITCH, PUSH: 6 BUTTON, 6 POLE, RANGE	80009	260-1971-00
A10S3	260-1973-00		SWITCH, PUSH: 2 BUTTON, 2 POLE, DB/HI-LO	80009	260-1973-00
A10S4	260-1953-01		SWITCH, PUSH: 1 BUTTON, 4 POLE, INPUT	80009	260-1953-01
A10T1301	120-1243-00		XFMR, PWR, STU:	80009	120-1243-00
A10TP1608	214-0579-00		TERM, TEST POINT: BRS CD PL	80009	214-0579-00
A10TP1615	214-0579-00		TERM, TEST POINT: BRS CD PL	80009	214-0579-00
A10TP1631	214-0579-00		TERM, TEST POINT: BRS CD PL	80009	214-0579-00
A10U1325	156-0312-00		MICROCIRCUIT, LI: VOLTAGE REGULATOR, 15V, 1A	27014	LM307-15
A10U1335	156-0872-00		MICROCIRCUIT, LI: VOLTAGE REGULATOR	80009	156-0872-00
A10U1429	156-1259-00		MICROCIRCUIT, LI: RMS/DC CONVERTER	80009	156-1259-00
A10U1431	156-0277-00		MICROCIRCUIT, LI: VOLTAGE REGULATOR	80009	156-0277-00
A10U1515	156-1134-00		MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-1134-00
A10U1538	156-0067-00		MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-0067-00
A10U1539	156-1156-00		MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-1156-00

Replaceable Electrical Parts—DM 501A

Component No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A10U1601	156-1306-00		MICROCIRCUIT,LI:4.5 DIGIT A/D CONVERTER	80009	156-1306-00
A10U1603	156-1305-00		MICROCIRCUIT,LI:4.5 DIGIT A/D CONVERTER	80009	156-1305-00
A10U1701	156-1245-00		MICROCIRCUIT,LI:7 XSTR,HV/HIGH CURRENT	80009	156-1245-00
A10U1703	156-0793-00		MICROCIRCUIT,DI:DUAL 4-INP NAND GATE	80009	156-0793-00
A10U1705	156-0524-00		MICROCIRCUIT,DI:HEX INVERTER W/OPEN COL	80009	156-0524-00
A10U1707	156-0793-00		MICROCIRCUIT,DI:DUAL 4-INP NAND GATE	80009	156-0793-00
A10U1737	156-0854-00		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER (REMOVE FOR OPTION 2)	80009	156-0854-00
A10U1805	156-0886-00		MICROCIRCUIT,DI:BCD TO 7 SEGMENT DCDR	80009	156-0886-00
A10VR1415	152-0508-00		SEMICONV DEVICE:ZENER,0.4W,12.6V,5%	80009	152-0508-00
A10VR1512	152-0317-00		SEMICONV DEVICE:ZENER,0.25W,6.2V,5%	80009	152-0317-00
A10VR1513	152-0727-00		SEMICONV DEVICE:ZENER,SI,6.3V,2%,0.4W	80009	152-0727-00
A10VR1626	152-0486-00		SEMICONV DEVICE:ZENER,0.25W,6.2V,5% (REMOVE FOR OPTION 2)	80009	152-0486-00
A10Y1720	131-0566-00		LINK,TERM.CONNE:0.086 DIA X 2.475 INCH L	55210	L-2007-1
A10Y1425	158-0195-00		XTAL UNIT,QTZ:163.84 KHZ,0.2%,PAR	00815	NE345D
A12	-----		CKT BOARD ASSY:SWITCH		
A120R1012	152-0141-02		SEMICONV DEVICE:SILICON,30V,40MA	80009	152-0141-02
A14	-----		CKT BOARD ASSY:ATTENUATOR BOARD		
A14C1100	285-1077-00		CAP.,FXD,PLSTC:0.10UF,20%,600V	14752	230B1F104
A14C1105	283-0317-00		CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	861-518-COK0109B
A14C1106	283-0317-00		CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	861-518-COK0109B
A14C1110	283-0431-00		CAP.,FXD,CER DI:28PF,1%,1000V	91418	CN0280F1021R0
A14C1112	283-0604-00		CAP.,FXD,MICA D:304PF,2%,300V	00853	D153F3040G0
A14C1114	281-0105-00		CAP.,VAR,GL DIE:0.8-8.5PF,750V	72982	562-013
A14C1120	283-0434-00		CAP.,FXD,CER DI:26.5 PF,2%,1000V	91418	OBD
A14C1122	283-0627-00		CAP.,FXD,MICA D:0.0033UF,5%,500V	00853	D195E332J0
A14C1124	285-1197-00		CAP.,FXD,PLSTC:0.033UF,5%,100V	50558	MC12D333J
A14C1126	283-0434-00		CAP.,FXD,CER DI:26.5 PF,2%,1000V	91418	OBD
A14C1128	281-0105-00		CAP.,VAR,GL DIE:0.8-8.5PF,750V	72982	562-013
A14C1129	281-0105-00		CAP.,VAR,GL DIE:0.8-8.5PF,750V	72982	562-013
A14R1100	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A14R1104	311-1558-00		RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91-80-0
A14R1110	311-1563-00		RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
A14R1112A,B,C,D	307-1134-00		RES.,NTWK,FXD,FI:9M OHM,900K OHM,90K	19647	1776-10
A14R1114	311-1567-00		RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
A14R1220	315-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A14RT1102	307-0662-00		RES.,THERMAL:1K OHM,40%	50157	180Q10200



Replaceable Electrical Parts—DM 501A

Component No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
A16	-----		CKT BOARD ASSY:DISPLAY		
A16DS1000	150-1066-00		LAMP,LED RDOUT:ORANGE,6 SEG,+/-1	50522	MAN 4605
A16DS1001	150-1048-00		LAMP,LED,DSPL:ORANGE,7 SEG,0.4 DIGIT	50522	MAN4640A
A16DS1100	150-1048-00		LAMP,LED,DSPL:ORANGE,7 SEG,0.4 DIGIT	50522	MAN4640A
A16DS1101	150-1048-00		LAMP,LED,DSPL:ORANGE,7 SEG,0.4 DIGIT	50522	MAN4640A
A16DS1200	150-1048-00		LAMP,LED,DSPL:ORANGE,7 SEG,0.4 DIGIT	50522	MAN4640A
A16P1901	131-2372-00		CONN,RCPT,ELEC:CKT BD,8 CONT,MALE	22526	65645
A16P1902	131-1934-00		TERM. SET,PIN:1 X 36,0.1 CTR,0.9 L	22526	65539-001
A16R1000	315-0101-00		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A16R1001	315-0561-00		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
A16R1100	315-0101-00		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
CHASSIS PARTS					
J500	131-1652-00		CONN,RCPT,ELEC:'LEMO' TYPE,1MALE,1 FEMALE	S2013	RA0302
	-----		(STANDARD ONLY)		
J510	355-0170-00		STUD,SHOULDERED:6-32 X 0.40 INCH LONG	80009	355-0170-00
J520	136-0730-00		JACK,TIP:BLUE	80009	136-0730-00
J530	136-0732-00		JACK,TIP:RED	80009	136-0732-00
J540	136-0731-00		JACK,TIP:BLACK	80009	136-0731-00



# DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

- Y14.15, 1966 Drafting Practices.
- Y14.2, 1973 Line Conventions and Lettering.
- Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute  
1430 Broadway  
New York, New York 10018

## Component Values

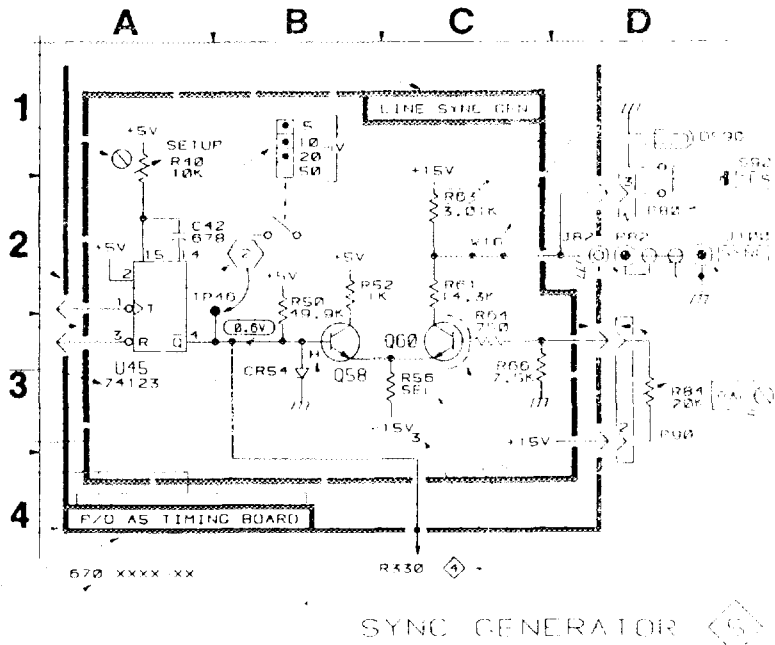
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).  
Values less than one are in microfarads ( $\mu$ F).

Resistors = Ohms ( $\Omega$ ).

The following special symbols may appear on the diagrams:

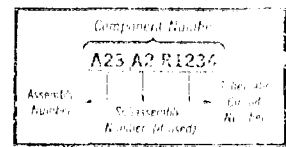
- Function Block Title
- Internal Screwdriver Adjustment
- Cam Switch Closure Chart (Dot indicates switch closure)
- Etched Circuit Board Outlined in Black
- Refer to Waveform Function Block Outline
- IC type
- Test Voltage
- Heat Sink
- Board Name
- P/O--Part of circuit board
- Assembly Number
- Tektronix Part No. for circuit boards



## Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration and in the lookup table for the schematic diagram and corresponding component location illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number (see following illustration for constructing a component number).

### COMPONENT NUMBER EXAMPLE



Unusually indicated components may have the assembly number prefix (see end of this manual for details).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.

- Modified Component (See Parts List for details in grey, or with grey outline)
- Shaded Link
- Etched Circuit Board
- Box Identifies Panel Labels, Connectors and Indicators
- Coaxial connectors male female
- Plug Index, signifies pin No. 1
- External Screwdriver Adjustment
- Shielding
- Selected value, see Parts List
- Decoupled or Filtered Voltage
- Refer to Diagram Number
- Schematic Name and Number

