

**Tektronix®**

**DM 504A**  
Auto Ranging  
Digital  
Multimeter

INSTRUCTION MANUAL



## 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. REFER TO THE SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

**PLEASE CHECK FOR CHANGE INFORMATION  
AT THE REAR OF THIS MANUAL.**

# **DM 504A**

**Auto Ranging  
Digital  
Multimeter  
Service**

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

070-7135-00  
Product Group 75

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

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Each instrument has a serial number on a panel insert, tag,  
or stamped on the chassis. The first number or letter  
designates the country of manufacture. The last five digits  
of the serial number are assigned sequentially and are  
unique to each instrument. Those manufactured in the  
United States have six unique digits. The country of  
manufacture is identified as follows:

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<b>100000</b>	Tektronix Guernsey, Ltd., Channel Islands
<b>200000</b>	Tektronix United Kingdom, Ltd., London
<b>300000</b>	Sony/Tektonix, Japan
<b>700000</b>	Tektronix Holland, NV, Heerenveen, The Netherlands

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# **SERVICING SAFETY SUMMARY**

*FOR QUALIFIED SERVICE PERSONNEL ONLY*

*Refer also to the Operators Safety Summary in the DM 504A Operators Manual*

## **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.

# THEORY OF OPERATION

The DM 504A is analog-to-digital convertor with the input circuits, logic, display devices, and power supplies necessary to display, in digital form, the value of an input voltage, current, resistance or temperature. Figure 1-1 is a block diagram of the DM 504A.

100 k $\Omega$  to 20 k $\Omega$  during the integration cycle. Analog multiplexer U103 switches the integration resistance during the proper cycle when instructed by microcontroller U1.

## ANALOG-TO-DIGITAL CONVERTOR

Analog-to-digital conversion is accomplished by dual slope convertor U102. The dual slope conversion is based on three cycles: integration, de-integration, and auto zero as shown in Fig. 1-2. These cycles are driven by microcontroller U1 through the CONTROL A and CONTROL B signals. U102 detects the polarity of the integrator output and generates the COMP signal which is interpreted by microcontroller U1. The sensitivity of the analog-to-digital convertor is either 2 V or 200 mV full scale. The 200 mV sensitivity is achieved by doubling the length of the integration cycle and reducing the integration resistance from

## DC VOLTAGE CIRCUITRY

DC voltages are applied to the V/ $\Omega$  and LOW input connectors. Table 1-1 lists the relay logic and analog-to-digital convertor sensitivity for the DC voltage measurement ranges. The LOW input is connected to analog ground through resistor R101.

In the 200 mV and 2V ranges, relay K104 is activated and the DC voltage is connected to the input (pin 1) of U102. Before reaching U102, the DC voltage is routed through the relay switches, the function switches, and a low-pass filter (R115 and C106).

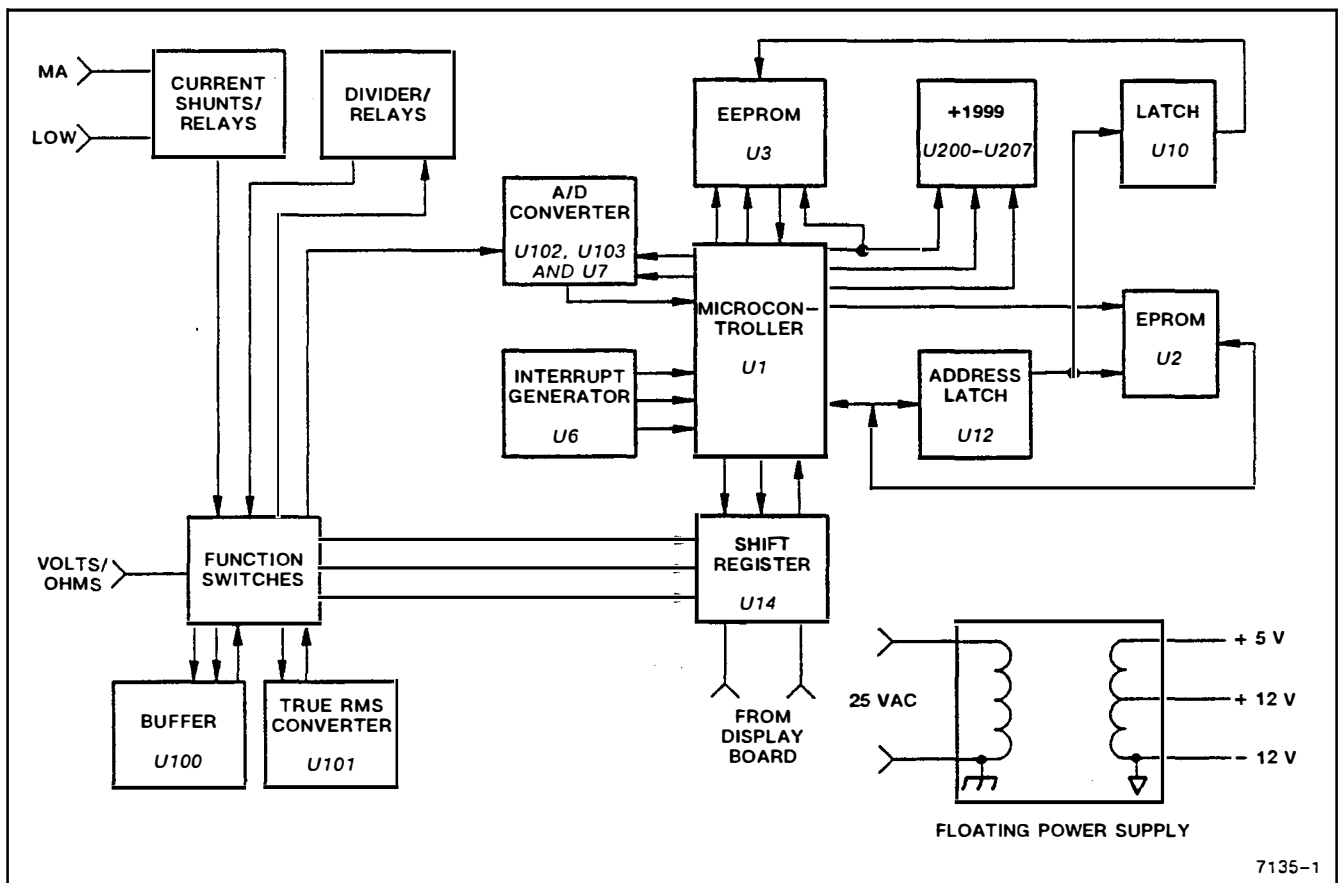


Fig. 1-1 DM 504A block diagram



## Theory of Operation—DM 504A

In the 20 V and 200 V ranges, relay K102 is activated and the DC voltage is connected to pin 1 of U102. In these ranges, the voltage is routed through R100-2, the relay switches, the function switches, and the low-pass filter formed by R115 and C106.

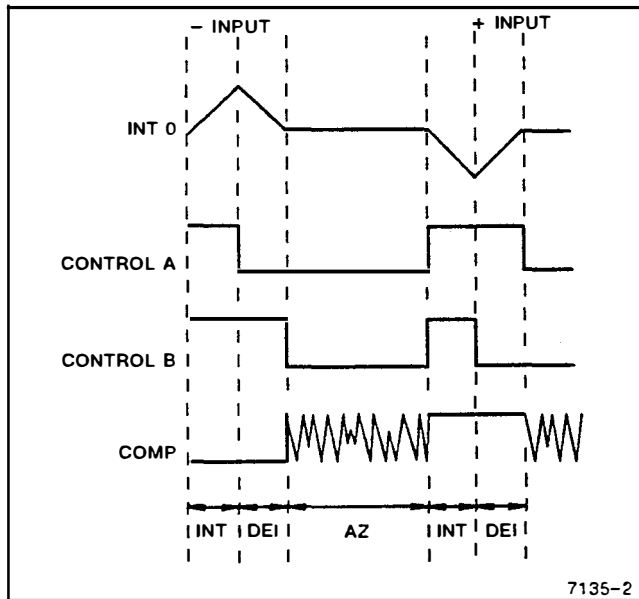


Fig. 1-2 Dual slope conversion

In the 1000 V range, relay K101 is activated. This connects the DC voltage to pin 1 of U102 through R100-3, the relay switches, the function switches, and the low-pass filter formed by R115 and C106.

The circuit consisting of R105, CR100, CR101, VR102, and VR103 provides over-voltage protection for the DC voltage circuitry.

## DC CURRENT CIRCUITRY

DC current is applied to the mA and LOW input connectors. The voltage developed across current sense resistors R101, R102, and R103 is routed to U102, pin 1, where it is converted to a digital measurement. Fuse F100 protects the current sense resistors from currents > 2A and diode bridge CR102 limits the voltage across them to approximately 1.5 V.

The current sense resistors are switched in and out of the DC current path by relays K100, K101, K102, and K103 as indicated in Table 1-2.

The value of the current sense resistance in the circuit for each range is a combination of the values of R101, R102, and R103 as indicated below:

200 $\mu$ A Range:	R103 + R102 + R101
2 mA Range:	R102 + R101
20 mA Range:	R101.2
200 mA Range:	R101.6
2000 mA Range:	R101.5

## OHMS CONVERTER

The ohms converter generates a known current that flows out of the front panel V/ $\Omega$  connector through the resistance being measured. The voltage developed at the input connectors is proportional to resistance being measured. The voltage is sensed by the analog-to-digital converter and displayed.

The ohms converter circuitry consists of a reference current source and a current sensing circuit. Operational amplifier U100 provides the reference current. Current flows from pin 6 of U100 through VR100, S1C, and R112 to the -12 V voltage source. Approximately 1.2 V is dropped across VR100, while approximately 1.0 V is dropped across R110.

Table 1-1  
DC VOLTAGE RELAY LOGIC

Range	K101	K102	K104	A/D Sensitivity
200 mV			*	200 mV
2 V			*	2 V
20 V		*		200 mV
200 V		*		2 V
1000 V	*			2 V

**Table 1-2  
DC CURRENT RELAY LOGIC**

Range	K100	K101	K102	K103	A/D Sensitivity
200 $\mu$ A					200 mV
2 mA	*				200 mV
20 mA		*			200 mV
200 mA			*		200 mV
2000 mA				*	200 mV

In the 200  $\Omega$  and 2 k $\Omega$  ranges, current flows from pin6 of U100 through S1E, K101SB, S1D, R108, R132, R107, S1B, and, finally, through the unknown resistance, between the V/ $\Omega$  and LOW connectors, to analog ground. Operational amplifier U100 balances the voltage at its inputs, producing a voltage of approximately 1 V across R108 and a constant reference current of 1  $\mu$ A in the 200  $\Omega$  and 2 k $\Omega$  ranges. If, for example, the unknown resistance is 200  $\Omega$ , the voltage across it is 200 mV. This voltage is sensed by the analog-to-digital converter and displayed as a resistance value.

In the 20 k $\Omega$  and 200 k $\Omega$  ranges, the reference current is 10 MA while in the 2 M $\Omega$  and 20 M $\Omega$  ranges it is 0.1  $\mu$ A.

The current sensing circuitry consists of R135, S1A, and the low-pass filter formed by R115 and C106.

The ohms converter circuitry is protected by the circuit consisting of thermistor R107 and diodes CR100, CR101, VR102, and VR103. A voltage inadvertently applied to the V/ $\Omega$  connector when OHMS is selected will cause R107 to heat and effectively open.

Table 1-3 lists the relay logic and analog-to-digital converter sensitivity for the resistance measurement function.

### AC VOLTAGE CIRCUITRY

The ac voltage circuitry consists of attenuator R100, buffer amplifier U100, and true rms-to-dc converter U101. Fig. 1-3 is a simplified block diagram of the ac voltage circuitry. Table 1-4 lists the full-scale sensitivity at several points in the circuit. Table 1-5 lists the relay logic and analog-to-digital converter sensitivity for the different measurement ranges.

In the 200 mV and 2 V ranges, the ac voltage is applied to the input of unity-gain buffer amplifier U100. The ac voltage passes through S1B, K104, S2D, R106, K102SB, K101SB, S3A, S1D, R108, and R109 to pin3 of U100. In the 20 V, 200 V, and 500 V ranges the voltage also passes through 100X attenuator R100 before reaching U100.

The output of buffer U100 at pin 6 is applied to pin 2 of true rms-to-dc converter U101. In the 2 V, 200 V, and 500 V ranges relay K100SB is energized and

**Table 1-3  
OHMS RELAY LOGIC**

Range	K104	K101	K102	A/D Sensitivity
200 $\Omega$		*		200 mV
2 k $\Omega$		*		2 V
20 k $\Omega$			*	200 mV
200 k $\Omega$			*	2 V
2 m $\Omega$	*			200 mV
20 m $\Omega$	*			2 V

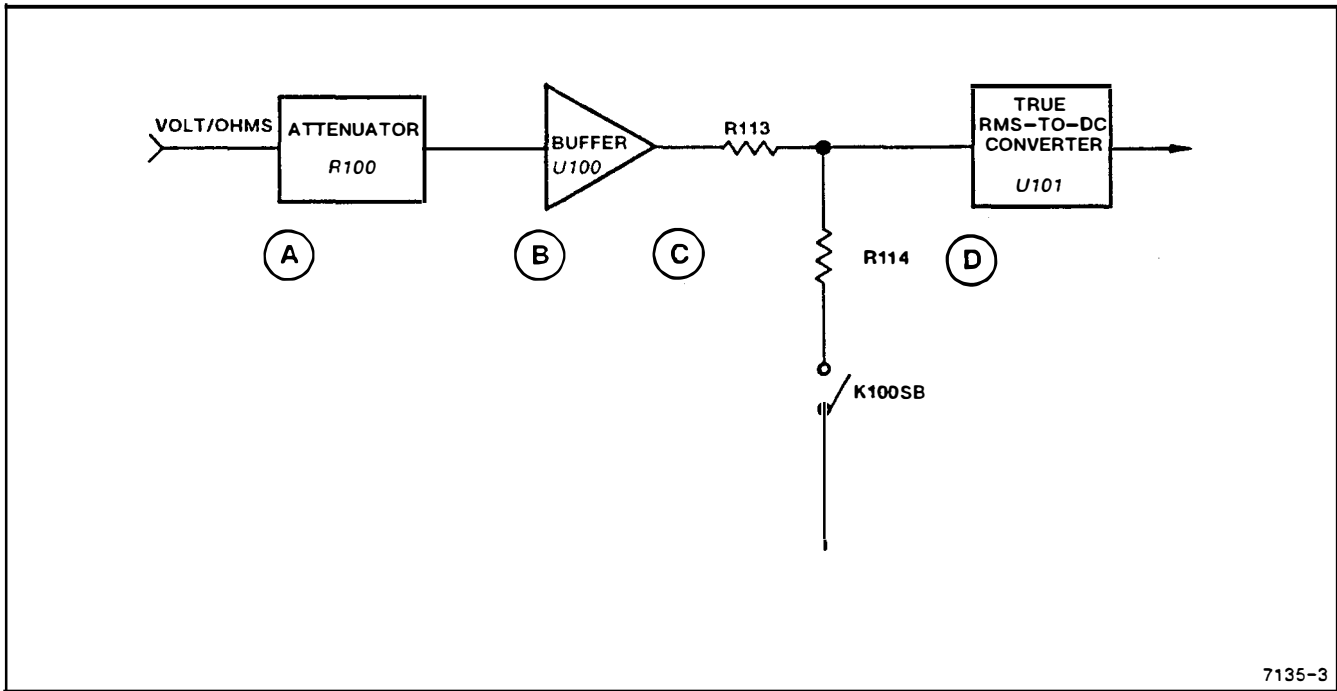


Fig. 1-3 Simplified ac voltage measurement circuitry

Table 1-4  
AC VOLTAGE CIRCUITRY FULL-SCALE SENSITIVITY

K100SB Status	A	B	C	D
Open	200 mV	200 mV	200 mV	200 mV
Closed	2 V	2 V	2 V	200 mV
Open	20 V	200 mV	200 mV	200 mV
Closed	200 V	2 V	2 V	200 mV
Closed	500 V	5 V	5 V	0.5 V

the 10X attenuator formed by R113 and R114 is switched into the circuit to provide further attenuation of the ac voltage.

True rms-to-dc converter U101 computes the root-mean-square level of the ac signal applied to its input and gives the equivalent dc output level from pin6. This dc output connects to the input of the analog-to-digital converter through S2C, S1A, and low-pass filter R115/C106.

### AC CURRENT CIRCUITRY

The ac current circuitry consists of current sensing resistors R101, R102, and R103, buffer amplifier U100, and true rms-to-dc converter U101. Fig. 1-4 is a simplified block diagram of the ac current circuitry. Table 1-6 lists the full-scale sensitivity at different points in the circuit.

The current sense resistors are switched in and out of the circuit by relays K100, K101, K102 and K103 as indicated in Table 1-7. The value of the current sense resistance in the circuit for each range is a

Table 1-5  
AC VOLTAGE RELAY LOGIC

Range	K104	K102	K100	A/D Sensitivity
200 mV	*			200 mV
2 V	*		*	200 mV
20 V		*		200 mV
200 V		*	*	200 mV
500 V		*	*	2 V

combination of the values of R101, R102, and R103 as indicated below:

200 $\mu$ A Range:	$R103 + R102 + R101$
2 mA Range:	$R102 + R101$
20 mA Range:	$R101.2$
200 mA Range:	$R101.6$
2000 mA Range:	$R101.5$

The voltage developed across the current sense resistors is applied to the input of unity-gain buffer amplifier U100.

The output of buffer U100 is applied to pin 2 of true rms-to-dc converter U101. U101, then, computes the root-mean-square of the ac signal applied to its input and gives the equivalent dc output level at pin 6. This dc output connects to the input of the analog-to-digital converter through S2C, S1A, and low-pass filter R115/C106.

## DIGITAL CIRCUITRY

Microcontroller U1 performs all the functions necessary to display the information from the measurement circuits. U1 also generates commands to correctly configure the DM 504A. The program for U1 is stored in EPROM U2.

U1 uses memory port0 as a multiplexed address/data bus and port2 as the address bus (A8-A12) to communicate with EPROM U2. The Address Latch Enable (ALE) pulse is used to demultiplex the lower address bus (A0-A7) in latch U12.

The Program Store Enable (PSEN) pulse is issued by U1 to begin fetching data from U2. Fig. 1-5 shows the beginning of the external program memory read cycle. The high order address (A8-A12) is at U1, port2, and the low order address (A0-A7) is at U1, port2 while ALE is high. When ALE goes low, the low order address byte is latched in U12. Thirteen (A0-A12) address inputs are available at U2.

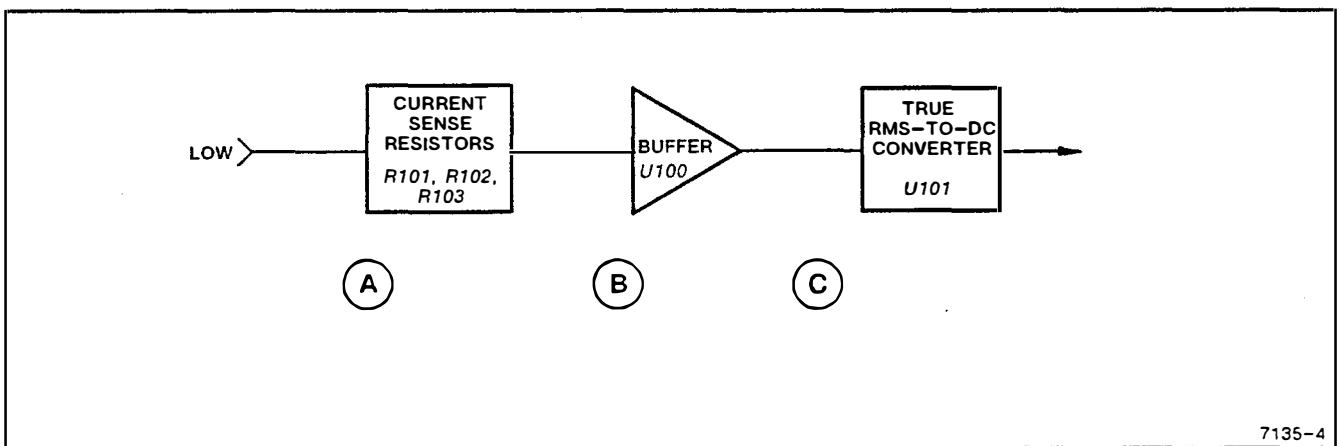


Fig. 1-4 Simplified AC current measurement circuitry

**Table 1-6  
AC CURRENT CIRCUITRY FULL-SCALE SENSITIVITY**

A	B	C
200 $\mu$ A	200 mV	200 mV
2 mA	200 mV	200 mV
20 mA	200 mV	200 mV
200 mA	200 mV	200 mV
2000 mA	200 mV	200 mV

**Table 1-7  
AC CURRENT RELAY LOGIC**

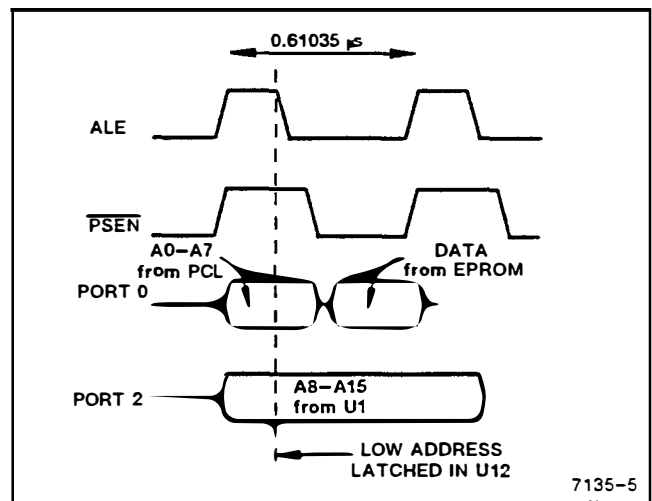
Range	K100	K101	K102	K103	A/D Sensitivity
200 $\mu$ A					200 mV
2 mA	*				200 mV
20 mA		*			200 mV
200 mA			*		200 mV
2000 mA				*	200 mV

When the PSEN pulse goes low, the output of U2 is enabled and the data in U2 is routed to U1, port0.

As shown in Fig. 1-6, latch U10 is updated with the low address byte during an external data memory read cycle. The leading edge of the external data memory stroke (RD) latches the low address byte in U10. Digital control signals 200MV, OFFSET, REL1, REL2, REL3, REL4, and REL5 are also latched in U11.

Binary counter U6 supplies 400 Hz, 800 Hz, and 204,800 Hz clock pulses to U1. The 400 Hz pulse is used to sequence the instrument's program. Most of program's actions are executed at 2.5 millisecond intervals (for example, refreshing the display). The 204,800 Hz clock pulses are used in the analog-to-digital conversion process. The 800 Hz pulse is used to drive the beeper.

Microcontroller U1 controls the analog-to-digital conversion process with the CONTRA and CONTRB signals. Every 10 milliseconds U1 reads the following information from shift register U14:



**Fig. 1-5 External program memory read cycle**

- The COMP output of U102.
- The position of the mA/Volts switch.
- The position of the DC/AC switch.
- The position of the  $\Omega$ /V/A switch.
- The position of the Cal/Norm jumper.
- The position of the UP switch.
- The position of the DOWN switch.

## DISPLAY CIRCUITRY

Five seven-segment display modules (U203-U207) and 12 LEDs (DS200-211) are used by the microcontroller to display the instrument's measurements. The display modules and LEDs are driven by strobe pulses D1-D6. Pulses D1-D5 are active for 2.5 ms and D6 is active for 5 ms.

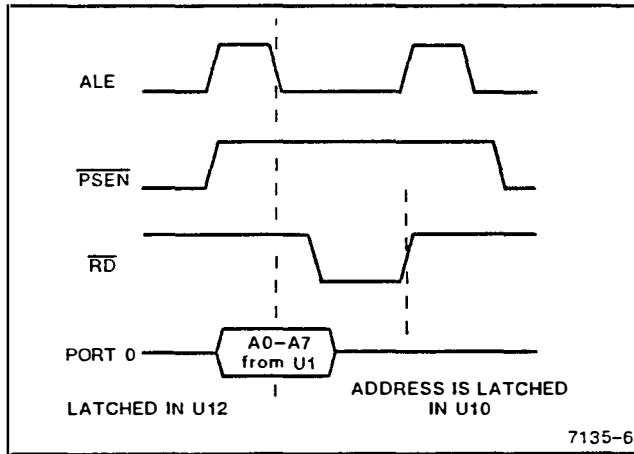


Fig. 1-6 External data memory read cycle.

The input for the display circuit is the serial input at P200-3 from the microcontroller. Shift registers U200 and U201 are cleared at the start of the strobe pulse. The display data is then clocked into these shift registers by clock pulses from the microcontroller. The strobe bits from shift register U201 are applied to transistor array U202 and the segment bits from U200 and U201 are applied to driver transistors Q200-Q209. The current supplied by the transistor array and the discrete transistors drive the LEDs and display modules.

## POWER SUPPLIES

The 25 V ac is supplied from the power module through rear interface pins 13A and 13B to the primary of T1. The ac output voltage at pin9 and pin12 of T1 is bridge rectified and applied to two three-terminal regulators. U105 for the +12 V and U106 for the -12 V. The ac output voltage at pin7 and pin8 of T1 is bridge rectified and applied to three-terminal regulator is +5 V. All the three-terminal regulators are internally current limited.



# CALIBRATION

## INTRODUCTION

This procedure checks and calibrates the electrical performance required as listed in the specification section of the *DM 504A Operator's Manual*. Perform the calibration procedure if the instrument fails to meet performance requirements.

## CALIBRATION INTERVAL

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

## SERVICES AVAILABLE

Textronix, 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.

## PERFORMANCE CALIBRATION PROCEDURE

The following test equipment, or equivalent, as listed in Table 2-1, is suggested to perform the performance/adjustment procedure.

Table 2-1  
TEST EQUIPMENT

Description	Performance Requirements	Applications	Example
AC-DC Current Source	Range, 0 to 2 A, sinewave from 20 Hz to 10 kHz; accuracy, +/- 0.06% Range, 0 to 2 A, DC accuracy +/-0.02%	AC-DC ammeter accuracy check	Valhalla Scientific Inc. 2500 AC-DC Current Calibrator
DC Voltage Source	Range, 0 to 1000 V; accuracy, +/- 0.01%	DC Voltmeter accuracy check	Fluke Model 343A or 341A DC Voltmeter Calibrator
AC Voltage Source	Range, 0 to 1000 V; accuracy +/- 0.05%, 20 Hz to 20 kHz. Adjustable +/-0.2 Hz at 50 Hz and 60 Hz	AC Voltmeter accuracy check	Fluke Model 5200A AC Calibrator and Fluke Model 5215A Power Amplifier
Resistance Standard	Range, 0 to 20 M $\Omega$ ; accuracy +/- 0.05%	Ohmmeter accuracy check	Electro Scientific Industries, Inc. Model DB62 Dekabox
Shorting Plug			Tektronix Part Number 134-0012-00
Temperature	Temp. bath: 0° C +/-0.1° C Temp. bath: 100° C +/-0.1° C	Temperature probe check and adjustment	RTE 4 Neslab ZX3 Tamson



**WARNING**

*Dangerous voltages may be encountered in the following steps. Exercise caution. Do not touch the output connectors of the voltage calibrator, the input terminals of the DM 504A, or the internal circuitry of the DM 504A.*

During calibration set the jumper on the main board of the instrument (see Fig. 2-1) to the Cal position.

Set the jumper in the Normal position after completion of the calibration procedure.

*Note*

*Pressing the DOWN and UP push buttons simultaneously initiates recalibration.*

Possible readout messages during calibration are shown in Table 2-2.

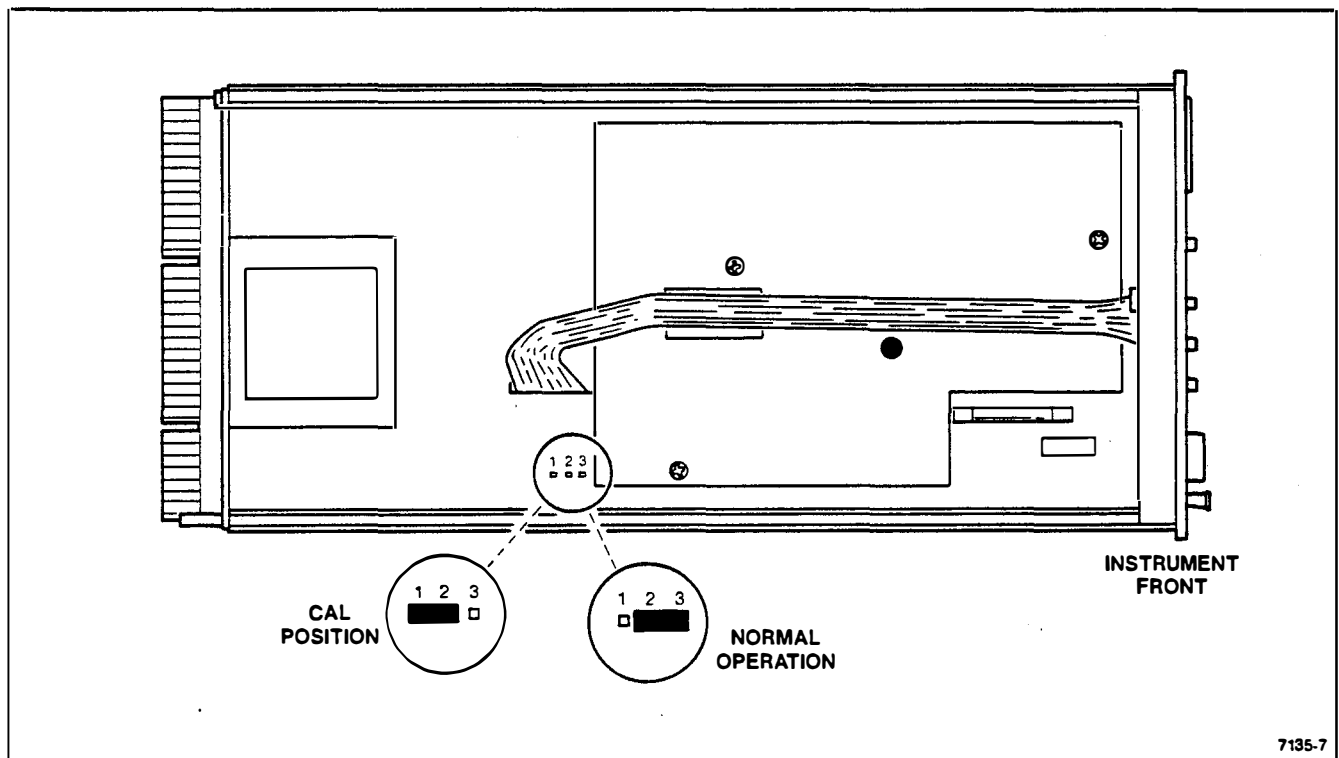


Fig. 2-1 Calibration jumper

During calibration you should keep the following information in mind:

- The AUTO LED readout blinks during calibration.
- Measurement ranges can only be selected manually.
- Calibrating a particular range does not effect other ranges.

**Table 2-2  
CALIBRATION MESSAGES**

Message	Problem and/or Suggested Action
UNSt	Unstable input during calibration; calibration has not been performed.
StoP	Calibration has stopped; the range or mode setting have been changed during calibration.
+0000	Positive offset calibration is busy; wait (only in the DC Voltage and DC Current ranges).
-0000	Negative offset calibration is busy; wait (only in the DC Voltage and DC Current ranges).
IFrSt	No gain calibration possible; calibrate the "LOW" range first (only in the AC Voltage and AC Current ranges).
500?	Apply 500 VAC to calibrate the 500 VAC range.
doNE	The DM 504A has executed the calibration.
????	Input reference is outside boundaries. Calibration is not possible.

**1. Adjust DC Voltage Accuracy**

- a. Set the DM 504A in the DC, 200 mV range.
- b. Short circuit the LOW and Volts/ $\Omega$  connectors.
- c. Press the DOWN and UP push buttons simultaneously. The DM 504A is now checking the positive offset voltage and the negative offset voltage.
- d. After completion of the check the readout shows: DONE.
- e. After a few seconds the readout returns to 0.00 mV. The offset voltage calibration is now complete (see Table 2-3).
- f. Repeat steps a through e for the remaining ranges.
- g. Remove the short circuit between the LOW and Volts/ $\Omega$  connectors.
- h. Set the DC voltage calibrator to +190 mV.
- i. Apply +190.000 mV from the DC voltage calibrator to the LOW and Volts/ $\Omega$  connectors of the DM 504A.
- j. Press the DOWN and UP push buttons simultaneously.
- k. After completion of the check the readout shows: DONE and the range is calibrated.
- l. Apply -190.000 mV from the DC voltage calibrator to the LOW and Volts/ $\Omega$  connectors.
- m. Press the DOWN and UP push buttons simultaneously. The DC, 200 mV range is now calibrated.
- n. Set the DM 504A in the 2 V, DC range and apply +1.90000 V from the DC voltage calibrator to the LOW and Volts/ $\Omega$  connectors.
- o. Press the DOWN and UP push buttons simultaneously.
- p. Set the DM 504A in the 20 V, DC range and apply +19.0000 V from the DC voltage calibrator to the LOW and Volts/ $\Omega$  connectors.
- q. Press the UP and DOWN push buttons simultaneously.

## Calibration—DM 504A

r. Set the DM 504A in the 200 V, DC range and apply +190.000 V from the DC voltage calibrator to the LOW and Volts/ $\Omega$  connectors.

s. Press the UP and DOWN push buttons simultaneously.

t. Set the DM 504A in the 1000 V, DC range and apply +1000.00 V DC from the DC voltage calibrator.

u. Press the UP and DOWN push buttons simultaneously.

v. Repeat steps n through u, but change the applied DC voltage to:

-1.90000 V in step h

-19.0000 V in step p

-190.000 V in step r

-1000.00 V in step t

The DC voltage ranges are now calibrated. See Table 2-4 for a summary of the calibration procedure.

**Table 2-3**  
**DC VOLTAGE OFFSET CALIBRATION FACTORS**

DM 504A Range	Press	Display Reading (+/-1 LS digit)
200 mV	DOWN + UP	0.00 mV
2 V	DOWN + UP	.0000 V
20 V	DOWN + UP	0.000 V
200 V	DOWN + UP	0.00 V
1000 V	DOWN + UP	0.0 V

**Table 2-4**  
**DC VOLTAGE GAIN CALIBRATION FACTOR**

DM 504A Range	DC Voltage Calibrator	Press	Display Reading
+200 mV	+190.000 mV	DOWN + UP	+190.00 mV
+2 V	+1.90000 V	DOWN + UP	+1.9000 V
+20 V	+19.0000V	DOWN + UP	+19.000 V
+200 V	+190.000 V	DOWN + UP	+190.00 V
+1000 V	+1000.00 V	DOWN + UP	+1000.0 V
-200 mV	-190.000 mV	DOWN + UP	-190.00 mV
-2 V	-1.90000 V	DOWN + UP	-1.9000 V
-20 V	-19.0000 V	DOWN + UP	-19.000 V
-200 V	-190.000 V	DOWN + UP	-190.00 V
-1000 V	-1000.00 V	DOWN + UP	-1000.0 V

**2. Adjust the Ohms Offset Calibration Factors**

- a. Set the DM 504A in the 200 beeper range.
- b. Short circuit the LOW and Volts/ $\Omega$  connectors with the shorting plug.
- c. Press the DOWN and UP push buttons simultaneously.
- d. After completion of the check the readout shows: DONE.
- e. The readout returns to 0.0  $\Omega$  after a few seconds. The offset in the beeper mode is now calibrated.
- f. Repeat steps a through e in the 200  $\Omega$ , 2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , 2 M $\Omega$  and 20 M $\Omega$  ranges (see Table 2-5 for readings).

**Table 2-5  
OHMS OFFSET CALIBRATION FACTOR**

DM 504A Range	Press	Display Reading (+/-1 LS digit)
Beeper	DOWN + UP	0.0 $\Omega$
200 $\Omega$	DOWN + UP	0.00 $\Omega$
2 k $\Omega$	DOWN + UP	.0000 k $\Omega$
20 k $\Omega$	DOWN + UP	0.000 k $\Omega$
200 k $\Omega$	DOWN + UP	0.00 k $\Omega$
2 M $\Omega$	DOWN + UP	.0000 M $\Omega$
20 M $\Omega$	DOWN + UP	0.000 M $\Omega$

**3. Adjust the Ohms Gain Calibration Factor**

- a. Set the DM 504A in the 200 beeper range.
- b. Connect the decade box to the LOW and Volts/ $\Omega$  connectors. Keep the leads as short as possible.
- c. Set the decade box to the value as listed in Table 2-6.
- d. Press the DOWN and UP push buttons simultaneously. The DM 504A now checks and adjusts the range selected (see Table 2-6).
- e. After completion of the adjustment the readout shows: DONE. The readout returns to the value as listed in Table 2-6 after a few seconds.
- f. Repeat steps c and d for the remaining ranges.
- g. Remove all connections to the DM 504A.

**Table 2-6  
OHMS GAIN CALIBRATION FACTORS**

DM 504A Range	Resistance Standard	Press	Display Reading
Beeper	100.00 $\Omega$	DOWN + UP	100.0 $\Omega$
200 $\Omega$	100.00 $\Omega$	DOWN + UP	100.00 $\Omega$
2 k $\Omega$	1.0000 k $\Omega$	DOWN + UP	1.0000 k $\Omega$
20 k $\Omega$	10.000 k $\Omega$	DOWN + UP	10.000 k $\Omega$
200 k $\Omega$	100.00 k $\Omega$	DOWN + UP	100.00 k $\Omega$
2 M $\Omega$	1.0000 M $\Omega$	DOWN + UP	1.0000 M $\Omega$
20 M $\Omega$	10.000 M $\Omega$	DOWN + UP	10.000 M $\Omega$

**4. Adjust DC Current Offset Accuracy**

- a. Set the DM 504A in the DC mode, 200  $\mu$ A range.
- b. Press the DOWN and UP push buttons simultaneously. The DM 504A checks the + offset and - offset, and the readout shows: DONE.

c. After a few seconds the readout returns to 0.00. The offset current calibration for the 200  $\mu$ A range is complete (see Table 2-7).

d. Repeat step b for the remaining ranges (see Table 2-7).

**Table 2-7  
DC OFFSET CURRENT CALIBRATION FACTORS**

DM 504A Range	Press	Display Reading (+/-1 LS digit)
200 $\mu$ A	DOWN + UP	0.00 $\mu$ A
2 mA	DOWN + UP	.0000 mA
20 mA	DOWN + UP	0.000 mA
200 mA	DOWN + UP	0.00 mA
2000 mA	DOWN + UP	0.0 mA

**5. Adjust DC Current Accuracy**

- a. Set the DM 504A in the DC mode, 200  $\mu$ A range.
- b. Connect the DC current source standard to the mA and LOW connectors through appropriate cables.
- c. Apply DC +190.000  $\mu$ A from the current source to the mA and LOW connectors.
- d. Press the DOWN and UP push buttons simultaneously.

e. After completion of the check the readout shows: DONE.

f. After a few seconds the readout returns to 190.00  $\mu$ A. The DC, +200  $\mu$ A range is now calibrated.

g. Repeat steps a through f with -190.000  $\mu$ A DC.

h. Repeat steps a through g for the remaining ranges. Use the input current listed in Table 2-8.

Table 2-8  
DC CURRENT GAIN FACTORS

DM 504A Range	Input Current	Press	Display Reading
+200 $\mu$ A	+190.000 $\mu$ A	DOWN + UP	+190.00 $\mu$ A
+2 mA	+1.90000 mA	DOWN + UP	+1.9000 mA
+20 mA	+19.0000 mA	DOWN + UP	+19.000 mA
+200 mA	+190.000 mA	DOWN + UP	+190.00 mA
+2000 mA	+1900.00 mA	DOWN + UP	+1900.0 mA
-200 $\mu$ A	-190.000 $\mu$ A	DOWN + UP	-190.00 $\mu$ A
-2 mA	-1.90000 mA	DOWN + UP	-1.9000 mA
-20 mA	-19.0000 mA	DOWN + UP	-19.000 mA
-200 mA	-190.000 mA	DOWN + UP	-190.00 mA
-2000 mA	-1900.00 mA	DOWN + UP	-1900.0 mA

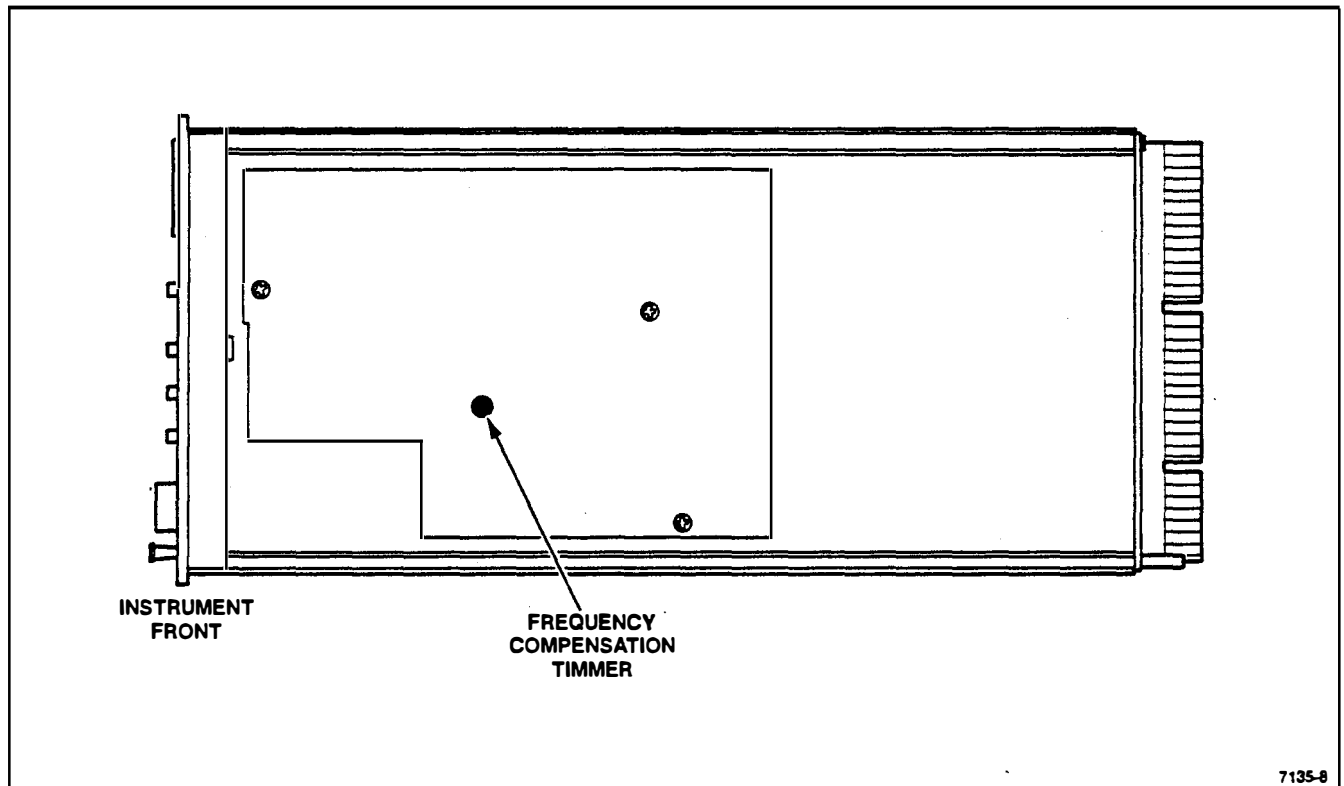


Fig. 2-2. Frequency compensation trimmer.

## Calibration—DM 504A

### 6. Adjust the AC Frequency Compensation

**Note**

*Before adjusting the frequency compensation, remove the right side cover of the DM504A. The location of the trimmer for frequency compensation is indicated in Fig. 2-2.*

- a. Set the DM 504A to the AC mode, 20 V range.
- b. Apply 18.000 V, AC, 300 Hz to the Volts/ $\Omega$  and LOW connectors.

- c. Note the display reading.
- d. Change the applied voltage to: 18.000 V, AC, 10 kHz.
- e. Adjust trimmer for the same readout reading as in the AC, 18.000 V, 300 Hz position.
- f. Repeat steps b through e if necessary. The DM 504A is now frequency compensated.

### 7. Adjust the AC Voltage Accuracy

- a. Set the DM 504A to the AC mode, 200 mV range.
- b. Set the AC voltage calibrator to AC, 10 mV, 300 Hz (5% of full scale).
- c. Apply 10.00 mV, AC, 300 Hz from the AC calibrator to the Volts/ $\Omega$  and LOW connectors (5% of full scale).
- d. Press the DOWN and UP push buttons simultaneously.
- e. After completion of the check the readout shows 190? indicating you should now apply 190 mV, AC.

- f. After a few seconds the readout reading returns to about 10 mV.
- g. Apply 190.00 mV, AC, 300 Hz from the AC calibrator to the DM 504A (95% of full scale).
- h. Press the DOWN and UP push buttons simultaneously .
- i. After completion of the check the readout shows: DONE, indicating the range has been calibrated now (offset as well as gain).
- j. Repeat steps a through i for the 2 V, 20 V and 500 V range, with the input voltages listed in Table 2-9.

**Table 2-9  
AC VOLTAGE GAIN FACTORS**

DM 504A Range	5% FS input	95% FS input	Press	Message	+/-1 LS digit Display
200 mV	10.00 mV		DOWN + UP	190?	10.0 mV (approx.)
200 mV		190.00 mV	DOWN + UP	DONE	190.00 mV
2V	0.1000 V		DOWN + UP	190?	0.1V (approx.)
2V		1.9000 V	DOWN + UP	DONE	1.9000 V
20 V	1.000 V		DOWN + UP	190?	1.0 V (approx.)
20 V		19.000 V	DOWN + UP	DONE	19.000 V
200 V	10.00 V		DOWN + UP	190?	10 V (approx.)
200 V		190.00 V	DOWN + UP	DONE	190.00 V

Table 2-9 (Cont.)  
AC VOLTAGE GAIN FACTORS

DM 504A Range	20% FS input	100% FS input	Press	Message	Display
500 V	100.0 V		DOWN + UP	500?	100 V (approx.)
500 V		500.00 V	DOWN + UP	DONE	500.0 V

*Note*

*Calibration of an AC range is only executed after steps a through j have been performed.*

f. After a few seconds the readout reading returns to approximately 10  $\mu$ A.

**8. Adjust AC Current Accuracy**

a. Set the DM 504A in the AC mode 200  $\mu$ A range.

b. Connect the AC current source to the mA and LOW connectors through appropriate cables.

c. Apply AC, 10.00  $\mu$ A from the current source (5% of full scale).

d. Press the DOWN and UP push buttons simultaneously.

e. After completion of the check the display reading is: 190?.

g. Apply 190.00  $\mu$ A, 300 Hz from the AC current source (95% of full scale).

h. Press the DOWN and UP push buttons simultaneously.

i. After completion of the check the readout shows: DONE, indicating the range has been calibrated (offset as well as gain).

j. Repeat steps a through h for the 2 mA, 20 mA, 200 mA, and 2000 mA ranges with the input currents listed in Table 2-10.

*Note*

*Calibration of an AC range is only executed after steps a through i have been performed.*



**Table 2-10  
AC CURRENT GAIN FACTORS**

DM 504A Range	5% FS input	95% FS input	Press	Message	Display
200 $\mu$ A	10.00 $\mu$ A		DOWN + UP	190?	10 $\mu$ A (approx.)
200 $\mu$ A		190.00 $\mu$ A	DOWN + UP	DONE	190.00 $\mu$ A
2 mA	100.0 $\mu$ A		DOWN + UP	190?	100 $\mu$ A (approx.)
2 mA		1.9000 mA	DOWN + UP	DONE	1.9000 mA
20 mA	1.000 mA		DOWN + UP	190?	1.0 mA (approx.)
20 mA		19.000 mA	DOWN + UP	DONE	19.000 mA
200 mA	10.00 mA		DOWN + UP	190?	10 mA (approx.)
200 mA		190.00 mA	DOWN + UP	DONE	190.00 mA
2000 mA	100.0 mA		DOWN + UP	190?	100 mA (approx.)
2000 mA		1900.0 mA	DOWN + UP	DONE	1900.0 mA

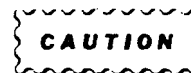
**9. Adjust the Temperature Accuracy**

- a. Set the DM 504A in the Temperature mode.
- b. Connect the temperature probe to the Volts/ $\Omega$  and LOW connectors.
- c. Put the tip of the temperature probe about 2.5 cm into a temperature bath of 0° C (+/-0.1° C).
- d. Watch the readout reading until there is no more change.
- e. Press the DOWN and UP push buttons simultaneously.
- f. After completion of the check the readout shows: DONE.
- g. Remove the temperature probe from the 0° C temperature bath and allow the probe to warm to +20° C.
- h. Repeat steps a through g with a 100° C temperature bath (+/-0.1° C).
- i. The temperature range is calibrated now.

Calibration of the DM 504A is complete. Set the jumper on the main board (see Fig. 2-1) back to the NORMAL position. The DM 504A is ready for use again.

# MAINTENANCE

This section provides general maintenance information.



## RECALIBRATION

To assure accurate measurements check the calibration of this instrument after each 1000 hours of operation or every six months if it is used infrequently.

Replacement of components may necessitate recalibration of the affected functions. Refer to the calibration section of this manual.

## CLEANING INSTRUCTIONS

This instrument should be cleaned as often as operating conditions require.

Accumulation of dirt on components may act as an insulating blanket and prevents efficient heat dissipation that can cause overheating and component breakdown.

Use a non-residue type of cleaner; preferable isopropyl alcohol or denatured ethyl alcohol. Before using any other type of cleaner consult your Tektronix Service Center or representative.

### Exterior

Loose dust accumulated on the front can be removed by 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. Do not use abrasive cleaners.

### Interior

To clean the interior of the instrument, first blow off any accumulated dust with dry low pressure air, then use a soft brush. If further cleaning is required, use a mild detergent and water solution.

*Variable capacitor C102 should not be cleaned, as its electrical performance will be degraded.*

## STATIC SENSITIVE COMPONENTS

This instrument contains electrical components that are susceptible to damage from static discharge.

Observe the following precautions to avoid damage:

1. Minimize handling of components.
2. Transport and store components or assemblies on conductive foam or on metal rails.
3. Discharge the static voltage from your body by wearing an approved wrist strap and pad connection while handling these components.
4. Do not allow anything on your workstation that is capable of generating a static charge.
5. Keep component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Use a soldering iron that is connected to earth ground.
8. Use only special anti-static suction or wick type desoldering tools.



# OPTIONS

## Standard Accessories

The following items are standard accessories to the DM504A:

*DM 504A Operators Manual* (070-6945-00)

Test Leads (196-3212-00)

## Options

The DM 504A can be ordered with the following option:

**Option 1**      DM 504A calibrated with a Tektronix P6602 Temperature Probe.

## Optional Accessories

Tektronix P6602 Temperature Probe

*DM 504A Service Manual* (070-7135-00)



# 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

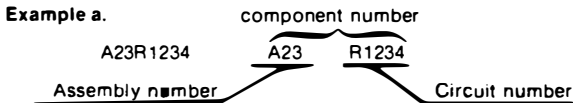
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

### ABBREVIATIONS

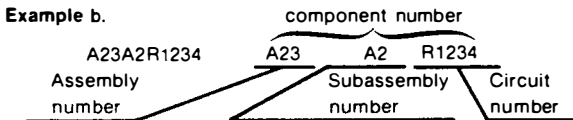
Abbreviations conform to American National Standard Y1.1

### 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 TO MANUFACTURER

MFR CODE	MFR. NAME	ADDRESS	ZIPCODE,CITY,STATE/COUNTRY
01423	ANALOG DEVICES NEDERLAND	BENELUXWEG 27	4904 SJ OOSTERHOUT, HOLLAND
02102	AURICMA	OODRAKKERSWEG 26	5642 MP EINDHOVEN, HOLLAND
03901	TEKTRONIX INC	P O BOX 500	97077 BEAVERTON, OREGON, USA
11102	BOURNS NEDERLAND	P O BOX 37	2270 AA OORBURG, HOLLAND
14808	BURNBY NEDERLAND	P O BOX 204	2740 AE WADDINKVEEN, HOLLAND
16806	DALE ELECTRONICS	P O BOX 1251	8039 PUCHHEIM/BHF, W. GERMANY
18401	DIODE NEDERLAND	MEIDOORNKADE 22	3992 AE NOUTEN, HOLLAND
18517	DJIE-ROEDERSTEIN	P O BOX 19	1180 AA AMSTELVEEN, HOLLAND
20406	DUPONT CONNECTOR SYSTEMS	P O BOX 2060	5202 CB DEN BOSCH, HOLLAND
21409	EBU ELEKTRONIK	PLANETENBAAN 2	3606 AK MAARSSENBROEK, HOLLAND
22105	ELINCOM	ODSTERKADE 33	9503 NP STADSKANAAL, HOLLAND
25623	GENERAL INSTRUMENT CLARE	OVERHAAMLAAH	3700 TONGEREN, BELGIUM
34101	RICHARD MIRSCHMAN ELECTRONICA	P O BOX 92	1380 AB WEESP, HOLLAND
38329	INTEL BENELUX	P O BOX 84130	3009 CC ROTTERDAM, HOLLAND
38408	ITT CANNON NEDERLAND	P O BOX 212	4900 AE OOSTERHOUT, HOLLAND
43902	KLEES ELECTRONICS	BOUWERY 70	1185 XX AMSTELVEEN, HOLLAND
54050	MALCHIUS	P O BOX 48	3100 AA SCHIEDAM, HOLLAND
58301	MOTOROLA	MAARSSENBROEKSEDIJK 37	3606 AG MAARSSEN, HOLLAND
59651	NATIONAL SEMICONDUCTOR BENELUX	P O BOX 90	1380 AB WEESP, HOLLAND
61401	NYKERK ELECTRONICA	DRENTESTRAAT 7	1083 HK A'DAM-BUITENVELDERT, HOLLAND
65606	PHILIPS NEDERLAND, ELOWCO	P O BOX 90050	5600 PB EINDHOVEN, HOLLAND
69803	RODELCO B.U. ELECTRONICS	P O BOX 6824	4802 HV BREDA, HOLLAND
82425	TECHNATION ELECTRONICS	P O BOX 9	4175 ZG HAARLEM, HOLLAND
82535	TEKTRONIX HOLLAND	P O BOX 526	8440 AM HEERENVEEN, HOLLAND
82902	TEXAS INSTRUMENTS	P O BOX 12995	1100 AZ AMSTERDAM, HOLLAND
96704	WITRONIC TER APEL	P O BOX 35	9560 AA TER APEL, HOLLAND

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE
A10	671-0647-00			BOARD ASSY MAIN DM504A	82535
A11	671-0648-00			BOARD ASSY DISPLAY DM504A	82535
A10----	214-2518-01			HEATSINK Xstr T0220/202 ALU	03901
A10----	136-0757-00			SKT, PL-IN ELEC, MICROCKT 40 DIP	14808
A10----	136-0755-00			SKT, PL-IN ELEC, MICROCKT 28 DIP	14808
A10----	344-0326-00			CLIP ELECTRICAL FUSE F100	34101
A10----	276-0635-00			CORE, EM TOROID, FERRITE	03901
A10BZ1	119-3196-00			BEEPER PIEZO PKM22EPP 4001	61401
A10C 2	281-0775-00			CAP FXD CER DI .1UF 20X 50V TUBULAR	61401
A10C 3	281-0775-00			CAP FXD CER DI .1UF 20X 50V TUBULAR	61401
A10C 4	281-0956-00			CAP FXD CER DI 33pf 2X 100V	65601
A10C 5	281-0956-00			CAP FXD CER DI 33pf 2X 100V	65601
A10C 6	290-0778-00			CAP FXD ELCTLT 1uF 20X 50V MPLZO	18401
A10C 7	281-0775-00			CAP FXD CER DI .1UF 20X 50V TUBULAR	61401
A10C 1	281-0775-00			CAP FXD CER DI .1UF 20X 50V TUBULAR	61401
A10C100	283-0793-00			CAP FXD MICA DI 3035pf 1X 500V	03901
A10C101	283-0199-00			CAP FXD CER DI 25pf 10X 4000V	03901
A10C102	281-0105-00			CAP VAR CER DI 0.8-8.5pf 750V	43902
A10C103	290-0920-00			CAP FXD ELECT 33uF +50-20X 35WVDC	18401
A10C104	290-0920-00			CAP FXD ELECT 33uF +50-20X 35WVDC	18401
A10C105	285-1431-00			CAP FXD PLASTIC 1uF 10X 160V	18517
A10C106	285-1436-00			CAP FXD MILZO .1uF 160V 10X	18517
A10C107	285-1431-00			CAP FXD PLASTIC 1uF 10X 160V	18517
A10C108	281-0773-00			CAP FXD CER DI 0.01uF 10X 100V	61401
A10C109	281-0773-00			CAP FXD CER DI 0.01uF 10X 100V	61401
A10C110	285-1432-00			CAP FXD PLASTIC .33uF 10X 160V	18517
A10C111	281-0773-00			CAP FXD CER DI 0.01uF 10X 100V	61401
A10C112	290-0804-00			CAP FXD ELCTLT 10uF +50-20X 25V	18401
A10C113	290-0804-00			CAP FXD ELCTLT 10uF +50-20X 25V	18401
A10C114	290-0804-00			CAP FXD ELCTLT 10uF +50-20X 25V	18401
A10C115	290-0845-00			CAP FXD ELCTLT 330uF +50-10X 25V	18401
A10C116	290-0845-00			CAP FXD ELCTLT 330uF +50-10X 25V	18401
A10C117	290-1204-00			CAP FXD ELCTLT 4400uF 16V	18517
A10C118	281-0826-00			CAP FXD CER DI 2200pF 10X 100V TUBULAR	61401
A10C119	281-0826-00			CAP FXD CER DI 2200pF 10X 100V TUBULAR	61401
A10C120	281-0826-00			CAP FXD CER DI 2200pF 10X 100V TUBULAR	61401



Replaceable Electrical Parts - DM 504A

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE
A10C121	281-0826-00			CAP FXD CER DI 2200pF 10% 100V TUBULAR	61401
A10CR 1	152-0141-02			SEMICOND DUC DI SW SI 30V 150mA 30U	65601
A10CR 2	152-0141-02			SEMICOND DUC DI SW SI 30V 150mA 30U	65601
A10CR100	152-0323-00			SEMICOND DUC DI SW SI 35V 0.1A 00-?	03901
A10CR101	152-0323-00			SEMICOND DUC DI SW SI 35V 0.1A 00-?	03901
A10CR102	152-0488-00			SEMICOND DUC DI BRIDGE SI 200V 1.5A	69803
A10CR104	152-0585-00			SEMICOND DUC DI RECT SI 200V 1A	69803
A10CR105	152-0585-00			SEMICOND DUC DI RECT SI 200V 1A	69803
A10F100	159-0021-00			FUSE CARTRIDGE 3AG 250V 2A FAST	34101
A10JP1	131-0993-00			BUS CONNECTOR SHUNT ASSEMBLY BLACK	20406
A10K100	148-0213-00			RELAY ARM 2FORMC 3U 5 OHMS	25623
A10K101	148-0213-00			RELAY ARM 2FORMC 3U 5 OHMS	25623
A10K102	148-0213-00			RELAY ARM 2FORMC 3U 5 OHMS	25623
A10K103	148-0213-00			RELAY ARM 2FORMC 3U 5 OHMS	25623
A10K104	148-0214-00			RELAY ARM FORM A 5U 140 OHMS	25623
A10R 1	315-0472-00			RES FXD FILM 4.7Kohm 5% .25W	65604
A10R 2	315-0472-00			RES FXD FILM 4.7Kohm 5% .25W	65604
A10R 3	315-0472-00			RES FXD FILM 4.7Kohm 5% .25W	65604
A10R 4	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 5	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 6	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 7	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 8	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 9	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 10	315-0103-00			RES FXD FILM 10Kohm 5% .25W	65604
A10R 11	315-0472-00			RES FXD FILM 4.7Kohm 5% .25W	65604
A10R100	307-1483-00			RES NJK FXD FI 9.9Kohm 0.1% 0.2U	82425
A10R101	307-0400-00			RES FILM FXD 10ohm 0.1%	03901
A10R102	321-0895-07			RES FXD FILM 90ohm 0.1% .125W	65606
A10R103	321-0754-07			RES FXD FILM 90ohm 0.1% .125W	65606
A10R104	321-0753-06			RES FXD FILM 9Kohm .25% .125W	65606
A10R105	307-0643-00			RES FXD FILM 200Kohm 1% 3U	03901
A10R106	307-0645-00			RES THERM 5Kohm 40%	03901
A10R107	307-0662-00			RES THERM 1Kohm 40%	03901
A10R108	321-0193-07			RES FXD FILM 1Kohm .1% .125W	65606
A10R109	315-0303-00			RES FXD FILM 30Kohm 5% .25W	65604
A10R110	321-0289-07			RES FXD FILM 10Kohm .1% .125W	65606
A10R111	321-0222-07			RES FXD FILM 2Kohm .1% .125W	65606
A10R112	315-0123-00			RES FXD FILM 12Kohm 5% .25W	65604

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE
A10R113	321-0289-07			RES FXD FILM 10Kohm .1% .125J	65606
A10R114	321-1718-07			RES FXD 1.111Kohm .1% .125J	65606
A10R115	315-0104-00			RES FXD FILM 100Kohm 5% .25J	65604
A10R116	321-0222-07			RES FXD FILM 2Kohm .1% .125J	65606
A10R117	321-0292-07			RES FXD FILM 10.7Kohm .1% .125J	65606
A10R118	321-0179-00			RES FXD FILM 715Kohm 1% .125J	65605
A10R119	321-0385-07			RES FXD FILM 100Kohm .1% .125J	65606
A10R120	321-0924-07			RES FXD FILM 40Kohm .1% .125J	65606
A10R121	307-0659-00			RES FXD FILM 2.2Kohm 5% .25J	03901
A10R122	321-0373-00			RES FXD FILM 75Kohm 1% .125J	65605
A10R123	321-0049-00			RES FXD FILM 31.6Kohm 1% .125J	65605
A10R124	321-0320-00			RES FXD FILM 21Kohm 1% .125J	65605
A10R127	307-0126-00			RES NTC THERMAL 100Kohm 10%	16806
A10R128	321-0924-07			RES FXD FILM 40Kohm .1% .125J	65606
A10R129	321-0320-00			RES FXD FILM 21Kohm 1% .125J	65605
A10R130	315-0221-00			RES FXD FILM 220Kohm 5% .25J	65604
A10R131	315-0221-00			RES FXD FILM 220Kohm 5% .25J	65604
A10R132	301-0182-00			RES FXD FILM 1.8Kohm 5% .5J	65603
A10R133	321-0210-00			RES FXD FILM 1.50Kohm 1% .125J	65605
A10R134	321-0174-00			RES FXD FILM 634Kohm 1% .125J	65605
A10R135	323-0385-00			RES FXD FILM 100Kohm 1% .5J	65605
A10R136	315-0331-00			RES FXD FILM 330Kohm 5% .25J	65605
A10S 1	260-2424-00			SWITCHSET P-P .6P.4P.2P FUNCTION	38408
A10T 1	120-1797-00			TRANSFORMER W2539 PRI 25U	96704
A10U 1	156-3269-00			MICROCKT DIGITAL 80C31B OIP40.6 BBIT 12MHz	65601
A10U 2	160-5426-00			MICROCKT DIGITAL 27C64 EPROM	82535
A10U 3	156-3447-00			MICROCKT DIGITAL 9346 NMOS 64X16	59651
A10U 6	156-2601-00			MICROCKT DIGITAL 74HC4040 DP16 HCMOS	65601
A10U 7	156-0513-00			MICROCKT DIGITAL DP16 CMOS	58301
A10U 10	156-1998-00			MICROCKT DIGITAL 74ALS273 DP20.3 ALSTTL	82902
A10U 11	156-1245-00			MICROCKT LINEAR 7 XSTR MPN SI HIGH CUR	58301
A10U 12	156-1065-00			MICROCKT DIGITAL 74LS373 DP20	82902
A10U 14	156-0789-02			MICROCKT DIGITAL 74LS165 DP16.3 LSTTL	82902
A10U100	156-1134-00			MICROCKT LINEAR CA3140E DPB OPER AMPLIF	03901
A10U101	156-3506-00			MICROCKT DIGITAL AD737 DPB RMS CONN	01423
A10U102	156-3607-00			MICROCKT DIGITAL 65536X4 DIP24 DRAM	82902
A10U103	156-0514-02			MICROCKT DIGITAL CD4052 DP16 CMOS	58301
A10U105	156-0285-00			MICROCKT LINEAR 7812 T0220 UREG	21409
A10U106	156-0872-00			MICROCKT LINEAR MC7912C T0220 UREG	58301
A10U107	156-0277-00			MICROCKT LINEAR 7805 T0220 UREG	58301

Replaceable Electrical Parts - DM 504A

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE
A10UR100	152-1054-00			BANDGAP REF 8069 50PPM	02102
A10UR101	152-0727-00			SEMICONO 1N827 007 6.3V ZEN SI 2X .4W	58301
A10UR102	152-0243-00			SEMICONO 1N965B 007 15V ZEN SI .4W	21409
A10UR103	152-0243-00			SEMICONO 1N965B 007 15V ZEN SI .4W	21409
A10UR104	152-0226-00			SEMICONO 1N751A 007 5.1V ZEN SI .4W	65601
A10X1	158-0343-00			CRISTAL 9.8304 MHZ	54050
A11---	174-1248-00			CABLE ASSY DMS04A	82535
A110S200	150-1208-00			LED ORANGE SQ 5MM	22105
A110S201	150-1208-00			LED ORANGE SQ 5MM	22105
A110S202	150-1208-00			LED ORANGE SQ 5MM	22105
A110S203	150-1208-00			LED ORANGE SQ 5MM	22105
A110S204	150-1208-00			LED ORANGE SQ 5MM	22105
A110S205	150-1208-00			LED ORANGE SQ 5MM	22105
A110S206	150-1208-00			LED ORANGE SQ 5MM	22105
A110S207	150-1208-00			LED ORANGE SQ 5MM	22105
A110S208	150-1208-00			LED ORANGE SQ 5MM	22105
A110S209	150-1208-00			LED ORANGE SQ 5MM	22105
A110S210	150-1208-00			LED ORANGE SQ 5MM	22105
A110S211	150-1208-00			LED ORANGE SQ 5MM	22105
A11Q200	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q201	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q202	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q203	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q204	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q205	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q206	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q207	151-0190-00			NPN SI TO-92 2N3904	58301
A11Q208	151-0190-00			NPN SI TO-92 2N3904	58301
A11R200	307-0545-00			RES NJK 75Kohm 5% F1-9 9XR	11102
A11R202	315-0200-00			RES FXD 20Kohm 5% .25W	65604
A11R203	307-0502-00			RES FXD NJK 1.8Kohm 20% .125W	11102
A11S200	260-2428-00			SWITCH MOMENTARY 225-05	38408
A11S201	260-2428-00			SWITCH MOMENTARY 225-05	38408
A11U200	156-0651-02			MICROCKT DIGITAL 74LS164 8BIT	82902
A11U201	156-0651-02			MICROCKT DIGITAL 74LS164 8BIT	82902
A11U202	156-1245-00			MICROCKT LINEAR MC1413PDS DP16 NPN	58301
A11U203	150-1213-00			RED DISPLAY +/- LTS-368HR	69803

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE
A11U204	150-1214-00			DISPLAY 7SEGM. LTS-367HR	69803
A11U205	150-1214-00			DISPLAY 7SEGM. LTS-367HR	69803
A11U206	150-1214-00			DISPLAY 7SEGM. LTS-367HR	69803
A11U207	150-1214-00			DISPLAY 7SEGM. LTS-367HR	69803



# 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:

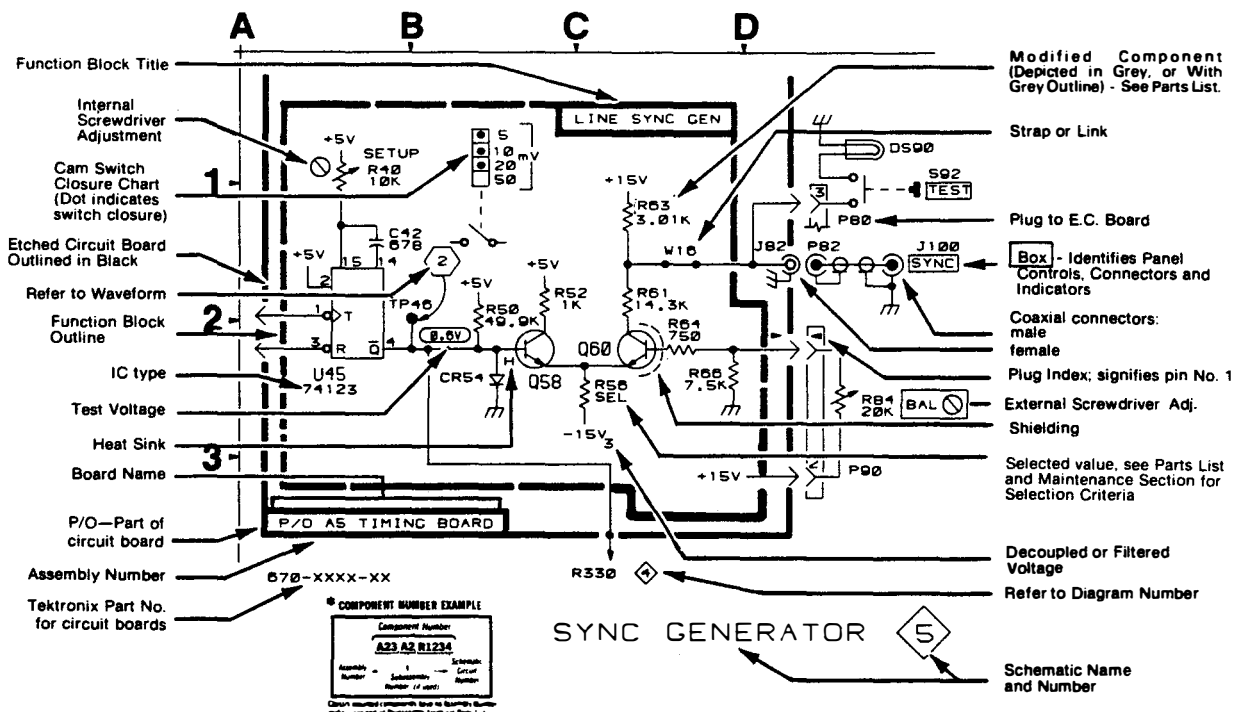
- Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads ( $\mu$ F).
- Resistors = Ohms ( $\Omega$ ).

———— The information and special symbols below may appear in this manual. ————

## 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 locator 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).

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.





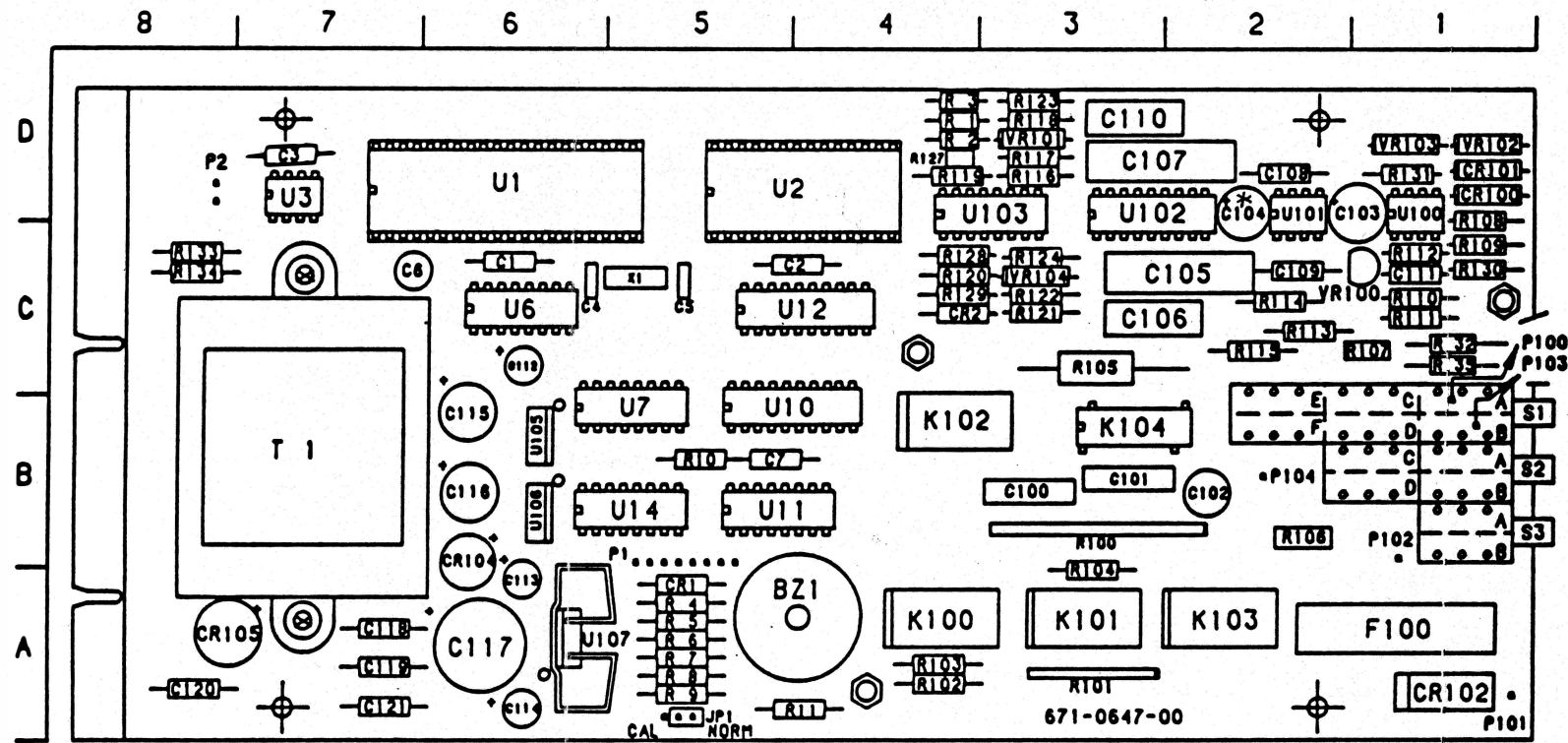
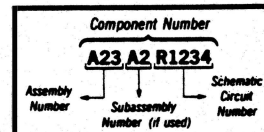


Table 6-1

DM504A DIGITAL CIRCUIT ① — MAIN BOARD, ASSEMBLY A10

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
BZ1	P11	A4	R1	D8	D4
C1	C10	C6	R2	D8	D4
C2	C10	C5	R3	D8	D4
C3	D10	D7	R4	E8	A5
C4	H6	C6	R5	E8	A5
C5	H5	C5	R6	E8	A5
C6	I6	C7	R7	D8	A5
C7	L8	B5	R8	D8	A5
C112	I2	C6	R9	D8	A5
C113	J2	A6	R10	L8	B5
C114	I4	A6	R11	Q11	A4
C115	H2	B6	R133	D2	C8
C116	I3	B6	R134	C2	C8
C117	H2	A6	T1	E2	B7
C118	F3	A7	U1	J5	D6
C119	G3	A7	U2	N6	D5
C120	F4	A8	U3	H9	D7
C121	G4	A7	U6	H10	C6
CR1	E7	A5	U7	F9	B5
CR104	G2	B6	U10	N8	B5
CR105	G4	A8	U11	P9	B5
JP1	C5	A5	U12	L10	C5
P1	B6	B5	U14	F5	B5
P105	B4	D8	U106	I1	B6
P106	B4	D8	U108	J2	B6
P2	R4	B2	U107	I3	A6
P500	B1	D8	X1	I6	C5

COMPONENT NUMBER EXAMPLE



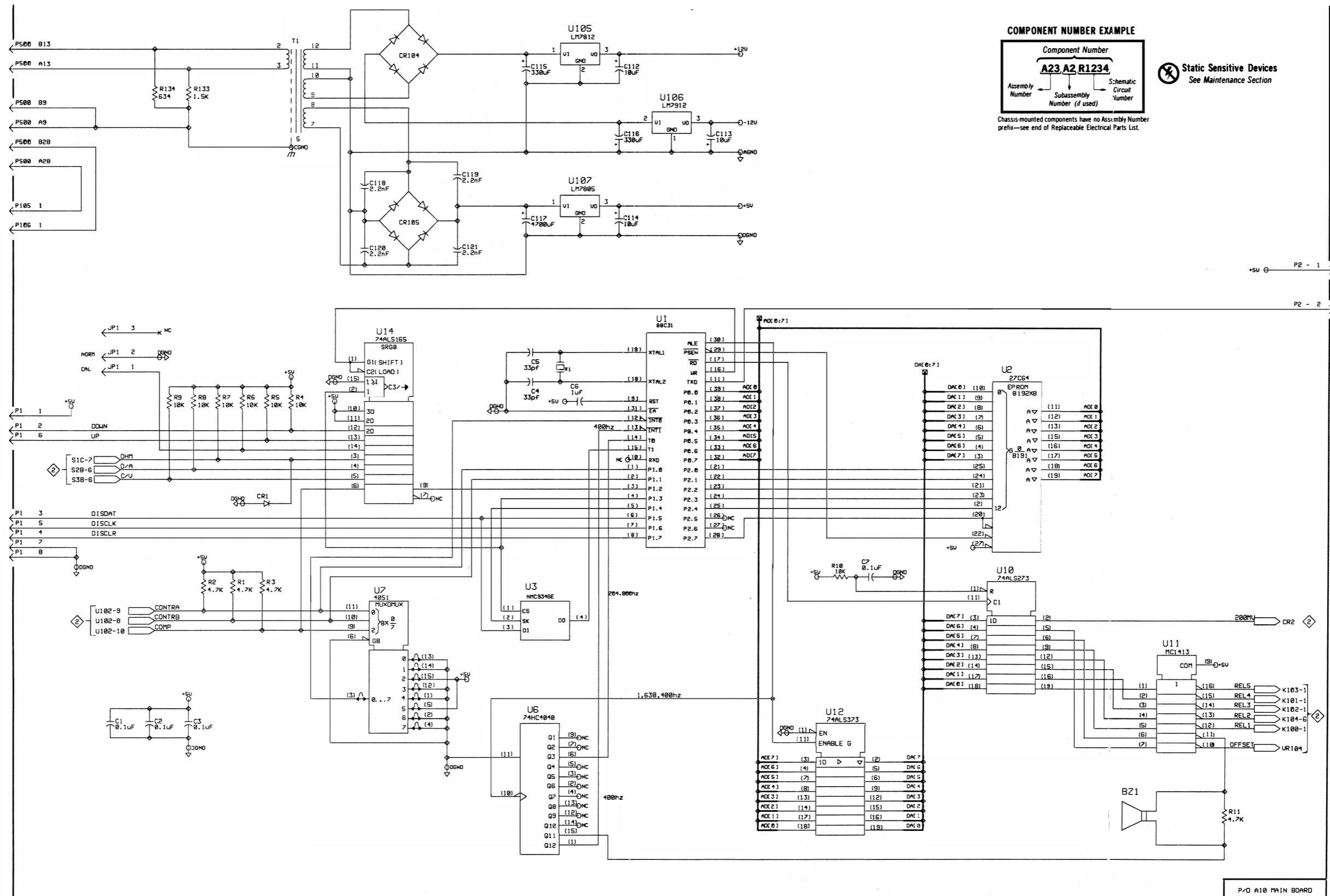
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

⊗ Static Sensitive Devices  
See Maintenance Section

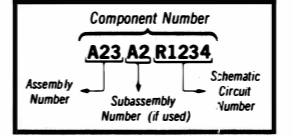


A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R

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COMPONENT NUMBER EXAMPLE



Static Sensitive Devices  
See Maintenance Section

+5V G P2 - 1  
P2 - 2

P/O A10 MAIN BOARD

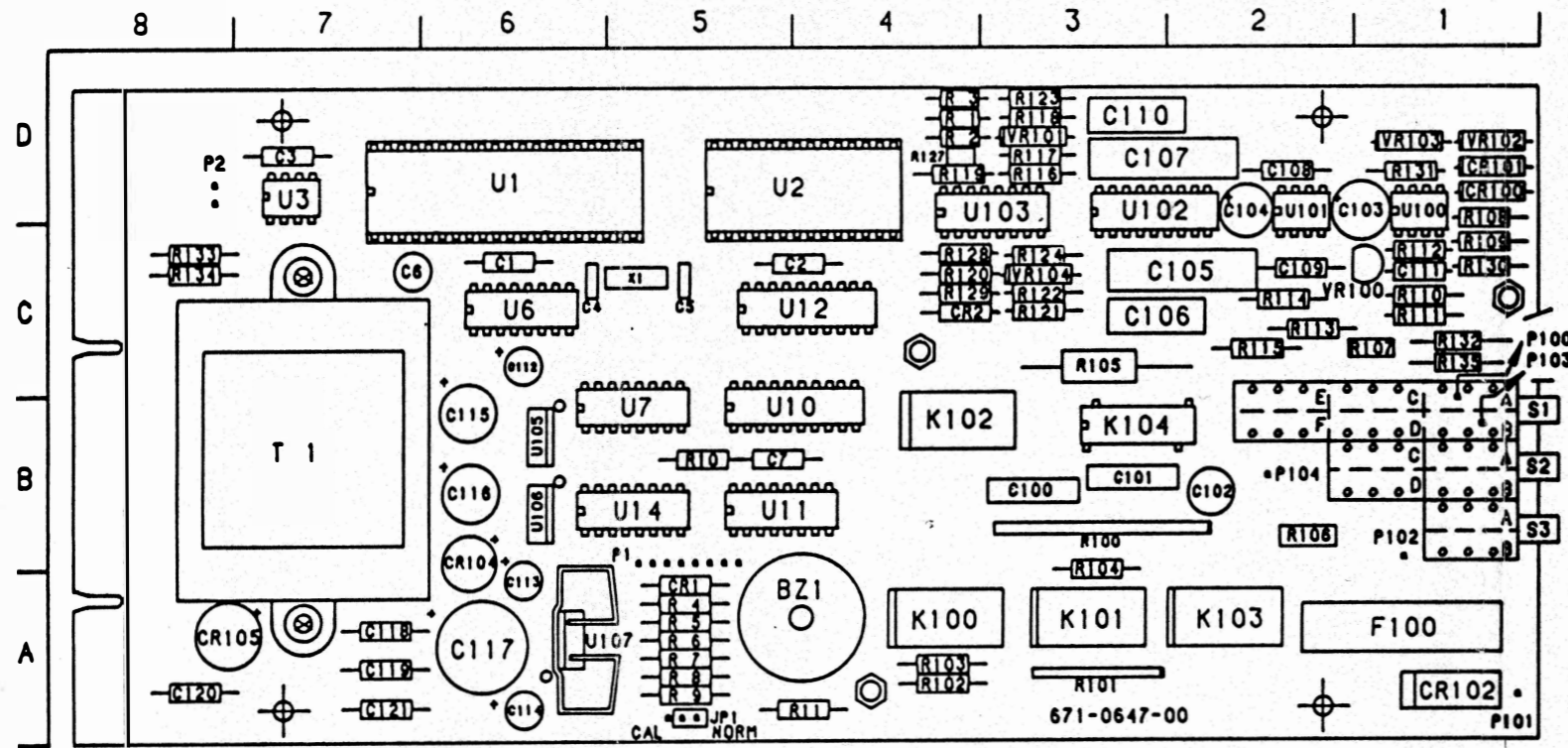
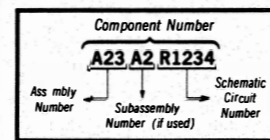


Table 6-2

ANALOG CIRCUIT 2 — MAIN BOARD, ASSEMBLY A10

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C100	I4	B3	R109	N4	C1
C101	H4	B3	R110	P5	C1
C102	H4	B2	R111	N5	C1
C103	P7	D1	R112	M5	C1
C104	O7	D2	R113	N7	C2
C105	D5	C2	R114	N7	C2
C106	E4	C3	R115	E3	C2
C107	D5	D3	R116	C5	D3
C108	Q7	D2	R117	C4	D3
C109	O7	C2	R118	C4	D3
C110	G6	D3	R119	EB	D4
C111	P5	C1	R120	EB	C4
CR2	D7	C4	R121	D4	C3
CR100	P3	D1	R122	D4	C3
CR101	P2	D1	R123	G7	D3
CR102	M10	A1	R124	D3	C3
			R127	G7	D4
F100	N9	A1	R128	E8	C4
			R129	D7	C4
K100	D9	A4	R130	P3	C1
K100SA	I8	A4	R131	P2	D1
K100SB	N8	A4	R132	M2	C1
K101	D10	A3	R135	G3	C1
K101SA	I8	A3	R136	G2	
K101SB	K4	A3	S1A	F3	B1
K102	D10	B4	S1B	G2	B1
K102SA	J9	B4	S1C	M5	B1
K102SB	J4	B4	S1D	M4	B1
K103	J9	A2	S1E	N6	B1
K104	I5	B3	S1F	L4	B1
P100	B2	B1	S2B	M9	B1
P101	R10	A1	S2C	M3	B1
P102	R9	B1	S2D	K5	B1
P103	B2	B1	S3A	L4	B1
P104	B2	B2	S3B	M8	B1
R100	H6	B3	U100	O4	D1
R101	H9	A3	U101	O7	D2
R102	H8	A4	U102	F5	D3
R103	H8	A4	U103	F7	D3
R104	I4	A3	VR100	N5	C1
R105	J6	C3	VR101	B4	D3
R106	J5	B2	VR102	Q3	D1
R107	L2	C1	VR103	Q2	D1
R108	N4	D1	VR104	D4	C3

COMPONENT NUMBER EXAMPLE



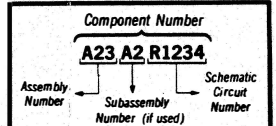
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices See Maintenance Section

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R

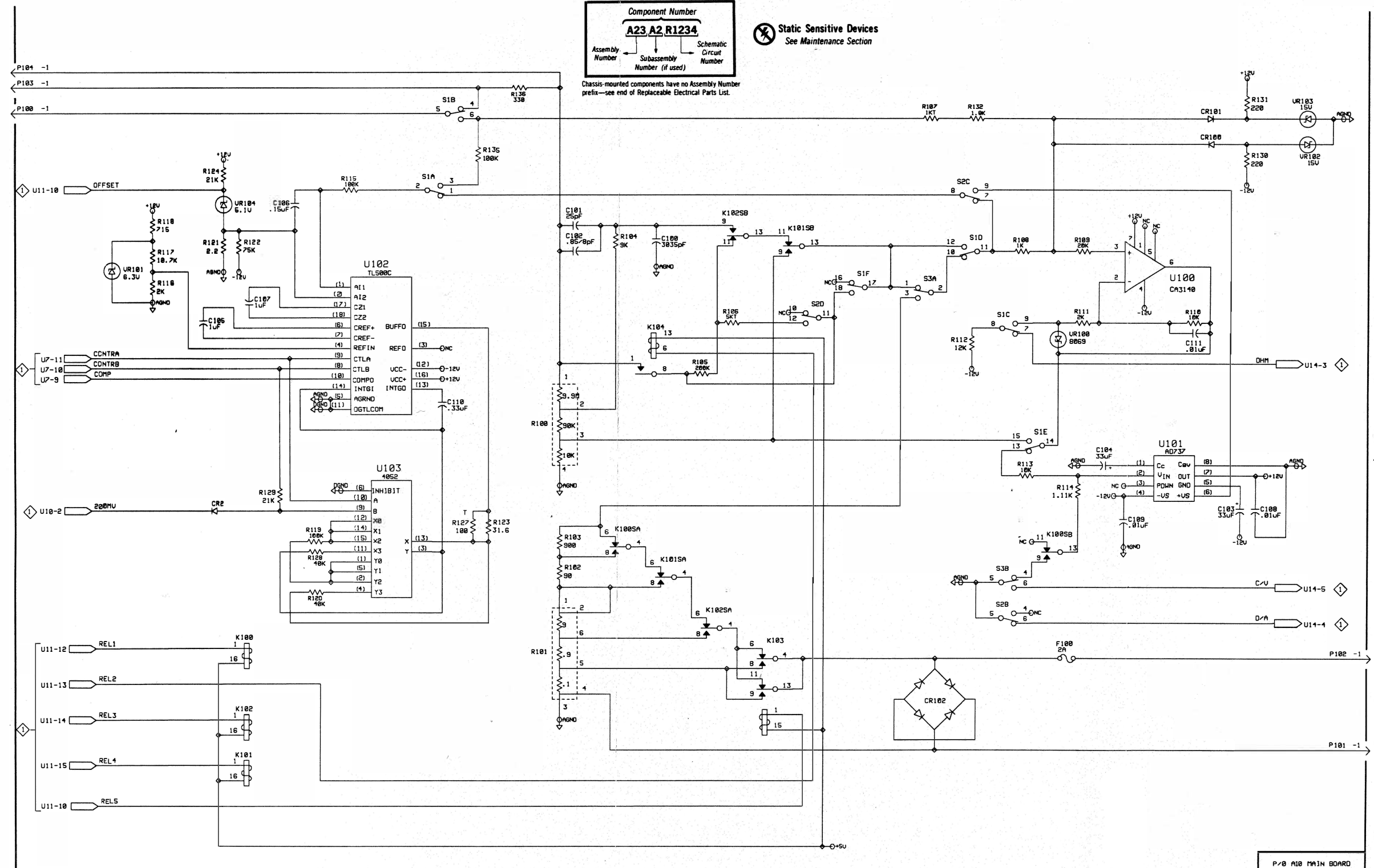
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COMPONENT NUMBER EXAMPLE



Static Sensitive Devices  
See Maintenance Section

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



P/B A10 MAIN BOARD

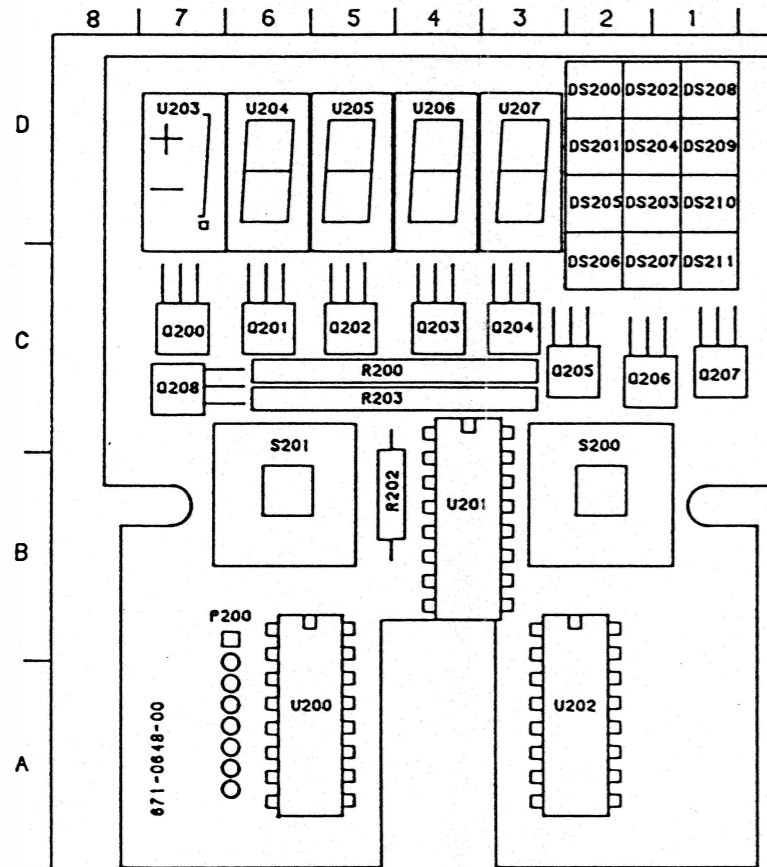
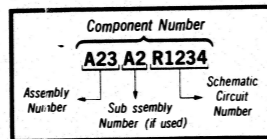


Table 6-3  
DM504A DISPLAY  — DISPLAY BOARD, ASSEMBLY A11

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
DS200	O11	D2	Q205	G9	C2
DS201	O11	D2	Q206	G8	C1
DS202	O10	D1	Q207	F8	C1
DS203	O10	D1	Q208	I2	C7
DS204	O9	D1			
DS205	O9	D2	R200	B11	C5
DS206	O8	C2	R202	I2	B5
DS207	O8	C1	R203	E3	C5
DS208	J1	D1			
DS209	J2	D1	S200	C5	B2
DS210	J2	D1	S201	C5	B6
DS211	J3	C1			
P200	B2	A6	U200	D3	A6
Q200	I11	C7	U201	H3	B4
Q201	I11	C6	U202	J3	A2
Q202	H10	C5	U203	J6	D7
Q203	H10	C4	U204	N1	D6
Q204	H9	C3	U205	N3	D5
			U206	N4	D4
			U207	N6	D3

COMPONENT NUMBER EXAMPLE



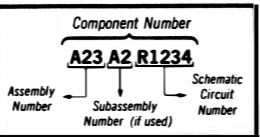
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

 Static Sensitive Devices  
See Maintenance Section

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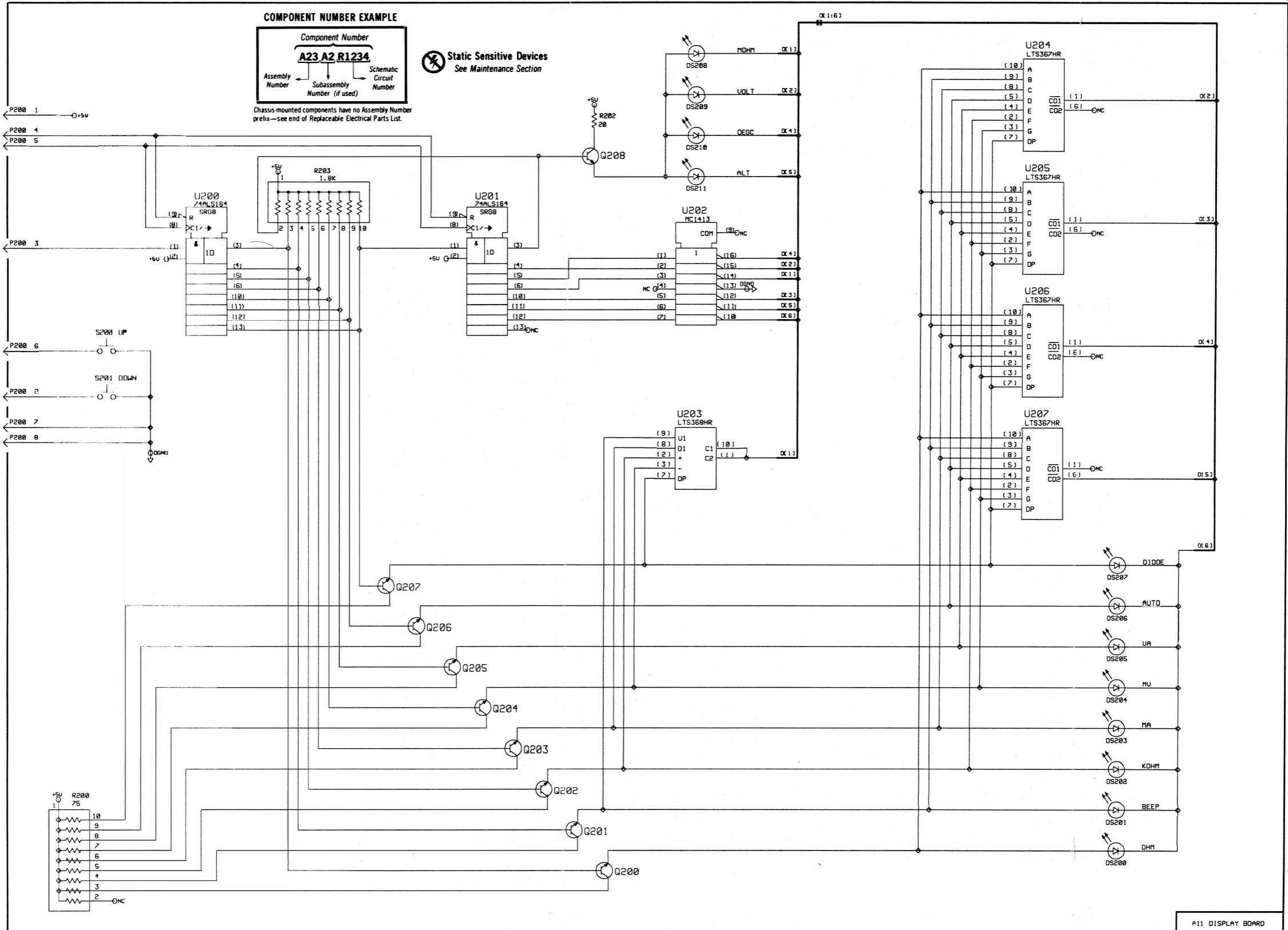
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COMPONENT NUMBER EXAMPLE



⚡ Static Sensitive Devices  
See Maintenance Section

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



# REPLACEABLE MECHANICAL 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.

## ITEM NAME

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.

## FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

## INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5                      *Name & Description*

*Assembly and/or Component*

*Attaching parts for Assembly and/or Component*

**END ATTACHING PARTS**

*Detail Part of Assembly and/or Component*

*Attaching parts for Detail Part*

**END ATTACHING PARTS**

*Parts of Detail Part*

*Attaching parts for Parts of Detail Part*

**END ATTACHING PARTS**

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

**Attaching parts must be purchased separately, unless otherwise specified.**

## ABBREVIATIONS

Abbreviations conform to American National Standards Institute Y1.1



CROSS INDEX-MFR.CODE TO MANUFACTURER

---

MFR CODE	MFR. NAME	ADDRESS	ZIPCODE,CITY,STATE/COUNTRY
03901	TEKTRONIX INC	P O BOX 500	97077 BEAVERTON, OREGON, USA
34101	RICHARD HIRSCHMAN ELECTRONICA	P O BOX 92	1380 AB WEESP, HOLLAND
58701	MULDER HARDENBERG	P O BOX 3059	2001 DB HAARLEM, HOLLAND
79601	STAUFFER SUPPLY INC	810 S.E. SHERMAN	97214 PORTLAND, OREGON, USA
82535	TEKTRONIX HOLLAND	P O BOX 526	8440 AM HEERENVEEN, HOLLAND



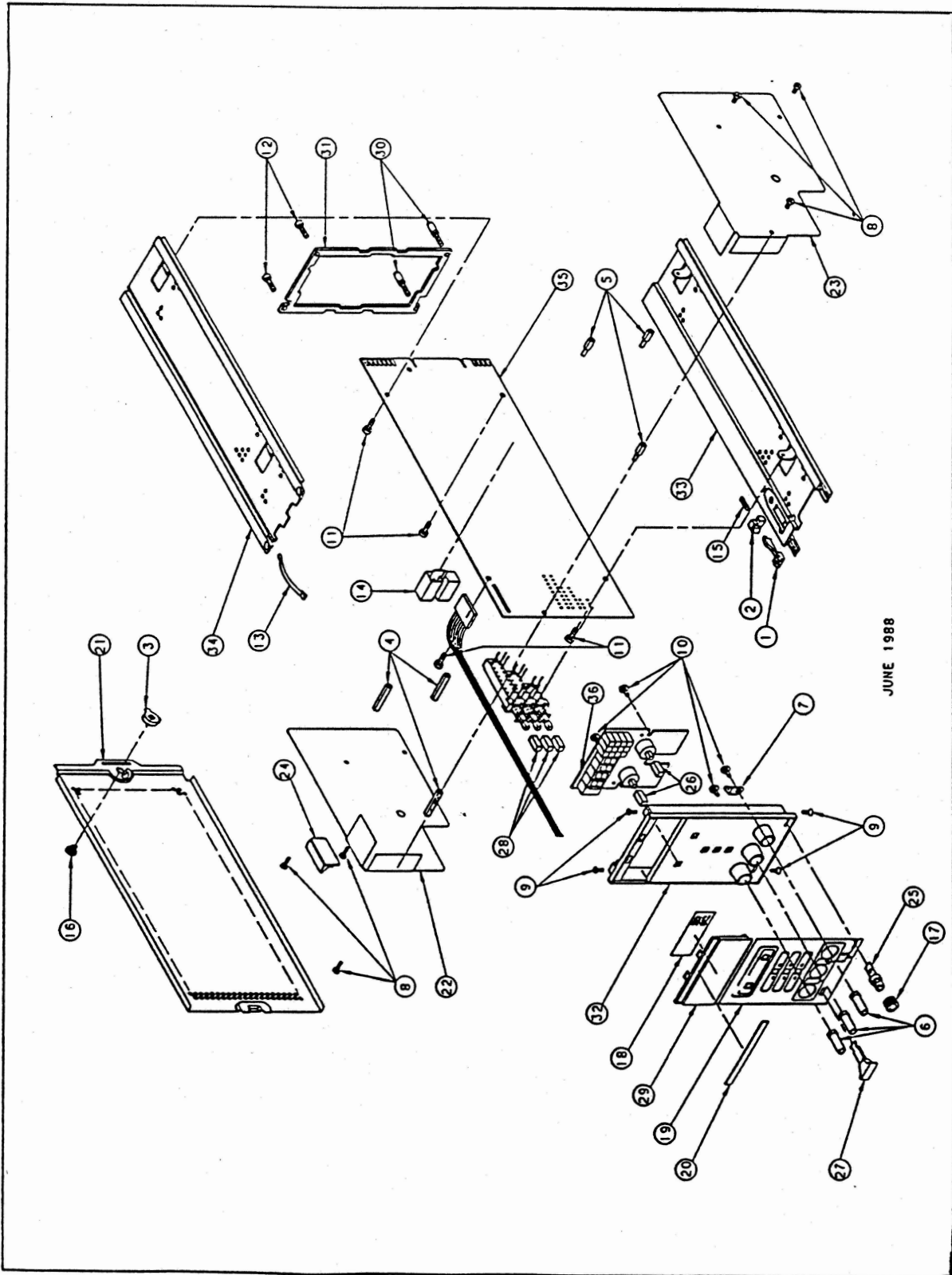


FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	QTY	NAME & DESCRIPTION	MFR CODE
-----	070-6945-00			1	USERS MANUAL	03901
1-1	105-0865-00			1	BAR LATCH RELEASE	03901
2	105-0866-00			2	LATCH RETAINING	03901
3	105-0932-00			3	LATCH PANEL SIDE	03901
4	129-0042-00			3	SPACER POST	03901
5	129-0299-00			3	POST BRASS	03901
6	136-0765-00			3	JACK TIP BANANA	03901
-----	196-3212-00			1	LEADS TEST SET RED/BLACK	34101
7	210-0202-00			3	TERMINAL LUG SOLO	79601
8	211-0007-00			6	SCREW MACH	79601
9	211-0101-00			4	SCREW MACH FLAT	79601
10	211-0304-00			5	SCREW W/WASHER	79601
11	213-0146-00			4	SCREW TAPPING	79601
12	213-0793-00			2	SCREW TAPPING	79601
13	214-1061-00			1	SPRING	79601
14	214-2518-01			1	HEATSINK	03901
15	214-3143-00			1	SPRING	03901
16	214-3364-00			2	FASTNER LATCH PANEL SIDE	03901
17	220-0633-00			1	NUT ROUND KNURLED BRASS	03901
18	331-0518-00			1	MASK STICKER LENS	03901
19	333-3614-00			1	FRONTPANEL DM504A	03901
20	334-7253-00			1	MARKER IDENT	03901
21	337-3039-00			2	SHIELD ELEC SIDE	03901
22	337-3505-00			1	GUARD SHIELD COMP SIDE	82535
23	337-3506-00			1	GUARD SHIELD SOLDER SIDE	82535
24	343-1399-00			1	CLAMP RETAINING	58701
25	355-0239-00			1	STUD SHOULDERED	03901
26	366-1559-09			2	PUSH BUTTON	03901
27	366-1851-01			1	KNOB LATCH	03901
28	366-2017-00			3	PUSH BUTTON	03901
29	378-2030-00			1	LENS LED DISPLAY	03901
30	386-3657-01			2	SUPPORT PL-IN	03901
31	386-4866-00			1	SUPPORT FRAME	03901
32	386-5780-00			1	FRONT SUBPANEL DM504A	03901
33	426-0724-99			1	FRAME SECTION	03901
34	426-0725-99			1	FRAME SECTION	03901
35	671-0647-00			1	A10 BOARD ASSY	82535
36	671-0648-00			1	A11 BOARD ASSY	82535

## **MANUAL CHANGE INFORMATION**

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.



Date: Dec 2, 1988 Change Reference: C1/1288

Product: DM 504A Digital Multimeter Manual Part No: 070-7135-00

DESCRIPTION

For Serial Number H700101 and above, please make the following changes:

**REPLACEABLE ELECTRICAL PARTS**

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**Change to:**

A10	671-0647-01	BOARD ASSY MAIN DM504A
A11	671-0648-01	BOARD ASSY DISPLAY DM504A

**Change the CORE,EM TOROID, FERRITE to read:**

A10-----	120-1853-00	TRANSF, TOROID
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**Change to:**

A10U2	160-5426-03	MICROCKT DIGITAL 27C64 EPROM
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**Change to:**

A11U200	160-0651-00	MICROCKT DIGITAL 74LS164 8BIT
A11U201	160-0651-00	MICROCKT DIGITAL 74LS164 8BIT

**Add:**

A11C200	281-0775-00	CAP FXD CER DI .1UF 20% 50V TUBULAR
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On Diagram 3 show A11C200 connecting between pins 2 and 7 on A11U201.

**OPTIONS**

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**Change the references to OPTION 1 to read:**

OPTION 2.

