

WARNING

The following servicing instructions are for use by qualified personnel. 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 Operators Safety Summary and Service Safety Summary prior to performing any service.


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

DM 5120/5520 Programmable Digital Multimeter

SERVICE

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INSTRUMENT SERIAL NUMBERS

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:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guemsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

PREFACE

This Service manual provides only servicing information intended for use by qualified service persons. No operating information is included in this manual. For instrument specifications and operating information refer to the DM 5120/5520 Instruction Manual.

Additional Documentation for the DM 5120 and DM 5520

Instruction Manual—070-7331-XX

Instrument Interfacing Guide—070-7329-XX

Reference Guide—070-7330-XX

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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. Safety information applies to both the DM 5120 and DM 5520 unless noted otherwise.

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 module connected to a power source (DM 5120) or from a power source (DM 5520) 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 module 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 module power cord is essential for safe operation.

Danger Arising from Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts can render an electric shock.

Use the Proper Power Cord (DM 5520)

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition. See Operating Instructions section of the Instruction Manual for power cord configuration. Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list of this manual.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

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

Do Not Operate Without Covers

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.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY
Refer also to the preceding Operator 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 may 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 in a power module connected to a power source (DM 5120) or from a power source (DM 5520) that will not apply more than 250 volts rms between the supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Section 1

THEORY OF OPERATION

Introduction

This section contains an overall functional description of the DM 5120/5520. Detailed schematics and component location drawings are located at the end of this instruction manual.

Overall Functional Description

A simplified block diagram of the DM 5120/5520 is shown in Figure 1-1. The instrument may be divided into two sections: analog and digital circuitry. The

analog and digital sections are electrically isolated from each other by the use of opto-isolators for control and communications. Separate power supplies for the analog and digital sections ensure proper isolation.

The analog section consists of the signal conditioning circuits, multiplexer, input amplifier, A/D converter and control circuitry. The heart of the digital section is a 68B09 microprocessor that supervises the entire operation of the instrument. Additional digital circuitry includes the display and IEEE-488 interface.

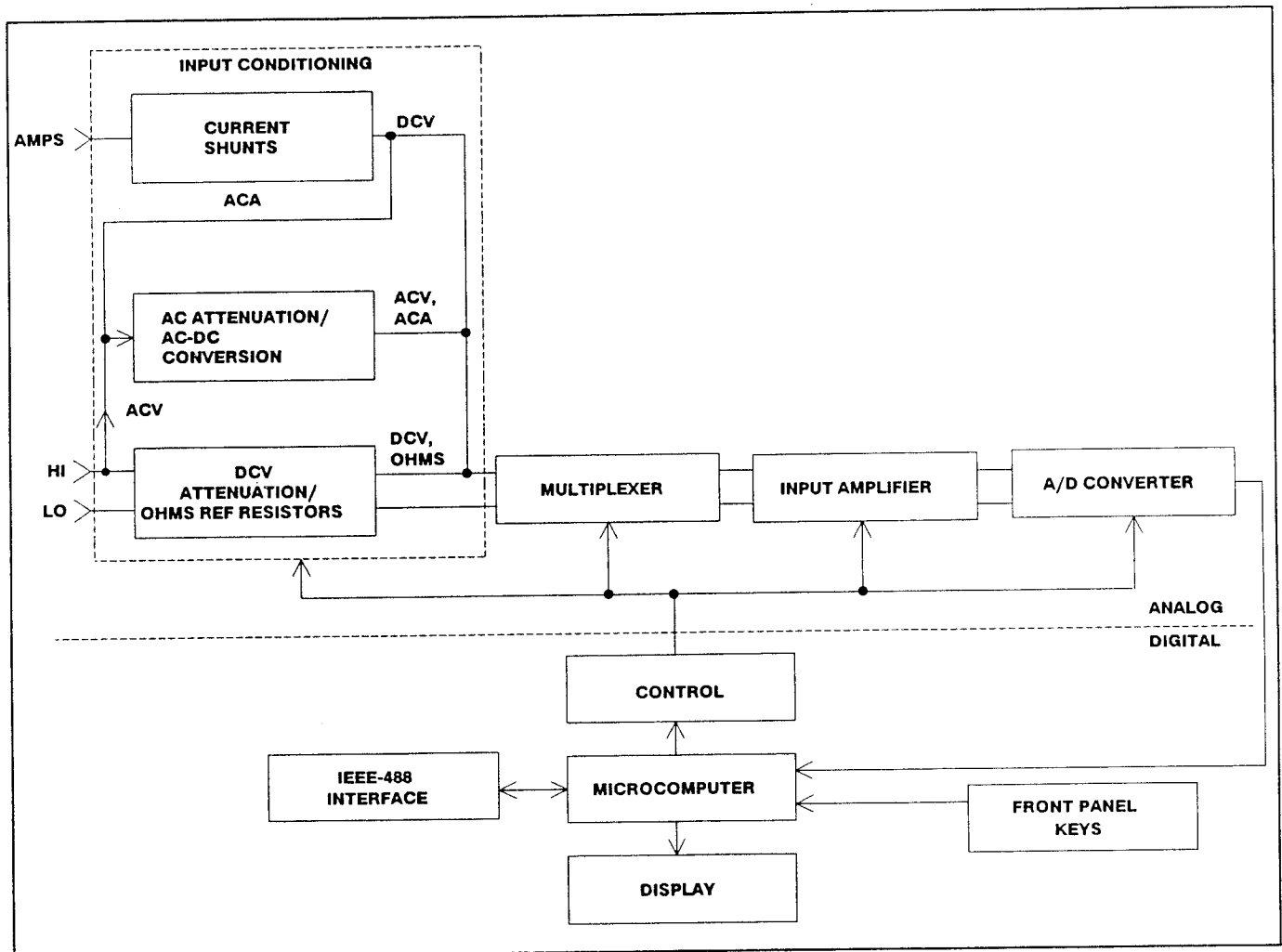


Fig. 1-1. Simplified Block Diagram.

Theory of Operation

Analog Circuitry

The detailed circuitry of the DM 5120/5520 analog section is located on diagrams 4, 5, 6, and 7.

Input Signal Conditioning

Signal conditioning circuitry modifies the input to a signal that is usable by the DM 5120/5520 and applies that signal to the multiplexer.

DCV (Diagram 4)

Signal conditioning for the 30 V and 300 V ranges is performed by resistor divider network R17. On these ranges, K1 and K2 are open, and the divider network is connected to signal ground through Q11 and U22A. The following attenuation of the input signal is provided:

- Divided by 10 on the 30 V range.
- Divided by 100 on the 300 V range.

On the 30 V range, Q13 is on and Q3 is off routing the input signal in the multiplexer (Q35). On the 300 V range, Q13 is off and Q3 is on routing the input signal to the multiplexer (Q35). On the 300 mV and 3 V ranges, the input signal is removed from the resistor divider network (Q13 and Q3 off) and applies directly to the multiplexer through K1 and R13.

ACV (Diagram 5)

The basic steps involved in ACV conditioning are as follows:

1. Relay K4 applies the ACV input to the gain circuitry. Here the signal undergoes a gain factor of 10 (300 mV range), 1 (3 V range), 1/10 (30 V range), or 1/100 (300 V range).
2. The signal is then applied to the TRMS converter (U27) where the ac signal is converted to a dc signal.
3. The dc signal is then applied to the multiplexer.

On the 300 mV and 3 V ranges, the signal is routed through relay K5 and buffer U28A. On the 3 V range, the signal proceeds through analog switch U21C and buffer U26B before being applied to the TRMS converter (U27). On the 300 mV range, the signal is detoured through analog switch U21A to U28B which is configured as a X10 amplifier. The amplified signal then proceeds through analog switch U21B and buffer U26B to the TRMS converter (U27).

In the 30 V range, the signal is applied to U26A. Because analog switch U23C is open on this range, amplifier U26A has a feedback resistance of 118 k Ω (R32) which results in a gain factor of 1/10. The divided signal is then routed through analog switch U23B and buffer U26B to the TRMS converter.

On the 300 V range, the signal is applied to U26A. Because analog switch U23C is closed on this range, amplifier U26A has a feedback resistance of 118 k Ω (R32) in parallel with 13 k Ω (R24), resulting in a gain factor of 1/100. The divided signal is then routed through analog switch U23B and buffer U26B to the TRMS converter.

OHMS (Diagram 4)

Resistance measurements are made using the ratio-metric technique (see Figure 1-2). When the resistance function is selected, a series circuit is formed between the ohms source, a reference resistor and the external unknown resistance. A current flows through the reference resistor and the unknown resistance. Since this current is common to both resistances, the value of the unknown resistance can be calculated by measuring the voltage across the reference resistor and the voltage across the unknown resistance.

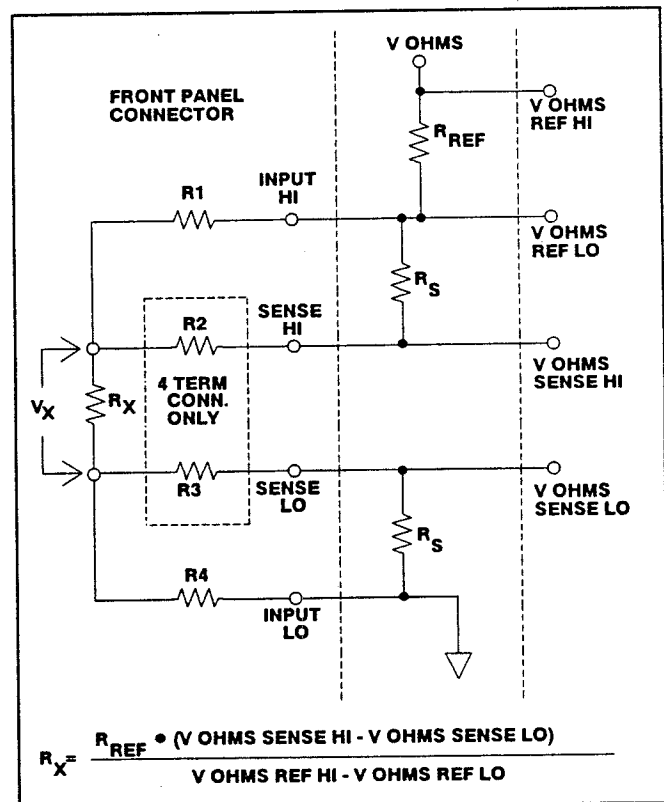


Fig. 1-2. Input Configuration during 2 and 4-Terminal Resistance Measurement.

The following ohms reference resistors are used (see Figure 1-3).

- 300 Ω and 3 kΩ ranges: R26 (2 kΩ)
- 30 kΩ range: R23 (30 kΩ)
- 300 kΩ range: R17A paralleled by R17C (100 kΩ)
- 3 MΩ range: R17A paralleled R17B (1 MΩ)
- 30 MΩ and 300 MΩ ranges: R17C (10 MΩ)

By measuring the four inputs to the A/D converter the unknown resistance can be computed by the microprocessor using this equation:

$$R_x = \frac{R_{REF} \cdot (V_{\Omega \text{ SENSE HI}} - V_{\Omega \text{ SENSE LO}})}{V_{\Omega \text{ REF HI}} - V_{\Omega \text{ REF LO}}}$$

For the 300 Ω range $V_{\Omega \text{ SENSE HI}}$ and $V_{\Omega \text{ SENSE LO}}$ are actually multiplied by a factor of 10 in the input buffer circuit.

Protection on the ohms ranges is accomplished by RT1, Q9 and Q16. For an input voltage applied to the Ω input terminals, Q9 and Q16 clamp the voltage to the reference resistors to a safe limit. RT1 limits the current to Q9 and Q16.

The DM 5120/5520 is equipped to make 2- or 4-terminal resistance measurements. Generally, the 4-terminal measurements should be made on the 300 Ω

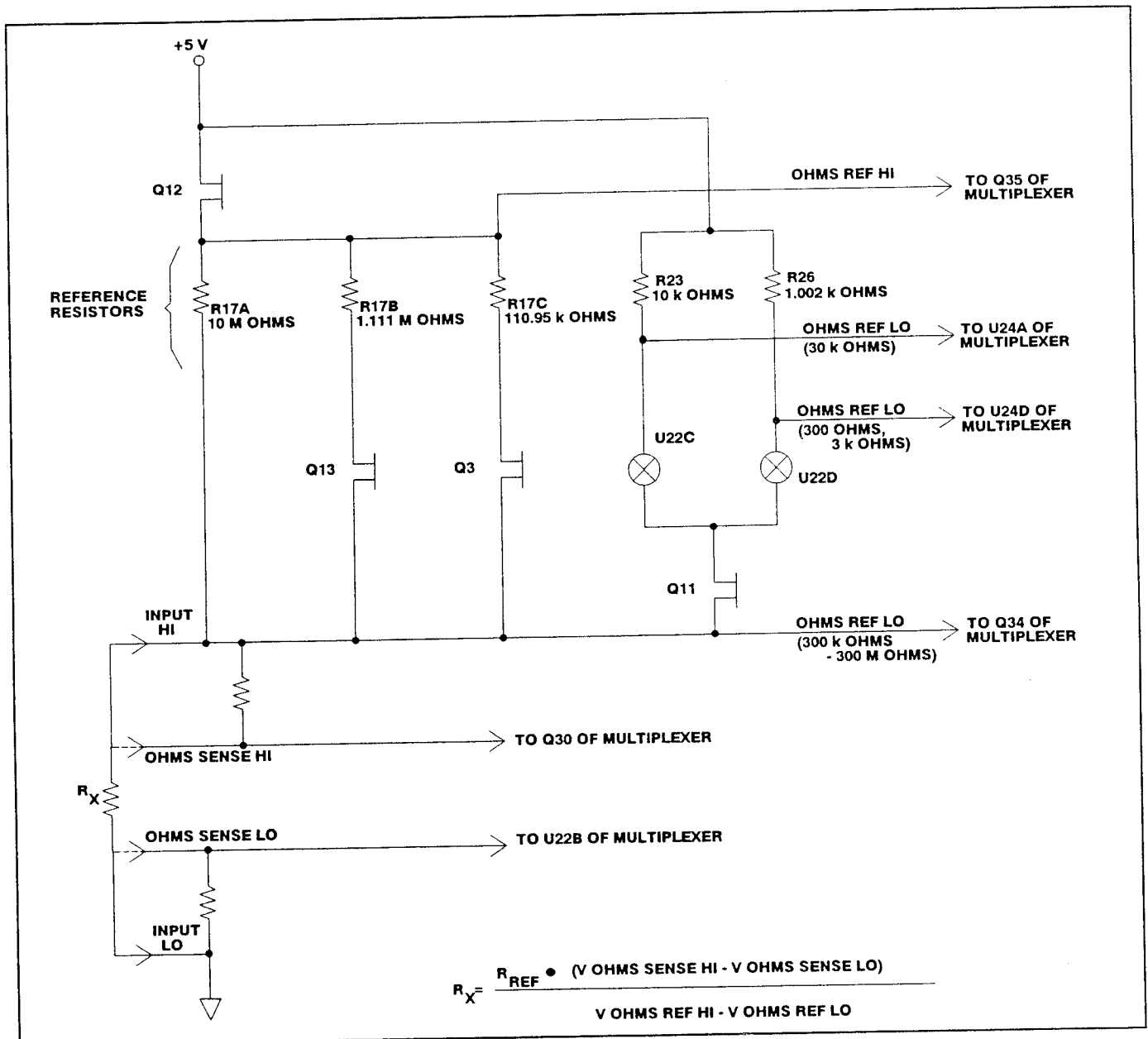


Fig. 1-3. Resistance Measurement Simplified Circuitry.

Theory of Operation

range because the relatively large output current can develop a significant voltage across the test leads, affecting measurement accuracy.

Figure 1-2 shows the equivalent circuit of the input circuit. R_x is the unknown measured resistance and R_1 , R_2 , R_3 and R_4 represent the test lead resistance. R_2 and R_3 are connected only during 4-terminal measurements. When using a 2-terminal configuration, all the current flows through the test leads R_1 and R_4 . If R_x has a low value, the amount of voltage developed across the test leads can be significant. Since the voltage is sensed across the combined resistance of R_1 , R_x , and R_4 , considerable error can be introduced into the reading. To use a 4-terminal connection, a second set of leads (R_2 and R_3) are connected to the unknown resistance. The amount of current through R_2 and R_3 is much smaller than the current through R_1 and R_4 . Thus, the voltage seen by the instrument is much closer to the actual value across the measured resistance, minimizing the error.

DCA and ACA (Diagram 5)

The resistor current shunt network R28 is configured so that a full scale current input will result in a 300 mV drop across the network on all current ranges. For DCA, this voltage is routed to the multiplexer through analog switch U24B (diagram 4). For ACA, the signal is routed through U21D to X10 amplifier U28B. The amplifier signal then travels through analog switch U21B and buffer U26B to the TRMS converter. The converted dc signal is then routed to the multiplexer.

Multiplexer (Diagram 4)

The multiplexer circuitry selects among the various signals that are part of the DM 5120/5520 measurement cycle and connects them to the input buffer amplifier. Figure 1-4 shows a simplified schematic of the multiplexer circuitry.

Figure 1-5 shows the general switching phases for the various signals. During each phase, an integration is performed by the A/D converter, and the resultant data is used by the microprocessor to calculate the final reading.

The precharge amplifier (U20B) is momentarily selected by Q31 just before signal FET Q30 is activated. The purpose of the precharge amplifier is to get the signal seen by the input buffer amplifier closer to the

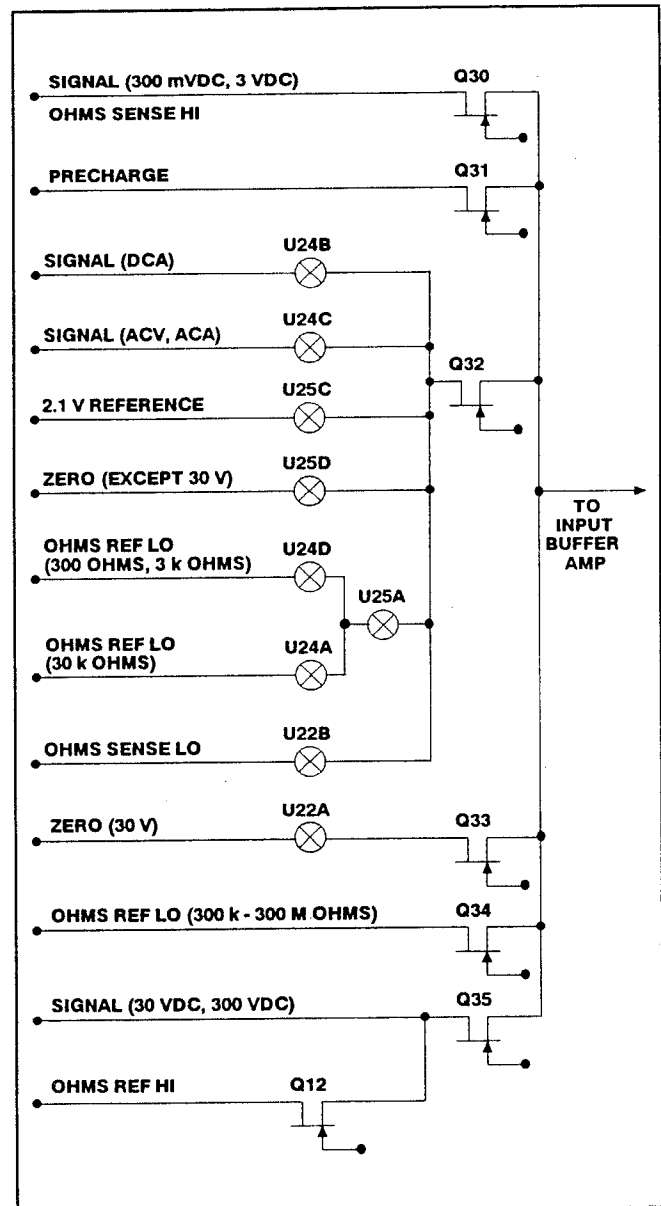


Fig. 1-4. JFET Multiplexer.

actual input at signal FET Q30. The precharge amplifier also provides the drive to keep the FETs on until turned off by the control circuitry.

+2.1 V Reference Source (Diagram 6)

Voltage and current measurements are based on comparing the unknown signal with an internal +2.1 V reference voltage source. During each measurement cycle, the unknown signal is sampled and then compared with signal common and the +2.1 V reference values.

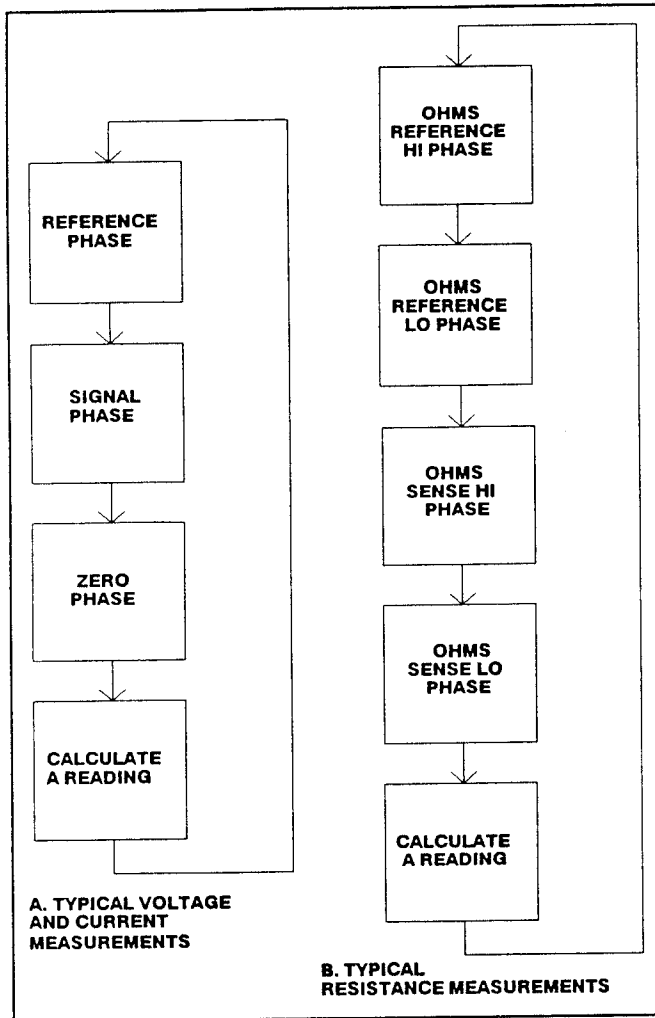


Fig. 1-5. Multiplexer Phases.

U34 provides a highly stable +6.95 V reference, while U13 and R10 provide a constant current to minimize zener voltage variations. R36 and R37 divide down the +6.95 V value to the final +2.1 V reference voltage.

Input Buffer Amplifier (Diagram 6)

The input buffer amplifier provides isolation between the input signal and the A/D converter. Q41 provides the low noise, high impedance FET input for amplifier U35. The amplifier can be configured for X1 or X10 gain with R41 and R42 acting as the feedback network. When X1 gain is selected by the microprocessor, feedback is routed through pin 12 of the analog switch U44A. At X10 gain, feedback is routed through pin 13 of the multiplex switch. Amplifier gain configurations for the various functions and ranges are listed in Table 1-1.

Table 1-1
INPUT BUFFER AMPLIFIER (U35) GAIN
CONFIGURATION

Function	Range	Gain
DCV	300 mV	X10
	3-300 V	X1
ACV	All	X1
	300 W	X10
W	3k-300 MW	X1
DCA	All	X10
ACA	All	X1

A/D Converter (Diagram 7)

The DM 5120/5520 uses a constant frequency, variable pulse width, analog-to-digital converter. A simplified schematic of the A/D converter used in the DM 5120/5520 is shown in Figure 1-6.

The charge balance phase begins when the input enable/disable line is set high. This occurs at the end of a software-generated delay period that allows the signal to settle after the appropriate multiplexer FET is turned on. Once the input is enabled, the signal from the buffer amplifier is added to the level shift current applied through R11C and R11D or R11C only. In this manner, the ± 3.03 V bipolar signal from the buffer amplifier is converted to a unipolar signal that can be integrated.

The integrator is made up of Q1, U19 and C32. When the input to the integrator is applied, the integrator output ramps up until its voltage is slightly higher than the voltage applied to the inverting input of the duty cycle comparator (U5A). The charge balance current, whose duty cycle is proportional to the input, is fed back to the integrator input through R8 and Q4. Since the charge balance current is much larger than the sum of the input and level shift currents, the integrator output now ramps in the negative direction until Q of U8B goes low. The VIA then counts the total number of pulses that occur during the charge balance phase.

At the end of the charge balance phase, the output of the integrator is resting at some positive voltage. Since the integrator output is connected to the non-inverting input of the final-slope comparator (U5B), the final-slope comparator output remains high until the integrator output ramps in the negative direction. During final-slope, Q4 is turned off and the feedback is fed through U16 back to the integrator input. The final-slope comparator output is then gated with the

Theory of Operation

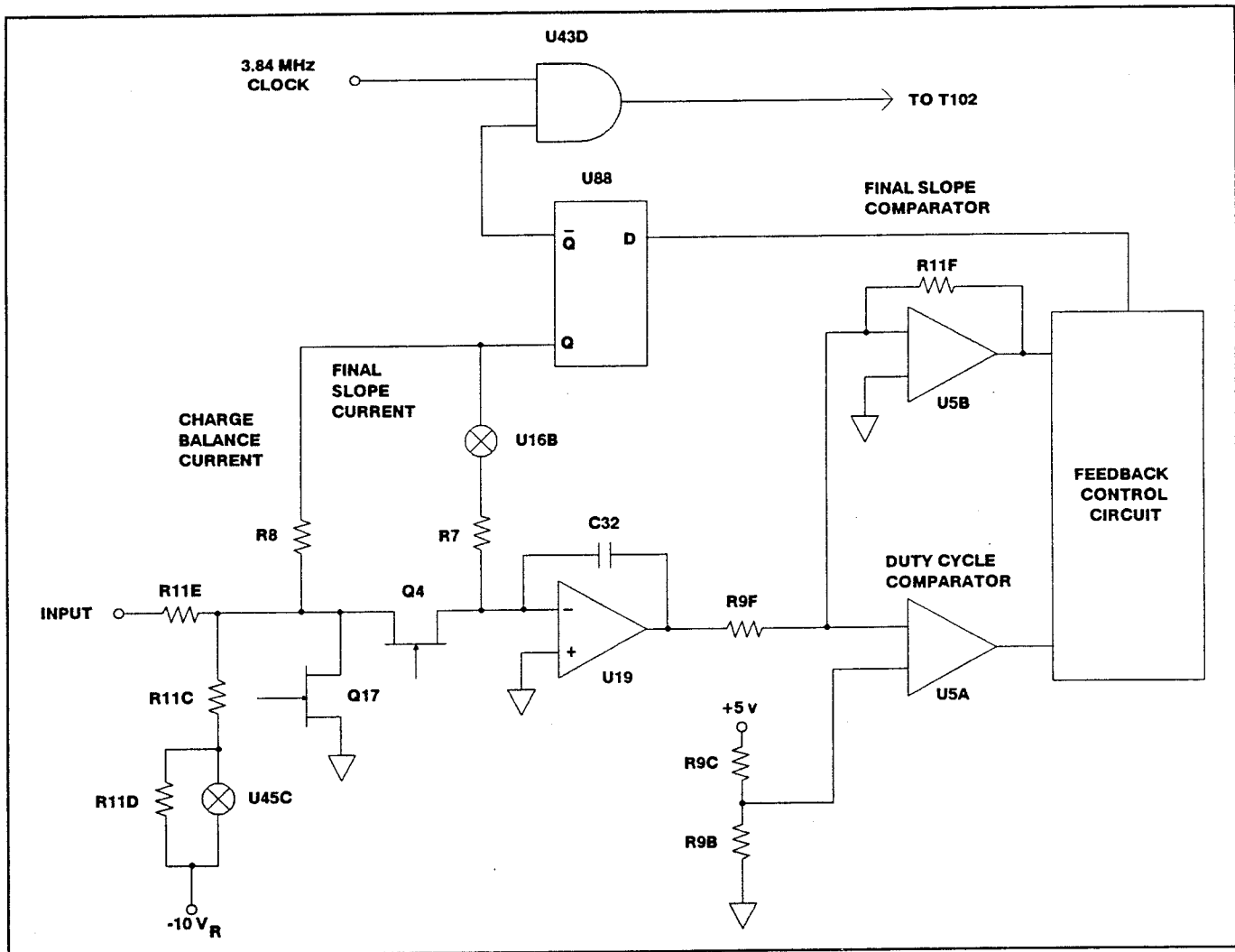


Fig. 1-6. A/D Converter Simplified Schematic.

3.84 MHz clock and counted. Once the comparator output goes low, the VIA stops counting and the reading can be computed.

Control Circuitry

The signals for the circuitry that provides control of the various FETs, relays, analog switches and logic levels are supplied by the shift store registers U29, U30, U31, and U32 (see diagram 6). CLOCK, DATA and STROBE signals are sent from the VIA (U109) across the opto-isolators AT1 and AT3 (see diagram 3). The opto-isolators transformers provide 350 V isolation between the analog and digital sections of the instrument. DATA is serially loaded into the shift store registers and a STROBE pulse causes the registers to simultaneously output the appropriate logic levels to the FET, analog switch and relay drivers.

Digital Circuitry

The DM 5120/5520 is controlled by an internal microcomputer. This section briefly describes the operation of the microcomputer and associated digital circuitry. Refer to diagrams 2 and 3 for circuit details.

Microcomputer (Diagram 2)

The microcomputer centers around the 8-bit 68B09 microprocessor (U10). The MPU has direct control over the display, front panel switches, A/D converter, IEEE-488 bus, as well as the READING COMPLETE Output and the EXTERNAL TRIGGER Input. Timing for the microprocessor is accomplished by the use of Y101, an 8 MHz crystal. Internally, this frequency is divided down by four to obtain a bus operating frequency of 2 MHz.

Instrument operation software is stored in EPROMs U105 and U106. The revision level of this software is displayed by the ID command. Calibration constants, and instrument set up conditions are stored in E2PROM (U20). U9 is the RAM. Partial address decoding is used in this system. The function selected is determined by the state of A11, A12, A13, A14 and A15 address lines. These address lines determine which is selected by the decoders (U1). Only one device (ROM, RAM, VIA, etc.) will have access to the data bus at any one time.

The heart of the IEEE-488 circuitry is the GPIBA (U5). The GPIBA is capable of performing all IEEE talker-listener protocols. The bidirectional data lines D0 through D7 permit the transfer of data between the microprocessor and the GPIBA. The transceivers U6 and U7 are used to drive the output. Data is buffered by U6 and U7 and is transmitted to the bus via connector J17.

Display Circuitry (Diagrams 1 & 2)

The display information is sent through display latches U11 and U12. Upon each display update, new segment information is presented to the display latches

and a clock pulse is sent on PA0 (U8). The clock pulse to U4 and U5 (see diagram 1) shifts a digit enable bit to the next digit to be enabled. Every 10 times the display is updated, a digit enable is generated at PA1 (U8) and goes to the data input of the shift register. U11 and U12 are the drivers for the LED segments of the display digits and the LED indicators.

Power Supplies (Diagram 3)

The main power supplies of the DM 5120/5520 are located on this diagram. Fuse F2 is the primary fuse which is mounted on the digital board. 26 Vac primary power is supplied by the power module to the power transformer T1. T1 has two secondary windings; one for the +5 V analog supply and one for the ± 15 V analog supply. CR1 and CR2 provide fullwave rectification for the two supplies, while U21, U22, and U23 provide the regulation.

The +5 V digital supply is derived from +8 Vdc supplied by the power module via J16. Regulation is provided by U18. Fuse protection for the +5 V digital supply is provided by F3, located on the digital board.



Section 2

PERFORMANCE CHECK PROCEDURE

Introduction

This procedure verifies that the DM 5120 or DM 5520 is operating within the limits of the performance requirements as listed in the Specification section of the DM 5120/5520 Instruction manual. This procedure may be used to determine acceptability of performance in an incoming inspection facility; it may also be used whenever there is a question of instrument accuracy, following repair or internal adjustment.

If the instrument fails to meet these performance checks, a qualified service person should perform the internal adjustment procedure in Section 3 and repeat the Performance Check Procedure. If readjustment does not correct the discrepancy, circuit troubleshooting is needed.

NOTE

If the instrument performance falls outside the specified range and it is still under warranty, contact Tektronix, Inc.

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.

Environmental Conditions

All performance checks should be made at 18 - 28°C (65 - 82°F) and at less than 75% relative humidity.

The DM 5120/5520 must be turned on and allowed to warm up for at least two hours before beginning the performance checks. If the instrument has been subject to extremes of temperature (outside the range specified above), additional time should be allowed for internal temperatures to reach a normal operating level. It would normally take one additional hour to stabilize a unit that is 10°C (18°F) outside the specified temperature range.

Recommended Test Equipment

The test equipment listed in Table 2-1, or equivalent is suggested to make the performance checks.

NOTE

The performance limits in this procedure do not include test equipment tolerance.

Table 2-1
TEST EQUIPMENT REQUIRED

Description	Performance Specifications	Required for These Checks	Recommended
Power Module		(DM 5120 only)	Tektronix TM 5003 or TM 5006
DC Voltage Calibrator	300 mV, 3 V, 30 V, 300 V ranges ± 15 ppm.	DC Volts, DC Current	Fluke 5440A
AC Voltage Calibrator	300 mV, 3 V, 30 V ranges: 20 Hz $\pm 0.1\%$; 50 Hz-20 kHz 0.02%; 100 kHz $\pm 0.33\%$	TRMS AC Volts, TRMS AC Current	Fluke 5200A
AC Power Amplifier	300 V range: 20 Hz $\pm 0.12\%$; 50 Hz-20 kHz $\pm 0.04\%$; 100 kHz $\pm 0.1\%$	TRMS AC Volts	Fluke 5215A
Resistance Calibrator	300 Ω -3 M Ω ranges ± 15 ppm; 30 M Ω ± 32 ppm; 300 M Ω range ± 225 ppm	Ohms	Fluke 5450A
Current Calibrator	300 μ -3 A ranges $\pm 0.025\%$	DC Current, TRMS AC Current	Valhalla 2500E
Coax Cables	2 ea. required	All checks	Tektronix PN 012-0057-01
BNC-to-dual banana adapter	2 ea. required	All checks	Tektronix PN 103-0090-00

Performance Check

Preparation

1. DM 5120 Only—Insert instrument into a TM 5003 or TM 5006 power module. (The DM 5520 contains its own power module.)
2. Check that the line selector (on the power module/cabinet) is set to the correct voltage.
3. Turn on the power.
4. Allow the instrument to warm up for at least two hours before continuing with the performance checks. (See Environmental Conditions above.)

Check Procedures

NOTE

In the following procedure, the DM 5120 and DM 5520 instruments are referred to as DMM.

The following steps are for verifying the one-year accuracy specifications of the DM5120 or DM 5520 at 5 1/2d resolution, for each of the five measuring functions: DC volts, TRMS AC volts, ohms, TRMS AC amps, and DC amps. These procedures are intended for use by qualified personnel using accurate and reliable test equipment.

WARNING

To prevent a shock hazard, do not exceed 350 V between input low and chassis ground. Some of the procedures in this section may expose the user to dangerous voltages. Always connect the shield side of the coax to the LO side of the output and input connectors. Never touch the BNC connectors when calibrator output is active. Use standard safety precautions when such dangerous voltages are encountered.

1. Check DC Volts

Test Equipment Required:

- DC Voltage Calibrator
- BNC Coax cables and BNC to Banana Adapters

CAUTION

Do not exceed 300 V between the input HI and LO terminals or instrument damage may occur.

- Press DMM keys as follows:
DCV (LED on)
AUTO (LED on)
PROGRAM (LED on, PROGRAM? displayed)
2 (current digits displayed)
↑ or ↓ to display 5 1/2d

- Connect the DMM to the DC voltage calibrator as shown in Fig. 2-1.

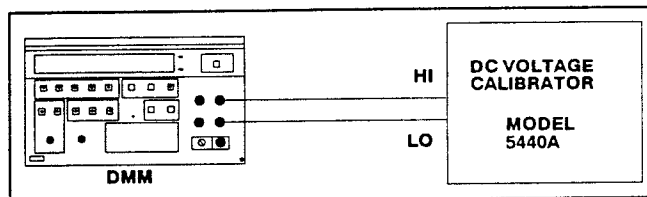


Fig. 2-1. Connections for DC Volts Check.

- Set the calibrator to 0 V and press the DMM NULL key (LED on).

- CHECK—DMM display reads 000.000 mV ± 2 counts.

NOTE

Low measurement techniques should be used when checking the 300 mV DC range. Refer to the DM 5020/5520 Instruction Manual for low-level measurement considerations.

- Set the calibrator to output +300 mV.
- CHECK—display reads a value within the limits listed in Table 2-2.
- Disable NULL (press NULL key to turn off LED) and leave it disabled for the remainder of the DCV checks.
- Check the 3 V, 30 V, and 300 V ranges by applying the respective DC voltage levels listed in Table 2-2.
- Repeat steps c thru h while applying negative voltages.

Table 2-2
LIMITS FOR DC VOLTS CHECK

DMM DCV Range	Applied DC Voltage	Reading Limits (18° to 28°C)
300 mV	300.000 mV	299.974 to 300.026
3 V	3.00000 V	2.99987 to 3.00013
30 V	30.0000 V	29.9973 to 30.0027
300 V	300.000 V	299.970 to 300.030

2. Check TRMS AC Volts

Test Equipment Required:

- AC Voltage Calibrator
- AC Power Amplifier
- Standard Test Leads



Do not exceed 300 V RMS 425 V peak 10⁷V •Hz between the input HI and LO terminals or instrument damage may occur.

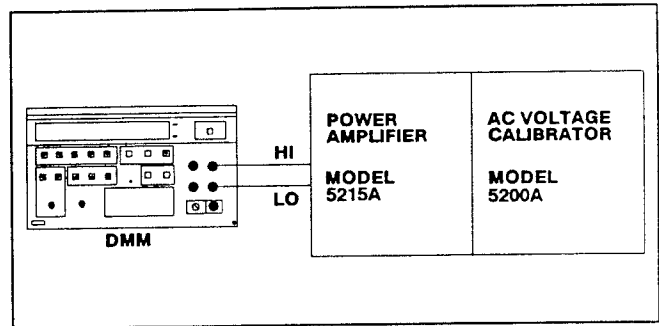


Fig. 2-2. Connections for TRMS AC Volts Check.

- a. Press DMM keys as follows:
 - ACV (LED on)
 - AUTO (LED on)
 - NULL (LED off)
 - PROGRAM (LED on, PROGRAM? displayed)
 - 2 (current digits displayed)
 - ↑ or ↓ to display 5 1/2d
- b. Connect the DMM to the AC voltage calibrator and the power amplifier as shown in Fig. 2-2.
- c. Set the calibrator to output 290 mV at a frequency of 20 Hz.
- d. CHECK—the reading is within the limits listed in Table 2-3.
- e. Repeat the 290 mV measurement at the other frequencies specified in Table 2-3.
- f. Repeat the procedure for the 3 V, 30 V and 300 V ranges by applying the respective AC voltages listed in Table 2-3.
- g. CHECK—the reading for each range should be within the limits listed in Table 2-3.

Table 2-3
LIMITS FOR TRMS AC VOLTS CHECK

DMM- ACV Range	Applied AC Voltage	Reading Limits (18°C to 28°C)					
		20 Hz	50 Hz	200 Hz	10 kHz	20 kHz	100 kHz
300 mV	290.000 mV	284.100 to 295.900	289.030 to 290.970	289.465 to 290.535	289.465 to 290.535	288.640 to 291.360	283.900 to 296.100
3 V	2.90000 V	2.84100 to 2.95900	2.89030 to 2.90970	2.89465 to 2.90535	2.89465 to 2.90535	2.88930 to 2.91070	2.85350 to 2.94650
30 V	29.0000 V	28.4100 to 29.5900	28.9030 to 29.0970	28.9465 to 29.0535	28.9465 to 29.0535	28.8640 to 29.1360	28.5350 to 29.4650
300 V	290.000 V	284.100 to 295.900	289.030 to 290.970	289.465 to 290.535	289.465 to 290.535	288.640 to 291.360	*

*Do not apply 290 V at 100 kHz to the input. This exceeds the V•Hz limit of the instrument. Maximum TRMS AC volt input at 100 kHz is 100 V. On the 300 V range, allowable readings with 100 V at 100 kHz applied to the input are 98.200 to 101.800. See Section 2 of the Instruction Manual for clarification of the V•Hz specification.

Performance Check

3. Check Ohms

Test Equipment Required:

- Resistance Calibrator
- Kelvin Test Leads

CAUTION

Do not exceed 300 V RMS 425 V peak between the input HI and LO terminals or instrument damage may occur.

- a. Press DMM keys as follows:
 - Ω (LED on)
 - AUTO (LED on)
 - PROGRAM (LED on, PROGRAM? displayed)
 - 2 (current digits displayed)
 - \uparrow or \downarrow to display 5 1/2d
- b. Connect the DMM to the resistance calibrator as shown in Fig. 2-3.
- c. Set the calibrator to the SHORT position and enable NULL on the DMM.
- f. CHECK—the display reads 000.000.
- g. Set the calibrator to output 190 Ω .
- h. CHECK—the reading is within the limits listed in Table 2-4.
- i. Disable NULL and leave it disabled for the remainder of this check.
- j. Connecting the DMM and resistance calibrator as shown in Fig. 2-3, check the 3 k Ω through 300 M Ω ranges by applying the respective resistance levels listed in Table 2-4.
- k. CHECK—the readings are within the limits listed in Table 2-4.

MUST use this probe setup be 5200 comp mv be (OFF) on the with anything 4-wire

Table 2-4
LIMITS FOR OHMS CHECK

DMM Range	Fig. 2-3 Set Up	Applied Resistance	Reading Limits (18°C to 28°C)
300 Ω	(A)	190.000 Ω	189.979 to 190.021
3 k Ω	(A)	1.90000 k Ω	1.89985 to 1.90015
30 k Ω	(A)	19.0000 k Ω	18.9985 to 19.0015
300 k Ω	(B)	190.000 k Ω	189.958 to 190.042
3 M Ω	(B)	1.90000 M Ω	1.89958 to 1.90042
30 M Ω	(B)	19.0000 M Ω	18.9808 to 19.0192
300 M Ω	(B)	100.000 M Ω	97.998 to 102.002

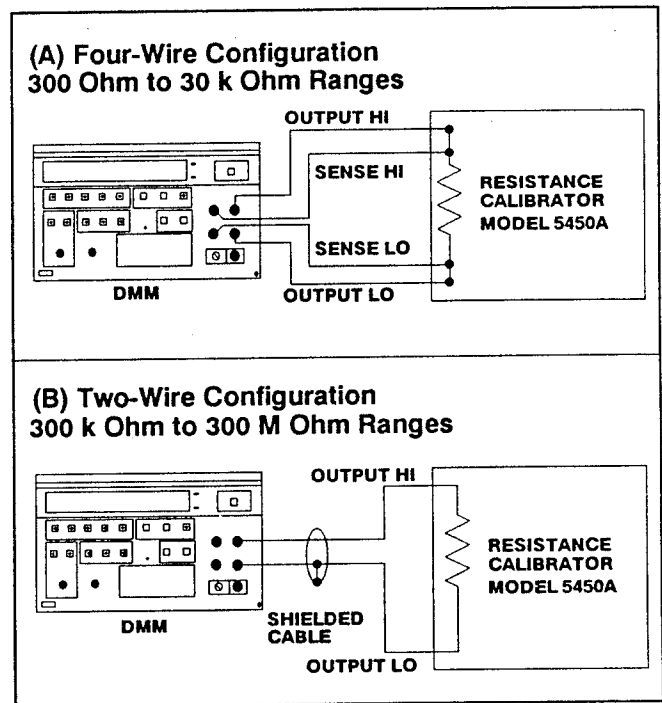


Fig. 2-3. Connections for Ohms Check.

4. Check DC Current

Test Equipment Required:

- Current Calibrator
- DC Voltage Calibrator
- Standard Test Leads

CAUTION

Do not exceed 3 A to the AMPS and LO input terminals or the front panel current fuse will blow.

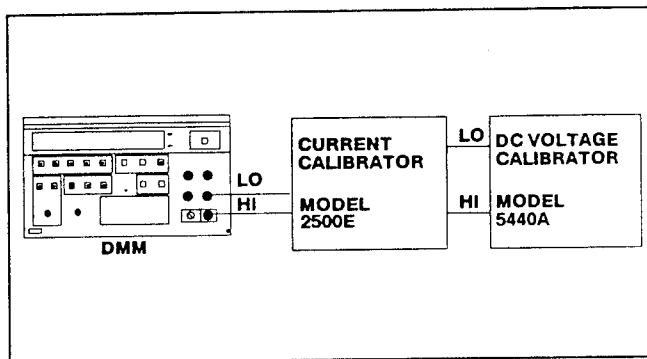


Fig. 2-4. Connections for DC Current Check.

- a. Press DMM keys as follows:
 DCA (LED on)
 AUTO (LED on)
 PROGRAM (LED on, PROGRAM? displayed)
 2 (current digits displayed)
 ↑ or ↓ to display 5 1/2d
- b. Connect the DMM to the current calibrator and the DC voltage calibrator as shown in Fig. 2-4.
- c. Set the calibrator source to output +300 μ A.
- d. CHECK—the reading is within the limits listed in Table 2-5.
- e. Repeat the procedure for the 3 mA, 30 mA, 300 mA and 3 A ranges by applying the respective DC current levels listed in Table 2-5.

- f. CHECK—the reading for each range is within the limits listed in Table 2-5.
- g. Repeat the procedure for each of the ranges with negative current levels.

Table 2-5
LIMITS FOR DC CURRENT CHECK

DMM Range	Applied DC Current	Reading Limits (18° to 28°C)
300 μ A	300.000 mV ^{NA}	299.710 to 300.290
3 mA	3.00000 V ^{MA}	2.99840 to 3.00160
30 mA	30.0000 V ^{MA}	29.9840 to 30.0160
300 mA	300.000 V ^{MA}	299.840 to 300.160
3 A	3.00000 A	2.99720 to 3.00280

Performance Check

5. Check TRMS AC Current

Test Equipment Required:

- Current Calibrator
- AC Voltage Calibrator
- Standard Test Leads

CAUTION

Do not exceed 3 A to the AMPS and LO input terminals or the rear panel current fuse will blow.

- a. Press DMM keys as follows:
 - ACA (LED on)
 - AUTO (LED on)
 - NULL (LED off)
 - PROGRAM (LED on, PROGRAM? displayed)
 - 2 (current digits displayed)
 - ↑ or ↓ to display 5 1/2d
- b. Connect the DMM to the current calibrator and the AC voltage calibrator as shown in Fig. 2-5.

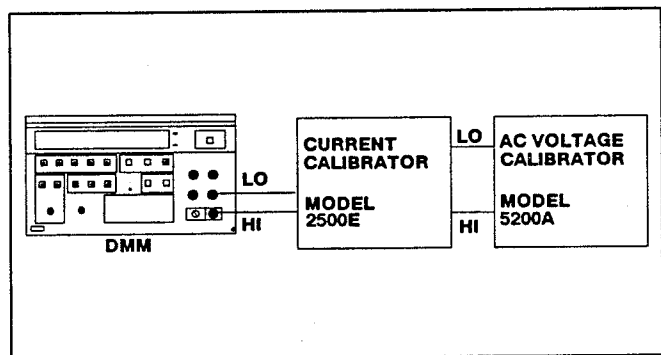


Fig. 2-5. Connections for TRMS AC Current Check.

c. Set the calibration source to output +300 μ A at a frequency of 20 Hz.

d. CHECK—the reading is within the limits listed in Table 2-6.

e. Repeat the 300 μ A measurement at the other frequencies specified in Table 2-6.

f. Repeat the procedure for the 3 mA, 30 mA, 300 mA and 3 A ranges by applying the respective AC current levels listed in Table 2-6.

g. CHECK—the reading for each range is within the limits listed in Table 2-6.

Table 2-6
LIMITS FOR TRMS AC CURRENT CHECK

DMM Range	Applied AC Current	Reading Limits (18°C to 28°C)		
		20 Hz	45 Hz	10 kHz
300 μ A	290.000 μ A	284.100 to 295.900	287.290 to 292.710	287.290 to 292.710
		3 mA	2.90000 mA	2.84100 to 2.95900
30 mA	29.0000 mA	28.4100 to 29.5900	28.8160 to 29.1840	28.8160 to 29.1840
		300 mA	290.000 mA	284.100 to 295.900
3 A	2.90000 A	2.84100 to 2.95900	2.88160 to 2.91840	2.88160 to 2.91840

Section 3

CALIBRATION PROCEDURE

Introduction

Use this calibration procedure to restore the DM 5120 or DM 5520 to the original performance requirements. This procedure need not be performed unless the Performance Check Procedure in Section 2 cannot be completed satisfactorily or the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section in the DM 5120/ 5520 Instruction manual.

Calibration Interval

Calibration should be performed at least every 12 months, or if the performance check procedures in Section 2 show that the DM 5120/5520 is out of specification. Calibration is also recommended following instrument repair or modification.

If any of the calibration procedures in this section cannot be performed properly, refer to the troubleshooting information in Section 4, Maintenance.

Environmental Conditions

Calibration should be performed under laboratory conditions having an ambient temperature of 22 - 24°C and a relative humidity of less than 70%.

Recommended Test Equipment

The test equipment listed in Table 3-1, or equivalent is suggested to perform the DM 5120/5520 calibration. Alternate equipment may be used as long as the accuracy is at least as good as the specifications listed in the table.

Table 3-1
TEST EQUIPMENT REQUIRED

Description	Performance Specifications	Required for These Adjustments	Recommended
Power Module		(DM 5120 Only)	Tektronix TM 5003 or TM 5006
DC Voltage Calibrator	300 mV, 3 V, 30 V, 300 V ranges ± 15 ppm.	DC Volts, DC Current	Fluke 5440A
AC Voltage Calibrator	300 mV, 3 V, 30 V ranges: 20 Hz $\pm 0.1\%$; 50 Hz-20 kHz 0.02%; 100 kHz $\pm 0.33\%$	TRMS AC Volts, TRMS AC Current	Fluke 5200A
AC Power Amplifier	300 V range: 20 Hz $\pm 0.12\%$; 50 Hz-20 kHz $\pm 0.04\%$; 100 kHz $\pm 0.1\%$	TRMS AC Volts	Fluke 5215A
Resistance Calibrator	300 Ω -3 M Ω ranges ± 15 ppm; 30 M Ω ± 32 ppm; 300 M Ω range ± 225 ppm	Ohms	Fluke 5450A
Current Calibrator	300 μ -3 A ranges $\pm 0.025\%$	DC Current, TRMS AC Current	Valhalla 2500E
Coax Cables	2 ea. required	All checks	Tektronix PN 012-0057-01
BNC-to-dual banana adapter	2 ea. required	All checks	Tektronix PN 103-0090-00

Calibration

Internal Adjustments

The entire calibration procedure may be performed without having to make any internal adjustments if high frequency (70 kHz) has been verified, as explained in step 4. Calibration can be performed by either of two methods: (1) from the front panel (Program 36) or (2) over the IEEE-488 bus (GPIB).

To make internal adjustments, you must operate the DM 5120/5520 outside the power module using the extender cables listed in Table 3-1.

Preparation for Calibration

1. DM 5120 Only—Insert instrument into the TM 5003 power module. (The DM 5520 contains its own power module.)
2. Check that the line selector (on the power module/cabinet) is set to the correct voltage.
3. Turn on the power and allow the instrument to warm up for at least two hours before continuing with the calibration procedure. (See Environmental Conditions above.)
4. Check that the instrument is set to the proper line frequency by running front-panel Program 32 as follows:

Press front-panel keys in this order:

PROGRAM (LED on, PROGRAM? displayed),

3, 2 (FREQ = 50 HZ or 60 HZ displayed).

Use ↑ or ↓ to toggle to your correct line frequency.

NOTE

If you changed the line frequency and want your change to remain the same when the instrument is again powered up, run Program 30 (SAVE CURRENT SETTINGS) or send PONSAVE from the IEEE bus.

5. Insert a small bladed screwdriver into the hole in the front panel marked CAL LOCK. Push in lightly to enable the calibration mode. When the calibration mode is on, the CAL LOCK indicators will be lit in the display.

Calibration Mode (Program 36)

To calibrate the DM 5120 from the front panel, you must enter the calibration mode using Program 36.

NOTE

Before you enter calibration mode, you must enable calibration with the CAL LOCK switch (CAL LOCK indicators must be lit in display).

To select Program 36, press the PROGRAM KEY (LED ON), then the numeric keys 3 and 6. If the CAL LOCK indicators are not lit in the display, error code 260 will be displayed and the calibration mode will not be entered.

Front Panel Calibration Command Sequence

1. Prepare instrument for calibration as described in this section.
2. Select function and range to be calibrated.
3. Connect the appropriate calibrator for the function selected.
4. Select Program 36. The first calibration point is displayed.
5. Set the calibrator output to match the displayed calibration point.
6. Press the ENTER key. The next calibration point is displayed.
7. Set the calibrator output to match the displayed calibration point.
8. Press the ENTER key. Except for DCV function, the entered calibration points are updated (stored) and the calibration program is ended for the selected function and range. For the DCV function only, a third calibration point is displayed.
9. For DCV function ranges, set the DC voltage calibrator output to the third displayed calibration point.
10. Press ENTER. The entered DCV calibration points are updated (stored) and the calibration program is ended for the selected DCV range.

GPIB Calibration Command Sequence

1. Prepare instrument for calibration as described in this section.

NOTE

See Tables 3-2 through 3-6 for calibration settings and GPIB commands. Notice that when sending GPIB calibration commands the first calibration point is positive, the second is positive and the last is zero.

2. Send the appropriate commands to select function and range to be calibrated. For example, FUNCT DCV;RANGE 1 selects dc volts function with a range of 300 mV.
3. Connect the appropriate calibrator for the function selected.
4. Set the calibrator output for the first calibration point (for DCV in 300 mV range it's 0.3000000 V).
5. Send CAL FIRST,300E-3 over the GPIB.
6. Set the calibrator output for the next calibration point (for DCV in 300 mV range it's -0.3000000 V).
7. Send CAL SECOND,300E-3 over the GPIB. The CAL SECOND command is used only for the DCV function.
8. Set the calibrator output for the last calibration point (for DCV in 300 mV range it's 0.0000000 V).
9. Send CAL LAST,0 over the GPIB. The calibration points are updated (stored) after the CAL LAST command is sent.
10. Repeat steps 2 through 9 for each function and range to be calibrated.

FRONT PANEL CALIBRATION PROCEDURE

Introduction

Prepare the instrument as explained in Preparation for Calibration earlier in this section.

This procedure calibrates the DM5120/5520 using the default calibration points in Program 36. If you change the calibration points, the calibrator output values will also have to be changed accordingly.

If a different calibration point is to be used, enter the new value using the numeric keys (0 through 9). Each press of a data button displays the number at the cursor location (at the bright flashing digit) and moves to the next digit. If the cursor is moved past the least significant digit, it will move back to the most significant digit.

NOTE

In the following procedure, the DM 5120 and DM 5120 instruments will be referred to as the DMM.

1. Calibrate DC Volts

- a. Select DCV function.
- b. Select DCV range of 300 mV.
- c. Connect the DMM to the DC voltage calibrator (Fig. 3-1A).

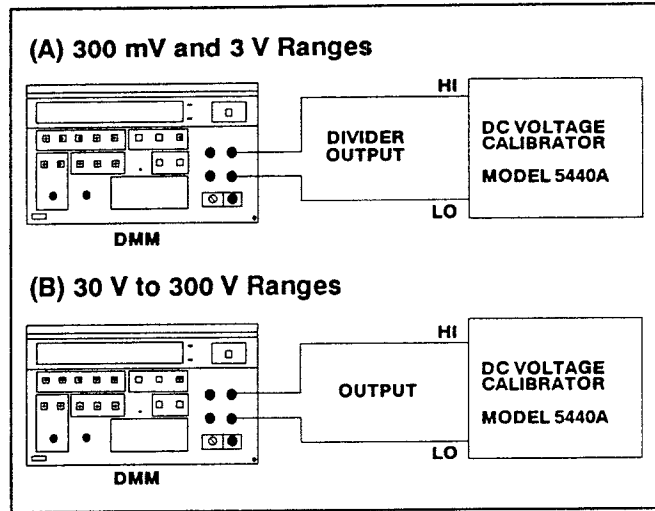


Fig. 3-1. DC Volts Calibration Configuration.

NOTE

Low level measurement techniques should be used when calibrating the 300 mV DC range. Refer to Section 2 of the Instruction Manual for low level measurement considerations.

- d. Select Program 36. The display prompts:
-300.0000 mV.
- e. Set the DC voltage calibrator to -0.3000000 V. Allow a few seconds for the voltage to stabilize.
- f. Press the ENTER key. The display prompts:
300.0000 mV.

g. Set the DC voltage calibrator to 0.3000000 V. Allow a few seconds for the voltage to stabilize.

h. Press the ENTER key. The display prompts:
000.0000 mV.

i. Set the DC voltage calibrator to 0.0000000 V. Allow a few seconds for the voltage to stabilize.

j. Press the ENTER key. The DCV calibration points are updated (stored) for the selected range and the DCV function returns to normal.

k. Repeat steps d through j for the remaining DCV ranges using Table 3-2 and Fig. 3-1 as a guide.

**Table 3-2
DC VOLTS CALIBRATION**

DMM DCV Range	Set Up	Front Panel DMM Calibration Point (DCV)	Front Panel DC Calibrator Setting ^a	IEEE-488 Bus (GPIB) Commands ^a
300 mV	Fig. 3-1 (A)	-300.0000 mV 300.0000 mV 000.0000 mV	-0.3000000 V 0.3000000 V 0.0000000 V	DCV;RANGE 1 CAL FIRST,300E-3 CAL SECOND,-300E-3 CAL LAST,0
3 V	Fig. 3-1 (A)	-3.000000 V 3.000000 V 0.000000 V	-3.000000 V 3.000000 V 0.000000 V	DCV;RANGE 2 CAL FIRST,3 CAL SECOND,-3 CAL LAST,0
30 V	Fig. 3-1 (B)	-30.00000 V 30.00000 V 00.00000 V	-30.00000 V 30.00000 V 00.00000 V	DCV;RANGE 3 CAL FIRST,30 CAL SECOND,-30 CAL LAST,0
300 V	Fig. 3-1 (B)	-300.0000 V 300.0000 V 000.0000 V	-300.0000 V 300.0000 V 000.0000 V	DCV;RANGE 4 CAL FIRST,300 CAL SECOND,-300 CAL LAST,0

^a When sending GPIB commands for dc volts calibration, the dc calibrator output voltage must be set to positive first, negative second, and zero last.

Calibration

*calibrate 4 wire with
probe comp (off) on 5700*

2. Calibrate (Resistance) Ω

- a. Select Ω function.
- b. Select Ω range of 300 Ω .
- c. Connect the DMM to the resistance calibrator as shown in Fig. 3-2 (A).
- d. Select Program 36. The display prompts:
190.0000 Ω .
- e. Set the resistance calibrator to 190.0000 Ω . Allow a few seconds for the resistance to stabilize.
- f. Press the ENTER key. The display prompts:
000.0000 Ω .
- g. Set the resistance calibrator to SHORT (0 Ω). Allow a few seconds for the resistance to stabilize.
- h. Press the ENTER key. The Ω calibration points are updated (stored) for the selected range and the Ω function returns to normal.
- i. Repeat steps d through h for the remaining ^{ohms} ~~DCV~~ ranges using Table 3-3 and Fig. 3-2 as a guide.

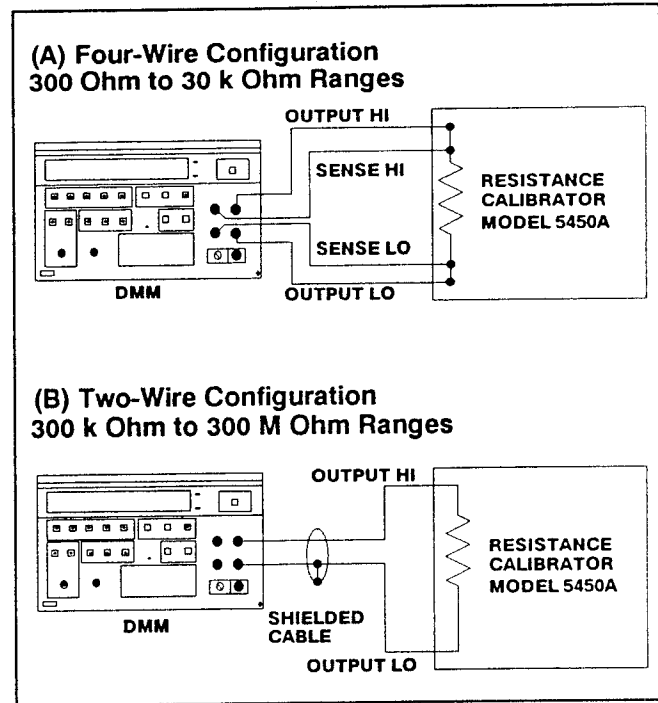


Fig. 3-2. Resistance Calibration Configuration.

MUST USE these settings - Probe Comp ON 5700 (OFF)

**Table 3-3
RESISTANCE CALIBRATION**

DMM Range	Set Up	DMM Calibration Point	Resistance Calibrator Setting	IEEE-488 Bus Command
300 Ω	Fig. 3-2 (A)	190.0000 Ω 000.0000 Ω	190 Ω Short (0 Ω)	OHMS;RANGE 1 CAL FIRST,190 CAL LAST,0
3 kΩ	Fig. 3-2 (A)	1.900000 kΩ 0.000000 kΩ	1.9 kΩ Short (0 Ω)	OHMS;RANGE 2 CAL FIRST,1.9E3 CAL LAST,0
30 kΩ	Fig. 3-2 (A)	19.000000 kΩ 00.000000 kΩ	19 kΩ Short (0 Ω)	OHMS;RANGE 3 CAL FIRST,19E3 CAL LAST,0
300 kΩ	Fig. 3-2 (B)	190.0000 kΩ 000.0000 kΩ	190 kΩ Short (0 Ω)	OHMS;RANGE 4 CAL FIRST,190E3 CAL LAST,0
3 MΩ	Fig. 3-2 (B)	1.900000 MΩ 0.000000 MΩ	1.9 MΩ Short (0 Ω)	OHMS;RANGE 5 CAL FIRST,1.9E6 CAL LAST,0
30 MΩ	Fig. 3-2 (B)	19.000000 MΩ 00.000000 MΩ	19 MΩ Short (0 Ω)	OHMS;RANGE 6 CAL FIRST,19E6 CAL LAST,0
300 MΩ	Fig. 3-2 (B)	100.000 MΩ 000.000 MΩ	100 MΩ Short (0 Ω)	OHMS;RANGE 7 CAL FIRST,100E6 CAL LAST,0

change the cal point from 190 mΩ to 100 with the keyboard on the front of the meter. Calibration will not be correct if this is not done.

Calibration

3. Calibrate AC Volts

- a. Select ACV function.
- b. Select ACV range of 300 mV.
- c. Connect the DMM to the AC calibrator as shown in Fig. 3-3.
- d. Select Program 36. The display prompts:
300.0000 mV.
- e. Set the AC calibrator output to 300 mV at 500 Hz. Allow a few seconds for the voltage to stabilize.
- f. Press the ENTER key. The display prompts:
030.0000 mV.
- g. Set the AC calibrator output to 30.000 mV at 500 Hz. Allow a few seconds for the resistance to stabilize.
- h. Press the ENTER key. The ACV calibration points are updated (stored) for the selected range and the ACV function returns to normal.
- i. Repeat steps d through h for the remaining ACV ranges using Table 3-4 and Fig. 3-3 as a guide.

NOTE

The AC Volts calibration is not complete until step 4 (below) is performed.

4. Check/Adjust AC Volts at 70 kHz

- a. Set ACV range to AUTO.
- b. Select Program 2 and set digits to 5 1/2.
- c. Set the AC calibrator output to 100.000 V at 70 kHz. Allow a few seconds for the voltage to stabilize.
- d. CHECK—display reading is 100.000 V \pm 1.500 V. If it is, continue with the next step. If not, skip to step g.
- e. Set the AC calibrator output to 10.0000 V at 70 kHz. Allow a few seconds for the voltage to stabilize.
- f. CHECK—display reading is 10.0000 V \pm 0.1500. If it is, the ACV function calibration is complete. If not continue with step g.

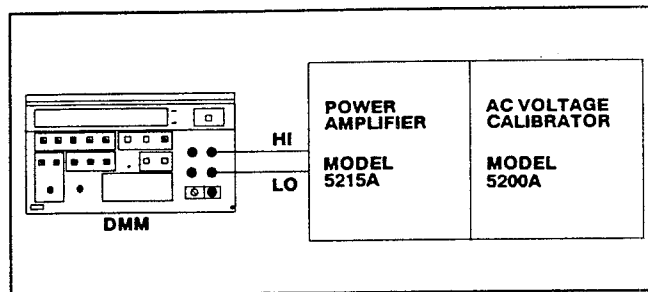


Fig. 3-3. AC Volts Calibration Configuration.

- g. Disconnect ac power to the DMM.
- h. Remove the DMM from its power module and reconnect it through the extender cables listed in Table 3-1.

WARNING

To avoid electric shock hazard, do not touch exposed circuitry. The shield on the analog board is at input low potential and can have up to 500 V on it. Use an insulated alignment tool to make the following adjustments.

- i. Turn on the DMM.
- j. Select Program 2 and set digits to 5 1/2.
- k. Select ACV function.
- l. Select ACV range of 300 V.

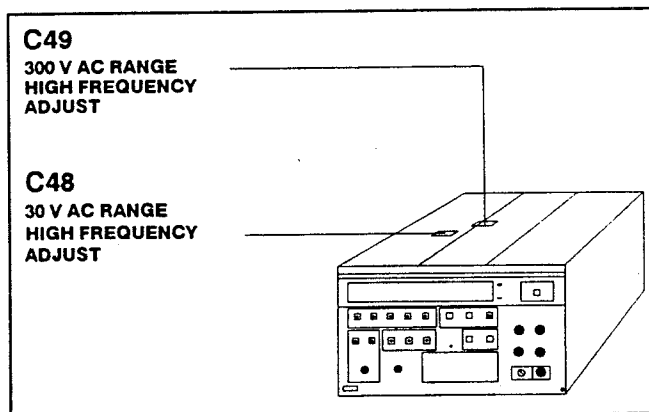


Fig. 3-4. AC Volts High Frequency Adjustments.

m. Set the AC calibrator output to 100.000 V at 70 kHz. Allow a few seconds for the voltage to stabilize.

n. ADJUST-C49 (Fig. 3-4) for a display reading of 100.000 V \pm 0.250 V.

o. Select ACV range of 30 V.

p. Set the AC calibrator output to 10.0000 V at 70 kHz. Allow a few seconds for the voltage to stabilize.

q. ADJUST-C48 (Fig. 3-4) for a display reading of 10.0000 V \pm 0.0250 V.

r. Repeat steps m through q until no adjustment is necessary.

Table 3-4
AC VOLTS CALIBRATION

DMM ACV Range	DMM Calibration Point	AC Calibrator Voltage Setting @ 500 Hz	IEEE-488 Bus Command
300 mV	300.000 mV 030.000 mV	300.000 mV 30.000 mV	ACV;RANGE 1 CAL FIRST,300E-3 CAL LAST,30E-3
3 V	3.00000 V 0.30000 V	3.00000 V 0.300000 V	ACV;RANGE 2 CAL FIRST,3 CAL LAST,300E-3
30 V	30.0000 V 3.0000 V	30.0000 V 3.00000 V	ACV;RANGE 3 CAL FIRST,30 CAL LAST,3
300 V	300.000 V 30.000 V	300.000 V 30.0000 V	ACV;RANGE 4 CAL FIRST,300 CAL LAST,30

Calibration

5. Calibrate DC Current

- a. Select DCA function.
- b. Select DCA range of 300 μA .
- c. Connect the DMM to the DC current calibrator (Fig. 3-5).
- d. Select Program 36. The display prompts:
300.000 μA .
- e. Set the DC current calibrator to 300.000 μA . Allow a few seconds for the voltage to stabilize.
- f. Press the ENTER key. The display prompts:
000.000 μA .
- g. Set the DC current calibrator to 000.000 μA . Allow a few seconds for the voltage to stabilize.

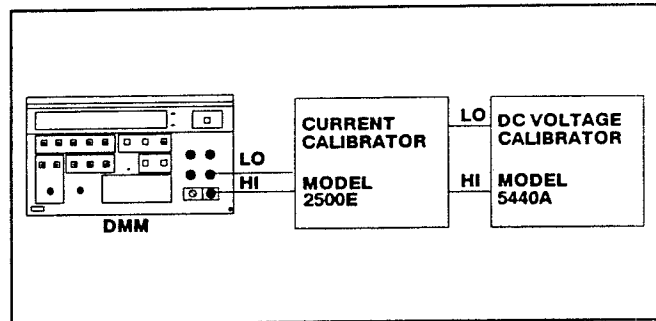


Fig. 3-5. DC Current Calibration Configuration.

- h. Press the ENTER key. The DCA calibration points are updated (stored) for the selected range and the DCA function returns to normal.
- i. Repeat steps d through h for the remaining DCA ranges using Table 3-5 as a guide.

Table 3-5
DC CURRENT CALIBRATION

DMM DCA Range	DMM Calibration Point	DC Current Calibrator Output	IEEE-488 Bus Command
300 μA	300.000 μA 000.000 μA	300.000 μA 000.000 μA	DCA;RANGE 1 CAL FIRST,300E-6 CAL LAST,0
3 mA	3.00000 mA 0.00000 mA	3.00000 mA 0.00000 mA	DCA;RANGE 2 CAL FIRST,3E-3 CAL LAST,0
30 mA	30.0000 mA 00.0000 mA	30.0000 mA 00.0000 mA	DCA;RANGE 3 CAL FIRST,30E-3 CAL LAST,0
300 mA	300.000 mA 000.000 mA	300.000 mA 000.000 mA	DCA;RANGE 4 CAL FIRST,300E-3 CAL LAST,0
3 A	3.00000 A 0.00000 A	3000.00 mA 0000.00 mA	DCA;RANGE 5 CAL FIRST,3 CAL LAST,0

6. Calibrate AC Current

- a. Select ACA function.
- b. Select ACA range of 300 μ A.
- c. Connect the DMM to the AC current calibrator (Fig. 3-6).
- d. Select Program 36. The display prompts:
300.000 μ A.
- e. Set the AC current calibrator to 300.000 μ A at a frequency of 500 Hz. Allow a few seconds for the voltage to stabilize.
- f. Press the ENTER key. The display prompts:
030.000 μ A.
- g. Set the AC current calibrator to 030.000 μ A at 500 Hz. Allow a few seconds for the voltage to stabilize.
- h. Press the ENTER key. The ACA calibration points are updated (stored) for the selected range and the ACA function returns to normal.

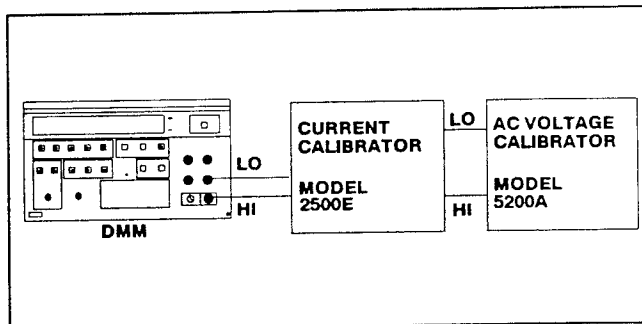


Fig. 3-6. AC Current Calibration Configuration.

- i. Repeat steps d through h for the remaining ACA ranges using Table 3-6 as a guide.

7. Disable Calibration Mode

After completing calibration, press the CAL LOCK switch with a small screwdriver to turn off the CAL LOCK indicators in the display. Place a dated calibration sticker over the CAL LOCK switch access hole.

Table 3-6
AC CURRENT CALIBRATION

DMM ACA Range	DMM Calibration Point	Current Calibrator Output @ 500 Hz	IEEE-488 Bus Command
300 μ A	300.000 μ A 030.000 μ A	300.000 μ A 030.000 μ A	ACA;RANGE 1 CAL FIRST,300E-6 CAL LAST,30E-6
3 mA	3.00000 mA 0.30000 mA	3.00000 mA 0.30000 mA	ACA;RANGE 2 CAL FIRST,3E-3 CAL LAST,300E-6
30 mA	30.0000 mA 03.0000 mA	30.0000 mA 03.0000 mA	ACA;RANGE 3 CAL FIRST,30E-3 CAL LAST,3E-3
300 mA	300.000 mA 030.000 mA	300.000 mA 030.000 mA	ACA;RANGE 4 CAL FIRST,300E-3 CAL LAST,30E-3
3 A	3.00000 A 0.30000 A	3000.00 mA 0300.00 mA	ACA;RANGE 5 CAL FIRST,3 CAL LAST,300E-3

Section 4 MAINTENANCE

General Information

Introduction

This section of the manual provides maintenance instructions and serving information for the DM 5120 and the DM 5520 (and power module).

WARNING

Dangerous potentials exist at several points throughout the instrument and power module. When the power module must be operated with the cabinet removed, do not touch exposed connections or components. Disconnect power before cabinet removal, cleaning, or replacing parts.

Static-Sensitive Components

CAUTION

Static discharge may damage semiconductor components 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 grounded 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. Allow nothing capable of generating or holding a static charge 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 4-1
RELATIVE SUSCEPTIBILITY TO STATIC
DISCHARGE DAMAGE**

Semiconductor Classes	Relative Susceptibility Levels ^a
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

^aVoltage 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.)

Maintenance

Cleaning Instructions

This instrument should be cleaned as often as operating conditions require. Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. Remove dirt that remains with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

CAUTION

To clean the front panel use freon, isopropyl alcohol, or denatured ethyl alcohol. Do not use petroleum based cleansing agents. Do not use air or any solvent to clean the Display (front panel) board. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in²) or use a soft brush or cloth dampened with a mild detergent and water solution.

Hold the board such that the residue runs away from the connectors. Do not scrape or use an eraser to clean the edge connector contacts. Abrasive cleaning can remove the gold plating.

CAUTION

Circuit boards and components must be dry before applying power.

Obtaining Replacement Parts

Electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained from a local commercial source. Before purchasing or ordering parts from a source other than Tektronix, Inc., 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 to include all of the following information.

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.

Soldering Techniques

WARNING

To avoid electric shock hazard, disconnect the instrument from the power source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision electronic equipment should be used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made.

When soldering on circuit boards or small wiring, use only a 15 watt, pencil type iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material and melt the insulation from small wiring. Always keep the soldering iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to remove the component or to make a good solder joint. To protect heat sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint. Use a solder removing wick to remove excess solder from connections or to clean circuit board pads.

Semiconductors

To remove the in-line integrated circuits installed in sockets, use an extracting tool. This tool is available from Tektronix, Inc.; order Tektronix Part Number 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the integrated circuit. Try to avoid disengaging one end before the other. IC's that are soldered in should be carefully unsoldered, using commercially available de-soldering tools. If these tools are not available, the pins in the IC may be clipped with diagonal cutters, and the pins then individually removed from the board.

Disassembly Instructions

WARNING

To avoid electric-shock hazard, disconnect the power source and other instrumentation connected to the instrument before disassembly.

NOTE

To disassemble the DM 5120/5520, refer to the following removal procedures and exploded views in the Replaceable Mechanical Parts section at the back of this manual.

DM 5520 Only—Power Module Disassembly

Power Module Cabinet Removal

Remove the Phillips screw from the bottom front edge of the cabinet. It is located just to the left of the cabinet bottom seam.

Pull on the two release latch handles to slide the DMM out of the cabinet.

Before removing the cabinet, turn the power switch off and disconnect the line voltage cord. Remove any plug-in modules and the handle assembly.

Two screws on each side and two screws on the bottom secure the cabinet to the 620-0046-00 front casting. Each guide rail is attached to the front casting via a screw. Additionally, four screws located on the bottom and two screws on the back hold the power supply to the cabinet. Remove the screws and slide the power supply assembly out through the front of the cabinet. Reinstall the cabinet to protect the interior from dust and to remove personnel shock hazards.

Power Module Board Removal

1. Remove the power supply assembly from the power module. Refer to Cabinet Removal in this section of the manual for instructions.
2. On the power supply assembly, remove the screws on each side and on the bottom that secure the series-pass transistor clamp. Remove the clamps.
3. Remove the six screws on the interface connector side of the power supply assembly that secure the circuit board to the chassis.

4. Disconnect from the circuit board the three connectors going to the transformer.
5. Slide the circuit board out of the power supply assembly.

Voltage Selector/Fuse Holder Assembly Removal

1. Remove the cabinet. Refer to DM 5520 Power Module Cabinet Removal in this section of the manual.
2. Disconnect the connectors from the terminals on the back of the voltage selector/fuse holder assembly, labeling each wire.

NOTE

The assembly has a locking tab on the top and bottom sides that secure it in the chassis hole. Do not apply excessive force to the locking tabs. Excessive pressure will reduce the strength of the plastic material.

3. Push the top tab in carefully, pulling gently on the assembly from the outside. That side of the assembly will be released. Repeat to release the bottom side. Pull the assembly through the chassis hole to the outside, taking care not to damage the capacitors.

Series Pass Transistor Replacement

NOTE

A new adhesive insulator plate must be applied to the transistor before installation. To maintain proper insulating characteristics, do not reuse the insulating plate from the transistor being replaced.

To replace a series pass transistor, remove the cabinet; then remove the circuit board. Refer to Cabinet Removal and Circuit Board Removal in this section of the manual.

1. Unsolder and remove the transistor being replaced, from the circuit board.
2. Carefully bend the new transistor leads according to the dimensions in Fig. 3-1.
3. Apply a new adhesive insulator plate to the transistor side having exposed metal.
4. Reinstall the circuit board into the power supply assembly.

Maintenance

5. Insert the leads of the replacement transistor into the circuit board holes, with the insulating plate facing the metal chassis.
6. Reinstall the transistor clamp.
7. Solder the transistor onto the board, applying minimum heat.
8. Reinstall the assembly into the power module cabinet. Reinstall the handle assembly.

Side Cover Removal

The two side panels are snapped into the top and bottom rails of the DM 5120/5520. To aid removal, there are cutouts along each of long edges of covers. To remove, insert tweezers or a small straight-edged screwdriver into the cutout near the back edge of the cover, and carefully pry the cover away from the rail.

To replace covers, insert the front edge of the cover into the groove along the inside edge of the front frame assembly. Then press the cover down over the rails.

Internal Fuse Replacement

Remove the DM 5120 or DM 5520 from its power module. The fuses are located under the cover on the right side of the DMM (as you face the front of the unit).

Three fuses are located toward the rear of the exposed circuit board, mounted in fuse holders. To remove a fuse, carefully pull it out of the fuse holder. Correct fuse values are marked on the circuit board. Replacement fuses are:

- 1 A, 250 V, 3 AG, fast blow, Tektronix Part No. 159-0019-00
- 3/8 A, 250 V, 3 AG, slow blow, Tektronix Part No. 159-0200-00

After fuse replacement, re-install the side cover.

Release Latch Handle and Slider Removal

All plastic parts of the latch assemblies and the return springs are individually replaceable. However, if a latch tension spring becomes damaged, the bottom frame rail assembly that it is attached to must be replaced.

1. Remove the side panel from the DM 5120/5520.
2. Pull the release latch handle out about 1/8" and hold.
3. Using a small screwdriver, move the release latch slider forward slightly while pushing down on the release latch handle to free the handle shaft from the slider. Pull out on handle to remove.
4. To repair the release latch assembly, remove the bottom rail that it is fastened to. The rails are held with screws into the front and rear panel assemblies and the Digital board.
5. To replace the release latch handle, push the handle shaft through slot in the front panel as far as it will go and hold it. Using a small screwdriver move the release latch slider forward and the handle upward until the T-shaped end of handle engages the end of the slider.

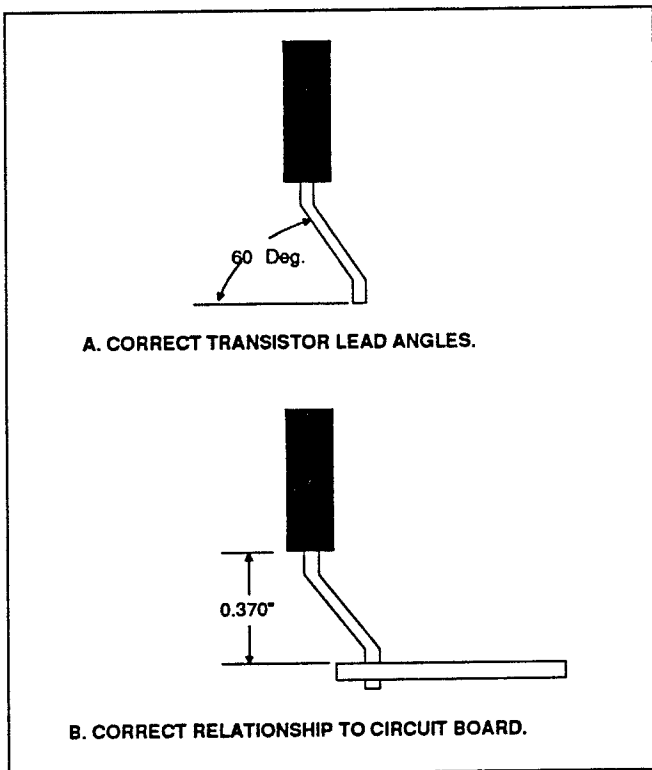


Fig. 4-1. Series Pass Transistor Replacement.

Rear Panel Removal

1. Remove side covers.
2. Unplug the power and GPIB cables from the Digital board.
3. Remove the four screws holding the rear panel to the top frame assembly.
4. Remove the four studs holding the rear panel to the bottom chassis assembly. (Use a 3/16" hex wrench.)
5. Remove the rear panel.
6. Reassemble in reverse order.

Front Frame Assembly Removal

1. Remove side panels.
2. Remove the two release latch handles. See removal procedure described above.
3. Unplug two cables from the Digital board and five wires from the Analog board.
4. Remove the ground post from the lower right corner of the front panel. Remove the knurled nut. Unscrew the ground post by inserting a thin point tool (such as a scribe) into the wire hole in the ground post shaft, and turning it counterclockwise.
5. Remove 12 screws (6 on top and 6 on bottom) holding the front panel assembly to the top and bottom frame assemblies.
6. Remove the front frame assembly.
7. Reassemble in reverse order.

Display Board Assembly (A10) Removal

NOTE

The Display board can be removed by first removing the front frame assembly or, by removing the Analog board as described below.

1. Remove side panels.
2. Unplug two cables from the Digital board.
3. Remove five screws holding the Display board to the front frame assembly.

4. Carefully move the Display board away from the front frame to clear the push buttons and remove the Display board from the instrument.
5. Reassemble in reverse order.

Digital Board Assembly (A20) Removal

1. Remove side panels.
2. Unplug five connectors from the top of the Digital board, two from the front panel and two from the rear panel, and one from the Analog board.
3. Lay the instrument on its right side with the bottom facing you.
4. Remove the five screws holding the Digital board to the bottom frame assembly. Hold the board as you remove the last screw to prevent the board from slipping.
5. Carefully lift the Digital board straight up and out of the instrument.
6. Reassemble in reverse order.

Analog Board Assembly (A30) Removal

1. Remove side panels.
2. Unplug from the Analog board the five wires attached to the input connectors.
3. Unplug from the Digital board the 8-wire connector coming from the Analog board.
4. Lay the instrument on its right side with the top facing you.
5. Remove the five flat-head screws holding the Analog board to the top frame assembly.
6. Carefully lift the Analog board out of the instrument.
7. The Analog board can be completely exposed by removing the four screws holding the Analog board between the two shields.
8. Reassemble in reverse order.

Troubleshooting

The troubleshooting information contained in this section is intended to aid qualified service personnel to isolate a defective circuit or circuit section. To aid in troubleshooting, schematic diagrams and component location drawings are located in subsequent sections of this manual.

Disassembly for Troubleshooting

To gain access to the circuitry on most circuit boards you will have to remove the boards and reconnect the cables outside of the instrument frame. Refer to the disassembly instructions in this section to remove a board, then appropriately support the board and reconnect the cables.

Recommended Test Equipment

Table 4-2 lists the test equipment recommended for troubleshooting the DM 5120/5520. Other equipment such as logic analyzers and capacitance meters could also be helpful, especially in difficult situations.

In addition you will need extender cables (see Table 3-1 for part numbers) for operating the instrument outside of the power module.

**Table 4-2
RECOMMENDED TROUBLESHOOTING
EQUIPMENT**

Equipment	Use
Five function DMM with 0.1% DCV accuracy, 10 M ohm input impedance	Power supply and DC voltage checks; analog signal tracing continuity, logic levels.
Dual-trace, triggered sweep oscilloscope, dc to 50 Mhz	Digital and analog waveform checks.
Digital frequency counter	Checking clock frequencies.
TM 5003 or TM 5006 Power Module	Power for DM 5120 only

Power Up Self Test

Upon power up, the instrument will do a number of tests on itself. Tests are performed on memory (ROM, RAM and E²PROM). Whenever one of the memory tests fails, the instrument will lock up and must be repaired. If all the tests pass, then the current IEEE address and software revision level of the instrument will be displayed. Immediately after turning on the DM 5120/5520, the following sequence will take place:

1. A digital check will be performed on the ROM circuitry. If the test fails, the instrument will lock up with the following message displayed:
OOOOOOOOOO
Replacing U4 may resolve the problem.
2. If the ROM passes, a digital self-test will then be performed on the RAM circuitry. If the RAM test fails, the instrument will lock up with the following error message displayed:
AAAAAAAAAA
Replacing U9 may resolve the problem.
3. Finally, the E²PROM circuitry where the calibration constants, IEEE address and line frequency settings are stored will be checked. If this test fails, the following message is displayed:
UNCAL
Pressing any front panel key will return the instrument to normal operation however, a complete calibration will have to be performed, and the IEEE address and line frequency setting should be checked. If the test still fails after calibration, try replacing U20 and recalibrating the instrument.
4. The instrument will then go to the power up default function.

Program 33—Self Diagnostic Program

This front panel program performs a display test and the same memory tests performed upon power up. Also included is a troubleshooting test mode, that is designed to switch on various switching FETs and relays to allow signal tracing through the instrument. Perform the following procedure to utilize Program 33:

1. Press the PROGRAM key and then the 3 and 3 numeric keys. The display test is first. Segments of the display characters will be sequentially displayed for a short time. The front panel LEDs will also be on during this test. This test allows the operator to note inoperative display segments or LEDs. Self test on the ROM, RAM, and E²PROM will then be performed. These are the same tests

- run on power up and are explained in detail under Power Up Self Test above.
- The DM 5120/5520 will now go into the troubleshooting mode with the first N mode being displayed as follows:
N 01
The instrument is still on the same function and range as it was before Program 33 was run.
 - Using Table 4-3, reference the N mode to the current function and range to determine the proper working status of the listed circuit components.
 - To change the N mode, use the ENTER button.
 - To troubleshoot a difference function and/or range, exit the program by pressing any front panel key (except ENTER), select the desired function and/or range and again run Program 33.

Table 4-3
DM 5120/5520 TROUBLESHOOTING MODE

Function & Range	Measurement Phase	N Mode	Input Buffer Gain	Relays Closed	Range Switches Closed	Multiplex Switches Closed
300 mV DC	SIG NULL	01	X10	K1	Q11, U22A	Q34
	CAL NULL	02	X1	K1	Q11, U22A	U25D, Q32
	CAL	03	X1	K1	Q11, U22A	U25C, Q32
	SIG	04	X10	K1	Q11, U22A	Q30
3 V DC	SIG NULL	01	X1	K1	Q11, U22A	Q33
	CAL NULL	02	X1	K1	Q11, U22A	U25D, Q32
	CAL	03	X1	K1	Q11, U22A	U25C, Q32
	SIG	04	X1	K1	Q11, U22A	Q30
30 V DC	SIG NULL	01	X1	—	Q13, Q11, U22A	Q33
	CAL NULL	02	X1	—	Q13, Q11, U22A	U25D, Q32
	CAL	03	X1	—	Q13, Q11, U22A	U25C, Q32
	SIG	04	X1	—	Q13, Q11, U22A	Q35
300 V DC	SIG NULL	01	X1	—	Q3, Q11, U22A	Q34
	CAL NULL	02	X1	—	Q3, Q11, U22A	U25D, Q32
	CAL	03	X1	—	Q3, Q11, U22A	U25C, Q32
	SIG	04	X1	—	Q3, Q11, U22A	Q35
300 mV AC	ZERO	01	X1	K4, K5	U21A, U21B	U25D, Q32
	CAL	02	X1	K4, K5	U21A, U21B	U25C, Q32
	SIG	03	X1	K4, K5	U21A, U21B	U25C, Q32
	No Test	04	—	—	—	—
3 V AC	ZERO	01	X1	K4, K5	U21C	U25D, Q32
	CAL	02	X1	K1, K5	U21C	U25C, Q32
	SIG	03	X1	K1, K5	U21C	U25C, Q32
	No Test	04	—	—	—	—
30 V AC	ZERO	01	X1	K4	U21A, U21B	U25D, Q32
	CAL	02	X1	K4	U21A, U21B	U25C, Q32
	SIG	03	X1	K4	U21A, U21B	U25C, Q32
	No Test	04	—	—	—	—
300 V AC	ZERO	01	X1	K4	U23C, U23B	U25D, Q32
	CAL	02	X1	K4	U23C, U23B	U25C, Q32
	SIG	03	X1	K4	U23C, U23B	U25C, Q32
	No Test	04	—	—	—	—

Table 4-3 (Cont)
DM 5120/5520 TROUBLESHOOTING MODE

Function & Range	Measurement Phase	N Mode	Input Buffer Gain	Relays Closed	Range Switches Closed	Multiplex Switches Closed
300 Ω	SENSE LO	01	X10	K2, K3	Q11, U22D, U24D	U22B, Q32
	REF HI	02	X1	K2, K3	Q11, U22D, U24D	Q35, Q12
	REF LO	03	X1	K2, K3	Q11, U22D, U24D	U25A, Q32
	SENSE HI	04	X10	K2, K3	Q11, U22D, U24D	Q30
3 K	SENSE LO	01	X1	K2, K3	Q11, U22D, U24D	U22B, Q32
	REF HI	02	X1	K2, K3	Q11, U22D, U24D	Q35, Q12
	REF LO	03	X1	K2, K3	Q11, U22D, U24D	U25A, Q32
	SENSE HI	04	X1	K2, K3	Q11, U22D, U24D	Q30
30 K	SENSE LO	01	X1	K2, K3	Q11, U22C, U24A	U22B, Q32
	REF HI	02	X1	K2, K3	Q11, U22C, U24A	Q35, Q12
	REF LO	03	X1	K2, K3	Q11, U22C, U24A	U25A, Q32
	SENSE HI	04	X1	K2, K3	Q11, U22C, U24A	Q30
300 K	SENSE LO	01	X1	K2, K3	Q12, Q3, U22C, U24A	U22B, Q32
	REF HI	02	X1	K2, K3	Q12, Q3, U22C, U24A	Q35
	REF LO	03	X1	K2, K3	Q12, Q3, U22C, U24A	Q34
	SENSE HI	04	X1	K2, K3	Q12, Q3, U22C, U24A	Q30
3 M	SENSE LO	01	X1	K2, K3	Q12, Q13, U22C, U24A	U22B, Q32
	REF HI	02	X1	K2, K3	Q12, Q13, U22C, U24A	Q35
	REF LO	03	X1	K2, K3	Q12, Q13, U22C, U24A	Q34
	SENSE HI	04	X1	K2, K3	Q12, Q13, U22C, U24A	Q30
30 M	SENSE LO	01	X1	K2	Q12, U22C, U24A	U22B, Q32
	REF HI	02	X1	K2	Q12, U22C, U24A	Q35
	SENSE HI	03	X1	K2	Q12, U22C, U24A	Q30
	No Test	04	—	—	—	—
300 M	SENSE LO	01	X1	K2	Q12, U22C, U24A	U22B, Q32
	REF HI	02	X1	K2	Q12, U22C, U24A	Q35
	SENSE HI	03	X1	K2	Q12, U22C, U24A	Q30
	No Test	04	—	—	—	—
300 μ A DC	SIG ZERO	01	X10	—	U23A	U25D, Q32
	CAL ZERO	02	X1	—	U23A	U25D, Q32
	CAL	03	X1	—	U23A	U25C, Q32
	SIG	04	X10	—	U23A	U24B, Q32

Table 4-3 (Cont)
DM 5120/5520 TROUBLESHOOTING MODE

Function & Range	Measurement Phase	N Mode	Input Buffer Gain	Relays Closed	Range Switches Closed	Multiplex Switches Closed
3 mA DC	SIG ZERO	01	X10	—	Q29, Q36	U25D, Q32
	CAL ZERO	02	X1	—	Q29, Q36	U25D, Q32
	CAL	03	X1	—	Q29, Q36	U25C, Q32
	SIG	04	X10	—	Q29, Q36	U24B, Q32
30 mA DC	SIG ZERO	01	X10	—	Q28, Q37	U25D, Q32
	CAL ZERO	02	X1	—	Q28, Q37	U25D, Q32
	CAL	03	X1	—	Q28, Q37	U25C, Q32
	SIG	04	X10	—	Q28, Q37	U24B, Q32
300 mA DC	SIG ZERO	01	X10	—	Q26, Q38	U25D, Q32
	CAL ZERO	02	X1	—	Q26, Q38	U25D, Q32
	CAL	03	X1	—	Q26, Q38	U25C, Q32
	SIG	04	X10	—	Q26, Q38	U24B, Q32
3 A DC	SIG ZERO	01	X10	—	Q39, Q40	U25D, Q32
	CAL ZERO	02	X1	—	Q39, Q40	U25D, Q32
	CAL	03	X1	—	Q39, Q40	U25C, Q32
	SIG	04	X10	—	Q39, Q40	U24B, Q32
300 μ A AC	ZERO	01	X1	—	U23A, U21D, U21B	U25D, Q32
	CAL	02	X1	—	U23A, U21D, U21B	U25C, Q32
	SIG	03	X1	—	U23A, U21D, U21B	U25C, Q32
	No Test	04	—	—	—	—
3 mA AC	ZERO	01	X1	—	Q29, Q36, U21D, U21B	U25D, Q32
	CAL	02	X1	—	Q29, Q36, U21D, U21B	U25C, Q32
	SIG	03	X1	—	Q29, Q36, U21D, U21B	U25C, Q32
	No Test	04	—	—	—	—
30 mA AC	ZERO	01	X1	—	Q28, Q37, U21D, U21B	U25D, Q32
	CAL	02	X1	—	Q28, Q37, U21D, U21B	U25C, Q32
	SIG	03	X1	—	Q28, Q37, U21D, U21B	U25C, Q32
	No Test	04	—	—	—	—
300 mA AC	ZERO	01	X1	—	Q26, 38, U21D, U21B	U25D, Q32
	CAL	02	X1	—	Q26, 38, U21D, U21B	U25C, Q32
	SIG	03	X1	—	Q26, 38, U21D, U21B	U25C, Q32
	No Test	04	—	—	—	—
3 A AC	ZERO	01	X1	—	Q39, 40, U21D, U21B	U25D, Q32
	CAL	02	X1	—	Q39, 40, U21D, U21B	U25C, Q32
	SIG	03	X1	—	Q39, 40, U21D, U21B	U25C, Q32
	No Test	04	—	—	—	—

Maintenance

Power Supplies

Table 4-4 shows the various checks that can be made to the power supplies of the DM 5120/5520. In addition to the normal voltage checks, it is a good idea to check the various supplies with an oscilloscope for signs of noise or oscillations.

Signal Conditioning Checks

These circuits can be checked by using the diagnostic program (Program 33) as explained above.

Digital and Display Circuitry Checks

The digital and display circuit can be checked out by using the troubleshooting data in Tables 4-5 and 4-6.

Table 4-4
POWER SUPPLY CHECKS

Step	Item/Component	Required Condition	Remarks
1	Power Module Line Switch	Set to 115 or 230 V as required.	Line voltage selection
2	Power Module Line Fuse	Check for continuity.	Remove fuse to check
3	Line Power	Plugged into live receptacle; power on.	
4	Extender Cable	Check for continuity	
5	+ 15 V Digital Supply U18, pin 3	+5 V, ± 5 V	Referenced to analog common
6	+ 15 V Analog Supply U22, pin 3	+5 V, ± 5 V	Referenced to analog common
7	± 15 V Analog Supplies U21, pin 3; U23, pin 3	+15 V, -15 V, ± 0.75 V	Referenced to analog common

**Table 4-5
DIGITAL CIRCUITRY CHECKS**

Step	Item/Component	Required Condition	Remarks
1	U4, U9, U20	Pass RAM, ROM and E ² PROM self-test on power up.	Display will lock if failure occurs
2	U8, pin 2 (PA0)	TTL level pulses every 1 ms	VIA clock
3	U8, pin 2 (PA1)	TTL level pulses every 15 ms	Data
4	U8, pin 6 (PA4)	Switch data (+5 V or 0 V)	Data input to VIA
5	U8, pin 7 (PA5)	Switch data (+5 V or 0V)	Data input to VIA
6	U8, pin 8 (PA6)	Switch data (+5 V or 0V)	Data input to VIA
7	U8, pin 7 (PA7)	Switch data (+5 V or 0V)	Data input to VIA
8	U8, pin 19	Variable pulse train (0 V to +5 V)	VIA Data Line
9	AT1, pin 6	Variable pulse train (0 V to +5 V)	Data output
10	U43, pin 13	Variable pulse train (0 V to +5 V)	Output of A/D converter
11	U8, pins 12 thru 16	Variable pulse train (0 V to +5 V)	Analog data to VIA
12	U10, pin 3	1 kHz pulses	IRQ line
13	U10, pin 37	+5 V, $\pm 5\%$	Reset line
14	U5, pin 9	+5 V signal pulsed 0 V to +5 V every 1 ms	INT line
15	U5, pin 19	+5 V (Logic "1")	RESET line
16	U5, pin 18	2 MHz square wave at 0 V to +5 V	Clock
17	U5, pin 28	Should go false (+5 V) when command is sent	ATN line Handshake sequence
18	U5, pins 28 (ATN), 24 (NDAC),	Refer to Figure 4-2 for required conditions	Handshake sequence

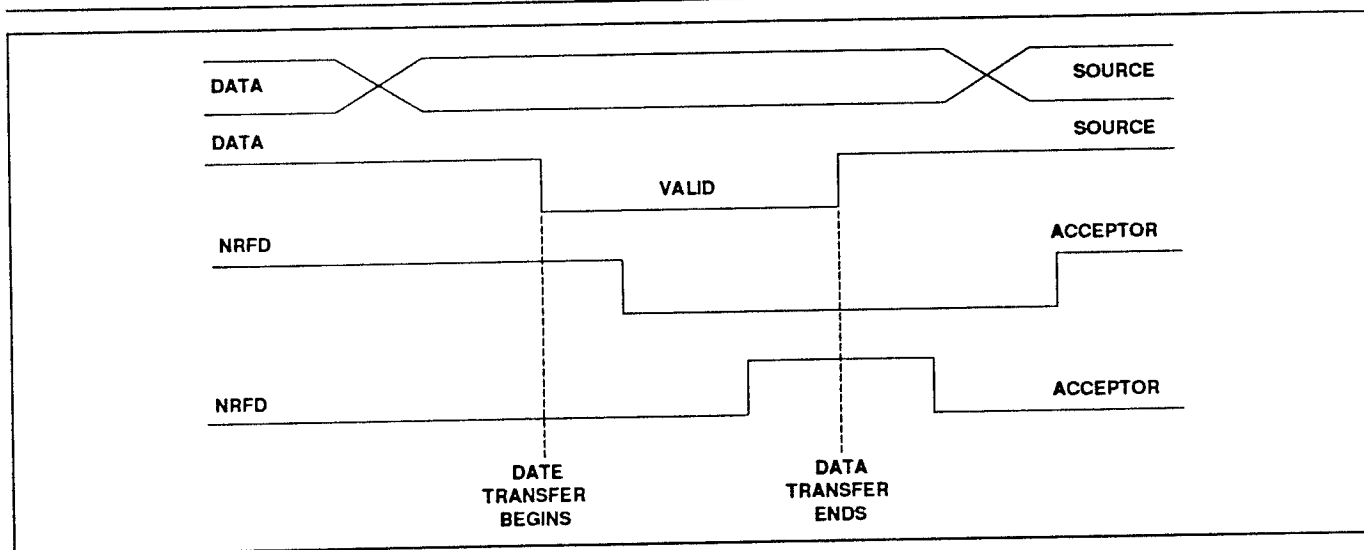


Fig. 4-2. IEEE handshake sequence.

**Table 4-6
DISPLAY CIRCUITRY CHECKS**

Step	Item/Component	Required Condition	Remarks
1	U4 and U5, pins 2, 9, 14	+5V, \pm 5%	+5 V supply
2	P14, pins 6, 11 thru 24	Variable pulses	Segment drivers
3	U1, pins 6, 16; U2, pins 4 thru 7, 14 thru 17	Variable pulses	Digital drivers
4	U5, pins 3, 4, 5, 6, 10, 11, 12; U4, PINS 1,3, 4, 5	1 ms negative going pulse every 10 ms	
5	P14, pin 7 (S0)	Press S1, S5, S12, S9, or S15 button	Pulse present when button pressed
6	P14, pin 5 (S1)	Press S2, S6, S10, S13, or S14 button	Pulse present when button pressed
7	P14, pin 3 (S2)	Press S3, S7, S11, S16, or S17 button	Pulse present when button pressed
8	P14, pin 9 (S3)	Press S4 or S8 button	Pulse present when button pressed

Section 5 OPTIONS

There are no options available for the DM 5120/5520 at this time. Future options will be listed in this section.



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.

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.

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

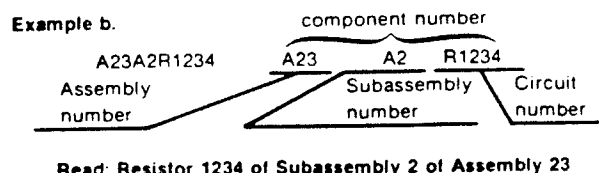
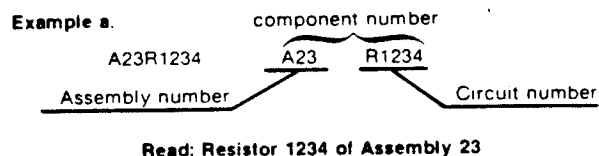
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

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:



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
Keithley	Keithley Instrument Div	28775 Aurora Road	44139 Cleveland, OH, USA

COMPONENT NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	NAME & DESCRIPTION	MFR CODE	Mfr. Part No.
A10	118-7950-00			Ckt Board Assy:Display Board	Keithley	5120-110
A20	118-7951-00			Ckt Board Assy:Digital Board	Keithley	5120-100
A30	118-7952-00			Ckt Board Assy:Analog Board	Keithley	5120-120

POWER SUPPLY

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscort	Name & Description	Mfr. Code	Mfr. Part No.
A1	671-1237-00		CIRCUIT BD ASSY:POWER SUPPLY	80009	671-1237-00
A1C1030	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C2020	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C2050	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C3010	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C3060	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C4011	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C4021	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C4030	290-1186-00		CAP,FXD,ELCTLT:4700UF,20%,50WVDC	56289	81D472M050KD5
A1C4060	290-1186-00		CAP,FXD,ELCTLT:4700UF,20%,50WVDC	56289	81D472M050KD5
A1C5010	290-1187-00		CAP,FXD,ELCTLT:18000UF,20%,16WVDC	56289	81D183M016KD5
A1C5030	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1C5050	281-0774-00		CAP,FXD,CER DI:0.022MFD,20%,100V	04222	MA201E223MAA
A1CR3031	152-0488-00		SEMICON DVC,DI:BRIDGE,SI,200V,1.5A	80009	152-0488-00
A1CR3070	152-0198-00		SEMICON DVC,DI:RECT,SI,200V,3A,A249	03508	1N5624
A1CR4010	152-0198-00		SEMICON DVC,DI:RECT,SI,200V,3A,A249	03508	1N5624
A1CR4012	152-0198-00		SEMICON DVC,DI:RECT,SI,200V,3A,A249	03508	1N5624
A1CR4020	152-0198-00		SEMICON DVC,DI:RECT,SI,200V,3A,A249	03508	1N5624
A1CR4070	152-0198-00		SEMICON DVC,DI:RECT,SI,200V,3A,A249	03508	1N5624
A1J1040	131-2484-00		TERM SET,PIN:8 PIN,INSULATED	27264	09-61-1081
A1J1070	131-1078-00		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
A1J1071	131-1078-00		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
A1J1072	131-1078-00		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
A1J2020	131-2527-00		TERM SET,PIN:HEADER,1 X 7,0.156 CTR	26742	3107-11-207-01
A1J3060	131-2789-00		CONN,RCPT,ELEC:HEADER,1 X 4,0.156 SPACING	27264	09-61-1045
A1Q2070	151-0918-00		TRANSISTOR:PNP POWER,15A,80V	80009	151-0918-00
A1Q3070	151-0917-00		TRANSISTOR:NPN POWER,15A,80V	80009	151-0917-00
A1Q5040	151-0917-00		TRANSISTOR:NPN POWER,15A,80V	80009	151-0917-00
A1R3030	303-0202-00		RES,FXD,CMPSN:2K OHM,5%,1W	01121	GB 2025
A1R3031	303-0202-00		RES,FXD,CMPSN:2K OHM,5%,1W	01121	GB 2025
A1R4040	308-0252-00		RES,FXD,WW:390 OHM,5%,3W	00213	1240S 390-5
A1R5030	303-0511-00		RES,FXD,CMPSN:510 OHM,5%,1W	01121	GB5115
A1R5031	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1R5033	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1R5034	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1VR5030	152-0512-00		SEMICON DVC,DI:ZEN,SI,9.1V,5%,1W,DO-41	12969	UZ8709
A2	671-1266-00		CIRCUIT BD ASSY:GPIB CONNECTOR	80009	671-1266-00
A2J1010	131-2542-00		CONN,RCPT,ELEC:CKT BD,24 CONTACT,RIGHT	00779	552791-2
A2J1110	131-1789-00		CONN,RCPT,ELEC:RTANG,2/10 0.025 SQ PINS	22526	65268-008
F100	159-0016-00		FUSE,CARTRIDGE:3AG,1.5,250V,FAST BLOW	71400	AGC-CW-1 1/2
FL100	119-3436-00		FILTER,ELEK:LINE FILTER W/AC CONN,ON/	80009	119-3436-00
T100	120-1772-00		TRANSFORMER,PWR:	75498	128-7065-EA
W100	196-3196-00		LEAD,ELECTRICAL:18 AWG,2.0 L,5-4	80009	196-3196-00

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:

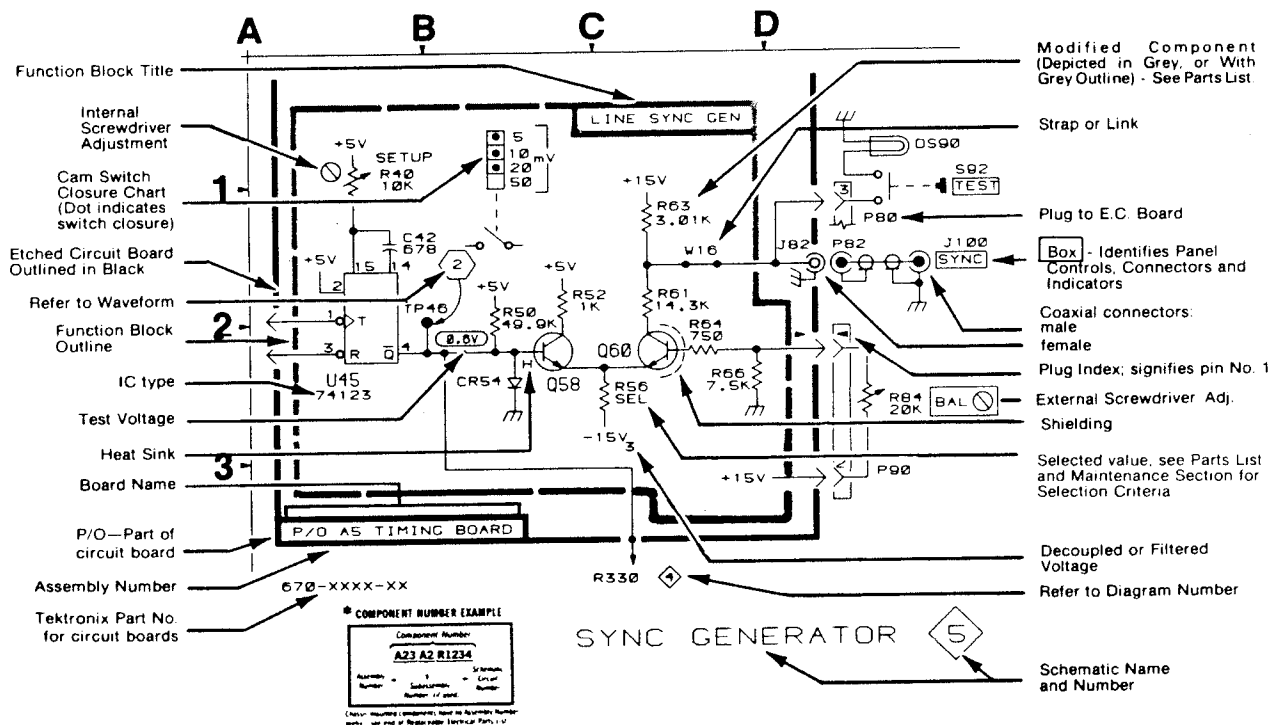
- Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μ F).
- Resistors = Ohms (Ω).

————— 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.





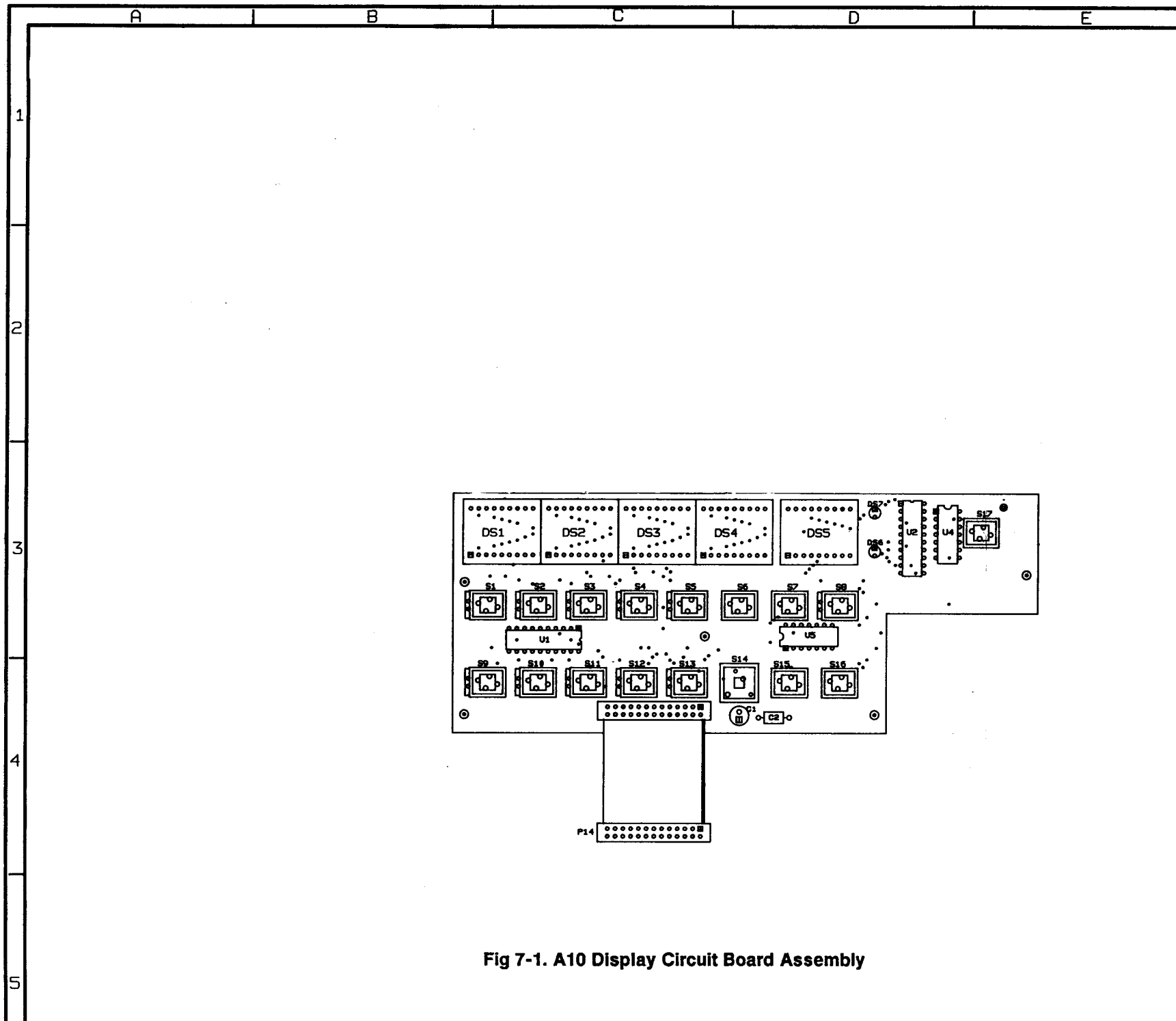
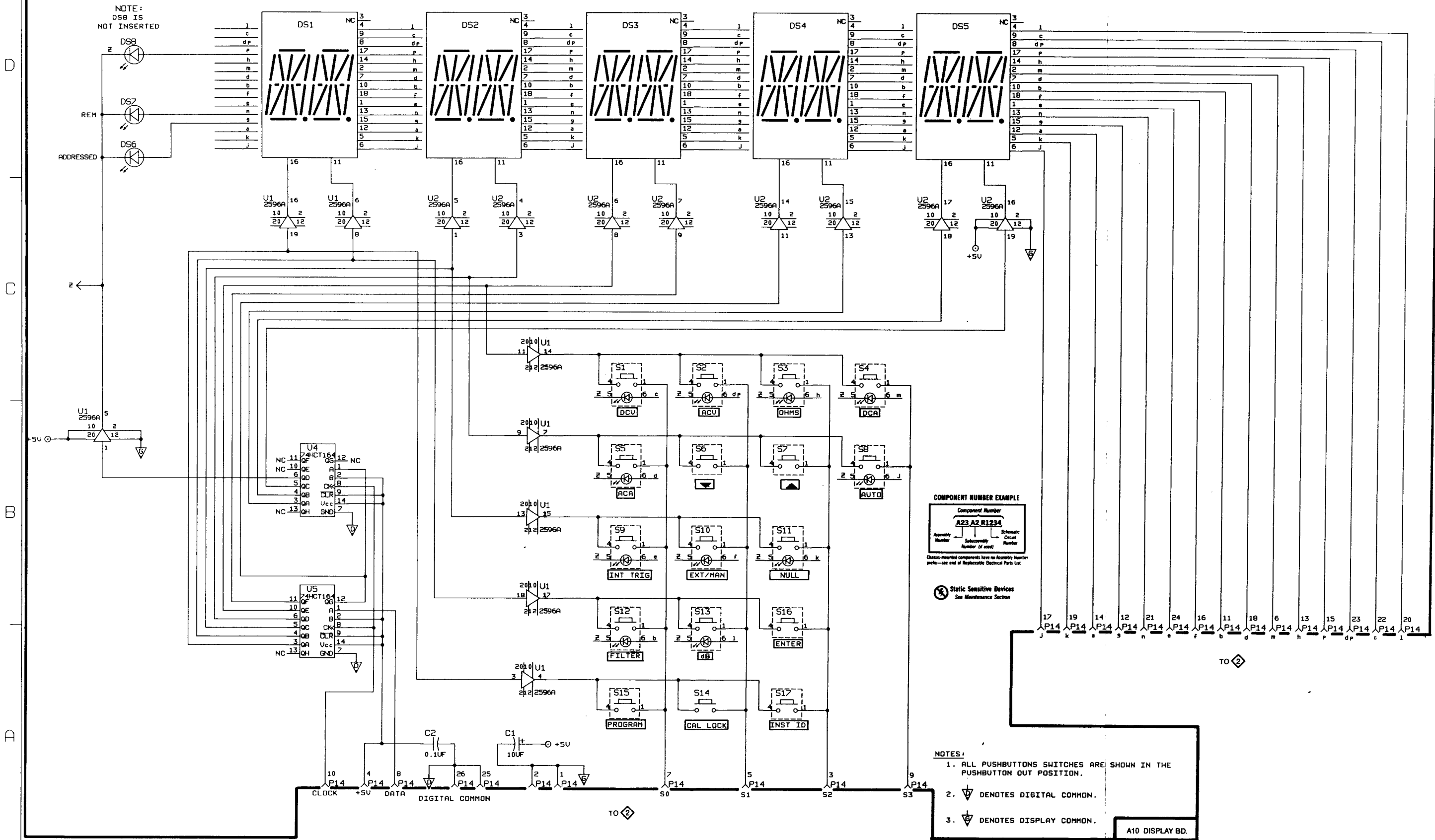


Fig 7-1. A10 Display Circuit Board Assembly

Table 7-1
FRONT PANEL & DISPLAY 1 -- DISPLAY BOARD, ASSEMBLY A10

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C1	A6	4D	S11	B4	4C
C2	A6	4D	S12	B5	4C
			S13	B5	4C
DS1	D7	3C	S14	A5	4D
DS2	D6	3C	S15	A5	4D
DS3	D5	3C	S16	B4	4D
DS4	D4	3C	S17	A4	3E
DS5	D3	3D			
DS6	D8	3D	U1A	B8	3C
DS7	D8	3D	U1B	A6	3C
DS8	D8	OFF BD.	U1C	C7	3C
			U1D	B6	3C
P14	A2	4C	U1E	C6	3C
P14	A4	4C	U1F	B6	3C
P14	A6	4C	U1G	B6	3C
			U1H	C7	3C
S1	C5	3B	U2A	C6	3D
S2	C5	3C	U2B	C6	3D
S3	C4	3C	U2C	C5	3D
S4	C4	3C	U2D	C5	3D
S5	B5	3C	U2E	C4	3D
S6	B5	3D	U2F	C4	3D
S7	B4	3D	U2G	C3	3D
S8	B4	3D	U2H	C3	3D
S9	B5	4B	U4	B7	3D
S10	B5	4C	U5	B7	35



NOTE:
DS8 IS
NOT INSERTED

COMPONENT NUMBER EXAMPLE

Component Number		
A23	A2	R1234
Assembly Number	Subassembly Number (if used)	Schematic Circuit Number

Classic inserted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

⊗ Static Sensitive Devices
See Maintenance Section

- NOTES:**
1. ALL PUSHBUTTON SWITCHES ARE SHOWN IN THE PUSHBUTTON OUT POSITION.
 2. ▽ DENOTES DIGITAL COMMON.
 3. ▽ DENOTES DISPLAY COMMON.

A10 DISPLAY BD.

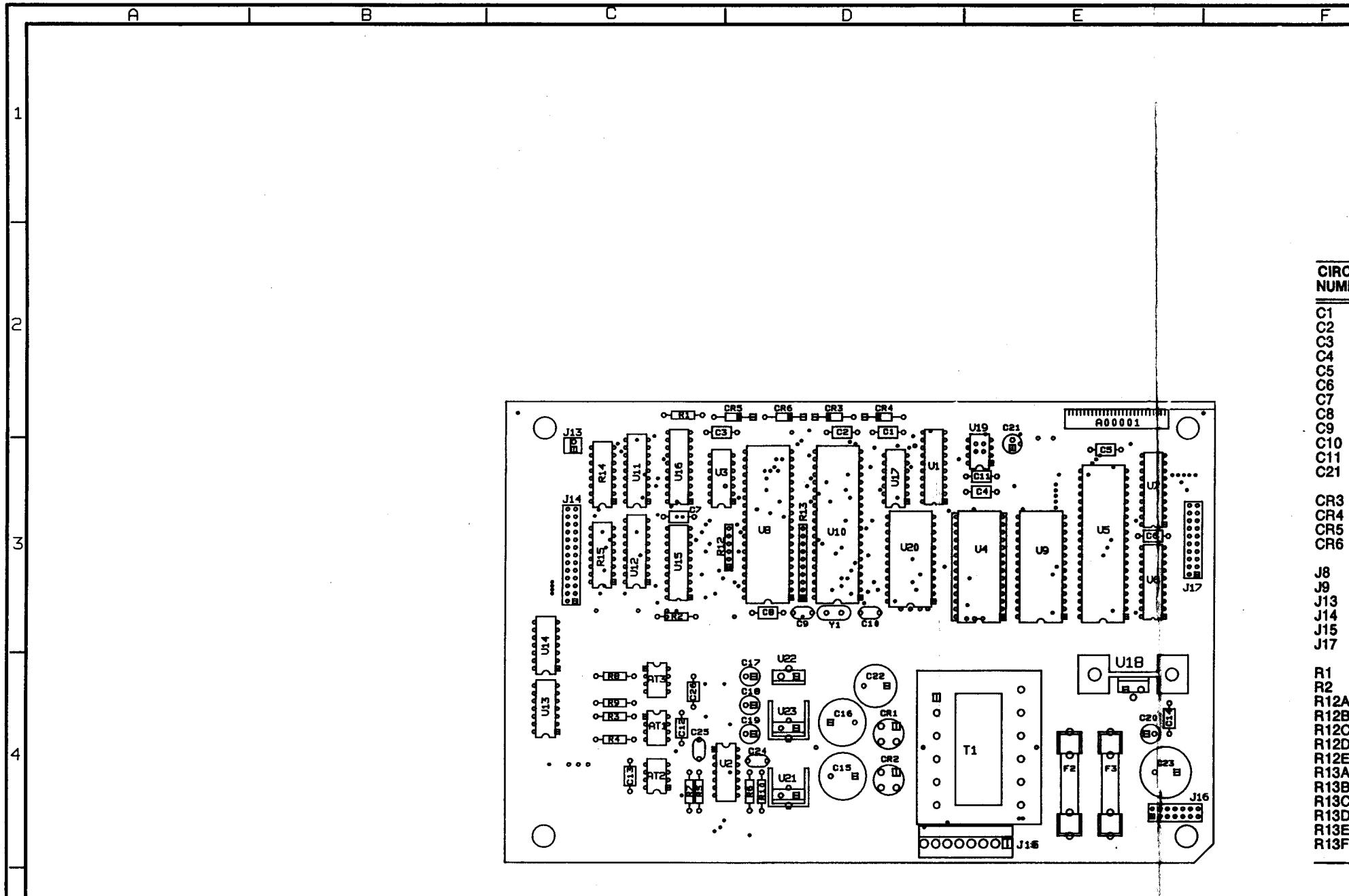


Fig 7-2. A20 Digital Circuit Board Assembly

Table 7-2
DIGITAL 1 2 — DIGITAL BOARD, ASSEMBLY A20

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C1	D7	2D	R13G	C8	3D
C2	B7	2D	R13H	A4	3D
C3	A5	2C	R14	C2	3C
C4	B6	3E	R15	B2	3C
C5	C5	3E	U1	D7	3D
C6	D1	3E	U3A	A2	3C
C7	C3	3C	U3B	A5	3C
C8	B4	3D	U4	C6	3E
C9	B8	3D	U5	D2	3E
C10	B8	3D	U6	D1	3E
C11	A8	3E	U7	D1	3E
C21	A8	3E	U8	C4	3D
CR3	A4	2D	U9	C6	3E
CR4	A4	2D	U10	C7	3D
CR5	A4	2D	U11	C5	3C
CR6	A4	2D	U12	B2	3C
J8	A4	OFF BD.	U13A	A6	4C
J9	A4	OFF BD.	U13B	A3	4C
J13	A4	3C	U13C	B6	4C
J14	C5	3C	U13D	A6	4C
J15	A4	4E	U13E	A6	4C
J17	D1	3EE	U13F	A6	4C
R1	A4	2C	U14A	B3	3C
R2	A4	3C	U14B	B2	3C
R12A	C4	3D	U14C	A6	3C
R12B	A3	3D	U14D	A6	3C
R12C	A3	3D	U14E	B3	3C
R12D	A3	3D	U14F	B2	3C
R12E	A4	3D	U15	B3	3C
R13A	C8	3D	U16	C3	3C
R13B	C8	3D	U17B	D6	3D
R13C	C8	3D	U17C	B4	3D
R13D	C8	3D	U17D	D5	3D
R13E	C8	3D	U19	A8	3E
R13F	C8	3D	U20	C6	3D
Y1	B8	3D			

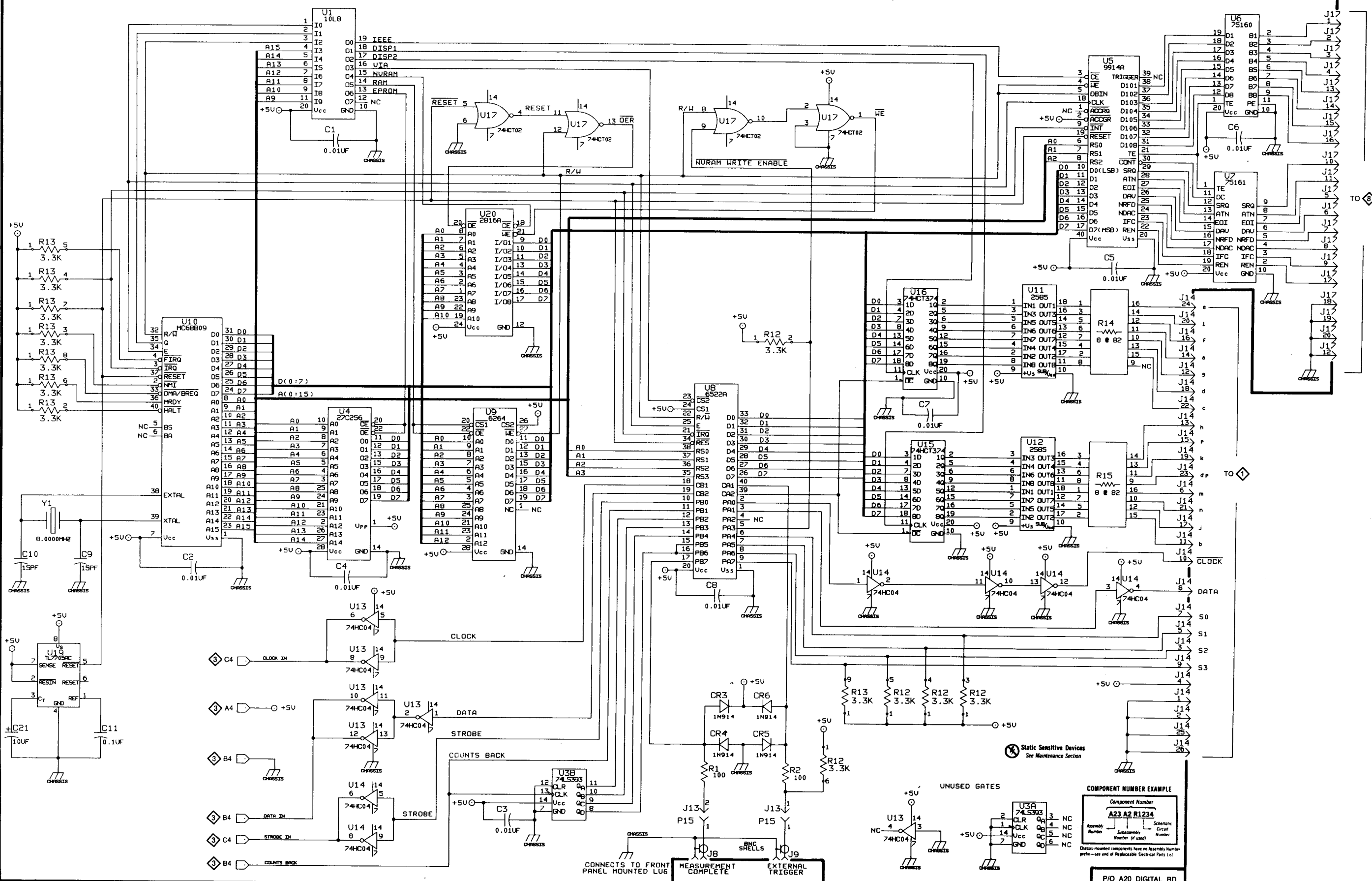
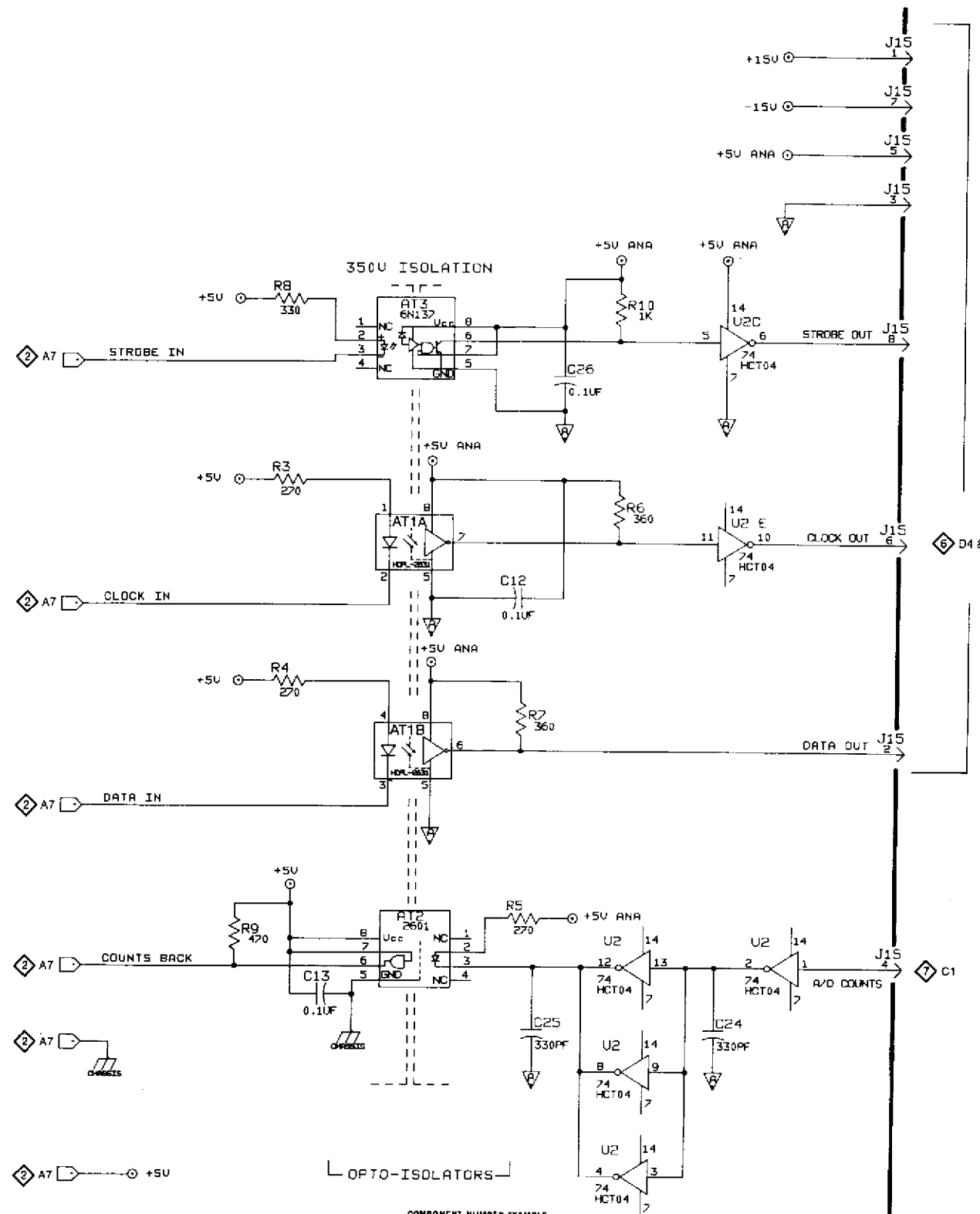
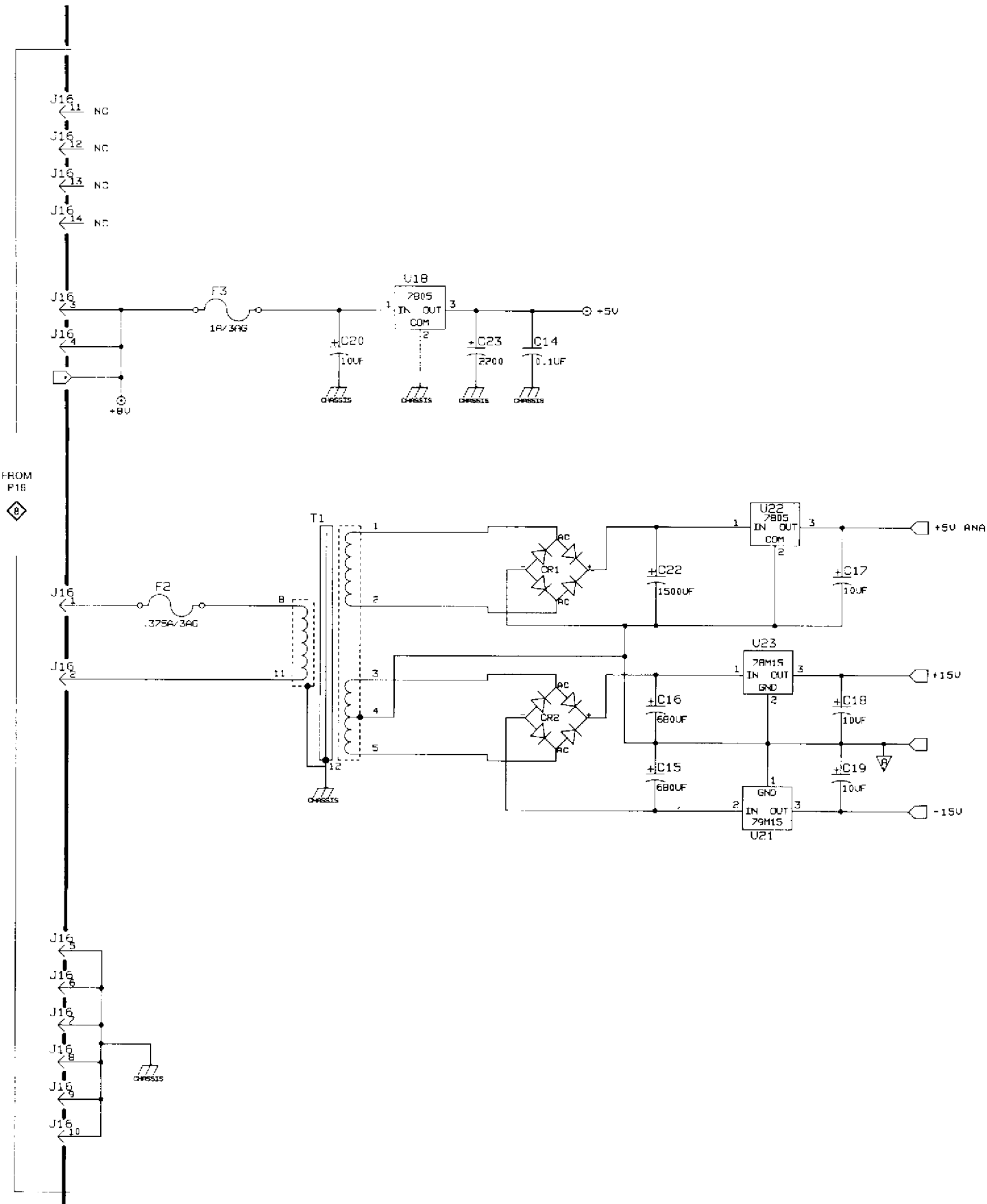


Table 7-3
POWER SUPPLY & OPTOISOLATORS, DIGITAL 2 3
DIGITAL BD., ASSEMBLY A20

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
AT1A	C3	4C	J15	D1	4E
AT1B	BB3	4C	J16	A8	4E
AT2	B3	4C	J16	D8	4E
AT3	D3	4C			
			R3	C3	4C
C12	C2	4C	R4	C3	4C
C13	B3	4C	R5	B2	4C
C14	C6	4E	R6	C2	4D
C15	B6	4D	R7	B2	4C
C16	B6	4D	R8	D3	4C
C17	C5	4D	R9	B3	4C
C18	B5	4D	R10	D2	4D
C19	B5	4D			
C20	C7	4E	T1	C7	4E
C22	C6	4D			
C23	C6	4E	U2A	B1	4C
C24	B2	4D	U2B	A2	4C
C25	B2	4C	U2C	D2	4C
C26	C2	4C	U2D	B2	4C
			U2E	C2	4C
CR1	C6	4D	U2F	B2	4C
CR2	B6	4D	U18	D7	4E
			U21	B5	4D
F2	C8	4E	U22	C5	4D
F3	D7	4E	U23	B5	4D

D
C
B
A



COMPONENT NUMBER EXAMPLE
 Component Number
A23 A2 R1234
 Assembly Number Subassembly Number (if used) Schematic Sheet Number

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

Static Sensitive Devices
 See Maintenance Section

P/O A20 DIGITAL BD.

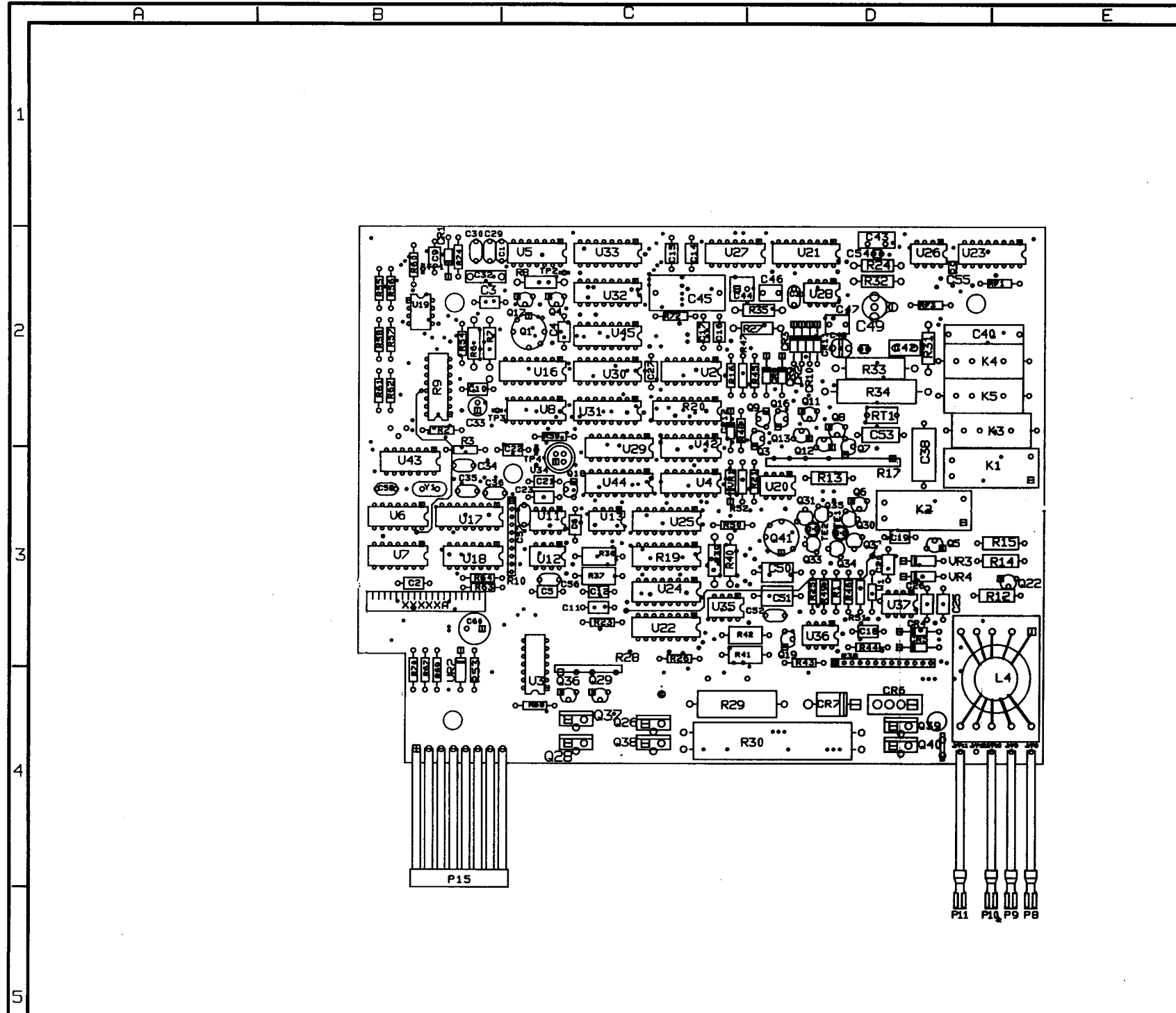
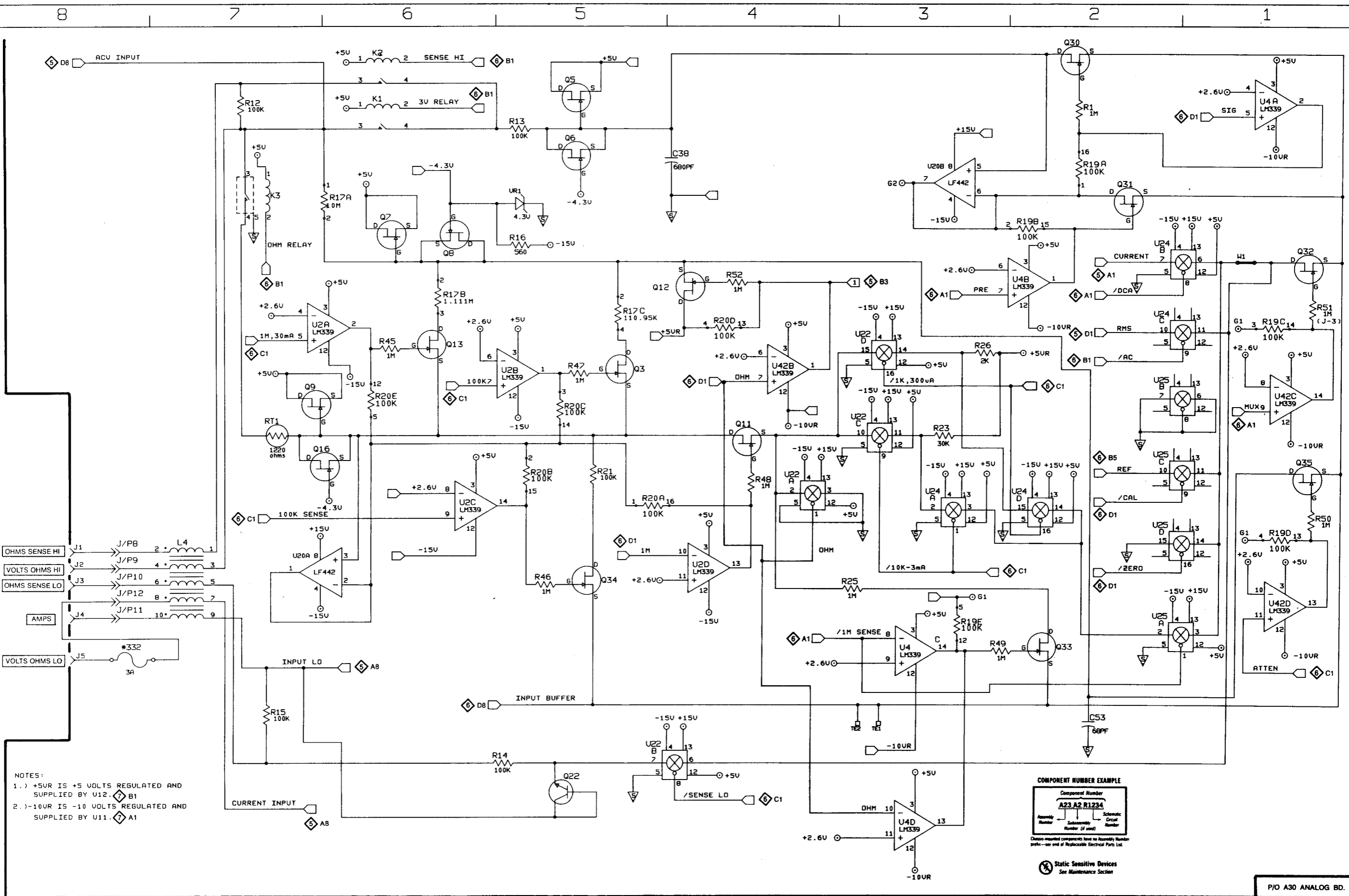


Fig 7-3. A30 Analog Circuit Board Assembly

Table 7-4
ANALOG 1 \diamond — ANALOG BOARD, ASSEMBLY A30

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C38	D4	3D	R19E	B3	3C
C53	A2	2D	R20A	B5	2C
F332	B8	OFF BD.	R20B	B5	2C
J1	B8	OFF BD.	R20C	C4	2C
J2	B8	OFF BD.	R20E	C5	2C
J3	B8	OFF BD.	R21	C6	2C
J4	B8	OFF BD.	R23	B5	3D
J5	B8	OFF BD.	R25	C3	3C
J/P10	B8	4E	R26	B3	3D
J/P11	B8	4D	R45	C3	3C
J/P12	B8	4E	R46	C6	2D
J/P8	B8	4E	R47	B5	3D
J/P9	B8	4E	R48	C5	2D
K1	D6	3D	R49	B4	2C
K2	D6	3D	R50	B3	3D
K3	D7	2D	R51	B1	3C
L4	B7	@ 4E	R52	C1	3D
Q3	C5	2D	RT1	C4	3C
Q5	D5	3D	TE1	D7	2D
Q6	D5	3D	TE2	A3	3D
Q7	D6	2D	U2A	A3	3D
Q8	C6	2D	U2B	C7	2C
Q9	D7	2D	U2C	C5	2C
Q11	C4	2D	U2D	B6	2C
Q12	C4	2D	U2E	B4	2C
Q13	C6	2D	U4	D1	3C
Q16	C6	2D	U4B	C2	3C
Q22	A5	3E	U4C	B3	3C
Q30	D2	3D	U4D	A3	3C
Q31	D2	3D	U20A	B7	3D
Q32	C1	3D	U20B	D3	3D
Q33	B2	3D	U22A	B4	3C
Q34	B5	3D	U22B	A4	3C
Q35	B1	3D	U22C	C3	3C
R1	D2	3D	U22D	C3	3C
R12	D7	3E	U24A	B3	3C
R13	D5	3D	U24B	C1	3C
R14	A5	3E	U24C	C1	3C
R15	A7	3E	U24D	B2	3C
R16	C5	2C	U25A	B1	3C
R17A	D6	3D	U25B	C1	3C
R17B	C6	3D	U25C	B1	3C
R17C	C5	3D	U25D	B1	3C
R19A	D2	3C	U42B	C4	3C
R19B	D2	3C	U42C	C1	3C
R19C	C1	3C	U42D	B1	3C
R19D	B1	3C	VR1	D5	3C
			W1	C1	3D




NOTES:
 1.) +5V IS +5 VOLTS REGULATED AND SUPPLIED BY U12. \diamond B1
 2.) -10V IS -10 VOLTS REGULATED AND SUPPLIED BY U11. \diamond A1

COMPONENT NUMBER EXAMPLE

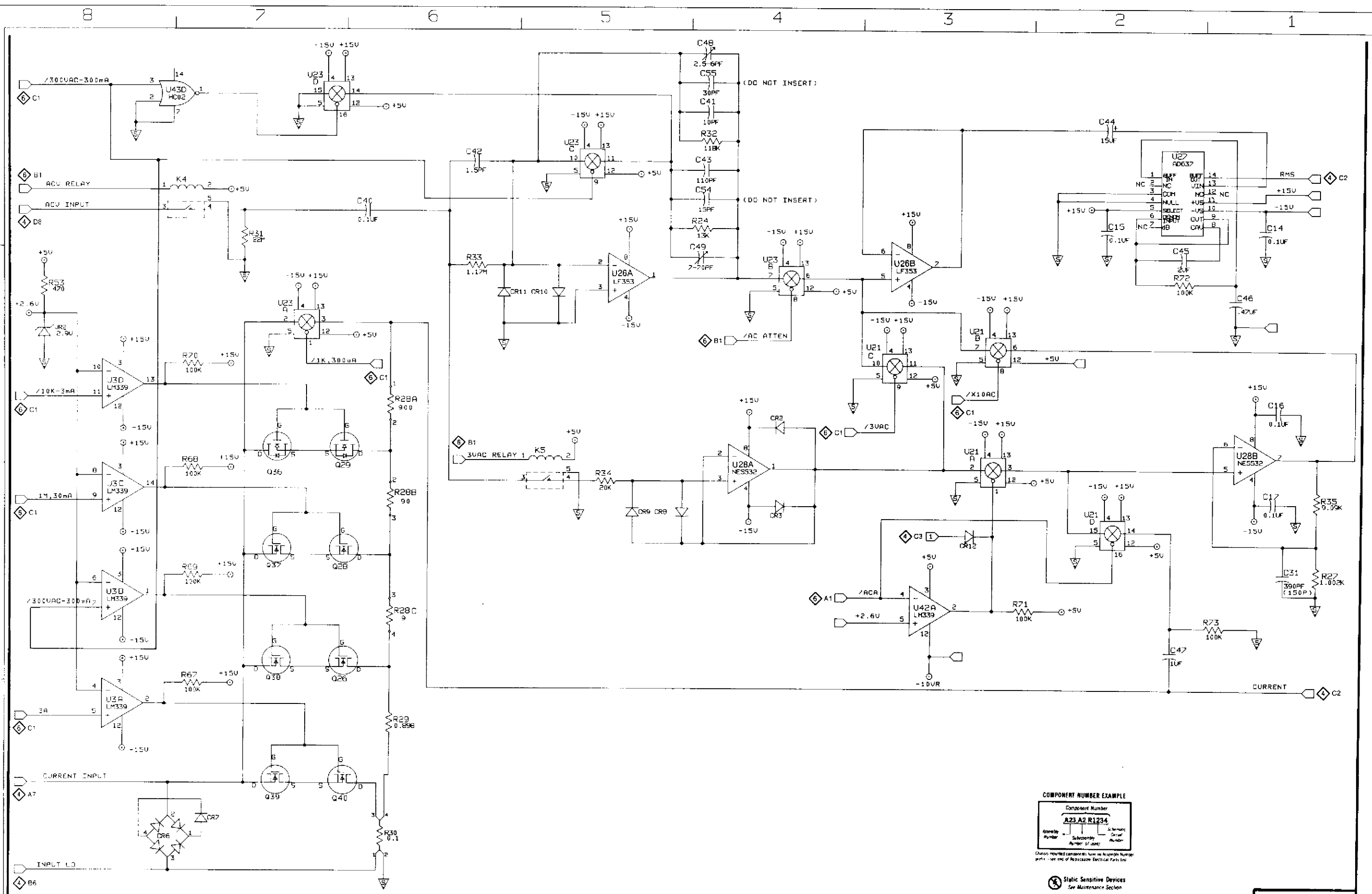
Component Number			
A23	A2	R1234	
Assembly Number	Subassembly Number (if used)	Schematic Circuit Number	

Chassis-mounted components have an Assembly Number prefix—see end of Replaceable Electrical Parts List

\otimes Static Sensitive Devices
 See Maintenance Section

Table 7-5
 ANALOG 2  — ANALOG BOARD, ASSEMBLY A30

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C14	D1	2C	R27	B1	2D
C15	D2	2C	R28A	C6	3C
C16	C1	2C	R28B	B6	3C
C17	B1	2C	R28C	B6	3C
C31	B1	2D	R29	A6	4C
C40	D6	2D	R30	A6	4D
C41	D4	2D	R31	D7	2D
C42	D6	2D	R32	D4	2D
C43	D4	2D	R33	C6	2D
C44	D2	2C	R34	B5	2D
C45	C2	2C	R35	B1	2D
C46	C1	2D	R53	C8	4B
C47	B2	2D	R67	A7	4B
C48	D4	2D	R68	B7	4C
C49	C4	2D	R69	B7	4B
C54	D4	2D	R70	C7	4B
C55	D4	2D	R71	B3	2E
			R72	C2	2C
CR2	C4	2D	R73	B1	2D
CR3	B4	2D			
CR6	A8	4D	U3A	A8	4C
CR7	A7	4D	U3B	B8	4C
CR8	B5	2D	U3B	C8	4C
CR9	B5	2D	U3C	B8	4C
CR10	C5	2D	U21A	C3	2D
CR11	C6	2D	U21B	C3	2D
CR12	B3	2C	U21C	C3	2D
			U21D	B2	2D
K4	D7	2D	U23A	C7	2D
K5	C5	2D	U23B	C4	2D
			U23C	D5	2D
Q26	B7	4C	U23D	D7	2D
Q28	B7	4C	U26A	C5	2D
Q29	C7	4C	U26B	C3	2D
Q36	C7	4C	U27	D2	2C
Q37	B7	4C	U28A	B4	2D
Q38	B7	4C	U28B	B1	2D
Q39	A7	4D	U42A	B3	3C
Q40	A7	4D	U43D	D8	3B
R24	D4	2D	VR2	C8	4B



COMPONENT NUMBER EXAMPLE

Component Number			
A23 A2 R1234			
Assembly Number	Subassembly Number (if used)	Item Number	Serial Number

Diagrams showing component values have no Assembly Number prefix - see end of Reproduction Electrical Parts List

⚡ Sensitive Devices
See Maintenance Section

P/O A30 ANALOG BD.

Table 7-6
 ANALOG 3  — ANALOG BOARD, ASSEMBLY A30

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C18	B7	3D	R38C	C8	3D
C19	C6	3D	R38D	A8	3D
C20	C6	3D	R38E	B8	3D
C21	B4	3C	R38F	B7	3D
C22	B3	3C	R38G	A7	3D
C23	B3	3C	R38H	A7	3D
C25	B6	3D	R38J	A7	3D
C26	B6	3D	R39	D7	3C
C27	D3	2C	R40	D8	3C
C50	D7	3D	R41	D6	3D
C51	D7	3D	R42	C6	3D
C52	D7	3D	R43	B6	3D
C60	C4	3B	R44	B6	3D
CR4	C8	3D	U13	B5	3C
CR5	C8	3D	U29	B2	3C
J/P20	D5	4B	U30	D2	3C
P15	D5	4B	U31	C2	3C
Q19	D8	3D	U32	B2	3C
Q41	D8	3D	U33	B2	3C
R10A	B4	3C	U34	B3	3C
R10B	B4	3C	U35	D7	3C
R10C	B4	3C	U36	C7	3D
R36	B5	3C	U37A	A7	3D
R37	B5	3C	U37B	B7	3D
R38A	D8	3D	U44A	C7	3C
R38B	C8	3D	U45A	D4	2C
			VR3	A7	3D
			VR4	A7	3D

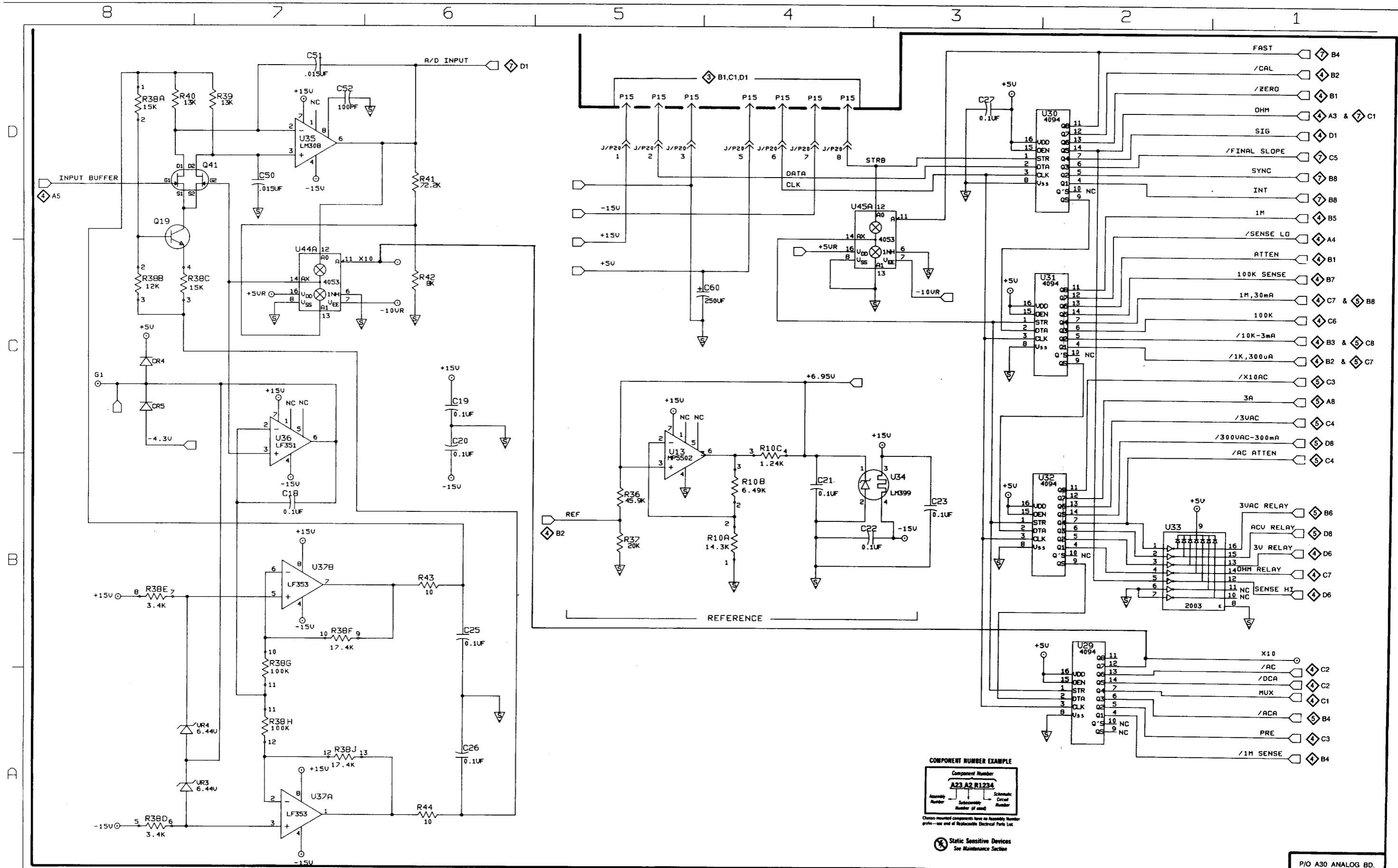

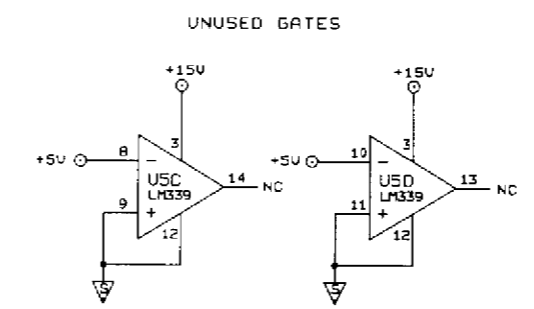
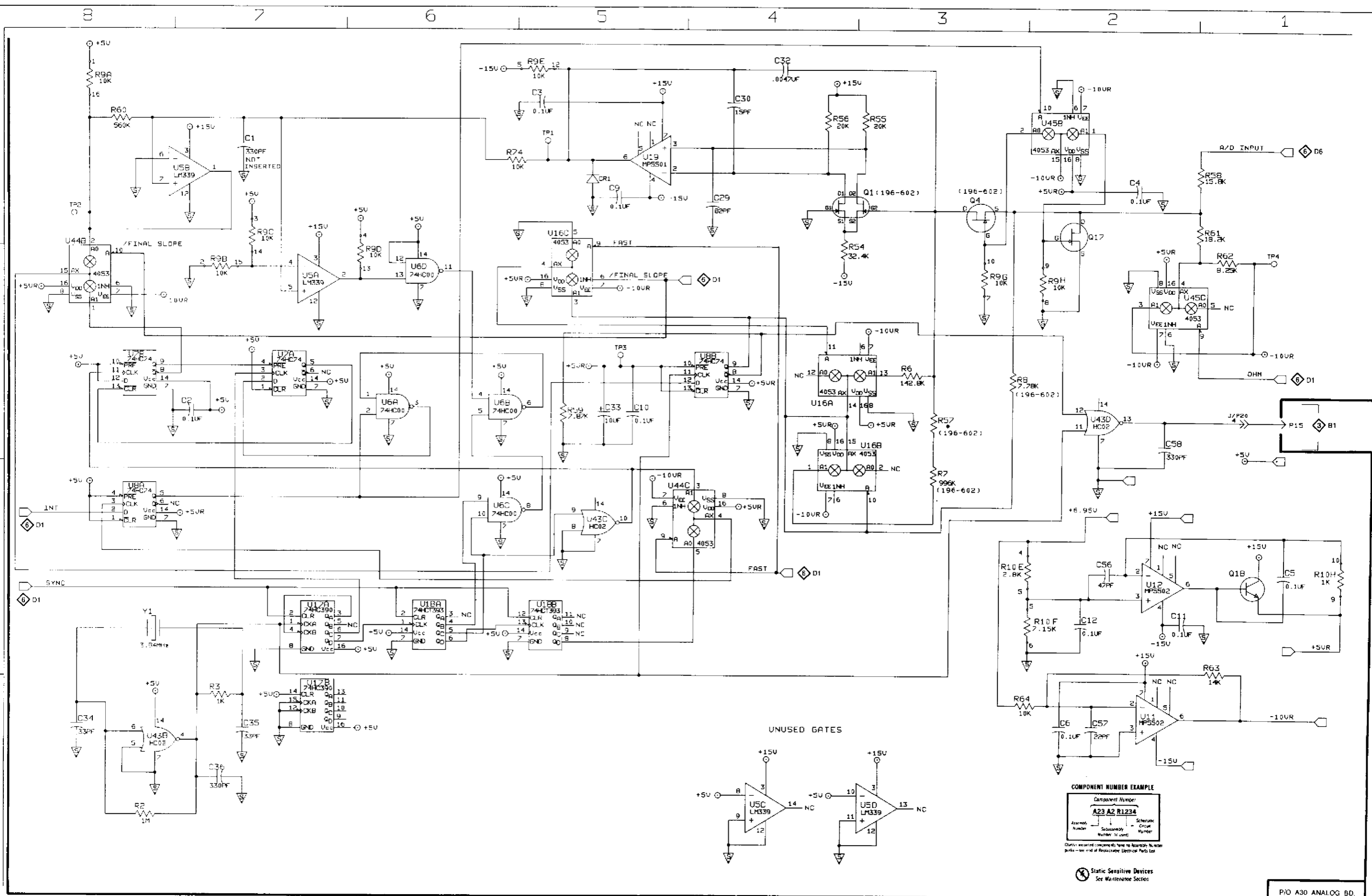


Table 7-7
 ANALOG 4  — ANALOG BOARD, ASSEMBLY A30

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C1	D7	2C	R56	D4	2B
C2	C7	3B	R57	C3	2B
C3	D5	2B	R58	D1	2B
C4	D2	2C	R59	C5	2C
C5	B1	3C	R60	D8	2B
C6	A2	3C	R61	D1	2B
C9	D5	2B	R62	C1	2B
C10	C5	2B	R63	B1	3B
C11	B2	3C	R64	A2	3B
C12	B2	3C	R74	D5	2B
C29	D4	2B	TP1	D5	2B
C30	D4	2B	TP2	D8	2C
C32	D4	2B	TP3	C5	2B
C33	C5	2B	TP4	C1	3C
C34	A8	3B			
C35	A7	3B	U5A	C7	2C
C36	A7	3B	U5B	D7	2C
C56	B2	3C	U5C	A4	2C
C57	A2	3C	U5D	A3	2C
C58	C2	3B	U6A	C6	3B
CR1	D5	2B	U6B	C6	3B
J/P20	C1	4B	U6C	B6	3B
P15	C1	4B	U6D	C6	3B
Q1	D4	2C	U7A	C7	3B
Q4	D3	2C	U7B	C8	3B
Q17	D2	2C	U8A	B8	2B
Q18	B1	3C	U8B	C4	2B
R2	A8	2B	U11	A2	3C
R3	A7	3B	U12	B2	3C
R6	C3	2B	U16A	C4	2C
R7	B3	2B	U16B	B4	2C
R8	C3	2C	U16C	C5	2C
R9A	D8	2B	U17A	B7	3B
R9B	C7	2B	U17B	A7	3B
R9C	D7	2B	U18A	B6	3B
R9D	C6	2B	U18B	B5	3B
R9E	D5	2B	U19	D5	2B
R9G	C3	2B	U43B	A8	3B
R9H	C2	2B	U43C	B5	3B
R10E	B2	3C	U43D	C2	3B
R10F	B2	3C	U44B	C8	3C
R10H	B1	3C	U44C	B4	3C
R54	C4	2B	U45B	D2	2C
			U45C	C2	2C
			Y1	B8	3B



COMPONENT NUMBER EXAMPLE

Component Number		
A23	A2	R1234
Assembly Number	Subassembly Number (if used)	Schematic Circuit Number

Circle around components that have no Assembly Number parts - see end of Resoucepage Electrical Parts List

Static Sensitive Devices
See Maintenance Section

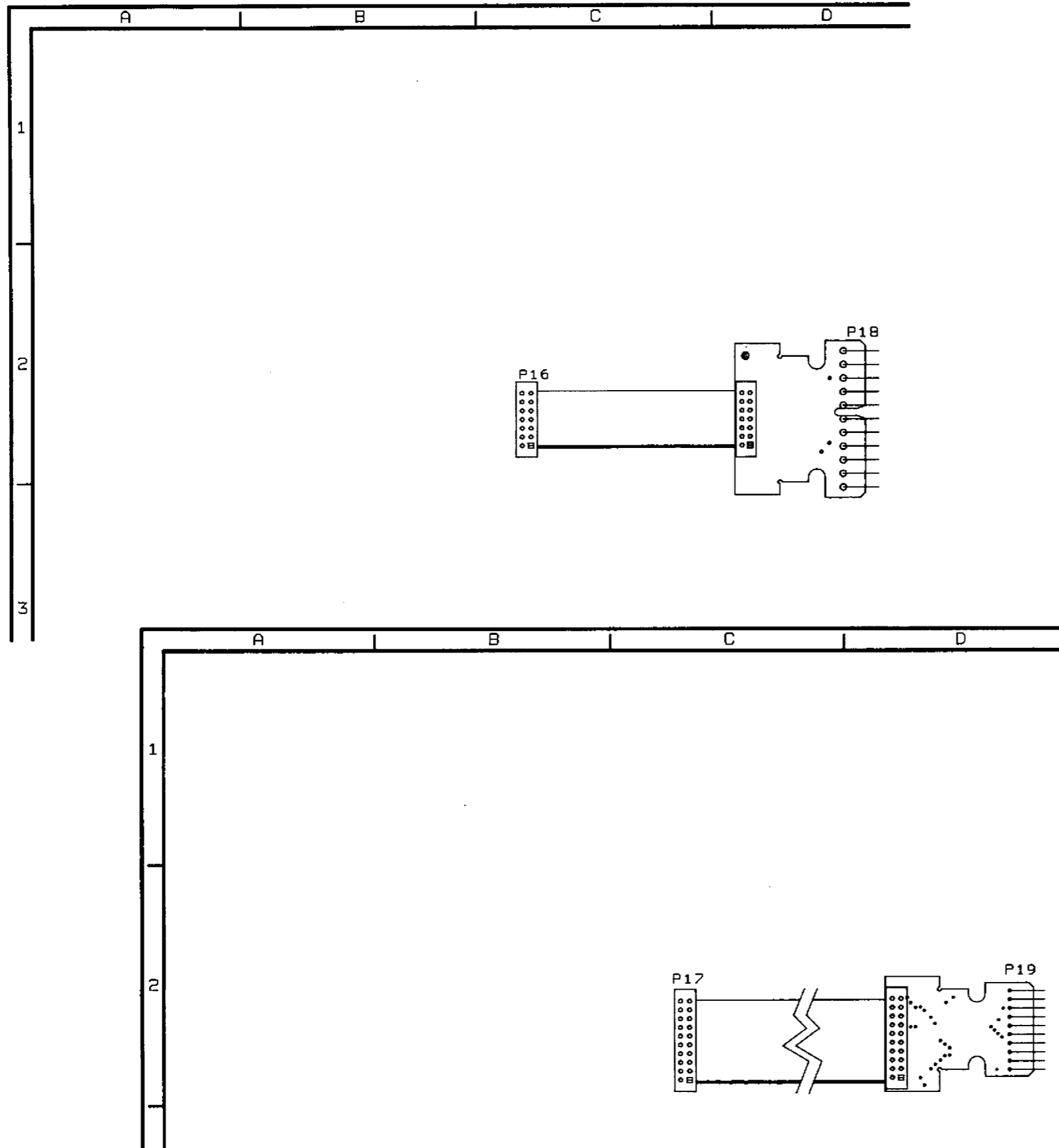


Fig 7-4. A40 Power Connector Assembly and A50 GPIB Connector Assembly

A | B | C | D | E | F | G | H | I | J | K | L

1

2

3

4

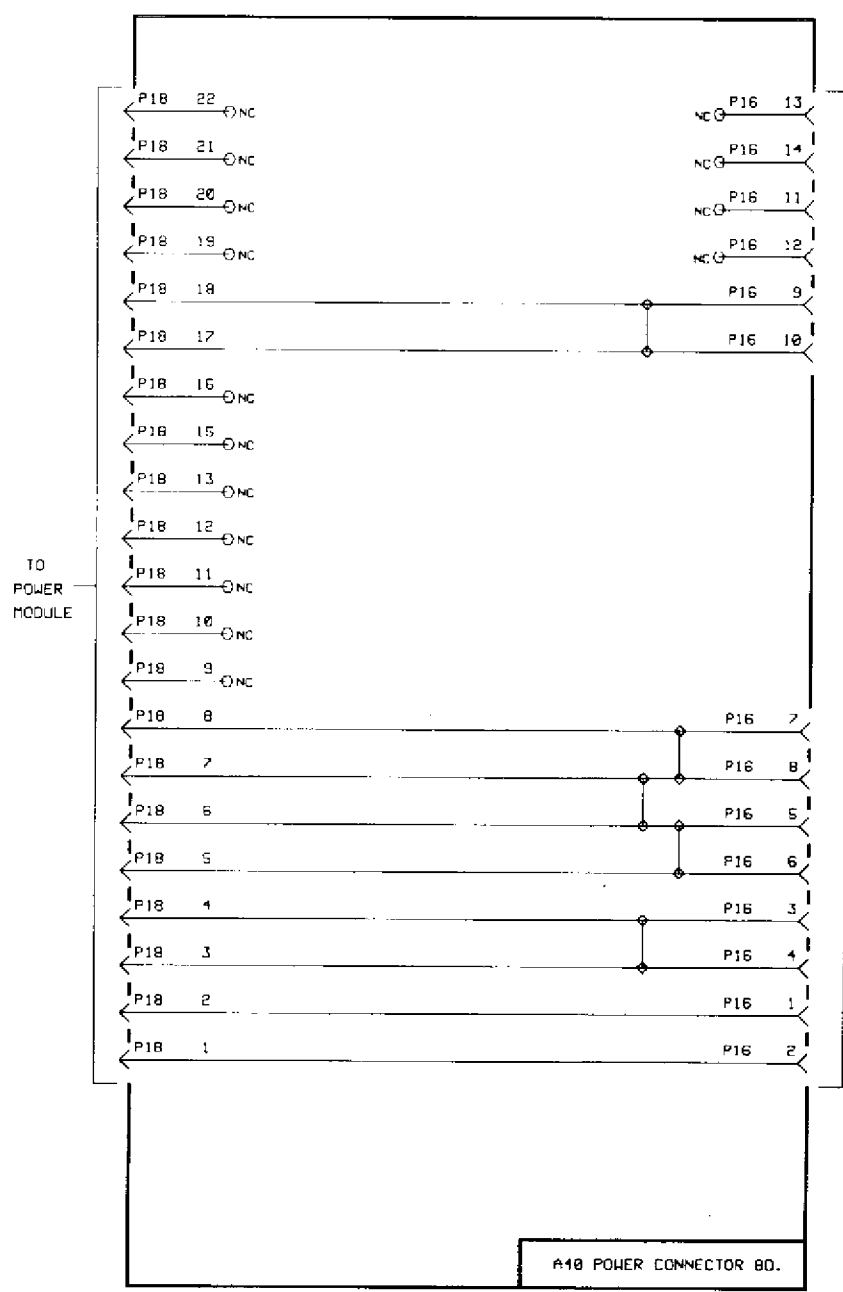
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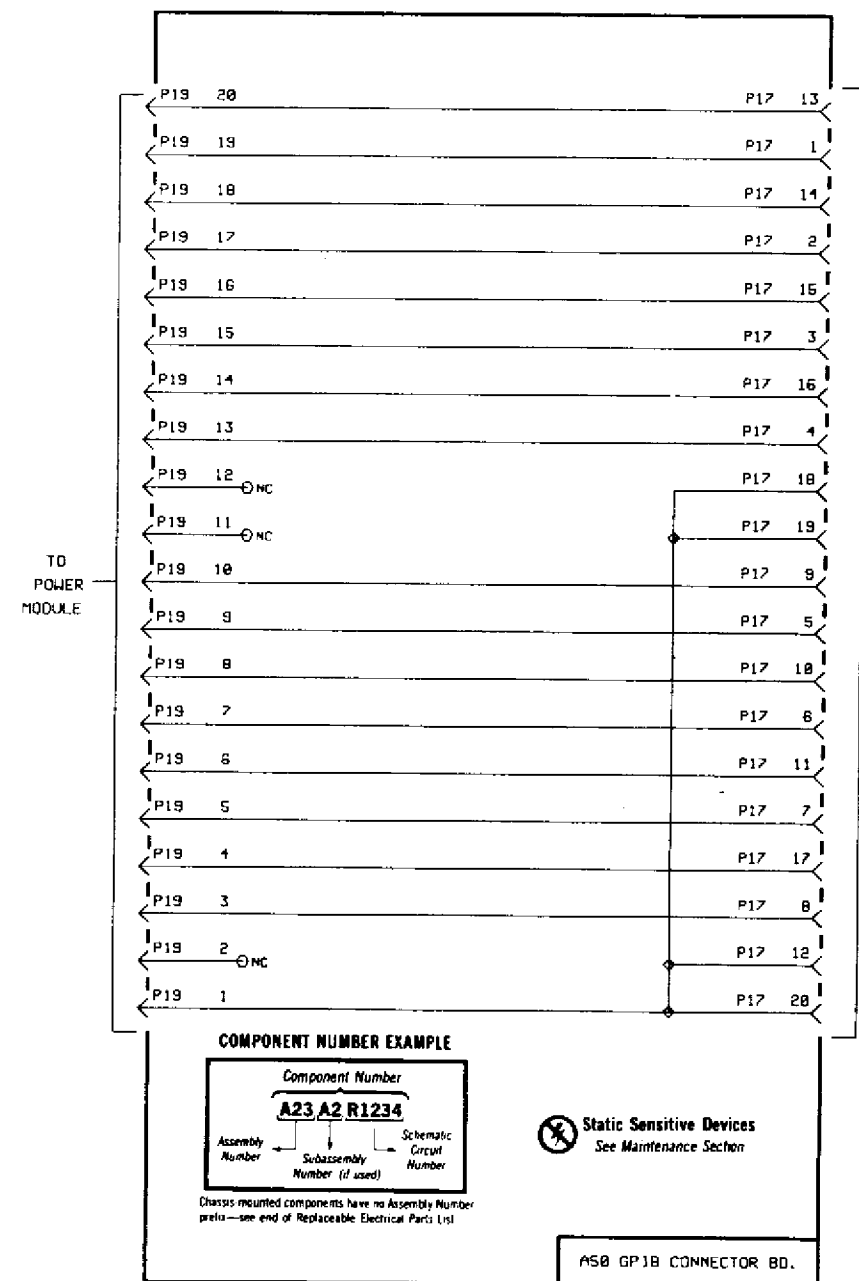
7

8

9



TO J16
3



INTERFACE CONNECTOR BOARDS 8

DM5120/5520

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 NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
74932	INDUSTRIAL SPECIALTIES, INC.		WARREN, MI 48091
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
83309	ELECTRICAL SPECIALITY CO SUB OF BELDEN CORP	345 SWIFT AVE	SOUTH SAN FRANCISCO CA 94080-6206
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0858	STAUFFER SUPPLY CO (DIST)	810 SE SHERMAN	PORTLAND OR 97214
TK1569	GERHART TOOL AND DIE	1116 W ISABEL ST	BURBANK CA 91506
KEITHLEY	KEITHLEY INSTRUMENT DIV	28775 AURORA ROAD	CLEVELAND, OH 44139

FIG. & INDEX NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	QTY	NAME & DESCRIPTION	MFR CODE	Mfr. Part No.
1-1	ALM01			1	Leads, Meter (not shown)	80009	ALM01
1-2	070-7240-xx			1	Manual, Instruction (not shown)	80009	070-7240-xx
1-3	070-7317-xx			1	Instrument I/F Guide (not shown)	80009	070-7317-xx
1-4	070-7318-xx			1	Reference Guide (not shown)	80009	070-7318-xx
1-5	105-0865-00			2	Bar, Latch Release	Keithley	5120-317
1-6	105-0866-00			2	Latch, Retaining	Keithley	5120-316
-----	Order by desc.			5	Display, LED	Keithley	00-39
1-7	159-0015-00			1	Fuse, Cartridge	Keithley	FU-82
1-8	211-0062-00			8	Screw, 2/56 x 5/16	Keithley	5120-325
1-9	211-0541-00			12	Screw, 6/32 x 0.250	Keithley	5120-323
1-10	213-0868-00			4	Screw, 6/32 x 0.375	Keithley	5120-324
1-11	214-1061-00			2	Contact, Elec.	Keithley	5120-322
1-12	214-3089-00			4	Lockout, Plug-In	Keithley	5120-319
1-13	214-3143-00			2	Spring, HL	Keithley	5120-320
1-14	220-0633-00			1	Nut, Knurled, (Bndg Post)	Keithley	5120-327
1-15	260-2453-00			5	Switch, Pushbutton (not shown)	Keithley	SW-474
1-16	260-2454-01			11	Switch, PB, Illuminated (not shown)	Keithley	SW-475
1-17	337-2665-00			2	Shield, Elec, Side (not shown)	Keithley	5120-304
1-18	337-3534-00			1	Shield, Elec. Top Center	Keithley	5120-312
1-19	337-3535-00			1	Shield, Elec. BTM Center	Keithley	5120-311
1-21	355-0170-00			1	Stud, Shldr, Bndg Post	Keithley	5120-328
1-22	361-1516-00			1	Spacer, Sleeve	80009	361-1516-00
1-23	366-1851-01			2	Knob, Latch	Keithley	5120-318
1-24	386-3657-01			4	Support, Plug-In	Keithley	5120-321
1-25	426-2301-00			2	Frame Sect., Bottom L & R	Keithley	5120-310
1-26	426-2303-00			1	Frame Sect., Top Right	Keithley	5120-313

CIRCUIT BOARDS:

1-27	-----	-	Ckt Board Assy:Display Board(see A10 REPL)
1-28	-----	-	Ckt Board Assy:Digital Board(see A20 REPL)
1-29	-----	-	Ckt Board Assy:Analog Board(see A30 REPL)

FIG. # INDEX NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	QTY	NAME & DESCRIPTION	MFR CODE	Mfr. Part No.
---------------------	-----------------------	------------------------	-----------------------	-----	--------------------	-------------	---------------

CUSTOMER SERVICE KITS:

----	Order by desc.			1	Front Panel Assembly (not shown) Includes: Connector, BMC Connector, Jack, Black Connector, Jack, Red Connector, Jack, White Cable, BJ-12-0 to Fuse Cable, BMC to Digital Board Fuse, Cartridge, 3A SLO Fuseholder, Cartridge Carrier, Fuse Overlay, Front Panel Subpanel, Front	Keithley	5120-KIT1
----	Order by desc.			1	Connector Kit (not shown) Includes: Connector, BMC Connector, Jack, Black Connector, Jack, Red Connector, Jack, White Fuse, Cartridge, 3A SLO Fuseholder, Cartridge Carrier, Fuse Circuit Bd, Pur Supply Interface Circuit Bd, IEEE Interface	Keithley	5120-KIT2
----	Order by desc.			1	Interconnect Cables (not shown) Includes: Cable, Power Supply Cable, IEEE Cable, Display to Digital Bd Cable, Analog to Digital Bd Cable, BMC to Digital Cable, BJ-12-0 to Fuse Choke Assy, Red Choke Assy, Grey Choke Assy, Orange Choke Assy, Black/White	Keithley	5120-KIT3
----	Order by desc.			1	Mounting Tool, Meter Jack (not shown)	Keithley	55425

FIG. # INDEX NO.	TEKTRONIX PART NO.	SERIAL NO EFFECTIVE	SERIAL NO DISCONT.	QTY	NAME & DESCRIPTION	MFR CODE	Mfr. Part No.
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CUSTOMER SERVICE ASSEMBLIES:

----	386-5833-xx			1	Rear Panel Assembly (not shown) Includes: Panel, Rear Marker, Warning, UL	80009	386-5833-xx
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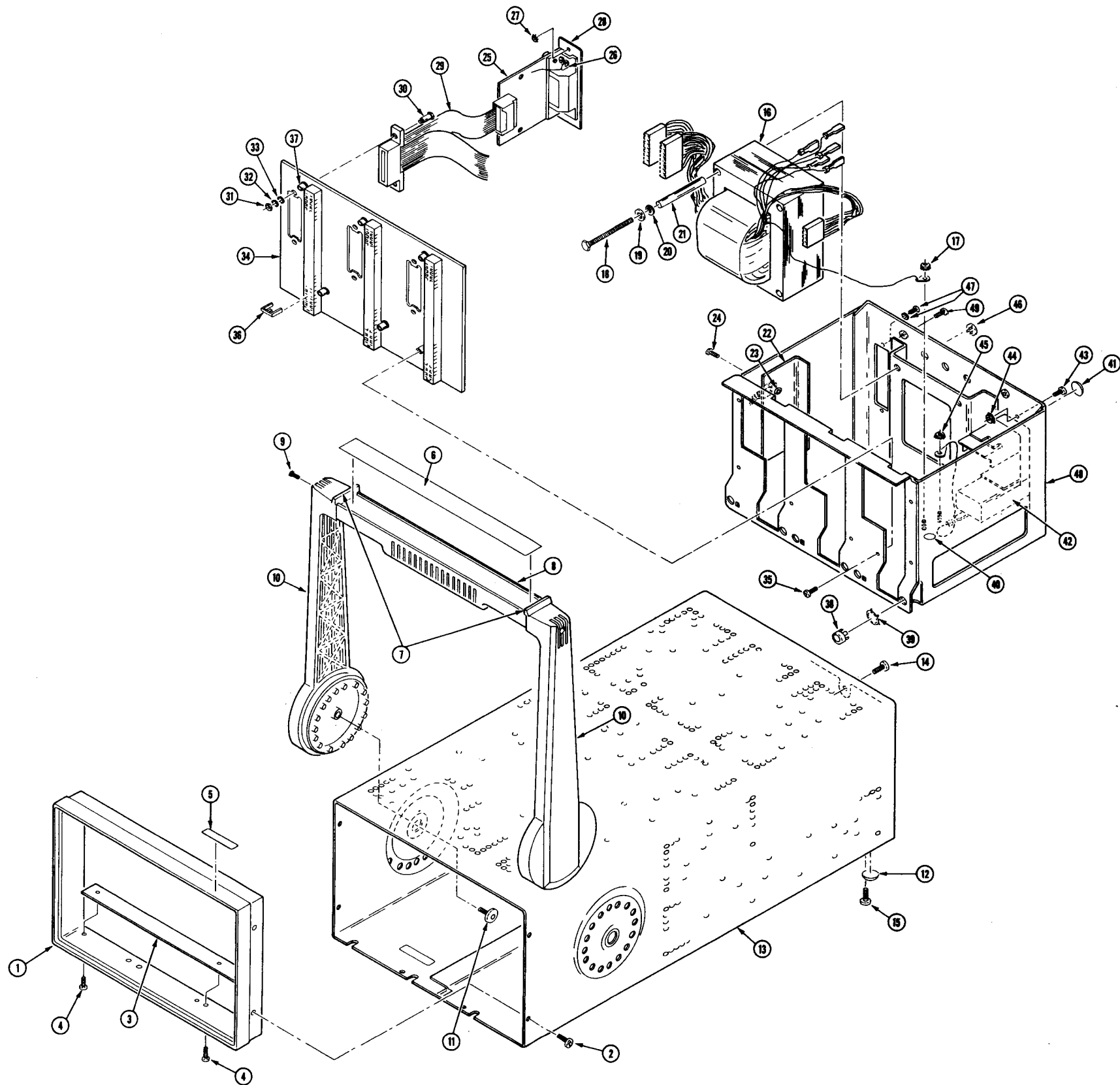
----	426-2302-xx			1	Top Left Front Sect. Assy. (not shown) Includes: Frame Section, Top Left Marker, Warning, Calibration	80009	426-2302-xx
------	-------------	--	--	---	--	-------	-------------

OPTIONAL ACCESSORIES:

----	012-1296-00			1	Lead Set, Banana to Kelvin (not shown) Includes: Cable, Intct, Ban. to Kel, Red Cable, Intct, Ban. to Kel, Blk	80009	012-1296-00
------	-------------	--	--	---	---	-------	-------------

POWER SUPPLY

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345 Name & Description	Mfr.	
		Effective	Discnt			Code	Mfr. Part No.
1-1	426-2289-00			1	FRAME PNL,CAB.:	80009	426-2289-00
					ATTACHING PARTS		
-2	211-0503-00			6	SCREW,MACHINE:6-32 X 0.188,PNH,STL	93907	ORDER BY DESCR
					END ATTACHING PARTS		
-3	361-1507-00			1	SPACER,MTG:7.8 L X 0.7 W X 0.063 THK	80009	361-1507-00
					ATTACHING PARTS		
-4	213-0107-00			2	SCREW,TPG,TF:4-40 X 0.25,TYPE C,FLH,100 DEG	83385	ORDER BY DESCR
					END ATTACHING PARTS		
-5	334-7564-00			1	MARKER,IDENT:MKD DM5520	80009	334-7564-00
-6	334-7342-00			1	MARKER,IDENT:MARKED TEKTRONIX,HANDLE	80009	334-7342-00
-7	348-1068-00			2	FOOT,HANDLE:NON SKID	80009	348-1068-00
-8	367-0398-00			1	HANDLE,GRIP:LEXAN	80009	367-0398-00
					ATTACHING PARTS		
-9	211-0467-00			2	SCREW,MACHINE:6-32 X 1.0,FILLISTER HEAD	80009	211-0467-00
					END ATTACHING PARTS		
-10	367-0397-00			2	ARM,PIVOT:HANDLE	80009	367-0397-00
					ATTACHING PARTS		
-11	212-0144-00			2	SCREW,TPG,TF:8-16 X 0.562 L,PLASTITE	93907	225-38131-012
					END ATTACHING PARTS		
-12	348-0430-00			4	BUMPER,PLASTIC:BLACK POLYURETHANE	74932	SJ5027
-13	200-3646-00			1	COVER,PLUG-IN:POWER SUPPLY,ALUMINUM	80009	200-3646-00
					ATTACHING PARTS		
-14	211-0504-00			2	SCREW,MACHINE:6-32 X 0.250,PNH,STL	TK0435	ORDER BY DESCR
-15	212-0023-00			4	SCREW,MACHINE:8-32 X 0.375,PNH,STL	93907	ORDER BY DESCR
					END ATTACHING PARTS		
-16	-----			1	TRANSFORMER,PWR: (SEE T100 REPL)		
					ATTACHING PARTS		
-17	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					END ATTACHING PARTS		
-18	212-0515-00			4	SCREW,MACHINE:10-32 X 2.25,HEX HD,STL	93907	ORDER BY DESCR
-19	210-0805-00			4	WASHER,FLAT:0.204 ID X 0.438 OD X 0.032,STL	12327	ORDER BY DESCR
-20	210-0812-00			4	WASHER,FLAT:0.188 ID X 0.375 OD X 0.31	83309	ORDER BY DESCR
-21	166-0227-00			4	INSUL SLVG,ELEC:0.187 ID X 1.5 L,MYLAR	80009	166-0227-00
-22	407-3420-00			2	BRACKET,CLAMP:TRANSISTOR	80009	407-3420-00
					ATTACHING PARTS		
-23	211-0012-00			3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	93907	ORDER BY DESCR
-24	211-0025-00			6	SCREW,MACHINE:4-40 X 0.375,FLH,100 DEG,STL	TK0435	ORDER BY DESCR
					END ATTACHING PARTS		
-25	-----			1	CIRCUIT BD ASSY:GPIB CONN (SEE A2 REPL)		
-26	210-0202-00			1	.TERMINAL,LUG:0.146 ID,LOCKING,BRZ TIN PL	86928	A-373-158-2
-27	210-0586-00			4	.NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-28	214-3312-00			1	.HARDWARE KIT:JACKSOCKET FOR GPIB	00779	552633-4
	386-5949-00			1	.PLATE,ADAPTER:ALUMINUM	80009	386-5949-00
-29	174-1709-00			1	CA ASSY,SP,ELEC:20 COND,12.4 L,RIBBON	80009	174-1709-00
					ATTACHING PARTS		
-30	211-0295-00			4	SCREW,SHOULDER:2-56 X 0.54,HEX HD,STL	80009	211-0295-00
-31	210-0405-00			4	NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
-32	210-0054-00			4	WASHER,LOCK:#4 SPLIT,0.025 THK STL	78189	ORDER BY DESCR
-33	210-0850-00			4	WASHER,FLAT:0.093 ID X 0.281 OD X 0.02,STL	12327	ORDER BY DESCR
					END ATTACHING PARTS		
-34	-----			1	CIRCUIT BD ASSY:PWR SPLY (SEE A1 REPL)		
					ATTACHING PARTS		
-35	211-0008-00			6	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
					END ATTACHING PARTS		
					CIRCUIT BD ASSY INCLUDES:		
-36	214-1593-02			3	.KEY,CONN PLZN:CKT BOARD CONN	80009	214-1593-02
-37	129-0160-00			6	.SPACER,POST:0.25 L,4-40 THRU,BRS	80009	129-0160-00
-38	348-0640-00			6	GROMMET,PLASTIC:BLACK,ROUND,0.188 ID	80009	348-0640-00
-39	214-3026-00			6	SPRING,GROUND:CU BE	TK1569	ORDER BY DESCR
-40	334-3379-04			1	MARKER,IDENT:MKD GROUND SYMBOL (12)	80009	334-3379-04
-41	348-0430-00			4	BUMPER,PLASTIC:BLACK POLYURETHANE	74932	SJ5027
-42	119-3358-00			1	FUSE DRAWER:VOLTAGE SELECTOR	80009	119-3358-00
-43	211-0025-00			2	SCREW,MACHINE:4-40 X 0.375,FLH,100 DEG,STL	TK0435	ORDER BY DESCR
-44	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-45	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-46	342-0860-00			3	INSULATOR,XSTR:POLYSULFONE,BLACK OR NATURAL	80009	342-0860-00
-47	211-0244-00			2	SCR,ASSEM WSHR:4-40 X 0.312,PNH STL	TK0858	211-0244-00
-48	441-1910-00			1	CHAS,PWR SUPPLY:ALUMINUM	80009	441-1910-00



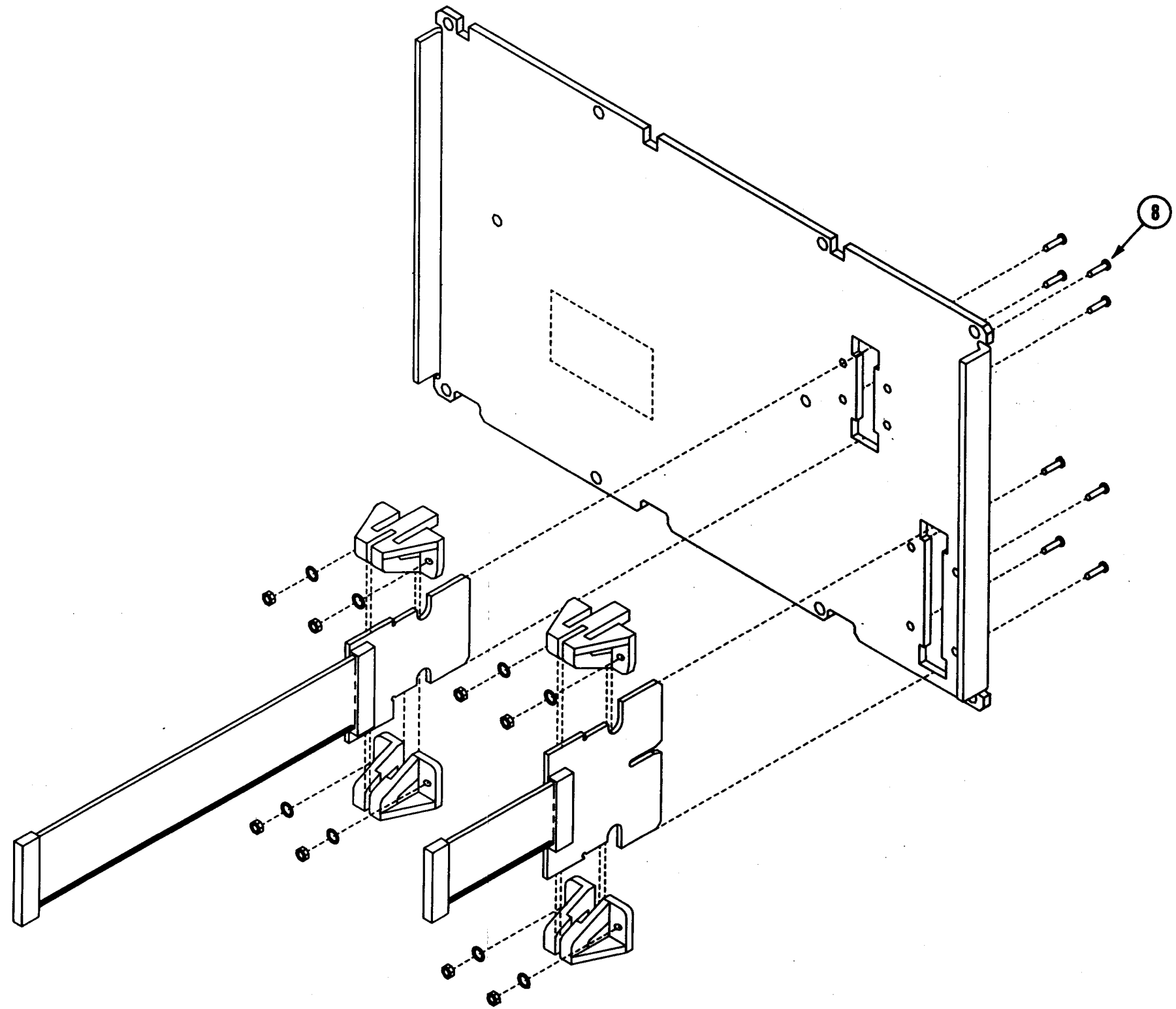


Fig 2. Rear Panel Assembly

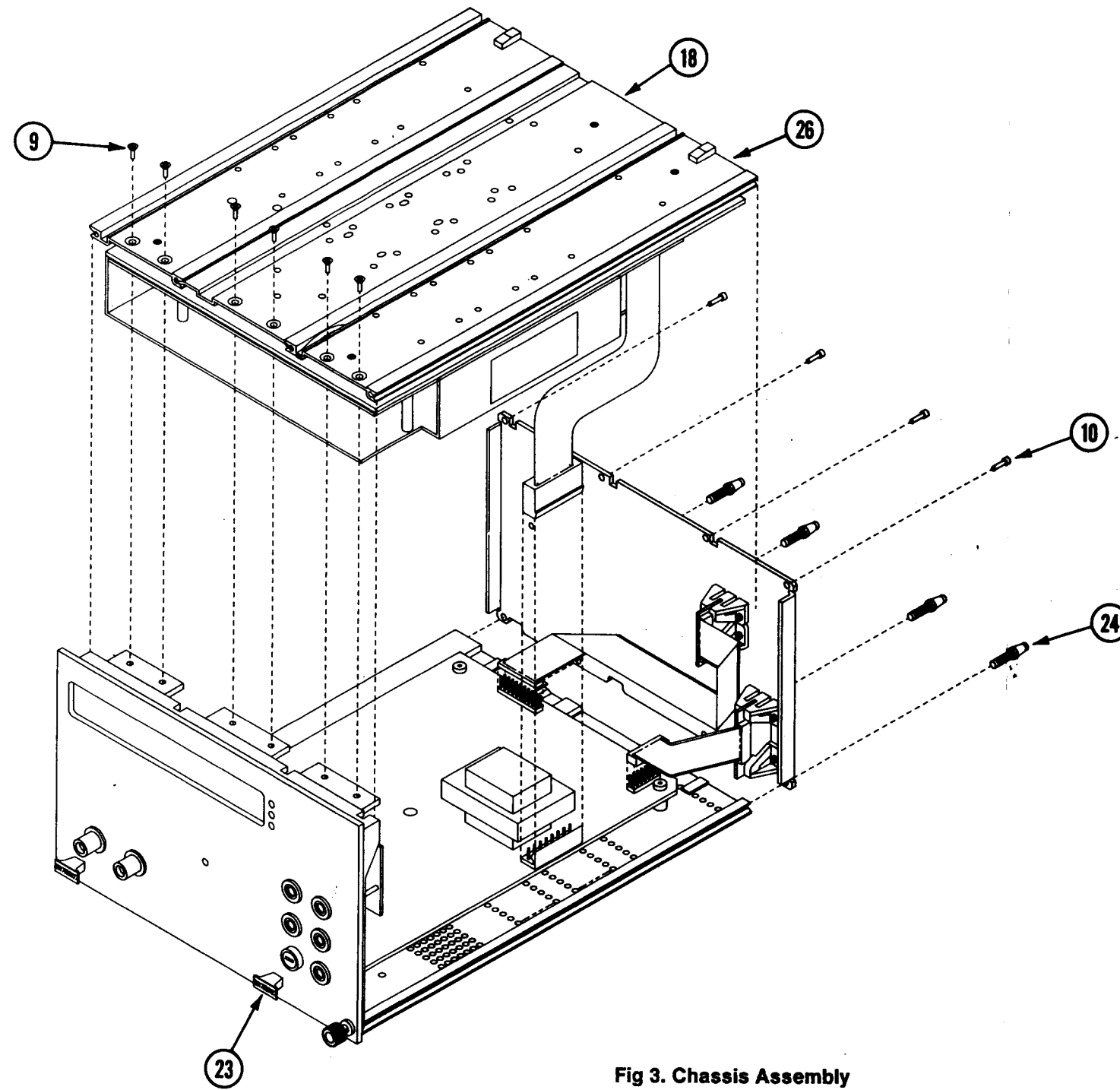


Fig 3. Chassis Assembly

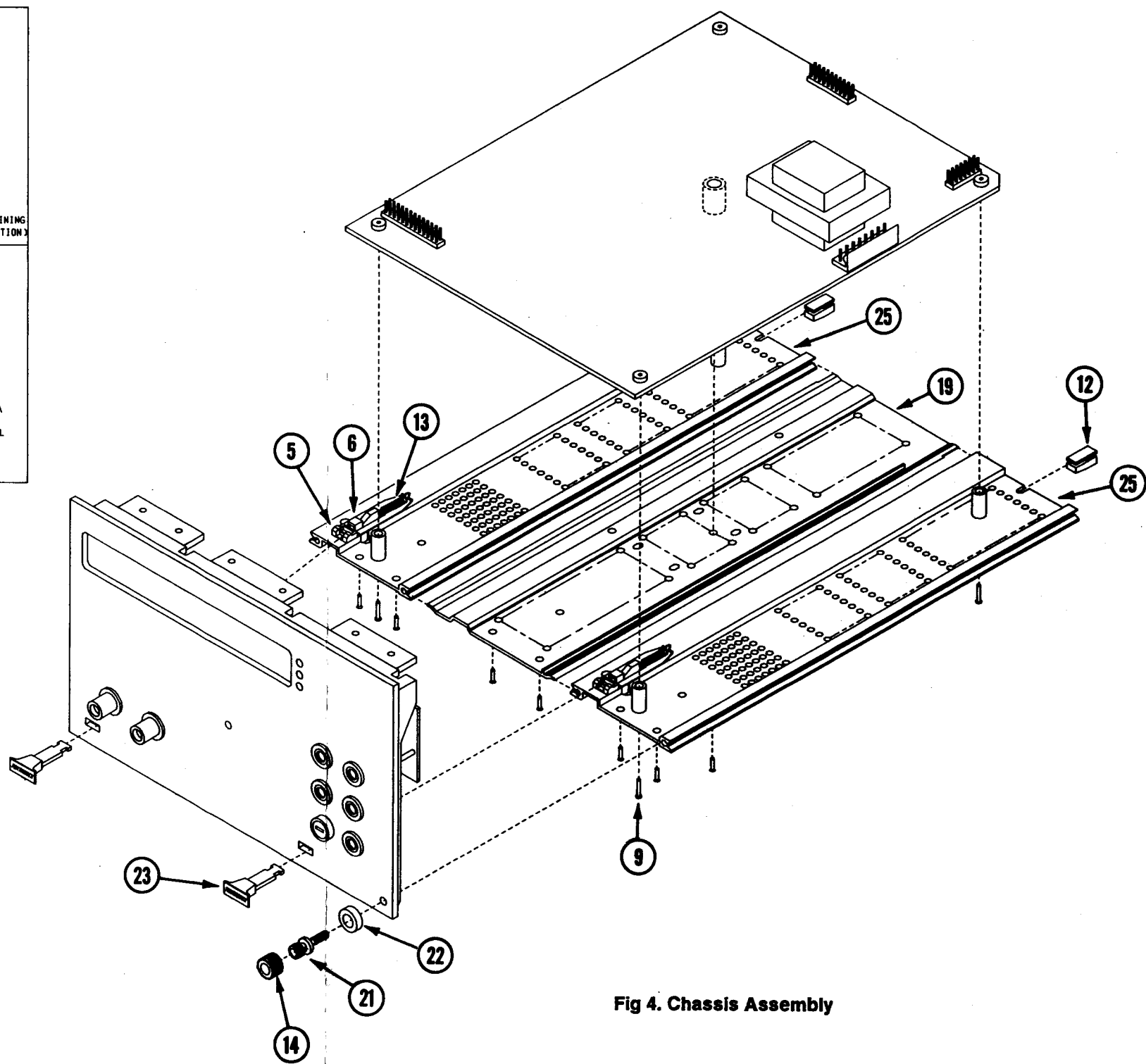
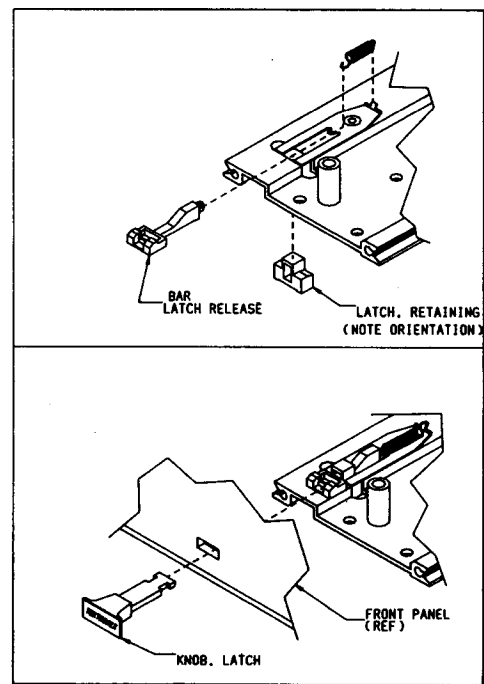


Fig 4. Chassis Assembly

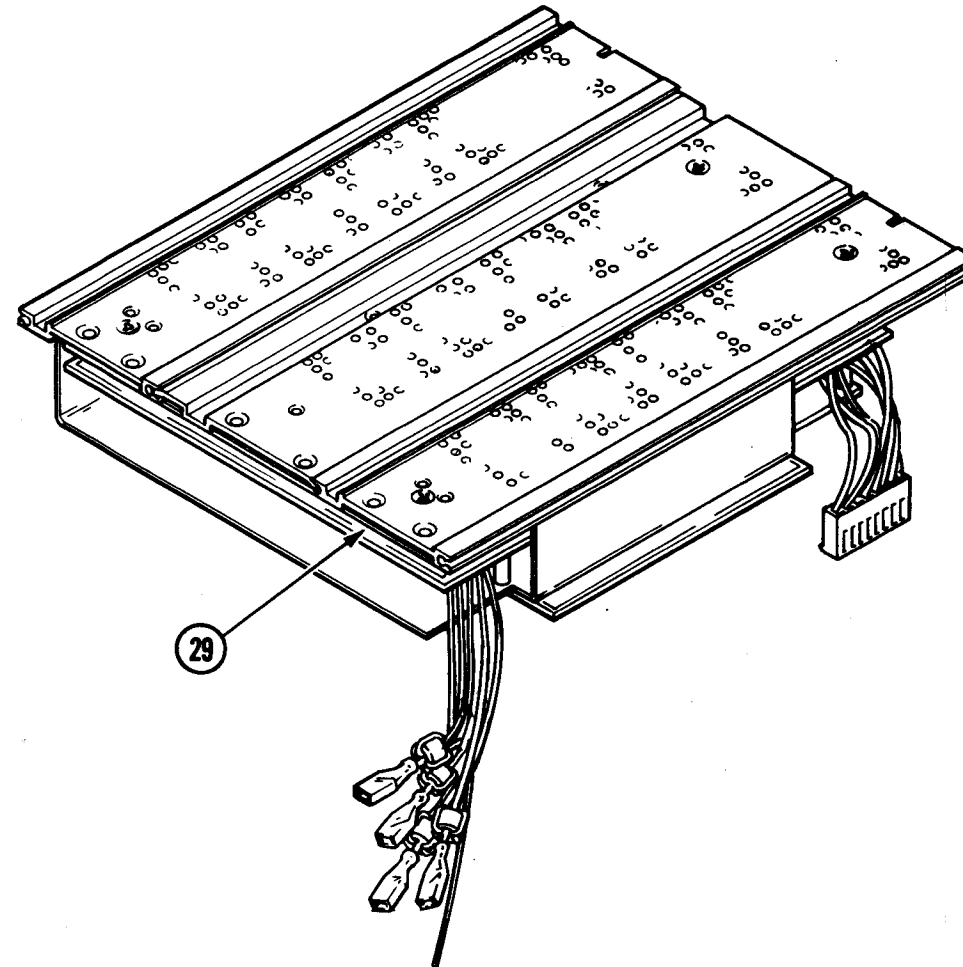


Fig. 5. Analog Board Assembly

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.