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

AM 503 CURRENT PROBE AMPLIFIER

INSTRUCTION MANUAL

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

070-2052-01
Product Group 75

Serial Number _____

First Printing SEP 1976
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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 Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

TABLE OF CONTENTS

WARNING

The remaining portion of this Table of Contents lists servicing instructions that expose personnel to hazardous voltages. These instructions are for qualified service personnel only.

LIST OF ILLUSTRATIONS

OPERATOR'S SAFETY SUMMARY

The following text contains a two-part summary of general safety precautions that must be observed during all phases of operation, service, and repair of this instrument.

OPERATORS SAFETY SUMMARY

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

TERMS

In This Manual

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

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

As Marked on Equipment

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

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

SYMBOLS

In This Manual

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

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

ATTENTION — refer to manual.

Power Source

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

Grounding the Product

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

Danger Arising From Loss of Ground

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

Use the Proper Power Cord

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

Use only a power cord that is in good condition.

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 for your product.

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 Remove Covers or Panels

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

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

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

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

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

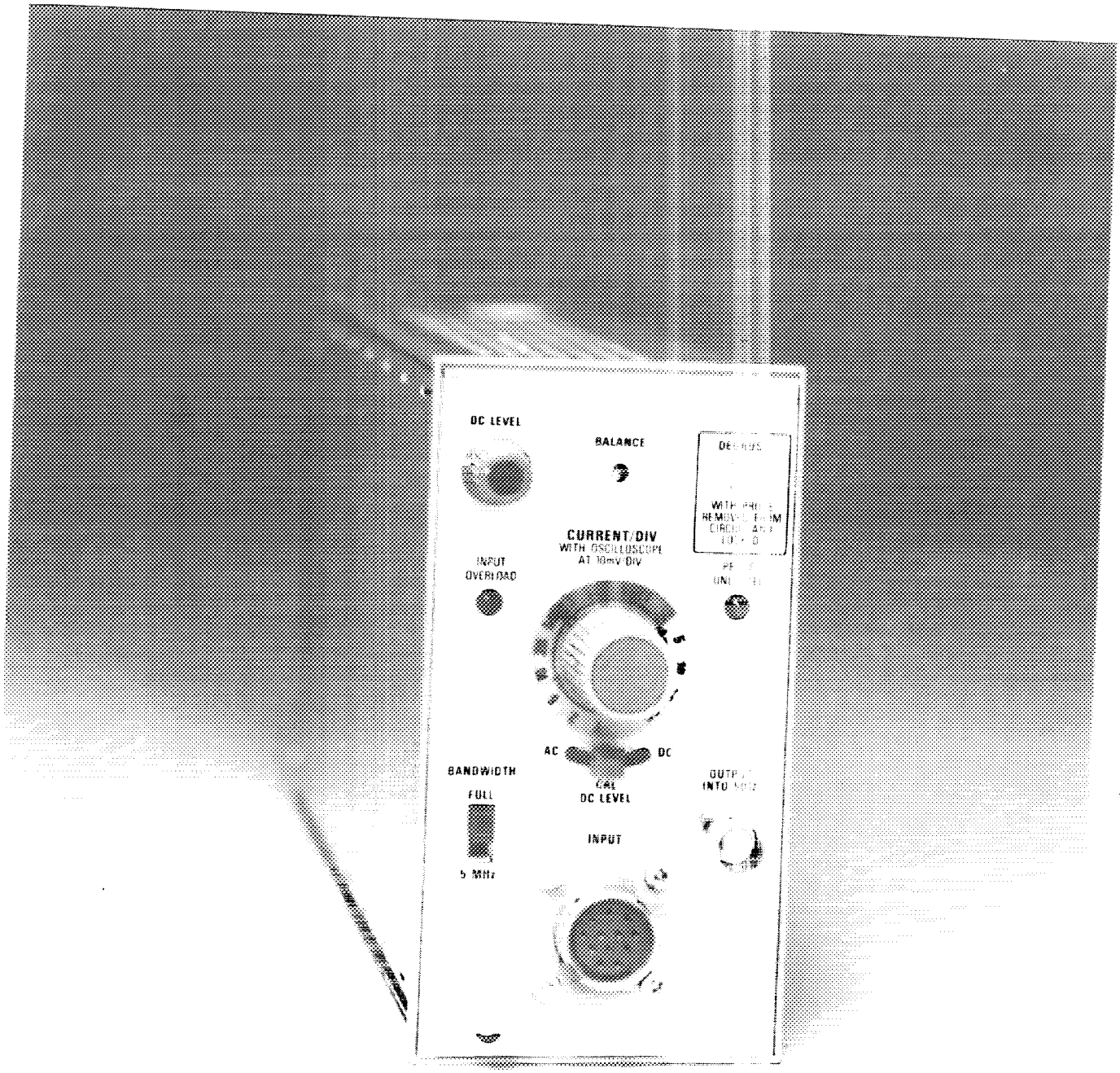
Use Care When Servicing With Power On

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

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

Power Source

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


DC LEVEL
BALANCE
CURRENT/DIV
WITH OSCILLOSCOPE
AT 10mV/DIV
INPUT
OVERLOAD
AC
DC
BANDWIDTH
FULL
5 MHz
CAL
DC LEVEL
INPUT

2052-9

OPERATING INSTRUCTIONS

NOTE

All references to the P6302 probe also apply to the A6302 probe.
All references to the P6303 probe also apply to the A6303 probe.

Description

The AM 503 Current Probe Amplifier is designed for use with any of the compatible current probes (see Mechanical Parts list for accessories). The input attenuator is calibrated in a 1, 2, 5 sequence, and the attenuator knob-skirt illumination provides direct indication of current/division. An auto-scale switch changes the knob-skirt illumination automatically to match the sensitivity of the probe used.

Bandwidth is selectable for either FULL (limited by current probe in use) or 5 MHz. Input coupling is selectable (ac or dc); ac provides a means of measuring low amplitude ac signals on a high level dc current.

The AM 503 operates in TEKTRONIX TM 500-Series power modules only. It will operate in any compartment of a multiple-compartment power module.

Installation and Removal

CAUTION

Turn the power module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry. It is also recommended that the power module be turned off before removing the AM 503. Refer to Fig. 1-1. Check to see that the plastic barriers on the interconnecting jack of the selected power module compartment match the cut-outs in the AM 503 circuit board edge connector.

Align the upper and lower groove of the AM 503 chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack.

To remove the AM 503, pull on the release latch

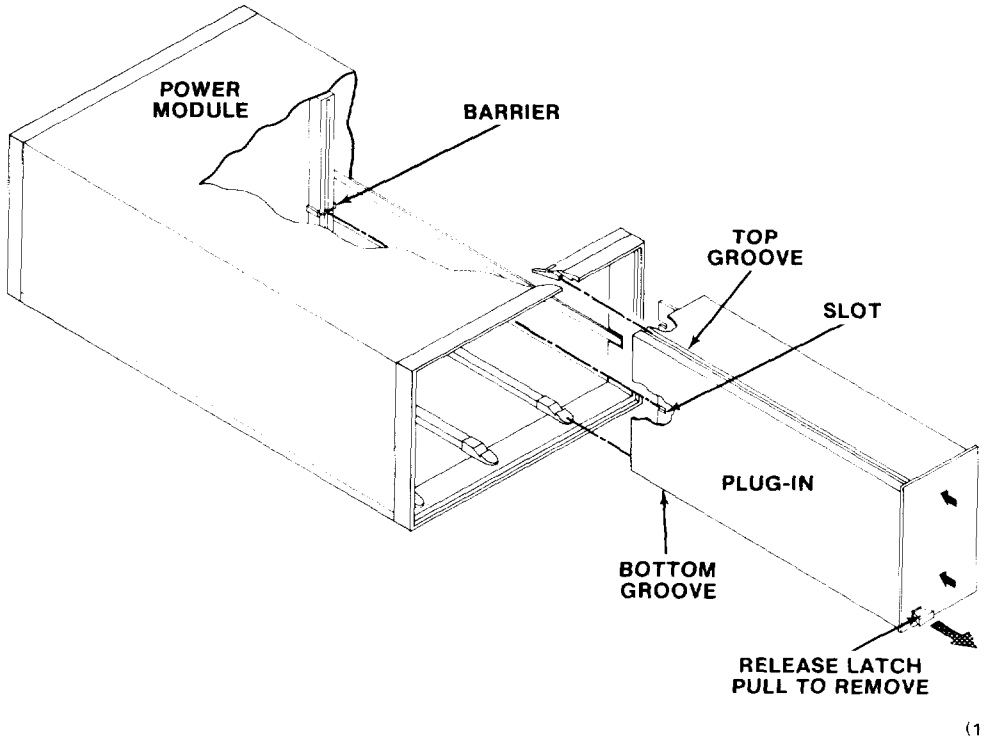


Fig. 1-1. Plug-in installation and removal.

(located in the lower left corner) until the interconnecting jack disengages and the AM 503 will slide out.

OPERATING CONSIDERATIONS

Introduction

The remainder of this section contains the operating information required to obtain the most effective performance from the instrument. This includes the function and actions of the controls and connectors, input connections, and a general description of the operating modes and procedures for making basic measurements.

Controls and Connectors

All of the major controls and connectors for operation of the AM 503 are located on the front panel of the unit. A brief functional description of each control and connector is included in Fig. 1-2.

Monitor Oscilloscope

The bandwidth required of the oscilloscope used with the AM 503 depends upon the frequency of the signal being measured. Oscilloscope vertical bandwidth should be at least twice the frequency of the signal being measured.

Deflection. Conventional current flowing in the direction of the arrow on the current-probe slider produces a positive deflection of the oscilloscope display.

Ground-clip Leads

Ground-clip leads are furnished with some current probes to ground the cable shield at the probe end. The ground lead is used to reduce high-frequency electrostatic voltages that could couple into the probe and cause errors in measuring. A ground lead is normally not used in the lower (1, 2, 5, and 10 mA) sensitivity positions of the attenuator switch because of undesirable chassis currents that may appear in these more sensitive positions.

When observing high-frequency signals, use the shortest practical ground-clip lead available.

Output Connection

Output connection can be accomplished through the OUTPUT INTO 50 Ω connector or the rear interconnecting jack at pin 28A. Pin 28A at the rear interconnecting jack is terminated in 50 Ω. Connector J480, located on the right side upper-rear of the instrument, is where the output cable connects for rear interface output. With the output cable connected for rear interface output, a termination is not required because of the internal (factory wired) termination. The monitor oscilloscope input impedance should not be 50 Ω if the rear interface connection is used. It will cause an impedance mis-match and possible loading of the AM 503.

Changing output to rear interface. Remove the right side snap-in cover from the AM 503. Unplug the coaxial cable from the rear of the OUTPUT INTO 50 Ω connector. Carefully align the coaxial cable at the upper-rear coaxial connector; pressing firmly, insert the cable.

CAUTION

The coaxial cable connector center pin is easily bent and alignment is critical when making the connection for rear interface output.

With the output cable (internal) connected to the rear interconnecting jack output, the front-panel OUTPUT INTO 50 Ω connector will not have an output signal available.

Connecting the AM 503

Install the AM 503 into the TM 500-Series power module. Ensure that the power module into which the AM 503 will be installed is suitably adapted to the line voltage to be applied.

Connect a 50 Ω cable with bnc connectors (and if necessary, a 50 Ω termination for impedance matching) to the monitor oscilloscope vertical input.

Set the monitor oscilloscope vertical sensitivity for 10 mV/Div. The horizontal sweep speed should be consistent with the signal frequency to be examined.

Connect a current probe to the AM 503 INPUT connector.

Turn all equipment on and allow 20 minutes for the equipment to warm up and stabilize.

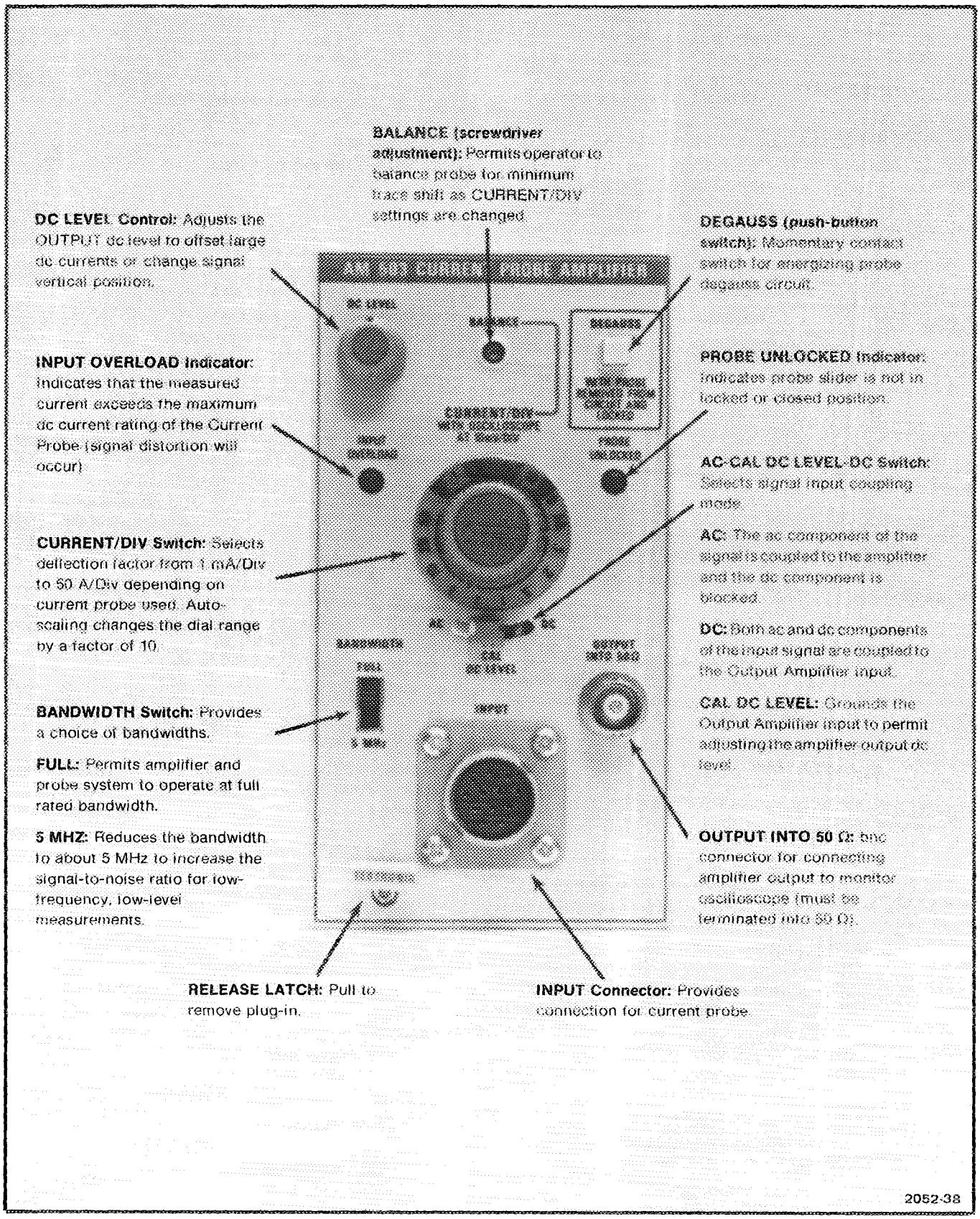


Fig. 1-2. AM 503 controls and connectors.

Using the AM 503 with Probe

Set the monitor oscilloscope vertical input to ground and position the trace vertically to graticule center. Reset the monitor oscilloscope vertical input to dc coupling.

Set the AM 503 AC-CAL DC LEVEL-DC switch to the CAL DC LEVEL position. Rotate the DC LEVEL control to position the monitor oscilloscope trace to graticule center.

With the current probe slide in the closed position (not connected around a conductor) press and release the DEGAUSS button.

NOTE

Removal of any magnetic flux present in the probe transformer core always requires degaussing the probe. This is important after connecting or reconnecting the probe, or after making measurements in excess of the instrument range.

Set the AM 503 AC-CAL DC LEVEL-DC switch to DC. Set the CURRENT/DIV full clockwise. Adjust the screwdriver BALANCE control to position the monitor oscilloscope trace to graticule center.

The AM 503 and current probe are balanced, degaussed, and ready to measure current in a conductor. The CURRENT/DIV switch is calibrated for use at the 10 mV/Div monitor oscilloscope vertical sensitivity. However, for low amplitude currents (less than 2 mA), added resolution may be gained by changing the monitor oscilloscope sensitivity to 5 mV/Div. With the vertical sensitivity at 5 mV/Div, the AM 503 1 mA/Div sensitivity becomes 0.5 mA/Div.

The AM 503 internal circuitry, in conjunction with a 10X probe, has a feature for automatically changing the amplifier gain. When the gain is changed for a 10X probe, the CURRENT/DIV knob-skirt illumination changes to display the corresponding switch range. If a 10X probe is used (e.g., P6303), the lowest range on the CURRENT/DIV switch becomes 10 mA/Div. Again, the monitor oscilloscope sensitivity can be changed to increase the monitor oscilloscope resolution for viewing lower amplitude signals.

Insertion Impedance

The insertion impedance of the current probe is the equivalent circuit that is placed in the circuit under test when the probe is clamped around a conductor. When observing fast-rise signals the insertion impedance should be considered to minimize loading. Consult the Instruction sheet for the probe in use to find the relationship of frequency to insertion impedance deviation.

High Currents

CAUTION

When measuring high currents, do not disconnect the probe cable from the AM 503 while the probe is clamped around the conductor. With the probe cable disconnected (unterminated), the high voltage developed in the secondary winding of the transformer may damage the current probe.

When measuring over 40 amperes peak (with a 1X probe), the AM 503 output may overdrive the monitor oscilloscope vertical display. When measuring these high currents, change the monitor oscilloscope vertical sensitivity to 20 mV/Div. With the vertical sensitivity at 20 mV/Div, the AM 503 5 A/Div sensitivity becomes 10 A/Div.

Maximum Currents

The maximum peak-to-peak currents (approximate) in amperes vs. signal frequency derating curve is listed in the appropriate instruction sheet for the current probe in use. Current is derated for a continuous signal to prevent excessive heating in the probe head.

INPUT OVERLOAD indicator light. The front panel indicator lights when the measured current exceeds the maximum dc current rating of the probe in use. The monitor oscilloscope display (regardless of input coupling) may be inaccurate with the INPUT OVERLOAD lamp lit.

SPECIFICATION AND PERFORMANCE CHECK

Performance Conditions

The electrical characteristics are valid only if the AM 503 has been calibrated at an ambient temperature between +20° C and +30° C and is operating at an ambient temperature between 0° C and +50° C, unless otherwise stated.

Items listed in the Performance Characteristics column of the Electrical Characteristics are verified by completing the Performance Check in this section of the manual. Items listed in the Supplemental Information column are not verified in this manual. The items are either explanatory notes or performance characteristics for which no limits are specified.

SPECIFICATION

Table 2-1
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Characteristics	Supplemental Information
Bandwidth (−3 dB)		
Full		OUTPUT terminated into 50 Ω, DC function
Amplifier Only	DC to at least 100 MHz.	
with P6303	DC to at least 15 MHz.	
with P6302	DC to at least 50 MHz.	
5 MHz	5 MHz, ±1 MHz	
ac coupled, lower limit	≤7 Hz	
Rise time (full bandwidth)	≤3.5 ns	
Noise		
Ampl random (1st two cw positions of CURRENT/DIV switch)	≤4 mV	BANDWIDTH Full, function in CAL DC LEVEL; dc level adjusted for zero dc out
Ampl random (CURRENT/DIV switch ranges except 1st two cw positions)	≤0.8 mV	BANDWIDTH Full, function in DC; CURRENT/DIV full cw; DC LEVEL adjusted for zero dc out
Random (typical probes)		
P6302	≤0.3 mA (Tangentially measured)	
P6303	≤3 mA (Tangentially measured)	
Attenuator Accuracy	Within 3% of indicated Current/Division	

Table 2-1 (cont)

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Characteristics	Supplemental Information
Deflection Factor (typical probes)		
P6302	1 mA to 5 A/div in a 1, 2, 5 sequence	
P6303	10 mA to 50 A/div in a 1, 2, 5 sequence	
Thermal Drift		
Amplifier Only		In first two cw positions; 2 mV/°C or less at OUTPUT (from +15°C to +35°C ambient) In all but first two cw positions; ≤ 0.4 mV/°C at OUTPUT (from +15°C to +35°C ambient)
OUTPUT dynamic range	+80 mV and −80 mV with less than 5% compression (into 50 Ω)	CURRENT/DIV set to 5 mA/Div. Monitor oscilloscope set for 20 mV/div
	POWER CONSUMPTION	
Standard Instrument		≈17 W

Table 2-2

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Information
Temperature	Test to procedures of MIL-STD-810C Methods 502.1 and 501.1 using Procedure I as specified in MIL-T-28800B paragraph 4.5.5.1.3 and 4.5.5.1.4.
Operating	0°C to +50°C.
Non-operating	−55°C to +75°C.
Humidity	
Operating	+50°C to 95% relative humidity.
Non-operating	+60°C to 95% relative humidity. Test to MIL-STD-810C Method 507.1 Procedure IV, modified as specified in MIL-T-28800B paragraph 4.5.5.1.1.2.
Altitude	Test to MIL-STD-810C Method 500.1 Procedure I as specified in MIL-T-28800B paragraph 4.5.5.2.
Operating	To 15,000 feet.
Non-operating	To 50,000 feet.

Table 2-2 (cont)

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Information
Vibration	
Operating and Non-operating	With the instrument operating, the vibration frequency is swept from 10 to 55 to 10 Hz. Vibrate 15 minutes in each of the three major axes at 0.015" total displacement. Hold 10 minutes at any major resonance, or if none, at 55 Hz. Total time, 75 minutes.
Shock	
Non-operating	30 g's 1/2 sine, 11 ms duration, 3 shocks in each direction along 3 major axes, for a total of 18 shocks.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

Table 2-3

PHYSICAL CHARACTERISTICS

Characteristics	Information
Maximum Overall Dimensions	
Height	≈5 inches (12.7 cm)
Width	≈2.6 inches (6.7 cm)
Length	≈11.7 inches (29.8 cm)
Front Panel	
Finish	Anodized aluminum
Net Weight	≈2 lbs.

PERFORMANCE CHECK

Introduction

This procedure checks the electrical characteristics of the AM 503 that appear in the Specification section of this manual. If the instrument fails to meet the requirements given in this performance check, the adjustment procedure should be performed. This procedure can also be used by an incoming inspection facility to determine acceptability of performance.

The electrical characteristics in Section 2 are valid only if the AM 503 is calibrated at an ambient temperature of +20° C to +30° C and operated at an ambient temperature of 0° C to +50° C.

Tolerances that are specified in this Performance Check procedure apply to the instrument under test and do not include test equipment error.

Test Equipment Required

The following test equipment, or equivalent, is required to perform the performance check. Test equipment characteristics listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerances.

Special test devices are used where necessary to facilitate the procedure. Most of these are available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

Table 2-4

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Minimum Specifications	Usage	Examples
1. Test Oscilloscope	Bandwidth: dc to 150 MHz; minimum vertical deflection 5 mV/Div; minimum Time/Div, 2 ns.	All amplifier output measurements	TEKTRONIX 7704A with 7A16A Amplifier and 7B80 Time Base
2. Power Module TM 500-Series	AM 503 and test	Provide power to equipment	TEKTRONIX TM 503 or TM 506 or TM 515
3. Digital Voltmeter	Ranges (ac rms), 0—200 mV, 0—2 V; Accuracy, ±0.5% ±1 count at 1 kHz.	Dynamic range	TEKTRONIX DM 502[a]
4. Calibration Generator	Amplitude Calibrator and two pulse modes: High Amplitude and Fast Rise Amplitude Calibrator. Amplitude to 5 V, p-p into 50 Ω; period, approx. 1 ms. High Amplitude Output: Period 1 μs to 10 ms; duty cycle, approx. 50%; amplitude range, 0.5 V or less to at least 5 V. Leading edge aberrations within 2%, into 50 Ω. Fast Rise Output. Period 1 μs to 10 ms; duty cycle, approx. 50%; amplitude range, 100 mV or less to at least 1.0 V into 50 Ω. Rise time (terminated in 50 Ω), 1.0 ns or less; leading edge aberrations, within 2% during first 10 ns; flatness within 0.5% after first 10 ns; trigger output (terminated in 50 Ω), positive going signal is at least 1.0 V.	Noise. Rise Time Bandwidth	TEKTRONIX PG 506[a] Pulse Generator
5. Constant Amplitude Sine-Wave Generator	Frequency range, to at least 50 MHz with 50 kHz reference frequency; Amplitude range to 4 V p-p; impedance, 50 Ω; amplitude accuracy (50 kHz reference) within 3% of indicated amplitude on 5 V range, into 1% termination; flatness, output amplitude does not	Bandwidth Checks	TEKTRONIX SG 503[a] Leveled Sine-Wave Generator

Table 2-4 (cont)

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Minimum Specifications	Usage	Examples
5. Constant Amplitude Sine-Wave Generator (cont)	vary more than 3% from actual amplitude of 50 kHz reference to 50 MHz.		
6. Function Generator	Output frequency, approx. 5 Hz to 1 kHz; amplitude, (into 50 Ω), or 5 V p-p; Amplitude flatness (sine wave), ±1.5 dB throughout required frequency range.	Ac low frequency −3 dB point check. Dynamic range	TEKTRONIX FG 502[a]
7. Cable (3 required)	Impedance, 50 Ω; length, 42 inches; connectors, bnc	Used in all test setups.	Tektronix Part No. 012-0057-01
8. Termination (2 required)	Impedance, 50 Ω, in-line; connectors, bnc	Used in all test setups	Tektronix Part No. 011-0049-01
9. Special Adapter	Impedance, 25 Ω, in-line; connectors, bnc	Used in all test setups	See Fig. 3-1
10. Adapter	bnc 'T'	AC Dynamic Range	Tektronix Part No. 103-0030-00
11. 10X Attenuator (3 required)	Impedance, 50 Ω; connectors, bnc	Noise; Dynamic range	Tektronix Part No. 011-0059-02

[a] **Requires TM 500-Series Power Module.**

Preliminary Procedure

1. Ensure that all power switches are off.

2. Ensure that all test equipment and the power module into which the AM 503 under test will be installed are suitably adapted to the line voltage to be applied.

3. Install the AM 503 into the power module, and if applicable, install all other TM 500-Series test equipment into the power module.

4. Connect the power module(s) and test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to warm up and stabilize.

1. Check Current/Division Accuracy

Set the following controls as indicated:

AM 503

CURRENT/DIV	5 A
Coupling	DC
BANDWIDTH	FULL

Calibration Generator

Amplitude	10 V
Mode	std ampl

Monitor Oscilloscope

Volts/Div	5 mV
Time/Div	50 μs
Input Coupling	dc
Triggering	ext

a. Connect the OUTPUT of the AM 503 to the input of the monitor oscilloscope using a 50 Ω cable and a 50 Ω terminator.

b. Connect the Ampl Output of the calibration generator to the AM 503 INPUT using the special adapter (see Fig. 3-1) and a 50 Ω cable.

c. Using the AM 503 DC LEVEL control and the monitor oscilloscope vertical position control, center the display.

d. Check—that the signal amplitude is two divisions.

e. Set the AM 503, calibration generator, and monitor oscilloscope as indicated in Table 2-2.

f. Check—that the signal amplitude in each step is five divisions ±0.15 division.

Table 2-2

CURRENT/DIVISION ACCURACY CONTROL SETTINGS

AM 503	Calibration Generator	Monitor Oscilloscope VOLTS/DIV
2.0 A	10.0 V	5 mV
1.0 A	10.0 V	10 mV
0.5 A	5.0 V	10 mV
0.2 A	2.0 V	10 mV
0.1 A	1.0 V	10 mV
50 mA	0.5 V	10 mV
20 mA	0.2 V	10 mV
10 mA	0.1 V	10 mV
5 mA	50 mV	10 mV
2 mA	20 mV	10 mV
1 mA	20 mV	20 mV

g. Remove test connections.

2. Check AC Dynamic Range

Set the following controls as indicated:

AM 503

CURRENT/DIV	5 mA
Coupling	DC
BANDWIDTH	FULL

Low Frequency Sine-Wave Generator

Frequency	100 Hz
Amplitude	Minimum
Offset	Off (in)

Monitor Oscilloscope

Volts/Div	20 mV
Coupling	dc
Time/Div	5 ms

a. See Fig. 2-1 for test setup.

b. Set the sine-wave generator for 28.3 mV, rms out of the AM 503 (monitor oscilloscope indicates 80 mV, peak-to-peak).

c. Set monitor oscilloscope input coupling to gnd. Position trace vertically four divisions below the center graticule line.

d. Reset monitor oscilloscope input coupling to dc.

e. Set AM 503 coupling to CAL DC LEVEL.

f. Adjust AM 503 DC LEVEL to position trace vertically four divisions below the center graticule line.

g. Reset the AM 503 coupling to DC.

h. Using the AM 503 DC LEVEL control, center the signal on the center graticule line.

i. Check—DVM should read at least 26.9 mV rms or greater.

j. Set monitor oscilloscope input coupling to gnd.

k. Position the trace vertically four divisions above the center graticule line.

l. Reset the monitor oscilloscope input coupling to dc.

m. Set the AM 503 coupling to CAL DC LEVEL.

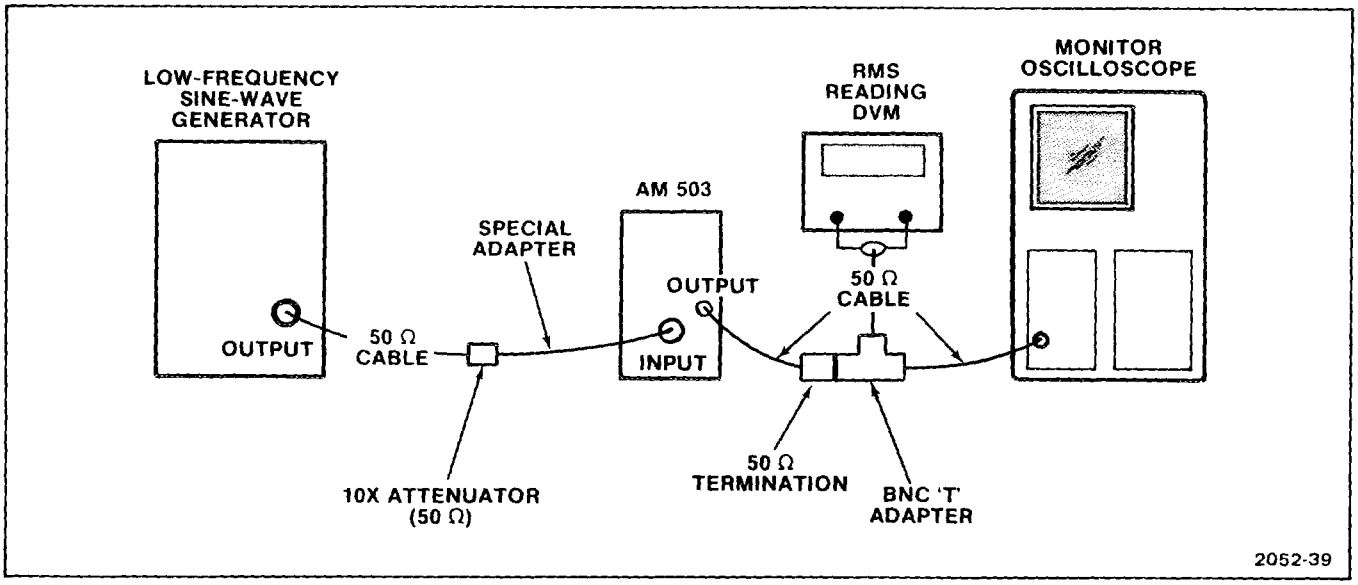


Fig. 2-1. Test setup for AC Dynamic Range Check.

n. Adjust the AM 503 DC LEVEL control to position the trace four divisions above the center graticule line.

o. Set the AM 503 coupling to DC.

p. Using the AM 503 DC LEVEL control, center the signal on the center graticule line.

q. Check—DVM should read at least 26.9 mV rms or greater.

r. Remove test connections.

3. Check Amplifier Noise

Set the following controls as indicated:

AM 503

CURRENT/DIV	1 mA
BANDWIDTH	FULL
Coupling	CAL DC LEVEL

Calibration Generator

Mode	Fast Rise
Period	1 ms
Pulse Amplitude	midrange

(Use short cables.)

Monitor Oscilloscope

Volts/Div	10 mV
Time/Div	10 μs
Input Coupling	gnd
Triggering	ext

a. Using a 50 Ω cable and a 50 Ω termination, connect the AM 503 OUTPUT to the input of the monitor oscilloscope.

b. Attach the three 10X attenuators to the + Fast Rise Output of the calibration generator. Using a 50 Ω cable and the special adapter, connect the AM 503 INPUT to the attenuators.

c. Set the monitor oscilloscope vertical Position control so that the trace is on the center graticule line.

d. Set the monitor oscilloscope input coupling to dc.

e. Using the AM 503 DC LEVEL control, position the trace to the center graticule line.

f. Set the AM 503 coupling to DC.

g. Decrease the calibration generator output amplitude until the two traces just merge (no dark area between the traces, see Fig. 2-2).

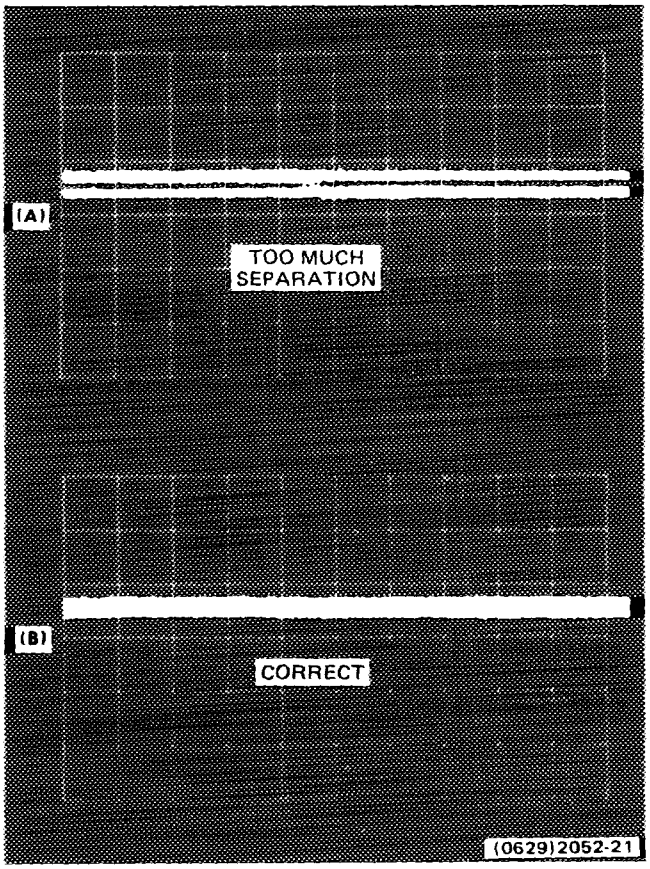


Fig. 2-2. Display of tangentially measured noise (A) incorrect; dark area showing between traces, (B) correct display.

h. Remove one 10X attenuator.

i. Divide display amplitude by 10. Example: 1.9 divisions of display at 10 mV/Div 19 mV. Divide 19 mV by 10; then the noise 1.9 mV.

j. Check for a maximum of 4 mV of noise.

k. Set the AM 503 CURRENT/DIV to 2 mA.

l. Check using the procedure in part i, for a maximum of 4 mV of noise.

m. Set AM 503 CURRENT/DIV to 5 mA.

n. Repeat parts b through i.

o. Check for a maximum of 0.8 mV of noise.

p. Repeat parts n and o for all remaining settings of the AM 503 CURRENT/DIV control.

NOTE

At 20 mV/Div with monitor oscilloscope, go to High Amplitude Output on Calibration generator. Remove 10X attenuator on 0.1 A setting. Remove last 10X attenuator on 1.0 A setting.

4. Check Rise Time/Bandwidth

Set the following controls as indicated:

AM 503

CURRENT/DIV	20 mA
BANDWIDTH	FULL
Coupling	DC

Calibration Generator

Mode	Fast Rise
Period	1 μs
Amplitude	Minimum

Monitor Oscilloscope

Volts/Div	10 mV
Bandwidth	Full
Time/Div	.02 μs
Magnifier	X10
Triggering	ext

a. Using the 50 Ω cable and 50 Ω termination, connect the AM 503 OUTPUT to the input of the monitor oscilloscope.

b. Using the special adapter and a 50 Ω cable, connect the calibration generator Fast Rise Output to the AM 503 INPUT.

c. Set the display amplitude to five divisions using the calibration generator Pulse Amplitude control.

d. Set the test oscilloscope to Internal Triggering and, using the Triggering Level and horizontal Position controls, obtain a display of the waveform leading edge.

e. Measure the rise time (10%—90% point).

f. Check that the rise time is 3.5 ns or less.

g. Disconnect the calibration generator from the special adapter.

h. Connect the sine-wave generator Output to the special adapter.

i. Set the following controls as indicated:

AM 503

CURRENT/DIV	5 mA
BANDWIDTH	FULL
Coupling	DC

Leveled Sine-Wave Generator

Frequency Range (MHz)	REF 350 kHz
Amplitude Multiplier	X .01
Output Amplitude	3.0

Monitor Oscilloscope

Volts/Div	10 mV
Time/Div	50 μs
Triggering	*ext*

j. Adjust the Output Amplitude control of the sine-wave generator for a six-division display.

k. Increase the frequency of the sine-wave generator until the display is reduced to 4.2 divisions.

l. Check—that the sine-wave generator frequency is at least 100 MHz.

m. Change the following controls as indicated:

AM 503

BANDWIDTH	5 MHz

Sine-Wave Generator

Frequency Range	Ref 350 kHz

n. Adjust Output Amplitude of the sine-wave generator for a six-division display.

o. Increase the frequency of the sine-wave generator until the display amplitude is reduced to 4.2 divisions.

p. Check—that the sine-wave generator frequency is at least 4 MHz and not more than 6 MHz.

q. Disconnect the cable from the Output of the sine-wave generator and connect to the Output of the function generator.

r. Set the following controls as indicated:

AM 503

CURRENT/DIV	20 mA
BANDWIDTH	5 MHz
Coupling	AC

Function Generator

Frequency	1 kHz
Amplitude	Minimum

Monitor Oscilloscope

Volts/Div	50 mV
Time/Div	10 μs
Triggering	*ext*

s. Set the function generator Amplitude control for a six-division display.

t. Decrease the frequency of the function generator until the display is reduced to 4.2 divisions.

u. Check—that the function generator frequency is not more than 7 Hz.

5. DC Level and Balance

Set the following controls as indicated:

AM 503

Current/Div	1 mA
Bandwidth	Full
Coupling	Cal DC

Monitor Oscilloscope

Volts/Div	10 mV
Time/Div	10 μs
Triggering	ext

c. Set vertical oscilloscope input coupling to gnd. d. Reset the AM 503 coupling to DC.

Table 3-1 (cont)

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Applications	Examples
Calibration Generator	Pulse Output: period 1 μs to 10 ms; duty cycle, ~50%; amplitude range, 0.5 V or less to at least 5 V. Leading edge aberrations ≤2%, into 50 Ω. Rise time (terminated into 50 Ω) ≤10 ns.	Gain and Compensation adjustment.	TEKTRONIX PG 506[a] Pulse Generator.
Digital Voltmeter	Range, 0 to 20 V; accuracy within 0.2%.	Power supply voltage check.	TEKTRONIX DM 502A[a] Digital Multimeter.
Probe	1X	Gain adjustment.	TEKTRONIX P6101.
Termination	Impedance, 50 Ω; connector, bnc.	All measurements.	Tektronix Part No. 011-0049-01.
Cable (2 required)	Impedance, 50 Ω; length, 42 inches; connectors, bnc.	All measurements.	Tektronix Part No. 012-0057-01.
Resistor	Fixed wire-wound, 3 Ω, 3 W, 5%.	Degauss adjustment.	Tektronix Part No. 308-0441-00.
Special Adapter		Used for all inputs to AM 503.	See Fig. 3-1.

[a] **Requires TM 500-Series Power Module.**

Preparation

a. Construct Special Adapter as shown in Fig. 3-1.

b. Remove the left side cover of the AM 503 to gain access to the adjustments. Pull the rear end of the side cover outward from the side of the instrument (the cover snaps into place).

c. Be sure that the power switch is off. Set the power module for the line voltage to be applied and connect it to the line voltage source.

d. Install the other TM 500-Series equipment into the power module.

e. Turn on all test equipment and allow 20 minutes for warm up and stabilization.

1. Adjust Power Supply Voltages

a. Connect the DVM between each voltage test point and ground for the supplies listed in Table 3-2. See Fig. 3-2 for test point and adjustment locations.

b. Examine each supply voltage to determine if it is within the range given.

c. Adjust each supply voltage with the indicated adjustment.

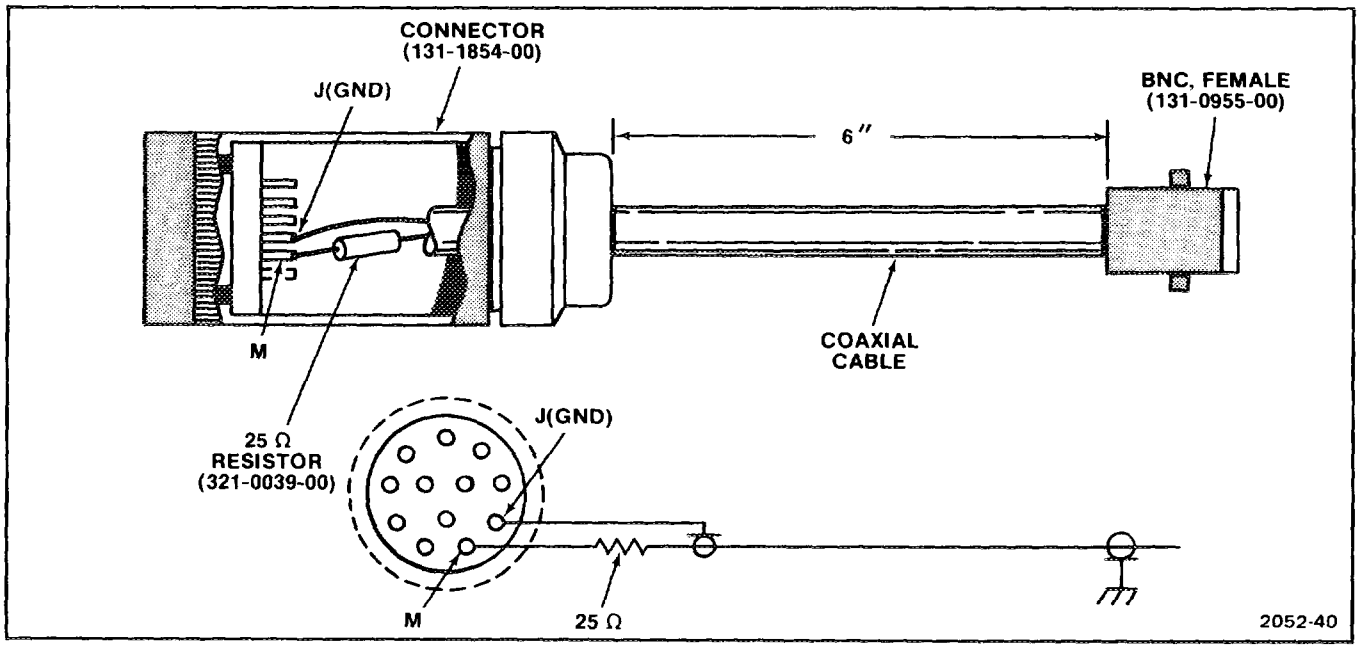


Fig. 3-1. Construction details for Special Adapter.

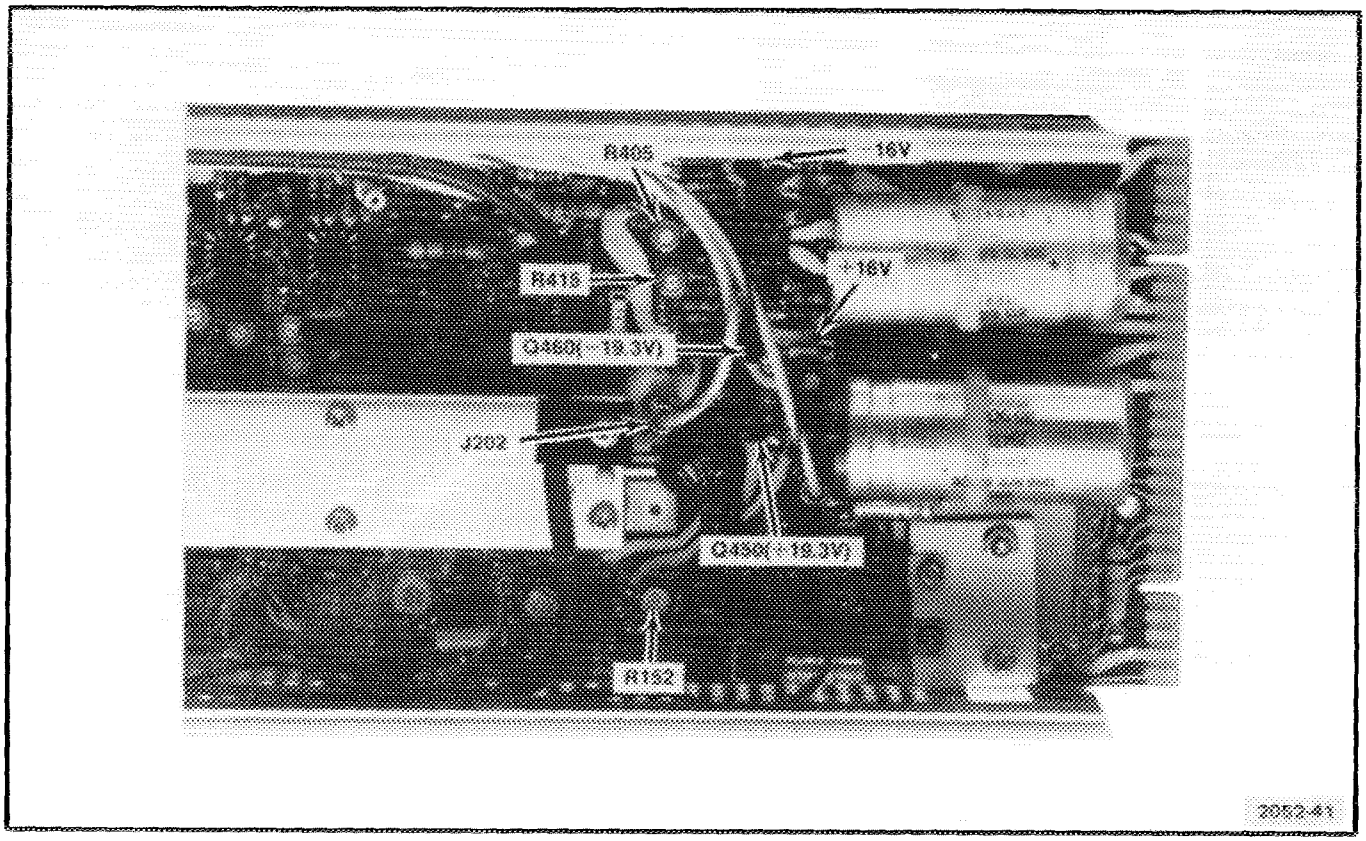


Fig. 3-2. Power supply test point and adjustment locations.

Table 3-2

POWER SUPPLY TEST POINTS, LIMITS, AND ADJUSTMENTS

Supply	Test Point	Limits	Adjustment
16 V	R422	16.1 V to 15.9 V	R405
-16 V	R412	-15.9 V to -16.1 V	R415
-19.3 V	Q450 emitter	-18 V to -21.5 V	no adjustment
19.3 V	Q460 emitter	21.5 V to 18 V	no adjustment

2. Adjust Gain

Set the following controls as indicated:

AM 503

CURRENT/DIV	.1 A
Coupling	DC
BANDWIDTH	FULL

Calibration Generator

Period	1 ms
Mode	Fast Rise*
Pulse Amplitude	Minimum
*Rising edge	1 V to 0 V

Monitor Oscilloscope

Volts/Div	50 mV
Time/Div	.5 ms

a. Using the special adapter and 50 Ω cable, connect the calibration generator output to the AM 503 INPUT.

b. Place the 1X probe on J202 (on the back side of the board).

c. Using the calibration generator pulse amplitude control, set the display amplitude for 200 mV, (ignoring the first 10 μs of each pulse).

d. With a 50 Ω cable and a 50 Ω termination, connect the AM 503 OUTPUT to the monitor oscilloscope.

e. Set the monitor oscilloscope to 10 mV.

f. Examine—for a four-division display on the monitor oscilloscope.

g. Adjust—R344 for a four-division display (see Fig. 3-3).

h. Set the current/Div on the AM 503 to 50 mA. (Display will now be 8 divisions.)

i. Connect a jumper wire between P346 (see Fig. 3-3) and ground.

j. Examine—for a display of 4.4 to 4.6 divisions.

k. Adjust—R346 for a display of 4.5 divisions.

3. Adjust Compensation

Set the following controls as indicated:

AM 503

CURRENT/DIV	5 mA
Coupling	DC

Calibration Generator

Period	1 μs
Mode	Fast Rise*
Pulse Amplitude	Minimum
*Rising edge	-1 V to 0 V

Monitor Oscilloscope

Volts/Div	10 mV
Time/Div	200 ns

a. Using a 50 Ω cable, the special adapter, and a 10X attenuator, connect the calibration generator fast rise output to the AM 503 INPUT.

b. Using a 50 Ω cable and a 50 Ω termination, connect the AM 503 OUTPUT to the monitor oscilloscope input.

c. Adjust the calibration generator pulse amplitude for a six-division display.

d. Set the monitor oscilloscope time/div to 20 ns.

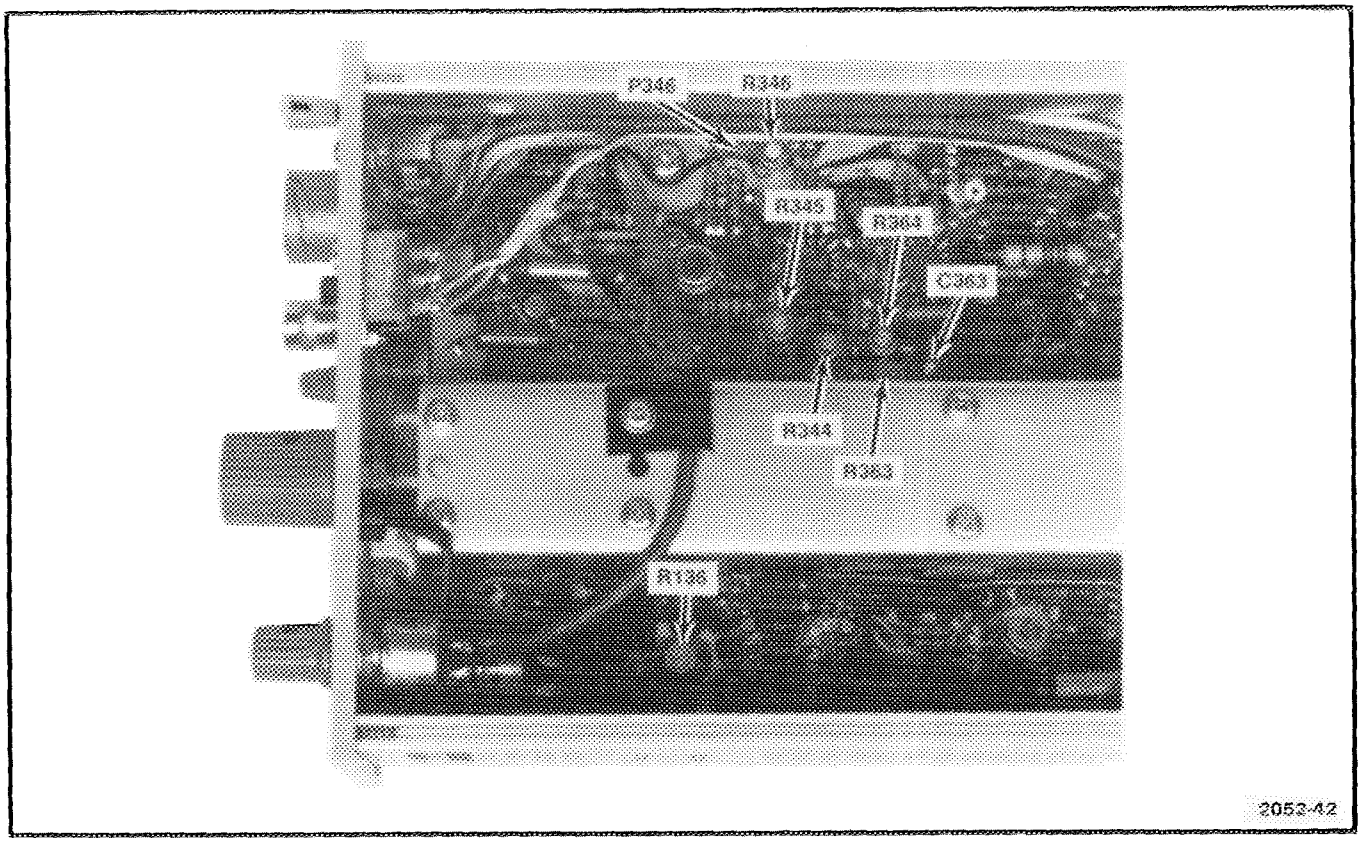


Fig. 3-3. Gain and compensation adjustment locations.

e. Examine—front corner of waveform for correct compensation (ignore long-term roll-off caused by L202).

f. Adjust—R364, R345, C363, and R363 for optimum compensation.

g. Refer to Fig. 3-4 for example.

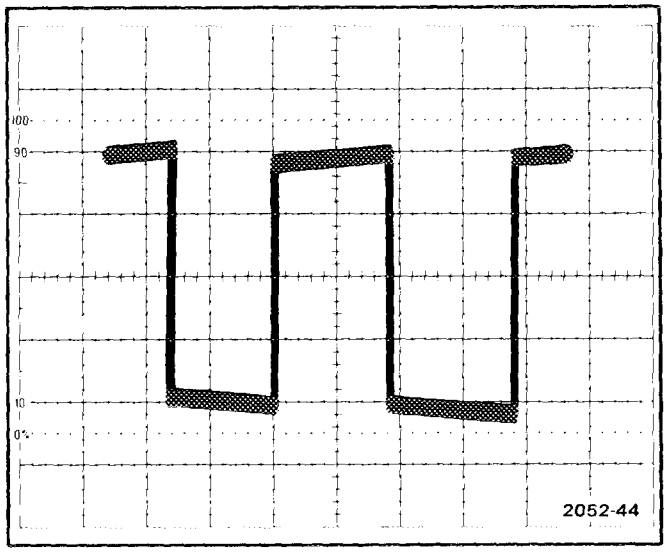


Fig. 3-4. Example of correct compensation.

NOTE

If compensation adjustments are made, it is necessary to re-check the bandwidths of the instrument. Refer to the RISE TIME/BANDWIDTH procedure in Section 2, Performance Check.

h. Remove test connections.

4. Adjust Degauss Offset/Signal Amplitude

Set the following controls as indicated:

AM 503

CURRENT/DIV	Fully clockwise
R136	Fully counterclockwise
Coupling	CAL DC LEVEL

Monitor Oscilloscope

Volts/Div	10 mV
Time/Div	1 ms
Triggering	ext
Input Coupling	gnd

a. Connect a 50 Ω coaxial cable from the AM 503 OUTPUT through a 50 Ω termination to the monitor oscilloscope input.

b. Position trace to the center graticule line using the monitor oscilloscope vertical Position control.

c. Set monitor oscilloscope input coupling to dc.

d. Using the AM 503 DC LEVEL control, re-position the trace to the center graticule line.

e. Set the AM 503 Coupling to DC.

f. Press and hold the AM 503 DEGAUSS button.

g. Examine—trace positioned at center graticule line.

h. Adjust—R152, Degauss Offset (see Fig. 3-2), for zero volts dc (trace positioned on center graticule line).

i. Connect the 3.0 Ω resistor between pins M and N of the AM 503 INPUT connector.

j. Set the AM 503 CURRENT/DIV fully counter-clockwise.

k. Press and hold the DEGAUSS button.

l. Adjust—R136, Degauss Level (see Fig. 3-3), for a 4.4 divisions ±0.4 division display.

This completes the AM 503 Adjustment Procedure.

MAINTENANCE

This section of the manual contains information about preventative maintenance, corrective maintenance, and troubleshooting.

PREVENTIVE MAINTENANCE

Preventive maintenance steps performed on a regular basis will enhance the reliability of the instrumentation system. However, periodic checks of the semiconductors in the absence of a malfunction are not recommended as preventive maintenance measures. See the semiconductor checking information under Troubleshooting Techniques, which follows. A convenient time to perform preventive maintenance is just before instrument calibration.

Cleaning

The AM 503 should be cleaned as operating conditions require. Accumulation of dirt on the components acts as an insulating blanket and prevents efficient heat dissipation, which can cause overheating and component breakdown.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in this instrument. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

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

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. Remove any remaining dirt with a soft brush, or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Visual Inspection

The AM 503 should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged circuit boards, and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Lubrication

Generally, there are no components in the AM 503 that require lubrication.

Pushbutton and Slide Switches. *The switches are* lubricated prior to leaving the factory and should not require further lubrication. However, if they become electrically noisy, cleaning and lubrication may solve the problem.

Cam Switches. In most cases, the factory lubrication of these switches is adequate for the life of the instrument. The switch contacts are designed to operate dry.

If the switch has been disassembled for the replacement of switch sub-parts, a lubrication kit containing the necessary lubricating materials and instructions is available through any Tektronix Field Office. Order Tektronix Part No. 003-0342-01. General Electric Versilube® G-322L silicone grease may be applied sparingly so that the lubricant does not get on the contacts. Refer to Fig. 4-1 for lubrication instructions.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

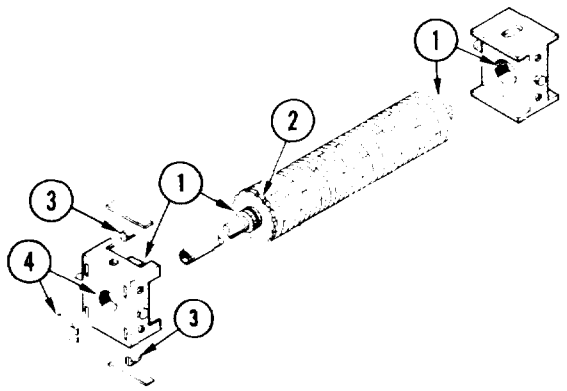
Obtaining Replacement Parts

Most electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, you should be able to obtain many of the

standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix Inc., please check the Replaceable Electrical Parts list for the proper value, rating, tolerance and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequencies. Each part should be a direct replacement unless it is known that a different component will not adversely affect instrument performance.



1. Apply lubricant to the drum journals and mating surface in the mounting bearings.

2. Apply lubricant to the wear surface of the index wheel.

3. Apply lubricant to the index roller and roller guide in the front bearing. A thin film should be applied to the inner face of the detent springs if more than one spring is replaced.

4. Ensure that some lubricant is present at the interface between the bearing and retainer clip.

2052-2 (1481-40)

Fig. 4-1. Lubrication procedure for a typical cam switch.

Some electrical parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc. to our specifications. Most of the mechanical parts used in this instrument are manufactured by Tektronix, Inc. To determine the manufacturer of parts, refer to parts list cross index, Mfr. Code number to Manufacturer.

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.

2. Instrument serial number.

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

4. Tektronix part number.

TROUBLESHOOTING

The following information is provided to help troubleshoot the AM 503. Information contained in other sections of this manual should be used along with the following information to aid in locating a defective component. An understanding of the circuit operation is very helpful in locating troubles, particularly where integrated circuits are used.

Control Settings

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of the manual.

Testing Equipment

Generally, a wide-band oscilloscope, a probe, and a multimeter are all that is needed to perform basic waveform and voltage checks for diagnostic purposes. The Adjustment Procedure lists specific equipment and the features necessary to adequately check out the AM 503.

Circuit Isolation

Note the symptom. It often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by making waveform and voltage measurements.

Incorrect operation of all circuits often means trouble in the power supplies. Using a multimeter, check first for correct voltages at the individual regulated supplies according to the plug-in module schematics and calibration procedures. Then check the unregulated supplies of the power modules. Defective components elsewhere in the instruments can appear as power supply problems. In these instances, suspected circuits should be disconnected from apparently bad power supplies one at a time to narrow the search.

Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on the schematic or in the calibration procedures. Such waveforms and voltage labels are typical indications and will vary between instruments. To obtain operating conditions similar to those used to take these readings, refer to the first diagram in the service sections.

Semiconductor Checks

Periodic checks of the semiconductors in the AM 503 are not recommended. The best check of semiconductor performance is actual operation of the instrument. More details on checking semiconductor operation are given under TROUBLESHOOTING.

Component Checking

If a component cannot be disconnected from its circuit, then the effects of the associated circuitry must be considered when evaluating the measurement. Except for soldered-in transistors and integrated circuits, most components can be lifted at one end from the circuit board.

Transistors and IC's. Turn the power switch off before removing or replacing any semiconductor.

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions. A suction-type desoldering tool must be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC's. Operating waveforms, logic levels, and other operating information for the IC's are given in the circuit description information of the appropriate manual. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin in-line IC's is with an integrated-circuit test clip. This device also doubles as an extraction tool.

Lead configurations for the semiconductors used in this instrument are shown in Fig. 4-2.

Diodes. Do not use an ohmmeter that has a high internal current. High currents may damage the diode.

A diode may be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 mV and 3 V, the resistance should be very high in one direction and very low when the leads are reversed.

Resistors. Check the resistors with an ohmmeter. Resistor tolerances are given in the Replaceable Electrical Parts list in every manual. Resistors do not normally need to be replaced unless the measured value varies widely from the specified value.

Capacitors. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale. Use an ohmmeter which will not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacity meter, or by checking whether it passes AC signals.

Power Supply. If incorrect operation of the power supply is suspected, first check that the power-module line selector block is in the correct position (see Power Module Instruction Manual). Use a dc voltmeter to check each supply voltage, and check ripple with a test oscilloscope. Voltages are measured between the power supply test points and chassis ground. Power supply test points are shown in the Calibration section of the manual. Check that each power supply is within the tolerance given in Table 4-1.

If a power supply is within the tolerance given in Table 4-1, the supply can be assumed to be working correctly. If outside the given tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Adjustment section to adjust the 16-volt power supplies.

Table 4-1

POWER SUPPLY TOLERANCES

Power Supply	Output Voltage	Maximum Ripple Peak-to-Peak
+16 V	15.9 to 16.1	2 mV
-16 V		
+19.3 V		
-19.3 V	18.3 to 20.3	150 mV

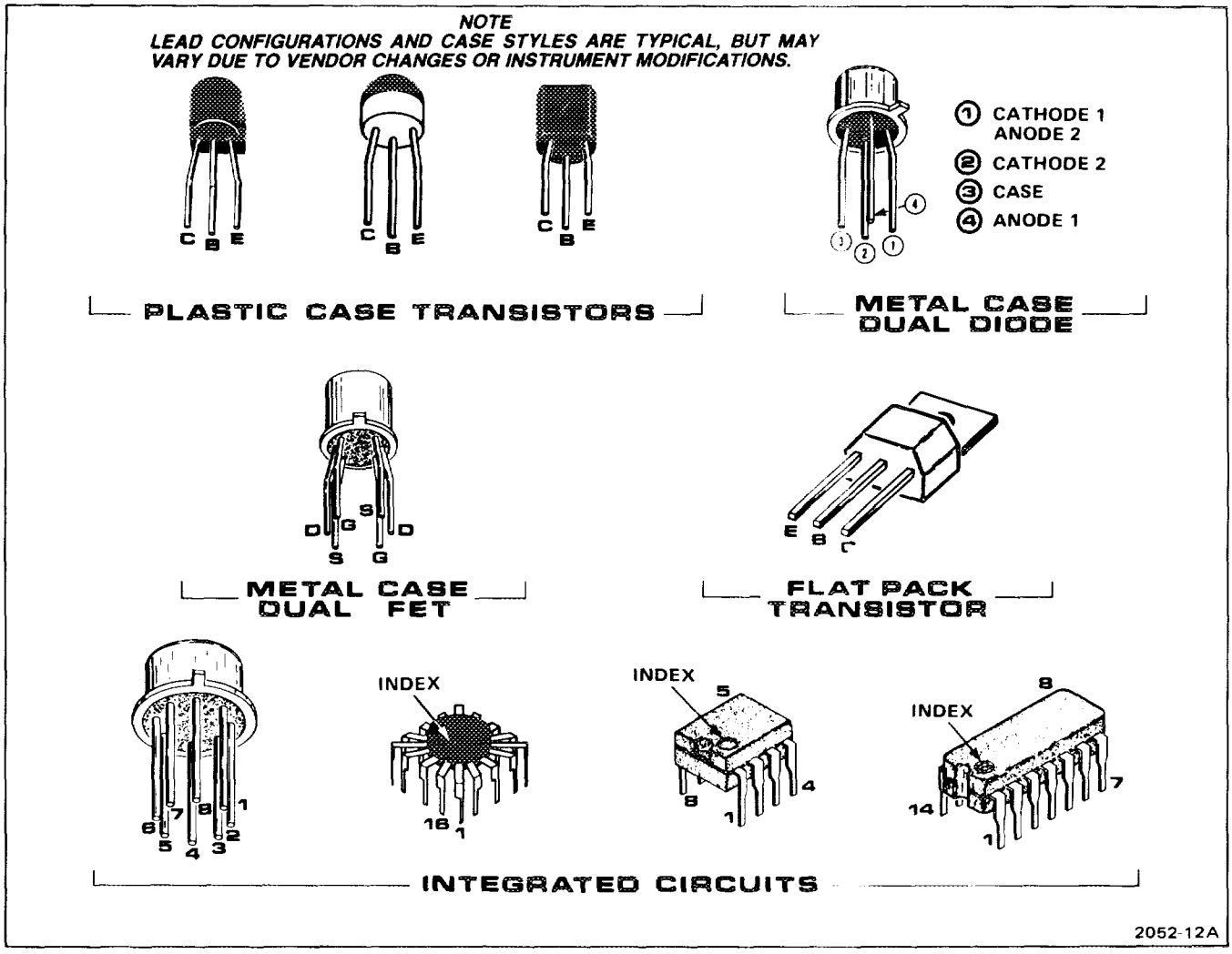


Fig. 4-2. Semiconductor lead configurations.

SOLDERING TECHNIQUES

The choice of soldering iron is determined by the repair to be made.

WARNING

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

When soldering on circuit boards, use a 15 to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. Avoid excessive heat; apply heat only long enough to remove the component or to make a good solder joint. Use only 60/40 rosin-core, electronic-grade solder. Apply only enough solder to make a firm solder joint.

CAUTION

The circuit board in this instrument is a multi-layer type board with conductive paths laminated between the top and bottom board layers. All soldering should be done with extreme care to prevent breaking the connections to the center conductors; only experienced maintenance personnel should attempt repair of these boards.

For metal terminals, (e.g., switch terminals, potentiometers, etc.) a higher wattage soldering iron is required

to accomplish the work. For example, if the component is connected to the chassis or other large heat-radiating surface, a 75-watt, or larger, soldering iron may be required.

The following technique should be used to replace a component on a circuit board:

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, gently pull the lead out. If unable to pull the lead without using force, try removing the opposite end of the component.

NOTE

Some component leads may be difficult to remove if their leads were bent during machine insertion in the manufacturing process. The bent lead held the component in place during a flow-soldering process.

If a component lead is extremely difficult to remove, it may be helpful to straighten the leads on the back side of the board with a small screwdriver or pliers while heating the soldered connection.

If it is desired to remove solder from a circuit-board hole for installation of a new component, use a solder-removing wick.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heatsink.

5. Clip off the excess lead that protrudes through the board (if not clipped off in step 3).

6. Clean the area around the solder connection with a flux-removing solvent. Be careful not to remove information printed on the board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electric shock, disconnect the instrument from the power source before replacing components.

The exploded-view drawing associated with the Replaceable Mechanical Parts list may be helpful in the removal or disassembly of individual components or subassemblies. Component locations and circuit board locations are shown in the Diagrams section.

Circuit Boards

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers are given in the Replaceable Electrical Parts list for completely wired boards.

Circuit Board Removal

1. Remove the knob from the CURRENT/DIV switch, and pull the knob off of the AC-CAL DC LEVEL-DC switch.

2. Disconnect all cables that terminate on the circuit board.

3. Remove 4 screws holding the circuit board to the frame tabs.

4. Slide the circuit board toward the rear of the frame until clear of the front panel and lift out.

5. To replace the circuit board, reverse the order of removal.

Switches

Three types of switches are used in this instrument: push-button, cam, and slide. The push-button or slide switch should be replaced as a unit if damaged. The following information is provided for the cam switch; your local Tektronix Field Office or representative can provide additional repair information.

Cam Switches. The cam switch used in this instrument consists of a rotating cam that mates with contacts on the circuit board. These contacts are activated by lobes on the cam as the switch is rotated. A cam switch can be disassembled for inspection, cleaning, repair, or replacement.

CAUTION

Repair of a cam switch should be undertaken only by experienced maintenance personnel.

A cam switch repair kit is available (Tektronix Part No. 003-0708-00) which contains special tools for use in repairing or replacing the switch contacts.

Use the following procedure to remove and replace a cam switch:

1. Remove the circuit board following instructions in Circuit Board Removal, in this section.

2. Remove eight screws that secure switch to circuit board.

3. Remove cam-switch assembly from board.

4. To replace cam switch, reverse the order of removal.

Semiconductors

Semiconductors should be replaced only when actually defective. Unnecessary replacement of semiconductors may affect the adjustment of the instrument. If removed from sockets during routine maintenance, return them to their original sockets.

CAUTION

To avoid component damage, power must be turned off before removing or replacing semiconductors.

Replacement devices should be of the original type or a direct replacement. Figure 4-2 shows the lead configurations of the semiconductors used in this instrument. When removing integrated circuits, pull the device out of the socket slowly and evenly. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as pulling unevenly may damage pins.

Interconnecting Pins

Two methods of interconnection are used to connect the circuit board with other components. When the interconnection is made with a coaxial cable, a special lead-end connector plugs into a socket on the board. When the interconnection is made with a wire lead, a lead-end pin connector is used. This connector mates with the interconnecting pin soldered into the board.

COAXIAL-TYPE LEAD-END CONNECTORS. Replacement of the coaxial-type lead-end connectors requires special tools and techniques; only experienced maintenance personnel should attempt to remove and replace these connectors. It is recommended that the cable be replaced as a unit. For cable part numbers, see Replaceable Mechanical Parts list. An alternative solution is to refer the replacement of the defective connector to your local Tektronix Field Office or representative.

LEAD-END PIN CONNECTORS. The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove and replace a damaged lead-end connector, remove the old pin connector from the lead and clamp the replacement connector to the lead.

If the lead-end connectors become dislodged from the plastic holder, they can be re-installed as follows (see Fig. 4-3):

1. Bend grooved portion of holder (part nearest cable) away from cable in the direction of its hinged side.

2. Re-insert terminal connector into its proper hole in the holder and bend the grooved part of the holder back to its vertical position so connector(s) fit into groove.

Some of the pin connectors are grouped together and mounted in a plastic holder; the result is that these connectors are removed and installed as a multi-pin connector. To provide correct orientation of this multi-pin connector when it is replaced, an arrow is stamped on the circuit board and a matching arrow is molded into the plastic housing of the multi-pin connector. See Fig. 4-3. Be sure these arrows are aligned as the multi-pin connector is replaced. If the individual lead-end pin connectors are removed from the plastic holder, note the color of the individual wires for replacement.

CIRCUIT-BOARD PINS. Replacement of circuit-board pins on multi-layer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

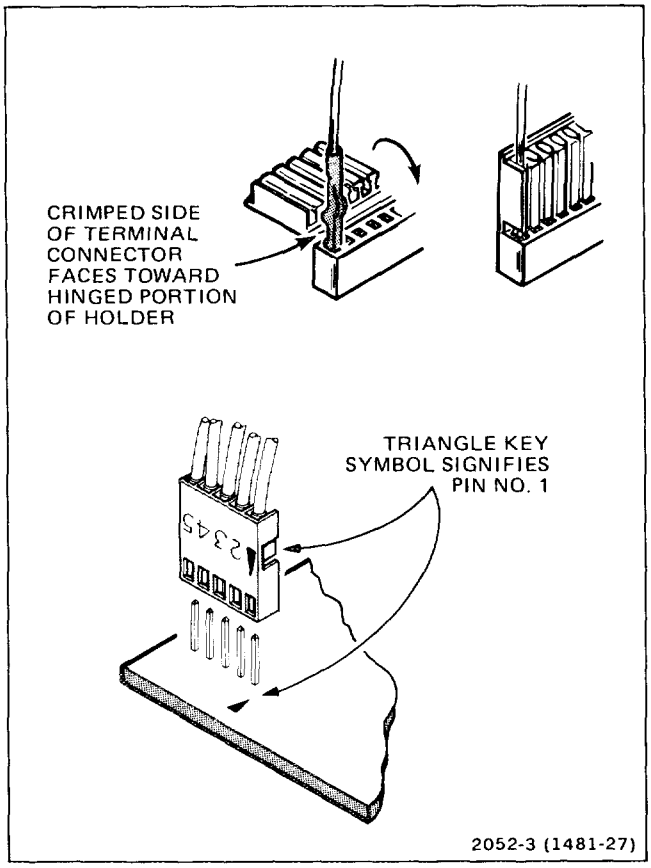


Fig. 4-3. Installation of lead-end connectors.

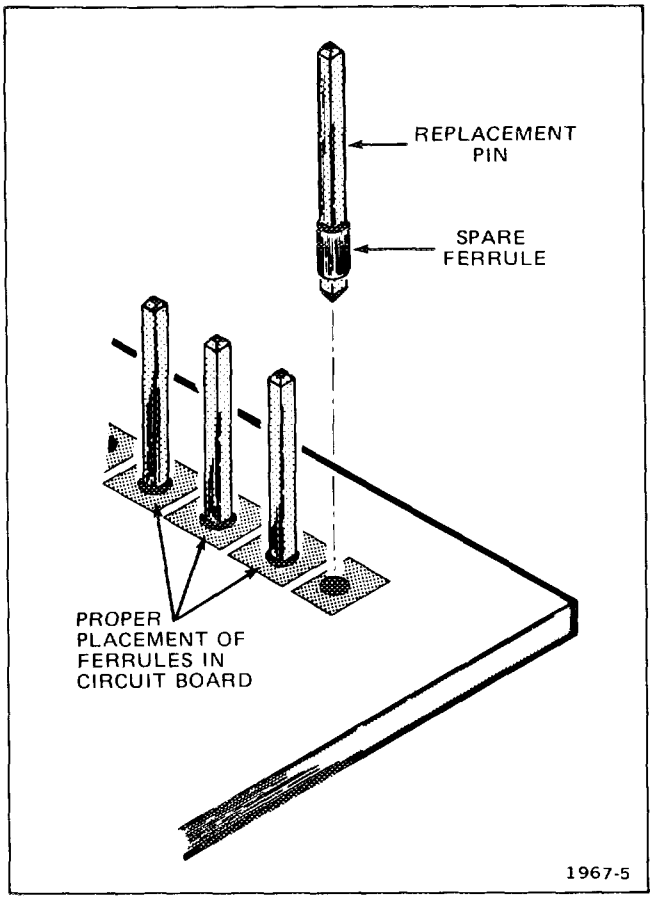


Fig. 4-4. Circuit-board pin and ferrule assembly.

A circuit-board pin-replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.

Use the following procedure to remove and replace a damaged circuit-board pin:

1. Grip the pin with long-nose pliers. Touch the soldering iron to the pin at the solder connection. do not lay the iron directly on the board, as the board may be damaged.

2. When the solder begins to melt, gently pull the damaged pin from the board. Leave the ferrule in the hole, if possible. Refer to Fig. 4-4.

3. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board.

If the ferrule is removed with the damaged pin, carefully clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin, with its attached spare ferrule, into the hole.

4. Position the replacement pin in the same manner as the old pin.

5. Solder the pin to the circuit board on each side of the board.

TROUBLESHOOTING PROCEDURE

This procedure lists most of the probable causes of a *number of possible troubles. The trouble symptom is* followed by a check procedure that lists the components that should be checked. See the component locator grid in the Diagrams section for component location.

Table 4-2 (cont)

TROUBLESHOOTING

A. TROUBLE SYMPTOM: No signal at OUTPUT connector. (cont)

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. Cable from J380 is properly installed (may be connected for rear interface output).	
2. +16 V Supply	a. F402, F406 b. C402, C406 c. U410 d. Q155, Q166 e. R412, R422
3. +19.3 V Supply	a. Q450, Q460 b. VR452, VR462 c. U145
4. +3 V Supply	a. VR100 b. VR172
5. Voltage at P202 with DEGAUSS button depressed is 11 V, p-p (with probe connected).	a. Cables from J100 to P160 and P202 are properly installed. b. Q155, Q165 c. Q115 d. U145 e. U135 f. Q130
6. Press and release DEGAUSS button and set level at P202 to zero volt with BALANCE control. Voltage at P202 should be 20 mV, p-p, with 40 mA, p-p, into 1X probe (e.g., P6302).	a. U110 b. Check probe.
7. Set Coupling to CAL DC LEVEL, adjust DC LEVEL control for zero volt out of OUTPUT connector and check bias voltages on schematics 2 and 3.	a. Q230 b. Q360 c. Q385 d. Q390 e. Q395 f. U370 g. U350 h. Q310, Q310 i. Q315, Q325

Table 4-2 (cont)

TROUBLESHOOTING

A. TROUBLE SYMPTOM: No signal at OUTPUT connector (cont)

8. Rotate CURRENT/DIV throughout its full range and note that there is no sudden loss of signal at OUTPUT connector.	a. R206 b. R208 c. R210 d. R212 e. R214

B. TROUBLE SYMPTOM: Unable to zero output level with Coupling in CAL DC LEVEL

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. +16 V Supply	a. F402, F406 b. R403, R407 c. U410 d. Q155, Q166
2. Check bias voltages on schematics 2 and 3.	a. Q230 b. Q360 c. Q385 d. Q390 e. Q395 f. U370 g. U350 h. Q310, Q320 i. Q315, Q325
3. Wiper of R302 adjusts between and +15 volts; with no sudden discontinuities.	a. R302 b. R300, R304

C. TROUBLE SYMPTOM: Unable to set signal at OUTPUT to zero with BALANCE control

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary
1. P160 and P202 plugged into the correct sockets.	
2. +19.3 V Supply	a. Q450, Q460 b. VR452, VR462
3. +3 V Supply	a. VR100 b. VR172
4. Voltage at P202 with	a. Cables from J100 to P160

Table 4-2 (cont)

TROUBLESHOOTING

C. TROUBLE SYMPTOM: Unable to set signal at OUTPUT to zero with BALANCE control (cont)

DEGAUSS depressed is 11 V p-p with probe connected.	and P202 are properly installed b. Q155 c. Q115 d. U145 e. U135 f. Q130
5. With probe removed and INPUT pin E shorted to pin F,E BALANCE should vary dc voltage at P160 from at least 5 V to greater than +5 V.	a. P110 b. U110 c. R120
CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
6. With probe reconnected, press and release DEGAUSS button and set OUTPUT level to zero with BALANCE control.	a. U110 b. Check probe using "Probe Check" following this troubleshooting table.

D. TROUBLE SYMPTOM: No Degauss Signal

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. +16 V Supply	a. F402, F406 b. U410 c. Q155, Q166 d. R403, R407
2. +19.3 V Supply	a. Q450, Q460 b. VR452, VR462
3. Voltage at U135, pin 6, with DEGAUSS button depressed is 7 V p-p +1 V at about 160 Hz.	a. Q130 b. U135 c. R136
4. Voltage at P202 with DEGAUSS button depressed is 11 V, p-p with probe connected.	a. Q155 b. Q115 c. U145

Table 4-2 (cont)

TROUBLESHOOTING

E. TROUBLE SYMPTOM: Excessive Droop in Pulse Response

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. Probe is CLOSED	
2. +3 V Supply	a. VR100 b. VR172
3. R364 Adjustment	
4. Voltage at P202 with DEGAUSS button depressed is 11 V, p-p with probe connected	a. Cables from J100 to P160 and P202 are properly installed. b. Q155, Q165 c. Q115 d. U145
5. Press and release DEGAUSS button and set OUTPUT voltage at P202 to zero with BALANCE control. Voltage at P202 should be 20 mV, p-p, with 40 mA, p-p, into P6302 probe.	a. U110 b. Check probe as shown in "Probe Check" following this troubleshooting table.

F. TROUBLE SYMPTOM: Excessive Pulse Aberrations or Poor Bandwidth

CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. +16 V Supply	a. F402, F406 b. U410 c. Q155, Q166 d. R403, R407
2. Gain Adjustment (R344)	a. Set gain per step B in Adjustments procedure, Section 6.
3. Aberrations Adjustments (R345 and R363)	a. Adjust per step C2 in Adjustments procedure, Section 6.
4. With Coupling set to CAL DC LEVEL, adjust DC LEVEL for zero volt at OUTPUT connector and check bias	a. Q230 b. Q360 c. Q385 d. Q390 e. Q395

Table 4-2 (cont)

TROUBLESHOOTING

F. TROUBLE SYMPTOM: Excessive Pulse Aberrations or Poor Bandwidth (cont)	
voltages on schematics 2 and 3 in Section 9.	f. U370 g. U350 h. Q310, Q320 i. Q315, Q325
5. Press and release DEGAUSS button and set voltage out at J202 to zero volt. Voltage at P202 should be 20 mV, p-p, with less than 3% droop with 40 mA, p-p into P6302 probe.	a. U110 b. +3 V Supply c. Check probe as shown in "Probe Check" following this troubleshooting table.
G. TROUBLE SYMPTOM: Excessive Line-Frequency Ripple at AM 503 OUTPUT connector	
CHECK:	If CHECK indicates a problem, examine the following components and replace, if necessary.
1. Is AM 503 grounded to display device (monitor oscilloscope)?	a. Be sure AM 503 is grounded to display device.

Table 4-2 (cont)

TROUBLESHOOTING

G. TROUBLE SYMPTOM: Excessive Line-Frequency Ripple at AM 503 OUTPUT connector (cont)	
2. Voltage level across C402 or C406 should be between 24 and 34 volts with maximum ripple 4.5 V, p-p.	a. Circuit-board edge connector is properly plugged into power supply module. b. F402, F406
3. +16 V Supply level and ripple shown in Table 4-1.	a. U410 b. R403, R407
4. +19.3 V Supply level and ripple shown in Table 4-1.	a. Q450, Q460 b. VR452, VR462

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as other closely related circuits. Refer to the Adjustment section of the manual.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the AM 503 Current Probe Amplifier. The description begins with a discussion of the instrument, using the block diagram shown in the Diagrams section.

Block Diagram Description

The block diagram shows the states and the basic interconnections of each major circuit in the description. The number by each title on the block diagram and circuit description refers to the corresponding circuit diagram in the Diagrams section of this manual.

Typical Current Probe. The probe area (depicted in grey tint) is shown to give a general overview of the signal flow from the typical probe. The current probe Hall device output is fed to the Hall device preamp (part of the DC Amplifier), Hall Disconnect, and Power Amplifier. The Power Amplifier output is fed back through the probe transformer to the input attenuators.

With a square wave input, the probe Hall device output and the probe transformer output are combined as shown in Fig. 5-1, to produce the square wave that is fed to the attenuators (Fig. 5-1D) and is seen at the OUTPUT connector.

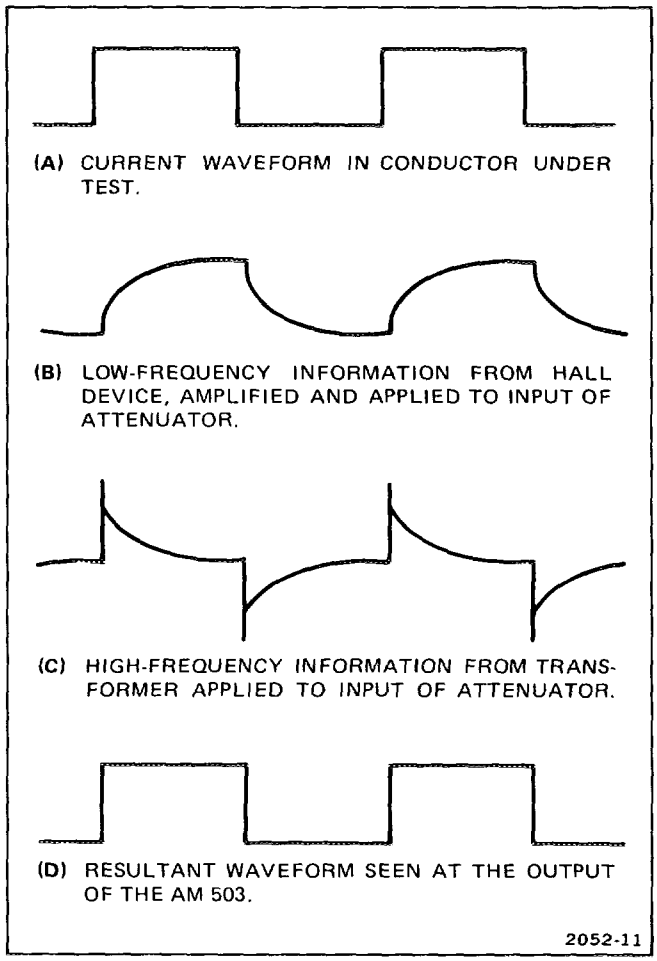


Fig. 5-1. AM 503 and probe waveforms.

DC Amplifier

The Hall Device Preamplifier provides single-ended output to the Hall Disconnect (Q115) which switches the Hall device output out of the circuit when using the degauss function.

The Power Amplifier provides gain, crossover-frequency compensation, and input overload indication.

The Degauss Oscillator provides a decaying sine-wave signal, through the Power Amplifier, to the probe transformer to remove residual magnetism in the transformer core.

The DC Amplifier also contains a deflection sensitivity indicator circuit. With a 1X probe (e.g., P6302) connected to the INPUT, the 1X lamp is lit (behind the knob-skirt) to indicate the proper deflection sensitivity. Another lamp is lit (10X) behind the knob-skirt when using a 10X probe (e.g., P6303).

A PROBE UNLOCKED lamp (on) indicates that the probe slide is not completely closed or locked.

Attenuator

The attenuator provides current-per-division sensitivities in a 1-2-5 sequence from 1 mA to 5 A for a 1X probe, and from 10 mA to 50 A for a 10X probe. It also provides a 25 Ω input termination for the DC Amplifier in all attenuator positions.

The attenuator also includes a source follower (Q230 A and B) that isolates the attenuator output from the X2 Gain Amplifier (on the Output Amplifier block diagram).

Output Amplifier

The X2 Gain Amplifier provides gain and a means of setting the output amplifier dc level (front-panel DC LEVEL control).

The selectable-gain amplifier provides a choice between two gains: one gain for the 1X probe and another for the 10X probe.

The selectable-bandwidth amplifier provides a choice of full bandwidth (100 MHz for the AM 503) or bandwidth limited to 5 MHz. The bandwidth is selected by BANDWIDTH switch S370.

The output amplifier provides current drive to the OUTPUT INTO 50 Ω connector, J390. It also provides, via S200A, 5X attenuation in the 50 mA to 50 A CURRENT/DIV switch positions.

Power Supply

The power supply provides four regulated voltages, 16, −16, 19.3, and −19.3 V to the AM 503.

Detailed Circuit Description

Circuits unique to this instrument are described in detail in this discussion. Complete schematic diagrams are located in the Diagrams section of this manual. Refer to these schematics throughout the following circuit description. The number inside the diamond after a heading refers to the schematic diagram for that circuit.

DC AMPLIFIER

Deflection Sensitivity Lamp Drivers ◇1

This circuit consists of Q180, Q185, VR187, DS190, DS192, and associated components.

One of the two lamps (DS190 or DS192), located behind the CURRENT/DIV knob-skirt, illuminates the appropriate deflection factor selector for either a 1X or 10X probe.

With a 1X probe (e.g., P6302) connected to the INPUT connector, pin L of the connector remains ungrounded. Q180 is biased off through R176. With Q180 biased off, Q185 is biased on through divider network R181, R182, R183, and DS190 (current in DS190 is not sufficient to light the lamp). With Q185 biased on (saturated), its collector is at about −15.5 V, lighting DS192 (1X) through R189.

Connecting a 10X probe (e.g., P6303) to the INPUT connector grounds pin L and the anode of CR175. Q180 collector current illuminates DS190, the 10X indicator; its collector voltage reverse-biases Q185. When Q185 is turned off, it turns off the 1X indicator (DS192).

Hall-Device Preamplifier ◇1

The Hall-device preamplifier consists of operational amplifier U110, its associated components, and the BALANCE control (R120).

With a probe connected to the INPUT connector and the probe coupled around a current-carrying conductor (e.g., a conductor carrying dc or low-frequency ac), the conductor magnetic field induces a voltage (through the probe transformer) at the output of the Hall device. The resultant dc or low-frequency output voltage is applied from pins E and F of the INPUT connector via R104 and R105, to pins 2 and 3 of U110.

To cancel any offset from the Hall device, a portion of the Hall device dc bias voltage is applied through a selected resistor in the probe, via pin H of the INPUT connector and R102, to pin 2 of U110.

BALANCE control R120 provides fine adjustment to cancel dc offset in the probe.

Hall Disconnect ◇1

The Hall disconnect switch consists of CR115, CR116, and Q115. In normal operation, Q115 gate is at about zero volt and Q115 is conducting. Signals from U110 are applied to Q115 drain through R116 and passed through Q115 to pin 2 of U145. Diodes CR115 and CR116 clamp the drain of Q115 when the signal levels exceed about +0.5 or −0.5 V.

Pressing the DEGAUSS switch (S125) applies −16 V through R122 to Q115 gate and junction of R124 and C124. C124 discharges and Q115 turns off.

When the DEGAUSS switch is released, Q115 remains biased off for approximately 1 second by the time constant of C124-R124, allowing the output of the degauss oscillator time (as determined by C126-R127) to decay to zero. The result is that the signal path is interrupted when the DEGAUSS button is pressed and released, permitting the probe transformer core to be degaussed by the degauss oscillator. The output is fed to the J100 (pins N and K), through P160.

Degauss Oscillator ◇1

The Degauss Oscillator consists of sine-wave oscillator U135, gain-regulating FET Q130, and associated components, including output-amplitude control R136.

In normal operation (DEGAUSS switch open), C126 charges to 16 V through R127. FET Q130 is biased off and the oscillator circuit is not operating.

When DEGAUSS switch S125 is depressed, it discharges C126, which turns on Q130. The Q130 drain-to-source resistance, in series with the parallel combination of R130 and RT135, increases the gain of U135, causing the circuit to oscillate. The RC network (R138, C138, R137, C137) applies positive feedback to U135 non-inverting input and sets the frequency of oscillation at approximately 160 Hz.

The oscillator (U135) output amplitude is limited by an AGC circuit composed of CR133, C133, R132, and R133. The oscillator output is rectified by CR133 and filtered by C133. This negative voltage is applied through R132 to Q130 gate to control its drain-to-source resistance and maintain the oscillator output at a constant level, as long as the DEGAUSS is held pressed. Oscillator output reaches U145 via R140.

When the DEGAUSS switch is released, Q130 remains biased on for approximately 0.5 second by R127-C126 time constant. As Q130 drain-to-source resistance increases (as Q130 goes toward cutoff) the oscillator output amplitude decays, degaussing the probe core.

Power Amplifier ◇1

This circuit consists of U145, Q155, Q165, VR166, VR167, CR167, CR168, and associated components, including the degauss offset control, R152.

The 160 Hz degaussing signal from U135 low-frequency input signal is applied to pin 2 of U145. Degaussing offset (R152) adjusts the offset (at J160) of the power amplifier when the DEGAUSS button is pressed.

Output signals from U145 (pin 6) drive the bases of Q155 and Q165, a complementary amplifier. R159, R156, R160, and R162 form the dc bias network for Q155-Q165. Thermal resistors RT156 and RT160 compensate for bias current changes due to temperature variation. CR158 and CR166 are protection diodes.

From dc to the crossover region, the Hall device provides all or most of the signal to the input attenuators. Above the crossover region, the probe transformer core provides the signal to the input attenuators.

A feedback system permits the Hall device and transformer core to operate at very low flux densities. This is accomplished by applying the output of the power amplifier (Q155 and Q165) to the probe transformer coil. The current through the transformer coil causes a flux in the core opposite and approximately equal to the flux generated by the current being measured. This feedback system permits the Hall-device element and ferrite core to operate at very low flux densities, providing excellent sensititivity and linearity.

Above the crossover region the output of the Hall device diminishes. At this time L168 blocks the ac signal from the power amplifier and the cable between the input attenuator and J160 is terminated in 50 Ω by C168-R168.

The remainder of the resistance-capacitance networks (R121, R129, R123, and C125) provide smooth transition in the crossover region. L202-R202, in series with the 25 Ω input impedance of the attenuator ◇2 terminates the coaxial cable at high frequencies.

Input Overload Indicator ◇1

If the output from Q155-Q165 swings about 12 V above or below zero, CR168 illuminates.

Zeners VR166 and VR167 (back to back) provide approximately 10 V drop from the output of Q155-Q165. Bridge rectifier CR167 provides drive to CR168 on both negative and positive output swings.

ATTENUATOR

Attenuator Source Follower ◇2

Q230A is a source follower with Q230B providing constant current. R220 limits current drive to Q230A gate. Dual diode CR226 provides current protection by limiting Q230 gate voltage swing to about +10 V.

R204, R216, and the attenuator sections provide a constant 25 Ω input termination throughout the full attenuator range.

OUTPUT AMPLIFIER

X2-Gain Amplifier ◇3

This circuit consists of Q310A and B, Q315, Q325, and

associated components in a cascode amplifier having a gain of two.

DC LEVEL control (R302) sets the dc level of the output amplifier at the 50 Ω output connector (J390).

Selectable-Gain Amplifier 3

The selectable-gain amplifier consists of U350, gain control R346, and associated components.

When P346 is at ground potential (through pin B of J100), the gain of U350 is decreased by a factor of about two. This gain is adjustable by R346.

R344 is a gain adjust and R345 is high-frequency compensation.

Selectable-Bandwidth Amplifier 3

This amplifier consists of U370 and associated components, including HF Comp (R363); LF Comp (R364); bandwidth selecting switch S370; and networks R370-R372, R373-R374.

With the BANDWIDTH switch in the 5 MHz position, U370 output is from pins 6 and 8, through a low-pass filter network L380-L383, C380-C383, to Q390.

With the BANDWIDTH switch in the FULL position, the signal path from U370 is changed to pins 5 and 9, bypassing the low-pass filter network.

Q360 is a current-source for U370. Q360 current level is established by the voltage level set by Q385 circuitry. A common-mode signal is fed back from VR380 to the base of Q360, thus minimizing common-mode dc bias drift. VR380 (normally not conducting) is protection for U370.

Output Amplifier 3

Q390 and Q395, cascaded emitter followers, isolate the output of U370 from the OUTPUT INTO 50 Ω connector (J390).

Switch S200A (CURRENT/DIV) connects a 5 times attenuation network in the 50 mA to 50 A positions.

Power Supply 4

The ac voltages from the power module (edge connector pins 13A, 13B, 1A, and 1B) are rectified by bridge rectifiers CR402 and CR406. The rectifier output is filtered by C402 and C406.

The regulating circuit consists of a dual-tracking regulator (U410), and two series-pass transistors (located in the power module) to provide regulated −16 and +16 V. Q440 and Q470 limit the voltage into U410 to ±20 and −20 V.

The output voltage of the −16 V supply is adjusted by the Volts control (R405). The Balance control (R415) sets the +16 V supply output to match the −16 V supply.

R403 and R407 are the load-current-sensing resistors. They set the bias on the series-pass transistors (located in the power module). The output voltage is sensed at the sense input (U410, pins 4 and 11). This sense voltage determines the current in R403 and R407. For example, if the voltage at the −16 V output decreases, the + sensing circuit increases the current in R403, which increases the forward bias on the series-pass transistor. Thus, the output voltage increases to −16 V.

The current through VR452 and VR462 is set to cause 20 V drop across them. This 20 V sets the pass-transistor bases (Q450-Q460) at 20 V. With 20 V on the base, the output is at about −19.3 V.

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.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

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.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000HX	SAN-O INDUSTRIAL CORP.	170 WILBUR PLACE	BAHEMIA LONG ISLAND, NY 11716
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P.O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD.PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
14193	CAL-R, INC.	1601 OLYMPIC BLVD.	SANTA MONICA, CA 90404
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
34333	SILICON GENERAL, INC.	7382 BOLSA AVE.	WESTMINSTER, CA 92683
34371	HARRIS SEMICONDUCTOR, DIV. OF HARRIS CORPORATION	P. O. BOX 883	MELBOURNE, FL 32901
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
50522	MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS	3400 HILLVIEW AVENUE	PALO ALTO, CA 94304
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71744	CHICAGO MINIATURE LAMP WORKS	4433 RAVENSWOOD AVE.	CHICAGO, IL 60640
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73899	JFD ELECTRONICS COMPONENTS CORP.	PINETREE ROAD	OXFORD, NC 27565
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST	SAN FERNANDO, CA 91341

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-4353-00	B010100	B029999	CKT BOARD ASSY:MAIN PLUG IN	80009	670-4353-00
A1	670-4353-01	B030000	B047648	CKT BOARD ASSY:MAIN PLUG IN	80009	670-4353-01
A1	670-4353-02	B047649	B049499	CKT BOARD ASSY:MAIN PLUG IN	80009	670-4353-02
A1	670-4353-03	B049500	B054926	CKT BOARD ASSY:MAIN PLUG-IN	80009	670-4353-03
A1	670-4353-04	B054927		CKT BOARD ASSY:MAIN PLUG-IN	80009	670-4353-04
C100	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C101	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C103	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C108	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C110	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C112	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D155E700F0
C124	285-1097-00			CAP.,FXD,PLSTC:0.47UF,10%,50V	14752	230B1A474K
C125	283-0693-00			CAP.,FXD,MICA D:1730PF,1%,500V	00853	D19-5F1731F0
C126	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C133	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C137	285-1050-00			CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C138	283-0051-00			CAP.,FXD,CER DI:0.0033UF,5%,100V	56289	1C20C0G332J100B
C140	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C146	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C148	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C153	283-0600-00	B010100	B019999	CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C153	283-0676-00	B020000		CAP.,FXD,MICA D:82PF,1%,500V	00853	D105E820F0
C155	290-0272-00			CAP.,FXD,ELCTLT:47UF,20%,50V	56289	109D476X0050F2
C156	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C160	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C165	290-0272-00			CAP.,FXD,ELCTLT:47UF,20%,50V	56289	109D476X0050F2
C168	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C172	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C176	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C187	283-0204-00	B010100	B020286	CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C218	283-0212-00	B010100	B032319	CAP.,FXD,CER DI:2UF,20%,50V	51642	400-050-Z5U205M
C218	283-0339-00	B032320		CAP.,FXD,CER DI:0.22UF,10%,50V	72982	8131N075W5R224K
C220	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C232	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C234	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C242	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C244	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C306	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C308	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C313	283-0077-00	B010100	B029999	CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
C323	283-0077-00	B010100	B029999	CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
C328	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C345	283-0600-00	B010100	B029999	CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C345	283-0615-00	B030000		CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C351	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C360	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C363	283-0615-00	B010100	B029999	CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C363	281-0158-00	B030000		CAP.,VAR,CER D1:7-45PF,50V	73899	DVJ-5006
C364	283-0210-00	B010100	B029999	CAP.,FXD,CER DI:0.0056UF,20%,50V	72982	8131N145W5R562M
C364	283-0639-00	B030000	B047648	CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C364	283-0600-00	B047649		CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C365	SELECTED	B010100	B029999			
C365	283-0212-00	B030000		CAP.,FXD,CER DI:2UF,20%,50V	51642	400-050-Z5U205M
C366	283-0238-00	B030000	B047648	CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C366	283-0268-00	B047649		CAP.,FXD,CER DI:0.015UF,10%,50V	56289	1C20X7R153K050B

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C367	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C380	283-0625-00			CAP.,FXD,MICA D:220PF,1%,500V	00853	D105F221F0
C383	283-0600-00			CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C385	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C388	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C391	283-0615-00	B010100	B047648	CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C391	283-0779-00	B047649		CAP.,FXD,MICA D:27PF,2%,500V	00853	D155E270G0
C393	281-0593-00			CAP.,FXD,CER DI:3.9PF,10%,500V	04222	7001-C0J-3R9C
C394	281-0626-00			CAP.,FXD,CER DI:3.3PF,1%,500V	59660	0301080C0J0339B
C396	283-0629-00			CAP.,FXD,MICA D:62PF,1%,500V	00853	D105E620F0
C398	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C402	290-0334-00			CAP.,FXD,ELCTLT:1250UF,+75-10%,50V	56289	D46468
C406	290-0334-00			CAP.,FXD,ELCTLT:1250UF,+75-10%,50V	56289	D46468
C413	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C414	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C423	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C434	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C436	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C444	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C446	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C452	290-0782-00	B030000		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C462	290-0782-00	B030000		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
CR103	150-1001-00			LT EMITTING DIO:RED,660NM,100MA MAX	50522	MV5024
CR115	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR116	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR127	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR133	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR158	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR166	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR167	152-0585-00			SEMICOND DEVICE:SILICON,BRIDGE,200V,1A	80009	152-0585-00
CR168	150-1001-00			LT EMITTING DIO:RED,660NM,100MA MAX	50522	MV5024
CR175	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR226	152-0321-00			SEMICOND DEVICE:SILICON,30V,0.1A	07263	FSA1480
CR320	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR380	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR383	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR386	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR402	152-0585-00			SEMICOND DEVICE:SILICON,BRIDGE,200V,1A	80009	152-0585-00
CR406	152-0585-00			SEMICOND DEVICE:SILICON,BRIDGE,200V,1A	80009	152-0585-00
CR452	152-0141-02	B020000	B029999	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR462	152-0141-02	B020000	B029999	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
DS190	150-0046-00			LAMP,INCAND:10V,0.04A	71744	CM2107
DS192	150-0046-00			LAMP,INCAND:10V,0.04A	71744	CM2107
F402	159-0064-00	B010100	B019999	FUSE,CARTRIDGE:1A,250V,10 SEC	75915	212001
F402	159-0107-00	B020000		FUSE,CARTRIDGE:2A,250V,10 SEC	000HX	SD6-2A
F406	159-0064-00	B010100	B019999	FUSE,CARTRIDGE:1A,250V,10 SEC	75915	212001
F406	159-0107-00	B020000		FUSE,CARTRIDGE:2A,250V,10 SEC	000HX	SD6-2A
J100	131-1315-01			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
J160	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00

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J202	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J380	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J480	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
L168	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L202	108-0853-00	B010100	B047648	COIL,RF:48.7UH,TOROIDAL	80009	108-0853-00
L202	108-0200-00	B047649		COIL,RF:40UH	80009	108-0200-00
L380	108-0345-00			COIL,RF:FIXED,1.89UH	80009	108-0345-00
L383	108-0345-00			COIL,RF:FIXED,1.89UH	80009	108-0345-00
Q115	151-1059-00			TRANSISTOR:SILICON,FE,N-CHANNEL	80009	151-1059-00
Q130	151-1059-00			TRANSISTOR:SILICON,FE,N-CHANNEL	80009	151-1059-00
Q155	151-0390-00			TRANSISTOR:SILICON,NPN	04713	SPS3414
Q165	151-0391-00			TRANSISTOR:SILICON,PNP	80009	151-0391-00
Q180	151-0254-00	B010100	B047648	TRANSISTOR:SILICON,NPN	03508	X38L3118
Q180	151-0190-00	B047649		TRANSISTOR:SILICON,NPN	07263	S032677
Q185	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q230A,B	151-1032-00			TRANSISTOR:SILICON,FET,DUAL	17856	DN399
Q310	153-0609-00	B010100	B029999	SEMICOND DVC SE:SILICON,PNP	80009	153-0609-00
Q310A,B	151-0461-00	B030000		TRANSISTOR:SILICON,NPN,DUAL	04713	SRF572
Q315	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q320	153-0609-00	B010100	B029999	SEMICOND DVC SE:SILICON,PNP	80009	153-0609-00
Q325	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q360	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q385	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q390	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q395	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q440	151-0347-00	B020000		TRANSISTOR:SILICON,NPN	56289	2N5551
Q450	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q460	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q470	151-0350-00	B020000		TRANSISTOR:SILICON,PNP	04713	SPS6700
R100	308-0243-00			RES.,FXD,WW:240 OHM,5%,3W	91637	CW2BB240R0J
R102	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R103	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R104	321-0162-00			RES.,FXD,FILM:475 OHM,1%,0.125W	91637	MFF1816G475R0F
R105	321-0162-00			RES.,FXD,FILM:475 OHM,1%,0.125W	91637	MFF1816G475R0F
R106	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	MFF1816G47501F
R108	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R110	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R112	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R113	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	MFF1816G47501F
R114	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R116	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R118	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R120	311-0580-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	11237	300SF-41695
R121	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	91637	MFF1816G11800F
R122	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R123	321-0183-00			RES.,FXD,FILM:787 OHM,1%,0.125W	91637	MFF1816G787R0F
R124	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R126	315-0470-00	B030000		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R127	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R128	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R129	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F

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R130	315-0200-00	B010100	B019999	RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R130	315-0300-00	B020000		RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R132	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R133	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R134	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R135	321-0230-00	B047649		RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R136	311-1267-00	B010100	B047648	RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R136	311-1264-00	B047649		RES.,VAR,NONWIR:1.5K OHM,10%,0.50W	32997	3329P-L58-152
R137	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R138	321-0431-00			RES.,FXD,FILM:301K OHM,1%,0.125W	91637	MFF1816G30102F
R140	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R142	315-0241-00	B010100	B029999	RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R145	321-0135-00	B010100	B019999	RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R145	315-0241-00	B020000		RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R146	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R148	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R150	315-0243-00	B010100	B029999	RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R150	315-0123-00	B030000		RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R151	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R152	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R153	315-0243-00	B010100	B029999	RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R153	315-0123-00	B030000		RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R156	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R158	308-0441-00			RES.,FXD,WW:3 OHM,5%,3W	91637	CW2B-3R00J
R159	322-0292-00			RES.,FXD,FILM:10.7K OHM,1%,0.25W	91637	MFF1421G10701F
R160	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R162	322-0292-00			RES.,FXD,FILM:10.7K OHM,1%,0.25W	91637	MFF1421G10701F
R166	308-0441-00			RES.,FXD,WW:3 OHM,5%,3W	91637	CW2B-3R00J
R168	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R169	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R172	308-0243-00			RES.,FXD,WW:240 OHM,5%,3W	91637	CW2BB240R0J
R174	315-0822-00	B010100	B020286	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R175	315-0274-00	B010100	B047648	RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R175	315-0103-00	B047649		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R176	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R181	302-0271-00			RES.,FXD,CMPSN:270 OHM,10%,0.50W	01121	EB2711
R182	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R183	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R185	315-0512-00	B010100	B020286	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R187	315-0512-00	B010100	B020286	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R189	302-0271-00			RES.,FXD,CMPSN:270 OHM,10%,0.50W	01121	EB2711
R202	321-0040-00			RES.,FXD,FILM:25.5 OHM,1%,0.125W	91637	MFF1816G25R50F
R204	307-1040-00			TERM,THK FILM:50 OHM	80009	307-1040-00
R206	307-1020-00			ATTENUATOR,FXD:50 OHM,2X	80009	307-1020-00
R208	307-1020-00			ATTENUATOR,FXD:50 OHM,2X	80009	307-1020-00
R210	307-1023-00			ATTENUATOR,FXD:50 OHM,5X	80009	307-1023-00
R212	307-1024-00			ATTENUATOR,FXD:50 OHM,10X	80009	307-1024-00
R214	307-1024-00			ATTENUATOR,FXD:50 OHM,10X	80009	307-1024-00
R216	307-1040-00			TERM,THK FILM:50 OHM	80009	307-1040-00
R220	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R222	315-0203-00	B010100	B032319	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R222	315-0164-00	B032320		RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R224	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R232	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015

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R234	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R236	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R242	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R244	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R246	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R300	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R302	311-0546-00	B010100	B050202	RES.,VAR,NONWIR:10K OHM,20%,0.75W	80009	311-0546-00
R302	311-0429-00	B050203		RES.,VAR,NONWIR:100K OHM X 10K OHM,20%,0.5W	59821	BA02600001
R304	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R306	321-0243-00	B010100	B029999	RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R306	321-0279-00	B030000		RES.,FXD,FILM:7.87K OHM,1%,0.125W	91637	MFF1816G78700F
R308	321-0032-00	B010100	B029999	RES.,FXD,FILM:21 OHM,1%,0.125W	91637	MFF1816G21R00F
R308	321-0068-00	B030000		RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R311	322-0172-00	B030000		RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-6040F
R312	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R313	315-0151-00	B010100	B029999	RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R313	321-0068-00	B030000		RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R314	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R315	308-0553-00			RES.,FXD,WW:680 OHM,1%,3W	91637	RS2B-D6R00J
R317	321-0010-00	B010100	B029999	RES.,FXD,FILM:12.4 OHM,1%,0.125W	91637	MFF1816G12R40F
R317	321-0068-00	B030000		RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R321	322-0172-00	B030000		RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-6040F
R323	315-0151-00	B010100	B029999	RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R323	321-0068-00	B030000		RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R326	321-0216-00	B010100	B029999	RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
R326	315-0821-00	B030000		RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R327	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
R328	317-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.125W	01121	BB6805
R330	322-0662-00	B010100	B029999	RES.,FXD,FILM:334 OHM,1%,0.25W	75042	CEBT0-3340F
R330	321-0140-00	B030000		RES.,FXD,FILM:280 OHM,1%,0.125W	91637	MFF1816G280R0F
R332	321-0068-00	B010100	B029999	RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R332	321-0097-00	B030000		RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R334	321-0068-00	B010100	B029999	RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R334	321-0097-00	B030000		RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R335	322-0109-00			RES.,FXD,FILM:133 OHM,1%,0.25W	91637	MFF1421G133R0F
R336	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R338	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R340	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R344	311-1260-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R345	311-1259-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3329P-L58-101
R346	311-1268-00	B010100	B047648	RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R346	311-1267-00	B047649		RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R347	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R349	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R351	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R352	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R353	322-0167-00			RES.,FXD,FILM:536 OHM,1%,0.25W	91637	MFF1421G536R0F
R354	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R355	322-0109-00			RES.,FXD,FILM:133 OHM,1%,0.25W	91637	MFF1421G133R0F
R356	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R357	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R358	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R360	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R361	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R362	301-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.50W	01121	EB1315
R363	311-1263-00	B010100	B029999	RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R363	311-1260-00	B030000	B047648	RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R363	311-1265-00	B047649		RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R364	311-1265-00	B010100	B047648	RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R364	311-1260-00	B047649		RES.,VAR,NONWIR:250 OHM,10%,0.50W	32997	3329P-L58-251
R365	315-0222-00	B030000		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R366	315-0911-00	B030000		RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R367	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R368	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R370	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R372	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	MFF1816G665R0F
R373	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R374	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	MFF1816G665R0F
R376	321-0130-00			RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221R0F
R377	323-0185-00			RES.,FXD,FILM:825 OHM,1%,0.50W	75042	CECT0-8250F
R380	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R382	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R383	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R384	301-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R386	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R387	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R388	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R390	322-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.25W	75042	CEBT0-1581F
R391	321-0068-00	B010100	B020286	RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R391	321-0066-00	B020287		RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R392	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R393	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R394	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R395	323-0183-00			RES.,FXD,FILM:787 OHM,1%,0.50W	75042	CECT0-7870F
R396	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R397	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R398	315-0511-00	B010100	B054926	RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R398	301-0361-00	B054927		RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
R399	321-0078-01			RES.,FXD,FILM:63.4 OHM,0.5%,0.125W	91637	MFF1816G63R40D
R403	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R404	321-0380-00	B010100	B047648	RES.,FXD,FILM:88.7K OHM,1%,0.125W	91637	MFF1816G88701F
R404	321-0387-00	B047649		RES.,FXD,FILM:105K OHM,1%,0.125W	91637	MFF1816G10502F
R405	311-1271-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	32997	3329P-L58-503
R406	321-0377-00	B010100	B047648	RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F
R406	321-0369-00	B047649		RES.,FXD,FILM:68.1K OHM,1%,0.125W	91637	MFF1816G68101F
R407	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R412	308-0755-00	B010100	B019999	RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R412	308-0679-00	B020000		RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R414	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R415	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R416	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R422	308-0755-00	B010100	B019999	RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R422	308-0679-00	B020000		RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R432	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R436	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R442	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R446	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R452	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R454	315-0471-00	B010100	B019999	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R454	315-0430-02	B020000		RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R458	308-0240-00	B047649		RES.,FXD,WW:2 OHM,5%,3W	91637	RS2B-D2R000J
R462	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R464	315-0471-00	B010100	B019999	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R464	315-0430-02	B020000		RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R480	323-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.50W	75042	CECT0-49R90F
RT135	307-0122-00			RES.,THERMAL:50 OHM,10%	50157	3D1515
RT156	307-0126-00			RES.,THERMAL:100 OHM,10%	14193	2D21-101-D
RT160	307-0126-00			RES.,THERMAL:100 OHM,10%	14193	2D21-101-D
RT342	307-0126-00			RES.,THERMAL:100 OHM,10%	14193	2D21-101-D
S125	260-1421-00			SWITCH,PUSH:1 STA,MOMENTARY,NON-SHORT	59821	OBD
S200A	263-1111-00			SW CAM ACTR AS:CURRENT/DIV	80009	263-1111-00
S200B	105-0243-00			ACTUATOR,SWITCH:AC,DC	80009	105-0243-00
S370	260-0816-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF-126-0012A
U110	156-0317-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	34371	HA2-2625-5
U135	156-0067-00	B010100	B056559	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U135	156-0067-01	B056560		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,CHK	01295	UA741CP3
U145	156-0317-00	B010100	B049499	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	34371	HA2-2625-5
U145	156-0317-03	B049500		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,SCRN	80009	156-0317-03
U350	155-0078-11	B010100	B033930	MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER,SEL	80009	155-0078-11
U350	155-0078-10	B033931		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U370	155-0078-11	B010100	B033930	MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER,SEL	80009	155-0078-11
U370	155-0078-10	B033931		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U410	156-0208-00	B010100	B049499	MICROCIRCUIT,LI:DUAL TRACKING VOLT RGLTR	34333	SG8195/3501AJ
U410	156-0208-01	B049500		MICROCIRCUIT,LI:DUAL TRACKING VOLT RGLTR	80009	156-0208-01
VR100	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR103	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR166	152-0306-00			SEMICOND DEVICE:ZENER,0.4W,9.1V,5%	15238	Z5409
VR167	152-0306-00	B010100	B047648	SEMICOND DEVICE:ZENER,0.4W,9.1V,5%	15238	Z5409
VR172	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR187	152-0226-00	B010100	B020286	SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980
VR380	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR452	152-0304-00	B010100	B029999	SEMICOND DEVICE:ZENER,0.4W,20V,5%	15238	Z5411
VR452	152-0680-00	B030000		SEMICOND DEVICE:ZENER,0.4W,19.3V,1%	80009	152-0680-00
VR462	152-0304-00	B010100	B029999	SEMICOND DEVICE:ZENER,0.4W,20V,5%	15238	Z5411
VR462	152-0680-00	B030000		SEMICOND DEVICE:ZENER,0.4W,19.3V,1%	80009	152-0680-00
W452	131-0566-00	B030000	B047648	BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
W462	131-0566-00	B030000	B047648	BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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 (μF).

Resistors = Ohms (Ω).

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 goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

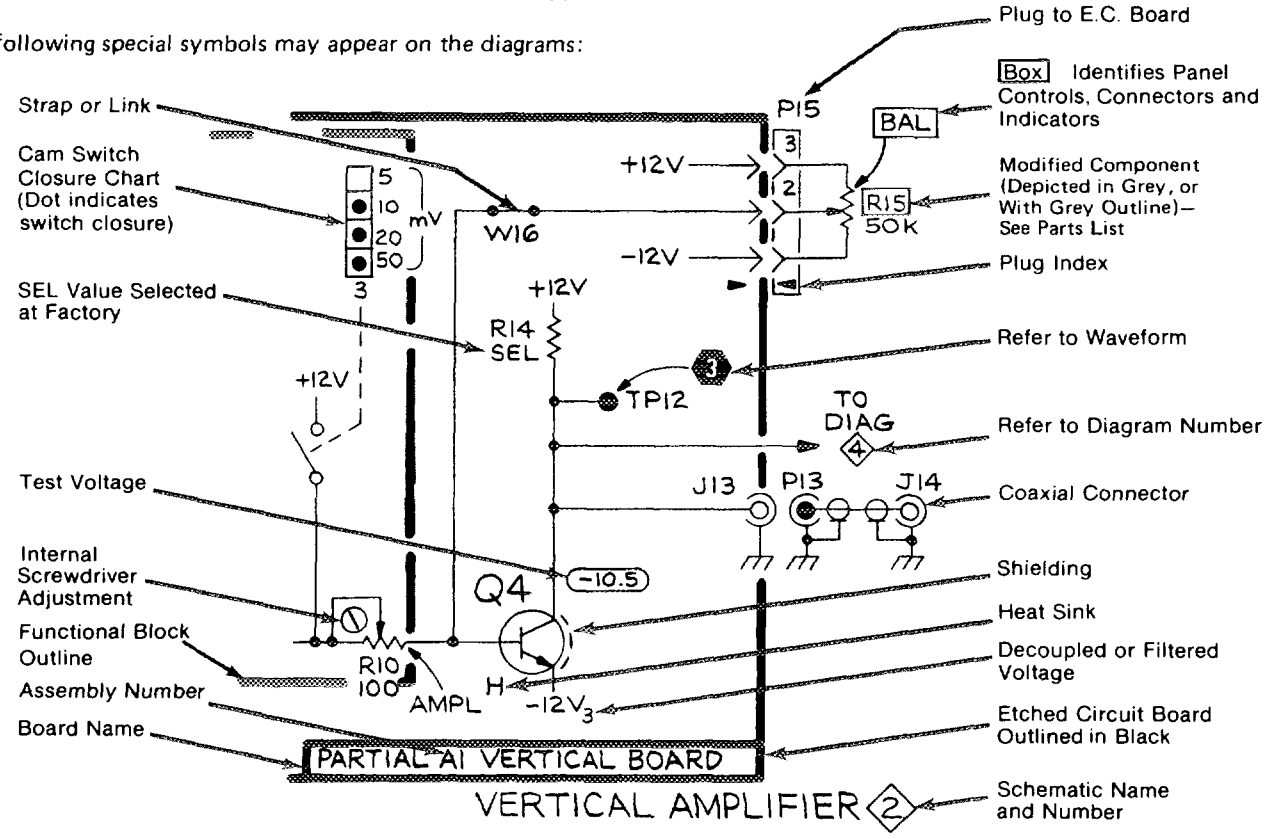
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	*Attenuator, fixed or variable*	HR	*Heater*	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	*Capacitor, fixed or variable*	K	Relay	U	Assembly, inseparable or non-repairable *(integrated circuit, etc.)*
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	*Connector, movable portion*	W	*Wirestrap or cable*
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:



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.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

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
        - - - * - - -
   Detail Part of Assembly and/or Component
   Attaching parts for Detail Part
        - - - * - - -
      Parts of Detail Part
      Attaching parts for Parts of Detail Part
        - - - * - - -
```

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. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

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.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip

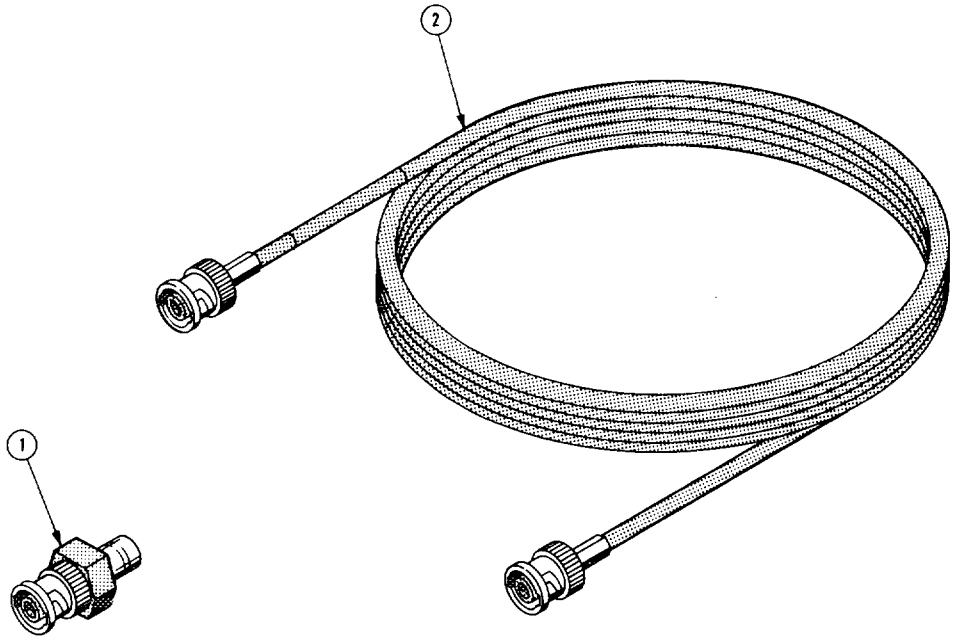


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						STANDARD ACCESSORIES		
-1	011-0049-01			1		TERMN,COAX:50 OHM,2W,BNC	18203	T-153-BS
-2	012-0057-01			1		CABLE ASSY,RF:50 OHM COAX W/BNC	80009	012-0057-01
	070-2052-01			1		MANUAL,TECH:INSTRUCTION	80009	070-2052-01
						OPTIONAL ACCESSORIES		
	010-6302-01			1		PROBE CURRENT:20 AMP,2 METER L,W/ACCESS	80009	010-6302-01
	010-6303-01			1		PROBE,CURRENT:100AMP,2 METER L,W/ACCESS	80009	010-6303-01

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C100	5D	CR133	5B	R112	5E	R314	2B	R404	2G
C108	5E	CR167	5G	R113	5E	R315	1A	R405	2G
C110	4E	CR175	5D	R114	5E	R317	2B	R406	1G
C112	5E	CR226	2A	R116	5E	R321	2C	R407	1H
C124	5E	CR320	2B	R118	4E	R323	2C	R412	3H
C125	4G	CR380	2E	R121	4G	R326	1C	R414	2G
C133	4A	CR383	2E	R122	5E	R327	1C	R415	2G
C137	5A	CR386	2F	R123	4G	R328	1C	R416	1G
C138	5B	CR402	3J	R124	5F	R330	1C	R422	1H
C140	4B	CR406	1J	R126	5A	R332	2C	R432	2G
C146	4F			R127	4A	R334	2C	R436	3G
C148	5F	F402 †	3J	R128	4A	R335	3C	R442	1G
C153	4G	F406 †	1J	R129	5G	R336	3C	R446	1G
C155	5H			R130	4B	R338	3C	R452	3H
C156	5H	L168	4H	R132	4A	R340	3C	R454	3H
C160	4H	L202	3G	R133	4A	R344	2C	R458 *	3I
C165	4I	L380	2E	R134	4B	R345	2C	R462	2H
C168	4H	L383	2E	R135 *	5A	R346	1C	R464	2H
C172	4D			R136	5B	R347	1C	R480	5J
C176	5C	P110	5D	R137	5B	R349	1C	RT135	4B
C218 †	3A	P120	5F	R138	5B	R351	1C	RT156	5H
C220	3B	P160	4H	R140	4B	R352	2D	RT160	4H
C232	2A	P168	5G	R145	5F	R353	1D	RT342	3C
C234	2A	P190	4C	R146	4F	R354	2D		
C242	2A	P195	5C	R148	5F	R355	1D	S125	5A
C244	2B	P202	3G	R150	5F	R356	2D	S200A	4C
C306	2B	P302	1B	R151	5G	R357	2D		
C308	2C	P346	1C	R152	5G	R358	2C	U110	5E
C328	2C	P370	1E	R153	4F	R360	3E	U135	4B
C345	2C	P380 †	3F	R156	5H	R361	3E	U145	5F
C351	2D	P470	4J	R158	5H	R362	2F	U350	2C
C360	3E	P475	5J	R159	5H	R363	3D	U370	2D
C363	3D	P480 †	5J	R160	5H	R364	2D	U410	2G
C364	2D			R162	4H	R365	2D		
C365	2D	Q115	5F	R166	4H	R366	2D	VR100	5D
C366	2D	Q130	4A	R168	4H	R367	1D	VR103	5G
C367	1D	Q155	5I	R169	5G	R368	1E	VR166	5G
C380	2D	Q165	4I	R172	5E	R370	1E	VR167 *	5G
C383	2E	Q180	5C	R175	5C	R372	1D	VR172	4D
C385	2E	Q185	5C	R176	5C	R373	1E	VR380	2F
C388	3E	Q230	3B	R181	4C	R374	1D	VR452	3H
C391	2F	Q310	2B	R182	5C	R376	2E	VR462	3H
C393	1D	Q315	2C	R183	5C	R377	2E		
C394	2F	Q325	2C	R189	4C	R380	1E	W452 *	3H
C396	1F	Q360	3E	R202	3G	R382	1E	W462 *	3H
C398	2E	Q385	2E	R220	3A	R383	2E		
C402	3I	Q390	1E	R222	3A	R384	2E		
C406	2I	Q395	2E	R224	3A	R386	2F		
C413	2G	Q440	2H	R232	1A	R387	2F		
C414	2G	Q450	3G	R234	2A	R388	3E		
C423	2G	Q460	3G	R236	2B	R390	1F		
C434	3G	Q470	1H	R242	1A	R391	2F		
C436	3G			R244	2A	R392	1F		
C444	1G	R100	4D	R246	3B	R393	2D		
C446	1G	R102	5D	R300	1B	R394	2F		
C452	4H	R103	5G	R304	1B	R395	2F		
C462	3H	R104	5D	R306	2B	R396	1F		
		R105	5D	R308	2B	R397	2F		
CR115	5F	R106	5D	R311	2B	R398	2F		
CR116	5F	R108	5E	R312	2B	R399	3F		
CR127	5A	R110	4E	R313	2C	R403	2H		

CONDITIONS USED TO MEASURE DC VOLTAGES ON SCHEMATICS

Probe not connected to input.

Bandwidth set to full.

AC-CAL DC Level—DC set to CAL DC LEVEL.

Set voltage at output to zero volts (into 50 ohms) with DC Level control.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
R352	2D	R368	1E	R391*	2F	R414	2G	RT160	4H	VR103	5G
R353	1D	R370	1E	R392	1F	R415	2G	RT342	3C	VR166	5G
R354	2D	R372	1D	R393	2D	R416	1G	RT135	4B	VR167	5G
R355	1D	R373	1E	R394	2F	R422*	1H			VR172	4D
R356	2D	R374	1D	R395	2F	R432	2G	S125	5A	VR187*	4C
R357	2D	R376	2E	R396	1F	R436	3G	S200A	4C	VR380	2F
R358	2C	R377	2E	R397	2F	R442	1G			VR452*	3H
R360	3E	R380	1E	R398	2F	R446	1G	U110	5E	VR462*	3H
R361	3E	R382	1E	R399	3F	R452	3H	U135	4B		
R362	2F	R383	2E	R403	2H	R454*	3H	U145	5F		
R363*	3D	R384	2E	R404	2G	R462	2H	U350*	2C		
R364	2D	R386	2F	R405	2G	R464*	2H	U370*	2D		
R365	2D	R387	2F	R406	1G	R480	5J	U410	2G		
R366	2D	R388	3E	R407	1H						
R367	1D	R390	1F	R412*	3H	RT156	5H	VR100	5D		

POWER SUPPLY ④

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AM503

J480 — R480 49.9 — INTERNAL 50ΩTERM — 27A

* OPTION ONLY

J475 pin 2 — 3 — 4 — 5 — 6 — 7

21A	TO MAINFRAME
22B	
22A	
23A	
23B	
24A	
25A	
28A	
27A	

J470 pin 7 — 17A

J470 pin 2 — 18B — 3 — 18A — 4 — 19B — 5 — 19A — 6 — 20B — J475 pin 5 — 21B

* OPTION ONLY

FROM MAINFRAME

PARTIAL A1 AMPLIFIER BOARD

NOTE:
* OPTION NOT ASSIGNED AT THIS DATE.

VOLTAGE & WAVEFORM CONDITIONS

+19.3V REGULATOR

Q450 — R454 43 — R452 1K — C452 4.7µF — VR452 20V@15mA

+16V REGULATOR

Q440 — R403 100 — R412 0.51Ω — R422 0.51Ω — C413 0.1 — C414 1µF — R414 49.9K — R415 10K CW — R416 49.9K — C423 0.1 — R405 50K — R404 10.5K — R406 68.1K — C402 1250µF — C406 1250µF — CR402 — CR406 — F402 2A — F406 2A — 25V AC

U410 350I — OUTPUT — SENSE — STAB — INPUT — VOLTS ADJ — BAL — BALANCE — 0V — -6.2 — -16V

-19.3V REGULATOR

Q460 — R464 43 — R462 1K — C462 4.7µF — VR462 20V@15mA

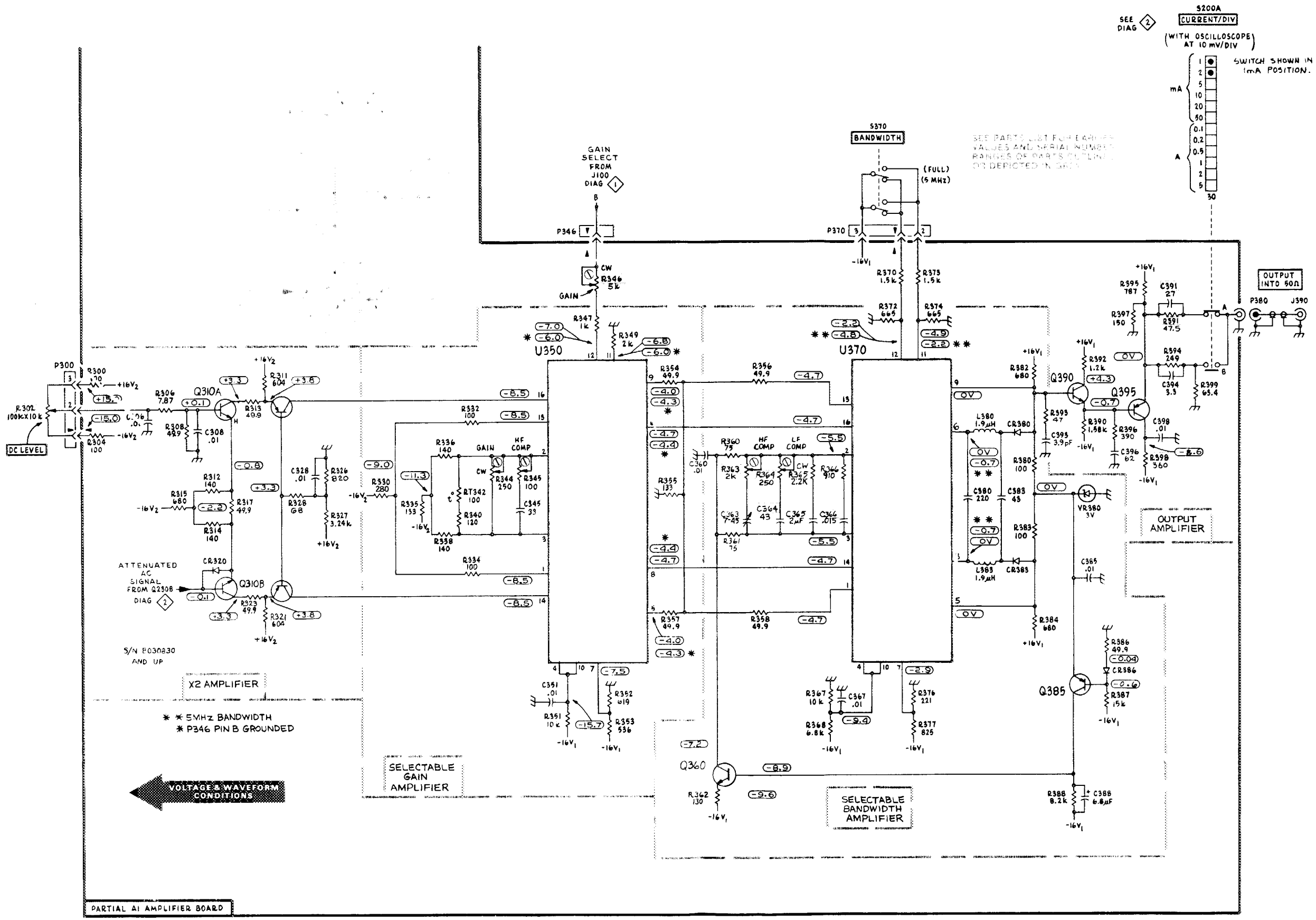
LOCATED ON MAINFRAME: 6A, 7A, 7B — R458 2

LOCATED ON MAINFRAME: 10A, 11A, 11B — R407 100 — Q470

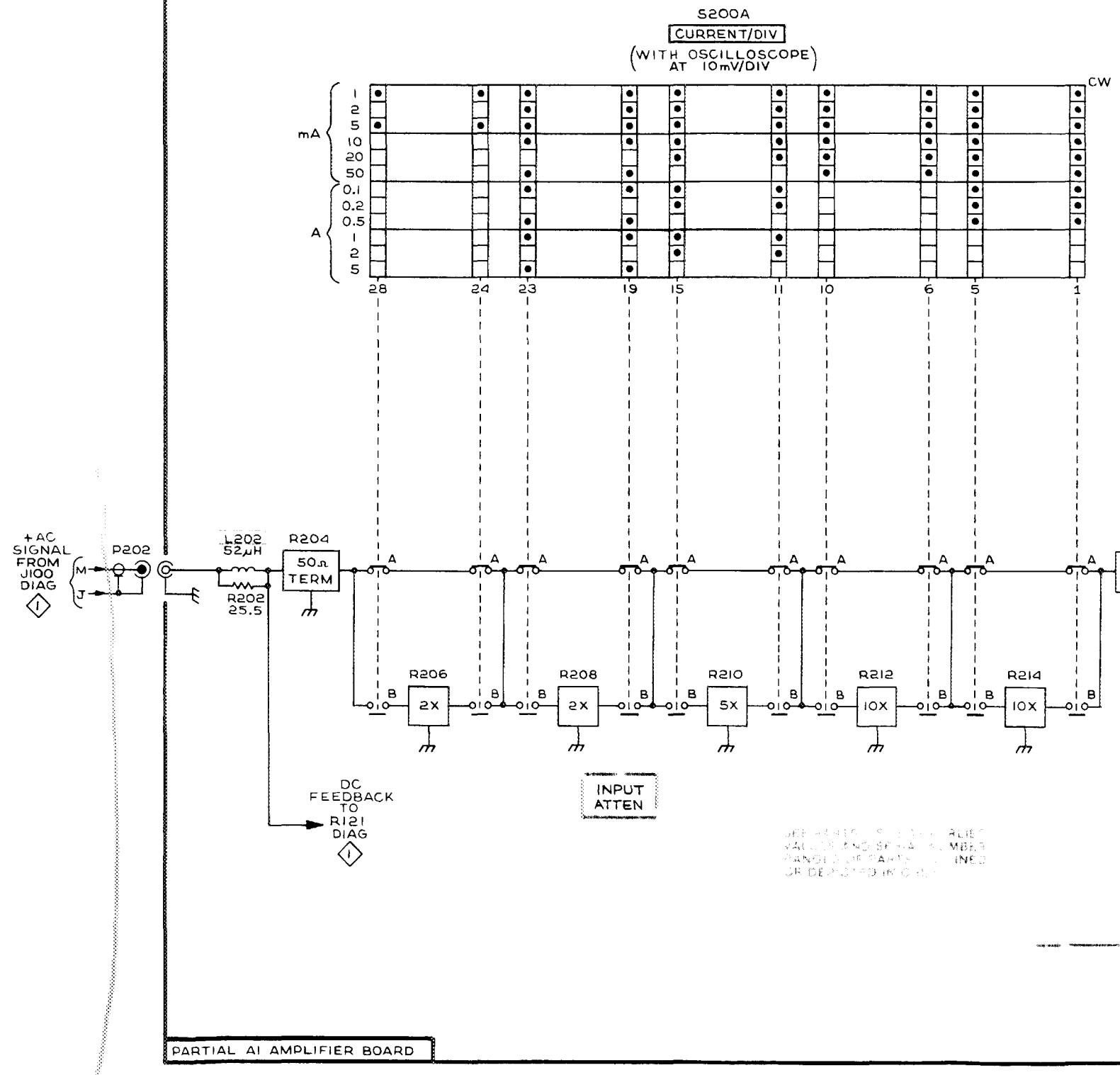
+19.3V — +16V — +16V$_1$ — +16V$_2$ — -16V — -16V$_1$ — -16V$_2$ — R432 2.7 C434 .01 — R436 10 C436 .01 — R442 2.7 C444 .01 — R446 10 C446 .01

DIODE BRIDGE RECTIFIERS

FROM MAIN FRAME: 1A, 1B, 3A, 3B


S200A
CURRENT/DIV
(WITH OSCILLOSCOPE AT 10 mV/DIV)
SEE DIAG 2
SWITCH SHOWN IN 1mA POSITION.
mA
A
S370
BANDWIDTH
(FULL)
(5 MHz)
GAIN SELECT FROM J100 DIAG 1
OUTPUT INTO 50Ω
P346
P370
P380
J390
P300
DC LEVEL
R302 100K x 10 k
R304 100
R306 7.87
R308 49.9
C308 .01
Q310A
R311 604
R312 140
R313 49.9
R314 140
R315 680
R317 49.9
ATTENUATED AC SIGNAL FROM Q230B DIAG 4
CR320
Q310B
R321 604
R323 49.9
S/N B030830 AND UP
X2 AMPLIFIER
R326 820
R327 3.24k
R328 68
C328 .01
R330 280
R332 100
R334 100
R335 133
R336 140
GAIN
HF COMP
LF COMP
CW
R340 120
RT342 100
R344 250
R345 100
C345 33
R338 140
CW R346 5k
GAIN
R347 1k
R349 2k
U350
R351 10 k
C351 .01
R352 619
R353 536
SELECTABLE GAIN AMPLIFIER
R354 49.9
R355 133
R356 49.9
R357 49.9
R358 49.9
R360 75
C360 .01
R361 75
R363 2k
R364 250
C363 7-45
C364 43
R365 2.2k
C365 2µF
R366 910
C366 .015
U370
R367 10 k
C367 .01
R368 6.8k
R370 1.5k
R372 665
R373 1.5k
R374 665
R376 221
R377 825
Q360
R362 130
SELECTABLE BANDWIDTH AMPLIFIER
R382 680
L380 1.9µH
CR380
R380 100
C380 220
C383 43
R383 100
L383 1.9µH
CR383
R384 680
Q390
Q395
R392 1.2k
R393 47
C393 3.9pF
R390 1.58k
R395 787
C391 27
R397 150
R391 47.5
R394 249
C394 3.5
R399 65.4
R396 390
C396 62
C398 .01
R398 560
VR380 3V
C385 .01
OUTPUT AMPLIFIER
R386 49.9
CR386
R387 15k
Q385
R388 8.2k
C388 6.8µF
* * 5MHz BANDWIDTH
* P346 PIN B GROUNDED
VOLTAGE & WAVEFORM CONDITIONS
PARTIAL A1 AMPLIFIER BOARD

VOLTAGE & WAVEFORM CONDITIONS



NOTES:

1. DOTS INDICATES 'A' CONTACTS ARE CLOSED AND 'B' CONTACTS OPEN.
2. 'A' CONTACTS ARE ON THE CAM SIDE OF THE BOARD.
3. SWITCH SHOWN IN 1mA POSITION.

PARTIAL A1 AMPLIFIER BOARD

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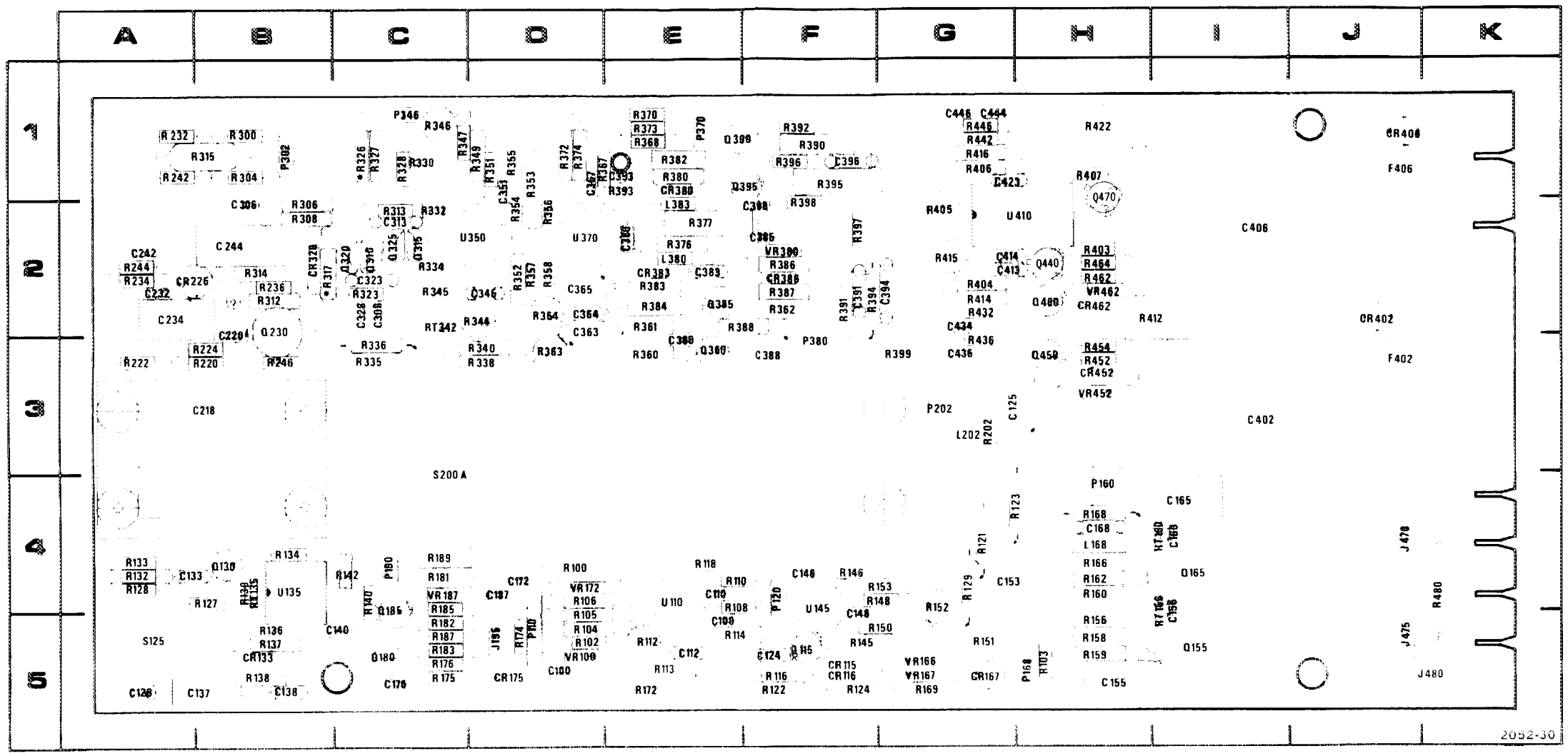
ATTENUATOR 2



*See Parts List for serial number ranges.

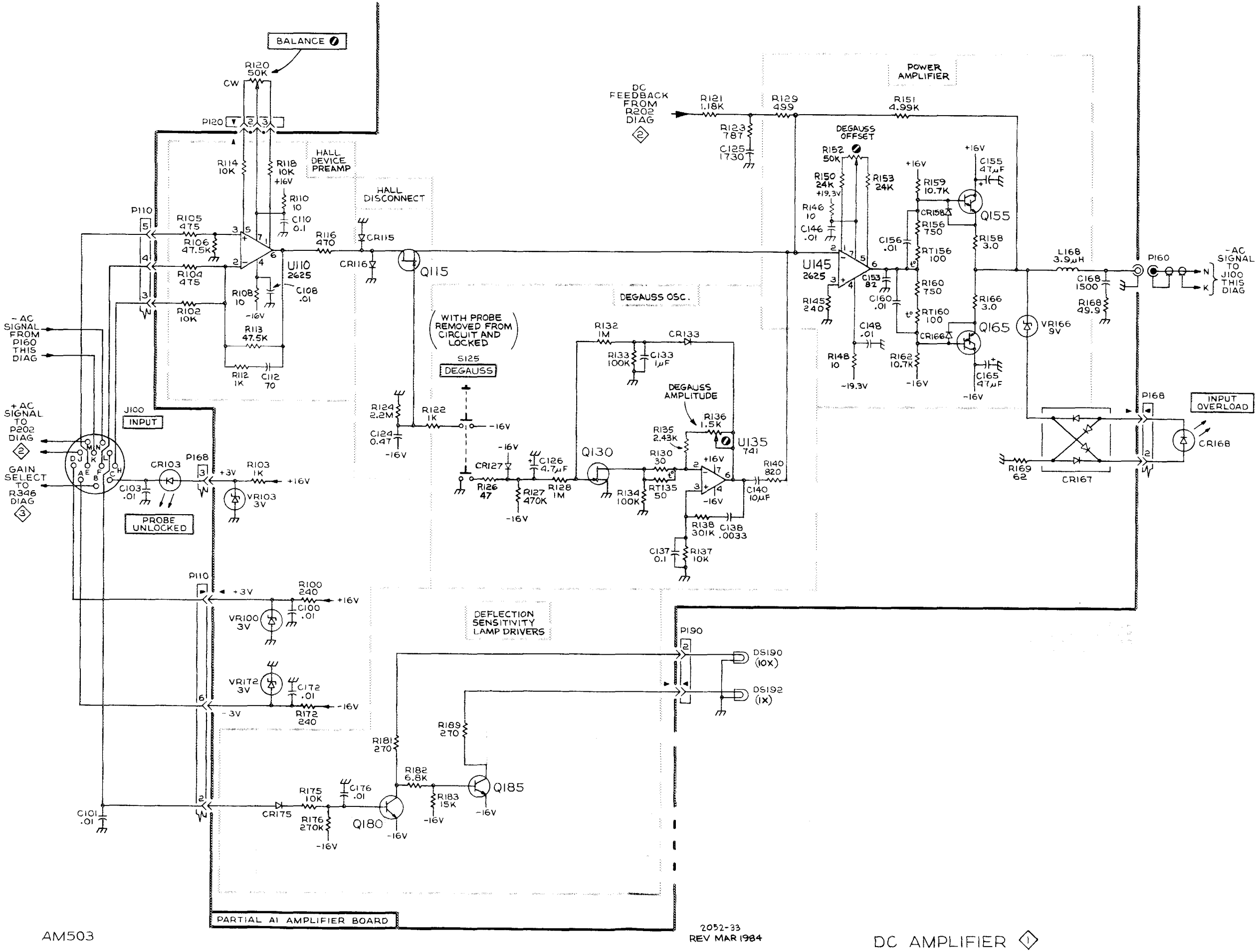
† Located on back of board

Fig. 7-2. A1—Amplifier circuit board with component locations of components (SN B030829 & below).

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C100	5D	C160	4H	C323 *	2C	C393	1D	CR127	5A	J110	5D	L380	2E
C108	5E	C165	4I	C328	2C	C394	2F	CR133	5B	J120	5F	L383	2E
C110	4E	C168	4H	C345 *	2C	C396	1F	CR167	5G	J160	4H		
C112	5E	C172	4D	C351	2D	C398	2E	CR175	5D	J168	5G	P302	1B
C124	5E	C176	5C	C360	3E	C402	3I	CR226	2A	J190	4C	P370	1E
C125	4G	C187 *	4D	C363 *	3D	C406	2I	CR320	2B	J195	5C	P380 †	3F
C133	4A	C218 *†	3A	C364 *	2D	C413	2G	CR380	2E	J202	3G	Q115	5F
C137	5A	C220	3B	C365 *	2D	C414	2G	CR383	2E	J346	1C	Q130	4A
C138	5B	C232	2A	C366	2D	C423	2G	CR386	2F	J380	3F	Q155	5I
C140	4B	C234	2A	C367	1D	C434	3G	CR402	3J	J470	4J	Q165	4I
C146	4F	C242	2A	C380	2D	C436	3G	CR406	1J	J475	5J	Q180	5C
C148	5F	C244	2B	C383	2E	C444	1G			J480	5J	Q185	5C
C153 *	4G	C306	2B	C385	2E	C446	1G	F402 *†	3J			Q230	3B
C155	5H	C308	2C	C388	3E	CR115	5F	F406 *†	1J	L168	4H	Q310 *	2C
C156	5H	C313 *	2C	C391	2F	CR116	5F			L202	3G	Q315	2C

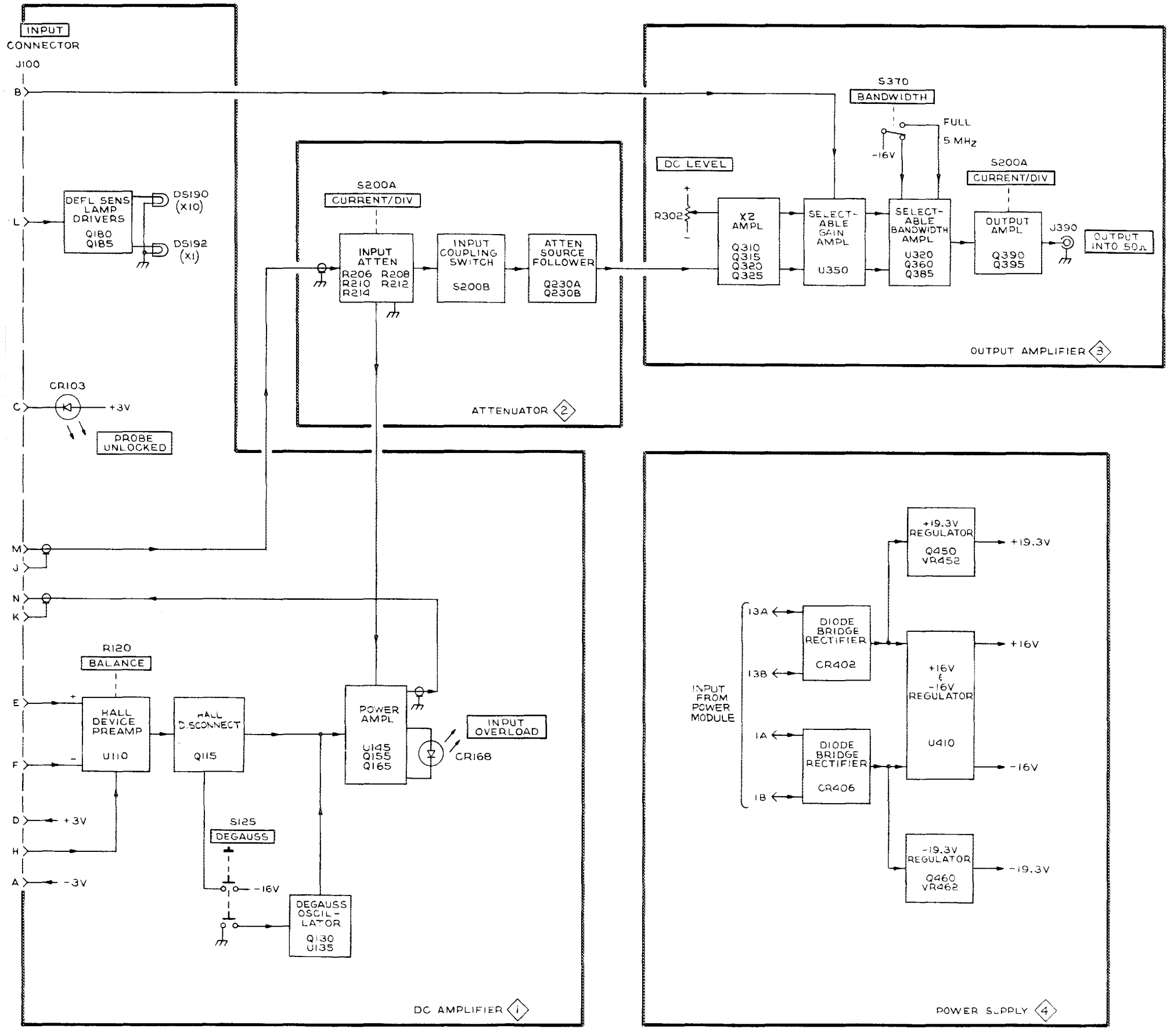
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
Q320 *	2C	R106	5D	R129	5G	R152	5G	R176	5C	R244	2A	R327	1C
Q325	2C	R108	5E	R130 *	4B	R153 *	4F	R181	4C	R246	3B	R328	1C
Q360	3E	R110	4E	R132	4A	R156	5H	R182	5C	R300	1B	R330 *	1C
Q385	2E	R112	5E	R133	4A	R158	5H	R183	5C	R304	1B	R332 *	2C
Q390	1E	R113	5E	R134	4B	R159	5H	R185 *	4C	R306 *	2B	R334 *	2C
Q395	2E	R114	5E	R136	5B	R160	5H	R187 *	5C	R308 *	2B	R335	3C
Q440 *	2H	R116	5E	R137	5B	R162	4H	R189	4C	R311	2B	R336	3C
Q450	3G	R118	4E	R138	5B	R166	4H	R202	3G	R312	2B	R338	3C
Q460	3G	R121	4G	R140	4B	R168	4H	R220 *	3A	R313 *	2C	R340	3C
Q470 *	1H	R122	5E	R142 *	4B	R169	5G	R222	3A	R314	2B	R344	2C
R100	4D	R123	4G	R145 *	5F	R172	5E	R224	3A	R315	1A	R345	2C
R102	5D	R124	5F	R146	4F	R174 *	5D	R232	1A	R317 *	2B	R346	1C
R103	5G	R126	5A	R148	5F	R175	5C	R234	2A	R321	2C	R347	1C
R104	5D	R127	4A	R150 *	5F			R236	2B	R323 *	2C	R349	1C
R105	5D	R128	4A	R151	5G			R242	1A	R326 *	1C	R351	1C

SN B030829 & BELOW



AM503

DC AMPLIFIER 1



AM503

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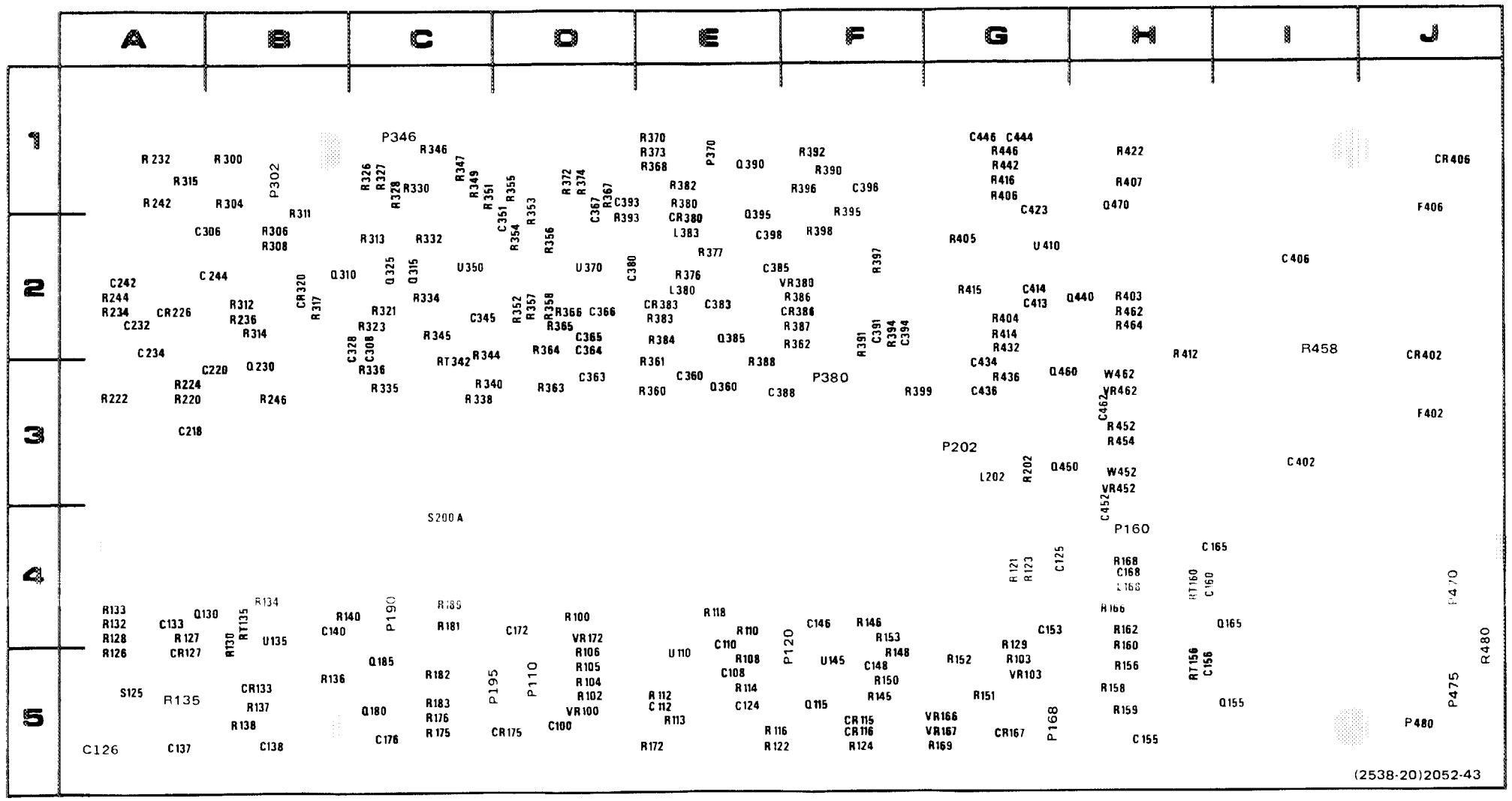
BLOCK DIAGRAM

COMPONENT LOCATIONS
SN B030830 & ABOVE

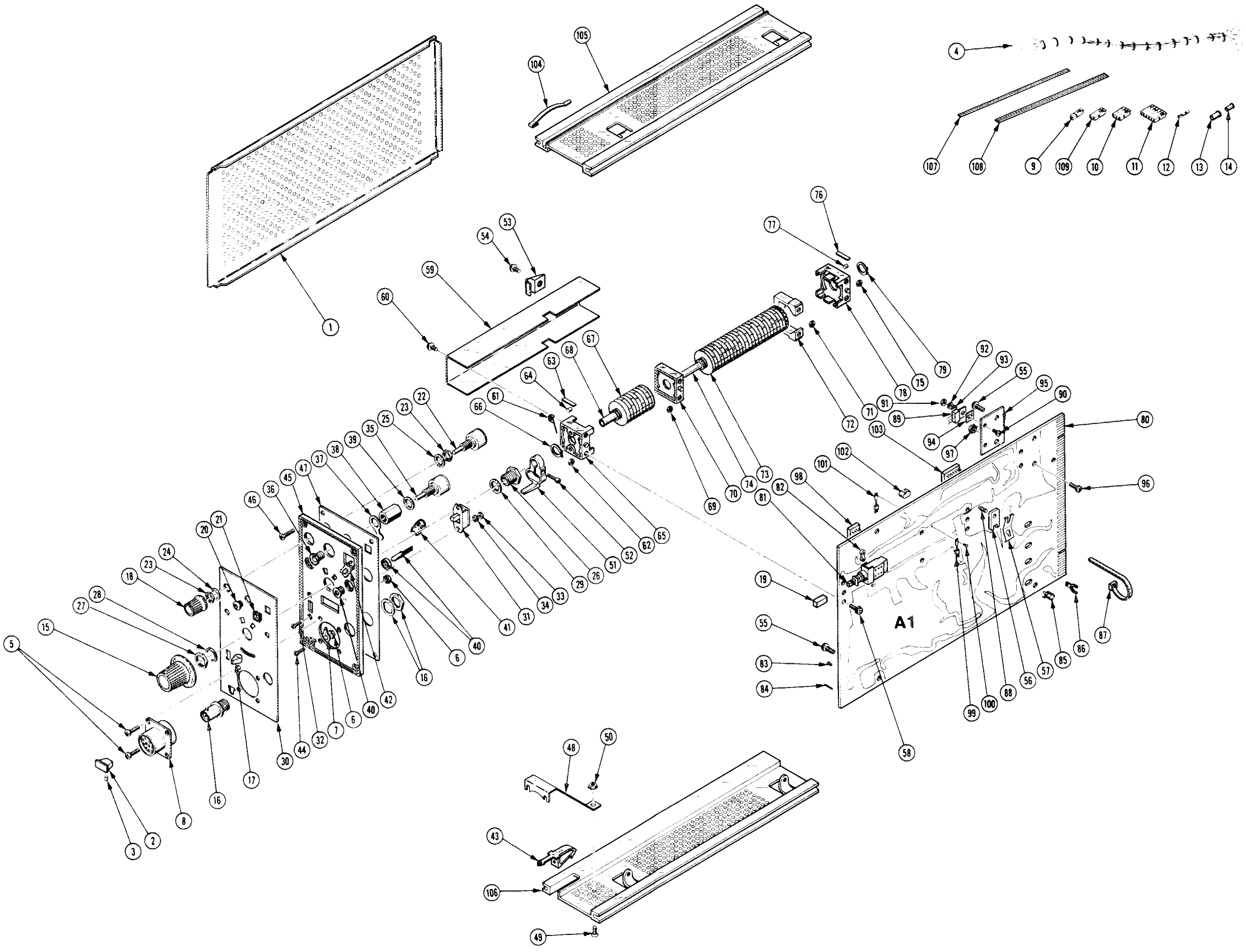


(2538-20)2052-43

† Located on back of board

*See Parts List for serial number ranges.

Fig. 7-1. A1—Amplifier circuit board with component locations of components (SN B030830 & above).


A1