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AM 502 DIFFERENTIAL AMPLIFIER

INSTRUCTION MANUAL

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

Serial Number _____

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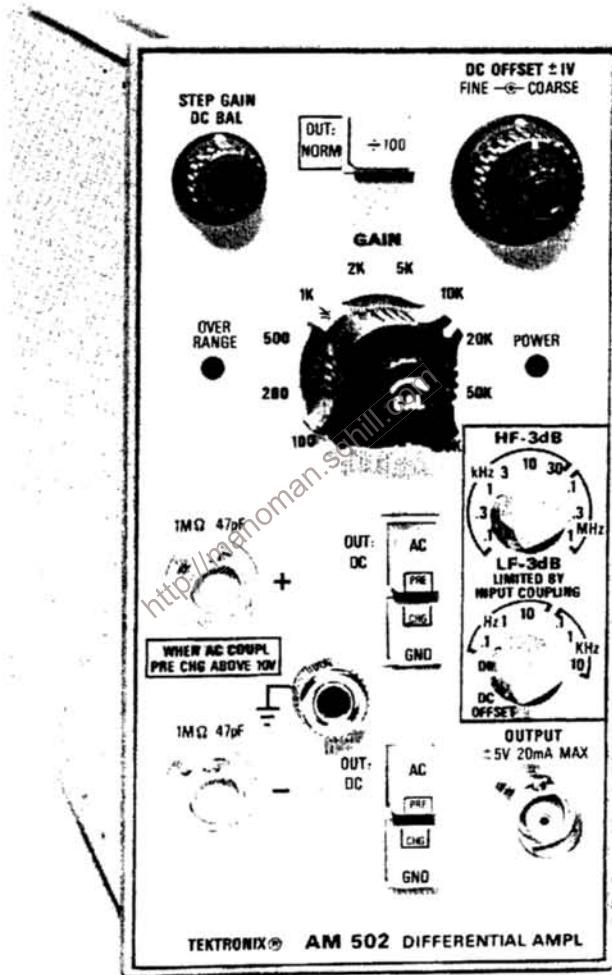
INSTRUMENT SERIAL NUMBERS

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

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<i>THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.</i>		Section 8 DIAGRAM AND CIRCUIT BOARD ILLUSTRATION	8-1
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1582-1

AM 502 Differential Amplifier plug-in module.

OPERATING INSTRUCTIONS

INTRODUCTION

Description

The AM 502 is a dc-coupled differential amplifier with excellent common-mode rejection capabilities and high gain for low voltage measurements. The dc offset capability permits nulling up to 1 volt dc, so that low level, low frequency signals impressed on a dc level can be amplified without the degradation often introduced by ac input coupling. High and low frequency -3 dB points can be selected at the front panel to suit the application. Signal inputs and outputs are available at the rear connector as well as at the front panel. A front panel lamp indicates most overrange conditions of excessive input signal, excessive gain, or excessive offset.

The input circuit can be represented by approximately 1 megohm to ground paralleled by approximately 47 picofarads. The input impedance can be raised to about 200 megohms with the removal of a jumper.

Overload protection is provided by fuses in series with the input which open when large amounts of current flow due to overloading conditions.

A STEP GAIN DC BALANCE control is provided to adjust for zero shift as the gain switch is changed from one position to another.

The DC OFFSET COARSE and FINE controls give offset up to ± 1 volt dc potential difference at the input connectors. The amplifier internal bias is changed to accomplish the offset. The LF -3 dB switch must be in the DC OFFSET position to actuate these controls.

The HF -3 dB switch is used to reduce the upper bandwidth limit as necessary to improve the signal-to-noise ratio when using the AM 502 in low-frequency applications. The LF -3 dB control increases the lower bandwidth frequency.

Use of the pre-charging feature prevents surge currents, due to charging the ac coupling capacitor, from damaging the circuit under test.

Installation and Removal

CAUTION

Turn the power module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry. Because of the high current drawn by the AM 502, it is also recommended that the power module be turned off before removing the AM 502. 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 502 circuit board edge connector.

Align the AM 502 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 502, pull on the release latch located in the lower left corner, until the interconnecting jack disengages and the AM 502 will slide out.

Controls and Connectors

Refer to Fig. 1-2. Even though the AM 502 is fully calibrated and ready to use, the functions and actions of the controls and connectors should be reviewed before attempting to use it. Pull the Power switch on the power module to apply power to the AM 502. The POWER indicator light indicates when power is applied to the AM 502.

OPERATING CONSIDERATIONS

Overheating

The AM 502 is designed to operate at an ambient temperature from 0° to $+50^{\circ}$ C. However, when operating several power supplies in a multi-plug-in power module, especially at low output voltages, or when operating close to other heat-producing equipment, internal temperature may exceed safe limits and actuate a thermal cutout in the power module. Refer to the power module instruction manual for more complete information.

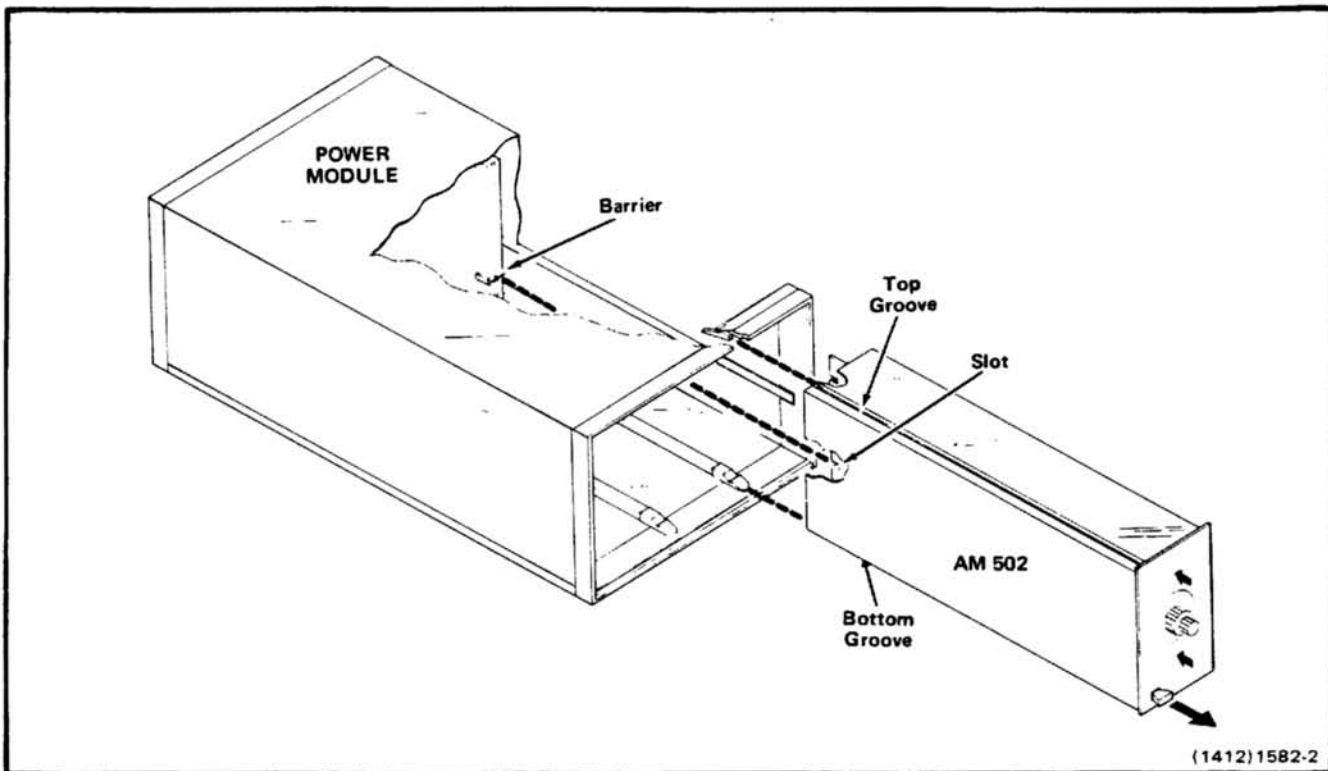


Fig. 1-1. Plug-in installation and removal.

Input Connections

Unshielded test leads can be used to connect the AM 502 to a signal source when a high-level, low-frequency signal is monitored at a low impedance point. However, when any of these factors is missing, it becomes increasingly important to use shielded signal cables. In all cases, the signal-transferring leads should be kept as short as practical.

When making single-ended input measurements (conventional amplifier operation), be sure to establish a common ground connection between the device under test and the AM 502. The shield of a coaxial cable is normally used for this purpose. See Fig. 1-3 for reference. Push the GND button for the input not connected to the device under test.

In some cases differential measurements require no common chassis ground connection, and therefore are less susceptible to interference by ground-loop currents.

Consider the change in the source operating characteristics due to loading by the signal input cables. The circuit at the input connectors can be represented by approximately 1 megohm to ground paralleled by approximately 47 picofarads. Two feet of 50 ohm coaxial cable increases the parallel capacitance by about 60 picofarads, which could be excessive in many situations. To minimize these effects, use a higher impedance cable or an attenuator probe.

Probes

Attenuator probes decrease the resistive-capacitive loading of a signal source. They also extend the measurement range of the AM 502 to substantially higher voltages. Some measurements require a higher resistance input to the AM 502, with very little source loading or signal attenuation. In such situations use a FET probe or the high-impedance input provision of the AM 502. Contact your Tektronix Representative for further information on probes.

High Impedance Input

To raise the internal input impedance of the AM 502 to about 200 megohms, remove the P40 plug (Fig. 3-1). Make certain the attenuator is in the NORM mode. Signal source impedance now becomes an important factor. For example, a 100 picoampere gate current through 10 megohms produces a one-millivolt offset. This offset may result in significant error when small voltages are measured.

Input Overloading

When measuring unknown dc voltages, push the ÷100 pushbutton in, and start with the 100 position on the GAIN switch. Increase the GAIN switch setting and finally release the ÷100 pushbutton until a suitable output signal is obtained. If the input circuit of the AM 502 is overdriven, large amounts of current will flow, opening the protective fuses.

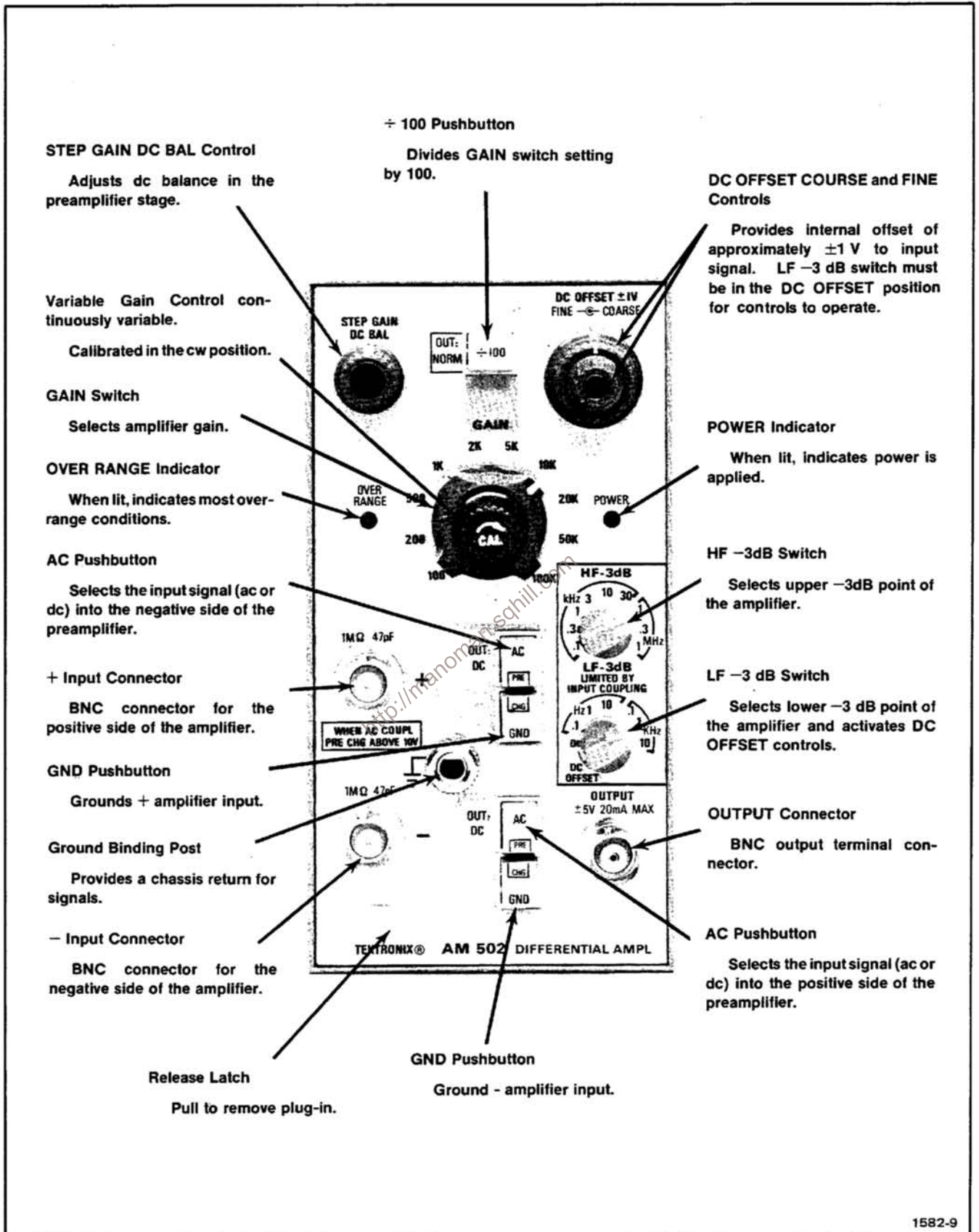


Fig. 1-2. AM 502 controls and connectors.

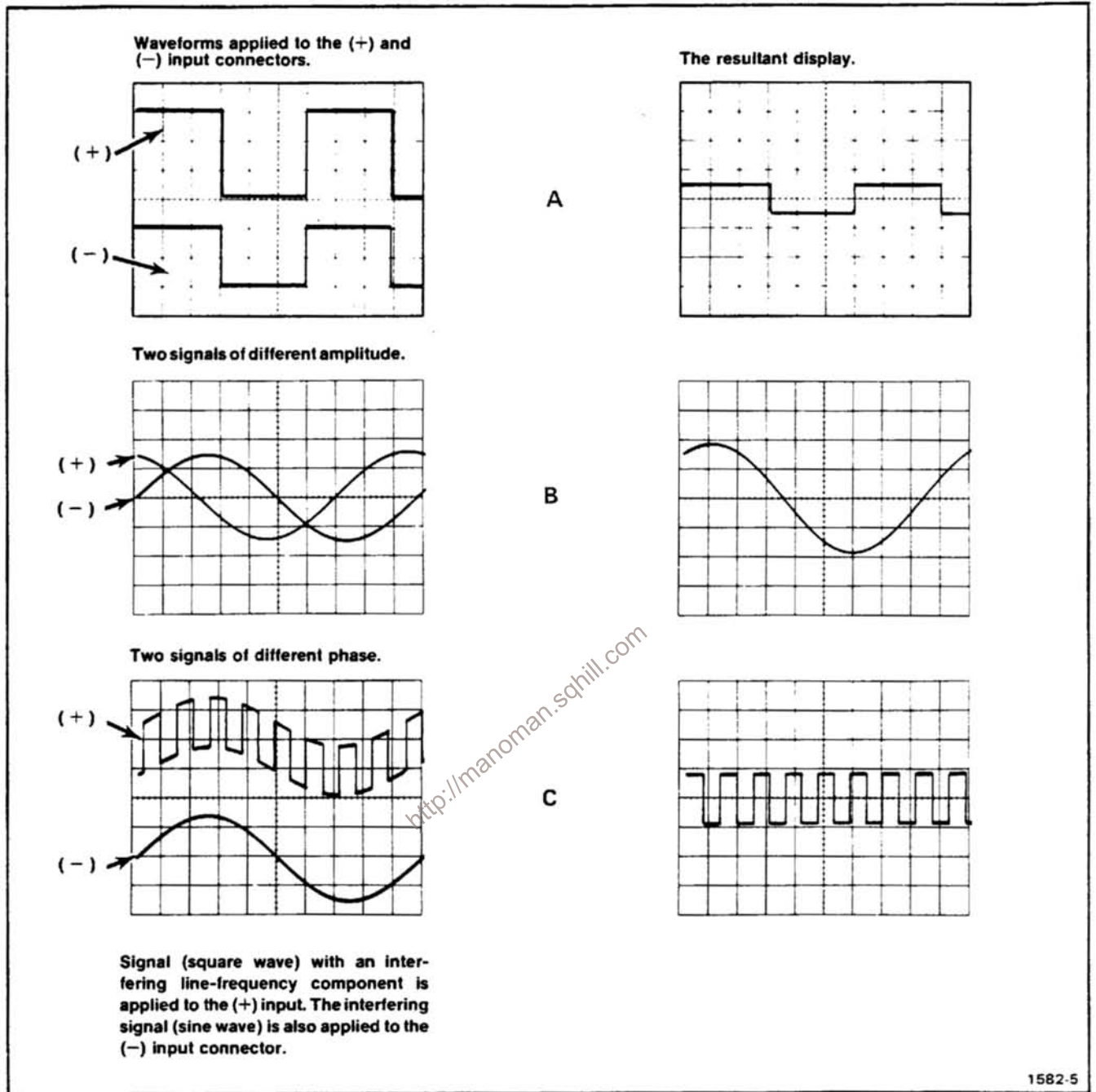


Fig. 1-3. Waveforms showing differential rejection of a common-mode signal. Resultant waveforms show the difference between the two signals.

Output Connections

Make output connections using a bnc to dual binding post connector, or a coaxial cable with at least one bnc connector. To prevent current limiting in the output stage, do not load the output with less than 250 ohms. Output current is limited to 20 milliamperes.

Step Gain DC Balance

If this control is misadjusted, the dc output level will shift as the GAIN switch position is changed. Push both GND buttons and place the GAIN switch in the 100 position. Rotate the GAIN switch from stop to stop while adjusting the STEP GAIN DC BAL control for no dc shift at the OUTPUT terminal.

DC Offset Coarse and Fine

Use these controls to offset up to ± 1 volt dc potential difference at the input connectors. The amplifier internal bias is changed to accomplish the offset. The differential rejection capabilities of the AM 502 are not affected. The LF -3dB switch must be in the DC OFFSET position to activate these controls.

HF and LF Bandwidth Reduction

Use the HF -3dB switch to reduce the upper bandwidth limit, as necessary, to improve the signal-to-noise ratio when using the AM 502 in low-frequency applications. The LF -3dB control increases the lower bandwidth frequency. Use this control to reduce dc drift, when raising the lower bandwidth does not undesirably reduce the bandwidth for the signal being measured.

Pre-Charging

Use of this feature prevents surge currents, due to charging the ac coupling capacitor in the AM 502, from damaging the circuit under test. Before connecting the AM 502 to a signal containing a dc component, push the AC and GND pushbuttons. Connect the input to the circuit under test. Wait about one second for the coupling capacitor to charge. Release the GND pushbutton, and the coupling capacitor is charged to the value of the dc voltage to be measured.

Differential Operation

A differential measurement is made by connecting each of the two inputs to selected points in the test circuit. The input to the amplifier will then be the difference in voltage of the two selected points. Consideration should be given to the proper connection method used between the AM 502 and the circuit under test; otherwise improper measurement results may occur. See Fig. 1-4 for reference.

Differential voltage measurements are made by applying the signals to the $+$ input and $-$ input connectors. Set the input coupling switches to the same position, AC or DC, depending on the measurement being made. In differential measurements, only the voltage difference between the two signals is amplified. Common mode signals (common in amplitude, phase, and frequency) are rejected. See Fig. 1-3 A, B, and C for reference.

Single-ended measurements often yield unsatisfactory results because of the interference resulting from ground-loop currents between the AM 502 and the device under test. In other cases, it may be desirable to eliminate a dc voltage by means other than the use of a blocking

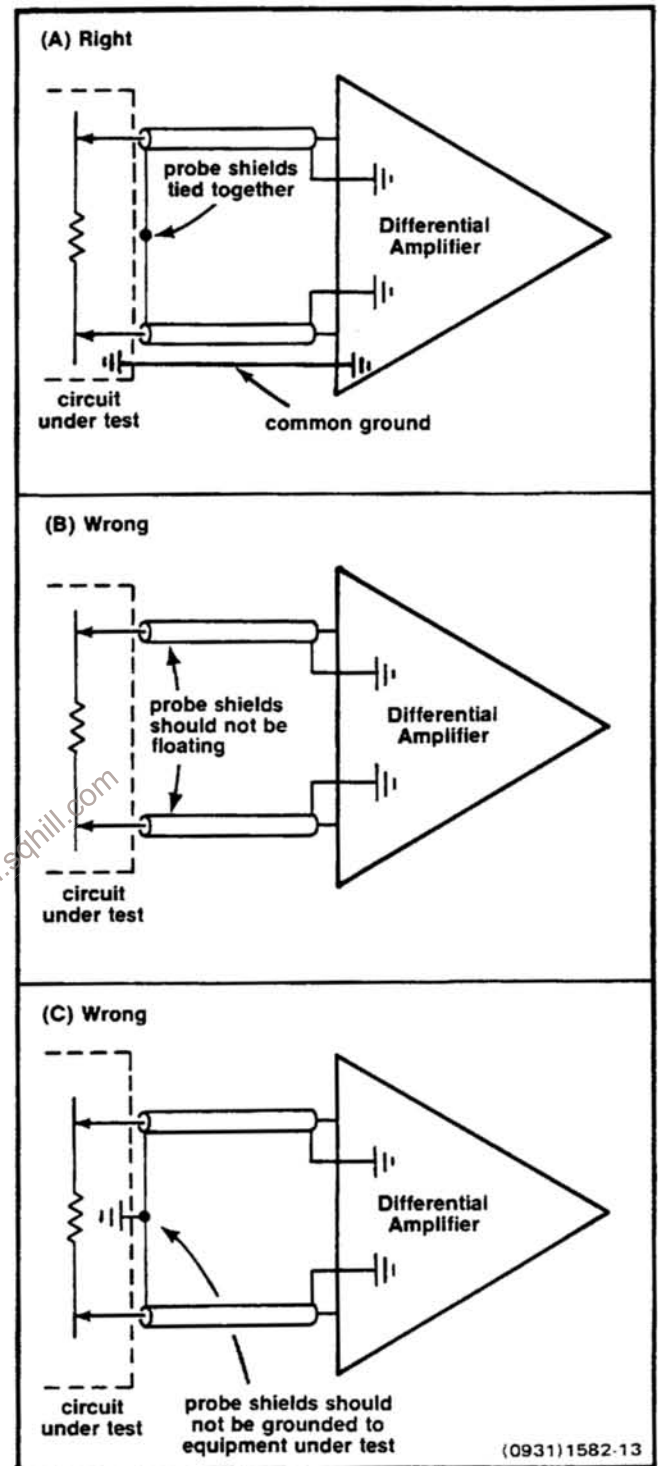


Fig. 1-4. Connecting a differential amplifier to a signal source.

capacitor, which could limit the low-frequency response. The limitations of single-ended measurements are effectively eliminated by using differential measurements.

DC Offset Operation

By using the FINE and COARSE DC OFFSET controls, it is possible to use the AM 502 differentially in a slide-back mode, to observe a small signal whose dc potential difference may be considerable. The offset voltage is continuously adjustable from plus 1 volt to minus 1 volt, and is internally available for all of the GAIN switch positions. The LF -3dB switch must be in the DC OFFSET position to activate the offset circuit.

Common Mode Rejection Ratio

The ability of the AM 502 to reject common-mode signals is indicated by the common-mode rejection ratio (cmrr). For example, assume that a signal consists of unwanted 60 hertz at 10 volts peak-to-peak (common mode connected to both inputs), plus a desired signal at 1 millivolt peak-to-peak (differentially connected to one input). The AM 502 gain is set at 200. The output of the AM 502 shows the desired signal at an amplitude of 0.2 volt (1 millivolt X 200), and the 60 hertz signal is viewed at an amplitude of 0.02 volts. The cmrr in this application is 100,000 to 1. This figure is calculated by multiplying the value of the common-mode signal (10 volt) by the gain of the amplifier (200) for a product of 2000 volts. This product is divided by the observed 60 hertz voltage at the output (0.02 volt) and result is the cmrr, 100,000 to 1. It would, of course be impossible to view the 1 millivolt signal superimposed on the 60 hertz signal by using single input methods.

Degradation of Common Mode Rejection

There are a number of factors that degrade common-mode rejection ratio (cmrr). The principal requirement for maximum rejection is for the common-mode signal to arrive at the input FET gates at the same phase and amplitude. A difference of only 0.01% in the attenuation ratios of the input attenuators will reduce the rejection ratio to 10,000 to 1. Also, any difference in source impedance will degrade the rejection ratio. Figures 1-5 and 1-6 show common-mode rejection degradation due to differences in source impedance. The frequency of the common-mode signal also affects the common-mode rejection ratio. Generally, as the frequency of the input signal increases, the common-mode rejection ratio is more difficult to maintain.

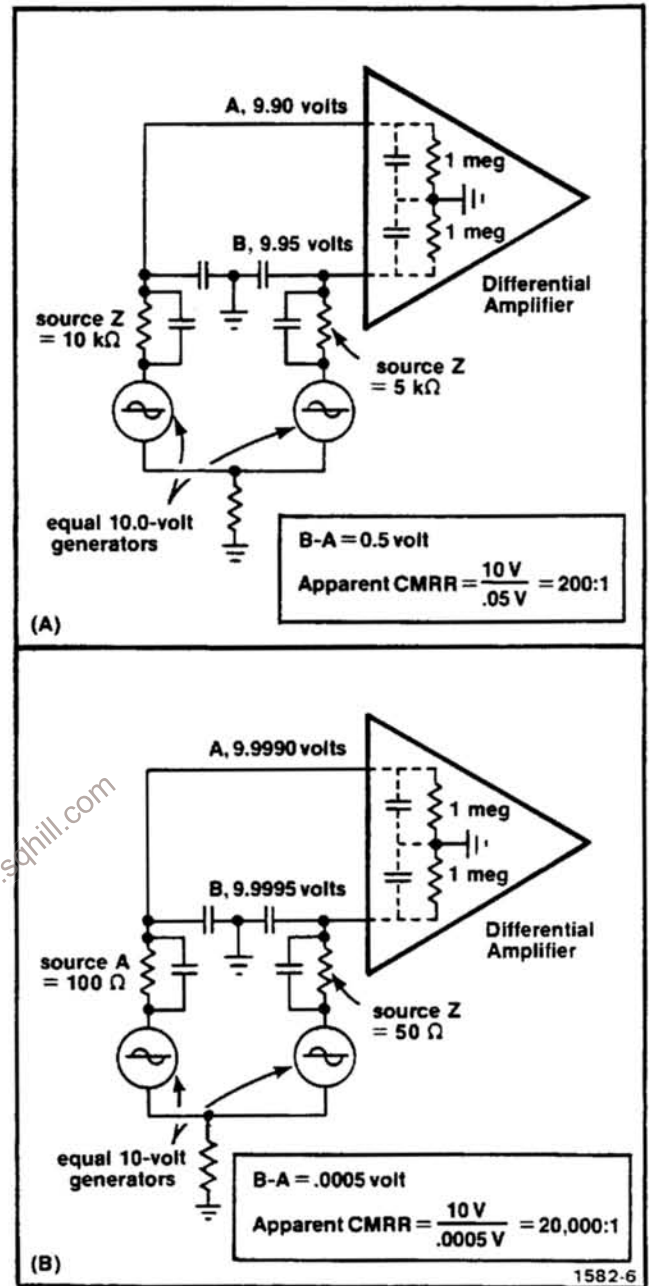


Fig. 1-5. Relationship of test point source impedance to the amplifier input impedance and the apparent CMRR caused by (A) large difference between test-point impedances and (B) low impedance test points.

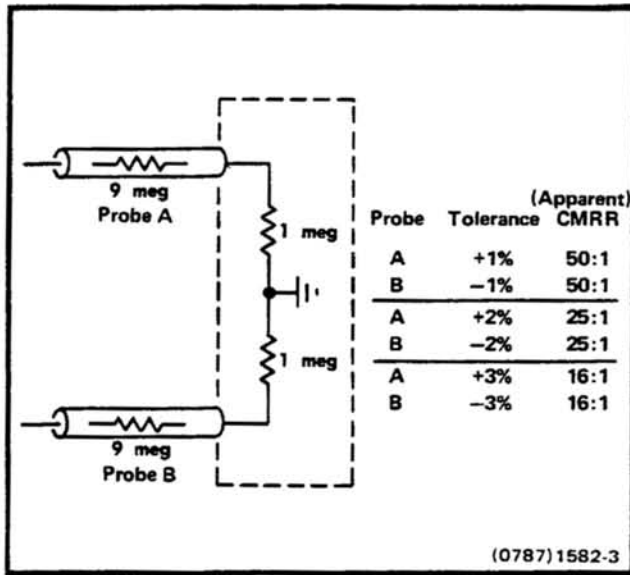


Fig. 1-6. Simplified input circuit and table showing the change in apparent CMRR due to 10X probes that are within 1, 2, and 3% of their attenuation values (with matched 1 megohm resistors).

The high frequency cmrr will also depend upon the signal source impedance, since various shunt capacitances between the source and the input gate must charge and discharge through that impedance.

Outside influences such as magnetic fields can also degrade the performance, particularly when low level signals are involved. Magnetic interference may be reduced by using identical signal transporting leads to the two inputs. Twist the two leads together over as much of their length as possible. Low-frequency measurements can be similarly protected by using a shielded cable that contains a twisted pair of conductors.

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SPECIFICATION AND PERFORMANCE CHECK

SPECIFICATION

Performance Conditions

The electrical characteristics are valid only if the AM 502 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 noted.

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

Table 2-1
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Gain		
Normal Mode	100 to 100,000 within 2%, 10 steps in 1, 2, 5 sequence.	
÷100 Mode	1 to 1000 within 2%.	
Variable Range		Continuously variable uncalibrated gain to at least 2.5 times the calibrated gain setting.
Frequency Response		
Direct Coupled	dc to 1 MHz	With Gain control set to 20K or less, selectable HF -3dB points are within +1dB, -2dB. Upper -3dB point reduces to 500 KHz at 50K gain, and 250 KHz at 100K gain.
AC Coupled	2 Hz or less, at lower frequency -3dB point to 1 MHz.	
Bandwidth		
HF -3dB	100 Hz to 1 MHz, 9 steps in 1-3 sequence.	Reference approximately 5.0 V peak-to-peak output at 1 KHz.
Accuracy	+1dB, -2dB	Reading range -2dB to -5dB.
LF -3dB	0.1 Hz to 10 kHz 6 steps in 1-10 sequence.	
Accuracy	+1dB, -2dB	Reading range -2dB to -5dB.

Table 2-1 (Con't)

Characteristics	Performance Requirements	Supplemental Information
Output		
Voltage Swing	± 5 V.	
Current		± 20 mA
R_o		5 Ω or less
Minimum Load Impedance		250 Ω
Common Mode		
Normal Mode Range	± 5 V.	
Rejection Range	100 dB, dc to 50 kHz.	Direct coupled with inputs shorted together.
$\div 100$ Mode Range	± 50 V.	
Rejection Range	50 dB, dc to 50 kHz.	Direct coupled with less than 100 V peak-peak sine-wave input.
DC Offset Range		At least + and - 1 V.
Maximum Safe Input Voltage		
Direct Coupled Normal Mode		15 V (dc plus peak ac) to 5 MHz or less.
$\div 100$ Mode		350 V (dc plus peak ac) to 5 MHz or less.
AC Coupled		350 V (dc plus peak ac) with coupling capacitor precharged.
Maximum Input Gate Current (each input)		50 pA at 25°C.
Noise (Referred to Input)		
NORM mode	≤ 25 μ V, tangentially measured with 25 Ω or less source resistance.	10 Hz to 1 MHz selected bandwidth. Typically ≤ 6.0 nV/ $\sqrt{\text{Hz}}$ above 1 kHz.
$\div 100$ Mode		Typically ≤ 2.0 μ V/ $\sqrt{\text{Hz}}$ from 1 kHz to 9 kHz, decreasing in a 1/F fashion to ≤ 600 nV/ $\sqrt{\text{Hz}}$ above 30 kHz.
Voltage Drift with Time		
Short Term		10 μ V (peak-to-peak) per hour

Table 2-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
Long Term		20 μ V (peak-to-peak) per hour.
Voltage Drift with Temperature		100 μ V per $^{\circ}$ C.
Input R and C		Resistance, 1 M Ω . Capacitance, Approximately 47 pF.

Table 2-2
ENVIRONMENTAL

Characteristics	Information
Temperature	
Operating	0 $^{\circ}$ C to +50 $^{\circ}$ C
Storage	-40 $^{\circ}$ C to +75 $^{\circ}$ C
Altitude	
Operating	To 15,000 feet; maximum operating temperature decreased by 1 $^{\circ}$ C/1000 feet from 5000 to 15,000 feet.
Storage	To 50,000 feet:
Vibration	
Operating and Non-operating	With the instrument complete and operating, vibration frequency swept from 10 to 55 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015 inch total displacement. Hold 10 minutes at any major resonance, or in none, at 55 Hz. Total time 75 minutes.
Shock	
Operating and Non-operating	30 g's 1/2 sine, 11 ms duration, 2 shocks in each direction along 3 major axes, for a total of 18 shocks.

Table 2-3
PHYSICAL CHARACTERISTICS

Characteristics	Information
Overall Dimensions (measured at maximum points)	
Height	5.0 inches 12.7 centimeter
Width	2.5 inches 6.35 centimeter
Length	11.8 inches 30.0 centimeter
Net Weight (Instrument Only)	1.8 lbs. .82 kilograms

PERFORMANCE CHECK

Introduction

This procedure checks the electrical characteristics of the AM 502 that appear in the Specification section of this manual. If the instrument fails to meet the requirements given in this performance check, the calibration 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 502 is calibrated at an ambient temperature of +20° C to +30° C and operated at an ambient temperature of 0° C to +50° C. Forced air circulation is required for ambient temperature above +40° 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	Performance Requirements	Applications	Example
Oscilloscope	Bandwidth, dc to 2 MHz; Minimum deflection factor, 20 mV/div; sweep rate, .2 ms/div to 1 μ s/div; accuracy, within 3%.	Used throughout procedure to provide display.	TEKTRONIX 5110. 5A13N, 5B10N.
Power Module	Three compartments or more.	All tests	TEKTRONIX TM 503 or TM 504.
Calibration Generator	Amplitude calibration, 5 mV to 10 V; accuracy, $\pm 0.25\%$ into 1 M Ω ; output, square wave at approximately 1 kHz.	Amplifier gain check	TEKTRONIX PG 506 Calibration Generator.*
Function Generator	Waveforms, sine and square; voltage amplitude, 10 V p-p; frequency range, 1 kHz to 50 kHz; accuracy, within 3%.	Signal generation for cross neutralization and high frequency cmrr check.	TEKTRONIX FG 501 Function Generator.*
Termination	Impedance, 50 Ω ; accuracy, within 2%; connectors, bnc.	Output termination for signal generator.	Tektronix Part No. 011-0049-01
Attenuator, 10X (4 required)	Impedance, 50 Ω ; accuracy, within 2%; connectors, bnc.	Output attenuation for signal generator. Noise check.	Tektronix Part No. 011-0059-02
Coaxial cable (2 required)	Impedance, 50 Ω ; length, 36 inches; connectors, bnc.	Provides signal interconnection.	Tektronix Part No. 012-0057-01

* Requires TM 500-Series power module

Preliminary Procedure

1. Ensure that all test equipment and the AM 502 under test are suitably adapted to the line voltage to be applied. Refer to the installation section of the power module manual.

2. Ensure that all test equipment is suitably adapted to the applied line voltage.

3. Install the AM 502 into the power module, and if applicable, install the TM 500 series test equipment into the test equipment power module.

4. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to stabilize.

Time Base Plug-In

Time/Div	.5 ms
Variable	(cal in)
Triggering	
+ Slope	selected
Mode	p-p auto
Coupling	ac
Source	internal
Position	Set so trace starts at left side of graticule.
Display Mode	main sweep
Magnifier	X1

Calibration Generator

Amplitude	1 V
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Initial Control Settings

Set the following controls during warm-up time:

AM 502

STEP GAIN DC BAL	midrange
÷100	pushbutton out
DC OFFSET	
FINE and COARSE	midrange
GAIN	100
CAL	fully clockwise (cal)
HF -3dB	1 MHz
LF -3dB	DC OFFSET
+ AC	pushbutton out
+ GND	pushbutton out
- AC	pushbutton out
- GND	pushbutton in

Oscilloscope

Intensity, Focus	Set for well-defined trace and normal brightness.
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Vertical Amplifier

Volts/Div	1 V
+ Input	dc
Variable	fully clockwise (cal)

PERFORMANCE CHECK PROCEDURE

NOTE

The oscilloscope vertical amplifier system gain, the 50-ohm termination, and 50-ohm attenuator are required to be calibrated within 0.5% accuracy prior to proceeding with Steps 1 and 2. The PG 506 calibration generator may be used to set the system to 0.5% accuracy.

1. Check Amplifier Gain. Gain Accuracy is within 2%

a. Connect the calibration generator to the AM 502 + input connector through a 50-ohm cable, a 50-ohm 10X attenuator and 50-ohm terminator.

b. Connect a 50-ohm cable from the AM 502 OUTPUT connector to the vertical amplifier input connector.

c. Adjust the AM 502 DC OFFSET controls (FINE and COARSE) until the OVERRANGE indicator light goes out. Position the crt display to the center of the graticule with the vertical amplifier position control.

d. Check—using the AM 502 GAIN and calibration generator amplitude settings given in Table 2-5, check the vertical deflection within the given limits.

Specification and Performance Check—AM 502

NOTE

The **OVER RANGE** indicator light must remain off during all switch settings. Adjust the DC OFFSET controls as required during the check procedure.

NOTE

Install both plug-in side covers and insert plug-in into power module for checking gain below 5K setting to minimize noise on the display.

Table 2-5

AMPLIFIER GAIN ACCURACY

AM 502 GAIN Setting	AM 502 HF -3 dB Switch Setting	Calibration Generator Amplitude Setting	Vertical Deflection in Divisions
100	1 MHz	1 V	4.9 - 5.1
200	1 MHz	.5 V	4.9 - 5.1
500	1 MHz	.2 V	4.9 - 5.1
1K	1 MHz	.1 V	4.9 - 5.1
2K	1 MHz	50 mV	4.9 - 5.1
5K	1 MHz	20 mV	4.9 - 5.1
10K	10 kHz	10 mV	4.9 - 5.1
20K	10 kHz	5 mV	4.9 - 5.1
50K	10 kHz	2 mV	4.9 - 5.1
100K	10 kHz	1 mV	4.9 - 5.1

2. Check $\div 100$ Amplifier Gain Accuracy. Gain Accuracy is within 2%

a. Disconnect all cables and repeat Step 1 parts a, b, c, and d.

b. Set the AM 502 GAIN switch to 10K and the HF -3 dB switch to 1 MHz; push in the $\div 100$ pushbutton.

c. Set the calibration generator amplitude control to 1 V. Adjust the AM 502 DC OFFSET control (FINE and COARSE) until the **OVER RANGE** indicator light goes out.

d. Position the crt display to the center of the graticule with the vertical amplifier position control.

e. Check—the crt display amplitude for 4.9 to 5.1 divisions.

f. Disconnect the 50-ohm terminator from the AM 502 + input connector and connect it to the - input connector. Push in the + input GND pushbutton and push and release the - input GND pushbutton.

g. Check—repeat parts d, e, and f of this step.

h. Disconnect the 50-ohm termination, 10X attenuator, and cable.

3. Check Common Mode Rejection. Rejection Ratio is 100 dB, dc to 50 kHz

a. Connect a dual-input connector cable between the AM 502 + input and - input connector.

b. Set the AM 502 $\div 100$ pushbutton out; the + input and - input AC and GND pushbuttons out, and the GAIN switch to 100.

c. Set the AM 502 HF -3 dB switch to .3 MHz and the LF -3 dB switch to DC.

d. Set the vertical amplifier deflection factor for 10 mV/div.

e. Connect a 50-ohm cable from the function generator to the center connector of the dual-input connector. Set the function generator for a 10 V, 50 kHz sine-wave output signal, with DC offset set to 0 at <1 V.

f. Adjust vertical amplifier position to center display on screen.

g. Check—the crt display for one division of vertical deflection or less.

4. Check $\div 100$ Common Mode Rejection. Rejection Ratio is 50 dB, dc to 50 kHz

a. Disconnect the 50-ohm cable from the function generator and connect it to the calibration generator output. Press in the $\div 100$ pushbutton.

b. Set the vertical amplifier deflection factor for 100 mV/div.

c. Set the calibration generator for a 100 volt, square-wave output signal.

d. Check—crt display for 3.1 divisions or less of vertical deflection.

e. Disconnect the dual-input connector and 50-ohm cable from the AM 502 input connectors.

5. Check HF -3 dB Bandwidth. Accuracy is +1 dB, -2 dB

a. Set the AM 502 HF -3 dB switch to 1 MHz, the - input pushbutton to GND, and ÷100 pushbutton out.

b. Set the vertical amplifier deflection factor to 1 V/div, and the time-base sweep rate to 1 ms/div.

c. Set the function generator controls for a 50 mV, 1 kHz sine-wave output signal. (Use appropriate attenuation to eliminate input overdrive condition.)

d. Connect a 50-ohm cable from the function generator to the AM 502 + input connector. Adjust the vertical deflection amplitude for a five-division display.

e. Set the function generator output frequency to 1 MHz.

f. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

NOTE

The specification in part f of this step must be met before proceeding with part g of this step.

g. Check—the remaining settings of the HF -3 dB switch, using Table 2-6 as reference. (Change time-base sweep rate as needed for lower frequencies.)

Table 2-6

HF -3 dB BANDWIDTH ACCURACY

AM 502 HF -3 dB Switch Setting	Function Generator Output Frequency	Vertical Deflection in Divisions
.3 MHz	300 kHz	3.15 - 3.85
.1 MHz	100 kHz	3.15 - 3.85
30 kHz	30 kHz	3.15 - 3.85
10 kHz	10 kHz	3.15 - 3.85
3 kHz	3 kHz	3.15 - 3.85
1 kHz	1 kHz	3.15 - 3.85
.3 kHz	300 Hz	3.15 - 3.85
.1 kHz	100 Hz	3.15 - 3.85

i. Set the HF -3 dB switch to 1 MHz.

6. Check LF -3 dB Bandwidth. Accuracy is +1 dB, -2 dB

a. Check—the settings of the LF -3 dB switch, using Table 2-7 as reference. Adjust the time-base sweep rate to obtain an appropriate display.

Table 2-7

LF -3 dB BANDWIDTH ACCURACY

AM 502 LF -3 dB Switch Setting	Function Generator Output Frequency	Vertical Deflection in Divisions
10 kHz	10 kHz	3.15 - 3.85
1 kHz	1 kHz	3.15 - 3.85
.1 kHz	.1 kHz	3.15 - 3.85
10 Hz	10 Hz	3.15 - 3.85
1 Hz	1 Hz	3.15 - 3.85

NOTE

The components used in the .1 Hz position are also used in the other positions of the switch; therefore, the tolerance of the .1 Hz position is checked.

b. Press in the AM 502 + input AC pushbutton. Set the function generator controls for a 2 Hz output signal.

c. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

d. Disconnect the 50-ohm cable from the AM 502 + input connector and connect it to the - input connector.

e. Press in the AM 502 + input GND pushbutton and - input AC pushbutton. Press to release the - input GND pushbutton.

f. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

g. Set the LF -3 dB switch to the DC OFFSET position. Press in the AM 502 - input GND pushbutton.

h. Disconnect the 50-ohm cable from the AM 502 - input connector.

Specification and Performance Check—AM 502

7. Check Overall Noise (Tangentially Measured)

a. Set the AM 502 GAIN control to 100K; press in to release the + input AC and GND pushbutton, and the - input AC pushbutton.

b. Set the vertical amplifier deflection factor to 5 V/div. Set the time-base sweep rate to 10 μ s/div, and the trigger source switch to external.

c. Connect a 50-ohm termination to the AM 502 + input connector; connect four series-connected 10X attenuators to the 50-ohm termination.

d. Connect a 50-ohm cable from the calibration generator fast-rise output connector to the end of the attenuator string. Set the pulse duration control for 1 ms.

e. Adjust the AM 502 DC OFFSET controls (FINE and COARSE) until the OVER RANGE indicator light goes out.

f. Adjust the calibration generator pulse amplitude control and observe two noise bands as shown in Fig. 2-1A (remove one attenuator if necessary, to produce the desired display).

g. Decrease the calibration generator pulse amplitude until the noise bands just merge. See Fig. 2-1B.

h. Remove three of the attenuators and connect the signal through the 50-ohm attenuator (including the 50-ohm termination), to the vertical amplifier input and measure the pulse amplitude. Calculate the tangentially measured display noise as follows:

$$\text{Noise (in } \mu\text{V)} = \frac{\text{Signal level (measured in part h)}}{\text{Attenuation Removed}}$$

Typical figures are:

$$\frac{12 \text{ mV}}{10^{33}} = 12 \times 10^{-6} = 12 \mu\text{V of noise}$$

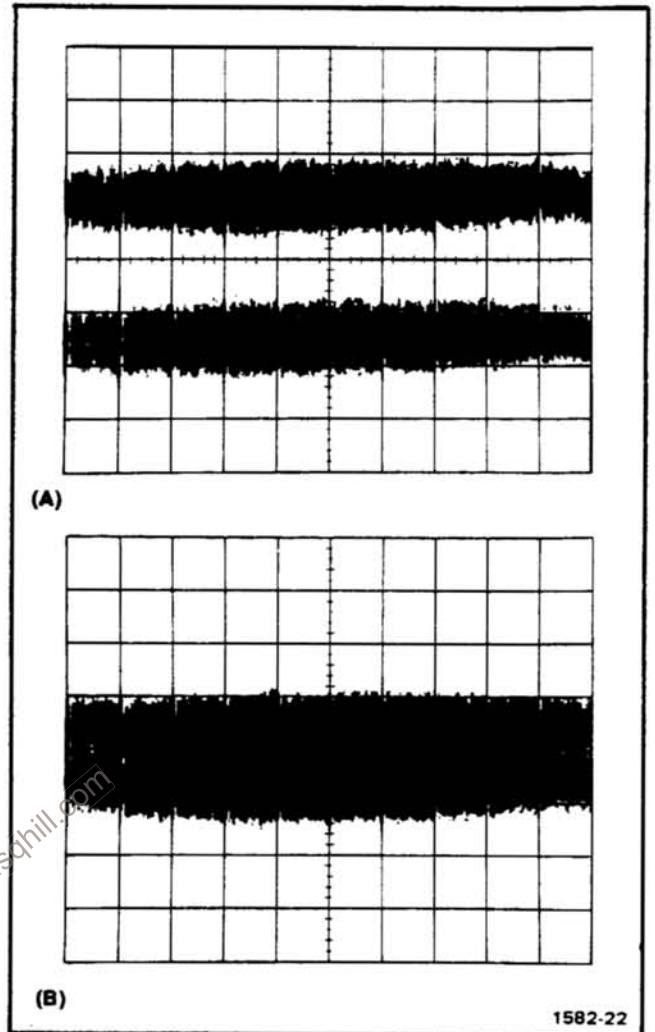


Fig. 2-1. Typical display of (A) two noise bands and (B) noise bands merged.

i. Disconnect all cables and equipment.

This completes the Performance Check of the AM 502 Differential Amplifier.

ADJUSTMENT

Introduction

This adjustment procedure is to be used to restore the AM 502 to the original performance specification. Adjustment need not be performed unless the instrument fails to meet the Performance Requirements of the Electrical Characteristics listed in the Specification section, or the Performance Check cannot be completed satisfactorily.

Completion of all adjustment steps in this procedure ensures that the instrument will meet the performance requirements listed in the Specification section. However, to fully ensure satisfactory performance, it is recommended that the Performance Check be performed after any adjustment is made.

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Test Equipment Required

The test equipment listed in Table 3-1, or equivalent, is required for adjustment of the AM 502. Specifications given for the test equipment are the minimum necessary for accurate adjustment and measurement. All test equipment is assumed to be correctly calibrated and operating within specification.

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

A flexible plug-in extender, Tektronix Part No. 067-0645-03, is useful for troubleshooting or adjusting the AM 502; however, the complete Adjustment Procedure can be performed without use of the extender. Remove the power module cabinet to make adjustments to the AM 502 inside the power module.

Table 3-1
LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Applications	Example
Oscilloscope	Bandwidth, dc to 2 MHz; minimum deflection factor, 20 mV/div; sweep rate, .2 ms/div to 1 μ s/div; accuracy, within 3%	Used throughout procedure to provide display	TEKTRONIX 5110. 5A13N, 5B10N
Digital Voltmeter	Range, 0 to 50 V; accuracy, within 0.1%	Voltage measurements. Output voltage flatness check.	TEKTRONIX DM 501 Digital Multimeter.*
Power Module	Three compartments or more.	All tests	TEKTRONIX TM 503 or TM 504.
Calibration Generator	Amplitude calibration, 5 mV to 10 V; accuracy, $\pm 0.25\%$ into 1 M Ω ; output, square wave at approximately 1 kHz.	Amplifier gain check	TEKTRONIX PG 506 Calibration Generator.*
Function Generator	Waveforms, sine and square; voltage amplitude, 10 V p-p; frequency range, 1 kHz to 50 kHz; accuracy, within 3%.	Signal generation for cross neutralization and high frequency cmrr check.	TEKTRONIX FG 501 Function Generator.*
Autotransformer with ac voltmeter	Capable of supplying an output voltage from 90 to 132 V, ac; 120 watts of power at the upper limit.	Power supply check.	General Radio W10MTR3W Variac Autotransformer.
Input RC normalizer	Time constant, 1 M Ω x 47 pF; connectors, bnc.	Input capacitance check.	Tektronix Part No. 067-0541-00
Termination	Impedance, 50 Ω ; connectors, bnc.	Output termination for signal generator.	Tektronix Part No. 011-0049-01.
Attenuator, 10X (4 required)	Impedance, 50 Ω ; connectors, bnc.	Output attenuation for signal generator. Noise check.	Tektronix Part No. 011-0059-02
Coaxial cable (2 required)	Impedance, 50 Ω ; length, 36 inches; connectors, bnc.	Provides signal interconnection.	Tektronix Part No. 012-0057-01.

*Requires TM 500 Series power module

Preparation

a. Remove the left and right side covers of the AM 502 to gain access to the component side of the circuit boards. Pull the rear end of the side cover outward from the side of the instrument (the cover snaps into place).

b. Install the AM 502 into the left power module compartment, or if appropriate, connect the AM 502 to the power module by means of the flexible plug-in extender.

c. Set the power module for the line voltage to be applied (see power module manual) and connect it to the variable autotransformer; connect the autotransformer to the line voltage source. Be sure that the power switch is off.

d. Install the TM 500-series equipment, including the AM 502 into the power module.

e. Connect all test equipment to a suitable line voltage source.

f. Turn on all test equipment and allow at least 20 minutes for the equipment to warm up and stabilize.

Initial Control Settings

Set the following controls during warm-up time:

AM 502

STEP GAIN DC BAL	midrange
÷100	pushbutton out
DC OFFSET	
(FINE and COARSE)	midrange
GAIN	100
CAL	fully clockwise (cal)
HF -3dB	.1 kHz
LF -3dB	10 kHz
+ AC	pushbutton out
+ GND	pushbutton in
- AC	pushbutton out
- GND	pushbutton in

Oscilloscope

Intensity, Focus	Set for well-defined trace and normal brightness.
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Vertical Amplifier

Volts/Div	1 V
+ Input	dc
Variable	fully clockwise (cal)

Time Base Plug-In

Time/Div	.5 ms
Variable	(cal in)
Triggering	
+ Slope	selected
Mode	peak-to-peak Auto
Coupling	ac
Source	internal
Position	Set so trace starts at left side of graticule.
Display Mode	main sweep
Magnifier	X1

ADJUSTMENT PROCEDURE**1. Check +15 Volt Power Supply**

a. Connect the digital voltmeter between the +15 V test point on the Main circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of +14.25 to +15.75 volts.

c. Disconnect the digital voltmeter.

2. Check -15 Volt Power Supply

a. Connect the digital voltmeter between the -15 V test point on the Main circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of -14.25 to -15.75 volts.

c. Disconnect the digital voltmeter.

3. Check +5 Volt Power Supply

a. Connect the digital voltmeter between the +5 V test point on the Main circuit board, and chassis ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of +4.50 to +5.50 volts.

c. Adjust the autotransformer output voltage from the low limit to the high limit as indicated in Table 3-2. Meter reading should not vary more than ± 500 millivolts. Repeat this check for the +15 volt and -15 volt supplies, except the meter reading should not vary more than ± 750 millivolts. Return the autotransformer to the nominal line voltage setting.

d. Disconnect the digital voltmeter.

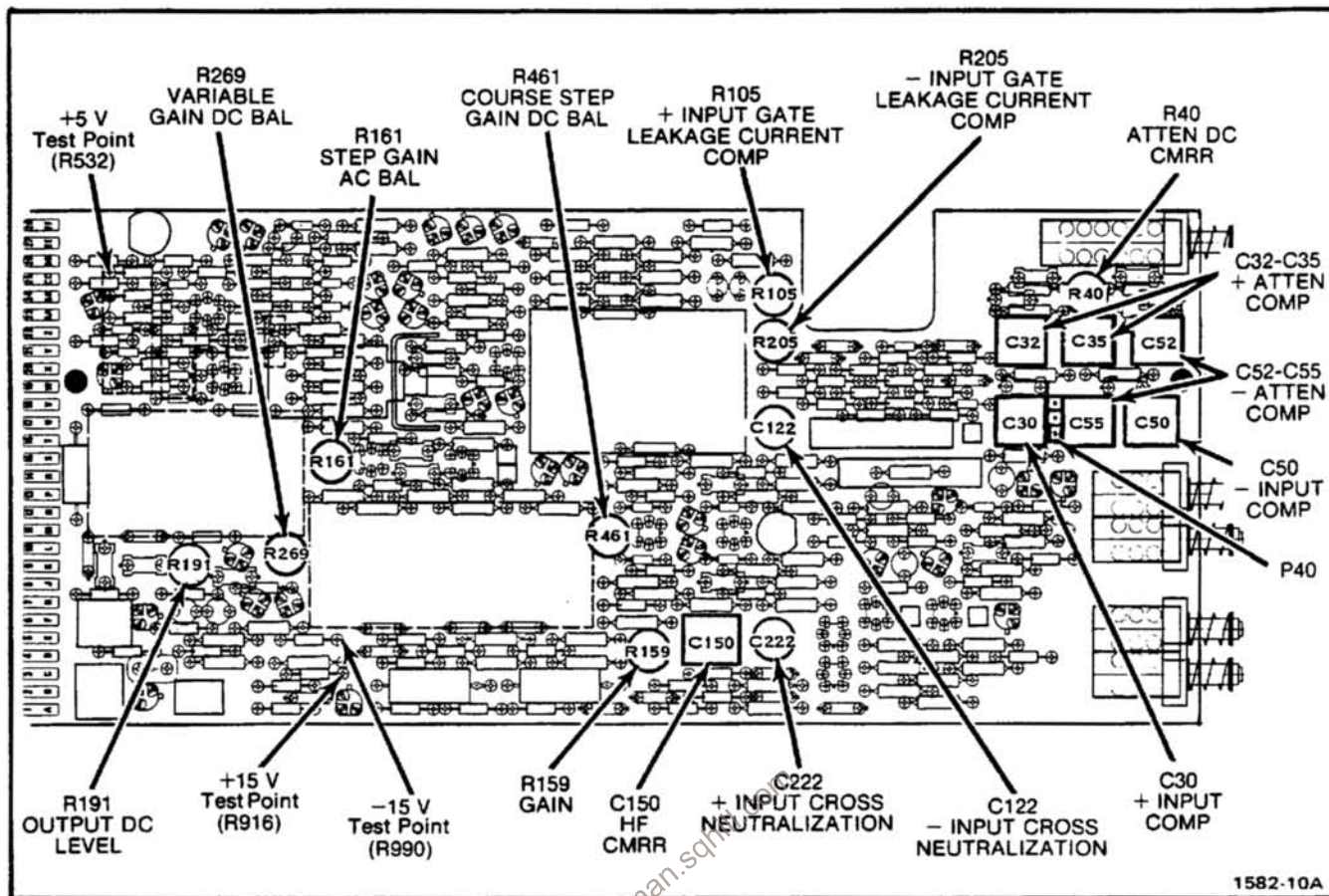


Fig. 3-1. Location of power supply test points, and all adjustments.

Table 3-2

POWER MODULE UNIVERSAL TRANSFORMER

Line Selector Block Position	Regulating Ranges	
	110-Volts Nominal	220-Volts Nominal
L	90 V ac to 110 V ac	180 V ac to 220 V ac
M	99 V ac to 121 V ac	198 V ac to 242 V ac
H	108 V ac to 132 V ac	216 V ac to 264 V ac
Line Fuse Data	1.6 A slow-blow	0.8 A slow-blow

4. Adjust Step Gain AC Balance

a. Connect a 50-ohm cable from the AM 502 OUTPUT connector the vertical amplifier input.

b. Check—for a trace shift of not more than three divisions vertically while switching the AM 502 GAIN switch between the 100 and 100K positions.

c. Adjust—Step Gain AC Bal, R161, for minimum trace shift while switching the AM 502 GAIN switch between the 100 and 100K positions. See Fig. 3-1 for adjustment location.

d. Return the AM 502 GAIN switch to the 100 position.

5. Adjust Variable Gain DC Balance

a. Set the vertical amplifier deflection factor to .1 V/div.

b. Check—for a trace shift of not more than one division vertically while rotating the AM 502 CAL control from fully clockwise to fully counterclockwise position.

c. Adjust—Variable Gain DC BAL, R269, for minimum trace shift while rotating the AM 502 CAL control from fully clockwise to fully counterclockwise position. See Fig. 3-1 for adjustment location. Return control to the fully clockwise position and note the position of the trace.

6. Adjust Output DC Level

- a. Set the vertical amplifier deflection factor to 10 mV/div.
- b. Without changing the AM 502 control positions from the previous step, note the position of the trace.
- c. Adjust—Output DC Level, R191, to place trace at same position as was established in Step 5 part c.

7. Adjust Coarse Step Gain DC Balance

- a. Set the vertical amplifier deflection factor to 2 V/div. Position the trace to the center of the graticule.
- b. Set the LF -3 dB switch to the DC position (not DC OFFSET), the GAIN switch to 10K, and STEP GAIN DC BAL control to midrange. Leave the other AM 502 controls as in the previous step.
- c. Adjust—Coarse Step Gain DC Bal, R461, to return trace to the center of the graticule. See Fig. 3-1 for adjustment location.
- d. Turn the AM 502 STEP GAIN DC BAL control fully clockwise and fully counterclockwise, and observe trace shift of at least two divisions above and below the graticule centerline, respectively. Return the trace to the graticule center.

8. Adjust + Input Gate Leakage Current Compensation

- a. Connect a 50-ohm termination to the AM 502 + input connector.
- b. Set the vertical amplifier deflection factor to .1 V/div. Press in to release the + GND pushbutton.
- c. Adjust—the + Input Gate Leakage Current Comp, R105, while alternately depressing and releasing the +AC pushbutton, for minimum trace shift.
- d. Press in to release the +GND and +AC pushbuttons. Remove the termination from the + input connector.

9. Adjust - Input Gate Leakage Current Compensation

- a. Connect a 50-ohm termination to the AM 502 - input connector.

- b. Press in to release the - GND pushbutton.
- c. Adjust—the - Input Gate Leakage Current Comp, R205, while alternately depressing and releasing the - AC pushbutton, for minimum trace shift.
- d. Press in the - GND pushbutton, and press in to release the -AC pushbutton. Remove the termination from the - input connector.

NOTE

The oscilloscope vertical amplifier system gain, the 50-ohm termination, and 50-ohm attenuator are required to be calibrated within 0.5% accuracy prior to proceeding with Steps 10 and 11. The PG 506 calibration generator may be used to set the system to 0.5% accuracy.

10. Check Amplifier Gain.

- a. Set the vertical amplifier deflection factor to 0.2 V/div.
- b. Set the AM 502 GAIN control to 100, the LF -3dB switch to DC OFFSET, and the HF -3dB switch to 1 MHz.
- c. Connect the calibration generator to the vertical amplifier input, using a 50-ohm cable.
- d. Set the calibration generator for a five-division, square-wave display; set the Deflection Error control for zero per cent error. Disconnect the 50-ohm cable from the vertical amplifier input.
- e. Connect the calibration generator to the AM 502 + input connector through a 50-ohm cable, a 50-ohm 10X attenuator, and a 50-ohm termination. (This reduces the generator output by 50%.)
- f. Connect a 50-ohm cable from the AM 502 OUTPUT connector to the vertical amplifier input connector. Set the vertical amplifier deflection factor to 1 V/div.
- g. Adjust the AM 502 DC OFFSET controls (FINE and COARSE) until the OVER RANGE indicator light goes out. Position the crt display to the center of the graticule with the vertical amplifier position control.
- h. Adjust—Gain, R159, for a five-division display amplitude.

Adjustment—AM 502

i. Rotate the AM 502 CAL control fully counterclockwise and check for two divisions or less of display amplitude.

j. Set the AM 502 CAL control fully clockwise and in the detent position.

k. Check—using the AM 502 GAIN and calibration generator amplitude settings given in Table 3-3, check the vertical deflection within the given limits.

NOTE

The OVER RANGE indicator light must remain off during all switch settings. Adjust the DC OFFSET controls as required during the check procedure.

NOTE

Install both plug-in side covers and insert plug-in into power module for checking gain below 5K setting to minimize noise on the display.

Table 3-3

AMPLIFIER GAIN ACCURACY

AM 502 GAIN Setting	HF -3 dB Switch Setting	Calibration Generator Amplitude Setting	Vertical Deflection in Divisions
100	1 MHz	1 V	4.9 - 5.1
200	1 MHz	.5 V	4.9 - 5.1
500	1 MHz	.2 V	4.9 - 5.1
1K	1 MHz	.1 V	4.9 - 5.1
2K	1 MHz	50 mV	4.9 - 5.1
5K	1 MHz	20 mV	4.9 - 5.1
10K	10 kHz	10 mV	4.9 - 5.1
20K	10 kHz	5 mV	4.9 - 5.1
50K	10 kHz	2 mV	4.9 - 5.1
100K	10 kHz	1 mV	4.9 - 5.1

11. Check $\div 100$ Amplifier Gain Accuracy. Gain Accuracy is within 2%

a. Disconnect all cables and repeat Step 10 parts a through f.

b. Set the AM 502 GAIN switch to 10K and the HF -3dB switch to 1 MHz; push in the $\div 100$ pushbutton.

c. Set the calibration generator amplitude control to 1.0 V. Adjust the AM 502 DC OFFSET control (FINE and COARSE) until the OVER RANGE indicator light goes out.

d. Position the crt display to the center of the graticule with the vertical amplifier position control.

e. Check—the crt display amplitude for 4.9 to 5.1 divisions.

f. Disconnect the 10X attenuator from the AM 502 + input connector and connect it to the - input connector. Push in the + input GND pushbutton and push in to release the - input GND pushbutton.

g. Check—repeat parts d and e of this step.

h. Disconnect the 50-ohm termination, 10X attenuator, and cable.

12. Adjust Input Cross Neutralization

a. Set the AM 502 $\div 100$ pushbutton out, the + and - input GND pushbuttons out, the + and - AC pushbuttons in, the LF -3dB switch to DC, and the GAIN switch to 100.

b. Connect a 50-ohm termination and a 10X attenuator to the AM 502 + input connector.

c. Connect a 50-ohm cable from the fast-rise output of the calibration generator to the 10X attenuator on the + input of the AM 502.

d. Set the calibration generator amplitude control to produce a five-division crt display (1 ms period). Set the time-base triggering controls for a stable, triggered display.

e. Check—the crt display for roll-off or overshoot (upper corner of the leading edge) within 0.2 division.

f. Adjust— + Input Cross Neutralization, C222, for minimum roll-off or overshoot (upper front corner of the leading edge).

g. Disconnect the 50-ohm termination (with 10X attenuator and 50-ohm cable attached) from the + input connector, and connect it to the - input connector.

h. Repeat part e of this step.

i. Adjust— -Input Cross Neutralization, C122, for minimum roll-off or overshoot (upper corner of the leading edge).

13. Adjust Input Capacitance

a. Disconnect the 50-ohm termination from the — input and connect a 47 pF Normalizer to the — input connector; connect the 50-ohm termination to the other end of the 47 pF Normalizer.

b. Increase the signal amplitude of the calibration generator to maintain five divisions of display.

c. Check—the upper front corner of the leading edge for roll-off or overshoot, within 0.2 division.

d. Adjust— —Input Comp, C50, for the best upper corner on the leading edge of the displayed square wave.

e. Disconnect the 47 pF Normalizer, with 50-ohm termination, 10X attenuator, and 50-ohm cable from the — input connector and connect them to the + input connector.

f. Repeat part c of this step.

g. Adjust— +Input Comp, C30, for best flat top (minimum roll-off or overshoot on upper front corner) on displayed waveform. See Fig. 3-1 for adjustment location.

14. Adjust Attenuator Compensation

a. Press in the $\div 100$ pushbutton. Set the vertical amplifier deflection factor to .1 V/division.

b. Disconnect the 10X attenuator that is connected between the 50-ohm termination and the 50-ohm cable; reconnect the 50-ohm cable to the termination.

c. Readjust the calibration generator amplitude control to maintain a five-division display.

d. Check—the crt display for roll-off or overshoot (upper corner of the leading edge) within 0.2 division.

e. Adjust— + Atten Comp, C32-C35, for best flat top (minimum roll-off or overshoot on upper front corner) on displayed waveform. See Fig. 3-1 for adjustment location.

f. Disconnect the 47 pF Normalizer, 50-ohm termination, and 50-ohm cable from the + input connector and connect them to the — input connector.

g. Readjust the calibration generator amplitude control to maintain a five-division display.

h. Check—the crt display for roll-off or overshoot (upper corner of the leading edge) within 0.2 division.

i. Adjust— —Atten Comp, C52-C55, for best flat top (minimum roll-off or overshoot on upper front corner) on displayed waveform. See Fig. 3-1 for adjustment location.

j. Disconnect the 47 pF Normalizer, 50-ohm termination and cable from the AM 502 — input connector.

15. Adjust High Frequency Common Mode Rejection

a. Connect a dual-input connector cable between the AM 502 + input and the — input connector.

b. Set the AM 502 $\div 100$ pushbutton out; the + input and — input AC and GND pushbuttons out, and the GAIN switch to 100.

c. Set the AM 502 HF —3 dB switch to .3 MHz and LF —3 dB switch to DC.

d. Set the vertical amplifier deflection factor for 10 mV/div.

e. Connect a 50-ohm cable from the function generator output to the center connector of the dual-input connector. Set the function generator for a 10 V, 50 kHz sine-wave output signal.

f. Check—the crt display for one division of vertical deflection or less.

g. Adjust—HF CMRR, C150, for minimum crt display amplitude within one division or less.

16. Adjust $\div 100$ Common Mode Rejection

a. Set the AM 502 $\div 100$ pushbutton in.

b. Set the vertical amplifier deflection factor for .1 V/div.

c. Disconnect the 50-ohm cable from the function generator output and connect it to the calibration generator output. Set the calibration generator for a 100 volt output signal.

d. Check—the crt display for 3.16 divisions of vertical deflection or less. (Disregard spikes on squarewave.)

Adjustment—AM 502

e. Adjust— Atten Comp, C52, and Atten DC CMRR, R40, for minimum crt display amplitude within one division or less. (Interaction between C52 and R40 will occur. Adjust for optimum display.)

f. Disconnect the dual-input connector and 50-ohm cable from AM 502.

17. Check HF —3dB Bandwidth

a. Set the AM 502 HF —3dB switch to 1 MHz, the ÷ 100 pushbutton out, the — input pushbutton to GND.

b. Set the vertical amplifier deflection factor to 1 V/div, and the time-base sweep rate to 1 ms/div.

c. Set the function generator controls for a 50 mV, 1 kHz sine-wave output signal. (Use appropriate attenuation to eliminate input overdrive condition.)

d. Connect a 50-ohm cable from the function generator output to the AM 502 + input connector. Adjust the vertical deflection amplitude for a five-division display.

e. Set the function generator output frequency to 1 MHz.

f. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

NOTE

The specification in part f of this step must be met before proceeding with part g of this step.

g. Check—the remaining settings of the HF —3dB switch, using Table 3-4 as reference. (Change time-base sweep rate as needed for lower frequencies.)

Table 3-4

HF —3 dB BANDWIDTH ACCURACY

AM 502 HF —3 dB Switch Setting	Function Generator Output Frequency	Vertical Deflection In Divisions
.3 MHz	300 kHz	3.15 - 3.85
.1 MHz	100 kHz	3.15 - 3.85
30 kHz	30 kHz	3.15 - 3.85
10 kHz	10 kHz	3.15 - 3.85
3 kHz	3 kHz	3.15 - 3.85
1 kHz	1 kHz	3.15 - 3.85
.3 kHz	300 Hz	3.15 - 3.85
.1 kHz	100 Hz	3.15 - 3.85

h. Set the HF —3 dB switch to 1 MHz.

18. Check LF —3 dB Bandwidth

a. Check—the LF —3 dB switch settings, using Table 3-5 as reference. (Adjust the time-base sweep rate as needed for lower frequency settings.) Obtain a 5 division display, dc coupled, on each range before proceeding to Step b.

Table 3-5

LF —3 dB BANDWIDTH ACCURACY

AM 502 LF —3 dB Switch Setting	Function Generator Output Frequency	Vertical Deflection In Divisions
10 kHz	10 kHz	3.15 - 3.85
1 kHz	1 kHz	3.15 - 3.85
.1 kHz	.1 kHz	3.15 - 3.85
10 Hz	10 Hz	3.15 - 3.85
1 Hz	1 Hz	3.15 - 3.85

NOTE

The components used in the .1 Hz position are also used in the other positions of the switch; therefore, the tolerance of the .1 Hz position is checked.

b. Press in the AM 502 + input AC pushbutton.

c. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

d. Disconnect the 50-ohm cable from the AM 502 + input connector and connect it to the — input connector.

e. Press in the AM 502 + input GND pushbutton and — input AC pushbutton. Press to release the — input GND pushbutton.

f. Check—the amplitude of the crt display for 3.15 to 3.85 divisions.

g. Set the LF —3 dB switch to the DC OFFSET position. Press in the AM 502 — input GND pushbutton.

h. Disconnect the 50-ohm cable from the AM 502 — input connector.

19. Check Overall Noise (Tangentially Measured)

a. Set the AM 502 GAIN control to 100K; press in to release the + input AC and GND pushbutton, and the - input AC pushbutton.

b. Set the vertical amplifier deflection factor to 5 V/division. Set the time-base sweep rate to 10 μ s/division and the trigger source switch to external.

c. Connect a 50-ohm termination to the AM 502 + input connector; connect four series-connected 10X attenuators to the 50-ohm termination.

d. Connect a 50-ohm cable from the calibration generator fast-rise output connector to the end of the attenuator string. Set the pulse duration control for 1 ms.

e. Adjust the AM 502 DC OFFSET controls (FINE and COARSE) until the OVER RANGE indicator light goes out.

f. Adjust the calibration generator pulse amplitude control and observe two noise bands as shown in Fig. 3-2A (remove one attenuator if necessary, to produce the desired display).

g. Decrease the calibration generator pulse amplitude until the noise bands just merge. See Fig. 3-2B.

h. Remove three of the attenuators and connect the signal through the 50-ohm attenuator (including the 50-ohm termination), to the vertical amplifier input and measure the pulse amplitude. Calculate the tangentially measured display noise as follows:

$$\text{Noise (in } \mu\text{V)} = \frac{\text{Signal level (measured in part h)}}{\text{Attenuation Removed}}$$

Typical figures are:

$$\frac{12 \text{ mV}}{10^3} = 12 \times 10^{-6} = 12 \mu\text{V of noise}$$

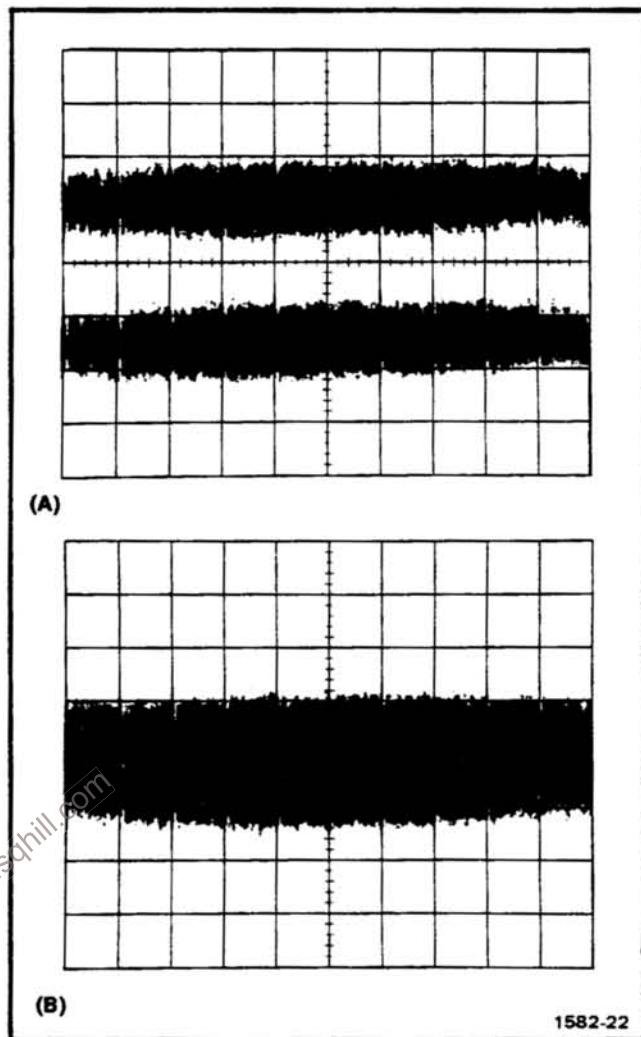


Fig. 3-2. Typical display of (A) two noise bands and (B) noise bands merged.

i. Disconnect all cables and equipment.

This completes the Adjustment procedure of the AM 502 Differential Amplifier.

MAINTENANCE AND INTERFACING INFORMATION

Preventive Maintenance

There are no special preventive maintenance procedures that apply to the AM 502. Refer to the power module instruction manual for general preventive maintenance procedures and instructions.

Corrective Maintenance

Refer to the power module instruction manual for general corrective maintenance procedures and instructions.

Troubleshooting

Use the Performance Check, Adjustment Procedure, and Circuit Description as aids to locate trouble in the event of equipment failure. The test equipment listed in the Performance Check and Adjustment Procedure will prove useful in troubleshooting the AM 502.

Functions Available at Rear Connector

A slot between pins 23 and 24 on the rear connector identifies the AM 502 as a member of the signal source family. Insert a barrier in the corresponding position of the power module jack to prevent other than signal source plug-ins from being used in that compartment; this protects the plug-in should specialized connections be made to that compartment. Consult the Building A System section of the power module manual for further information.

Signal outputs, or other specialized connections, are made to the rear interface connectors as shown in Fig. 4-1. The Signal In and Signal Ground are not factory wired. If Signal In connections are made, use coaxial cable. Connect one end to the pads as shown in Fig. 4-1 and the other end to the front panel bnc connector.

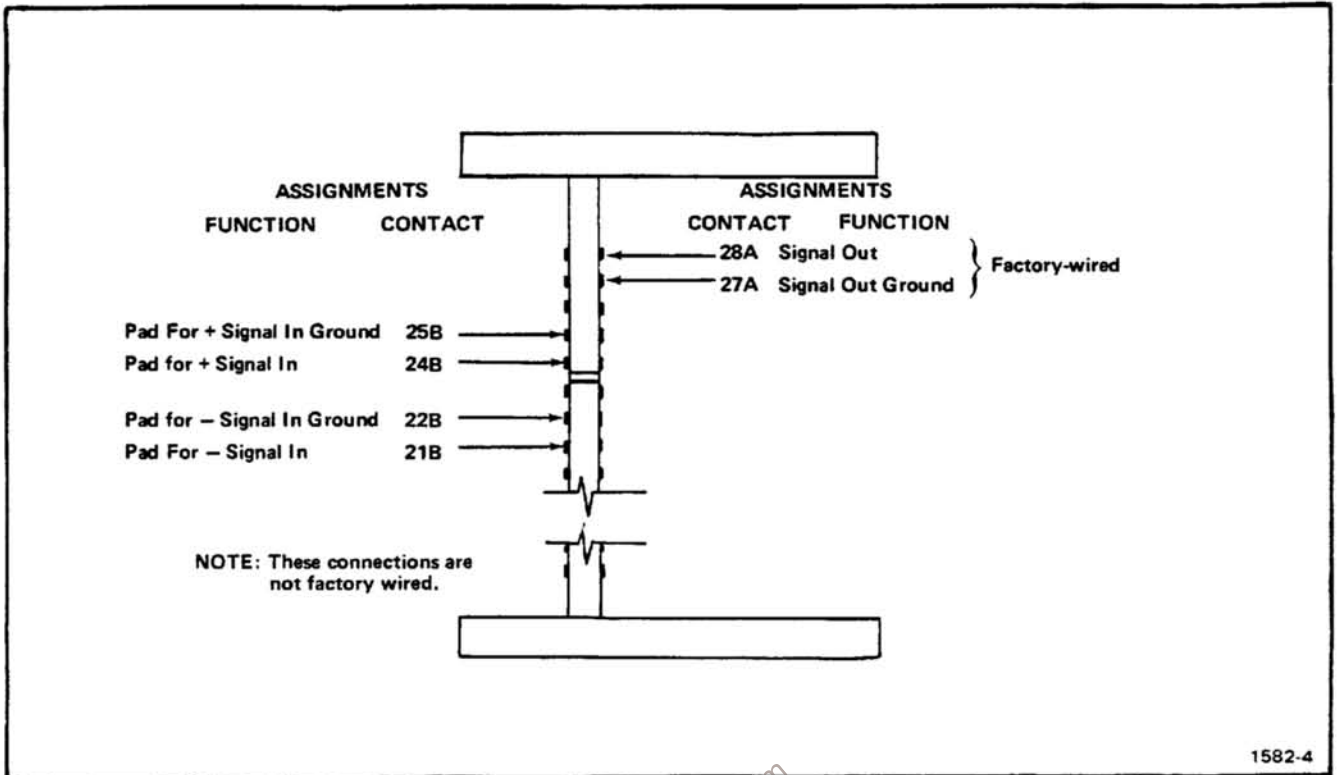
REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted. Include complete instrument serial number and a description of the service required.

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

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

The carton test strength for your instrument is 200 pounds.



1582-4

Fig. 4-1. Input/Output assignments at rear connector.

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CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the AM 502 Differential Amplifier. Individual descriptions are separated into the following parts; Input Coupling, Input Attenuators, Input Overdrive Protection, Gate Current Compensation, Preamp, Floating Power Supply, Common Mode Rejection, Cross Neutralization, DC Offset, LF -3 dB Frequency Selector, Gain Switching Amplifier, HF -3 dB Frequency Selector, Variable Gain Stage, Output Amplifier, Overrange Indicator, and Power Supplies. The circuit titles correspond to those listed in the Block Diagram. The numbered diamond by each title refers to the corresponding circuit diagram in the Diagrams section of this manual.

Input Coupling

A signal applied to the + or - input connector passes through the input-coupling selector switch to the input-attenuator circuit. The signals can be ac coupled, dc coupled or disconnected internally. The + and - inputs are identical except for circuit numbers. Except where needed for clarification, only the amplifier for the + input will be described in detail.

When the input-coupling switch is in the DC position, the input signal is coupled directly to the attenuator. In the AC position, the signal is coupled through capacitor C10. The capacitor prevents the dc component of the signal from passing to the attenuator. The GND position disconnects the input signal from the attenuators and connects it to ground through C10 and R10. This represents the same load to the signal source as was presented when the input switch was set in the AC mode. Thus, a ground reference to the input of the amplifier is provided without the need to remove the applied signal source. The PRECHG position limits the instantaneous current, caused by connecting a large signal to the input connector, by inserting R10 in series with C10.

Input Attenuators

The input attenuators for the + and - inputs are identical and are conventional RC type attenuators. The attenuators are frequency-compensated voltage dividers that provide a straight-through or NORM position, or a $\div 100$ position. Resistor R30 provides the 1 megohm input resistance, while C28, C30, and stray capacitance make up the 47 picofarad input capacitance in the NORM position. In the $\div 100$ position, R35 in series with R38 comprise the 1 megohm input resistance, and also form

the 100X divider for the dc component of the signal. The parallel combination of C32 and C34 in series with C38, comprise the ac 100X circuit. Each attenuator contains an adjustable capacitor to provide correct attenuation at high frequencies, and adjustable shunt capacitance to provide correct input capacitance.

Input Overdrive Protection

Fuses F100 and F200, combined with diode clamps CR108, CR109, CR208, and CR209 provide overdrive protection for Q121A and B at the ± 16.2 volt level. The ± 16.2 volt level is set by zeners VR438 and VR448, through isolation diodes CR438 and CR448, and the clamp diodes. If the signal amplitude exceeds approximately 16.2 volts, depending on the duration of the excess voltage, the fuses will open.

Gate Current Compensation

The leakage associated with the gates of the input Field-Effect Transistors (FET) may be as high as 100 picoamperes. This amount of leakage current (through 1 megohm, R30 or R50, to ground) will produce an offset of 100 microvolts, which at high gain settings, drives the output into overrange. To compensate for this effect, the gates of the input FET may be adjusted to zero volts by returning R107 and R106 through variable controls R105 and R205 to a slightly negative supply voltage.

Leakage current associated with the gates of the input FET and the overdrive protection diodes, increases rapidly with temperature, approximately doubling for every 10 degree Celsius. To compensate for this increase, a temperature sensitive input-current balancing network is included, using thermistors RT104 and RT203 as sensing elements.

As the gate current increases due to a temperature increase, the resistance of the thermistors decreases, thus maintaining a constant voltage difference as a function of temperature.

Preamp

From the input attenuators, the signal is coupled to the preamp. The preamp consists of two identical feedback amplifiers connected in a differential configuration. Except where needed for clarification, only the amplifier for the + input will be described in detail.

Circuit Description—AM 502

The supply voltages for the two amplifiers are obtained from a common power supply that is bootstrapped to the input to improve the common-mode rejection ratio of the preamp.

The feedback circuit for the + input consists of comparator Q121A, error amplifier Q131A and Q136, feedback modifier R125 and R126, and output load resistor R136. R126 is the gain-setting resistor for the amplifier. Diode CR131 connected between the base-emitter of Q131A protects the transistor against reverse-bias breakdown, and also provides negative feedback to stabilize the circuit at higher frequencies.

The last stage of the preamp consists of Q152A and Q152B. Zener diode VR252 provides the collector supply voltage for this stage. The gain of this stage is approximately 5.

STEP GAIN DC BAL control, R158, balances the dc level at the output and is adjusted for minimum dc level shift when the GAIN switch is rotated throughout its range.

Floating Power Supply

Refer to Fig. 5-1. The supply voltages for the preamp and the dc offset circuit are derived from a series-connected resistor chain consisting of R431, R433, R435, two current sources, plus a current-setting transistor, Q443. The positive current source consists of Q410A and B, and Q416. The negative current source consists of Q422A and B, and Q426.

Any common-mode changes that occur in the input amplifier, except at the output, are coupled to the power supply through Q451, which is connected as an emitter follower. It acts as a X1 bootstrap amplifier whose gain is maintained very close to unity by the minimum loading presented to its output by the high collector impedance of Q121A and B, thus achieving good bootstrap efficiency.

Quiescently, approximately 13 milliamperes of current flows through Q422A and B. R421 shunts about 4 milliamperes of this current from Q422A, leaving a balance of 9 milliamperes flowing through the positive current source, Q410A, Q410B, and Q416. Approximately 12 milliamperes of current from the negative current source also flows from Q422B and Q426, and to the dc offset circuit, Q141A and B, and Q145A and B. In any mode except the dc offset, the 12 milliamperes of current splits equally and becomes the negative current source for Q121A and B. About 4 milliamperes is shunted through Q136 and Q236. This leaves the balance of 9 milliamperes of current to flow through Q121A and B, and to the summing point at the collector of Q416.

Resistors R440, R441, R442, and R443 set the base voltage of Q443, with CR441 providing the temperature compensation. Current through R445 divides between Q443 and Q445. The current through Q445 is the negative current source for Q131A and B. After flowing through Q131A and B, it returns and passes through emitter-follower Q431, then to the summing point at the collector of Q416.

The 1.9 milliamperes of current flowing from Q443 and through resistor chain R435, R433, and R431, continues to the summing point at the collector of Q416. The voltage drop across each resistor, in reference to the emitter of Q451, sets the "floating" power supplies. The difference in the 9 milliamperes of current needed to satisfy the current demand of the positive current source, and what flows into the summing point from Q433, Q431, and Q121A and B, will come from Q451.

Common Mode Rejection

One of the primary functions of the preamp is to reject any common-mode component in the input signals, and amplify only the difference. In the extreme case of the inputs tied together and a common voltage applied, the output of the amplifier is ideally zero, and would actually be zero provided that the characteristics of all corresponding elements on the two sides of the amplifier (see Figs. 1-5 and 1-6) were exactly matched. In practice, any mismatch will cause a differential output. Even with perfect matching, there is still a common-mode output current resulting in an undesirable common-mode signal applied to the subsequent stages of the amplifier (common mode gain):

The floating power supply eliminates these difficulties and improves the common mode rejection. It can be seen that the entire power supply and amplifier moves an amount equal to the common-mode voltage, and that no change in voltage or current levels occur anywhere within the amplifier as a result of this common-mode voltage, except for Q136 and Q236 drain to gate voltage. Thus the only mismatch of importance is that of Q136, Q236 amplification factors. Being in the third stage of the amplifier at a point of relatively large differential signal level, this causes only a small degradation in common mode rejection.

At higher frequencies the stray capacitances from various points in the preamp to ground begin to inject significant current into the amplifier as a result of common mode signals. Differential capacitor C150, connected from a point in the floating power supply to the two output lines, is used to inject adjustable currents into the output to compensate for the change.

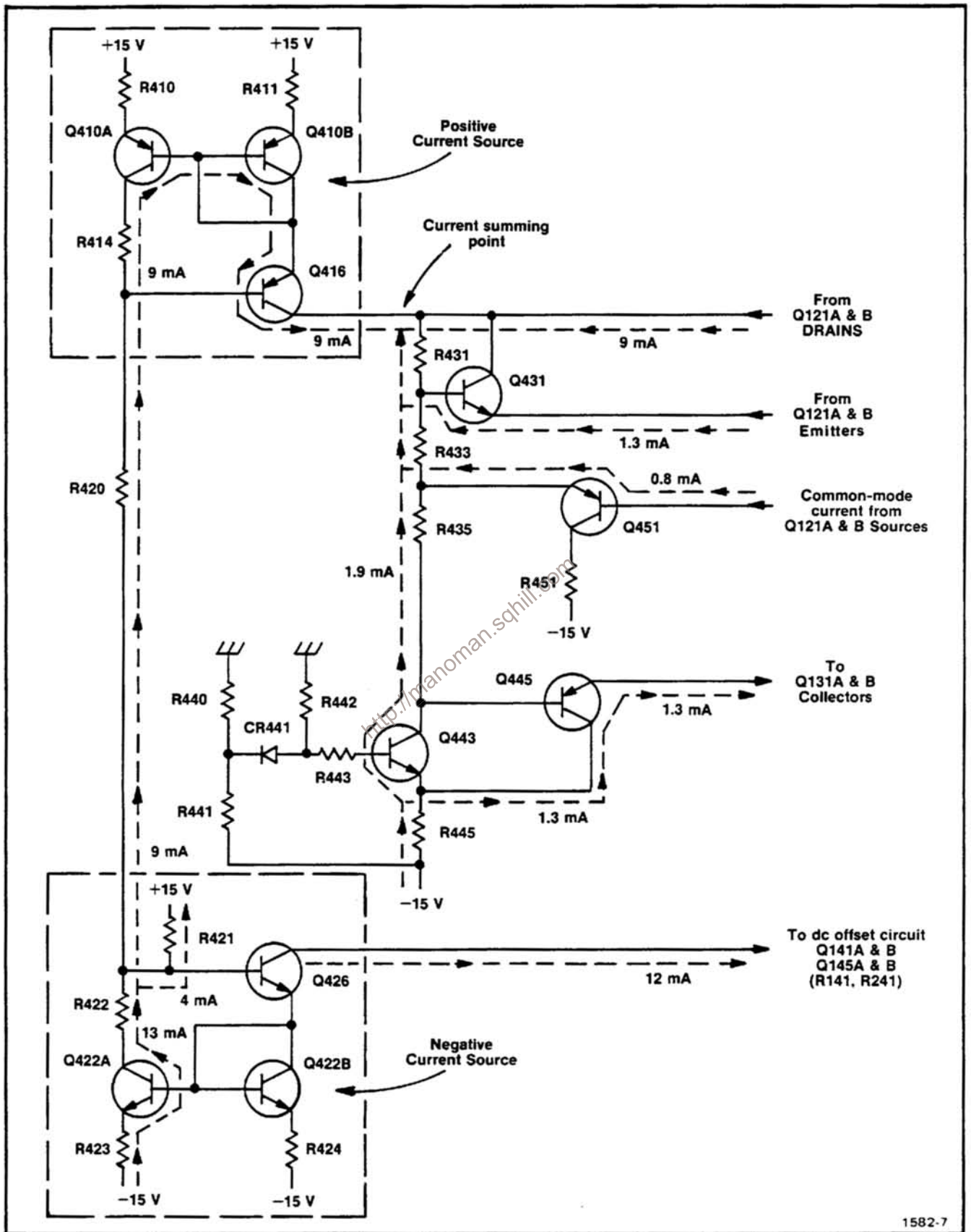


Fig. 5-1. Preamp floating power supply showing positive and negative current source.

Cross Neutralization



Refer to Fig. 5-2. The use of a common bootstrap power supply results in an undesirable capacitive coupling between the two inputs. Consider the effect of applying +1 volt to the + input of Q121A while keeping the - input of Q121B at zero volts.

The results are: an output current of i_o of 4 milliamperes, and a shift of all supply voltages and several other voltage levels by +0.5 volt due to the divider action of R126 and R226, operating into the bootstrapped power supply system. Specifically, the drain of Q121B also rises +0.5 volt and injects current i_s through the drain to gate capacitance, C_{dg} of Q121B, and into the - input. If there is any impedance between the - input and ground, i_s will develop a voltage across the impedance, and since it's applied to the - input, subtracts from the original + input, thereby causing an erroneous output (see Fig. 5-3).

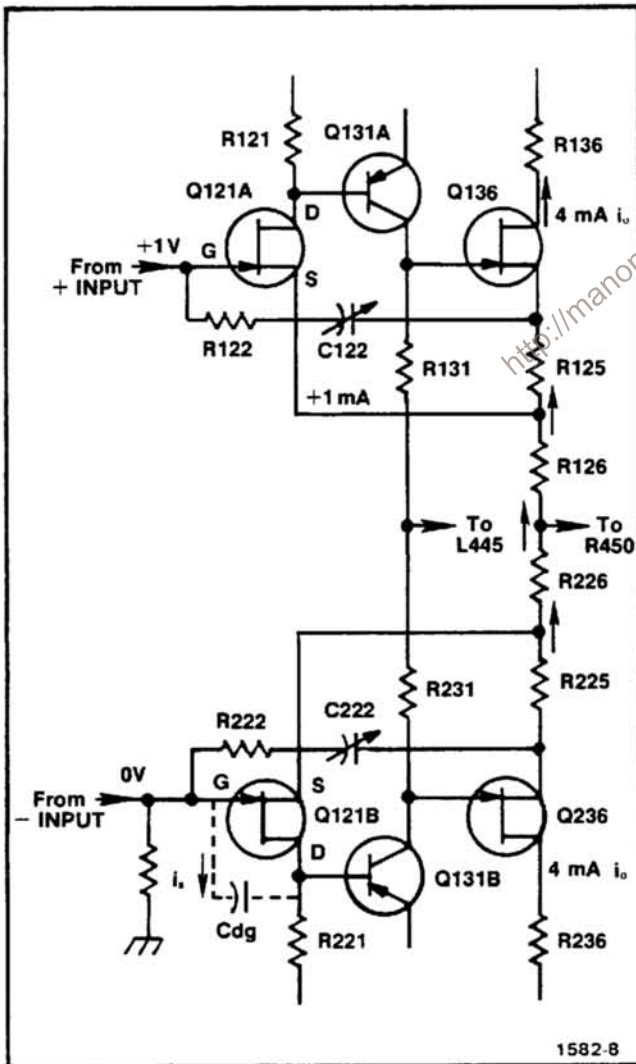


Fig. 5-2. Simplified preamp circuit showing cross neutralization circuit.

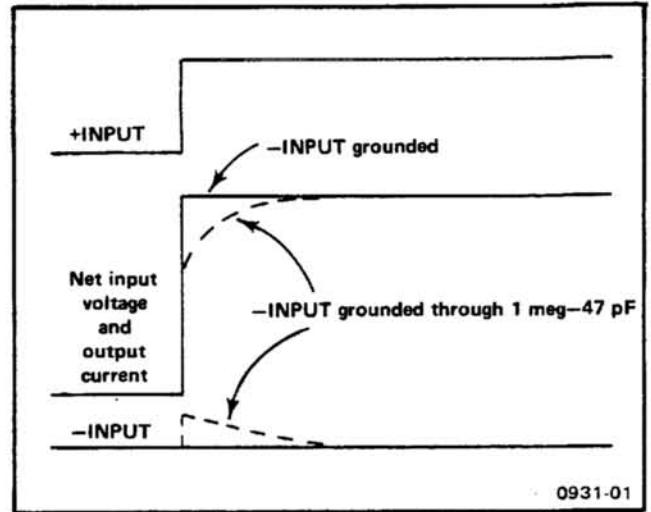


Fig. 5-3. Effects of high impedance to ground in the - input.

Capacitor C122, connected in the + input circuit, is adjusted to divert the undesirable capacitive current away from the input point, minimizing the unbalance. Capacitor C222 performs the same function for signals applied to the - input circuit.

DC Offset



The purpose of the dc offset system is to allow a differential slide-back measurement; that is, to buck out small dc components of input signals and allow the amplifier to amplify only the varying components, while keeping the differential capability. This means that when a dc voltage is applied across the inputs, some means must be found to balance out the resultant output current.

The dc offset system, with zero input signal conditions and resultant currents is illustrated in Fig. 5-4. Source and output currents remain at 2 milliamperes and 5 milliamperes respectively, thereby producing a balanced output. The amplifier and dc offset system illustrated in Fig. 5-5 shows the current conditions when a 0.25 volt dc signal voltage is applied to the + input. This voltage causes an additional 1 milliampere of current to flow through R126 and R226. However, if a 1 milliampere offset current is supplied by the offset generator, the net output current will remain at its zero signal value.

When the dc offset is not used, the dc offset controls are switched by the LF -3 dB switch, to a fixed reference voltage divider R460, R461, and R462.

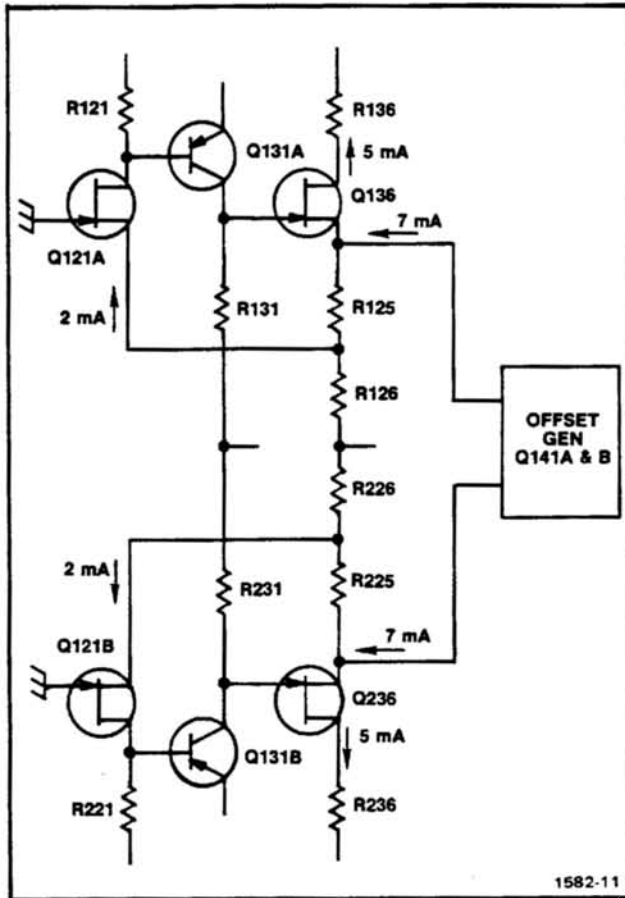


Fig. 5-4. Amplifier and dc offset system, showing balanced output conditions.

LF -3 dB Frequency Selector

3

This switch selects the low frequency -3 dB point of the amplifier and has a range of 0.1 Hz to 10 kHz in six decade steps. Selection is done by switching the resistor and capacitor of a pair of capacitor couplings in each side of the amplifier, between the pre-amp and the gain-switching amplifier. For 100 Hz to 10 kHz, C470 is used, and resistors R474, R478, and R470 are switched to the output in the following combinations:

-3 dB frequency	100 Hz	1 kHz	10 kHz
output resistors	R470	R470 & R474	R470 & R478

Whenever R474 or R478 is not used on the output side of C258, the resistance (R474 or R478) is placed across the input to keep the high frequency load resistance, as seen by the pre-amp, constant.

Capacitor C472 is switched across C470 for the lower three ranges (0.1 Hz, 1 Hz, and 10 Hz) and C258 is shorted out for dc coupling. Resistors R474, R478, and R470 are switched in the same combination for the lower three positions as they are for the three higher positions.

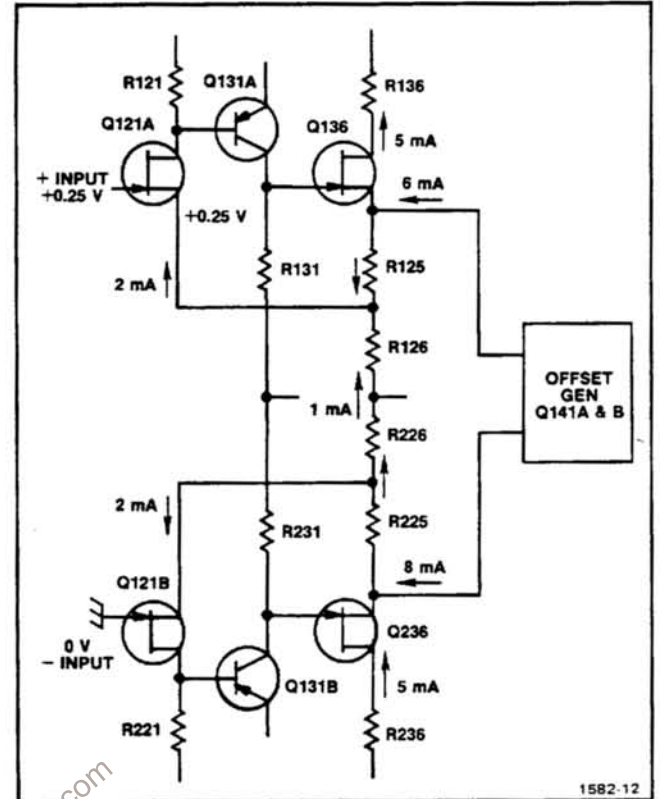


Fig. 5-5. Amplifier and dc offset system, showing a 0.25 volt dc offset and resultant current conditions.

Gain Switching Amplifier

2

The gain switching amplifier is a balanced differential configuration very similar to the preamp but with a fixed power supply. A gain of 0.48 to 480 is changed by switching different values of resistance with switch S480. Q162A, Q164A, and Q168 comprise the switching amplifier. Q167 and Q267 serve two functions; the base-emitter junctions serve as reverse bias protection for Q168 and Q268 and they drive the over range indicator circuitry to indicate a differential over range condition.

Step Gain AC Balance control, R161, is used to remove any initial unbalance in the gate-to-source voltages of Q162A and B, and sets the voltage across the gain-setting resistors when the differential input (gate-to-gate) voltage is zero.

Capacitors C164 and C264 are in the circuit for peaking at frequencies near 2 MHz. Inductors L164 and L264 reduce the gain at high frequencies, thus preventing oscillations.

Circuit Description—AM 502

HF -3 dB Frequency Selector

This switch selects the high frequency -3 dB point of the amplifier and has a range of 100 Hz through 1 MHz in nine steps of a 1-3 sequence. This is accomplished by simply switching different values of capacitance across the output of the gain-switched stage.

Variable Gain Stage

The variable gain stage (Q171A, Q171B and Q181, Q281) is a feedback amplifier having a gain range of approximately 2.5:1, determined by CAL control R178. Feedback resistors R173 and R273, plus gain setting resistors R177, R277, and R178 set the overall gain of the stage at 10.

The common mode signal at the output of the feedback amplifier is compared to ground by comparator Q195 and Q196. A dc feedback loop is provided to feed back the output of the comparator to Q171A and B via emitter follower Q269 to maintain the junction of R175 and R275 at a zero volt level.

Variable Gain DC Balance R269 adjusts the input levels of Q171A and B so their source voltages will be equal. With the source levels equal, rotating the front panel VAR control causes no shift of the dc output level.

Output DC Level control R191 adjusts for a zero-volt dc level at the output of the amplifier. R191 and R193 act as a current source or sink to set the voltage difference across R175 and R275. Their common junction is at zero volts due to feedback action described earlier. Q185 and Q285 act as the negative current source for the variable gain stage.

Diodes CR181 and CR182 act as peak detectors, providing a signal to the over-range detector circuit (Q501 emitter). A voltage swing greater than +6 volts on the collector of Q181 or Q281 will produce an over range indication, lighting indicator lamp DS50.

Output Amplifier

The output amplifier stage consists primarily of transistors Q561A and B and Q571A and B and provides a ± 5 volt differential voltage swing with a zero-volt dc level. The output R_o is 5 ohms or less. Transistors Q555 and Q558 comprise the positive and negative current sources respectively.

The output stage is short-circuit protected to ground. If the current in R571 causes the voltage at Q571B collector to fall below the level of Q555 emitter, CR555 conducts, taking current from Q555, thereby reducing the drive to Q571B, limiting the output current.

Over Range Indicator

When the LF -3 dB switch is in a position other than DC, there is no on-screen indication of the dc conditions in the preamp or output amplifier, and it may be driven into non-linearity or overload by a dc component, leading to erroneous displays. The over range indicator circuit detects this condition and so indicates by means of indicator lamp DS50.

The over range circuit consists of three input transistors Q501, Q511, and Q521, monostable multivibrator Q532 and Q541, indicator lamp driver Q540. When any of the three input transistors become turned on by an over-range signal from the respective amplifiers, a turn-on current is supplied to the base of Q532. This starts the multivibrator action which has a minimum on time of approximately 200 milliseconds; thus the indicator lamp is held on for a minimum of 200 milliseconds regardless of the duration of the over-range signal. The timing components are C536, R536, and R531.

Power Supplies

Regulation of the +15 volt and -15 volt supply is accomplished through the respective operational amplifier, U910 and U990. Zener diode VR910 sets the reference voltage for U910; the +15 volt supply sets the reference for U990. The operational amplifiers control the current to the AM 502 through series-pass transistors located in the power module. The inputs of both integrated circuits seek common levels by varying the current supplied to the unit. Should the power supply load increase, pin 2 of U990 goes more positive, causing pin 6 to go more negative. This action increases current flow in the series-pass transistor and restores the voltage to the initial level. The +15 volt supply operates in the same manner except the polarities are different.

Transistors Q910 and Q990 act as current sensing regulators. Should the current increase to a level that the voltage drop across R970 (R920) is great enough to cause Q990 (Q910) to conduct, current is taken from the series-pass transistor until it is turned off. This action limits the current available to the amplifier, should an overload or short circuit occur.

The +5 volt supply is comprised of Q940 and Q942. The base voltage level of Q942 is set by divider R945 and R946. The base-emitter drop of the transistors produce the +5 volt supply.

OPTIONS

No options are available at this time.

<http://manoman.sqhill.com>

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 Code
00853	SANGAMO MESTON INC	SANGAMO RD	PICKENS SC 29671
01121	SANGAMO CAPACITOR DIV	P O BOX 128	
02114	ALLEN-BRADLEY CO	1201 SOUTH 2ND ST	MILWAUKEE WI 53204
03508	AMPEREX ELECTRONIC CORP	5083 KINGS HWY	SAUGERTIES NY 12477
04222	FERROXCUBE DIV		
04713	GENERAL ELECTRIC CO	M GENESEE ST	AUBURN NY 13021
05397	SEMI-CONDUCTOR PRODUCTS DEPT		
07716	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH	MYRTLE BEACH SC 29577
13511		P O BOX 867	
14193	MOTOROLA INC	5005 E MCDONNELL RD	PHOENIX AZ 85008
14433	SEMICONDUCTOR GROUP		
14552	UNION CARBIDE CORP MATERIALS SYSTEMS	11901 MADISON AVE	CLEVELAND OH 44101
19396	DIV		
24546	TRM INC	2850 MT PLEASANT AVE	BURLINGTON IA 52601
31918	TRM ELECTRONICS COMPONENTS		
32293	TRM IRC FIXED RESISTORS/BURLINGTON		
32997	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
33095	CAL-R INC	1601 OLYMPIC BLVD	SANTA MONICA CA 90404
52763	ITT SEMICONDUCTORS DIV		NEST PALM BEACH FL
54473	MICRO/SEMICONDUCTOR CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704
56289	ILLINOIS TOOL WORKS INC	900 FOLLIN LANE S E	VIENNA VA 22180
57668	PAKTRON DIVISION		
58854	MEPCO/ELECTRA INC	P O BOX 760	MINERAL WELLS TX 76067
59660	A NORTH AMERICAN PHILIPS CO		
59821	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701
71400	ITT SCHADOM INC	8081 MALLACE RD	EDEN PRAIRIE MN 55343
71590	INTERFIL INC	10900 N TANTAU AVE	CUPERTINO CA 95014
71744	BOURNS INC	1200 COLUMBIA AVE	RIVERSIDE CA 92507
73138	TRIMPOT DIV		
74970	SPECTRUM CONTROL INC	8061 AVONIA RD	FAIRVIEW PA 16415
80009	STETTNER ELECTRONICS INC	6135 AIRWAYS BLVD	CHATTANOOGA TN 37421
84411		PO BOX 21947	
87034	MATSUSHITA ELECTRIC CORP OF AMERICA	ONE PANASONIC MAY	SECAUCUS NJ 07094
91637	SPRAGUE ELECTRIC CO	87 MARSHALL ST	NORTH ADAMS MA 01247
91836	ROHM CORP	16931 MILLIKEN AVE	IRVINE CA 92713
TK1036	GTE PRODUCTS CORP	60 BOSTON ST	SALEM MA 01970
TK1345	LIGHTING PRODUCTS GROUP		
	TUSONIX INC	2155 N FORBES BLVD	TUCSON, ARIZONA 85705
	CENTRALAB INC	7158 MERCHANT AVE	EL PASO TX 79915
	SUB NORTH AMERICAN PHILIPS CORP		
	BUSSMANN MFG CO	114 OLD STATE RD	ST LOUIS MO 63178
	MCGRAW EDISON CO	PO BOX 14460	
	GLOBE-UNION INC	HWY 20 N	FORT DODGE IA 50501
	CENTRALAB ELECTRONICS DIV	P O BOX 858	
	GENERAL INSTRUMENT CORP LAMP DIV	4433 N RAVENSMOOD AVE	CHICAGO IL 60640
	BECKMAN INSTRUMENTS INC HELIPOT DIV	2500 HARBOR BLVD	FULLERTON CA 92634
	JOHNSON E F CO	299 10TH AVE S M	MASECA MN 56093
	TEKTRONIX INC	4900 S M GRIFFITH DR	BEAVERTON OR 97077
		P O BOX 500	
		301 WEST O ST	OGALLALA NE 69153
	ILLUMINATED PRODUCTS INC	S MAIN ST	CRYSTAL LAKE IL 60014
	DALE ELECTRONICS INC	P O BOX 609	COLUMBUS NE 68601
	KINGS ELECTRONICS CO INC	40 MARBLEDALE ROAD	TUCKAHOE NY 10707
	E F JOHNSON CO	299 10TH AVE SM	MASECA MN 56093
	ZMAN AND ASSOCIATES	7633 S 180TH	KENT WA 98032

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	670-2733-00	8010100	8051720	CIRCUIT 80 ASSY:MAIN	80009	670-2733-00
A1	670-2733-01	8051721	8052349	CIRCUIT 80 ASSY:MAIN	80009	670-2733-01
A1	670-2733-02	8052350	8057429	CIRCUIT 80 ASSY:MAIN	80009	670-2733-02
A1	670-2733-03	8057430	8059999	CIRCUIT 80 ASSY:MAIN	80009	670-2733-03
A1	670-2733-04	8060000	8070609	CIRCUIT 80 ASSY:MAIN	80009	670-2733-04
A1	670-2733-05	8070610	8071449	CIRCUIT 80 ASSY:MAIN	80009	670-2733-05
A1	670-2733-06	8071450	8071936	CIRCUIT 80 ASSY:MAIN	80009	670-2733-06
A1	670-2733-07	8071937		:	80009	670-2733-07
C10	295-0155-00			CAP SET, MATCHED: (2) 0.1UF, MATCHED 1%	80009	295-0155-00
C20	-----			(PART OF C10)		
C28	281-0663-00			CAP, FXD, CER DI: 10.4PF, 1%, 500V	52763	2RDPLZ007 10P4LC
C30	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C32	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C34	281-0645-00			CAP, FXD, CER DI: 8.2PF, +/-0.25PF, 500V	52763	2RDPLZ007 8P20CC
C35	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C38	283-0626-00			CAP, FXD, MICA DI: 1800PF, 5%, 500V	00853	D195F182J0
C48	281-0663-00			CAP, FXD, CER DI: 10.4PF, 1%, 500V	52763	2RDPLZ007 10P4LC
C50	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C52	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C54	281-0645-00			CAP, FXD, CER DI: 8.2PF, +/-0.25PF, 500V	52763	2RDPLZ007 8P20CC
C55	281-0081-00			CAP, VAR, AIR DI: 1.8-13PF, 375VDC	74970	189-0506-075
C58	283-0626-00			CAP, FXD, MICA DI: 1800PF, 5%, 500V	00853	D195F182J0
C107	283-0005-00			CAP, FXD, CER DI: 0.01UF, +100-0%, 250V	04222	SR303E103ZAA
C122	281-0093-00	8010100	8039999	CAP, VAR, CER DI: 5.5-18PF, 350V	52763	302322237
C122	281-0092-00	8040000		CAP, VAR, CER DI: 9-35PF, 200V	33095	53-717-001 09-35
C131	281-0612-00			CAP, FXD, CER DI: 5.6PF, +/-0.5PF, 500V	52763	2RDPLZ007 5P600C
C146	283-0177-00			CAP, FXD, CER DI: 1UF, +80-20%, 25V	04222	SR302E105ZAATR
C150	281-0114-00			CAP, VAR, AIR DI: 1.3-5.4PF, 425V	TK1036	189-0752-075
C164	281-0523-00			CAP, FXD, CER DI: 100PF, 20%, 350V	52763	2RDPLZ007 100PMU
C176	281-0618-00			CAP, FXD, CER DI: 4.7PF, +/-0.5PF, 500V	52763	2RDPLZ007 4P700C
C195	281-0518-00			CAP, FXD, CER DI: 4.7PF, +/-9.4PF, 500V	52763	2RDPLZ007 4P700C
C207	283-0005-00			CAP, FXD, CER DI: 0.01UF, +100-0%, 250V	04222	SR303E103ZAA
C222	281-0093-00	8010100	8039999	CAP, VAR, CER DI: 5.5-18PF, 350V	52763	302322237
C222	281-0092-00	8040000		CAP, VAR, CER DI: 9-35PF, 200V	33095	53-717-001 09-35
C231	281-0612-00			CAP, FXD, CER DI: 5.6PF, +/-0.5PF, 500V	52763	2RDPLZ007 5P600C
C252	290-0512-00	8052350	8059999	CAP, FXD, ELCTLT: 22UF, 20%, 15V	05397	T3688226M015AS
C252	290-0745-00	8060000		CAP, FXD, ELCTLT: 22UF, +50-10%, 25V	54473	ECE-A25V22L
C264	281-0523-00			CAP, FXD, CER DI: 100PF, 20%, 350V	52763	2RDPLZ007 100PMU
C276	281-0618-00			CAP, FXD, CER DI: 4.7PF, +/-0.5PF, 500V	52763	2RDPLZ007 4P700C
C431	290-0527-00	8010100	8059999	CAP, FXD, ELCTLT: 15UF, 20%, 20V	05397	T3688156M020AS
C431	290-0745-00	8060000		CAP, FXD, ELCTLT: 22UF, +50-10%, 25V	54473	ECE-A25V22L
C433	290-0527-00	8010100	8059999	CAP, FXD, ELCTLT: 15UF, 20%, 20V	05397	T3688156M020AS
C433	290-0745-00	8060000		CAP, FXD, ELCTLT: 22UF, +50-10%, 25V	54473	ECE-A25V22L
C435	290-0527-00	8010100	8059999	CAP, FXD, ELCTLT: 15UF, 20%, 20V	05397	T3688156M020AS
C435	290-0745-00	8060000		CAP, FXD, ELCTLT: 22UF, +50-10%, 25V	54473	ECE-A25V22L
C438	283-0177-00			CAP, FXD, CER DI: 1UF, +80-20%, 25V	04222	SR302E105ZAATR
C443	290-0527-00	8010100	8059999	CAP, FXD, ELCTLT: 15UF, 20%, 20V	05397	T3688156M020AS
C443	290-0745-00	8060000		CAP, FXD, ELCTLT: 22UF, +50-10%, 25V	54473	ECE-A25V22L
C448	283-0177-00			CAP, FXD, CER DI: 1UF, +80-20%, 25V	04222	SR302E105ZAATR
C450	281-0613-00	8010100	8051720	CAP, FXD, CER DI: 10PF, 1%, 500V	59660	374-018C0G0100F
C450	281-0629-00	8051721		CAP, FXD, CER DI: 33PF, 5%, 600V	52763	2RDPLZ007 33P0JC
C470	283-0594-00			CAP, FXD, MICA DI: 0.001UF, 1%, 100V	00853	D151F102F0
C471	283-0594-00			CAP, FXD, MICA DI: 0.001UF, 1%, 100V	00853	D151F102F0
C472	285-0809-00			CAP, FXD, PLASTIC: 1UF, 10%, 50V	56289	LP66A1A105K
C473	285-0809-00			CAP, FXD, PLASTIC: 1UF, 10%, 50V	56289	LP66A1A105K
C490	281-0511-00			CAP, FXD, CER DI: 22PF, +/-2.2PF, 500V	52763	2RDPLZ007 22P0KC
C491	281-0721-00			CAP, FXD, CER DI: 72PF, 5%, 500V	52763	2RDPLZ007 72P0JU
C493	283-0604-00			CAP, FXD, MICA DI: 304PF, 2%, 500V	00853	D155F3040G0

Replaceable Electrical Parts - AM 502

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C494	283-0594-00			CAP,FXD,WICA DI:0.001UF,1%,100V	00853	0151F102F0
C495	285-0627-00			CAP,FXD,PLASTIC:0.0033UF,5%,100V	07716	TEK44-33251
C496	285-0598-00			CAP,FXD,PLASTIC:0.01UF,5%,100V	19396	0U4908103J
C497	285-0702-00			CAP,FXD,PLASTIC:0.033UF,5%,100V	19396	0U591/74-16903
C498	285-0703-00			CAP,FXD,PLASTIC:0.1UF,5%,100V	19396	104J01PT605
C499	285-0633-00			CAP,FXD,PLASTIC:0.22UF,10%,100V	84411	663UM-22491
C530	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C536	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
C552	281-0511-00			CAP,FXD,CER DI:22PF,+/-2.2PF,500V	52763	2R0PLZ007 22P0KC
C560	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C570	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C910	290-0512-00	B010100	B059999	CAP,FXD,ELCTLT:22UF,20%,15V	05397	T368B226M015AS
C910	290-0745-00	B060000		CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C922	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C924	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C926	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C930	290-0527-00			CAP,FXD,ELCTLT:15UF,20%,20V	05397	T368B156M020AS
C942	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C960	290-0527-00			CAP,FXD,ELCTLT:15UF,20%,20V	05397	T368B156M020AS
C964	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C966	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
C968	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104MSU1CA
CR108	152-0323-00			SEMICONO DVC,DI:SM,SI,35V,0.1A,00-7	14433	MG1518
CR109	152-0323-00			SEMICONO DVC,DI:SM,SI,35V,0.1A,00-7	14433	MG1518
CR131	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR150	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR181	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR208	152-0323-00			SEMICONO DVC,DI:SM,SI,35V,0.1A,00-7	14433	MG1518
CR209	152-0323-00			SEMICONO DVC,DI:SM,SI,35V,0.1A,00-7	14433	MG1518
CR231	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR250	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR281	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR438	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR441	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR448	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR531	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR555	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR558	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR560	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR561	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR570	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
CR571	152-0141-02			SEMICONO DVC,DI:SM,SI,30V,150MA,30V	03508	0A2527 (1N4152)
D550	150-0107-00	B010100	B052349	LAMP,INCAND:12V,0.04A,#227AS25,WIRE LD	87034	227AS25
D550	150-0048-01	B052350		LAMP,INCAND:5V,0.06A,#683,AGED & SEL	58854	683A515
D5900	150-0107-00	B010100	B052349	LAMP,INCAND:12V,0.04A,#227AS25,WIRE LD	87034	227AS25
D5900	150-0109-00	B052350		LAMP,INCAND:18V,0.026A,#CW7220,WIRE LD	71744	CW7220
F100	159-0024-00			FUSE,CARTRIDGE:3AG,0.062A,250V,0.35SEC	71400	MGB 1/16
F200	159-0024-00			FUSE,CARTRIDGE:3AG,0.062A,250V,0.35SEC	71400	MGB 1/16
J10	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J15	129-0103-00			POST,BDG,ELEC:ASSEMBLY	80009	129-0103-00
J20	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J550	131-0818-00			CONN,RCPT,ELEC:BNC,FEMALE	91836	KC-19-153
L164	108-0409-00			COIL,RF:FIXED,17.5UH	TK1345	108-0409-00
L264	108-0409-00			COIL,RF:FIXED,17.5UH	TK1345	108-0409-00
L416	276-0507-00			SHLD BEAD,ELEK:FERRITE	02114	56-590-658/3B
L426	276-0507-00			SHLD BEAD,ELEK:FERRITE	02114	56-590-658/3B
L445	276-0507-00			SHLD BEAD,ELEK:FERRITE	02114	56-590-658/3B
Q121	151-1027-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1027-00
Q131	151-0261-00			TRANSISTOR:PMP,SI,TO-77	04713	S0441

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
Q136	151-1025-00	8010100	8059999	TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3036
Q136	151-1042-00	8060000		SEMICONO DVC SE:FET,SI,TO-92	04713	SPF627M2
Q141	151-0176-00			TRANSISTOR:NPN,SI,TO-78	04713	S0555
Q145	151-0261-00			TRANSISTOR:PNP,SI,TO-77	04713	SD441
Q152	153-0586-00	8010100	8057429	SEMICONO DVC SE:MATCHED PAIR	80009	153-0586-00
Q152	151-0354-00	8057430		TRANSISTOR:PNP,SI,TO-78	32293	ITS-1200-A
Q162	151-1036-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1036-00
Q164	153-0586-00	8010100	8057429	SEMICONO DVC SE:MATCHED PAIR	80009	153-0586-00
Q164	151-0354-00	8057430		TRANSISTOR:PNP,SI,TO-78	32293	ITS-1200-A
Q167	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q168	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q171	151-1029-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1029-00
Q181	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q185	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q195	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q196	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q236	151-1025-00	8010100	8059999	TRANSISTOR:FET,N-CHAN,SI,TO-92 (PART OF Q136)	04713	SPF3036
Q267	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q268	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q269	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q281	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q285	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q410	153-0586-00	8010100	8071449	SEMICONO DVC SE:MATCHED PAIR	80009	153-0586-00
Q410	151-0354-00	8071450		TRANSISTOR:PNP,SI,TO-78	32293	ITS-1200-A
Q416	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q422	153-0587-00	8010100	8071449	SEMICONO DVC SE:MATCHED PAIR	80009	153-0587-00
Q422	151-0236-00	8071450		TRANSISTOR:NPN,SI,DUAL,TO-77	32293	ITS1074
Q426	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q431	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q443	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q445	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q451	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q501	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q511	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q521	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q532	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q540	151-0260-00			TRANSISTOR:NPN,SI,TO-39	04713	ST1083
Q541	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q555	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q558	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q561	151-0307-00			TRANSISTOR:PNP,SI,TO-78	04713	2N3726
Q571	151-0309-00			TRANSISTOR:NPN,SI,TO78	04713	S03167
Q910	151-0301-00	8010100	8040389	TRANSISTOR:PNP,SI,TO-18	04713	ST898
Q910	151-0302-00	8040390		TRANSISTOR:NPN,SI,TO-18	04713	ST899
Q940	151-0334-00			TRANSISTOR:NPN,SI,TO-126,SEL	04713	SJE914
Q942	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q990	151-0302-00	8010100	8040389	TRANSISTOR:NPN,SI,TO-18	04713	ST899
Q990	151-0301-00	8040390		TRANSISTOR:PNP,SI,TO-18	04713	ST898
R10	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25M	19701	5043CX1M000J
R20	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25M	19701	5043CX1M000J
R30	322-0687-07			RES,FXD,FILM:1.005MEG OHM,0.1%,0.25M,TC=T9	19701	5043RE1M005B
R35	322-0624-07			RES,FXD,FILM:990K OHM,0.1%,0.25M,TC=T9	19701	5043RE990K0B
R38	321-0289-03			RES,FXD,FILM:10.0K OHM,0.25%,0.125M,TC=T2	07716	CEAC10001C
R40	311-1566-00	8010100	8052349	RES,VAR,NONMM:TRMR,200 OHM,0.5M	32997	3352T-1-201
R40	311-1568-00	8052350		RES,VAR,NONMM:TRMR,50 OHM,0.5M	32997	3352T-1-500
R50	322-0687-07			RES,FXD,FILM:1.005MEG OHM,0.1%,0.25M,TC=T9	19701	5043RE1M005B
R55	322-0624-07			RES,FXD,FILM:990K OHM,0.1%,0.25M,TC=T9	19701	5043RE990K0B

Replaceable Electrical Parts - AM 502

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R58	321-0289-03			RES,FXD,FILM:10.0K OHM,0.25%,0.125M,TC=T2	07716	CEAC10001C
R103	321-0281-00	8010100	8059999	RES,FXD,FILM:8.25K OHM,1%,0.125M,TC=TO	19701	5043ED8K250F
R103	321-0239-00	8060000		RES,FXD,FILM:3.01K OHM,1%,0.125M,TC=TO	19701	5043ED3K010F
R105	311-1559-00			RES,VAR,NONMM:TRMR,10K OHM,0.5M	32997	3352T-1-103
R106	315-0107-00			RES,FXD,FILM:100M OHM,5%,0.25M	01121	CB1075
R107	315-0107-00			RES,FXD,FILM:100M OHM,5%,0.25M	01121	CB1075
R120	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R121	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125M,TC=TO	19701	5033ED2K00F
R122	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
R125	321-0114-00			RES,FXD,FILM:150 OHM,1%,0.125 M,TC=TO	19701	5033ED150R0F
R126	321-0927-07			RES,FXD,FILM:125 OHM,0.1%,0.125M,TC=T9	19701	5033RE125R0B
R131	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125M,TC=TO	19701	5033ED4K020F
R136	321-0199-06			RES,FXD,FILM:1.15K OHM,0.25%,0.125M,TC=T9	07716	CEAE11500C
R137	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R141	321-0813-07			RES,FXD,FILM:495 OHM,0.1%,0.125M,TC=T9	19701	5033RE4950B
R145	321-0353-00			RES,FXD,FILM:46.4K OHM,1%,0.125M,TC=TO	07716	CEAD46401F
R146	321-0272-00			RES,FXD,FILM:6.65K OHM,1%,0.125M,TC=TO	19701	5043ED6K650F
R152	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125M,TC=TO	19701	5033ED2K00F
R154	321-0225-06			RES,FXD,FILM:2.15K OHM,0.25%,0.125M,T=T9MI	07716	CEAE21500C
R155	321-0154-00	8010100	8039999	RES,FXD,FILM:392 OHM,1%,0.125M,TC=TO	07716	CEAD392R0F
R155	321-0150-00	8040000		RES,FXD,FILM:357 OHM,1%,0.125M,TC=TO	07716	CEAD357R0F
R157	315-0564-00	8010100	8059999	RES,FXD,FILM:560K OHM,5%,0.25M	19701	5043CX560K0J
R157	321-0457-00	8060000		RES,FXD,FILM:562K 1%,0.125 M,TC=TO	19701	5043ED562K0F
R158	311-0467-00			RES,VAR,NONMM:PNL,100K OHM,0.5M	01121	M7705B
R159	311-1567-00	8010100	8039999	RES,VAR,NONMM:TRMR,100 OHM,0.5M	32997	3352T-1-101
R159	311-1566-00	8040000		RES,VAR,NONMM:TRMR,200 OHM,0.5M	32997	3352T-1-201
R160	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JE01K0
R161	311-1564-00	8010100	8059999	RES,VAR,NONMM:TRMR,500 OHM,0.5M	32997	3352T-CK5501
R161	311-1307-00	8060000		RES,VAR,NONMM:TRMR,500 OHM,0.5M	32997	3299M-R27-501
R162	321-0240-00			RES,FXD,FILM:3.09K OHM,1%,0.125M,TC=TO	07716	CEAD30900F
R164	321-0309-00			RES,FXD,FILM:16.2K OHM,1%,0.125M,TC=TO	19701	5033ED16K20F
R166	321-0143-00			RES,FXD,FILM:301 OHM,1%,0.125M,TC=TO	07716	CEAD301R0F
R168	321-0224-00			RES,FXD,FILM:2.10K OHM,1%,0.125M,TC=TO	07716	CEAD21000F
R170	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JE01K0
R171	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125M,TC=TO	24546	NA5507501F
R173	321-0239-07			RES,FXD,FILM:3.01K OHM,0.1%,0.125M,TC=T9MI	07716	CEAE30100B
R175	321-0289-07			RES,FXD,FILM:10.0K OHM,0.1%,0.125M,TC=T9	19701	5033RE10K00B
R176	321-1267-03			RES,FXD,FILM:5.97K OHM,0.25%,0.125M,TC=T2	19701	5033RC5K971C
R177	321-0147-00			RES,FXD,FILM:332 OHM,1%,0.125M,TC=TO	07716	CEAD332R0F
R178	311-1494-00			RES,VAR,NONMM:PNL,2K OHM,1M,M/SM (PART OF 5178)	01121	11M187
R181	321-0187-00			RES,FXD,FILM:866 OHM,1%,0.125M,TC=TO	07716	CEAD866R0F
R184	321-0297-00			RES,FXD,FILM:12.1K OHM,1%,0.125M,TC=TO	07716	CEAD12101F
R185	321-0236-00			RES,FXD,FILM:2.80K OHM,1%,0.125M,TC=TO	07716	CEAD28000F
R191	311-1555-00			RES,VAR,NONMM:TRMR,100K OHM,0.5M	32997	3352T-1-104
R193	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25M	19701	5043CX470K0J92U
R195	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
R196	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25M	57668	NTR25J-E06K8
R198	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25M	57668	NTR25J-E04K7
R205	311-1559-00			RES,VAR,NONMM:TRMR,10K OHM,0.5M	32997	3352T-1-103
R206	315-0107-00			RES,FXD,FILM:100M OHM,5%,0.25M	01121	CB1075
R207	315-0107-00			RES,FXD,FILM:100M OHM,5%,0.25M	01121	CB1075
R220	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R221	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125M,TC=TO	19701	5033ED2K00F
R222	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
R225	321-0114-00			RES,FXD,FILM:150 OHM,1%,0.125 M,TC=TO	19701	5033ED150R0F
R226	321-0927-07			RES,FXD,FILM:125 OHM,0.1%,0.125M,TC=T9	19701	5033RE125R0B
R231	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125M,TC=TO	19701	5033ED4K020F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R236	321-0199-06			RES,FXD,FILM:1.15K OHM,0.25%,0.125M,TC=T9	07716	CEAE11500C
R237	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R241	321-0813-07			RES,FXD,FILM:495 OHM,0.1%,0.125M,TC=T9	19701	5033RE49508
R245	321-0353-00			RES,FXD,FILM:46.4K OHM,1%,0.125M,TC=T0	07716	CEAD46401F
R246	321-0272-00			RES,FXD,FILM:6.65K OHM,1%,0.125M,TC=T0	19701	5043ED6K650F
R252	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125M,TC=T0	19701	5033ED2K00F
R254	321-0225-06			RES,FXD,FILM:2.15K OHM,0.25%,0.125M,T=T9MI	07716	CEAE21500C
R255	321-0154-00	8010100	8039999	RES,FXD,FILM:392 OHM,1%,0.125M,TC=T0	07716	CEAD392R0F
R255	321-0150-00	8040000		RES,FXD,FILM:357 OHM,1%,0.125M,TC=T0	07716	CEAD357R0F
R260	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25J-E01K0
R261	321-0239-00			RES,FXD,FILM:3.01K OHM,1%,0.125M,TC=T0	19701	5043ED3K010F
R262	321-0240-00			RES,FXD,FILM:3.09K OHM,1%,0.125M,TC=T0	07716	CEAD30900F
R264	321-0309-00			RES,FXD,FILM:16.2K OHM,1%,0.125M,TC=T0	19701	5033ED16K20F
R266	321-0143-00			RES,FXD,FILM:301 OHM,1%,0.125M,TC=T0	07716	CEAD301R0F
R268	321-0224-00			RES,FXD,FILM:2.10K OHM,1%,0.125M,TC=T0	07716	CEAD21000F
R269	311-1564-00	8010100	8059999	RES,VAR,NONHM:TRMR,500 OHM,0.5M	32997	3352T-CK5501
R269	311-1307-00	8060000		RES,VAR,NONHM:TRMR,500 OHM,0.5M	32997	3299M-R27-501
R270	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
R271	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125M,TC=T0	24546	NA5507501F
R273	321-0239-07			RES,FXD,FILM:3.01K OHM,0.1%,0.125M,TC=T9MI	07716	CEAE30100B
R275	321-0289-07			RES,FXD,FILM:10.0K OHM,0.1%,0.125M,TC=T9	19701	5033RE10K008
R276	321-1267-03			RES,FXD,FILM:5.97K OHM,0.25%,0.125M,TC=T2	19701	5033RC5K971C
R277	321-0147-00			RES,FXD,FILM:332 OHM,1%,0.125M,TC=T0	07716	CEAD332R0F
R284	321-0314-00			RES,FXD,FILM:18.2K OHM,1%,0.125M,TC=T0	19701	5043ED18K20F
R285	321-0236-00			RES,FXD,FILM:2.80K OHM,1%,0.125M,TC=T0	07716	CEAD28000F
R410	321-0068-00			RES,FXD,FILM:49.9 OHM,0.5%,0.125M,TC=T0	91637	CMF55116G49R90F
R411	321-0068-00			RES,FXD,FILM:49.9 OHM,0.5%,0.125M,TC=T0	91637	CMF55116G49R90F
R414	315-0680-00	8010100	8071936	RES,FXD,FILM:68 OHM,5%,0.25M	57668	NTR25J-E68E0
R414	315-0470-00	8071937		RES,FXD,FILM:47 OHM,5%,0.25M	57668	NTR25J-E47E0
R420	322-0238-00			RES,FXD,FILM:2.94K OHM,1%,0.25M,TC=T0	19701	5043RD2K940F
R421	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125M,TC=T0	19701	5043ED6K980F
R422	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25M	57668	NTR25J-E47E0
R423	321-0068-00			RES,FXD,FILM:49.9 OHM,0.5%,0.125M,TC=T0	91637	CMF55116G49R90F
R424	321-0068-00			RES,FXD,FILM:49.9 OHM,0.5%,0.125M,TC=T0	91637	CMF55116G49R90F
R431	321-0182-00			RES,FXD,FILM:768 OHM,1%,0.125M,TC=T0	07716	CEAD768R0F
R433	321-0179-00			RES,FXD,FILM:715 OHM,1%,0.125M,TC=T0	07716	CEAD715R0F
R435	321-0233-00			RES,FXD,FILM:2.61K OHM,1%,0.125M,TC=T0	07716	CEAD26100F
R436	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25M	57668	NTR25J-E04K7
R438	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25M	57668	NTR25J-E02K2
R440	321-0268-00			RES,FXD,FILM:6.04K OHM,1%,0.125M,TC=T0	19701	5043ED6K040F
R441	321-0247-00			RES,FXD,FILM:3.65K OHM,1%,0.125M,TC=T0	19701	5043ED3K650F
R442	321-0400-00			RES,FXD,FILM:143K OHM,1%,0.125M,TC=T0	19701	5043ED143K0F
R443	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25M	57668	NTR25J-E470E
R445	321-0218-00			RES,FXD,FILM:1.82K OHM,1%,0.125M,TC=T0	19701	5033ED1K82F
R446	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25M	57668	NTR25J-E04K7
R448	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25M	57668	NTR25J-E02K2
R450	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25M	57668	NTR25J-E02K2
R451	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R460	321-0229-00			RES,FXD,FILM:2.37K OHM,1%,0.125M,TC=T0	19701	5043ED2K37F
R461	311-1566-00	8010100	8059999	RES,VAR,NONHM:TRMR,200 OHM,0.5M	32997	3352T-1-201
R461	311-1036-00	8060000		RES,VAR,NONHM:TRMR,200 OHM,0.5M	32997	3299M-R27-201
R462	321-0229-00			RES,FXD,FILM:2.37K OHM,1%,0.125M,TC=T0	19701	5043ED2K37F
R464	321-0204-00			RES,FXD,FILM:1.30K OHM,1%,0.125M,TC=T0	19701	5033ED1K300F
R466	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25M	19701	5043CX1M000J
R467	311-1057-00			RES,VAR,MM:PNL,5K OHM,2M	73138	7266-371-1
R468	311-0887-00			RES,VAR,NONHM:PNL,50K OHM,10%,0.5M	71590	8A02520017
R470	316-0155-00			RES,FXD,CMP5N:1.5M OHM,10%,0.25M	01121	CB1551
R471	316-0155-00			RES,FXD,CMP5N:1.5M OHM,10%,0.25M	01121	CB1551
R474	321-0408-00			RES,FXD,FILM:174K OHM,1%,0.125M,TC=T0	07716	CEAD17402F

Replaceable Electrical Parts - AM 502

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R475	321-0408-00			RES,FXD,FILM:174K OHM,1%,0.125M,TC=T0	07716	CEAD17402F
R478	321-0303-00			RES,FXD,FILM:14.0K OHM,1%,0.125M,TC=T0	07716	CEAD 14001F
R479	321-0303-00			RES,FXD,FILM:14.0K OHM,1%,0.125M,TC=T0	07716	CEAD 14001F
R480	321-0289-03			RES,FXD,FILM:10.0K OHM,0.25%,0.125M,TC=T2	07716	CEAC10001C
R481	321-0816-07			RES,FXD,FILM:5K OHM,0.1%,0.125M,TC=T9	19701	5033RESK0008
R482	321-0222-03			RES,FXD,FILM:2.0K OHM,0.25%,0.125M,TC=T2	19701	5033RC2K000C
R483	321-0193-03			RES,FXD,FILM:1K OHM,0.25%,0.125M,TC=T2	07716	CEAC10000C
R484	321-0612-03			RES,FXD,FILM:500 OHM,0.25%,0.125M,TC=T2	19701	5033RC500R0C
R485	321-0126-03			RES,FXD,FILM:200 OHM,0.25%,0.125M	19701	5033RC200R0C
R486	321-0097-03			RES,FXD,FILM:100 OHM,0.25%,0.125M,TC=T0	91637	CMF551160100R0C
R487	321-0751-06			RES,FXD,FILM:50 OHM,0.25%,0.125M,TC=T9	91637	CMF55116C50R00C
R488	321-0030-02			RES,FXD,FILM:20.0 OHM,0.5%,0.125M,TC=T2	91637	CMF55116D20R00D
R489	321-0001-01			RES,FXD,FILM:10.0 OHM,0.5%,0.125M,TC=T0	19701	5033R010R00D
R501	316-0225-00			RES,FXD,CMPSN:2.2M OHM,10%,0.25M	01121	CB2251
R503	321-0452-00			RES,FXD,FILM:499K OHM,1%,0.125M,TC=T0	19701	5043ED499K0F
R504	321-0423-00			RES,FXD,FILM:249K OHM,1%,0.125M,TC=T0	19701	5043ED249K0F
R507	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25M	57668	NTR25J-E47K0
R510	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
R511	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
R513	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
R521	316-0276-00			RES,FXD,CMPSN:27M OHM,10%,0.25M	01121	CB2761
R523	321-0423-00			RES,FXD,FILM:249K OHM,1%,0.125M,TC=T0	19701	5043ED249K0F
R524	321-0452-00			RES,FXD,FILM:499K OHM,1%,0.125M,TC=T0	19701	5043ED499K0F
R527	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
R531	315-0224-00			RES,FXD,FILM:220K OHM,5%,0.25M	57668	NTR25J-E220K
R532	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
R533	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
R536	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
R541	315-0681-00			RES,FXD,FILM:680 OHM,5%,0.25M	57668	NTR25J-E680E
R542	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
R550	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25M	57668	NTR25J-E06K8
R551	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25M	19701	5043CX15K00J
R552	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25J-E01K0
R553	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25M	57668	NTR25J-E06K8
R555	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25M	57668	NTR25J-E03K0
R558	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25M	57668	NTR25J-E03K0
R559	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25M	57668	NTR25J-E 2K
R560	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R561	315-0181-00			RES,FXD,FILM:180 OHM,5%,0.25M	57668	NTR25J-E180E
R562	307-0104-00			RES,FXD,CMPSN:3.3 OHM,5%,0.25M	01121	CB33G5
R570	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25M	57668	NTR25J-E 100E
R571	315-0181-00			RES,FXD,FILM:180 OHM,5%,0.25M	57668	NTR25J-E180E
R572	307-0104-00			RES,FXD,CMPSN:3.3 OHM,5%,0.25M	01121	CB33G5
R900	304-0102-00	8010100	8029999	RES,FXD,CMPSN:1K OHM,10%,1M	01121	GB1021
R900	303-0511-00	8030000	8052349	RES,FXD,CMPSN:510 OHM,5%,1M	01121	GB5115
R900	303-0751-00	8052350		RES,FXD,CMPSN:750 OHM,5%,1M	01121	GB7515
R910	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25M	19701	5043CX820R0J
R915	321-0285-00			RES,FXD,FILM:9.09K OHM,1%,0.125M,TC=T0	07716	CEAD90900F
R916	321-0268-00			RES,FXD,FILM:6.04K OHM,1%,0.125M,TC=T0	19701	5043ED6K040F
R920	307-0105-00			RES,FXD,CMPSN:3.9 OHM,5%,0.25M	01121	CB 39G5
R922	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J
R924	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J
R926	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J
R940	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25M	01121	CB 47G5
R942	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25J-E01K0
R945	315-0912-00			RES,FXD,FILM:9.1K OHM,5%,0.25M	57668	NTR25J-E09K1
R946	315-0622-00			RES,FXD,FILM:6.2K OHM,5%,0.25M	19701	5043CX6K200J
R964	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J
R966	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R968	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25M	19701	5043CX10RR00J
R970	307-0105-00		RES,FXD,CMPSN:3.9 OHM,5%,0.25M	01121	CB 39G5
R989	315-0561-00		RES,FXD,FILM:560 OHM,5%,0.25M	19701	5043CX560R0J
R990	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
R994	321-0306-00		RES,FXD,FILM:15.0K OHM,1%,0.125M,TC=TO	19701	5033ED15J00F
R995	321-0306-00		RES,FXD,FILM:15.0K OHM,1%,0.125M,TC=TO	19701	5033ED15J00F
RT104	307-0181-00		RES,THERMAL:100K OHM,10%,NTC	14193	K10-10002K
RT203	307-0181-00		RES,THERMAL:100K OHM,10%,NTC	14193	K10-10002K
S10	260-1207-00		SWITCH,PUSH:DPDT,28VDC,PUSH-PUSH	59821	ORDER BY DESCR
S20	260-1207-00		SWITCH,PUSH:DPDT,28VDC,PUSH-PUSH	59821	ORDER BY DESCR
S30	260-1209-00		SWITCH,PUSH:1BUTTON,4 POLE,DISPLAY	31918	601347
S178	-----		(PART OF R178)		
S470	263-1004-00		SM CAM ACTR AS:LF-30B POINT	80009	263-1004-00
S480	263-1005-00		SM CAM ACTR AS:GAIN	80009	263-1005-00
S490	263-1003-00		SM CAM ACTR AS:HF-30B POINT	80009	263-1003-00
U910	156-0067-00		MICROCKT,LINEAR:OPNL AMPL,SEL	04713	MC1741CP1
U990	156-0067-00		MICROCKT,LINEAR:OPNL AMPL,SEL	04713	MC1741CP1
VR252	152-0168-00		SEMICOND DVC,DI:ZEN,SI,12V,5%,0.4M,00-763B	14552	T0331689
VR438	152-0243-00		SEMICOND DVC,DI:ZEN,SI,15V,5%,0.4M,00-7	04713	SZ13203 (1N965B)
VR448	152-0243-00		SEMICOND DVC,DI:ZEN,SI,15V,5%,0.4M,00-7	04713	SZ13203 (1N965B)
VR910	152-0123-00		SEMICOND DVC,DI:ZEN,SI,9V,5%,0.5M,00-7	04713	SZ11530RL

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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.

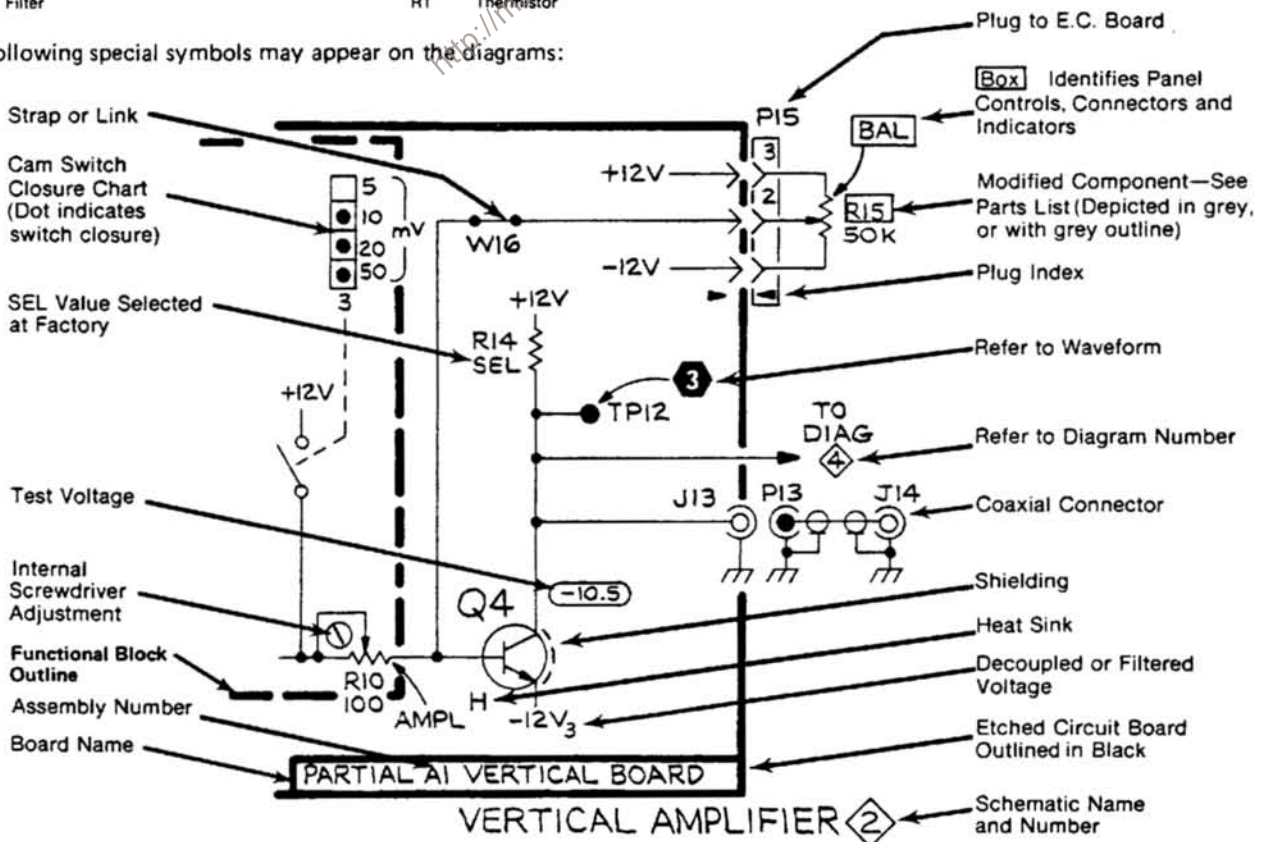
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

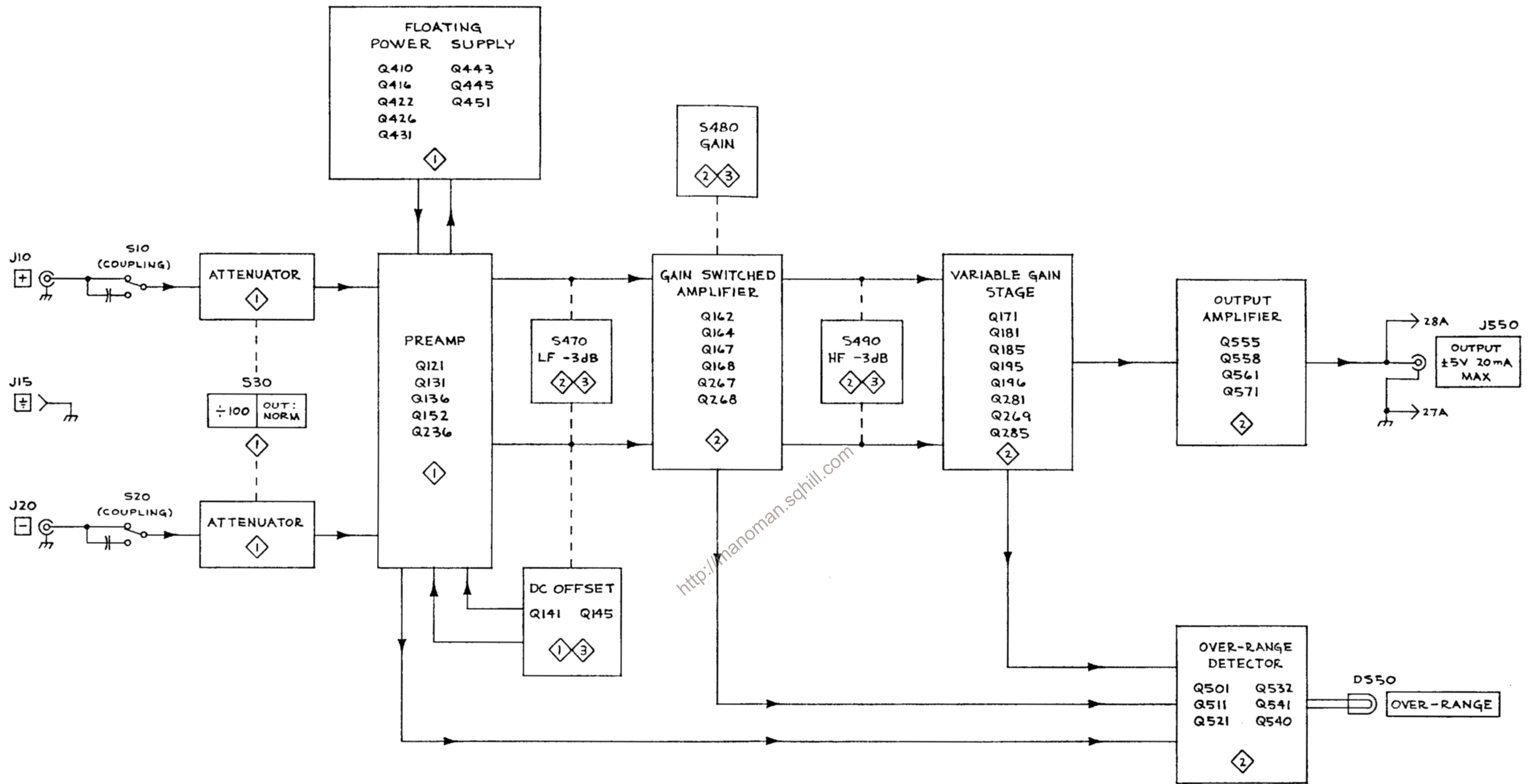
- Y14.15, 1966 Drafting Practices.
- Y14.2, 1973 Line Conventions and Lettering.
- Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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				

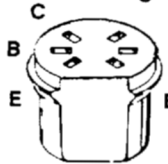
The following special symbols may appear on the diagrams:





1582-14
 REV. B, MAR. 1978

AM502 BLOCK DIAGRAM DEH 0573

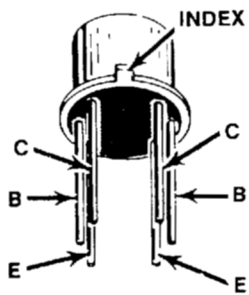


Q152 (SN B057429 & BELOW),
Q410, Q422



Q416, Q426, Q431
Q443, Q445, Q451

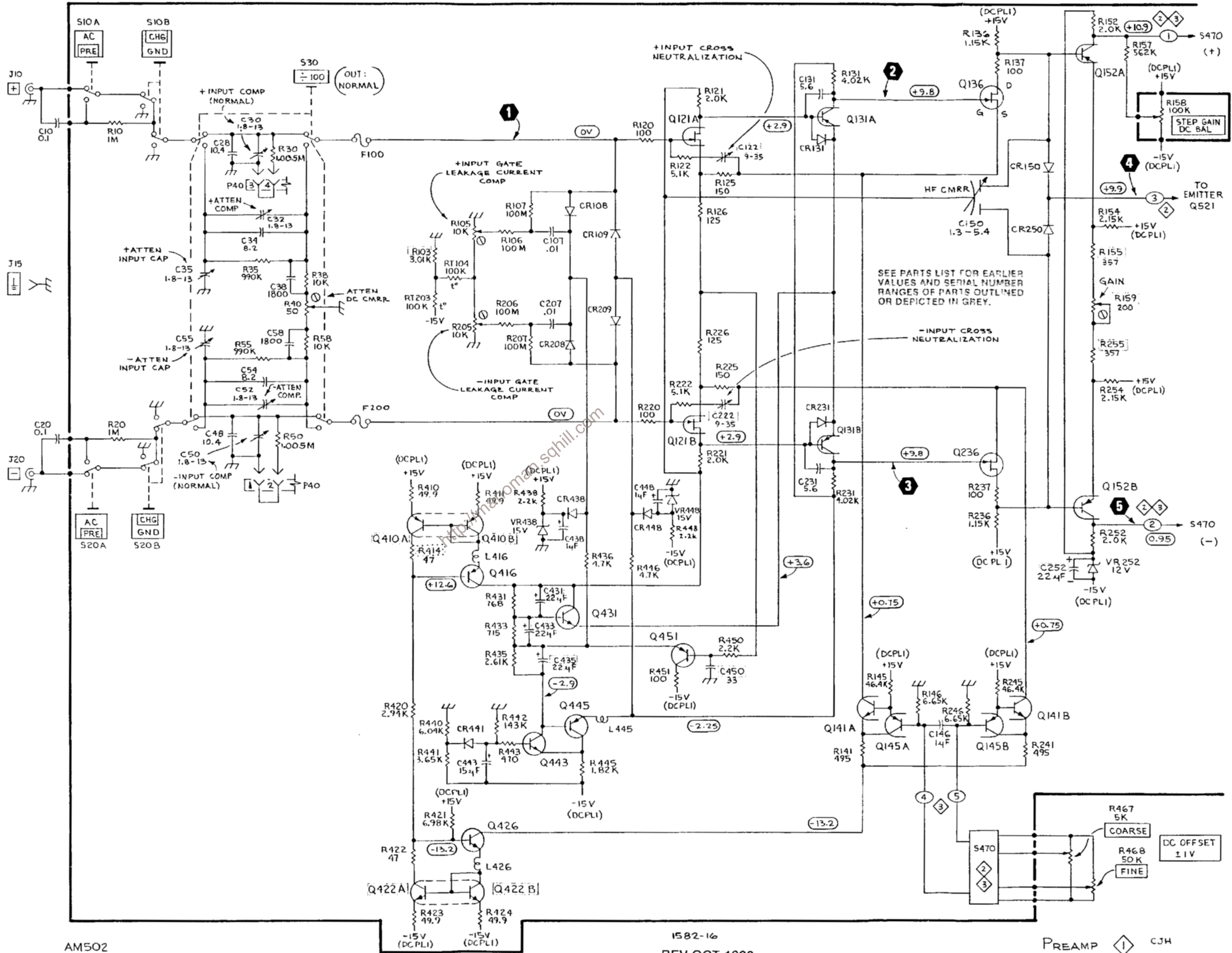
DUAL



Q121, Q131, Q141, Q145,
Q152, Q410, Q422



Q136, Q236



Component Reference Chart

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C28	K3	CR108	I2	Q501	E1	R185	C2	R451	J4	R926	H6
C30	K3	CR109	J3	Q511	F1	R191	B4	R460	F4	R940	C6
C32	K2	CR141	H4	Q521	E1	R193	C4	R461	G4	R942	E6
C34	K2	CR150	G4	Q532	C1	R195	C5	R462	F4	R945	E6
C35	L2	CR181	D2	Q540	B1	R196	B5	R464	H1	R946	F6
C38	K1	CR208	I3	Q541	C1	R198	A5	R466	H1	R964	H6
C48	L3	CR209	J3	Q555	B3	R205	I2	R470	F5	R966	H6
C50	L3	CR231	H4	Q558	A2	R206	I3	R471	E5	R968	E5
C54	M2	CR250	G4	Q561	C2	R207	I3	R474	G5	R970	B5
C55	L3	CR281	D2	Q571	C3	R220	I4	R475	F5	R989	B5
C58	L1	CR438	J2	Q910	B6	R221	I4	R478	G6	R990	D5
C107	I2	CR441	K4	Q940	B6	R222	H5	R479	F6	R994	C5
C122	I3	CR448	K3	Q942	D6	R225	H5	R480	G2	R995	C5
C131	H4	CR531	D1	Q990	B5	R226	I5	R481	G1	RT104	H2
C146	I6	CR555	B3			R231	I5	R482	G1	RT203	H2
C150	H5	CR558	B2	R10	K4	R236	G5	R483	G1		
C164	E3	CR560	B2	R20	K5	R237	G5	R484	G1	S10A	L4
C176	E2	CR561	B3	R30	K3	R241	J6	R485	G2	S10B	L4
C195	C5	CR570	B2	R35	K2	R245	J6	R486	G2	S20A	L5
C207	I2	CR571	B2	R38	K2	R246	H6	R487	F1	S20B	L6
C222	I5			R40	L2	R252	G5	R488	F1	S30	L1
C231	H5	F100	J3	R50	L2	R254	H5	R489	F2	S178	C3
C252	G5	F200	I3	R55	L2	R255	G5			S470 †	E5
C264	E4			R58	L2	R260	D4	R501	D1	S480	G3
C276	E3	L164	F3	R103	H1	R261	E3	R503	D1	S490 †	B4
C431	J4	L264	F4	R105	I2	R262	D4	R504	D1		
C433	J4	L416	J5	R106	I2	R264	E4	R507	D1	U910	A6
C435	K4	L426	K5	R107	I3	R266	E4	R510	F2	U990	A5
C438	J2	L445	K3	R120	I4	R268	E4	R511	E1		
C443	L4	P40	K3	R121	I4	R269	C4	R513	F1	VR252	G5
C448	K3	Q121	I4	R122	H4	R270	F3	R521	G3	VR438	J2
C450	K4	Q131	H4	R125	H4	R271	E2	R523	E1	VR448	J3
C470	F5	Q136	H4	R126	I4	R273	E2	R524	D1	VR910	C6
C471	E5	Q141	I5	R131	I3	R275	D3	R527	E1		
C472	F6	Q145	I6	R136	G4	R276	D3	R532	B1		
C473	E6	Q152	G4	R137	G4	R277	D3	R533	C1		
C490	B4	Q162	D3	R141	J6	R284	D2	R536	C1		
C491	A4	Q164	E3	R145	J5	R285	C2	R541	B1		
C493	B4	Q167	F3	R146	H6	R410	J5	R542	A1		
C494	A4	Q168	E3	R152	G3	R411	J6	R550	B2		
C495 †	C2	Q171	F2	R154	H3	R414*	J5	R551	A2		
C496 †	C2	Q181	E2	R155	G4	R420	K5	R552	D2		
C497 †	C2	Q185	D2	R157	F1	R421	K5	R553	B2		
C498 †	B2	Q195	C4	R159	G5	R422	K5	R555	B3		
C499 †	B2	Q196	C5	R160	D3	R423	K5	R558	B2		
C530	F1	Q236	H4	R161	D3	R424	K6	R559	B2		
C536	C1	Q267	F3	R162	D3	R431	J4	R560	C2		
C552	C2	Q268	F3	R164	E3	R433	J4	R561	A2		
C560	B2	Q269	C5	R166	E3	R435	J4	R562	C2		
C570	B2	Q281	E2	R168	D4	R436	J3	R570	C2		
C910	B6	Q285	D2	R170	F2	R438	J2	R571	B3		
C922	D5	Q410*	J5	R171	E2	R440	K4	R572	C3		
C924	H6	Q416	J4	R173	E2	R441	K4	R900	A4		
C926	H6	Q422*	J5	R175	D2	R442	K4	R910	D6		
C930	B5	Q426	K5	R176	D3	R443	K4	R915	C5		
C942	D6	Q431	J4	R177	D2	R445	K3	R916	D6		
C960	C5	Q443	L4	R178	E3	R446	J3	R920	C5		
C964	G6	Q445	K4	R181	E2	R448	J2	R922	E5		
C966	G6	Q451	J4	R184	C1	R450	J4	R924	H6		
C968	D5										

*See Parts List for serial number ranges.

REV OCT 1986

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

The voltages and waveforms shown on the diagram 1 and 2 were taken with the AM 502 front panel controls set as follows:

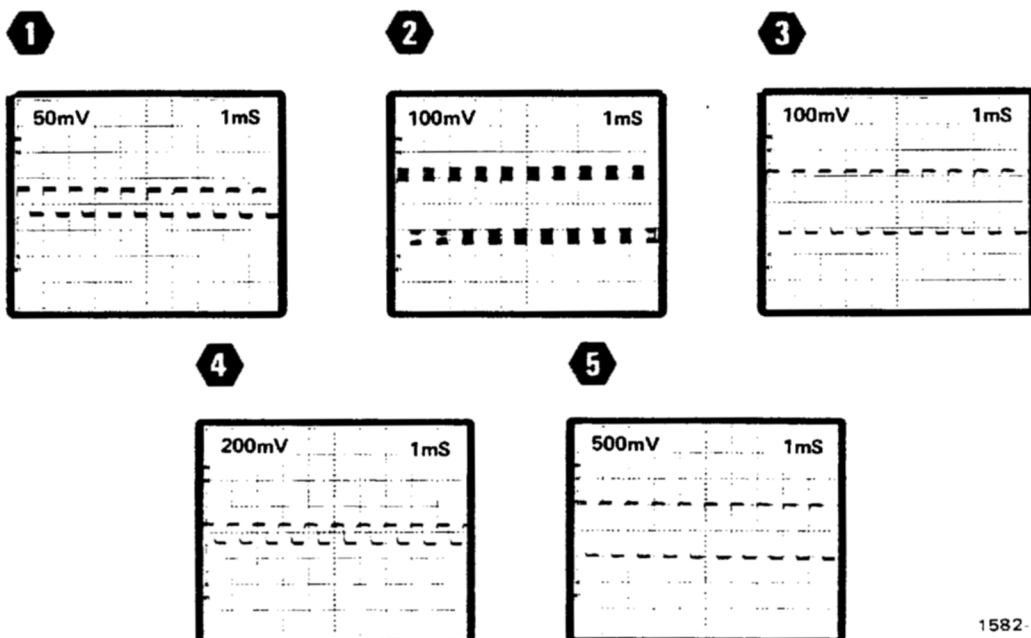
VOLTAGES		WAVEFORMS ¹	
GAIN	100	GAIN	100
÷100	pushbutton out	÷100	pushbutton out
HF -3 dB switch	1 MHz	HF -3 dB switch	1 MHz
LF -3 dB switch	DC	LF -3 dB switch	DC
+ input AC	pushbutton out	+ input AC	pushbutton out
GND	pushbutton in	GND	pushbutton out
- input AC	pushbutton out	- input AC	pushbutton out
GND	pushbutton in	GND	pushbutton in
STEP GAIN	centered	STEP GAIN	centered
DC BAL		DC BAL	
DC OFFSET	centered	DC OFFSET	centered
(COURSE - FINE)		(COURSE- FINE)	

¹Ground reference: center horizontal graticule line

The waveforms shown were taken with a 50 mV square-wave input signal applied to the + input connector of the AM 502.

Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 10 megohm input impedance (TEKTRONIX DM 501 Digital Multimeter or TEKTRONIX 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

Waveform Conditions. The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.



VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

The voltages and waveforms shown on the diagram 1 and 2 were taken with the AM 502 front panel controls set as follows:

VOLTAGES		WAVEFORMS ^a	
GAIN	100	GAIN	100
÷100	pushbutton out	÷100	pushbutton out
HF -3 dB switch	1 MHz	HF -3 dB switch	1 MHz
LF -3 dB switch	DC	LF -3 dB switch	DC
+ input AC	pushbutton out	+ input AC	pushbutton out
GND	pushbutton in	GND	pushbutton out
- input AC	pushbutton out	- input AC	pushbutton out
GND	pushbutton in	GND	pushbutton in
STEP GAIN	centered	STEP GAIN	centered
DC BAL		DC BAL	
DC OFFSET	centered	DC OFFSET	centered
(COURSE - FINE)		(COURSE- FINE)	

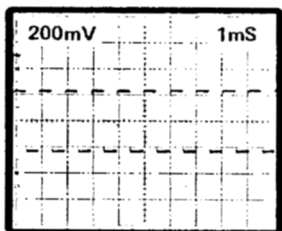
^aGround reference: center horizontal graticule line

The waveforms shown were taken with a 50 mV square-wave input signal applied to the + input connector of the AM 502.

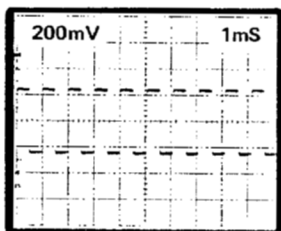
Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 10 megohm input impedance (TEKTRONIX DM 501 Digital Multimeter or TEKTRONIX 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

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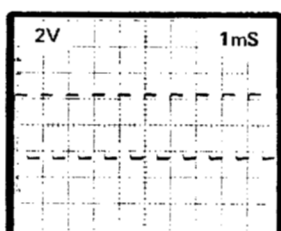
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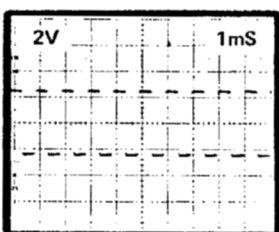
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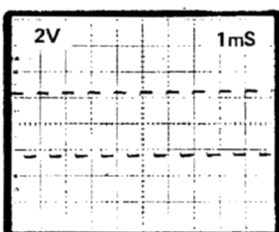
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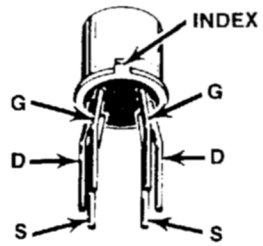


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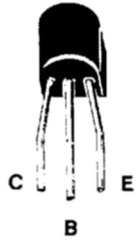


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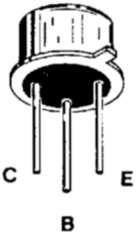




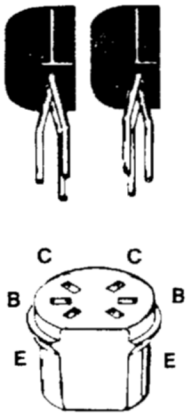
Q162, Q171



Q501, Q511, Q521, Q532
Q541, Q555, Q558

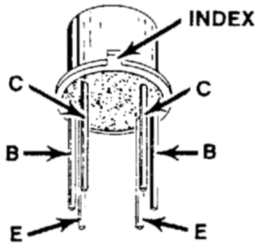


Q540



Q164 (SN B057429 & BELOW)

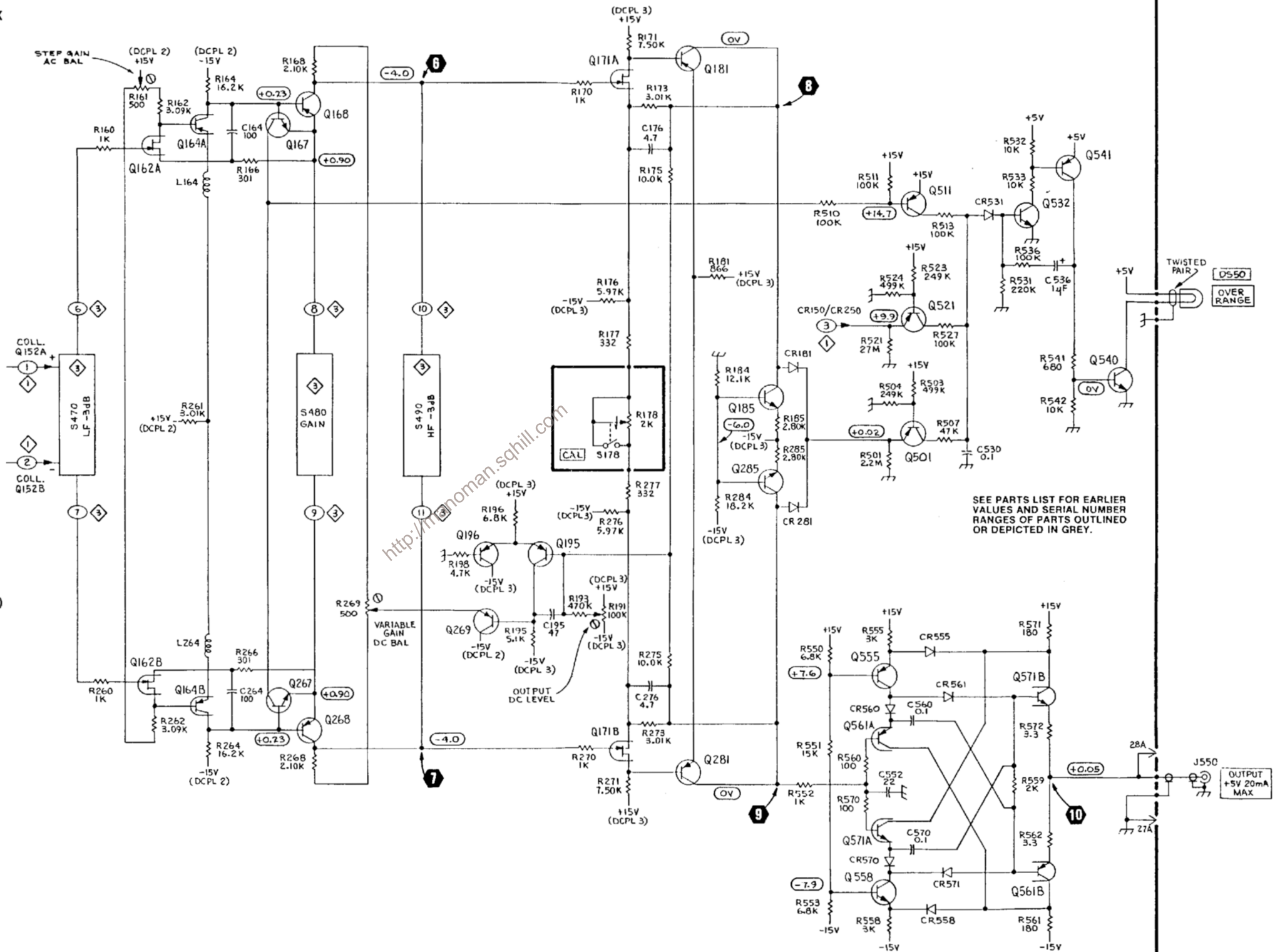
DUAL



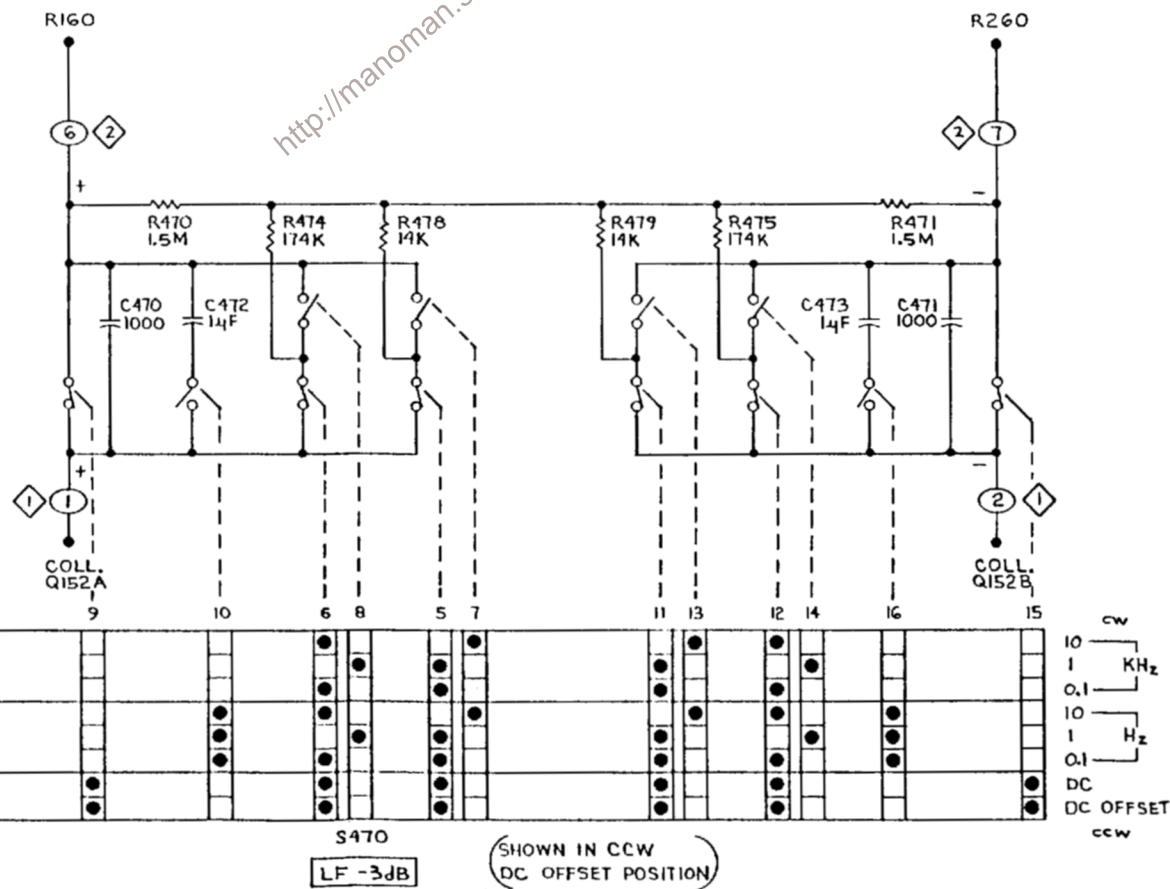
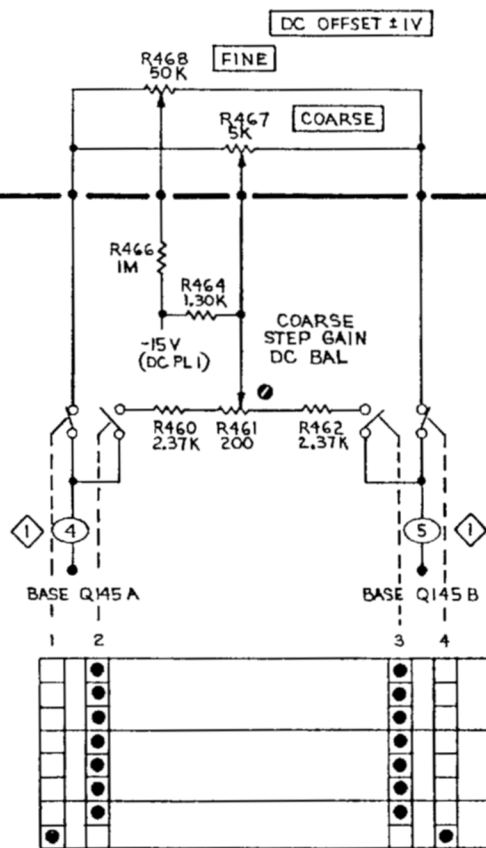
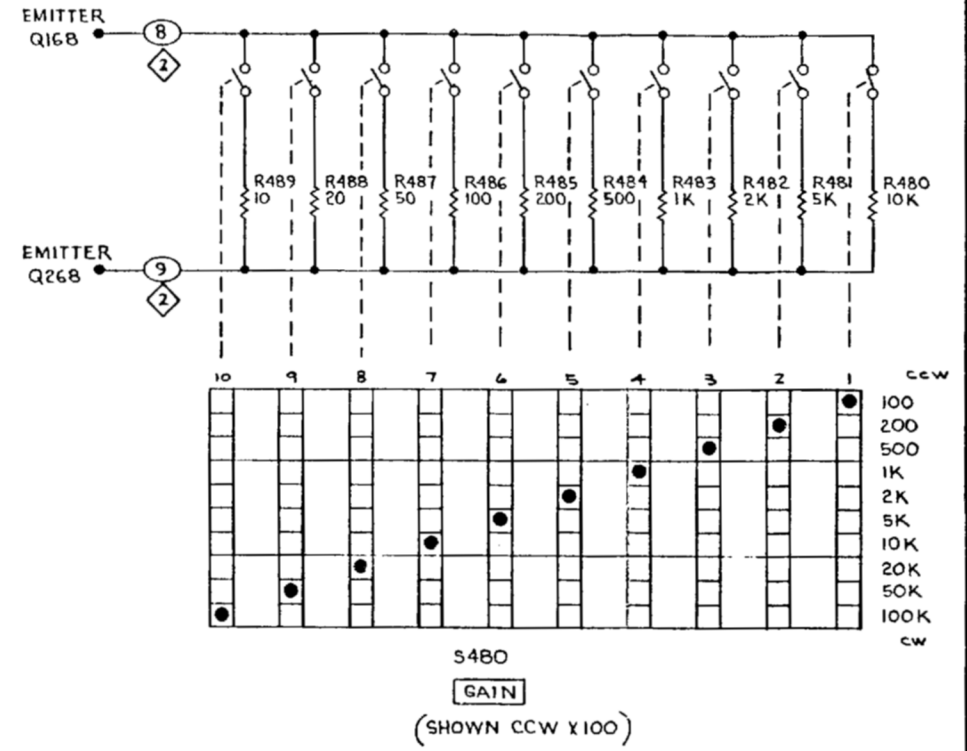
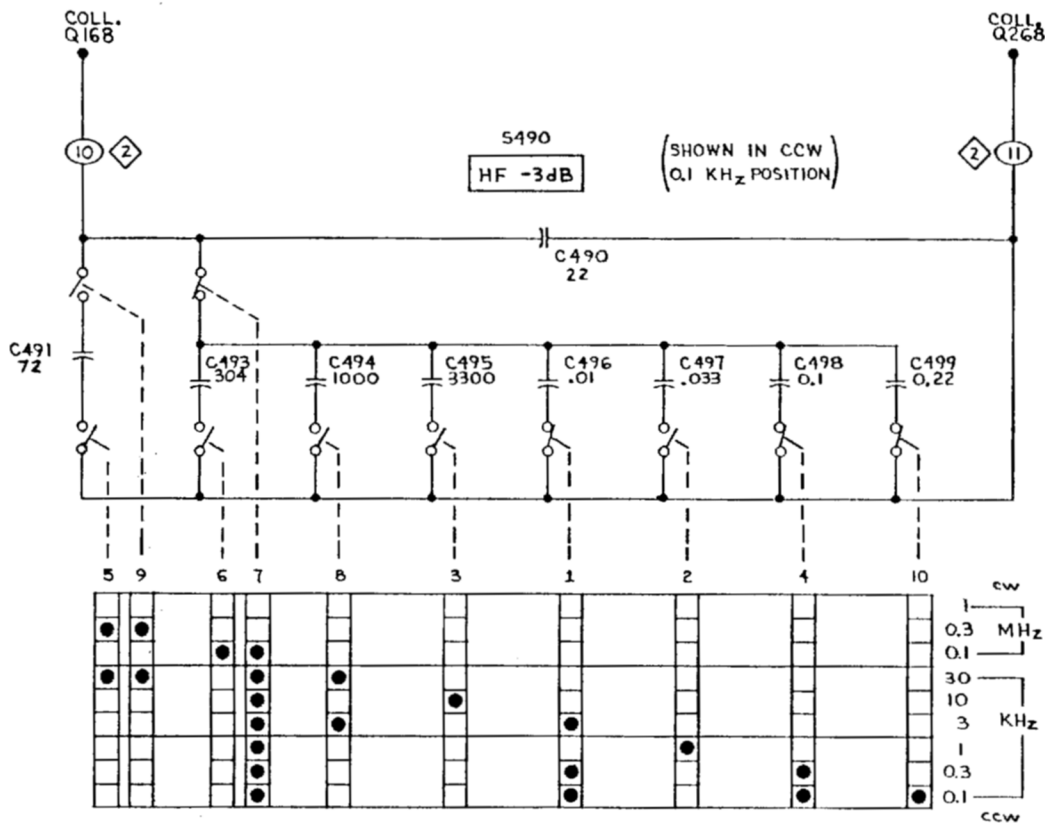
Q164, Q561, Q571



Q167, Q168, Q181, Q185
Q195, Q196, Q267, Q268
Q269, Q281, Q285



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



VOLTAGE CONDITIONS

WARNING

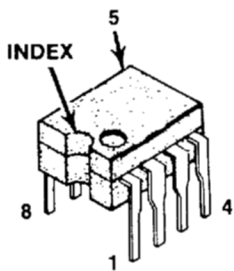
Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

The voltages shown on the diagram were taken with the AM 502 front panel controls set as follows:

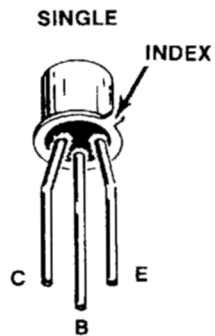
VOLTAGES

Gain	100
÷100	pushbutton out
HF -3 dB switch	1 MHz
LF -3 dB switch	DC
+ input AC	pushbutton out
GND	pushbutton in
- input AC	pushbutton out
GND	pushbutton in
STEP GAIN	centered
DC BAL	
DC OFFSET	centered
(COURSE - FINE)	

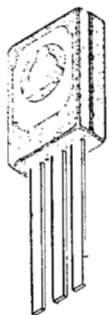
Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 10 megohm input impedance (TEKTRONIX DM 501 Digital Multimeter or TEKTRONIX 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).



U910, U990



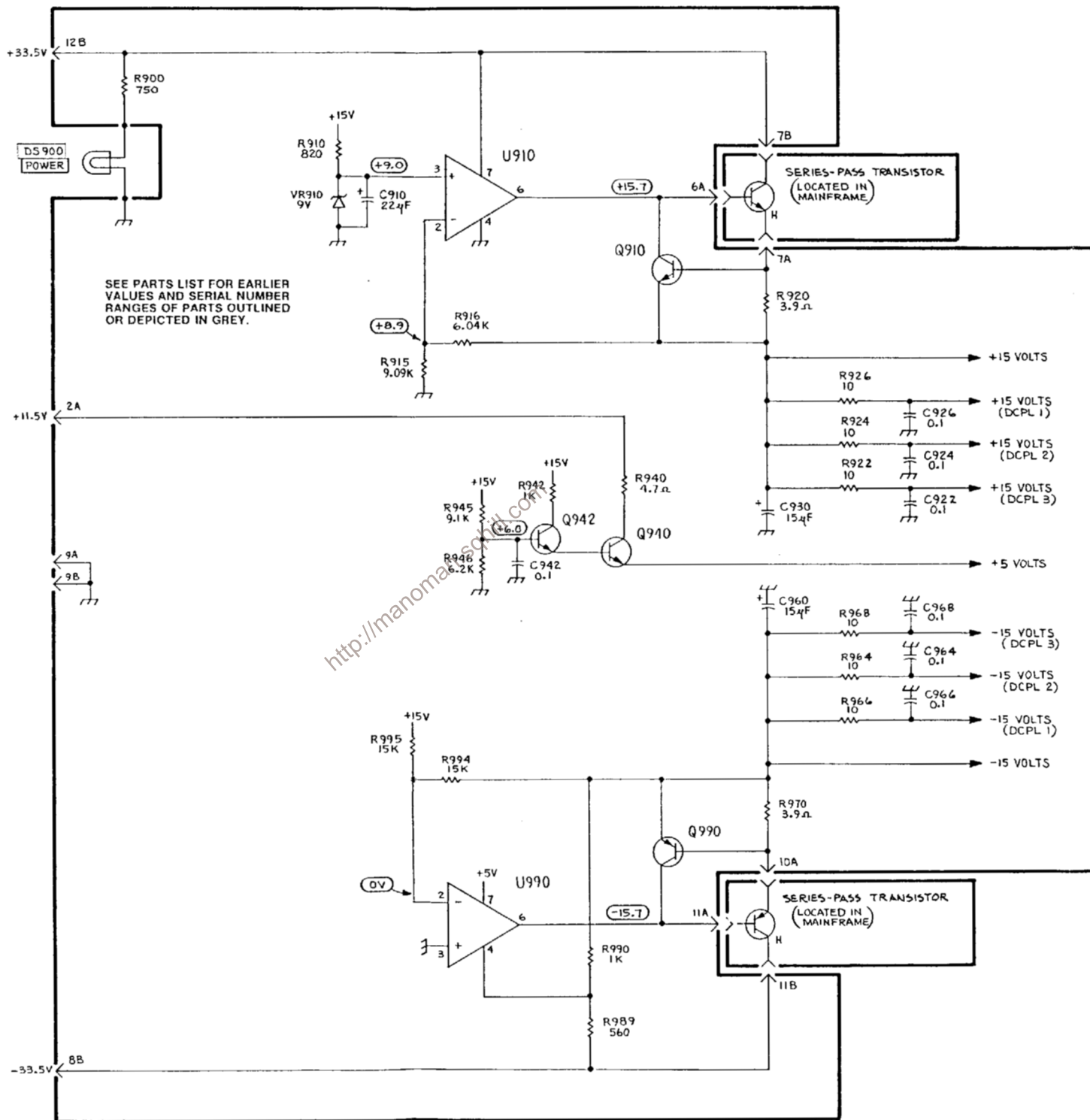
Q910, Q990



Q940



Q942



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

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

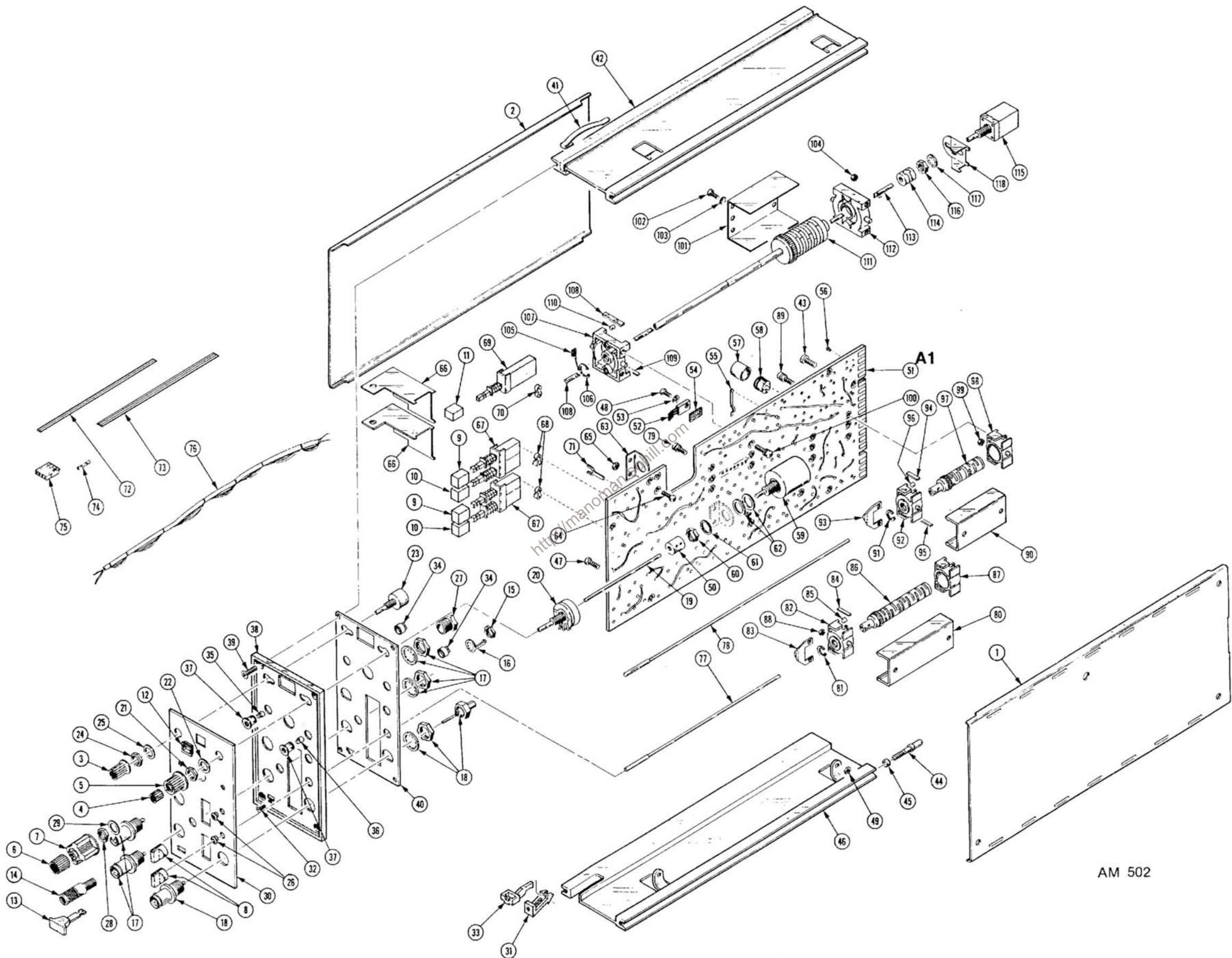
Mfr. Code	Manufacturer	Address	City, State, Zip Code
02107	SPARTA MFG CO	5200 N WOOSTER RD P O BOX 449	DOVER OH 44622
09922	BURNDY CORP	RICHARDS AVE	NORMALK CT 06852
12327	FREEMAY CORP	9301 ALLEN DR	CLEVELAND OH 44125
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS	30 HUNTER LANE	CAMP HILL PA 17011
28520	HEYCO MOLDED PRODUCTS	147 MICHIGAN AVE P O BOX 160	KENILWORTH NJ 07033
45722	USM CORP., PARKER-KALON FASTENER DIV		CAMPBELLSVILLE, KY 42718
56878	SPS TECHNOLOGIES INC	HIGHLAND AVE	JENKINTOWN PA 19046
71159	BRISTOL SOCKET SCREW CO		WATERBURY CT
71785	TRM INC TRM CINCH CONNECTORS	1501 MORSE AVE	ELK GROVE VILLAGE IL 60007
73743	FISCHER SPECIAL MFG CO	446 MORGAN ST	CINCINNATI OH 45206
74445	HOLD-KROME CO	31 BROOK ST	WEST HARTFORD CT 06110
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIVISION	ST CHARLES ROAD	ELGIN IL 60120
79136	MALDES KOHINOOR INC	47-16 AUSTEL PLACE	LONG ISLAND CITY NY 11101
80009	TEKTRONIX INC	4900 S M GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
83385	MICRODOT MANUFACTURING INC GREER-CENTRAL DIV	3221 M BIG BEAVER RD	TROY MI 48098
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201
91836	KINGS ELECTRONICS CO INC	40 MARBLEDALE ROAD	TUCKAHOE NY 10707
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
TK0392	NORTHWEST FASTENER SALES INC	7923 SM CIRRUS DRIVE	BEAVERTON OR 97005
TK0435	LENIS SCREW CO	4114 S PEDRIA	CHICAGO IL 60609
TK0507	O HARA METAL PRODUCTS CO	542 BRANNAN ST	SAN FRANCISCO CA 94107

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	337-1399-01	8010100	8130524	2	SHIELD,ELEC:SIDE	80009	337-1399-01
	337-1399-01	8130525		1	SHIELD,ELEC:SIDE	80009	337-1399-01
-2	337-1399-00	8130525		1	SHIELD,ELEC:SIDE	80009	337-1399-00
-3	366-0494-00			1	KNOB:GRAY WITH SETSCREM	80009	366-0494-00
	213-0153-00			1	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-4	366-1518-00	8010100	8040799	1	KNOB:GY,0.083 ID X 0.392 OD X 0.4 H	80009	366-1518-00
	213-0153-00	8010100	8040799	1	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
	366-1084-00	8040800	8049999	1	KNOB:GY,0.08 ID X 0.392 OD X 0.4 H	80009	366-1084-00
	213-0725-00	8040800	8049999	1	.SETSCREM:3-48 X 0.094,STL	56878	ORDER BY DESCR
	366-1023-00	8050000		1	KNOB:GY,0.127 ID X 0.392 OD X 0.531 H	80009	366-1023-00
	213-0246-00	8050000		1	.SETSCREM:5-40 X 0.125,STL	71159	ORDER BY DESCR
-5	366-1101-00			1	KNOB:GY,0.127 ID X 0.706 OD X 0.6 H	80009	366-1101-00
	213-0153-00			1	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-6	366-1317-00			1	KNOB:RED,CAL,0.127 ID X 0.5 OD X 0.531 H	80009	366-1317-00
	213-0153-00			1	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-7	366-1001-00			1	KNOB:GY,0.252 ID X 0.925 OD X 0.67	80009	366-1001-00
	213-0153-00			2	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-8	366-1163-00			2	KNOB:GY,0.127 ID X 0.392 OD X 0.466 H	80009	366-1163-00
	213-0153-00			1	.SETSCREM:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-9	366-1257-11			2	PUSH BUTTON:SIL GY,AC PRE	80009	366-1257-11
-10	366-1257-12			2	PUSH BUTTON:SIL GY,CHG GND	80009	366-1257-12
-11	366-1489-31			1	PUSH BUTTON:SIL GY,DIVIDE BY 10	80009	366-1489-31
-12	426-0681-00			5	FRAME,PUSH BTN:	80009	426-0681-00
	214-1840-00	8010100	8053579	1	PIN,KNOB SECRG:0.12 L X 0.094-0.1 OD,ACETAL	80009	214-1840-00
-13	366-1422-01	8010100	8053579	1	KNOB:LATCH	80009	366-1422-01
	366-1690-00	8053580		1	KNOB,LATCH:SIL GY,0.53 X 0.23 X 1.059	80009	366-1690-00
-14	129-0103-00			1	POST,BDG,ELEC:ASSEMBLY (ATTACHING PARTS)	80009	129-0103-00
-15	210-0455-00			1	NUT,PLAIN,HEX:0.25-28 X 0.375,BRS NP	73743	3089-402
-16	210-0223-00			1	TERMINAL,LUG:0.26 ID,LOCKING,BRZ TIN PL (END ATTACHING PARTS)	86928	5441-37
	200-0103-00			1	.NUT,PLAIN,KNURL:0.25-28 X 0.375*00 BRASS	80009	200-0103-00
	129-0077-00			1	STUD,SHOULDERED:0.938 L X 0.375,0.250-28	80009	129-0077-00
-17	131-0955-00			2	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-18	131-0818-00			1	CONN,RCPT,ELEC:BNC,FEMALE	91836	KC-19-153
-19	384-1221-00	8010100	8049999	1	EXTENSION SHAFT:3.0 L X 0.081 OD,SST	80009	384-1221-00
	384-0415-01	8050000		1	EXTENSION SHAFT:3.18 L X 0.081 OD,STEEL	80009	384-0415-01
-20	-----			1	RESISTOR,VARIABLE:(SEE R468 REPL) (ATTACHING PARTS)		
-21	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-22	210-0940-00			1	MASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL (END ATTACHING PARTS)	12327	ORDER BY DESCR
-23	-----			1	RESISTOR,VARIABLE:(SEE R158 REPL) (ATTACHING PARTS)		
-24	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-25	210-0940-00			1	MASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL (END ATTACHING PARTS)	12327	ORDER BY DESCR
-26	358-0378-00	8010100	8054649	2	BUSHING,SLEEVE:0.131 ID X 0.18 OD X 0.125 L	80009	358-0378-00
	358-0599-00	8054650		2	BUSHING,SLEEVE:0.125 ID X 0.25 OD X 0.234	28520	8-187-125
-27	358-0029-00			1	BSHG,MACH THD:0.375-32 X 0.5 HEX,BRS NP (ATTACHING PARTS)	80009	358-0029-00
-28	210-0590-00			1	NUT,PLAIN,HEX:0.375-32 X 0.438 BRS CD PL	73743	28269-402
-29	210-0978-00			1	MASHER,FLAT:0.375 ID X 0.5 OD X 0.024,STL (END ATTACHING PARTS)	12327	ORDER BY DESCR
-30	333-1711-00			1	PANEL,FRONT:	80009	333-1711-00
-31	214-1513-01	8010100	8053579	1	LCH,PL-IN RTNG:PLASTIC	80009	214-1513-01
	105-0719-00	8053580		1	LATCH,RETAINING:PLUG-IN (ATTACHING PARTS)	80009	105-0719-00
-32	213-0254-00			1	SCREM,TPG,TF:2-32 X 0.25,TYPE B,FLH,100 DEG	45722	ORDER BY DESCR
-33	105-0718-00	8053580	8054529	1	BAR,LATCH RLSE:	80009	105-0718-00
	105-0718-01	8054530		1	BAR,LATCH RLSE: (END ATTACHING PARTS)	80009	105-0718-01
-34	200-0935-00			2	BASE,LAMPHOLDER:0.29 OD X 0.19 L,BK PLSTC	80009	200-0935-00
-35	378-0602-01			1	LENS,LIGHT:AMBER	80009	378-0602-01
-36	378-0602-00			1	LENS,LIGHT:GREEN	80009	378-0602-00
-37	352-0157-00			2	LAMPHOLDER:(1)T-2 UNBASED,WHITE	80009	352-0157-00
-38	386-2529-00	8010100	8049999	1	SUBPANEL,FRONT:	80009	386-2529-00

Replaceable Mechanical Parts - AM 502

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	386-2529-01	8050000		1	SUBPANEL, FRONT: (ATTACHING PARTS)	80009	386-2529-01
-39	213-0229-00	8010100	8054759	4	SCREW, TPG, TF:6-20 X 0.375, TYPE B, FLH, STL	93907	ORDER BY DESCR
	213-0123-00	8054760		4	SCREW, TPG, TF:6-32 X 0.375, SPCL TYPE, FLH (END ATTACHING PARTS)	93907	234-21940-026
-40	337-1782-00	8010100	8049999	1	SHIELD, ELEC: REAR PANEL	80009	337-1782-00
	337-1782-01	8050000		1	SHIELD, ELEC: REAR	80009	337-1782-01
-41	214-1061-00			1	CONTACT, ELEC: GROUNDING, CU BE	80009	214-1061-00
-42	426-0725-00			1	FR SECT, PLUG-IN: TOP (ATTACHING PARTS)	80009	426-0725-00
-43	213-0146-00			2	SCREW, TPG, TF:6-20 X 0.312, TYPE B, PNH, STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-44	386-3657-00	8053580	8055259	2	SUPPORT, PLUG-IN:	80009	386-3657-00
	386-3657-01	8055260		2	SUPPORT, PLUG-IN:	93907	ORDER BY DESCR
-45	210-1270-00	8053580		2	WASHER, FLAT: 0.141 ID X 0.219 OD X 0.04, AL	80009	210-1270-00
-46	426-0724-00			1	FR SECT, PLUG-IN: BOTTOM (ATTACHING PARTS)	80009	426-0724-00
-47	213-0146-00			1	SCREW, TPG, TF:6-20 X 0.312, TYPE B, PNH, STL	83385	ORDER BY DESCR
-48	211-0012-00			1	SCREW, MACHINE: 4-40 X 0.375, PNH, STL	TK0435	ORDER BY DESCR
-49	210-0406-00			1	NUT, PLAIN, HEX: 4-40 X 0.188, BRS CD PL (END ATTACHING PARTS)	73743	12161-50
-50	376-0039-00			1	CPLG, SHAFT, RGD: 0.082 & 0.128 ID, AL	80009	376-0039-00
	213-0075-00			2	.SETSCREW: 4-40 X 0.094, STL	74445	ORDER BY DESCR
-51	-----			1	CKT BOARD ASSY: MAIN (SEE A1 REPL)		
-52	-----			1	.TRANSISTOR: (SEE A10940 REPL)		
-53	210-1122-00			1	.WASHER, LOCK: 0.12 ID, DISHED, 0.025 THK, STL	86928	ORDER BY DESCR
-54	210-0910-00			1	.WASHER, FLAT: 0.19 OD X 0.281 OD X 0.046	02107	5-47-11
-55	131-0604-00			36	.CONTACT, ELEC: CKT BD SM, SPR, CU BE	80009	131-0604-00
-56	136-0252-04	8010100	8030294	72	.SOCKET, PIN TERM: U/M 0.016-0.018 DIA PINS	22526	75060-007
	136-0252-04	8030295		56	.SOCKET, PIN TERM: U/M 0.016-0.018 DIA PINS	22526	75060-007
	136-0514-00	8030295	8058919	2	.SKT, PL-IN ELEC: MICROCIRCUIT, 8 DIP	09922	D1L88P-108
-57	200-0687-01			1	.COVER, XSTR: TO-5, ACETAL	80009	200-0687-01
	131-0608-00			4	TERMINAL, PIN: 0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-58	136-0235-00			1	.SKT, PL-IN ELEC: TRANSISTOR, 6 CONTACT	71785	133-96-12-062
-59	-----				.RESISTOR, VARIABLE: (SEE A1R467 REPL) (ATTACHING PARTS)		
-60	210-0583-00			1	.NUT, PLAIN, HEX: 0.25-32 X 0.312, BRS CD PL	73743	2X-20319-402
-61	210-0046-00			1	.WASHER, LOCK: 0.261 ID, INTL, 0.018 THK, STL	77900	1214-05-00-0541C
-62	210-1025-00	8010100	8059999	2	.WASHER, FLAT: 0.312 ID X 0.469 OD X 0.031, BR .S	12327	ORDER BY DESCR
	210-0465-00	8060000		1	.NUT, PLAIN, HEX: 0.25-32 X 0.375, BRS CD PL (END ATTACHING PARTS)	73743	3095-402
-63	407-1337-00			1	.BRACKET, VAR RES: STEEL (ATTACHING PARTS)	80009	407-1337-00
-64	211-0008-00			2	.SCREW, MACHINE: 4-40 X 0.25, PNH, STL	93907	ORDER BY DESCR
-65	210-0551-00			2	.NUT, PLAIN, HEX: 4-40 X 0.25, ST CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCR
-66	337-1883-00			2	.SHIELD, ELEC: PUSHBUTTON, CTR	80009	337-1883-00
-67	-----			2	.SWITCH, PUSH: (SEE A1S10 AND A1S20 REPL)		
-68	361-0385-00	8010100	8052349	8	.SPACER, PB SM: 0.164 L, GREEN POLYCARBONATE	80009	361-0385-00
	361-0384-00	8052350		8	.SPACER, PB SM: 0.133 L, RED POLYCARBONATE	80009	361-0384-00
-69	-----			1	.SWITCH, PUSH: (SEE A1S30 REPL)		
-70	361-0383-00			2	.SPCR, PB SM: 0.33 L, CHARCOAL, POLYCARBONATE	80009	361-0383-00
-71	344-0154-00			4	.CLIP, ELECTRICAL: FUSE, CKT BD MT	80009	344-0154-00
	198-2155-00			1	.WIRE SET, ELEC:	80009	198-2155-00
-72	175-0825-00			1	.CABLE, SP, ELEC: 2, 26 AWG, STRD, PVC JKT, RBN	80009	175-0825-00
-73	175-0826-00			1	.CABLE, SP, ELEC: 3, 26 AWG, STRD, PVC JKT, RBN	80009	175-0826-00
-74	131-0707-00			4	.CONTACT, ELEC: 22-26 AWG, BRS, CU BE GLD PL	22526	47439-000
-75	352-0162-02			1	.HLDR, TERM CONN: 4 WIRE, RED	80009	352-0162-02
-76	179-2028-00			1	.WIRING HARNESS: MAIN	80009	179-2028-00
	175-3112-00			1	.CABLE ASSY, RF: 50 OHM COAX, 0.958 L	80009	175-3112-00
-77	384-0173-00			1	EXTENSION SHAFT: 6.438 L X 0.125 STEP OD, STL	80009	384-0173-00
-78	384-0348-01			1	EXTENSION SHAFT: 9.161 L X 0.125 STEP OD	80009	384-0348-01
	263-1004-00			1	SM CAM ACTR AS: LF-3DB POINT (ATTACHING PARTS)	80009	263-1004-00
-79	211-0116-00	8010100	8057469	4	SCR, ASSEM WSHR: 4-40 X 0.312, PNH, BRS, NP	77900	ORDER BY DESCR
	211-0292-00	8057470		4	SCR, ASSEM WSHR: 4-40 X 0.29, PNH, BRS, NI PL	78189	51-040445-01

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
1-					(END ATTACHING PARTS)		
-80	200-1598-00		1		.COVER,CAM SM:16 ELEMENTS	80009	200-1598-00
-81	354-0219-00		1		.RING,RETAINING:EXT,CRESCENT,U/O 0.25 DIA	79136	5103-25-S-Z0-R
-82	401-0155-00		1		.BEARING,CAM SM:FRONT,0.454 DIA CAM	80009	401-0155-00
-83	131-0840-00		1		.CONTACT,ELEC:GROUNDING,NI BE	80009	131-0840-00
-84	214-1704-01		2		.SPRING,FLAT:0.52 X 0.125 X 0.008,CU BE	80009	214-1704-01
-85	214-1127-00		2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-86	105-0498-00		1		.ACTUATOR,CAM SM:LF-30B	80009	105-0498-00
-87	401-0156-00		1		.BEARING,CAM SM:REAR,0.454 DIA CAM	80009	401-0156-00
-88	210-0406-00		4		.NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
	213-0075-00		2		.SETSCREW:4-40 X 0.094,STL	74445	ORDER BY DESCR
	263-1003-00		1		SM CAM ACTR AS:HF-30B POINT	80009	263-1003-00
					(ATTACHING PARTS)		
-89	211-0116-00		4		SCR,ASSEM MSHR:4-40 X 0.312,PNH,BRS,NP	77900	ORDER BY DESCR
					(END ATTACHING PARTS)		
-90	200-1597-00		1		.COVER,CAM SM:10 ELEMENTS	80009	200-1597-00
-91	354-0219-00		1		.RING,RETAINING:EXT,CRESCENT,U/O 0.25 DIA	79136	5103-25-S-Z0-R
-92	401-0155-00		1		.BEARING,CAM SM:FRONT,0.454 DIA CAM	80009	401-0155-00
-93	131-1248-00		1		.CONTACT,ELEC:SHAFT GND,NI BE	80009	131-1248-00
-94	214-1704-00		1		.SPRING,FLAT:0.52 X 0.125 X 0.006,CU BE	80009	214-1704-00
-95	214-1704-01		1		.SPRING,FLAT:0.52 X 0.125 X 0.008,CU BE	80009	214-1704-01
-96	214-1127-00		2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-97	105-0502-00		1		.ACTUATOR,CAM SM:HF-30B	80009	105-0502-00
-98	401-0156-00		1		.BEARING,CAM SM:REAR,0.454 DIA CAM	80009	401-0156-00
-99	210-0406-00		4		.NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
	213-0075-00		2		.SETSCREW:4-40 X 0.094,STL	74445	ORDER BY DESCR
	263-1005-00		1		SM CAM ACTR AS:GAIN	80009	263-1005-00
					(ATTACHING PARTS)		
-100	211-0116-00		4		SCR,ASSEM MSHR:4-40 X 0.312,PNH,BRS,NP	77900	ORDER BY DESCR
					(END ATTACHING PARTS)		
-101	200-1596-00		1		.COVER,CAM SM:10 ELEMENTS	80009	200-1596-00
					(ATTACHING PARTS)		
-102	211-0008-00		4		SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
-103	210-0004-00		4		WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
-104	210-0406-00		3		.NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
-105	131-0963-00		1		.CONTACT,ELEC:GROUNDING,PH BRZ,M/BRACKET	TK0507	ORDER BY DESCR
					(END ATTACHING PARTS)		
-106	354-0391-00		1		.RING,RETAINING:EXT,U/O 0.438 DIA SFT	80009	354-0391-00
-107	401-0081-02		1		.BEARING,CAM SM:FRONT M/O MOUNTING BOSSES	80009	401-0081-02
-108	214-1139-03		1		.SPRING,FLAT:0.885 X 0.156 CU BE RED CLR	80009	214-1139-03
-109	214-1139-02		1		.SPRING,FLAT:0.885 X 0.156 CU BE GRN CLR	80009	214-1139-02
-110	214-1127-00		2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-111	105-0503-00		1		.ACTUATOR,CAM SM:GAIN	80009	105-0503-00
-112	401-0115-00		1		.BEARING,CAM SM:CNTR,0.83 DIA CAM,DBL BD	80009	401-0115-00
	210-0406-00		3		.NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
	131-0963-00		1		.CONTACT,ELEC:GROUNDING,PH BRZ,M/BRACKET	TK0507	ORDER BY DESCR
-113	384-1220-00		1		EXTENSION SHAFT:8.038 L X 0.125 OD,AL	80009	384-1220-00
-114	376-0029-00	8010100	1	8059999	CPLG,SHAFT,RGD:0.128 ID X 0.312 OD,AL	80009	376-0029-00
	376-0051-00	8060000	1	8070609	CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD	80009	376-0051-00
	376-0051-01	8070610	1		CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD	80009	376-0051-01
	213-0075-00		2		.SETSCREW:4-40 X 0.094,STL	74445	ORDER BY DESCR
-115			1		RESISTOR,VARIABLE:(SEE R178/S178 REPL)		
					(ATTACHING PARTS)		
-116	210-0583-00		1		NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-117	210-0046-00		2		WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
-118	407-0803-00		1		BRACKET,ELEC SM:BRASS	80009	407-0803-00
					(END ATTACHING PARTS)		
					STANDARD ACCESSORIES		
	070-1582-01		1		MANUAL,TECH:INSTRUCTION	80009	070-1582-01



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