Tektronix®

COMMITTED TO EXCELLENCE

AM-6565/U AMPLIFIER

WITH OPTIONS

INSTRUCTION MANUAL

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INSTRUCTION MANUAL

Tektronix, Inc.
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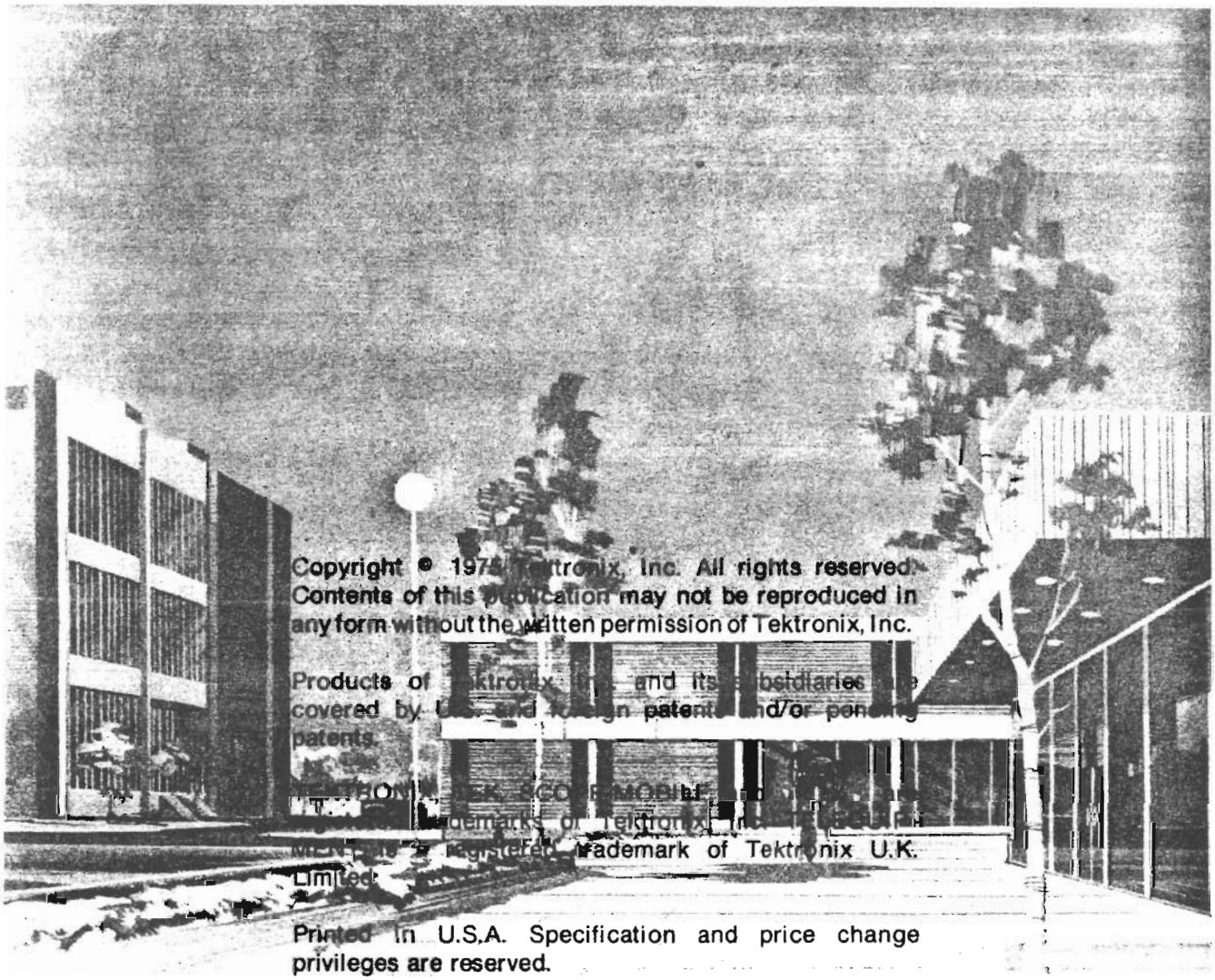

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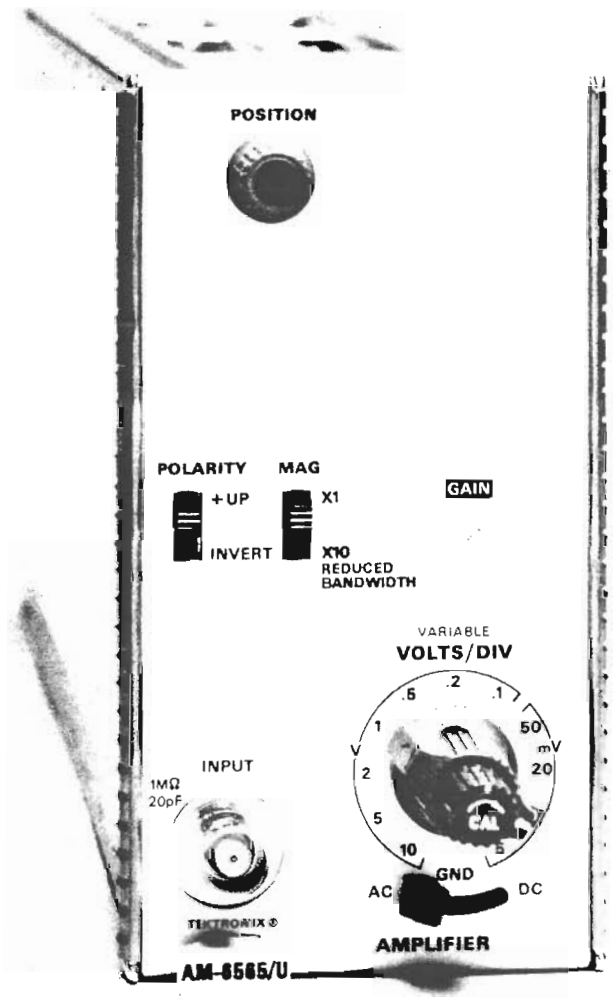

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Fig. 1-1. AM-6565/U Amplifier unit.

OPERATING INSTRUCTIONS

This manual includes operating information, instrument specifications, circuit description, maintenance and calibration information, schematics and circuit board illustrations, and complete parts lists for the AM-6565/U, hereafter referred to as the Amplifier unit.

To effectively use the Amplifier unit, the operation and capabilities of the instrument must be known. This section describes front-panel control functions, general information on signal input connections, and other subjects that pertain to measurement applications.

INSTALLATION

The Amplifier unit is calibrated and ready for use as received. It can be installed in any compartment of a Tektronix 7000-series oscilloscope, but is intended for use primarily in vertical plug-in compartments. To install, align the upper and lower rails of the Amplifier unit with the oscilloscope tracks and insert the plug-in. The front panel is flush with the front of the oscilloscope and the latch is in place against the front panel when the Amplifier unit is fully inserted.

To remove the Amplifier unit, pull on the latch (which is inscribed with the unit identification) and slide the Amplifier unit out of the oscilloscope.

FRONT PANEL CONTROLS AND CONNECTORS

VOLTS/DIV Switch — Selects calibrated deflection factors from 5 mV/Division to 10 V/Division; 11 steps in a 1-2-5 sequence.

VARIABLE Control — Provides continuously variable uncalibrated settings between calibrated steps. Extends the deflection factor range to at least 25 volts/division.

GAIN Adjustment — Screwdriver adjustment permits calibration of deflection factor.

POLARITY Switch — Provides means of inverting the display.
+UP: A positive-going signal at the INPUT connector deflects the display upward.

INVERT: A positive-going signal at the INPUT connector deflects the display downward.

MAG Switch — Provides means of increasing the sensitivity of the Amplifier unit.
X1: Deflection factor is selected by VOLTS/DIV and VARIABLE controls.

X10 REDUCED BANDWIDTH: Sensitivity is ten times the value selected by the VOLTS/DIV and VARIABLE controls.

INPUT Connector — Provides signal connection to the amplifier.

Coupling (AC-GND-DC) Switch — Selects signal input-coupling mode.
AC: The ac component of the signal is coupled to the amplifier while the dc component is blocked.

DC: Both ac and dc components of the signal are coupled to the amplifier.

GND: Grounds the amplifier while maintaining a 1 megohm load for the input signal. (Also provides a path to precharge the ac coupling capacitor before switching to AC coupling.)

POSITION Control — Controls position of the trace on the crt.

BASIC OPERATION

This procedure demonstrates the use of the controls and connectors of the Amplifier unit and checks the basic operation of the instrument.

Preliminary Setup

Insert the Amplifier unit into any 7000-series oscilloscope vertical compartment and set the oscilloscope controls to display the plug-in units used.

Install a time-base unit in the horizontal compartment. Set the time-base unit for an auto-triggered sweep rate of one-millisecond per division.

Procedure

1. Set the Amplifier unit Coupling switch to GND and position the trace to the center of the graticule.

2. Set the VOLTS/DIV switch to 200 mV and apply a 1 volt, 1 kilohertz square-wave signal from the oscilloscope calibrator to the Amplifier unit. Set the Coupling switch to AC. The vertical deflection should be five divisions. If not, set the front panel GAIN adjustment for exactly five divisions.

3. Set the POLARITY switch to INVERT and check that the displayed signal is inverted as compared to its appearance in step 2.

4. Set the VOLTS/DIV switch to 2 V and the Amplifier unit MAG switch to X10. Check for a five-division display.

5. Reset the MAG switch to X1 and disconnect the calibrator signal from the Amplifier unit.

GENERAL OPERATING INFORMATION

Signal Connections

In general, probes offer the most convenient means of connecting a signal to the Amplifier unit. A 10X attenuator probe offers a high impedance and allows the circuit under test to operate normally.

Refer to Tektronix catalog for information on appropriate probes.

Input Coupling

The Coupling switch allows a choice of input coupling methods. The type of display desired and the applied signal will determine the coupling to use.

The DC position can be used for most applications. Dc-coupling must be used to obtain a satisfactory display of ac signals with frequencies below about 30 Hz, or square waves whose low-frequency components are important to the display.

In the AC position, the dc component of the signal is blocked by a capacitor in the input circuit. Ac coupling provides the best display of signals with a dc component much larger than the ac component. The pre-charge feature should be used when there is a possibility of having a residual charge on the input capacitor of the opposite polarity to the intended input. To use this feature, first set the coupling switch to GND, then connect the probe to the circuit and wait about two seconds for the coupling capacitor to charge before setting the coupling switch to AC.

The GND position provides a ground reference for the Amplifier unit without externally grounding the INPUT connector. The signal connected to the INPUT is not grounded, and the same dc load is presented to the signal source.

VOLTS/DIV, VARIABLE, and MAG Controls

The amount of deflection produced by a signal is determined by the signal amplitude, the attenuation factor of the probe, and the sensitivity of the Amplifier unit. Calibrated deflection factors represented by the setting of the VOLTS/DIV switch apply only when the VARIABLE control is in the CAL position (fully clockwise) and when the MAG switch is set to X1.

The VARIABLE control provides variable deflection factors between the calibrated steps of the VOLTS/DIV switch. With the VARIABLE control set fully counterclockwise, the uncalibrated deflection factor is extended to at least 2.5 times the VOLTS/DIV setting. By applying a calibrated voltage source to the INPUT connector, any specific deflection factor can be set within the range of the VARIABLE control.

The MAG switch increases the Amplifier unit sensitivity by a factor of 10 when in the X10 position. Thus, with the MAG switch set to X10 and the VOLTS/DIV switch set to 5 mV, the deflection factor is decreased to 500 microvolts per division.

NOTE

With the MAG switch set to X10, the bandwidth of the amplifier is reduced. Refer to Specifications, Section 2.

Polarity Switch

The POLARITY switch provides a means of inverting the displayed signal. With the POLARITY set to +UP, a positive-going signal produces an upward deflection of the crt display.

With the POLARITY set to INVERT, a positive-going signal produces a downward deflection of the crt display.

APPLICATIONS

The following information describes the procedures and techniques for making measurements with the Amplifier unit and the associated oscilloscope and time-base unit. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurements. This instrument can also be used for many applications which are not described in this manual. Contact your local Tektronix Field Office or representative for assistance in making specific measurements with this instrument.

Peak-to-Peak Voltage Measurements

To make peak-to-peak voltage measurements, use the following procedure:

1. Apply the signal to the INPUT connector.

2. Set the Coupling switch to AC.

NOTE

For low-frequency signals (below about 30 hertz), use the DC position to prevent attenuation of the signal.

3. Set the VOLTS/DIV switch to display about five vertical divisions of the waveform. (Check that the VARIABLE control is in the CAL position.)

4. Set the time-base controls for a stable display. Set the time-base unit for a sweep rate which displays several cycles of the waveform.

5. Adjust the Amplifier unit POSITION control so the lower portion of the waveform coincides with one of the graticule lines below the center horizontal line, and the top of the waveform is within the viewing area. With the time-base position control, move the display to set one of the upper peaks on the center vertical line (see Fig. 1-2).

6. Measure the divisions of peak-to-peak vertical deflection.

NOTE

This technique can also be used to make measurements between two points on the waveform, rather than peak-to-peak.

7. Multiply the distance measured in step 6 by the VOLTS/DIV switch setting. Include the attenuation factor of the probe, if used.

EXAMPLE: Assume that the peak-to-peak vertical deflection is 4.5 divisions using a 10X attenuator probe, and the VOLTS/DIV switch is set to 1 V.

$$\text{Volts} = \begin{matrix}\text{vertical}\\ \text{deflection}\\ \text{(divisions)}\end{matrix} \times \begin{matrix}\text{VOLTS/DIV}\\ \text{setting}\end{matrix} \times \begin{matrix}\text{probe}\\ \text{attenuator}\\ \text{factor}\end{matrix}$$

Substituting the given values:

Volts (Peak-to-Peak) = 4.5 X 1 X 10 = 45 volts

Instantaneous Voltage Measurements

To measure the dc level at a given point on a waveform, proceed as follows:

1. Connect the signal to the INPUT connector.

2. Set the VOLTS/DIV switch to display about five divisions.

3. Set the Coupling switch to GND and position the trace to the bottom graticule line or other reference line. If the voltage is negative with respect to ground, position the trace to the top graticule line. Do not move the POSITION control after this reference line has been established.

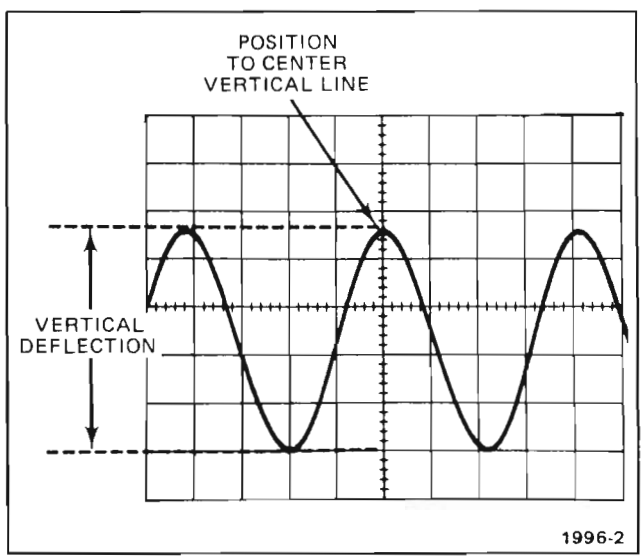


Fig. 1-2. Measuring the peak-to-peak voltage of a waveform.

NOTE

To measure a voltage level with respect to another voltage rather then ground, make the following changes to step 3: Set the Coupling switch to DC and apply the reference voltage to the INPUT connector. Then position the trace to a reference line and disconnect the reference voltage.

4. Set the Coupling switch to DC. The ground reference line can be checked at any time by switching to the GND position.

5. Set the time-base controls for a stable display. Set the time-base sweep rate for an optimum display of the waveform.

6. Measure the distance in divisions between the reference line and the point on the waveform at which the dc level is to be measured. For example, in Fig. 1-3, the measurement is between the reference line and point A.

7. Establish the polarity of the waveform. With the POLARITY switch in the +UP position, any point above the reference line is positive.

8. Multiply the distance measured in step 6 by the VOLTS/DIV switch setting. Include the attenuation factor of the probe, if used.

EXAMPLE: Assume the vertical distance measured is 4.6 divisions (see Fig. 1-3), and the waveform is above the reference line using a 10X probe with a VOLTS/DIV switch setting of 0.5 V.

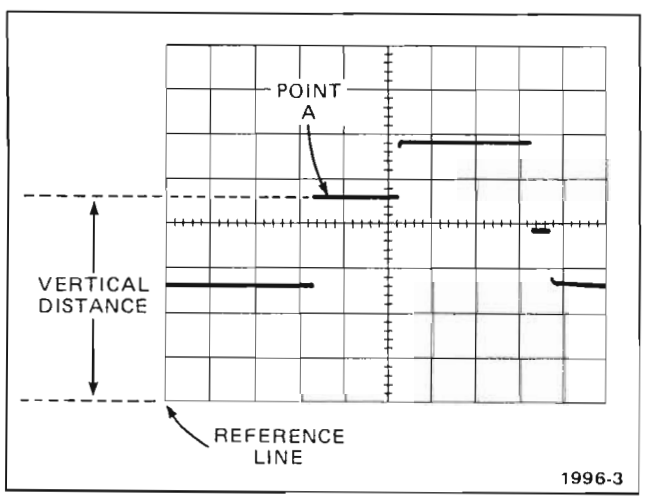


Fig. 1-3. Measuring instantaneous voltage with respect to a reference voltage.

Using the formula:

Instantaneous Voltage = signal polarity X Vertical distance (divisions) X VOLTS/DIV setting X probe attenuation factor

Substituting the given values:

Instantaneous Voltage = +4.6 X 0.5 V X 10 = +23 volts

Comparison Measurements

In some applications, it may be desirable to establish units of measurement other than those indicated by the VOLTS/DIV switch. This is particularly useful when comparing unknown signals to a reference amplitude. One use for the comparison-measurement technique is to facilitate calibration of equipment where the desired amplitude does not produce an exact number of divisions of deflection. The adjustment will be easier and more accurate if arbitrary units of measurement are established, so that the correct adjustment is indicated by an exact number of divisions of deflection. The following procedure describes how to establish arbitrary units of measure for comparison measurements.

To establish a vertical deflection factor based upon a specific reference amplitude, proceed as follows:

1. Connect the reference signal to the INPUT connector. Set the time-base sweep rate to display several cycles of the signal.

2. Set the VOLTS/DIV switch and the VARIABLE control to produce a display which is an exact number of vertical divisions in amplitude. Do not change the VARIABLE control after obtaining the desired deflection.

3. To establish a conversion factor, the amplitude of the reference signal must be known. If it is not known, it can be measured before the VARIABLE control is set in step 2.

4. Divide the amplitude of the reference signal (volts) by the product of the vertical deflection (divisions) established in step 2 and the setting of the VOLTS/DIV switch.

$$\text{Conversion Factor} = \frac{\text{reference signal amplitude (volts)}}{\text{vertical deflection (divisions)} \times \text{VOLTS/DIV setting}}$$

5. To measure the amplitude of an unknown signal, connect the unknown signal to the INPUT connector. Set the VOLTS/DIV switch to a setting that provides sufficient vertical deflection to make an accurate measurement. Do not re-adjust the VARIABLE control.

6. Measure the vertical deflection in divisions and calculate the amplitude of the unknown signal using the following formula:

$$\text{Signal Amplitude} = \text{VOLTS/DIV setting} \times \text{conversion factor} \times \text{vertical deflection (divisions)}$$

EXAMPLE: Assume a reference signal amplitude of 33 volts, a VOLTS/DIV setting of 5 V and the VARIABLE control adjusted to provide a vertical deflection of four divisions.

Substituting these values in the conversion factor formula (step 4):

$$\text{Conversion Factor} = \frac{33\ \text{V}}{4 \times 5\ \text{V}} = 1.65$$

Then, with a VOLTS/DIV setting of 2 V, the peak-to-peak amplitude of an unknown signal which produces a vertical deflection of five divisions can be determined by using the signal amplitude formula (step 6):

$$\text{Signal Amplitude} = 2\ \text{V} \times 1.65 \times 5 = 16.5\ \text{volts}$$

SPECIFICATION

The following electrical characteristics are valid over the stated environmental range for instruments calibrated at an ambient temperature of +20°C to +30°C, and after a five minute warmup unless otherwise noted.

TABLE 2-1
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
Deflection Factor		
Calibrated Range	5 mV/Div to 10 V/Div, 11 steps in a 1-2-5 sequence.	
Deflection Factor Accuracy	Within 2% of indicated deflection factor with GAIN adjusted at 10 mV/Div.	
Uncalibrated (VARIABLE)	Continuously variable between calibrated steps; extends deflection factor to at least 25 V/Div.	
X10 GAIN	Increases amplifier gain by a factor of 10 within 10%, decreasing deflection factor to 500 μV/Div.	
Frequency Response		
Upper Bandwidth Frequency (at −3 dB)		
X1 (System Dependent)	At least 65 MHz in OS-245 (P)/U oscilloscope mainframe.	
X10	10 MHz.	
Lower Bandwidth Frequency (AC Coupled)	10 Hz or less without probe.	1 Hz or less with 10X probe.
Maximum Input Voltage		400 V (dc + Peak ac); ac component 500 V p-p maximum, 1 kHz or less.
Input R and C		
Resistance		Approximately 1 MΩ.
Capacitance		Approximately 20 pF.
RC Tolerance		Within 1% at all deflection factors.
Overdrive Recovery Time		0.1 ms or less to recover to within one division after removal of overdrive signal of up to +75 divisions or −75 divisions regardless of overdrive signal duration.

TABLE 2-2
Environmental Characteristics

Refer to the specifications for the associated oscilloscope.

TABLE 2-3
Physical Characteristics

Size	Fits all 7000-series plug-in compartments.
Weight	1 pound 13 ounces (0.82 kilogram).

THEORY OF OPERATION

This section of the manual contains a description of the circuitry used in the Amplifier unit. The description begins with a discussion of the instrument using the block diagram shown in the Diagrams section. Each circuit is then described in detail, using the block diagram to show the interconnections between stages and the relationship of the front-panel controls to the individual stages.

Complete schematics are given in the Diagrams section. Refer to these schematics throughout the following circuit description for electrical values and relationships.

BLOCK DIAGRAM

The following discussion is provided to aid in understanding the overall concept of the Amplifier unit before the individual circuits are discussed in detail. Only the basic interconnections between the individual blocks are shown on the block diagram (see Diagrams section). Each block represents a major circuit within the instrument.

The signal to be displayed is applied to the INPUT connector. The signal passes through the Input Coupling and Attenuators to the Source Follower. The Source Follower has a high input impedance and a low output impedance to drive the Paraphase Amplifier. The Paraphase Amplifier converts the single-ended input signal to a push-pull output signal. The output signal from the Paraphase Amplifier is connected to the Inverting Amplifier where the polarity of the signal (+UP or INVERT) is selected. The gain of the Amplifier unit (X1 or X10) is selected in the X1 and X10 Amplifiers. The output of the X1 and X10 Amplifiers is connected to the Signal Output Amplifier and to the Trigger Output Amplifier.

CIRCUIT DESCRIPTION

Input Coupling

Signals connected to the INPUT connector can be ac-coupled, dc-coupled, or internally disconnected, with the front-panel Coupling switch. Switch S100A is a cam-type switch; a chart showing the operation is given on Diagram 1. The dots on this chart indicate when the associated contacts are in the position shown (open or closed). When the Coupling switch is in the DC position, the input signal is coupled directly to the Attenuator. In the AC position, the input signal passes through capacitor C10. The capacitor prevents the dc component of the signal from passing to the amplifier. The GND position opens the signal path and connects the input of the amplifier to ground. This provides a ground reference without the need to disconnect the applied signal from the INPUT connector. Resistor R102, connected across the Coupling switch, allows C10 to be pre-charged in the GND position so the trace remains on screen when switching to the AC position if the applied signal has a high dc level.

Attenuators

The effective overall deflection factor of the Amplifier unit is determined by the setting of the VOLTS/DIV switch, S100B. The basic deflection factor is five millivolts per division of crt deflection (with MAG switch set to X1). To increase the deflection factor to the values indicated on the front panel, precision attenuators are switched into the circuit. In the 5 mV position, input attenuation is not used; the input signal is connected directly to the Source Follower.

For switch positions other than 5 mV, the attenuators are switched into the circuit singly or in pairs to produce the deflection factor indicated on the front panel. These hybrid attenuators are frequency-compensated voltage dividers. For dc and low-frequency signals, the attenuators are primarily resistance dividers and the voltage attenuation is determined by the resistance ratio in the circuit. The reactance of the capacitors in the circuit is so high at low frequencies that their effect is negligible. However, at higher frequencies the reactance of the capacitors decrease and the attenuator becomes primarily a capacitive divider.

In addition to providing constant attenuation at all frequencies within the bandwidth of the instrument, the attenuators are designed to maintain the same input RC characteristics (1 megohm X 20 picofarad) for each setting of the VOLTS/DIV switch. Each attenuator contains an adjustable series capacitor to provide correct attenuation at high frequencies, and an adjustable shunt capacitor to provide correct input capacitance.

Source Follower

The Source Follower, Q210A, provides a high input impedance with a low impedance drive for the following stage. Dual-diode CR210, provides circuit protection by limiting the voltage at the gate of Q210A to about 15 volts (positive or negative). Transistor Q210B, provides a constant current source for Q210A.

Paraphase Amplifier

The signal from the Source Follower is applied to Paraphase Amplifier Q220-Q320. The Paraphase Amplifier converts the single-ended input to a differential (push-pull) output. It also provides a means of compensating for stray currents throughout the entire amplifier by varying the dc level at the base of Q320 via the DC Bal control, R322.

Inverting Amplifier

The differential signal from the Paraphase Amplifier is cascoded to the Inverting Amplifier, a set of common-base differential amplifiers, Q230-Q330 and Q235-Q335. With the POLARITY switch set to +UP, Q230 and Q330 are forward biased while Q235 and Q335 are reverse biased. The signal is therefore allowed to pass un-inverted through Q230 and Q330. By setting the POLARITY switch to INVERT, Q230 and Q330 are reverse biased and Q235 and Q335 are forward biased. The signal is inverted by Q235 and Q335. Current gain for amplifiers Q230-Q330 and Q235-Q335 is controlled by GAIN adjustment R238, and VARIABLE control R239.

X1 and X10 Amplifiers

The output from Q230-Q330 or Q235-Q335 (depending on the POLARITY switch setting) is connected to the X1 amplifier, Q240-Q340, and the X10 amplifier, Q245-Q345. The MAG switch determines which amplifier (X1 or X10) is on, by switching their emitter supply voltages. Current gain for the X10 amplifier is adjusted by R245.

Signal and Trigger Output Amplifiers

The signal from the X1 or X10 amplifier (depending on the MAG switch setting) is cascoded through common base amplifier Q250-Q350, to the Signal Output Amplifier, Q260-Q360, and the Trigger Output Amplifier, Q270-Q370.

MAINTENANCE

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, and troubleshooting of the Amplifier unit. Further information relating to general maintenance can be found in the service manual for the oscilloscope.

PREVENTIVE MAINTENANCE

Preventive maintenance, consisting of cleaning, visual inspection, etc., performed on a regular basis, will improve the reliability of this instrument. Periodic checks of the semiconductor devices used in the unit are not recommended as a preventive maintenance measure. See semiconductor-checking information given under Troubleshooting.

CLEANING

CAUTION

Avoid the use of chemical cleaning agents which may damage the plastics used in this instrument. Special care should be taken when cleaning the polyphenylene oxide attenuator board. Do not apply any solvent containing ketones, esters or halogenated hydrocarbons. To clean, use only water soluble detergents, ethyl, methyl, or isopropyl alcohol.

Front Panel

Loose dust may be removed with a soft cloth or a dry brush. Water and mild detergent may be used; however, abrasive cleaners should not be used.

Interior

Cleaning the interior of the unit should precede calibration, since the cleaning process could alter the settings of the adjustments. Use low-velocity compressed air to blow off the accumulated dust. Hardened dirt can be removed with a soft, dry brush, cotton-tipped swab, or cloth dampened with a mild detergent and water solution.

Lubrication

Use a cleaning-type lubricant on shaft bushings, interconnecting plug contacts, and switch contacts. Lubricate switch detents with a heavier grease. A lubrication kit containing the necessary lubricating materials and instructions is available through any Tektronix Field Office. Order Tektronix part 003-0342-00.

TROUBLESHOOTING

The following is provided to augment information contained in other sections of this manual when troubleshooting the Amplifier unit. The circuit diagrams, circuit description, and calibration sections should be used to full advantage.

TROUBLESHOOTING AIDS

Diagrams

Circuit diagrams are given on foldout pages in Section 8. The circuit number and electrical value of each component in this instrument are shown on the diagrams. Important voltages are also shown.

Circuit Boards

The circuit boards used in the Amplifier unit are outlined on the circuit diagrams, and photographs of the boards are shown on the backs of the circuit diagrams. Each board-mounted electrical component is identified on the photograph by its circuit number.

Component and Wiring Color Code

Colored stripes or dots on resistors and capacitors signify electrical values, tolerances, etc., according to the EIA standard color code. Components not color coded usually have the value printed on the body.

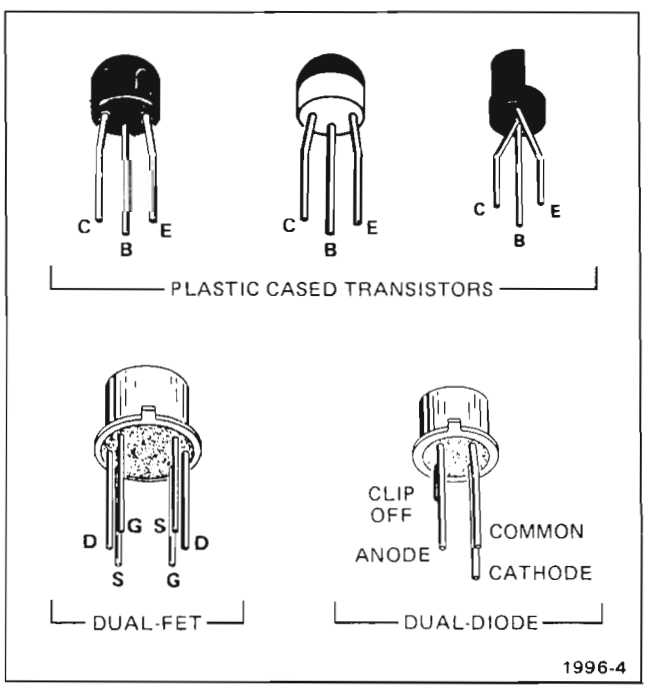


Fig. 4-1. Electrode configurations for semiconductors in the AM-6565/U.

The insulated wires used for interconnection in the Amplifier unit are color coded to facilitate tracing wires from one point to another in the unit.

Semiconductor Lead Configuration

Figure 4-1 shows the lead configurations of the semiconductor devices used in this instrument.

TROUBLESHOOTING EQUIPMENT

The following equipment is useful for troubleshooting the Amplifier unit.

1. Semiconductor Tester—Some means of testing the transistors, diodes, and FET's used in this instrument is helpful. A transistor-curve tracer such as the Tektronix Type 576 will give the most complete information.

2. DC Voltmeter and Ohmmeter—A voltmeter is required for checking voltages within the circuits, and an ohmmeter for checking resistors and diodes.

3. Test Oscilloscope—A test oscilloscope is required to view waveforms at different points in the circuit.

4. Plug-in Extender—A fixture that permits operation of the Amplifier unit outside of the plug-in compartment provides better accessibility during troubleshooting. Order Tektronix part 067-0589-00.

TROUBLESHOOTING PROCEDURE

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting.

1. Check Control Settings

An incorrect setting of the Amplifier unit controls can indicate a trouble that does not exist. If there is any question about the correct function or operation of a control or front-panel connector, see the Operating Instructions section.

2. Check Associated Equipment

Before proceeding with troubleshooting of the Amplifier unit, check that the equipment used with this instrument is operating correctly. If possible, substitute an Amplifier unit known to be operating correctly into the oscilloscope and see if the problem persists. Check that the input signals are properly connected and that the interconnecting cables are not defective.

3. Visual Check

Visually check the portion of the instrument in which the trouble is suspected. Many troubles can be located by visible indications, such as unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

4. Check Instrument Performance

The apparent trouble may only be a result of misadjustment, and may be corrected by calibration. Complete calibration instructions are given in Section 5.

5. Check Voltages

Often the defective component or stage can be located by checking voltages in the circuit. Typical voltages are given on the diagrams; however, these are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the instructions in the Diagrams section.

6. Check Individual Components

The following methods are provided for checking the individual components in the Amplifier unit. Components that are soldered in place are best checked by disconnecting one end to isolate the measurement from the effects of surrounding circuitry.

NOTE

To locate intermittent or temperature sensitive components mounted on the circuit boards, Quik Freeze (Miller Stephenson, MS-240, Tektronix part 006-0173-01) is recommended. Dry ice or dichlorodifluoromethane (Freon 12, Dupont or Can-O-Gas) may also be used. Other types of circuit coolant may damage the polyphenylene oxide board.

A. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can be checked by substituting a component known to be good; however, be sure that circuit conditions are not such that a replacement might also be damaged. If substitute transistors are not available, use a dynamic tester (such as Tektronix Type 576). Static-type testers may be used, but since they do not check operation under simulated operating conditions, some defects may go unnoticed. Figure 4-1 shows base pin and socket arrangements of semiconductor devices. Be sure the power is off before attempting to remove or replace transistors.

B. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter set to the RX1k scale. The resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

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

C. RESISTORS. Check resistors with an ohmmeter. Resistor tolerance is given in the Replaceable Electrical Parts list. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

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

7. Repair and Re-adjust the Circuit

Special techniques required to replace components in this unit are given under Component Replacement. Be sure to check the performance of any circuit that has been repaired or that has any electrical components replaced. Recalibration of the affected circuit may be necessary.

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements for the Amplifier unit can be obtained through your local Tektronix Field Office or representative. However, many of the electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

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

Special Parts

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc. to our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine manufacturer of parts, refer to Parts List, Cross Index Mfr. Code Number to Manufacturer.

Ordering Parts

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

1. Instrument Type.

2. Instrument Serial Number.

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

4. Tektronix Part Number.

SOLDERING TECHNIQUES

WARNING

Due to potentials present within the instrument, disconnect the instrument from the power source before soldering.

Attenuator Circuit Board

The Attenuator circuit board is made of polyphenylene oxide. Use more than normal care when cleaning or soldering this material. The following rules should be observed when removing or replacing parts:

1. Use a low-wattage soldering iron (not over 15 watts).

2. Do not apply more heat than is absolutely necessary.

3. Use some form of vacuum-type solder remover when removing multi-lead devices.

4. Do not apply any solvent containing ketones, esters, or halogenated hydrocarbons.

5. To clean, use only water-soluble detergents, ethyl, methyl or isopropyl alcohol.

Circuit Boards (except Attenuator board)

The components mounted on the circuit boards can be replaced using normal circuit board soldering techniques. Keep the following points in mind when soldering on the circuit boards:

1. Use a pencil-type soldering iron with a power rating of 15 to 20 watts.

2. Apply heat from the soldering iron to the junction between the component and the circuit board.

3. Heat-shunt the component lead by means of a pair of long-nose pliers.

4. Avoid excessive heating of the junction with the circuit board, as this could separate the circuit board wiring from the base material.

5. Use electronic grade 60-40 tin-lead solder.

6. Clip off any excess lead length extending beyond the circuit board. Clean off any residual flux with a flux-removing solvent.

Metal Terminals

When soldering metal terminals (potentiometers, etc.), use 60-40 tin-lead solder and a 15 to 50 watt soldering iron. Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-removing solvent.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

Due to potentials present within the instrument, disconnect the equipment from the power source before replacing components.

Semiconductors

Transistors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors may change the calibration of this instrument. When transistors are replaced, check the performance of the part of the instrument that may be affected.

Replacement semiconductors should be of the original type or a direct replacement. Figure 4-1 shows the lead configurations of the semiconductors used in this instrument. If the replacement semiconductor is not of the original type, check the manufacturer's basing diagram for proper basing.

Circuit Boards

In general, the circuit boards used in the Amplifier unit need never be removed unless they must be replaced.

Electrical connections to the boards are made by solder connections. If it is necessary to replace a circuit board assembly, use the following procedures.

A. Attenuator Circuit Board

1. Disconnect the resistor and capacitor connected to the rear of the board.

2. Loosen the front set-screw on the VARIABLE control shaft coupling (use a 0.050-inch hex-key wrench).

3. Remove the red VARIABLE control knob and shaft from the control shaft.

4. Remove the remaining front-panel knobs using a 1/16-inch hex-key wrench.

5. Remove the front panel from the instrument.

6. Remove the attenuator shields.

7. Disconnect the wires and resistors from the input BNC connector.

8. Remove the input BNC connector.

9. Remove the attenuator board with cam switch from the instrument.

10. Replace by reversing the removal procedure.

B. Amplifier Circuit Board

1. Remove the plastic plug-in guide from the rear of the instrument.

2. Disconnect the wires connected to the board from the front-panel controls.

3. Loosen the hex-socket screw in the coupling of the VARIABLE control shaft using a 0.050-inch hex-key wrench. Pull the VARIABLE knob and shaft from the front of the instrument.

4. Disconnect the resistor-capacitor combinations connected to the ceramic strip at the front of the board.

5. Remove the screws and nuts securing the board to the chassis or other mounting surface.

6. Remove the board from the instrument.

7. To replace, reverse the order of removal.

Switches

Several types of switches are used in the Amplifier unit. The slide and micro-switches should be replaced as a unit if damaged.

CAUTION

Repair of cam-type switches should be undertaken only by experienced maintenance personnel. Switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch. For assistance in maintenance of the cam-type switches, contact your local Tektronix Field Office or representative.

RECALIBRATION AFTER REPAIR

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Refer to Section 5 for these procedures.

CALIBRATION

To ensure instrument accuracy, check the calibration of the Amplifier unit every 1000 hours of operation, or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section.

PRELIMINARY INFORMATION

Tektronix Field Service

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

Using This Procedure

PARTIAL CALIBRATION. A partial calibration is often desirable after replacing components, or to touch up the adjustment of a portion of the instrument between major recalibrations. To calibrate only part of the instrument, set the controls as given under Preliminary Control Settings and start with the nearest numbered step preceding the desired portion. To prevent unnecessary recalibration of other parts of the instrument, re-adjust only if the tolerance given in the CHECK– part of the step is not met.

SHORT FORM PROCEDURE. To facilitate instrument calibration for the experienced calibrator, the short form procedure lists only the calibration adjustments necessary for each step and the applicable tolerances.

COMPLETE CALIBRATION PROCEDURE. Completion of each step in the Calibration Procedure ensures that this instrument meets the electrical specifications given in Section 2. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance when performing a complete calibration procedure, make each adjustment to the exact setting even if the CHECK– is within the allowable tolerance.

TEST EQUIPMENT REQUIRED

The following test equipment and accessories, or its equivalent, is required for complete calibration of the Amplifier unit. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may be somewhat below the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications of the recommended equipment.

TABLE 5-1
Test Equipment

Description	Minimum Specifications	Examples of Applicable Test Equipment
Calibration Oscilloscope	Bandwidth, at least 65 MHz.	a. Tektronix 0S-245(P)/U Oscilloscope, National Stock Number 6625-00-106-9623. b. Tektronix 7603 Oscilloscope, National Stock Number 6625-00-261-5127.
Time Base Unit	Sweep rate, to at least 1 μs/div.	a. Tektronix TD-1085/U Dual Time Base, National Stock Number 6625-00-106-9624. b. Tektronix 7B53AN Time Base, National Stock Number 6625-00-270-8409.

TABLE 5-1 (CONT.)
Test Equipment

Description	Minimum Specifications	Examples of Applicable Test Equipment
Amplitude Calibrator	Amplitude accuracy, within 0.25%; signal amplitude, 2 mV to 50 V; frequency, approximately 1 kHz.	a. Tektronix PG506 Calibration Generator with Power Module. b. Tektronix Part 067-0502-01 Calibration Fixture.
Pulse Generator	High Amplitude, at least 60 V into 1 MΩ; risetime, 150 ns or less. Low Amplitude, Fast-Rise, at least 500 mV into 50 Ω; risetime, 1 ns or less.	a. Tektronix PG506 Calibration Generator with Power Module. b. Tektronix 106 Squarewave Generator, National Stock Number 6625-00-455-7302.
Sinewave Generator	Frequency, to at least 65 MHz; Amplitude, at least 500 mV into 50 Ω.	a. Tektronix SG503 Signal Generator with Power Module. b. Tektronix 191 Signal Generator.
Cable, Coaxial	Impedance, 50 Ω; connectors, BNC; Length, 42 inch.	a. Tektronix Part 012-0057-01.
Termination	Impedance, 50 Ω; connectors, BNC.	a. Tektronix Part 011-0049-01.
10X Attenuator	Impedance, 50 Ω; connectors, BNC.	a. Tektronix Part 011-0059-02.
RC Normalizer	Time constant, 1 MΩ X 20 pF; connectors, BNC.	a. Tektronix Part 067-0538-00.

SHORT-FORM PROCEDURE

1. GAIN CALIBRATION

a. Set GAIN adjustment for vertical deflection within 2% of applied signal with VOLTS/DIV switch set to 10 mV.

b. Check that the VARIABLE control will reduce the vertical deflection by a factor of at least 2.5:1.

c. Set X10 Gain adjustment (number 3, Fig. 5-1) for a vertical deflection within 10% of applied signal with VOLTS/DIV switch set to 10 mV.

d. Check that the vertical deflection is accurate to within 2% at all VOLTS/DIV switch settings (X1 MAG).

2. DC BALANCE ADJUSTMENT

a. Set DC Bal adjustment (number 1) for a VARIABLE trace shift of not more than 0.5 division.

b. Set X10 DC Bal adjustment (number 2) for a minimum MAG trace shift.

3. COMPENSATION ADJUSTMENTS

a. Adjust input capacitance (C100) for optimum squarewave response.

b. Adjust attenuator compensation (see Table 5-3) for flat top and square corner within 0.15 division at all VOLTS/DIV switch settings.

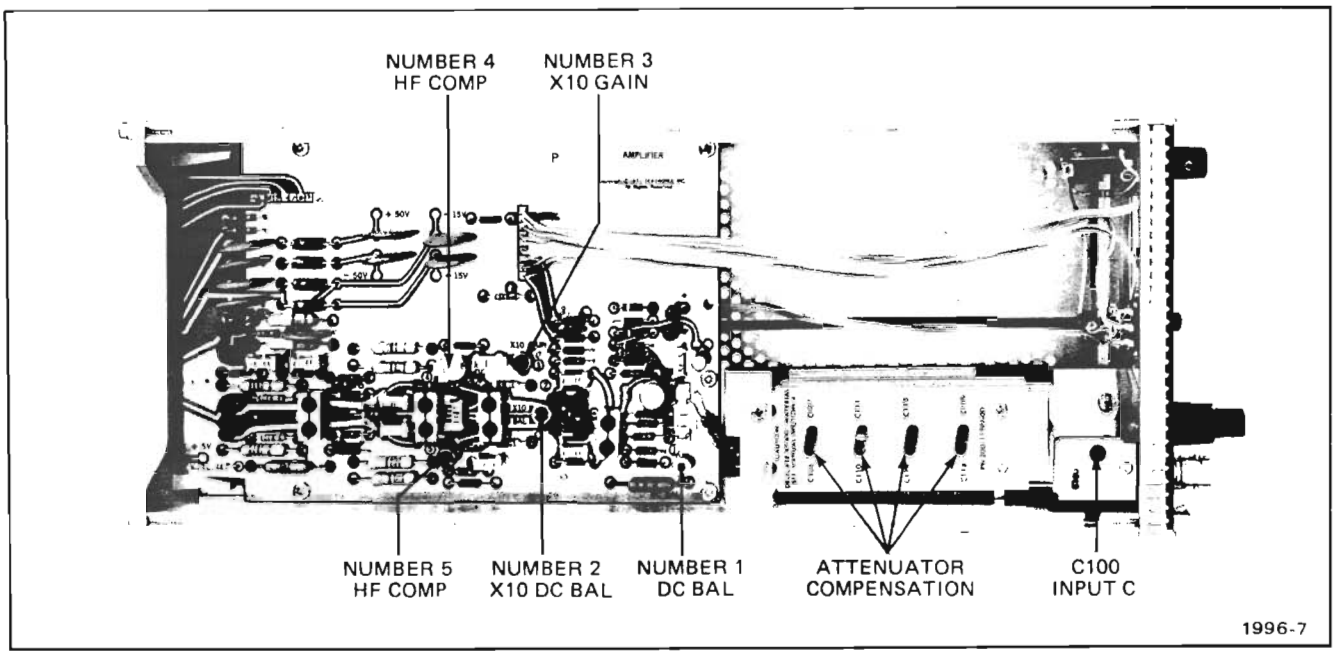


Fig. 5-1. Adjustment locations.

c. Adjust high-frequency compensation (numbers 4 and 5) for optimum square-wave response with aberrations not to exceed 5% peak-to-peak.

d. Check for at least 65 MHz bandwidth.

CALIBRATION PROCEDURE

The following procedure is arranged so that the Amplifier unit can be calibrated with the least interaction of adjustments and reconnection of equipment. The control settings and test equipment setup throughout this procedure continue from the preceding step(s) unless otherwise noted. Refer to Fig. 5-1 for location of adjustments.

NOTE

Control titles which are printed on the front panel of the Amplifier unit are capitalized in this procedure (e.g., POSITION). Internal adjustments and associated equipment controls are initially capitalized only (e.g., oscilloscope Vertical Mode).

Preliminary Procedure for Calibration

1. Remove the left side covers from calibration oscilloscope and Amplifier unit.

2. Insert the Amplifier unit in the calibration oscilloscope left vertical compartment.

3. Insert the time base unit in the calibration oscilloscope horizontal compartment.

4. Connect the oscilloscope to a suitable power source.

5. Turn the oscilloscope on and allow 20 minutes warmup before proceeding.

NOTE

This instrument should be calibrated at an ambient temperature of +20°C to +30°C for best overall accuracy. The performance of the instrument can be checked at any temperature within the 0°C to +50°C range.

Preliminary Control Settings

Set the calibration oscilloscope and Amplifier unit controls as follows:

Calibration Oscilloscope

Intensity	Midrange
Focus	Adjust for well-defined display

Calibration Oscilloscope (cont.)

Control Illum	As desired
Grat Illum	As desired
Vertical Mode	Left
Trigger Source	Left Vert

Amplifier Unit

POSITION	Midrange
POLARITY	+UP
MAG	X1
VOLTS/DIV	10 mV
Coupling	DC
VARIABLE	CAL (full clockwise)

1. CHECK/ADJUST GAIN

a. Connect BNC cable from amplitude calibrator to Amplifier unit INPUT connector.

b. Set amplitude calibrator for 50-millivolt square-wave output.

c. CHECK–Display for vertical deflection of five divisions within 0.1 division.

d. ADJUST–Front panel GAIN control for exactly five divisions of vertical deflection.

2. CHECK VARIABLE GAIN RANGE

a. Rotate VARIABLE control fully counterclockwise.

b. CHECK–That vertical deflection is two divisions, or less. Return VARIABLE control to CAL position.

3. CHECK/ADJUST X10 GAIN

a. Set amplitude calibrator for 5-millivolt square-wave output. Set MAG to X10.

b. CHECK–Display for vertical deflection of five divisions within 0.5 division.

c. ADJUST–X10 Gain adjustment (number 3) for exactly five vertical divisions. Return MAG to X1.

4. CHECK DEFLECTION FACTOR ACCURACY

a. CHECK–Using VOLTS/DIV switch and amplitude calibrator settings given in Table 5-2, check that vertical deflection is within 2% for each position of VOLTS/DIV switch.

b. Disconnect all test equipment and return VOLTS/DIV switch to 10 mV.

TABLE 5-2
Vertical Deflection Accuracy

VOLTS/DIV Switch Setting	Amplitude Calibrator Output	Vertical Deflection in Divisions	Maximum Error for ±2% Accuracy (divisions)
5 mV	20 mV	4	±0.08
10 mV	50 mV	5	Set in Step 4
20 mV	0.1 V	5	±0.1
50 mV	0.2 V	4	±0.08
.1 V	0.5 V	5	±0.1
.2 V	1 V	5	±0.1
.5 V	2 V	4	±0.08
1 V	5 V	5	±0.1
2 V	10 V	5	±0.1
5 V	20 V	4	±0.08

5. CHECK/ADJUST DC BAL

a. Set Coupling switch to GND.

b. CHECK–While rotating VARIABLE control throughout its range, that displayed trace does not move more than 0.5 division vertically.

c. ADJUST–DC Bal adjustment (number 1) for minimum vertical trace shift while rotating VARIABLE control throughout its range.

d. ADJUST–X10 Bal (number 2) for minimum vertical trace shift while switching MAG switch between X1 and X10.

e. Return MAG switch to X1 position.

f. Recheck X10 Gain (step 1).

6. ADJUST INPUT CAPACITANCE

a. Set VOLTS/DIV switch to 5 mV and Coupling switch to DC.

b. Connect square-wave generator high-amplitude output to Amplifier unit INPUT connector through a 10X BNC attenuator, thru-line BNC termination, and 20 pF normalizer.

c. Set square-wave generator for six-division display of one-kilohertz signal.

d. Set time-base unit for triggered display at 0.2 millisecond/division.

e. ADJUST—C100 for optimum square corner on displayed waveform.

7. ADJUST ATTENUATOR COMPENSATION

a. Set VOLTS/DIV switch to 10 mV.

b. Set square-wave generator for six-division display of one-kilohertz signal.

c. ADJUST—Attenuator compensations as given in Table 5-3 for optimum square corner and flat top (within 0.15 divisions) on displayed waveform (use tuning tool).

d. Disconnect 50-ohm cable from square-wave generator.

8. CHECK/ADJUST HIGH-FREQUENCY COMPENSATION

a. Set VOLTS/DIV switch to 5 mV.

b. Set time-base unit for 5 microseconds/division sweep rate.

c. Connect sine-wave generator to Amplifier unit INPUT through a 10X BNC attenuator and 50-ohm termination.

TABLE 5-3
Attenuator Compensation

VOLTS/DIV Switch Setting	Adjust for Optimum	
	Square Corner	Flat Top
10 mV	C106	C107
20 mV	C110	C111
50 mV	C114	C115
0.1 V	Check	Check
Remove 10X BNC attenuator.		
0.2 V	Check	Check
0.5 V	C118	C119
1 V	Check	Check
Remove 50-ohm termination.		
2 V	Check	Check
5 V	Check	Check

d. Set sine-wave generator for 6 divisions of 50-kilohertz signal.

e. Set sine-wave generator for 65 megahertz output signal.

f. CHECK—Crt display for at least 4.2 divisions of amplitude.

g. Disconnect 50-ohm cable from sine-wave generator and connect to fast-rise output of square-wave generator.

h. Set square-wave generator for 6 divisions of 100-kilohertz signal.

i. Set time-base unit for 1 microsecond/division sweep rate.

j. CHECK—Crt display for optimum square-wave response with aberrations not to exceed 0.24 divisions (peak-to-peak).

k. ADJUST—Adjustments 4 and 5 for optimum square-wave response with minimum aberrations. (Use low-capacitance screwdriver to adjust variable capacitor).

l. Repeat parts a through f of this step if adjustments 4 and 5 were changed.

This completes the calibration of the Amplifier unit. Disconnect all test equipment.

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
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1706-00			CKT BOARD ASSY:ATTENUATOR	80009	670-1706-00
A2	670-1998-00			CKT BOARD ASSY:AMPLIFIER	80009	670-1998-00
C10	285-1025-00			CAP.,FXD,PLSTC:0.1UF,10%,400V	80009	285-1025-00
C100	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C106	307-1010-00			ATTENUATOR,FXD:2X	80009	307-1010-00
C107						
C110	307-1011-00			ATTENUATOR,FXD:4X	80009	307-1011-00
C111						
C114	307-1013-00			ATTENUATOR,FXD:10X	80009	307-1013-00
C115						
C118	307-1014-00			ATTENUATOR,FXD:100X	80009	307-1014-00
C119						
C210	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C212	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C216	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C225	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C231	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C235	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C240	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C241	281-0517-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	308-000C0G0390K
C243	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C244	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C250	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301000 X5P0 102K
C261	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C270	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C281	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C282	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C283	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C284	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C285	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C286	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C287	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C288	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C313	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C316	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C325	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C339	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C341	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C343	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C344	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C345	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C346	281-0592-00			CAP.,FXD,CER DI:4.7PF,+/-0.5PF,500V	72982	301-Q23C0H0479D
C350	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301000 X5P0 102K
C361	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
CR210	152-0321-00			SEMICOND DEVICE:SILICON,30V,0.1A	07263	FSA1480
L339	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
LR281	108-0184-00			COIL,RF:3.2UH(WOUND ON A 10 OHM RESISTOR)	80009	108-0184-00
LR283	108-0184-00			COIL,RF:3.2UH(WOUND ON A 10 OHM RESISTOR)	80009	108-0184-00
LR285	108-0184-00			COIL,RF:3.2UH(WOUND ON A 10 OHM RESISTOR)	80009	108-0184-00
LR287	108-0184-00			COIL,RF:3.2UH(WOUND ON A 10 OHM RESISTOR)	80009	108-0184-00
Q210	151-1032-00			TRANSISTOR:SILICON,FET,DUAL	80009	151-1032-00
Q220	153-0596-00			SEMICOND DVC SE:SILICON,NPN	80009	153-0596-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q320)		
Q230	153-0595-00			SEMICOND DVC SE:SILICON,NPN	80009	153-0595-00
Q235	----- -----			(FURNISHED AS A MATCHED QUAD WITH Q330 & Q335)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q240	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q340)		
Q245	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q345)		
Q250	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q260	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	07263	FMT5092
Q270	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q320	153-0596-00			SEMICOND DVC SE:SILICON,NPN	80009	153-0596-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q220)		
Q330	153-0595-00			SEMICOND DVC SE:SILICON,NPN	80009	153-0595-00
Q335	----- -----			(FURNISHED AS A MATCHED QUAD WITH Q230 & Q235)		
Q340	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q240)		
Q345	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
	----- -----			(FURNISHED AS A MATCHED PAIR WITH Q245)		
Q350	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q360	151-0269-00			TRANSISTOR:SILICON,NPN,SEL FROM SE3005	07263	FMT5092
Q370	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
R10	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R45	311-0310-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R102	317-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.125W	01121	BB1055
R130	322-0481-01			RES.,FXD,FILM:1M OHM,0.5%,0.25W	75042	CEBT0-1004D
R210	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R212	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R213	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R215	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R216	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R218	321-0032-00			RES.,FXD,FILM:21 OHM,1%,0.125W	91637	MFF1816G21R00F
R221	311-0633-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	82-30-0
R223	323-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.50W	91637	MFF1226G46400F
R224	321-0032-00			RES.,FXD,FILM:21 OHM,1%,0.125W	91637	MFF1816G21R00F
R225	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R231	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R234	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R235	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R236	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R237	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	MFF1816G383R0F
R238	311-0310-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R239	311-1094-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	01121	GH-7709
R240	321-0118-00			RES.,FXD,FILM:165 OHM,1%,0.125W	91637	MFF1816G165R0F
R241	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R242	323-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.50W	75042	CECT0-4421F
R243	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R244	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R245	311-1007-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	73138	82-38-0
R246	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R247	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R248	311-0613-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	73138	82-27-0
R249	323-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.50W	75042	CECT0-4421F
R250	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R251	321-0137-00			RES.,FXD,FILM:261 OHM,1%,0.125W	91637	MFF1816G261R0F
R252	323-0153-00			RES.,FXD,FILM:383 OHM,1%,0.50W	75042	CECT0-3830F
R253	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R260	323-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.50W	75042	CECT0-1501F
R261	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R262	323-0164-00			RES.,FXD,FILM:499 OHM,1%,0.50W	75042	CECT0-4990F
R270	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R271	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R280	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R281	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R313	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R315	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R316	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R318	321-0032-00			RES.,FXD,FILM:21 OHM,1%,0.125W	91637	MFF1816G21R00F
R322	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R323	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R324	321-0032-00			RES.,FXD,FILM:21 OHM,1%,0.125W	91637	MFF1816G21R00F
R325	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R331	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R335	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R336	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R338	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R339	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R341	311-0634-00			RES.,VAR,NONWIR:TRMR,500 OHM,0.5W	32997	3326H-G48-501
R342	323-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.50W	75042	CECT0-4421F
R343	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R344	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R345	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R349	323-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.50W	75042	CECT0-4421F
R350	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R351	321-0137-00			RES.,FXD,FILM:261 OHM,1%,0.125W	91637	MFF1816G261R0F
R352	321-0109-00			RES.,FXD,FILM:133 OHM,1%,0.125W	91637	MFF1816G133R0F
R353	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R360	323-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.50W	75042	CECT0-1501F
R361	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R362	323-0164-00			RES.,FXD,FILM:499 OHM,1%,0.50W	75042	CECT0-4990F
R371	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
S32	260-0816-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF-126-0012A
S47B	260-0816-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF-126-0012A

INSTRUMENT OPTIONS

No options were available for this instrument at the time of this printing. Information on any subsequent options may be found in the CHANGE INFORMATION section in the back of this manual.

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).

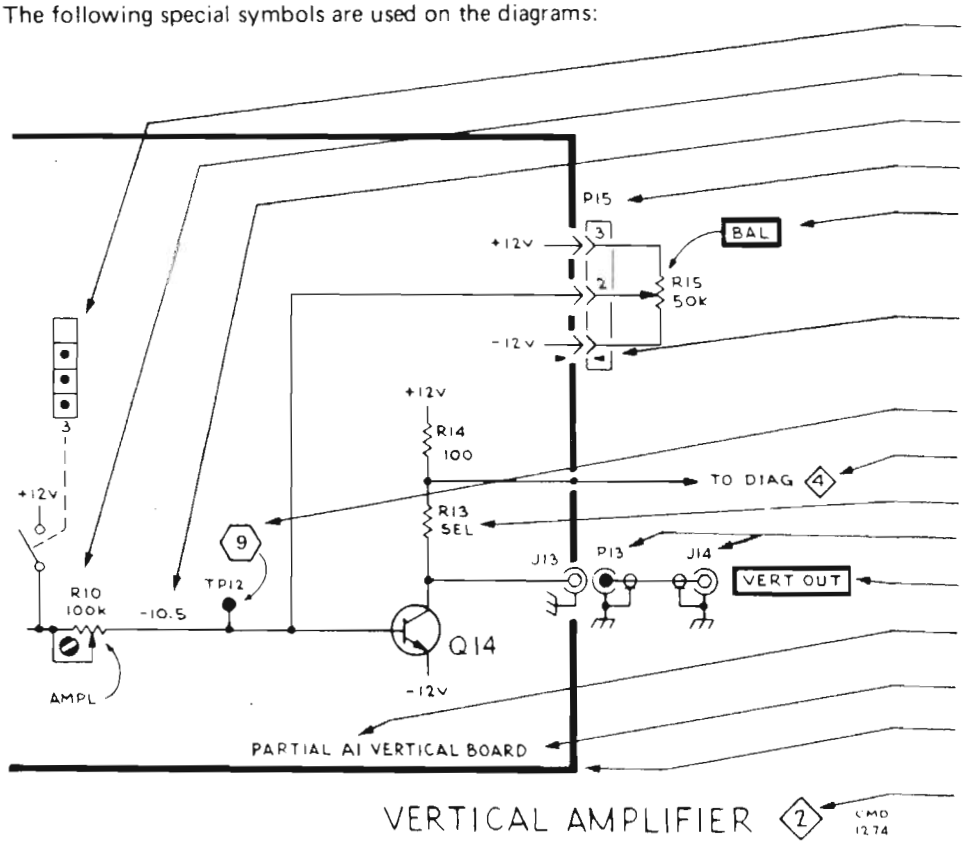
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

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.

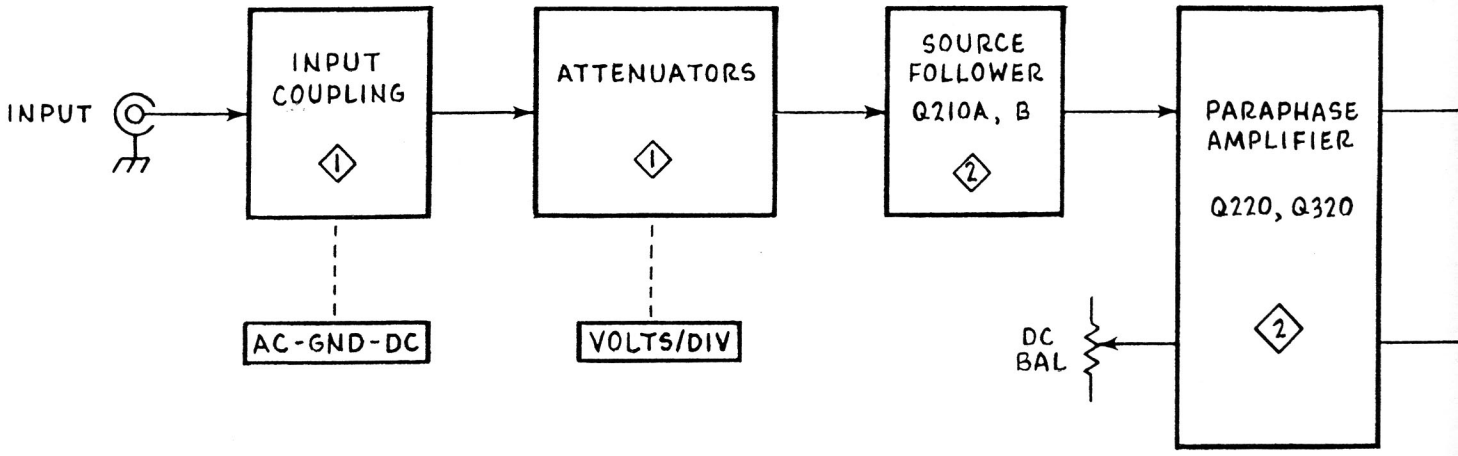
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

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

The following special symbols are used on the diagrams:



Cam Switch Closure Chart
Internal Screwdriver Adjustment
Test Voltage
Plug to E.C. Board
Panel Adjustment
Plug Index
Refer to Waveform
Refer to Diagram Number
SEL Value Selected at Factory
Coaxial Connector
Panel Connector
Assembly Number
Board Name
Etched Circuit Board Outlined
Schematic Name and Number



AM-6565/U

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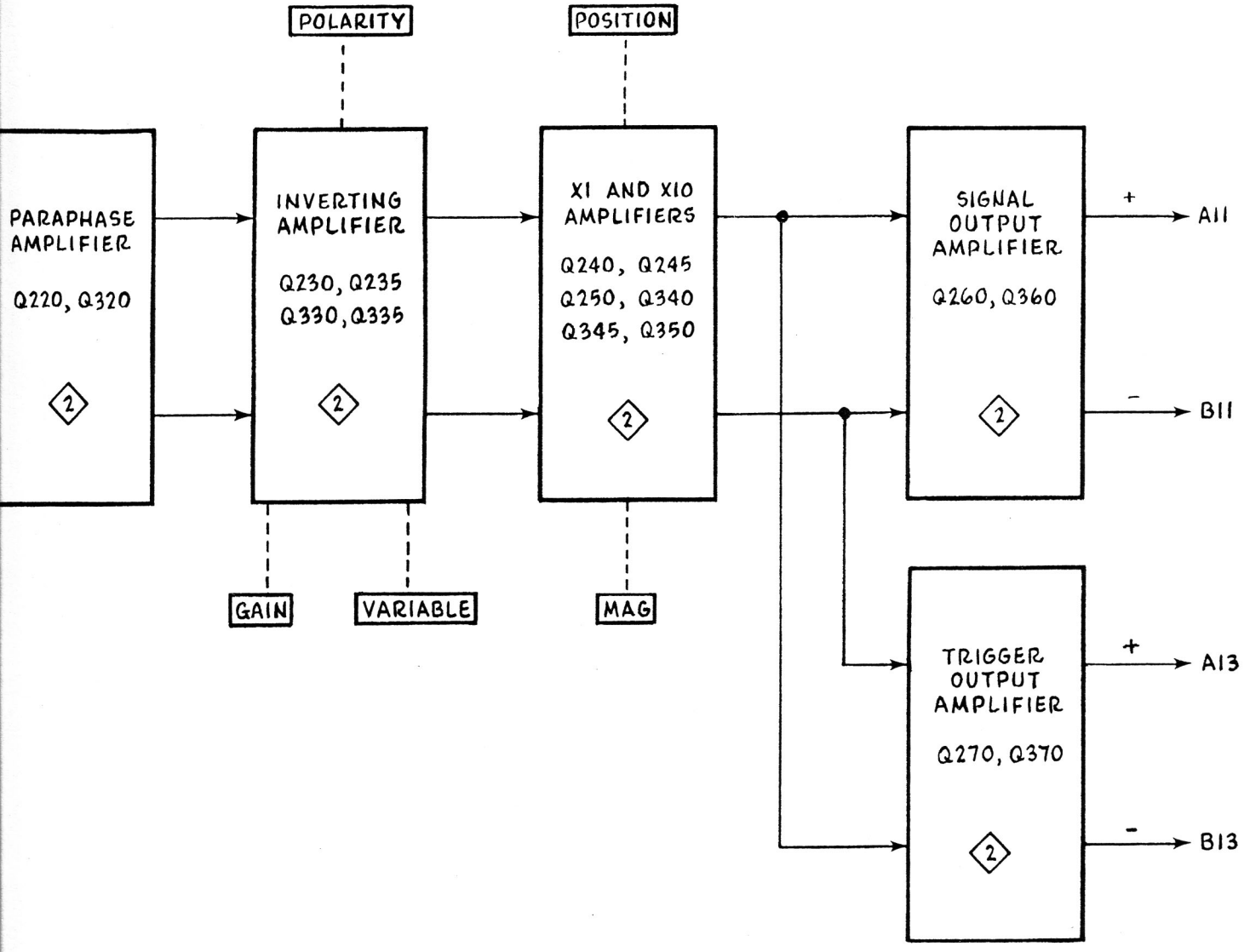
Fig. 8-1. Block diagram.



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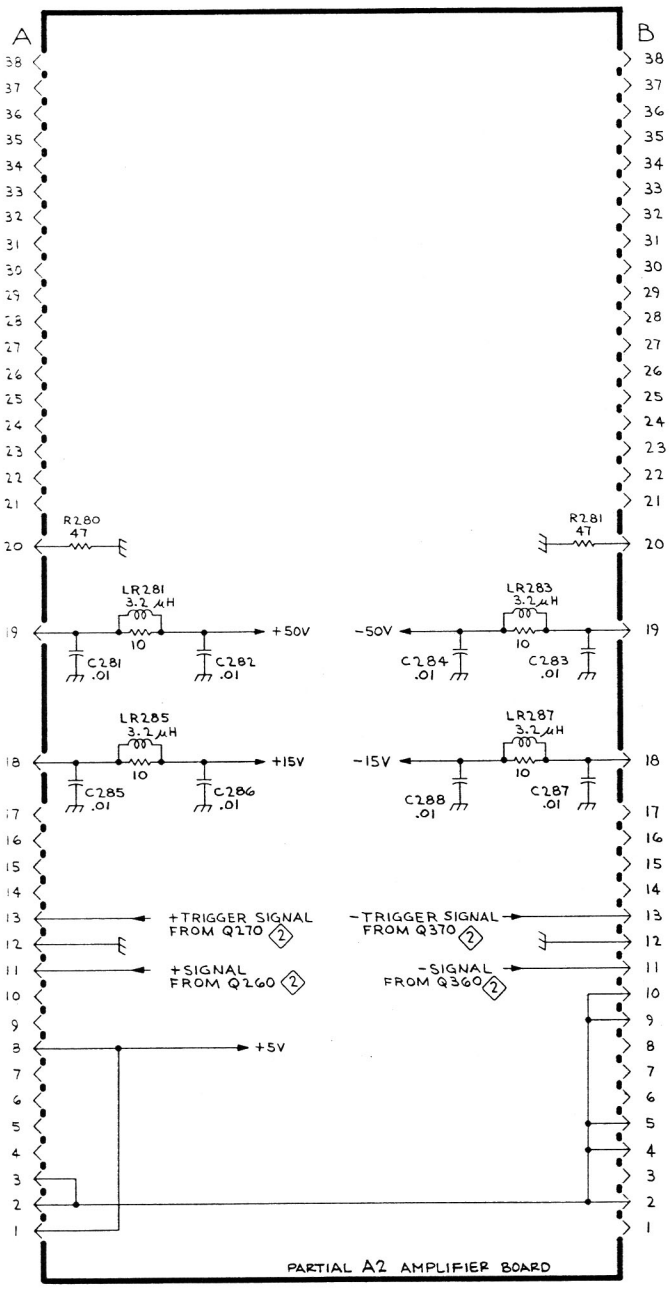
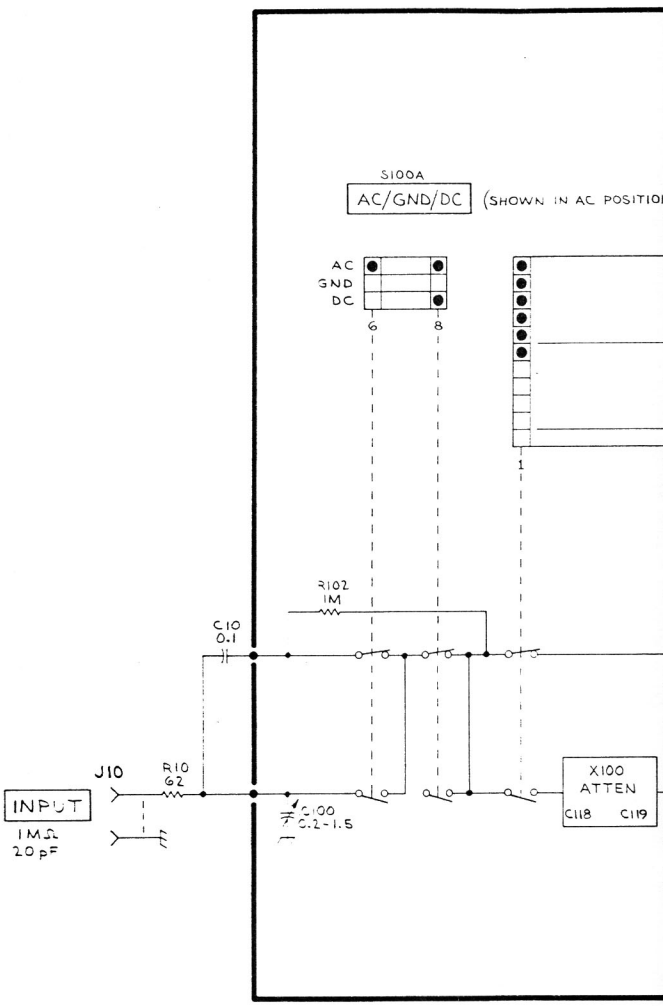
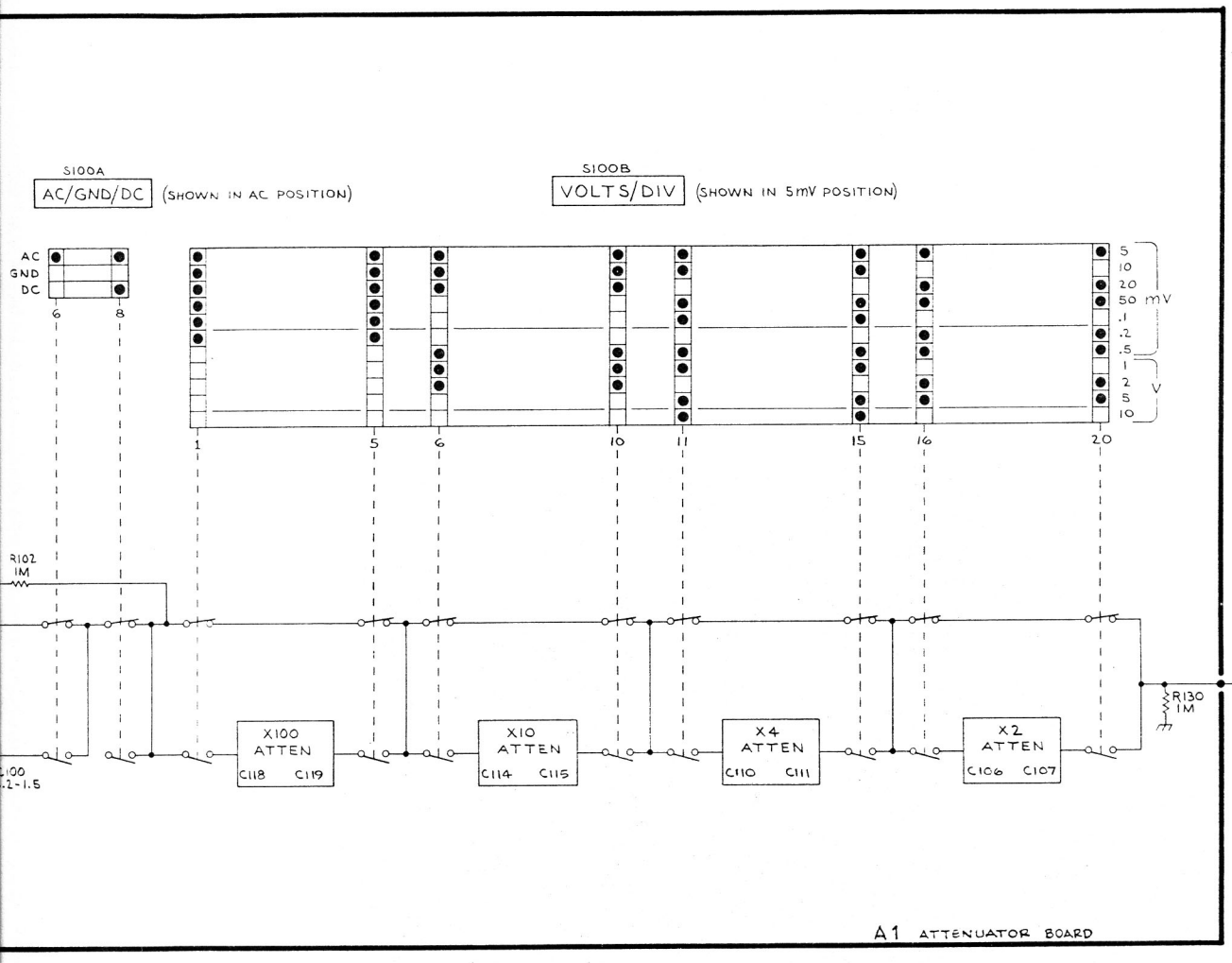
BLOCK DIAGRAM

Fig. 8-1. Block diagram.

1996-5


A
B
R280
47
R281
47
LR281
3.2 μH
10
+50V
C281
.01
C282
.01
LR283
3.2 μH
10
-50V
C284
.01
C283
.01
LR285
3.2 μH
10
+15V
C285
.01
C286
.01
LR287
3.2 μH
10
-15V
C288
.01
C287
.01
+TRIGGER SIGNAL
FROM Q270
2
-TRIGGER SIGNAL
FROM Q370
2
+SIGNAL
FROM Q260
2
-SIGNAL
FROM Q360
2
+5V
PARTIAL A2 AMPLIFIER BOARD


S100A
AC/GND/DC
(SHOWN IN AC POSITIO
AC
GND
DC
6
8
1
R102
1M
C10
0.1
J10
R10
62
INPUT
1MΩ
20pF
C100
7 C.2-1.5
X100
ATTEN
C118
C119



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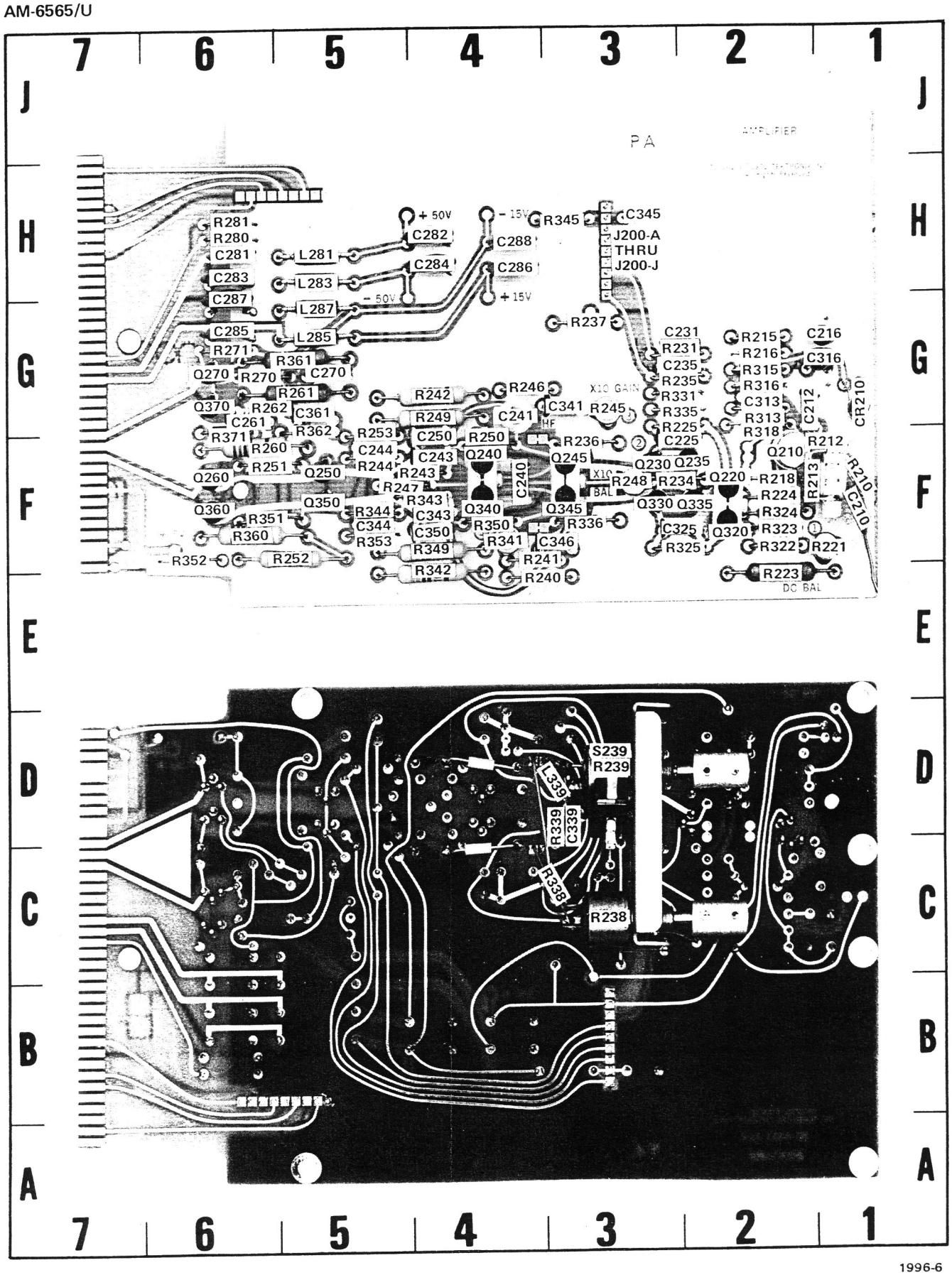
ATTENUATORS AND CONNECTORS 1

mgf
1172



1996-6

Fig. 8-2. A2—Amplifier circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C210	1F	J200A	3H	R223	2E	R318	2F
C212	2G	J200B	3H	R224	2F	R322	2F
C216	1G			R225	2G	R323	2F
C225	2F	L281	5H	R231	2G	R324	2F
C231	2G	L283	5H	R234	3F	R325	2F
C235	2G	L285	5G	R235	2F	R331	2G
C240	4F	L287	5G	R236	3F	R335	2G
C241	4G	L339	3D	R237	3G	R336	3F
C243	4F			R238	3C	R338	3D
C244	5F	Q210	2F	R239	3D	R339	3D
C250	4F	Q220	2F	R240	3E	R341	4E
C261	6G	Q230	3F	R241	3F	R342	4E
C270	5G	Q235	2F	R242	4G	R343	4F
C281	6H	Q240	4F	R243	4F	R344	5F
C282	4H	Q245	3F	R244	5F	R345	3H
C283	6H	Q250	5F	R245	3G	R349	4F
C284	4H	Q260	6F	R246	4G	R350	4F
C285	6G	Q270	6G	R247	5F	R351	6F
C286	4H	Q320	2F	R248	3F	R352	6F
C287	6G	Q330	3F	R249	4G	R353	5F
C288	4H	Q335	2F	R250	4F	R360	6F
C313	2G	Q340	4F	R251	6F	R361	5G
C316	1G	Q345	3F	R252	5F	R362	5F
C325	2F	Q350	5F	R253	5G	R371	6F
C339	3D	Q360	6F	R260	6F		
C341	3G	Q370	6G	R261	5G	S239	3D
C343	4F			R262	6G		
C344	5F	R210	1F	R270	6G		
C345	3H	R212	1F	R271	6G		
C346	3F	R213	1F	R280	6H		
C350	4F	R215	2G	R281	6H		
C361	5G	R216	2G	R313	2G		
		R218	2F	R315	2G		
CR210	1G	R221	1F	R316	2G		

VOLTAGE AND WAVEFORM CONDITIONS

The voltages and waveforms shown on this diagram were obtained by using the test conditions and equipment listed below. Voltages and waveforms are not absolute and may vary between instruments.

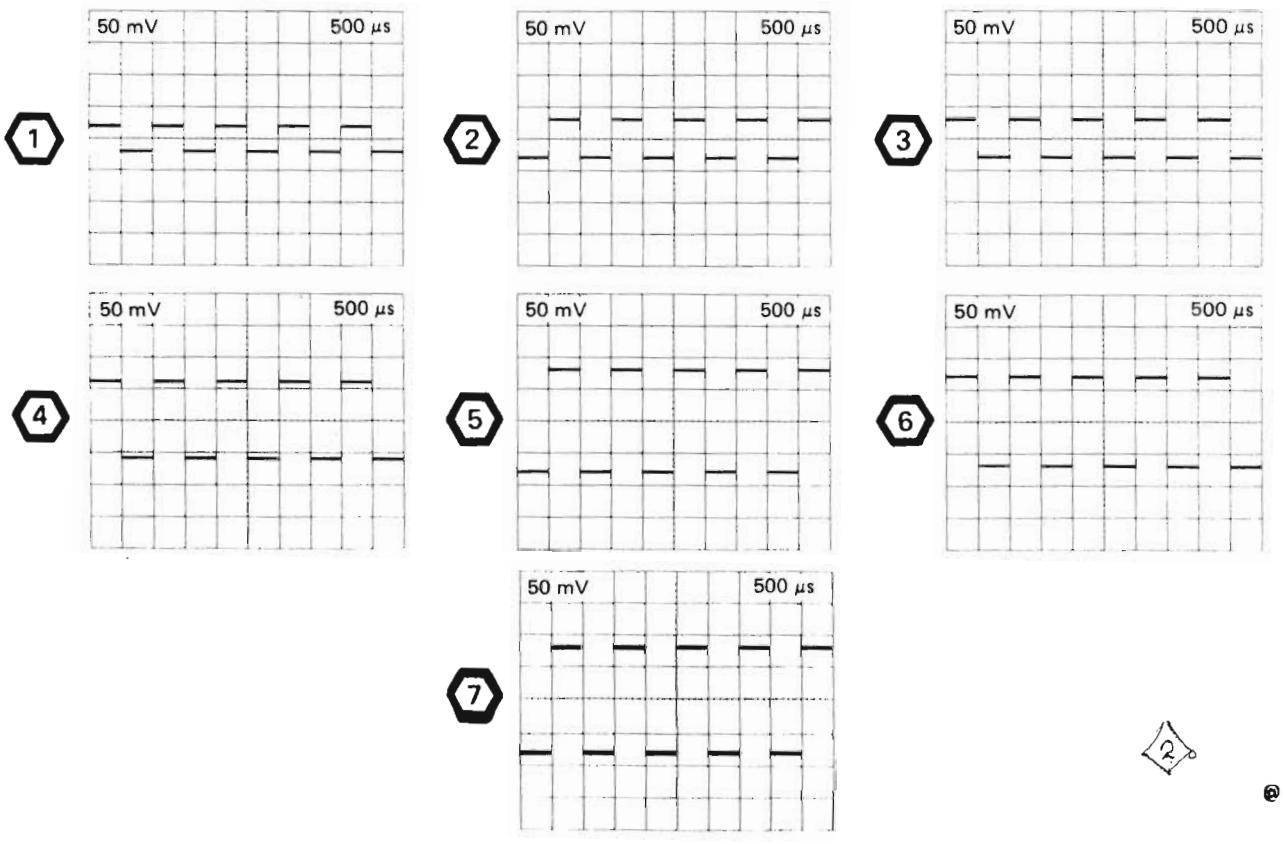
Recommended Test Equipment

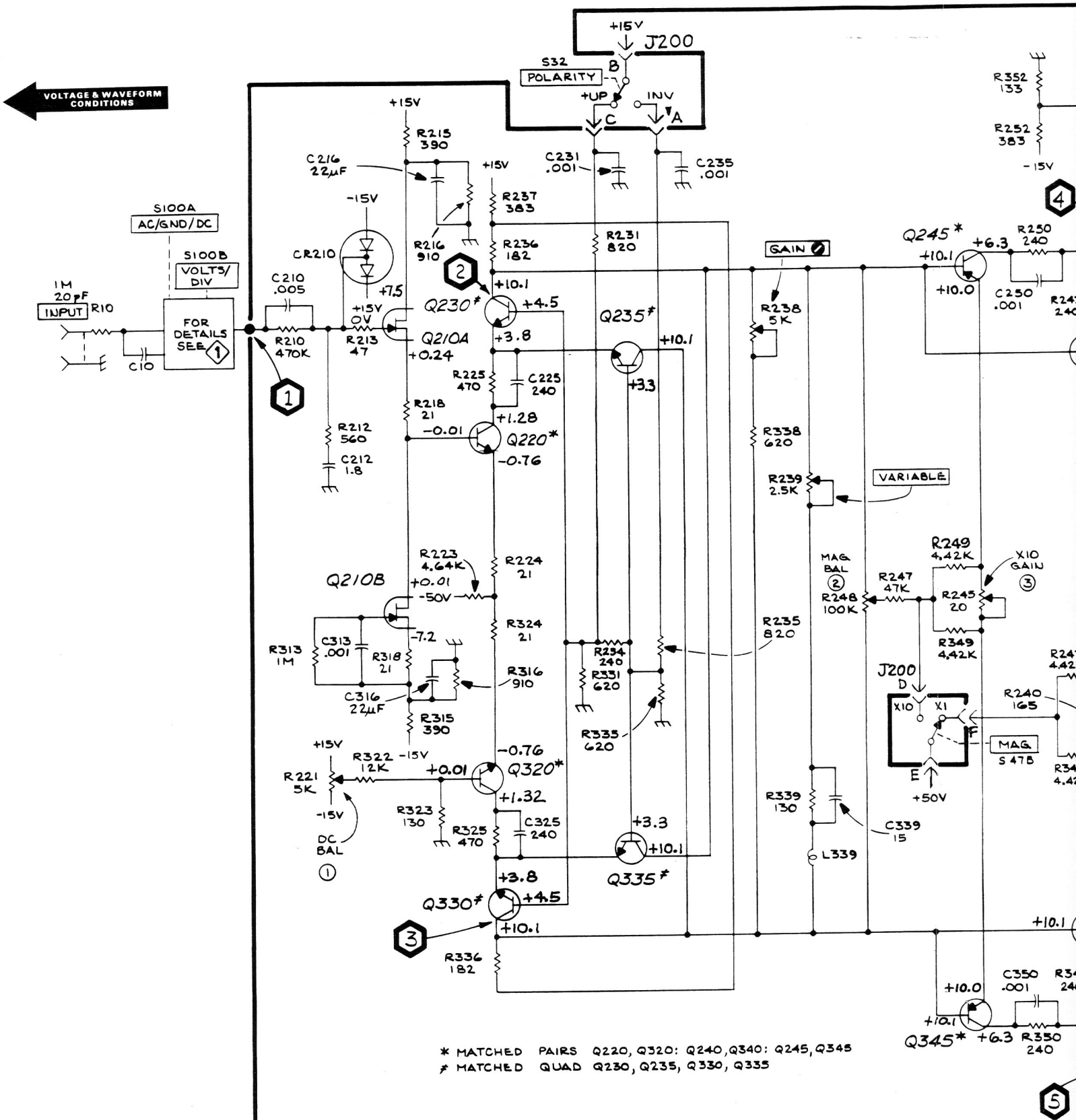
Item	Specification		Recommended Type
Test Oscilloscope System	Bandwidth	Dc to 65 MHz.	OS-245(P)/U Oscilloscope with AM-6565/U Amplifier unit, TD-1085/U Time Base unit, and P6053B Probe; or equivalent.
	Deflection Factor	5 mV to 5 V.	
	Sweep Rate	To 0.5 μs/div.	
	Input Impedance	10 MΩ.	
	Probe	10X, fast rise.	
Voltmeter	Input Impedance	10 MΩ.	Tektronix DM501 Digital Multimeter with TM500-series Power Module.
	Range	To 200 V dc.	
Plug-in Extender	Allows Tektronix 7000-series plug-ins to be extended from the oscilloscope mainframe.		Tektronix Part 067-0589-00 (rigid) or 067-0616-00 (flexible).

Control Settings

AM-6565/U	VOLTS/DIV	.2
	VARIABLE	CAL
	Coupling	AC
	POLARITY	+UP
	MAG	X1
	POSITION	To center waveform

A 1 volt, 1 kilohertz square-wave signal is applied to the AM-6565/U INPUT and to the external trigger input of the Test Oscilloscope System. The test oscilloscope input is ac coupled. All voltages are referenced to chassis ground.




VOLTAGE & WAVEFORM CONDITIONS
+15V
J200
S32
POLARITY
B
+UP
INV
C
A
S100A
AC/GND/DC
S100B
VOLTS/DIV
1M
20pF
INPUT
R10
C10
FOR DETAILS SEE 1
C210 .005
R210 470K
R213 47
C216 22µF
R215 390
R216 910
CR210
-15V
+7.5
0V
Q210A
+0.24
+10.1
+4.5
Q230*
+3.8
R225 470
C225 240
R218 21
+1.28
-0.01
Q220*
-0.76
R212 560
C212 1.8
R237 383
R236 182
C231 .001
C235 .001
R231 820
GAIN
R238 5K
Q235*
+10.1
+3.3
R338 620
R239 2.5K
VARIABLE
Q245*
+10.1
+10.0
+6.3
R250 240
C250 .001
R352 133
R252 383
-15V
R223 4.64K
R224 21
Q210B
+0.01
-50V
-7.2
R313 1M
C313 .001
R318 21
R324 21
R316 910
C316 22µF
R315 390
R234 240
R331 620
R335 620
R235 820
MAG BAL 2
R248 100K
R247 47K
R249 4.42K
X10 GAIN 3
R245 20
R349 4.42K
J200
D
X10
X1
F
E
+50V
MAG S47B
R240 165
R339 130
C339 15
L339
+15V
R322 12K
-15V
R221 5K
DC BAL 1
-0.76
Q320*
+0.01
+1.32
R323 130
R325 470
C325 240
+3.3
+10.1
Q335*
+3.8
Q330*
+4.5
+10.1
R336 182
+10.1
+10.0
C350 .001
+10.1
Q345*
+6.3
R350 240
* MATCHED PAIRS Q220, Q320: Q240, Q340: Q245, Q345
≠ MATCHED QUAD Q230, Q235, Q330, Q335
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
PARTIAL A2 AMPLIFIER BOARD

AM-6565/U

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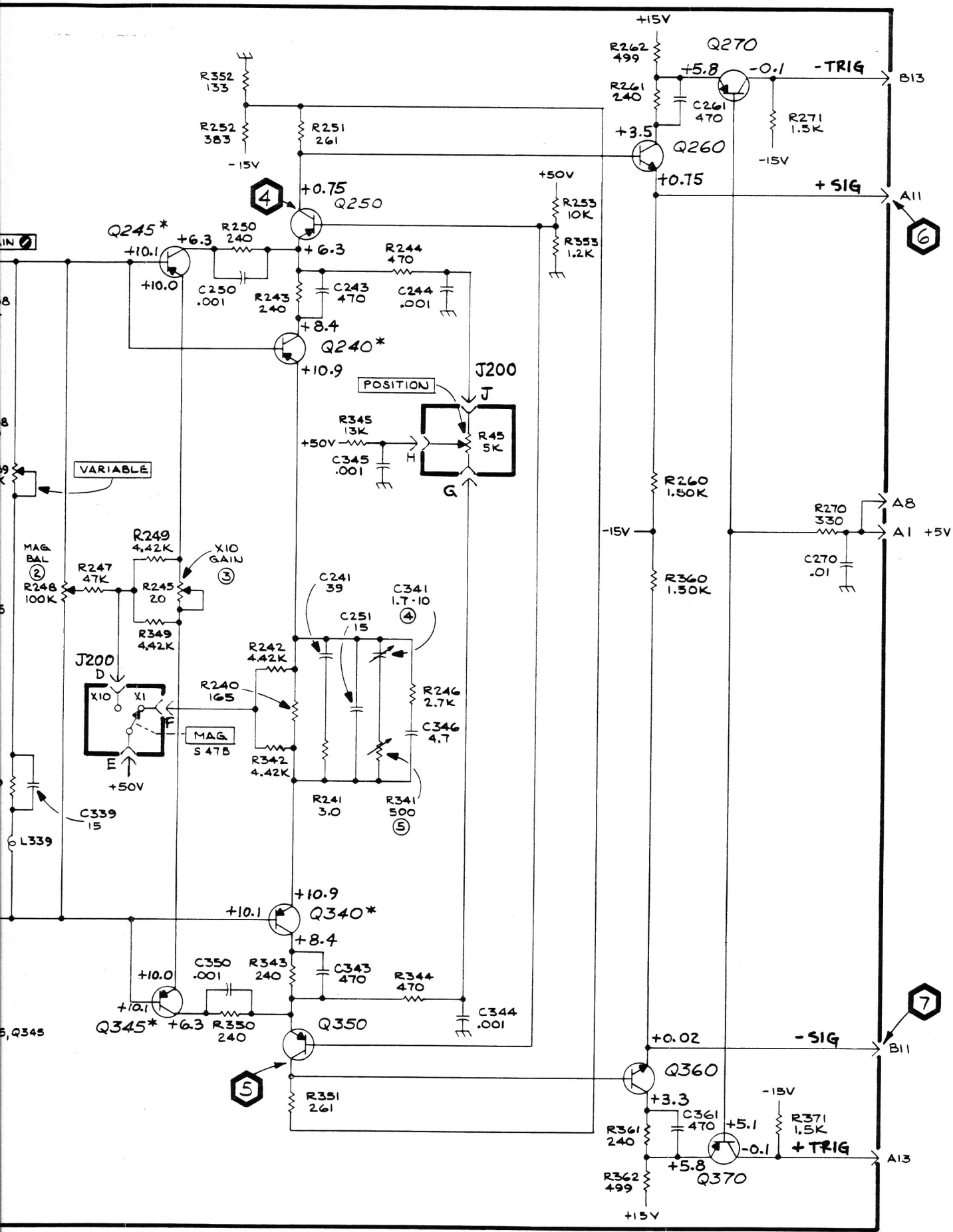
+15V
R262 499
Q270
+5.8
-0.1
-TRIG
B13
R261 240
C261 470
R271 1.5K
+3.5
Q260
-15V
+0.75
+SIG
A11
6
R352 133
R252 383
-15V
R251 261
4
+0.75
Q250
+50V
R253 10K
R353 1.2K
Q245*
+6.3
R250 240
+10.1
+6.3
R244 470
+10.0
C250 .001
R243 240
C243 470
C244 .001
+8.4
Q240*
+10.9
J200
POSITION
J
R345 13K
+50V
C345 .001
H
R45 5K
G
VARIABLE
R260 1.50K
R270 330
A8
A1 +5V
-15V
C270 .01
R360 1.50K
MAG BAL 2
R248 100K
R247 47K
R249 4.42K
X10 GAIN 3
R245 20
R349 4.42K
C241 39
C341 1.7-10 4
C251 15
R242 4.42K
J200
D
X10
X1
F
E
+50V
R240 165
MAG S 47B
R246 2.7K
C346 4.7
R342 4.42K
R241 3.0
R341 500 5
C339 15
L339
+10.9
+10.1
Q340*
+8.4
+10.0
C350 .001
R343 240
C343 470
R344 470
+10.1
Q345*
+6.3
R350 240
Q350
C344 .001
7
+0.02
-SIG
B11
5
Q360
R351 261
+3.3
-15V
C361 470
+5.1
R371 1.5K
R361 240
-0.1
+TRIG
A13
+5.8
Q370
R362 499
+15V

AMPLIFIER 2

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
000EX	O'HARA METAL PRODUCT COMPANY	542 BRANNAN STREET	SAN FRANCISCO, CA 94107
000FW	WESTERN SINTERING CO INC.	2620 STEVENS DRIVE	RICHLAND, WA 99352
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV. OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
24618	TRANSCON MFG. CO.	2655 PERTH ST.	DALLAS, TX 75220
42838	NATIONAL RIVET AND MFG. CO.	1-21 EAST JEFFERSON ST.	WAUPUN, WI 53963
70278	ALLIED STEEL AND CONVEYORS, DIV. OF SPARTON CORP.	17333 HEALY	DETROIT, MI 48212
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1064-04			2		SHIELD,ELEC:SIDE PLUG-IN UNITS	80009	337-1064-00
-2	366-0494-00			1		KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-3	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-4	366-1031-03			1		KNOB:RED--CAL	80009	366-1031-03
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-5	366-1299-00			1		KNOB:GRAY	80009	366-1299-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-0215-02			1		KNOB:LEVER SWITCH	80009	366-0215-02
-7	366-1058-39			1		KNOB:LATCH	80009	366-1058-39
						(ATTACHING PARTS)		
-8	214-1095-00			1		PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	22599	52-022-094-0187
						- - - * - - -		
-9	105-0076-00			1		REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-00
-10	214-1280-00			1		SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA W	80009	214-1280-00
-11	348-0235-00			2		SHLD GSKT,ELEC:4.734 INCH LONG	80009	348-0235-00
-12	333-1475-00			1		PANEL,FRONT:	80009	333-1475-00
-13	----- -----			1		RES.,VARIABLE:(SEE R45 EPL)		
						(ATTACHING PARTS)		
-14	210-0583-00			2		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-15	210-0046-00			1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-16	----- -----			2		SWITCH,SLIDE:(SEE S32 & S47B EPL)		
						(ATTACHING PARTS)		
-17	211-0030-00			4		SCREW,MACHINE:2-56 X 0.25"82 DEG,FLH STL	83385	OBD
-18	210-0405-00			4		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
-19	131-0126-00			1		CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
-20	386-1447-54			1		SUBPANEL,FRONT:	80009	386-1447-54
						(ATTACHING PARTS)		
-21	213-0192-00			4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						- - - * - - -		
-22	348-0284-00			FT		SHLD,GSKT,ELEC:4.734 INCH LONG	80009	348-0284-00
-23	384-1110-00			1		EXTENSION SHAFT:8.122 L X 0.124 INCH OD	80009	384-1110-00
-24	384-1112-00			1		EXTENSION SHAFT:0.50 L X 0.125 INCH OD	80009	384-1112-00
-25	384-1111-00			1		EXTENSION SHAFT:7.04 L X 0.125 INCH OD	80009	384-1111-00
	----- -----			1		CKT BOARD ASSY:ATTENUATOR(SEE A1 EPL)		
-26	105-0243-00			1		. ACTUATOR,SWITCH:AC,DC	80009	105-0243-00
						(ATTACHING PARTS)		
-27	213-0214-00			1		. SCREW,CAP SCH:2-56 X 0.375"HEX HD STL	70278	OBD
						- - - * - - -		
	105-0485-00			1		. ACTR ASSY,CAM S:ATTENUATOR	80009	105-0485-00
						(ATTACHING PARTS)		
-28	129-0299-00			4		. POST,ELEC-MECH:HEX,0.333 INCH LONG	80009	129-0299-00
-29	210-0004-00			6		. WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
-30	211-0097-00			2		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. . **ACTUATOR ASSY INCLUDES:**		
-31	200-1227-00			1		. . COVER,CAM SW:3 & 24 ELEMENTS,AL	80009	200-1227-00
						(ATTACHING PARTS)		
-32	211-0116-00			6		. . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-33	214-1139-00			1		. . SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
	214-1139-02			2		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03			2		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-34	210-0406-00			10		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-35	131-0963-00			2		. . CONTACT,ELEC:GROUNDING	000EX	OBD
-36	214-1127-00			4		. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-37	401-0081-02			1		. . BEARING,CAM SW:FRONT	80009	401-0081-02
						(ATTACHING PARTS)		
-38	354-0391-00			1		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
						- - - * - - -		
-39	105-0242-00			1		. . ACTUATOR,CAM SW:AC,DC,GND	80009	105-0242-00
-40	401-0115-00			1		. . BEARING,CAM SW:CENTER	80009	401-0115-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-41	105-0272-00			1		. . ACTUATOR,CAM SW:	80009	105-0272-00
						(ATTACHING PARTS)		
	354-0391-00			1		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
						- - - * - - -		
-42	401-0081-02			1		. . BEARING,CAM SW:FRONT	80009	401-0081-02
-43	----- -----			1		. CKT BOARD ASSY:ATTENUATOR(SEE A1 EPL)		
						(ATTACHING PARTS)		
-44	211-0001-00			3		. SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
-45	210-0053-00			3		. WASHER,LOCK:INTL,0.092 ID X 0.175"OD,STL	83385	OBD
						- - - * - - -		
	----- -----			-		. . CKT BOARD ASSY INCLUDES:		
-46	131-1030-00			10		. . CONT ASSY,ELEC:CAM SWITCH,BOTTOM	80009	131-1030-00
	131-1031-00			10		. . CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00
						(ATTACHING PARTS)		
	210-0779-00			10		. . RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
						- - - * - - -		
-47	136-0252-01			8		. . CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
	136-0333-00			2		. . SOCKET,PIN TERM:0.138 INCH LONG	00779	1-331677-4
	337-1406-00			1		. . SHLD,ELECTRICAL:CAM CONTACTS	80009	337-1406-00
-48	441-0992-04			1		. CHAS,PL-IN UNIT:ATTENUATOR	80009	441-0992-04
-49	200-1199-00			1		COV,ATTEN CHAS:	80009	200-1199-00
						(ATTACHING PARTS)		
-50	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-51	210-0994-00			3		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
						- - - * - - -		
-52	337-1423-00	B010100	B034205	1		SHIELD,ELEC:ATTENUATOR	80009	337-1423-00
	337-1423-02	B034206		1		SHIELD,ELEC:ATTENUATOR	80009	337-1423-02
						(ATTACHING PARTS)		
-53	213-0055-00			1		SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	93907	OBD
						- - - * - - -		
-54	407-0977-00			1		BRACKET,CKT BD:ALUMINUM	80009	407-0977-00
						(ATTACHING PARTS)		
-55	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-56	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-57	376-0029-00			2		CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
-58	----- -----			-		CKT BOARD ASSY:AMPLIFIER(SEE A2 EPL)		
						(ATTACHING PARTS)		
-59	211-0008-00			3		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
	124-0162-00			1		. TERMINAL BOARD:4 NOTCH,CERAMIC,STUD MTD	80009	124-0162-00
-60	131-0589-00			9		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-61	136-0252-04			53		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-62	200-0945-01			3		. COVER,HALF XSTR:DUAL TO-18,W/2-56 THD	80009	200-0945-01
-63	200-0945-00			3		. COVER,HALF XSTR:DUAL TO-18,ALUMINUM	80009	200-0945-00
-64	211-0001-00			3		. SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	83385	OBD
-65	----- -----			-		. RES.,VARIABLE:(SEE R238 EPL)		
						(ATTACHING PARTS)		
-66	210-0583-00			1		. NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-67	210-0046-00			1		. WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-68	----- -----			1		. RES.,VARIABLE:(SEE R239/S239 EPL)		
						(ATTACHING PARTS)		
-69	210-0583-00			1		. NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-70	210-0046-00			1		. WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-71	407-0976-00			1		. BRACKET,VAR RES:BRASS	80009	407-0976-00
-72	386-1402-00			1		PANEL,REAR:	80009	386-1402-00
						(ATTACHING PARTS)		
-73	213-0192-00			4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
-74	361-0326-00			1		SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L	80009	361-0326-00
						- - - * - - -		
-75	220-0547-01			4		NUT,BLOCK:0.38 X 0.25 X 0.282"OA	000FW	OBD
						(ATTACHING PARTS)		
-76	211-0105-00			4		SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-77	210-0288-00			1		TERMINAL,LUG:0.125 ID X 1.125 INCH LONG	80009	210-0288-00
						(ATTACHING PARTS)		
-78	211-0105-00			1		SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL	83385	OBD
-79	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-80	105-0075-00			1		BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00
-81	214-1054-00			1		SPRING,FLAT:0.825 X 0.322,SST	80009	214-1054-00
-82	214-1061-00			1		SPRING,GROUND:FLAT	80009	214-1061-00
-83	426-0736-00			1		FR SECT,PLUG-IN:TOP	80009	426-0736-00
	334-2078-05	XB040760		1		MARKER,IDENT:MKD AM-6565/U MIL NOMEN	80009	334-2078-05
-84	426-0737-00			1		FR SECT,PLUG-IN:BOTTOM	80009	426-0737-00
-85	352-0167-00			1		HLDR,TERM CONN:9 WIRE BLACK	80009	352-0167-00
-86	131-0707-00			9		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-87	175-0832-00			FT		WIRE,ELECTRICAL:9 WIRE RIBBON	08261	SS-0926(1061)0C
-88	006-0531-00			1		STRAP,TIEDOWN,E:BLUE PLASTIC BEADED	24618	700-3688

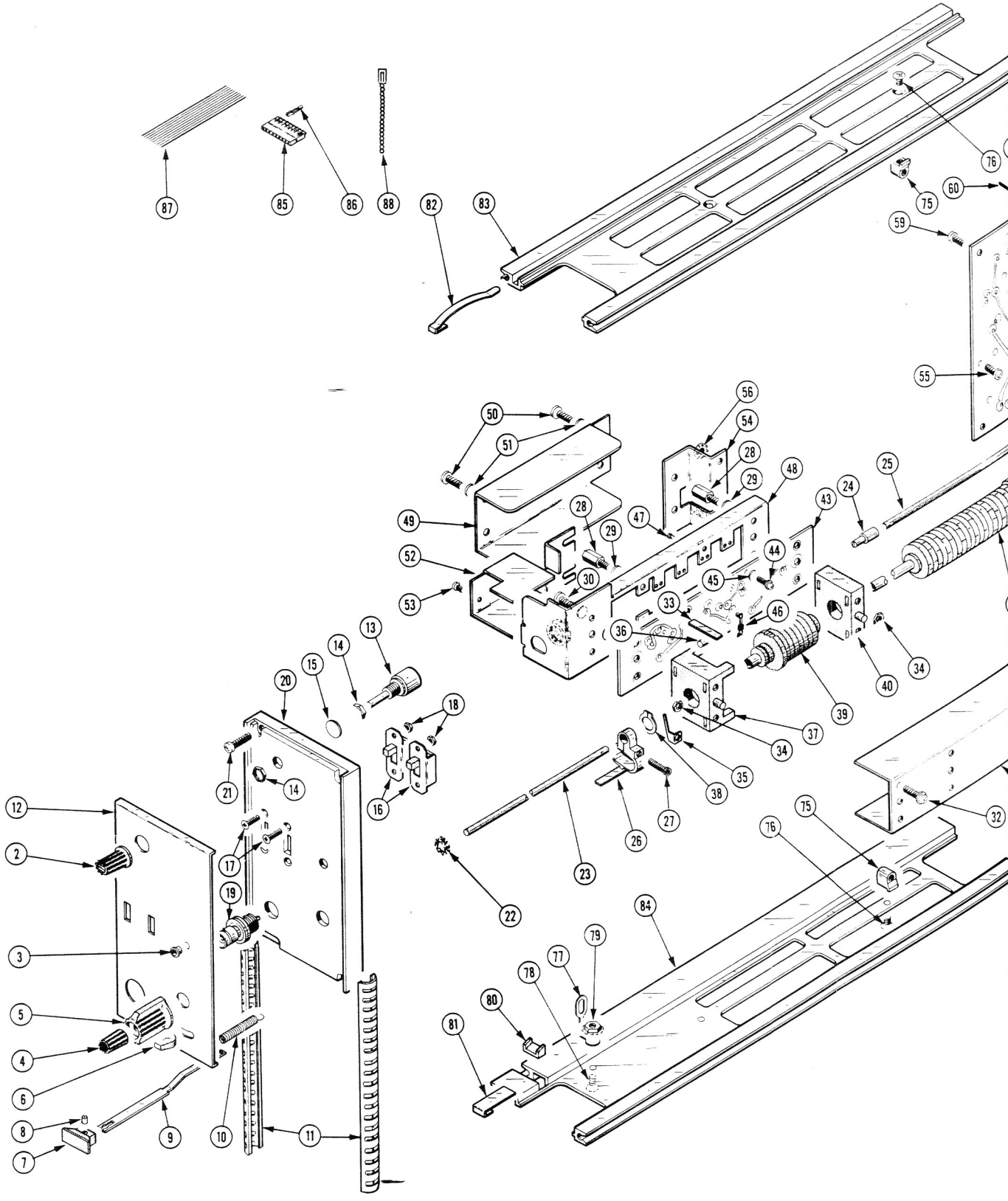
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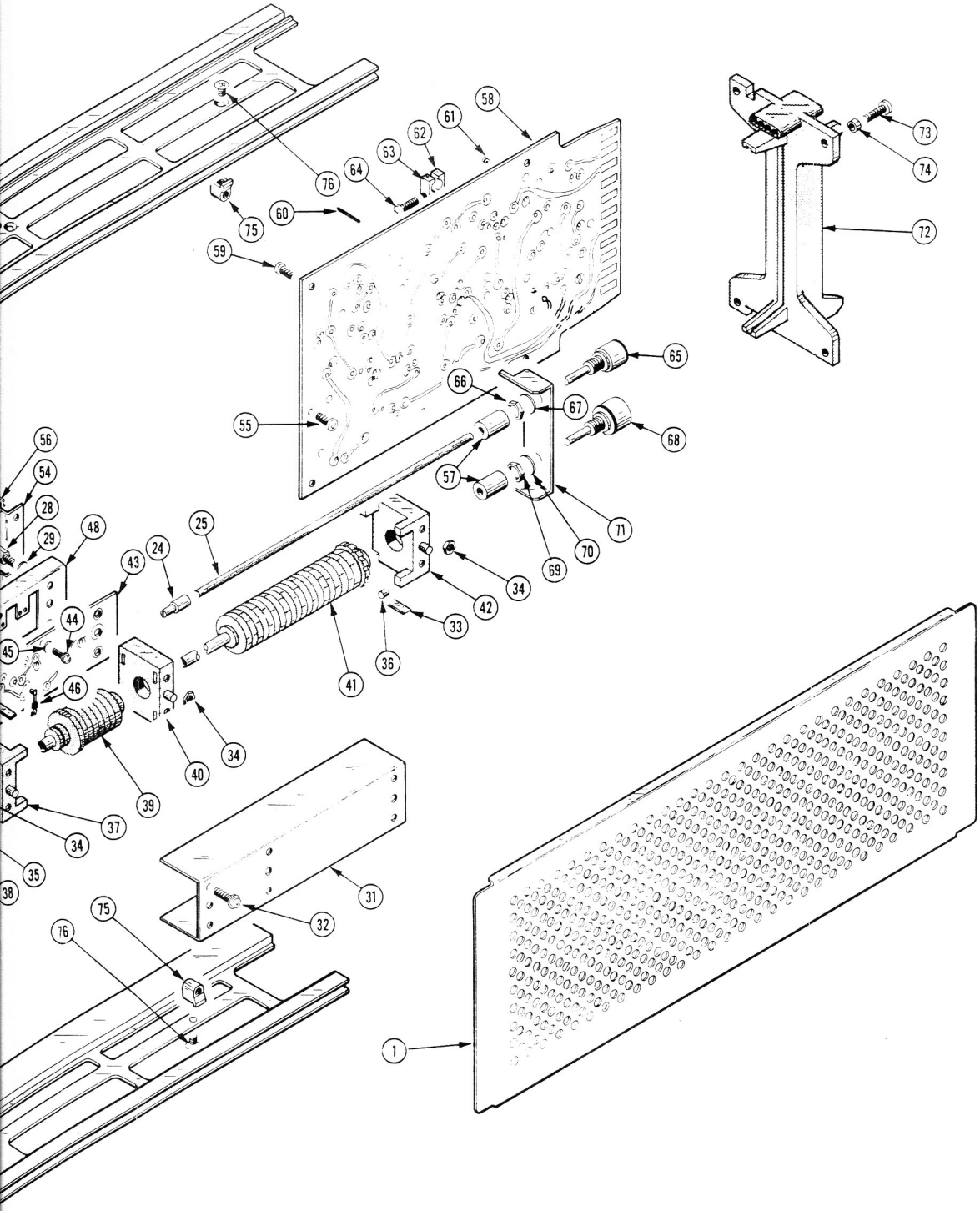
FIG. 1 EXPLODED



AM-6565/U

MANUAL CHANGE INFORMATION

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

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

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

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime	108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114	Performance of replacement equipment is the same or better than equipment being replaced.	
115		
2101		
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191		
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
067-0650-00		
TG 501 replaces 180, 180A	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181		181 - Multiple time-marks
184	TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs.
2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

7603
R7603

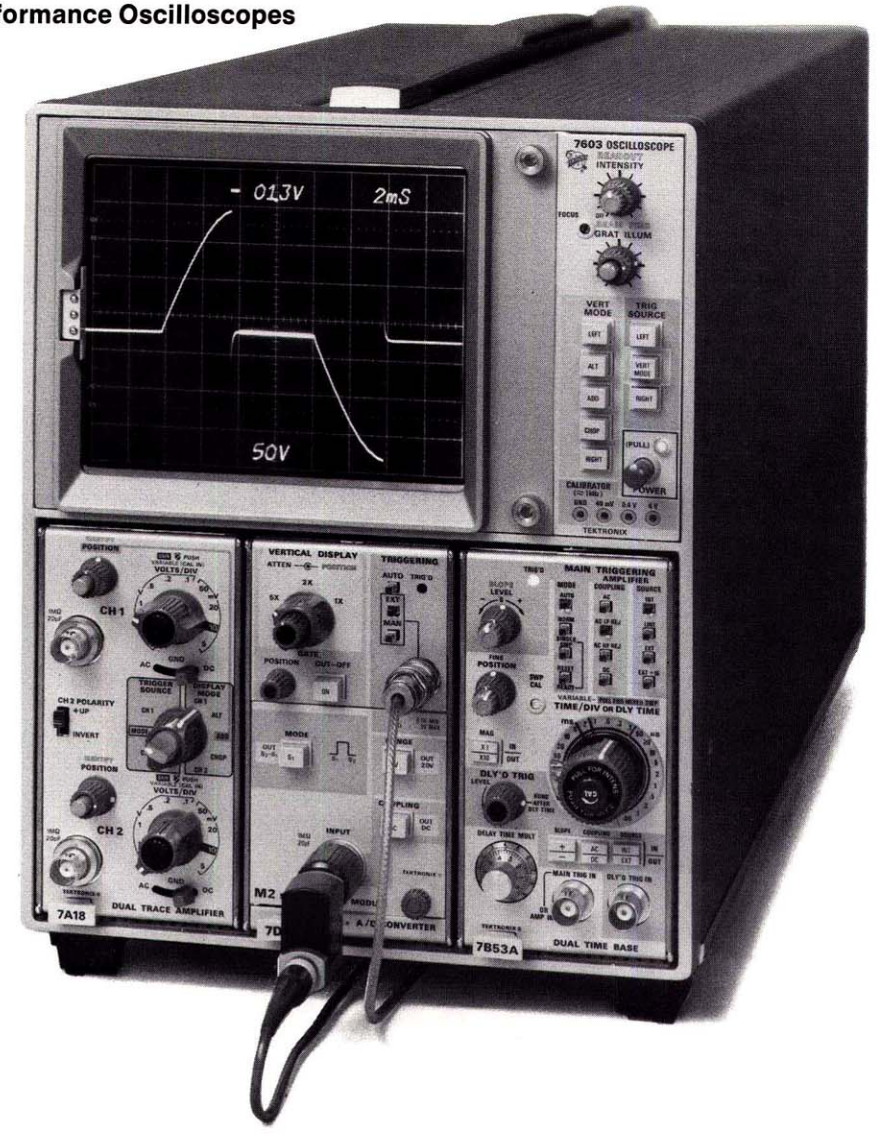
7000-Series 100-MHz Wide Performance Oscilloscopes

Dc-to-100 MHz Bandwidth

6½ in Crt

Crt Readout

5¼ in Rackmount



The TEKTRONIX 7603 and R7603 Oscilloscopes represent the best price/performance ratio available in the 100-MHz plug-in oscilloscope market today.

The crt is large, 8 x 10 div (1.22 cm/div), and features an internal graticule with variable illumination and 15 kV accelerating potential. An optional maximum brightness crt with a smaller 8 x 10 cm display and 18 kV potential gives you greater visual brightness and higher photographic writing speed.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments; compatible with all 7000-Series Plug-ins. Bandwidth determined by mainframe and plug-in unit; see Vertical System Specifications Chart.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT.

Chopped Mode — Repetition rate is approx 1 MHz.

Delay Line — Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels — One right-hand plug-in compartment; compatible with all 7000-Series Plug-ins.

Fastest Calibrated Sweep Rate — 5 ns/div.

X-Y Mode — The phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz. Bandwidth is dc to at least 2 MHz.

CRT AND DISPLAY FEATURES

Standard — Internal 8 x 10-div (1.22 cm/div) graticule with variable illumination. Accelerating potential is 15 kV with P31 phosphor.

Option 01, without Crt Readout — No crt readout.

Option 04, Max Brightness Crt — Internal 8 x 10 cm graticule with variable illumination. Accelerating potential is 18 kV with P31 phosphor standard.

Option 06, Spectrum Analyzer Graticule.

Optional Phosphors (Specify) — P7, P11, or P7/SA. (Phosphor/Spectrum Analyzer graticule combination.)

Minimum Photographic Writing Speed — Using Polaroid film without film fogging. Can be increased by using the TEKTRONIX Writing Speed Enhancer.

Crt	Writing Speed div/μs				Camera	Lens
	Type 107/47		Type 410			
	P31	P11	P31	P11		
Standard 8 x 10 div (1.22 cm/div)	100	150	200	300	C-50	f/1.9 1:0.7
Option 04 8 x 10 div (1 cm/div)	200	300	400	600		

External Z-Axis Input — 2 V p-p for full intensity range from dc to 2 MHz; intensity range diminishes to 20% of full range at 10 MHz. A positive signal blanks the trace. Max input voltage is 10 V (dc + peak ac) and p-p ac.

Autofocus — Reduces the need for additional manual focusing with changes in intensity after focus control has been adjusted.

Beam Finder — Limits display within graticule area.

OUTPUTS/INPUTS

+SAWTOOTH — Sawtooth starts 1 V or less from ground (into 1 MΩ). Output R is 950 Ω. Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω.

+Gate — Positive pulse of the same duration and coincident with sweep. Output R is 950 Ω. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Rise time is 20 ns or less into 50 Ω. Source is selectable from Main, Delay, or Auxiliary Gate.

Sig Out — Selected by TRIGGER SOURCE switch. Output voltage is 0.5 V/div (±10%) into 1 MΩ, 25 mV/div (±10%) into 50 Ω. Output R is 950 Ω. Bandwidth depends upon vertical plug-in; see Vertical System Specifications Chart.

External Single-sweep Reset — Ground closure, rear panel BNC provides input to reset sweep.

Single-sweep Ready Indicator — Rear panel BNC provides 5 V for single-sweep ready condition.

Option 07, without Signal Outputs/Inputs — No outputs/inputs.

CAMERA POWER OUTPUT

Three-prong connector to the left of the crt provides power, ground, and remote single-sweep reset access for the C-50-Series Cameras.

CALIBRATOR

Voltage Output — Rectangular waveshape, positive-going from ground (dc voltage available when selected by internal jumper). Ranges are 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15°C to +35°C); within 2% (0°C to +50°C). Repetition rate is approx 1 kHz.

Current Output — 40-mA rectangular waveshape (dc current available when selected by internal jumper) with optional current-loop accessory (012-0259-00) connected between 4 V and gnd pin jacks.

POWER REQUIREMENTS

Line Voltage Ranges — 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.

Line Frequency — 50 Hz to 400 Hz (7603); 50 Hz to 60 Hz (R7603).

Option 5, Line Frequency Change (50-400 Hz) — Converts the R7603 to 50-400 Hz operation (not required for 7603).

Max Power Consumption — 180 W, 2.0 A at 115 V line, 60 Hz. Cooling is provided by a fan for the R7603.

Included Accessories — (For 7603 and R7603) 20 in cable (two-pin-to-BNC) (175-1178-00); crt filter (Blue 337-1700-01, Clear 337-1700-04). The R7603 includes rackmounting hardware.

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

The R7603 requires only 5¼ in of rack height in a standard 19 in rack. It is fan cooled and comes complete with slide-out chassis tracks.

ORDERING INFORMATION

(Plug-ins not Included)

7603 Oscilloscope $1850

R7603 Oscilloscope $2050

7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50
Option 08	Protective Panel Cover	Add $100

R7603 OPTIONS

Option 01	without Crt Readout	Sub $400
Option 03	Emi Modification	Add $100
Option 04	Max Brightness Crt (Specify Phosphor)	Add $100
Option 05	Line Freq Change (50-400 Hz) (not required for 7603)	Add $125
Option 06	with Internal Spectrum Analyzer Graticule	No charge
Option 07	without Sig Out/In	Sub $50

7603 CONVERSION KITS

040-0654-02	Crt Readout	$550
040-0662-00	Emi Modification	$165
040-0629-01	Sig Out/In	$120
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

R7603 CONVERSION KITS

040-0674-02	Crt Readout	$550
040-0679-00	Emi Modification	$165
040-0633-00	Sig Out/In	$85
040-0686-00	Power Supply to Light Plug-in Pushbuttons	$30
040-0718-00	X-Y Horiz Comp	$150

PHOSPHOR OPTIONS (7603/R7603)

Option 76	P7 Phosphor	No charge
Option 77	P7 Phosphor with Internal Spectrum Analyzer Graticule	No charge
Option 78	P11 Phosphor	No charge

7000-Series Ruggedized Oscilloscope System | 7603N11S

Ruggedized for Extreme Environments

Meets or Exceeds MIL-O-24311 (EC) (AN/USM-281C Specifications)

Large Bright Display—6½ in Crt (15 kV)

5 ns/div Delaying Sweep

0.5 mV Vertical Sensitivity

Three-plug-in Flexibility

Versatile Trigger-source Selection

Pushbutton Switching

Illuminated No-Parallax Graticule

Color-keyed Panels

Protective Cover with Accessories

The 7603N11S Ruggedized Oscilloscope System meets the rigid environmental and electrical specifications required by MIL-O-24311 (EC) and appears on U.S. Navy QPL-24311. The system consists of a three-plug-in mainframe, two single-trace amplifiers, a dual time base, and a front-panel cover with probes and accessories.

Although the military spec requires only 50-MHz performance, this system actually performs to 65 MHz. Other better-than-required specs include operating altitude, sensitivity at reduced bandwidth with X10 gain, "X" sensitivity in X-Y mode, triggering frequency range, delaying and delayed sweep speeds, and crt size.

7603N11S Ruggedized Oscilloscope System

The mainframe and plug-ins are compatible with the TEKTRONIX 7000-Series product line. The system does not have crt readout, and it can't be used with the digital plug-ins.

ENVIRONMENTAL

Temperature — Nonoperating −62°C to +75°C, operating −28°C to +65°C.

Humidity — 0 to 95% rh over entire temperature range, operating or nonoperating.

Altitude — Nonoperating sea level to 50,000 ft, operating sea level to 15,000 ft.

Vibration (Operating) — 5 to 15 Hz at 0.060 in ±0.012 in p-p amplitude, 16 to 25 Hz at 0.040 in ±0.008 in p-p amplitude, 26 to 33 Hz at 0.020 in ±0.004 in p-p amplitude.

Shock (Operating) — 9 consecutive 400-pound hammer blows without failure from 1, 3, and 5 ft in vertical, horizontal, and longitudinal axis as per MIL-S-901 for Grade A, Class 1, Type A for lightweight equipment.

Inclination (Operating) — As per MIL-E-16400.

Drip Proof (Nonoperating) — As per MIL-STD-198.

Salt Spray (Nonoperating) — As per MIL-E-16400.

Electromagnetic Interference — As per MIL-STD-462 performed by MIL-STD-461 for the following tests:

CE-01	30 Hz to 20 kHz	Power lead emission
CE-03	20 kHz to 50 MHz	Power lead emission
CS-01	30 Hz to 50 kHz	Power lead, radiation susceptibility
CS-02	50 kHz to 4C0 MHz	Power lead, radiation susceptibility
CS-06	Spike Test	Power lead, spike susceptibility
RE-01	30 Hz to 30 kHz	Instrument radiation, magnetic
RE-02	14 kHz to 10 GHz	Instrument radiation, electric
RS-01	30 Hz to 30 kHz	Instrument susceptibility, magnetic
RS-03	14 kHz to 10 GHz	Instrument susceptibility, electric

Reliability — Optimum performance and reliable service are provided during continuous or interrupted operation. The MIL-O-24311(EC) MTBF requirement of greater than 600 hours is met as tested under the following conditions: temperature +40°C ±2°C; relative humidity 70% ±5%; vibration 25 Hz at 0.040 in ±0.0008 in p-p amplitude for 10 minutes of each "Power On" hour during each day of the 8 hour manned schedule; power cycled at 4 hour intervals with 10 minutes power off for each 4 hour period of the manned test schedule. An MTBF of greater than 2000 hours was achieved during testing.

VERTICAL SYSTEM
(Includes Two 7A15AN11 Plug-ins)

Channels — Two left-hand plug-in compartments, with a delay line which allows the leading edge of the displayed waveform to be viewed. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Display Modes — LEFT, ALT, ADD, CHOP, RIGHT. Chopped frequency is approx 1 MHz. Added mode displays signals algebraically with a cmrr of 20:1 to 25 MHz.

Bandwidth/Sensitivity — Dc to 65 MHz from 5 mV/div to 10 V/div, accuracy within 2%, variable extends to 25 V/div. Max sensitivity is 0.5 mV at 10 MHz with X10 gain. Ac-coupling lower −3 dB point is less than 2 Hz. Rise time is 5.4 ns with less than 2% aberrations.

Input R and C — 1 MΩ within 2%, less than 27 pF.

Max Input Voltage — 400 V (dc + peak ac).

Dc Stability — Less than 1 div/hr drift at 25°C.

HORIZONTAL SYSTEM
(Includes One 7B53AN11 Plug-in)

Channels — One right-hand plug-in compartment. All 7000-Series Plug-ins are compatible (except those which require crt readout).

Internal Trigger Modes — LEFT VERT, VERT MODE, RIGHT VERT.

X-Y Mode — The phase shift between vertical and horizontal channels is less than 2° from dc to 35 kHz. Bandwidth is at least 2 MHz. Rise time is less than 175 ns. Using the 7B53AN11 time-base external amplifier, 10 mV, 100 mV, and 1 V sensitivities (±10%) are available. Input R and C for 7B53AN11 is 1 MΩ within 2%, 20 pF within 2 pF. Any vertical plug-in, such as the 7A15AN11, may be used in the horizontal compartment, providing a greater number of sensitivities for calibrated X-Y displays.

Sweep Display Modes — Main Sweep, Main Sweep Intensified by Delayed Sweep, Delayed Sweep.

MAIN (DELAYING) SWEEP

Sweep Rate — 0.05 μs/div to 5 s/div in 25 steps (1-2-5 sequence). 5 ns/div fastest calibrated sweep rate, obtained with X10 magnifier. The uncalibrated variable is continuous between steps and to 12.5 s/div.

Sweep Accuracy — Within 3% from 0.05 μs/div to 5 s/div, within 5% at 5 ns/div.

Sweep Modes — Normal, Auto, Single Sweep.

Delay Time — Multiplier range is 0 to 10 times the Time/Div setting. Accuracy is within 1% from 0.5 s/div to 0.5 μs/div, within 2% from 5 s/div to 1 s/div. Incremental linearity is within 0.2% of full scale. Jitter is less than 1 part in 20,000 of X10 Time/Div setting.

Triggering (Source/Sensitivity) — Internal 0.5 cm to 50 MHz. External, 0.25 V to 20 MHz, 0.5 V to 50 MHz. Ext ÷ 10, 2.5 V to 20 MHz, 5 V to 50 MHz. Triggering extends to 100 MHz with reduced sensitivity in both Internal and External Modes. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; ac lf Rej, 30 kHz to 50 MHz; ac hf Rej, 30 Hz to 50 kHz; dc, dc to 50 MHz. With external level range, slope is ±30 V.

DELAYED SWEEP

Triggering (Source/Sensitivity) — Internal 0.3 div to 10 MHz increasing to 1.5 div at 50 MHz. External, 0.1 V to 10 MHz increasing to 0.5 V at 100 MHz. Input R and C is 1 MΩ within 2%, 20 pF within 2 pF.

Triggering Frequency Range — Ac, 30 Hz to 50 MHz; dc, dc to 50 MHz.

Sweep Rate — 0.05 μs/div to 0.5 s/div in 22 steps (1-2-5 sequence). The delayed sweep runs after delay time or is triggerable after delay time.

Sweep Accuracy — Within 3% from 50 ms/div to 0.5 μs/div, within 4% for all other sweep rates except the magnified X10 sweep rate of 5 ns/div, which is within 6%.

CRT

Accelerating Potential — 15 kV.

Phosphor — P31.

Graticule — Internal 8 x 10 cm with variable illumination. The 6½ in crt permits 2 cm of linear overscan in both axes, making a total viewing area of approx 10 x 12 cm.

Crt Controls — Located on front panel are Focus, Intensity, Graticule Illumination, Beam Finder, and Trace Rotation. Astigmatism is an internal control.

External Z-Axis Input (BNC Connector on Rear Panel) — 2 V p-p for full intensity range from dc to 2 MHz, intensity range diminishes to 20% of full range at 10 MHz. Max input voltage is 10 V (dc + peak ac).

OUTPUTS

Calibrator (BNC Connector on Front Panel) — 1 V within 1%, 1 kHz square wave within 20%.

Horizontal — Main Sweep +5 V, Delayed Sweep +5 V, Main Sweep Gate +2 V, Delayed Sweep Gate +2 V, Delayed Trigger +1 V with pulse width of greater than 50 ns. All amplitudes are minimum and measured when working into at least 100 kΩ and 15 pF.

POWER REQUIREMENTS

Input Voltages — 100, 110, 120, 220, and 240 V ac ± 10% internally selectable with quick-change jumpers with 47.5−440 Hz single phase line frequency. Max power consumption is 125 W.

C281 COVER WITH ACCESSORIES

The cover provides protection during transport and packages the included accessories.

INCLUDED ACCESSORIES
(All Packaged in Cover)

Two P6006 probe packages (010-0127-00); two 8 ft long 50-Ω BNC cables (012-0366-00); two BNC female to uhf male adapters (103-0015-00); two BNC male to uhf female adapters (103-0032-00); two BNC male to binding post adapters (103-0033-00); two BNC T connectors (103-0030-00). One set of technical manuals (not packaged in cover).

Dimensions and Weights — See page 49.

For Recommended Cameras — See page 50.

ORDERING INFORMATION

7603N11S Oscilloscope System (AN/USM-281C)
Order 7603NMS **$3450**

System Includes — One each 7603N11 Oscilloscope, two each 7A15AN11 Amplifier Plug-ins, one each 7B53AN11 Time Base*, and one each C281 Cover with Accessories.

To Order Separately:

7603N11 Oscilloscope (OS-245(P)/U) **$1775**

7A15AN11 Amplifier Plug-in (AM-6565/U) **$350**

7B53AN11 Time Base* Plug-in (TD-1085/U) **$975**

016-0553-00, C281 Cover W/Accessories **$120**

*Not compatible with 7844.