TEKTRONIX®

AM511
CATV
PREAMPLIFIER

INSTRUCTION MANUAL

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

Serial Number _____

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WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

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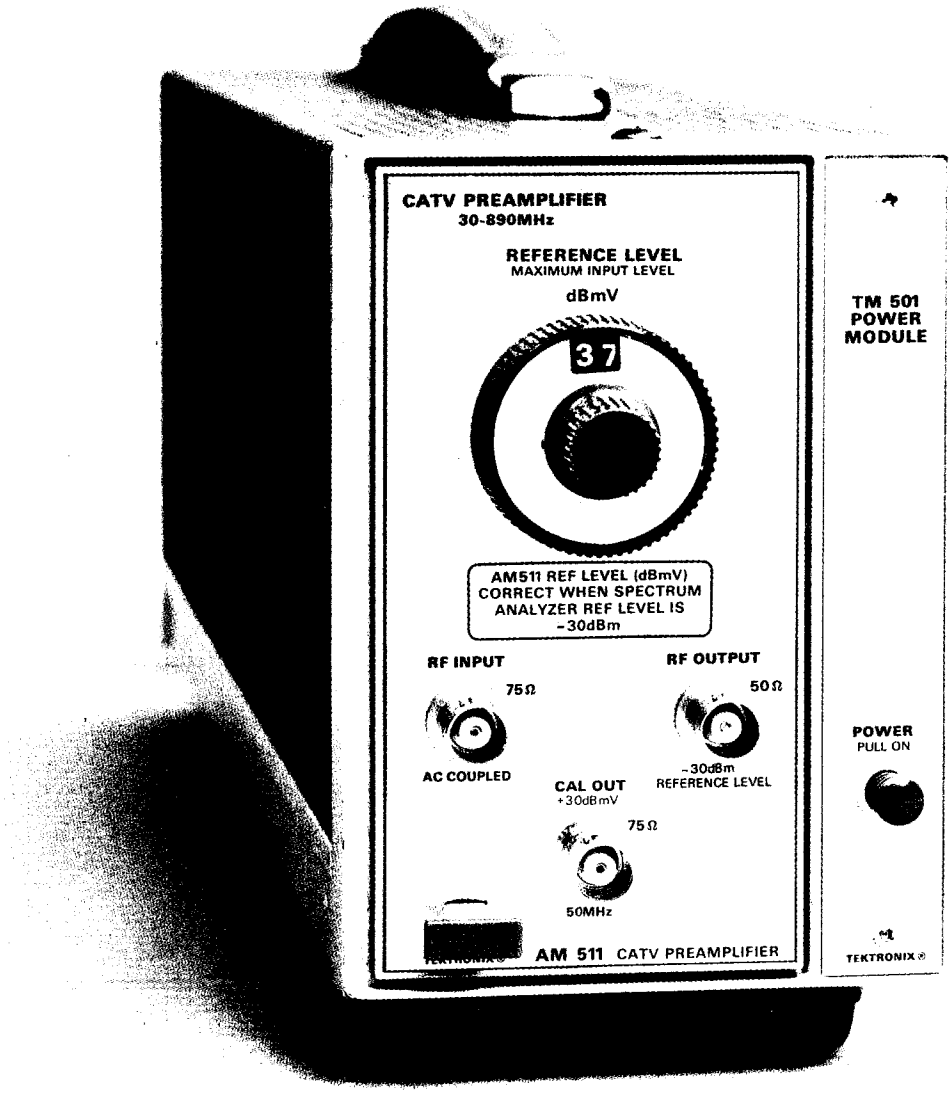

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Fig. 1-1. AM 511 CATV Preamplifier.

GENERAL INFORMATION

Description

The AM 511 is a TM 500-Series plug-in preamplifier unit designed to operate as an accessory to the 7L12 or 7L13 Spectrum Analyzer. In combination with one of these analyzers, cable television performance can be measured and compared to FCC and industry standards.

Electrical Characteristics (with 7L12 or 7L13)

Frequency Range: 30 MHz to 890 MHz.

Display Flatness: (AM 511/7L12) ±1.0 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB over the full frequency range.

(AM 511/7L13) +1.0 dB, −1.5 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz and +2.0 dB, −2.5 dB, over the full frequency range.

Sensitivity: Signal + noise = 2X noise, in LIN mode. The following characteristics apply at 50 MHz.

Sensitivity	Resolution Bandwidth
−90 dBmV	30 Hz
−80 dBmV	300 Hz
−73 dBmV	3 kHz
−65 dBmV	30 kHz
−55 dBmV	300 kHz
−45 dBmV	3 MHz

Noise figure for the AM 511 is no greater than 5 dB.

Intermodulation Distortion: (AM 511/7L12 or AM 511/7L13) IM products and harmonics from two signals within the frequency span of the AM 511 are 70 dB or more down from the reference level for: 1) Third-order intermodulation with two signals at the reference level (full screen), or 2) Second-order intermodulation and harmonics, with two signals 10 dB below the reference level.

Reference Level: Calibrated level in 1 dB steps from +79 dBmV to 0 dBmV. Accuracy is referenced to the +30 dBmV calibrator at 50 MHz. Maximum deviation from this reference is 0.2 dBmV +0.01 dBmV per dB deviation from the +30 dBmV AM 511 reference level. This is equivalent to ±(0.2 dBmV ±0.01 |dBmV Ref Lvl −30 dBmV|).

Input Impedance: 75 Ω with a VSWR of 2:1 or better with 10 dB or more attenuation (between 50 MHz and 300 MHz).

Calibrator: 50 MHz ±0.01% with an absolute amplitude level of +30 dBmV ±0.3 dB, from 75 Ω at 25°C.

Environmental Characteristics

This instrument will meet the electrical characteristics over the environmental limits of the TM 500-Series mainframes. Complete details of test procedures, including failure criteria, etc., can be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

Standard Accessories

1	Instruction Manual	070-2043-00
1	50 Ω cable, BNC to BNC, 42 inches	012-0057-01
1	BNC to F Adapter	013-0126-00
1	75 Ω cable, BNC to BNC, 42 inches	012-0074-00
1	Advertising Brochure "No Loose Ends"	A-2698

OPERATION

Introduction

This section describes the function of the front panel controls and connectors, a general operating procedure and some applications[1] for the instrument. Performing the operating procedure should help acquaint you with the AM 511 as an accessory for the spectrum analyzers in CATV applications.

FUNCTION OF THE FRONT PANEL CONTROLS AND CONNECTORS

REFERENCE LEVEL (and MAXIMUM INPUT LEVEL)

Concentric controls select the reference level in either 1 dB or 10 dB steps and indicate this level in dBmV via a readout window. The indicated level is also the maximum signal input level for linear operation. Readout level is only applicable when the 7L12 or 7L13 REFERENCE LEVEL is set for −30 dBm.

RF INPUT Connector

A 75 Ω connector to which the input signal is applied. This connector is ac-coupled.

RF OUTPUT Connector

Supplies the output signal from a 50 Ω source. The reference level readout assumes an output of −30 dBm as a reference; therefore, the 7L12 or 7L13 REFERENCE LEVEL must be set for −30 dBm.

CAL OUT Connector

Provides an accurate +30 dBmV, 50 MHz signal source from 75 Ω. This signal provides an absolute reference on the display of the 7L12 or 7L13 to check dBmV readings and calibrate the REFERENCE LEVEL. Harmonics of the 50 MHz provide picket fence markers across the frequency span for accurate frequency and span calibration.

Adjust the 7L12 or 7L13 AMPL CAL to set the correct reference level.

[1]**For a complete treatise on applications and measurement evaluation we recommend the Tektronix brochure "No Loose Ends", No. A-2698 (supplied with the AM 511 accessories); and Tektronix brochure "Spectrum Analysis and CATV Systems", No. A-2515.**

GENERAL OPERATING INFORMATION[1]

The following describes the operational procedure required to calibrate the AM 511 and appropriate spectrum analyzer (7L12 or 7L13) as a CATV measurement system.

1. Preliminary Setup and Calibration Procedure

a. Plug the AM 511 into a TM 500-Series mainframe. Plug the spectrum analyzer into a 7000-Series mainframe.

b. Connect the AM 511 and spectrum analyzer as shown in Fig. 2-1 and turn the power on.

c. Set the controls as shown in Fig. 2-1.

d. Allow approximately 30 to 40 minutes for the instrument to stabilize.

e. Adjust the oscilloscope Intensity and Focus controls for optimum display definition with normal intensity.

f. Press the LOG 2 dB/DIV display mode button on the analyzer and position the baseline of the display to the bottom graticule line with the Vertical Position control. Center the display with the Horizontal Position control.

g. Now press the LOG 10 dB/DIV display pushbutton on the analyzer. Display should now resemble that shown in Fig. 2-1.

NOTE

When the oscilloscope has a crt with P7 phosphor, a viewing hood will help shield ambient light and enhance the display information.

2. Calibrate the sweep span and reference level, using the AM 511 calibrator signal and the procedure described in the spectrum analyzer manual.

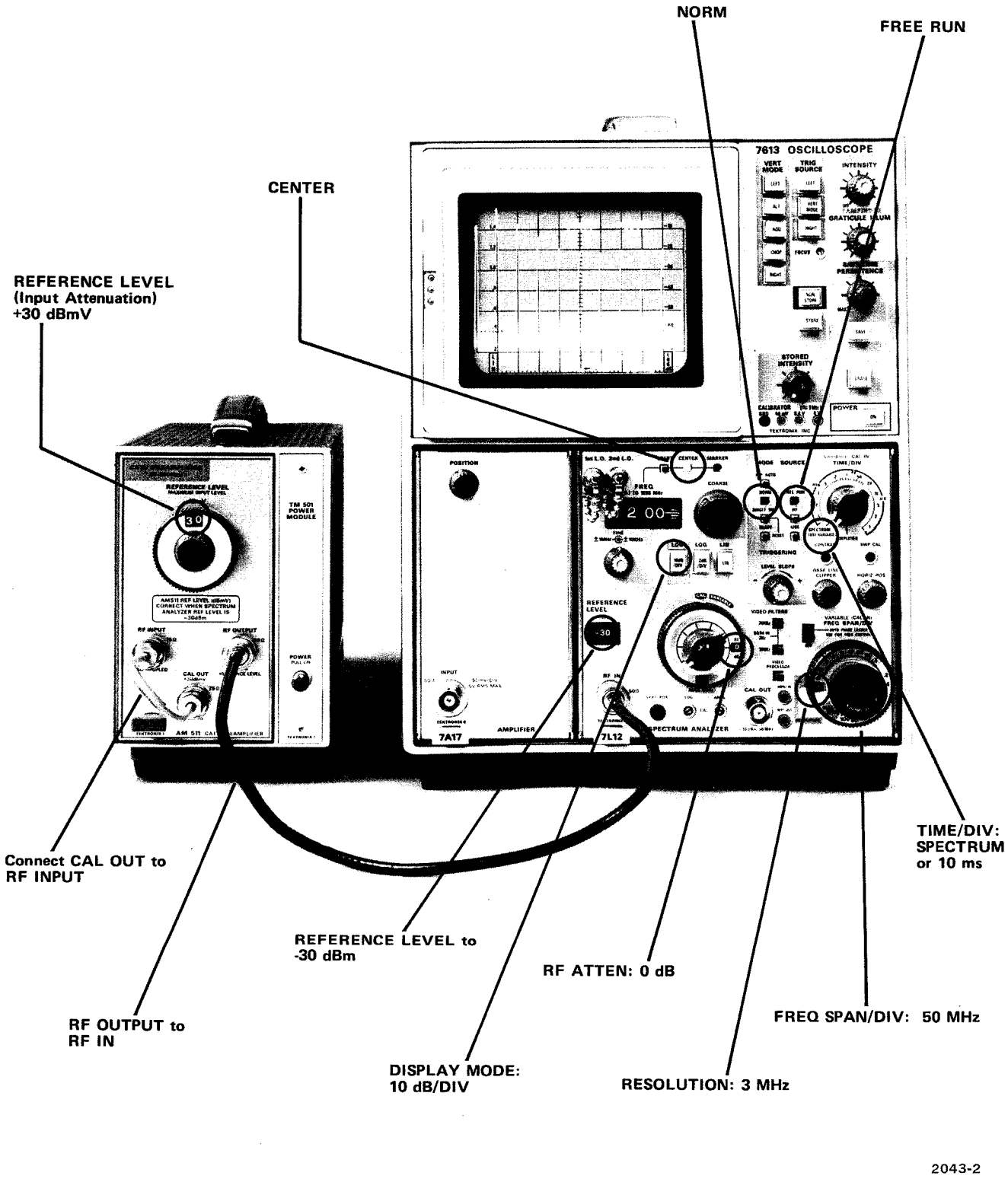


Fig. 2-1. Initial setup, showing control and selector positions.

APPLICATIONS

The gain and 75 Ω-to-50 Ω conversion of the AM 511 provide the increased sensitivity that is necessary for the spectrum analyzer to make all CATV performance tests. Tektronix "Proof of Performance" brochure provides procedures for making these measurements. The following describes a typical application for the AM 511/7L12.

Sensitive Intermodulation Measurements:

a. Connect the test point of the CATV system to the AM 511 RF INPUT connector.

b. Select a FREQ SPAN/DIV so the spectrum of one channel is displayed (0.5 MHz). Tune the spectrum analyzer Center Frequency to the center of the channel.

c. Adjust the RESOLUTION and TIME/DIV for a flicker-free display with distinct video and sound carrier. Adjust the sweep speed so the video information moves across the display and does not obscure any intermodulation (beat) products. Switch in filters and adjust Resolution, Persistence, and Intensity until the carrier to noise amplitude ratio is optimized.

d. Use the 10 dB/DIV display mode and check for a peak carrier to noise ratio that is 50 dB or more.

e. Check the display for intermodulation products above and below the picture carrier by tuning slowly either side of the carrier signal or switch the center frequency from CENTER to START position. Once a beat is located, compare the peak video carrier level to the peak intermodulation (beat) signal level. See Fig. 2-2.

f. Check to ensure that the beat signal is not a product of the AM 511 amplifier by changing the input attenuation (REFERENCE LEVEL) a few dB (e.g., 3 dB). If the change of the beat signal amplitude level is more than the input attenuation change, the AM 511 amplifier is producing the signal.

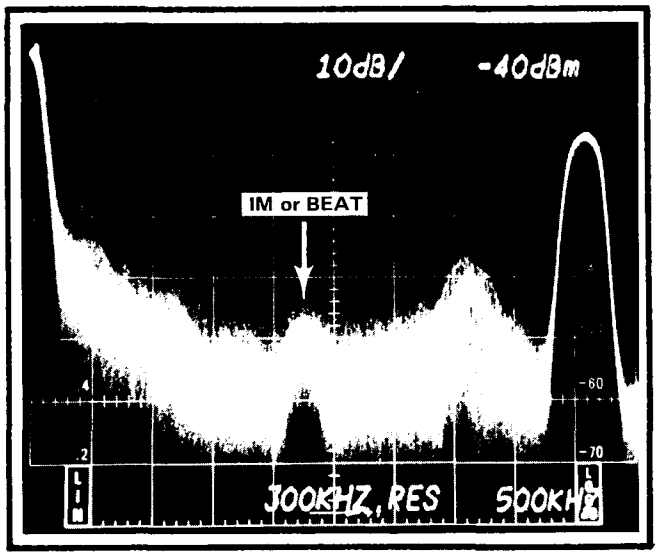


Fig. 2-2. Display showing intermodulation above the picture carrier.

PERFORMANCE CHECK

Introduction

This section verifies the operational performance of the AM 511 to the characteristics specified in the General Information section. Verification of the electrical characteristics requires sophisticated test equipment; however, an incoming acceptance check procedure is provided in the first portion of this section to check the instrument operation. The second portion provides a list of test equipment and the procedures necessary to measure the specified parameters and characteristics.

OPERATIONAL CHECK AND INSTRUMENT FAMILIARIZATION

Preliminary Preparation

Perform the Preliminary Front Panel Setup Procedure that is described in the Operating Instructions so the system display (amplitude and frequency span) is calibrated.

1. Check Frequency Range (30 MHz to 890 MHz)

a. Apply the CAL OUT signal through the 75 Ω, 5-1/2 inch cable, to the RF INPUT and connect the RF OUTPUT to the spectrum analyzer RF IN through a 50 Ω coaxial cable.

b. Set the AM 511 and spectrum analyzer selectors as follows:

AM 511

REFERENCE LEVEL	+10 dBmV (This is 20 dB above the calibrator +30 dBmV reference level so harmonics of the fundamental will spread across the 900 MHz spectrum.)

Spectrum Analyzer

Center Frequency	500 MHz
REFERENCE LEVEL (RF Attenuator at 0 dB)	— dBm
Display Mode	10 db/Div
FREQ SPAN/DIV	100 MHz
RESOLUTION	3 MHz
TIME/DIV	10 ms or slower

c. Check the 1000 MHz span for 50 MHz markers out to 900 MHz. Marker amplitude will decrease toward the upper end of the spectrum. See Fig. 3-1.

2. Check the Calibrator Reference Level

a. Change the spectrum analyzer display mode to 2 dB/Div. Tune the FREQUENCY to the 50 MHz fundamental. Uncouple the FREQ SPAN/DIV from the RESOLUTION and open the display to 10 MHz/Div. Resolution should remain at 3 MHz. Change the AM 511 REFERENCE LEVEL to +30 dBmV.

b. Disconnect the cable between the AM 511 RF OUTPUT and the spectrum analyzer RF IN and apply the spectrum analyzer calibrator signal to the AM 511 RF INPUT. Note the amplitude of the 50 MHz, −30 dBm signal.

c. Now apply the AM 511 RF OUTPUT to the spectrum analyzer RF IN and the CAL OUT (+30 dBmV) to the AM 511 RF INPUT. The amplitude difference between the two calibrator signals should be slight.

NOTE

Because of the additive tolerances of the AM 511 and spectrum analyzer calibrators, plus the AM 511 attenuator and amplifier, it is impractical to establish limits. This comparison is only an operational check.

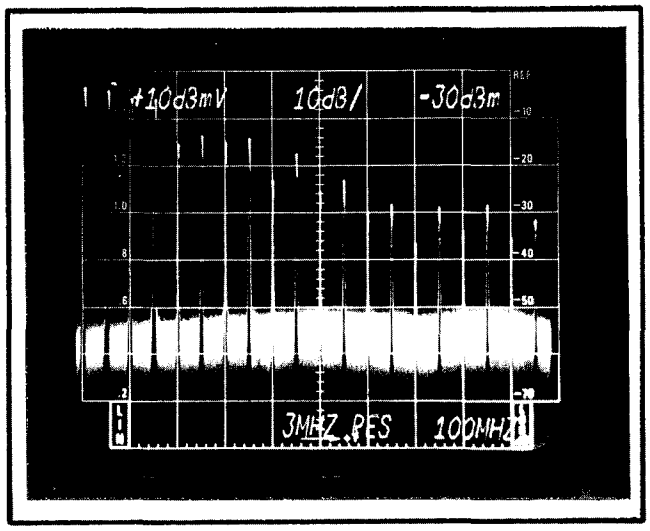


Fig. 3-1. 50 MHz markers across a 1000 MHz display.

3. Check the Attenuator

NOTE

The attenuator accuracy is checked at the factory. This check will detect component failure but it will not check the tolerance characteristics. If the tolerance characteristics are to be checked, a reference attenuator calibrated by the user or manufacturer to specifications more rigid than the AM 511 attenuator must be used.

a. Apply the 50 MHz, +30 dBmV CAL OUT signal to the RF INPUT. Connect the RF OUTPUT to the RF IN of the spectrum analyzer.

b. Set the front panel controls as follows:

AM 511	
REFERENCE LEVEL	+20 dBmV
Spectrum Analyzer	
RF Attenuator	40 dB
REFERENCE LEVEL	−10 dBm
Display Mode	10 dB/DIV
FREQ SPAN/DIV	5 MHz
RESOLUTION	0.3 MHz
TIME/DIV	10 ms/DIV or slower

c. Tune the 50 MHz signal to the center of the graticule, then open the display by decreasing the FREQ SPAN/DIV to 2 MHz.

d. Adjust the signal amplitude with the spectrum analyzer VARIABLE gain control to the graticule line one division below the top line.

e. Check the AM 511 attenuator by changing the settings as indicated below and noting that the signal amplitude stays within 1.5 dB of the reference.

AM 511	Spectrum Analyzer	
REFERENCE LEVEL	RF Attenuator	REFERENCE LEVEL
20 dBmV	40 dB	−10 dBm
30 dBmV	30 dB	−20 dBm
40 dBmV	20 dB	−30 dBm
50 dBmV	10 dB	−40 dBm
60 dBmV	0 dB	−50 dBm
70 dBmV	0 dB	−60 dBm

f. Insert a 75 Ω, 10X (20 dB) attenuator between the AM 511 CAL OUT and RF INPUT, then check for the same signal amplitude as above with the following settings:

10 dBmV	30 dB	−20 dBm
0 dBmV	40 dB	−10 dBm

g. Return the attenuators to +30 dBmV and 30 dB. Switch to the 2 dB/DIV display mode and reestablish a signal reference level with the Variable Gain control.

h. Check the 1 dB steps of the AM 511 attenuator by noting the decrease of signal amplitude on the display as the attenuation is increased.

i. Remove the 10X attenuator and connect the CAL OUT directly to the RF INPUT.

4. Check Sensitivity (−45 dBmV at 3 MHz Resolution)

a. Switch the spectrum analyzer display mode to LIN and add 30 kHz of VIDEO FILTER.

b. Increase the AM 511 attenuator setting 45 dB (REFERENCE LEVEL to 75 dBmV). Now increase the spectrum analyzer IF gain (selector and variable) setting until the average noise floor on the display rises one division.

c. Check that the amplitude of the signal is at least twice the noise level (≥ 2 div). See Fig. 3-2.

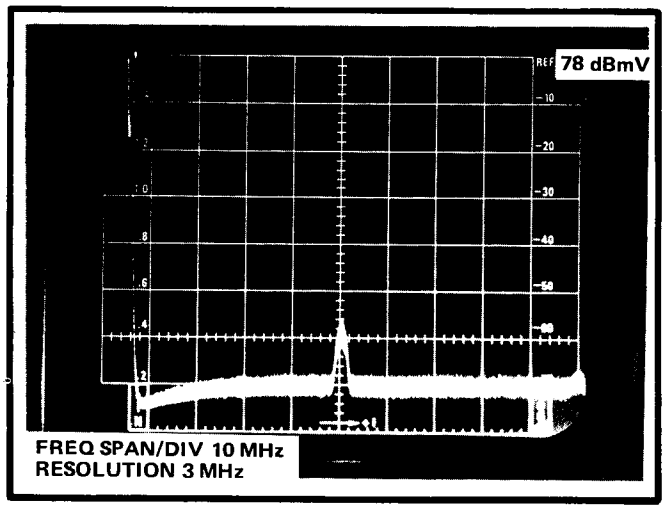


Fig. 3-2. Measuring sensitivity. Signal level = 2X noise.

This completes the operational check of the instrument's performance. If you desire to validate the specified parameters (which requires sophisticated test equipment), continue to the next part of this section.

PERFORMANCE VERIFICATION OF SPECIFIED CHARACTERISTICS

The following procedures describe how to measure the Am 511 characteristics as specified. It does not include internal adjustments or checks. If the instrument fails to meet specified performance requirements, the adjustment procedure will be found in the Service section under Calibration.

History Information

The instrument and manual are continually evaluated and updated. Circuits and manual procedures may be modified. Information applicable to earlier instruments are included either as deviations within these steps or as a subpart of the steps. These modifications are added at the back of the manual as inserts or indicated in the procedure.

Equipment Required and Recommended

The following test equipment and fixtures are recommended to perform this portion of the performance check. Test equipment specifications are the minimum requirements for accurate checks. Substitute equipment must equal or exceed these specifications.

The fixtures (attenuators, etc.) are used where necessary to facilitate the procedure. These fixtures are available from Tektronix, Inc., and can be ordered through your local Tektronix Field Office or representative.

EQUIPMENT LIST

NOTE: This equipment is also required to recalibrate the instrument.

1. Spectrum analyzer ensemble (oscilloscope and 7L12 or 7L13 Spectrum Analyzer).

2. Leveled sweeper or signal generators that cover the frequency range of 30 MHz to 890 MHz. (Use a power meter to verify that the generator ouput remains constant over this frequency range.)

a. Hewlett Packard Model 8660A with 86602A RF Section; or

b. Hewlett Packard Model 608E (10 MHz to 480 MHz) plus Model 612A. The Model 612A does not have a leveled output; therefore, it must be adjusted manually as the frequency is changed.

3. Vector voltmeter with a frequency range of 50 MHz, to measure the Calibrator +30 dBmV output level tolerance: Hewlett Packard Model 8405A.

4. Digital counter to check 50 MHz accuracy of the calibrator: Tektronix 7D14 Digital Counter with a readout 7000-Series oscilloscope, or a DC 502 with the TM 500-Series.

5. 50 Ω to 75 Ω Minimum Loss Attenuator: Tektronix Part No. 011-0057-00.

6. Two 5:1, 50 Ω Attenuators: Tektronix Part No. 011-0060-01.

7. Two 18 inch, 50 Ω low loss coaxial cables with BNC connectors: Tektronix Part No. 012-0076-00.

8. BNC "T" Connector: Tektronix Part No. 103-0030-00.

9. 75 Ω Feedthrough Termination: Tektronix Part No. 011-0055-00.

10. TM 500-Series mainframe to power AM 511.

PERFORMANCE CHECK

1. Check the Calibrator Frequency (Accuracy 50 MHz ±0.01%)

The frequency of the calibrator may be checked by an accurate frequency counter such as a Tektronix DC 502 with a TM 500-Series mainframe, or a 7D14 Digital Counter Plug-In Unit in a readout 7000-Series oscilloscope. No procedure for this check is provided because the CAL OUT signal can be connected through the CATV preamplifier unit to the input of the counter and the frequency readout noted.

2. Check Calibrator Output (+30 dBmV ±0.3 dB)

The output of the calibrator contains hamonics; therefore, direct measurement is not possible.

Vector Voltmeter Method (Hewlett Packard Model 8405A Vector Voltmeter).

a. Terminate the "A" probe with a BNC 75 Ω feed-through termination and connect the probe, through the termination, to the CAL OUT connector on the AM 511.

b. Switch the vector voltmeter frequency to 50 MHz.

c. Check for an RMS reading between 31.2 mV to 32.1 mV (+30 dBmV is 31.6 mV RMS into 75 Ω). If output is out of specification, refer to Calibrator Output adjustment in the Calibration Procedure.

3. Check RF Attenuator Accuracy (Within ±0.2 dB +1% of the dB readout)

NOTE

The RF attenuator accuracy is checked at the factory to ensure that it is within specifications. Step 3 in the first portion of this section will detect any component failure within the attenuator but it will not check the tolerance characteristics. If the exact attenuation error of the selector is required, a reference attenuator, calibrated by the user or manufacturer to more rigid specifications than the AM 511 RF attenuator, must be used.

4. Check the Frequency Range and Display Flatness (±2 dB, 30 MHz to 890 MHz, +1 dB, 50 MHz to 300 MHz).

a. Set the AM 511 and spectrum analyzer controls as follows:

AM 511	
REFERENCE LEVEL	10 dBmV

Spectrum Analyzer	
FREQUENCY	50 MHz
REFERENCE LEVEL (RF at 0 dB)	−30 dBm
Display Mode	2 dB/DIV
FREQ SPAN/DIV	100 MHz
RESOLUTION	3 MHz
TIME/DIV	10 ms or slower

b. Apply the output of a leveled sweeper or signal generator through a 50 Ω to 75 Ω minimum loss attenuator to the RF INPUT of the AM 511. Connect the RF OUTPUT to the RF IN of the spectrum analyzer.

c. Tune the sweeper or signal generator to 50 MHz and adjust the output for a signal reference level of approximately 5 divisions on the display.

d. Check the frequency range and flatness of the AM 511/spectrum analyzer ensemble, by sweeping or tuning the signal generator(s) from 30 MHz to 890 MHz. Display flatness must be within 1 dB from 50 MHz to 300 MHz with reference to 50 MHz, and within 2 dB from 30 MHz to 890 MHz. Frequency range must equal or exceed 30 MHz to 890 MHz.

5. Check Intermodulation Distortion

One method of checking this specification is to check the AM 511/spectrum analyzer ensemble to ensure that the IM distortion characteristics of the spectrum analyzer have not been degraded. Check by performing the procedure described in the spectrum analyzer manual. NOTE: Use a 50 Ω to 75 Ω minimum loss attenuator (Tektronix Part No. 011-0112-00) between the 50 Ω signal source and the RF INPUT of the AM 511.

The gain of the AM 511 amplifier remains relatively constant, or on a 1:1 ratio, over the linear operating range. The ratio of intermodulation products from two or more signals is about 2:1 for second-order products and 3:1 for third-order products. This analogy is used to extrapolate the intermoduation distortion figure of the AM 511 by the following procedure.

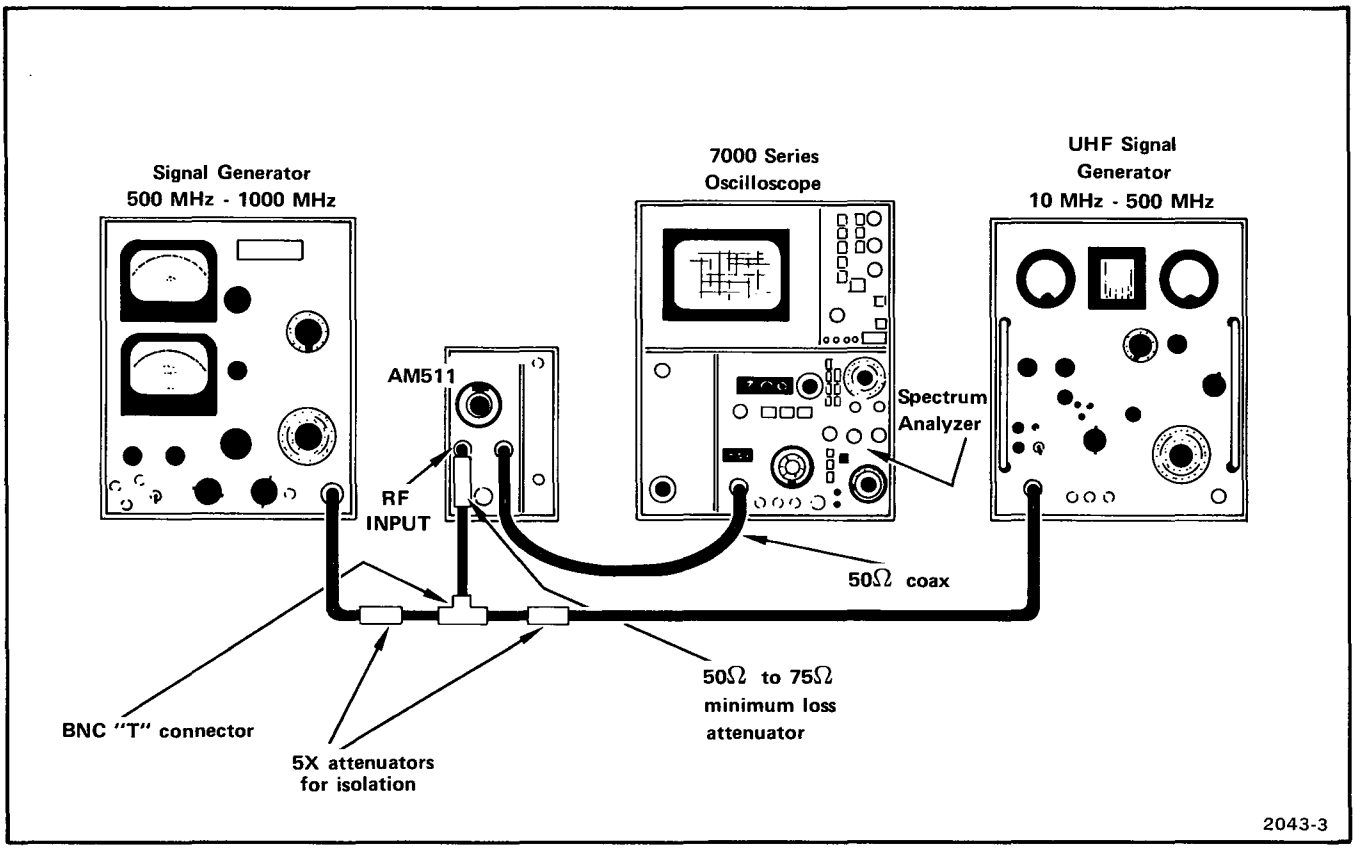


Fig. 3-3. Equipment setup and connections necessary to measure intermodulation distortion.

a. Apply two signals within the frequency range of the AM 511 and separated approximately 2 MHz to 10 MHz, through two 5X attenuators (for isolation), a BNC "T" connector, then through a 50 Ω to 75 Ω minimum loss attenuator, to the AM 511 RF INPUT. Fig. 3-3 illustrates this setup.

b. Set the front panel controls and selectors as follows:

AM 511

REFERENCE LEVEL	+30 dBmV

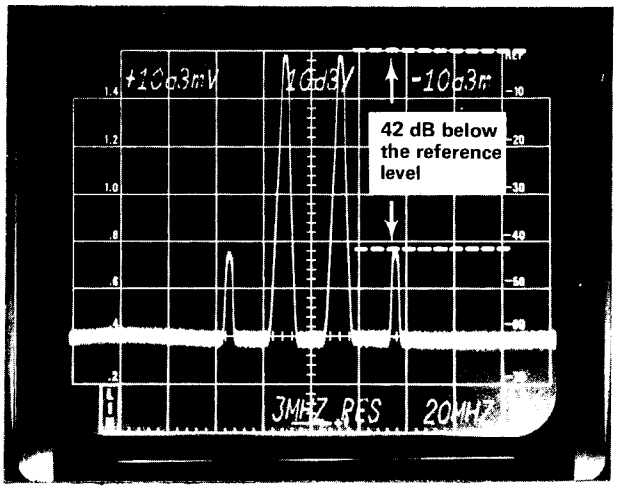
Spectrum Analyzer

Display Mode	10 dB/DIV
RF Attenuator	0 dB
REFERENCE LEVEL	−30 dBm
VIDEO FILTER	30 kHz
FREQUENCY	Tuned midway between the two applied signals
FREQ SPAN/DIV and RESOLUTION	Span should be wide enough to observe the two input signals and their intermodulation products. RESOLUTION set for optimum sensitivity.

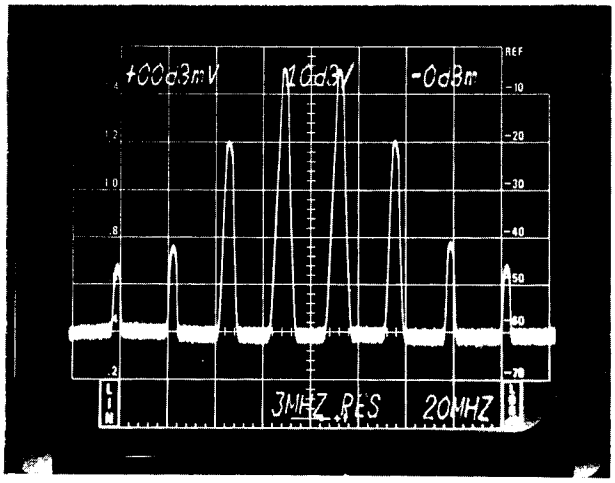
c. Adjust the output of the two signal sources until both signals are full screen or at the reference level.

NOTE

When the AM 511 REFERENCE LEVEL is +30 dBmV, the input to the amplifier stage is 0 dBmV, because the attenuator is between the amplifier and the RF INPUT connector.



A. IM products on either side of two signals.



B. An overdriven amplifier generates additional spurii.

Fig. 3-4. Display of IM distortion and an overdriven amplifier.

d. Decrease the AM 511 REFERENCE LEVEL (attenuator) setting in 10 dB steps and increase the spectrum analyzer RF attenuator setting in 10 dB steps until the intermodulation signals appear on the display. See Fig. 3-4. NOTE: Verify the 2:1 ratio of the intermodulation products by noting the amplitude increase for a 10 dB change in the AM 511 input level. If the amplifier is not overdriven, the amplitude level of the intermodulation products will increase 20 dB with a change of 10 dB attenuation. When the amplifier is overdriven, additional spurs will be generated either side of the intermodulation signals. If this occurs, increase the AM 511 RF ATTENUATOR setting and decrease the spectrum analyzer RF attenuator setting.

e. Note the level of the intermodulation signals; then determine the level of the intermodulation signals below 0 dBmV by extrapolating. For example: A change of 20 dB in attenuation would add 40 dB to the noted level of the intermodulation signals below the reference level. If the level of the intermodulation signals is 45 dB below the reference level, with the signal input to the AM 511 20 dB above the reference level, the interpolated intermodulation distortion would equal (45 dB + 40 dB) 85 dB.

This completes the performance check for the AM 511. It will now perform within the specifications described in Section 1.

SERVICE INSTRUCTIONS

Introduction

This section includes data relative to servicing the AM 511. This data includes circuit description, calibration, preventive maintenance and corrective maintenance procedures.

CIRCUIT DESCRIPTION

The CATV Preamplifier unit contains an attenuator assembly, a crystal-controlled 50 MHz oscillator with a calibrated +30 dBmV output, and a regulated power supply.

The attenuator assembly consists of an amplifier and selectable 1, 2, 4, 10, and 20 dB attenuator pads that can be switched into the signal path by cam switches S900A and S900B. This attenuator provides 1 dB to 79 dB of attenuation in 1 dB or 10 dB steps.

With both cam switches in the 0 dBmV position, the signal path from the RF INPUT is ac-coupled through C900 to the input of IC amplifier U900. This amplifier has an input impedance of approximately 75 Ω and a gain of 25 dB. The output of the amplifier drives the 50 Ω RF OUTPUT connector through a 6 dB matching pad. Conversion from dBmV at 75 Ω to dBm at 50 Ω is 49 dB. Therefore, a +30 dBmV signal is converted to a −30 dBm signal at the output, when the REFERENCE LEVEL selector (attenuator) is set to +30 dBmV. A +30 dBmV signal at the RF INPUT is attenuated 30 dB through AT912 and AT914, amplified 25 dB by U900, and attenuated 6 dB through AT916 to a level of +19 dBmV, or −30 dBm. Output impedance is 50 Ω.

The 50 MHz calibrator is similar to the calibrator in the 7L12 or 7L13 except that its output impedance is 75 Ω. It is a crystal-controlled oscillator with the crystal Y950 in series with the feedback loop. Output of the oscillator is set by adjusting the oscillator current with R956 so the output level at 50 MHz is +30 dBmV.

CALIBRATION

There are only two calibration steps for the AM 511: check the power supplies, and adjust the output of the 50 MHz calibrator.

1. Check the Power Supplies

a. Remove the mainframe and AM 511 left side panels to expose the left side of the AM 511 when it is installed in the mainframe. Alternately, use a flexible extender cable (Tektronix Part No. 067-0645-01) and remove the AM 511 left side panel.

b. Connect a voltmeter between chassis ground and either end of inductor L919 (see Fig. 4-1).

c. Check that the +24 V regulated supply measures 24 V ±2.4 V.

d. Move the voltmeter to the forward end of diode VR970 (see Fig. 4-1) and check for +15 V ±3.5 V.

e. Move the voltmeter to the forward end of R932 (see Fig. 4-1), reverse meter leads if necessary, and check for −15 V ±2.0 V.

2. Adjust the Calibrator Output (+30 dBmV ±0.3 dB)

Since the output of the calibrator contains harmonics, direct power measurements are not possible. The following method will check and adjust the output level to specifications.

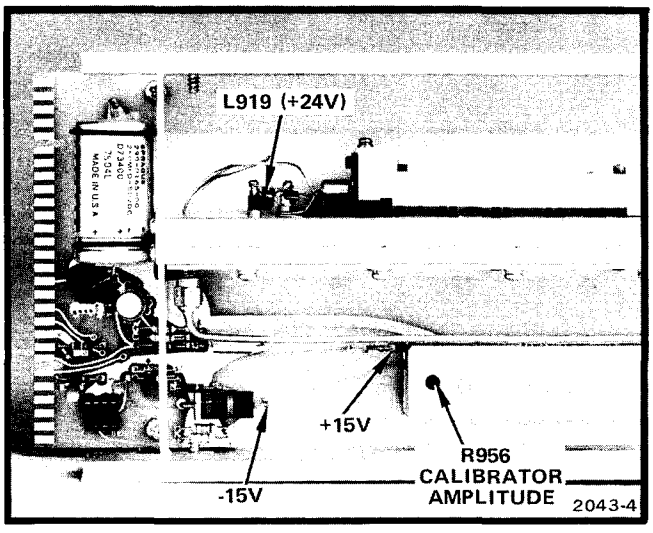


Fig. 4-1. AM 511 power supply check and calibrator adjustment location.

Vector Voltmeter Method (Hewlett Packard Model 8405A Vector Voltmeter)

a. Terminate the "A" probe with a BNC 75 Ω feedthrough termination and connect the probe, through the termination, to the CAL OUT connector on the AM 511.

b. Switch the vector voltmeter frequency to 50 MHz.

c. Check that the RMS reading is between 31.2 mV to 32.1 mV (+30 dBmV is 31.6 mV RMS into 75 Ω.

d. The calibrator output level can be adjusted by removing the left side panels to gain access to the calibrator. Adjust R956 (see Fig. 4-1) for an output level of +30 dBmV (31.6 mV RMS).

MAINTENANCE

Introduction

The following describes the recommended procedure for reducing or preventing instrument malfunction, troubleshooting, and corrective maintenance to repair the instrument. Preventive maintenance improves instrument reliablility. Should the instrument fail to function properly, corrective measures should be taken immediately; otherwise, additional problems may develop within the instrument.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, performance check, and if needed, a recalibration. The preventive maintenance schedule should be based on the environment the instrument is operated in and the amount of use. Under average conditions (laboratory situation) a preventive maintenance check should be performed every 1000 hours of instrument operation.

Cleaning

Clean the instrument often enough to prevent dust or dirt from accumulating in or on it. Dirt acts as a thermal insulating blanket and prevents efficient heat dissipation. If it becomes damp it can provide electrical high resistance leakage paths between conductors and/or components.

Exterior. Clean the dust from the outside of the instrument by wiping or brushing the surface with a soft cloth or small brush. Hardened dirt may be removed with a cloth dampened in water that contains a mild detergent. Abrasive cleaners should not be used.

Interior. Normally the interior of the instrument will not require cleaning unless it has been left out of the oscilloscope plug-in compartment and uncovered for an extended period of time. Clean the interior by loosening accumulated dust with a dry soft brush, then remove the loosened dirt with low pressure air to blow the dust clear. (High velocity air can damage some components.) Hardened dirt or grease may be removed with a cotton tipped applicator dampened with a solution of mild detergent in water. Abrasive cleaners should not be used. If the circuit board assemblies need cleaning, remove the circuit board by referring to the instructions under Corrective Maintenance in this section.

After cleaning, allow the interior to thoroughly dry before applying power to the instrument.

CAUTION

Do not clean any plastic materials with organic cleaning solvents such as benzene, toluene, xylene, acetone or similar compounds because they may damage the plastic.

Visual Inspection

After cleaning, carefully check the instrument for such defects as defective connections, damaged parts, and improperly seated transistors and integrated ciruits, The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, try to determine the cause of overheating before the damaged part is replaced. Otherwise, the damage may be repeated.

Transistor and Integrated Circuit Checks

Periodic checks of the transistors and integrated circuits are not recommended. The best measure of performance is the actual operation of the component in the circuit. Performance of these components is thoroughly checked during the performance check or recalibration, and any substandard transistors or integrated circuits will usually be detected at that time.

Performance Checks and Recalibration

The instrument performance should be checked after each 1000 hours of operation or every six months if the instrument is used intermittently to ensure maximum performance and assist in locating defects that may not be apparent during regular operation.

TROUBLESHOOTING

The ability to recognize and locate trouble is acquired with experience and as you become familiar with the instrument. The following are a few aids and suggestions that may assist in locating a problem. After the defective assembly or component has been located, refer to Corrective Maintenance part of this section for removal and replacement instructions.

Troubleshooting Aids

NOTE

Corrections and modifications to the manual and instrument are described on inserts bound into the rear of the manual. Check this section for possible changes and corrections to the manual or the instrument.

Circuit Board Illustrations. Electrical components, connectors, and test points are identified on circuit board diagrams located on the inside fold of the circuit diagram or the back or the preceding page. This allows the troubleshooter to trace and check the operation of each circuit, and physically locate circuit components.

Resistor Color Code. Brown composition resistors, metal-film resistors (identifiable by their gray body color) and some wire-wound resistor (usually light blue or gray-green) are used in the AM 511. The resistance value of a wire-wound resistor is printed on the body of the component. The resistance value of a composition resistor or metal-film resistor is color-coded on the component with EIA color-code (some metal-film resistors may have the value printed on the body).

Capacitor Marking. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors are color coded in picofarads.

Diode Color Code. The cathode of each glass encased diode is indicated by a stripe, a series of stripes or a dot. Fig. 4-2 illustrates diode types and polarity markings that are used in this instrument.

Transistor and Integrated Circuit Electrode Configurations. Lead identification for the transistors, MOS FETs and ICs are shown in Fig. 4-3.

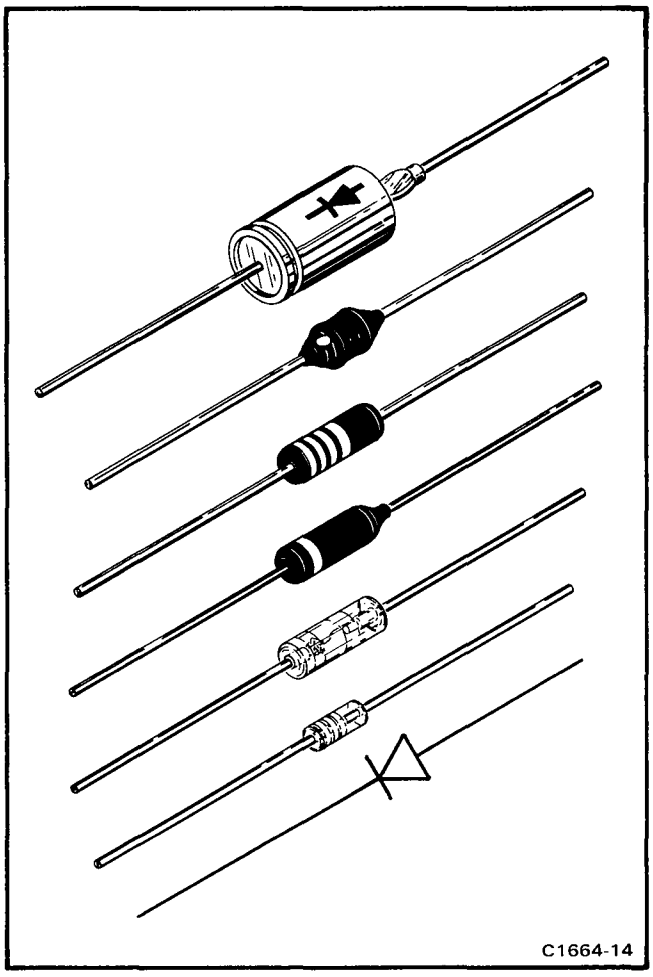


Fig. 4-2. Diode polarity markings.

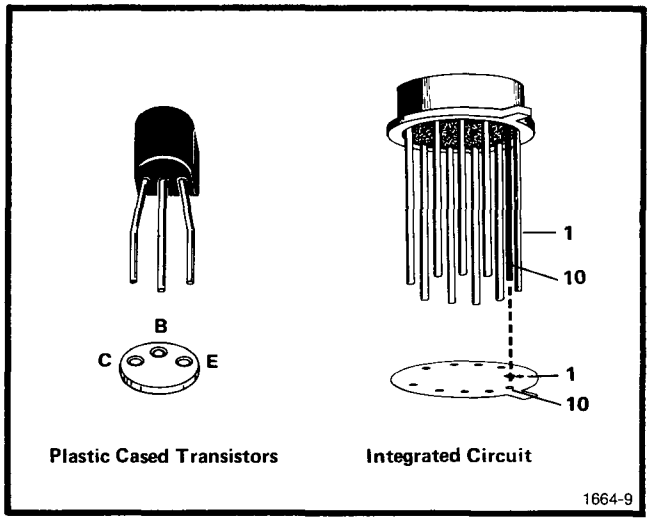


Fig. 4-3. Electrode configuration for socket-mounted transistors and IC's.

General

The following procedure is recommended to isolate a problem and expedite repairs.

1. Ensure that the malfunction exists in the instrument. Check the operation of associated equipment and the operating procedure of the AM 511 (see Operating Instructions).

2. Determine and evaluate all trouble symptoms. Try to isolate the problem to a circuit or assembly.

3. Visually inspect the area or the assembly for such defects as broken or loose connections, improperly seated components, over-heated or burned components, chafed isolation or cracked insulators, etc. Repair or replace all obvious defects. In the case of overheated parts, try to determine the cause of overheating and correct before applying power.

4. Check the calibration adjustments of the affected circuit, if applicable. Before changing the setting of any adjustment, note its position so it can be returned to its original setting. This will facilitate recalibration after the trouble has been located and repaired.

5. Semiconductor failures account for the majority of electronic equipment failures. Most semiconductor devices (transistors and ICs) are socket-mounted; therefore, substitution is often the most practical means for checking their perfomance. The following guide lines should be followed when substituting these components:

a. First determine that circuit voltages are safe for the substituted component, so the replacement will not be damaged.

b. Use only good components for substitution.

c. Turn the power off before a component is substituted.

d. Be sure the component (transistor or IC) is inserted properly in the socket (see Fig. 4-3).

e. After the operational check, return the good components to their original sockets to reduce calibration time and run-in period.

NOTE

If a substitute is not available, check the transistor or MOS FET with a dynamic tester such as the Tektronix Type 576 Curve Tracer. Static type testers, such as an ohmmeter, can be used to check resistance ratios across some semiconductor junctions if no other method is available. (Do not measure resistance across MOS FETs because they are very susceptible to static charges.) Use the high resistance ranges (1 kΩ or higher) so the external current is limited to less than 2 mA. If uncertain, measure the external current with an ammeter. Resistance ratios across the base-to-emitter or base-to-collector junctions usually run 100:1 or higher. The ratio is measured by connecting the meter leads across the terminals, noting the reading, then reversing the leads and noting the second reading.

CORRECTIVE MAINTENANCE

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

Obtaining Replacement Parts

All electrical and mechanical parts replacements can be obtained through your local Tektronix Field Office or representative. Many of the standard electronic components, however, can be obtained locally more conveniently than ordering from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance and rating. The Parts section contains instructions on how to order these replacment parts.

It is best to duplicate the original component as closely as possible. Parts orientation and lead dress should also duplicate those of the original part because some components are oriented to reduce or control circuit capacitance and inductance. After repair, the circuits may need recalibration.

Soldering Technique

CAUTION

Disconnect the instrument from its power source before replacing or soldering components.

@

The components that are soldered on the circuit boards can be replaced by using normal circuit board soldering technique. Use a pencil type, 25 watt soldering iron and a desoldering tool to remove the old solder. Heat sink the leads of active components such as diodes or transistors with needle nose pliers. Avoid excessive or prolonged heat at the connection because this could cause the board run to separate from the board. Use a good quality solder (63/37) to resolder the new component on the board.

Diode Checks

Most diodes can be checked in the circuit by taking measurements across the diode and comparing these with voltages listed on the diagram. Forward-to-back resistance ratios can usually be taken by referring to the schematic and pulling appropriate transistors and pin connectors to remove low resistance loops around the diode.

CAUTION

Do not use an ohmmeter scale with a high external current to check the diode junction. Do not check the forward-to-back resistance ratios of tunnel diodes or mixer diodes.

Integrated Circuit (IC) Checks

Integrated circuits are most easily checked by direct replacement. When substitution is impossible, check input and output signal states as described in the circuit description and on the diagram. Lead configuration for the IC used in this instrument is provided by Fig. 4-3.

Check calibration and performance after a faulty component has been replaced.

If the above procedure fails to locate the trouble, a more detailed analysis must be performed. The Circuit Description describes the operational theory of each circuit and may aid to further evaluate the problem.

Disassembly for Parts Replacement

The AM 511 is easily disassembled to facilitate parts replacement; the following procedures describe how to replace the assemblies and components.

1. Remove the cross brace at the rear of the attenuator, near the rear of the instrument.

2. Unplug the two-conductor connector from the circuit board and the coax connector from the calibrator assembly, then remove the circuit board.

3. Remove both ends of both semi-rigid coax cables, using a 5/16-inch end wrench.

4. To gain access to the attenuators and amplifier inside the assembly, remove the twelve screws and two 5/16-inch nuts from the coax connectors, then remove the cover. Perform the following steps **only** to remove the attenuator assembly from the instrument, to remove the cam switch, or to gain access to the back side of the Attenuator circuit board.

5. Remove the remaining end of the calibrator coax from its connector, using a 7/16-inch end wrench.

6. Remove the three coax connectors from the front panel, using a 1/2-inch end wrench.

7. Set both REFERENCE LEVEL knobs to zero, then remove them. Note their arrangement to ease reassembly.

8. Carefully pull the front panel away from the subpanel as far as the plastic plug-in latch will permit, using care not to bend the front panel. With an offset Posidrive screwdriver, remove the four screws securing the attenuator to the front panel. An alternate procedure is to cut off the plastic latch to permit complete removal of the front panel; however, this necessitates replacing the latch.

Cam Switch Replacement

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 cam-type switches, contact your local Tektronix Field Office or representative.

The cam switch consists of a rotating cam which actuates switch contacts mounted on the circuit boards. The cams on the attenuator switch actuate contacts on the readout board and drive push rods that actuate switch contacts on the Attenuator circuit board.

Remove the Attenuator circuit board, being careful to not lose the plastic push rods that go through the metal attenuator extrusion. Remove the switch mounting screws and lift the cam assembly from the attenuator assembly.

Replacing Attenuator Chips

Attenuator thick film IC chips, rated dB, are used as attenuation pads. These chips are positioned and held over the cam switch contacts by pins and a retainer spring (see Fig. 4-4).

The chips are mounted so the closed end fits over the pin nearest the outer edge of the circuit board and the open end over the pin near the center of the board. The chips can be removed by pushing on the spring at both ends and sliding it back until it slips over the positioning pins. When reinserting the spring, ensure that the spring is pushed all the way home so that the closed end slips up and locks over the pin.

Replacing the Square Pin for the Multi-pin Connectors

It is important not to damage or disturb the ferrule when removing the old stub of a broken pin. The ferrule is swaged into the circuit board and provides a base for soldering the pin connector.

If the broken stub is long enough, grasp it with a pair of the needle nose pliers, apply heat with a small soldering iron to the pin base of the ferrule and pull the old pin out. (The pin is pressed into the ferrule so a firm pull is required to pull it out.)

If the broken stub is too short to grasp with pliers, use a small dowel (0.028 inch in diameter) clamped in a vise to push the pin out of the ferrule after the solder has been heated.

The old ferrule can be cleaned by reheating the solder and placing a sharp object such as a toothpick or small dowel into the hole. A 0.031 drill mounted in a pin vise may also be used to ream the solder out of the old ferrule.

Use a pair of diagonal cutters to remove the ferrule from the new pin, then insert the pin into the old ferrule and solder the pin to both sides of the ferrule.

Replacing the Amplifier

NOTE

We recommend replacing the shielding clip (Tektronix Part No. 337-1979-00) when the amplifier is replaced.

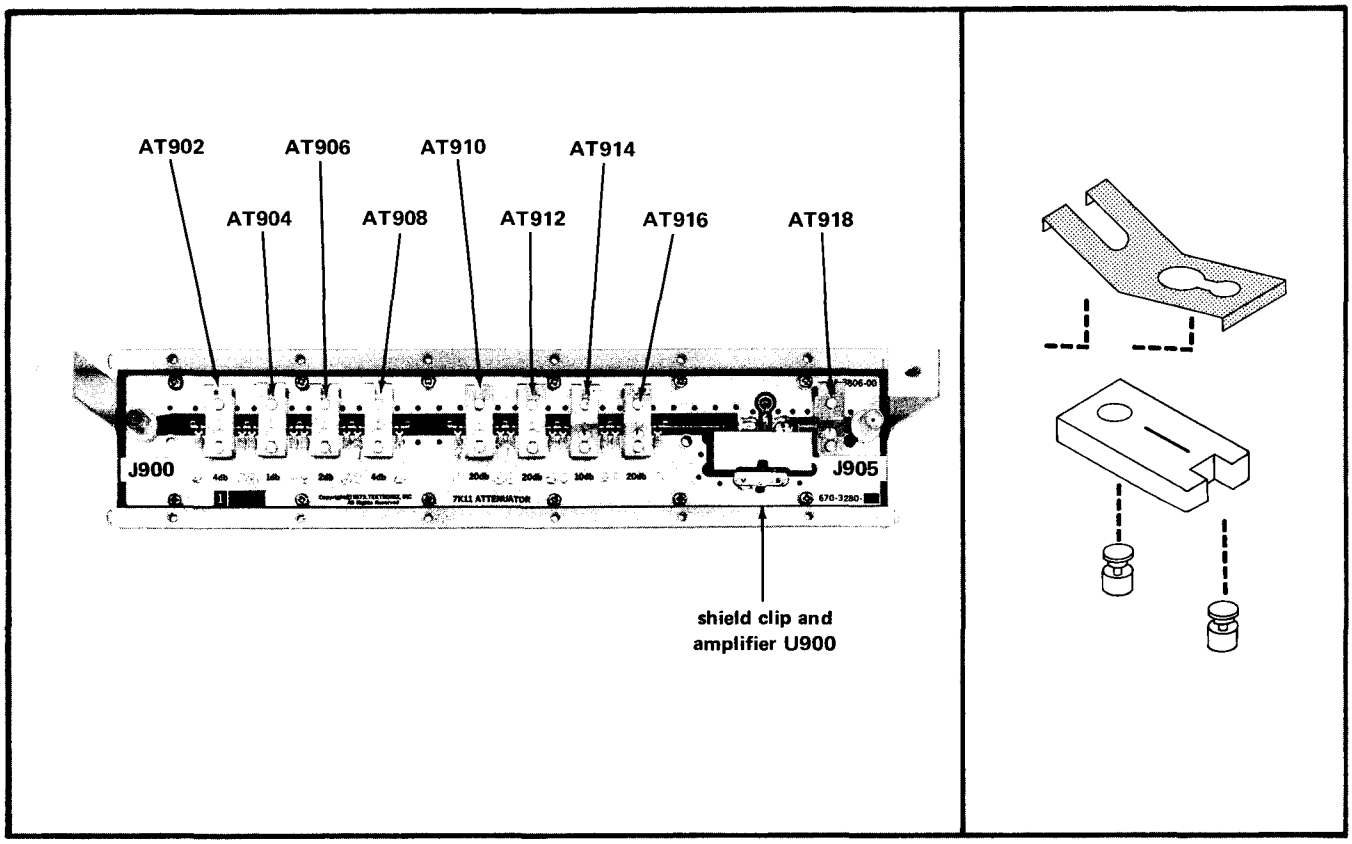


Fig. 4-4. Illustration showing the location and mounting of the attenuator chips on the circuit board.

The amplifier is enclosed in a metal shield clip. The clip and amplifier are replaced as a unit. Unsolder the input, output, and power leads to the amplifier. Use a high wattage iron (approximately 75 watts) to unsolder the three shield tabs and lift the assembly out. Unsolder the shield tabs from each other to allow the amplifier to slide out.

CAUTION

Heat applied to the board for extended periods may cause the board runs to separate from the board. Use high voltage irons for short periods to melt the solder and free the amplifier shield.

Reverse the procedure to replace the amplifier and shielding clip.

Reassembling the Instrument

The reassembly procedure is, in general, the reverse of the disassembly procedure described above.

When installing the semi-rigid coax connectors, tighten the nuts until they are just snug.

If the attenuator switch is moved with the knobs off, check that all contacts are lifted from the board, or that all rods are pushed in by the cams. This corresponds to the zero setting.

OPTIONS AND MODIFICATIONS

Your instrument may be equipped with one or more options. This section describes those options, or directs the reader to where the option is documented.

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
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P. O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
13571	ELECTRONIC RESEARCH CO.	P. O. BOX 913	SHAWNEE MISSION, KS 66201
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	600 W. JOHN ST.	HICKSVILLE, NY 11802
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
72136	ELECTRO MOTIVE CORP., SUB OF INTERNATIONAL ELECTRONICS CORP.	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE.	COMPTON, CA 90224
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	672-0569-00			CKT BOARD ASSY:ATTENUATOR,W/CAM SWITCH	80009	672-0569-00
A2	670-4337-00			CKT BOARD ASSY:INTERFACE	80009	670-4337-00
A1A1	670-3280-00			CKT BOARD ASSY:ATTENUATOR	80009	670-3280-00
AT902	307-1029-00			ATTENUATOR,FXD:75 OHM,4DB	80009	307-1029-00
AT904	307-1027-00			ATTENUATOR,FXD:75 OHM,1DB	80009	307-1027-00
AT906	307-1028-00			ATTENUATOR,FXD:75 OHM,2DB	80009	307-1028-00
AT908	307-1029-00			ATTENUATOR,FXD:75 OHM,4DB	80009	307-1029-00
AT910	307-1031-00			ATTENUATOR,FXD:75 OHM,20 DB	80009	307-1031-00
AT912	307-1031-00			ATTENUATOR,FXD:75 OHM,20 DB	80009	307-1031-00
AT914	307-1030-00			ATTENUATOR,FXD:75 OHM,10 DB	80009	307-1030-00
AT916	307-1031-00			ATTENUATOR,FXD:75 OHM,20 DB	80009	307-1031-00
AT918	307-1020-00			ATTENUATOR,FXD:50 OHM,2X	80009	307-1020-00
C900	283-0252-00			CAP.,FXD,CER DI:1000PF,10%,50V	72982	CC0805W5R102K
C906	290-0165-00			CAP.,FXD,ELCTLT:250UF,100-10%,50V	56289	TVA1312
C908	283-0523-00			CAP.,FXD,MICA:500PF,5%,500V	72136	CM19C501J
C912	290-0340-00			CAP.,FXD,ELCTLT:10UF,10%,50V	56289	109D106X9050C2
C918	281-0697-00			CAP.,FXD,CER DI:5000PF,+100-0%,100V	80009	281-0697-00
C919	283-0191-00			CAP.,FXD,CER DI:0.022UF,20%,50V	72982	8121N063651223M
C922	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N058651103M
C924	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N058651103M
C950	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C951	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C952	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C953	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C954	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C962	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
CR906	152-0585-00			SEMICOND DEVICE:SILICON,BRIDGE,75V,75MA	14936	W02M
J900	131-1536-00			CONNECTOR,RCPT:50 OHM,0 TO 18.0 GHZ	98291	050-651-0039-31
J905	131-1536-00			CONNECTOR,RCPT:50 OHM,0 TO 18.0 GHZ	98291	050-651-0039-31
J910	131-0391-01			CONNECTOR,RCPT,:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0119
J915	175-1763-00			CABLE ASSY,RF:1-75 OHM COAX,5.0 INCH LONG	80009	175-1763-00
J940	175-1764-00			CABLE ASSY,RF:1-50 OHM COAX,2.794 INCH LONG	80009	175-1764-00
J945	175-1765-00			CABLE ASSY,RF:1-50 OHM COAX,8.728 INCH LONG	80009	175-1765-00
L919	108-0551-00			COIL,RF:14UH	80009	108-0551-00
L950	108-0538-00			COIL,RF:2.7UH	76493	70F276A1
L951	108-0666-00			COIL,RF:900NH	80009	108-0666-00
L954	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D
L958	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D
Q950	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q960	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
R908	321-0311-00			RES.,FXD,FILM:16.9K OHM,1%,0.125W	75042	CEAT0-1692F
R910	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	75042	CEAT0-7151F
R912	307-0109-00			RES.,FXD,CMPSN:8.2 OHM,5%,0.25W	01121	CB82G5
R920	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R922	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R924	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R926	321-0311-00			RES.,FXD,FILM:16.9K OHM,1%,0.125W	75042	CEAT0-1692F
R928	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	75042	CEAT0-2432F
R930	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R932	305-0471-00			RES.,FXD,CMPSN:470 OHM,5%,2W	01121	HB4715

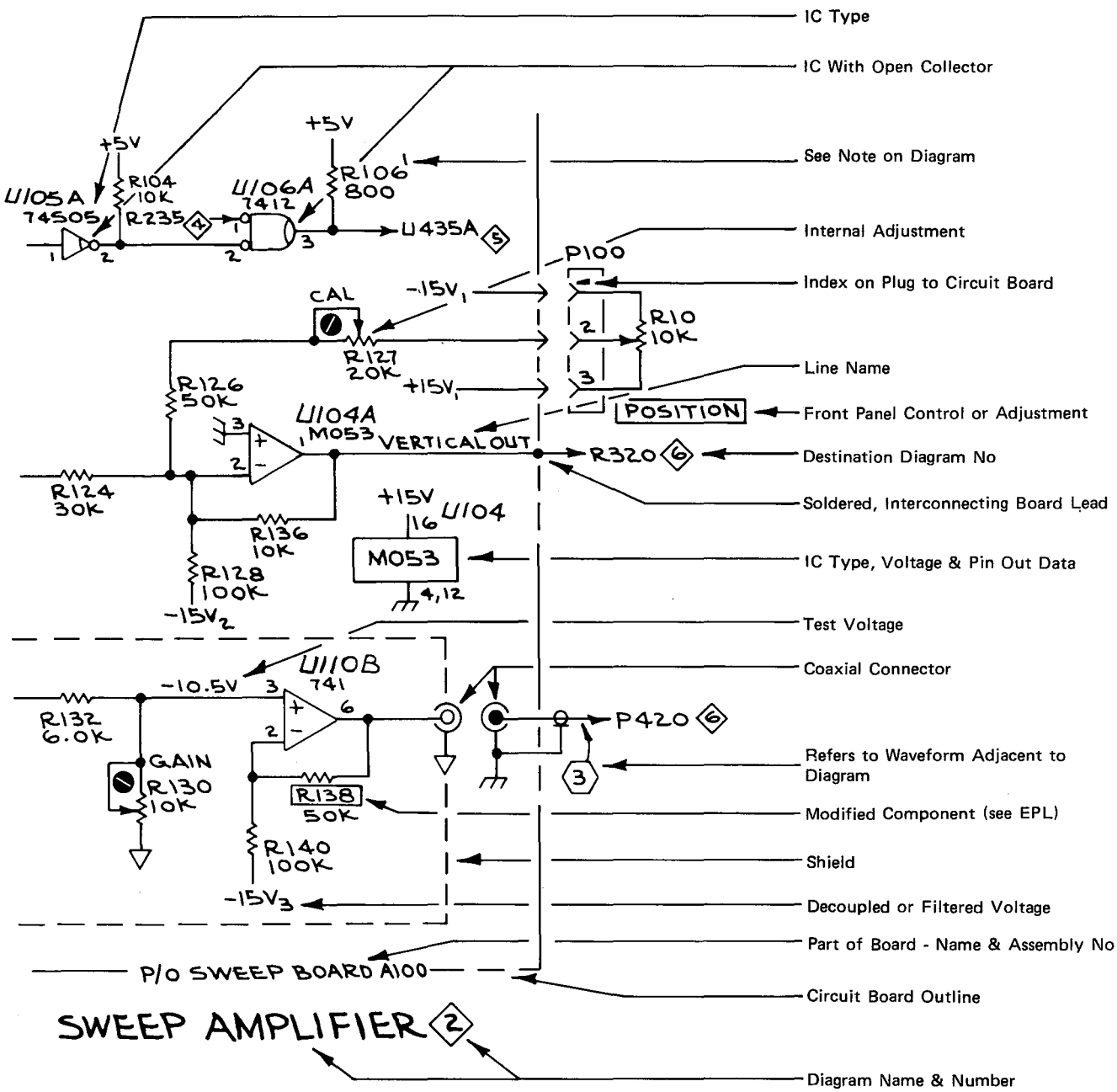
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R951	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R952	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	75042	CEAT0-3091F
R954	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R955	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R956	311-0540-00			RES.,VAR,WW:2.5K OHM,5%	75042	100-1000-252
R958	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R959	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R960	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	75042	CEAT0-3091F
R964	321-0132-00			RES.,FXD,FILM:232 OHM,1%,0.125W	75042	CEAT0-2320F
R966	321-0098-00			RES.,FXD,FILM:102 OHM,1%,0.125W	75042	CEAT0-1020F
R967	321-0098-00			RES.,FXD,FILM:102 OHM,1%,0.125W	75042	CEAT0-1020F
U900	156-0474-00			MICROCIRCUIT,DI:AMPLIFIER,40-890 MHZ	80009	156-0474-00
U905	156-0053-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	U5R7723393
U920	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
VR922	152-0461-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N821
VR970	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646
W900	175-1764-00			CABLE ASSY,RF:1-50 OHM COAX,2.794 INCH LONG	80009	175-1764-00
W905	175-1765-00			CABLE ASSY,RF:1-50 OHM COAX,8.728 INCH LONG	80009	175-1765-00
W910	175-1763-00			CABLE ASSY,RF:1-75 OHM COAX,5.0 INCH LONG	80009	175-1763-00
Y950	158-0068-00			XTAL UNIT,QTZ:5 MHZ,0.01%	13571	ER-1234

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Graphic symbols for electrical and logic symbols, used on the diagrams, are based on ANSI Y32.2, 1970, and ANSI Y32.14, 1973, "American National Standards Institute." Logic symbols depict the logic function of the device in positive logic. Copies of these standards can be obtained from the Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, N.Y., 11017. Exceptions and additions are shown on this sample diagram. These conform or are based on the manufacturers data sheet and industry trends.

Resistor values are in ohms, unless noted otherwise, and the Ω symbol is omitted. Capacitor values ≥1 (e.g. 10) are in picofarads (pF) and values <1 (e.g. 0.01) are in microfarads unless otherwise noted.



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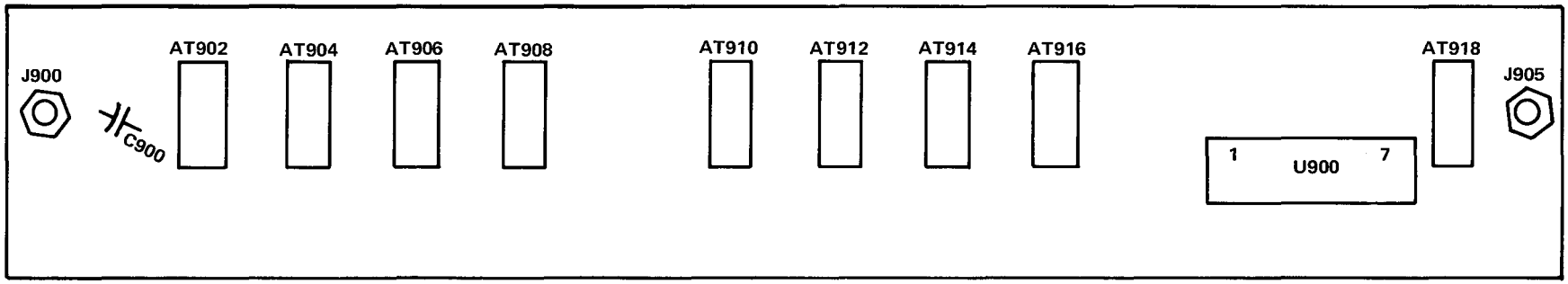
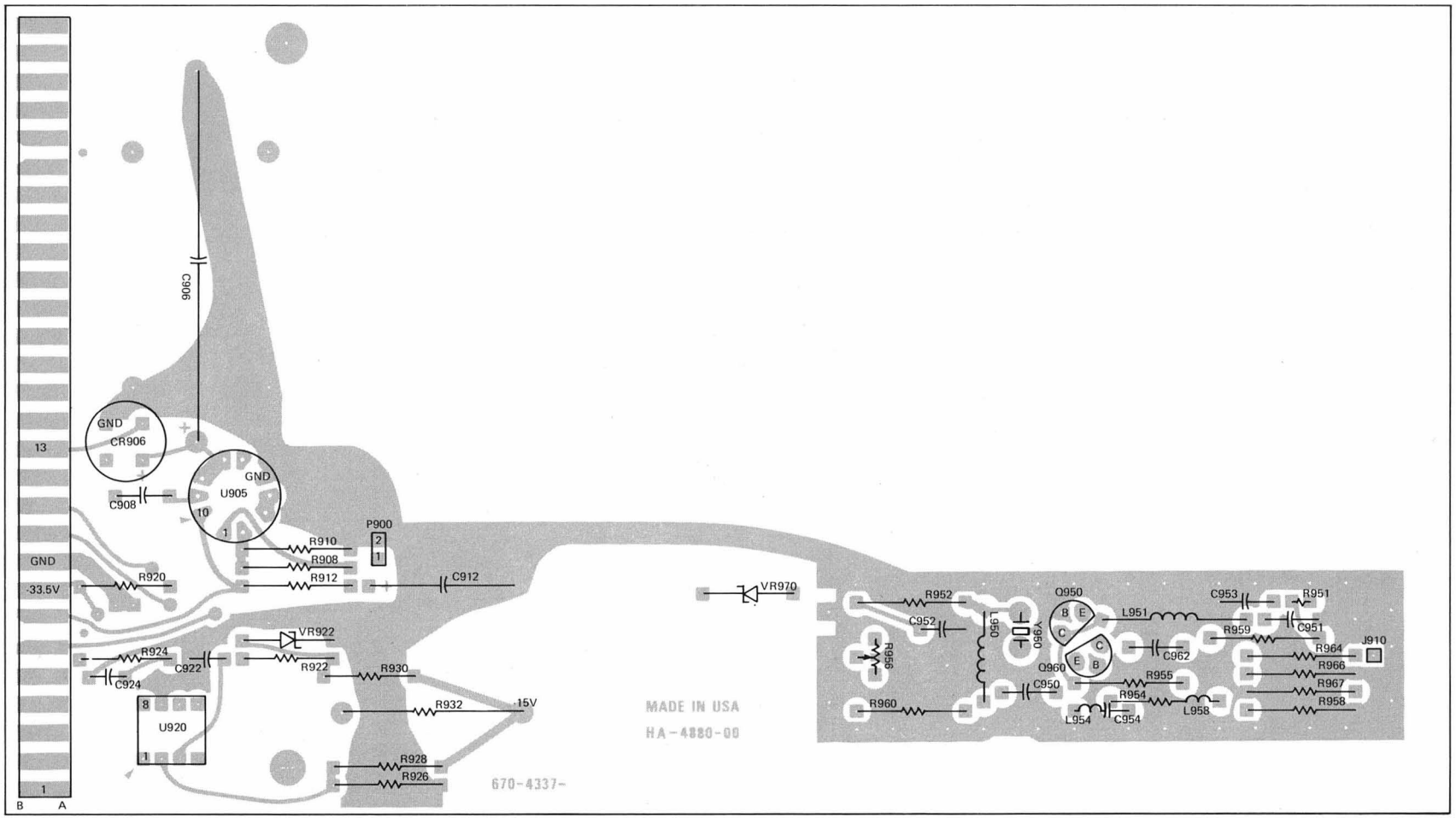
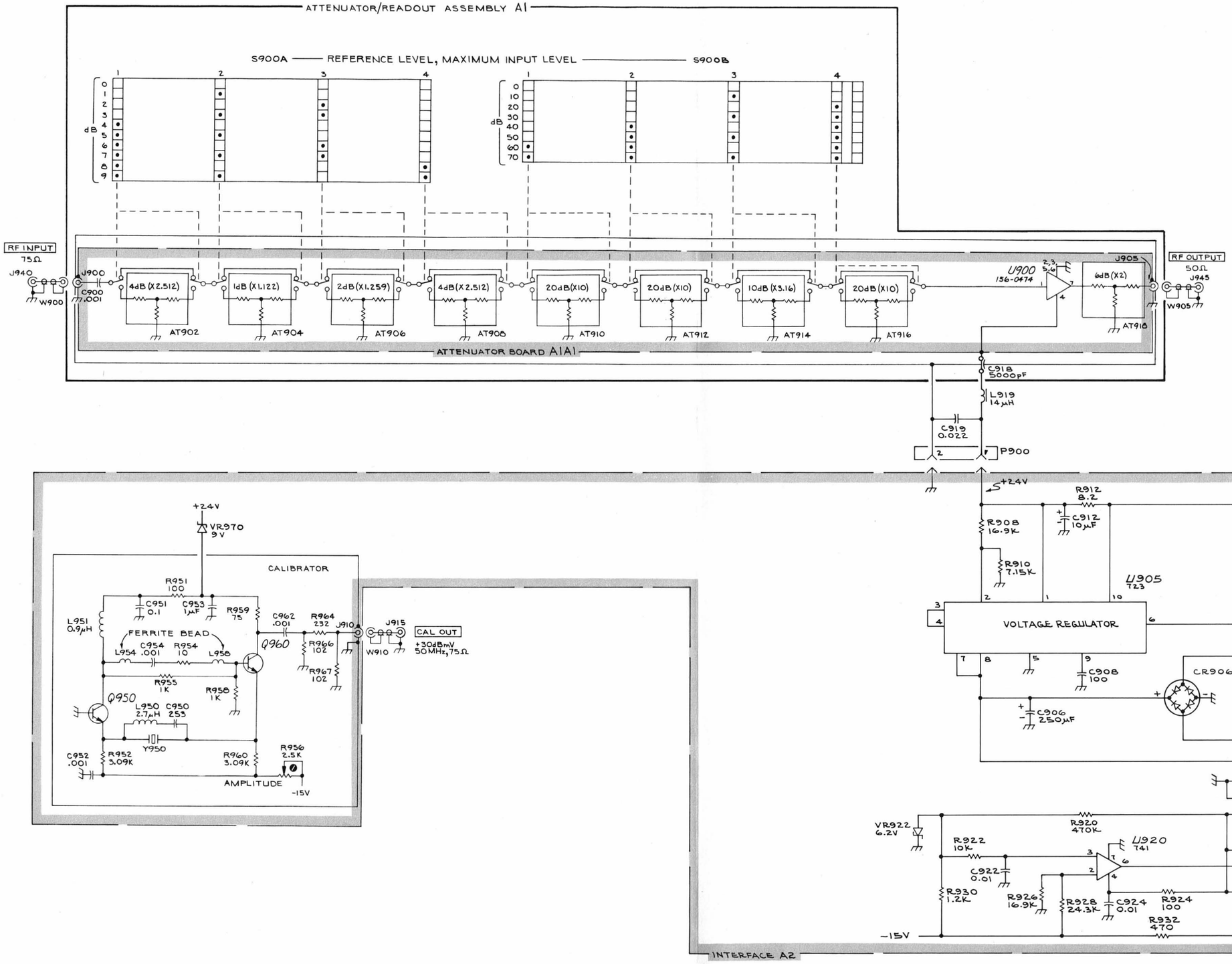


Component location on the Attenuator Board, A1A1.

2043-5



Component location on the Interface Board, A2.



AM511 SCHEMATIC

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
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
NO ENTRY	FOR 24831		
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
42838	NATIONAL RIVET AND MFG. CO.	1-21 EAST JEFFERSON ST.	WAUPUN, WI 53963
45722	USM CORP., PARKER-KALON FASTENER DIV.	1 PEEKAY DRIVE	CLIFTON, NJ 07014
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
98159	RUBBER TECK, INC.	19115 HAMILTON AVE.	GARDENA, CA 90247
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544

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:RIGHT SIDE	80009	337-1064-00
-2	366-1530-00			1	KNOB:GRAY	80009	366-1530-00
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-3	210-0847-00			1	SHIM:0.164 ID X 0.500 OD,NYLON	86445	OBD
-4	331-0372-00			1	MASK,DIAL:	80009	331-0372-00
-5	366-1531-00			1	KNOB:GRAY	80009	366-1531-00
-6	----- -----			1	CABLE ASSY,RF:1-50 OHM COAX(SEE W900 EPL)		
-7	131-1124-00			1	. CONNECTOR,RCPT:BNC	24931	28JS155-1
-8	----- -----			1	CABLE ASSY,RF:1-50 OHM COAX(SEE W905 EPL)		
-9	131-1124-00			1	. CONNECTOR,RCPT:BNC	24831	28JS155-1
-10	----- -----			1	CABLE ASSY,RF:1-75 OHM COAX(SEE W910 EPL)		
-11	131-0818-00			1	. CONNECTOR,RCPT,:BNC,FEMALE	91836	KC19-153BNC
-12	366-1520-00			1	KNOB:LATCH	80009	366-1520-00
					(ATTACHING PARTS)		
-13	214-1840-00			1	PIN,KNOB SECRG:	80009	214-1840-00
					- - - * - - -		
-14	333-2136-00			1	PANEL,FRONT:	80009	333-2136-00
-15	214-1513-01			1	LCH,PLUG-IN RET:	80009	214-1513-01
					(ATTACHING PARTS)		
-16	213-0254-00			1	SCR,TPG,THD CTG:2-56X0.25"100 DEG,FLH STL	45722	OBD
					- - - * - - -		
-17	129-0070-00			1	TERMINAL,STUD:W/2-56 STUD AND SOLDER TERM	71279	2255-1
	672-0569-00			1	CKT BOARD ASSY:ATTENUATOR,A1	80009	672-0569-00
					(ATTACHING PARTS)		
-18	211-0101-00			4	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-19	211-0008-00			4	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-20	384-1418-00			1	. EXTENSION SHAFT:0.125 OD X 8.275" LONG	80009	384-1418-00
					(ATTACHING PARTS)		
-21	213-0075-00			1	. SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	70276	OBD
					- - - * - - -		
-22	384-1419-00			1	. SHAFT,CAM SW:0.156 OD X 4.4" LONG BRS	80009	384-1419-00
-23	337-1978-00			1	. SHIELD,ELEC:ATTENUATOR	80009	337-1978-00
					(ATTACHING PARTS)		
-24	211-0116-00			12	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-25	386-1701-00			2	. PL,BACKING,SPR:CAM SW,0.63 X0.65 X 0.050A	80009	386-1701-00
					(ATTACHING PARTS FOR EACH)		
-26	211-0180-00			1	. SCR,ASSEM WSHR:2-56 X 0.25 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-27	200-0924-01			1	. COVER,CAM SW:WHITE PLASTIC	80009	200-0924-01
-28	344-0248-00			9	. CLIP,ATTENUATOR:	80009	344-0248-00
-29	----- -----			1	. CKT BOARD ASSY:ATTENUATOR(SEE A1A1 EPL)		
					(ATTACHING PARTS)		
-30	211-0180-00			12	. SCR,ASSEM WSHR:2-56 X 0.25 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSEMBLY INCLUDES:		
-31	129-0501-00			2	. . POST,ELEC-MECH:0.25 OD X 0.15" LONG	80009	129-0501-00
-32	131-1536-00			2	. . CONNECTOR,RCPT:	98291	050-651-0039-31
-33	214-1797-00			18	. . PIN,ATTEN CLIP::	80009	214-1797-00
-34	210-0779-00			16	. . RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
-35	131-1030-00			16	. . CONTACT ASSY,EL:CAM SWITCH,BOTTOM	80009	131-1030-00
-36	131-1031-00			16	. . CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00
-37	337-1979-00			1	. . SHIELD,ELEC:AMPLIFIER	80009	337-1979-00
	263-1146-00			1	. ACTR ASSY,CAM S:ATTENUATOR		
-38	210-0405-00			1	. . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-39	214-1126-02			2	. . SPRING,FLAT:RED COLORED	80009	214-1126-02
-40	214-1127-00			1	. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-41	401-0058-01			1	. . BEARING,CAM SW:FRONT,THREADED BUSHING	80009	401-0058-01
					(ATTACHING PARTS)		
-42	210-0406-00			2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-43	211-0008-00			2	. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-44	210-0004-00			2	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
-45	354-0219-00			1	. . RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
-46	105-0715-00			1	. . ACTUATOR,CAM SW:ATTENUATOR	80009	105-0715-00
-47	210-0405-00			2	. . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-48	401-0271-01			1	. . BEARING,CAM SW:	80009	401-0271-01
					(ATTACHING PARTS)		
-49	210-0406-00			2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-50	211-0008-00			2	. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-51	210-0004-00			2	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-52	105-0565-01			1	. . DRUM,CAM SWITCH:	80009	105-0565-01
					(ATTACHING PARTS)		
-53	354-0219-00			1	. . RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
					- - - * - - -		
-54	214-1126-01			1	. . SPRING,FLAT:GREEN COLORED	80009	214-1126-01
	214-1126-02			1	. . SPRING,FLAT:RED COLORED	80009	214-1126-02
-55	214-1127-00			1	. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-56	210-0405-00			1	. . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-57	401-0058-01			1	. . BEARING,CAM SW:FRONT,THREADED BUSHING	80009	401-0058-01
					(ATTACHING PARTS)		
-58	210-0406-00			2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-59	211-0008-00			2	. . SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-60	210-0004-00			2	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-61	105-0564-00			16	. . ACTUATOR,SWITCH:	80009	105-0564-00
-62	358-0503-00			16	. . BUSHING,SLEEVE:0.083 ID X 0.102 INCH OD	80009	358-0503-00
-63	432-0092-00			1	. . BASE-SHLD,ATTEN:	80009	432-0092-00
-64	----- -----			1	. CAP.,FXD,CER DI:(SEE C918 EPL)		
-65	210-0205-00			1	. TERMINAL,LUG:SE #8	78189	2104-08-00-2520N
-66	386-3506-00			1	SUBPANEL,FRONT:	80009	386-3506-00
					(ATTACHING PARTS)		
-67	213-0229-00			4	SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-68	200-1943-00			1	COVER,SUBPANEL:BACK	80009	200-1943-00
-69	----- -----			1	CKT BOARD ASSY:INTERFACE(SEE A2 EPL)		
					(ATTACHING PARTS)		
-70	213-0054-00			4	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-71	337-1562-00			1	. SHIELD,ELEC:TOP	80009	337-1562-00
					(ATTACHING PARTS)		
-72	211-0007-00			2	. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-73	337-1563-00			1	. SHIELD,ELEC:BOTTOM	80009	337-1563-00
					(ATTACHING PARTS)		
-74	210-0406-00			2	. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-75	129-0354-00			2	. SPACER,POST:0.188 INCH HEX X 0.54" LONG	80009	129-0354-00
					- - - * - - -		
-76	131-0391-01			1	. CONNECTOR,RCPT,:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0119
-77	337-1557-00			1	. SHIELD,ELEC:	80009	337-1557-00
-78	337-1556-00			1	. SHIELD,ELEC:	80009	337-1556-00
-79	136-0514-00			1	. SOCKET,PLUG-IN:MICROCIRCUIT,8 CONTACT	82647	C930802
-80	136-0252-04			18	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-81	346-0032-00			2	. STRAP,RETAINING:	98159	2829-75-4
-82	131-0608-00			2	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-83	407-1788-00			1	BRACKET,FR SECT:	80009	407-1788-00
					(ATTACHING PARTS)		
-84	213-0229-00			2	SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-85	426-1298-00			1	FRAME SECT,PL-IN:TOP	80009	426-1298-00
-86	426-1297-00			1	FRAME SECT,PL-IN:BOTTOM	80009	426-1297-00
-87	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	23499	TEK-175-0825-00
-88	131-0707-00			2	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-89	352-0169-01			1	CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01

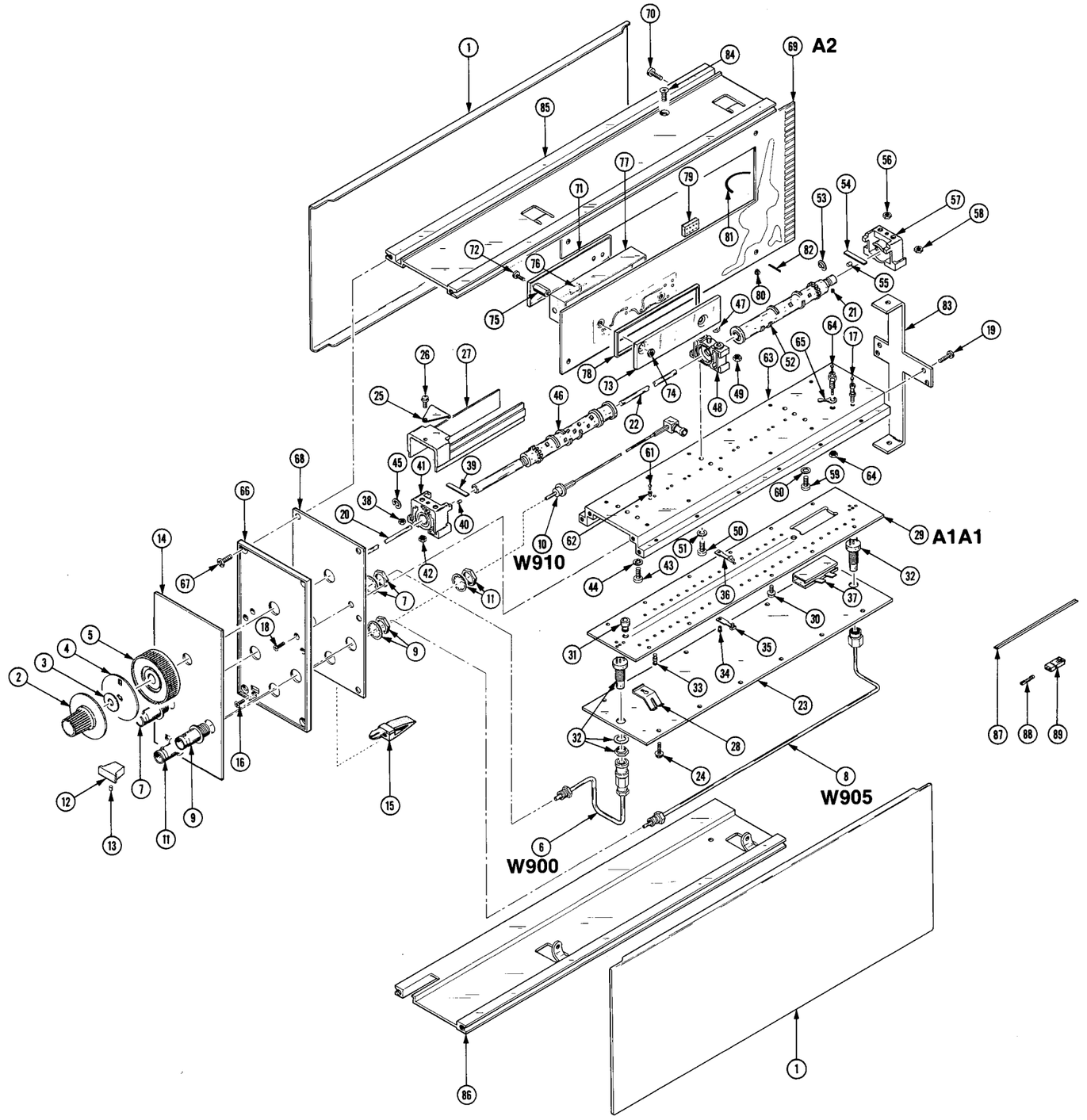


FIG. 1 EXPLODED

FIG. 2 ACCESSORIES & REPACKAGING

ACCESSORIES

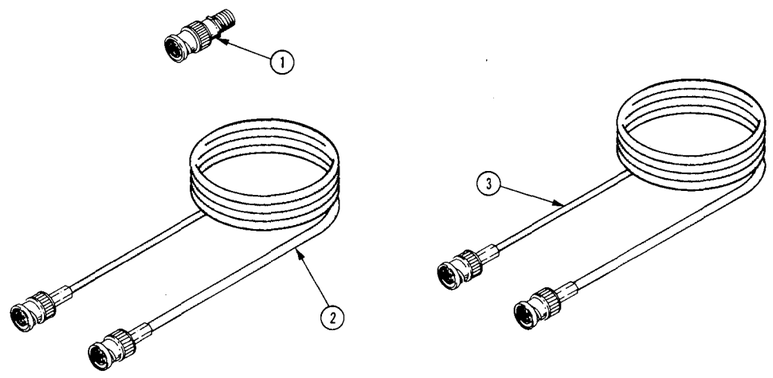
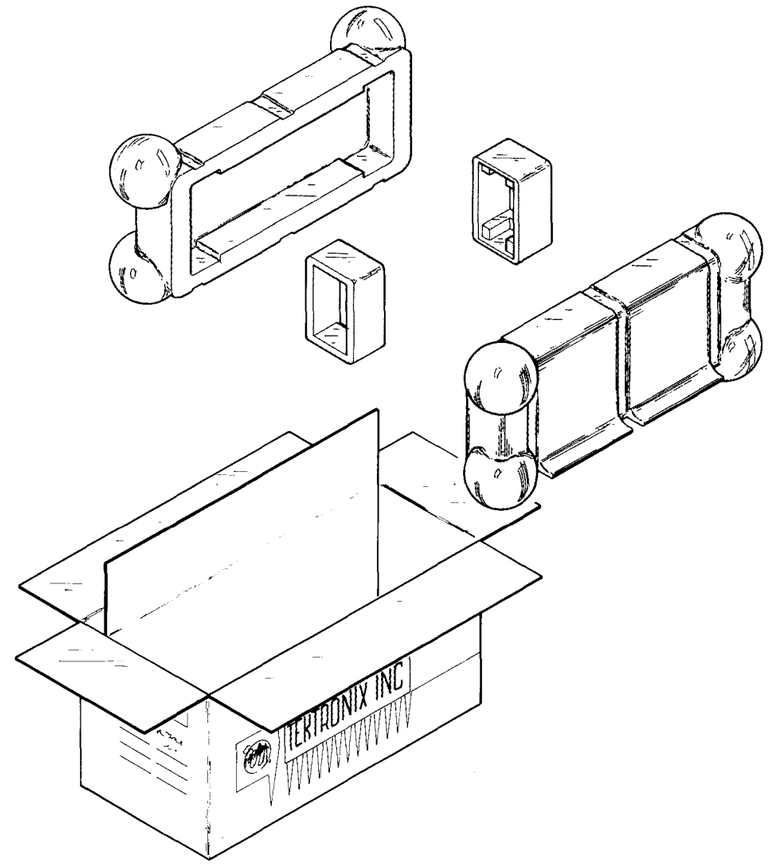


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	013-0126-00			1	ADAPTER,CONN:BNC TO TYPE F	80009	013-0126-00
-2	012-0057-01			1	CABLE ASSY RF:50 OHM,COAX,42.0 INCH LONG	80009	012-0057-01
-3	012-0074-00			1	CABLE ASSY RF:75 OHM COAX,42.0 INCH LONG	80009	012-0074-00
	070-2043-00			1	MANUAL,TECH:INSTRUCTION	80009	070-2043-00
				1	ADVERTISING BROCHURE:"NO LOOSE ENDS",A-2698		

REPACKAGING



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
	065-0125-00			CARTON ASSY:	80009	065-0125-00