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7K11
CATV PREAMPLIFIER

INSTRUCTION MANUAL

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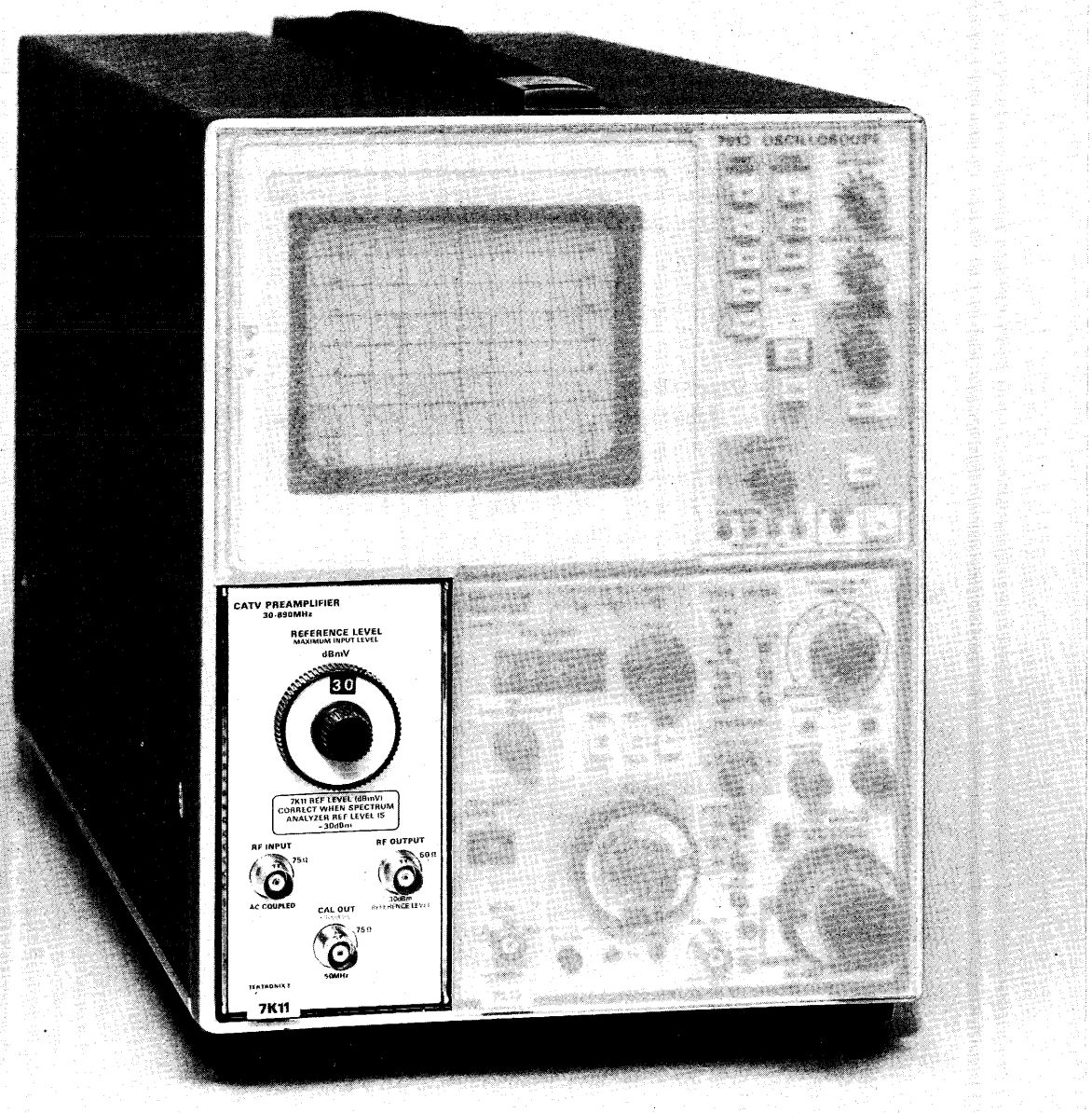


Fig. 1-1. 7K11 CATV Preamplifier.

SPECIFICATIONS

Introduction

This manual contains information relative to the operation and service of the 7K11 CATV preamplifier. The manual is divided into sections with appropriate titles. The Table of Contents that precedes this section gives a breakdown of each section.

The 7K11 Preamplifier is a 7000-Series Plug-In Unit that is designed to operate as an accessory for the 7L12 or 7L13 Spectrum Analyzers. This unit, in combination with a spectrum analyzer, will measure CATV system performance as required by the FCC and compare system performance to industry standards.

ELECTRICAL CHARACTERISTICS

(Includes the 7L12 or 7L13)

Frequency Range

30 MHz to 890 MHz.

Display Flatness (7K11/7L12)

±1.0 dB, with respect to the level at 50 MHz, over the frequency range of 50 MHz to 300 MHz; increasing to +2.0 dB, -2.5 dB over the full frequency range.

Display Flatness (7K11/7L13)

+1.0 dB, -1.5 dB, with respect to the level at 50 MHz, over the frequency range 50 MHz to 300 MHz and +2.0 dB, -2.5 dB, over the full frequency range.

Sensitivity (Signal + noise = 2X noise, LIN mode)

The following characteristics apply to 50 MHz in combination with the 7L12 or 7L13 Spectrum Analyzer.

Signal Level	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 7K11 is 5 dB or less.

Intermodulation Distortation (7K11/7L12 or 7K11/7L13)

IM products and harmonics from two signals within the frequency span of the 7K11, are 70 dB or more down from the reference level for third order intermodulation with two signals at the reference level (full screen).

Reference Level

Calibrated levels 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, 7K11 reference level. This is equivalent to:
± [0.2 dBmV + 0.01 | 7K11 REF LVL – 30 dBmV|].

Calibrator

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

The input impedance of the 7K11 is approximately 75 Ω, with a VSWR of 2:1 or better with 10 dB or more attenuation (from 50 MHz to 300 MHz).

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 7K11 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 that select a calibrated reference level for the top of the graticule on the CRT display. This level can be selected in 1 dBmV or 10 dBmV steps to +79 dBmV. The reference level is indicated via a readout window on the selectors and in the upper left section of the CRT display when the 7K11 is used with a 7000-Series oscilloscope that has the readout feature. This REFERENCE LEVEL is also the MAXIMUM INPUT signal level for linear operation. Accuracy is referenced to the +30 dBmV Calibrator at 50 MHz.

RF INPUT Connector

A 75 Ω BNC input connector for the input signal application.

RF OUTPUT Connector

A 50 Ω signal source of the signal that is applied to the RF INPUT. This signal level depends on the setting of the REFERENCE LEVEL selector and applied signal level. The output is −30 dBm when the input signal level equals that indicated by the REFERENCE LEVEL readout. NOTE: The 7L12 or 7L13 Reference Level can be set to a setting such as −40 dBm, to increase sensitivity, provided the additional level (in this case 10 dB) is summed with the 7K11 REFERENCE LEVEL indication.

CAL OUT Connector

Provides access to an accurate +30 dBmV, 50 MHz signal, from a 75 Ω source. This signal is used as an absolute reference for the display and is used to calibrate the 7K11/Spectrum Analyzer ensemble. Harmonics of the 50 MHz pilot signal provide a picket fence of markers across the frequency span, which are used for accurate frequency and span calibration. The pilot or fundamental 50 MHz provides the amplitude REFERENCE LEVEL. NOTE: Always use the 75 Ω cable which is supplied with the accessories, to connect the CAL OUT to the RF INPUT.

GENERAL OPERATING INFORMATION[1]

This portion of the section describes the front panel adjustment procedure necessary to calibrate the 7K11, Spectrum Analyzer, and 7000-Series mainframe as a system.

NOTE

External graticules are designed so they compensate for parallax of the camera. Graticule markings will therefore be correct on photographed displays.

1. Preliminary Setup and Calibration Procedure

a. Plug the 7K11 and Spectrum Analyzer into a 7000-Series mainframe. An oscilloscope with variable persistence or bi-stable storage is recommended.

b. Connect the 7K11 and Spectrum Analyzer as shown in Fig. 2-1 and turn the power on.

c. Set the controls and selectors as shown in the illustration. Connect the CAL OUT signal of the 7K11 to the RF INPUT and the RF OUTPUT to the Spectrum Analyzer RF Input. Ensure that the Spectrum Analyzer Reference Level is set to −30 dBm and the 7K11 REFERENCE LEVEL is +30 dBmV.

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

[1]Tektronix brochure, "no loose ends", No. A-2698 (supplied with the 7K11 accessories), "Spectrum Analysis and CATV Systems", No. A-2515, is recommended treatise on applications and measurements evaluation.

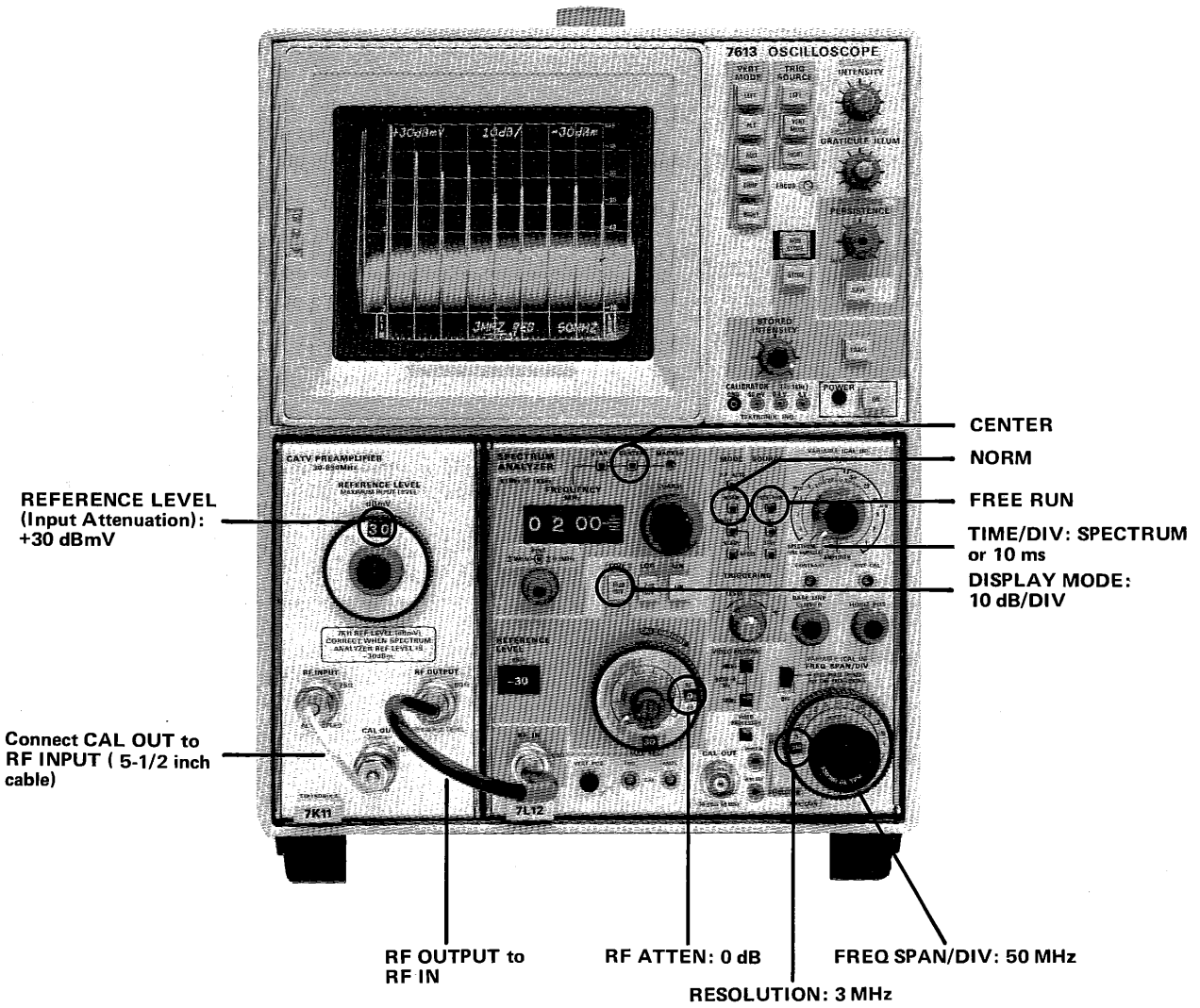


Fig. 2-1. Initial setup, showing control and selector positions.

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

f. Depress the 2 dB/Div display mode button on the analyzer and position the baseline of the display to the bottom graticule line with the Vert Position control. Center the display with the Horizontal Position control.

g. Now depress the 10 dB/Div (LOG) display push-button 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 7K11 Calibrator signal and the procedure described in the Spectrum Analyzer manual.

APPLICATIONS

The gain and 75 Ω to 50 Ω conversion of the 7K11 provide the increased sensitivity that is necessary for the Spectrum Analyzer (7L12) 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 7K11/7L12.

Sensitive Intermodulation Measurements:

a. Connect the test point of the CATV system to the 7K11 RF INPUT connector.

b. Select a Frequency 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 sweep speed 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 IM (beat) products. Switch in filters, 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 IM 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 7K11 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 7K11 amplifier is producing the signal.

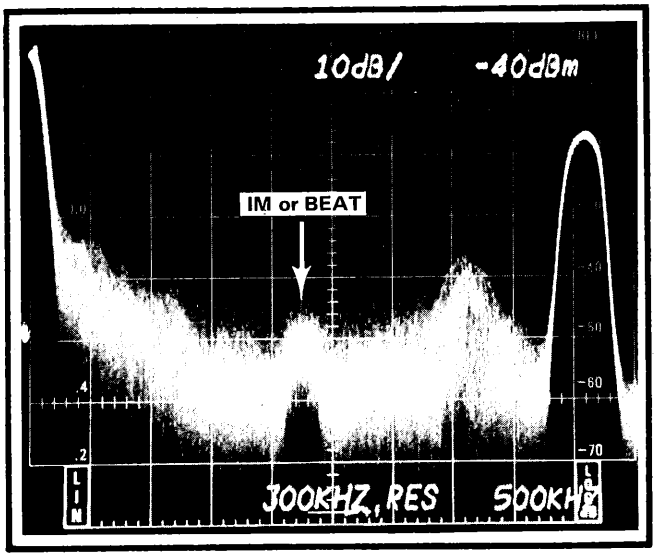


Fig. 2-2. Display showing intermodulation above the picture carrier.

PERFORMANCE CHECK

Introduction

This section verifies the operational performance of the 7K11 to the characteristics specified in the Specifications 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. This procedure will not measure specified parameters. The second portion of this section provides a list of test equipment and procedures for measuring the specified parameters and characteristics.

OPERATIONAL CHECK AND INSTRUMENT FAMILIARIZATION

This portion contains a sequence of procedures that checks the instrument operation and will help familiarize you with the instrument operation. Because the 7K11 Calibrator and attenuator are very accurate, they are used as the reference for this operational checkout.

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 Input through a 50 Ω coaxial cable.

b. Set the 7K11 and Spectrum Analyzer selectors as follows:

7K11

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)	–30 dBm
Display Mode	10 dB/Div
Freq. Span/Div	100 MHz
Resolution	3 MHz
Time/Div	Spectrum or 10 ms

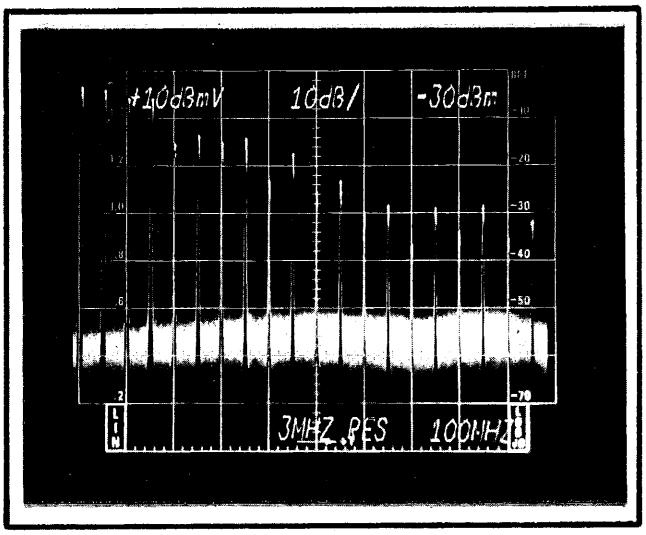


Fig. 3-1. 50 MHz markers across a 1000 MHz display.

c. Check the 1000 MHz span for 50 MHz markers out to 900 MHz. Marker amplitude will decrease towards 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 Center 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 7K11 REFERENCE LEVEL to +30 dBmV.

b. Disconnect the cable between the 7K11 RF OUTPUT and the Spectrum Analyzer RF Input and apply the Spectrum Analyzer Calibrator signal to its RF Input. Note the amplitude of the 50 MHz, –30 dBm signal.

c. Now apply the 7K11 RF OUTPUT to the Spectrum Analyzer RF Input and the CAL OUT (+30 dBmV) to its RF INPUT. The amplitude difference between the two calibrator signals should be slight.

NOTE

Because of the additive tolerances of the 7K11 and Spectrum Analyzer Calibrators, plus the 7K11 attenuator and amplifier, it is impractical to establish limits. This comparison is only an operational check.

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 7K11 attenuator must be used.

a. Apply the 50 MHz, +30 dBmV signal to the RF INPUT and connect the RF OUTPUT to the RF Input of the Spectrum Analyzer.

b. Set the front panel controls as follows:

7K11

REFERENCE LEVEL	+30 dBmV

Spectrum Analyzer

RF Attenuator	30 dB
Reference Level	–20 dBm
Display Mode	10 dB/Div
Freq. Span/Div	5 MHz
Resolution	.3 MHz
Time/Div	Spectrum or 10 ms/Div

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 a graticule reference line (e.g., one division below the top line).

e. Check the 7K11 attenuator by increasing the settings in 10 dB steps above +30 dBmV while decreasing the Spectrum Analyzer RF attenuator setting in 10 dB increments and noting the difference in signal amplitude. Now decrease the 7K11 attenuator settings below +30 dBmV and increase the analyzer RF attenuator settings and note the difference. Difference between the two should not exceed 1.5 dB.

f. Return the attenuators to +30 dBmV and 30 dB. Switch to the 2 dB/Div display mode and re-establish a signal reference level with the Variable Gain control.

g. Check the 1 dB steps of the 7K11 attenuator by noting the decrease of signal amplitude on the display as the attenuation is increased.

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

a. Switch the Spectrum Analyzer Display Mode to Lin, R F Attenuator to O dB, and add 30 kHz Video Filter.

b. Increase the 7K11 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 ($\geqslant$ 2 div). See Fig. 3-2.

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.

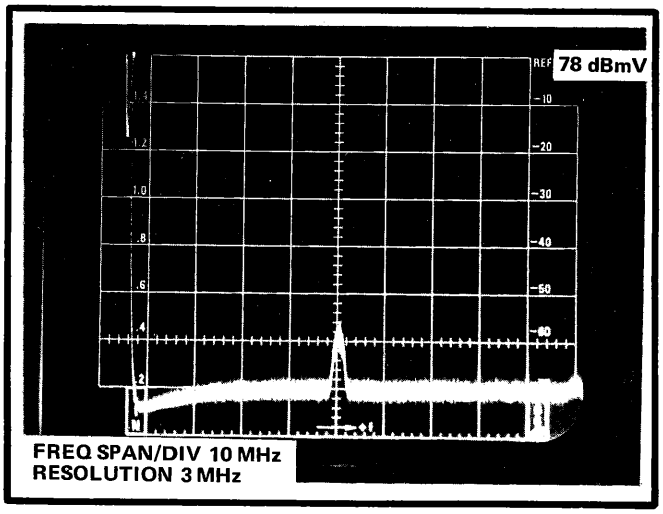


Fig. 3-2. Measuring sensitivity. Signal level = 2X noise.

PERFORMANCE VERIFICATION OF SPECIFIED CHARACTERISTICS

The following procedures describe how to measure the 7K11 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). NOTE: Storage or variable persistence oscilloscopes are desirable for spectrum analysis. Tektronix 7000-Series storage or variable persistence oscilloscopes (7613, 7623, 7313) accept three plug-in widths. The 7L13 Spectrum Analyzer requires three plug-in widths; therefore, the 7K11/7L13 ensemble must be used with non-storage mainframes such as 7704A and 7904.

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

6. Two 5:1, 50 Ω Attenuators: Tektronix Part No. 011-0060-02.

7. Two 18 inch, 50 Ω low loss coaxial cables with BNC to 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.

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 Tektronix 7D14 Digital Counter Plug-In Unit with a readout 7000-Series Oscilloscope or a DC-502 with TM-500-Series. 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 harmonics; 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 feedthrough termination and connect the probe, through the termination, to the CAL OUT connector on the 7K11.

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 7K11 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 7K11 and Spectrum Analyzer controls as follows:

7K11	
REFERENCE LEVEL	10 dBmV
Spectrum Analyzer	
Center 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	Spectrum or 10 ms

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 7K11. Connect the RF OUTPUT to the RF Input 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 7K11/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 7K11/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 between the 50 Ω signal source and the RF INPUT of the 7K11.

Over the linear operating range of the 7K11 amplifier, the gain remains relatively constant or on a 1:1 ratio. The ratio of 3rd order IM products from two or more input signals is about 3:1.

a. Apply two signals within the frequency range of the 7K11 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 7K11 RF INPUT. Fig. 3-3 illustrates this setup.

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

	7K11
REFERENCE LEVEL	+30 dBmV
Spectrum Analyzer	
Display Mode	10 dB/Div
RF Attenuator	0 dB
Reference Level	−30 dBm
Video Filter	30 kHz
Center 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 IM products. Resolution set for optimum sensitivity.

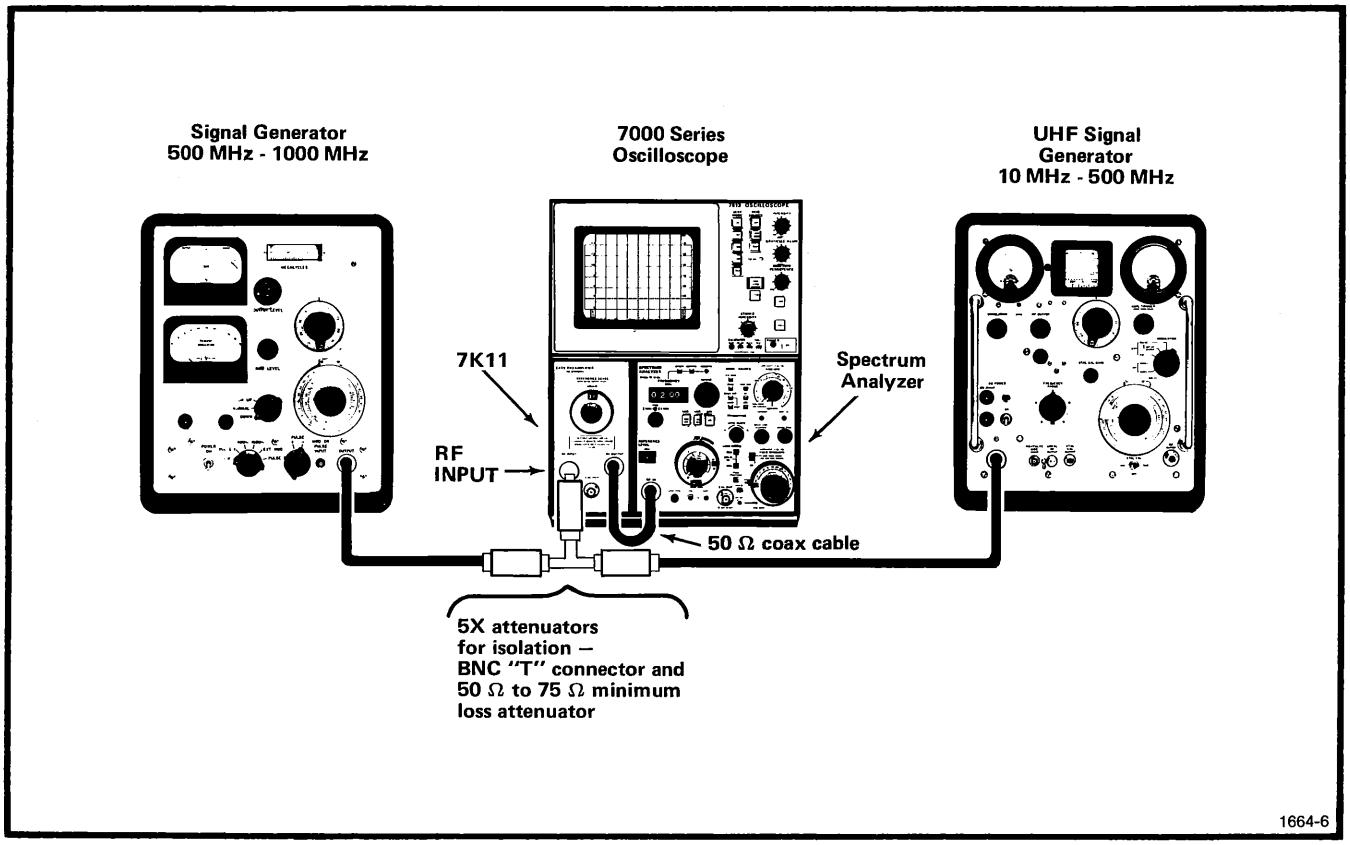


Fig. 3-3. Equipment setup and connections necessary to measure intermodulation distortion.

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

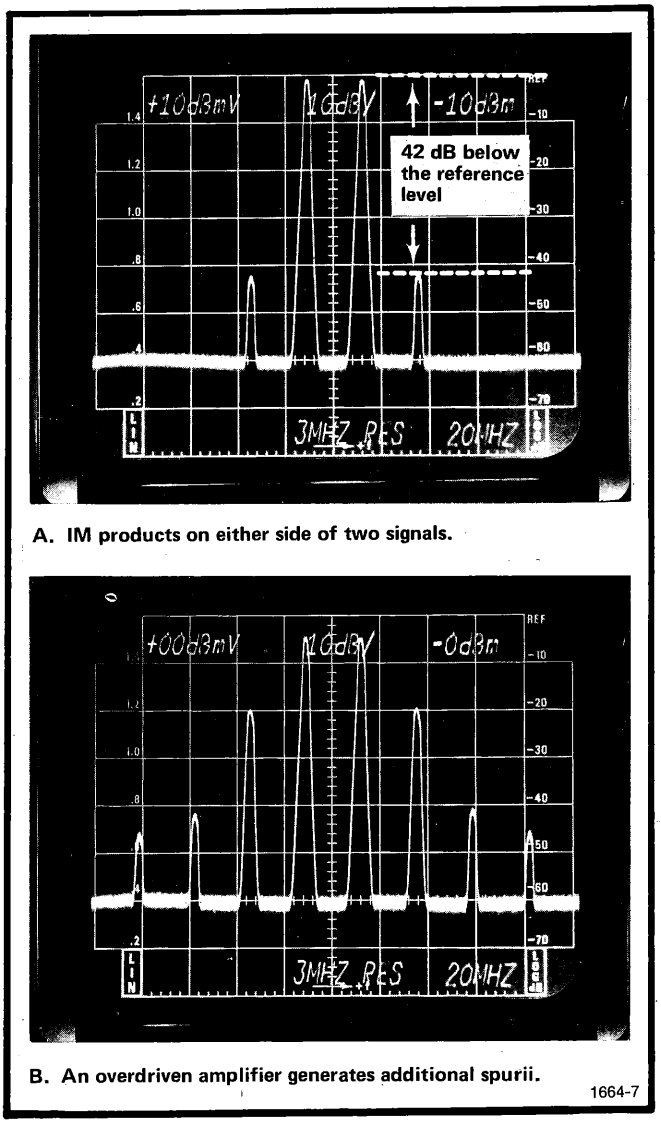
NOTE

When the 7K11 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.

d. Decrease the 7K11 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 IM products by noting the amplitude increase for a 10 dB change in the 7K11 input level. If the amplifier is not overdriven, the amplitude level of the IM 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 IM signals. If this occurs, increase the 7K11 RF ATTENUATOR setting and decrease the Spectrum Analyzer RF Attenuator setting.

e. Note: The level of the IM products down from the reference level must equal or exceed 70 dB.

This completes the performance check for the 7K11. It will now perform within the specifications described in Section 1.



A. IM products on either side of two signals.

B. An overdriven amplifier generates additional spurii.

1664-7

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

SERVICE INSTRUCTIONS

Introduction

This section includes data relative to servicing the 7K11. This data includes circuit description, calibration, preventive maintenance and corrective maintenance procedures that describe replacement procedures for components and assemblies.

CIRCUIT DESCRIPTION

The CATV Preamplifier unit contains an attenuator assembly with a readout circuit, 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 S900 and S902. This attenuator provides 1 dB to 79 dB of attenuation in 1 dB or 10 dB steps. Readout resistors are added or removed in sequence with the attenuator switching to furnish readout information to the mainframe readout circuit. Cam 5 of S902 closes only in the 0 dBmV position to eliminate the extra 0 digit of the readout through the 0 to 9 dBmV range.

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 an 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. Its output level is adjusted to +30 dBmV with R956.

CALIBRATION

There are only two calibration steps for the 7K11. Check the +24 V regulated supply and adjust the output of the 50 MHz calibrator.

1. Check the 24 V Regulated Power Supply

a. Remove the oscilloscope and 7K11 left side panels to expose the left side of the 7K11 when the instrument is installed in the mainframe.

b. Connect a voltmeter between chassis ground and the feedthrough capacitor C918 (see Fig. 4-1).

c. Check the +24 V regulated supply. Must measure 24 V ±2.4 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.

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 7K11.

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 7K11 and oscilloscope left side panels to gain access to the 7K11 calibrator. Adjust R956 (Fig. 4-1) for an output level of +30 dBmV (31.6 mV RMS).

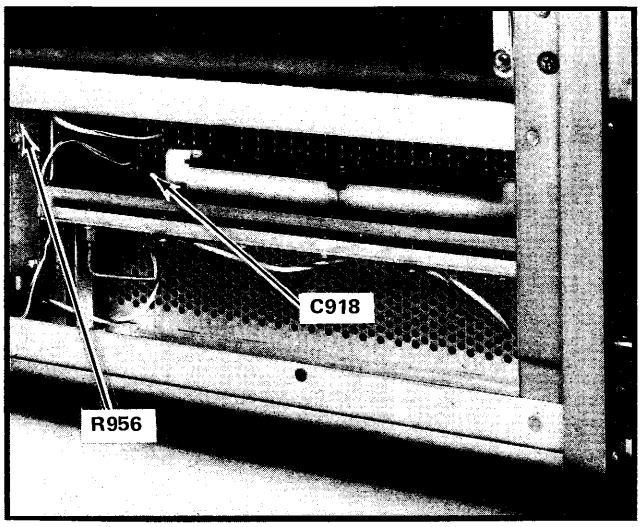


Fig. 4-1. Side panels removed to show the location of C918 and the Calibrator output adjustment R956.

MAINTENANCE

Introduction

The following describes: recommended procedure for reducing or preventing instrument malfunction, trouble-shooting, and corrective maintenance to repair the instrument. Preventive maintenance improves instrument reliability. 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 circuits. The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, try to determine the cause of over-heating 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 is 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

Diagrams. Block and circuit diagrams on foldout pages in the Diagrams section contain significant waveform and voltage information. Refer to the Electrical Parts List section for a description of all assemblies and components.

NOTE

Corrections and modifications to the manual and instrument are described on inserts bound into the rear of the manual. Check this section for 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 corresponding circuit diagram or the back of the preceding diagram. This allows the troubleshooter to trace and check the operation of each circuit, and physically locate circuit components.

Wiring Color Code. Color coded wires are used to aid circuit tracing. Power supply, DC voltage leads have either a white background for positive voltage or a violet background for negative voltage. Signal wires and coaxial cables use an identifying one-band or two-band color code.

Multiple Terminal (Harmonica) Connector Holders. Most intercircuit connections are made through pin connectors which may be mounted in a harmonica type holder. The terminals in the holder are identified by numbers. Connector orientation to the circuit board is keyed by triangles on the holder and the circuit board (see Fig. 4-2). All connectors are identified on the schematic and board with 'P' numbers.

Resistor Color Code. Brown composition resistors, metal-film resistors (identificable by their gray body color) and some wire-wound resistors (usually light blue or gray-green) are used in the 7K11. 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).

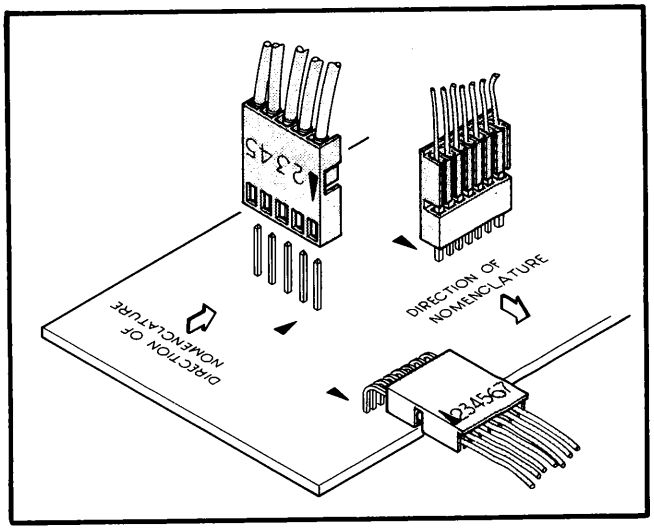


Fig. 4-2. Multipin circuit board connectors.

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. 4-3 illustrates diode types and polarity markings that are used in this instrument.

Transistor and Integrated Circuit Electrode Configurations. Lead identification for the transistors, MOS FET's, and IC's are shown in Fig. 4-4.

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 7K11 (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 insulation 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.

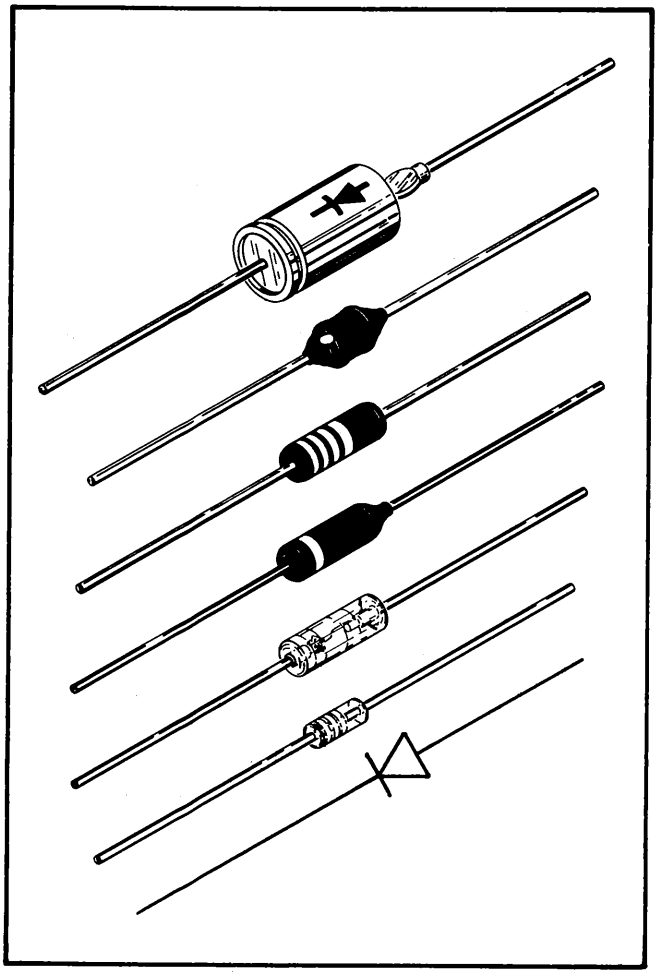


Fig. 4-3. Diode polarity markings.

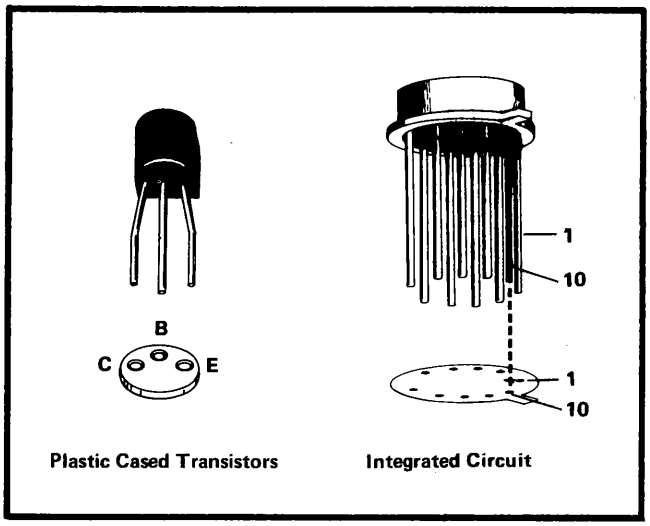


Fig. 4-4. Electrode configuration for socket mounted transistors and IC's.

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 IC's) are socket-mounted, therefore, substitution is often the most practical means for checking their performance. 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. 4-4).

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 FET's because they are very susceptible to static charges.) Use the high resistance ranges (R X 1 k 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 in less time than that required to order 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 replacement 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. 4-4.

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.

Replacing Assemblies, Sub-assemblies and Components

The assemblies and sub-assemblies are easily removed and replaced. The following procedures describe how to replace these assemblies and components.

To remove the assemblies: 1) Disconnect the semi-rigid coaxial conductors. Use a 5/16 open end wrench to loosen the nuts. 2) Remove the back plate plug-in guide and interface circuit board. 3) Remove the screws holding the mounting brackets for the attenuator assembly. 4) Set the attenuator switch for 00 readout, then remove the front panel knobs. 5) Slide the assembly back to clear the switch shaft and remove.

The Interface circuit board is held onto the plastic back plate plug-in guide. Use a tapered punch or tool such as needle nose pliers to pry the retainer clips up and free the board.

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

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 and readout board from the attenuator assembly.

Replacing Attenuator Chips

Attenuator, thick film IC chips, rated in 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. 4-5).

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 re-inserting 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 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 (.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.

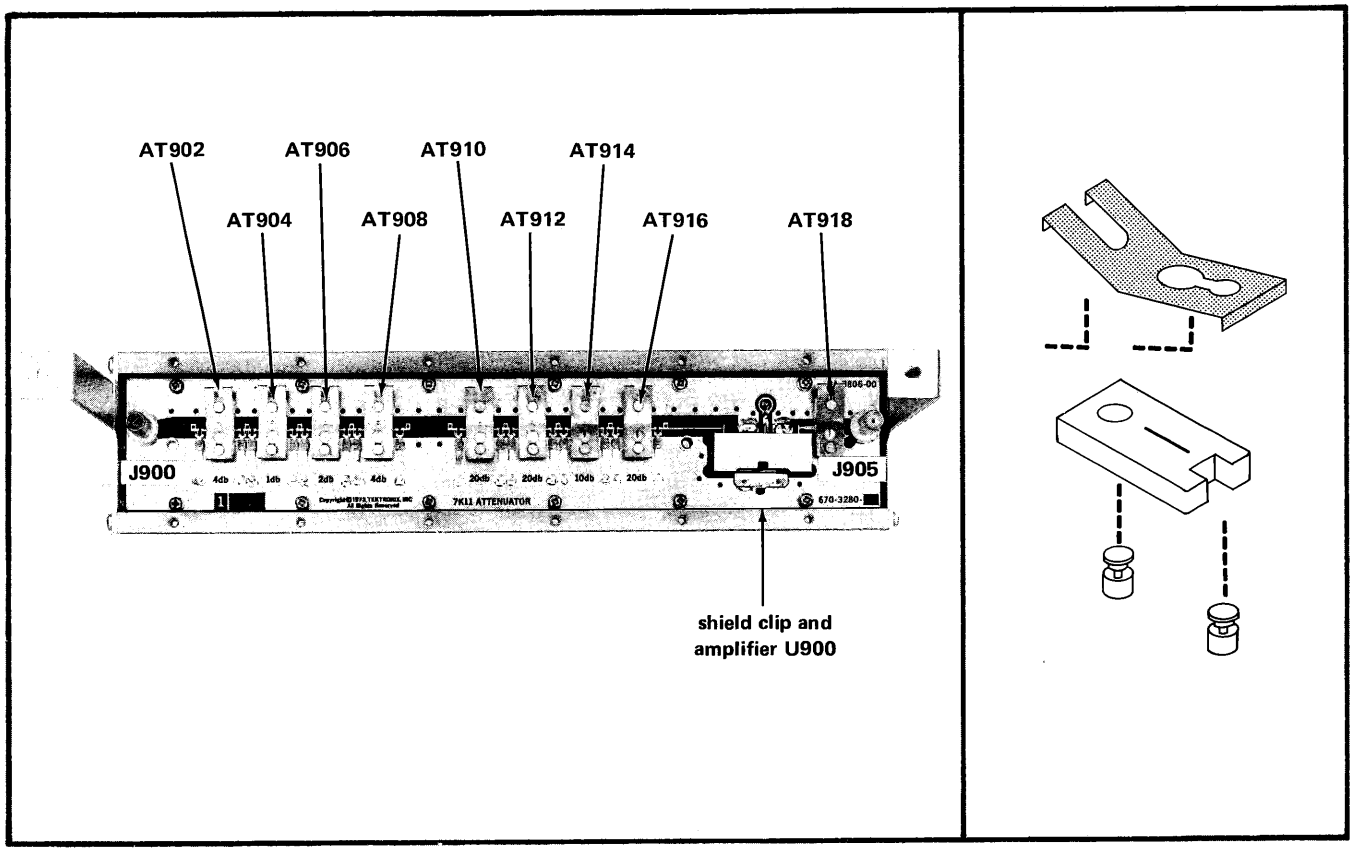


Fig. 4-5. Illustration showing the location and mounting of the attenuator chips on the circuit board.

If it is necessary to bend the new pin, grasp the base of the pin with needle nose pliers and bend against the pressure of the pliers to avoid breaking the board around the ferrule.

Replacing the Amplifier

NOTE

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

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 about 75 watt irons for short periods to melt the solder and free the amplifier shield.

Reverse the procedure to replace the amplifier and shielding clip.

OPTIONS AND MODIFICATIONS

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
ASSY	ASSEMBLY
CAP	CAPACITOR
CER	CERAMIC
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
ELCTLT	ELECTROLYTIC
ELEC	ELECTRICAL
INCAND	INCANDESCENT
LED	LIGHT EMITTING DIODE
NONWIR	NON WIREWOUND
PLSTC	PLASTIC
QTZ	QUARTZ
RECP	RECEPTACLE
RES	RESISTOR
RF	RADIO FREQUENCY
SEL	SELECTED
SEMICOND	SEMICONDUCTOR
SENS	SENSITIVE
VAR	VARIABLE
WW	WIREWOUND
XFMR	TRANSFORMER
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
09023	CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO.	2652 DALRYMPLE ST.	SANFORD, NC 27330
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
33096	COLORADO CRYSTAL CORPORATION	2303 W 8TH STREET	LOVELAND, CO 80537
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
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., P O BOX 5825	COMPTON, CA 90224
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
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	672-0432-00			CKT BOARD ASSY:ATTENUATOR	80009	672-0432-00
A1A1	670-3280-00			CKT BOARD ASSY:ATTENUATOR	80009	670-3280-00
A1A2	670-3281-00			CKT BOARD ASSY:READOUT	80009	670-3281-00
A2	670-3282-00			CKT BOARD ASSY:INTERFACE	80009	670-3282-00
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
AT918	----- -----			(307-1021-00 MAY BE USED)		
C900	283-0252-00			CAP.,FXD,CER DI:1000PF,10%,50V	04222	ULA105C102K2T60
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	8121N075Z5U0223M
C940	290-0340-00			CAP.,FXD,ELCTLT:10UF,10%,50V	56289	109D106X9050C2
C950	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	09023	CD15EC(253)J03
C951	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C952	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	0831610Y5P0102D
C953	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	0831610Y5P0102D
C954	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	0831610Y5P0102D
C962	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	0831610Y5P0102D
CR940	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR942	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR946	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
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	131-0818-00			CONNECTOR,RCPT,:BNC,FEMALE	91836	KC-19-153
J915	131-0375-00			CONNECTOR,PLUG,:RIGHT ANGLE	98291	051-328-3188-220
J940	131-1124-00			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JS155-1
J945	131-1124-00			CONN,RCPT,ELEC:BNC,FEMALE	24931	28JS155-1
L919	108-0551-00			COIL,RF:14UH	80009	108-0551-00
L950	108-0538-00			COIL,RF:2.7UH	76493	JWM#B7059
L951	108-0666-00			COIL,RF:900NH	80009	108-0666-00
L954	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L958	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
Q950	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q960	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
R900	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R902	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R904	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R906	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R908	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R910	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R912	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R914	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R916	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R918	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R920	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R922	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R924	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
R926	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R928	321-0321-00			RES.,FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R930	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R932	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R934	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R936	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R938	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R940	301-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.50W	01121	EB3915
R942	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R944	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R946	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R948	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
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	91637	MFF1816G30900F
R954	321-0001-00			RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
R955	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R956	311-0540-00			RES.,VAR,WW:2.5K OHM,5%,1W	80294	3345P-1-252
R958	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R959	321-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R960	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	91637	MFF1816G30900F
R964	321-0132-00			RES.,FXD,FILM:232 OHM,1%,0.125W	91637	MFF1816G232R0F
R967	321-0098-00			RES.,FXD,FILM:102 OHM,1%,0.125W	91637	MFF1816G102R0F
S900	263-1067-00			SW CAM ACTR AS:REFERENCE LEVEL	80009	263-1067-00
S902				(NONREPLACEABLE SUBPART OF S900)		
U900	156-0474-00			MICROCIRCUIT,DI:AMPLIFIER,40-890 MHZ	80009	156-0474-00
U905	156-0053-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	SL21721
W900	175-1510-00			CABLE ASSY,RF:50 OHM COAX,3.0 L	80009	175-1510-00
W905	175-1511-00			CABLE ASSY,RF:50 OHM COAX,12.5 L	80009	175-1511-00
W910	175-1509-00			CABLE ASSY,RF:75 OHM COAX,14.5 L	80009	175-1509-00
Y950	158-0068-00			XTAL UNIT,QTZ:5MHZ,0.01%	33096	PB-3071

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

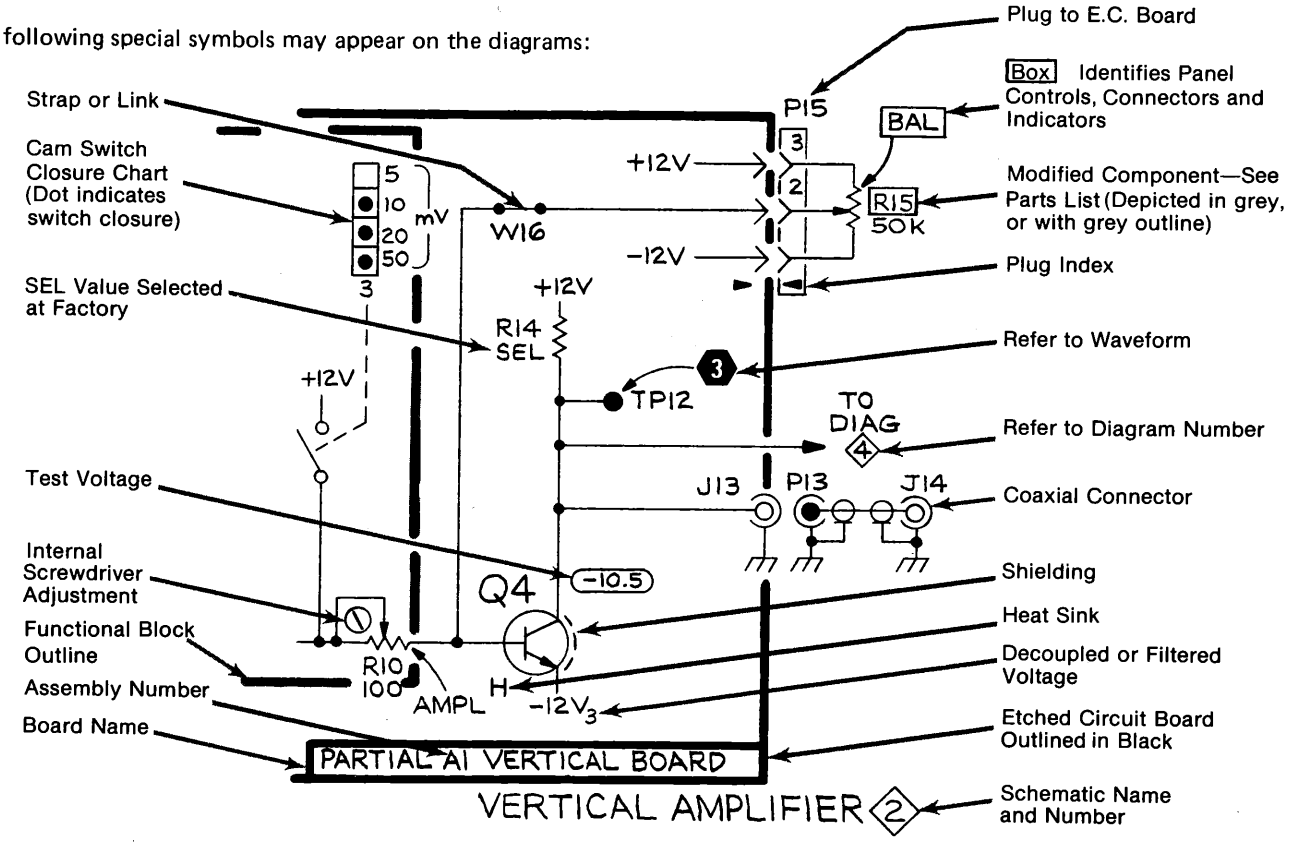
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

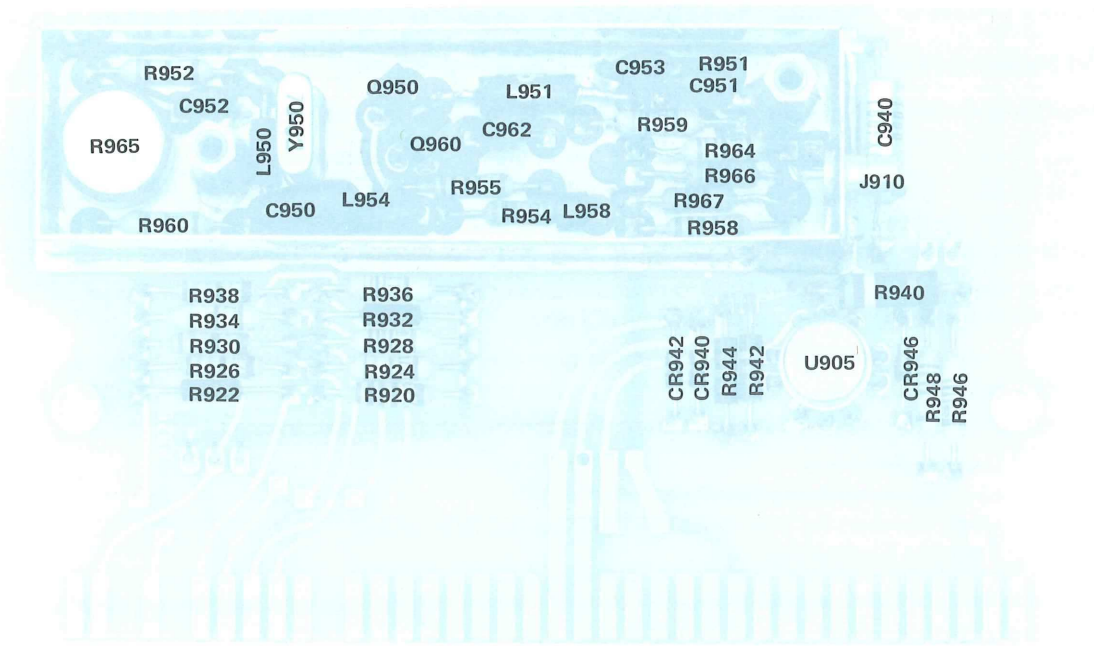
Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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

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

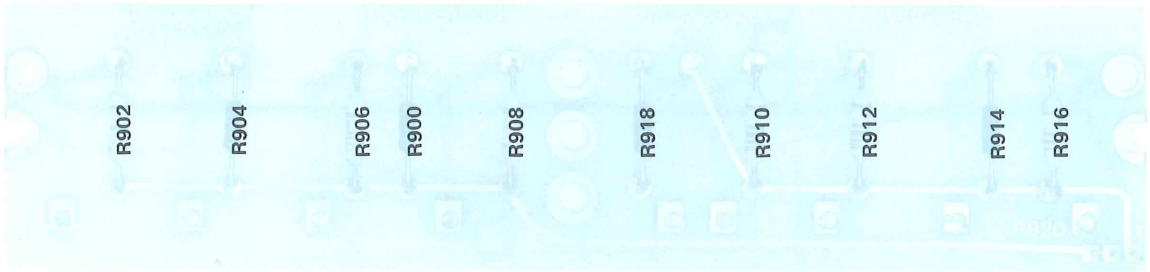
The following special symbols may appear on the diagrams:





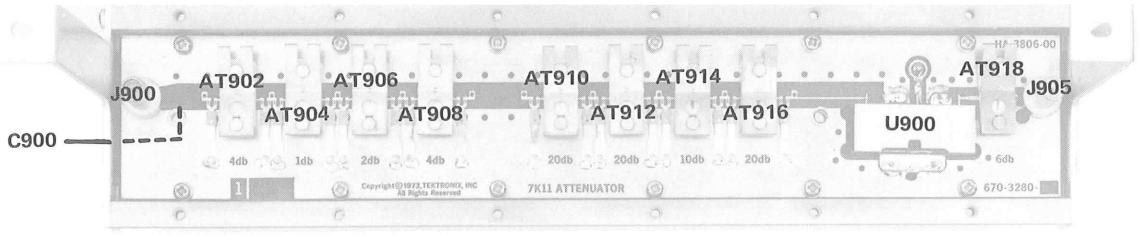
1664-11

Fig. 7-1. A2—Interface Board component locations.



1664-12

Fig. 7-2. A1A2—Readout Board component locations.



1664-13

Fig. 7-3. A1A1—Attenuator Board component locations.

ATTENUATOR/READOUT ASSEMBLY A1

S900 — REFERENCE LEVEL, MAXIMUM INPUT LEVEL — S902

dB 0 1 2 3 4 5 6 7 8 9

dB 0 10 20 30 40 50 60 70

RF INPUT 75Ω J940 W900 J900 C900 .001

4dB (1.58X) AT902 · 1dB (1.122X) AT904 · 2dB (1.259X) AT906 · 4dB (1.58X) AT908 · 20dB (10X) AT910 · 20dB (10X) AT912 · 10dB (3.16X) AT914 · 20dB (10X) AT916

ATTENUATOR BOARD A1A1

U900 J905 8dB (2.5X) AT918 RF OUTPUT 50Ω J945 W905

+50V CR940 CR942 U905 R940 390 R942 5.1K CR946 R944 3.6K +15V R946 2.15K -15V R948 22.1K C940 10μF

P930 C919 .022 L919 14μH C918 5000pF P/O INTERFACE A2

R900 150K

R902 37.4K · R904 150K · R906 75K · R908 37.4K · R910 75K · R912 75K · R914 150K · R916 75K · R918 150K

READOUT BOARD A1A2

P920 P925

A32 A37 B32 A33 B31 A31 B30 A30 B37 A19 +50V A18 +15V B18 -15V A12 GND B12 GND A35 A2

R936 75K · R928 21.5K · R920 30.1K · R932 150K · R924 24.9K · R938 37.4K · R930 37.4K · R922 150K · R934 49.9K · R926 37.4K

P/O INTERFACE A2

CALIBRATOR

+15V R951 100 C951 0.1 C953 .001 R959 75 L951 0.9μH FERRITE BEAD L954 C954 .001 R954 10 L958 Q960 C962 .001 R964 232 J910 J915 CAL OUT +30dBmV 50MHz, 75Ω W910 R966 102 R967 102 R955 1K R958 1K Q950 L950 2.7μH C950 253 Y950 C952 .001 R952 3.09K R960 3.09K R956 2.5K AMPLITUDE -15V

7K11

REV APR 1983

DD 673

CATV PREAMPLIFIER

7K11 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
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
04348	LAWRENCE ENGINEERING AND SUPPLY, INC.	500 S FLOWER ST, PO BOX 30	BURBANK, CA 91503
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV. OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
42838	NATIONAL RIVET AND MFG. CO.	1-21 EAST JEFFERSON ST.	WAUPUN, WI 53963
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83309	ELECTRICAL SPECIALITY CO., SUBSIDIARY OF BELDEN CORP.	213 E. HARRIS AVE. SOUTH	SAN FRANCISCO, CA 94080
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
92101	SCHULZE MFG, 50 INGOLD RD BURLINGAME, CA 94010		
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111
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:SIDE PLUG-IN UNITS	80009	337-1064-00
-2	366-1530-00			1		KNOB:GRAY	80009	366-1530-00
	213-0153-00			1		.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-3	331-0372-00			1		MASK,DIAL:	80009	331-0372-00
-4	210-0847-00			1		WASHER,FLAT:0.164 ID X 0.500 OD,NYLON	83309	OBD
-5	366-1531-00			1		KNOB:GRAY	80009	366-1531-00
	213-0153-00			2		.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-1058-00			1		KNOB:LATCH	80009	366-1058-00
						**********(ATTACHING PARTS)**********		
-7	214-1095-00			1		PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	22599	52-022-094-0187
						**********(END ATTACHING PARTS)*********		
-8	105-0076-02	B010100	B030589	1		REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02
	105-0076-04	B030590		1		RELEASE BAR,LCH:PLUG-IN UNIT	80009	105-0076-04
-9	214-1054-00			1		SPRING,FLAT:0.825 X 0.322,SST	80009	214-1054-00
-10	105-0075-00			1		BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00
-11	214-1280-00			1		SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA	80009	214-1280-00
-12	348-0235-00			2		SHLD GSKT,ELEC:4.734 INCH LONG	92101	OBD
-13	333-1821-00			1		PANEL,FRONT:	80009	333-1821-00
-14	175-1509-00			1		CABLE ASSY,RF:75 OHM COAX,14.5 L	80009	175-1509-00
-15	175-1510-00			1		CABLE ASSY,RF:50 OHM COAX,3.0 L	80009	175-1510-00
-16	175-1511-00			1		CABLE ASSY,RF:50 OHM COAX,12.5 L	80009	175-1511-00
	166-0209-00	B030000		1		SPACER,SLEEVE:0.939 L X 0.18 ID,AL	80009	166-0209-00
						**********(ATTACHING PARTS)**********		
	211-0239-00	B030000		1		SCREW,MACHINE:4-40 X 1.25,FLH,100 DEG,STL	04348	OBD
						**********(END ATTACHING PARTS)*********		
-17	386-1447-75			1		SUBPANEL,FRONT:	80009	384-1447-75
						**********(ATTACHING PARTS)**********		
-18	213-0192-00			4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						**********(END ATTACHING PARTS)*********		
-19	386-1402-00			1		PANEL,REAR:	80009	386-1402-00
						**********(ATTACHING PARTS)**********		
-20	213-0192-00			4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
-21	361-0326-00			1		SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L	80009	361-0326-00
						**********(END ATTACHING PARTS)*********		
-22	---- ----			1		CKT BOARD ASSY:INTERFACE(SEE A2 REPL)		
-23	136-0252-07			16		.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0252-01			2		.CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
-24	131-0608-00			5		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-25	131-0391-01			1		.CONNECTOR,RCPT,:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0119
-26	337-1557-00			1		.SHIELD,ELEC:CALIBRATION,TOP	80009	337-1557-00
-27	337-1563-00			1		.SHIELD,ELEC:CAL COVER,BOTTOM	80009	337-1563-00
						**********(ATTACHING PARTS)**********		
-28	210-0406-00			2		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
						**********(END ATTACHING PARTS)*********		
-29	337-1556-00			1		.SHIELD,ELEC:CALIBRATION BOTTOM	80009	337-1556-00
-30	129-0354-00			2		.SPACER,POST:0.54 L,W/4-40 THD ONE END	80009	129-0354-00
						**********(ATTACHING PARTS)**********		
-31	210-0406-00			2		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-32	210-0994-00			2		.WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
						**********(END ATTACHING PARTS)*********		
-33	337-1562-00			1		SHIELD,ELEC:CAL COVER,TOP	80009	337-1562-00
						**********(ATTACHING PARTS)**********		
-34	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						**********(END ATTACHING PARTS)*********		
-35	214-1061-00			1		SPRING,GROUND:FLAT	80009	214-1061-00
-36	386-2892-00			2		SUPPORT,ATTEN:	80009	386-2892-00
						**********(ATTACHING PARTS)**********		
-37	211-0101-00			4		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
-38	210-0586-00			4		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-39	211-0007-00	B010100	B029999	8		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
	211-0007-00	B030000		6		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						**********(END ATTACHING PARTS)*********		
-40	426-0505-18			1		FR SECT,PLUG-IN:TOP	80009	426-0505-18
-41	426-0499-19			1		FR SECT,PLUG-IN:BOTTOM	80009	426-0499-19
-42	344-0210-00			1		CLIP,SPR TNSN:	80009	344-0210-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-43	344-0211-00			1		CLIP,SPR TNSN:BOTTOM,PLASTIC	80009	344-0211-00
	----- -----			1		CKT BOARD ASSY:ATTEN/REGULATOR(SEE A1 REPL		
-44	386-1701-00			2		.PL,BACKING,SPR:CAM SWITCH,CU BE CD PL	80009	386-1701-00
						.**********(ATTACHING PARTS)**********		
-45	211-0001-00			2		.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	87308	OBD
-46	210-0001-00			2		.WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
						.**********(END ATTACHING PARTS)**********		
-47	200-0924-01			2		.COVER,CAM SW:PLASTIC	80009	200-0924-01
-48	344-0248-00			9		.CLIP,ATTENUATOR:	80009	344-0248-00
-49	384-1241-00			1		.EXTENSION SHAFT:0.125 DIA X 9.26 INCH LON	80009	384-1241-00
-50	384-0942-00			1		.SHAFT,CAM SW:STATIONARY	80009	384-0942-00
-51	337-1978-00			1		.SHIELD,ELEC:ATTENUATOR	80009	337-1978-00
						.**********(ATTACHING PARTS)**********		
-52	211-0007-00			8		.SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-53	210-0004-00			8		.WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
-54	211-0008-00			4		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-55	210-0994-00			4		.WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-56	343-0144-00			4		.CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
						.**********(END ATTACHING PARTS)**********		
-57	----- -----			1		.CAPACITOR(SEE C918 REPL)W/HARDWARE		
						.**********(ATTACHING PARTS)**********		
-58	210-0205-00			1		.TERMINAL,LUG:SE #8	86928	5442-7
						.**********(END ATTACHING PARTS)**********		
-59	129-0070-00			1		.TERMINAL,STUD:0.038 L,GOLD PLATED	71279	2255-1
-60	213-0075-00			1		.SETSCREW:4-40 X 0.094,STL BK OXD,HEX	000BK	OBD
	263-1067-00			1		.SW CAM ACTR AS:REFERENCE LEVEL	80009	263-1067-00
-61	354-0391-00			2		..RING,RETAINING:0.395"FREE ID X 0.025" S	97464	3100-43-CD
-62	401-0058-01			2		..BEARING,CAM SW:FRONT,THREADED BUSHING	80009	401-0058-01
-63	214-1126-00			-		..SPRING,FLAT:GOLD COLORED	80009	214-1126-00
	----- -----			-		..(REPLACE W/PART BEARING THE SAME COLOR		
	----- -----			-		..CODE PART IN YOUR INSTRUMENT)		
	214-1126-01			-		..SPRING,FLAT:0.7 X 0.125,CU BE GRN CLR	80009	214-1126-01
	----- -----			-		..(SEE FOOTNOTE ON FIG.1-63)		
	214-1126-02			-		..SPRING,FLAT:RED COLORED	80009	214-1126-02
	----- -----			-		..(SEE FOOTNOTE ON FIG.1-63)		
-64	214-1127-00			2		..ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-65	105-0566-00	B010100	B020287	1		..ACTUATOR,CAM SW:ATTEN	80009	105-0566-00
	105-0566-01	B020288		1		..ACTUATOR,CAM SW:ATTEN	80009	105-0566-01
-66	401-0271-00	B010100	B020287	1		..BEARING,CAM SW:REAR	80009	401-0271-00
	401-0271-01	B020288		1		..BEARING,CAM SW:REAR,0.454 DIA	80009	401-0271-01
-67	105-0565-00	B010100	B020287	1		..ACTUATOR,CAM SW:ATTEN	80009	105-0565-00
	105-0565-01	B020288		1		..ACTUATOR,CAM SW:ATTEN	80009	105-0565-01
-68	105-0564-00			16		..ACTUATOR CONT:HIGH FREQ	80009	105-0564-00
-69	358-0503-00			16		..BUSHING,SLEEVE:0.083 ID X 0.102 INCH OD	80009	358-0503-00
-70	211-0008-00			6		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-71	210-0004-00			6		..WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
-72	210-0405-00			2		..NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-73	210-0406-00			8		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-74	432-0092-00			1		..BASE-SHLD,ATTEN:	80009	432-0092-00
-75	----- -----			1		.CKT BOARD ASSY:READOUT(SEE A1A2 REPL)		
						.**********(ATTACHING PARTS)**********		
-76	211-0116-00	B010100	B030576	2		.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B030577		2		.SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
						.**********(END ATTACHING PARTS)**********		
	---- ----			-		.CKT BOARD ASSY INCLUDES:		
-77	131-0608-00			3		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-78	210-0779-00			9		..RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
-79	131-1031-00			9		..CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00
-80	----- -----			1		.CKT BOARD ASSY:ATTENUATOR(SEE A1A1 REPL)		
						**********(ATTACHING PARTS)**********		
-81	211-0180-00			12		.SCR,ASSEM WSHR:2-56 X 0.25 INCH,PNH BRS	83385	OBD
						**********(END ATTACHING PARTS)**********		
	----- -----			-		.CKT BOARD ASSY INCLUDES:		
-82	139-0501-00			2		. . SPACER,SLEEVE:0.15 L X 0.25 OD X 0.129	80009	129-0501-00
-83	131-1031-00			16		..CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-84	131-1030-00	B010100	B030578	16		..CONT ASSY,ELEC:CAM SWITCH,BOTTOM	80009	131-1030-00
	131-1030-01	B030579		16		..CONT ASSY,ELEC:CAM SWITCH,BOTTOM	80009	131-1030-01
-85	210-0779-00			16		..RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
-86	214-1797-00			18		..PIN,ATTEN CLIP:	80009	214-1797-00
-87	337-1979-00			1		..SHIELD,ELEC:AMPLIFIER	80009	337-1979-00
-88	131-1536-00			2		..CONNECTOR,RCPT,:50 OHM,0 TO 18.0 GHZ	98291	050-651-0039-31
-89	337-1985-00			1		.SHIELD,ELEC:ARMATURE	80009	337-1985-00
-90	131-0707-00			8		CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-91	175-0825-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-92	175-0826-00			FT		WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-93	352-0169-00			1		HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-94	352-0161-00			2		HLDR,TERM CONN:3 WIRE,BLACK	80009	352-0161-00