

TEKTRONIX®

23

PLUG-IN MODU

Tektronix, Inc.

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Beaverton, Oregon 97005

INSTRUCTIONS

170-100

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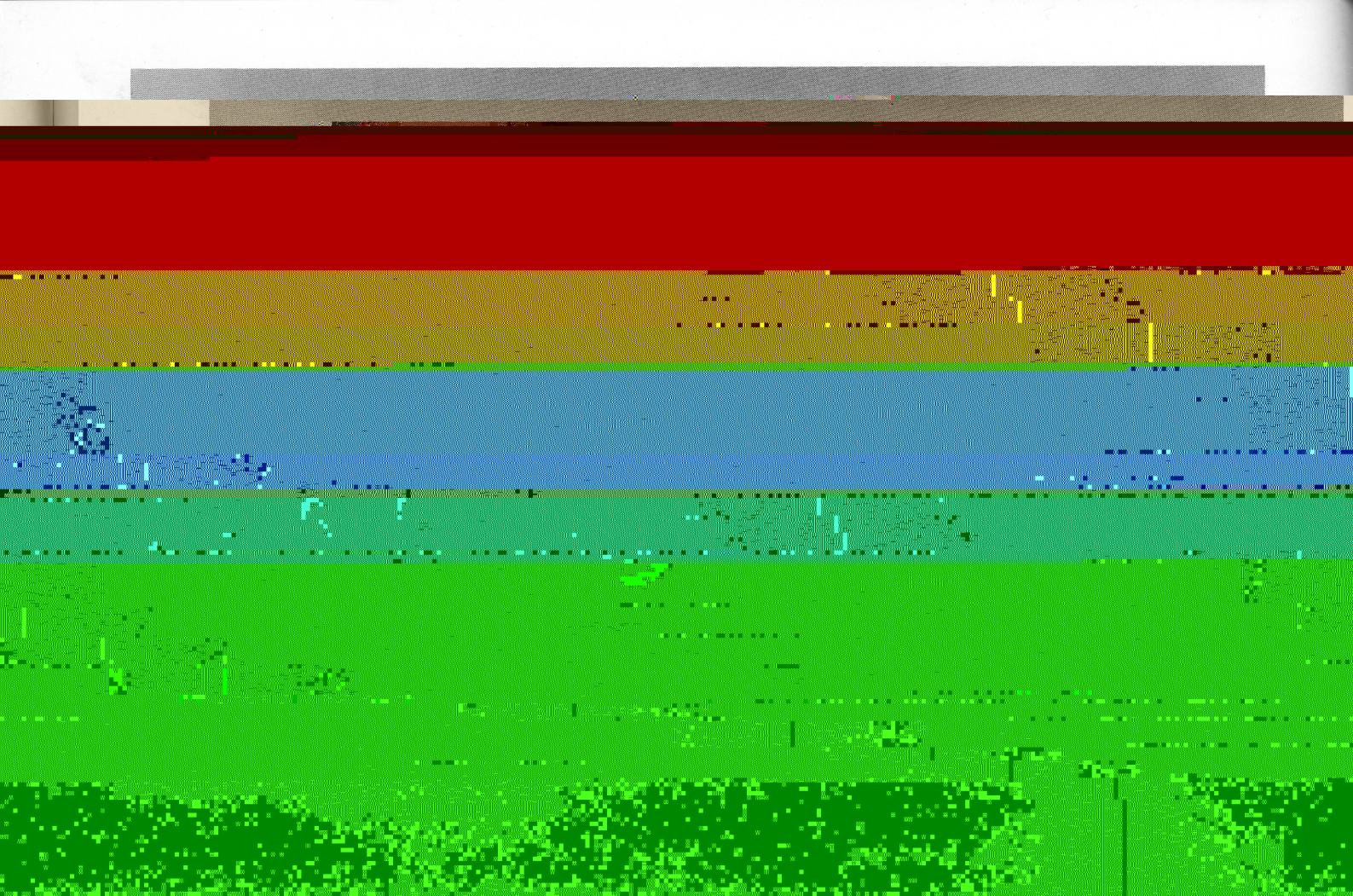
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GENERAL INFORMATION

DESCRIPTION

The L3 Plug-In Module is one of a series of modules that are used with the Tektronix 7L5 Spectrum Analyzer to provide it with various front end capabilities. The L3 has a switch-selectable input termination: 50 Ω , 600 Ω , or a high impedance (1 M Ω /28 pF) probe compatible input.

Options for the L3 are described in the Options section.

With two on-screen signals and reference levels of -53 dB or less, intermodulation distortion is at least 80 dB down.

With two out-of-band (>5 MHz) signals equal to or less than the reference level, second-order intermodulation products are at least 50 dB down.

ELECTRICAL CHARACTERISTICS

With the INPUT BUFFER switch on, second and third

Resolution Bandwidth**Equivalent Input Noise****Residual Response**

10 Hz	-148 dBV
30 Hz	-146 dBV
100 Hz	-143 dBV
300 Hz	-138 dBV

Internally generated spurious signals are -143 dBV or less (referred to the input), or -138 dBV or less for calibrator harmonics.

1 kHz	-133 dBV
3 kHz	-128 dBV
10 kHz	-123 dBV

Display Flatness

Maximum peak-to-peak amplitude variation is 0.5 dB from 25 Hz to 5 MHz, or 0.75 dB from 20 Hz to 5 MHz, (quantization error if digital storage is used specifications).

NOTE

Sensitivity is degraded an additional 8 dB when the INPUT BUFFER is on (illuminated): e.g., at 3 kHz,

Reference Level

In the log mode, reference level refers to the horizontal graticule line and is calibrated

With operation in LIN mode, reference level calibration range is from 200V/div to 2000V/div, within 5% in a 1-2-5 sequence. A variable reference level control, VAR, can be used to increase the display amplitude by ≥ 8 dB.

Input Connector

The INPUT connector is a three-conductor bnc connector with the outer ring used to detect the presence of a 10X probe so that the reference level readout is changed by 10X (+20 dB).

NOTE

A > sign is displayed adjacent to the reference level readout when the reference level is not calibrated

due to an incompatible selection of the REFERENCE LEVEL, FREQUENCY SPAN/DIV, and TIME/DIV

NOTE

Readout changes by a factor of only 10X if a 100X probe is connected.

100 V (dc plus peak ac) for signals with risetimes slower than 2 V/ μ s.

ENVIRONMENTAL CHARACTERISTICS

The L3 Plug-In Module will meet the foregoing electrical characteristics when installed in a 715 Spectral Analyzer within the environmental limits of a 7000 oscilloscope. Complete details on environmental procedures including failure criteria etc., call from your local Tektronix Field Office or representative.

OPERATING INSTRUCTIONS

INTRODUCTION

This section of the manual contains installation instructions for the L3 plug-in, describes the function of its front panel controls and connectors, and includes general operating information such as initial calibration and signal application.

Align the L3 module in front of the 7L5 plug-in aperture with its edge card connector to the rear and the dBV/dBm switch to the right. Carefully slide the L3 into the 7L5 plug-in cavity and apply a steady pressure to the front panel until its rear connector is flush with the front panel is approximately flush with the 7L5 front panel.

INSTALLATION

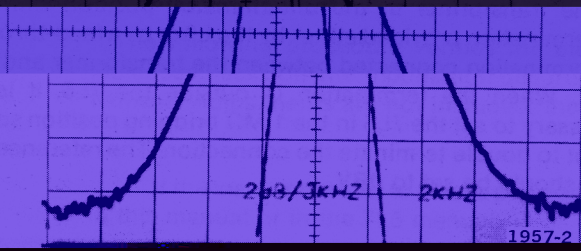
FRONT PANEL CONTROLS AND CONNECTOR

INPUT REF

This three-position switch selects the reference level scale factor: dBm for 50 Ω , dBm for 600 Ω , or dBV. This switch is independent of the INPUT TERM Z selection.

b. Select mainframe Vertical Mode, Horizontal Mode, and Trigger Source (Right or Left) settings to correspond with plug-in compartments occupied by the 7L5.

c. Connect the 7L5 CALIBRATION signal connector on the L3 front panel with a shielded coaxial cable. Set the INPUT TERM Z selection to 50 Ω .



connector may cause signal loss on the display and an overall degraded performance of the analyzer. To minimize the probability of an impedance mismatch, all cables and transmission lines fastened to the input connector should have the same impedance as the module. All cables used should be of minimum length and of good quality with connector center conductors not worn, protruding or recessed. Degraded display caused by impedance mismatch may be improved by setting the 7L5's INPUT BUFFER control.

USING THE OPTION WITH BALANCED CONNECTIONS

Since the transformer has an insertion loss of less than 0.1 dB, the theoretical correction factors offer sufficient accuracy.

Baseband telephony systems frequently utilize balanced connections. This is accommodated by a balanced to single-ended transformer, part number 013-0182-00. See Fig. 2-2. Frequency range of the Balanced Transformer is 50 kHz to 3 MHz (useable from 10 kHz to 20 MHz). Flatness is 0.25 dB peak-to-peak, including nominal 0.1 dB insertion loss, and common mode rejection of 25 dB minimum (within 50 kHz to 3 MHz range). The transformer has a three-position switch at the output to provide a 124 Ω termination, a 135 Ω termination, and no termination. The L3 Output 3 in conjunction with the accessory transformer provides all of the common baseband impedances (75 Ω , 50 Ω , 600 Ω , 12 Ω , 100 Ω , and 1 M Ω for bridging).

Balance connection at other than 124 Ω or 135 Ω is accomplished by connecting the transformer in the unterminated position with termination provided either by the L3 or by a feed-through termination connected between the transformer and the L3. When the termination is outside the 7L5, it is necessary to set the 7L5 in the 1 M Ω bridging position. The level should be set to dBV.

Balanced connections at 124 Ω or 135 Ω are accomplished by connecting the Balanced Transformer between the balanced connections and the L3. Set the L3 INPUT TERMIN 7 to 1 M Ω and the

dBm is: $\text{dBm} = \text{dBV} - 10 \text{Log}Z + 30$, where Z equals the terminating impedance. For the two impedances provided in the balanced transformer, the theoretical relationship is: $\text{dBm} (124 \Omega) = \text{dBV} + 9.07$, $\text{dBm} (135 \Omega) = \text{dBV} + 8.7$.

Fig. 2-2. Balance Transformer.

PERFORMANCE CHECK

INTRODUCTION

The following procedure verifies the electrical characteristics of the L3 Blue In Module and

EQUIPMENT REQUIRED

Type	Minimum Performance Requirements	Typical Model or Part No.
7L5 Spectrum Analyzer Plug-In installed in a 7000-series mainframe		
	10 kHz to 5 MHz	Hewlett-Packard 654 or 651

PROCEDURE

1. Preliminary Steps

- a. Install the L3 in the 7L5, and install the 7L5 in the oscilloscope mainframe.
- b. Turn the instruments on and allow to warm up for 10 minutes or more.
- c. Perform the Initial Calibration procedure described in Section 2 of this manual.

2. Check Readout

- a. Set REFERENCE LEVEL to 0 dB, 600 Ω .
- b. Switch INPUT REF to dBV and check for a readout of +8 dBV.
- c. Switch INPUT REF to dBm 600 Ω and check for a readout of +10 dBm.
- d. Momentarily connect a 10X probe to the INPUT or short circuit the INPUT connector ring to the shell, and check that the readout increases by 20 dB.

3. Check Reference Level Accuracy

- a. Set the front panel controls as follows:

DOT FREQUENCY	1 MHz
RESOLUTION	COUPLED
FREQUENCY SPAN/DIV	10 kHz
INPUT REF	dBV
REFERENCE LEVEL	-45 dBV; LOG 2 dB/DIV
TRIGGERING	FREE RUN NORM
TIME/DIV	AUTO
INPUT TERM Z	50 Ω

- b. Connect a HP 654 signal generator, through a 2701 step attenuator, to the INPUT. Set the attenuator to 48 dB attenuation, and adjust the signal generator for a 7-division display at 1 MHz.
- c. Set the REFERENCE LEVEL to -37 dBV, set the step attenuator to 40 dB, and check for a display of 7 divisions ± 0.1 division (0.2 dB).
- d. Repeat the above procedure of adding 8 dB in 7L5 and taking out 8 dB in the step attenuator, to a +3 dBV reference level. Check that the level at each step is within ± 0.1 division of the level at the previous step.

@

Performance Check—L3

4. Check Display Flatness

Leave all other controls as they were in the previous set-up.

a. Set the front panel controls as follows:

DOT FREQUENCY 10.00 kHz
FREQUENCY SPAN/DIV 20 kHz
INPUT REF 0 dBm 50 Ω
REFERENCE LEVEL 0 dBm; LOG 2 dB/DIV

b. Connect two signal generators, such as HP654 or 651 plus the attenuators as shown in Fig. 3-1. Set the step attenuators for 32 dB of attenuation, and adjust the signal generators for two full-screen signals one division apart (such as 4495 kHz and 4500 kHz).

Leave all other controls as they were in the previous set-up.

b. Connect a HP 654 signal generator to the input and adjust it for a 7-division display at 10 kHz.

c. Check that the intermodulation sidebands are at least 75 dB below the signals.

d. Set the REFERENCE LEVEL to -14 dBV, and set the

e. Simultaneously tune the signal generator frequency and the DOT FREQUENCY from 10 kHz to 5 MHz, and check that the display flatness is within 0.5 dB peak-to-peak.

f. Check that the intermodulation sidebands are at least 75 dB below the signals.

5. Check Third-Order Intermodulation Distortion

a. Set the front panel controls as follows:

DOT FREQUENCY 4500.00 kHz
FREQUENCY SPAN/DIV 5 kHz
INPUT REF 0 dBV
REFERENCE LEVEL -38 dBV; LOG 10 dB/DIV

f. Set the REFERENCE LEVEL to -14 dBV, and set the step attenuators for 0 dB attenuation.

g. Check that the intermodulation sidebands are at least 75 dB below the signals.

OSCILLOSCOPE

653,
SIGNAL
GENERATOR
N^o. 1

5X(14 dB)
ATTENUATOR
50 Ω



6. Check Second-Order Intermodulation Distortion

a. Set one signal generator to 5 kHz, then repeat the test procedure in step 5, checking that the intermodulation products are at least 72 dB below the signals.

7. Check Out-of-Band Intermodulation Distortion

a. Set the front panel control as follows:

DOT FREQUENCY 4500.00 kHz
REFERENCE LEVEL -14 dBV

Leave all other controls as they were in the previous set-up.

b. Connect two signal generators, such as HP 8654, to the L3 input. Adjust generator one to 14.5 MHz and generator two to 14.5 MHz.

c. Adjust the generators so that each signal is 560 mV P-P at the L3 input. To do this: monitor the L3 input with an oscilloscope, disconnect generator two, and terminate the

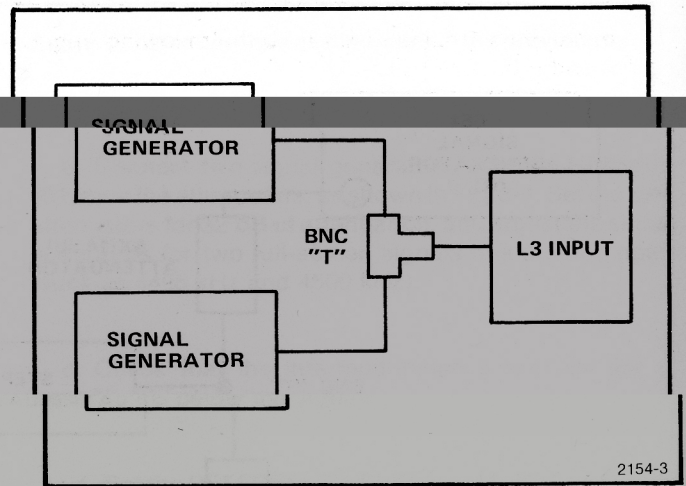


Fig. 3-2. Test set-up for out-of-band intermodulation distortion.

cable into 50 Ω . Adjust generator one, then disconnect it, terminate its cable into 50 Ω , and reconnect and adjust generator two. Remove the termination and reconnect generator one.

d. Check that the display at 4500 kHz is more than 50 dB below the signals.

e. Set the signal generators to the following frequencies and repeat steps c and d:

20 MHz	24.5 MHz
40	44.5
60	64.5
75	79.5
90	94.5
120	124.5

8. Check Residual Response and Sensitivity

Refer to the 7L5 Instruction Manual and perform the residual response and sensitivity checks found there, with a non-shorting bnc cap installed on the INPUT connector. Make the checks with the INPUT TERMN Z switch set to both 1 MO/25 and 50 Ohms.

SERVICE INFORMATION & DIAGRAM

WARNING

The service information in the remainder of this manual is intended for use by qualified personnel only.

INTRODUCTION

This section includes safety information, procedures, a circuit description, and other information that requires access to the interior of the instrument. There

CALIBRATION PROCEDURE

Equipment Required

Type	Minimum Performance Requirements	Typical Model
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1. Preliminary

- a. Install the L3 in the 7L5 Spectrum Analyzer Plug-In.
- b. Connect the 7L5 to the oscilloscope mainframe through the two extender cables.

c. Turn on the power and allow the instruments to warm up for at least 30 minutes.

d. Refer to the adjustment locations drawing on the facing page while performing the following steps. Also included on the drawing are brief notes intended to aid the experienced calibrator; the numbers correspond to the

2. Adjust 0 Hz Spur Amplitude

- a. Set the L3 and 7L5 front panel controls as follows:

DOT FREQUENCY	0.00 kHz
DIGITAL STORAGE	DISPLAY A and B ON;
BASELINE CLIPPER	midrange
FREQUENCY SPAN/DIV	20 kHz
RESOLUTION	30 kHz
REFERENCE LEVEL	LOG 10 dB/DIV; -30 dBm
TRIGGERING	FREE RUN and NORM
TIME/DIV	AUTO
INPUT TERM	50 Ω
INPUT REF	dBm 50 Ω

3b. 7 divisions 100 kHz, -21 dBV

4c. Apply 10.7 MHz

C132
3f. BUFFER ON

C136
3d. -5 dBV

C126
3c. -13 dBV

C190

C210
2b. Minimum 0 Hz

3. Adjust Attenuators.

a. Set the front panel controls as follows:

DOT FREQUENCY	1000.00 kHz
INPUT TERM Z	50 Ω
INPUT REF	dBV
REFERENCE LEVEL	-21 dBV; LOG 2 dB/DIV

Leave all other controls as they were in the previous set-

e. Set the REFERENCE LEVEL TO +3 dBV, decrease the attenuator setting to 0 dB, and adjust C135 for a 7-division display.

f. Push the INPUT BUFFER pushbutton to ON, then adjust C132 for a 7-division display. Push the button again to turn off the input buffer.

g. Recheck all parts of step 3, and readjust as

... the REFERENCE LEVEL to +3 dBV, decrease the attenuator setting to 0 dB, and adjust C135 for a 7-division display.

... the REFERENCE LEVEL to +3 dBV, decrease the attenuator setting to 0 dB, and adjust C135 for a 7-division display.

... the REFERENCE LEVEL to +3 dBV, decrease the attenuator setting to 0 dB, and adjust C135 for a 7-division display.

... the REFERENCE LEVEL to +3 dBV, decrease the attenuator setting to 0 dB, and adjust C135 for a 7-division display.

d. Set the REFERENCE LEVEL to -5 dBV, decrease the step attenuator setting to 3 dB, and adjust C136 for a 7-division display.

j. Set the REFERENCE LEVEL to -5 dBV, decrease the step attenuator setting to 3 dB, and adjust C136 for a 7-division display. Discor

to

to

Service Information—L3

4. Adjust Low Pass Filter

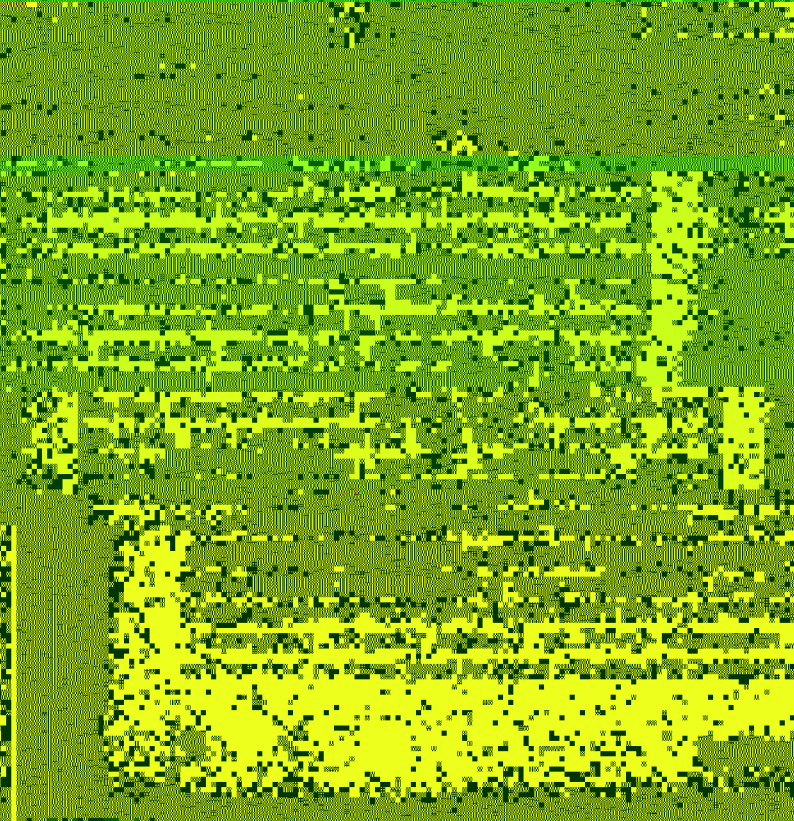
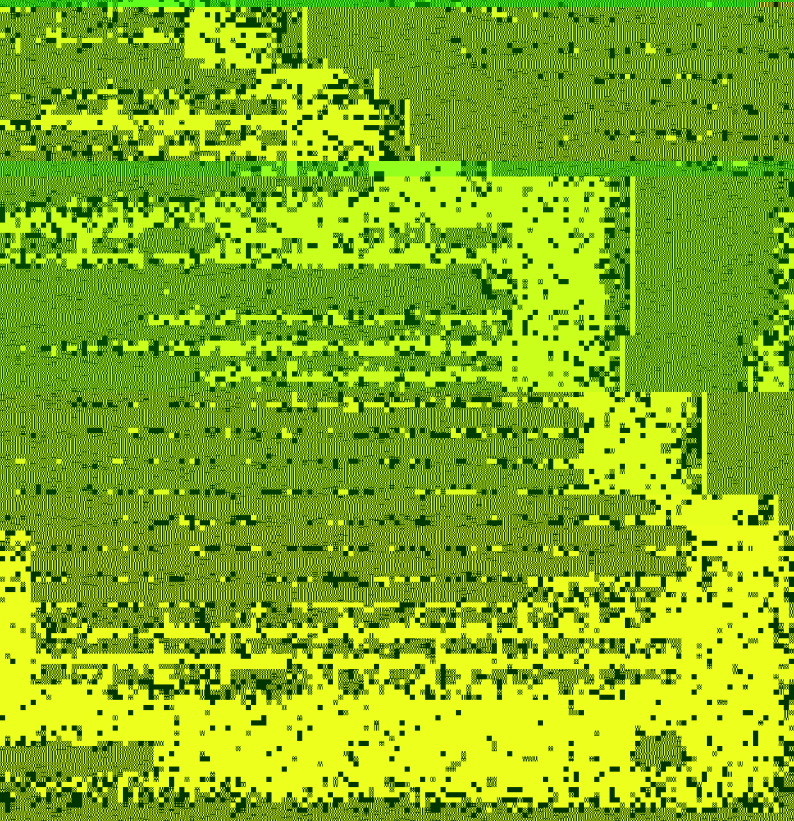
adjust the

a. Turn off the instruments, remove the UL3 from the

e. Connect a signal generator

LP005414

input, and set its output for 10.7 MHz at 0 dBm frequency slightly for maximum baseline rise



The other section of the INPUT TERMN Z switch connects P2210-B13 to ground through W58 in the 50 Ω position, or through R56 in the 600 Ω position. This sets the input level in the 7L5 to provide the correct level

These capacitors block dc primarily for Q130 and Q150. L125, R125, and the plug-in input capacitance form a low-pass filter with cutoff at about 10 MHz.

for the input termination selected. Also, when the switch is in the 600 Ω position, the output of U95E goes high to

Amplifier

generated by the
transfer charac-
5) is connected to
connected back to

impedance is changed; refer to the change period line area
in this section.

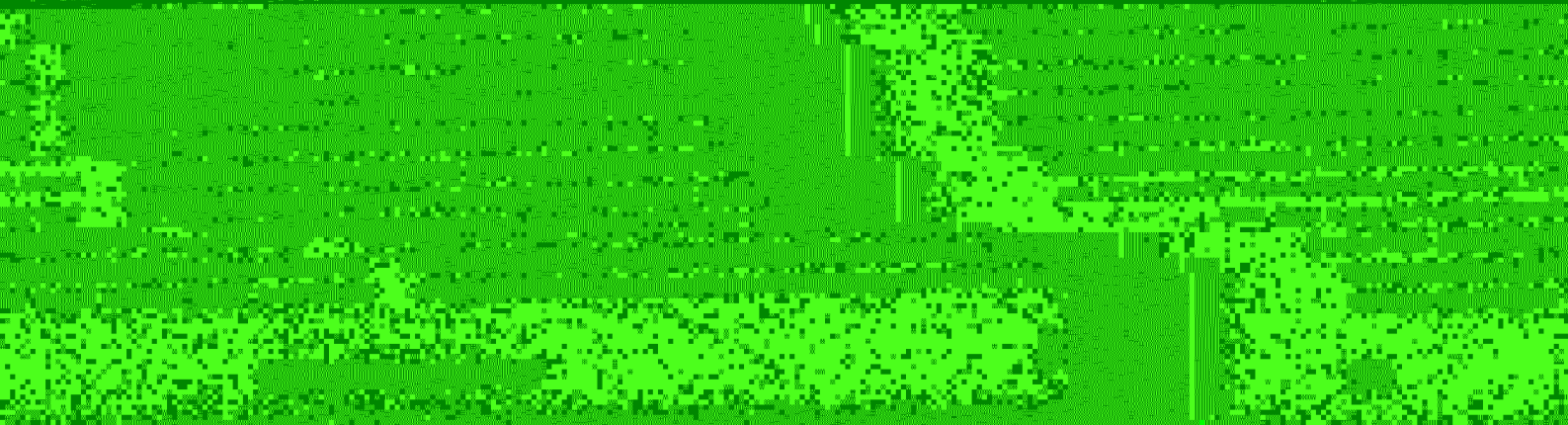
second-order intermediate, a distortion
nonlinear gate voltage-drive charac-
teristics of the JFET. The collector
the base of Q150; the emitter of Q1

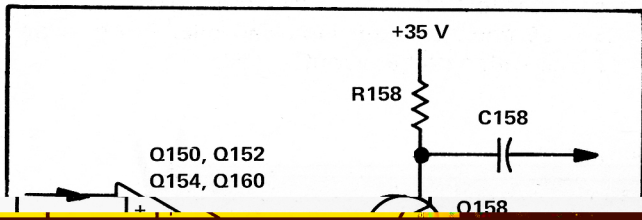
range of 0.5 dB and
range of the 0.5 dB and
ance. The emitter resistance consists
of medium inductance selected by relays



The 100-ohm gate is a 100-ohm resistor which
imposed the 100-ohm gate, and the
K140. In addition, Q130 gates in an additional 3 dB of
attenuation when both attenuators are in and the input

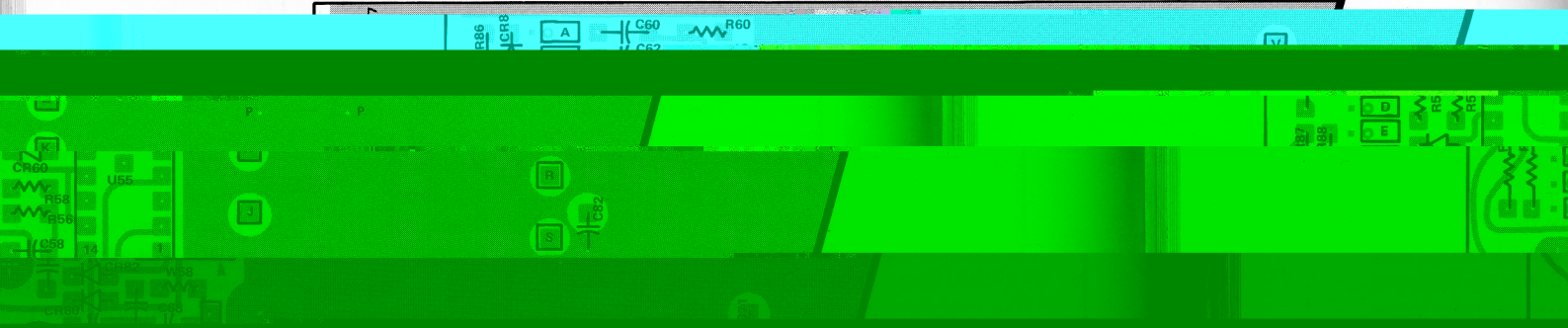
proportional to
to its emitter re-

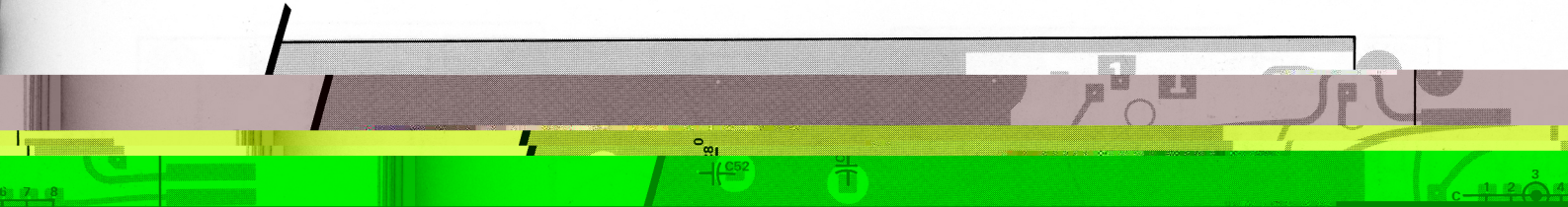




Low-Pass Filter

The low-pass filter is a seven-pole elliptical filter with a bandpass of slightly more than 5 MHz and an impedance of 300 Ω . The first zero point is at 10.7 MHz, giving about 110 dB of rejection at the 7L5 first IF frequency. The minimum out-of-band attenuation is 85 dB, up to 400 MHz. C90 is a 100 pF capacitor.





Q130

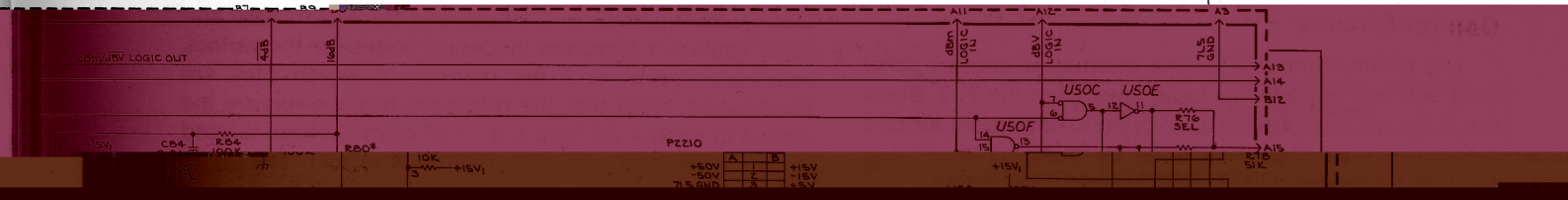
I/C133

R154

Q154



PZZ10 CONNECTS TO JZZ10 ON 7L5



	A	B	
+50V	1	1	+15V
-50V	2	2	-15V
7L5 GND	3	3	-15V

Control Circuits

The control circuits for the attenuator and amplifier

gain settings decode the logic lines from the 7L5. Since the 7L5 logic lines are set up to operate only attenuators, a different decoding arrangement must be used. This is accomplished by diodes CR81, CR83, and CR84, gates

U60A, U60B, U60C, and U60D, and transistors Q80 and Q85. Table 4-1 gives the incoming codes for the various

reference levels, and in which they are established. Note that the reference levels given are lowest in each 4-dB step (i.e., -28 dBm position is used for -28, -27, -26, and -25 dBm reference levels). Intermediate 1-dB steps are accomplished in the 7L5

Table 4-1
Attenuator and gain switching logic

Z	Interface Pin Designations				
	U	T	N	J	W

Table 4-1 (cont)

Lowest ref level		Inputs (conn pin no.)				Interface Pin Designations					
						U	T	N	J	W	Z
50 Ω dbm	dBV	32(B8)	16B(9)	8(B10)	4(B7) ¹	Outputs					
						K162 ²	K164 ²	K130 ¹	K140 ¹	K176 ¹	K179 ¹
	-4	-17	0	1	1	0	0	0	0	0	0
	0	-13	1	0	0	1	0	0	1	0	1
	+4	-9	1	0	0	0	0	0	1	0	0
0	+8	-5	1	0	1	1	0	0	0	1	1
0	+12	-1	1	0	1	0	0	0	0	1	0
0	+16	+3	1	1	0	1	0	0	1	1	1
0	+20	+7	1	1	0	0	0	0	1	1	0
1	+16 with input buffer	+3	1	1	1	1	0	0	1	1	1
	+20	+7	1	1	1	0	0	0	1	1	1

Input Impedance Change Provisions

Although the L3 Plug-In module is normally supplied with input terminations of 50 Ω and 600 Ω , it is possible to change either or both of these to any termination impedance desired from 50 Ω to about 900 Ω . The following is an outline of the changes involved; complete instructions are given in the Change Procedure.

(4) Resistor R76 or R78, or both, may be changed to add a small amount of gain (up to 1 dB) in the 7L5 so that the L3 will be calibrated in dBm with respect to the new termination impedance. The resistor value is given in Fig. 4-3.

(5) The programmable logic array is reprogrammed

Power Supplies

The supply voltages used in the 7L5 are -15 V , $+5\text{ V}$, $+15\text{ V}$, and $+35\text{ V}$. The -15 V supply is decoupled by Q70 to provide the improved ripple rejection needed by the amplifier. The $+15\text{ V}$ supply is decoupled by L82-C82 and C142, and provides a source for the $+5\text{ V}$ supply, R74-VR74. The $+35\text{ V}$ supply is derived by dropping the 7L5's $+50\text{ V}$ source through decoupling resistor R50.

1. Disassembly of the Unit

- a. Remove the L3 from the 7L5, then remove the screws securing the top and bottom covers.
- b. Disconnect the two wires coming from the INPUT connector to the circuit board. Note their locations for later replacement.
- c. Remove the five screws securing the mother board, then remove the mother board, by carefully prying it straight out at the front and rear.

INPUT IMPEDANCE CHANGE PROCEDURE

The following describes the procedure necessary to change the input termination of the L3. No provision is made to change the front panel nomenclature, nor is any

2. Changing Input Terminations (R64 and R66)

Replace input terminating resistors R64 or R66, or both, as desired. R64 should be the larger value of the two if they are both less than $300\ \Omega$. R66 should be less than $600\ \Omega$ and R64 should be less than $900\ \Omega$ if the instrument meets its 0.5 dB flatness specification.

3. Change Calibrator Level-Setting Resistors (R56 and R58)

a. R56 sets the calibrator level for the R64 termination; R58 sets it for the R66 termination. Compute R56 or R58 according to the following formulas.

$$R56 = 4100 \left(\frac{R64}{50 \Omega} - 1 \right) \quad R58 = 4100 \left(\frac{R66}{50 \Omega} - 1 \right)$$

b. Replace the resistor(s) located on the mother board

directly behind the switch that interconnects pins G and H. To maintain calibrator accuracy, use 1/8 watt, 0.1% T9 metal film resistors.

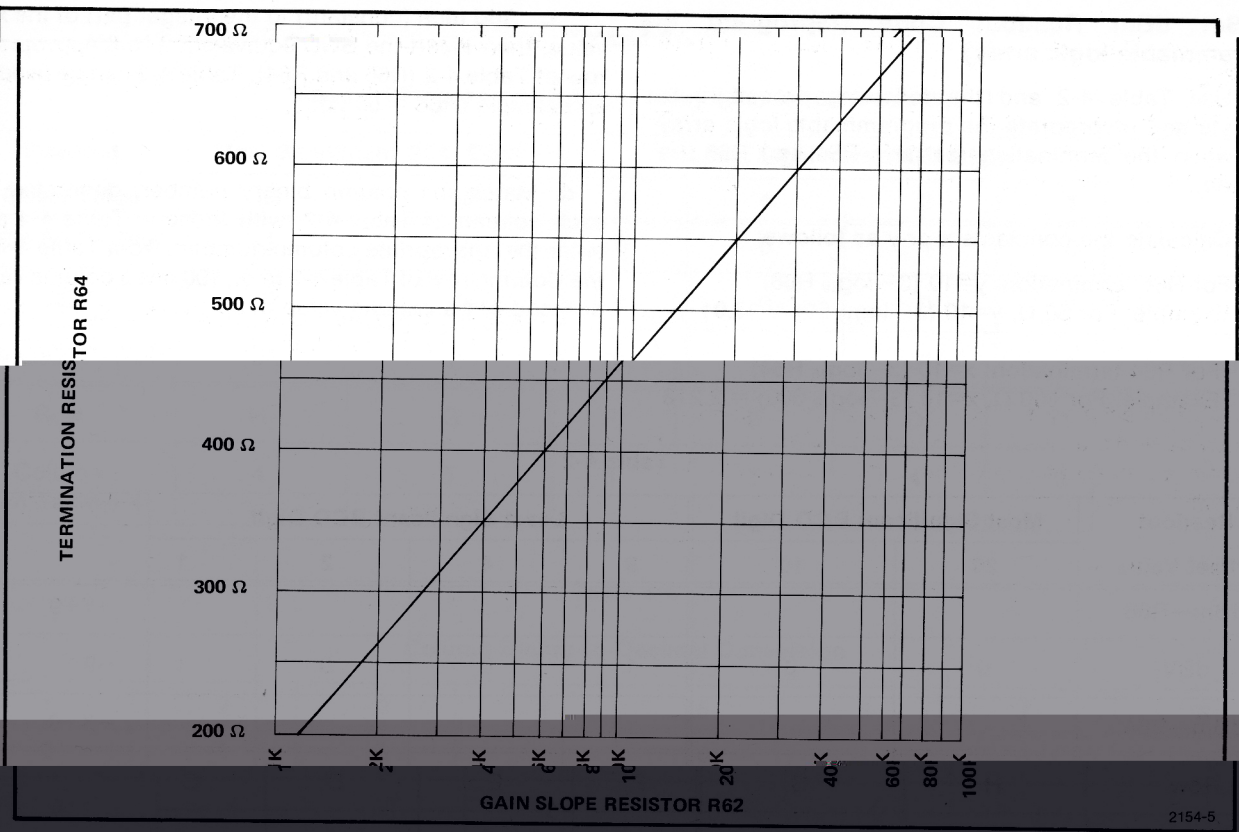
4. Replace Gain Slope Resistor

a. Select the gain slope resistor R62 value from the graph in Fig. 4-2 and replace.

NOTE

If the termination impedance is less than 200 Ω , R62 is 0 Ω . If the termination impedance is more than 700 Ω , R62 is omitted.

b. R62 is located on the mother board near U55



2154-5

Fig. 4-2. Gain slope resistor R62 vs input impedance.

IBM Header Code (reprogram, no - Add sign (negative) to the integer part of the x-axis only, and the sign of the PDP equivalent is the same as the sign of the x-axis.

IBM Header Code (reprogram, no - Add sign (negative) to the integer part of the x-axis only, and the sign of the PDP equivalent is the same as the sign of the x-axis.

IBM Header Code (reprogram, no - Add sign (negative) to the integer part of the x-axis only, and the sign of the PDP equivalent is the same as the sign of the x-axis.

Table 4:

IBM Header Code (reprogram, no - Add sign (negative) to the integer part of the x-axis only, and the sign of the PDP equivalent is the same as the sign of the x-axis.

Parameter	Most Significant PDP Digit	Least Significant PDP Digit
Column number	10 ¹⁷	10 ¹⁸

IBM Header Code (reprogram, no - Add sign (negative) to the integer part of the x-axis only, and the sign of the PDP equivalent is the same as the sign of the x-axis.

Column
10 ¹⁷
10 ¹⁸

Table 4-3

Standard Programmable Logic Array (pla) for 50 Ω and 600 Ω

Readout Offset Value	Most Significant BCD Digit		Least Significant BCD Digit				
	20	10	8	4	2	1	
dBm 50 Ω—R66	1	0	0	0	1	0	←Y+9=22
dBV	0	0	1	0	0	1	←9
dBm 600 Ω—R64	0	1	0	0	0	1	←X+9=11
Row	H	G	F	E	D	C	
Column from Table 4-4	4	5	8	1	4	3	

Table 4-4

Column Binary-to-Decimal Conversion

1	2	3	4	5	6	7	8
0	1	0	1	0	1	1	0
0	1	1	0	0	1	0	1
0	1	1	0	1	0	1	0

e. Compare the row column pairs (e.g., H4, G5, etc.) generated in Table 4-2 to those of Table 4-3. Those that are different indicate the changes necessary in the pla. Change the programmable logic array (pla) as follows:

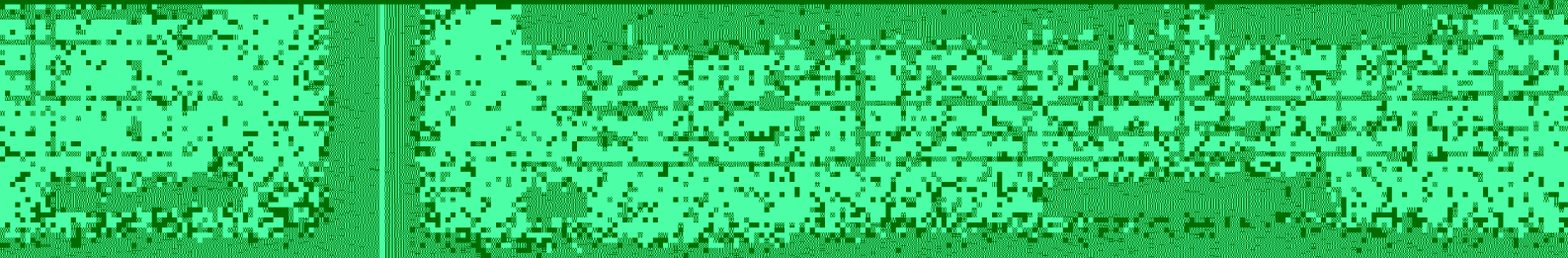
24.60 k Ω . In step 4, part 1, the graph in Fig. 4-2 shows that $R_{62} = 4.0$ k Ω (a standard value is 3.9 k Ω , 5% resistor). In step 5, part b, for R_{66} , $y = 10 (3 - \log 50) = 13.01$ and for R_{64} , $x = 10 (3 - \log 350) = 4.56$.

1) Remove plated-through connections by drilling

In step 5, parts c and d, adding 9 to the integer of the x

2) Install new connections by drilling a hole with #60

Table 4-2, generates Table 4-3. Comparison with Table 4-3 gives the resultant column numbers listed in Table 4-



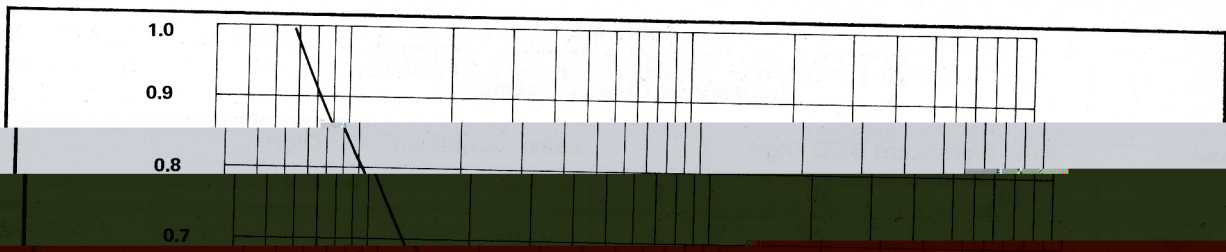


Table 4-5

Impedance Change Example

Readout Offset Value	Most Significant BCD Digit		Least Significant BCD Digit				
	20	10	8	4	2	1	
dBm—R66	1	0	0	0	1	0	-Y+9=22
dBV	0	0	1	0	0	1	-9
dBm—R64	0	1	0	0	1	1	-X+9=13
Row	H	G	F	E	D	C	
Column from Table 4-4	4	5	8	1	7	3	

6. Change the Gain Setting Resistors (R76 and R78)

a. The value of R76 and R78 can be determined from the graph in Fig. 4-3. R76 pairs with R66 termination and R78 goes with R64 termination. The horizontal axis of the graph represents the fractional part of x or y, determined by the computations in step 5, part b (e.g., 0.218 for y value of 2.218 is 51 kΩ for R78).

b. Replace R78 with the nearest standard value 5%, 0.25 W resistor. (R78 is located near U50, pin 8, on the mother board, and R76 is adjacent to R78. See Component Location figure for the mother board.)

REPLACEABLE 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 specify the following

information: instrument 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

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

REPLACEABLE PARTS

ABBREVIATIONS

"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
	NUMBER SIZE	ELEC	ELECTRICAL	INCAN	INCANDESCENT	RECT	SECTION

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
87308	N. I. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
95146	ALCO ELECTRONICS PRODUCTS, INC.	P. O. BOX 1348	LAWRENCE, MA 01842

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00000	STANDARD PRESSED STEEL CO. UNBRAKO DIV.	8535 BOND ROAD	SANTA FE SPRINGS, CA 90670
0000A	LEMO USA	2015 2ND STREET	BERKLEY, CA 94710
0000L	MATSHITA ELECTRIC	200 PARK AVENUE, 54TH FLOOR	NEW YORK, NY 10017
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00953	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A50	670-4563-00			CKT CARD ASSY:MOTHER	80009	670-4563-00
A50 ¹	670-4563-01			CKT CARD ASSY:MOTHER	80009	670-4563-01
	A120	670-4609-00		CKT CARD ASSY:SWITCH	80009	670-4609-00
	A125	670-4567-00		CKT CARD ASSY:ATTENUATOR	80009	670-4567-00
	A145	670-4565-00		CKT CARD ASSY:AMPLIFIER	80009	670-4565-00
	A185	670-4566-00		CKT CARD ASSY:LOW PASS FILTER	80009	670-4566-00
	A205	670-4564-00		CKT CARD ASSY:MIXER	80009	670-4564-00
C50	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
	C52	283-0111-00		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U1
	C54	283-0204-00		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075Z5U01
	C56	283-0204-00		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075Z

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr	
		Eff	Dscont		Code	Mfr Part Number
C127	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145 E 104Z
C128	281-0657-00			CAP.,FXD,CER DI:13PF,2%,500V	72982	374-005COG0130G
C130	281-0505-00			CAP.,FXD,CER DI:12PF,+/-1.2PF,500V	72982	301-012C0G0120K
C132	281-0161-00			CAP.,VAR,CER DI:5-15PF,350V	72982	518-000A5-15
					72982	8111M100C0G0A101

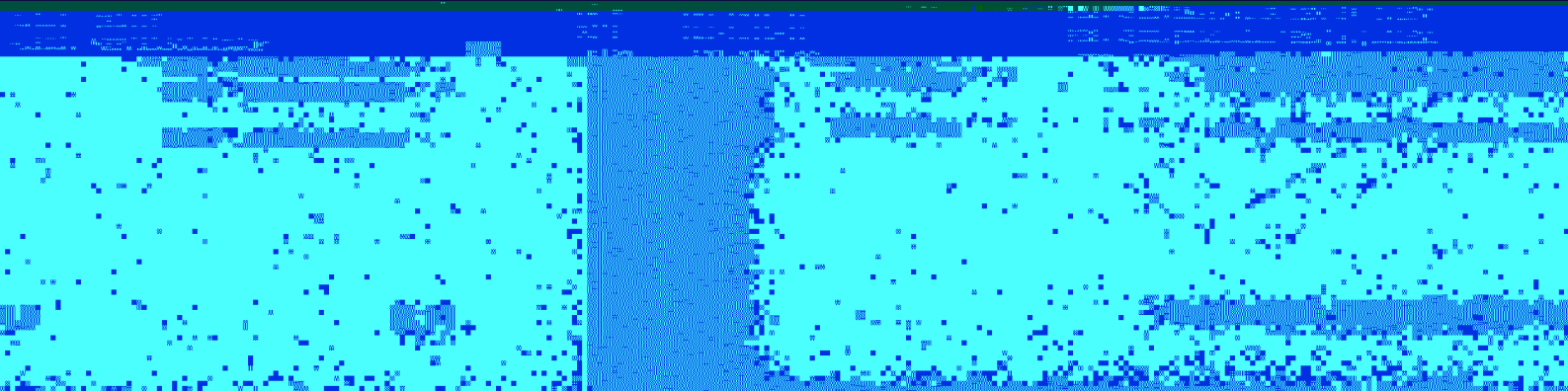
Ckt No.	Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
C196	281-0221-00		CAP.,FXD,CER DI:2-10PF,100V	72982	5J2500J1A20010
C198	283-0168-00		CAP.,FXD,CER DI:12PF,5%,100V	72982	8111-100C0G0120J
C200	283-0646-00		CAP.,FXD,MICA D:170PF,1%,100V	00853	D151E171F0
C202	283-0600-00		CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C204	283-0600-00		CAP.,FXD,MICA D:43PF,5%,500V	00853	D105E430J0
C206	281-0599-00		CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	374001-C0K0-109C
C210	281-0161-00		CAP.,VAR.CER DI:5-15PF,250V	72982	374001-C0K0-109C
C212	281-0670-00		CAP.,FXD,CER DI:1.8PF,+/-0.1PF,500V	72982	374-005C0K0189
CR50	152-0066-00		SEMICONV DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR60	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR62	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR64	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR80	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR81	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR82	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR83	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR84	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR86	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR87	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR88	152-0141-02		SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR146	152-0457-00		SEMICONV DEVICE:SILICON	72982	5080-2673

Tektronix		Serial/Model No.				Mfr		
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Part	Part	Number
CR148	152-0457-00			SEMICONV DEVICE:SILICON	28480	5082-2671		
CR162	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152		
CR164	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152		
CR176	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152		
CR206	153-0025-00			SEMICONV DVC SE:SILICON,50UA/10MV & 1MA/10MV	80009	153-0025-00		
CR208	153-0037-00			SEMICONV DVC SE:SILICON,MTCHD PAIR,15V	80009	153-0037-00		
CR210	153-0037-00			SEMICONV DVC SE:SILICON,MTCHD PAIR,15V	80009	153-0037-00		
CR212	153-0025-00			SEMICONV DVC SE:SILICON,50UA/10MV & 1MA/10MV	80009	153-0025-00		
F125	159-0056-00			FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279-100		
K62	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K64	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K130	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K140	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K162	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K164	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
K176	148-0107-01			RELAY,ARMATURE:18VDC COIL	80009	148-0107-01		
L82	108-0598-00			COIL,RF:200UH	80009	108-0598-00		
L125	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00		
L172	108-0724-00			COIL,RF:12.5NH	80009	108-0724-00		
L188	108-0833-00			COIL,RF:FIXED,10.2UH	80009	108-0833-00		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
L190	108-0833-00			COIL,RF:FIXED,10.2UH	80009	108-0833-00
L198	108-0833-00			COIL,RF:FIXED,10.2UH	80009	108-0833-00
L200	108-0215-00			COIL,RF:1.1UH	80009	108-0215-00
Q70	151-0435-00			TRANSISTOR:SILICON,PNP	04713	MPS-A65
Q80	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q83	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q130	151-1021-00			TRANSISTOR:SILICON,FET	80009	151-1021-00
	Q150	151-1070-00		TRANSISTOR:SILICON,FET	80009	151-1070-00
	Q152	151-0190-00		TRANSISTOR:SILICON,NPN	80009	151-0190-00
	Q154	151-0220-00		TRANSISTOR:SILICON,PNP	80009	151-0220-00
	Q158	151-0333-00		TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
	Q160	151-1070-00		TRANSISTOR:SILICON,FET	80009	151-1070-00
	Q162	151-0190-00		TRANSISTOR:SILICON,NPN	80009	151-0190-00

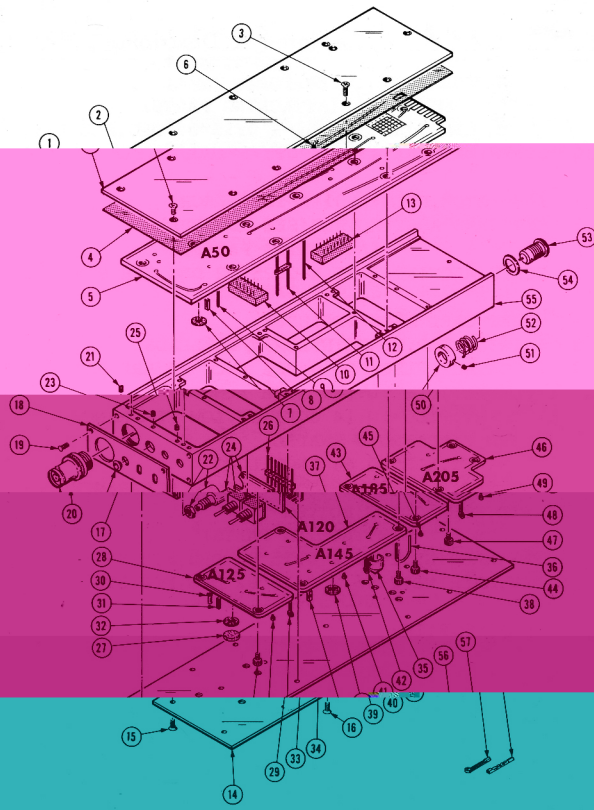
Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr	
	Part No.	Eff	Dscont	Code		Mfr Part Number	
R62	315-0303-00				RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R64	322-0172-00				RES.,FXD,FILM:604 OHM,1%,0.25W	75042	CEBT0-60400
R66	322-0068-00				RES.,FXD,FILM:49.9 OHM,1%,0.25W	75042	CEBT0-49R90F
R68	315-0474-00				RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R70	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R71	317-0510-00				RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
R74	315-0432-00				RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R76 ¹	315-0513-00				RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R78	315-0531-00				RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R80	307-0542-00				RES.,NETWORK:THICK FILM,10K OHM,5%,0.125W	01121	CB1045
R82	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1035
R83	315-0103-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R84	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	BB1045
R86	317-0104-00				RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
R87	317-0103-00				RES.,FXD,CMPSN:1M OHM,5%,0.125W	01121	BB1055
R88	317-0105-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R125	315-0201-00				RES.,FXD,FILM:92.5K OHM,0.25%,0.125W	91637	HFF1816D9250C
R130	321-0831-03				RES.,FXD,FILM:602 OHM,0.1%,0.125W	91637	HFF1816D60202B
R132	321-0976-04				RES.,FXD,FILM:651K OHM,0.1%,0.125W	91637	HMF188C65102B
R134	321-1654-07				RES.,FXD,FILM:841K OHM,0.5%,0.125W	91637	HFF1816D84102D
R142	321-1697-01				RES.,FXD,FILM:841K OHM,0.5%,0.125W	91637	HFF1816D84102D

Ckt No.	Part No.	Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R146	321-0510-00			RES., FXD, FILM, 2M OHM, 1%, 0.125W	91605	100-00000



Ckt No.	Tektronix		Serial/Model No.	Name & Description	Code	Mfr	
	Part No.	Eff	Dscont			Mfr Part Number	
R212	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F	
R214	321-0096-00			RES.,FXD,FILM:97.6 OHM,1%,0.125W	91637	MFF1816G97R60F	
R216	307-0107-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.25W	01121	CB56G5	
R220	311-1007-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	80294	3329HG48-200	
R222	317-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.125W	01121	BB1205	
R224	317-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.125W	01121	BB4315	
R226	317-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.125W	01121	BB4315	
S120	260-1841-00			SWITCH,TOGGLE:DPDT,10MA,5V	95146	TT21PG-PC-2	
S122	260-1841-00			SWITCH,TOGGLE:DPDT,10MA,5V	95146	TT21PG-PC-2	
T205	120-0920-00			XFMR,RF,TOROID,3 WINDINGS	80009	3330-1076-00	
T210	120-1074-00			XFMR,RF,TOROID,12 TURNS,TRIFILAR	80009	120-1074-00	
T215	120-1075-00			XFMR,RF,TOROID,3 WINDINGS	80009	120-1075-00	
T220	120-0445-00			XFMR,TOROID:8 TURNS,BIPILAR	80009	120-0445-00	
U50	156-0767-00			MICROCIRCUIT,DI:HEX GATE	80009	156-0767-00	
U55	156-0790-00			MICROCIRCUIT,DI:HEX INVERTER	04713	MC689P	
U60	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-00	
VR74	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	07910	CD332305	
VR75	152-0277-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	07910	CD332305	

FIG. 1 EXPLODED



13 PIN PLUG-IN MODULE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty						Name & Description	Mfr	
				1	2	3	4	5		Code	Mfr Part Number
1-1	337-2362-00		1						SHIELD,ELEC:COVER, TOP (ATTACHING PARTS)	80009	337-2362-00
-2	211-0030-00		2						SCREW,MACHINE:2-56 X 0.25"82 DEG,FLH STL	83385	OBD
-3	211-0112-00		10						SCREW,MACHINE:4-40 X 0.375"100DEG,FLH STL - - - * - - -	83385	OBD
-4	342-0351-00		1						INSULATOR,FILM:5.31 X 1.92 INCH	80009	342-0351-00
-5	-----		1						CKT CARD ASSY:MOTHER(SEE A50 EPL) (ATTACHING PARTS)		
-6	211-0030-00		5						SCREW,MACHINE:2-56 X 0.25"82 DEG,FLH STL - - - * - - -	83385	OBD
	-----		-						. CKT CARD ASSY INCLUDES:		
-7	342-0356-00		3						. INSULATOR,PLATE:NYLON,W/10 LEADS	13103	7717-231N
-8	136-0263-04		8						. CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-9	131-0608-00		1						. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-10	136-0269-02		2						. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C931402
-11	131-1612-02		2						. TERM,FEEDTHRU:U-SHAPED	80009	131-1612-02
-12	131-0787-00		11						. CONTACT,ELEC:0.64 INCH LONG	22526	47359
-13	136-0260-02		1						. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	01295	C931602
-14	337-2361-00		1						SHIELD,ELEC:COVER,BOTTOM (ATTACHING PARTS)	80009	337-2361-00
-15	211-0030-00		1						SCREW,MACHINE:2-56 X 0.25"82 DEG,FLH STL	83385	OBD
-16	211-0030-00		17						SCREW,MACHINE:2-56 X 0.25"82 DEG,FLH STL - - - * - - -	83385	OBD
-17	342-0301-00		1						INSULATOR,FILM:	80009	342-0301-00

Fig. &
Index
No.

Tektronix Serial/Model No.
Part No. Eff Dscont Qty 1 2 3 4 5

Name & Description

Mfr Code Mfr Part Number

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Model No. Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
	1-18	333-2218-00		1						PANEL, FRONT:	80009	333-2218
		333-2218-01		1						PANEL, FRONT:	80009	333-2218
										(ATTACHING PARTS)		
	-19	213-0109-00	B010100	B010140	4					SCREW, DRIVE: 00 X 0.125 INCH LONG	77250	OBD
		211-0650-00	B010141		4					SCR, CAP, SOC HD: 0.80 X 0.187 INCH, SST	000AH	OBD
										-----*		
	-20	131-0679-02			1					CONNECTOR, RCPT, :BNC W/HARDWARE	24931	28JR
										(ATTACHING PARTS)		
	-21	213-0048-00			1					SETSCREW: 4-40 X 0.125 INCH, HEX SOC STL	74445	OBD
										-----*		
	-22	-----			1					RESISTOR, VAR: (SEE R10 EPL)		
										(ATTACHING PARTS)		
	-23	213-0048-00			2					SETSCREW: 4-40 X 0.125 INCH HEX SOC STL	74445	OBD

Fig. &
Index
No.

Tektronix
Part No.

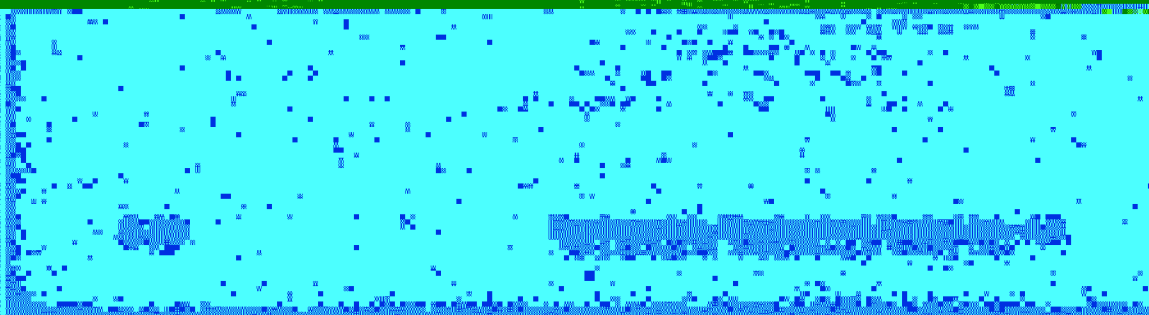
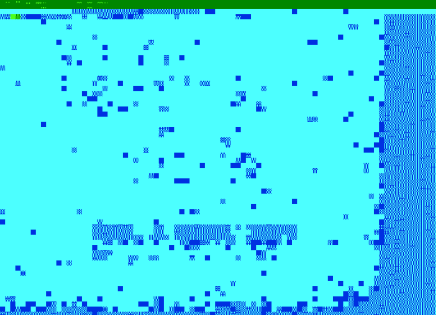
Serial/Model No.
Eff Dscont

Qty 1 2 3 4 5

Name & Description

Mfr
Code Mfr Part Number

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-20	212-0256-00		2								
1-21	158-0025-04		1						1 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE PIN		
1-22	142-0056-00		1						2 . INDICATOR PLATE 0.009, 0.125 INCH		
1-23	136-0055-04		1						12 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE		
1-24	114-0079-00		1						2 . PIN, 0.009, 0.125 INCH SQUARE		
1-25			1						1 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE WITH 2.005 INCH SQUARE PIN		
1-26	111-0036-00		1						2 . SOCKET, SQUARE: 1-40 X 1/4 INCH, SQUARE PIN		
1-27			1						1 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE		
1-28	136-0051-04		1						2 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE		
1-29			1						1 . CONTACT SUBASSEMBLY 2.005 INCH SQUARE		



ACCESSORIES

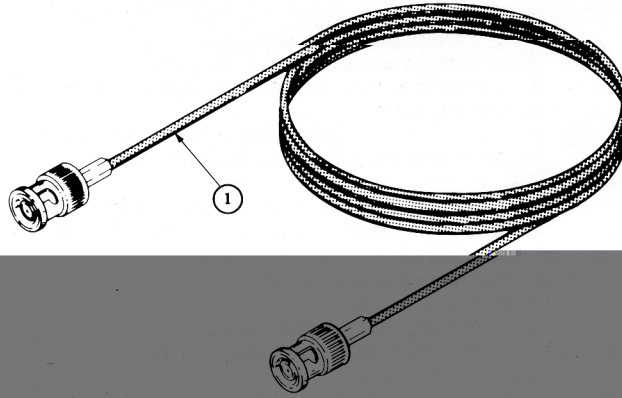


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
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STANDARD ACCESSORIES

012-0113-00		1								CABLE ASSY, RF:50 OHM COAX, 72 INCH LONG	80009	012-0113-00
070-2154-01		1								MANUAL, TECH:INSTRUCTION	80009	070-2154-01

OPTIONAL ACCESSORIES

-----1		1								2703:ATTENUATOR, STEP, 75 OHM		
-----		1								2701:ATTENUATOR, STEP, 50 OHM		
-----		1								P6053B:10X PROBE		

Option 1 only.

L3 PLUG-IN MODULE

REV. A NOV. 1977

OPTIONS

L3 Option 1

The L3 Option 1 provides an input termination of 75 Ω . The following changes and additions to the L2 manual