INSTRUCTION MANUAL

Serial Number _____

TYPE 282 PROBE ADAPTER

Tektronix, Inc.
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070-0544-00

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WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any is located at the rear of this manual.

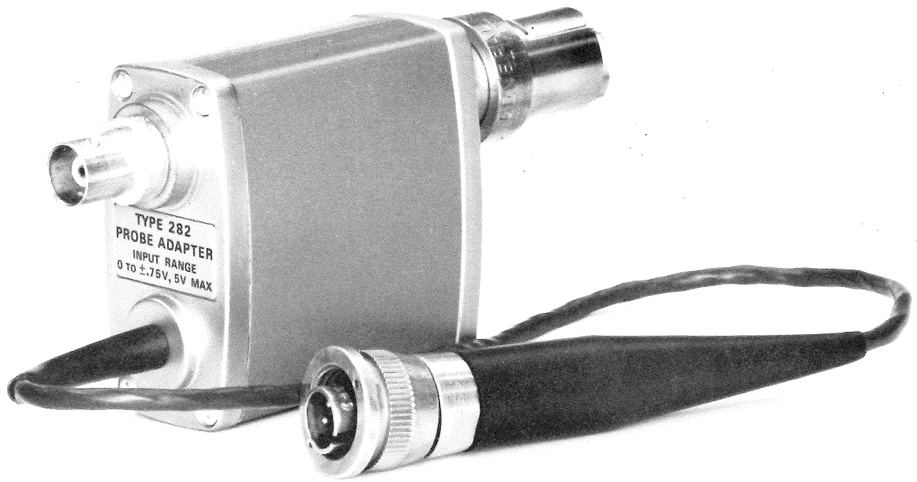

Fig. 1-1. Type 282 Probe Adapter.

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SECTION 1
CHARACTERISTICS

General Information

The Type 282 Probe Adapter (Tektronix Part No. 015-0074-00) has been designed to permit the use of high-impedance probes with 50-ohm sampling systems. Some of the advantages of using sampling systems with high-impedance probes rather than using high-impedance probes with real-time oscilloscopes are: (a) faster risetimes; (b) all the offset, smoothing and overload recovery features of sampling systems (not normally available on real-time oscilloscopes) are available. The design of the Type 282 provides good linearity and stability over its entire dynamic range.

TABLE 1-1

Characteristic	Performance Requirement	Supplemental Information
Gain	Unity ±3%	Output signal is in phase with input signal.
Transient Response	Less than or equal to ±3% of rounding, ringing or tilt when Type 282 is driven from a 25-ohm source.	
Risetime	Less than or equal to 3 ns when Type 282 is driven from a 25-ohm source.	
DC Output Level	Zero volt ±10 millivolts.	DC output level is adjustable by the ZERO control.
Dynamic Range	Zero to ±0.75 volts when Type 282 is connected to a 50-ohm system.	
Noise		Typically less than 1.5 mV of tangential noise.
Dynamic Range Linearity		Using a 100-mV square-wave signal superimposed on a +0.70 V to −0.70 V variable DC component, the deviation from unity gain for a small signal is typically less than ±2% from −0.5 V to +0.5 V and typically less than +2% or −5% from −0.70 V to +0.70 V.
Output Impedance		Approximately 1.5 ohms.
Maximum Overload Voltage	±5 volts of combined DC plus peak AC.	The field effect transistor will be damaged with inputs equal to or greater than +10 V or −50 V when they are from a low impedance source.
Input Resistance	1 Megohm ±1%.	
Input Capacitance	16.5 picofarads ±2 picofarads.	
Current Requirements From External Power Supply +100 V Power Supply −12 V DC to −25 V DC Power Supply		 Approximately 25 mA. Approximately 50 mA.
Internal Power Supply Voltages +10 V DC Power Supply −10 V DC Power Supply	 9.3 V DC to 10.3 V DC −9 V DC to −10 V DC	

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Compatibility

The Type 282 Probe Adapter can be used with any Type 1S1, 4S1, 4S2 (A), or 3S76 vertical sampling unit. The Type 282 may be used with other sampling units than those listed above, but it may require a compatible power supply for operation.

Table 1-2 lists the recommended high-impedance probes and their characteristics when used with the Type 282.

TABLE 1-2

Probe/Type 282 Characteristics[1]

Probe Type	Overall Risetime	Input RC	Input Signal Range	Deflection Factor Range	Available Vertical Sampling Unit Offset
P6008	≈4 ns	10 MΩ, 7.4 pF	±7.5 V	20 mV/cm to 2 V/cm	±10 V
P6009	≈3.2 ns	10 MΩ, 2.5 pF	±75 V	200 mV/cm to 20 V/cm	±100 V
P6010	≈3.2 ns	10 MΩ, 10 pF	±7.5 V	20 mV/cm to 2 V/cm	±10 V
P6011[2]	≈12 ns	1 MΩ, 42 pF	±0.75 V	2 mV/cm to 200 mV/cm	±1 V

[1]All characteristics referred to the probe input.

[2]Caution must be exercised when using a 1× probe, or no probe, so as not to overload and damage the input stage. ±5 volts at the tip of a 1× probe is the maximum allowable overload.

SECTION 2

OPERATING INSTRUCTIONS

Introduction

This section covers connecting the Type 282, obtaining a display, operating precautions, probe compensating with the Type 282, and application information.

Connecting The Type 282

Connect the Type 282 OUTPUT (GR type) connector to the appropriate input connector on the vertical sampling unit. Connect one of the recommended (see Table 1-2) high-impedance probes to the BNC type INPUT connector on the Type 282. Connect the Type 282 power plug P10 to a probe power connector on the vertical sampling unit.

Obtaining a Display

The following equipment is used in this example: A Type 282, a P6010 probe, Type 106 Square-Wave Generator, and a Type 661 with a Type 5T3 time base unit and a Type 4S1 vertical sampling unit.

NOTE

The control settings listed below have been generalized to fit various vertical sampling and time base units which might be used.

Set the vertical sampling unit controls for the channel in use as follows:

Position	Midrange
Smoothing	Normal
Mode	Set to channel being used
Norm/Inv	Normal
DC Offset	0 volt
MV/Div	20
Triggering	Set to channel being used

Set the time base unit controls as follows:

Position	Midrange
Time Position	Fully clockwise
Samples/Div	100
Time/Div	5 ns
Trigger Source	+Internal
Display Mode	Normal
Trigger Sensitivity	Adjusted for triggered display

Set the Type 106 controls as follows:

Repetition Rate Range	1 kHz
Multiplier	1 (fully counterclockwise)
Symmetry	Midrange
Amplitude	Midrange
Hi Amplitude-Fast Rise	Fast Rise
+Transition Amplitude	Fully clockwise
—Transition Amplitude	Midrange
Power	ON

Connect the Type 282, P6010 probe, Type 106 Square-Wave Generator, and Type 661 with Type 5T3 time base unit and a Type 4S1 vertical sampling unit together as follows:

a. Connect the Type 282 to the Type 4S1 vertical sampling unit as described under Connecting the Type 282.

b. Connect the P6010 probe to the INPUT (BNC) connector of the Type 282.

c. Connect a 5-ns coaxial cable to the +Output connector of the Type 106.

d. Connect an in-line type 50-ohm termination to the unconnected end of the 5-ns coaxial cable.

e. Connect the tip of the P6010 probe to the unconnected end of the in-line 50-ohm termination (a probe adapter Tektronix Part No. 017-0076-00 and a GR to BNC female adapter Tektronix Part No. 017-0063-00 may be used).

f. Adjust the Type 5T3 triggering controls to obtain a stable display similar to that shown in Fig. 2-1.

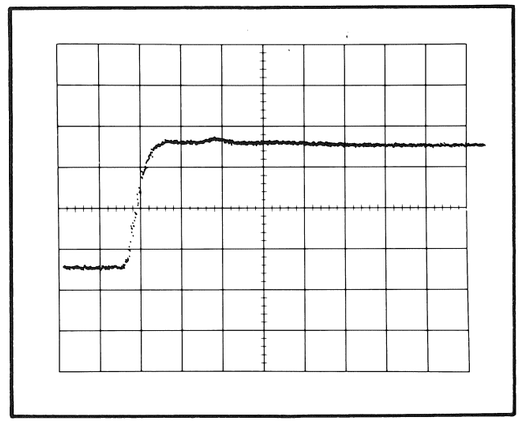

Fig. 2-1. Waveform obtained using the Type 282 with a P6010 probe, Type 106 Square-Wave Generator, and a Type 661 with a Type 5T3 and Type 4S1.

Operating Precautions

Caution must be exercised to prevent the input signal from exceeding the values listed in Table 1-2 so as not to overload and damage the input stage of the Type 282.

When using the Type 282 with either a Type 4S1 or 4S2(A) vertical sampling unit, it is not advisable to operate the Type 282 with a constant negative DC signal input voltage in excess of 700 mV. Operation at higher input voltage for any length of time will cause the operating life of Voltage Regulator transistor Q9 to be shortened. It is permissible to run the Type 282 at a negative DC voltage of 750 mV for short periods if the voltage at pin B of the Probe Power connector is lowered to a voltage between 12 and 19 volts. This is accomplished by moving the wire on P10 (Power Plug) from pin B to pin C.

NOTE

If the above wiring change is made, the Type 282 will not work when connected to a Type 1S1, or 3S76 vertical sampling unit unless the Type 282 is rewired as it was originally.

Probe Compensating with Type 282

a. Connect the Type 282, probe and vertical sampling unit together as described in the paragraph titled, Connecting the Type 282.

b. Set the vertical sampling unit and time base unit controls as follows:

NOTE

The control settings listed below have been generalized to fit the various vertical sampling and time base units which might be used.

Set the vertical sampling unit control for the channel in use as follows:

Position	Midrange
Smoothing	Normal
Mode	Set the channel being used
Norm/Inv	Normal
DC Offset	0 volt
MV/Div	50
Triggering	Set to channel being used

Set the time base unit controls as follows:

Position	Midrange
Time Position	Fully clockwise
Samples/Div	10 or minimum
Time/Div	Set for maximum free run trigger rate
Trigger Source	Free run
Display Mode	Normal
Trigger Sensitivity	Fully clockwise

c. Connect the probe tip to the Cal Out connector of an Amplitude Calibrator whose frequency is about 1 kHz and whose output amplitude is 2 volts.

d. Adjust the probe compensation (disregarding the first dot) until the displayed waveform is similar to that shown in Fig. 2-2.

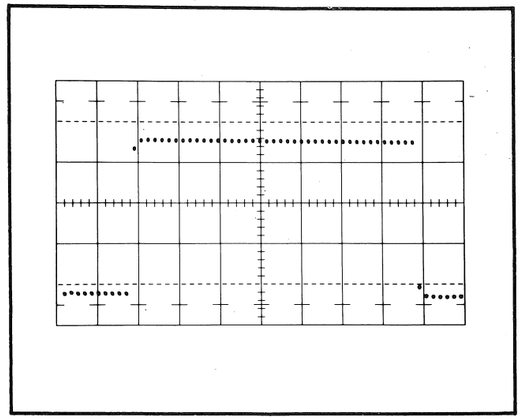

Fig. 2-2. Waveform obtained when probe is properly compensated.

Application Information

The Type 282 Probe Adapter will change any mechanically compatible, 50-ohm input impedance into a 1-megohm input impedance connector. For example, a Type 282 could be used on the 50-ohm external trigger input connector of a Type 5T3. This converts the 50-ohm external trigger input into a 1-megohm input impedance connector with 10 times the sensitivity and much better frequency response than the 1-MΩ external trigger input connector.

However, the bandwidth of the 50-ohm input connector will be reduced somewhat when a Type 282 is connected to it; otherwise, the Type 282 will not affect the 50-ohm input connector as long as the input signal is within the characteristics for both the Type 282 and the particular 50-ohm input connector.

SECTION 3

CIRCUIT DESCRIPTION

The high input impedance of the Type 282 is obtained by using field effect transistor Q4 (see circuit diagram). The input signal from the high impedance probe to the gate[1] of Q4A is shunted by R1-C1 to increase the maximum capacitance of the Type 282, so probes having a wide range of capacitances may be used. R1 is in series with C1, insuring that the input capacitance will remain constant at all frequencies. R2, which is in series with the Q4A gate, damps out any oscillations which might occur in the input circuitry while R3 sets the input impedance of the Type 282.

Q4A is a source follower[2] and Q4B is a current source for Q4A. Q4A and B are a matched pair; this means that the current which flows between Q4A and Q4B is just enough to zero bias Q4A. Q4A and B being a matched pair also means that Q4B will temperature-compensate Q4A. Diode D4 offsets the Q4A source voltage level by an amount to equal the emitter-base junction drop of Q14 so that the emitter of Q14 is at the same potential as the input. D4 helps to temperature compensate Q14. R4 and R5 (GAIN adjustment) shunt the base impedance of Q14 and by doing so, adjust the gain of the source follower Q4A.

From the source[3] of Q4A (after D4) the signal is supplied to the input of a feedback amplifier composed of Q14 and Q24. The gain of the feedback pair amplifier is determined approximately by the formula: $\text{Gain} = 1 + \frac{R16}{R14}$. The gain is set slightly greater than unity to compensate for any low gain transistors in the feedback pair amplifier and to give ample control over the leading edge of a step type signal input. The output from the feedback pair amplifier is supplied through J39 to the 50 ohm input connector of the sampling unit.

R24 supplies current to J39 from the +10 volt supply composed of Zener diode D20, R20 and the +100 volt probe power supply voltage, while Q24 pulls current from J39 and supplies it to the —10 volt supply composed of Zener diode D10, R10, Voltage Regulator Q9 and the negative probe power supply voltage (—25 V, —19 V, or —12 V). Since both R24 and Q24 are each capable of supplying 15 mA of current into the 50 ohm output resistance at J39, the total signal swing available will be +750 mV to —750 mV.

The DC output baseline voltage at J39 is controlled by R30 (ZERO adjustment). R30 controls the amount of current flowing through Q14 via Q28, R28 and D32. This current is equal to the current determined by R14 plus the base current of Q24. Any change in current through R14 must be opposed by a current flow in R16. Quiescently (DC output baseline voltage set for zero volts) the emitter of Q14 is near ground, resulting in little or no current flow through R16.

For purposes of explanation, assume that the input is driven negative. This will result in the base and emitter of Q14 being driven negative. The increased current flow through R14 must be offset by a current flow through R16, so as to maintain the emitter current of Q14 constant. To do this the collector voltage of Q24 decreases, thus opposing the increased current flow through R14. The decreasing voltage at the collector of Q24 thus results in an output signal which is in phase with the input signal.

C12 and R13 (HIGH FREQ COMP adjustments) peaks up the gain at the front leading corner of the pulse. D32 provides a fixed DC point for the emitter of Q24, and along with R28 and R30, sets the current through Q28.

[1]The gate is analogous to the grid of a tube.

[2]A source follower is analogous to a cathode follower.

[3]The source is analogous to the cathode of a tube.

NOTES

SECTION 4
MAINTENANCE

Visual Inspection

If trouble occurs in the Type 282 Probe Adapter, make sure the associated equipment is operating and the controls are properly set. If it is determined that the trouble is definitely in the Type 282, a visual check may reveal the cause. Defects such as loose or broken connections, frayed or broken cables, damaged connectors, and burned components can generally be detected by a visual inspection. Except for heat-damaged components, the remedy for such defects is obvious. Overheating of components is usually a symptom of other, less apparent troubles in the circuit. For this reason, it is essential to determine the actual cause of overheating before the damaged parts are replaced; otherwise, the damage may be repeated.

Transistor Replacement

Transistors should not be replaced unless they are actually defective. Transistor defects usually take the form of the transistor opening, shorting, or developing excessive leakage. To check a transistor for these defects, use an ohmmeter.

Usually a defective transistor can be found by measuring the transistor forward-to-back resistance, using proper ohmmeter ranges, or by using the substitution method. However, if a more accurate check than an ohmmeter will provide on a transistor is desired, then a transistor curve display instrument such as a Tektronix Type 575 should be used. A component location guide is given in Fig. 4-1.

NOTE

When unsoldering a transistor from the etched-circuit board use a heat sink between the point where the lead enters the transistor case and the point being unsoldered. If no heat sink is used and the transistor lead becomes excessively hot, damage to the transistor may result.

To check a transistor using an ohmmeter, know your ohmmeter ranges, the currents they deliver, and the internal battery voltage(s). If your ohmmeter does not have sufficient resistance in series with its internal voltage source, excessive current will flow through the transistor under test. Excessive current and/or high internal source voltage may permanently damage the transistor.

NOTE

As a general rule, use the R×1 k range where the current is usually limited to less than 2 mA and the internal voltage is usually 1½ volts. You can quickly check the current and voltage by inserting a multimeter between the ohmmeter leads and measuring the current and voltage for the range you intend to use.

When you know which ohmmeter ranges will not harm the transistor, use those ranges to measure the resistance with the ohmmeter connected both ways as given in Tables 4-1 and 4-2.

TABLE 4-1

Transistor Resistance Checks

Ohmmeter Connections[1]	Resistance Readings That Can Be Expected Using the R×1 kΩ Range
Emitter-Collector	High reading both ways (about 60 kΩ to around 500 kΩ).
Emitter-Base	High reading one way (about 200 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ).
Base-Collector	High reading one way (about 500 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ).

TABLE 4-2

Field Effect Transistor Resistance Checks

Ohmmeter Connections[1]	Resistance Reading That Can Be Expected Using the R×1 kΩ Range
Source-Drain	Low reading both ways (about 250 Ω).
Source-Gate	High reading one way (about 100 MΩ or more). Low reading the other way (about 1 kΩ to 5 kΩ).
Drain-Gate	High reading one way (about 100 MΩ or more). Low reading the other way (about 1 kΩ to 5 kΩ).

[1]Test prods from the ohmmeter are first connected one way to the transistor leads and then the test prods are reversed (connected the other way). Thus, the effects of the polarity reversal of the voltage applied from the ohmmeter to the transistor can be observed.

If there is doubt about whether the transistor is good or not, substitute a new transistor. When checking transistors by substitution, be sure that the voltages and loads on the transistor are normal before making the substitutions. If a transistor is substituted without first checking out the circuit, the new transistor may immediately be damaged by some defect in the circuit.

To check a field effect transistor using a transistor curve display instrument such as a Tektronix Type 575, set up the instrument as follows:

Type 575 control settings for I_d —V_{ds} curves of an N-Channel field effect transistor.

Test Panel

Configuration Switch	Emitter Grounded
Comparison Switch	Centered

Collector Sweep Block

Peak Range Volts	0-20
Peak Volts	20

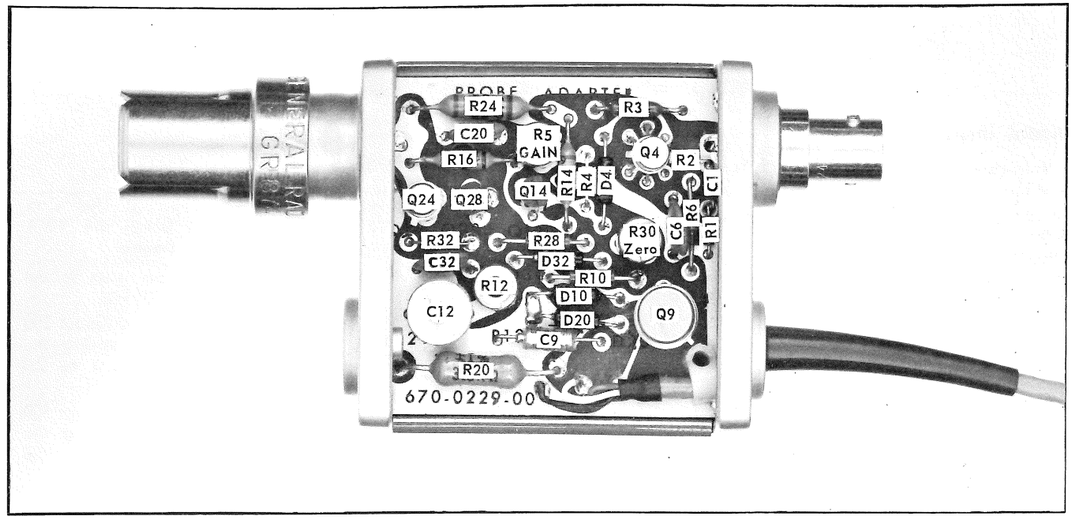

Fig. 4-1. Type 282 etched-circuit board component locations.

Polarity	+(NPN)
Dissipating Limiting Resistor	1 kΩ

Base Step Generator Block

Display Switch	Repetitive
Steps/Family	(fully counterclockwise)
Polarity	—(to back bias field effect transistor)
Steps/Sec	Any setting
Step Selector	.1 mA per step
Series Resistor	Any setting

The Series Resistor switch is not connected in the circuit when Step Selector switch is in the mA per step range.

Indicator Unit

Vertical Current Or Voltage Per Division	
Collector mA	.5
Horizontal Volts/Div	
Collector Volts	2

Attach a 1 kΩ, 1% ½ W resistor between the B (base) and E (emitter) binding posts on the left side of the test panel. Place the field effect transistor to be tested into the socket on the left side of the test panel connecting the field effect transistor gate lead to the base connection on the socket, the drain lead to the collector connection, and the source lead to the emitter connection.

Set the Comparison Switch to Transistor A and observe a display of I_d — V_{ds} curves which appear similar to the I_p — E_p curves of a pentode tube.

NOTE

The gate of the field effect transistor is being stepped with voltage. This voltage is equal to step Selector mA Per Step times the 1 kΩ resistor connected between the B and E connectors on the test panel, i. e.

Gate step voltage = (step Selector mA Per Step) (1 kΩ).

Soldering Precautions and Procedures

Premium workmanship and materials are used in the construction of the etched circuit board. Each component hole is through-plated to the opposite side of the card, giving it strength and resoldering durability. With care, components can be removed and replaced on the etched circuit board numerous times without lifting the etched circuit from the glass laminate.

Use 60-40 solder and a 35- to 40-watt soldering iron with a small wedge-shaped tip for soldering and unsoldering components. Let the iron reach operating temperature. Use needle nose pliers to grip the component lead next to its body before applying heat. Apply heat and lift the lead out of its mounting hole.

When installing a new component, bend the leads to match the length and position of the leads of the removed part. Heat the solder in the mounting hole to a liquid state and shake out the excess. Tin the prepared leads of the new part, then install the leads in the mounting holes. When soldering, do not apply excessive heat nor leave the soldering iron on the etched circuit board an undue length of time. Use sufficient heat, however, along with a small amount of new solder, to establish a full flow, clean joint.

SECTION 5

CALIBRATION

Introduction

This calibration procedure can be used either for complete calibration of the Type 282 to return it to original performance, or as an operational check of instrument performance. Completion of every step in this procedure returns the Type 282 to original factory performance standards. If it is desired to merely touch up the calibration, perform only those steps entitled Adjust. . . .

General Information

Any needed maintenance should be performed before proceeding with calibration. Troubles which become apparent during calibration should be corrected using the techniques given in the Maintenance section of this manual.

This procedure is arranged in a sequence which allows this instrument to be calibrated with the least interaction of adjustments and reconnection of equipment. If desired, the steps may be performed out of sequence or a step may be done individually. However, some steps interact with other steps. When a step interacts with others, the step(s) which need to be checked will be noted.

The location of adjustments is shown in each step. Waveforms which are helpful in determining the correct adjustment or operation are also shown.

Where references are made to divisions of deflection, the indication will be major divisions.

EQUIPMENT REQUIRED

(see Fig. 5-1)

The following equipment, or its equivalent, is required for complete calibration of the Type 282. Specifications given are the minimum necessary for accurate calibration of this instrument. All test equipment is assumed to be correctly calibrated and operating within the original specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

1. Test oscilloscope. Bandpass, DC to at least 1 MHz; compatibility, must function properly with the sampling unit plug-in. Tektronix Type 547 Oscilloscope recommended.

2. Sampling unit plug-in. Bandpass, DC to effectively 1 GHz; minimum deflection factor, 0.1 volt/division; input impedance, 50 ohms; slowest sweep rate, 0.2 microseconds/

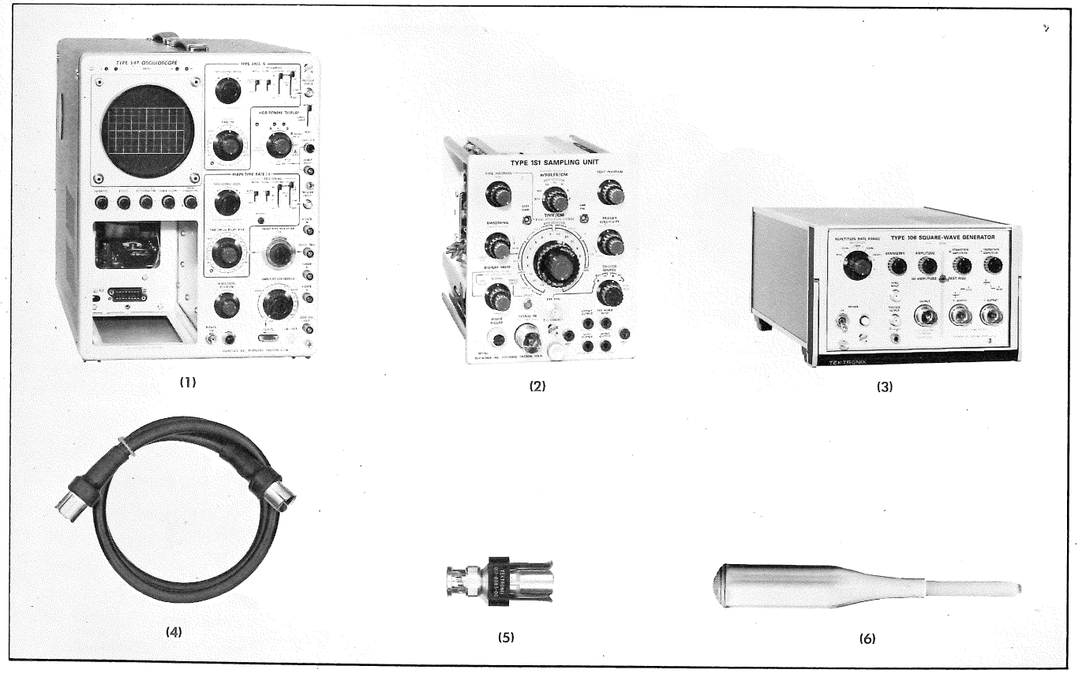

Fig. 5-1. Recommended calibration equipment.

division; triggering, must internally trigger on a 0.1 volt amplitude signal; probe power, must supply the necessary voltages to power the Type 282; compatibility, must function properly with test oscilloscope. Tektronix Type 1S1 Sampling Unit recommended.

3. Square-wave generator. Frequency of 1 kHz; output amplitude variable from about 50 to 500 millivolts. Tektronix Type 106 recommended.

4. Cable. Impedance 50 ohms; length 5 nanoseconds; connectors, GR. Tektronix Part No. 017-0502-00.

5. Termination. Impedance 50 ohms; accuracy, ±3% connectors, GR to BNC female; power capabilities, 2 watts. Tektronix Part No. 017-0083-00.

6. Adjustment tool. Type, insulated screwdriver; length 1½ inches; shaft material, non-metallic. Tektronix Part No. 003-0000-00.

CALIBRATION PROCEDURE

The following procedure uses the equipment listed under Equipment Required. If substitute equipment is used, control settings or setup must be altered to meet the requirements of the equipment used.

NOTE

When performing a complete recalibration, best performance will be provided if each adjustment is made to the exact setting, even if the Check is within the allowable tolerance.

1. Install the sampling unit plug-in into the test oscilloscope.

2. Make the necessary adjustment to the Sampling Unit/Test oscilloscope to obtain correct operation; see First-Time Operation instructions in Type 1S1 instruction manual.

3. Connect the Type 282 to the sampling unit Signal In connector. Note: Larger part of Type 282 case is up i. e., Type 282 is upside down.

4. Connect Type 282 power plug to sampling unit Probe Power connector.

5. Remove the right side (Type 282 connected as described in step 3 above) from the Type 282 by removing two screws from each end, then pulling right half of the cover outward. It will be necessary to momentarily disconnect the Type 282 from the sampling unit Signal In connector to remove the two screws located at the front end. If the right side is not easily removed after completing the instructions above, loosen the four screws which attach the left side to the Type 282. The right side can then be easily removed.

6. Allow at least 10 minutes warm up time at 25° C ±5°, before checking the Type 282 to the given accuracies in the procedure.

Control Settings

	Sampling Unit
mVolts/Cm	200
mVolts/Cm Variable	Cal

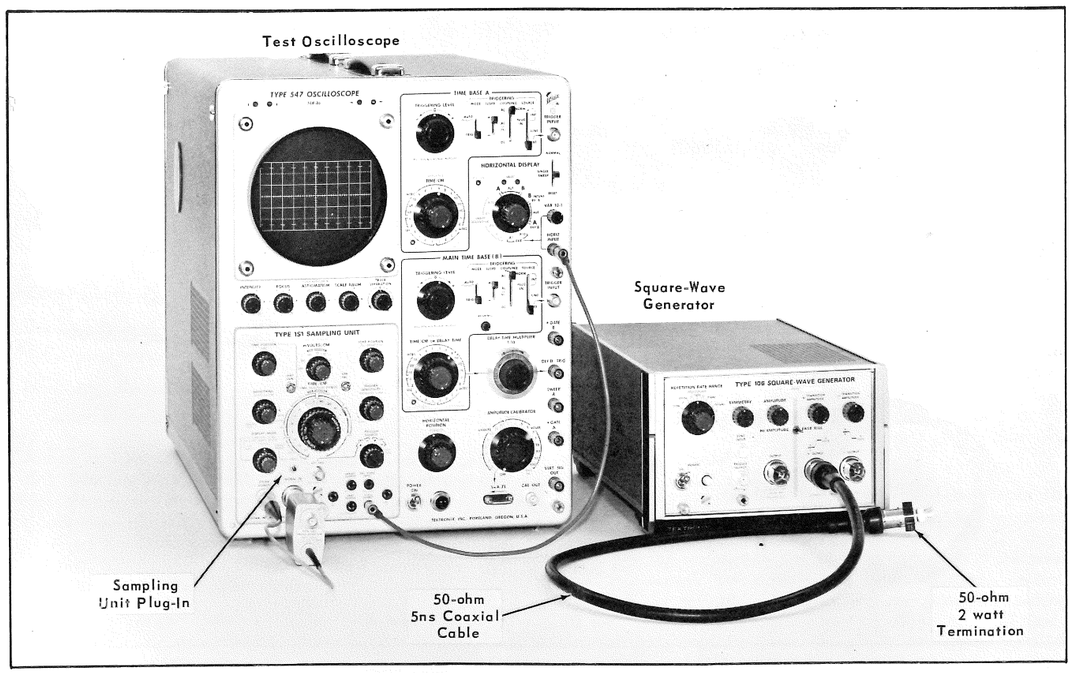

Fig. 5-2. Test equipment setup for calibration procedure.

Vert Position	Centered
DC Offset	Set for Zero volts offset
Time Position	Clockwise
Fine	Centered
Smoothing	Norm (Clockwise)
Samples/Cm	Centered
Display Mode	Normal
Manual Scan Ext Horiz Atten	Clockwise
Time/Cm	5 ns
Time/Cm Variable	Cal
Trigger Source	Free Run
Trigger Sensitivity	Clockwise
Recovery Time	Centered

Test Oscilloscope

See First-Time Operation instructions in Type 1S1 Instruction Manual.

1. Adjust ZERO Control, R30

a. Test equipment is shown in Fig. 5-2.

b. Disconnect the Type 282 from the sampling unit Signal In connector.

c. Check that the sampling unit DC offset voltage is exactly zero, then with the sampling unit Vert Position control, position the trace to the center horizontal graticule line.

d. Re-connect the Type 282 to the sampling unit Signal In connector.

e. Check that the trace remains superimposed on the center horizontal graticule line.

f. Adjust—ZERO control, R30 (see Fig. 5-3) until the trace is again superimposed on the center horizontal graticule line.

2. Adjust GAIN Control, R5

a. Test equipment set up is shown in Fig. 5-2.

b. Connect one end of a 5 ns, 50 ohm coaxial cable to the + Output connector on the square-wave generator. To the other end of the 5 ns, 50 ohm coaxial cable connect a 50 ohm GR to BNC in-line termination.

c. Connect the 50 ohm GR to BNC in-line termination to the Type 282 Input connector.

d. Set the square-wave generator controls as follows:

Repetition Rate Range	1 kHz
Multiplier	1 (fully counterclockwise)
Symmetry	Midrange
Amplitude	Midrange
Hi Amplitude-Fast Rise	Fast Rise
+ Transition Amplitude	Fully Clockwise
— Transition Amplitude	Midrange
Power	ON

e. Set the sampling unit Trigger Source switch to Int and adjust the Trigger Sensitivity control to obtain a stable display.

f. Disconnect the Type 282 from the sampling unit Signal In connector.

g. Disconnect the 50 ohm GR to BNC in-line termination from the Type 282.

h. Disconnect the 50 ohm GR to BNC in-line termination, from the 5 ns 50 ohm coaxial cable.

i. Connect the square-wave generator signal to the sampling unit Signal In connector via the 5 ns 50 ohm coaxial cable. Readjust the triggering control, if necessary to obtain a stable display.

j. Adjust the sampling unit mVolts/Cm Variable control until a display exactly 6 major divisions high is displayed on the test oscilloscope.

k. Disconnect the square-wave generator signal from the sampling unit.

l. Re-connect the 50 ohm GR to BNC in-line termination to the 5 ns 50 ohm coaxial cable, than connect the square-wave generator signal via the 5 ns 50 ohm coaxial cable and the 50 ohm GR to BNC in-line termination to the Type 282.

m. Connect the Type 282 to the sampling unit Signal In connector. Readjust the triggering control, if necessary, to obtain a stable display.

NOTE

Be sure when measuring the amplitude of the waveform to always make the measurement using the same side of the trace.

n. Check that exactly a 6 major division display is obtained on the test oscilloscope, i. e., Type 282 has unity gain.

o. Adjust—GAIN control, R5 to obtain exactly a 6 major division display on the test oscilloscope.

p. Reset the sampling unit mVolts/Cm Variable control to its Cal position.

q. Interaction—Recheck step p if GAIN control, R5, requires any adjustment.

3. Adjust Transient Response, C12 and R12

a. Test equipment setup is given in step 2.

b. Note the leading edge and top of the displayed waveform.

c. Disconnect the Type 282 from the sampling unit Signal In connector.

d. Disconnect the 50 ohm GR to BNC in-line termination from the Type 282.

e. Disconnect the 50 ohm GR to BNC in-line termination, from the 5 ns 50 ohm coaxial cable.

f. Connect the square-wave generator signal to the sampling unit Signal In connector via the 5 ns 50 ohm coaxial

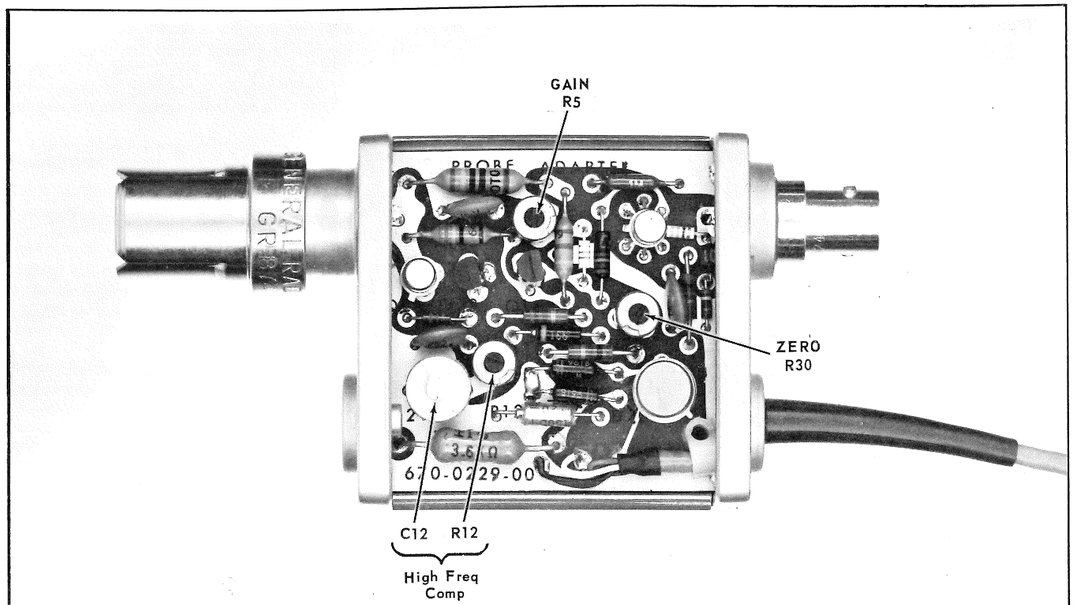

Fig. 5-3. Location of Type 282 calibration adjustments.

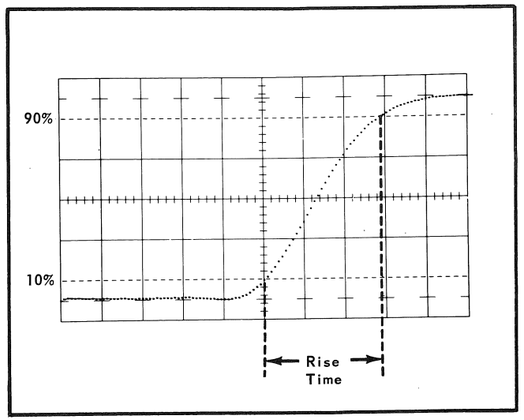

Fig. 5-4. Measuring risetime.

cable. Readjust the triggering control, if necessary, to obtain a stable display.

g. Note the leading edge and top of the displayed waveform.

h. Check that the waveform noted in part b matches the waveform noted in part g.

i. If the waveforms are not the same, disconnect the square-wave generator signal from the sampling unit.

j. Connect the 50 ohm GR to BNC in-line termination to the 5 ns 50 ohm coaxial cable, then connect the square-wave generator signal via the 5 ns 50 ohm coaxial cable and the 50 ohm GR to BNC in-line termination to the Type 282.

k. Connect the Type 282 to the sampling unit Signal In connector. Readjust the triggering control, if necessary, to obtain a stable display.

l. Adjust—C12 and R12, see Fig. 5-3, until the displayed waveform matches the waveform noted in part g.

4. Check Risetime

a. Test equipment setup is given in step 2.

b. Set the sampling unit Time/Cm switch to 1 ns.

c. Adjust the sampling unit mVolts/Cm Variable control to obtain a display exactly 5 major divisions high.

d. Adjust the sampling unit Time Position control to bring the rising portion of the waveform into the display area.

e. Check that the risetime, see Fig. 5-4 is equal to or less than 2.5 ns.

f. This completes the calibration of the Type 282. Disconnect all test equipment and replace the cover. If the instrument has been completely calibrated to the tolerances given in this procedure, it will perform to the limits given in the Characteristics section of this Instruction Manual.

ABBREVIATIONS AND SYMBOLS

A or amp	amperes
AC or ac	alternating current
AF	audio frequency
α	alpha—common-base current amplification factor
AM	amplitude modulation
$\approx$	approximately equal to
β	beta—common-emitter current amplification factor
BHB	binding head brass
BHS	binding head steel
BNC	baby series "N" connector
$\times$	by or times
C	carbon
C	capacitance
cap.	capacitor
cer	ceramic
cm	centimeter
comp	composition
conn	connector
$\sim$	cycle
c/s or cps	cycles per second
CRT	cathode-ray tube
csk	countersunk
dB	decibel
dBm	decibel referred to one milliwatt
DC or dc	direct current
DE	double end
°	degrees
°C	degrees Celsius (degrees centigrade)
°F	degrees Fahrenheit
°K	degrees Kelvin
dia	diameter
$\div$	divide by
div	division
EHF	extremely high frequency
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ϵ	epsilon—2.71828 or % of error
$\geqslant$	equal to or greater than
$\leqslant$	equal to or less than
ext	external
F or f	farad
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
FM	frequency modulation
ft	feet or foot
G	giga or 10^9
g	acceleration due to gravity
Ge	germanium
GMV	guaranteed minimum value
GR	General Radio
$>$	greater than
H or h	henry
h	height or high
hex.	hexagonal
HF	high frequency
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
HV	high voltage
Hz	hertz (cycles per second)
ID	inside diameter
IF	intermediate frequency
in.	inch or inches
incd	incandescent
∞	infinity
int	internal
$\int$	integral
k	kilohms or kilo (10^3)
k Ω	kilohm
kc	kilocycle
λ	lambda—wavelength
$<$	less than
LF	low frequency
lg	length or long
LV	low voltage
M	mega or 10^6
m	milli or 10^{-3}
MΩ or meg	megohm
μ	micro or 10^{-6}
mc	megacycle
met.	metal
mm	millimeter
ms	millisecond
—	minus
mtg hdw	mounting hardware
n	nano or 10^{-9}
no. or #	number
ns	nanosecond
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
Ω	omega—ohms
ω	omega—angular frequency
p	pico or 10^{-12}
/	per
%	percent
PHB	pan head brass
ϕ	phi—phase angle
π	pi—3.1416
PHS	pan head steel
+	plus
$\pm$	plus or minus
PIV	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
pwr	power
RC	resistance capacitance
RF	radio frequency
RFI	radio frequency interference
RHB	round head brass
ρ	rho—resistivity
RHS	round head steel
r/min or rpm	revolutions per minute
RMS	root mean square
s or sec.	second
SE	single end
Si	silicon
SN or S/N	serial number
T	tera or 10^{12}
TC	temperature compensated
TD	tunnel diode
THB	truss head brass
Θ	theta—angular phase displacement
thk	thick
THS	truss head steel
tub.	tubular
UHF	ultra high frequency
V	volt
VAC	volts, alternating current
var	variable
VDC	volts, direct current
VHF	very high frequency
VSWR	voltage standing wave ratio
W	watt
w	wide or width
w/	with
w/o	without
WW	wire-wound
xmfr	transformer

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 or model 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.

SPECIAL NOTES AND SYMBOLS

×000	Part first added at this serial number
00×	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.
	Screwdriver adjustment.
	Control, adjustment or connector.
	Heat sink.

SECTION 6

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			S/N Range
		Capacitors			
Tolerance ±20% unless otherwise indicated.					
C1	283-0136-00	10 pF	Cer	50 V	5%
C6	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C9	290-0267-00	1 μF	EMT	35 V	
C12	281-0093-00	5.5-18 pF	Cer Var		
C20	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C32	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
		Diodes			
D4	*152-0185-00	Silicon	Replaceable by 1N3605		
D10	152-0149-00	Zener	1N961B	0.4 W, 10 V, 5%	
D20	152-0149-00	Zener	1N961B	0.4 W, 10 V, 5%	
D32	152-0166-00	Zener	1N753A	0.4 W, 6.2 V, 5%	
		Connectors			
J1[1]					
P10[1]					
J39[1]					
		Transistors			
Q4 A,B	*151-1003-00	Silicon	Dual, Tek Spec		
Q9	*151-0087-00	Silicon	Replaceable by 2N1131		
Q14	*151-0199-00	Silicon	Replaceable by MPS-3640		
Q24	151-0205-00	Silicon	2N3959		
Q28	151-0190-00	Silicon	2N3904		
		Resistors			
Resistors are fixed, composition, ±10% unless otherwise indicated.					
R1	317-0391-00	390 Ω	1/8 W		5%
R2	317-0330-00	33 Ω	1/8 W		5%
R3	318-0004-00	1 MΩ	1/8 W	Prec	1%
R4	317-0472-00	4.7 kΩ	1/8 W		5%
R5	311-0614-00	30 kΩ	Var		

[1]See Mechanical Parts List.

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Resistors *(Cont)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R6	315-0101-00	100 Ω	¼ W		5%	
R10	315-0202-00	2 kΩ	¼ W		5%	
R12	311-0609-00	2 kΩ		Var		
R14	321-0231-00	2.49 kΩ	⅛ W	Prec	1%	
R16	321-0148-00	340 Ω	⅛ W	Prec	1%	
R20	308-0349-00	3.6 kΩ	3 W	WW	1%	
R24	322-0171-00	590 Ω	¼ W	Prec	1%	
R28	315-0152-00	1.5 kΩ	¼ W		5%	
R30	311-0635-00	1 kΩ		Var		
R32	317-0511-00	510 Ω	⅛ W		5%	

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

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.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears 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.

Mounting hardware must be purchased separately, unless otherwise specified.

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 or model 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.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

SECTION 7

MECHANICAL PARTS LIST

FIG. 1 EXPLODED VIEW

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	175-0388-00			1		CABLE ASSEMBLY
-2	334-1047-00			1		PLATE, identification, INPUT
-3	131-0318-00			1		CONNECTOR, BNC
-4	670-0229-00			1		ASSEMBLY, circuit board
	- - - - - -			-		assembly includes:
	388-0745-00			1		BOARD, circuit
-5	214-0744-00			6		SPRING, grounding, V shaped
-6	214-0745-00			1		CONTACT, electrical, 0.0625 inch diameter
-7	132-0007-00			1		SNAP RING
-8	132-0028-00			1		INSULATOR
-9	132-0002-00			1		SLEEVE, conductor, outer
-10	204-0227-05			1		BODY, probe adapter, INPUT
	- - - - - -			-		mounting hardware: (not included w/body)
-11	211-0122-00			4		SCREW, 2-56 x 0.312 inch, OHS
-12	343-0128-00			1		CLAMP, cable, plastic
-13	200-0684-00			2		COVER, half, probe adapter
-14	204-0227-06			1		BODY, probe adapter, OUTPUT
	- - - - - -			-		mounting hardware: (not included w/body)
-15	211-0122-00			4		SCREW, 2-56 x 0.312 inch, OHS
-16	334-1048-00			1		PLATE, identification, OUTPUT
-17	132-0001-00			1		NUT, coupling
-18	132-0122-00			1		INNER TRANSITION
-19	132-0029-00			1		INNER CONDUCTOR
-20	386-1130-00			1		INSULATOR, disc (not shown)

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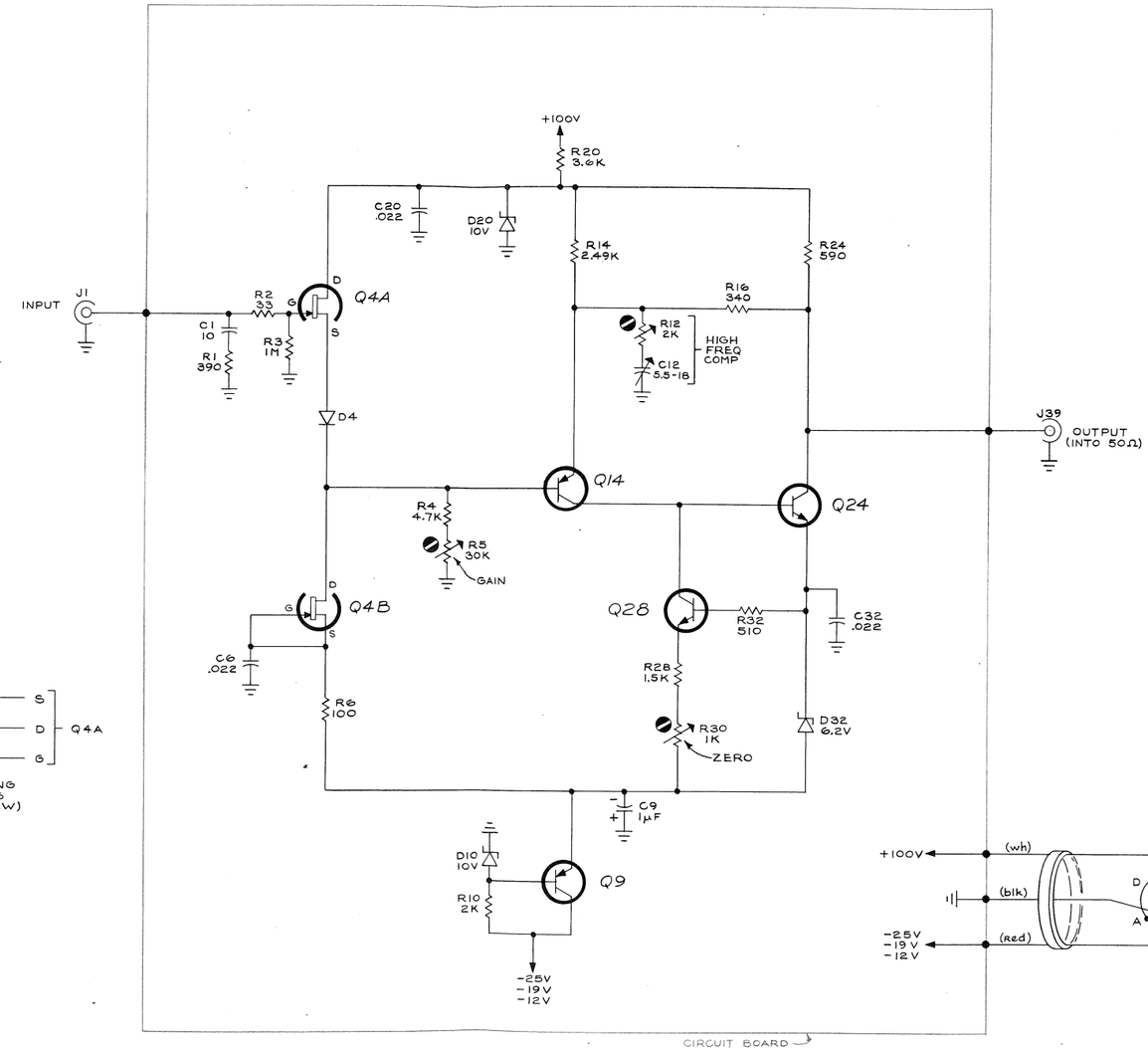

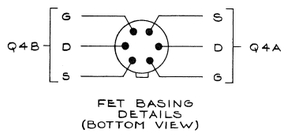

FET BASING
DETAILS
(BOTTOM VIEW)

P10
POWER
PLUG
(FRONT VIEW)

SEE PARTS LIST FOR
SEMICONDUCTOR TYPES

566

TYPE 282

A

PROBE ADAPTER

FIG. 1 EXPLODED VIEW

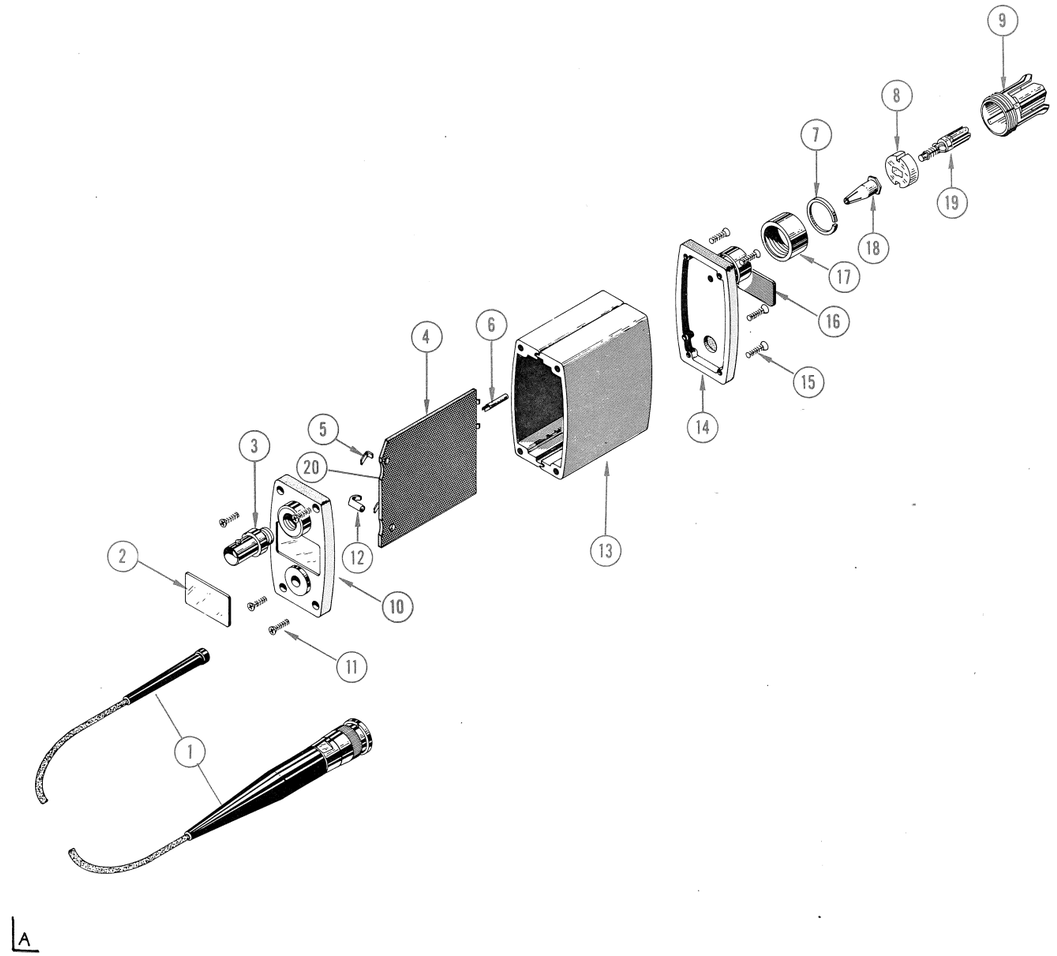

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FIG. 1

TYPE 282 PROBE ADAPTER

MANUAL CHANGE INFORMATION

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

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

TYPE 282

PARTS LIST CORRECTIONS

Page 7-1, Ref. No. 1 should include one Cable Relief Tektronix Part No. 200-0488-00

CABLE ASSEMBLY REPLACEMENT

1. Removing cable

   a. Remove leads of cable from board and cut shrinkable tubing from end of cable.

   b. Loosen cable clamp and pull the cable out through the cable relief.

2. Replacing cable

   a. Thread loose end of new cable through the cable relief and cable clamp.

   b. With a match or hot soldering iron shrink the shrinkable tubing onto the end of the cable to prevent it from grounding against the board.

   c. Solder leads to their respective positions and tighten the cable clamp securely.