Instruction Manual

P6035 PROBE

070-369 463

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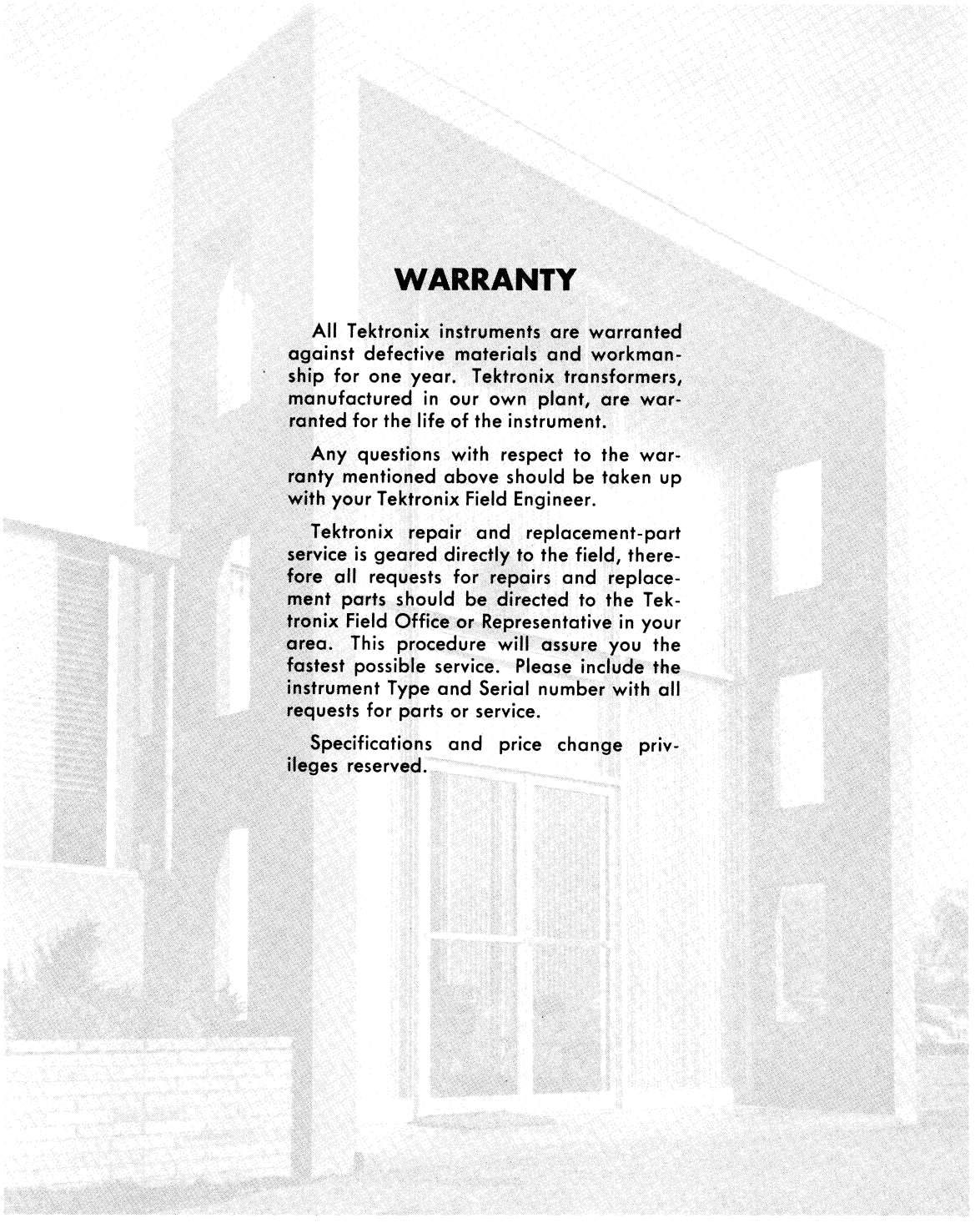


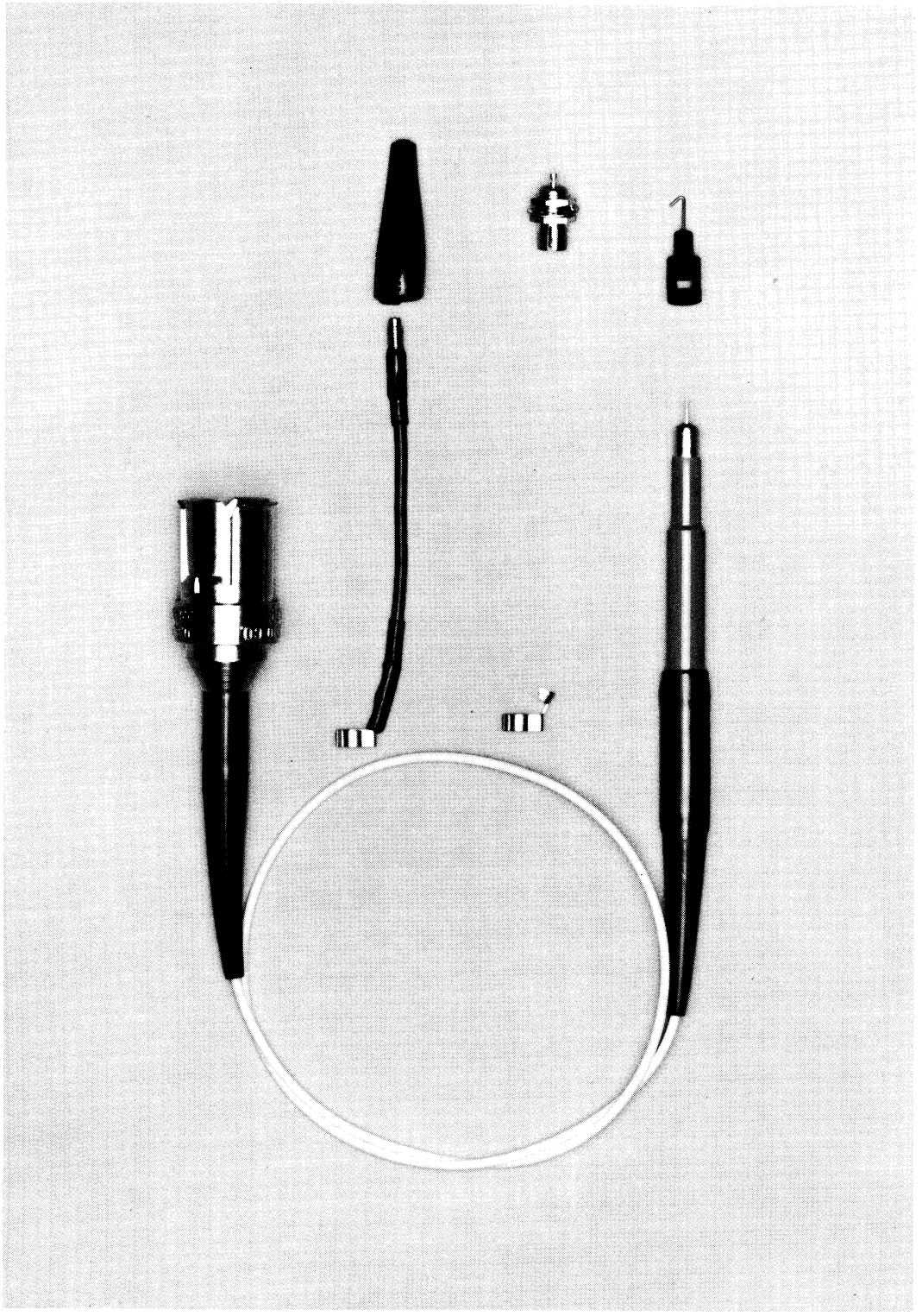
WARRANTY

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 number with all requests for parts or service.

Specifications and price change privileges reserved.



SECTION 1

CHARACTERISTICS

General

The P6035 is a miniature passive probe that provides 100:1 signal attenuation and is intended for use with low-impedance sources. The probe is designed for use with sampling plug-in units such as the Tektronix Type 4S1, 4S2, and 3S76. It can also be used in some applications, with wideband, non-sampling oscilloscopes when an extremely low input capacitance is required.

The probe has been factory-compensated and will not require adjustment unless the setting of the compensation mechanism is disturbed.

Characteristics

The following characteristics are valid only when the probe operates into a 50Ω oscilloscope input or a 50Ω termination:

Attenuation Ratio	100:1
Input Resistance (at dc)	5000 ohms, ±1.5%
Input Resistance (at 1 gigacycle)	≈1500 ohms[1]
Input Capacitance (dc to 100 mc)	0.6 (±0.1) pf
Risetime	200 picoseconds or less
Frequency Response (dc coupled)	Dc to 1.7 gigacycles (—3 db point)[2]
Bandpass (ac coupled with GR 874-K Coaxial Coupling Capacitor)	≈6 kc[3] to 1.7 gigacycles[2] (—3 db points)
Maximum Dc Input Voltage	50 volts[4]
Maximum Cw Input Voltage	See Fig. 4
Maximum Power Input	0.5 watt
Pulse Ringing and/or Overshoot (with a 25Ω source impedance and coaxial ground on probe)	2% or less of the pulse peak amplitude
Pulse Ringing and/or Over shoot (when pulse risetime is 0.5 nanoseconds or greater and using ground strap on probe).	Typically less than 5% of the pulse peak amplitude

[1] see Fig. 1.

[2] upper frequency limit calculated from risetime.

[3] assuming capacitance value of GR 874-K to be 4700 pf and source impedance of 50 ohms. The lower —3 db point moves to lower frequencies with higher source impedance. See Fig. 3.

[4] 500 volts when ac coupled with a GR 874-K Coaxial Coupling Capacitor.

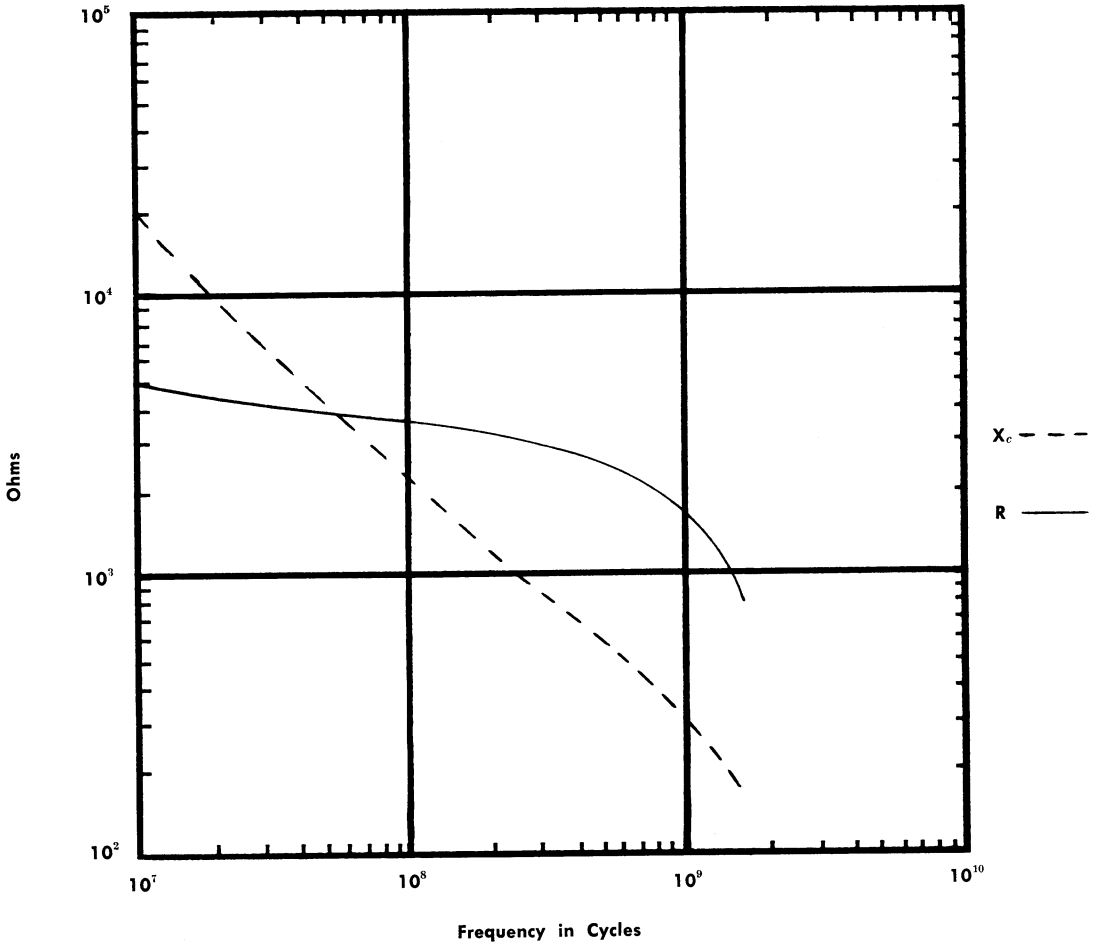


Fig. 1. Input resistance and capacitive reactance versus frequency.

SECTION 2
OPERATING INSTRUCTIONS

General

The principle advantages offered by the P6035 Probe include low input parallel capacitance, relatively constant input resistance over a wide range of frequencies, and fast response.

Handling

The P6035 Probe is a delicate device. In particular, be careful not to bend or otherwise strain the tip, as the resistor inside the probe body may be broken. If it becomes necessary to straighten the tip, use a pair of needle-nose pliers to hold the tip near its base and a second pair of pliers to straighten the tip. This method will reduce the strain on the internal resistor.

Soldering components to the tip can break the bond between the tip and the internal resistor. If a self-holding tip connection is required, use one of the small test jacks included with the probe, or a pin contact taken from a small transistor socket.

Avoid kinks, sharp bends, and dents in the probe cable, as any of these can cause a reflective discontinuity in the probe response.

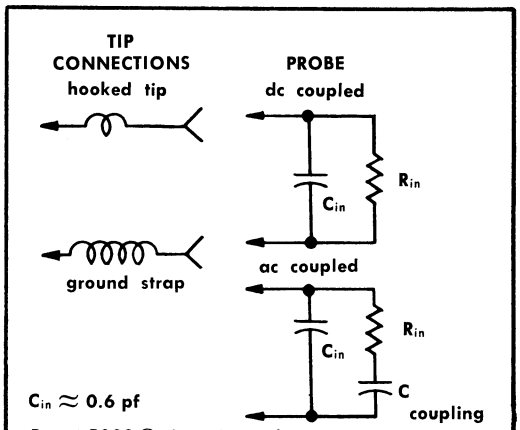


Fig. 2. Probe equivalent circuits as seen by the test circuit.

Measurement Considerations

Fig. 2 represents the probe equivalent circuit as seen by the test circuit. If necessary, the effect of adding these components to the test circuit can be calculated as a change in circuit resistance, capacitive reactance, time constant, or impedance. The nature of the test circuit and the frequency involved determine which of the factors will be appropriate. Fig. 1 shows the probe resistance and capacitive reactance throughout its range of operating frequencies. The values shown should be used, when necessary, to determine the accuracy of a measurement.

Dc Coupling and Cable Extensions

It is usually necessary to determine whether the probe will be a significant dc current path during a measurement. Dc current through the probe could disturb the test circuit or exceed the maximum input limits of the probe. (These limits are discussed in greater detail under "Maximum Voltage and Power Input".) The probe can be ac coupled (up to 500 v dc, plus peak ac) by adding a GR Type 874-K Coaxial Coupling Capacitor (Tektronix part number 017-028) between the probe cable connector and the oscilloscope input. This will, however, limit the low frequency response of the system to a frequency which depends upon the signal source impedance. The relationship between the signal source impedance and the frequency response is shown in Fig. 3.

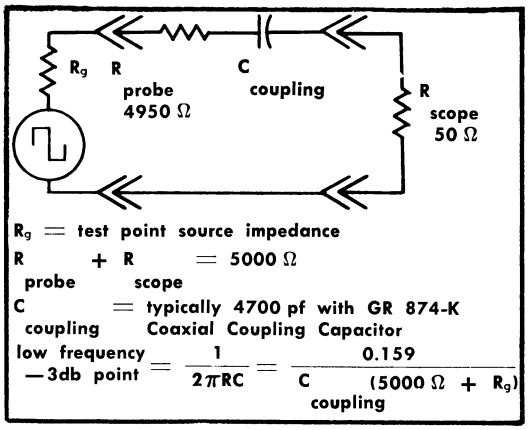


Fig. 3. Ac-coupled probe low-frequency response.

If it it necessary to have greater separation between the oscilloscope and the probe than is provided by the probe cable, add RG-8A/U cable. The added cable will not change the probe input characteristics, but remember to allow for the effects of the high-frequency cable losses in the interpretation of the displayed signal. Six feet of extension cable can be used during measurements at 200 megacycles with negligible effect on the signal display.

When both an extension cable and dc blocking capacitor must be used, place the capacitor between the probe cable connector and the extension cable. This will provide a more uniform low-frequency response.

Probe Tip Connections

The effect of interconnecting hardware used between the test point and the probe tip must be considered in high frequency measurements. In general, the high-frequency characteristics of the probe will be best when minimum hardware is used.

A good way to make the probe connections is to touch the tip and ground sleeve to the appropriate points in the test circuit. When the ground connection cannot be made in this manner, attach a ground clip to the sleeve. If necessary, a short stub of wire can be soldered to the clip to extend the ground connection.

The hooked tip can be used in most measurements without adverse effects on the display, since the small series inductance it exhibits is insignificant except at very high frequencies. The ground-strap assembly acts as a much larger series inductor. Its effect on the display may be noticeable at frequencies above 500 megacycles, or with pulse risetimes faster than about 0.6 or 0.7 nanoseconds.

The small test jacks (Tektronix part number 131-258) included with the probe are intended for permanent installation in a test circuit. The jack provides an easy-to-use, coaxial test point that will hold the probe and allow the operator greater freedom of movement.

The jack should be mounted as close as possible to the actual test point so both the ground and signal paths are short. It is generally more convenient to use the jack with new equipment so the small capacitance of the jack can be properly considered in the circuit design.

VP-1 Voltage Pickoff

The Type VP-1 is a special 50Ω coaxial tee for use with the P6035. The inline portion of the tee is fitted with GR Type 874 connectors and the tee branch is a receptacle for the probe tip.

The VP-1 may be used with the probe for signal pickoff from a 50Ω system. The signal picked off is then available for display on an oscilloscope, triggering an oscilloscope, or other purposes.

When the P6035 is used with the VP-1 in a 50 Ω system, the signal voltage across the the 50 Ω system receiving-end termination will be about 99.5% of the voltage obtained with the probe disconnected. The percentage decreases at high frequencies where the probe input resistance decreases. See Fig. 1.

Since the input and output ends of the VP-1 are in parallel (as seen from the pickoff point), the system offers a 25Ω source impedance to the probe. Due to the low impedance, the VP-1 can be used to compensate the probe.

The VP-1 compensates for the small parallel input capacitance of the probe so minimum reflection is introduced into the 50Ω system. If the probe is disconnected from the VP-1, the VP-1 will act as a small inductor in series with the 50Ω system. For this reason, it is suggested that the VP-1 be left in the system only when a terminated probe is connected to it.

Common-Mode Rejection

In measurements involving fractional-nanosecond risetime signals, a substantial fast-rise common-mode signal often exists between the oscilloscope chassis and the test-circuit chassis due to the inductance of ground connections (other than he probe cable shield). The P6035 Probe will, to a high degree, reject these common-mode signals. If necessary, the rejection can be increased by forming the probe cable into several loops through a ferrite toroid. Toroids having the necessary high frequency properties are available from Tektronix; order part number 276-501.

MAXIMUM VOLTAGE AND POWER INPUT

The basis power rating of the P6035 Probe at dc is that of the series resistor inside the probe body; 0.5 watt. The related dc input voltage is 50 volts. Greater dc voltages must

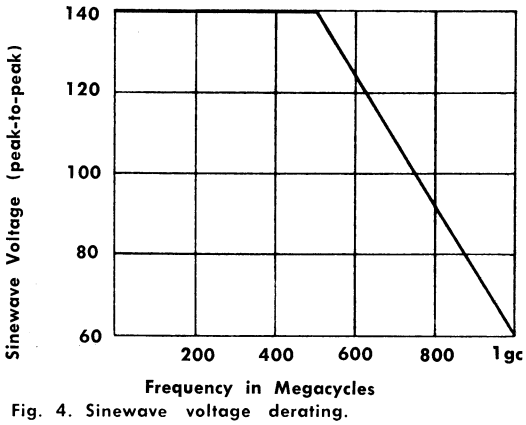


Fig. 4. Sinewave voltage derating.

be blocked by a suitable coupling capacitor as discussed previously in this manual. At low frequencies, the sinewave voltage rating is 140 volts peak-to-peak. Above 500 megacycles, the power dissipation of the capacitive elements in the probe becomes significant. This dissipation adds to the heating of the probe resistor, and therefore must be offset by a reduced input voltage. Fig. 4 shows the allowable peak-to-peak voltage for zero referenced sinewaves versus frequency.

Pulse peak voltages up to 500 volts can be measured with the P6035 Probe provided the rms probe-input voltage is 50 volts or less. (500 volts is the probe break-down voltage and the voltage rating of a GR Type 874-K Coaxial Coupling Capacitor.) In no case, however, should any portion of the signal hold a voltage level greater than 50 volts for longer than 1 millisecond.

The rms voltage of a pulse signal should be estimated before measurement .The pulse time duration duty factor, and dc level determine the average signal voltage. Remember that pulses contain energy at frequencies above the pulse repetition frequency. Therefore, if the pulse repetition frequency exceeds several hundred megacycles, derating will be necessary for the same reason as sinewave derating.

SPECIAL APPLICATIONS

Permanent Test-Point Monitor

In certain devices, such as production line test sets, the designer may wish to provide a permanent 50Ω front-panel test jack from an odd-impedance point (other than 50Ω) in the circuit. In such cases, the P6035 may be installed inside the device with the tip connection made through a small in-circuit test jack as previously discussed. The probe cable connector can be converted into a panel mounting connector by using two fittings: Tektronix part number 132-040 (adapter) and 132-016 (locking ring). Whenever the "test connector" is not connected to an oscilloscope, it should be terminated with a 50Ω end-line termination, such as Tektronix part number 017-047. This will maintain constant test circuit conditions.

Non-Sampling Uses

In some high-frequency or pulse measurements with non-sampling oscilloscopes, the input capacitive loading of certain probes may be the limiting factor. In such cases, the otherwise impossible measurement can sometimes be made by substituting the resistive loading of the P6035 for the capacitive loading of another probe. The discussion that follows describes how the probe can be properly used with wide-band non-sampling oscilloscopes.

The P6035 must be terminated in 50 ohms. Since non-sampling oscilloscopes usually have a high resistance input, a 50 Ω termination must be used at the oscilloscope input. The Tektronix part number 011-049 termination unit can be used with appropriate adapters. It is important to remember that ac signal coupling within the oscilloscope will not block dc current through the probe and termination. If it is necessary to block dc, insert a GR Type 874-K coaxial coupling capacitor between the probe cable connector and the termination (see Fig. 5).

Because the shunt capacitance of the oscilloscope input is in parallel with the 50Ω termination, there will be a slight capacitive signal reflection in the system. In pulse measurement applications, where the effect of the reflection is within the area of interest in the display, add RG-8A/U cable between the termination and probe if additional time displacement is desired.

As an alternative method of controlling the reflection, add a 50Ω 2XT attenuator (Tektronix part number 017-046) at the point shown in Fig. 5. While the attenuation factor of the probe will be increased by a factor of two, the reflection percentage will be decreased by a factor of four. However, the 2XT does not change the probe voltage and power ratings.

In sinewave applications, it is generally best to use a 2XT attenuator to minimize standing waves.

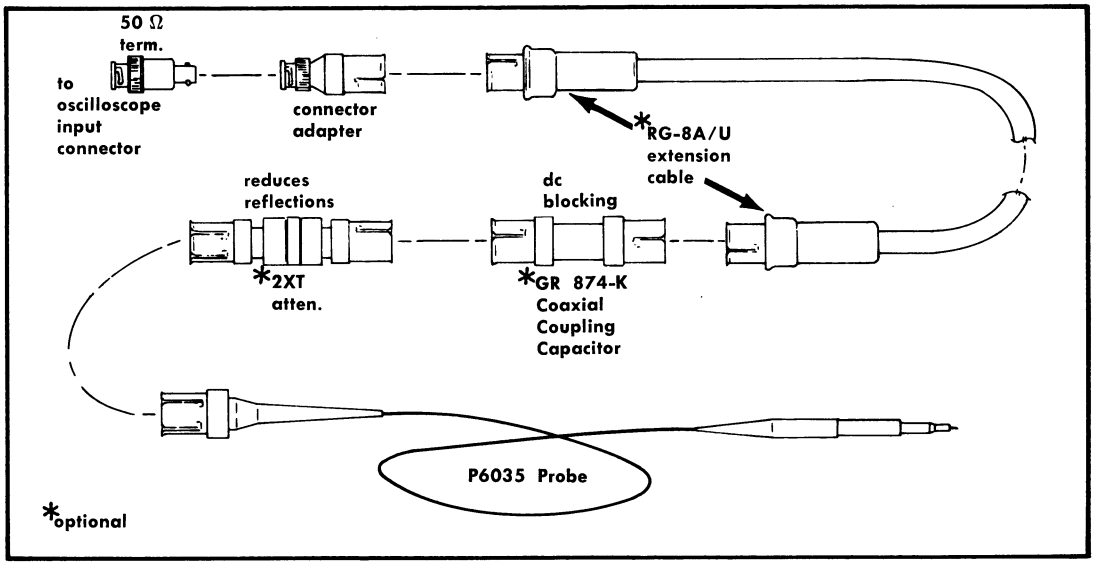


Fig. 5. Component sequence in non-sampling oscilloscope applications.

SECTION 3
MAINTENANCE AND CALIBRATION

General

The P6035 consists of several sub-assemblies as illustrated in the back of this manual. Repair of the sub-assemblies is not recommended.

The probe compensation should be checked when either the probe body or adjustment assembly is replaced and whenever the adjustment has been disturbed.

Compensation equalizes the high and low frequency probe attenuation factors. This is accomplished by passing a fast-rise, flat-top pulse through the probe from a low-impedance source and adjusting the probe so a sampling oscilloscope display indicates proper probe response.

Equipment Required

1. Pulse generator: Tektronix Type 109, 110 (with about a 5 nanosecond charge-line), or equivalent. Pulse rise-time: 0.25 nanoseconds or faster. Pulse amplitude: about ten volts peak. Pulse duration: about 10 nanoseconds.
2. Two 10XT 50 Ω attenuators: Tektronix part number 017-044 or equivalent.
3. Tektronix 50Ω end-line termination: part number 017-047.
4. RG-8A/U cable: about 5 nanoseconds electrical length, with GR Type 874 connectors.
5. Sampling oscilloscope system, such as the Tektronix Type 661/4S1/5T1 or Type 560-Series/3S76/3T77.

Procedure

1. Connect the equipment as shown in set-up #1, Fig. 7.
2. Set the sampling oscilloscope sweep rate at 1-nanosecond per division.
3. Set the pulse generator for about a 10-volt peak pulse output.

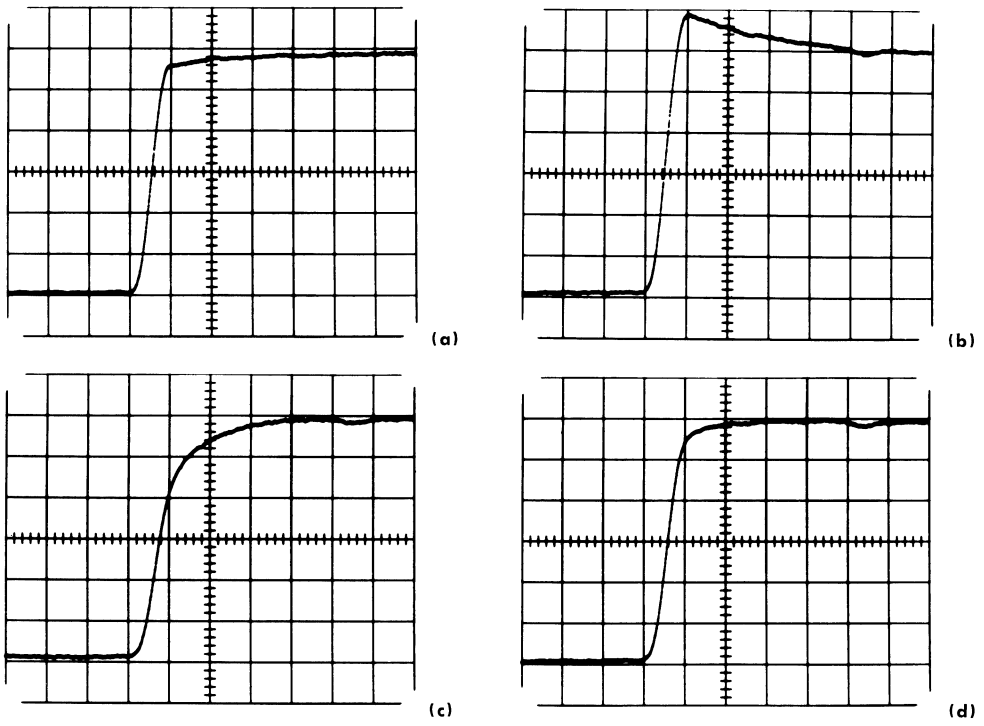


Fig. 6. (a) Pulse generator output, (b) probe over-compensated, (c) probe under-compensated and (d) probe properly compensated.

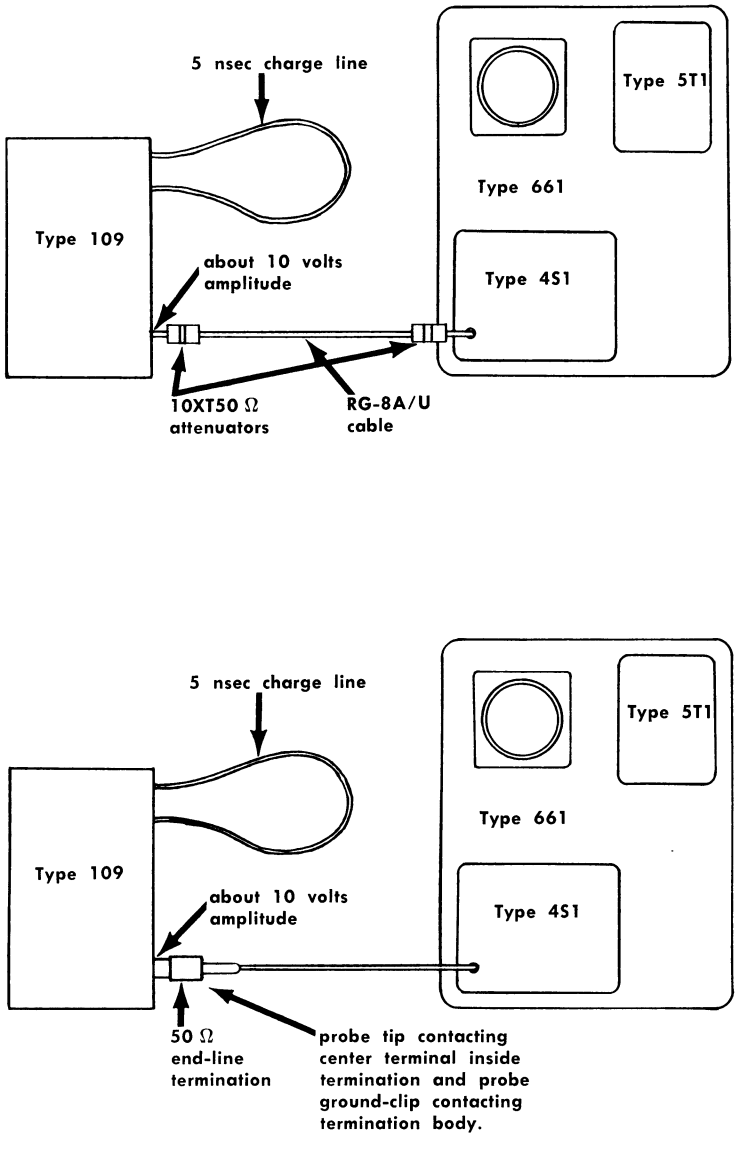


Fig. 7. Equipment set-up for compensating the P6035.

4. Observe the shape of the leading edge and corner area of the pulse generator output signal display; it should be similar to that shown in Fig. 6a. This display will be the reference for proper probe compensation.
5. Remove the metal cap from the end-line termination. Connect the equipment as shown in set-up #2, Fig. 6. Do not use an extension cable between the probe cable connector and the sampling oscilloscope input. Make the probe ground connection to the termination body with a ground-clip (without strap or other leads). This set-up provides a 25Ω source impedance to the probe.
6. Compare the leading edge and corner area of the pulse display to that obtained in step 4. Figures 6b and 6c show typical displays with the probe over-compensated and under-compensated. Fig. 6d shows a display obtained with probe properly compensated. The slight roll-off in the corner area is due to normal losses in the probe cable.
7. If step 6 shows that compensation is required, proceed as follows:
   a. Grasp the strain relief boot near the middle and use a pulling and turning motion to separate it from the probe body. See Fig. 8.
   b. Loosen the locking ring and back it away from the probe body.
   c. Turn the probe body to obtain the proper pulse response.
   d. Tighten the locking ring against the probe body without disturbing the compensation.
   e. Replace the strain relief boot.

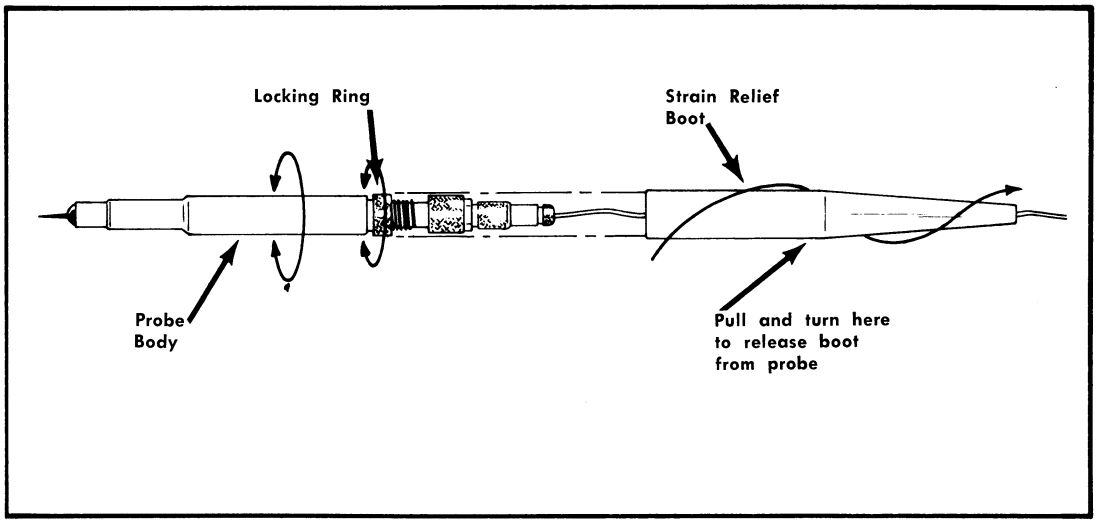


Fig. 8. Probe compensated.

Section 4
Parts List and Schematic

HOW TO ORDER PARTS

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

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, for your order to contain the following information: Part number including any suffix, instrument type, serial number, and modification number if applicable.

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

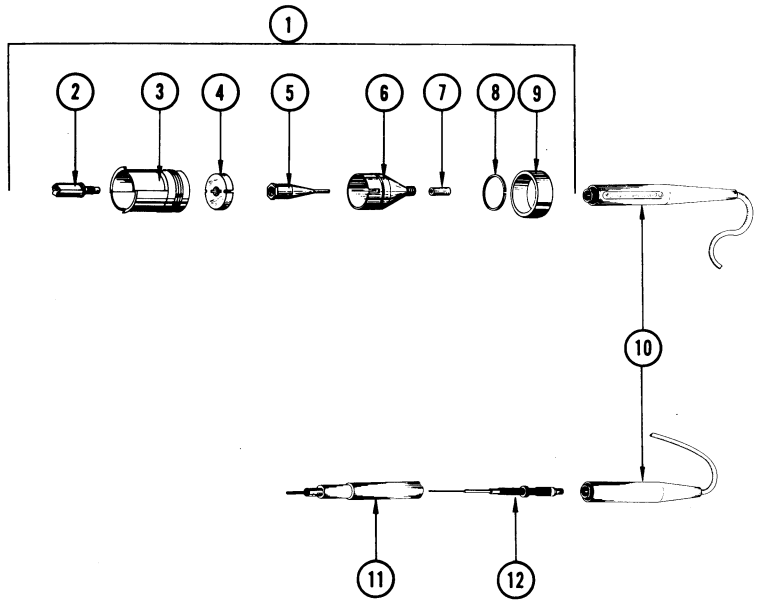
ABBREVIATIONS

BHS	Binding Head Steel	p	Pico, or 10^{-12}
f	Farad	PHS	Pan Head Steel
K or k	Kilohms, or kilo (10^3)	Var.	Variable
M or meg	Megohms, or mega (10^6)	w	Watt
Ω	Ohm	w/	With

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, also reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.

REPLACEABLE PARTS



REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
	010-111				PROBE, P6035 Includes:
1.	132-105			1	ADAPTER ASSEMBLY Consisting Of:
2.	132-029			1	INNER CONDUCTOR
3.	132-002			1	SLEEVE, conductor, outer
4.	132-028			1	INSULATOR
5.	132-104			1	CENTER CONDUCTOR
6.	132-103			1	ADAPTER
7.	166-281			1	SLEEVE INSULATOR
8.	132-007			1	SNAP RING
9.	132-001			1	NUT, coupling
10.	175-242			1	CABLE ASSEMBLY
11.	204-165			1	BODY AND RESISTOR ASSEMBLY
12.	358-191			1	BUSHING ADJ. ASSEMBLY