PRELIMINARY
INSTRUCTION MANUAL

TYPE P6025

This instruction manual is not complete and it may contain errors. We are sending it with your instrument so you will have something to use until the permanent manual is completed. Please put your name and address on the post card and mail it to us. We will send you a permanent manual just as soon as they are ready.

SECTION 1

CHARACTERISTICS

General

The Tektronix Type P6025 Probe is a high-frequency cathode-follower probe designed for use with the Type N Sampling System. It has a frequency range of dc to 600 mc when used with the Type N Unit. A gain control allows accurate setting of the overall gain. A variable capacitor in each head adjusts an RC attenuator to provide the correct ac attenuation ratio.

The probe consists of two parts--the probe body and the power regulator. Seven plug-on attenuator heads provide attenuation ratios between 10 and 1000. A coupling capacitor is provided for ac operation.

Probe and Attenuator Heads

Attenuation Ratios -- 10, 20, 50, 100, 200, 500, and 1000 (including probe attenuation of 5). Selected by changing attenuator heads.

Frequency Response --
Risetime --
Maximum Input Voltage --
Input Resistance --
Input Capacitance --
— See Table 1-1.

DC Level -- Approximately 0.4 v dc.

Maximum Output -- ±100 mv into 50Ω load.

Delay -- 10 nsec, (approximately).

Coupling Capacitor

Capacitive Element -- .001 μfd.

Voltage Rating -- 600 wvdc.

Low-frequency 3 db Point -- 20 cps, (approximately).

Power Requirements

Heater -- 6.3 v ac at 180 ma.

Plate Supply -- +100 v dc at 10 ma.

Mechanical

Cable Length -- 54 inches.

Power Plug -- 4-pin Amphenol.

Signal Out Connector -- GR 874 (50Ω).

Construction

Probe Body -- Plated brass tubing.

Probe Cover -- Aluminum, covered with plastic.

Attenuator Heads -- Plated brass tubing, covered with plastic.

Power Regulator Case -- Zamok #5.

Regulator Chassis -- Etched circuit board.

Accessories

2 -- Spring Clips.

1 -- Ground Clip.

2 -- Instruction Manuals.

TABLE 1-1

Attenuator Head	Frequency Response(3db)	Risetime (nsec)	Max. Input Voltage	Input Capacitance at DC (10%)	Input Resistance at DC (±2%)
10X (010-323)	600 mc	0.6	±1 volt	5 pf	10 meg
20X (010-324)	600 mc	0.6	±2 volts	3.5 pf	10 meg
50X (010-325)	600 mc	0.6	±5 volts	2.5 pf	10 meg
100X (010-326)	600 mc	0.6	±10 volts	1.8 pf	10 meg
200X (010-327)	600 mc	0.6	±20 volts	1.5 pf	10 meg
500X (010-328)	450 mc	0.8	±50 volts	1.3 pf	10 meg
1000X (010-329)	450 mc	0.8	±100 volts	1.2 pf	10 meg

SECTION 2

OPERATING INSTRUCTIONS

General

The Tektronix Type P6025 Probe is designed for high-frequency measurements with the Type N Sampling System. The following section will help you obtain good waveform displays using the P6025 Probe. Measurement considerations and typical test systems are included.

General Precautions

The P6025 Probe has been constructed as ruggedly as possible, consistent with extremely good high-frequency response. As with all devices handling signals in the nanosecond range, however, small changes in capacitance and inductance will produce pronounced changes in response. For this reason, observing a few precautions in the handling of the probe and cable will insure continued performance and reliability. The following malpractices should be avoided: dropping or rolling equipment on the probe or cable, kinking the cable, closing doors or drawers on the cable, dropping the probe, and pulling on the probe or cable.

Probe Connection (See Fig. 2-1)

Whenever the P6025 Probe is connected to the N Unit, the N Unit must be compensated for the dc offset voltage of the probe. To do this, connect the probe Power Plug to the N Unit PROBE POWER jack. Connect the probe Signal Out connector to the SIGNAL INPUT connector of the N Unit. Allow the probe to warm up for several minutes before making any adjustments.

Set the N Unit TRIGGER SENSITIVITY control to FREE RUN. When the probe has warmed up, adjust the N Unit VERTICAL POSITION control to compensate for the dc level of the probe.

Attach an attenuator head to the probe; the attenuation ratios are indicated on the attenuator bodies.

Use the ground clips or bayonet ground provided with the P6025 Probe to establish a ground between the signal source and the probe. A long ground lead on the probe or a common ground between instruments should not be used, as this will introduce inductance into the source loop and produce ringing.

CAUTION

No protection is provided for the input grid circuit when the probe is used without an attenuator head. Do not apply more than 100 mv directly to the probe tip.

Generally, the P6025 Probe can be used in any test system where the N Unit is used and a high-impedance input is required. The following test systems are representative of those with which the P6025 can be used. Other systems may be used if a pretrigger pulse, 45 nsec before arrival of the input signal, is supplied to the N Unit trigger system.

P6025 Probe with Type 113 Delay Cable and Type P6033 Trigger Probe

If the device under test can furnish a trigger pulse of 5 to 20 volts in amplitude with a repetition rate of 50 mc or less, the P6033 Trigger Probe may be used in conjunction with the P6025 Probe. This is illustrated in the test system shown in Fig. 2-2. The input impedance of the P6033 Probe is low, and it has approximately a 10X attenuation above 1.5 mc. Connect the trigger through a 50Ω termination to the TRIGGER INPUT connector of the N Unit. For best results

use a 50Ω BNC feed-through termination (Tektronix Part No. 011-049) with a GR to BNC adapter.

Since the P6033 Probe is a low-impedance probe, the trigger should be obtained from a low-impedance point. If the P6033 Probe is connected to the same point as the P6025, it may distort the signal waveform. (See the P6033 Probe instruction manual for the accurate attenuation and input impedance of the probe at the trigger frequency being used.)

This test system may also be used without the P6033 Probe, for signals having an amplitude of 0.5 to 2 volts and a repetition rate of 50 mc or less. In this case, connect the trigger signal directly to the TRIGGER INPUT connector of the N Unit. Obtain the trigger from a low-impedance point to prevent distortion.

P6025 Probe with Type 110 Pulse Generator and Type 113 Delay Cable

The test system shown in Fig. 2-3 can be used to display signals that either have insufficient trigger pulse amplitude, or do not supply a suitable trigger pulse without distorting the signal. The Trigger Takeoff and Regenerator section of the Tektronix Type 110 Pulse Generator is used in this system. Connect the Probe Power Plug to the N Unit PROBE POWER jack. Then, connect the Probe Signal Out connector through a 50Ω cable to the Type 110 SIG. IN FOR TRIG. TAKEOFF connector. Connect the Type 110 SIGNAL OUT 98% connector to the Type 113 Delay Cable. The output of the Type 113 is connected to the SIGNAL INPUT connector on the N Unit. Connect the Type 110 REGENERATED TRIG. OUT 50Ω connector to the REGENERATED TRIGGER INPUT connector of the N Unit.

Select the attenuator head that gives a proper display of the signal. The Trigger Takeoff Amplifiers 1 and 2 in the Type 110 should be adjusted as needed to obtain a triggered display. With the N Unit TRIGGER SENSITIVITY turned fully counterclockwise, adjust the Type 110 TRIGGER SENSITIVITY control for a stable display.

P6025 Probe with Type 111 Pulse Generator

The test system shown in Fig. 2-4 can be used for testing devices that must be driven externally. Connect the PRE-TRIGGER OUTPUT of the Type 111 to the REGENERATED TRIGGER INPUT of the N Unit. Connect the Type 111 PULSE OUTPUT to the input of the device under test. The output of the Type 111 should be terminated in 50Ω; use the 50Ω BNC termination (Tektronix Part No. 011-049) with a GR to BNC adapter. Then, connect the P6025 Probe to the output of the device under test.

This system can be used to measure the signal delay through a device. With the Type 111 PULSE OUTPUT connector properly terminated in 50Ω, connect the P6025 Probe to the output of the termination and note the 50% amplitude point of the waveform. Then, connect the Type 111 PULSE OUTPUT to the input of the device under test, and connect the probe to the output of the device under test. To calculate the delay, multiply the distance in centimeters between the 50% points of the two waveforms by the reading on the Type N NANOSEC/CM control.

For other test systems, see the Type 110, 111, or N Unit manuals for the correct procedure.

NOTE

The probe power jacks on the Tektronix Type 517, 524, and 128 mate with the P6025 Power Plug. However, the voltage at these jacks is higher than specified for the P6025 Probe and will change the gain of the probe. The GAIN ADJUST control in the P6025 does not have enough range to correct this error.

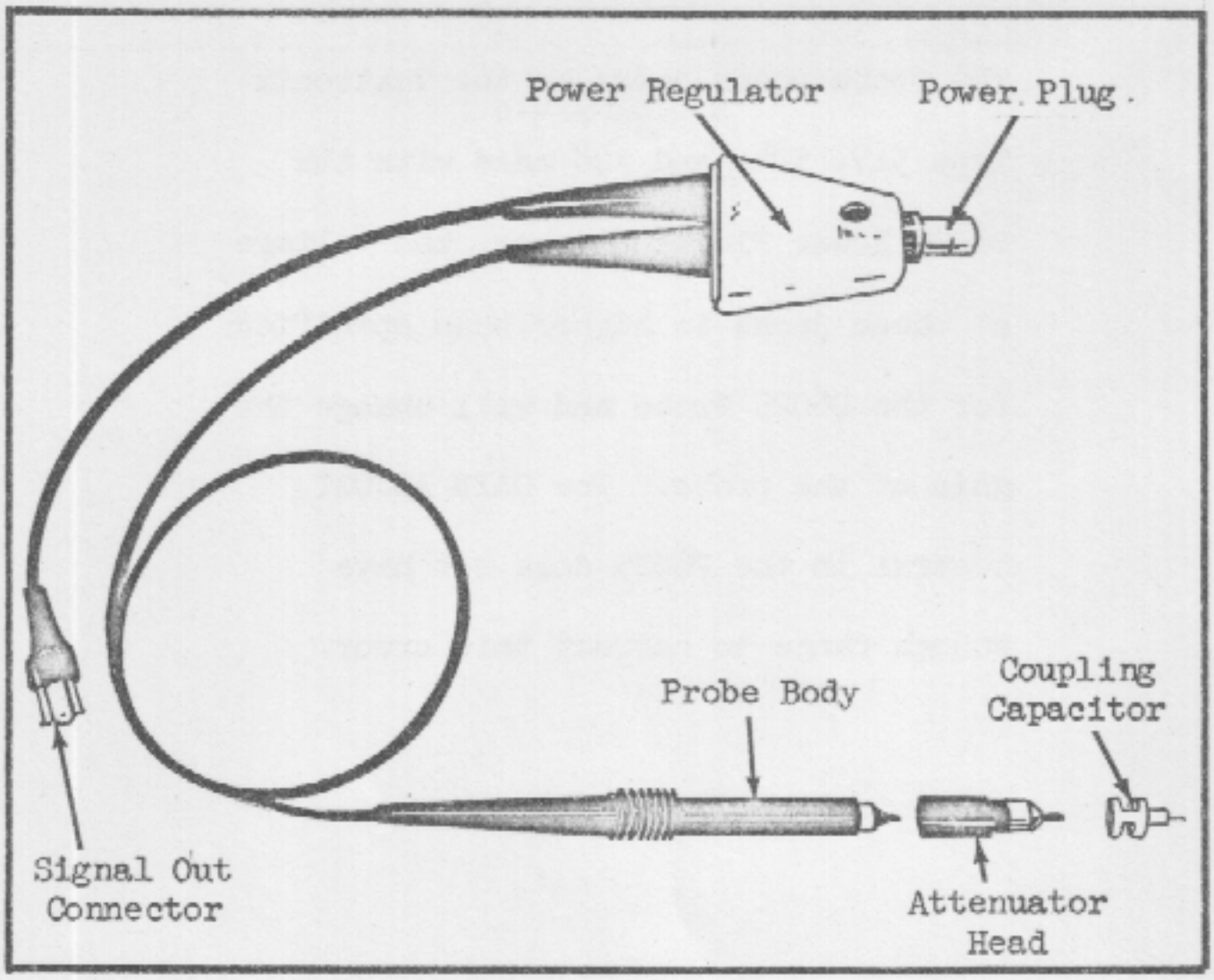


Fig. 2-1. P6025 Probe with attenuator head and coupling capacitor.

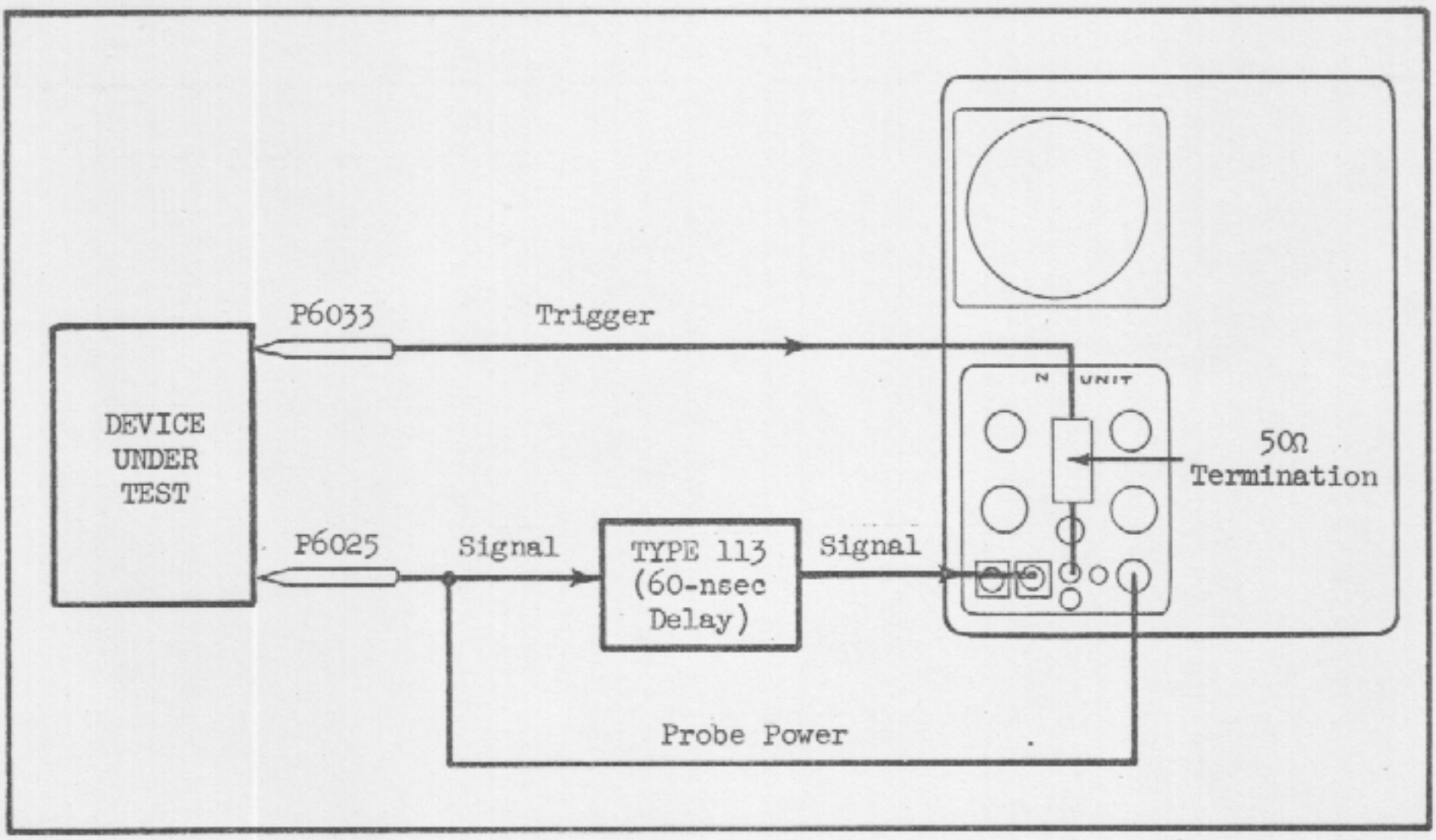


Fig. 2-2. Test setup using P6033 Trigger Pickoff Probe and Type 113 Delay Cable.

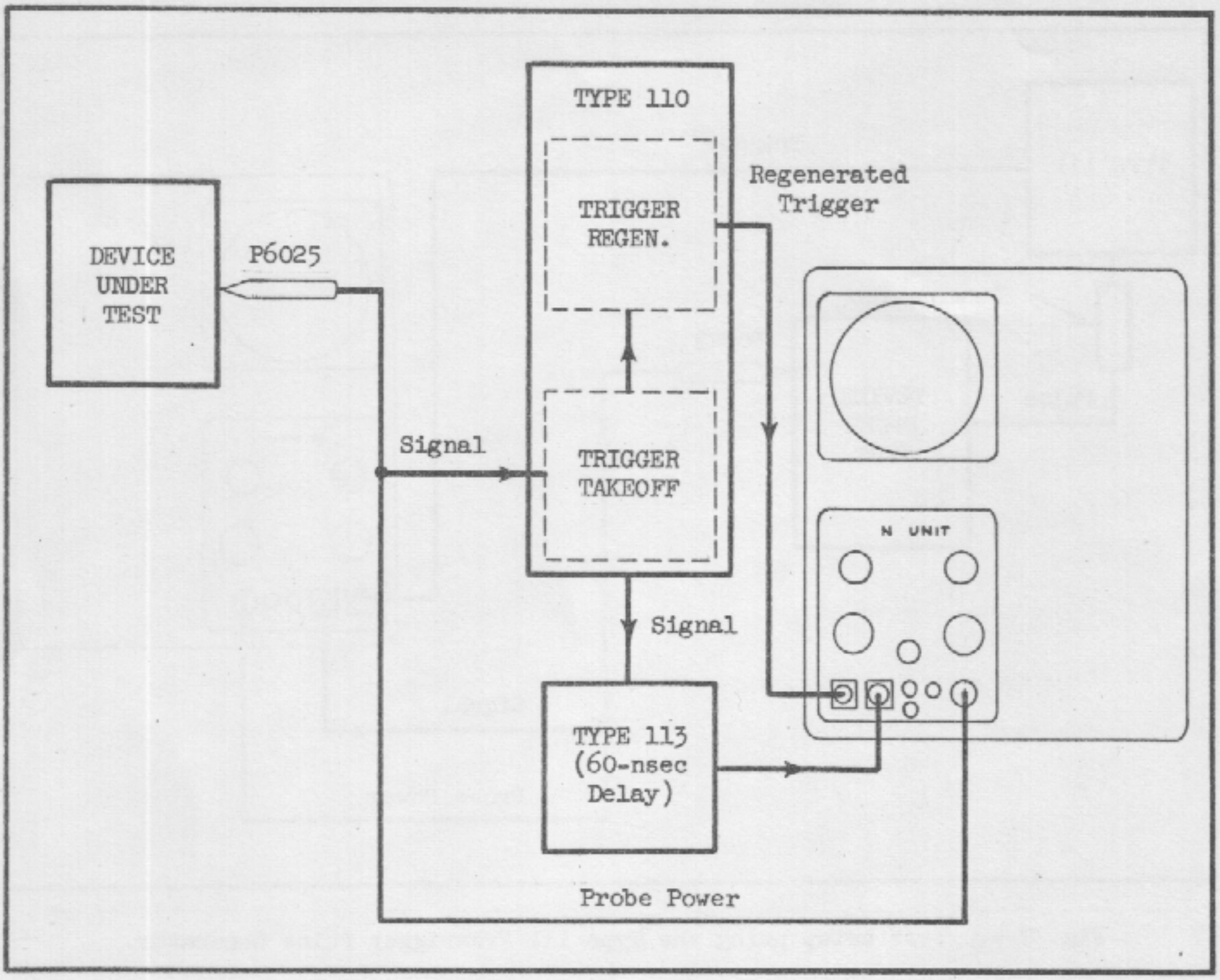


Fig. 2-3. Test setup where Device Under Test cannot supply required trigger.

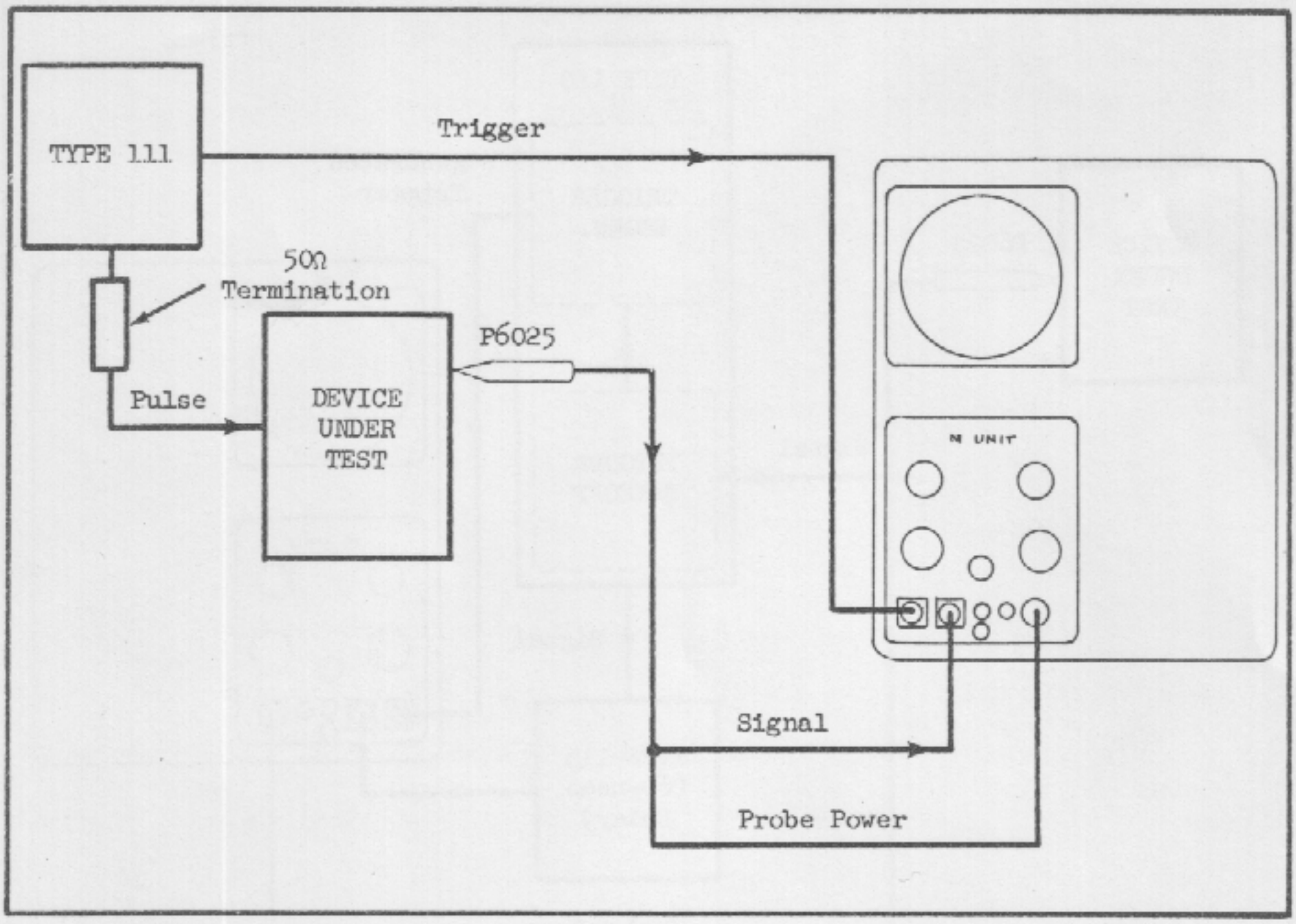


Fig. 2-4. Test setup using the Type 111 Pretrigger Pulse Generator.

SECTION 3

CIRCUIT DESCRIPTION

General

The circuit of the P6025 Probe consists of three parts; the cathode follower input circuit, the attenuator heads, and the power regulator. A five conductor cable connects the signal take-off circuit to the power regulator. One element of the cable is a 50Ω coaxial line for signal transfer.

The circuit diagrams at the rear of this manual may be used throughout the following discussion.

Cathode Follower Circuit

V103 is connected as a cathode follower to provide high-impedance input with low-impedance output. Plate power for the stage is obtained from the Power Regulator. R106, L106, R107, and C107 in the plate circuit provide a constant damping resistance of approximately 75 ohms for all frequencies up to about 600 mc. The plate voltage is adjustable (by means of the GAIN ADJUST in the Power Regulator) to control the stage gain.

The output signal is obtained from the cathode circuit of V103. The Diode D103 is a dc-setting device; it offers very little signal attenuation. The signal is obtained from the junction of D103 and R104 and applied to the Signal Out connector through the interconnecting cable.

Sampling pulses from the N Unit SIGNAL INPUT connector reflect back through the interconnecting cable. The network consisting of R102, R103, D103, R104, and the cathode output impedance of V103, terminate the pulses in 50 ohms. This prevents the sampling pulses from reflecting back to the SIGNAL INPUT of the N Unit and interfering with the displayed waveform.

The signal path of the P6025 Probe is completely dc-coupled. Therefore, any dc voltage at the probe tip will be displayed on the crt as a vertical shift in the trace. Since a cathode follower provides no polarity inversion, the displayed waveform will be the same polarity as the signal.

L108 and L109 prevent high-frequency signals at the cathode of V103 from being coupled to the N Unit through the heater circuit.

Power Regulator

The Power Regulator contains the GAIN ADJUST circuit, the regulator circuit, and the Power Plug. It is connected to the probe body by the interconnecting cable. The 50Ω signal cable passes through the Power Regulator housing to the Signal Out connector.

The Power Plug is a four pin connector which mates with the N Unit PROBE POWER jack. The pin connections are as follows:

Pin 1	6.3 volts ac, elevated to +100 volts dc.
Pin 2	6.3 volts ac, elevated to +100 volts dc.
Pin 3	+100 volts dc.
Pin 4	Ground.

The heater wires from pins 1 and 2 pass through the Power Regulator housing to the interconnecting cable. Pin 4 establishes a common ground between the N Unit, Power Regulator, and Probe body.

The +100 volts at pin 3 of the Power Plug is applied across the divider R610, R611, and R612. R612, the GAIN ADJUST, adjusts the voltage at the base of Q614 between about +61 and +81 volts. This in turn controls the voltage

at the plate of V103. C611 grounds any ac at the base of Q614. D614 holds the base of Q614 near its emitter and thus protects the transistor when the Power Plug is connected.

In addition to setting the plate voltage of V103, Q614 in conjunction with Q627 cancels out any change in voltage at the plate of V103. For example, if the emitter voltage of Q614 increases because of a decrease in conduction of V103, the transistor current decreases. This raises the voltage at the base of Q627, which increases the drop across the collector load R624 and lowers the voltage at the emitter of Q614. This regulator action tends to cancel any tendency for the plate voltage of V103 to change. This action occurs very rapidly so that as the voltage attempts to change it is immediately opposed by an equal and opposite voltage.

D627 places a small bias on Q627, which raises its base-input resistance and raises the load resistance seen by Q614. R627 is a current shunt, sharing the load current with Q627. The R626-C626 network is a filter to keep high frequencies out of the regulator.

Attenuator Heads and Coupling Capacitor

The attenuator heads contain series and shunt capacitors and resistors designed to give the desired attenuation ratio. The 10-megohm input resistance and low input capacitance remains constant, regardless of the attenuator head used. Each head contains a variable capacitor to set the ac attenuation ratio correctly.

The coupling capacitor plugs onto the attenuators to provide ac coupling. The low-frequency 3-db point, with the coupling capacitor, is approximately 20 cps for all heads.

SECTION 4

MAINTENANCE

Inspection

If trouble developes in the Type P6025 Probe, a thorough visual inspection may reveal the problem quickly. Foreign metallic material within the Power Regulator can lead to electrical failure. Check for mechanical defects such as loose or broken connections, broken circuit board, and frayed or damaged cables. Scorched or burned parts should be replaced. However, it is essential that you determine the cause of overheating before replacing heat-damaged parts.

Cleaning the Probe

Preventive maintenance should include wiping the P6025 Probe clean of any accumulated dust or dirt with a soft, lint-free cloth. If dirt remains, it can be removed by using a cloth dampened with water and a liquid detergent. Allow the probe to dry thoroughly before operating.

CAUTION

Do not use organic solvents to clean the plastic parts of the probe.

Soldering

Many of the components in the P6025 Probe have a small thermal mass. It is important, therefore, to use care when soldering these components. Use a low wattage soldering iron (60 watts or less.) A small soldering tip transfers heat to the junction at the best rate. Apply the heat for as short a time as necessary to make a good solder joint.

When soldering to a ceramic wafer in the probe body, use solder containing about 3% silver. This type of solder is used for printed circuit-work and is generally available

locally.

Ordinary 60/40 solder may be used on the etched circuit board of the Power Regulator. Since excessive heat may break the bond between the etched wiring and the board, use a low wattage iron with a small tip.

Whenever soldering on any part of the P6025 Probe system, always use a heat sink between the soldering iron tip and the part being removed or replaced. The long-nosed pliers used to hold the part can serve as an adequate heat sink in most cases.

Parts Replacement

When replacing parts in the P6025 Probe, maintain the original lead length and part position. The replacement procedure for some of the critical parts and assemblies is contained in the following information. However, since many of the parts require no special replacement procedure, simply observe normal soldering and replacement procedures.

Removing the Probe Cover

Entry into the P6025 Probe is accomplished by the removal of a small allen set-screw from the rear of the probe cover. Then, grasp the cover firmly in one hand and the ventilation section in the other and pull the cover straight off the tip end of the probe. Since the cover is tightly fitted to the body, it may require a little pull to remove. Do not remove it by a jerking motion; a steady straight pull is best.

Replacing the probe cover is accomplished by reversing the removal procedure. The allen set-screw should be located to go through the hole in the chromed inner body and seat on the black metal under the chrome.

Removing the Power Regulator Cover

Remove the four screws located in the corners of the large end of the Power Regulator. The blue cover will then slip off the regulator body over the connector end.

Tube Replacement

To replace the tube in the probe body, remove the probe cover and tube shield. Unsolder the two resistors connected to the tube tip. Slide the tube forward, out of its socket and out of the probe. When replacing the tube, replace the resistors in their original position. Replacement tubes may be purchased only from Tektronix.

Ceramic Wafer Replacement

The ceramic wafers within the P6025 Probe are held in place by 3% silver-bearing solder at their base. To replace a wafer, remove all of the component leads, noting their exact locations. Then, using a quarter-inch tip in a 60-watt iron, unsolder the base of the wafer from the probe body and remove it. Clean any excess solder from the probe body. Position the new wafer in the body and solder it in place. Use 3% silver-bearing solder, both on the wafer base and for replacing the components.

Circuit Board Replacement

Replacement Power Regulator circuit boards are available from the factory fully wired. Use the following procedure for replacing the board. First, unsolder all connections leading to the Power Plug and the interconnecting cable. Note their color-code and location. Remove the nut and washer from Q627. Remove the screw next to the GAIN ADJUST control that holds the circuit board to the frame and remove

the board. Before putting in the new circuit board, attach all components not furnished with the board. Replace the circuit board by reversing the removal procedure.

Attenuator Heads and Coupling Capacitor

Attenuator head or coupling capacitor repair should not be attempted. When damaged, they should be replaced. Order replacements through your local Tektronix Field Office. When ordering, include a description of the part and the Tektronix part number stamped on the part being replaced.

TROUBLESHOOTING

All forms of Type P6025 Probe failure cannot be foreseen. The following procedure covers some of the basic troubles that may occur.

Most troubles occurring in Tektronix instruments result from the failure of vacuum tubes or transistors. Therefore, if trouble occurs, tubes and transistors should be checked as one of the first steps. It is preferable to check them by substitution rather than with a tester since testers frequently fail to indicate certain troubles which can affect instrument performance. When a tube or transistor develops shorted elements, associated components can be damaged. Look for burned resistors, etc., when replacing defective tubes or transistors.

No Signal at SIGNAL OUT Connector

If the plate voltage of V103 is less than +60 to +80 volts, the trouble is probably in the Power Plug, Power Regulator, or interconnecting cable.

If the voltage is satisfactory at the plate of V103, check for 6.3v ac between pins 3 and 6 of the tube.

CAUTION

The heater of V103 is elevated to +100 volts.

If no heater voltage exists between pins 3 and 6 of V103, either L108 or L109 may be open. If they are good, check the voltage at the N Unit PROBE POWER jack.

If all voltages are correct, apply a test oscilloscope Amplitude Calibrator signal of .1 VOLTS directly to the probe tip. Check for the 0.1 volt-signal at the grid of V103, for slightly less than 0.1 volt at the cathode of V103, and for about 20 millivolts of signal into the signal output cable. If the proper signal appears at each of the above test points, check the continuity of the signal output cable with an ohmmeter.

Incorrect Gain

If it is impossible to obtain a probe gain of about 0.2 within the full rotation range of the GAIN ADJUST control, then check the Type N Unit for proper operation. (Any time the GAIN ADJUST control of the P6025 Probe Power Regulator is adjusted, it may be necessary to readjust the Type N Unit to compensate for the changing dc voltage at the output of the probe interconnecting cable). If the trouble does not lie within the N Unit, some of the following suggestions may help locate the problem.

If the plate voltage of V103 cannot be adjusted through the range of +60 to +80 volts by the GAIN ADJUST control, either the load drawn by V103 is incorrect, or the Power Regulator is at fault.

If the plate voltage of V103 is higher than +80 volts, V103 may be at fault with low cathode emission, one of the

cathode-return components may have changed in value, or Q627 may be shorted. With the P6025 Probe disconnected from the N Unit, a check of the cathode circuit of V103 can be made with an ohmmeter. The ohmmeter should have a 1.5-volt internal battery, and should be set at its X10 resistance range. Connect the ohmmeter positive lead (usually the COMMON lead) to the cathode of V103, and the other lead to the probe frame. The ohmmeter should indicate a resistance value of about 250 ohms. Reversing the ohmmeter leads should show an open circuit. If both ohmmeter polarities indicate an open circuit, either D103 or one or more of the 75-ohm resistors is open.

If the cathode circuit of V103 appears normal, replace V103 and check again for a probe gain of about 0.2 within the full rotational range of the GAIN ADJUST control.

If the plate voltage of V103 is lower than +60 volts, V103 may be gassy and conducting heavily. It is doubtful that a shorted D103 can cause this effect, but rather that the tube itself should be changed.

Incorrect gain, associated with incorrect plate voltage for V103, can also be caused by problems within the Power Regulator. The first thing to suspect - after making certain V103 is good - is the semiconductors. Begin by changing Q614, and then Q627. The usual trait of transistor failure is for the transistor to either short or open. Thus, it is probable that if a Power Regulator transistor is at fault, the GAIN ADJUST control will not be able to vary the plate voltage of V103 at all.

Normal voltage changes due to rotation of the GAIN ADJUST control within the Power Regulator are listed below. Each voltage range is obtained by connecting a voltmeter to

the collector and emitter leads of the transistor, or directly across a resistor. The voltage range across Q614 should be from 15 to 36 volts, and across R624 about 13 to 20 volts.

If you find Q614 shorted, check to see if D614 is open. If you find Q627 is shorted, check to see if D627 is shorted.

If any semiconductor is shorted, visually inspect the Power Regulator for other scorched or burned components.

Signal Off Screen

If the oscilloscope crt trace cannot be brought to the crt center by normal adjustments of the Type N Unit, disconnect the P6025 Probe Signal Output Connector from the N Unit. If the trace still cannot be restored, refer to the Maintenance section of the Type N Unit instruction manual.

If the Type N Unit can be adjusted to bring the trace to the crt center, then measure the voltage at the P6025 Probe Signal Out Connector. It should be about 0.4 volt. If considerably higher, an ohmmeter check across the Signal Out Connector (with the probe power off) should show if R104 is open or the correct value. If R104 appears to be the correct value, check for a shorted transistor in the Power Regulator unit.

SECTION 5

CALIBRATION

General

The Type P6025 Probe is a stable unit and should not require frequent calibration.

When calibrating the P6025 Probe always use a properly calibrated test oscilloscope and Type N Unit. If calibrating the probe due to a failure, refer to the maintenance section of this manual for some correction suggestions.

Probe Gain Adjustment

The Test oscilloscope AMPLITUDE CALIBRATOR can be used to aid in setting the P6025 GAIN ADJUST control.

Place the 10X Attenuator head on the probe tip.

Set the AMPLITUDE CALIBRATOR to .2 VOLTS.

Set the Type N Unit TRIGGER SENSITIVITY fully clockwise to FREE RUN.

Touch the 10X Attenuator tip to the CAL OUT. connector and adjust the GAIN ADJUST control of the Probe Power Regulator for two centimeters of display. The Calibrator waveform will appear as a two-trace crt display with occasional peaks. Adjust the GAIN ADJUST control so the center of each of the two horizontal traces is centered over a horizontal graticule line, and that the traces are two centimeters apart.

When it is necessary to change V103, there is a possibility that one of the cathode circuit selected resistors, R102-R103 will have to be reselected. The need to change one of them will be based upon the ability of the GAIN ADJUST control to establish correct probe gain. It is suggested that only one of the two resistors, R102-R103, be changed, and that the one mounted down inside the probe case remain 75Ω.

For probes having excess gain, a value of 82Ω or 100Ω may be necessary. For probes with low gain, a value of 68Ω or 56Ω may be necessary. Choose a resistor that permits proper gain adjustment with the GAIN ADJUST control near its midrange point, preferably not near one end of its rotation.

Attenuator Head High-Frequency Compensation

The attenuator head high-frequency attenuation (when driven by a fairly low-impedance square-wave generator), must be compensated for proper probe performance. This is accomplished by rotation of a small nylon set-screw located near the tip end of each attenuator.

The procedure for attenuator compensation follows:

Set the Type N Unit TRIGGER SENSITIVITY control to FREE RUN.

Patch the test oscilloscope AMPLITUDE CALIBRATOR output to the oscilloscope external TRIGGER INPUT connector.

Contrary to normal N Unit operation, set the oscilloscope HORIZONTAL DISPLAY control to NORMAL or A SWEEP. Set the TIME/CM control to .5 mSEC, and trigger the display externally on the calibrator signal.

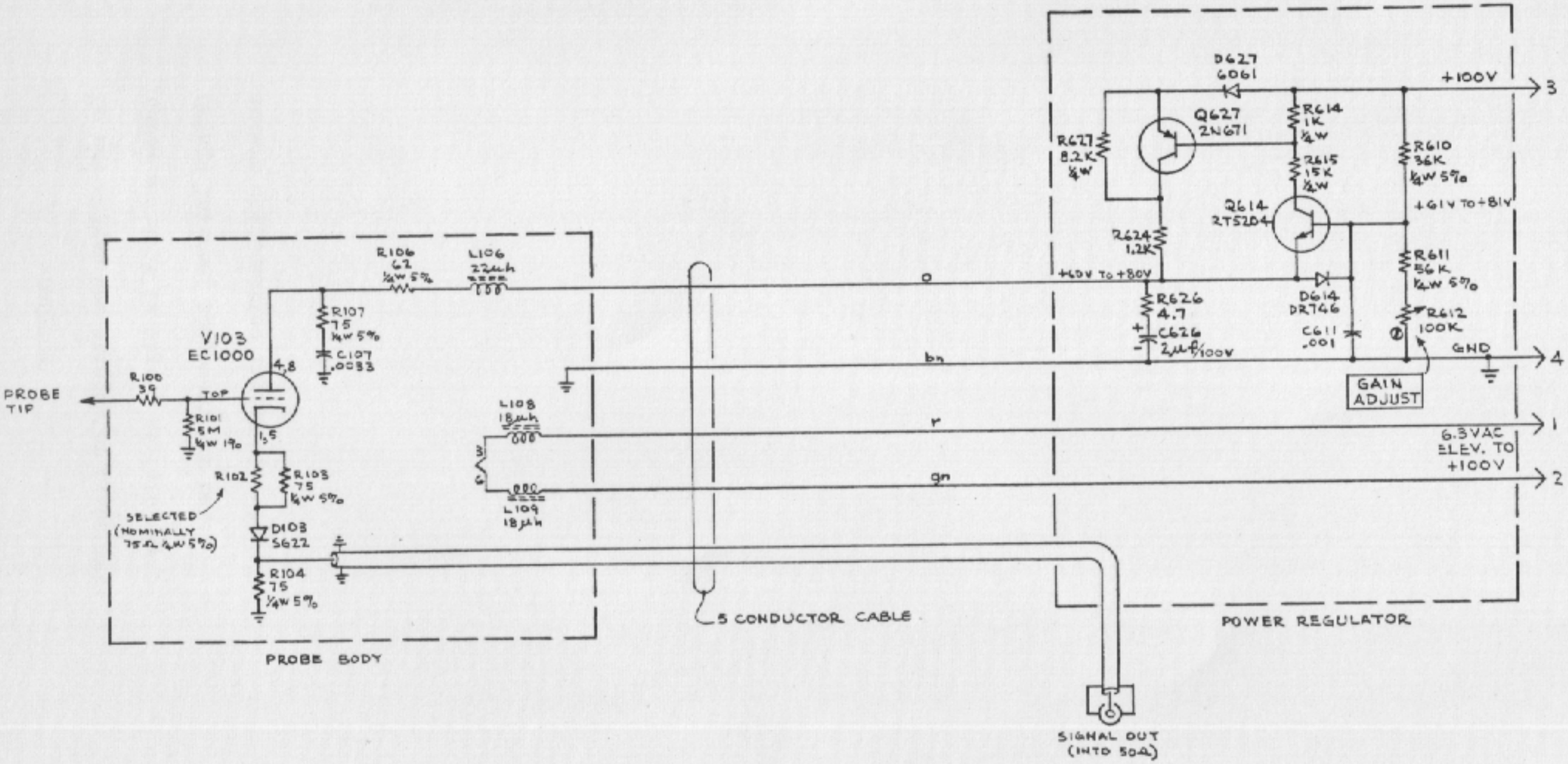
Adjust the setting of the Amplitude Calibrator output to permit individual attenuator heads to present two or three centimeters of crt display.

By careful adjustment of the oscilloscope STABILITY and TRIGGERING LEVEL controls, and perhaps the N Unit TRIGGER SENSITIVITY control at its FREE RUN end of rotation, a stable calibrator waveform can be presented.

Make small adjustments to the nylon high-frequency compensation set-screw on each attenuator head, so the display exhibits a square corner at the top of each square-wave.

CAUTION

Do not adjust the attenuator nylon set-screw until it is tight, as this may damage internal components or make future compensation impossible.



TYPE 6025 CF PROBE