INSTRUCTION MANUAL

Serial Number B050420

TYPE S-5 SAMPLING HEAD

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix
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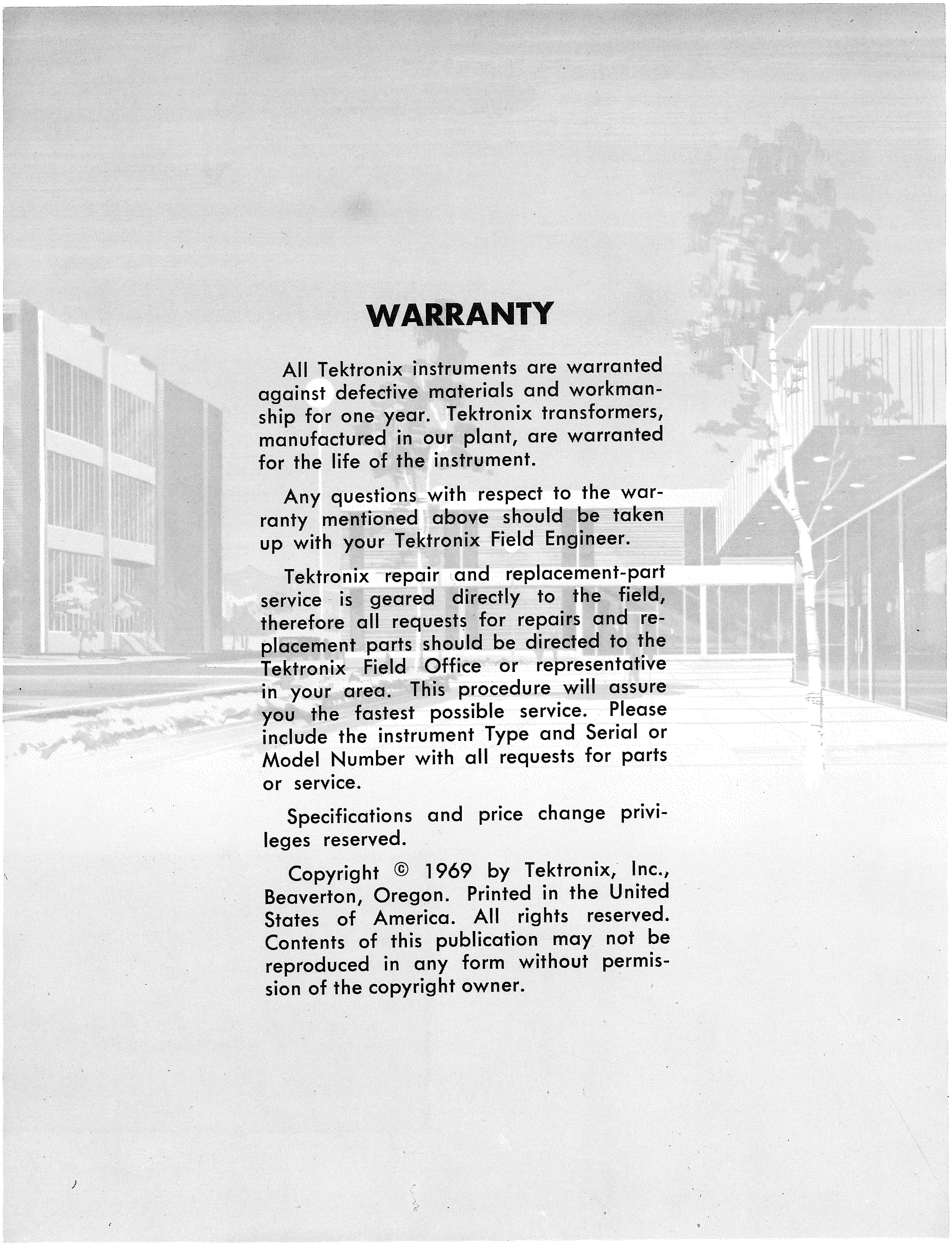

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our 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.

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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.

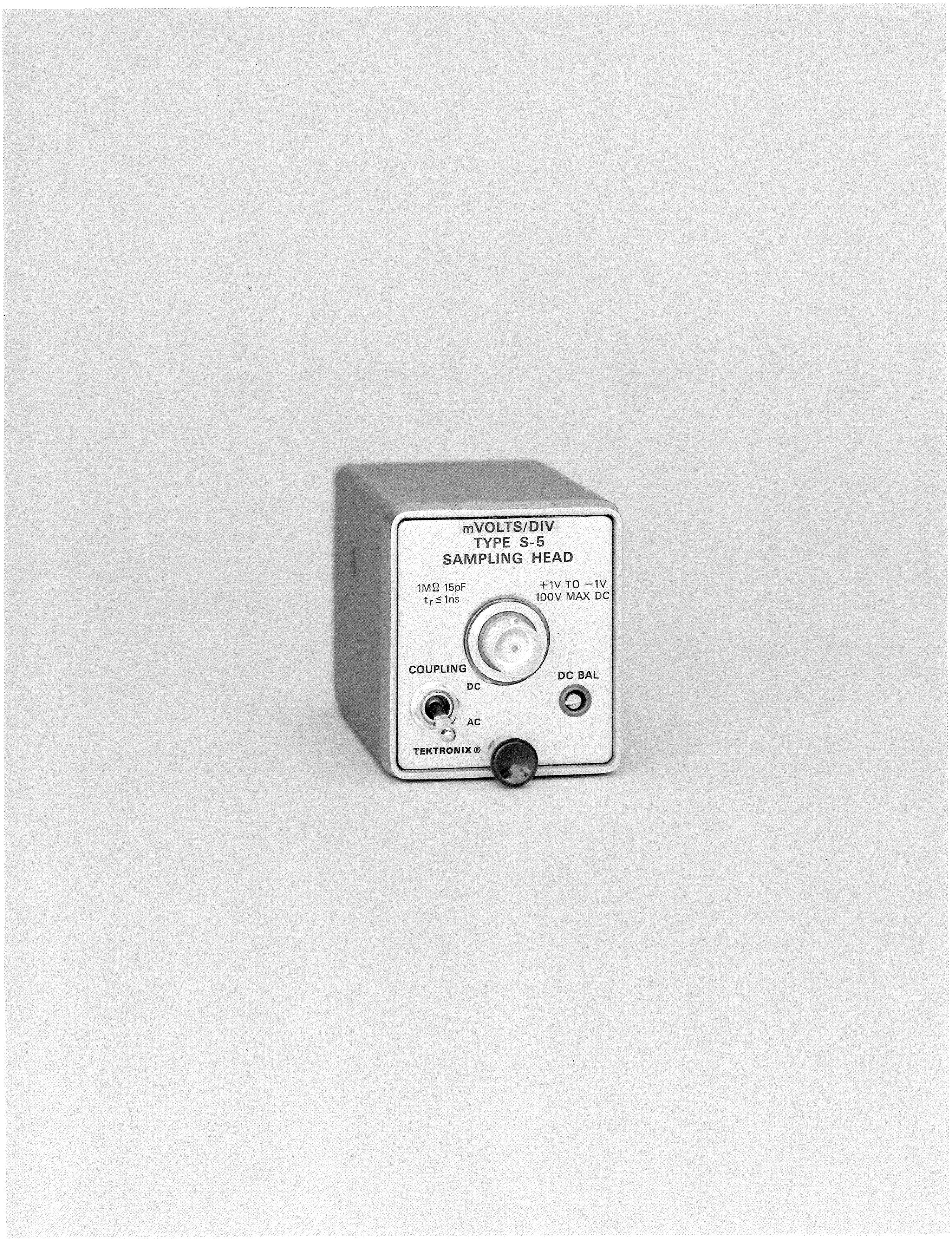


Fig. 1-1. Type S-5 Sampling Head

SECTION 1
SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

General Information

The Type S-5 Sampling Head is an input signal processing unit for Tektronix sampling units such as the Type 3S2, 3S5 and 3S6. Input characteristics of the sampling system channel in which the unit is installed are determined by the Type S-5. The low frequency input resistance is 1 MΩ paralleled by 15 pF capacitance. It has a 10% to 90% pulse risetime of 1 ns or less when driven from a 25Ω source. Input signals can be either AC or DC coupled. It is the 1 MΩ input that allows passive attenuator probes to be used, such as the 10× P6010 Probe (3.5 ft. long supplied with the Type S-5). The P6010 retains the 10% to 90% pulse risetime of 1 ns or less when driven from a 50Ω source. Deflection factors range from 2 mV/Div to 200 mV/Div without a probe, and are multiplied by the probe attenuation factor such as 10× for the P6010 and 100× for the P6009.

The Type S-5 can be installed directly into a sampling unit or used remotely (with the Type 3S2 or Type 3S5) on an optional 3 foot or 6 foot extender cable. When used with a Type 3S6 Sampling Unit, the Type S-5 is plugged onto the dual input extender cable supplied with the Type 3S6.

A portion of the signal delivered to the sampling head input is coaxially coupled to the sampling unit for use as an internal trigger signal. The Type 3S2 allows selection of the trigger pickoff signal from the Channel A or Channel B sampling head. Type 3S5 and 3S6 Sampling Units permit use of the trigger pickoff signal only from Channel A. Use of this trigger pickoff signal is dependent upon the type of sampling unit and sampling sweep unit used in the system. See the instruction manual for your sampling unit and sampling sweep unit for further information.

Vertical deflection factors of the sampling system are labeled at the top of the Type S-5 as mVOLTS/DIV; the label refers to the sampling unit Units/Div switch of the corresponding channel, and does not include any probe attenuation factor.

Digital Unit Programming Connections

The Type S-5 has two contacts at its rear connector that program the decimal and units-of-measure lamps of a Tektronix Type 6R1A or Type 230 Digital Unit. These connections are not used with a Type 3S2 Sampling Unit. When using a Type 3S5 or Type 3S6, one of the sampling head contacts notifies the digital readout unit, through the sampling unit digital control circuits, that the Type S-5 is a voltage measuring head. This causes the Volts lamp of the digital readout unit to light. The other sampling head contact notifies the digital readout unit, through the sampling unit digital control circuits, that the Type S-5 basic sensitivity requires no decimal shift of the numbers around the sampling unit Units/Div switch.

ELECTRICAL CHARACTERISTICS

Characteristics

The following characteristics apply over an ambient temperature range of 0° C to +50° C and after a five minute warmup providing the instrument was calibrated at a temperature between +20° C and +30° C.

Characteristics listed below apply only after the Type S-5 has been properly mated to the sampling unit and indicator oscilloscope and after these units have been given sufficient warmup time. To determine the particular system warmup requirements, refer to the related amplifier and indicator oscilloscope instruction manuals. A procedure for mating the Type S-5 to the sampling unit can be found in the Operating Instructions section of this manual.

ELECTRICAL CHARACTERISTICS

Characteritsics	Performance Requirement
Input RC	
Resistance	1 MΩ, ±1%.
Capacitance	15 pF, ±1 pF.
Response to Step Signals	(Verify using step 11 of Section 5.)
Risetime (10% to 90%	1 ns or less when driven by 25 Ω source. B.W. = 350MHz
Pulse Flatness Deviation (after 100% point on display)	(Verify using step 12 of Section 5.)
0 to 17 ns	+2%, —5% or less, total of 7% or less.
17 ns thereafter	+0.5%, —2% or less, total of 2.5% or less.
Maximum Operating Signal Voltage	
DC Coupled	1 V combined DC and AC peak.
AC Coupled	100 V DC and 1 V AC peak-to-peak.
Safe Overload Input Voltage	
DC Coupled	100 V DC or AC peak to 1 kHz.
Derating with Frequency	Derated 6 dB/octave above 1 kHz to 5 V AC peak at 20 kHz; no further derating required above 20 kHz.
Random Noise	500 μV or less, measured tangentially. (Verify using step 9 of Section 5.)

Characteritsics	Performance Requirement
Loop Gain (Dot transient Response)	Adjustable in the sampling unit to unity for signals up to 500 mV peak to peak; when the loop gain is adjusted to unity with positive input signals, the loop gain will be within 5% of unity with negative signals and vice versa.
With 3.5 foot length P6010 Probe compensated to operate with the Type S-5.	
Input RC	See the P6010 Probe instruction manual.
Response to Step Signals	(Verify using step 13 of Section 5).
Risetime (10% to 90%)	1 ns or less when driven by 50 Ω source.
Pulse Flatness Deviation (after 100% point on display) 0 to 17 ns	+5%, —5% or less, total of 10% or less.
17 ns thereafter	+1%, −3% or less, total of 4% or less.
Maximum Operating Signal Voltage DC Coupled	10 V peak-to-peak combined DC and AC peak.
AC Coupled	100 V DC and 10 V AC peak-to-peak.
Random Noise	5 mV or less, measured tangentially. (Verify using step 15 of Section 5).

ENVIRONMENTAL CHARACTERISTICS

Storage	Operating
Temperature— —40° C to +65° C	0° C to +50° C
Altitude To 50,000 feet.	To 15,000 feet.
Vibration	Will operate during and after 15 minutes along each axis at 0.015". Vary the Frequency from 10 to 50 Hz in 1-minute cycles. Three minutes at any resonance point or at 50 Hz.
Shock Will operate after 1000 g's, ½ sine, ½ ms duration, 2 shocks per axis. Total of 6 shocks.	
Transportation	Qualifies under National Safe Transit Committee Test Procedure Category IV (48 inch drop).

MECHANICAL CHARACTERISTICS

Finish—Anodized aluminum front panel, extruded aluminum blue-vinyl painted wrap-around cabinet.

Approximate Dimensions—4½" long; 1¾" wide; 2" high.

Weight—Net: approximately 9 ounces.

SECTION 2
OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

General Information

This section provides the basic information required for operation of the Type S-5 Sampling Head, including installation and First Time Operation.

The Type S-5 completes the circuitry of some Tektronix sampling units such as the Type 3S2. Used with these sampling units, the Type S-5 controls the input characteristics of the vertical channel by providing the Strobe Generator, Sampling Gate, Preamplifier and Trigger Pickoff Amplifier circuits. A Type S-5, Type 3S2, and a sampling sweep unit plugged into an indicator oscilloscope make up a sampling system. A choice of real or equivalent time sampling is provided by the type of sweep unit used.

The high input resistance (1 MΩ paralleled by 15 pF) allows the Type S-5 to be used with the many voltage and current probes now in use with real time oscilloscopes. However, maximum performance is obtained using the 3.5 foot version of the Tektronix Type P6010 10× probe supplied. Another very useful probe is the Type P6009, which gives 100× attenuation with 2 ns displayed risetime.

A portion of the input signal is provided to the sampling unit. In the Type 3S2, this signal is selected from Channel A or B, and returned to the front panel Trig Out connector for external triggering of sampling sweep units.

Function of Front Panel Controls

COUPLING Switch

AC position	The Type S-5 accepts only the AC component of the input signal.
DC position	The Type S-5 accepts both the AC and the DC components of the input signal.
DC BAL	This control is adjusted to balance the Type S-5 Gate circuit. Such balance minimizes the zero DC offset trace shift when the sampling unit Units/Div switch position is changed. The DC BAL control also may be specially adjusted to eliminate trace shift when the Variable Gain control is adjusted on any single mV/div switch setting and a particular setting of the DC Offset control. The DC BAL control must be readjusted whenever the signal source resistance is changed. (Examples of source resistance change are changes in probe types or from probe input to coaxial line input. Changing the probe from one source impedance to another will not affect DC BAL.)

Installing the Type S-5 Sampling Head

Fig. 2-1 shows the Type S-5 partially installed into a Type 3S2 Sampling Unit with Type 561B Oscilloscope and Type 3T2 Random Sampling Sweep. The sampling head (or heads) can be plugged into the sampling unit as shown, or used remotely on a special extender cable.

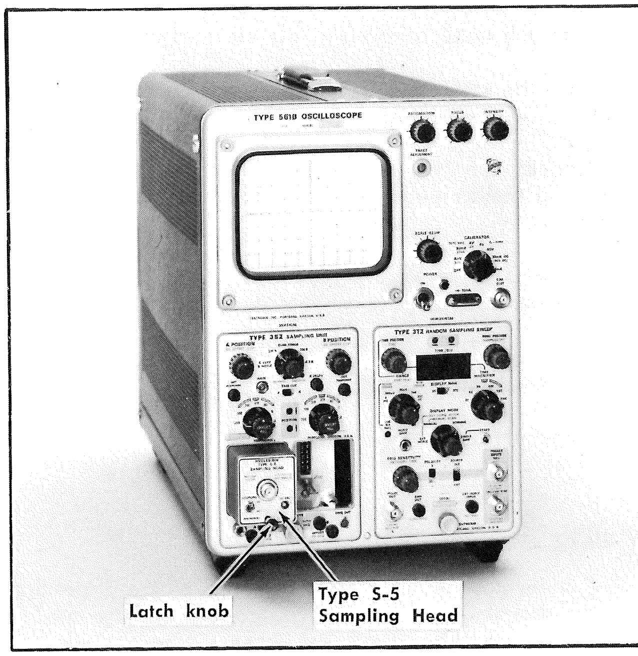


Fig. 2-1. Installation information.

Three and six foot extender cables are available. Order the three foot extender cable by Tektronix Part No. 012-0124-00, or the six foot extender cable by Tektronix Part No. 012-0125-00. Contact your local Tektronix Field Engineer or Representative for price and availability of these optional accessories. Power supplies and circuit interconnections are made through the two connectors at the rear of the Type S-5.

To insert the Type S-5 into the right or left hand compartments of the sampling unit, proceed as follows:

1. Pull the latch knob (Fig. 2-1) outward from the front panel (the latch knob will push out normally when the unit is inserted if the knob is left free to move).

2. Insert the Type S-5 slowly into the compartment, so the two plastic guides in the compartment engage the S-5.

3. Push the Type S-5 completely into the compartment.

3. Push the Type S-5 completely into the compartment.

4. Push the latch knob to lock the S-5 in place.

To remove the S-5 from the compartment, pull the latch knob away from the front panel, then pull the unit from the compartment.

To use the Type S-5 on an extender cable, use as follows:

1. Pull the latch knob located on the head end of the extender cable outward from the panel (the latch knob will push out normally when the extender is inserted if the knob is free to move).

2. Insert the extender cable head end slowly into the desired compartment in the sampling unit so the two plastic guides in the compartment engage the unit.

3. Push the head completely into the compartment.

4. Push the latch knob to lock the extender cable head in place.

5. Connect the Type S-5 to the other end of the extender cable in a similar manner, and set the latch knob to hold it in place.

6. To remove the Type S-5 from the extender cable, pull the latch knob on the front panel of the Type S-5, and remove the unit from the extender cable.

7. To remove the extender cable head from the sampling unit compartment, pull the latch knob outward from the front panel, then pull the unit free.

Mating

The vertical deflection factor labeled by the Type S-5, and the sampling system loop balance (adjusted by the DC Bal control) must be considered when mating a Type S-5 with a sampling unit.

The mVOLTS/DIV label on the Type S-5 names the deflection factor units of the sampling unit Units/Div switch located directly above the label. For example, with the Type S-5 installed in a Type 3S2 and the Units/Div switch set at 100, each major division of CRT deflection corresponds to 100 millivolts of input signal (when the Variable control is in the Cal position). The deflection factor is mated to the indicator oscilloscope CRT by adjusting the sampling unit Gain control while the Type S-5 is in Channel B. Refer to the sampling unit manual for its Gain adjustment.

DC Balance

The DC Balance control of the Type S-5 may need adjustment whenever the sampling head is changed from one sampling unit to another, is operated on an extender cable or when changing source resistance. Location of the control and details of its adjustment are described in First Time Operation which follows.

FIRST TIME OPERATION

The First Time Operation procedure utilizes, in addition to the Type S-5, a Type 3S2, a Type 561B, and a Type 284. The Type 284 may be replaced with a square wave signal source having about 1 μs period and about 1 V amplitude. The Type 3T2 Random Sampling Sweep unit is recommended for use with the Type S-5 because random sampling permits viewing the signal in advance of the triggering event. Such trigger lead-time is required by the Type S-5 with the Type 3S2 to view fast pulses without a pretrigger. The Type 284 is used as a signal source.

Setup Information

1. With the Type 561B Power switch off, insert a Tektronix Type 3S2 Sampling Unit into the vertical compartment (left) and a Tektronix Type 3T2 Random Sampling Sweep into the horizontal plug-in compartment (right).

2. Insert the Type S-5 Sampling Head into Channel A comcompartment (left) in the Type 3S2 leaving the latch knob free to move. Once the S-5 is seated, push the latch to lock it in place.

3. Set the Intensity control on the Type 561B fully counterclockwise.

4. Connect the Type 561B to a power source which meets its voltage and frequency requirements.

5. Set the Power switch to On. Allow about 5 minutes warm-up so the units reach operating temperature before proceeding.

6. For single-trace operation, set the controls as follows:

Type 3S2

Display Mode	Ch A
Normal-Smooth	Normal
A and B Position	Midrange
DC offset (both channels)	Midrange (5 turns from one end)
Units/Div (both Channels)	50
Variable (both Channels)	Cal
Invert (both Channels)	Push in
Dot Response (both Channels)	Midrange
B Delay	Midrange

Type 3T2

Horiz Position	Midrange
Samples/Div	9 o'clock position
Display Mode	Normal
Start Point	With Trigger
Sweep Rate	200 ns/Div
Range	10 μs
Display Mag	$\times 1$
Time Magnifier	$\times 5$

Period	1 μs
Mode	Square Wave Output
Lead Time	Optional

7. Connect a Probe tip to GR adapter, (Tektronix Part No. 017-0076-00) to the Type 284 Square Wave Output connector.

8. Connect a P6010 (10× attenuation) probe to the Type S-5 INPUT connector and insert the probe tip into the adapter. The probe should be compensated according to its instruction manual.

9. Place the Type S-5 COUPLING switch at AC.

10. Connect the trigger output signal from the Type 284 through a coaxial cable to the External Input 50 Ω connector on the Type 3T2.

11. Advance the Type 561B Intensity control until the free running trace brilliance is at the desired viewing level.

12. Center the trace on the graticule with the Type 3S2 A Position control and/or the DC Offset control. Adjust the Type 3T2 Trig Sensitivity control for a stable triggered display of a two-cycle square wave with an amplitude of about 4 divisions.

Adjusting the Dot Response Control, Sequential Sampling

One method of adjusting the dot response control for unity loop gain is to use a double or multiple-triggered sweep. This causes each sample to respond to the full signal amplitude and produce a display similar to Fig. 2-2A or B.

13. To obtain a display similar to that of Fig. 2-2A or B, turn the Type 3T2 Trig Sensitivity control clockwise into the free run region. Then adjust the Recovery Time control until the desired display appears.

14. Turn the Channel A Dot Response control to obtain a display showing unity loop gain (see Fig. 2-2B). Fig 2-2A shows greater than unity loop gain. This requires counter clockwise rotation of the Dot Response control to obtain unity loop gain. The double triggering shown in Fig. 2-2A and B is useful to adjust the loop gain, but should not be used in making measurements.

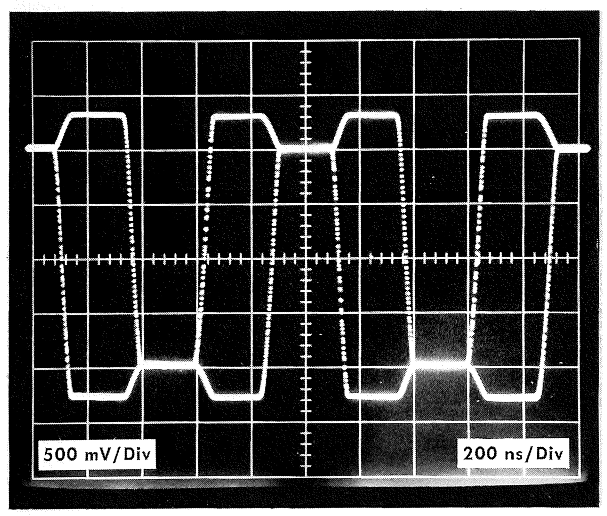
15. After the loop gain is adjusted to unity, turn the Trig Sensitivity control counterclockwise into the triggered region for a stable trace of a properly triggered display similar to Fig. 2-2C.

Adjusting the Dot Response Control, Random Sampling

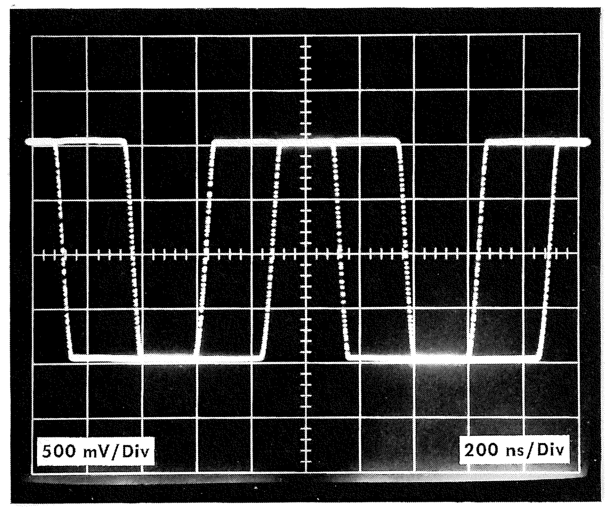
16. Another convenient method of adjusting the loop gain to unity can be shown with random process sampling. Change the following Type 3T2 controls:

Start Point	Before Trigger
Samples/Div	Fully Clockwise
Recovery Time	Fully counterclockwise

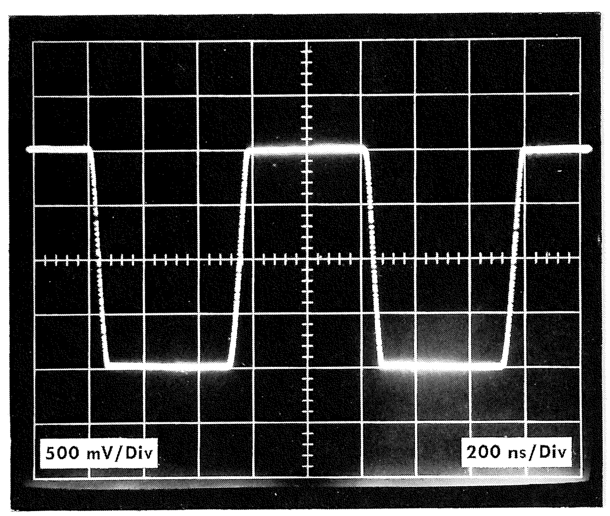
17. Adjust the Trig Sensitivity control for a triggered display.



(A) Double-triggered, > unity loop gain



(B) Double-triggered, unity loop gain



(C) Properly triggered

Fig. 2-2. Typical display for unity dot transient response adjustment in normal sequential sampling. (The 10X probe is included in the mV/Div.)

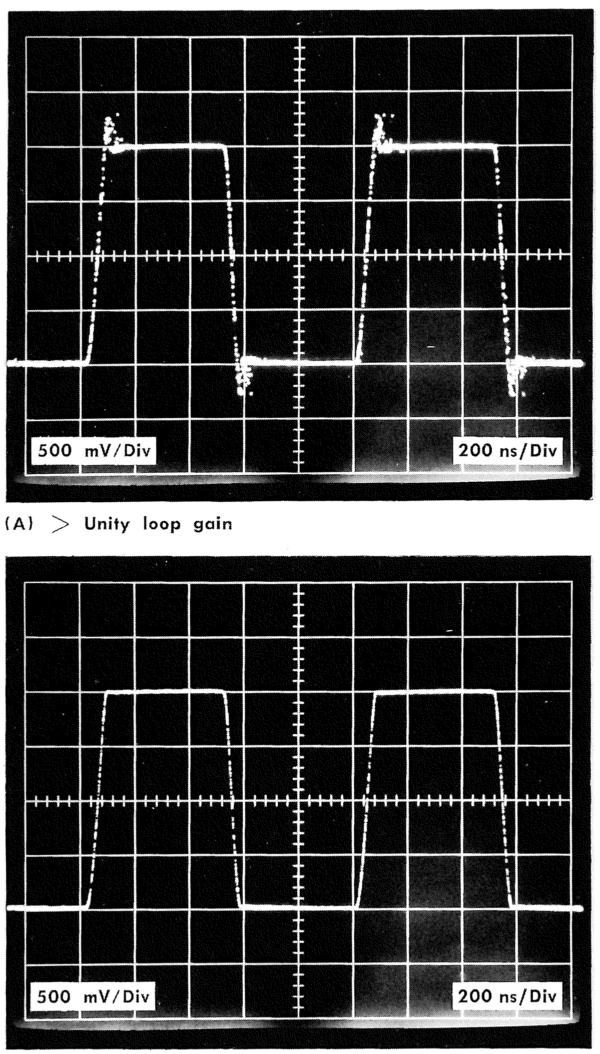
18. A loop gain greater than unity will produce a display similar to Fig. 2-3A. Adjust the Type 3S2 Dot Response control for a unity loop gain display similar to Fig. 2-3B. This method is also suitable for pulse signals.

DC Balance Adjustment

19. Remove the probe tip from the adapter. Turn the Type 3S2 Trig Sensitivity control clockwise to free run the trace.

20. Insert the probe tip into the Channel A Offset output and locate the trace with the Channel A Position control. Adjust the DC Offset control for no trace shift while making and breaking the probe contact with the Offset output. The DC Offset is now 0 V.

21. Switch the Type 3S2 Units/Div control throughout its range, adjusting the Type S-5 DC BAL control for a trace shift of not over one division as the sampling unit Units/Div control is switched from one end to the other. The DC BAL control is adjusted with a screwdriver which is inserted into the hole located on the front panel. This adjustment should be made when the Type S-5 is shifted from one sampling unit to another, when operated on a sampling head extender cable and when changing signal source.



(A) > Unity loop gain

(B) Unity loop gain

Fig. 2-3. Typical display for unity loop gain adjustment in random sampling operation. (The 10X probe is included in the mV/Div.)

If a coaxial line is used in place of the probe, the coaxial line must be $\geq$2 ns in electrical length in order to make the system insensitive to drive impedance for DC balance and dot response.

GENERAL OPERATING INFORMATION

Input Voltage Considerations

Proper displays of various signal amplitudes require special attention to the type of time base generation in use. There are also input voltage limits that must be observed to prevent either display distortion or damage to the Type S-5.

Input voltage limits depend upon whether an attenuator probe or coaxial line is used to connect the signal source to the Type S-5. Table 2-1 shows the maximum permissible signal voltage and the safe overload voltage for each position of the Type S-5 COUPLING switch. Refer to your sampling unit manual for further information on signal coupling.

TABLE 2-1

TYPE S-5 INPUT SYSTEM VOLTAGE RATINGS

SYSTEM	Input Signal Maximum	Safe Overload
10X Probe DC Coupled DC + Peak AC	10 V	See P6010 instruction manual
AC Coupled, DC Voltage	100 V	100 V
Coaxial Line DC Coupled, DC + Peak AC	1 V	100 V (DC + peak AC) to 1 kHz; derate 6 dB/octave above 1 kHz to 5 V (DC + peak AC) at 20 kHz; no further derating above 20 kHz
AC Coupled DC Voltage	100 V	100 V

Unity Loop Gain

Where unity loop gain is required, accurate displays are possible to achieve only when the input amplitude and the time base generation mode are both considered. The two time base generation modes are: (1) normal process sampling, where each dot is displayed in sequence across the CRT, and (2) random process sampling where the dots are not necessarily displayed in a sequence that progresses uniformly across the CRT. The Type 3T2 Random Sampling Sweep unit presents random process sampling displays in a controlled sequence very similar to normal process sampling when the Time Magnifier switch is at ×1 or ×2 and the trigger signal repetition rate is uniform. The random process dot sequence is definitely not sequential when the Time Magnifier switch is anywhere between ×5 and ×50.

Unity loop gain displays are not usually required when the signal rate of rise and the sweep rate selected provide a large number of dots for any vertical display change. Unity loop gain is required for some random process sampling displays, and for normal process displays where there are either no samples, or less than about 6 samples in a step transition. (Many dots in any vertical change permits valid random process displays without unity loop gain when the Type 3T2 Time Magnifier is at ×1 or ×2).

In summary, unity loop gain exists when the vertical channel (sampling head and sampling unit) will accurately shift a sample dot 100% of the signal amplitude. The Specification Section lists the loop gain linearity limits as ±5% for ≤500 mV input signals. A 5% loop gain linearity means that the vertical channel will shift a dot in the positive direction 100% of the full signal amplitude, but minus transitions may shift a dot between —95% and —105% of the full signal amplitude, and vice versa. (The Dot Response control thus allows either the display top or bottom to be adjusted to unity loop gain for close examination of signal detail.) Unity loop gain is obtained by proper adjustment of the sampling unit Dot Response control as described in First Time Operation.

Dot Response Control

Unity dot transient response for a P6010 probe is obtained with the Dot Response control set near the 3 o'clock position. If a 50 Ω coaxial line (terminated at the Type S-5 with a 50 Ω termination) is used, then unity dot transient response is obtained with the Dot Response control set near the 9 o'clock position. If the Dot Response control cannot be set to obtain unity dot transient response, then the Type S-5 Pre-amp Gain control R58 should be adjusted.

To adjust R58, which is located on the left side of the Type S-5, set the Dot response control to the desired position and adjust R58 for unity dot transient response by using the same type of dot transient response adjustment procedure as is given in the First Time Operation. The head may be left inserted in the Type 3S2 or mounted on a head extender for this adjustment.

Smoothing

Setting the Normal-Smooth switch of your sampling unit to smooth will result in a reduction of displayed noise. Since switching to smooth reduces loop gain to approximately 0.3, transient response problems caused by low loop gain may show up.

NOTE

Smoothing should not be used when the Type 3T2 is used as a random sampler.

A loop gain of less than unity can be useful, if the resulting compromise is understood and the system is operated properly. Random noise in the display is reduced when loop gain is less than unity, since several consecutive samples are averaged. The averaging may also slow down the fastest risetime capability, depending upon the number of dots contained in the step transition. By increasing the number of dots (Samples/Sweep or Samples/Div) in a step transition, the display will follow the actual step transition more closely. If the number of samples (dots) in the step transition is reduced below 12 the true waveshape may not be displayed in Smooth.

Smoothing is normally not needed with the Type S-5 because the noise level of the system is about one minor division of CRT deflection even when operating at 2 mV/div.

DC OFFSET Control

The sampling unit DC offset control permits selection of the offset voltages in the +1 V or —1 V range when the input signal is coupled into the Type S-5 with a coaxial cable or a 1× probe. The offset voltage can be used to cancel the effect of a DC input voltage of up to +1 V to −1 V. When the Type P6010 (a 10× probe) is used with the Type S-5, the offset voltage can be used to cancel the effect of a DC input voltage to the probe of up to +10 V to —10V. A 100× probe extends the range from +100 V to −100 V. For additional information on the DC Offset control, see the Operating Instruction section of the manual for the sampling unit in use.

Triggering from the Signal

The Type S-5 provides a Trigger pickoff signal to the sampling unit. This signal is an amplified version of the input signal.

In the Type 3S2, the signal is selected from the Channel A or B sampling head and returned to the front panel Trig Out connector by the trigger circuit. The amplitude is about 10% of the input signal into 50 Ω. The Type 3S2 (from Serial Number B040250-up) has approximately 1× the input signal voltage into 50 Ω and is AC coupled.

A Type 3S2 standard accessory trigger coupling cable can be used between the Type 3S2 and Type 3T2 for triggering the sampling sweep unit from the sampling head pickoff signal. Connect the cable between the Type 3S2 Trig Out connector and the Type 3T2 50 Ω Trigger input connector. Operate the Type 3T2 as if externally triggered. Repetitive sine or square wave displays are best viewed when operating the Type 3T2 Start Point switch at With Trigger (normal process sequential dot sampling.) Fast pulse signals require random process sampling with the Type 3T2 Start Point switch at Before Trigger.

The Type 3T4 and the Type 3T5 have external trigger input connectors. Both sampling sweep units operate in sequential sampling and may be used with the Type 3S2 providing a pretrigger is available for pulse signal displays.

The Type 3S5 Programmable Sampling Unit (which has an internal trigger path) may also be used. Where the triggering pulses have fast rise and have short duration (low energy content) a method of externally triggering the sampling sweep unit must be devised.

Additional trigger signal information should be obtained from the sampling unit and sampling sweep unit manuals.

Input Signal Connections

The Type S-5 input circuit has the unusual characteristic for a sampling oscilloscope of having a 1 MΩ input resistance paralleled by 15 pF. (Fig. 2-6, at the end of this section, shows the S-5 input resistance and reactance versus frequency curves.) Normally such an input circuit is available only in a conventional real-time oscilloscope. The primary advantage of the 1 MΩ input resistance is that it allows the operator to use a passive attenuator probe, such as the Tektronix P6010 10× Probe shipped as an accessory to the Type S-5. The 3.5 foot cable length P6010 does not degrade the S-5 risetime or bandpass limits when driven from a 25 Ω or 50 Ω signal source. All other Tektronix probes may be used with the Type S-5 with some decrease in bandwidth. Additional information, such as signal derating curves, are provided in the instruction manual for each probe. The 1× P6011, 10× P6010 and some coaxial cable input systems are described in brief tabular form in Table 2-2.

A second advantage of the 1 MΩ input resistance is that any characteristic impedance coaxial cable can be used as a signal input connection. Table 2-2 mentions some of the limitations of 25 Ω and 50 Ω systems that also apply to any other impedance coaxial input connection. Primary limitations of coaxial input connections include limited risetime response of very small cables, and power dissipation ratings of coaxial attenuators. In general, the Type S-5 maximum risetime and bandwidth performance is obtained using either a terminated 50 Ω coaxial cable, or the P6010 10× Probe driven from a 25 Ω or 50 Ω signal source.

TABLE 2-2

Type S-5 Input Systems

System	Advantages	Limitations	Accessories Req'd	Source Loading	Precautions
1. Terminated 50 Ω coaxial line. 25 Ω source.	Fastest risetime and smallest pulse distortion. Full sensitivity.	Kickout from sampler strobe. DC and AC voltage limits.	50 Ω BNC termination for input cable.	15 pF.	Reflections caused by 15 pF input C. Power limit of termination.
2. Unterminated 50 Ω coaxial line. 50 Ω source.	Full bandwidth to 2T of cable, then reflections. 2× sensitivity of system 1.	Input Z remains R_o for only 2T of cable. Reflection probelms. Strobe kickout.	Coaxial cable with BNC connector.	15 pF.	100% reflection sent back to source.
3. Terminated 50 Ω coaxial line with attenuators at termination.	Reduced strobe kickout. Attenuation of reflections from 15 pF at input. Larger signals can be displayed.	Reduced signal.	Attenuators with correct fittings.	R_o only.	Power limit of attenuators.
4. 10× P6010 Probe (3.5 ft cable).	Fastest of probes from low Z source. Reduced strobe kickout into source. Convenient for most uses. ≈1 ns risetime from 50 Ω source.	Loss of sensitivity. Ground clip rings at high frequency.	May wish to obtain coaxial cable to probe tip adapter. Others supplied with probe.	10 MΩ and 10 pF.	100% reflection if driven by coaxial cable. Max DC voltage at probe tip, COUPLING sw at DC: 500 V; COUPLING sw at AC: 100 V.
5. P6010 Probe tip placed next to a fast signal circuit test point. (Signal is coupled through dielectric around the tip.)	Fast pulse duration accurately measured. Probe 10 pF does not load test circuit. Can measure pulse risetime. No ground return needed.	Input TC ≈100 μs. Uncalibrated vertical deflection factor.	None.	<1 pF.	Insulate probe tip from accidental contact with circuit.
6. 100× P6009 Probe.	Large signal measurements, AC and DC.	Risetime limited to about 2 ns from low Z source. Special compensation required.	Coaxial cable to probe tip adapter. Others supplied with probe.	2.5 pF and 10 MΩ.	Max. DC voltage at probe tip, COUPLING sw at DC: 1500 V; COUPLING sw at AC: 1000 V. Max. AC signal: 100 V P-P.
7. 1× P6011 Probe.	Full sensitivity and 1 MΩ input.	Input C:≈43 pF for 3.5 ft length. Risetime < 12 ns.	None.	1 MΩ and 43 pF.	Max. DC limit is 100 V.
8. Tap into terminated coaxial system.	Permits signal to go to normal load. DC or AC coupling without coaxial attenuators.	Probe input C load at tap point. P6009 does not fit tap adapter.	Special tap adapter such as Tektronix VP-1 or VP-2.	See Probe manual.	Reflection from tap point. Not to be used on high power rf lines.

When connecting the signal from the source to the Type S-5 input connector, many factors must be taken into consideration including loading of the source, signal losses in cables, time of signal propagation in cables, AC or DC coupling, signal attenuation and matching of impedances in the case of probes built-into the circuit being tested.

Coupling

If the signal has a DC voltage component greater than ± 1 volt referred to the Type S-5 input jack, the COUPLING switch must be placed at the AC position. (This is true up to the limits stated in Table 2-2 and on the Type S-5 front panel.) Signals of 1 volt peak to peak riding on 1 volt DC are positionable into view using the sampling unit DC Offset control. However, low levels signals riding on 2 volts DC require AC coupling.

Attenuation

Maximum signal amplitude that can be properly displayed using the sequential sampling process is 1 volt peak to peak, and using the random sampling process is 0.5 volt peak to peak. If the signal at the source is greater, use either a passive attenuator probe, or a correct impedance coaxial attenuator. Attenuators used must have a bandpass through about 500 MHz in order to not distort the display. When attenuators are stacked (used in series) their attenuation factors multiply. Passive attenuator probes available are either 10× or 100× as discussed in Table 2-2.

Passive Probe Compensation

The input circuit of the Type S-5 requires special careful low and high frequency compensation of both the P6010 and P6009 probes. In addition, proper use of either attenuator probe requires that the sampling unit loop gain be set to unity. Without the sampling unit loop gain at unity, dot distortion occurs at the leading edge of fast pulses or any display that has very few dots in the rise. Displays with over 15 dots in the rise do not require unity loop gain.

Obtaining unity loop gain is best achieved for square wave signals by free running the sampling unit at 100 μs/div or 10 μs/div and connecting the probe tip to a low frequency (60 Hz or 1 kHz) square wave calibrator. Choose a sweep rate of 100 μs/div if the sampling sweep unit is a Type 3T5 or Type 3T6. Choose a sweep rate of 10 μs/div if the sampling sweep unit is a Type 3T2, and set the Samples/Div control for a slow dot movement. The signal should be 20 to 40 volts peak-to-peak for a 10× probe, and 40 to 100 volts peak-to-peak for a 100× probe. Set the sampling unit Units/Div switch to 100 and adjust the sampling unit Dot Response control until the display is two moving dots the correct amplitude apart. If the Dot response control is set for less than unity loop gain, there will be four dots with two of them less than proper amplitude. If the Dot Response control is set for greater than unity loop gain, there will again be four dots, but two of them will have more than the proper amplitude.

Adjusting the probe low frequency compensation capacitor. Check in the probe instruction manual whether the low frequency compensation capacitor is located at the probe tip barrel or is in the compensation box at the BNC connector end. Set the S-5 COUPLING switch to its DC position. Use either a 60 Hz or 1 kHz square wave calibrator when compensating a 10× P6010, but use only 1 kHz or higher square wave calibrator when compensating a 100× P6009. (The time constant of the 100× probe 10 MΩ and 2.5 pF input is much too fast for proper compensation from 60 Hz square wave.)

Choose a sweep rate, either equivalent or real time, that shows several calibrator cycles on the CRT. Adjust the low frequency compensating capacitor until there is no overshoot or undershoot at the square wave leading edge. It may be desirable to use a false equivalent time display at 1 μs/div. Free run the sampling sweep unit and adjust the Samples/Div and Recovery Time controls to obtain a very slowly drifting square wave. Double check that the loop gain is unity (there should not be one dot significantly above or below the square wave leading edge.) Adjust the low frequency compensating capacitor for a flat topped leading edge.

P6009 Low Frequency Adjustment (Alternative Method)

1. Set the Type 561B Calibrator for 4 V and connect the 100× probe from the Type S-5 to the Cal Out using a Probe Tip to BNC adapter (Tektronix Part No. 013-0054-00).

2. Set the Type 3T2 controls as follows:

Start Point	With Trigger
Range	10 μs
Time Magnifier	×5
Trig Sensitivity	Fully Clockwise
Recovery Time	Fully Clockwise
Samples/Div	9 to 12 o'clock

3. Set the Type 3S2 Units/Div switch to 10 and the Type S-5 Coupling switch at DC.

4. Center the trace and adjust the Type 3S2 Dot Response control for minimum trace width. Adjusting the capacitor (after loosening the lock ring) in the probe body may help to minimize the trace width. Refer to the probe manual for this adjustment.

A false square wave display can be obtained by carefully adjusting the Samples/Div control. Then the corners of the square wave can be properly set by adjusting the capacitor and the Dot Response.

5. Check for 4 vertical divisions of display. Adjust the Type 3S2 Gain control if necessary to obtain the 4 divisions.

6. Connect the probe and its adpater to a Type 284 Square Wave Output with a GR to BNC adapter.

7. Set the Type 284 controls as follows:

Square Wave Amplitude	1.0 V
Period	10 μs
Mode	Square Wave Output

8. Externally trigger the Type 3T2 from the Type 284.

9. Set the Type 3T2 Range switch to 100 μs and adjust the Type 3S2 Dot Response control for unity loop gain. The adjustment procedure for unity loop gain is given in the First Time Operation instructions.

10. Set the low frequency compensation of the probe by adjusting the capacitor in the probe for 2 divisions of deflection (20 mV). The Type 284 voltage output is actually 2.0 V since it is not terminated into 50 Ω.

Adjusting the probe high frequency compensations. The 10× P6010 probe that is shipped as a standard accessory with the Type S-5 has been properly adjusted at the factory and no special high frequency adjustments need to be made. (Such a specially adjusted probe, either P6010 or P6009, is no longer properly compensated for operation on conventional real-time oscilloscopes.) Should you purchase additional passive attenuator probes for use with the S-5, each new probe needs special high frequency compensation. Be sure to order only the 3.5 foot length P6010, and only the 15 pF P6009 probes. See your Tektronix catalog or Field Engineer for part numbers and prices.

High frequency compensations require a fast pulse generator, such as the Tektronix Type 284 Pulse Generator, and a coaxial cable to probe tip adapter. The P6010 coaxial to probe tip adapter Tektronix Part Number is: Probe Tip-to GR Adapter, 017-0076-00, or Probe Tip-to-BNC Adapter 013-0084-00. The P6009 coaxial to probe tip adapter Tektronix Part Number is: Probe Tip-to-BNC-Adapter, 013-0054-00. There is no GR adapter available for the P6009.

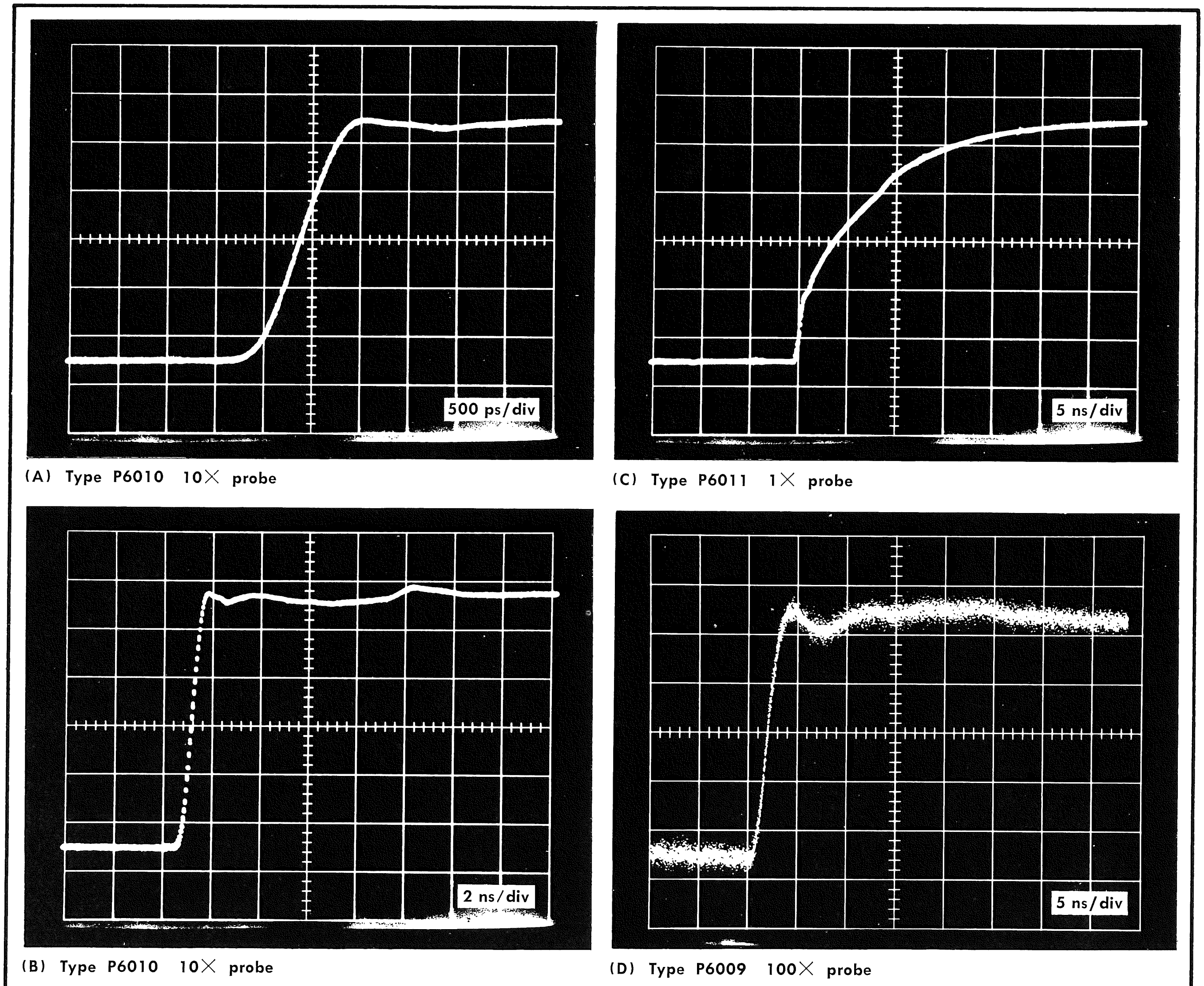
P6010 High Frequency Adjustment Procedure

1. Set the sampling unit Dot Response control for unity loop gain and set the low frequency response using the procedure described above.

2. Place a GR to Probe Tip adapter on the Type 284 Pulse Output connector. Place the Mode switch to Pulse Output and the Lead Time switch to 75 ns. Turn on the power.

3. Install the P6010 Probe onto the Type S-5 and the tip into the adapter on the Type 284.

4. Set the sampling sweep unit for an externally triggered 5 ns/div sweep rate. Connect a BNC connector coaxial cable from the Type 284 Trigger Output connector to the sampling



(A) Type P6010 10× probe

(C) Type P6011 1× probe

(B) Type P6010 10× probe

(D) Type P6009 100× probe

Fig. 2-4. Risetime and waveform of three Tektronix probes.

sweep unit 50 Ω External Trigger input connector. Set the Sample/Div control to about 9 o'clock. Adjust the Trig Sensitivity for a triggered display. Check the Type 284 instruction manual for the procedure to adjust its TD Bias control because it may need readjustment without a 50 Ω termination on the fast pulser. Use the Sampling Sweep unit Time Position control to place the fast pulse rise about 1 or 2 graticule divisions from the left edge.

5. Back off the knurled nut that holds the cover over the probe compensation box and slide both the nut and cover back onto the probe cable. This exposes the two compensation potentiometers. Use a plastic handle adjustment tool during the next step.

6. The potentiometer near the cable affects the response from about 5 ns after the step leading edge to about 25 ns after the leading edge. Adjust it until that portion of the display is flattest. There is a normal peak 8 ns after the step.

The potentiometer near the variable capacitor adjusts the step leading edge overshoot or undershoot. Adjust it so that the step corner is at a level which is the average of the remaining flat portions of the display.

Repeat both adjustments. Replace the compensation box cover.

P6009 High Frequency Adjustment Procedure

For the P6009, use only a 10 ns/Div sweep rate and adjust all three variable resistors in the compensation box for the best looking square wave. The three variable resistors affect only the first 10 to 20 ns of the step display.

Probe Response

When a fast rise pulse is applied to a probe, it is desirable to know if the risetime of the probe will distort the waveform of the applied signal and if it does, to what extent.

The operator may wish to use a Type P6011 1× or a Type P6009 100× probe in place of the Type P6010 10× probe that is supplied with the Type S-5. Fig. 2-4 shows the risetime capabilities of these probes.

Built-In Probes

A satisfactory method of coupling fractional nanosecond signals from within a circuit is to design the circuit with a built-in 50 ohm output terminal. With this method, the circuit can be monitored without being disturbed. When the circuit is not being tested, a 50-ohm terminating resistor can be submitted for the test cable. If it is not convenient to build in a permanent 50-ohm test point, an external coupling circuit, which may be considered a probe, can be attached to the circuit.

Several factors must be considered when constructing such a built-in signal probe. A probe is designed to transfer energy from a source to a load, with controlled fidelity and attenuation. Both internal and external characteristics affect its operation. It must be able to carry a given energy level, be mechanically adaptable to the measured circuit, and be equally responsive to all frequencies within the limits of the system. The probe must not load the circuit significantly or the display may not present a true representation of the circuit operation. Loading may even disrupt the operation of the circuit. When it is necessary to AC-couple the probe, the capacitor should be placed between the series resistance and the probe cable to minimize differences between the input characteristics with and without the capacitor. In this 50-ohm environment, stray capacitance to ground has a shorter and more uniform time constant than if the capacitor were placed at the signal source where the impedance is usually higher and of unknown value.

Fig. 2-5A shows the parallel method of coupling to a circuit under test. Resistor R_s is connected in series with the 50-ohm input cable to the Type S-5, placing R_s + 50 ohms across the impedance in the circuit. This method usually requires the use of an amplitude correction factor. In order to avoid over-loading the circuit, the total resistance of R_s + 50 ohms should not be less than 5 times the impedance of the device (R_1 in parallel with Z_0) requiring a 20% correction. The physical position of R_s will affect the fidelity of the coupling.

Fig. 2-5B shows the series method of coupling to a circuit. Resistor R_s plus the 50-ohm termination replaces the impedance of the circuit under test. If R_L is 50 ohms, simply substitute the 50-ohm test cable with no additional series resistance. It is best to locate R_s in the original position of R_L and to ground the coax where R_L was grounded.

A variation of the parallel method is the reverse-terminated network shown in Fig. 2-5C. This system may be used across any impedance up to about 200 ohms. At higher source impedances, circuit loading would require more than 20% correction. The two 100-ohm resistors across the cable input serve to reverse-terminate any small reflections due to connectors, attenuators, etc. The series capacitor, which is optional, blocks any dc component and protects the resistors.

Measuring Risetime

The Type S-5 is useful to show risetime and detect aberrations of signals in circuits that are properly coupled to the Type S-5. The risetime of the generator (or source), the coaxial cable, and the Type S-5 must be taken into consideration.

Signals with risetimes as fast as about 4 ns can be measured using the Type S-5 without any special considerations. Read the 10% to 90% risetime directly from the CRT (or digital unit) to know the risetime of the signal.

Signals with risetime faster than about 4 ns can best be measured using a Sampling Head faster than the S-5. However, fair approximations of risetime down to about 1 ns can be made using the Type S-5 and calculating the signal risetime by formula (2-1) below. Formula (2-1) is based upon the signal, the coaxial cable, and the sampler having Gaussian risetime characteristics.

Formula 2-1

$$T_r \text{ Signal} = \sqrt{(T_{r1})^2 - (T_{r2})^2 - (T_{r3})^2 - (T_{r4})^2}$$

Where T_{r1} = Displayed risetime

T_{r2} = Type S-5 risetime

T_{r3} = Coaxial line risetime

T_{r4} = Each connector risetime

Probe Adapters

Voltage Pick-off Adapter. The Tektronix Voltage Pick-off Adapter VP-2 (Tektronix Part No. 017-0077-01) permits using the Type P6010 probe within a closed 50 ohm system with little effect on the signal. A VP-2, terminated in 50 Ω at each end of a GR874 connector, presents a 62.5 Ω source resistance to the Type P6010 probe tip.

Probe Tip to GR Adapter. (Tektronix Part No. 017-0076-00). Allows the probe to be connected directly to GR874 coaxial connectors. If the probe and adapter are connected to an unterminated 50 Ω cable, the source resistance to the probe tip is 50 Ω. The signal amplitude from a 50 Ω source is 2× its terminated value, and signal reflections back to the signal source must be considered. Re-reflections from signal sources other than 50 Ω may be included as part of the display. The Probe Tip to GR Adapter should be used at the end of 50 Ω coaxial cables whose signal source impedance is also 50 Ω. Use of a good reverse termination will absorb the reflected signal returned to the source by the probe tip mismatch and prevent display confusion.

Probe Tip to BNC Adapter. (Tektronix Part No. 013-0034-00) This adapter is identical in function to the Probe Tip to GR Adapter, but is fitted with a BNC connector.

Bayonet Ground Assembly (Tektronix Part No. 013-0085-00) The Bayonet ground assembly (a probe accessory supplied with the Type P6010) provides a very short ground connection at the probe tip. The bayonet tip is convenient when the ground plane is adjacent to the signal source.

Chassis Mount Test Jack. (Tektronix Part No. 131-0258-00) Can be mounted directly into the test circuit so that the Type P6010 probe can be conveniently connected. This allows a good signal ground connection but adds about 2 pF capacitance over the normal probe tip value.

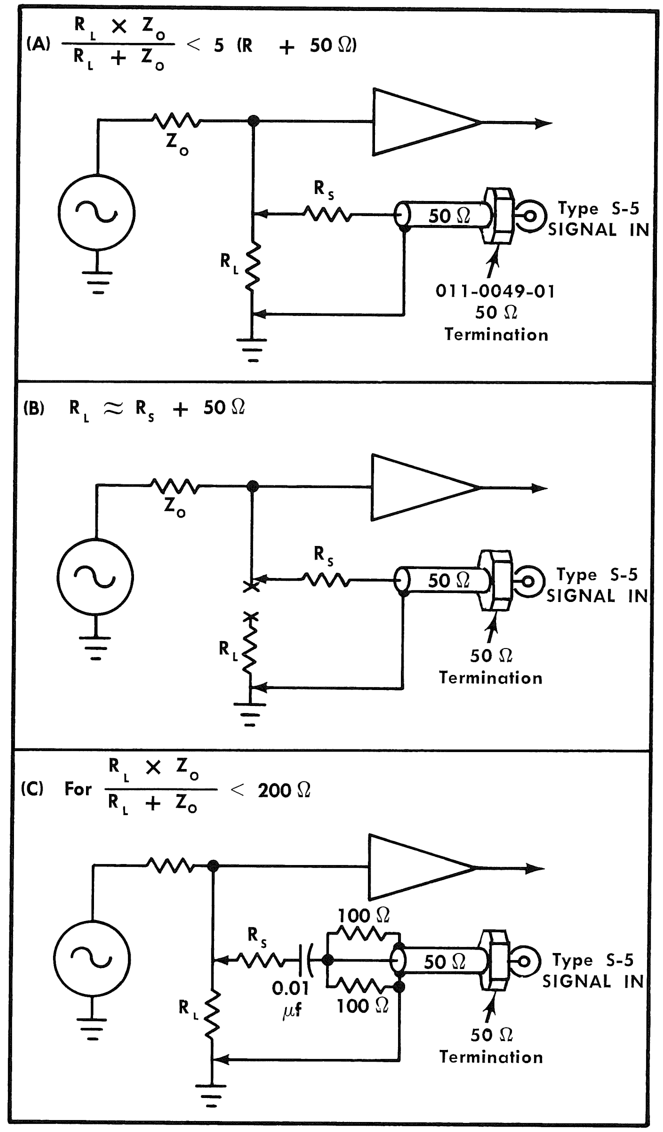


Fig. 2-5. Built-in probes for coupling to a test circuit. (A) Parallel method; (B) series method; (C) reverse-terminated parellel method.

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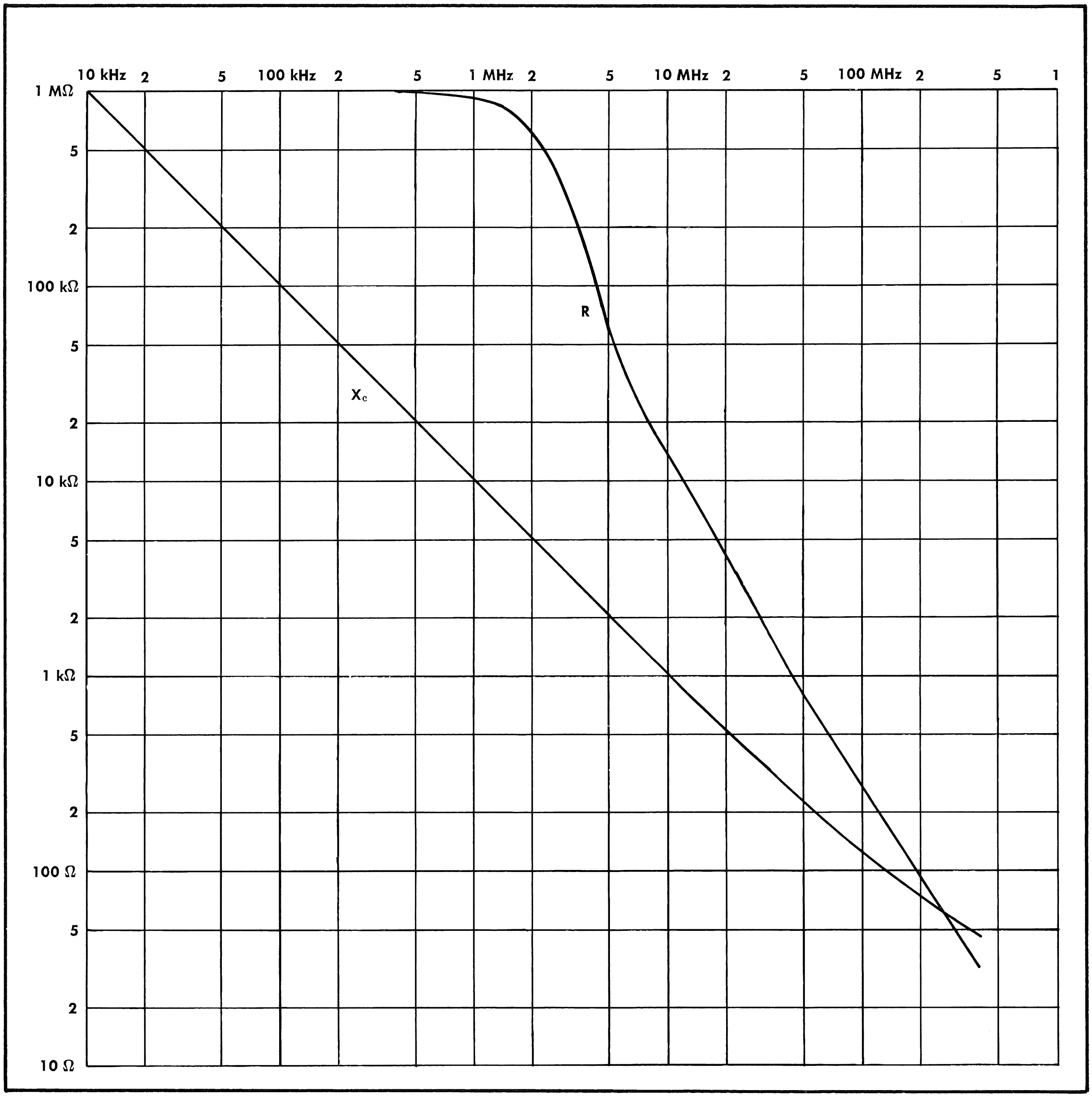

Fig. 2-6. Type S-5 input resistance and reactance vs frequency curves.

NOTES

SECTION 3
CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

General

This section of the manual contains a block diagram description of the Type S-5 Sampling Head, followed by a detailed circuit description. Read the section on Basic Tektronix Sampling Principles, located in the associated sampling unit manual, if the function of a particular Type S-5 circuit is not clear. Both the block and schematic diagrams are located at the rear of this manual.

The Type S-5 is the signal input section of a sampling system, and determines the vertical channel input characteristics. The special traveling-wave gate and input circuits differ from the sampling bridge described in the Basic Sampling Principles section of the sampling unit instruction manual.

BLOCK DIAGRAM

The formal block diagram and circuit schematic (located at the manual rear) each have dashed lines around three groups of circuits, indicating the three circuit boards within the unit. The Preamp Board contains the Isolation & Trigger Pickoff amplifier and the Preamplifier; the Gate Board contains most of the Sampling Gate and part of the Gate Volts circuit, and the Strobe Board contains the rest of the Sampling Gate, the Strobe Generator and part of the Gate Volts circuit. Circuit relationships are described by discussing the blocks, not the circuit board outlines.

Input Circuits

A simplified block diagram appears in Fig. 3-1. Input

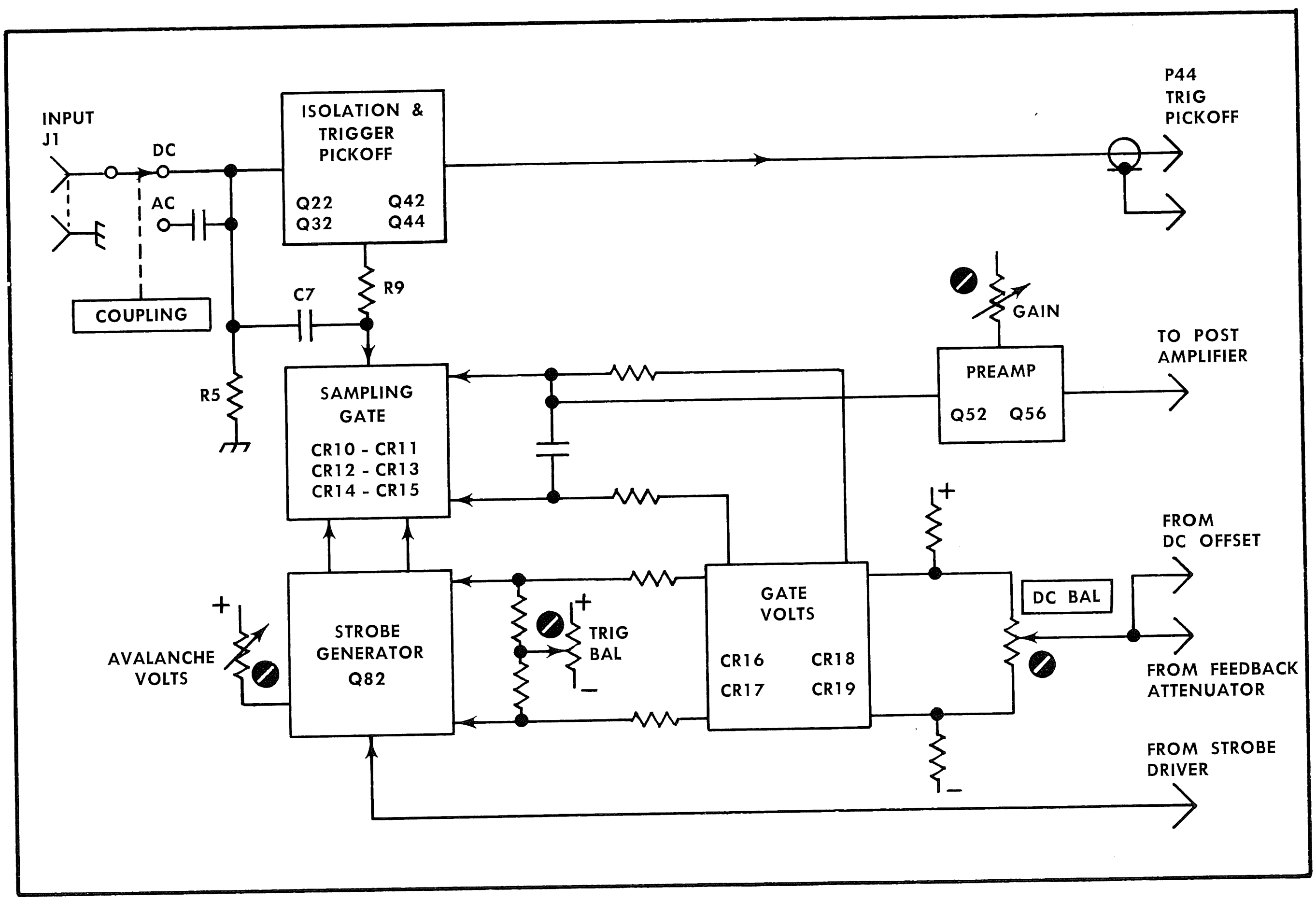

Fig. 3-1. Type S-5 simplified block diagram.

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circuits of the Type S-5 include those parts from the INPUT connector J1, through the AC-DC COUPLING switch, the Isolation & Trigger Pickoff amplifier (including C7) and the traveling-wave Sampling Gate. Between samples, the Isolation amplifier removes any charge that may be gained by C7 during the sampling interval, thus assuring that the input signal is properly coupled to the Sampling Gate at the time of each sample. Another function of the Isolation amplifier is that it drives the Trigger Pickoff amplifier so the Type S-5 can be used in a sampling system that uses internal triggering.

Sampling Gate

The Sampling Gate (called the Sampling Bridge in earlier Tektronix sampling circuitry) connects the input signal to the Preamplifier only during the short time when each sample is taken. The six diodes, CR10 through CR15, form what is technically termed a traveling wave gate. It is the way the end of the Strobe Drive pulse travels through the gate that determines the step response of the sampler. In most other sampling bridges, the step response risetime is controlled by the strobe pulse duration. In the Type S-5, the step response risetime is controlled instead by the length of time it takes the strobe pulse end to travel through part of the Sampling Gate.

At the end of each strobe pulse, part of the input signal is stored temporarily between Sampling Gate diodes and is then fed to the Preamplifier input at a rate much slower than the step response risetime. It is only the input circuits and the special traveling wave gate that have their electrical environment controlled for minimum reflections of fast pulse signals. All circuit parts that pass the sampled error signal (see the sampling unit manual section on Basic Sampling Principles for definition of error signal) to the Preamplifier handle only moderate rate-of-rise signals.

Strobe Generator

The Strobe Generator develops heavy-current (several mA), short-duration, push-pull pulses that drive the Sampling Gate into balanced conduction. Output occurs at the time of each sample when a command pulse arrives from the Strobe Driver circuit of the associated sampling unit. The pulse lasts for a short period, turning on the Sampling Gate diodes. At the end of the pulse, the diodes turn off very quickly, retaining a portion of the input signal. Strobe pulse duration and fall time are fixed by the strobe generator, but do not determine the Type S-5 risetime. The Strobe Generator construction is carefully controlled to end the + and − strobe pulses at the same time, ensuring proper operation of the traveling wave sampling gate.

Gate Bias

Reverse bias is applied to the Sampling Gate diodes by the Gate Bias circuit. The average voltage of the gate bias is controlled by the front panel DC BAL control and the associated sampling unit DC Offset and Feedback signals. The Sampling Gate output is DC coupled to the Preamplifier input through a portion of the Gate Bias circuit.

Preamplifier

The preamplifier circuit both amplifies and time-stretches the signal it receives from the Sampling Gate. The signal received is a portion of the difference between the Feedback combined with the DC Offset voltage and the input signal. This "error signal" is amplified and AC coupled to the Post Amplifier in the sampling unit. The Preamplifier gain is adjustable to aid in setting the overall sampling head and sampling unit "loop" gain to unity for proper dot response.

CIRCUIT DESCRIPTION

Refer to the main schematic diagram during the following descriptions. The Type S-5 Sampling Head uses the power supplies of the indicator oscilloscope and associated sampling unit. Interconnections to the sampling unit circuits are by two connectors at the sampling head rear. The following description includes references to circuits in the sampling unit and sampling sweep unit, all units forming one sampling system. Reference to diagrams and circuit descriptions in the instruction manuals for the other sampling units will help in gaining a full understanding of the circuit relationships.

Input Circuit

The input circuit includes the path between Input connector J1 and the Sampling Gate. It is the components in and around this path that determine the Type S-5 input resistance and shunt capacitance. Transient response of the instrument is dependent upon the components of the input circuit.

An input signal can be either AC or DC coupled to the Sampling Gate by Coupling switch S1. When S1 is at DC, C4 is shorted by R1, R3 and S1, placing R1, R3 and C7 in series to the Sampling Gate input. (DC coupling around C7 is provided by the Isolation amplifier, which is not part of the high frequency input circuit.) When S1 is at AC, the input circuit is AC coupled by C4 and the Sampling Gate DC return is maintained by R5. It is R5 that sets the input resistance at 1 MΩ.

A direct high speed signal path between J1 and the Sampling Gate input (at junction of CR12 and CR13) is provided by leadless capacitors C4 and C7. This high speed path is the same for both AC and DC coupling. All other circuit elements with a capacitive component to ground (S1, C2 and J7-P7) include a series isolation resistor. Thus, a high speed signal arriving at J1 is coupled directly to the Sampling Gate with a minimum of attenuation. The upper bandpass limits of the Type S-5 are therefore set by the characteristics of the Sampling Gate and not by an intervening amplifier. The only attenuation possible is due to the Sampling Gate input capacitance of about 1.5 pF loading the input signal through 100 pF C7.

The low frequency input capacitance of 15 pF is adjustable by C2. It is part of the total input capacitance of all input circuits, and like them is resistance isolated for high speed signals by R2. C1 in series with R2 and C2 reduces the adjustment range of C2.

The isolation amplifier is driven through R7, J7-P7 and R21-C21. The amplifier output is connected to the Sampling Gate through R35, square-pin connector G-0, and R9. Primary function of the Isolation amplifier is to restore the potential difference across C7 to zero between samples. A potential may appear across C7 either due to a DC component in the signal or right after a sample is taken.

The Isolation Amplifier

Circuit type, use of transistors with high f_t and point-to-point component connections gives the isolation amplifier a gain close to unity with a very fast step response time. Protection against damage by heavy overdrive signals is provided for signal voltages far outside the linear range. Q22 and Q32 are the amplifier active elements, they drive both the Sampling Gate and the Trigger Pickoff amplifier.

All power supply leads to the Isolation amplifier are decoupled to prevent Strobe Generator transients from being inserted into the output line of the Trigger Pickoff amplifier. +50 V is decoupled by R27 and C25 (at Q22A collector circuit); +15 V is decoupled by R97 and C97 and −50 V is decoupled by C91 (diagrammed where the supply enters the Preamp Board).

The amplifier is a differential operational (feedback) circuit connected as a voltage follower with the + input (Q22A gate) driven by the input signal and the —input (Q22B gate) driven by the output terminal (Q32 collector). Operating current for Q22 is set by R23 at about 1 mA in each channel supplied by +15 volts to Q22B drain and by +50 volts and R25 to Q22A drain. Q22A drain also drives Q32 base, whose emitter is tied to +15 volts. Thus the amplifier halves are provided with almost identical operating conditions assuring good balance. The amplifier output terminal is connected directly to Q42 base and through R35 and R9 to the Sampling Gate. R33 gives Q32 positive output overload protection from Q42 base current and C33 assures high speed amplifier response around R33. R29 also enhances high speed operation of the overall amplifier by slightly delaying the feedback to Q22B gate about 2 ns. Q32 operating current is set at about 3 mA by R31.

Protection against overloads and malfunctions is provided by CR21, R21, CR22 and CR32. CR32 protects Q32 base from overdrive reverse breakdown when Q22A stops conducting due to a negative overdrive input signal. R21 protects CR22 from over dissipation due to negative overdrive and protects Q22A gate from over dissipation due to positive overdrive. C21 maintains amplifier bandwidth by coupling fast signals around R21 into the very small capacitance at the amplifier input.

Trigger Pickoff Amplifier

The Trigger Pickoff amplifier takes its drive from the Isolation amplifier output, attenuates the signal amplitude to 0.1× the input signal and applies it to the sampling unit for internal triggering of the sampling sweep unit. Q42 is an emitter follower that places almost no load on the Isolation amplifier output. Q42 drives the output common base stage Q44, through R41. CR 42 protects Q42 base emitter juntion from excessive reverse bias when the S-5 input receives a negative overdrive signal. R45 and R47 reduce Q42 collector voltage to limit dissipation in Q42 collector. They also permit Q42 to saturate very easily thereby reducing its current gain to a very low value for positive overdrive signals.

Traveling Wave Sampling Gate

The Sampling Gate consists of six diodes, CR10 through CR14, four resistors, R12 through R15 and three capacitors, C13, C14 and C16. See Fig. 3-2 during the following discussion.

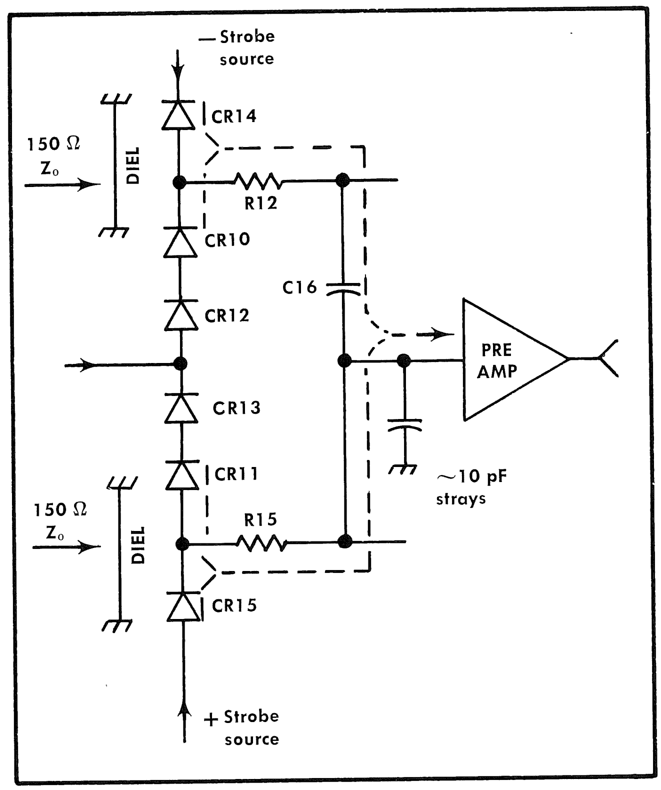

Fig. 3-2. Error-signal source and path to Preamp shown by dotted lines.

Input to the Sampling Gate is at the junction of CR12 and CR13. Output to the Preamplifier is at one side of C16. When the Sampling Gate is reverse biased (not being strobed into conduction) CR12 and CR13 present a very small value of capacitive load to the incoming signal circuit. When the diodes conduct due to Strobe current, the input signal is coupled into the traveling wave gate.

Push-pull strobe pulses from the Strobe Generator cause the six Sampling Gate diodes to conduct for about 2 ns. While the diodes are conducting, the signal at the input connector propagates down the diode transmission paths from CR12 to CR10 to CR14, and at the same time from CR13 to CR11 to CR15. As the fast falling strobe pulse end begins to propagate into the diode transmission paths, the diodes are quickly switched off (into reverse bias), one set after another. First, diodes CR14 and CR15 turn off, then

CR10 and CR11, and finally CR12 and CR13. Turn off time of the diode sets is controlled by the mechanical spacing and thereby the propagation time between sets. The Sampling Gate risetime is determined by these propagation times, and is thus not influenced by the strobe pulse amplitude or duration. The sampling process is thus one of trapping signal charge between sets of diodes, in particular, between set CR14-CR10 and the set CR15 and CR11. The risetime is very close to the double transit time between diodes of a set.

Once the signal charge trapping process has taken place (at the strobe pulse end), the Preamplifier begins to receive the trapped charge by conduction through resistors R12 and R15 (See Fig. 3-2). Between samples, the Gate Bias circuit restores the traveling wave gate voltages back to their quiescent state as before the last strobe pulse and sample time.

Because of the carefully adjusted balance of the plus and minus strobe signals (set by the physical position of T80 windings in the Strobe Generator), the Preamplifier receives only the trapped signal charge and nothing from the Strobe Generator.

Capacitor C11 and Resistor R11 damp multiple reflections within the charge trapping sections of the traveling wave gate. Their purpose is to prevent CR10 and/or CR11 from conducting a second time right after the strobe pulse ends.

The very small junction capacitance of each reverse biased Sampling Gate diode can couple unwanted energy into the S-5 from high frequency signals. If signal energy does

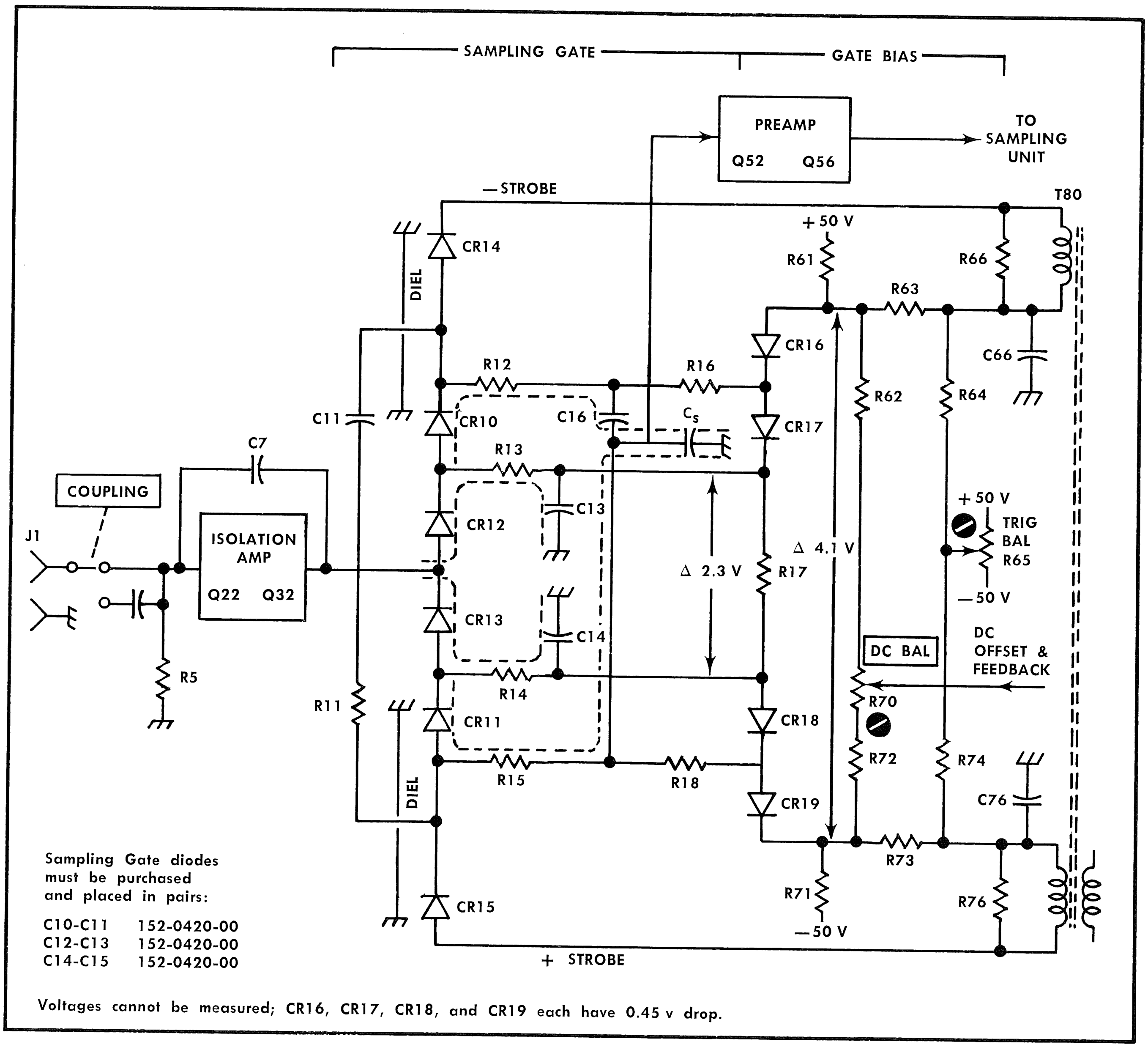

Fig. 3-3. Traveling-wave Sampling Gate, and Gate Bias. Circuit components, with input signal blow-by differentiating paths shown by dotted lines.

couple through the diodes, it is called a "blow-by" signal. The traveling wave gate is constructed to double differentiate signals in the Preamplifier response domain while not affecting the sampled charge quantities obtained during each sample interval.

Blow-by rejection in the Sampling Gate is assured by the double differentiation networks that have very fast RC times. They are located between the signal input and the Preamplifier. The first differentiation network is formed by reverse biased diodes CR12 and CR13 and their respective resistors to ground (see Fig. 3-3), R13 and R14. The second network is formed by diodes and resistors CR10, CR11 and R12, R15, respectively. All the Sampling Gate diodes are normally non-conducting and are therefore very small capacitors. The differentiating networks eliminate virtually all effects of blow-by in the Type S-5.

Gate Biasing

Quiescent condition of the Sampling Gate diodes is controlled by the Gate Bias circuit CR14, CR10, CR11 and CR15 are each reverse biased about 0.5 volt by CR16, CR17, CR18 and CR19 respectively. CR12 and CR13 are reverse biased about 1.15 volts each, a total of 2.3 V from the voltage drop across R17. The Gate Bias circuit receives its current from the two 50-V supplies and includes R61, R62, R70, R72 and R71 of the DC BAL control circuit. The diodes of the Gate Bias circuit are used for their 0.5-V drop to reverse bias the traveling wave gate diodes between Strobe times. Reverse bias for the gate diodes is coupled through resistors R12-R16, R13, R14 and R15-R18. It is R16 and R18 that permit the DC bias voltages to reach the Sampling Gate diodes but prevent the sampled error signal from being loaded by the Gate Bias circuit.

Except for the short strobed conduction time (about 2 ns), the Sampling Gate diodes do not conduct.

Feedback and DC Offset

The Gate Bias circuit, as seen from the sampling unit combined feedback and DC offset source, has a fixed DC resistance to ground of slightly more than 50 kΩ. Attached to the Gate Bias circuit is all the stray capacitance to ground of the Sampling Gate and Preamplifier circuits. Applying DC Offset to the Gate Bias circuit actually moves the Sampling Gate input voltage. If the front panel input signal is not equal to the DC Offset, then that voltage becomes an error signal and is processed by the sampling loop. Feedback arrives then (before the next sample) in an amount equal and opposite to the DC Offset, thereby returning the Sampling Gate input to equal the last sampled input signal voltage. The feedback rate of change is slowed by all the stray capacitance, therefore L70 gives series peaking to the feedback signal, speeding it up so the Sampling Gate and Preamplifier inputs will equal the feedback before the next sample is taken.

Strobe Generator

The Strobe Generator circuit is all located on the (right side) Strobe circuit board. The generator contains an Avalanche transistor circuit that converts the sampling unit strobe drive pulse into equal and opposite output pulses to drive the Sampling Gate into conduction.

The sampling unit Strobe Drive pulse is transformer coupled by T85 to the base and emitter of Avalanche transistor Q82. Two outputs are AC coupled to the primary winding of a three winding torroidal transformer, T80; one output is from Q82 collector, the other from its emitter. The Avalanche Volts control adjusts Q82 collector voltage to alter the drive amplitude to T80; typical quiescent voltage at Q82 collector is +7.5 volts. Before Avalanche conduction, there is a potential of about 60 volts between Q82 collector and emitter.

As the Strobe Drive pulse arrives, Q82 is driven into Avalanche conduction essentially shorting the collector and emitter terminals. C81 and C82 original charge of about 30 volts each is now converted to a 2 ns current drive to T80. Their total capacitance of 5 pF forms the short term current path that includes the inductive reactance of T82. Both capacitors are discharged in about 2 ns after Q82 avalanches.

T80 two secondary windings apply equal and opposite polarity strobe pulses to the Sampling Gate. Before strobe time, each winding rests at a DC potential 2 volts from the value of the feedback voltage at the arm of the DC BAL control, R70. One side of each winding is AC coupled to ground, through C66 (for the — strobe side) and through C76 (for the +strobe side). Thus as Q82 avalanches, T80 secondaries apply their equal and opposite polarity 2 ns signals to the Sampling Gate diodes. R66 and R76 damp T80 secondary windings from ringing, allowing only one strobe pulse to be produced for each Q82 avalanche conduction. At the end of avalanche conduction when Q82 goes to cut-off, C81 and C82 charge slowly through R83 and R81, not causing any signal to be sent to the Sampling Gate.

DC Balance and Trigger Circuit Balance

The Gate Bias circuit contains two potentiometers; DC BAL control R70, and Trig Bal control, R65. The DC BAL control is an operator adjustment and is therefore on the front panel. The Trig Bal control is not an operator adjustment, but is accessable from the instrument right side because it should be adjusted with the cover on.

Function of the DC BAL control is to allow the operator to adjust the quiescent voltage at the junction of gate diodes CR12 and CR13 to equal the feedback voltage from the sampling unit. This is called balancing the sampling loop, and must be done whenever the signal source resistance is changed and a zero reference DC measurement is to be made. (It is not always necessary to adjust the DC BAL control if the measurement is not referenced to ground, but is instead just a simple peak-to-peak measurement.)

The function of the Trig Bal control is to adjust the quiescent voltage balance of T80 secondary windings so there is zero strobe voltage at the junction of gate diodes CR12 and CR13. When the gate is balanced, the Trig Bal adjustment effects relate directly to the DC BAL adjustment effects, and therefore don't need to be made except at calibration time.

See the Operating Instructions for a DC BAL control adjustment procedure.

Preamplifier

The Preamplifier circuit amplifies and time-stretches the error signal pulse from the Sampling Gate, and AC couples it to the Post Amplifier in the associated sampling unit.

Input transistor Q52 operates as a high gain, high input resistance, inverting amplifier. Temperature compensation is provided by thermistor RT53 in series with the large source return resistor R51. A total of 4.6 mA channel current passes from the +50-volt supply through R55, Q52, RT53 and R51 to the —50-volt supply. C53 bypasses RT53 and R51 for AC signals assuring high AC gain and permitting a DC gain of less than 1. With a DC gain of less than 1, Q52 gate can follow the Sampling Gate voltage excursions without altering the AC gain.

Q56 is a variable gain, single stage, feedback amplifier that inverts Q52 signal and applies it to the output lead to the sampling unit Post Amplifier. Minimum gain is about 0.75; maximum gain is about 2.5. Gain control R58 is AC coupled from the transistor collector to its base, causing maximum gain at maximum resistance. The stage is temperature stabilized by DC feedback from the collector to the base by R57. R56 draws enough current from R57 to set the output collector voltage at about +8 volts.

The output is AC coupled through C59 (and L59) to the sampling unit. L59 forces the AC pulse signals to apply charge to the Post Amplifier input in a constant current manner, shaping the signal rate-of-rise to the characteristics needed by the sampling unit.

SECTION 4
MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section is a maintenance guide for the Type S-5 Sampling Head. Information for parts ordering, disassembly, and reassembly is included.

Parts Ordering

All parts used in the Type S-5 can be purchased directly through your Tektronix Field Office or Representative, although standard electronic items may be obtained locally. Replacements for the special parts used in the Type S-5 should be ordered from Tektronix since these parts are either manufactured or selected by Tektronix to satisfy a particular requirement. Before purchasing or ordering, consult the Electrical or Mechanical Parts List to determine the value, tolerance and ratings required.

Case Removal

Loosen the four retaining screws on the back of the Type S-5 to remove the Sampling Head from its case. Then slide the back off and remove the case by sliding it to the rear. Directions for replacing the case will be found at the end of this section.

Parts Removal and Replacement

Transformer Replacement. The primary winding of a replacement for T80 is free-wound to allow correct positioning. Calibration Procedure step 5 gives equipment setup and method for the winding placement, after which it can be permanently set by doping. No further adjustment of Input connector kickout by positioning the winding is necessary.

Transistor Replacement. Cut the leads of a replacement transistor to the same length as the transistor removed and bend the leads as necessary. The lead configurations of the transistors used in the Type S-5 are shown in Fig. 4-1. Location of all transistors is silkscreened on the circuit board next to the mounting or pin socket which is fabricated as part of the circuit board.

The transistors with soldered leads and associated point-to-point wiring are best removed with tweezers after the soldered-on circuit components are removed. A 3× viewing loupe and a small (15 watt) soldering iron make easier the job of removing and replacing the smaller components.

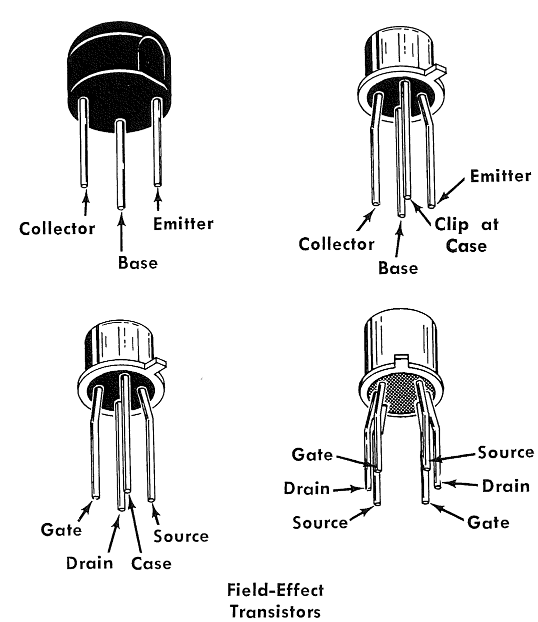

Fig. 4-1. Lead configurations of transistors in the Type S-5.

NOTE

When selecting the replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. Parts orientation and lead dress should duplicate those of the original part since many of the components are mounted in a particular way to reduce or control stray capacitance and inductance. Good high-frequency response is the purpose of the point-to-point parts mounted on the Preamp circuit card. After repair, the sampling head may require calibration.

Leadless Capacitors. There are leadless ceramic capacitors soldered directly to the circuit board. Care must be taken when replacing these capacitors as they crack easily. Use high quality solder with good cold flow characteristics such as 60/40 or 62/38 solder.

Solder the leadless capacitor into place by positioning the part and applying heat to the adjacent plated area. Sometimes heat can be applied from the opposite side of the etched board. Solder leads to the leadless capacitor by applying heat to the leads of the connected parts. Use only enough solder to obtain a good full-flow joint. Excess solder on either side of the capacitor can lead to a shorted circuit.

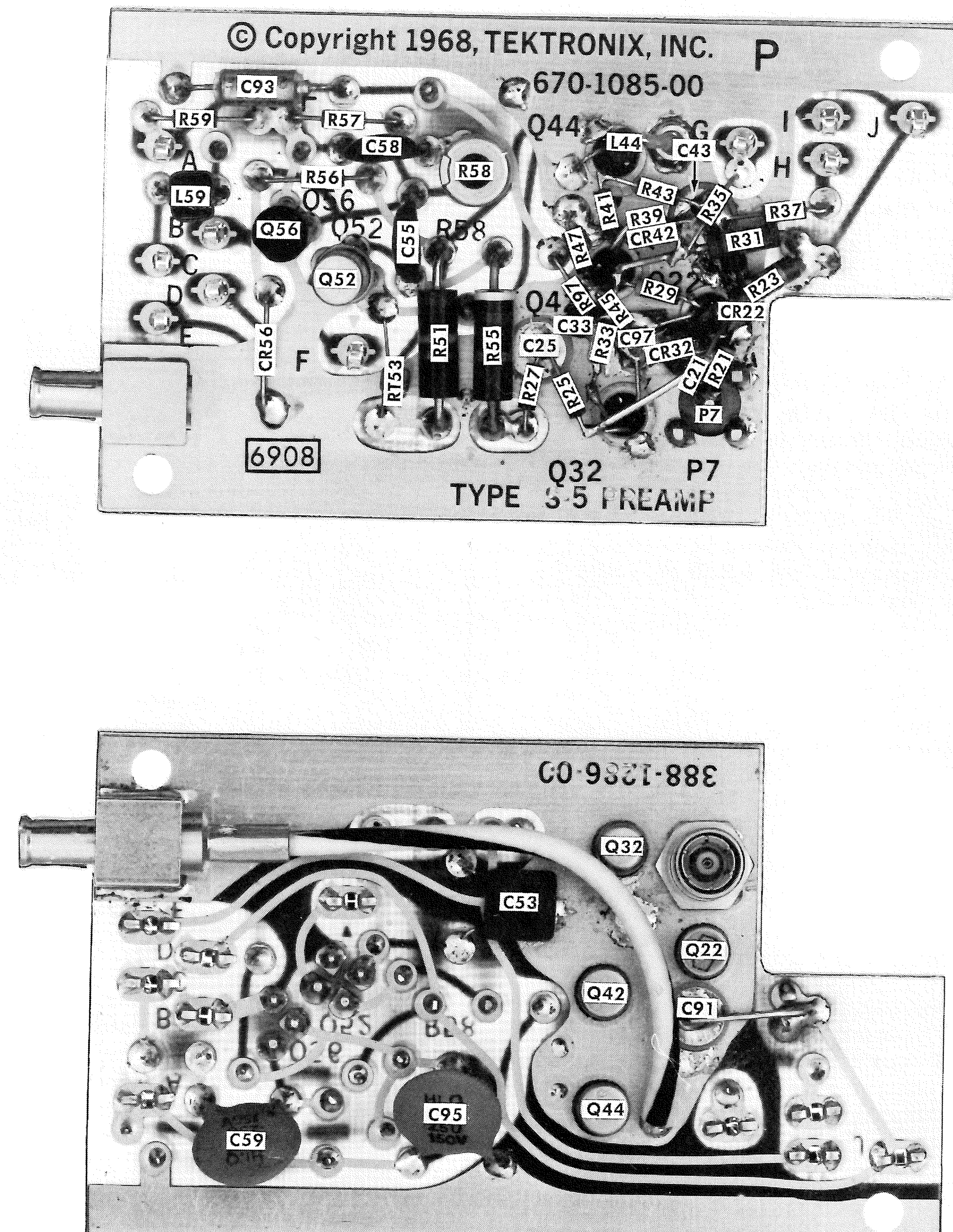

Fig. 4-2. Preamp circuit board.

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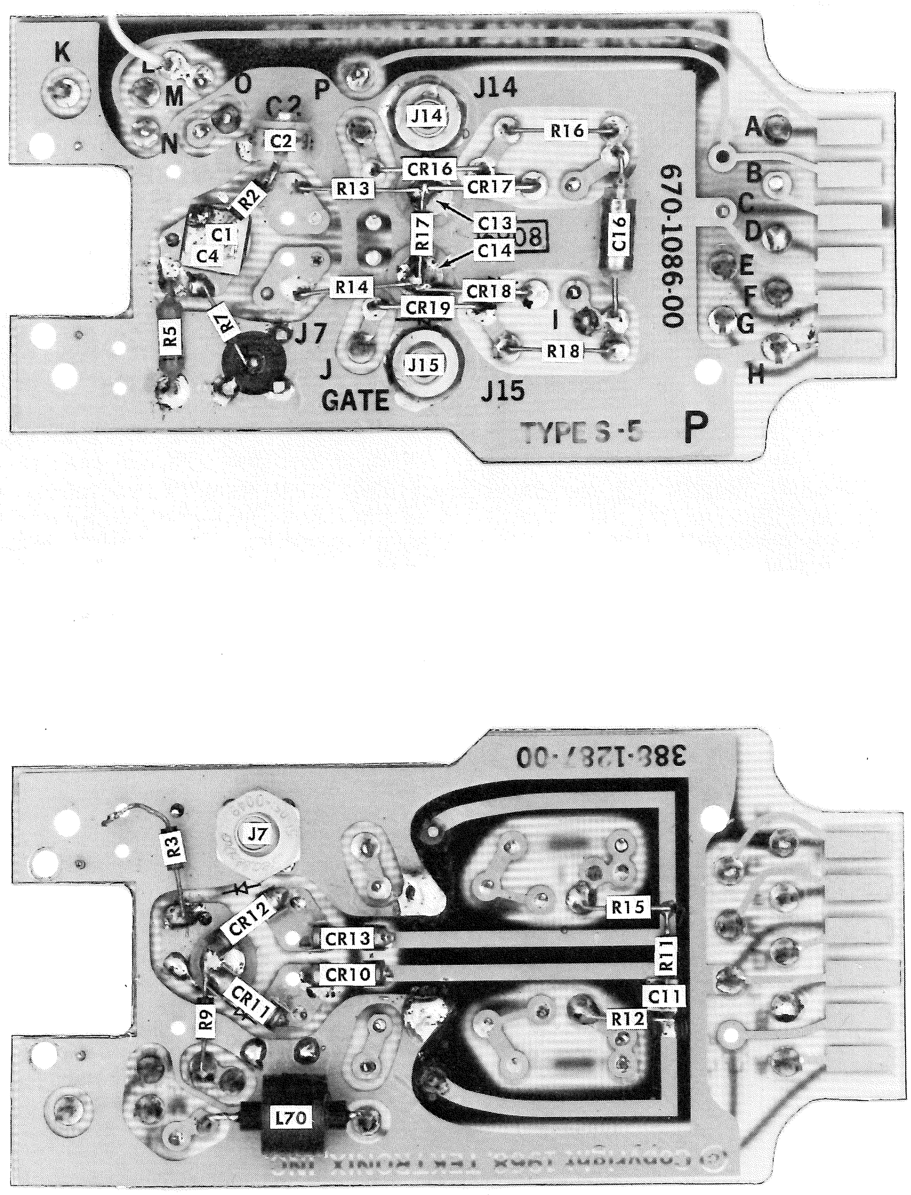

Fig. 4-3. Gate circuit board.

Gate and Strobe Diodes. Diodes which are mounted in small metal clips, as shown on the circuit board illustrations, are best removed or replaced with a pair of plastic tweezers, such as Tektronix Part No. 006-0765-00 or equivalent.

Circuit Board Replacement. If a circuit board is damaged and cannot be repaired, the entire assembly including all soldered-on components should be replaced. The part number given in the Mechanical Parts List is for the completely wired board.

The Strobe Board and the Preamp Board are removed by gently pulling outward from the Gate Board. The Preamp Board holds the trigger pickoff connector. Two wires from the DC BAL control are soldered to the Strobe Board at R67 and R68. For replacement, align the connectors and pin contacts and ease the boards into position. Pin connectors should not protrude beyond the clamps.

The Gate Board is removed with both the Strobe Board and Preamp Board removed. Unsolder the resistors from the COUPLING switch at the Gate Board and remove the switch. Unsolder the wire from the Gate Board to the Input connector at the connector. Use caution to avoid stressing the 0.01 μF leadless capacitor. Remove the hexagonal screws at the Input connector with a $^5/_{64}$ inch Allen wrench and the Gate Board can be pulled away from the alignment slots at the front panel casting.

Reinstall the Gate Board, aligned with the slots at the front panel casting, install and secure the Input connector with the hexagonal screws. Resolder the resistors from the COUPLING switch. Reinstall the COUPLING switch. Replace the Preamp and Strobe Boards.

Major Circuit and Part Locations

This section includes photographs of the Type S-5 circuit boards. Major circuit areas are identified. All components mounted on circuit boards are identified by circuit numbers.

Replacing the Sampling Head Case

To replace the case on the sampling head, align the case so the Trig Bal control R65 and Preamp Gain control R85 are in proximity to the holes, and both the upper and lower corners of the Preamp and Strobe Boards enter in the zig-zag-spring channels. Push the body gently forward until it contacts the front panel. Be sure that the white plastic pawl on the locking knob is properly aligned and that no insulated wires are likely to be pinched as the sampling head unit is slid into the case. Check the alignment of the drilled holes in the case with the potentiometers on the circuit boards. In attaching the rear casting, be sure that the hole at one side of the casting fits over the trigger pickoff signal output connector. Insert the four long mounting bolts and tighten them securely.

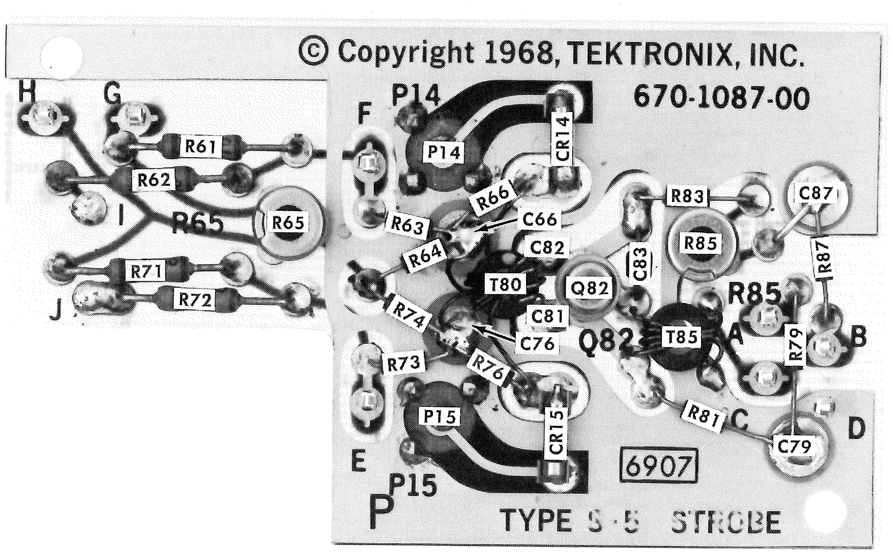

Fig. 4-4. Strobe circuit board.

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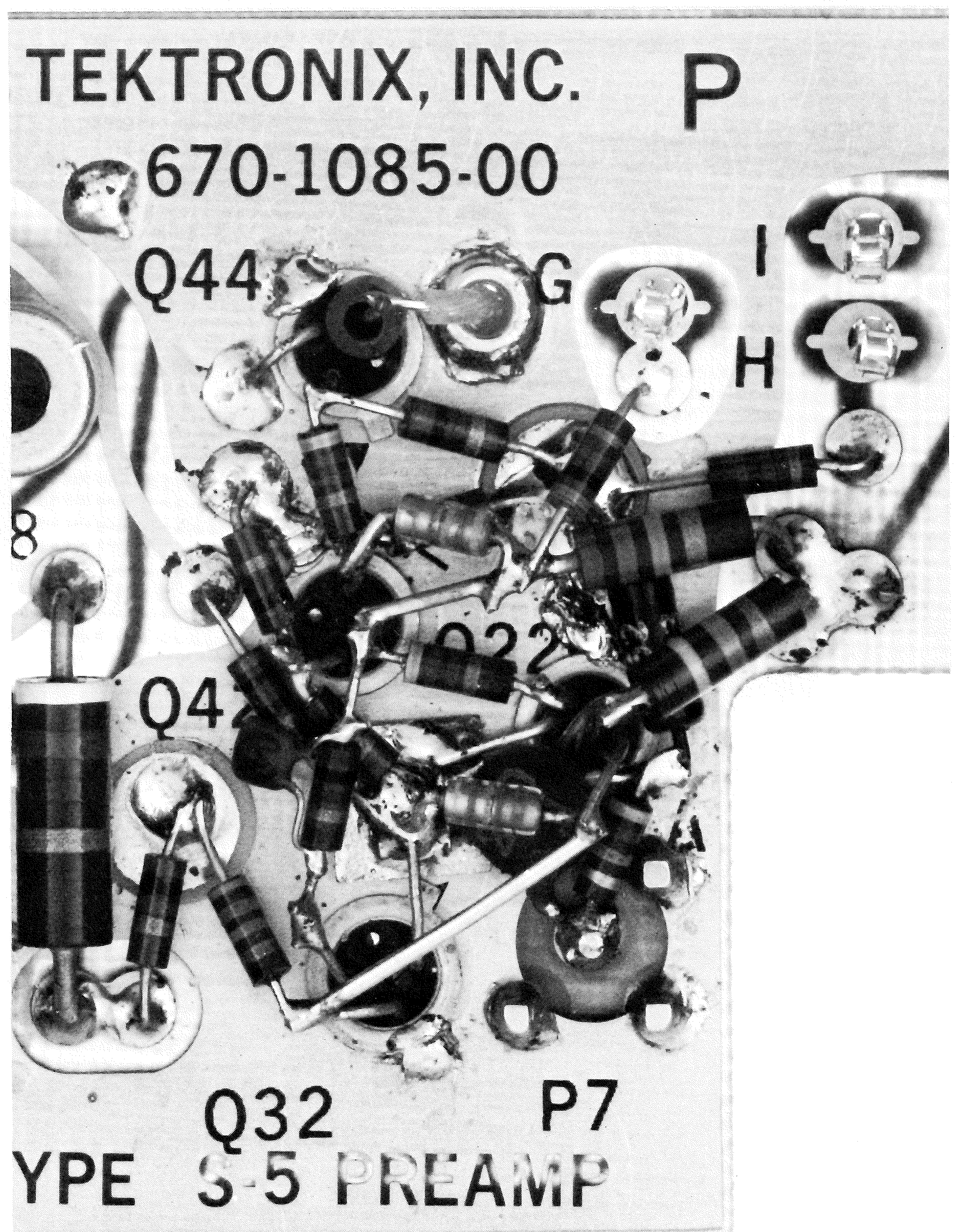

Fig. 4-5. Wiring details of Isolation and Trigger Pickoff amplifiers.

NOTES

SECTION 5
PERFORMANCE CHECK/CALIBRATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

Performance of the Type S-5 can be checked without making internal adjustments by using the steps of this procedure whose headings are set in the type face used in step 1. Failure to meet the requirements given in any check indicates the need for calibration and/or repair.

The sampling head performance can be restored to the limits stated in Section 1 by performing the calibration steps of this procedure. Calibration steps are headed by the type face shown in step 2. Any needed maintenance should be performed before proceeding with calibration.

Since the sampling head functions as a part of the associated sampling unit, the sampling unit calibration must be correct before starting this procedure. It is recommended that the performance checks for the sampling unit be performed and any faults corrected just before the Type S-5 performance checks are made.

In the following procedure, the "indicator oscilloscope" contains the Type S-5 being calibrated, and the "test oscilloscope" contains the Type S-5 being used to make signal checks.

EQUIPMENT REQUIRED

This performance check and calibration procedure for the Type S-5 Sampling Head requires the use of the test equipment listed below and shown in Fig. 5-1. The test equipment specifications given are the minimum acceptable for the particular use of each item. If other test equipment is substituted, it must meet or exceed the requirements stated. All test equipment must be correctly calibrated.

1. Indicator oscilloscope, with sampling plug-in units, such as a Type 561B Oscilloscope with Type 3T2 Random Sampling Sweep and Type 3S2 Sampling Unit. All units should be calibrated.

2. Test oscilloscope. Requirements: bandwidth DC to at least 350 MHz, minimum deflection factor 10 mV. For example, a Tektronix Type 561B with Type 3S2 and 3T2 Plug-In Units, and an S-5 Sampling Head.

3. 10× Probe for use with test oscilloscope, Tektronix Type P6010 Probe (included with the Type S-5) recommended.

4. Signal Generator-Pulse Generator, such as the Tektronix Type 284 Pulse Generator used in this procedure. Requirements: pulse risetime 250 ps or less, amplitude approximately 200 mV into 50 Ω, with a 180 mV positive-going trigger signal available at least 75 ns in advance of the pulse. Trigger signal risetime must be 2 ns or less. Square wave signal output of 1 μs period (1 MHz) and 100 ns (10 MHz) with output amplitude ranges of 10 mV, 100 mV and 1.0 V into 50 Ω. (If your Type 284 Lead time switch is labeled 5 ns-50 ns, order modification kit, Tektronix Part No. 040-0487-00.)

5. A special Variable Attenuator with GR874 connectors. It consists of 100 Ω potentiometer across the 50 Ω line, and does not have a guaranteed response. Tektronix Part No. 067-0511-00.

6. Input Normalizer, 15 pF, with BNC connectors, RC time constant 1 mΩ × 15 pF. Tektronix Part No. 067-0537-00.

7. 50 Ω 2× attenuator with BNC connectors. Tektronix Part No. 011-0069-00.

8. 50 Ω termination with BNC connectors. Tektronix Part No. 011-0049-01. (Supplied as a Type S-5 accessory.)

9. GR 874 to BNC female adapter, Tektronix Part No. 017-0063-00.

10. BSM male to BNC female adapter, Tektronix Part No. 103-0036-00.

11. GR 874 to Probe tip adapter, Tektronix Part No. 017-0076-00.

12. Three 50 Ω coaxial cable with BNC connectors, approximately 40 inches long. Tektronix Part No. 012-0057-01.

13. Flexible extender cable for operating the sampling head outside the sampling unit, Tektronix Part No. 012-0124-00.

14. BNC female to clip lead adapter, Tektronix Part No. 013-0076-00.

15. An RMS reading line voltage meter, accurate within 3% at the line voltage to which the indicator oscilloscope is connected. (Not shown).

16. Pocket screwdriver with shank at least 2 inches long and a blade width of approximately 3/32 inch. Tektronix Part No. 003-0192-00. (Not shown.)

17. DC Bridge for measuring 1 MΩ. Requirements: plus or minus 1 volt DC maximum across 1 MΩ resistor. Accurate within 0.1%. (Not shown.)

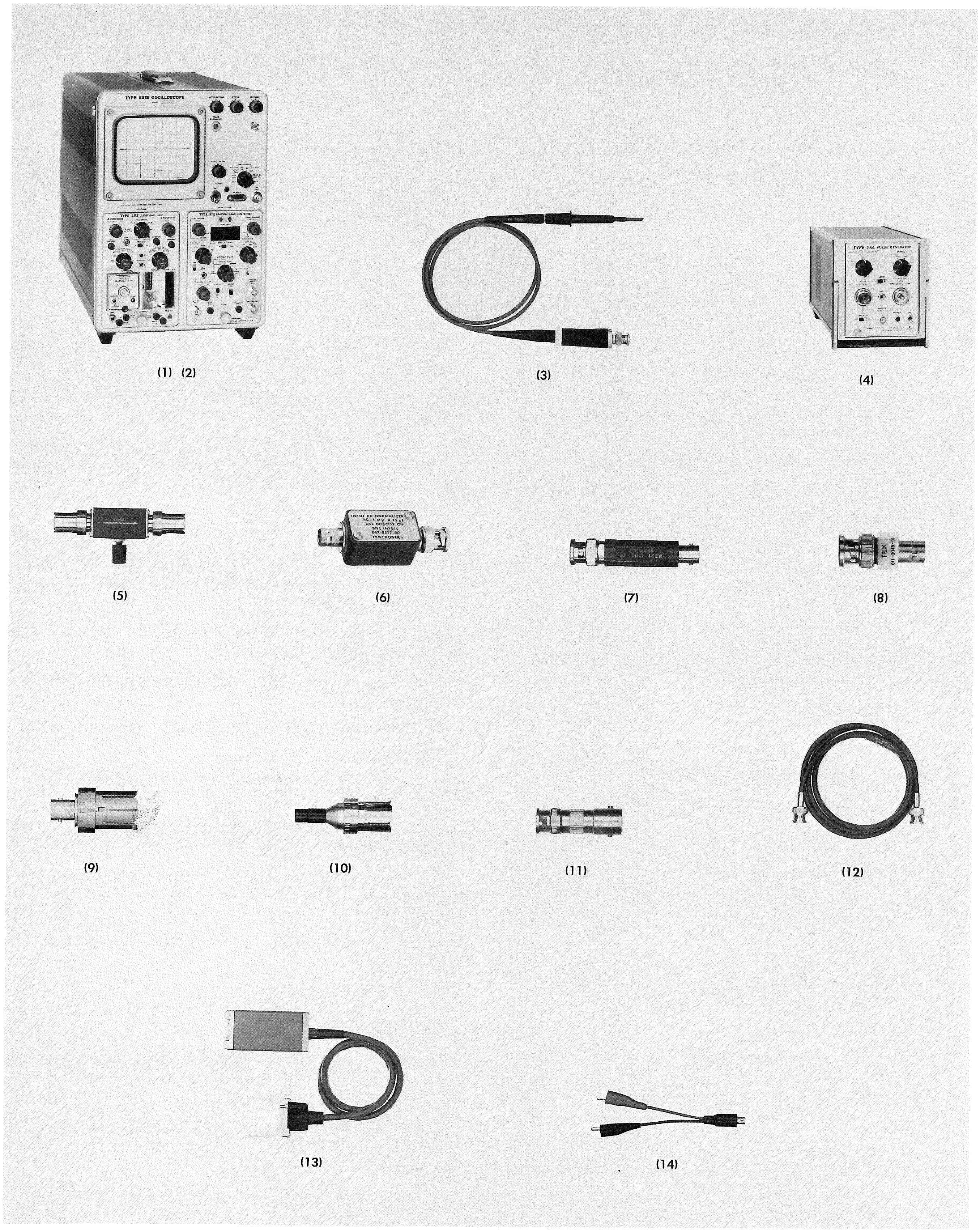

Fig. 5-1. Equipment required for performance check and calibration.

PERFORMANCE CHECK AND CALIBRATION RECORD AND INDEX

The following abridged procedure may be used as a guide by the experienced technician for checking the performance of the Type S-5 Sampling Head. The abridged procedure can be used as a maintenance record (the procedure may be reproduced without special permission of Tektronix, Inc.). The step numbers and titles are identical to those in the complete procedure.

Type S-5, Serial No. ______________________

Calibration Date ______________________

Calibrated By ______________________

Check By ______________________

Short-Form Calibration Procedure

PRELIMINARY PROCEDURE

Checking DC Input Resistance

a. Disconnect the sampling head from the sampling unit and connect the clip lead adapter (item 14) through a coaxial with cable (item 12) to the Type S-5 Input connector.

b. Measure the DC input resistance with a DC Resistance Bridge from one clip lead to the other. Be sure the bridge does not apply more than ±1 volt to the input.

The Type S-5 input resistance must be 1 MΩ within 1%, (0.99 MΩ to 1.01 MΩ).

Complete any needed repairs before proceeding.

Setting Up The Equipment

a. Indicator oscilloscope system. Install the Type 3T2 in the right side compartment of the Type 561B and the Type 3S2 in the left side compartment. Install the extender cable with the Type S-5 Sampling Head connected into the Channel A compartment of the Type 3S2. Leave the Channel B compartment vacant.

b. Connect the RMS line-voltage meter to the power mains. Determine that the oscilloscope (and other equipment) input voltage selector is set for the correct value of line voltage. Connect all equipment to the proper power outlets and turn on the power.

c. Obtain a free-running trace on the indicator oscilloscope and allow five minutes for equipment warm up. After the warm up period, adjust the Trace Alignment control so the trace is parallel to the graticule lines.

NOTE

The case should be in place on the Type S-5 unless access to internal controls is necessary.

d. Set the controls as listed following Fig. 5-2.

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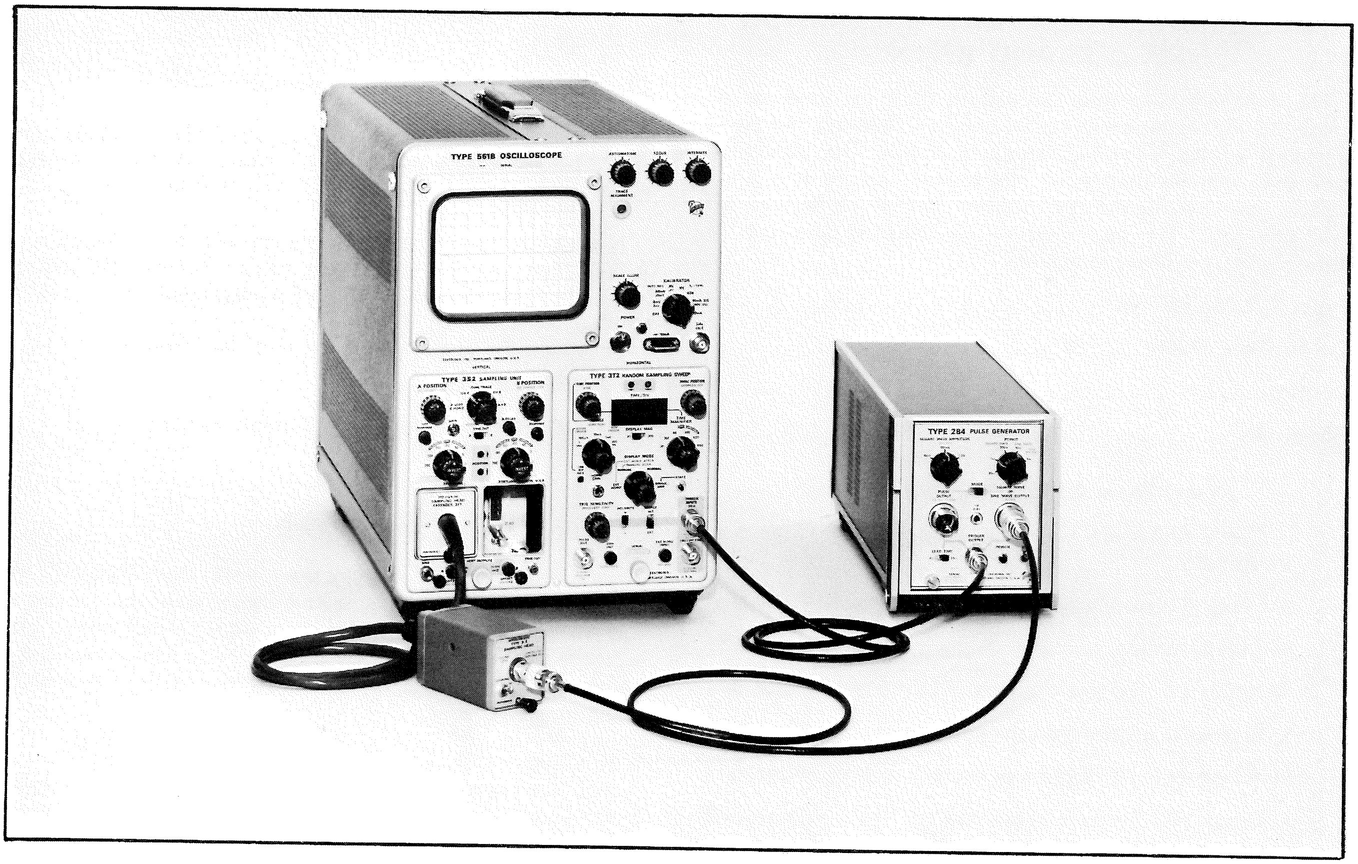


Fig. 5-2. Initial equipment setup.

Sampling unit, both channels (Type 3S2 listed).

Mode Switch	Ch A
Dot Response	Unity loop gain
Units/Div	20
Variable	Cal
Invert	Pushed in
Position	Midrange
DC Offset	0 volts at Offset Out
Horiz Plug-In Compatability (Internal)	Sampling

Sampling sweep unit (Type 3T2 listed).

Display Mode	Normal
Start Point	With Trigger
Time/Div	200 ns
Range	10 μs
Time Magnifier	5
Variable	Cal
Display Mag	×1
Time Position Controls	Fully clockwise
Horiz Position	Midrange
Recovery Time	Optional
Trigger Polarity	+
Trigger Source	Ext
Samples/Div SW (Internal)	Variable
Samples/Div control	100, Dot at 9 0'clock

Type 284

Mode	Square Wave
Period	1 μs
Amplitude	100 mV
Leadtime	75 ns

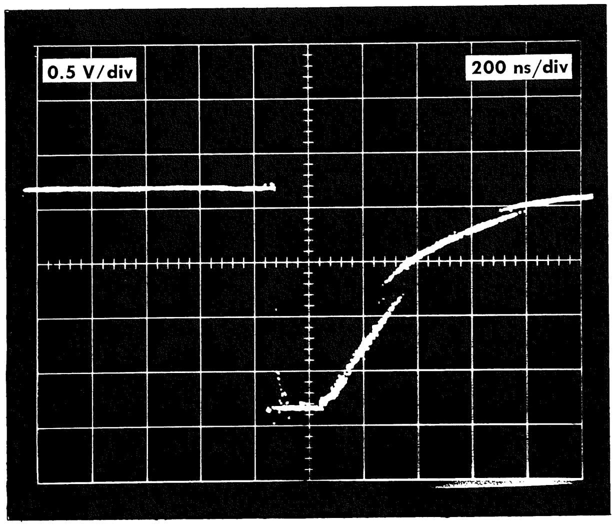
PERFORMANCE CHECK AND CALIBRATION PROCEDURE

1. Check Maximum Operating Signal Voltage

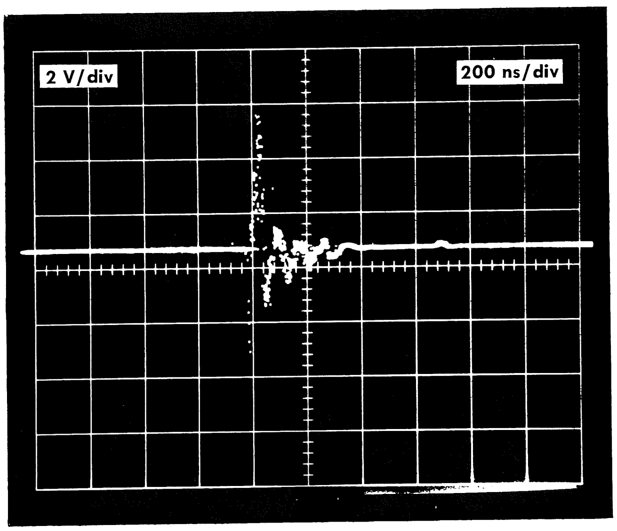
Requirement—Signal amplitude up to 1 V peak-to-peak must be displayed without distortion.

a. Connect the Type 284 Square Wave Output to the Type S-5 Input connector through a GR to BNC adapter, a BNC coaxial cable and 50 Ω termination. Connect the Trigger Output connector to the sampling sweep unit Trigger Input connector through a BNC coaxial cable.

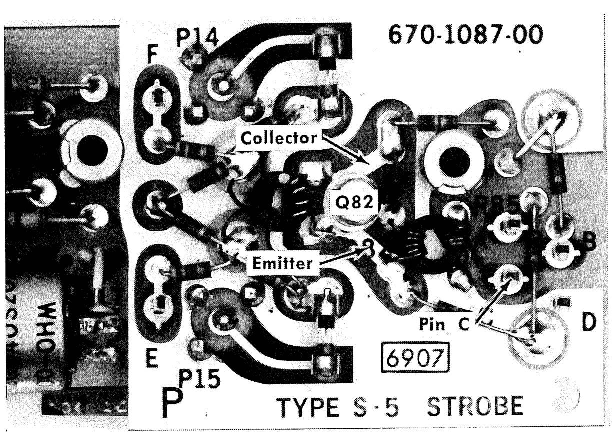
b. Obtain a stable display. Observe the top and bottom portions of the display.



A. Q82 collector waveform.

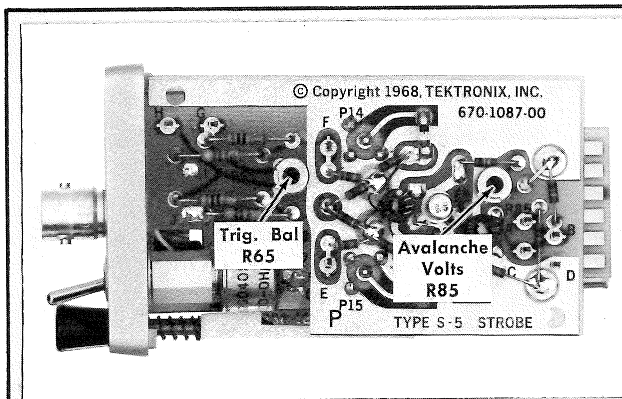


B. Drive signal at Pin C.

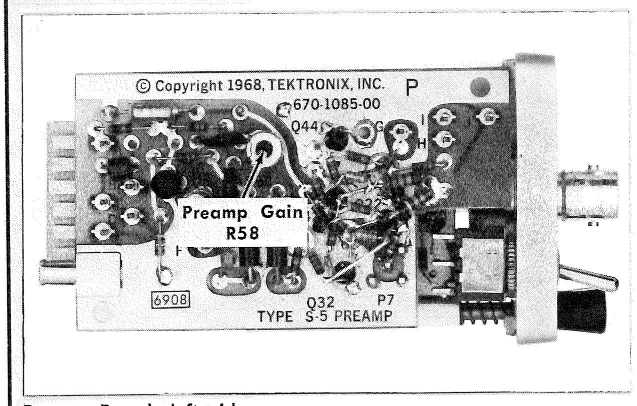


C. Locations of test points.

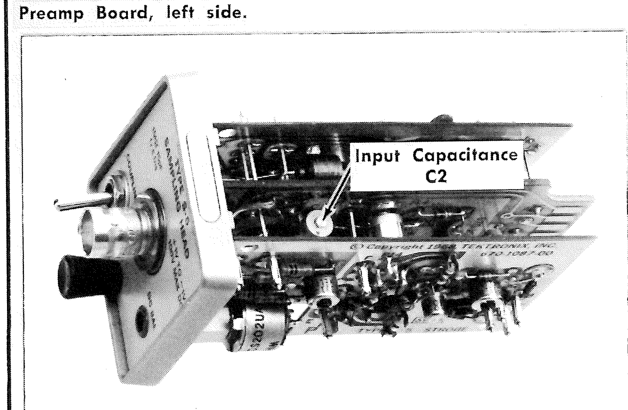
Fig. 5-3. Strobe operation check, step 2.



Strobe Board, right side



Preamp Board, left side.



Gate Board, center.

Fig. 5-4. Type S-5 control locations.

c. Change the Units/Div switch to 200 and the Type 284 amplitude switch to 1.0 V.

d. Check that the square wave display is not distorted at the top or bottom portions as observed in part c.

A distorted (compression) square wave display may be caused by Gate imbalance. Check step 4 Adjust DC Bal or check the gate diodes.

2. Check Strobe Operation

To be performed when no trace or dots can be obtained with a free run sweep.

a. Remove the Sampling Head from the extender cable (the indicator oscilloscope power may be left on).

b. Remove the Type S-5 case. First, remove the four round-head screws visible at the back casting, then slide the cover off by gently pulling it away from the front casting and input connector.

c. Connect the Type S-5 to the extender cable, taking care to properly align the Trigger Pickoff connector. Set the sampling sweep unit Range switch to 100 ns (10 ns/div).

d. Connect a BNC coaxial cable and BSM to BNC adapter between the Sampling Unit Trig Out connector and the Trigger Input connector on the test oscilloscope. Set the trigger controls on the test oscilloscope to obtain a display, using the Before Trigger operation. Set the sweep rate to 200 ns/div.

e. Check for proper strobe operation by bringing the 10× probe from the test oscilloscope close to the emitter and then the collector of avalanche transistor Q82, and at the primary of T85 (Pin C of the Strobe Board), see Fig. 5-3A.

If T85 is receiving drive, but there is no signal out of Q82, change Q82 (see Section 4, maintenance).

3. Adjust Avalanche Volts

Avalanche Volts control R85 (see Fig. 5-4) alters the strobe pulse amplitude. The strobe pulse affects the display noise, DC balance, and dot transient response.

a. Connect the Type 284 Pulse Output connector to the Type S-5 Input connector through a GR to BNC adapter and BNC 50 Ω termination.

b. Set the Pulse Generator Mode switch to Pulse Output.

c. Set the sampling sweep unit Time/Div to 1 ns (Range switch to 100 ns and Time Magnifier to ×10). Obtain a stable display with the Trig Sensitivity control and position the rising portion of the pulse on the graticule with the Time Position control.

d. Turn the Avanlanche Volts control R85 clockwise into the free-run position. The trace will become very noisy and the pulse will disappear. Turn R85 counterclockwise while the pulse moves down until the pulse beings to move to the left. Leave the control set at the point where the display just begins to move to the left.

e. Disconnect the termination from the Type S-5 Input connector.

4. Adjust DC BAL (front panel)

The DC BAL control R70 introduces an internal offset voltage to the feedback loop to cancel normal error signals in the sampling loop, including normal unbalance in the sampling gate. R70 is adjusted (with the sampling unit DC Offset at zero) to cancel most of the vertical trace shift as the Units/Div switch setting is changed.

a. Connect the 50 Ω termination to the Type S-5 Input connector. Set the sampling unit DC offset control for zero volts at the Offset Out jack. Preset the Dot Response control 10° from its counterclockwise end of rotation.

b. Observe the no-signal trace as the sampling unit Units/Div switch is operated through its ranges and adjust DC BAL (front panel) for no more than one division of vertical shift of the trace.

c. Set the sampling unit Units/Div switch to 100.

NOTES

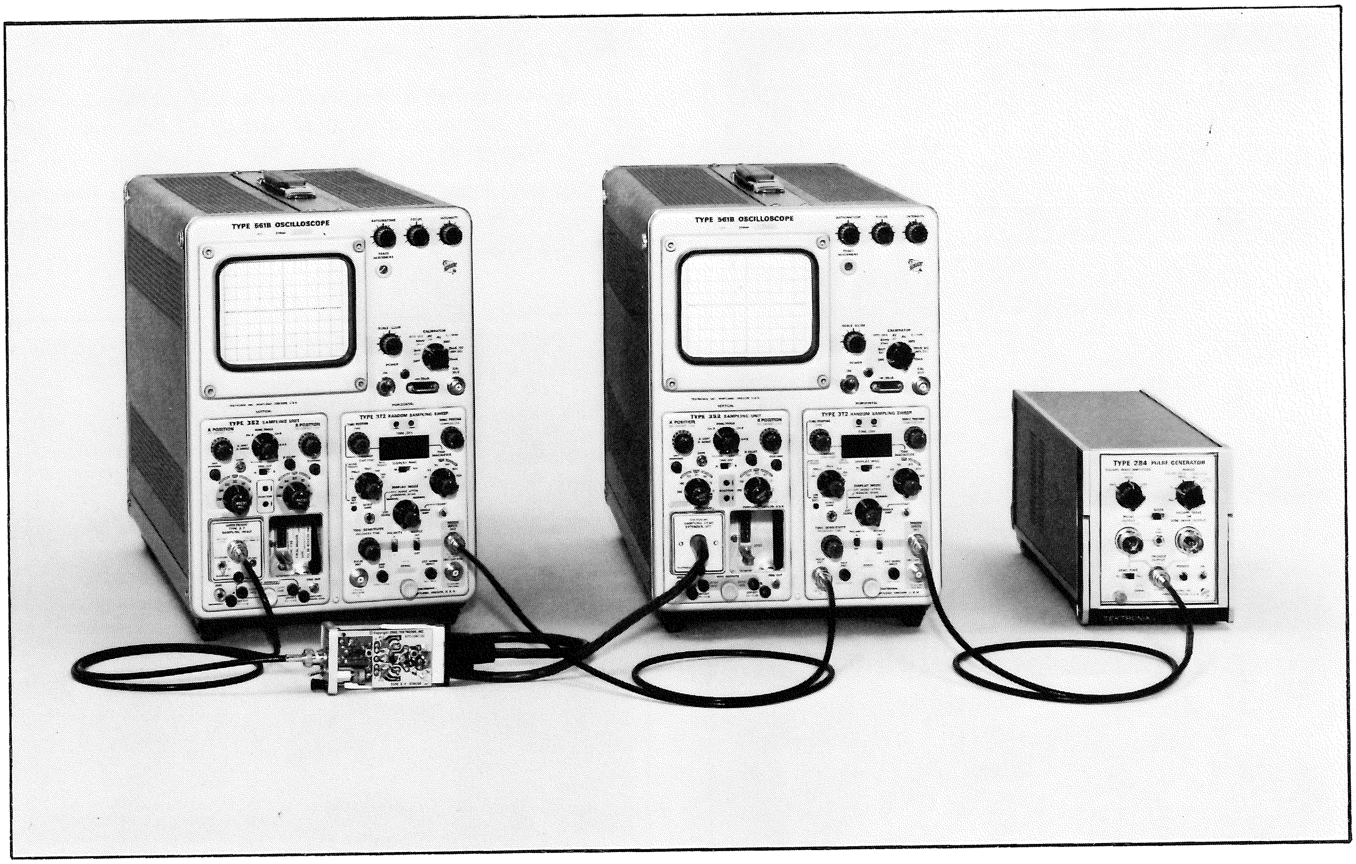


Fig. 5-5. Equipment setup for step 5, T80 adjustment.

5. Replacement T80 Adjustment

This adjustment is to physically place the primary winding on T80 for minimum strobe kickout at the Input connector. Perform this step only if T80 is replaced. Equipment setup is shown in Fig. 5-5.

a. Connect the Type S-5 Input connector to the test oscilloscope vertical Input connector through a 50 Ω BNC coaxial cable. Free run the indicator oscilloscope sampling sweep unit by clockwise rotation of the Trig Sensitivity control.

b. Set the test oscilloscope vertical Units/Div switch to 20 mV/div and center the trace. Set the sweep rate for 1 ns/div and the sampling mode to With Trigger. Connect a BNC coaxial cable from the indicator oscilloscope sampling sweep unit (3T2) Pulse Out connector to the Trigger Input connector on the test oscilloscope. Set the test oscilloscope Polarity switch to — and adjust the Trig Sensitivity control for a stable display.

c. Set the Type S-5 indicator oscilloscope sampling unit Units/Div switch at 2 mV/div and the sampling sweep unit Range to 100 ns and Time Magnifier switch to ×1 (10 ns/div). Set the Display Mode switch to Manual Scan. Connect the Type 284 Trigger Output connector to the indicator sampling sweep oscilloscope unit Trigger Input connector through a BNC coaxial cable. Set the Type 284 Mode switch to Pulse Output.

d. Adjust the Time Position controls (indicator oscilloscope) to observe the kickout from the Type S-5 on the test oscilloscope, see Fig. 5-6. Do not use a metallic or sharp tool to move the winding. The narrow, flat end of a Walsco No. 2543 plastic tool or other non-metallic tool may be used, for only a minimum of wire movement is necessary. Vary the setting of the indicator DC Offset control to null the kickout, then vary the position of the wire at either end of the winding. If this does not accomplish minimum kickout, move the turns individually on the core for minimum kickout. The final adjustment requires very slight wire movement. It is more important that the trailing portion of the strobe be nulled than the leading. See Fig. 5-6, display 2, for correct display.

Set the winding permanently in place by cementing with a doping compound, such as an acrylic lacquer with low dielectric characteristics.

Disconnect all signal cables. Put the case on the Type S-5.

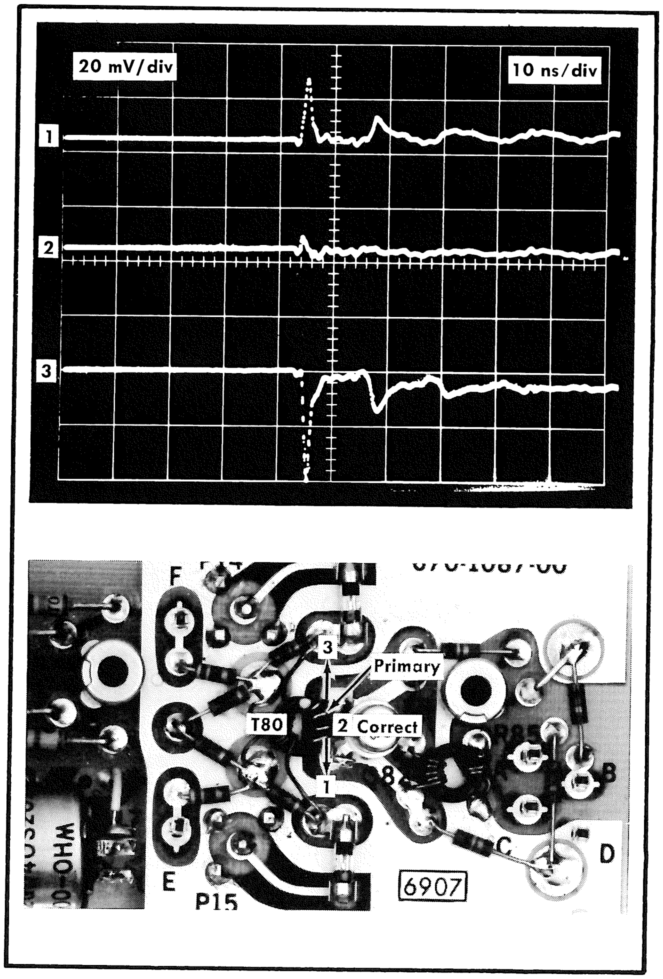


Fig. 5-6. Replacement T80 adjustment for minimum kickout.

6. Adjust Trig Bal R65 (right side panel)

Strobe kickout, as observed at the sampling unit Trigger Out connector, (or at the collector of Q44 with no Trigger Out connector on the sampling unit) can be reduced to an absolute minimum by adjustment of the Trig Bal control.

a. Remove any connector at the Input. (Place the Units/Div switch to 10 mV.) Be certain the trace remains on the CRT. Adjust the DC OFFSET control as necessary.

b. Connect the sampling unit Trig Out connector to the test oscilloscope vertical input through a BSM to BNC adapter, BNC coaxial cable, and 50 Ω termination. Set the sampling sweep unit Display Mode switch to Manual Scan. Connect the Pulse Out connector to the Trigger Input connector on the test oscilloscope.

c. Set the test oscilloscope sweep rate to 1 μs/div and the vertical deflection factor to 10 mV/div. Obtain a display. There may not be more than a trace width (indicates properly adjusted Trig Bal control) of spikes with approximately a 1 μs time constant.

d. Adjust Trig Bal control R65 for a test oscilloscope display with a minimum amount of energy in the spikes (see Fig. 5-7, display 2).

e. Disconnect the Trig Out and Pulse Out cables from the sampling units and test oscilloscope. Set the sampling sweep unit Display Mode switch to Normal.

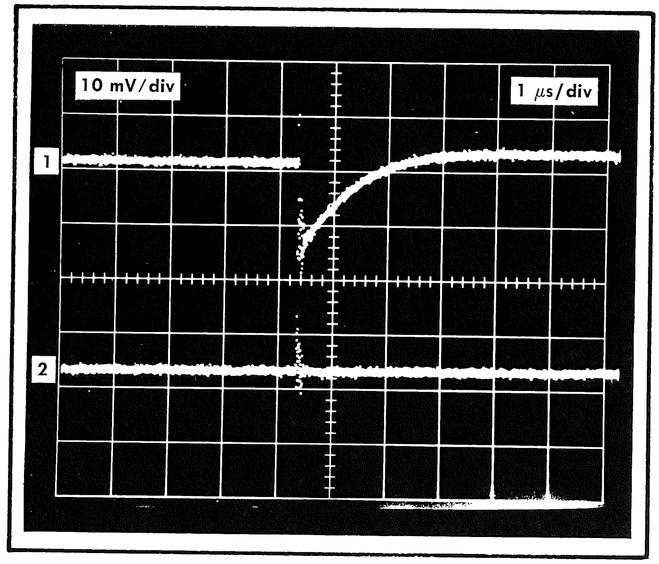


Fig. 5-7. Kickout at Trigger Out connector.

7. Check Dot Transient Response

Requirement—Dot will move full amplitude ±5%, of any signal up to 500 mV peak-to-peak when sampling sweep unit is either double triggered or free run.

a. Connect the Type 284 Square Wave Output connector to the Type S-5 Input connector through a GR to BNC adapter, 50 Ω BNC coaxial cable, 2× attenuator, and 50 Ω termination.

b. Connect a BNC coaxial cable from the Type 284 Trigger Output connector to the sampling sweep Trigger Input connector.

c. Set the Type 284 Period switch to 100 ns (set it to 1 μs when the sampling sweep unit is other than a Type 3T2). Set the Type 3T2 Range switch to 10 μs, the Time Magnifier to ×50 (20 ns/div) and the Start Point switch to With Trigger.

d. Set the sampling unit Units/Div switch to 100 and obtain a triggered square wave display.

e. Set the Type 3T2 Start Point switch to Before Trigger (or free run the sampling sweep unit at 0.5 μs/div if not a Type 3T2). Obtain a triggered display.

f. Set the sampling unit Dot Response control so the top of the square wave is at unity loop gain (one trace). If it is not possible to set one edge to unity loop gain, then perform Step 8 before completing this step. The bottom of the square wave can show two traces, but the dot response overshoot or undershoot must not be greater than 5% or 0.25 major division on the graticule (see Fig. 5-8).

If the dot response overshoots or undershoots more than 5% on one edge with the other edge adjusted to unity loop gain, perform steps 2 and 3. If the dot transient response is still poor on one edge, check the gate diodes.

8. Adjust Preamp Gain (left side panel)

Preamp Gain control R58 changes the feedback loop gain.

a. Use the same setup as the preceeding step. Set the sampling unit Dot Response control about 15° from the fully counterclockwise position.

b. Adjust Preamp Gain control R58 for unity loop gain as shown in Fig. 5-8.

Minor adjustment of Avalanche Volts control R85 may interact with the Preamp Gain control to correct a dot response overshoot or undershoot in excess of the 5% tolerance. It may also be desirable to set the Preamp Gain control for best compensation of the dot transient response at unity loop gain for a particular most-used input, such as a P6010 probe or a coaxial source.

9. Check Displayed Random Noise

NOTE

When making a visual noise reading from a sampling display, the eye interprets a noise value which is neither the RMS nor the peak to peak value. Since most observers agree that the displayed noise value is approximately 3 times the RMS value, the Tangential measured noise here defined is 3 times the RMS value. (The measurement technique given produces acceptable agreement between various operators as to the instrument's noise value).

Requirement—Random displayed noise, measured tangentially, will not be greater than 500 μV when the signal source resistance is 25 Ω and the case is on the Type S-5.

a. Set the sampling unit Units/Div switch to 2 mV/Div. Connect the 50 Ω termination to the Type S-5 Input connector.

b. Set the sampling sweep unit for a 1 μs/div sweep and the Trigger Sensitivity control clockwise for free run operation. Disconnect the coaxial cable to the Trigger Input connector.

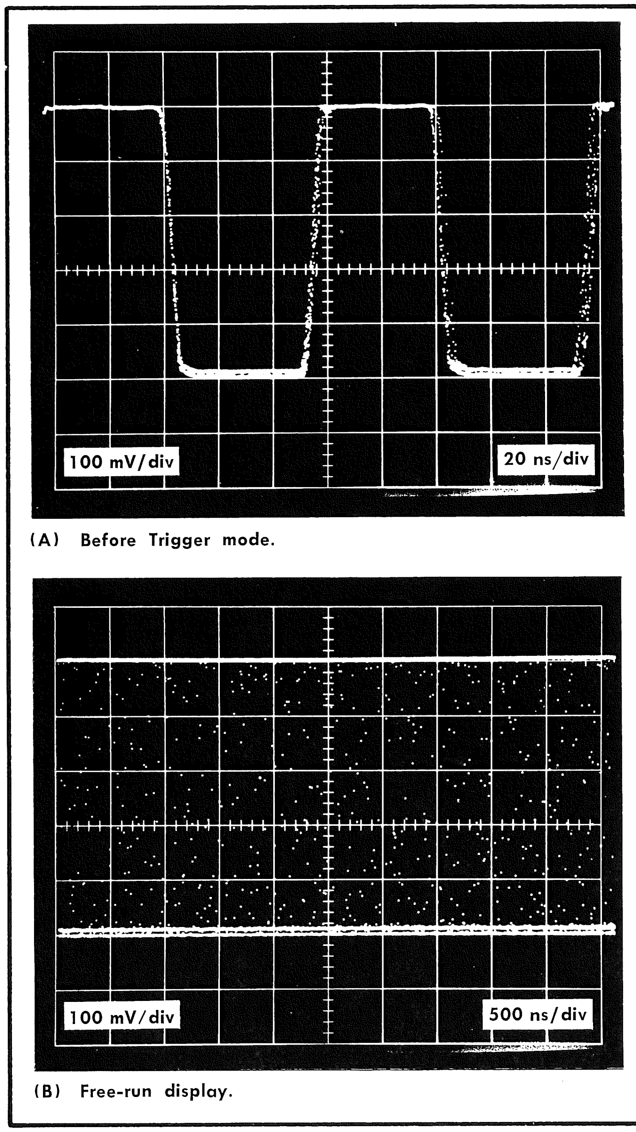


Fig. 5-8. Dot transient response check.

c. Observe the trace width on the graticule (increase the number of dots by turning the Type 3T2 Samples/Div control counterclockwise).

If the trace width appears to be approximately one minor division (0.2 div) the tangential noise method for measurement need not be performed (most observers encounter difficulty obtaining consistent measurement at one minor division). The allowable noise can be one and one quarter minor divisions, so if the noise appears to be greater than one minor division, proceed with the rest of this step.

d. Connect the Type 284 Square Wave Output to the Type S-5 Input connector through the variable attenuator, GR to BNC adapter, BNC coaxial cable, 2× attenuator and 50 Ω termination.

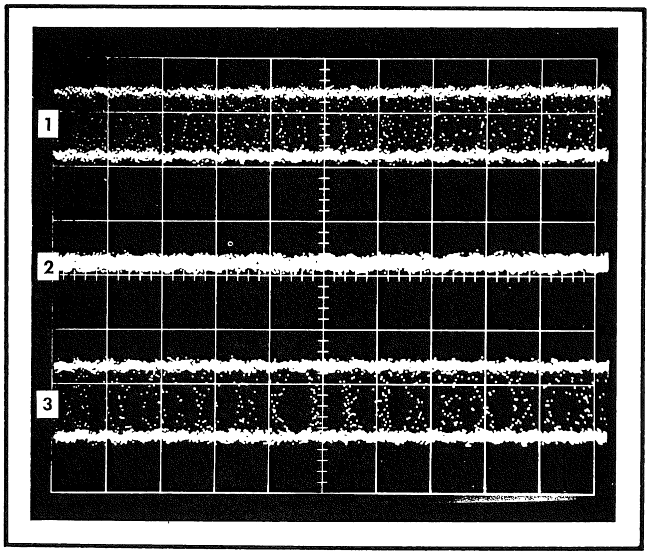


Fig. 5-9. Tangential noise measurement technique, triple exposure.

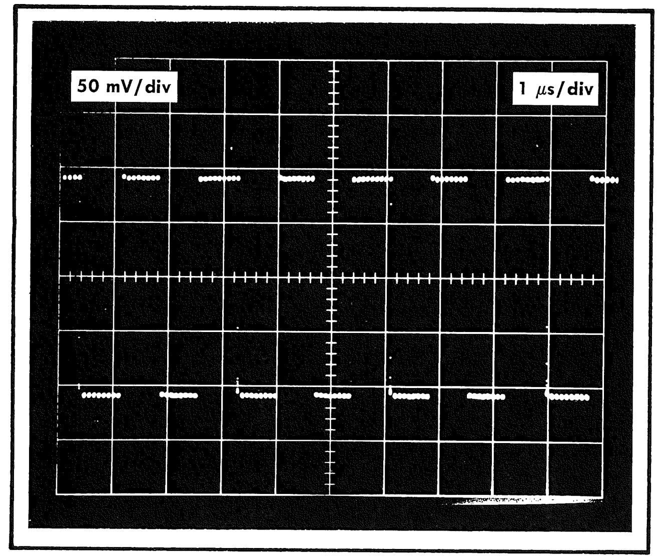


Fig. 5-10. False display for adjustment of C2.

e. Set the Type 284 Square Wave Amplitude switch to 10 mV. Free run the sweep and refer to Fig. 5-9 for displays. of the following tangential noise measurement procedure.

(1) Obtain a display of two traces.

(2) Adjust the variable attenuator until the two traces blend together just to the point at which they appear as one trace.

(3) Change the Type 284 Amplitude switch to 100 mV, 10 times the signal amplitude. The display now has a tangential deflection factor of 300 μV/div.

Tangential voltage per division is equal to the Units/Div setting of 2 mV divided by 2, times 3 divided by 10 = 300 μV/div.

The 500 μV tangential display noise limit includes 1.7 graticule divisions (3) of Fig. 5-9. Check that the bottom edges of the two traces are not more than 1.7 divisions apart. Waveform (3) measures as 360 μV tangential noise.

Determining Tangential Noise Deflection Factor. The noise displays of Fig. 5-9 have a noise deflection factor based upon the signal amplitude, the sampling unit Units/Div setting, the fact that the final trace separation is twice the RMS noise, and that the tangential noise is 3 times the RMS noise. The square wave signal amplitude that makes two traces appear as one sets the trace separation to twice the RMS noise. The procedure used here then permits a noise deflection factor to be determined by dividing the input mV/div deflection factor by 2 (trace separation is 2 times the RMS noise), multiplying by 3 (tangential noise is 3 times the RMS noise) and then dividing by 10 (the signal amplitude change factor).

f. Disconnect the Type S-5 from the Type 284.

10. Adjust Input Capacitance C2

Standardization of the input capacitance is provided with the adjustment of C2.

a. Set the oscilloscope Calibrator to 0.4 V.

b. Connect the oscilloscope Cal Out connector to the Type S-5 Input connector through a BNC coaxial cable and the Tektronix 15 pF normalizer (item 6.)

c. Set the sampling unit Units/Div switch to 50. Set the sampling sweep unit Range switch to 10 μs (1 μs/div) and the Trigger Source switch to Int.

d. Set the Trig Sensitivity control fully clockwise. Set the sampling unit Dot Response control for unity loop gain There should be no overshoot or undershoot of dots beyond normal amplitude of the square wave (this can be easily seen with the Samples/Div control fully counterclockwise.

e. Stabilize the false display with the Samples/Div and Recovery Time controls. The Trig Sensitivity control may also be used.

f. Check for a square front corner on the false display. If C2 needs adjustment, remove the Type S-5 case and adjust C2 for a square front corner and level top of the square wave, see Fig. 5-10.

g. Disconnect the calibrator signal. Put the Type S-5 case back on.

11. Check Risetime

Requirement—The 10% to 90% risetime is equal to or less than 1 ns (with a signal source resistance of 25 Ω).

a. Connect the Type 284 Pulse Output to the Type S-5 Input connector through a GR to BNC adapter, BNC coaxial cable and 50 Ω termination.

Ⓐ

b. Set the Type 284 Mode switch to Pulse Output. Connect a BNC coaxial cable from the Trigger Output connector to the sampling sweep unit Trigger Input connector.

c. Set the sampling unit Units/Div switch to 50 and the sampling sweep unit for a 1 ns/div sweep rate (Range switch to 100 ns and Time Magnifier switch to ×10. Center the rising portion of the pulse on the graticule. Use the Variable Units/Div control to increase the amplitude to 8 divisions (see Fig. 5-11) or other convenient amplitude to measure the risetime from the 10% to 90% amplitude points.

d. Check that the 10% to 90% risetime is 1 ns or less.

e. Use the same setup for the pulse flatness deviation check in step 12.

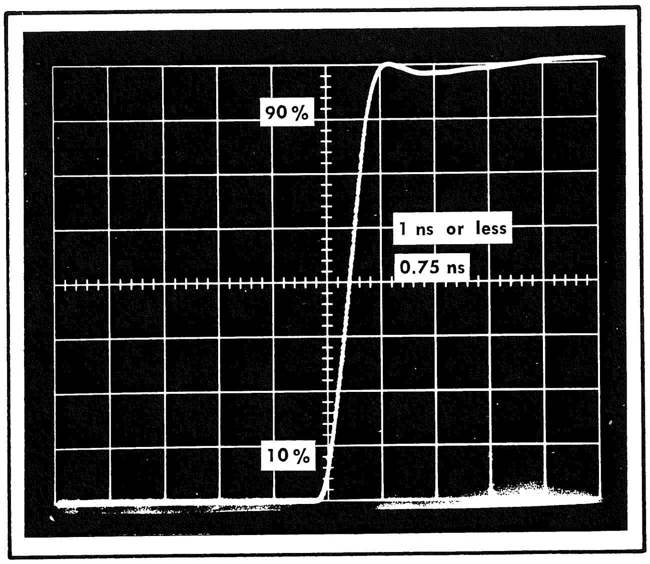


Fig. 5-11. Risetime measurement.

12. Check Pulse Flatness Deviation

Requirement—Display will not deviate from the flat more than the following limits.

First 17 ns after step, +2%, —5% or less, total less than 7% peak-to-peak.

After 17 ns, +0.5%, −2% or less, total less than 2.5% peak-to-peak.

Use only the Tektronix Type 284 Pulse Generator. Use the setup of step 11.

a. Set the sampling sweep unit for a 100 ns/div sweep rate (Range switch to 1 μs and Time Magnifier switch to ×1) and the Start Point switch to Before Trigger. Obtain a stable display.

b. Use the sampling sweep unit Time Position control to place the rising portion of the pulse one division from the left edge of the graticule. Set the sampling unit Variable Units/Div control for 5 divisions between the 0% amplitude and the 100% amplitude level. See Fig. 5-12A. Use the point 50 ns before the pulse as 0% and the point 500 ns after the pulse as 100%.

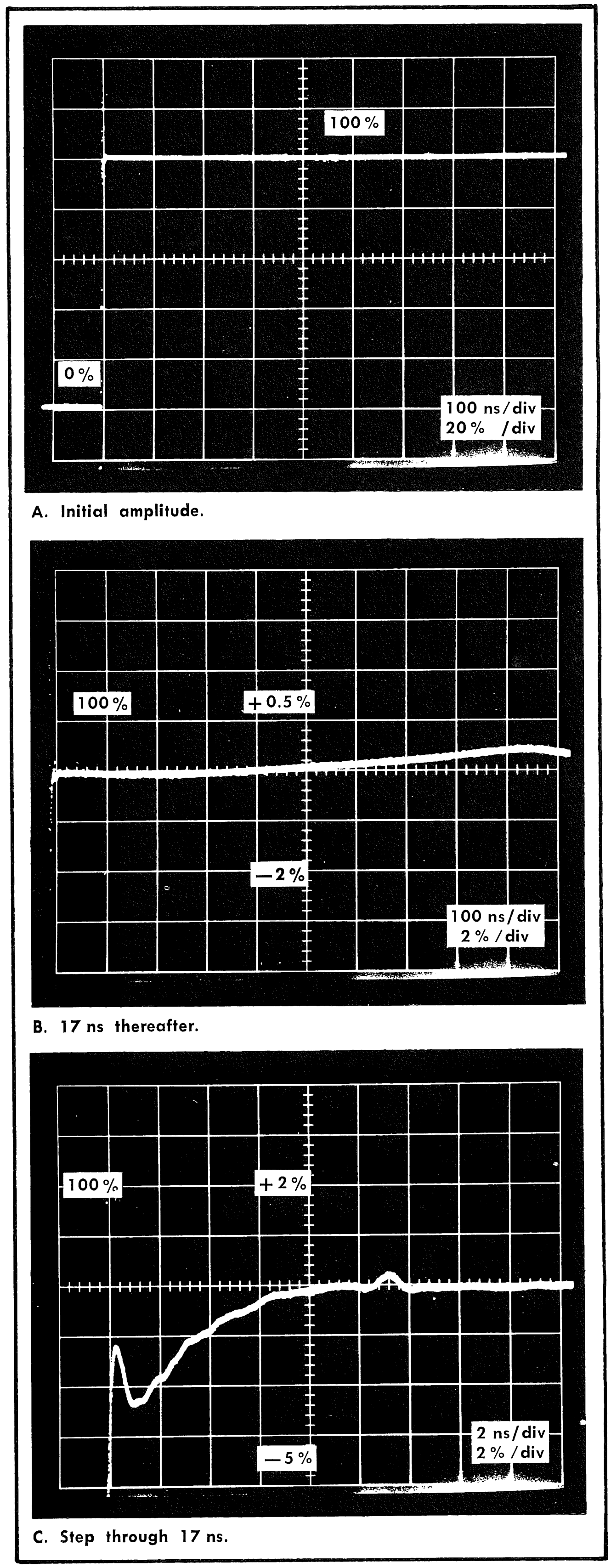


Fig. 5-12. Pulse flatness deviation measurement.

c. Change the Units/Div switch to 5 (without moving the Variable control) for a signal amplitude now 2% per division.

d. Position the pulse top to the 100% amplitude point (500 ns after pulse rise) on the center graticule line.

e. Check the pulse flatness deviation from 17 ns after the pulse rise through the end of the pulse. (The Time Position control may be used.) See Fig. 5-12B.

Check that the pulse flatness deviation is not more than +0.5%, —2% (total 2.5% peak-to-peak).

f. Set the sampling sweep unit for a 2 ns/div sweep rate (Range switch to 100 ns and Time Magnifier switch to ×5) and set the Start Point switch to With Trigger.

g. Reposition the rising portion of the pulse one division from the left edge of the graticule. Check the pulse flatness deviation from the rising portion of the pulse through 17 ns, see Fig. 5-12C.

h. Check that the pulse flatness deviation is not more than +2%, —5% (total 7% peak-to-peak).

13. Check Risetime with P6010 Probe

Requirement—The 10% to 90% risetime is equal to or less than 1 ns, (when the signal source resistance is 50 Ω and the pulse t_r is less than 250 ps).

a. Attach the P6010 probe to the Type S-5 Input connector.

b. Connect the Pulse Output connector of the Type 284 to the P6010 probe tip through the GR to Probe adapter. Connect the BNC coaxial cable from the Trigger Output connector to the sampling sweep unit Trigger Input connector.

c. Set the sampling sweep unit sweep rate to 1 ns/div (Range switch to 100 ns and the Time Magnifier switch to ×10). Set the sampling unit Units/Div switch to 10 and center the rising portion of the pulse on the graticule as in step 11. Use the Variable Units/Div control to increase the amplitude to 8 divisions, see Fig. 5-11. Measure the risetime from the 10% to 90% amplitude points.

d. Check that the 10% to 90% risetime is 1 ns or less.

e. Use the same setup for step 14.

14. Check P6010 Probe Pulse Flatness Deviation

Requirement—Display will not deviate from being flat more than the following limits:

First 17 ns after step, +5%, —5% or less, total less than 10% peak-to-peak;

After 17 ns, +1%, —3% or less, total less than 4% peak-to-peak.

With a 50 Ω signal source resistance. Use only a Tektronix Type 284 Pulse Generator.

a. Set the sampling sweep unit for a 100 ns/div sweep rate (Range switch to 1 μs and Time Magnifier switch to ×1) and the Start Point switch to Before Trigger. Obtain a stable display.

b. Use the sampling sweep unit Time Position control to place the rising portion of the pulse one division from the left edge of the graticule. Set the sampling unit Variable Units/Div control for 5 divisions between the 0% amplitude and the 100% amplitude level, as in Fig. 5-12, for a display amplitude of 20% per division.

c. Change the Units/Div switch to 2 (without moving the Variable control) for a signal amplitude of 4% per division.

d. Position the 100% amplitude point at the center graticule line.

e. Check the pulse flatness deviation from 17 ns after the pulse rise through the end of the pulse, (Time Position control may be used).

f. Check that the pulse flatness deviation is not more than +1% (0.25 div), —3% (0.75 div) or a total of 4% (1 div) peak-to-peak.

g. Set the sampling sweep unit for a 2 ns/div sweep rate (Range switch to 100 ns and Time Magnifier switch to ×5) and set the Start Point switch to With Trigger.

h. Reposition the rising portion of the pulse one division from the left edge of the graticule. Check the pulse flatness deviations from the rising portion of the pulse through 17 ns, as in step 12.

i. Check that the pulse flatness deviation is not more than +5% (1.25 div), —5% or a total of 10% (2.5 div) peak-to-peak.

If the probe does not meet the requirement, the high speed compensation controls may require adjustment.

15. Check P6010 Probe Random Noise

Requirement—Random Noise, measured tangentially, will be not greater than 5 mV, using the test system listed below.

a. Set the sampling unit Units/Div switch to 2.

b. Set the sampling sweep unit for a 1 μs/div sweep and the Trig Sensitivity control clockwise for free run operation. Disconnect the coaxial cable to the Trigger Input connector.

c. Connect the Variable attenuator and GR to Probe adapter to the Type 284 Square Wave Output connector and connect the P6010 to the adapter.

d. Set the Type 284 Mode switch to Square Wave Output and the Square Wave Amplitude switch to 100 mV. Refer to Fig. 5-9 for the displays of the following tangential noise measurement procedure.

(1) Obtain a display of two traces.

(2) Adjust the variable attenuator until the two traces blend together just to the point at which they appear as one trace.

(3) Change the Type 284 Square Wave Amplitude switch to 1.0 V, 10 times the signal amplitude. The display now has a tangential deflection factor of 3 mV/div. Refer to step 9 for the method of tangential noise deflection factor determination.

Check that the bottom edges of the two traces in (3) are not more than 1.7 divisions apart.

16. Check Probe Attenuation

Requirement—P6010 Probe must attenuate the input signal 10× within 3%.

a. Set the sampling unit Units/Div switch to 50 and remove the variable attenuator from the Type 284. Set the Type 284 Square Wave Amplitude switch to 100 mV.

b. Connect the Type 284 Square Wave Output connector to the Type S-5 Input connector through a GR to BNC adapter and BNC coaxial cable. Connect a BNC coaxial cable from the Type 284 Trigger Output connector to the sampling sweep unit Trigger Input connector.

c. Set the sampling sweep unit sweep rate to 1 μs/div. Obtain a stable display.

d. Check that the display amplitude is 4 divisions, or set the Variable Units/Div control for 4 divisions.

e. Disconnect the GR to BNC adapter and BNC coaxial cable and connect the GR to Probe adapter to the Square Wave Output connector. Place the P6010 Probe tip into the adapter. Set the Type 284 Square Wave Amplitude switch to 1.0 V.

f. Check that the display amplitude is 4 divisions within 3% (use the same Variable control setting as in part d) 3.88 to 4.12 divisions. If the display is not the same, the high frequency compensation capacitor in the probe may require adjustment.

NOTES

NOTES

PARTS LIST ABBREVIATIONS

BHB	binding head brass
BHS	binding head steel
cap.	capacitor
cer	ceramic
comp	composition
conn	connector
CRT	cathode-ray tube
csk	countersunk
DE	double end
dia	diameter
div	division
elect.	electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ext	external
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
h	height or high
hex.	hexagonal
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
ID	inside diameter
incd	incandescent
int	internal
lg	length or long
met.	metal
mtg hdw	mounting hardware
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
PHB	pan head brass
PHS	pan head steel
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
RHB	round head brass
RHS	round head steel
SE	single end
SN or S/N	serial number
SW	switch
TC	temperature compensated
THB	truss head brass
thk	thick
THS	truss head steel
tub.	tubular
var	variable
w	wide or width
WW	wire-wound

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.

SECTION 6
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model Eff	Disc	Description			

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Eff	Disc	Description			
C1	283-0137-00			7 pF	Cer	w/o leads	
C2	281-0139-00			2.5-9 pF, Var	Cer		
C3	283-0000-00			0.001 μF	Cer	500 V	
C4	283-0072-01			0.01 μF	Cer	w/o leads	
C7	283-0135-00			100 pF	Cer	w/o leads	
C11	283-0132-00			10 pF	Cer	w/o leads	
C13	283-0135-00			100 pF	Cer	w/o leads	
C14	283-0135-00			100 pF	Cer	w/o leads	
C16	290-0188-00			0.1 μF	Elect.	35 V	10%
C21	283-0047-00			270 pF	Cer	500 V	5%
C25	283-0121-00			0.001 μF	Cer	w/o leads	
C33	283-0139-00			150 pF	Cer	50 V	
C43	283-0121-00			0.001 μF	Cer	w/o leads	
C53	283-0051-00			0.0033 μF	Cer	100 V	5%
C55	283-0000-00			0.001 μF	Cer	500 V	
C58	283-0000-00			0.001 μF	Cer	500 V	
C59	283-0003-00			0.01 μF	Cer	150 V	
C66	283-0135-00			100 pF	Cer	w/o leads	
C76	283-0135-00			100 pF	Cer	w/o leads	
C79	283-0121-00			0.001 μF	Cer	w/o leads	
C81	283-0132-00			10 pF	Cer	w/o leads	
C82	283-0132-00			10 pF	Cer	w/o leads	
C83	283-0141-00			4.7 pF	Cer	50 V	5%
C87	283-0121-00			0.001 μF	Cer	w/o leads	
C91	283-0121-00			0.001 μF	Cer	w/o leads	
C93	290-0136-00			2.2 μF	Elect.	20 V	
C95	283-0003-00			0.01 μF	Cer	150 V	
C97	283-0072-01			0.01 μF	Cer	w/o leads	

Semiconductor Device, Diodes

Ckt. No.	Tektronix Part No.	Eff	Disc	Description	
CR10, CR11	*152-0420-00			Silicon	Tek made (1 pair)
CR12, CR13	*152-0420-00			Silicon	Tek made (1 pair)
CR14, CR15	*152-0420-00			Silicon	Tek made (1 pair)

Semi-conductor Device, Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model Eff	Disc	Description	
CR16	152-0333-00			Silicon	High speed and conductance
CR17	152-0333-00			Silicon	High speed and conductance
CR18	152-0333-00			Silicon	High speed and conductance
CR19	152-0333-00			Silicon	High speed and conductance
CR22	*152-0323-00			Silicon	Tek Spec
CR32	*152-0185-00			Silicon	Replaceable by 1N4152
CR42	*152-0185-00			Silicon	Replaceable by 1N4152
CR56	*152-0185-00			Silicon	Replaceable by 1N4152

Connectors

J1	131-0768-00	BNC
J7	131-0391-00	Coax, 50 Ω, male
J14	131-0391-01	Receptacle, electrical, male
J15	131-0391-01	Receptacle, electrical, male
P7	131-0582-00	Receptacle, electrical
P14	131-0582-00	Receptacle, electrical
P15	131-0582-00	Receptacle, electrical
P44	131-0565-00	Receptacle, electrical, male

Inductors

L44	276-0543-00	Core, ferrite
L59	*108-0440-00	Toroid, 8 μH, 4 turns
L70	108-0324-00	10 mH

Transistors

Q22	151-1011-00	Silicon	FET, dual
Q32	151-0202-00	Silicon	2N4261
Q42	151-0282-00	Silicon	2N5179
Q44	151-0282-00	Silicon	2N5179
Q52	151-1012-00	Silicon	FET
Q56	151-0224-00	Silicon	2N3692
Q82	*153-0556-00	Silicon	Tek Spec

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R1	317-0301-00	300 Ω	1/8 W		5%
R2	317-0181-00	180 Ω	1/8 W		5%
R3	317-0301-00	300 Ω	1/8 W		5%
R5	321-0481-00	1 MΩ	1/8 W	Prec	1%
R7	317-0511-00	510 Ω	1/8 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model Eff	Disc	Description			
R9	317-0103-00			10 kΩ	1/8 W		5%
R11	317-0102-00			1 kΩ	1/8 W		5%
R12	317-0102-00			1 kΩ	1/8 W		5%
R13	317-0332-00			3.3 kΩ	1/8 W		5%
R14	317-0332-00			3.3 kΩ	1/8 W		5%
R15	317-0102-00			1 kΩ	1/8 W		5%
R16	317-0104-00			100 kΩ	1/8 W		5%
R17	317-0393-00			39 kΩ	1/8 W		5%
R18	317-0104-00			100 kΩ	1/4 W		5%
R21	317-0474-00			470 kΩ	1/8 W		5%
R23	315-0243-00			24 kΩ	1/4 W		5%
R25	317-0363-00			36 kΩ	1/8 W		5%
R27	317-0101-00			100 Ω	1/8 W		5%
R29	317-0471-00			470 Ω	1/8 W		5%
R31	315-0163-00			16 kΩ	1/4 W		5%
R33	317-0202-00			2 kΩ	1/8 W		5%
R35	317-0301-00			300 Ω	1/8 W		5%
R37	317-0511-00			510 Ω	1/8 W		5%
R39	317-0102-00			1 kΩ	1/8 W		5%
R41	317-0471-00			470 Ω	1/8 W		5%
R43	317-0102-00			1 kΩ	1/8 W		5%
R45	317-0202-00			2 kΩ	1/8 W		5%
R47	317-0202-00			2 kΩ	1/8 W		5%
R51	301-0103-00			10 kΩ	1/2 W		5%
RT53	307-0127-00			1 kΩ	Thermal		
R55	301-0912-00			9.1 kΩ	1/2 W		5%
R56	317-0224-00			220 kΩ	1/8 W		5%
R57	317-0303-00			30 kΩ	1/8 W		5%
R58	311-0635-00			1 kΩ, Var			
R59	317-0102-00			1 kΩ	1/8 W		5%
R61	321-0385-00			100 kΩ	1/8 W	Prec	1%
R62	317-0253-00			4.22 kΩ	1/8 W	Prec	1%
R63	317-0332-00			3.3 kΩ	1/8 W		5%
R64	317-0105-00			1 MΩ	1/8 W		5%
R65	311-0606-00			500 kΩ, Var			
R66	317-0101-00			100	1/8 W		5%
R70	311-0949-00			2 k, Var			
R71	321-0385-00			100 k	1/8 W	Prec	1%
R72	321-0253-00			4.22 kΩ	1/8 W	Prec	1%
R73	317-0332-00			3.3 kΩ	1/8 W		5%
R74	317-0105-00			1 MΩ	1/8 W		5%
R76	317-0101-00			100 Ω	1/8 W		5%
R79	317-0101-00			100 Ω	1/8 W		5%
R81	317-0103-00			10 kΩ	1/8 W		5%
R83	317-0103-00			10 kΩ	1/8 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model Eff	Disc	Description		
R85	311-0644-00			20 kΩ, Var		
R87	317-0101-00			100 Ω	⅛ W	5%
R97	317-0100-00			10 Ω	⅛ W	5%

Switch

	Wired or Unwired		
S1	260-0613-00	Toggle	COUPLNG

Transformers

T80	*120-0620-00	Toroid, 3 turns, trifilar
T85	*120-0544-00	Toroid, 2 turns-5 turns

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.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATION

(Located behind diagrams)

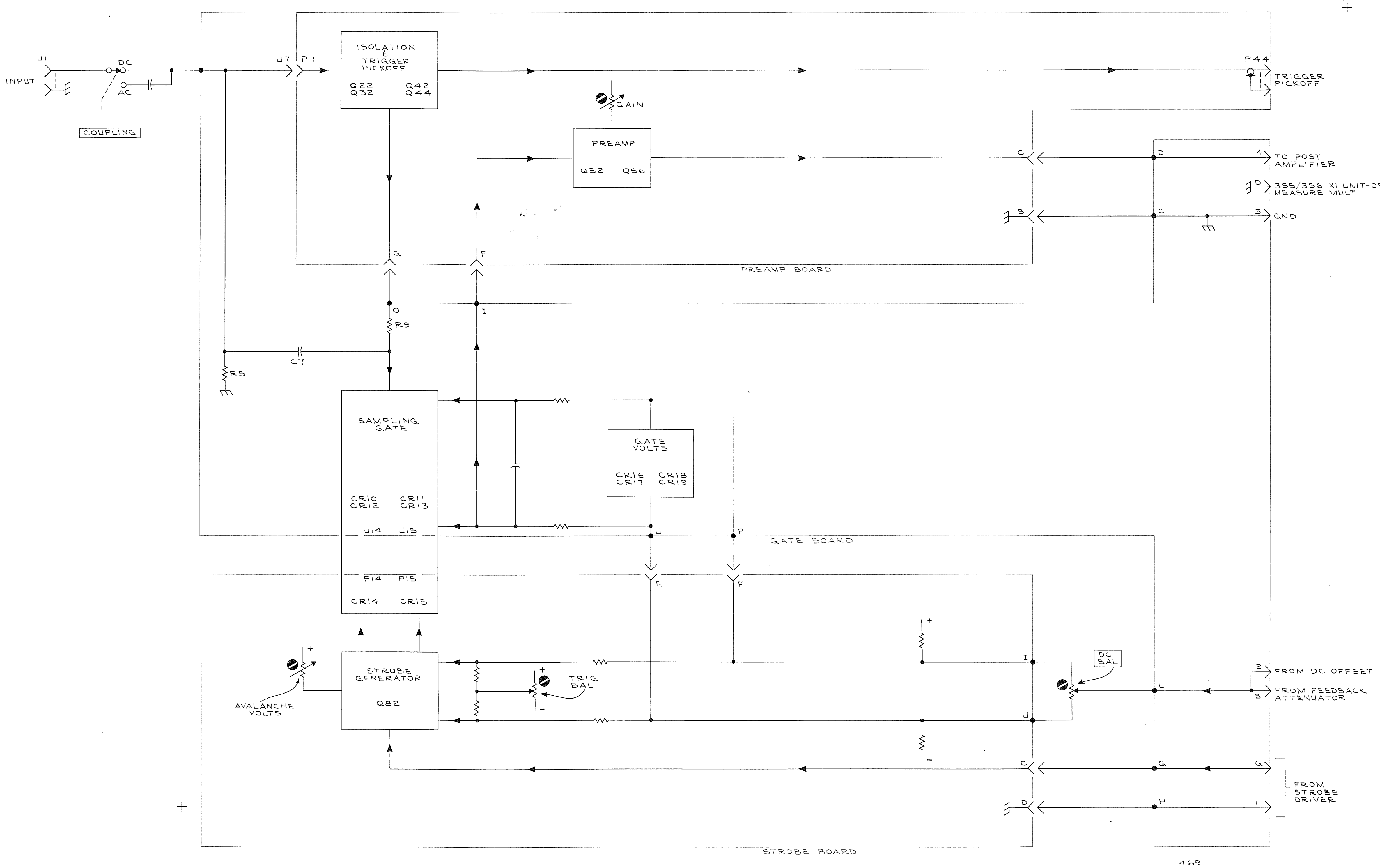
SECTION 7
MECHANICAL PARTS LIST

FIG. 1 EXPLODED

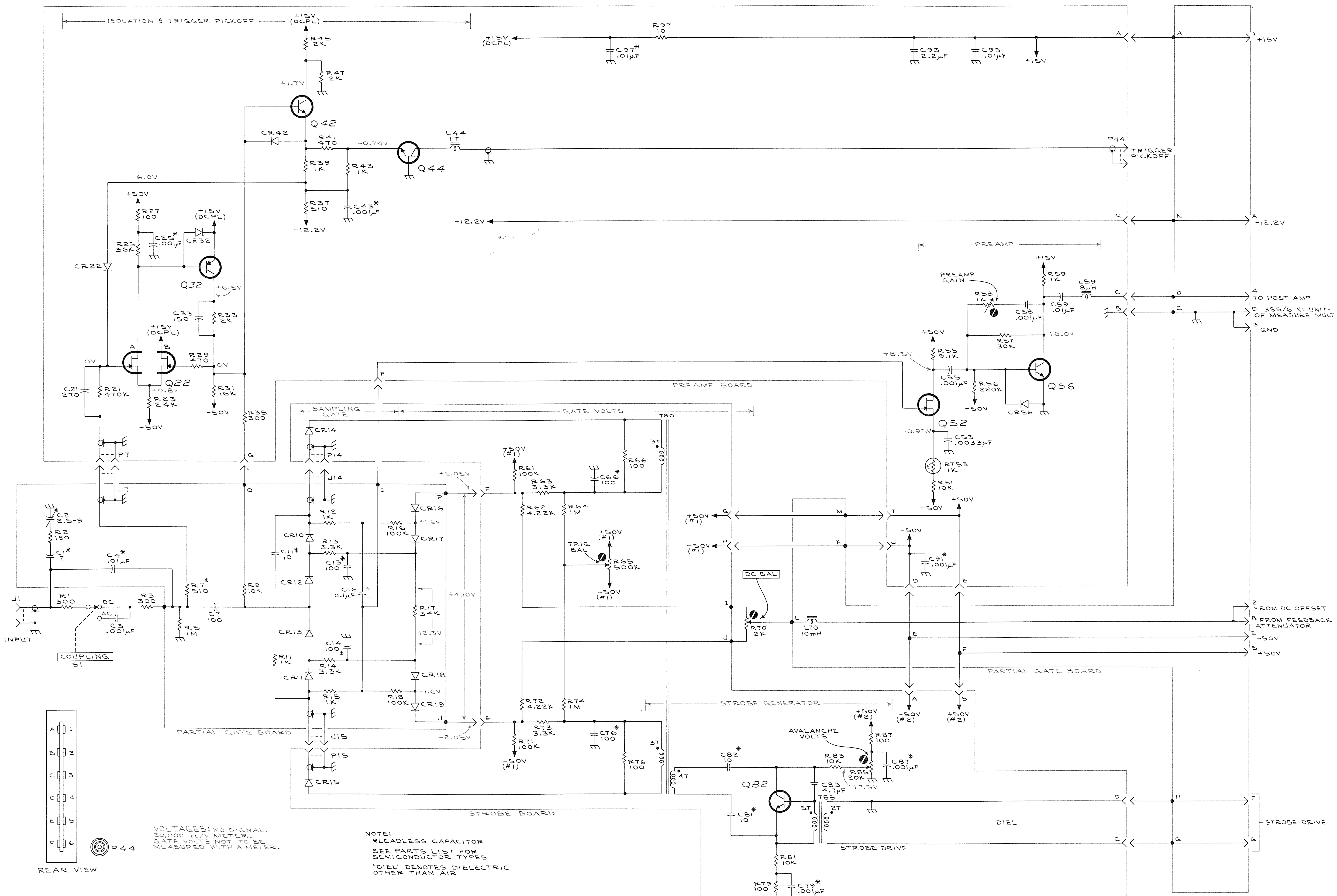
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	333-1214-00			1	PANEL, front
-2	386-1338-11			1	SUB-PANEL, front
-3	260-0613-00			1	SWITCH, toggle—COUPLING AC-DC
	------			-	mounting hardware: (not included w/switch)
-4	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-5	220-0510-00			1	NUT, hex., 1/4-32 x 0.312 inch
-6	------			1	RESISTOR, variable
	------			-	mounting hardware: (not included w/resistor)
-7	220-0510-00			1	NUT, hex., 1/4-32 x 0.312 x 0.40 inch long
	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.400 inch OD
-8	358-0343-00			1	BUSHING, 1/4-32
-9	358-0301-01			1	BUSHING, sleeve
-10	131-0768-00			1	CONNECTOR, coaxial, 1 contact BNC
	------			-	mounting hardware: (not included w/connector)
-11	352-0178-01			1	HOLDER, connector
-12	220-0545-00			1	NUT, retaining, 1/2-28 x 0.531 inch
-13	384-0687-00			1	SHAFT, latch
-14	214-1226-01			1	SPRING, helical, compression
-15	105-0066-00			1	STRIKE, latch
	670-1085-00			1	ASSEMBLY, circuit board—PREAMP
	------			-	assembly includes:
-16	388-1286-00			1	BOARD, circuit
-17	131-0582-00			1	CONNECTOR, coaxial, 1 contact female (P7)
-18	136-0252-01			7	SOCKET, pin connector (eyelet)
-19	136-0263-01			10	SOCKET, pin terminal
-20	210-0707-00			1	EYELET, metallic
-21	175-1054-01			1	ASSEMBLY, cable, w/connector & holder
	670-1087-00			1	ASSEMBLY, circuit board—STROBE
	------			-	assembly includes:
-22	388-1288-00			1	BOARD, circuit
-23	344-0061-00			4	CLIP, diode
-24	131-0582-00			2	CONNECTOR, coaxial, 1 contact female (P14, P15)
-25	136-0252-01			3	SOCKET, pin connector (eyelet)
-26	136-0263-01			8	SOCKET, pin terminal

FIG. 1 EXPLODED *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-	670-1086-00			1	ASSEMBLY, circuit board—GATE
	- - - - - -			-	assembly includes:
-27	388-1287-00			1	BOARD, circuit
-28	344-0061-00			8	CLIP, diode
-29	131-0391-00			1	CONNECTOR, coaxial, 1 contact male (J7)
-30	131-0391-01			2	CONNECTOR, coaxial, 1 contact male (J14, J15)
-31	131-0591-00			10	TERMINAL, pin
-32	131-0594-00			4	TERMINAL, pin, feed-thru
-33	214-1081-00			2	PIN, spiral
	- - - - - -			-	mounting hardware: (not included w/assembly)
-34	211-0162-00			2	SCREW, cap, 2-56 x $^3/_{16}$ inch, SS
-35	380-0170-00			1	HOUSING
	- - - - - -			-	housing includes:
-36	131-0555-00			4	CONTACT
-37	386-1337-06			1	PANEL, rear
	- - - - - -			-	mounting hardware: (not included w/panel)
-38	211-0141-00			4	SCREW, 4-40 x 3$^1/_4$ inches, PHS
					STANDARD ACCESSORIES
-39	010-0188-00			1	PROBE PACKAGE, P6010
-40	011-0049-01			1	TERMINATION
	070-0942-00			1	MANUAL, instruction (not shown)



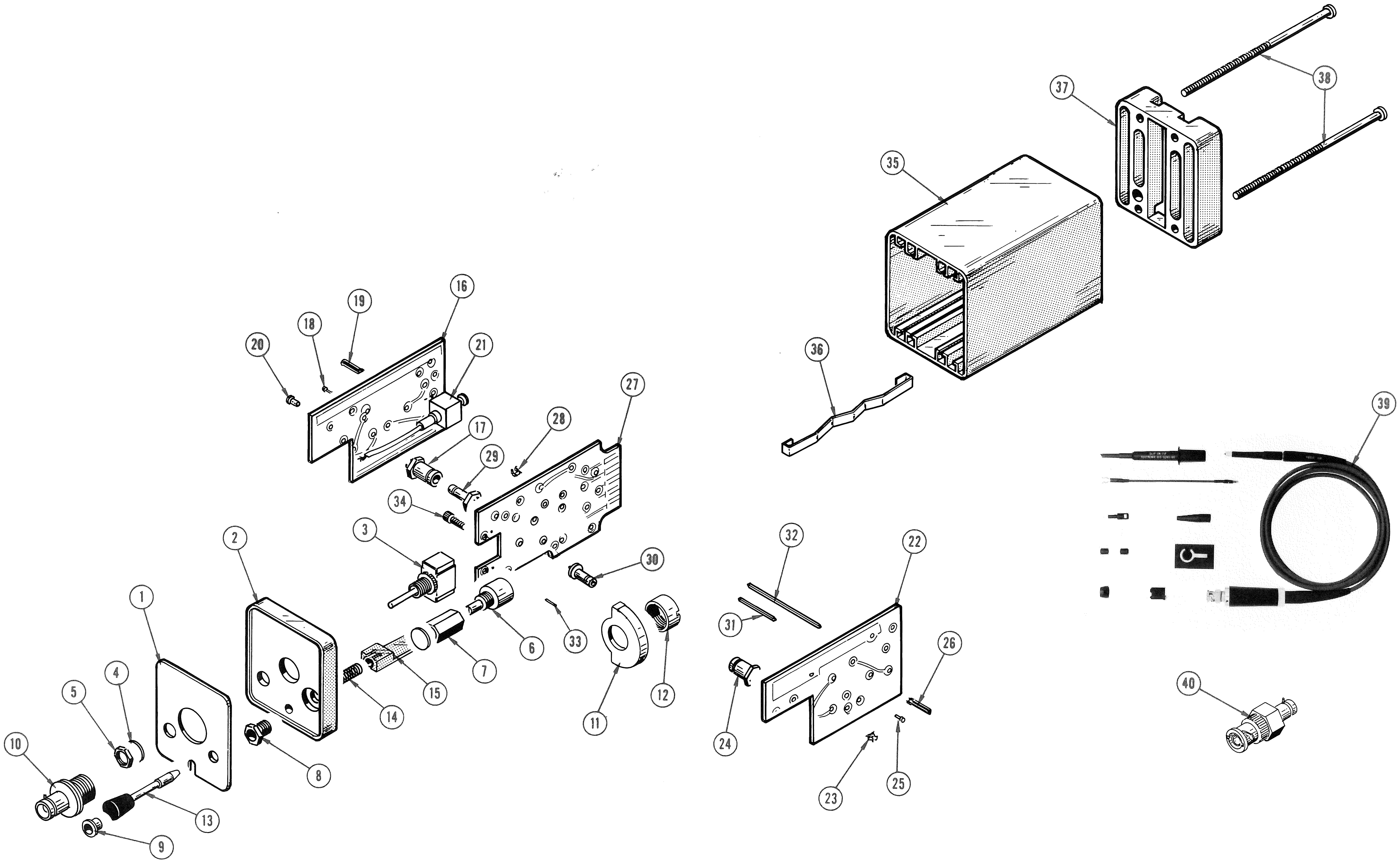
TYPE S-5 SAMPLING HEAD　　Ⓐ　　BLOCK DIAGRAM



TYPE S-5 SAMPLING HEAD

Ⓐ

FIG 1 EXPLODED



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.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

TEXT CORRECTIONS

Section 1 Specification

Page 1-1 right column

ADD: to the ELECTRICAL CHARACTERISTICS table, just before "Input RC":

	With 50 Ω connected to the input.

Page 1-2 left column

ADD: after "Loop Gain":

Trace shift with trigger rate change Vertical shift or tilt	Vertical shift of trace is less than 10 mV from 10 Hz to 100 kHz trigger rate. Less than 10 mV tilt in 10 horizontal div when strobe from sampling sweep unit is interrupted during retrace while triggered at 10 Hz. Verify with Step 5, page 5-7.

ADD: in same column below "With P6010 Probe..." after "Random Noise":

Trace shift with trigger rate change Vertical shift or tilt	Vertical shift of trace is less than 10 mV (indicated) from 10 Hz to 100 kHz trigger rate. Less than 10 mV (indicated) tilt in 10 horizontal div when strobe from sampling sweep unit is interrupted during retrace while triggered at 10 Hz. Verify by Step 5, page 5-7.

NOTE

While this insert remains in this instruction manual, verify the above by Step 5 included below.

Section 5 Performance Check/Calibration

Page 5-1 Equipment Required

ADD: the following to the Equipment Required list:

18. Trigger generator, such as the Tektronix Type 111 with a frequency of 10 Hz. Provides at least 100 mV peak pulse into 50 Ω. If using the Type 111, two 50 Ω 10X GR attenuators are also required, Tektronix Part No. 017-0078-00.

19. A 50 Ω coaxial cable (RG58C/U) with GR connectors, 5 ns signal delay, Tektronix Part No. 017-0512-00.

20. A coaxial adapter, GR to BNC male. Tektronix Part No. 017-0064-00.

Page 5-7

REPLACE: Step 5 with the following:

5. Check Trace Shift and Strobe Kickout/Adjust T80

Requirement--With either a 50 Ω cable or a P6010 Probe on the S-5 input, the trace will not shift more than 10 mV vertically (equivalent time sampling) when the sampling sweep unit is triggered over a range of 10 Hz to 100 kHz. Trace will not tilt more than 10 mV (real time sampling) in 10 horizontal divisions as the strobe signal from the sampling sweep unit is interrupted during retrace and when triggered at 10 Hz. When the above limits are met, there will be no more than 30 mV peak strobe kickout into 50 Ω at the input connector (strobe kickout limit is not guaranteed).

NOTE

When the trace shift limits above are met, the trace tilt will also be within limits. Trace tilt can be best checked with a Tektronix Type 3T5 (or Type 3T6), while trace shift can be checked with any Tektronix sampling sweep unit. Both trace shift (or trace tilt) and strobe kickout are observed at the same time in the following step.

Using a Type 3T2 (or other equivalent time sampling sweep unit)

a. Connect a 50 Ω coaxial cable with BNC connectors to the Type S-5 input connector. Install a BNC 50 Ω termination on the cable other end and connect it to the test oscilloscope input (other Type S-5, or do not use a 50 Ω termination if the test oscilloscope is an S-1, 3S1 or other 50 Ω input sampler).

Connect two 50 Ω 10X attenuators in series at the Type 111 pulse generator pretrigger output connector. Use a 50 Ω coaxial cable with GR 874 connectors and a GR to BNC male adapter and connect the cable output end to the sampling sweep unit external trigger connector.

b. Set the pulse generator controls to deliver a 10 Hz repetition rate trigger signal.

c. Set the Type 3T2 controls:

Range	100 ns	10 ns/Div
Time Magnifier	X1	
Display Mag	X1	
Display Mode	Normal	
Trig Sensitivity	Triggered region	
Trig Polarity/Source	+Ext	
Others	Optional	

Set the Sampling Unit controls:

Mv/Div	2
Smooth/Normal	Normal
DC Offset/Position	Centered trace

Set the test oscilloscope controls to observe the strobe kickout from the Type S-5 under test. If using an S-5 and 3T2, use Before Trigger random sampling and internal triggering. Use a sweep rate of 10 ns/Div and vertical deflection factor of 10 mV/Div. Adjust the Time Position controls to place the strobe kickout signal into view on the test oscilloscope CRT.

d. Adjust the indicator oscilloscope trace to be behind a graticule line. Change the Type 3T2 Trig Sensitivity control fully clockwise so the sweep is free run and then slowly turn the Recovery Time control through its range. Watch the trace, it should not move vertically more than 10 mV or 5 divisions from the position when the sweep is triggered at 10 Hz.

Observe the test oscilloscope CRT. The strobe kickout signal should not be greater than 30 mV peak to peak without reference to zero volts.

If either the strobe kickout is greater than 30 mV peak to peak, or the indicator oscilloscope trace moves more than 10 mV, the physical positioning of T80 requires adjustment as described in part g of this step.

Using a Type 3T5/6

e. Make the same connections as in parts a and b of this step. Set the Type 3T5/6 controls:

Time/Div Decade	3 } 1 ms/Div
Multiplier	1
Trigger	
Sensitivity	Triggered
Mode	Ext
Polarity	+
Program Selector	Int
Samples/Sweep	1000
Delay	0000

Set the indicator oscilloscope sampling unit controls as in part c of this step. The trace should flicker, and show some tilt. Set the test oscilloscope controls as in part c of this step.

f. Check the indicator oscilloscope display. The trace should not tilt (upward or downward) more than 10 mV or 5 divisions. At the same time the test oscilloscope display should show 30 mV or less peak to peak strobe kickout signal without reference to zero volts.

Change the Type 3T5 Time/Div Decade switch to 0 (sweep rate of 100 ps/div) and free run the sweep by placing the Trigger Sensitivity control fully clockwise. Slowly turn the Recovery Time control through its range. The trace should not move farther away vertically than 10 mV or 5 divisions from the 10 Hz triggered position.

If either the trace slope at 1 ms/div (real time sampling) or the vertical trace shift at 100 ps/div (equivalent time sampling) or the test oscilloscope display shows more than 30 mV peak to peak strobe kickout, the physical positioning of T80 requires adjustment as described in part g of this step.

Positioning T80 Core

g. Using either test setup described previously, and using a non-conducting plastic tool (such as the narrow, flat end of a Walsco No. 2543 plastic tool), move the core of T80 slightly. The movement should be such that the core turns inside the unsecured primary winding, changing the spacing between the primary and the secondary windings. One secondary moving farther from, and the other secondary moving closer to the primary. Then recheck both the trace tilt (or vertical shift) and the strobe kickout amplitude. It is possible to adjust the transformer position so that trace shift/tilt is not over about 6 mV, and strobe kickout is not greater than about 20 mV.

In the event this adjustment is being made after replacing T80, all leads of T80 must be as short as is physically possible. The above limits will not be attainable if T80 leads are not connected to their solder points in a short straight path. Figure 5-6 shows both the transformer location and a test oscilloscope multiple exposure of strobe kickout. Fig. 5-6 (2) is the most desirable form of strobe kickout, while at the same time the trace shift/ tilt is within limits.

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE:

C1	283-0127-00	2.5 pF	Cer	100 V

TEXT CORRECTIONS

Section 1 Specification

Page 1-1 General Information

ADD: the following note after the first paragraph:

NOTE

The P6010 Probe shipped with the Type S-5 is compensated at the factory. It is normal that a probe compensated for operation on one Type S-5 requires recompensation when used with another Type S-5. If more than one Type S-5 and P6010 Probe is at hand, mark the probes in a manner that assures they are used with the sampling head with which they were compensated. Any P6010 Probe purchased seperately must be compensated using the procedure on pages 2-8 and 2-9 of this manual.

Page 1-1 right column

CHANGE: under Pulse Flatness Deviation, change the limits:

0 to 17 ns	+2.5%, -5% or less, total of 7.5% or less.
17 ns thereafter	+1%, -1% or less, total of 2% or less.

Page 1-2 left column

CHANGE: under Pulse Flatness Deviation (with P6010 Probe):

0 to 25 ns	same limits
25 ns thereafter	+1%, -1% or less, total of 2% or less.

Section 2 Operating Instructions

Page 2-5 Input Signal Connections

ADD: the following note immediately after the heading Input Signal Connections:

NOTE

Always have a coaxial line of at least 30 cm length between the Type S-5 input connector and the output connector of signal generators that are sensitive to signal voltages fed back into the output. An example, the tunnel diode in the Type 284 Fast Pulse output line may have its signal distorted by the Type S-5 strobe kickout signal if the coupling cable is 20 CM or less long.

Page 2-7 Passive Probe Compensation

ADD: the folloiwng note after the first paragraph under Passive Probe Compensation:

NOTE

The P6010 Probe shipped with the Type S-5 is compensated for the associated Type S-5 at the factory. It is normal that a probe compensated for operation on one Type S-5 requires recompensation when used with another Type S-5. If more than one Type S-5 and P6010 Probe is at hand, mark the probes in a manner that ensures they are used with the sampling head with which they were compensated. Any P6010 Probe purchased seperately must be compensated using the procedure that begins on the next page.

Section 3 Circuit Description

Page 3-3 The Isolation Amplifier

ADD: at the end of the third paragraph under The Isolation Amplifier:

R36 reduces the feedback just enough so the overall gain is essentially unity, making up for less than infinite gain of Q22 and Q32 amplifiers.

Page 3-6 Preamplifier, right column

CHANGE: the second sentence in the first paragraph to read:

Minimum gain is about 1; maximum gain is about 6, with the limits set by Q52 Gm and the series resistance values of R54 and R58.

CHANGE: the fourth sentence in the first paragraph to read:

The stage is temperature stabilized for DC by feedback resistor R57, and for AC by R60 and RT60 in series with the output lead.

Section 5 Performance Check/Calibration

Page 5-1

ADD: to the Equipment Required list:

21. GR 874 to BNC male coaxial connector adapter, Tektronix Part No. 017-0064-00.

22. 10 inch RG 213/U 50 Ω coaxial cable with GR 874 connectors, Tektronix Part No. 017-0513-00, (or a GR874-L30 air line).

23. A Tektronix Type 106 Square-Wave Generator.

Page 5-11 Fig. 5-11

REPLACE: the existing Fig. 5-11 with the one below:

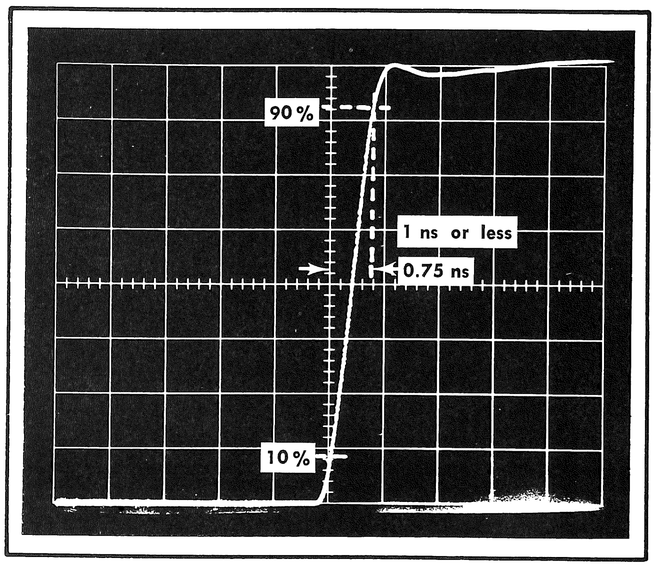


Fig. 5-11. Risetime measurement.

Page 5-11 Step 12

CHANGE: Step 12 to read:

12. Check Pulse Flatness Deviation

Requirement: Display will not deviate from the flat more than the following limits.

First 17 ns after step, +2.5%, -5% or less, total less than 7.5% peak-to-peak.

After 17 ns, +1%, -1% or less, total less then 2% peak-to-peak.

In each of the above cases, locate the 100% point 6 μs after the pulse rise. Use the Tektronix Type 106 to locate the 100% point and to check after 100 ns. Use the Tektronix Type 284 to check before 100 ns.

NOTE

This step must be performed any time Q22 of the Isolation amplifier is changed and after adjusting R85 the Avalanche Volts control. Changing Q22 may require a new resistance value for R36. The procedure uses two different pulse generators in order to obtain the very best flat topped pulse checks over a long time period. The Tektronix Type 284 is used from the pulse rise through 100 ns, and the Tektronix Type 106 is used for the time period 100 ns through 6 μs.

a. Initial control settings for all equipment.

Type 284

Mode	Pulse Output
Lead Time	5 ns
Others	Optional

Type 106

Repetition Rate Range	10 kHz
Multiplier	Approx. 5
Hi Amplitude/Fast Pulse	Fast Pulse
+Transition Amplitude	Fully clockwise

Type 3S2

A Position	Midrange
DC Offset	Midrange and used to set display vertical position.
Units/Div	100
Variable	For 5 division pulse display.
Dot Response	Unity Loop Gain
Normal/Smoothing	Normal
Channel Selector	CH A

Type 3T2

This procedure requires a sampling sweep unit with random sampling (to obtain triggering leadtime).

Time Position	See Fig. 5-12	
Range	10 μs	1 μs/Div
Time Magnifier	X1	
Variable	Cal	

Start Point	Before Trigger
Display Mode	Normal
Samples/Div	About 9 o'clock
Triggering	+ External 50 Ω
Trig Sensitivity	Stable display
Recovery Time	Optional

b. Use the following equipment: a 10" RG 213/U 50 Ω coaxial cable with GR 874 connectors; a 42 inch 50 Ω coaxial cable with BNC connectors; a GR to BNC male coaxial adapter and the BNC 50 Ω termination mentioned in the equipment required list. Do not substitute any other kind of termination.

Make the following connections: Place the BNC connector cable between the Type 106 Trigger Output connector and the Type 3T2 50 Ω External Trigger input connector. Place the 10" coaxial cable on the Type 106 Pulse Output connector; to the other end, attach the GR to BNC male adapter and the 50 Ω BNC termination. Place the termination on the Type S-5 input connector.

c. Adjust the sampling sweep unit triggering and the sampling unit vertical Units/Div Variable control for a 5 division peak-to-peak display. The deflection is now 20% per division. Change the Units/Div switch (without touching the Variable control) to the 5 position and bring the pulse top into view using the DC Offset control. The display deflection is now 1% per division like that shown in Fig. 5-12. Set the top of the trace to a graticule line at a point 6 μs after the step rise. This is the 100% point.

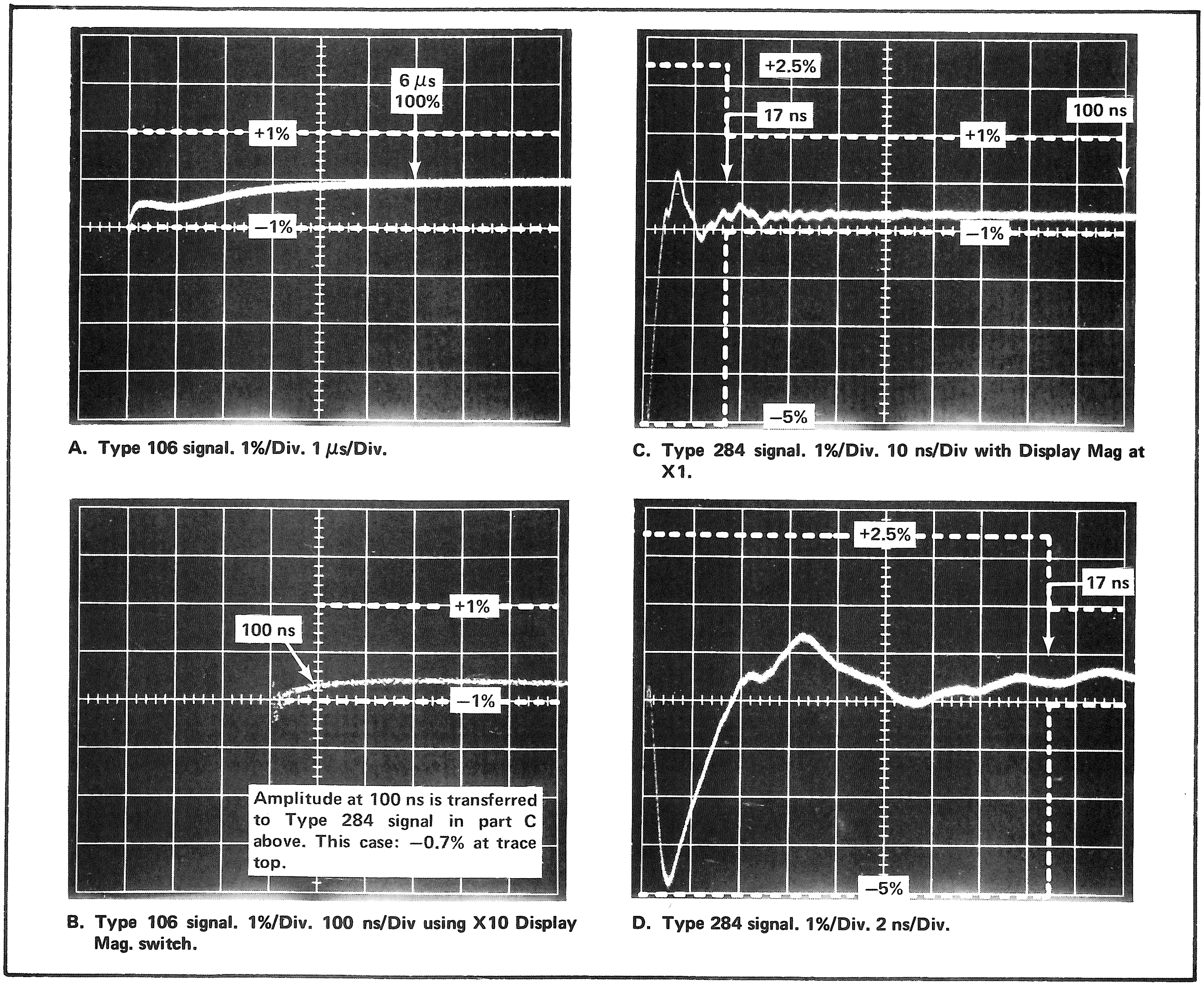
d. Check that the pulse top does not deviate from 100% more than +1% or -1% (+1 division or -1 division) between the pulse rise and the CRT right edge. This checks the pulse flatness deviation from 100 ns thereafter.

NOTE

If the display is out of specs between 1 and 6 μs after the step rise, change R36. If the display is out of tolerance upward, make R36 larger, and vica versa. Resistance limits are 10 kΩ and 30 kΩ -- usually Q22 Gm is not high enough to permit the 30 kΩ value to be used. If 10 kΩ is not small enough, select another Q22 transistor with higher Gm, rather than go lower in resistance value. R35 is typically 10 kΩ to 16 kΩ.

Page 5-11 Fig. 5-12

REPLACE: the existing Fig. 5-12 with the one below:



A. Type 106 signal. 1%/Div. 1 μs/Div.

C. Type 284 signal. 1%/Div. 10 ns/Div with Display Mag at X1.

B. Type 106 signal. 1%/Div. 100 ns/Div using X10 Display Mag. switch.

D. Type 284 signal. 1%/Div. 2 ns/Div.

Fig. 5-12. Type S-5 pulse flatness deviation displays, Step 12.

e. Change the sweep rate to 100 ns/Div by use of the Display Magnifier switch. There will possibly be a slight vertical shift of the display, but not over one-half minor division. Correct for any shift after the display is magnified. Use the sampling sweep unit Time Position control to bring the pulse rise to a position like that in Fig. 5-12B and carefully note the amplitude at 100 ns after the pulse rise. This is the time/amplitude transfer point for setting up the display of the Type 284 fast pulse.

f. Disconnect the two cables from the Type 106 and move them to the Type 284. Set the Type 3T2 Range switch to 100 ns, Display Mag X1 and Time Magnifier to X1 for a 10 ns/Div sweep rate. Return the sampling unit Units/Div switch to 100 and again adjust the Variable control for a 5 division peak-to-peak display. The vertical deflection is now 20%/Div. Change the Units/Div switch to 5, for a deflection of 1%/Div and position the display similar to Fig. 5-12C. Carefully locate the vertical position so the point 100 ns after the step rise is at the same vertical point as determined in Fig. 5-12B. This completes the time/Amplitude transfer from the Type 106 to the Type 284 Pulse Generator.

Check that the display top does not deviate from 100% more than +1% or -1% between 17 ns and 100 ns after the pulse step.

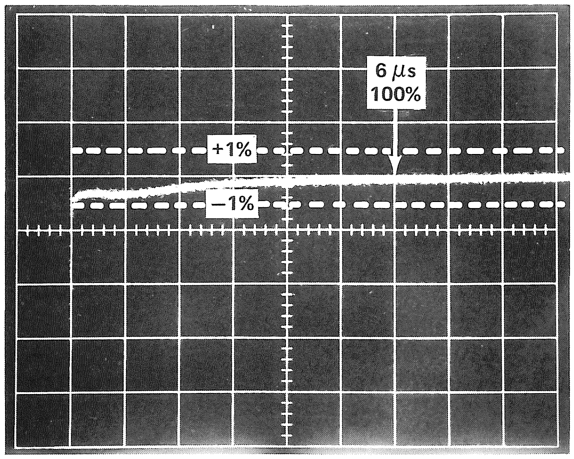
g. Change the sweep rate to 2 ns/Div (Time Magnifier control to X5) and check the pulse top deviations from the step rise to the 17 ns point. The display must not go above 100% more than +2.5% nor below 100% more than -5% as shown in Fig. 5-12D. Make all checks along the top of the trace. Out of tolerance displays require the adjustment of R85 or new sampling gate diodes.

Page 5-12 Step 14
CHANGE: Step 14 to read:

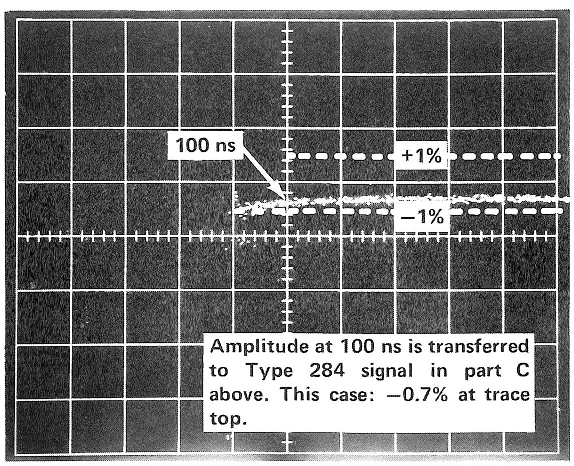
14. Check P6010 Probe Pulse Flatness Deivation
Requirement: Display will not deviate from being flat more than the following limits:

First 25 ns after step, +5%, -5% or less, total less than 10% peak-to-peak.
After 25 ns, +1%, -1% or less, total less than 2% peak-to-peak.

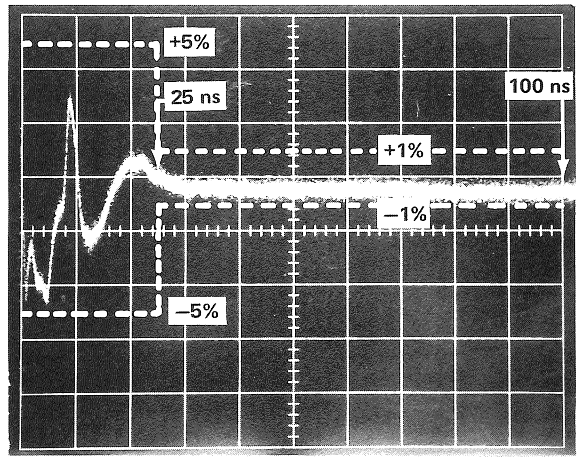
ADD: the following Figure with the new Step 14:



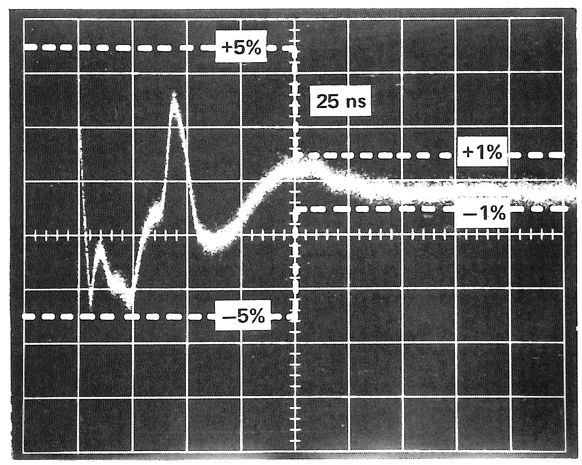
A. Type 106 signal. 2%/Div. 1 μs/Div.



B. Type 106 signal. 2%/Div. 100 ns/Div using X10 Display Mag.



C. Type 284 signal. 2%/Div. 10 ns/Div with Display Mag at X1.



D. Type 284 signal. 2%/Div. 5 ns/Div.

Fig. 5-13. Type S-5 with P6010 Probe pulse flatness displays, Step 14.

NOTE

This step is very similar to step 12 except that the P6010 Probe tip is driven without a termination on the 10 " coaxial cable, and the most sensitive display is 2%/Div instead of 1%/Div.

a. Use the same control settings as in Step 12, except place the Type 3S2 sampling unit Units/Div control to 50.

b. Connect a 10 " RG 213/U 50 Ω coaxial cable to the Type 106 +Transition Output connector. To the other end, attach the GR to Probe adapter, item 10 of the equipment required. Insert the probe tip into the adapter.

Connect a 42 inch BNC 50 Ω coaxial cable from the Type 106 Trigger Output connector to the Type 3T2 external 50 Ω trigger input connector.

c. Adjust the sampling sweep unit triggering controls and the sampling unit Units/Div Variable control for a 5 division peak-to-peak display. The deflection is now 20% per division. Change the Units/Div switch (without touching the Variable control) to the 5 position and bring the pulse top into view using the DC Offset control. The display deflection is now 2% per division like that shown in Fig. 5-13A. Set the top of the trace to a graticule line at a point 6 μs after the step rise. This is the 100% point.

d. Check that the pulse top does not deviate from 100% more than +1% or -1% (+1/2 division or -1/2 division) between the pulse rise and the CRT right edge. This checks the pulse flatness deviation from 25 ns thereafter.

NOTE

If the display is out of specs, the probe needs to be recompensated.

e. Change the sweep rate to 100 ns/Div by use of the Display Magnifier switch. There will possibly be a slight vertical shift of the display, but not over one-half minor division. Correct for any shift after the display is magnified. Use the sampling sweep unit Time Position control to bring the pulse rise to a position like that of Fig. 5-13B and carefully note the amplitude at 100 ns after the pulse rise. This is the time/amplitude transfer point for setting the display of the Type 284 fast pulse.

f. Disconnect the cables from the Type 106 and move them to the Type 284. Set the Type 3T2 Range switch to 100 ns, Display Mag to X1 and Time Magnifier to X1 for a 10 ns/Div sweep rate. Return the sampling unit Units/Div switch to

50 and again adjust the Variable control for a 5 division peak-to-peak display. The vertical deflection is now 20%/Div. Change the Units/Div switch to 5, for a deflection of 2%/Div and position the display similar to Fig. 5-13C. Carefully locate the vertical position so the point 100 ns after the step rise is at the same vertical point as determined in Fig. 5-13B. This completes the time/amplitude transfer from the Type 106 to the Type 284 Pulse Generator.

Check that the display top does not deviate more than +1% or -1% between 25 ns and 100 ns after the pulse step.

g. Change the sweep rate to 5 ns/Div (Time Magnifier control to X2) and check the pulse top deviations from the step rise to the 25 ns point. The display must not go above 100% more than +5% nor below 100% more than -5% as shown in Fig. 5-13D. Make all checks along the top of the trace.

NOTE

If the display is outside the limits in part g, the probe needs recompensation.

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

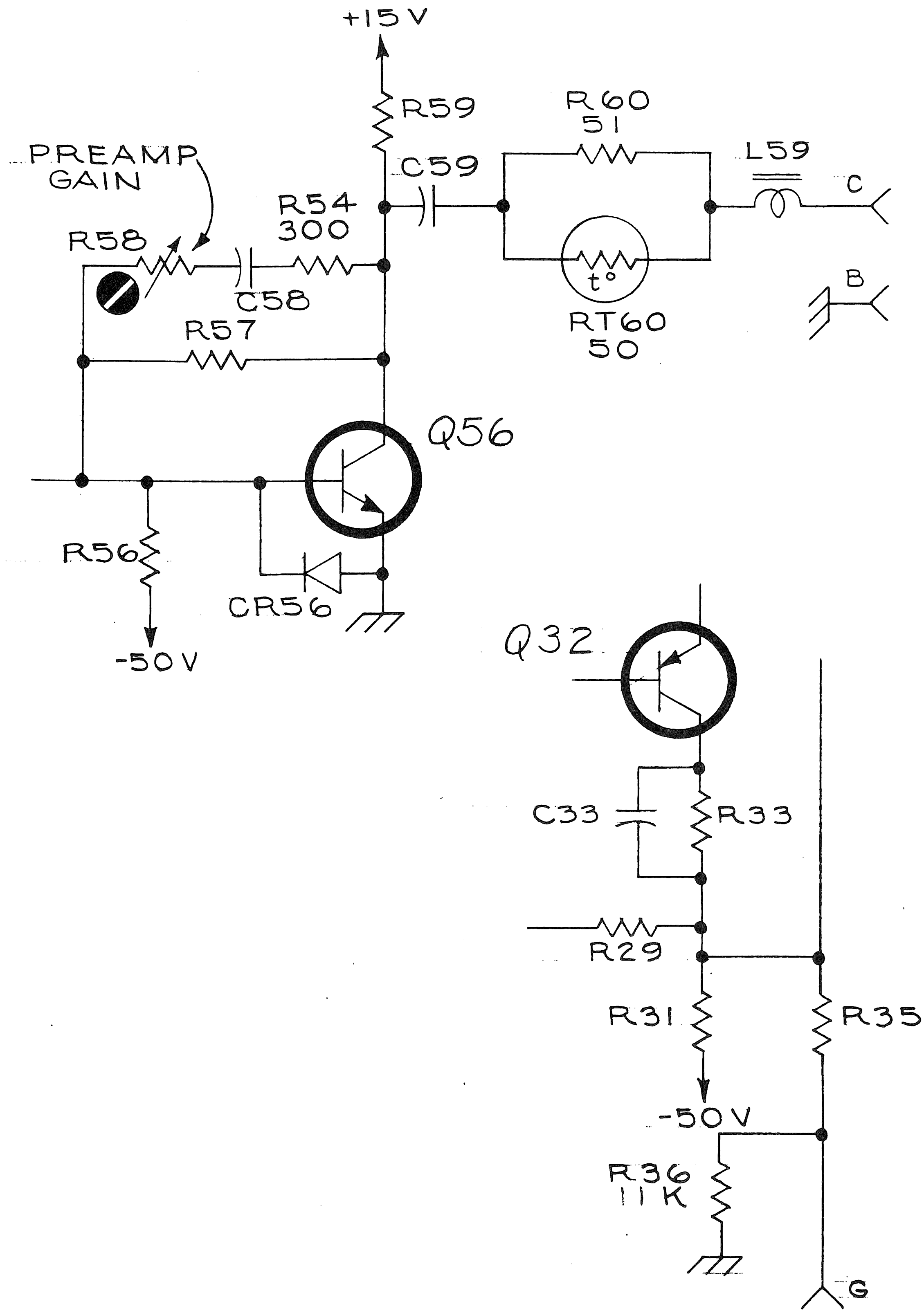
CHANGE:

C21	283-0156-00	1000 pF	Cer	200 V	
R2	317-0331-00	330 Ω	1/8 W		5%
R7	317-0221-00	220 Ω	1/8 W		5%
R16	321-0385-00	100 kΩ	1/8 W		1%
R18	321-0385-00	100 kΩ	1/8 W		1%
R29	317-0101-00	100 Ω	1/8 W		5%

ADD:

R36	317-0113-00	11 kΩ nominal value		Selected
R54	317-0301-00	300 Ω	1/8 W	5%
R60	317-0510-00	51 Ω	1/8 W	5%
RT60	307-0122-00	50 Ω	Thermal	

SCHEMATIC CORRECTIONS



Where applicable this insert supercedes C3/669.

ELECTRICAL PARTS LIST CORRECTION

CHANGE:

C21	283-0156-00	1000 pF	Cer		
C83	283-0140-00	4.7 pF	Cer	50 V	5%
R36		Selected (between 10 kΩ and 16 kΩ)			

SCHEMATIC CORRECTION

CHANGE: R17 to read 39 K
R36 to read SEL