INSTRUCTION MANUAL

Serial Number _____

TYPE S-50 PULSE GENERATOR HEAD

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070-0897-00

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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.

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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.

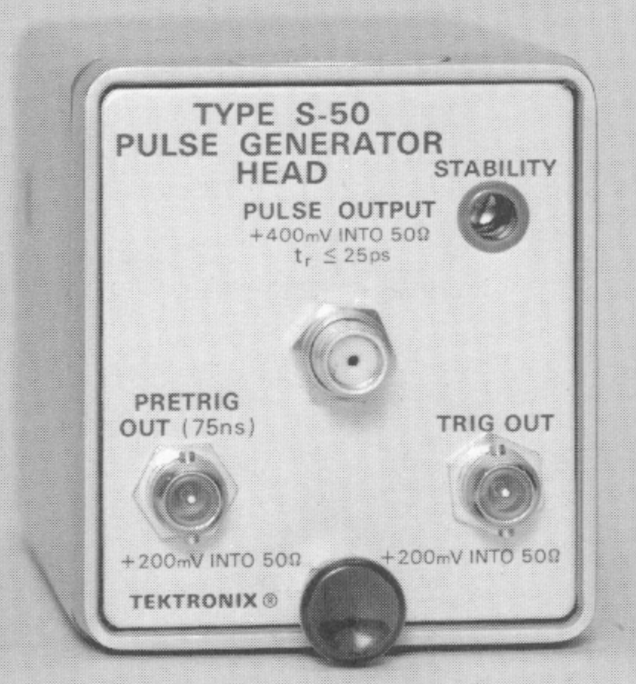


Fig. 1-1. Type S-50 Pulse Generator Head.

SECTION 1
TYPE S-50 SPECIFICATION

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

General Information

The Type S-50 Pulse Generator Head provides a fastrise pulse that is useful in determining the risetime of a sampling system. The less than 25 ps risetime output pulse of the Type S-50, when combined with a fastrise sampling system, also provides high resolution TDR displays. The positive-going output pulse of the Type S-50 has an amplitude of at least 400 mV into 50 Ω and a duration of approximately 100 ns. Repetition rate of the output pulse is approximately 25 kHz.

A pretrigger pulse is available at the Type S-50 front and rear panels. The pretrigger pulse occurs approximately 75 ns before the output pulse. The pretrigger pulse is useful for internal or external triggering of non-random sampling sweep units.

A trigger pulse, occurring at the same time as the fastrise output pulse, is available at the TRIG OUT connector on the Type S-50 front panel.

The operating power required by the Type S-50 is obtained from the Tektronix Type 285 Power Supply or from Tektronix Type 3S2, 3S5, or 3S6 Sampling Units.

ELECTRICAL CHARACTERISTICS

Characteristics

The following characteristics apply over an ambient temperature range of 0° C to +50° C after a five minute warm-up for an instrument that was calibrated at a temperature between +20° C and +30° C. Operating voltages applied to the Type S-50 must be within the limits stated in Section 2 of this manual.

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirement
PULSE OUTPUT	
Risetime (10% to 90%)	25 ps or less (Verify using step 7, Section 5).
Pulse Flatness Deviation (after 90% point on display)	
0 ps to 400 ps	—10% to +10% with a total of 20% or less. (Verify using step 8, Section 5).
400 ps to 5 ns	—5% to +5% with a total of 5% or less. (Verify using step 8, Section 5).
5 ns or more	—2% to +2% with a total of 4% or less. (Verify using step 8, Section 5).
Amplitude into 50 Ω	At least 400 mV, positive going.
Pulse Duration	100 ns to 120 ns
Repetition Rate	25 kHz, within 10%
PRETRIG OUT	
Risetime (10% to 90%)	400 ps or less
Amplitude into 50 Ω	At least 180 mV, positive going.
Pulse Duration	3 ns to 5 ns
Pretrigger to Pulse Time Interval	70 ns to 80 ns
Pretrigger to Pulse Output Jitter	15 ps or less
Pretrig Out (Rear Panel)	
Risetime (10% to 90%)	400 ps or less
Amplitude into 50 Ω	At least 70 mV, positive-going
Pulse Duration	4 ns to 8 ns
TRIG OUT	
Risetime (10% to 90%)	250 ps or less
Amplitude into 50 Ω	At least 200 mV, positive-going
Pulse Duration	100 ns to 120 ns
Time Coincidence with PULSE OUTPUT	Within 5 ns

ENVIRONMENTAL CHARACTERISTICS

Storage	Operating
Temperature— —40° to +65° C	Temperature— As stated above Electrical Characteristics table
Altitude— To 50,000 feet	Altitude— To 15,000 feet

MECHANICAL CHARACTERISTICS

Dimensions— Height ≈2 inches
Width ≈1⅞ inches
Length ≈4 inches

Construction— Epoxy laminated circuit boards. Aluminum wrap-around cabinet with aluminum casting at front and rear. Anodized aluminum front panel.

Accessories— An illustrated list of the accessories supplied with the Type S-50 is at the end of the Mechanical Parts List pullout pages.

NOTES

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-50 Pulse Generator Head, and includes installation and First Time Operation instructions.

The Type S-50 may be powered by the Type 3S2, 3S5, or 3S6 Sampling Unit in place of a sampling head, at the sacrifice of one sampling channel. Or the unit may be powered separately by a Tektronix Type 285 Power Supply for S-Series Heads. The Type S-50 may also be operated on one of two accessory extender cables for semi-portable use permitting short-length coaxial cables to be used between the PULSE OUTPUT connector and the load.

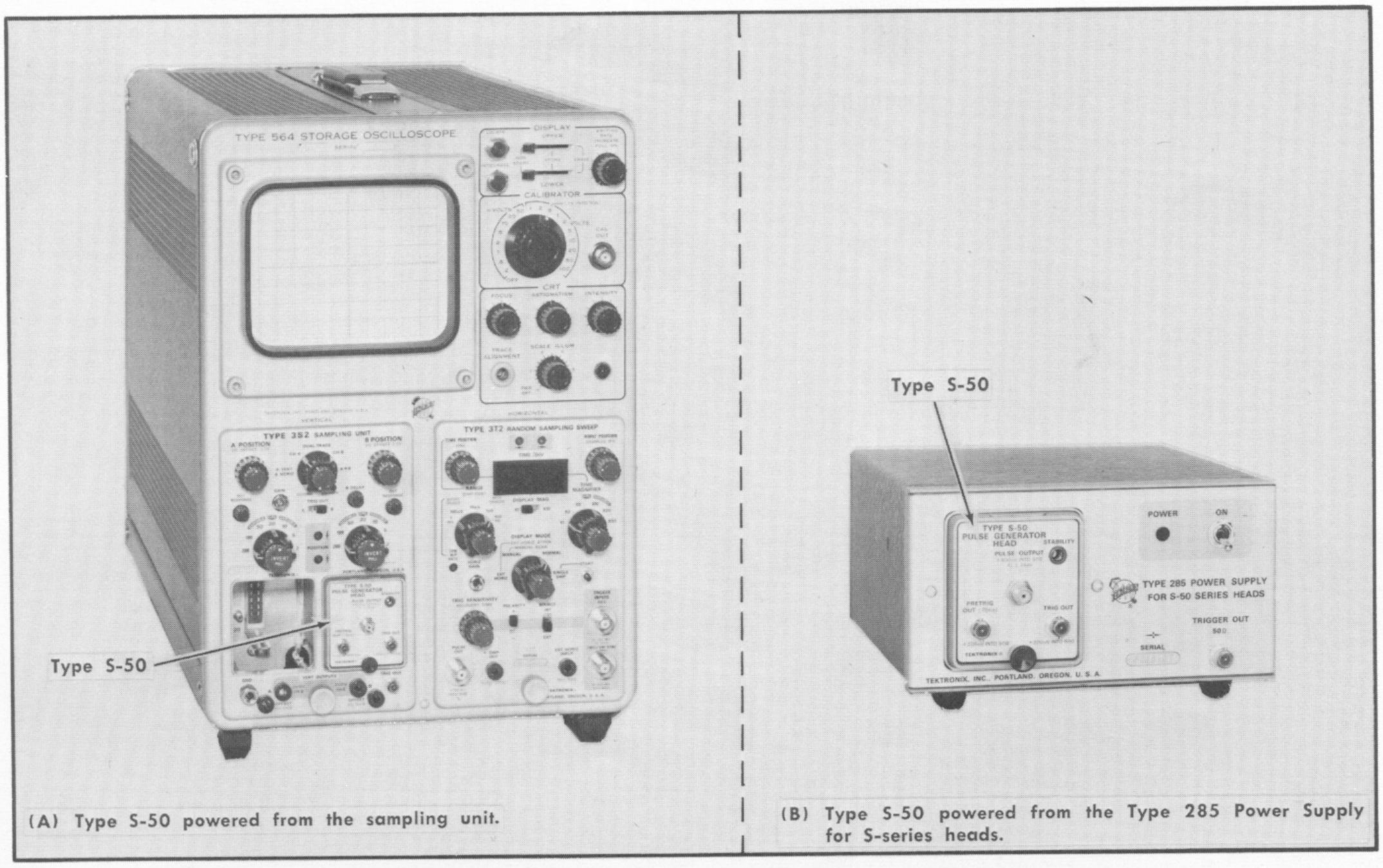
High resolution TDR measurements of coaxial cable discontinuities can be made using the Type S-50 and a Type S-4 Sampling Head. The fastrise output pulse also is valuable for checking the 10% to 90% risetime of amplifiers, or of a fast rise sampling system.

A pretrigger output pulse allows a sequential sampling system to display the main pulse without using a delay line in the signal path. This pretrigger pulse is also available at the rear for internal triggering of a sampling sweep unit. Another front panel connector provides a trigger pulse that is time coincident with the fastrise output pulse. The PRETRIG OUT and TRIG OUT connectors are BSM type, while the PULSE OUTPUT connector is a threaded 3 mm type.

Minimum time jitter between the main fastrise output pulse and both trigger pulses is maintained by occasional operator adjustment of the front panel STABILITY control (a screwdriver control). A procedure for adjusting the STABILITY control is given in the First Time Operation description later in this section.

Installing the Type S-50 Pulse Generator Head

Fig. 2-1A shows the Type S-50 installed in the Channel B compartment of a Type 3S2 Sampling Unit. Operating the



(A) Type S-50 powered from the sampling unit.

(B) Type S-50 powered from the Type 285 Power Supply for S-series heads.

Fig. 2-1. Obtaining operating power for the Type S-50.

Type S-50 in this manner leaves only Channel A of the sampling unit available to operate a sampling head. The Type S-50 can be plugged into the sampling unit as shown, or used remotely on a special extender cable. 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.

To insert the Type S-50 into a compartment of the sampling unit, proceed as follows:

1. Pull the latch knob (Fig. 2-1A) 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 unit slowly into the compartment, so the two plastic guides enter the rear connector opening.

3. Push the Type S-50 completely into the compartment.

4. Push the latch knob to lock the unit in place.

To remove the Type S-50 from the compartment, pull the latch knob away from the front panel, then pull the unit from the compartment.

To use the Type S-50 on an extender cable, install as follows:

1. Pull the latch knob located on the head end of the extender cable outward from its 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 engage the unit.

3. Push the head completely into the compartment.

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

5. Connect the Type S-50 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-50 from the extender cable, pull the latch knob on the front panel of the Type S-50, 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 of the panel, then pull the unit free.

The Type S-50 may also be operated in a Type 285 Power Supply for S-Series Heads as shown in Fig. 2-1B. Powering the Type S-50 from the Type 285 permits both sampling unit channels to be used for sampling heads. The Type S-50 is installed in the Type 285 in the manner discussed above for insertion into a sampling unit.

FIRST-TIME OPERATION

In addition to the Type S-50, this procedure uses a Type S-4 Sampling Head, Type 3S2 Dual-Trace Sampling Unit, Type 3T2 Random Sampling Sweep, and a Type 564 Storage Oscilloscope. See Fig. 2-2. The Type 3T2 Random Sampling Sweep permits viewing the signal in advance of the triggering event without a pretrigger. Since the Type S-50 has a pretrigger output, the fastrise pulse output may also be viewed using a sequential sampling sweep unit (this function is also available in the Type 3T2).

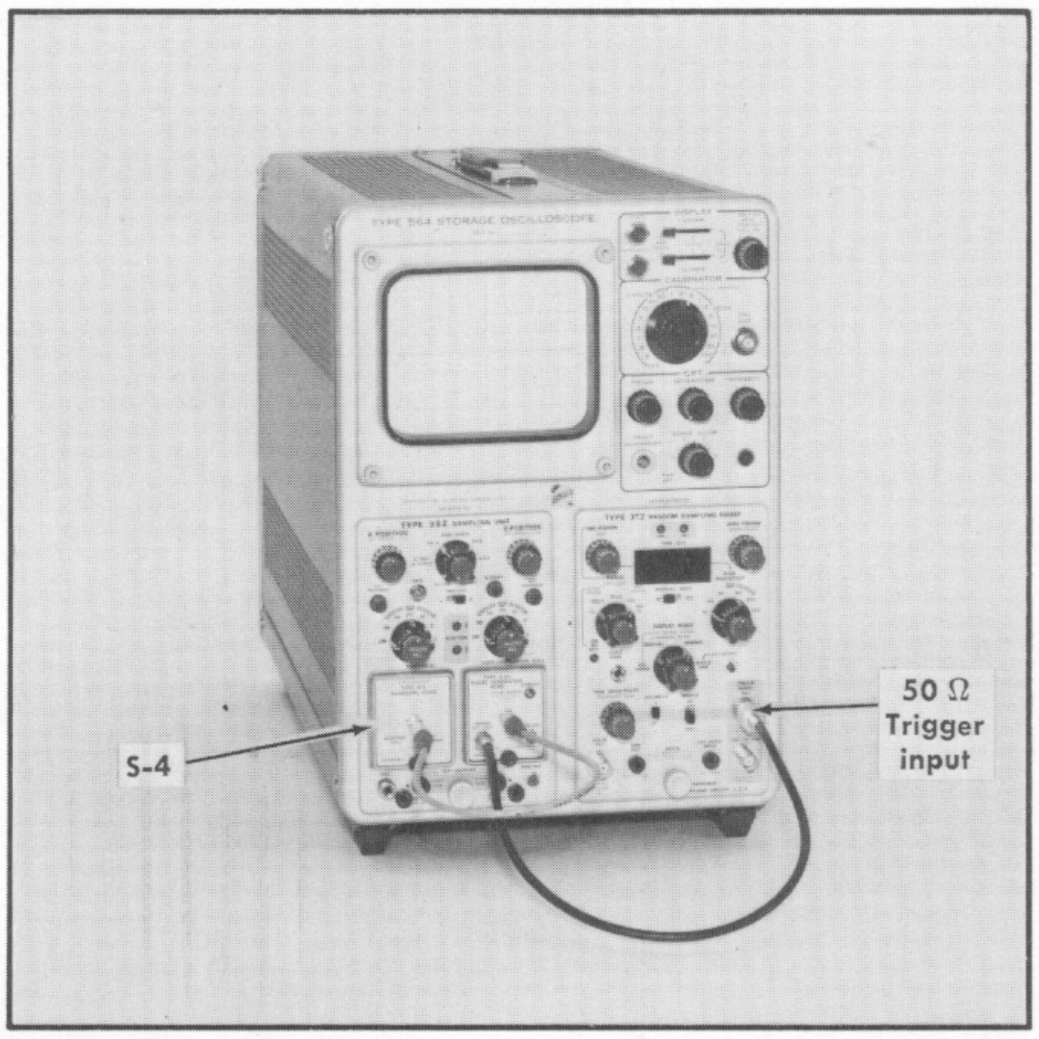


Fig. 2-2. Equipment setup used during First-Time Operation.

Setup Information

1. With the Type 564 Power switch off, insert a Tektronix Type 3S2 Sampling Unit into the vertical compartment (left) and a Tektronix Type 3T2 Random Sampling Sweep Unit into the horizontal plug-in compartment.

2. Insert the Type S-4 into Channel A (left) of the Type 3S2, leaving the latch knob free to move. Once the S-4 is seated, push the latch to lock it in place.

3. Insert the Type S-50 into Channel B (right) of the Type 3S2, leaving the latch knob free to move. Once the Type S-50 is seated, push the latch to lock it in place.

4. Connect the Type S-50 PULSE OUTPUT connector to the Type S-4 input connector using a 2 ns signal delay section of 3 mm flexible coaxial line.

NOTE

Connectors at both ends of all signal coaxial cable should be tightened firmly to mating connectors or adapters. Tighten slightly more than finger tight using a $^5/_{16}$ inch end wrench. A good connection is necessary to minimize reflections at the connector junctions.

5. Connect the Pretrigger Out connector to the 50 Ω Trigger Input of the Type 3T2. Use trigger cable such as Tektronix Part No. 012-0128-00 (7 inch) or Tektronix Part No. 012-0127-00 (18 inch).

6. Set the Type 564 Intensity control fully counterclockwise.

7. Connect the Type 564 to the power line and set the Power switch to On.

8. Allow about 5 minutes warm-up so the units reach operating temperature before proceeding.

9. Set instrument controls as follows:

Type 3S2

Display Mode	CH A
Normal-Smooth	Normal
Horiz Plug-In Compatibility SW	Sampling, 3T-Series
Channel A controls	
Position	Midrange
DC Offset	Midrange (5 turns from one end)
Units/Div	200
Variable	Cal
Invert	Pushed In
Dot Response	Midrange
Channel B controls	Optional

Type 3T2

Time Position	Midrange
Horiz Position	Midrange
Samples/Div	9 o'clock position
Samples/Div SW	Variable
Display Mode	Normal
Start Point	Before Trigger
Sweep Rate	100 ns/Div
Range	1 μs
Display Mag	×1
Time Magnifier	×1
Variable	Cal
Trigger Source	Ext
Trig Sensitivity	Fully clockwise
Trig Polarity	(+)

Type 564

Astigmatism	Midrange
Focus	Midrange
Intensity	Fully counterclockwise
Upper and Lower Screen	Non-store

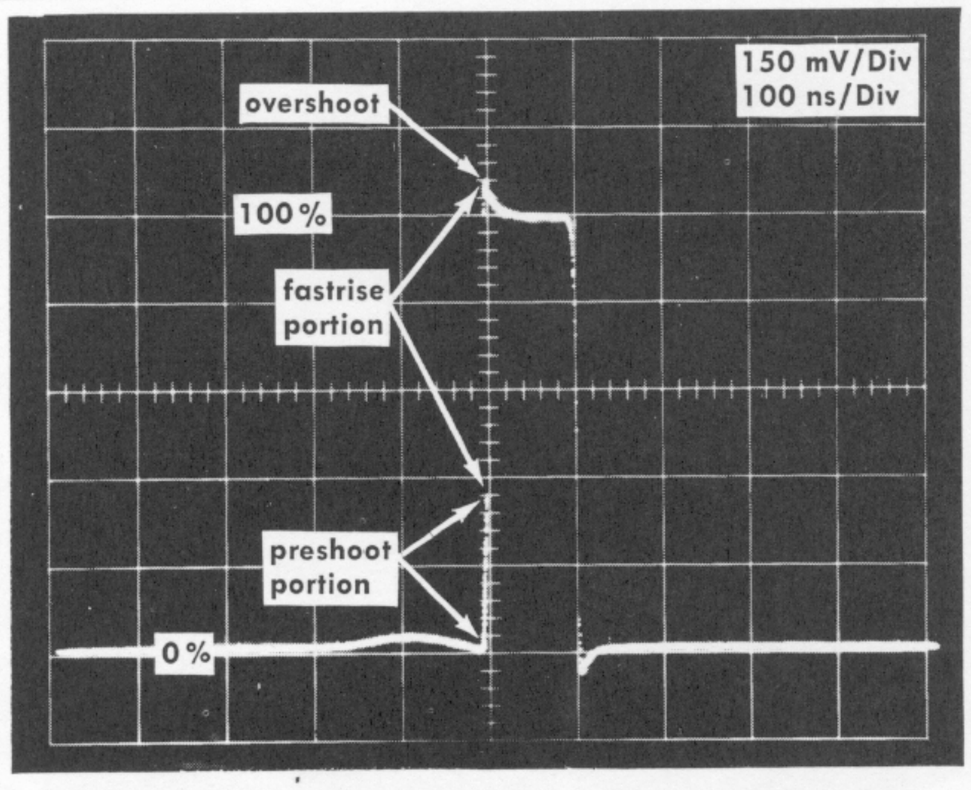
11. Set the Type 564 Intensity control so the trace brillance is correct. Adjust Astigmatism and Focus controls for best focus.

12. Center the trace on the graticule with the Type 3S2 DC Offset control.

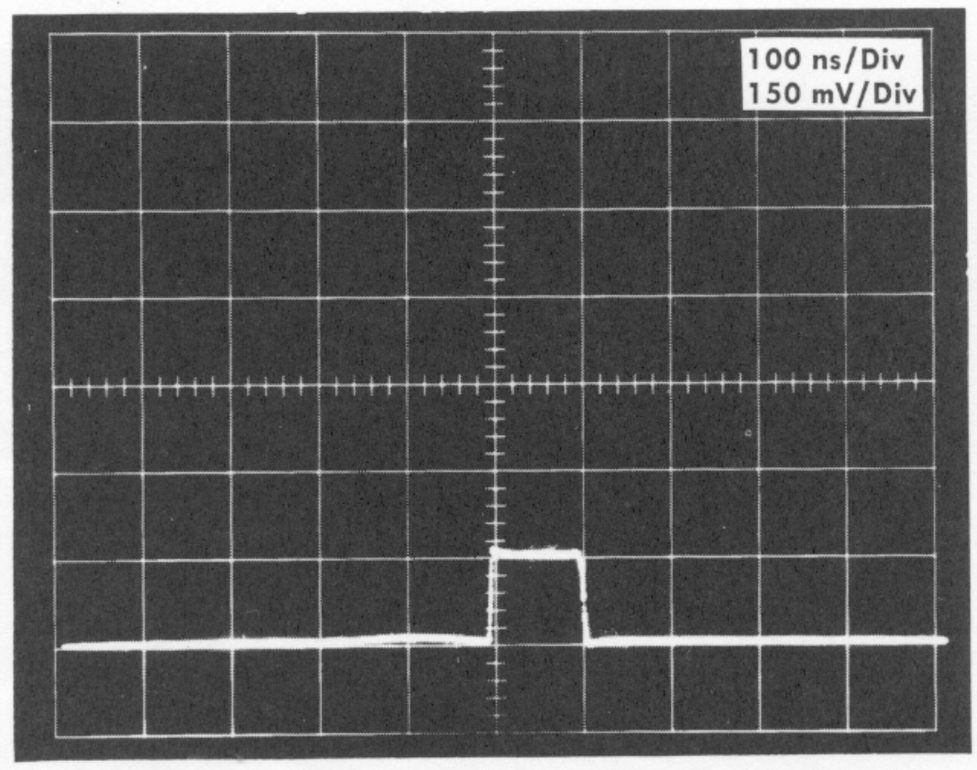
13. Adjust the Type 3T2 Trigger Sensitivity and Time Position controls for a stable triggered display of the Type S-50 output pulse. See Fig. 2-3A (display amplitude is approximately 5 divisions set by the Type 3S2 A Variable control).

Characteristics of the Output Pulse

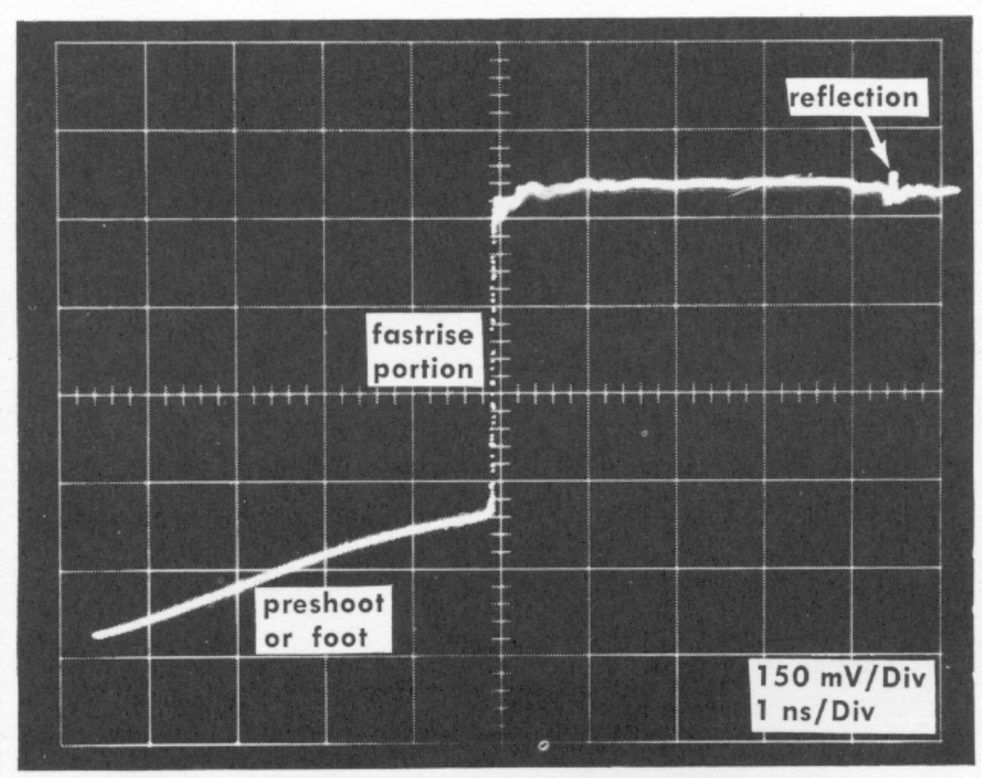
The pulse appearing at the Type S-50 PULSE OUTPUT connector has both a preshoot and a fastrise portion. Fig. 2-3A



(A) Typical display with the Type S-50/Type S-4 combination.



(B) Typical display with STABILITY fully counterclockwise.



(C) Display at faster sweep rate with STABILITY properly adjusted.

Fig. 2-3. Displays of Type S-50 output pulse.

shows both parts with the preshoot portion starting upward 5 divisions from the graticule left edge and 3 divisions below graticule center. The preshoot region ends approximately 1.2 divisions below graticule center.

In most Type S-50 applications the preshoot portion of the output pulse is not useful and is of no interest. The preshoot can be considered to be an unavoidable delay in starting of the fastrise pulse output. The preshoot amplitude is affected by adjustment of the STABILITY control. See the Circuit Description Section of this manual for further information.

In Fig. 2-3A the fastrise portion starts 1.2 divisions below graticule center and rises vertically to a point 2.2 divisions above graticule center. No samples or at most one, are visible during the fastrise portion due to the relatively slow sweep rate. The trace therefore has a gap in this region. In order to measure risetime, a much faster sweep rate must be used.

Stability Control

A STABILITY control is provided on the Type S-50 front panel. This control must be adjusted to obtain minimum time jitter between the main output pulse and both trigger pulses.

Fig. 2-3A shows the appearance of a normal output pulse.

To learn how the STABILITY control affects the display, turn it fully counterclockwise.

This will stop the fastrise output pulse and produce a display as shown in Fig. 2-3B. Slowly rotate the STABILITY control clockwise until the output pulse fastrise portion reappears at the preshoot region as shown in Fig. 2-3A.

Change the sweep rate to 1 ns/Div by changing the Type 3T2 Range switch top 100 ns, and the Time Magnifier to ×10. Set the Type 3T2 Start Point Switch to With Trigger. Adjust the Type 3T2 Time Position control for a display similar to that shown in Fig. 2-3C. After a rather gradual rise requiring about 5 ns (5 divisions), the amplitude of the signal shown increases by about 500 mV. The preshoot or foot (the gradual rise) occupies the portion of the graticule to the left of graticule center. The fastrise leading edge of the output pulse is approximately at graticule center.

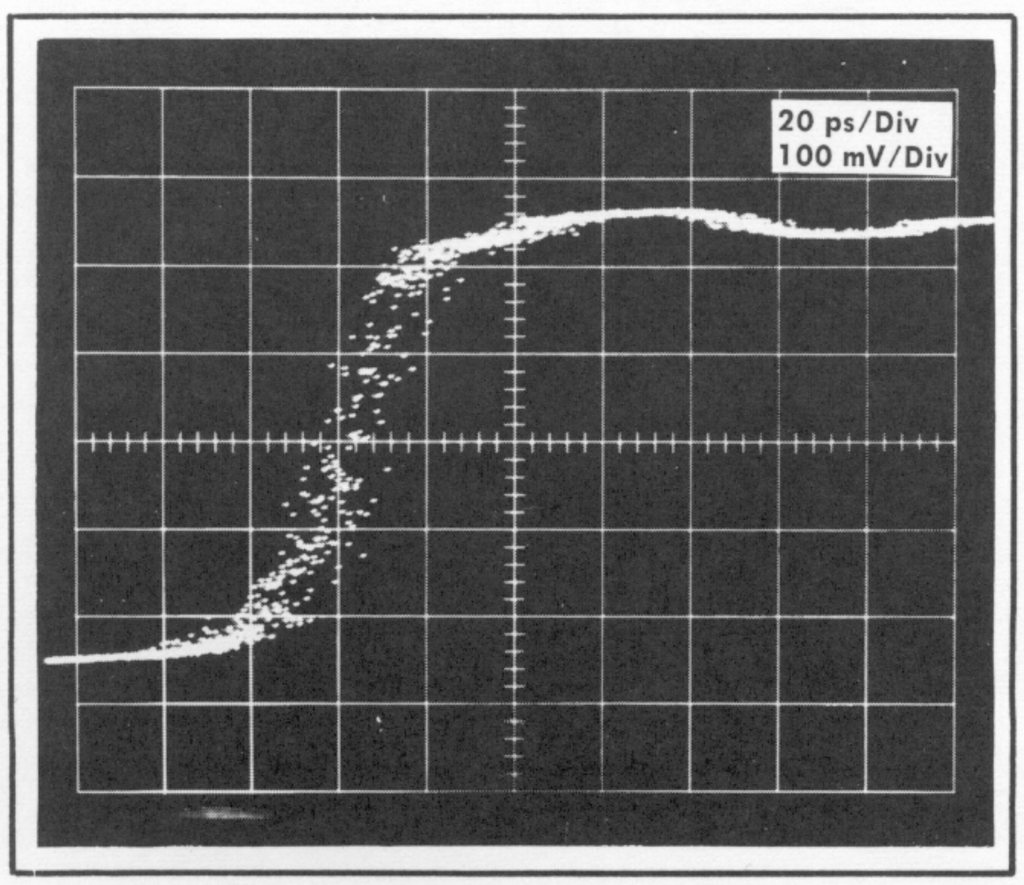


Fig. 2-4. Fastrise portion of Type S-50 output pulse at 20 ps/Div sweep rate (equipment: 2 n signal delay 3 mm flexible coaxial cable and Type S-4 Sampling Head).

Slowly rotate the Type S-50 STABILITY control counterclockwise and observe that the fastrise pulse moves to the right and away from the preshoot region or disappears from view. Now slowly turn the Type S-50 STABILITY control clockwise until the fastrise portion just reaches the preshoot region of the display. See Fig. 2-3C. Note the horizontal position of the fastrise portion of the display or set the fastrise portion to graticule center using the Type 3T2 Time Position control. Turn the Type S-50 STABILITY control carefully clockwise until the fastrise portion moves 0.5 to 1.0 ns to the left of the position previously noted. The Type S-50 STABILITY control is now correctly adjusted.

Making Risetime Measurements

In order to measure the risetime of very fast step signal displays, a sweep rate considerably faster than 1 ns/Div is necessary.

1. Change the Type 3S2 deflection factor to 100 mV/Div and set the Variable control to Cal.

2. Vertically center the fastrise part of the step using the Type 3S2 DC Offset control.

3. Set the Type 3T2 Time Magnifier at ×50 (200 ps/Div sweep rate) and readjust the triggering for minimum jitter using the Type 3T2 Sensitivity control.

4. Set the Type 3T2 Display Mag at ×10 (20 ps/Div sweep rate) and carefully adjust the Time Position control for a display similar to that of Fig. 2-4.

In order to accurately measure the step 10% to 90% risetime, the display should be photographed or stored on a Storage oscilloscope CRT to permit careful analysis. To store the display, set the Type 3T2 Display Mode to Single Sweep and the Type 564 upper and lower screen switch for storage; then push the Type 3T2 Single Sweep Start pushbutton.

NOTE

A detailed discussion is given later in this section for properly positioning the display when using the Type S-50 for verification of a Type S-4 risetime.

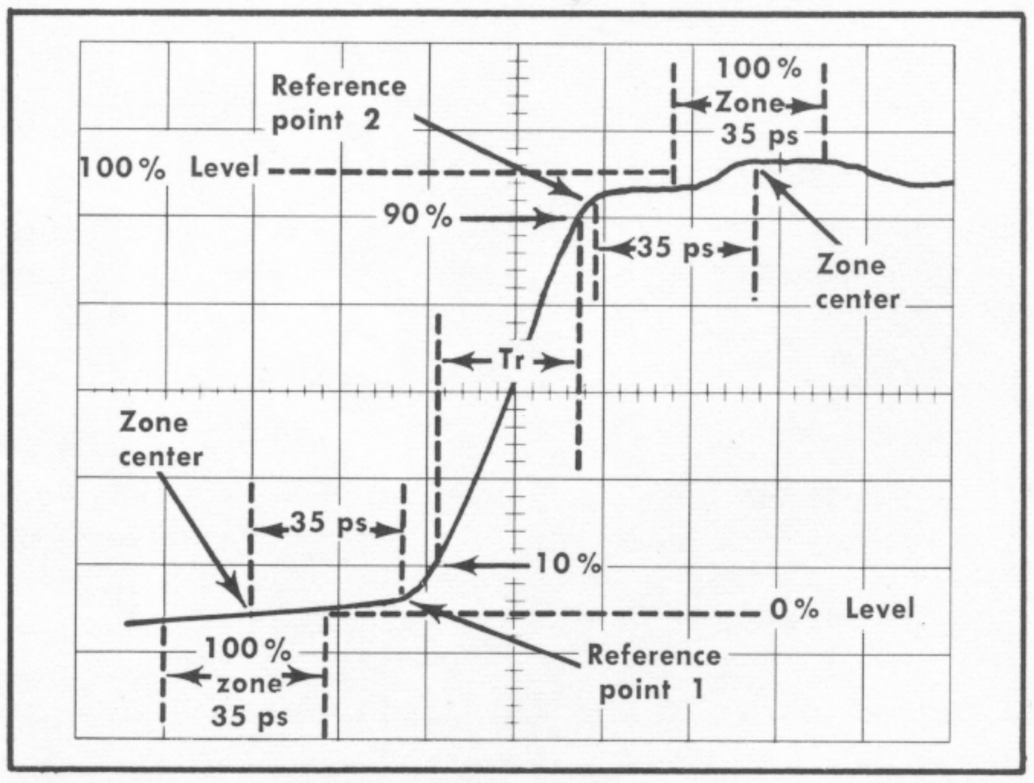


Fig. 2-5. Special S-50/S-4 system risetime measurement technique.

If the sampling unit is operated with a low loop gain (smoothed), the displayed risetime may be longer than the actual risetime unless there are a large number of samples during the step rise. Switching to Normal loop gain (while resulting in a noisier display) will permit this effect to be checked. The Pulse generator risetime may also have considerable effect on the displayed risetime. The effects of the pulse generator on displayed risetime is discussed later in this section.

OPERATING INFORMATION

Measuring Step Signal Risetime

In the First Time Operation example given earlier in this section a storage oscilloscope was used to hold a fastrise display for careful measurement of risetime. Ability to store a display gives an operator an accuracy advantage at a low signal repetition rate. An alternate method of holding a fastrise display for careful measurements is to use a Tektronix trace-recording camera to photograph a single sweep display.

Accurate risetime measurements from a CRT display require that the 10% and 90% points be located accurately and that the horizontal distance between these points be carefully measured. The sampling sweep unit timing accuracy must be known. Changing the sampling sweep unit from operation in one oscilloscope to operation in another requires readjustment of the front panel horizontal gain control. See your sampling sweep unit instruction manual for timing accuracy specifications and complete instructions for checking timing.

A displayed pulse risetime is found by multiplying the horizontal distance (in divisions) between the 10% and 90% amplitude points by the sweep rate. It is recommended that the display amplitude be adjusted so the 0% and 100% points are exactly 5 divisions apart (using the sampling unit Variable control). Vertically center the display (using the DC Offset control) to place the 0% and 100% points 2.5 divisions from the graticule center. The 10% and 90% amplitude points are 2 divisions from the graticule center. A special method is used to locate the 0% and 100% points when the equipment is the Type S-50/Type S-4 combination; it is discussed below.

Special S-50/S-4 system risetime measurement. Refer to Fig. 2-5 during the following description.

Reference point 1 is at the corner that preceeds the display step. Reference point 2 is at the corner following the fastrise portion of the step. Both reference points are located where the slope rate of change is maximum (where the radius or curvature is least). Special zones are used to locate the 0% and 100% amplitude points. The 0% zone center is 35 ps before the first reference point and the 100% zone center is 35 ps after the second reference point. Each zone is 35 ps wide. The 0% and 100% amplitude points are then placed at the average amplitude of their respective zones.

Follow the procedure below for measurement of the displayed S-50/S-4 system risetime:

1. Locate reference point 1 and the 0% zone.
2. Locate reference point 2 and the 100% zone.
3. Use the sampling unit DC Offset and Variable controls and place 0% zone average value 2.5 divisions below graticule center and the 100% zone average value 2.5 divisions above graticule center.
4. Locate the step 10% point where the trace crosses the —2 division horizontal graticule line.
5. Locate the step 90% point where the trace crosses the +2 division horizontal graticule line.
6. Multiply the horizontal separation, in divisions, between the 10% and 90% points by the sampling sweep unit sweep rate to find the system risetime. The specified combined risetime of the Type S-50/S-4 system is 35 ps.

Effect of System Components on Displayed Risetime

The displayed risetime of a pulse generator and sampling oscilloscope system is affected by the pulse generator rise-

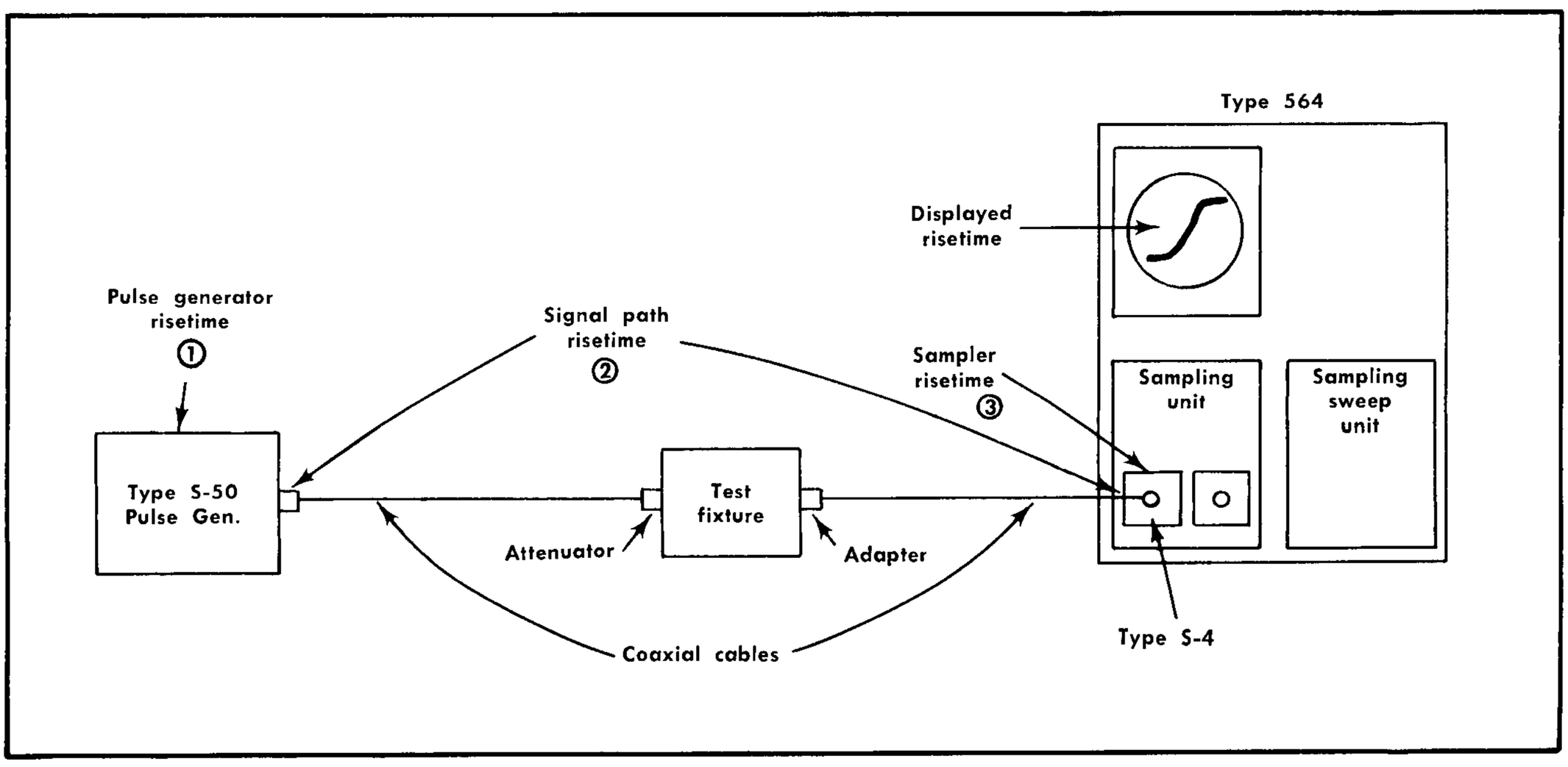


Fig. 2-6. Parts of a pulse generator and sampling oscilloscope system that affect displayed risetime.

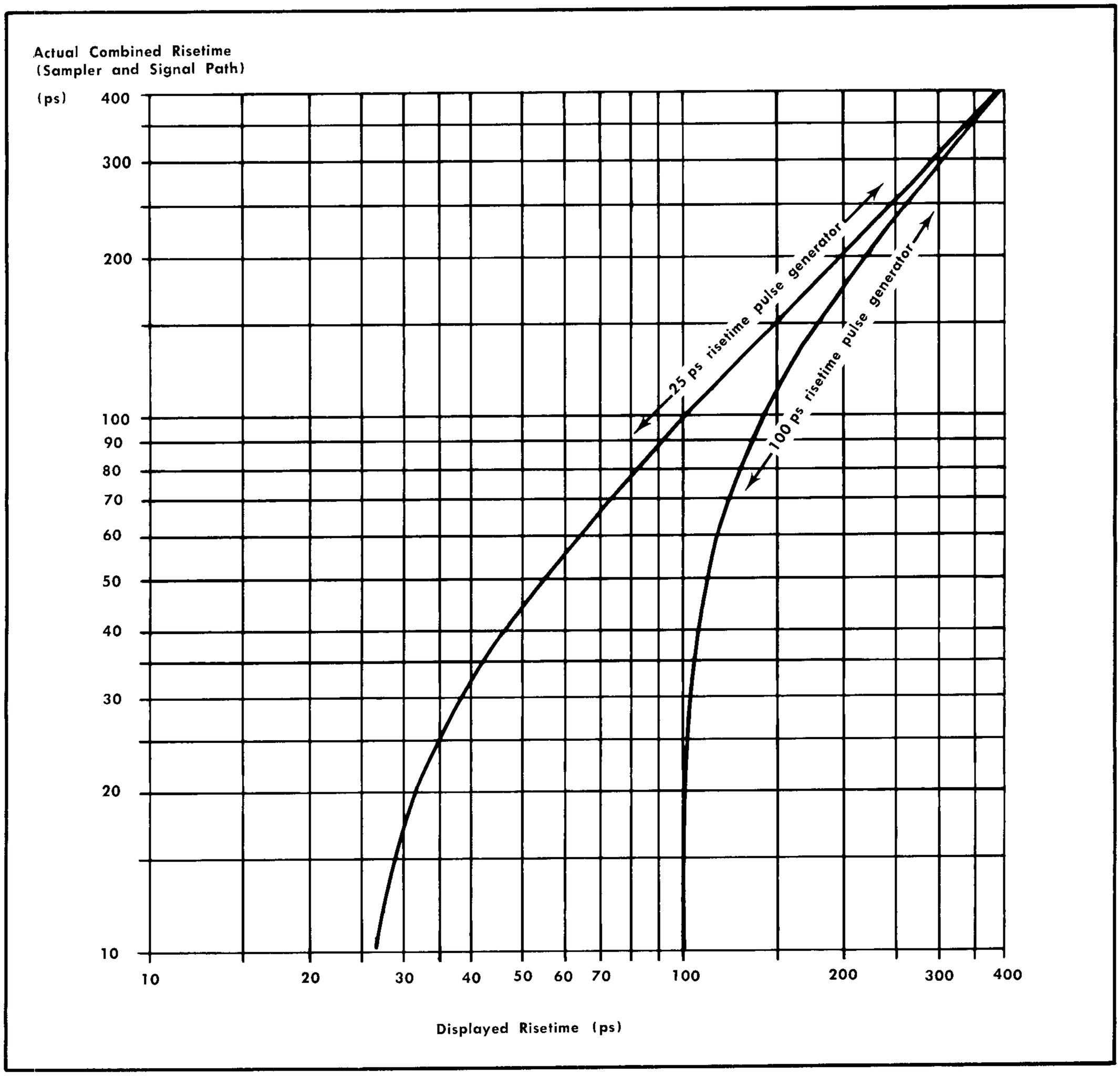


Fig. 2-7. Displayed risetime versus actual combined risetime of sampler and signal path (approximate values).

time, the signal path risetime, and the sampler risetime. Fig. 2-6 shows these three contributors to overall displayed risetime. The signal path risetime is considered to be the combined risetime of everything in the signal path between the pulse generator output and the sampler input. The effect on displayed risetime of any one of the three parts shown in Fig. 2-6 is insignificant if the risetime of the part is at least four times faster than the remainder of the system. Therefore, a 25 ps risetime pulse generator (part 1 of Fig. 2-6) will have very little effect on the overall system risetime if the combined risetime of the remainder of the system (parts 2 and 3 of Fig. 2-6) is more than 100 ps. Formula (2-1) shows the approximate relationship between the displayed or overall system risetime and the parts contributing to this risetime.

$$\text{Tr (displayed)} \approx \sqrt{(\text{Tr pulse gen})^2 + (\text{Tr signal path})^2 + (\text{Tr sampler})^2} \quad (2\text{-}1)$$

Formula (2-1) may be put into a different form by transposing one or more of the terms under the square root sign. An example is shown in Formula (2-2).

$$\text{Tr (signal path and sampler combined)} \approx \sqrt{(\text{TR displayed})^2 - (\text{Tr pulse gen})^2} \quad (2\text{-}2)$$

Fig. 2-7 is a graph showing the effect of pulse generator risetime on the displayed or overall system risetime. The values shown in Fig. 2-7 are approximate since the graph is based on approximations using Formula (2-1).

Effect of Sampling Head on Displayed Type S-50 Output Pulse

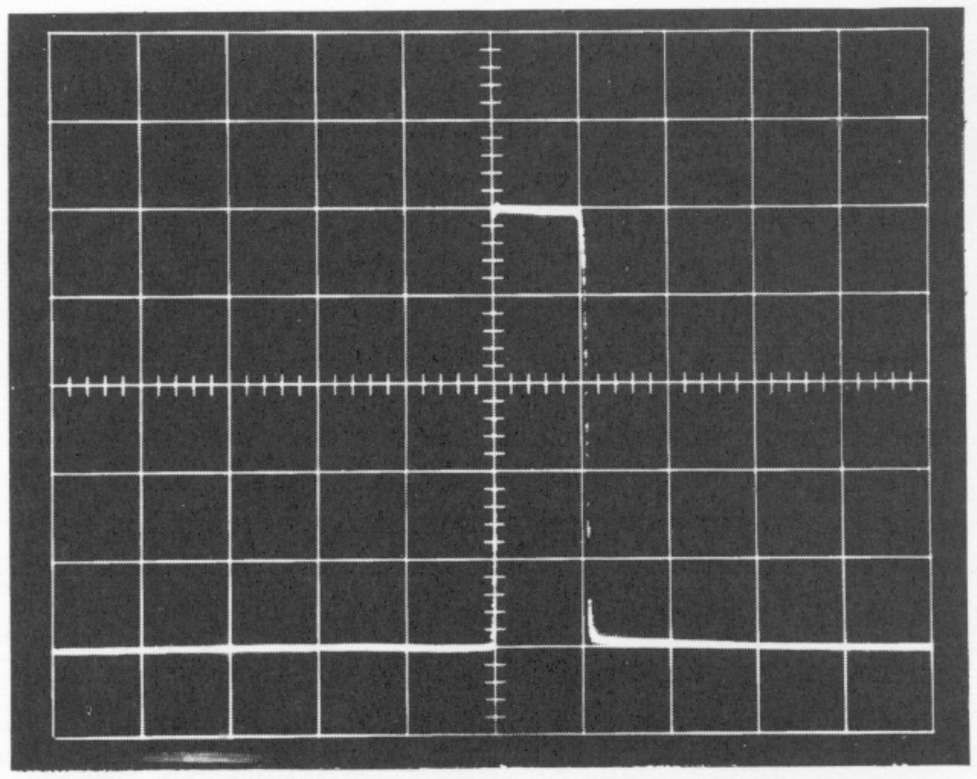
The Type S-50 may be used with S-series sampling heads other than the Type S-4. Typical Type S-50 output pulse displays with Type S-1, S-2, and S-4 Sampling Heads are shown in Figures 2-8, 2-9 and 2-10.

Coaxial Cables and Accessories

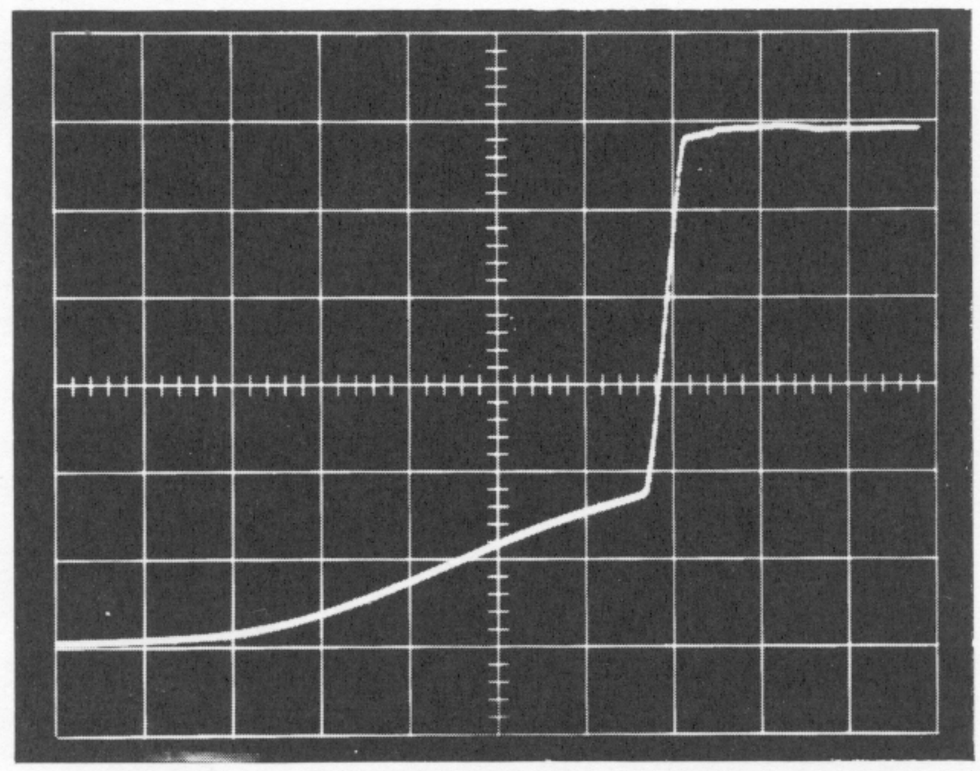
The Type S-50 output connector (threaded 3 mm) is intended for use with Teflon dielectric coaxial cable having an outer conductor with an outside diameter of 0.141 inches. Standard and optional 3 mm accessories available from Tektronix operate to frequencies above 18 GHz, and are generally useful up to 25 GHz. Accessories (3 mm) include flexible and semi-rigid coaxial cables, attenuators, adapters to change from 3 mm to other connector types, and a power divider tee. See your Tektronix Field Engineer or Representative for price and avaliability of optional accessories.

CAUTION

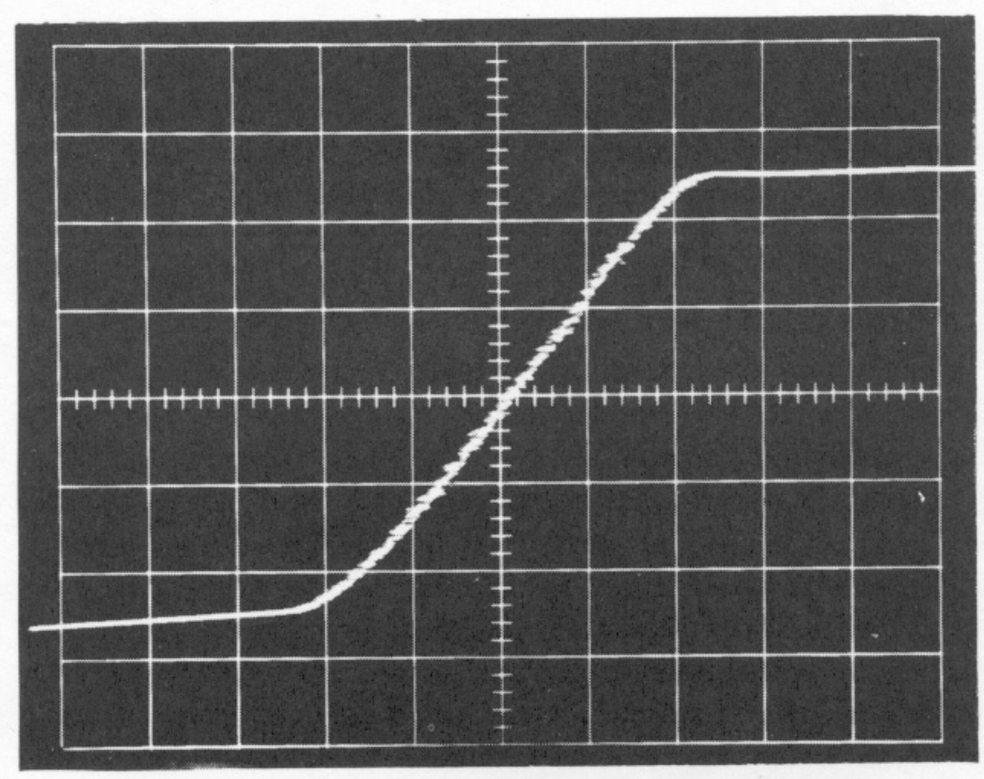
The two coaxial lines listed under part numbers 015-1015-00 (500 ps semi-rigid 3 mm coax) and 015-1005-00 (2 ns flexible 3 mm coax) must be treated with care to obtain maximum life and least signal distortion. The semi-rigid line may have its shape changed just twice in its lifetime, providing the minimum bend radius is no less than 10 times its outside diameter or approximately 1½ inches. The flexible (2 ns delay) cable must not be given a bend radius less than 10 times its outside diameter, or approximately 2¼ inches. (The same applies to the 5 ns signal delay flexible cable, Tektronix Part No. 015-1006-00.) The two flexible cables may have their outer conductor damaged by tighter bending. Few flexures assure longer life.



(A) At sweep rate of 100 ns/div.

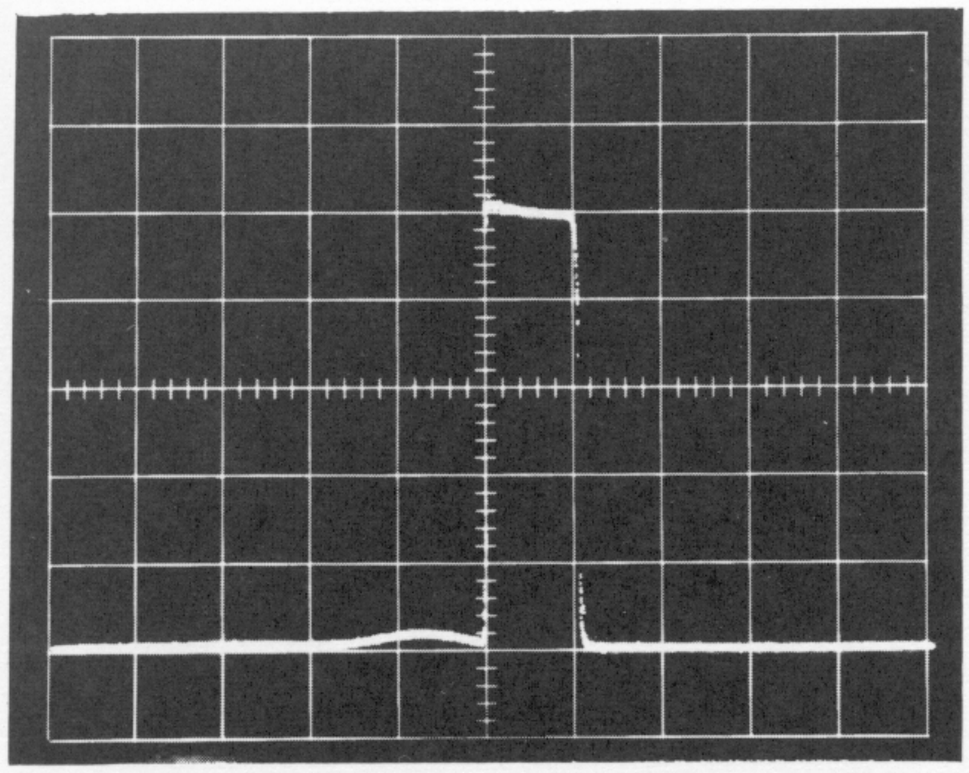


(B) At sweep rate of 1 ns/div.

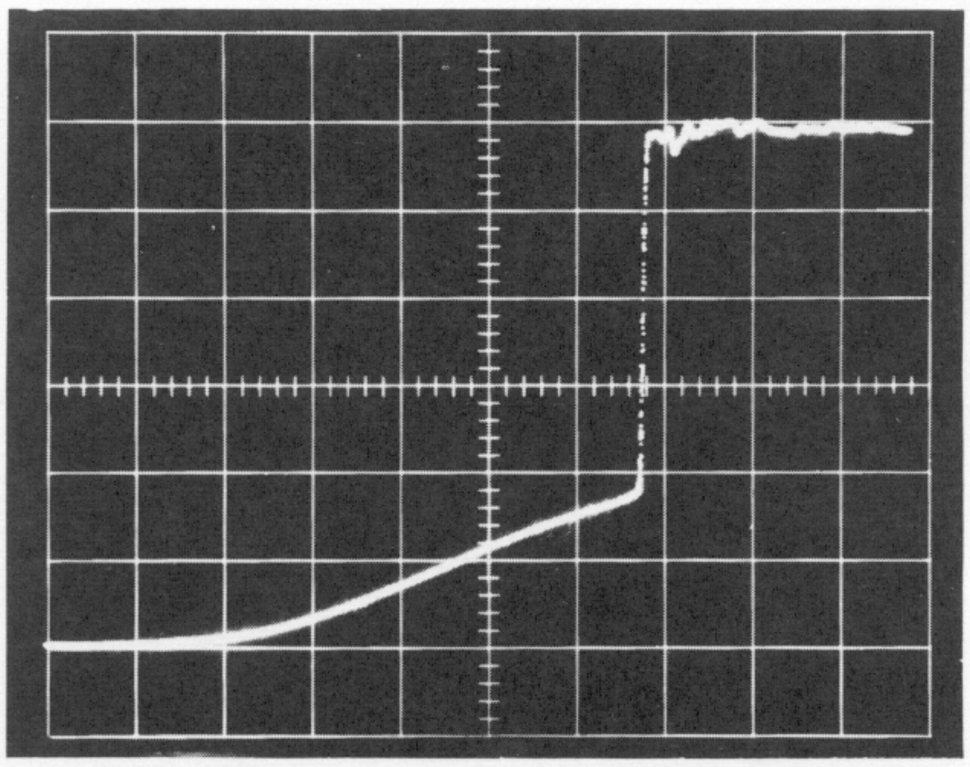


(C) At sweep rate of 100 ps/div.

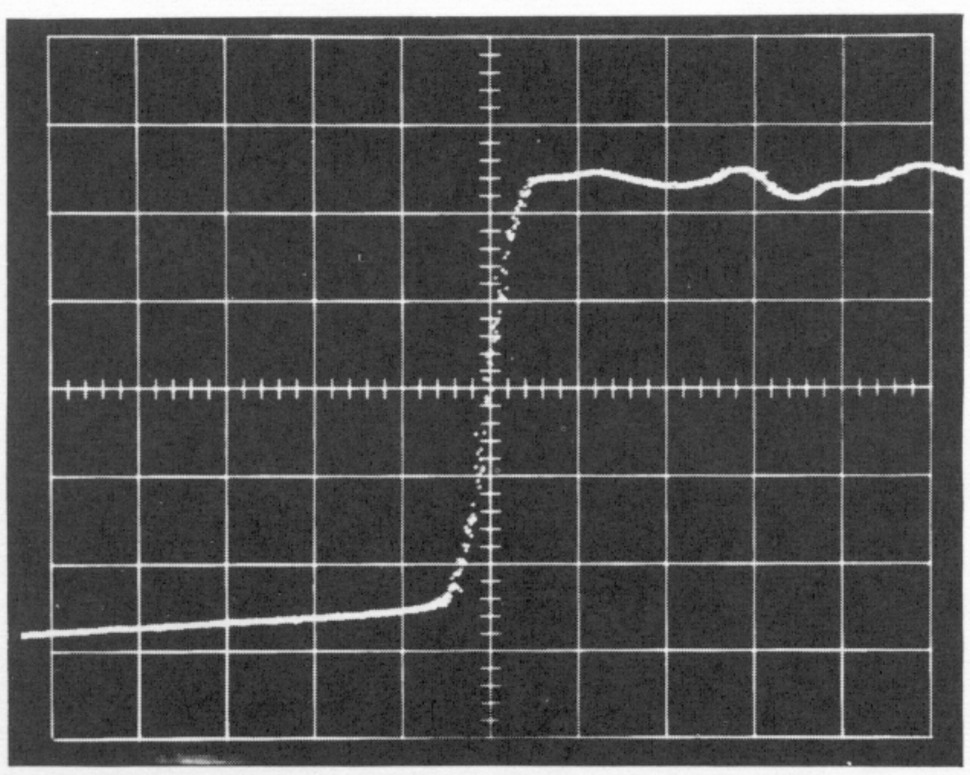
Fig. 2-8. Type S-50 output pulse displays using the Type S-1 Sampling Head.



(A) At sweep rate of 100 ns/div.

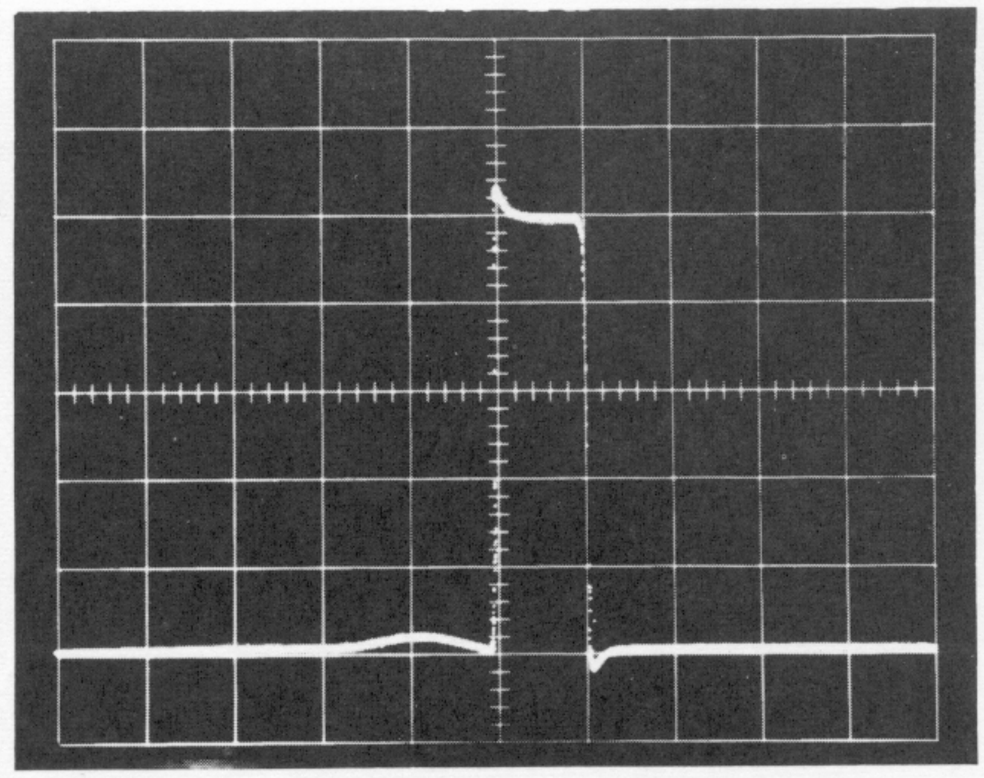


(B) At sweep rate of 1 ns/div.

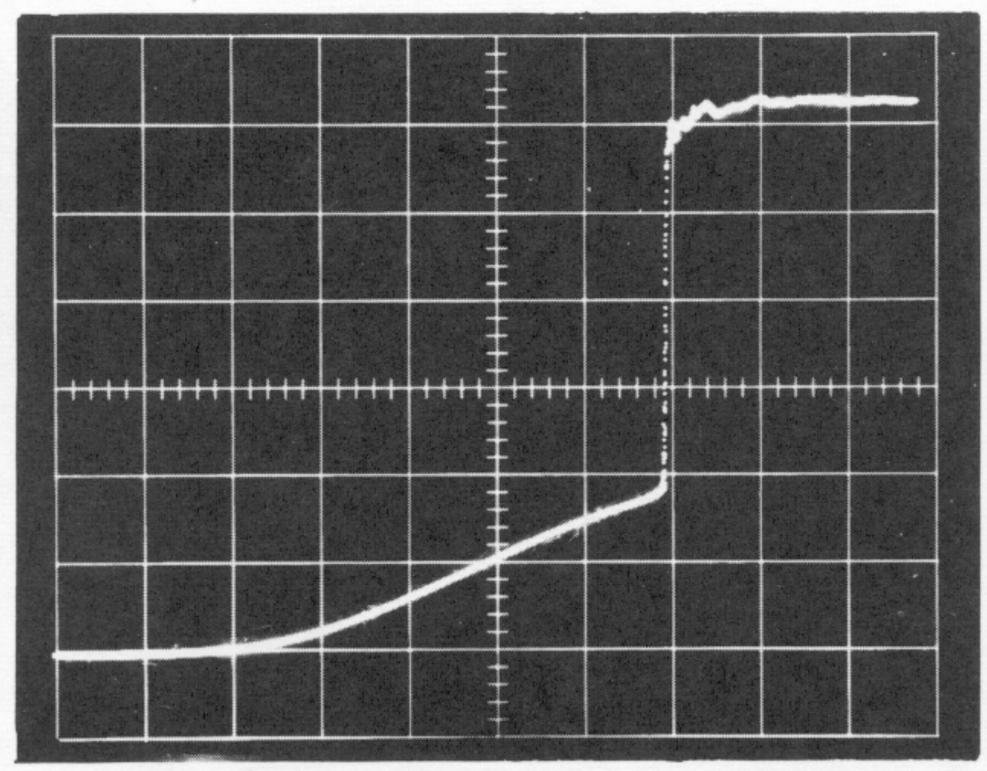


(C) At sweep rate of 100 ps/div.

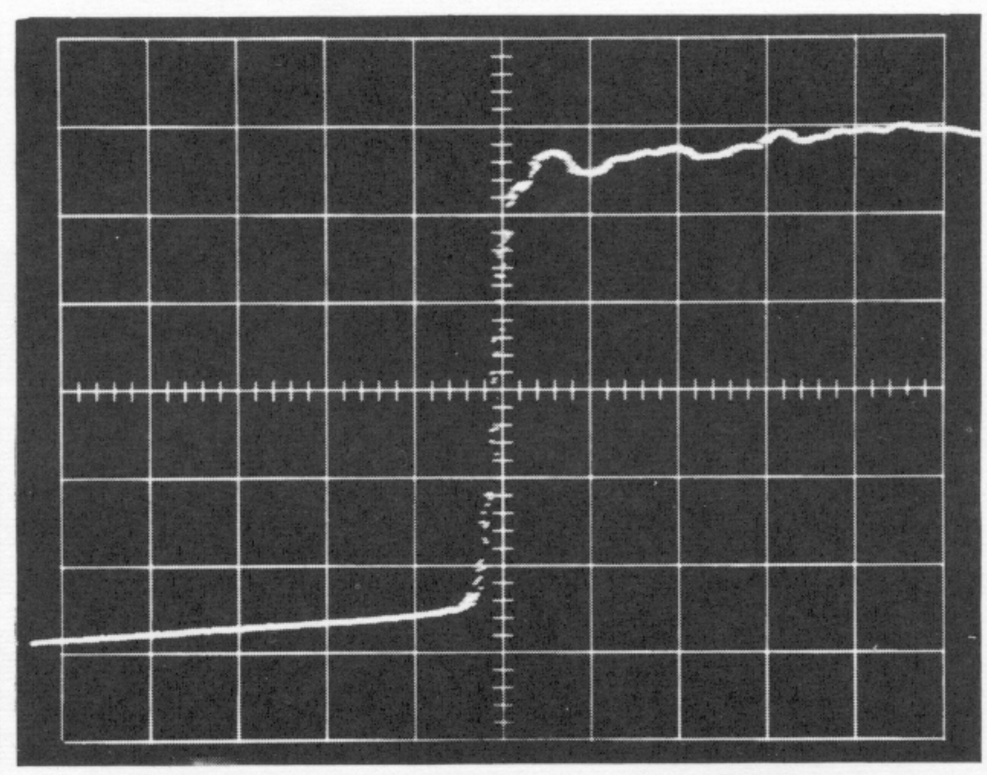
Fig. 2-9. Type S-50 output pulse displays using the Type S-2 Sampling Head.



(A) At sweep rate of 100 ns/div.



(B) At sweep rate of 1 ns/div.



(C) At sweep rate of 100 ps/div.

Fig. 2-10. Type S-50 output pulse displays using the Type S-4 Sampling Head.

SECTION 3
CIRCUIT DESCRIPTION

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

General

The Type S-50 Pulse Generator Head circuits are contained on two circuit boards. Except for the output tunnel diode assembly, all the circuits use standard etched wiring and discrete components. Properly oriented transistor sockets are fabricated as part of the circuit boards.

The Type S-50 requires +15 V and —12.2 V input power. The input power is normally obtained from either a Type 285 Power Supply For S-50 Series Heads or from one of the dual-channel sampling units that accept S-series heads. When the S-50 is operated in such a sampling unit, another S-series head can be plugged into the other channel.

BLOCK DIAGRAM

The major circuits of the Type S-50 (see Fig. 3-1) consist of the 25 kHz Multivibrator, the Pretrigger Generator, the Leadtime Control circuit, the Trigger Delay Generator, the Stability and TD (tunnel diode) Drive circuit, the Pulse Output circuit, and the Trigger Output TD circuit. The 25 kHz pulse output repetition rate is controlled by the 25 kHz Multivibrator. The Multivibrator drives the Pretrigger Generator, which in turn drives the two PRETRIG OUT connectors (one on the front panel, the other internal) and the Leadtime Control circuit. The Leadtime Control circuit drives the Trigger Delay Generator. Jitter-free leadtime trigger-pulse to output-pulse timing and uniform output pulse duration is ensured by the Trigger Delay Generator (the circuit is of a differential design that ignores power supply ripple and noise). The Trigger Delay Generator output is applied to the Stability and TD Drive circuit. The Stability and TD Drive circuit drives both the (time coincident) Trigger Output TD, and (through an emitter follower) the Pulse Output TD. The STABILITY control permits the operator to adjust the Output TD current to compensate for aging and temperature variations (see Operating Instructions section).

CIRCUIT DESCRIPTION

25 kHz Multivibrator

The 25 kHz multi (see circuit diagram) is a low-component circuit that operates with transistors Q1 and Q5 conducting alternately. For purposes of explanation, assume that Q1 has just turned off and Q5 has turned on. Under these conditions, the operation is as follows:

Transistor Q5 base voltage is set by voltage divider resistors R1 and R4 at —1.11 V. Q5 emitter is at about —1.7 V with a total instantaneous emitter current (through R3-C7 and R7) of 4.3 mA. The 4.3 mA value is based upon current in R7 paralleled by current in R3-C7. Capacitor C7 has a charge on it that places Q1 emitter instantaneously about +0.5 V more positive than Q5 emitter. The voltage starts to change as R3 pulls current out of C7 and drives Q1 emitter in a negative direction. As soon as Q1 emitter voltage reaches about —6.5 V, the multi switches; Q1 becomes the conducting transistor and Q5 turns off.

At the instant Q1 starts to conduct, the voltage of the charge on C7 is about 4.8 V. Q1 collector drops to about —6.5 V, reverse biasing Q5 by about 5.4 V (and stopping the drive to Q9). Current through R7 drains charge from C7 until the voltage across R7 drops to about 0.5 V and Q5 emitter voltage reaches about —7 V. At this point the multi again switches with Q5 becoming the conducting transistor and Q1 turning off.

It is the AC coupling by C7 between Q1 and Q5 emitters and the DC coupling between Q1 collector and Q5 base that provides the regenerative switching path which ensures that the multi changes state rapidly in either direction. Almost all of Q5 collector current (4 mA) is taken from Q9 base, ensuring that Q9 is driven into saturation each time Q5 in the 25 kHz multi conducts. (R5 is an I_{CBO} leakage path to ensure that Q9 remains cut off when Q5 is not conducting; it is not the collector load for Q5).

Pretrigger Generator

The Pretrigger Generator consists of transistor Q9, tunnel diode D10 and associated circuit elements. Q9 drives D10 so it delivers a fast, positive step to the two PRETRIG OUT connectors and to the Leadtime Control circuit once each 25 kHz multi cycle. Drive from the multi is sufficient to saturate Q9, effectively connecting R9 to ground. Current in R9 and D10 is then about 25 mA, more than enough to trip tunnel diode D10 from its low-voltage state to its high-voltage state. Caacitor C10 at D10 cathode ensures that the fast change in state delivers a positive step from D10 anode, and that the signal is decoupled from the power supply.

The positive output step from D10 is RC coupled to both the Type S-50 front-panel PRETRIG OUT connector and rear-panel (internal) pretrigger output connector P21. The 2- to 3 Ω conduction resistance of D10 is raised to 50 Ω by R23 in series with the lead to the front-panel PRETRIG OUT connector. The PRETRIG OUT signal is $\geq$ +200 mV into 50 Ω due to R23 forming an approximate 2:1 voltage divider with the output load resistance (50 Ω). The internal pretrigger signal amplitude is $\geq$ +70 mV into 50 Ω due to the approximate 4:1 voltage divider of R20 and the parallel value of R21 and the 50 Ω at the sampling sweep unit internal trigger input circuit.

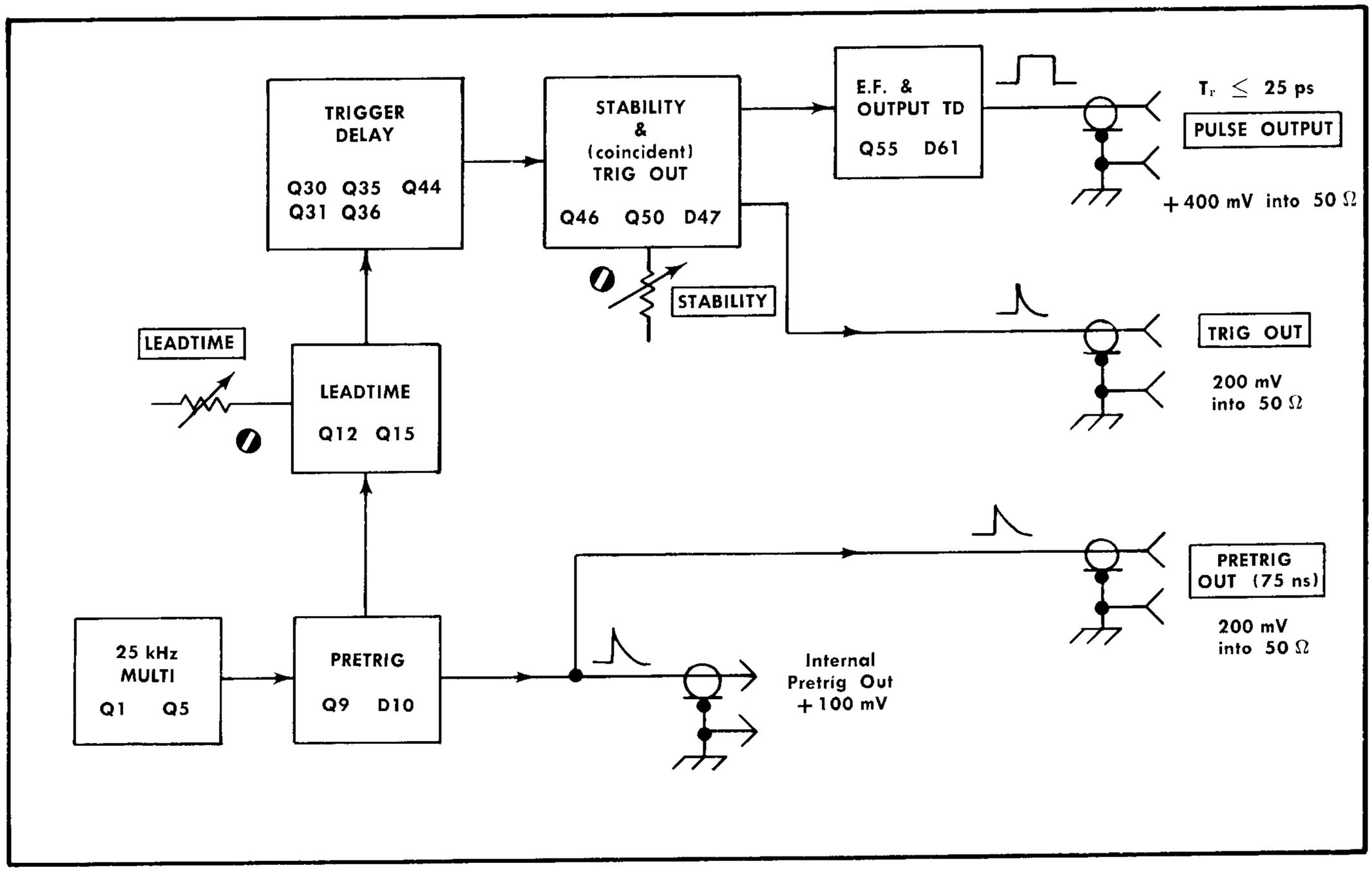


Fig. 3-1. Type S-50 Block Diagram.

Leadtime Control Circuit

The positive step from the Pretrigger Generator also drives the Leadtime Control circuit (transistors Q12 and Q15 and associated circuit elements) via resistor R11 to Q12 base. The Leadtime Control circuit functions as an adjustable current switch and is used to drive the Trigger Delay Generator.

When D10 is at its low-voltage state, Q12 is cut off and Q15 conducts all the current of R13 and R14. Transistor Q15 base is biased about 0.3 V positive from the —6 V supply to ensure that Q12 base-emitter bias (the base is only +0.3 V in respect to the emitter) prevents Q12 from conducting. Leadtime Control R14 permits adjustment of the current through R13 from approximately 6.4 mA to 8.0 mA. The actual value is set during calibration to obtain a pretrigger leadtime (in relation to the Pulse Output) of 75 ns.

When the conduction of Q5 saturates Q9 and drives D10 to its high-voltage state, Q12 suddenly conducts all the current of R13 and R14. The current path switches from Q15-R15 to Q12-R33-R34. The resulting sudden voltage step developed across resistors R33 and R34 initiates the 75 ns delay between the pretrigger event and the pulse output event. When the 25 kHz multi again switches state, Q9, D10 and Q12 are once more cut off. Q15 picks up the current of R13 and R14 and shunts it to ground through R15. Output pulse duration is independent of the length of time Q12 conducts.

Trigger Delay Generator

The Trigger Delay Generator, consisting of transistors Q30-Q31, Q35-Q36 and Q44, generates the 75 ns delay between the Pretrigger Pulse and the Output Pulse. After a delay of 75 ns from the time that Q12 conducts, Q35 applies a turn-on signal to the Stability circuit (Q46) and the Pulse Output steps positive. When an additional 100 ns has elapsed, Q30 turns on Q44 which removes the drive to Q46 and stops the Output Pulse.

For purposes of explanation, assume that Q12 is cut off. There is no current in R33 so the bases of Q30 and Q35 are at ground potential. Both these transistors conduct current as controlled by Q31 and Q36. Transistor Q30 conducts about 2.9 mA, most of which is base current from Q44, driving that transistor into saturation. The low saturation resistance of Q44, is connected across the base-emitter junction of Q46. The saturation of Q44 provides about 7.3 mA to Q35 and ensures that Q46 remains at cutoff. The total 10.2 mA comes from the +15 V supply through R43.

When D10 drives Q12 into conduction, the base voltage of both Q30 and Q35 drops to about —3.5 or —4 volts, the value depending upon the resistance of Leadtime control R14. Since the base voltages of Q30 and Q35 are now more negative than the voltage of their emitters (held at about —0.6 V by capacitors C31 and C36) both transistors stop conducting. Q44 is released from saturation, but with Q35 cut off, Q46 is also left at cut off. (R45 provides on I_{CBO} leakage path that ensures that Q46 remains cut off.) Current in Q31 (2.9 mA) now comes from C31 and the current in Q36 (7.3 mA) now comes from C36. Since both C31 and C36 are the same value (within 1%), C36 changes its charge about 2.5 times faster than C31 changes its charge.

Q31 and Q36 charge C31 (and Q30 emitter) and C36 (and Q35 emitter) in a negative direction. At the end of 75 ns, the voltage on C36 is enough negative to turn on Q35. With Q30 and Q44 still cut off, the full 7.3 mA of Q36 is applied to the base of Q46 through Q35. Q46 is biased into conduction turning on Q55 and switching tunnel diode D45 to its high-voltage state. The conduction of Q55 switches Pulse Output tunnel diode D61 to its high-voltage state, generating the output pulse in time coincidence (±5 ns) with the trigger output from D47. Capacitor C43 holds Q44 and Q46 emitter voltage constant as the circuit current changes from 10.2 mA to 0 mA, then to 7.3 mA and back again to 10.2 mA.

About 100 ns after Q35 is returned to conduction as explained above, the charge on C31 becomes negative enough to turn on Q30. The conduction of Q30 drives Q44 into saturation, which shunts Q46 base-emitter junction with a low resistance, turning Q46 off. With Q46 now cut off, both the time-coincident trigger output and pulse tunnel diodes return to their low-voltage state.

Stability and TD Drive Circuits

The Stability circuit is an adjustable current switch with Q50 normally conducting. When the 75 ns trigger delay period ends and the output pulse is to occur, Q46 conducts. Q46 conduction switches D47 to its high voltage state and also drives the current amplifier Q55 which then drives the Pulse Output tunnel diode.

Adjustment of the STABILITY control alters the steady state voltage charge of C43 by changing the current in R43. Adjusting the control clockwise makes Q50 base voltage more positive, causing the emitter current through R43 to decrease. This makes C43 voltage more positive so that when Q46 conducts to saturation (for its short 100 ns period) its collector voltage goes more positive than for a counterclockwise control setting. Thus the STABILITY control adjusts Q46 collector saturation current by changing the voltage at Q46 emitter. Another way of saying the same thing is to consider Q46 collector saturation voltage as a variable and the current then set by Ohms Law and the value of R48. Very little current is required of Q46 collector by the base of Q55, however, the current to D61 is altered in the same way because Q46 collector saturation voltage sets Q55 emitter voltage. The current through Q55 and the resistors in series with its emitter and D61 is controlled by Ohms Law and the total circuit series resistance.

Trigger Out and Pulse Output Circuits

Both Trig Out tunnel diode D47 and Pulse Output tunnel diode D61 operate without prebias between pulses. Their low-output state is set with no current through either diode. As Q46 goes into conduction, R48 couples the signal to D47 and the Trig Out signal is developed as D47 switches to its high-voltage state. At the same time, Q55 emitter voltage follows Q46 collector voltage and provides the 62 mA required to switch D61 to its high voltage-state and drive the 50 Ω load. Since both diodes start without prebias, both signals contain a rising ramp signal that is obvious just before the tunnel diodes switch from their low-voltage current peak to their high-voltage state.

Minimum time jitter between the Pretrigger output pulse and the main Pulse Output signal is obtained by careful adjustment of the STABILITY control. See the Operating Instructions section for proper setting of the STABILITY control.

Special Components

Special components not mentioned in any of the previous description include the following:

Resistor R8 limits Q9 base current and prevents parasitic oscillations. Capacitor C33 slows the rate of change at Q30 and Q35 base leads so that when Q12 cuts off there is no difference in Q30 or Q33 collector current. C33 slows the base signals well below the F_t frequency of either transistor, forcing both collector circuits to change at the same rate and thus prevent an output pulse when Q12 cuts off. R36 and R41 prevent parasitic oscillations. R50 and R55 limit collector dissipation and prevent parasitic oscillations.

Special output circuit components that aid impedance matching and critically damp stray capacitances include R57, R58 and R61. Resistor R59 and capacitor C59 add a small capacitive load to Q55 to compensate for the inherent inductance of Q55 emitter lead. Resistor R47 (in the Trig Out line) raises the dynamic resistance of D47 from about 2- or 3 Ω to 50 Ω, making the trigger circuit have a 50 Ω source impedance.

NOTES

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-50 Pulse Generator Head. Information for parts ordering, disassembly, component checks and reassembly is included.

To remove the Type S-50 Pulse Generator Head from its case, loosen the four retaining screws on the back. 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.

Obtaining Replacement Parts

All parts used in the Type S-50 can be purchased directly through your Tektronix Field Office or Representative, however, it is suggested that standard electronic items be obtained locally. Replacements for the special parts used in the Type S-50 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 rating required.

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.

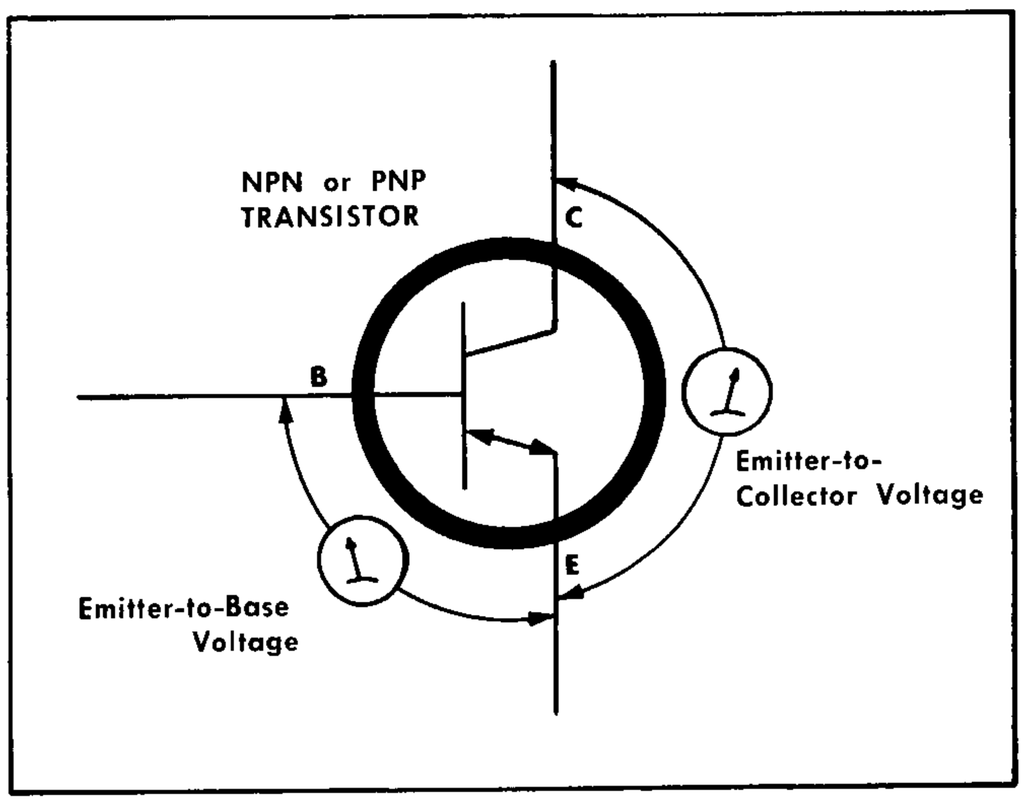


Fig. 4-1. In-circuit voltage checks NPN or PNP transistors.

Parts Removal and Replacement

Transistor Replacement. Transistors should not be replaced unless they are actually defective. Transistor defects usually take the form of the transistor opening, shorting or developing excessive leakage. To check a transistor for these and other defects, use a transistor curve display instrument such as a Tektronix Type 575. However, if a good transistor checker is not readily available, a defective transistor can be found by making in-circuit voltage checks, or by substitution. Transistor circuit numbers are screened on the circuit board next to the pin sockets which are fabricated as part of the circuit board.

To check transistors using a voltmeter, measure the emitter-to-base and emitter-to-collector voltages and determine if the voltages are consistent with the normal resistances and currents in the circuit (see Fig. 4-1). Note the lead configuration in Fig. 4-2.

If there is doubt about whether the transistor is good or not, substitute a new transistor, but first be certain the circuit voltages applied to the transistor are correct before making the substitution. If a transistor is substituted without first checking out the circuit, the new transisor may immediately be damaged by some defect in the circuit.

Parts Replacement. To replace parts soldered to the circuit board, clip the leads of the component, remove the component and then remove the clipped leads individually.

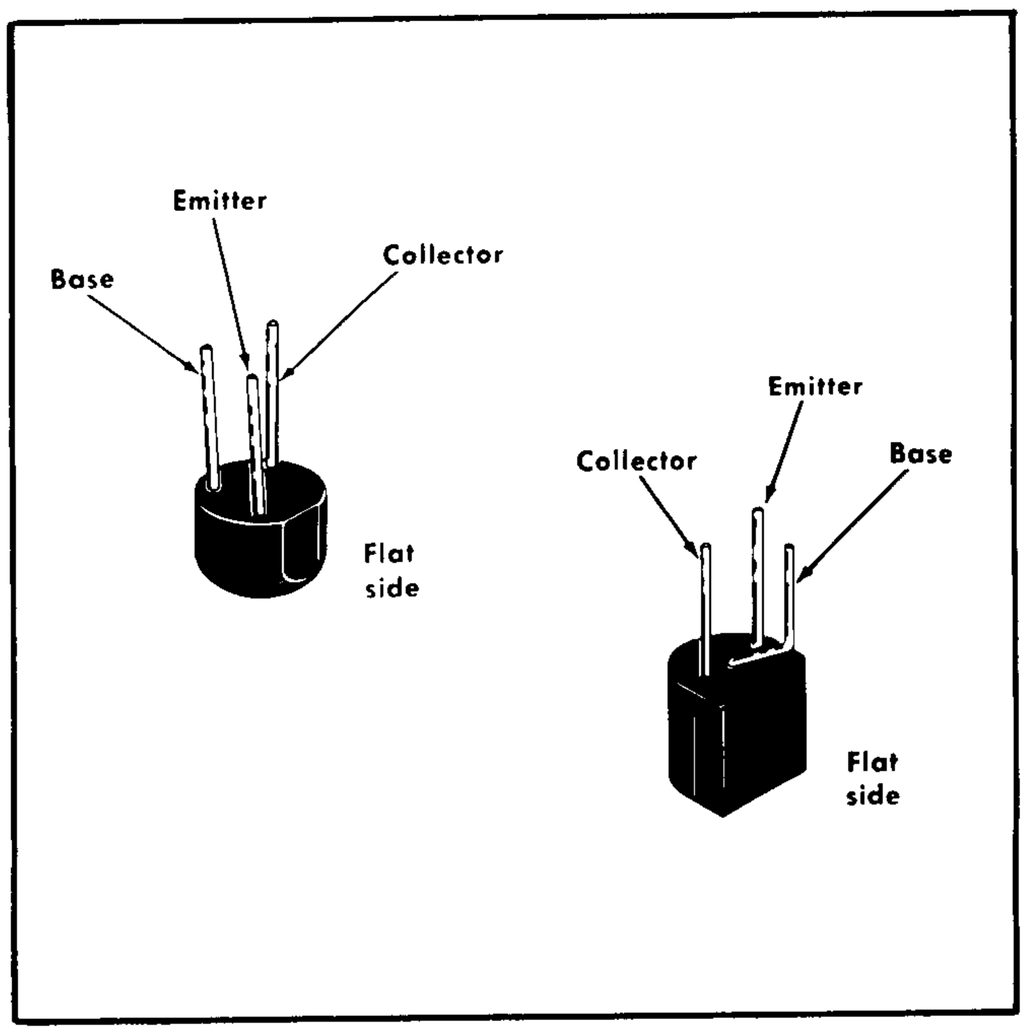
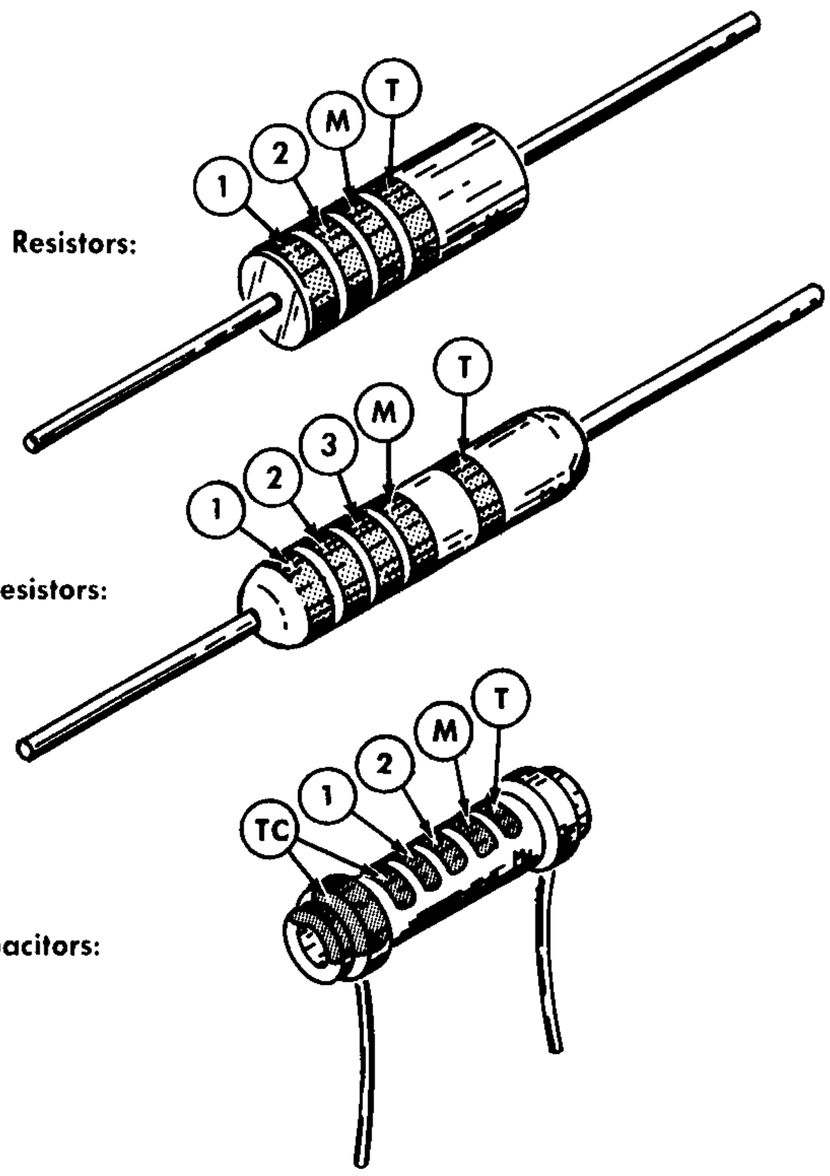


Fig. 4-2. Lead configuration of transistors in the Type S-50.



1 2 and 3 —1st, 2nd and 3rd significant figures;

M —multiplier; T —tolerance;

TC —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier: Resistors	Multiplier: Capacitors	Tolerance: Resistors	Tolerance: Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% —0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% —20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

NOTE: T and/or TC color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-3. Resistors and ceramic capacitor color-code.

NOTE

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.

Install the new part, with leads bent to fit the holes and clipped so they will just protrude through the board; apply heat and solder for a firm solder joint.

The soldering iron tip should be of copper with a chisel or bevel shape. To obtain a low working-tip temperature, consider the following:

1. At slow soldering speeds, a 25-watt iron and 1/8 inch tip.

2. At medium soldering speeds, a 40-watt iron and a 3/16 inch tip.

3. At fast soldering speeds, a 50- or 60-watt iron and a 1/4 inch tip.

The best type of solder for use on the Tektronix circuit boards is a eutectic type cored wire solder of size #20 AWG, composed of 63% tin and 37% lead with a central core of activated resin flux.

Replacing Leadless capacitors. Use a small soldering iron with low heat to tin the capacitor. A silver coin at the edge will hold it in place. Tin the circuit board placement area.

Place the capacitor on the desired location and apply heat to the adjacent area, not to the capacitor directly. Apply light pressure with a toothpick or small wooden stick until the capacitor settles, indicating that the solder has melted underneath. Remove the heat and allow the area to cool.

Bend the wire(s) over the top of the capacitor, within approximately one lead diameter. Heat the wire and apply solder until the solder wicks down onto the top of the capacitor. Remove the soldering iron and allow the lead to settle.

Resistor Coding and Capacitor Marking

Fig. 4-3 shows the color-coding sequence of the resistors and ceramic capacitors used in the Type S-50.

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 Driver Board is removed by gently pulling outward from the Pulser Board. For replacement, align the connector and the pin contacts and ease the board into position. The pin connectors should not protrude beyond the clamps.

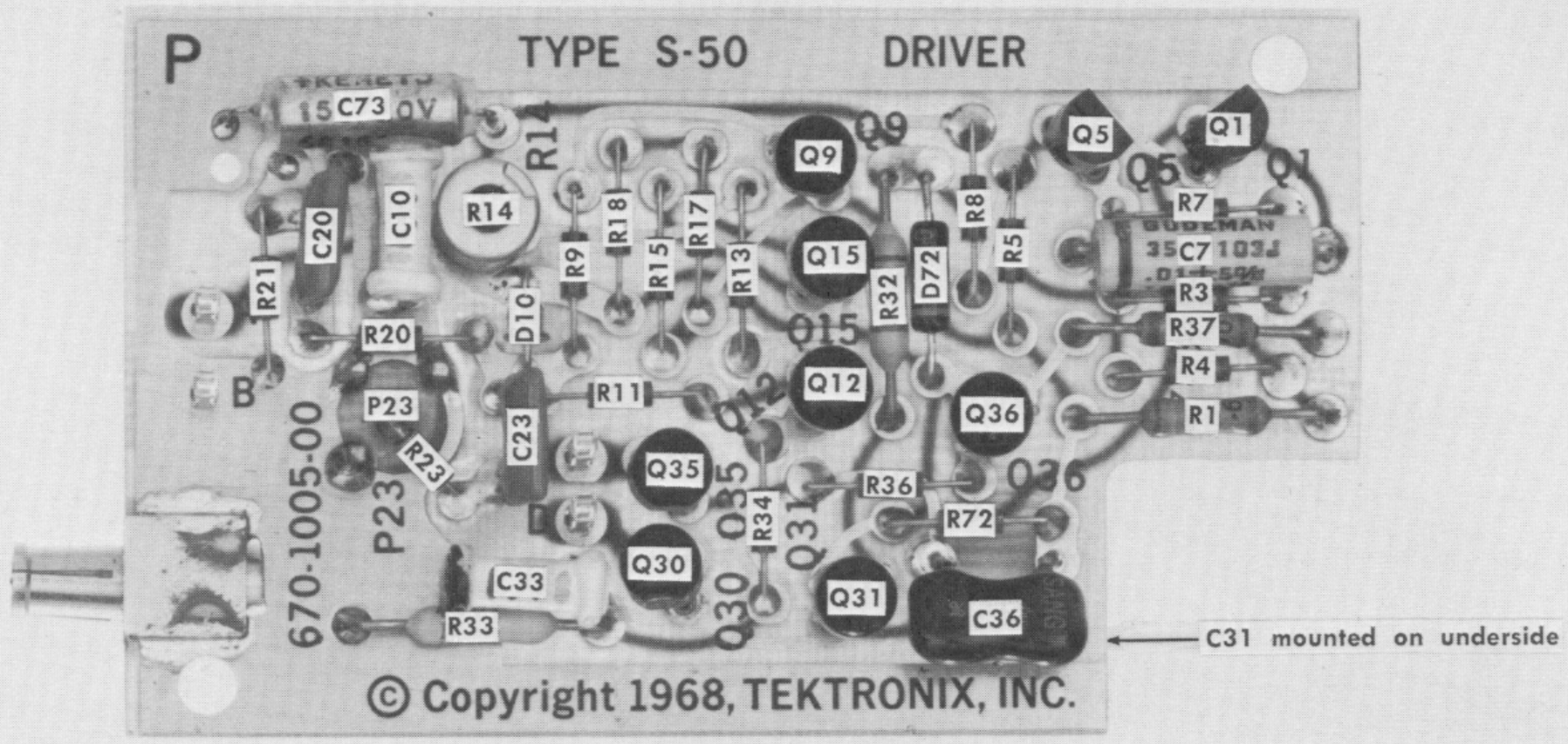


Fig. 4-4. Driver circuit board.

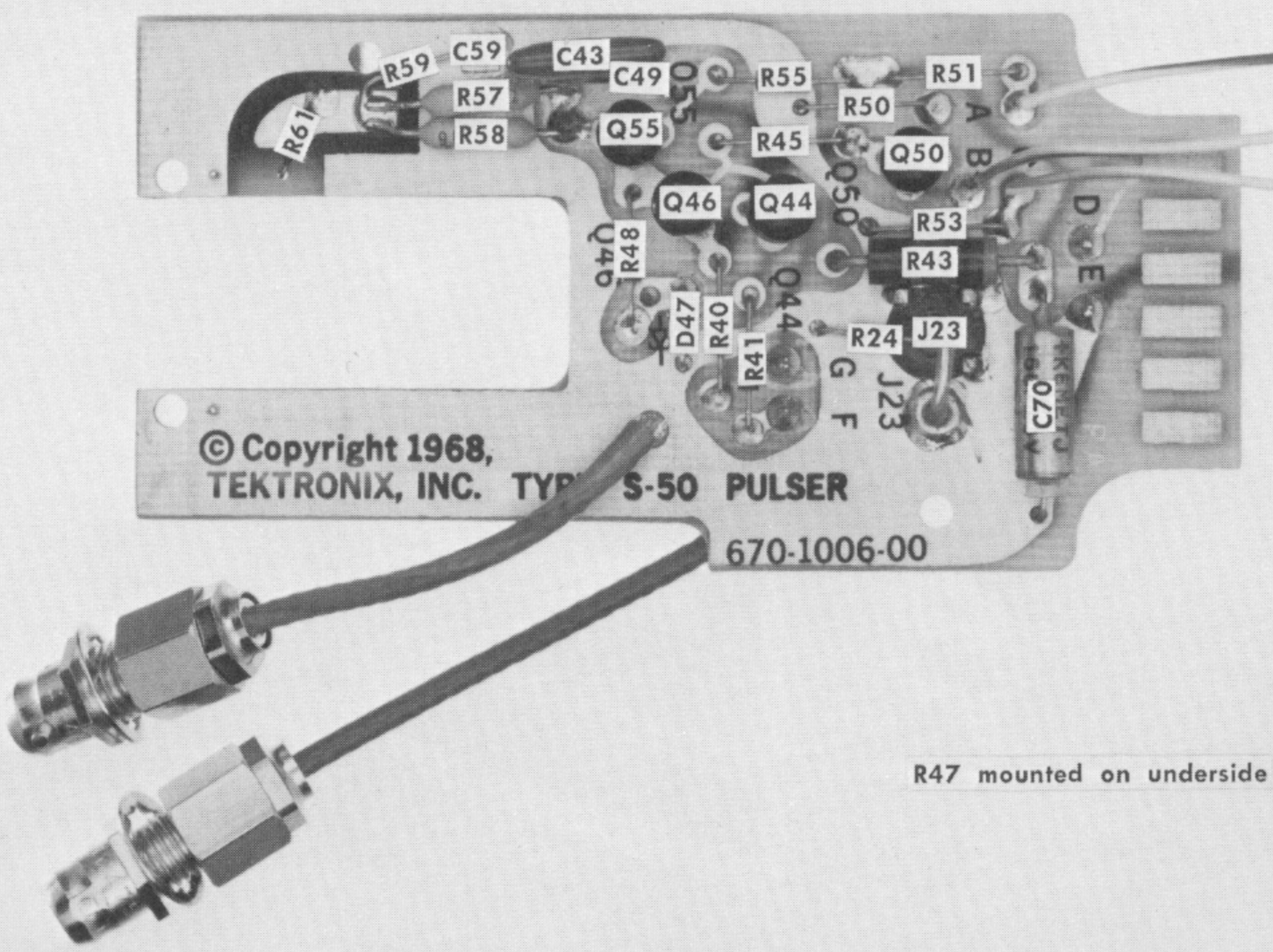


Fig. 4-5. Pulser circuit board.

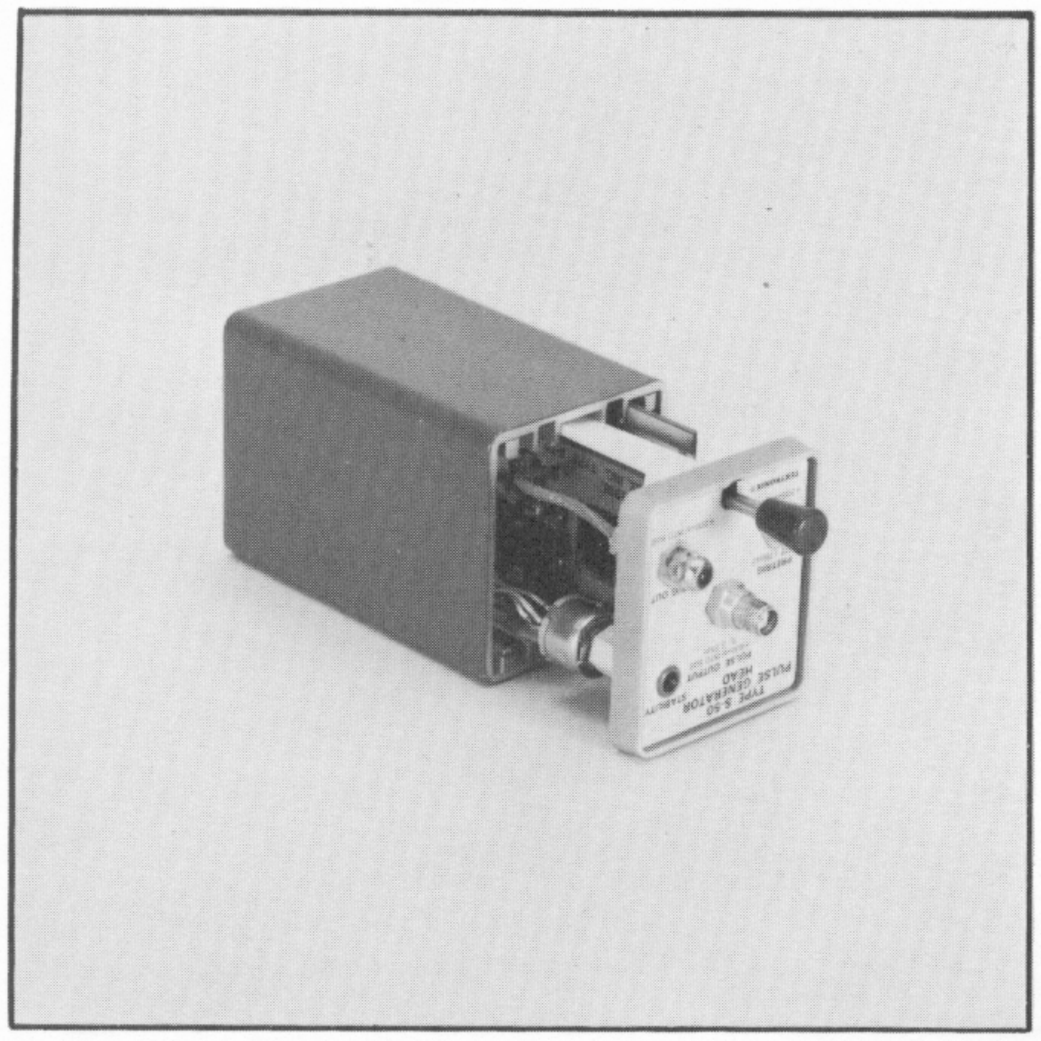


Fig. 4-6. Correct board and latch positions when re-installing the Type S-50 case.

Remove the Pulser Board as follows:

1. Remove the nut on the Pulse Output connector with a $^5/_{16}$ inch wrench. DO NOT LOOSEN THE PULSE OUTPUT CONNECTOR. The Pulser board is now held by wires connected to the trigger connectors and the stability control.

2. Unsolder the wires to the potentiometer and remove the trigger output connectors with a $^9/_{32}$ inch wrench.

3. Remove the Pulser board with the tunnel diode holder mounting attached.

4. Remove the tunnel diode holder mounting by first unsoldering the fine wire at the end of R61 and removing the Allen head screws with a $^3/_{64}$ inch Allen wrench.

5. Lift the mounting away from the Pulser board with the Pulse Output connector attached.

The tunnel diode, D61, is removable with only the Driver Board removed. Unscrew the knurled knob, which holds a spring and the tunnel diode D61, and lift it from the mounting.

NOTE

The tunnel diode, D61, is very small and expensive. Hold the assembly over the work area, preferably a light background, to minimize the possibility of loss or damage by accidental dropping of the holder. Always set the Stability control fully counterclockwise before operation of a new tunnel diode.

Place the mounting on the Pulser Board so the hexagonal nuts can be properly installed. Place the front panel slot on the Pulser Board with correct alignment of the Pulse Output connector with the tunnel diode holder mounting. Tighten the threaded nut on the Pulse Output connector with a $^5/_{16}$ inch wrench to approximately 15 inch-pounds. Replace the Driver Board.

Parts Locations

All components mounted on circuit boards are identified by circuit numbers as shown in Fig. 4-4 and Fig. 4-5.

Case Replacement

Align the case body so the hole in the side will appear over the Leadtime control, R14, located on the left side. Check that the upper and lower corners of the Driver Board is aligned with the channel containing the zigzag spring. Push the case body forward until it contacts the front panel. Be sure that the white plastic pawl on the locking knob is properly aligned as the Head is slid into the case. Attach the rear casting so the hole is over the Trigger Takeoff connector. Insert the four long mounting bolts and tighten them securely. Check that the Pulser Board is centered in the rear casting opening so the Type S-50 can be properly inserted into the sampling unit or Type 285 Power Supply.

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-50 Pulse Generator Head can be checked using the steps of this procedure which are headed in the type face used in step 2. Failure to meet the requirement given in any check indicates the need for adjustment or repair. Calibration is headed by the type face in step 1.

EQUIPMENT REQUIRED

The equipment listed below or its equivalent is required for a complete performance check and calibration of the Type S-50 Pulse Generator Head, see Fig. 5-1. Equipment specifications given are the minimum necessary for the particular use of each item. All test equipment must meet or exceed the limits stated below.

All equipment items listed can be obtained by ordering through your local Tektronix Field Engineer or Representative.

1. Oscilloscope, with proper sampling plug-in units, such as a Type 561B Oscilloscope with Type 3S2 Sampling Unit and Type 3T2 Random Sampling Sweep.

2. Sampling Head; Type S-4 with 25 ps risetime is recommended.

3. Pulse generator for pulse flatness deviation reference; Tektronix Type 284 Pulse Generator with pulse output of a 70 ps risetime and maximum 3% pulse flatness deviation is recommended.

4. Signal delay coaxial cable, impedance, 50 Ω; delay, 60 ns; connectors, GR874. Tektronix Type 113 Delay Cable is recommended.

5. Flexible extender cable for operating either the Type S-50 or Type S-4 outside the sampling unit; Tektronix Part No. 012-0124-00.

6. Power supply, with access to rear panel Pretrigger Out connector. Tektronix Type 285 Power Supply recommended.

7. One 42-inch coaxial cable with BNC connectors; characteristic impedance approximately 50 ohms. Tektronix Part No. 012-0057-01.

8. One 3 mm coaxial cable, 2 ns delay. Tektronix Part No. 015-1005-00.

9. Solid coaxial line with 3 mm connectors, Tektronix Part No. 015-1005-00.

10. One 7-inch coaxial cable, type RG58, with BNC to BSM connectors. Tektronix Part No. 012-0128-00.

11. One 18-inch coaxial cable, type RG58, with BNC to BSM connectors. Tektronix Part No. 012-0127-00.

12. Adapter, 3 mm male to GR874, Tektronix Part No. 015-1007-00.

13. Adapter, 3 mm female to GR874, Tektronix Part No. 015-1008-00.

14. Adapter, BNC female to GR874, Tektronix Part No. 017-0063-00.

15. Two adapters, BNC female to 3 mm male, Omni Spectra No. O/S 21190.

16. Adapter, BNC female to BSM male, Tektronix Part No. 103-0036-00.

17. Pocket screwdriver with shank at least 2 inches long and a blade width of approximately 3/32 inch. Tektronix Part No. 003-0192-00.

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-50 Pulse Generator 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-50, Serial No. _____

Performance Check Date _____

Performed By _____

☐ 1. Adjust Stability, R52. (Page 5-4)

☐ 2. Check Pretrigger to Pulse Time Interval. (Page 5-5)

☐ 3. Adjust Leadtime, R14. (Page 5-5)

☐ 4. Check Pulse Duration. (Page 5-5)

☐ 5. Check Pulse Repetition Rate. (Page 5-5)

☐ 6. Check Pulse Amplitude into 50 Ω. (Page 5-6)

☐ 7. Check Pulse Risetime. (Page 5-6)

☐ 8. Check Pulse Flatness Deviation. (Page 5-7)

☐ 9. Check Pretrigger Pulse Duration. (Page 5-7)

☐ 10. Check Pretrigger Pulse Amplitude. (Page 5-8)

☐ 11. Check Pretrigger Pulse Risetime. (Page 5-8)

☐ 12. Check Pretrigger to Pulse Jitter. (Page 5-9)

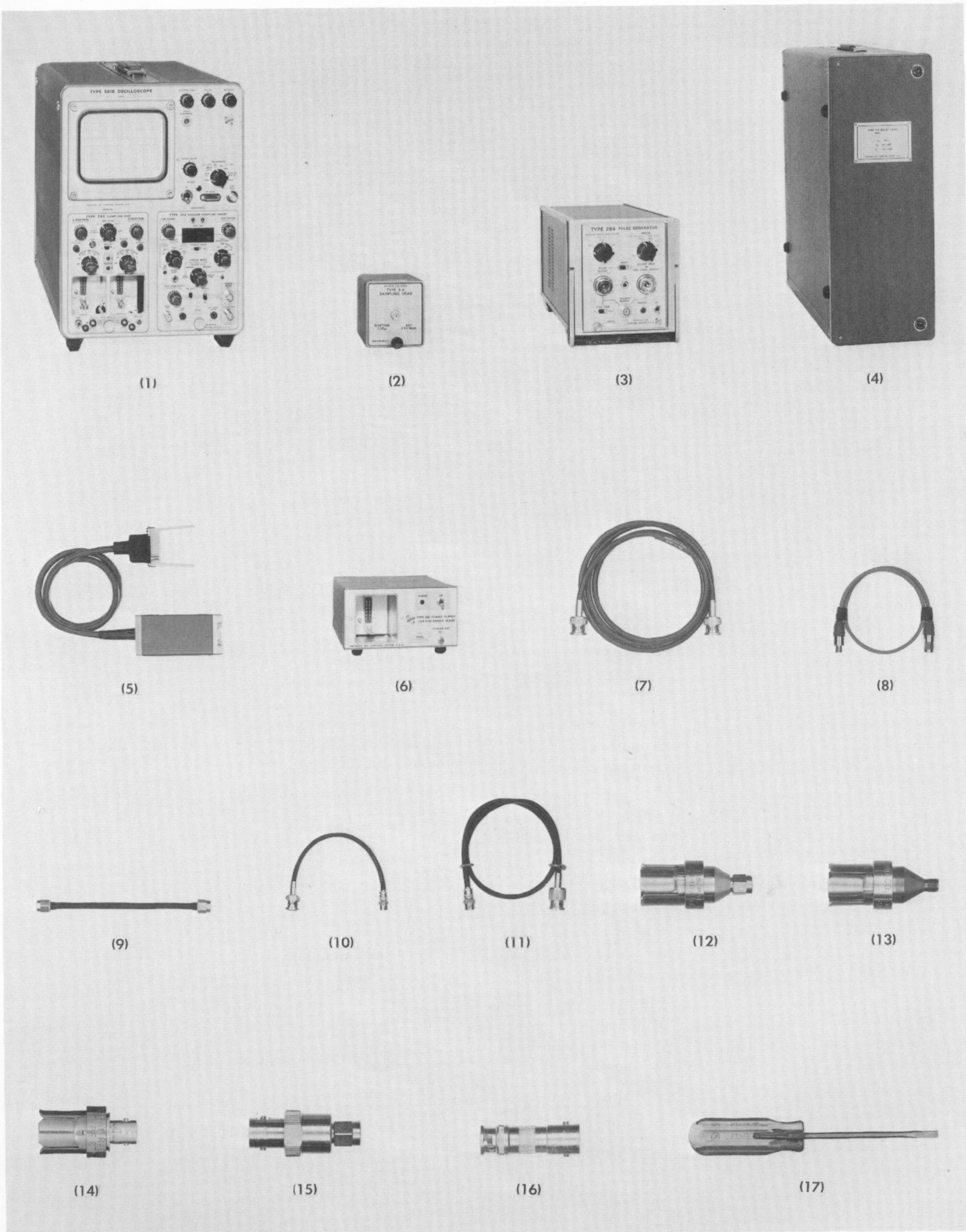


Fig. 5-1. Equipment required for performance check and calibration.

- ☐ 13. Check Pretrigger Pulse Duration (Rear Panel). (Page 5-9)
- ☐ 14. Check Pretrigger Pulse Amplitude (Rear Panel). (Page 5-10)
- ☐ 15. Check Pretrigger Pulse Risetime (Rear Panel). (Page 5-10)
- ☐ 16. Check Trigger Pulse Amplitude into 50 Ω. (Page 5-10)
- ☐ 17. Check Trigger Pulse Risetime. (Page 5-10)
- ☐ 18. Check Trigger Pulse Duration. (Page 5-10)
- ☐ 19. Check Pulse Output to Trigger Output Time Interval. (Page 5-10)

PRELIMINARY PROCEDURE

Install the sampling unit into the left compartment of the oscilloscope and the sampling sweep unit into the right compartment. Place the Type S-4 Sampling Head in the Channel A compartment of the sampling unit and place the extender in the Channel B compartment. Connect the Type S-50 to the extender.

Set the controls as listed following Fig. 5-2. Adjustments are accessible without removing the case.

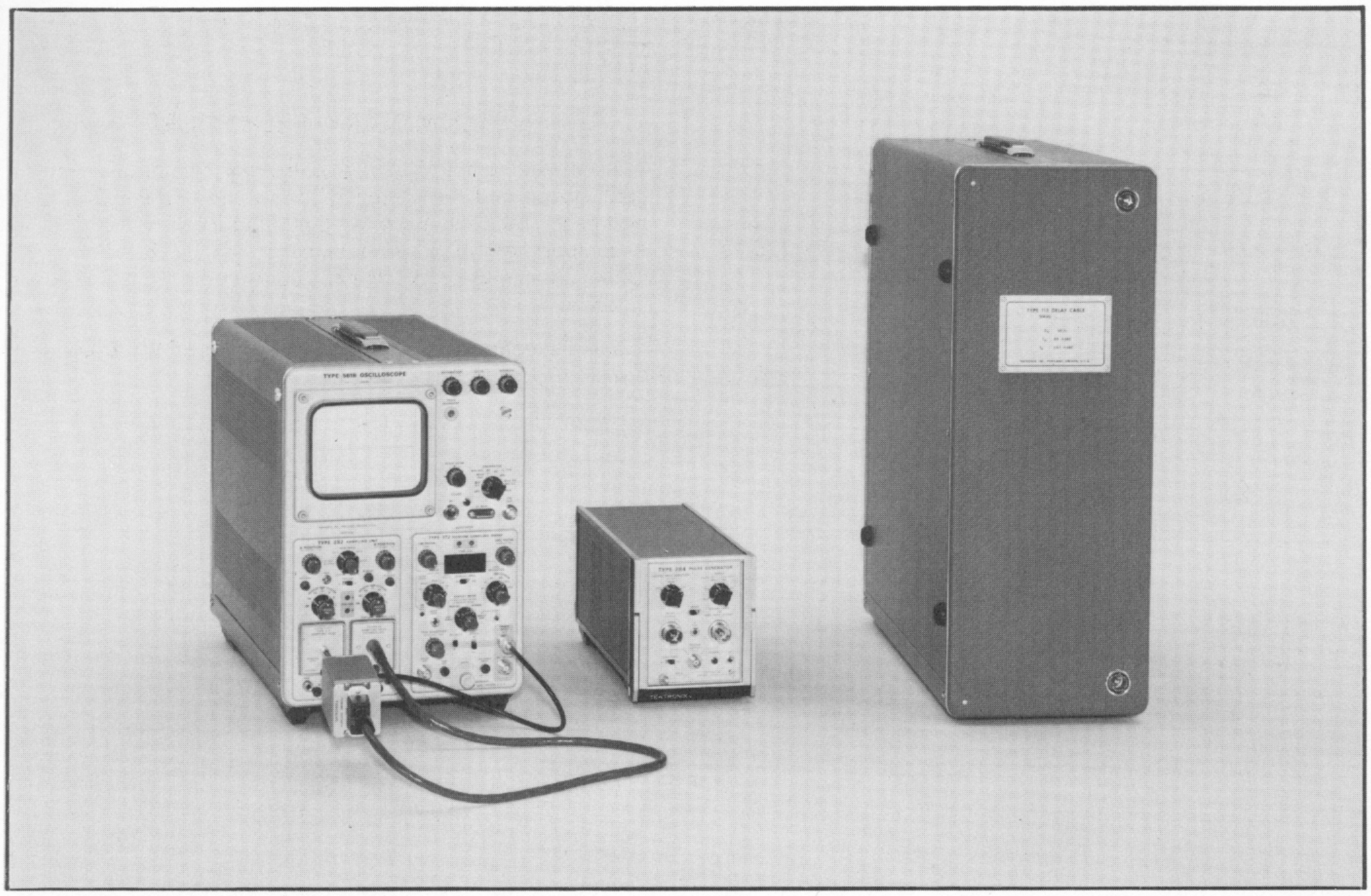


Fig. 5-2. Initial equipment setup.

Sampling Unit (Both Channels)

Mode Switch	CH A
Dot Response	Midrange
Units/Div	100
Trig Out	B
Variable	Cal
Invert	Pushed in
Position	Midrange
DC Offset	0 volts at Offset Out
Internal Horiz Plug-In Compatibility	Sampling

Sampling Sweep Unit

Display Mode	Normal
Start Point	With Trigger
Time/Div	1 ns
Range	100 ns
Time Magnifier	×10
Variable	Cal
Display Mag	×1
Time Position controls	Fully clockwise
Horiz Position	Midrange
Trig Sensitivity	Stable Display
Recovery Time	Optional
Trigger Polarity	+
Trigger Source	Ext
Samples/Div	100, Dot at 9 o'clock

Type 284

Mode	Pulse
Lead Time	75 ns
Other controls	Optional

PERFORMANCE CHECK AND CALIBRATION PROCEDURE

1. Adjust Stability Control, R14

a. Connect the Pulse Output connector to the solid coaxial line with 3 mm connectors and to the Type S-4 Input connector. Connect the Pretrig Out connector to a BNC to BSM coaxial and to the sampling sweep unit 50 Ω Trigger Input connector. The equipment setup is shown in Fig. 5-2.

b. Initially set the STABILITY control fully counterclockwise and observe that the fast rise portion of the pulse is absent.

c. Turn the STABILITY control clockwise through the following displays;

(1) Appearance of the fast rise portion with a less than tolerance pulse width,

(2) Fast rise portion moves to the left to position at the top of the slow rising portion, note this position,

(3) Continue clockwise rotation to move the fast rise portion ½ to 1 ns to the left of the position noted in (2).

d. Disconnect the Type S-50 from the Type S-4. Remove the extender and install the Type S-50 into the sampling unit.

2. Check Pretrigger to Pulse Time Interval

Requirement—Pretrigger must lead the pulse by 75 ns within 5 ns.

a. Connect the 3 mm to BNC female adapter to the Pulse Output connector and the BSM to BNC adapter to the Pretrig Out connector.

b. Connect a BNC coaxial cable from the Pretrig Out adapter to a BNC to 3 mm adapter and the Type S-4 Input connector. Connect a BSM to BNC cable from the sampling unit Trig Out connector to the sampling sweep unit 50 Ω Trigger Input connector.

c. Set the sampling sweep unit for a sweep rate of 10 ns/div (Time Multiplier switch to ×1) and the Start Point switch to Before Trigger. Use the Time Position controls to position the rising portion of the pulse at the left edge of the graticule.

d. Move the BNC coaxial cable from the Pretrig Out adapter to the Pulse Output adapter.

e. Check that the position of the rising portion of the Pulse Output is between 7 and 8 divisions from the left edge of the graticule, 75 ns within 5 ns. Fig. 5-3 is a double exposure for this measurement.

f. If the leadtime is not between 70 and 80 ns, perform step 3.

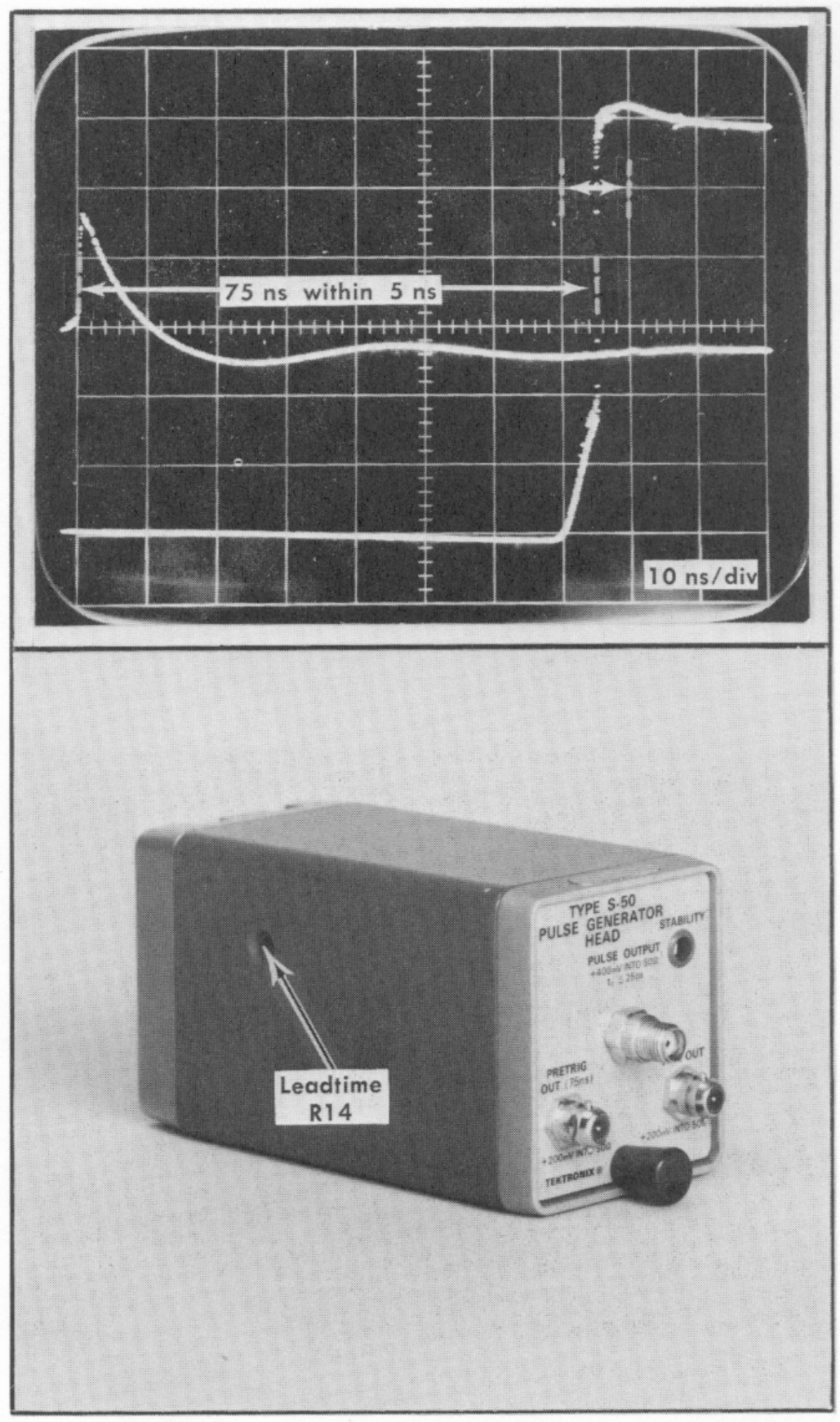


Fig. 5-3. Pretrigger to Pulse time interval and adjustment.

3. Adjust Leadtime, R14

a. Remove the Type S-50 from the sampling unit and install the extender. Connect the Type S-50 onto the extender.

b. Use the method described in step 2. If the position of the Pulse Output is not between 7 and 8 divisions from the reference Pretrigger Out pulse at the left edge of the graticule, adjust Leadtime, R14, located under the case hole on the left side, to position the Pulse Output pulse 75 ns from the Pretrigger Out pulse.

4. Check Pulse Duration

Requirement—Pulse duration at 50% amplitude point must be 100 ns, —0%, +20%.

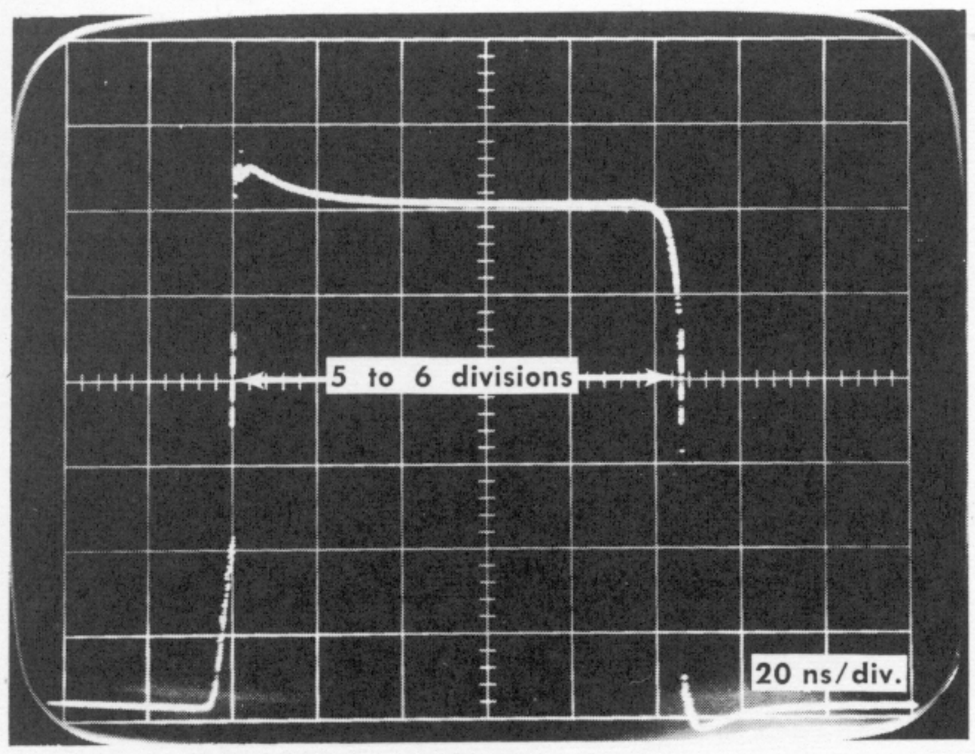
a. Connect the Pulse Output connector to the solid coaxial line with 3 mm connectors and to the Type S-4 Input connector. Connect the Pretrig Out connector to a BNC to BSM coaxial cable and to the sampling sweep unit 50 Ω Trigger Input connector. The equipment setup is shown in Fig. 5-2.

b. Set the sampling sweep unit sweep rate to 20 ns/div (Range switch to 1 μs and Time Multiplier to ×5).

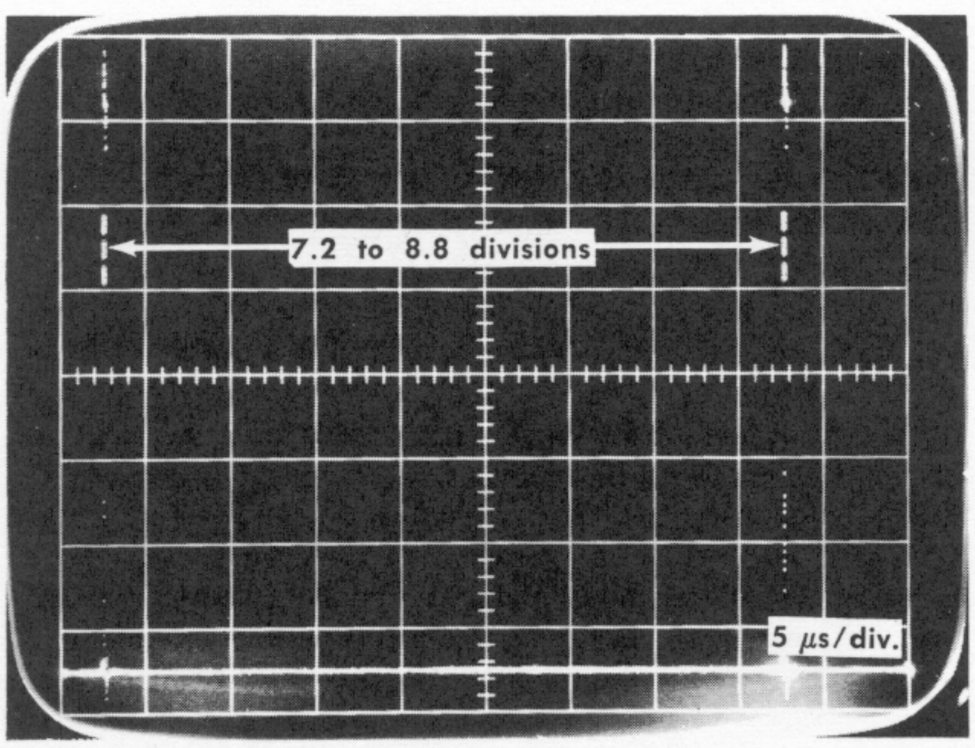
c. Center the display with the sampling unit Position control and check that the pulse duration at the 50% amplitude point is between 5 and 6 divisions (100 ns, —0%, +20%). See Fig. 5-4A.

5. Check Pulse Repetition Rate

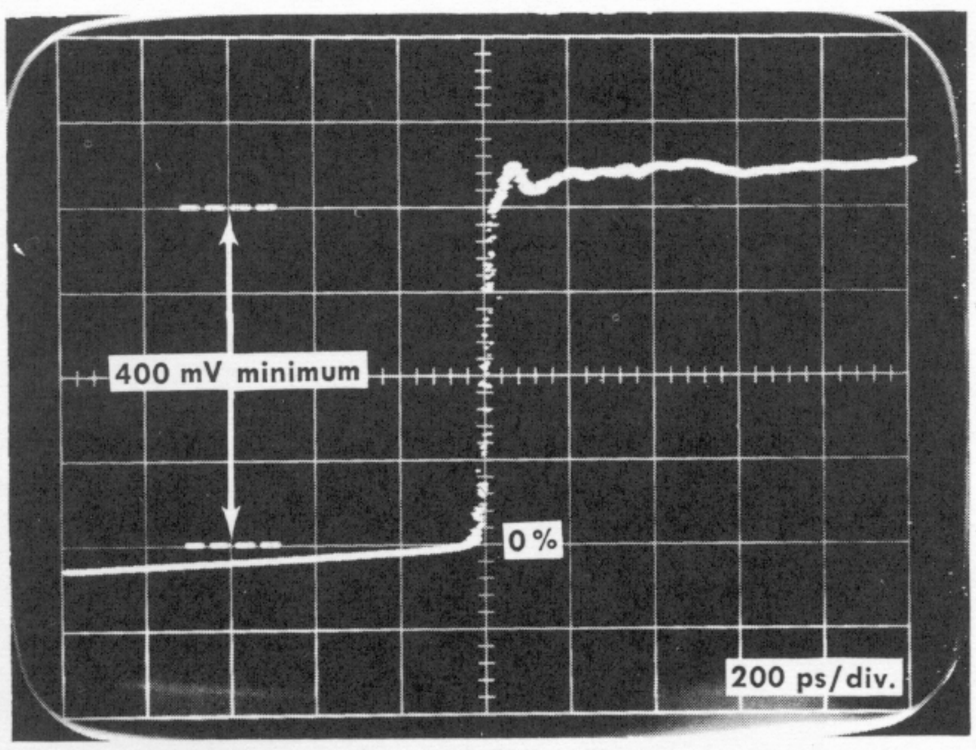
Requirement—Repetition rate must be 25 kHz within 10%.



(A) Pulse duration.



(B) Pulse repetition rate.



(C) Pulse amplitude.

Fig. 5-4. Typical displays for checking Pulse Output.

a. Set the sampling sweep unit sweep rate to 5 μs/div (Range switch to 100 μs and Time Magnifier to ×2). Set the Display Mode switch to Manual and use the Manual Scan control to measure the time between positive going pulses.

b. Check that time between pulses is between 36 μs and 44 μs (7.2 and 8.8 divisions) or 25 kHz within 10%. See Fig. 5-4B.

c. Set the sampling sweep unit Display Mode switch to Normal.

6. Check Pulse Amplitude into 50 Ω

Requirement—Amplitude must be 400 mV or more, positive going, into 50 Ω.

a. Set the sampling sweep unit Start Point to With Trigger and the sweep rate to 200 ps (Range switch to 100 ns and Time Magnifier switch to ×50).

b. Measure the amplitude of the pulse from the 0% level to the 100% level.

c. Check that the amplitude is 400 mV or more (at least 4 divisions). See Fig. 5-4C.

7. Check Pulse Risetime

Requirement—The 10% to 90% risetime is equal to or less than 25 ps, displayed as 35 ps or less using the Type S-4 Sampling Head.

Risetime measurement requires either a camera or a storage oscilloscope because the dot density must be increased for an accurate display and the sweep becomes too slow for visual interpretation.

a. Set the sampling sweep unit for a 20 ps/div sweep rate (Range switch to 100 ns, Time Magnifier switch to ×50 and the Display Mag switch to ×10). Center the rising portion of the pulse on the graticule and obtain at least 100 dots per division. Photograph or store the display.

b. Measure the risetime as follows:

(1) Mark reference points at maximum rate of change, the break points shown in Fig. 5-5.

(2) Mark the centers of the 0% zone and 100% zone, 35 ps wide (the specified system risetime) and 35 ps from reference break points, shown in Fig. 5-5.

(3) Mark the average level of the 0% and 100% zones through the centers of the zones.

(4) Mark the 10% and 90% points in relation to the 0% and 100% average levels.

(5) Measure the risetime between the 10% and 90% points.

c. Check that the risetime is 35 ps or less.

d. Use the same setup for the pulse flatness deviation check.

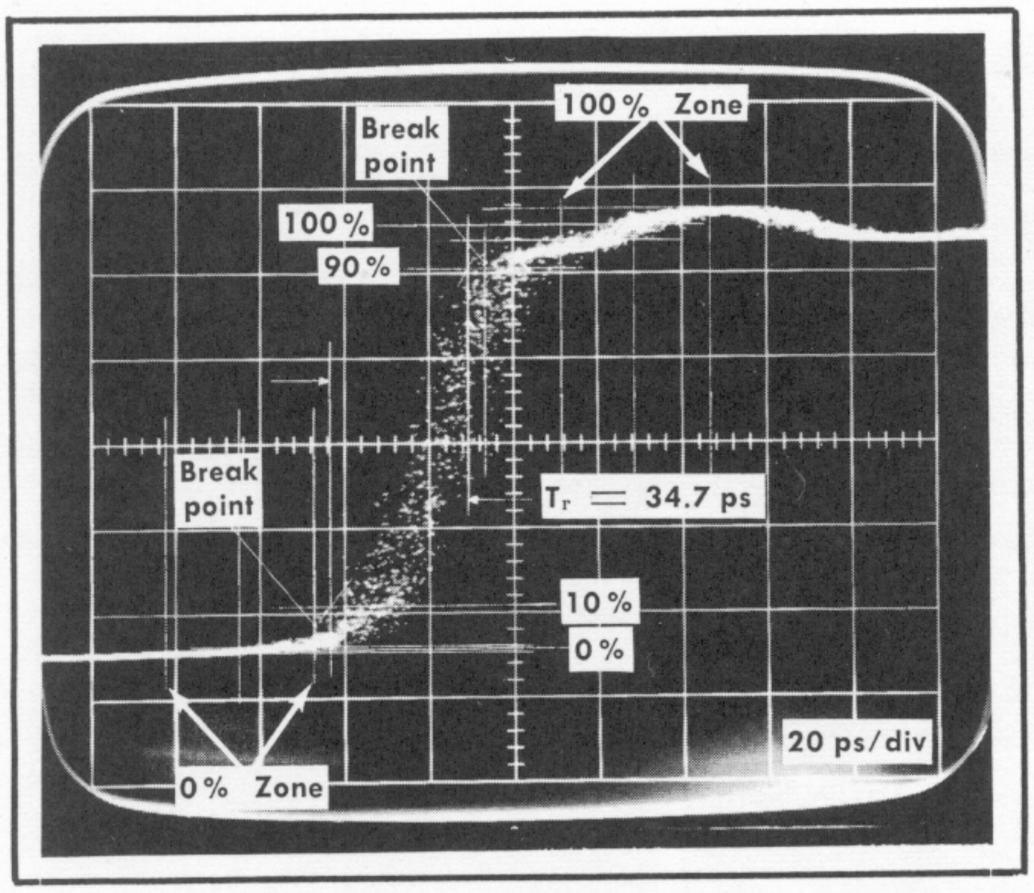


Fig. 5-5. Combination of Type S-50 and Type S-4 risetime measurement.

8. Check Pulse Flatness Deviation

Requirement—Pulse will deviate from the flat;

First 400 ps after step, +10%, —10% or less, total of 20% peak to peak;

Between 400 ps and 5 ns after step, +5%, —5% or less, total of 5% peak to peak;

Between 5 ns and 100 ns after step, +2%, —2% or less, total of 4% peak to peak.

The Type 284 is used to determine pulse flatness deviation present in the Type S-4 Sampling Head from 400 ps to 100 ns.

The double exposure pictures of Fig. 5-6 are provided to show a comparison of the pulse flatness deviation characteristics of the Type S-50 and the Type 284 with the same sampling unit. Pulse flatness deviations of the Type S-50 are seen as changes in separation between the Type 284 waveform and the Type S-50 waveform. This method requires either a camera for double exposures, or a storage oscilloscope in order to make valid comparisons.

a. Use the same setup as in step 7 and set the 100% zone on a graticule line. Change the sampling sweep unit sweep rate to 50 ps/div (Time Magnifier switch to ×20) and Time Position the display so the 90% amplitude point is near the first division on the graticule.

b. Check that the pulse does not deviate from the 100% level more than +10% or —10% or a total of 20% (10% is about a half division) during the first 400 ps, see Fig. 5-6A.

c. Set the sampling sweep unit for a 10 ns/div sweep rate (Display Mag switch to ×1 and the Time Magnifier switch to ×1) and obtain a stable display.

d. Set the sampling unit Variable Units/Div control so the 0% to 100% levels of the pulse are 5 divisions apart, *20% per division*, (the 100% level is about 80 ns from the rising portion of the pulse).

e. Change the Units/Div switch (without moving the Variable control) to 20. Each vertical division represents 4% of the total display height. Set the sampling sweep unit sweep rate to 500 ps/div (Time Magnifier switch to ×20).

Use the DC Offset control to vertically place the pulse at a reference on the graticule and the sampling sweep unit Time Position controls for horizontal placement. (This display must be retained for reference either by storage on a storage oscilloscope, or by photograph which is not developed until a second waveform is also exposed. Remember the location on the graticule). This completes obtaining the Type S-50 waveform for the 400 ps through 5 ns interval.

f. Remove the Type S-50 and the BNC to BSM cable. Connect the Type 284 Pulse Output connector to the Type S-4 Input connector through a 3 mm to GR adapter and the solid coaxial 3 mm line.

g. Connect the Type 284 Trigger Output to the sampling sweep unit 50 Ω Trigger Input connector with a BNC coaxial cable.

h. Set the sampling unit Units/Div switch at 50, the sampling sweep unit for a 10 ns/div sweep (Time Magnifier switch to ×1) and obtain a stable display. Set the sampling unit Variable Units/Div control for a display amplitude equal to the Type S-50 pulse amplitude including the step preceeding the fast pulse, see Fig. 5-6B.

i. Change the Units/Div switch (without moving the Variable control) to 10 and place the display near the stored Type S-50 display, using only the DC Offset control. Change the sweep rate to 500 ps (Time Magnifier switch to ×20) and Time Position the display at the same horizontal placement as the Type S-50. Expose the waveform and develop the photograph. Determine the separation differences between the two waveforms. This is the percentage of pulse flatness deviation for the Type S-50 Pulse Generator Head and should not exceed +5%, —5% or total 5% peak to peak.

j. Change the sampling sweep unit for a sweep rate of 10 ns/div (Time Magnifier switch to ×1) and repeat the procedure to determine the pulse flatness deviation from 5 ns through 100 ns, for a deviation not more than +2%, —2%, or a total 4% peak to peak. Maintain the 10 ns/div sweep rate.

k. Disconnect the Type 284 from the Type S-4 and the sampling sweep unit.

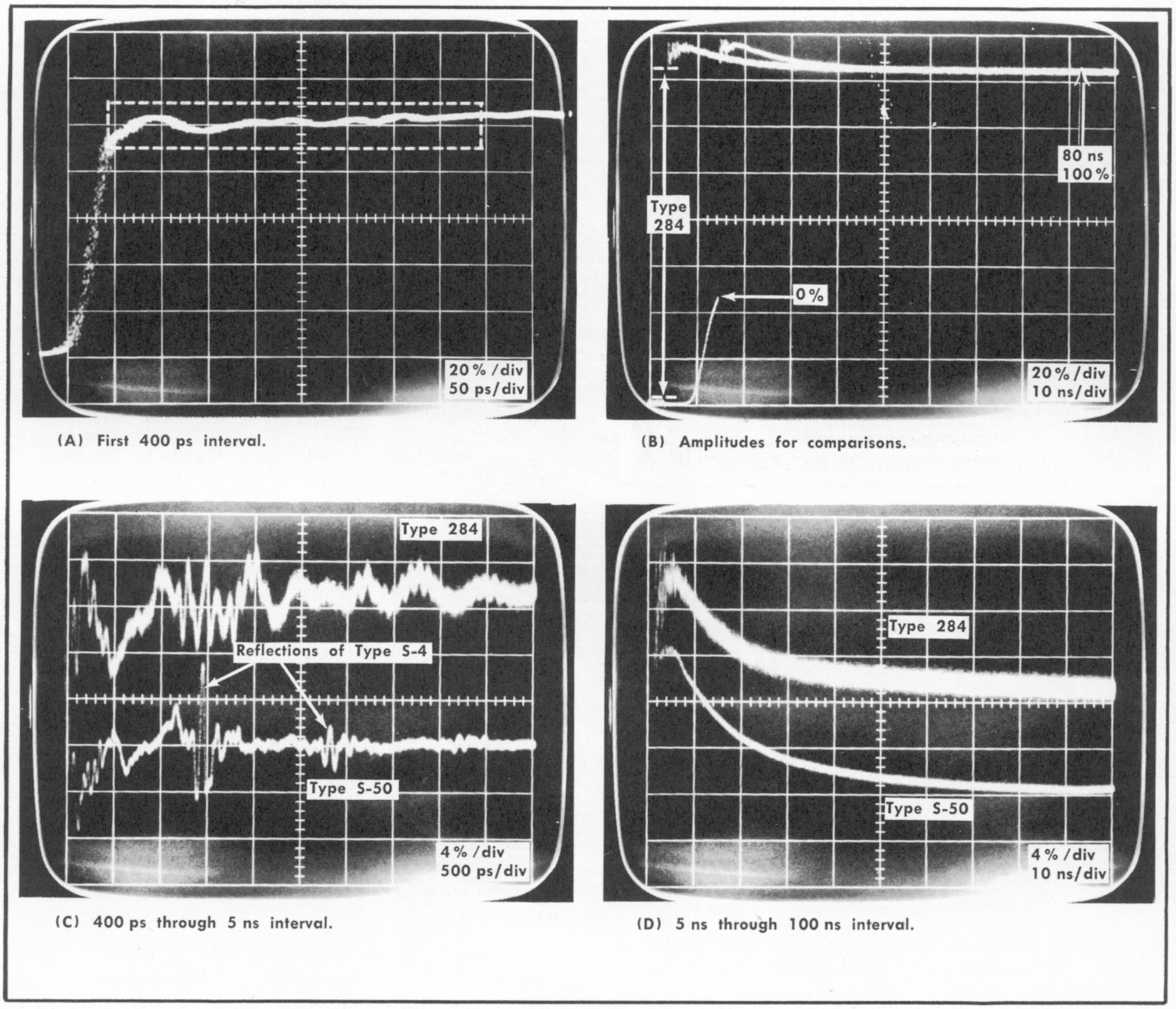
9. Check Pretrigger Pulse Duration

Requirement—Pulse duration must be 4 ns within 1 ns.

a. Remove the sampling head extender and install the Type S-50 in the Channel B compartment of the sampling unit.

b. Connect the Pretrig Out connector to a BNC to BSM cable, a BNC to 3 mm adapter and to the Type S-4 Input connector.

c. Connect a BNC to BSM cable from the sampling unit Trig Out connector to the sampling sweep unit 50 Ω Trigger Input connector.



(A) First 400 ps interval.

(B) Amplitudes for comparisons.

(C) 400 ps through 5 ns interval.

(D) 5 ns through 100 ns interval.

Fig. 5-6. Pulse flatness deviation check.

d. Set the sampling unit Units/Div switch to 50 and the Variable control to Cal.

e. Set the sampling sweep unit for a sweep rate of 2 ns/div (Range switch to 100 ns and Time Magnifier switch to ×5). Set the Start Point switch to Before Trigger and the Display Mag switch to ×1. Obtain a stable display.

f. Check that the pulse duration at the 50% amplitude points is between 3 and 5 ns. See Fig. 5-7.

10. Check Pretrigger Pulse Amplitude

Requirement—Amplitude must be 180 mV or more.

a. Measure the amplitude on the positive going portion from the preshoot to the maximum amplitude level, see Fig. 5-7.

b. Check that the amplitude is at least 180 mV.

11. Check Pretrigger Pulse Risetime

Requirement—Risetime must be 400 ps or less.

a. Set the sampling sweep unit sweep rate to 200 ps/div (Time Magnifier switch to ×50). Center the rising portion of the pulse with the Time Position controls.

b. Set the sampling unit Variable Units/Div control for an amplitude convenient to measure the risetime from the 10% to 90% levels.

c. Check that the 10% to 90% risetime is not more than 400 ps.

d. Set the Variable Units/Div control to Cal.

e. Disconnect the cable from the Pretrig Out connector to the Type S-4 Input connector.

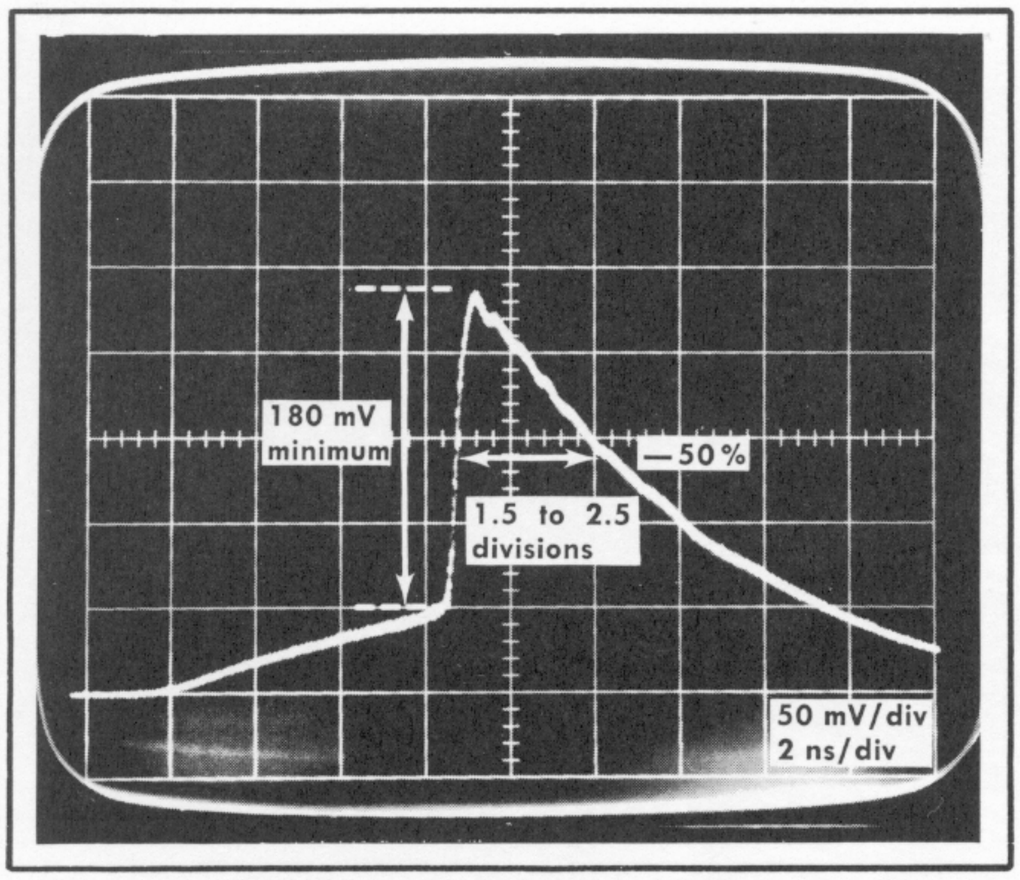


Fig. 5-7. Typical display for checking Pretrigger pulse duration and amplitude.

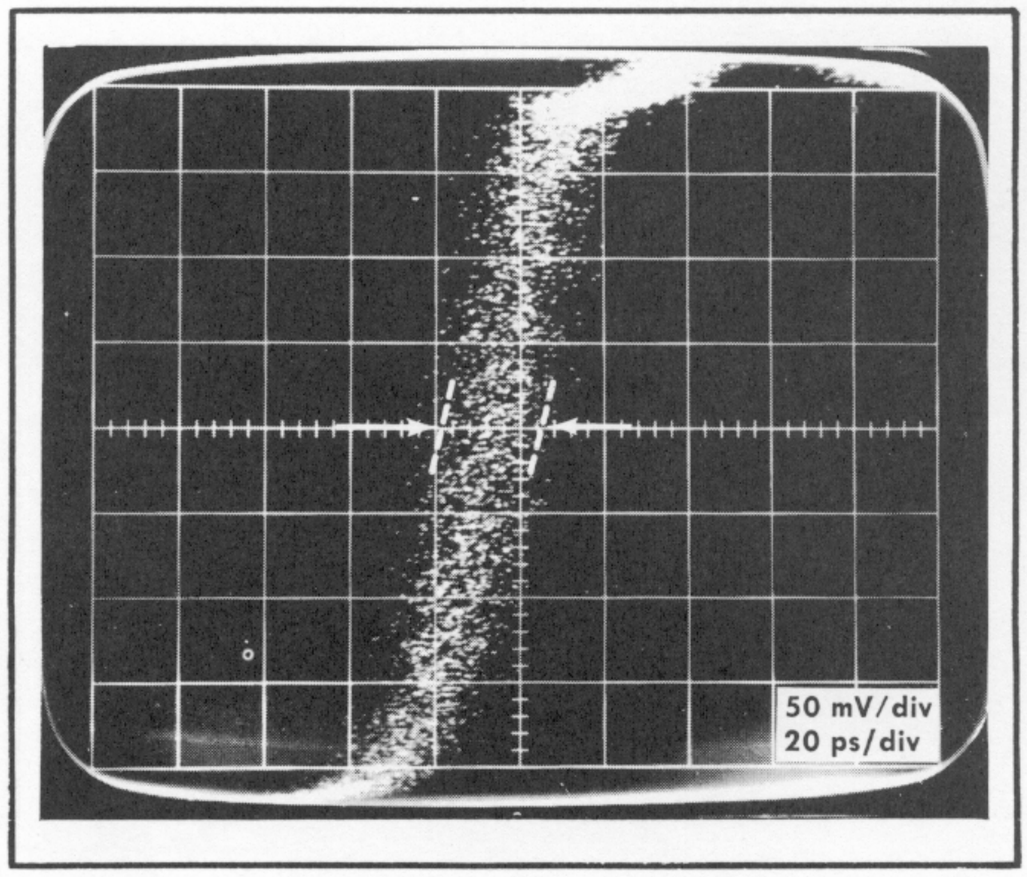


Fig. 5-8. Jitter measurement.

12. Check Pretrigger to Pulse Jitter

Requirement—Jitter must be 15 ps or less; will be 20 ps or less with the Type 3T2.

a. Remove the Type S-50 from the sampling unit and install the extender. Connect the Type S-50 to the extender.

b. Connect a BNC to BSM coaxial cable from the Type S-50 Pretrig Out connector to the sampling sweep unit 50 Ω Trigger Input connector. Connect the solid coaxial line with 3 mm connectors from the Pulse Output connector to the Type S-4 Input connector.

c. Set the Start Point switch to With Trigger and set the Trigger controls for a stable display. Set the Samples/Div control for the maximum number of dots and the Display Mag switch to ×10.

d. Determine the jitter by measuring 90% of the dot density on the rising portion, see Fig. 5-8.

e. Check that the jitter is not more than 20 ps as displayed with the Type 3T2 Random Sampling Sweep. Proceed to step 13.

If the jitter measurement is greater than 20 ps, note the measurement and determine the Type 3T2 jitter by the following method.

f. Disconnect the solid coaxial line and remove the Type S-50 from the extender. Do not distrub the sampling sweep unit trigger connection or controls.

g. Install the Type S-50 into the Type 285 Power Supply. Connect the Type 285 Triger Out to the Type S-4 Input connector through a BNC to BSM coaxial cable, a BNC to GR adapter, the 60 ns Delay Cable, a GR to 3 mm adapter and the 3 mm cable.

h. Set the sampling unit Units/Div switch to 5 and adjust the Variable Units/Div control to align the leading edge of the pulse on a 45° angle with the graticule lines.

i. Measure 90% of the horizontal dot density in terms of graticule divisions. Note this measurement (A).

j. Disconnect the cable from the Type 285 Trigger Out connector. Position the trace at the graticule center and measure 90% of the vertical dot density in graticule divisions. Note this measurement (B).

k. Calculate the Type 3T2 jitter with the following formula:

$$\text{Type 3T2 jitter} = \sqrt{A^2 - B^2} \times 20\text{ ps}$$

l. Calculate the Type S-50 jitter by the following formula:

$$\text{Type S-50 jitter} = \sqrt{\left(\begin{array}{c}\text{observed jitter}\\ \text{part e}\end{array}\right)^2 - \left(\begin{array}{c}\text{Type 3T2 jitter}\\ \text{part k}\end{array}\right)^2}$$

13. Check Pretrigger Pulse Duration (Rear Panel)

Requirement—Pulse duration must be 6 ns within 2 ns.

a. Disconnect the solid coaxial line and remove the Type S-50 from the extender. Install the Type S-50 into the Type 285 Power Supply.

b. Connect the Type 285 Trigger Out to the Type S-4 Input connector through a BNC to BSM coaxial cable and a BNC to 3 mm adapter.

c. Set the sampling unit Units/Div switch to 20 and the Variable Units/Div control to Cal.

d. Set the sampling sweep unit for a sweep rate of 2 ns/div (Range switch to 100 ns and Time Magnifier switch to ×5). Set the Samples/Div control to 9 o'clock, 100 dots per division. Set the Start Point switch to Before Trigger and the Display Mag switch to ×1. Obtain a stable display.

e. Check that the pulse duration at the 50% amplitude points is between 4 and 8 ns, 2 to 4 divisions.

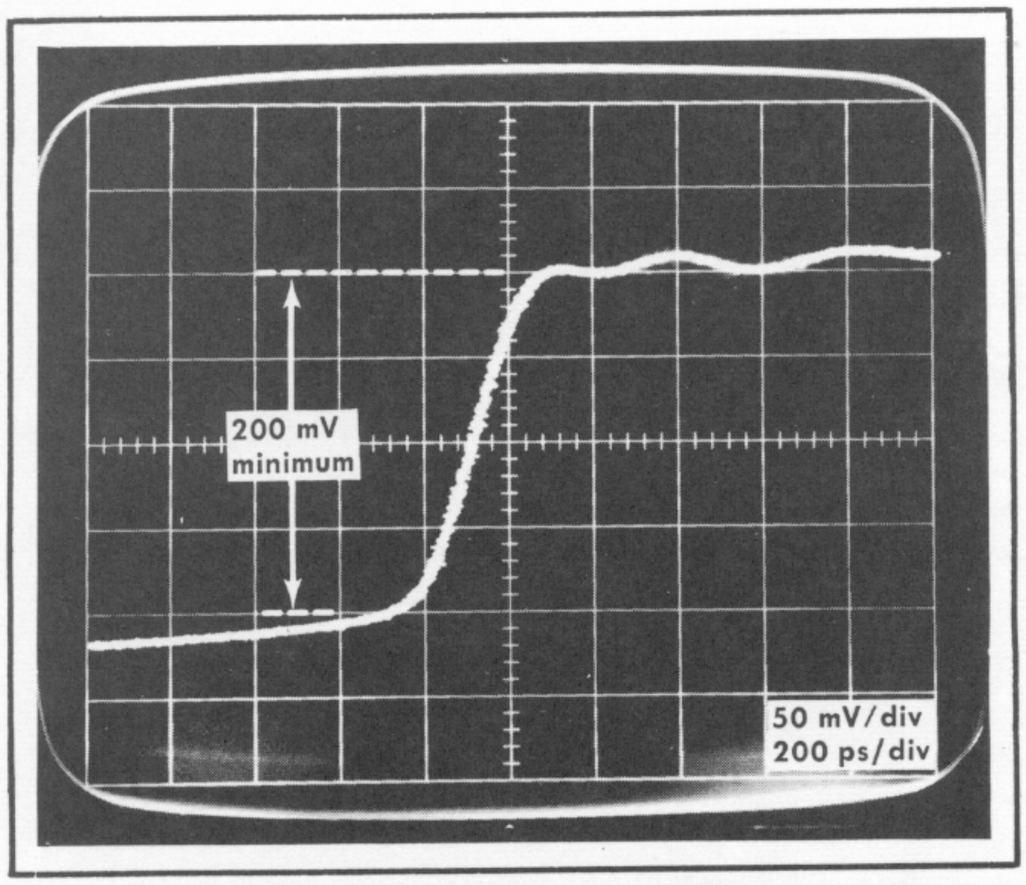


Fig. 5-9. Typical display for measuring Trigger pulse amplitude.

14. Check Pretrigger Pulse Amplitude (Rear Panel)

Requirement—Amplitude must be 70 mV or more.

a. Measure the amplitude on the positive going portion from the top of the preshoot to the maximum amplitude level.

b. Check that the amplitude is at least 70 mV.

15. Check Pretrigger Pulse Risetime (Rear Panel)

Requirement—Risetime must be 400 ps or less.

a. Set the sampling sweep unit sweep rate to 200 ps/div (Time Magnifier switch to ×50). Center the rising portion of the pulse with the Time Position controls.

b. Set the sampling unit Variable Units/Div control for an amplitude convenient to measure the risetime from the 10% to 90% levels.

c. Check that the 10% to 90% risetime is not more than 400 ps.

d. Set the Variable Units/Div control to Cal.

e. Disconnect the cables to the Type S-50 and remove it from the Type 285 Power Supply. Remove the extender and install the Type S-50 into the sampling unit.

16. Check Trigger Pulse Amplitude into 50 Ω

Requirement—Amplitude must be 200 mV or more.

a. Connect the Type S-50 Trig Out connector to a BNC to BSM coaxial cable and BNC to 3 mm adapter to the Type S-4 Input connector. Connect the Pretrig Out connector to the sampling sweep unit 50 Ω Trigger Input connector through a BNC to BSM coaxial cable.

b. Set the sampling unit Units/Div switch to 50 and the sampling sweep unit Start Point switch to With Trigger.

c. Measure the amplitude on the positive going portion, see Fig. 5-9.

d. Check that the amplitude is at least 200 mV.

17. Check Trigger Pulse Risetime

Requirement—Risetime must be 250 ps or less.

a. Set the sampling unit Variable Units/Div control for an amplitude convenient to measure the risetime from the 10% to 90% levels.

b. Check that the 10% to 90% risetime is not more than 250 ps.

c. Set the Variable Units/Div to Cal.

18. Check Trigger Pulse Duration

Requirement—Trigger pulse duration at 50% amplitude point must be 100 ns, —0%, +20%.

a. Set the sampling sweep unit sweep rate to 20 ns/div (Range switch to 1 μs and the Time Magnifier switch to ×5).

b. Set the Start Point switch to Before Trigger. Obtain a stable display.

c. Center the display and check that the pulse duration at the 50% amplitude point is between 5 and 6 divisions, 100 ns, —0%, +20%. See Fig. 5-4A.

d. Disconnect the cables from the Type S-4 and the sampling sweep unit.

19. Check Pulse Output to Trigger Out Time Interval

Requirement—Trigger Out pulse will coincide with the Pulse Output pulse within 5 ns.

a. Set the sampling sweep unit sweep rate to 2 ns/div (Range switch to 100 ns).

b. Connect the Type S-50 Pulse Output to the Type S-4 Input connector through a 3 mm to BNC female adapter, BNC coaxial cable, and 3 mm to BNC female adapter. Connect the sampling unit Trigger Out to the sampling sweep unit 50 Ω Trigger Input connector through a BSM to BNC cable.

c. Obtain a stable display and set the rising portion of the display at the center of the graticule.

d. Connect the BSM to BNC adapter to the Trig Out connector and move the BNC coaxial cable from the Pulse Output to the Trig Out adapter.

e. Check that the leading edge of the Trigger Out pulse is within 5 ns (2.5 divisions) of the center graticule setting of the Pulse Output pulse.

f. Disconnect the cables from the Type S-4 and the sampling unit.

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 No. Eff	Disc	Description		
				Capacitors		
Tolerance ±20% unless otherwise indicated.						
C7	285-0598-00			0.01 μF	PTM	100 V	5%
C10	281-0536-00			1000 pF	Cer	500 V	10%
C20	283-0107-00			51 pF	Cer	200 V	5%
C23	283-0107-00			51 pF	Cer	200 V	5%
C31	283-0644-00			150 pF	Mica		1%
C33	281-0504-00			10 pF	Cer	500 V	1%
C36	283-0644-00			150 pF	Mica		1%
C43	283-0059-00			1 μF	Cer	25 V	+80%—20%
C59	283-0132-00			10 pF	Cer	50 V	5%
C70	290-0135-00			15 μF	Elect.	20 V	
C73	290-0135-00			15 μF	Elect.	20 V	
				Semi-conductor Device, Diodes		
D10	152-0379-00			Tunnel	20 mA 10 pF	
D47	152-0379-00			Tunnel	20 mA 10 pF	
D61	*153-0040-00			Tunnel	Diode Assembly, selected	
D72	152-0227-00			Zener	1N753A 400 mW, 6.2 V, 5%	
				Connectors		
J23	131-0582-00			Receptacle, electrical		
J25	131-0579-00			Receptacle, electrical, male		
J48	131-0579-00			Receptacle, electrical, male		
J62	131-0631-00			Receptacle, electrical		
P21	131-0565-00			Receptacle, electrical, male		
P23	131-0391-00			Coax, 50 Ω, male		
				Transistors		
Q1	*151-0192-00			Silicon	Replaceable by MPS 6521	
Q5	*151-0192-00			Silicon	Replaceable by MPS 6521	
Q9	151-0221-00			Silicon	2N4258	
Q12	151-0225-00			Silicon	2N3563	
Q15	151-0225-00			Silicon	2N3563	

Transistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
Q30	151-0223-00			Silicon 2N4275
Q31	151-0225-00			Silicon 2N3563
Q35	151-0223-00			Silicon 2N4275
Q36	151-0225-00			Silicon 2N3563
Q44	151-0221-00			Silicon 2N4258
Q46	151-0221-00			Silicon 2N4258
Q50	151-0221-00			Silicon 2N4258
Q55	151-0223-00			Silicon 2N4275

Resistors

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

R1	321-0209-00	1.47 kΩ	1/8 W	Prec	1%
R3	317-0512-00	5.1 kΩ	1/8 W		5%
R4	317-0153-00	15 kΩ	1/8 W		5%
R5	317-0103-00	10 kΩ	1/8 W		5%
R7	317-0103-00	10 kΩ	1/8 W		5%
R8	317-0101-00	100 Ω	1/8 W		5%
R9	317-0241-00	240 Ω	1/8 W		5%
R11	317-0201-00	200 Ω	1/8 W		5%
R13	317-0751-00	750 Ω	1/8 W		5%
R14	311-0605-00	200 Ω, Var			
R15	317-0101-00	100 Ω	1/8 W		5%
R17	317-0122-00	1.2 kΩ	1/8 W		5%
R18	317-0560-00	56 Ω	1/8 W		5%
R20	317-0151-00	150 Ω	1/8 W		5%
R21	317-0331-00	330 Ω	1/8 W		5%
R23	317-0470-00	47 Ω	1/8 W		5%
R24	317-0103-00	10 kΩ	1/8 W		5%
R32	321-0220-00	1.91 kΩ	1/8 W	Prec	1%
R33	321-0155-00	402 Ω	1/8 W	Prec	1%
R34	317-0101-00	100 Ω	1/8 W		5%
R36	317-0101-00	100 Ω	1/8 W		5%
R37	321-0182-00	768 Ω	1/8 W	Prec	1%
R40	317-0431-00	430 Ω	1/8 W		5%
R41	317-0101-00	100 Ω	1/8 W		5%
R43	301-0301-00	300 Ω	1/2 W		5%
R45	317-0103-00	10 kΩ	1/8 W		5%
R47	317-0470-00	47 Ω	1/8 W		5%
R48	317-0331-00	330 Ω	1/8 W		5%
R50	317-0331-00	330 Ω	1/8 W		5%
R51	317-0122-00	1.2 kΩ	1/8 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R52	311-0486-00			500 Ω, Var			
R53	317-0152-00			1.5 kΩ	⅛ W		5%
R55	317-0750-00			75 Ω	⅛ W		5%
R57	321-0093-00			90.9 Ω	⅛ W	Prec	1%
R58	321-0093-00			90.9 Ω	⅛ W	Prec	1%
R59	317-0470-00			47 Ω	⅛ W		5%
R61	325-0037-00			100 Ω	1/20 W	Prec	1%
R72	317-0102-00			1 kΩ	⅛ W		5%

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

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

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

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

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

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

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

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

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

(Located behind diagrams)

FIG. 1 EXPLODED

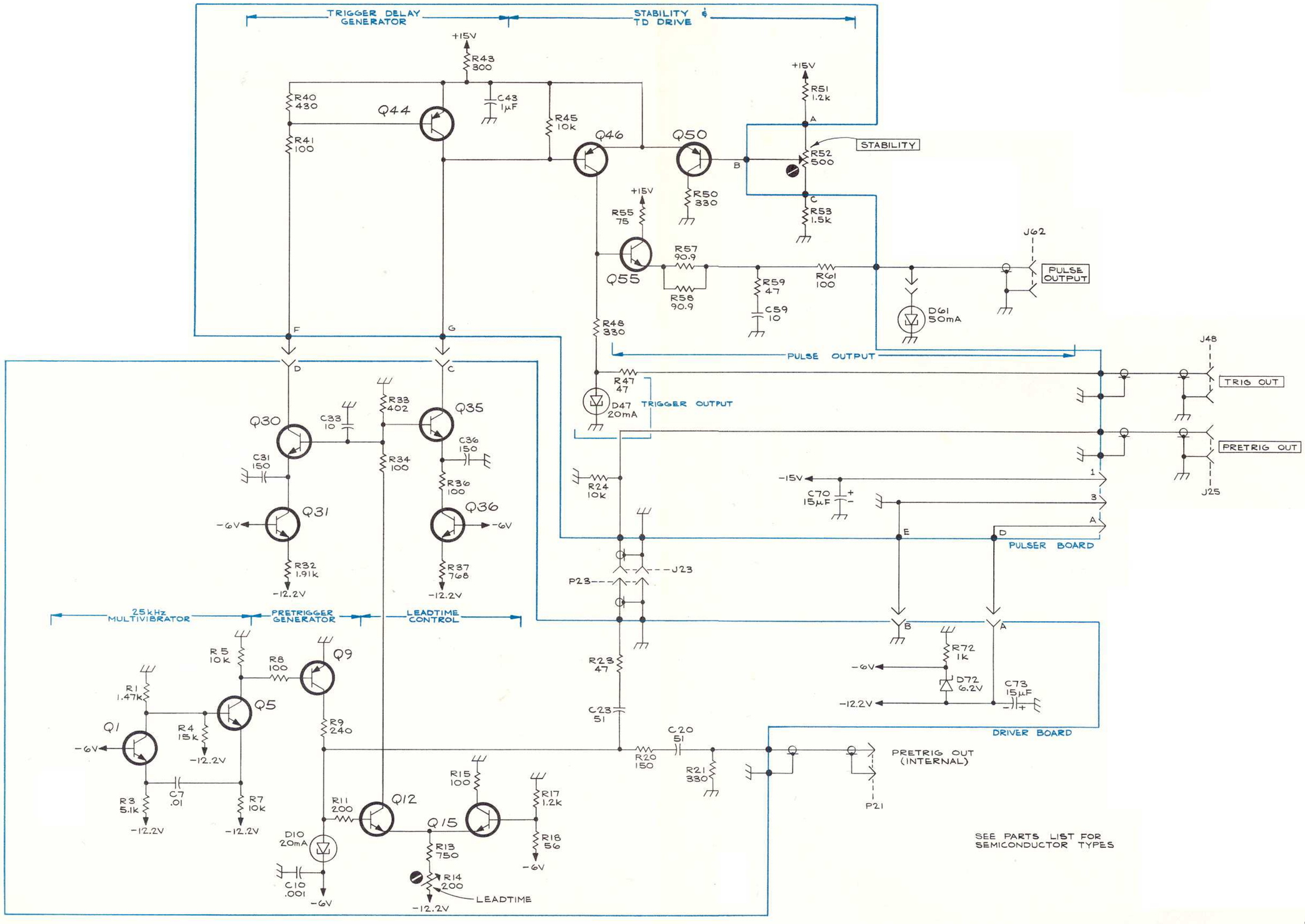
SECTION 7
MECHANICAL PARTS LIST

FIG. 1 EXPLODED

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	333-1096-00			1	PANEL, front
-2	386-1338-09			1	SUBPANEL, front
	670-1005-00			1	ASSEMBLY, circuit board—DRIVER
	- - - - - -			-	assembly includes:
-3	388-1043-00			1	BOARD, circuit
-4	136-0252-01			27	SOCKET, pin connection
-5	136-0263-01			4	SOCKET, connector pin
-6	131-0391-00			1	CONNECTOR, standoff male
-7	175-1036-01			1	ASSEMBLY, cable, w/connector and holder
	670-1006-00			1	ASSEMBLY, circuit board—PULSER
	- - - - - -			-	assembly includes:
-8	388-1044-00			1	BOARD, circuit
-9	136-0252-01			12	SOCKET, pin connection
-10	131-0582-00			1	CONNECTOR, standoff female
-11	131-0591-00			4	TERMINAL, pin, 0.835 inch long
-12	214-1081-00			2	PIN, spiral
-13	210-0707-00			2	EYELET, metalic
-14	131-0631-00			1	CONNECTOR, single contact
-15	131-0742-01			1	CONTACT, electrical
-16	384-0687-00			1	SHAFT, latch
-17	105-0066-00			1	STRIKE, latch
-18	175-1038-00			1	CABLE, w/connector
	- - - - - -			-	cable includes:
-19	131-0579-00			1	CONNECTOR, coaxial, miniature bayonet w/hardware
-20	175-1039-00			1	CABLE, w/connector
	- - - - - -			-	cable includes:
-21	131-0579-00			1	CONNECTOR, coaxial, miniature bayonet w/hardware
-22	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-23	358-0301-01			1	BUSHING, sleeve, gray plastic
-24	358-0343-00			1	BUSHING, machine thread, 1/4-32 x 2.06 inches
-25	210-0046-00			1	WASHER, internal, 0.261 ID x 0.400 inch OD
-26	220-0510-00			1	NUT, hex., 1/4-32 x 0.312 inch x 0.40 inch long
-27	153-0040-00			1	HOLDER, diode assembly (D61)
-28	131-0741-00			1	CONNECTOR, block
	- - - - - -			-	mounting hardware: (not included w/connector)
-29	211-0092-00			2	SCREW, 2-56 x 3/16 inch, socket cap, black
-30	220-0531-00			1	NUT, hex., 1/4-32 x 0.375 inch
-31	380-0125-00			1	HOUSING
	- - - - - -			-	housing includes:
-32	131-0555-00			4	CONTACT
-33	386-1337-01			1	PANEL, rear
	- - - - - -			-	mounting hardware: (not included w/panel)
-34	211-0141-00			4	SCREW, machine, 4-40 x 3 1/4 inches, PHS

FIG. 1 *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
						STANDARD ACCESSORIES
1-	070-0897-00			1		MANUAL, instruction (not shown)
-35	015-1015-00			1		CABLE ASSEMBLY, rf, 50 ohm
						OPTIONAL ACCESSORIES
	015-1001-00			1		ATTENUATOR, fixed, 2X, 3 mm male to female
	015-1002-00			1		ATTENUATOR, fixed, 5X, 3 mm male to female
	015-1003-00			1		ATTENUATOR, fixed, 10X 3 mm male to female
	015-1004-00			1		TERMINATION, coaxial, 50 ohm, 3 mm male to female
	015-1005-00			1		CABLE ASSEMBLY, rf, 2 nsec, 3 mm male to female
	015-1006-00			1		CABLE ASSEMBLY, rf, 5 nsec, 3 mm male to female
	015-1007-00			1		ADAPTER, connector, 3 mm male to GR
	015-1008-00			1		ADAPTER, connector, 3 mm female to GR
	015-1009-00			1		ADAPTER, connector, 3 mm male to N
	015-1010-00			1		ADAPTER, connector, 3 mm to 7 mm
	015-1011-00			1		ADAPTER, connector, 3 mm male to male
	015-1012-00			1		ADAPTER, connector, 3 mm female to female



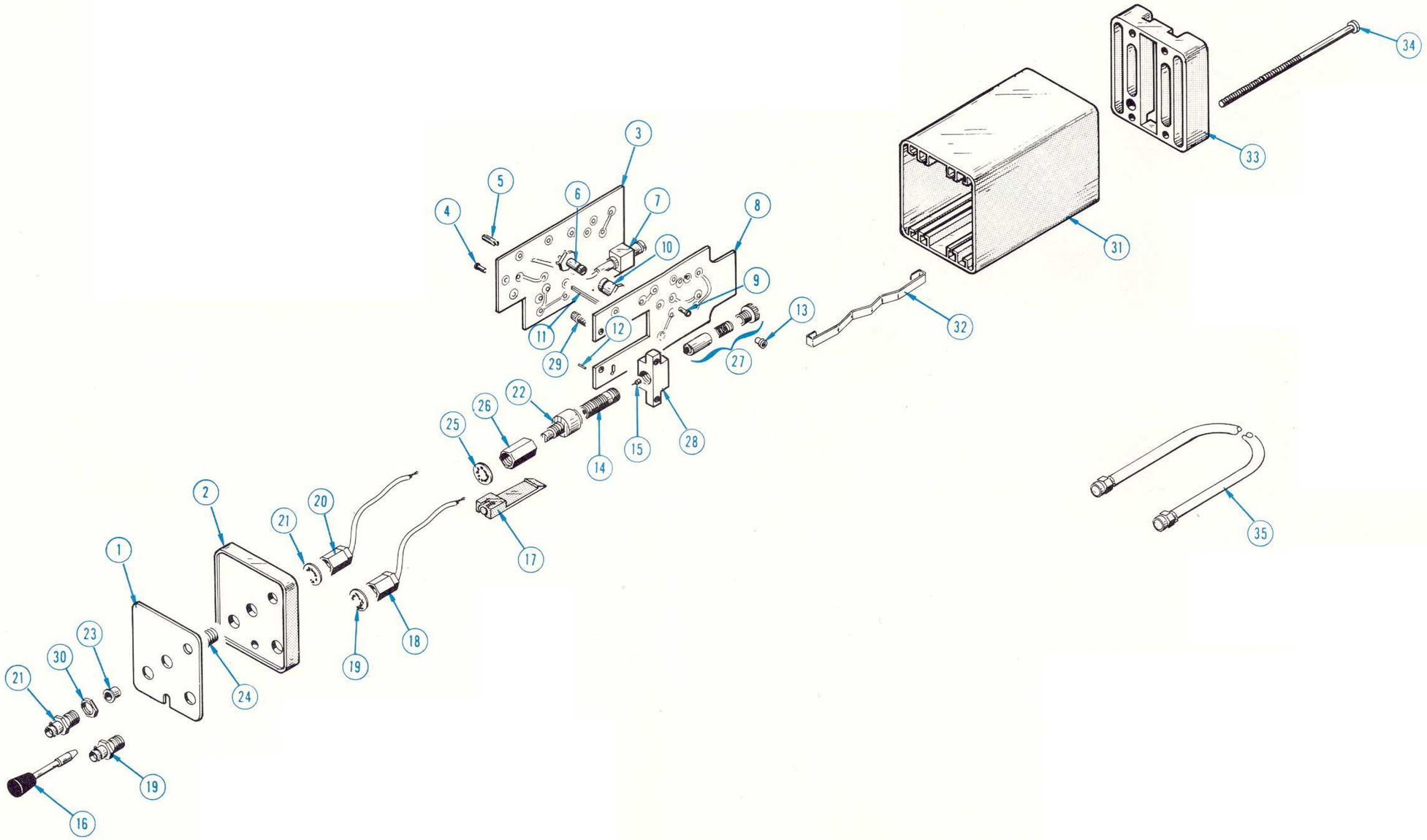
TYPE S-50

A

1168

PULSE GENERATOR 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 4 Maintenance

Page 4-4 left column

CHANGE: Fig. 4-6 to Fig. 4-7.

ADD: the following after number 1:

CAUTION

Turning the Pulse Output connector may move the fine wire connected to a contact in the mounting. The movement may ground or break the fine wire, part of item 15 in the Mechanical Parts List.

ADD: the following after number 5:

Tunnel Diode, D61. Performance of D61 should be checked only by observing the normal operation of the Type S-50.

CAUTION

Do not check D61 with an ohmmeter or curve tracer.

Fig. 2-3A and B show normal displays with operation of the Type S-50 Stability control. Failure to obtain a fast rise pulse may indicate failure of D61.

ADD: the following after the NOTE:

Fig. 4-6 shows the physical placement of the fine wire as it makes contact with the Pulse Output connector and as it is soldered to R61.

To replace the connector, remove the tunnel diode holder and fine wire contact from the mounting. Place a small drop of Loctite (screw-lock)®, catalogue number 59-21, on the connector threads and tighten the connector securely. Install and center the fine wire contact, then replace the tunnel diode holder and be certain that the fine wire does not touch the holder.

ADD: the following new Figure 4-6:

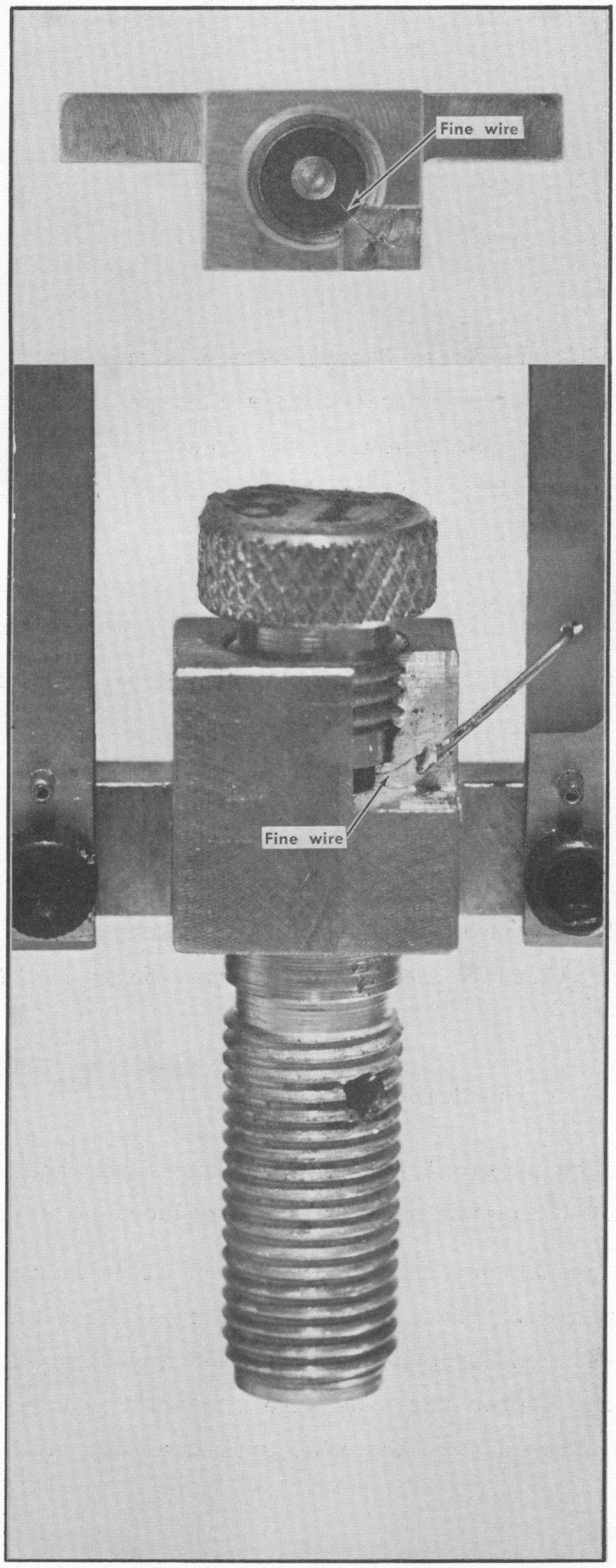


Fig. 4-6. Electrical contact of fine wire at mounting and R61.

Section 5 Performance Check/Calibration

Page 5-7 Step 8 (d)

ADD: to the last sentence:

, see Fig. 5-6B. Note the total display amplitude including the step preceding the 0% level.

Page 5-7 Step 8 (h)

ADD: the following paragraph to part h:

Sampler blowby, if present, would be sentitive to the step as well as the fast rise pulse of the Type S-50. Therefore, the Type 284 display amplitude is set to the Type S-50 total display amplitude for the most accurate comparison.

Page 5-7 Step 8 (i)

CHANGE: line 6 to read:

as the Type S-50 <u>display</u>. Expose the waveform and develop the

TEXT CORRECTION

Section 1 Specification

Page 1-1 Table of ELECTRICAL CHARACTERISTICS

CHANGE: the Performance Requirement of Pulse Flatness Deviation as noted below:

400 ps to 5 ns	-5% to +5% with a total of 8% or .....
5 ns or more	-4% to +1% with a total of 5% or.....

Section 2 Operating Instructions

In Section 2 any time the rigid cable is identified as semi-rigid, remove the word "semi" from the text.

Page 2-7 CAUTION

REPLACE: the present CAUTION text with the following:

CAUTION

The two coaxial lines listed under part numbers 015-1015-00 and 015-1005-00 must be treated with care to obtain maximum life and least signal distortion. The rigid line may not have its shape changed and still have the propagation delay and Z_o guaranteed. In cases where the line is not used at its maximum performance limits, small amounts of bending can be made providing mating connectors are on each end before bending. If bent to a curve radius of 1-1/2 inches, the line may be made totally inoperative. The flexible cable must not be given a bend radius less than 10 times its OD, or approximately 2-1/4 inches. Flexible cables may suffer outer conductor breakage by tighter bending. Few flexures assure longer life.

Section 3 Circuit Description

Page 3-3 first column, first paragraph

REPLACE: the last three lines of the first paragraph with the following:

output from D47. Capacitors C43 and C46 hold Q44 and Q46 emitter voltage constant as the circuit current changes from 10.2 mA to 0 mA, then to 7.3 mA and back again to 10.2 mA. C43 is located near Q44. Inductance of the wire connecting Q46 to C43 reduces the effectiveness of C43 in maintaining Q46 collector voltage constant. Therefore, C46 is connected directly to the emitter of Q46.

Page 3-3 Special Components

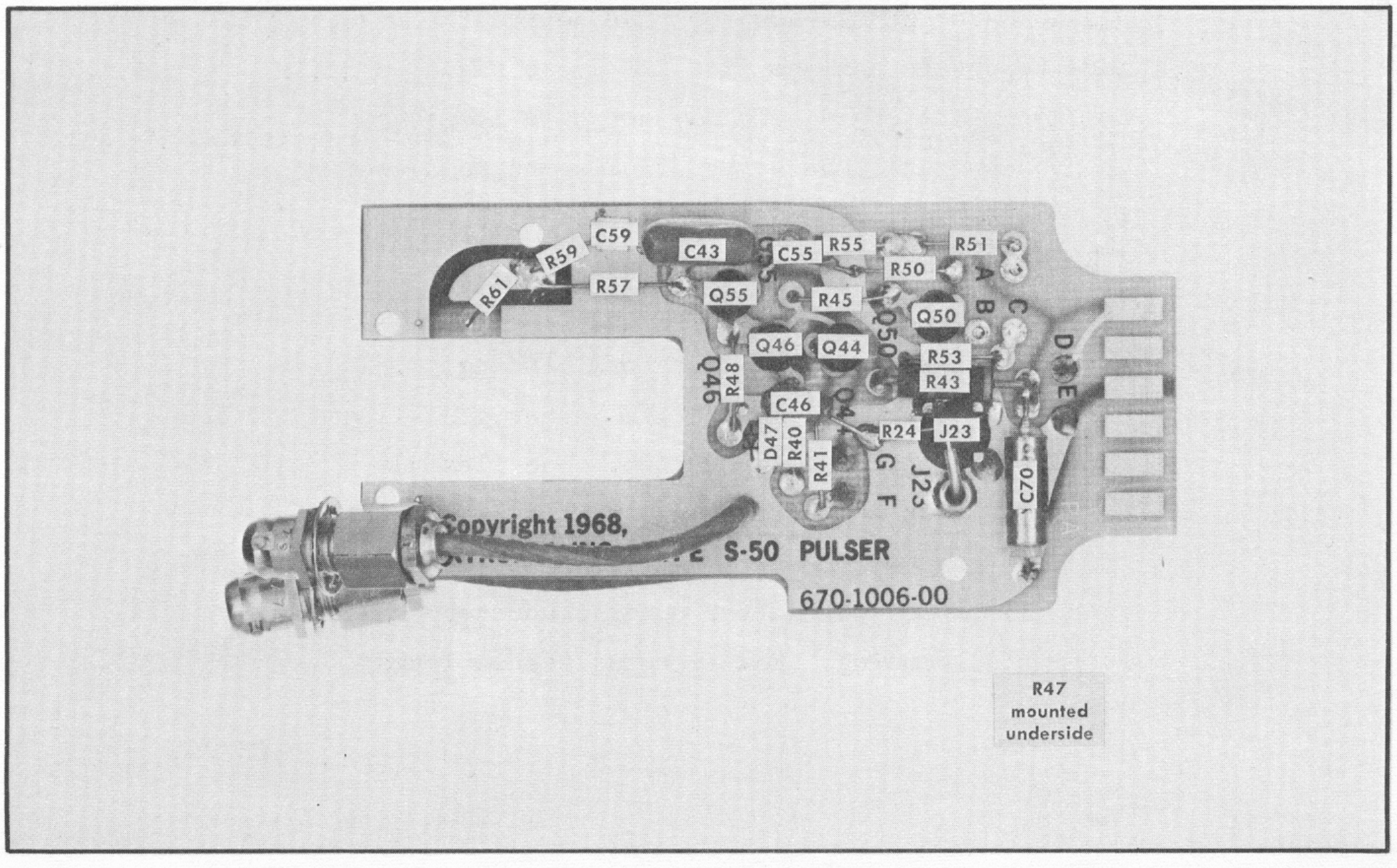
ADD: the following sentence to the end of the second paragraph:

C55 together with R55 provide power supply decoupling.

Section 4 Maintenance

Page 4-3 Fig. 4-5

REPLACE: the present Fig. 4-5 with the one below:



Section 5 Performance Check/Calibration

In Section 5 when reference to solid coaxial line is made change designation to rigid coaxial line.

Page 5-1 EQUIPMENT REQUIRED

CHANGE: Item 9 to read:

9. Rigid coaxial line with 3 mm connectors, Tektronix Part No. 015-1015-00.

Page 5-4 PERFORMANCE CHECK AND CALIBRATION PROCEDURE

CHANGE: the Step 1 heading and part a to read:

1. Adjust Stability Control, R52

a. Connect the Pulse Output connector to the rigid coaxial line.....

Page 5-7 8. Check Pulse Flatness Deviation

CHANGE: specified percentages as shown:

.....

Between 400 ps and 4 ns after step, +5%, -5% or less, total of 8% peak to peak;

Between 5 ns and 100 ns after step, +1%, -4% or less, total of 5% peak to peak.

Page 5-7 Step 8(i)

CHANGE: the last line of part i to read as follows:

not exceed +5%, -5% or total 8% peak to peak.

Page 5-7 Step 8 (j)

CHANGE: the third and fourth line to read:

through 100 ns, for a deviation not more than +1%, -4% or a total 5% peak to peak. .....

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

C43	283-0164-00	2.2 μF	Cer	25 V	
C46	283-0177-00	1 μF	Cer	25 V	+80%-20%
C55	283-0178-00	0.1 μF	Cer	100 V	+80%-20%
C59	283-0093-00	15 pF	Cer	50 V	
R57	317-0430-00	43 Ω	1/8 W	Fixed	5%

REMOVE:

R58	321-0093-00	90.0 Ω	1/8 W	Prec	1%

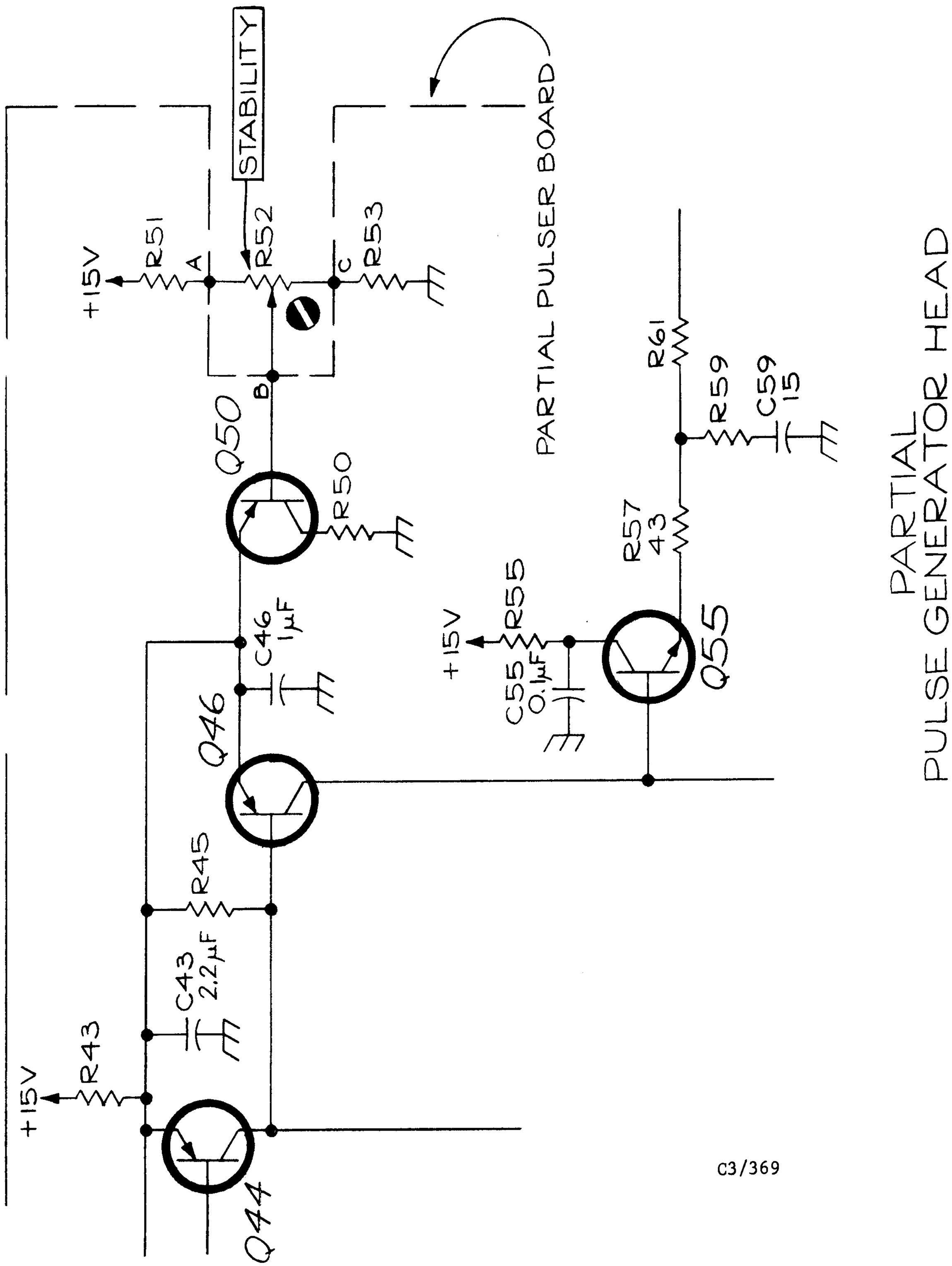
MECHANICAL PARTS LIST CORRECTION

Page 7-1

CHANGE: Fig. and Index No. 1-29 to read:

-29	211-0162-00	2 SCREW, 2-56 x 3/16 inch, socket cap, stainless steel

SCHEMATIC CORRECTION



PARTIAL PULSE GENERATOR HEAD

C3/369