TEK INSTRUCTION MANUAL

Part No. 070-0896-01
Product Group 42

S-4
SAMPLING HEAD

Please Check for
CHANGE INFORMATION
at the Rear of This Manual

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

CONTENTS

Section 1	Specification
Section 2	Operating Instructions

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

Section 3	Circuit Description
Section 4	Performance Check/Calibration
Section 5	Maintenance
Section 6	Options
Section 7	Electrical Parts List
Section 8	Diagrams
Section 9	Mechanical Parts List Information
	Mechanical Parts List Illustrations
	Accessories

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 the manual.

0896-03

Fig. 1-1. Type S-4 Sampling Head.

TYPE S-4 SPECIFICATION

GENERAL INFORMATION

The type S-4 Sampling head is an input signal processing unit for Tektronix sampling units. Input characteristics of the sampling system are determined by the Type S-4. The Type S-4 has an input impedance of 50 Ω and a rise time of 25 ps or less.

The Type S-4 can be installed directly into a sampling unit or used remotely on optional 3 foot or 6 foot extender cable. A portion of the signal delivered to the sampling head input is coupled to the sampling unit for use as an internal trigger signal. Use of this trigger pickoff signal is dependent upon the type of vertical sampling unit and sampling sweep unit used in the system. See the instruction manual for your vertical sampling unit and sampling sweep unit for further information.

The vertical deflection factor of the sampling system is labeled at the top of the Type S-4 as mVOLTS/DIV. The label refers to the sampling unit Units/Div switch.

NOTE

The electrical characteristics in this section are applicable for an instrument calibrated with ambient temperatures between +20° C and +30° C, and after a 5 minute warm-up. Unless otherwise stated, electrical characteristics apply over an operating temperature range from 0° C to +50° C and to an altitude of 15,000 feet. Supplemental information items are for information only and are not specifications.

Table 1-1
SPECIFICATIONS

Characteristic	Performance Requirements			Supplemental Information
Step Response				
Risetime	25 ps or less			
Observed with S-50 or S-52				35 ps or less
Aberrations	Time From Step			
	With S-50 or S-52	With 284		
	0 - 400 ps	400 ps - 25 ns	After 25 ns	
	−10%, +10% or less; total less than 20% p-p	0%, +10% or less; total less than 10% p-p	+2%, −2% or less; total less than 4% p-p	
Displayed Noise	5 mV or less, measured tangentially			

Table 1-1 (cont)

Characteristic	Performance Requirements	Supplemental Information
Dot Transient Response	Within 5% for input signals up to 500 mV P-P	Plug-in unit may require adjustment of DOT RESPONSE control when switching Units Div. Avalanche voltage may have to be readjusted with extreme ambient temperature.
Signal Voltage		
Maximum Operating	1 V P-P	Maximum DC limits which may be displayed depend on DC OFFSET range and Deflection Factor
Safe Overload	Do not exceed + or −5 V limits	
Input R	50 Ω within 5%	
Baseline Shift With Repetition Rate Change	10 mV or less from 30 Hz to 50 kHz	
Temperature		
Nonoperating	−40°C to +65°C	
Operating	0°C to +50°C	
Altitude		
Nonoperating	To 50,000 feet	
Operating	To 15,000 feet	
Vibration		
Operating	15 minutes along each axis at 0.015″. Vary the frequency from 10 to 50 to 10 c/s in 1-minute cycles. Three minutes at any resonant point or at 50 c/s	
Shock		
Nonoperating	1000 g's, 1/2 sine, 1/2 ms duration, 2 shocks per axis. Total of 6 shocks	
Transportation	Qualifies under National Safe Transit Committee Test Procedure Category IV (48 inch drop)	

OPERATING INSTRUCTIONS

General Information

This section provides the basic information required for operation of the Type S-4 Sampling Head.

The Type S-4 can be used on an extender cable without compromising the response of the measurement system. Signals are applied to the 50 Ω input of the samping head through a 3 mm, 50 Ω coaxial connector.

Unity loop gain can be obtained with input signals of up to 0.5 volt (peak-to-peak). Unity loop gain ensures the most accurate displays during fast changes in input signal amplitude. See the Basic Sampling Principals Section of your sampling unit manual for further information.

The Type S-4 may be used with input signals up to 1 volt (peak-to-peak). Specifications for the Type S-4 Sampling Head are given in Section 1 of this manual.

NOTE

Attenuators, with threaded 3 mm connectors, are available as optional accessories. These attenuators are useful in reducing the amplitude of large signals. Other optional accessories with 3 mm connectors include coaxial cables, a 50 Ω termination, and adapters for interconnecting various types of connectors.

Installation instructions are located in the vertical sampling unit instruction manual.

Effect of Excessive Input Voltage

A maximum operating signal voltage of 1 volt (peak-to-peak) is specified for the Type S-4 in Section 1 of this manual. Signals having an amplitude of more than 1 volt (P-P) at the Type S-4 input may be distorted by the samping head. Large signals must be reduced in amplitude to not more than 1 volt (P-P) at the Type S-4 input.

WARNING

Signals in excess of plus 5 volts or minus 5 volts may destroy the sampling diode bridge.

A 15 volt (P-P) signal can be reduced to a suitable amplitude at the Type S-4 input by inserting a series combination of 10X and 2X attenuators in the coaxial line delivering the signal. A series combination of 10X and 5X attenuators would also be satisfactory.

See the discussion on Sine Wave Signal measurements later in this section for information on signal amplitude affect upon display amplitude accuracy.

Risetime Measurements

Accurately determining risetime from an observed display requires that the position of the 10% and 90% points be accurately known and that the horizontal distance between these points be accurately measured. The timing accuracy of the sampling sweep unit must also be known. Switching the sampling sweep unit from one oscilloscope to another requires readjustment of the horizontal gain control on the sampling sweep front panel. See your sampling sweep unit instruction manual for timing accuracy specifications and complete instructions for checking timing.

Displayed Risetime and Actual Risetime

Differences in displayed and actual signal risetime will result unless the risetime of the sampling system is about four times faster than the risetime of the signal to be measured. As used in this discussion, the sampling system is considered to be made up of the sampling head and any coaxial line, connectors or accessories between the signal source and the sampling head. Displayed risetime is dependent upon the risetime of the sampling head, the risetime of the pulse generator, and the risetime of the cable and connecting components between the generator and sampling head. With signals as fast as about 100 ps arriving at the Type S-4 input, the displayed risetime will be very close to the actual signal risetime.

Since the risetime of the Type S-52 Pulse Generator output signal is much faster than 100 ps, the displayed risetime (with this pulse applied to the Type S-4 input) will not be the actual signal risetime.

The risetime of signals that are faster than 100 ps can still be determined using the Tektronix Type S-4 Sampling head. However, the signal risetime is calculated using formula (2-2). Signal risetime calculated using formula (2-2) will provide a close approximation of the actual signal risetime.

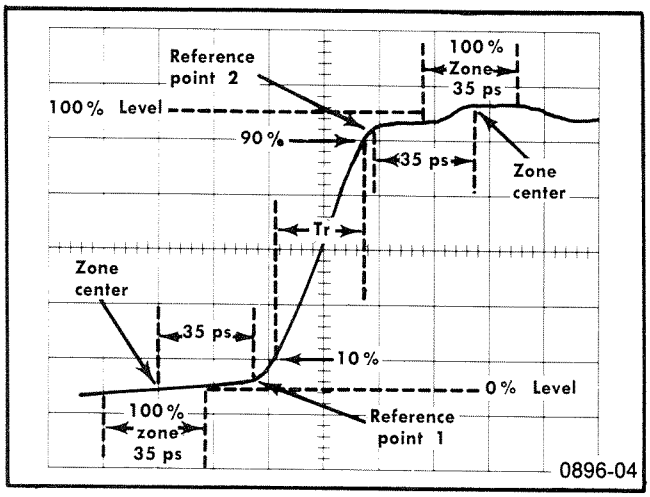


Fig. 2-1. Special S-4/S-52 system risetime measurement technique.

The relationship between displayed risetime, signal risetime, signal path risetime, and sampling head risetime is shown by formula (2-1). T_r of signal path, and T_r of Type S-4 in formula (2-1). T_r of signal path includes the combined risetime of all coaxial cables, connectors, or accessories between the signal source and the Type S-4 input. If the signal path consists of a coaxial cable having a risetime of 8 ps and connectors and accessories having a risetime of 6 ps, the combined signal path risetime is

$$\sqrt{(8)^2 + (6)^2} \approx 10 \text{ ps}$$

$$T_r \text{ (displayed)} \approx \sqrt{(T_r \text{ signal})^2 + (T_r \text{ of sig. path})^2 + (T_r \text{ of Type S-4})^2} \quad (2\text{-}1)$$

For example, assuming an input signal having a risetime of 25 ps; connecting cable, accessories, and connectors having a risetime of 10 ps; and a sampling head with a risetime of 25 ps gives:

$$T_r \text{ (displayed)} \approx \sqrt{(25)^2 + (10)^2 + (25)^2}$$
$$T_r \text{ (displayed)} \approx \sqrt{625 + 100 + 625}$$
$$T_r \text{ (displayed)} \approx 37 \text{ ps}$$

Transposing formula 2-1 to permit calculation of signal risetime when the displayed risetime, signal path risetime, and sampling head risetime is known gives:

$$T_r \text{ (signal)} \approx \sqrt{(T_r \text{ displayed})^2 + (T_r \text{ of Type S-4})^2 - (T_r \text{ of sig. path})^2} \quad (2\text{-}2)$$

Additional information concerning the effect of connecting cables on the displayed signal risetime may be found under Cable and Accessory Considerations later in this section.

Sine Wave Signal measurements

The parameters of the Type S-4 are specified using pulse or time domain parameters and nomenclature. The frequency response characteristics of the unit, while not specified, are such that it may be used for relative sine wave measurements through its calculated upper 3 dB rolloff point of 14 GHz.

Because of the traveling wave gate used in the Type S-4, it is capable of handling very large signals as compared to other microwave samplers. Even so, the peak to peak signal amplitude should be held to as low a level as possible consistent with good signal to noise ratio when making checks in the 5 to 15 GHz region to avoid compression effects.

Cable and Accessory Considerations

When connecting a signal to the Type S-4 it is important that the signal coupling cable, connectors, attenuators and any other devices between the signal source and sampling head have the correct characteristic impedance, be capable of handling the signal frequency without causing excessive loss or distortion, and be of high quality. Care must be taken to firmly tighten all connectors, or unwanted reflections may result.

Accurate displays of signals containing very fast transitions or very high frequencies are possible only if the cables carrying the signal to the sampling head do not distort the signal. The Type S-4 input resistance is 50 Ω and requires the use of high quality, low loss, 50 Ω coaxial cables and attenuators between the signal source and the sampling head input connector. Using an adapater to change from 3 mm to a larger diameter coaxial cable will result in a loss of system bandwidth.

The Type S-4 sampling head is useful from DC up to at least 14 GHz. Standard and optional 3 mm accessories available from Tektronix are intended for use at frequencies to 18 GHz and are generally useful at frequencies to 25 GHz. Since any accessories in the path between the signal source and the Type S-4 input will increase the displayed signal risetime, use only high quality accessories of adequate high frequency capability. Accessories (3 mm) supplied with the Type S-4, or available as optional equipment, include flexible and rigid coaxial cable, attenuators, adapters to change from 3 mm to larger size coaxial cable, and a power divider.

The physical and electrical characteristics of the cable determine the characteristic impedance, velocity of propagation and nature of signal losses.

It is important to use cables or airlines, in the signal-handling side of the system, that are as short as possible.

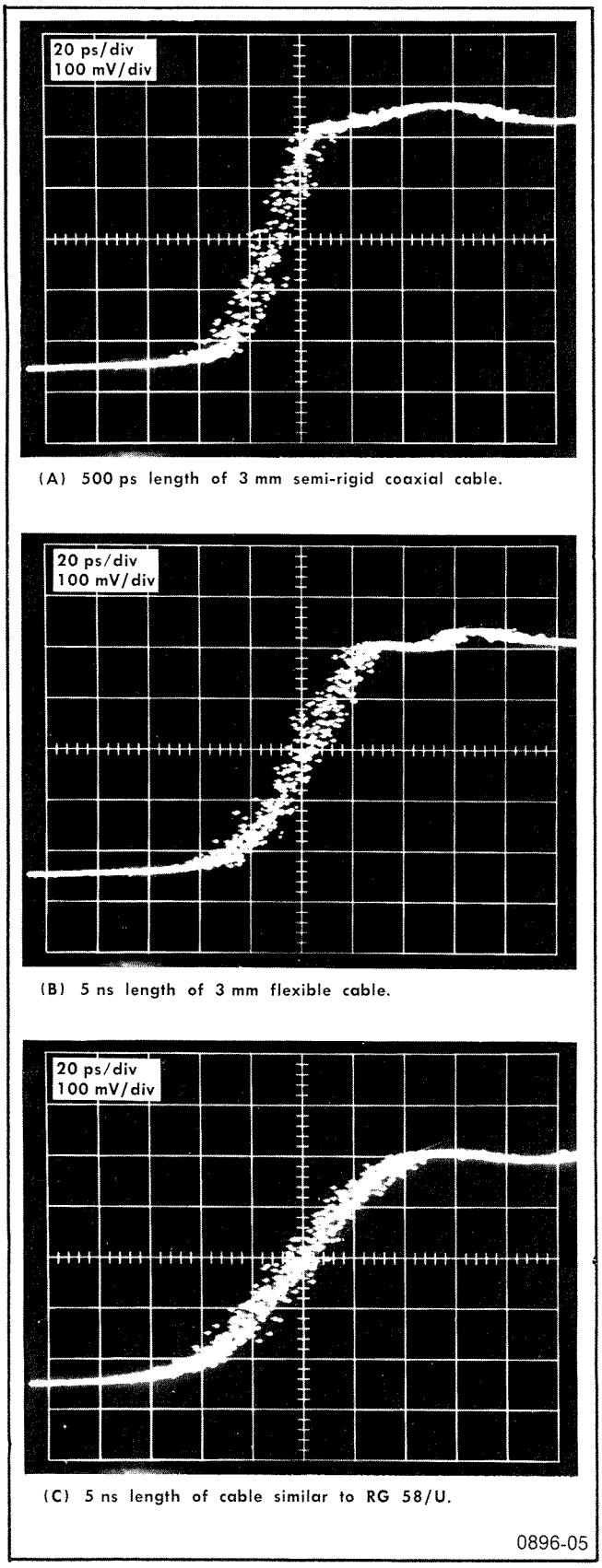
Use of the optional 3 foot or 6 foot head extender cable permits locating the Type S-4 near the signal source and thereby keeps the input coaxial cable short and signal losses to a minimum. Signal losses along a coaxial line, due to skin effect or dielectric loss, result in a loss of high-frequency signal amplitude as the signal travels along the line. Dielectric loss along the coaxial line also results in an increase in the displayed risetime of fast step pulses. Dielectric and skin effect losses increase with signal frequency and the length of the coaxial cable. Fig. 2-2A shows the displayed waveform when the 25 ps output pulse of the Type S-52 is fed to the Type S-4 input through a rigid 3 mm coaxial line. In Fig. 2-2B the 25 ps pulse is fed to the S-4 input through a 5 ns length of flexible 3 mm coaxial cable. Fig. 2-2C shows the risetime of the displayed signal when the same 25 ps pulse is sent through a 5 ns length of good quality coaxial cable similar to Type RG-58/U. The importance of using a short length of the proper type coaxial between the signal source and the Type S-4 input is apparent from comparison of the waveforms of Fig. 2-2.

Another factor that can result in loss of signal in a coaxial cable is use of coaxial cable having a diameter that is large compared to the wavelength of the highest frequency components of the signal. The Type S-4 input connector is intended for use with Teflon dielectric coaxial cable having an outer conductor with an outside diameter of 0.141 inches.

Resistive losses in large diameter coaxial cable is less than in smaller diameter cable for frequencies below the critical value.

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.



(A) 500 ps length of 3 mm semi-rigid coaxial cable.

(B) 5 ns length of 3 mm flexible cable.

(C) 5 ns length of cable similar to RG 58/U.

0896-05

Fig. 2-2. Effect of cable length, diameter, and quality on displayed risetime.

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CIRCUIT DESCRIPTION

General

This section of the manual contains a block diagram description of the Type S-4 Sampling Head followed by a detailed circuit description. Both the block and schematic diagrams are located at the rear of this manual.

The Type S-4 is the signal input section of a sampling system, and determines the vertical channel input characteristics.

BLOCK DIAGRAM

Both the Block Diagram and the circuit schematic show the Type S-4 circuits outlined by dashes, indicating the individual circuit boards within the unit. One circuit board is devoted to the generation of the sampling gate strobe pulses, one to the sampling gate, one to the blow-by and trigger pickoff amplifier and one to the preamplifier.

Stobe Generator

The Strobe Generator develops heavy-current (several mA), short-duration, push-pull pulses that drive the Sampling Gate into balanced conduction. Output occurs at the time of each sample when a command pulse arrives from the Stobe Driver circuit of the associated sampling unit. The pulse lasts for a period of about 125 ps, turning on the Sampling Gate diodes. At the end of the pulse, the diodes turn off very quickly, retaining a portion of the input signal. Strobe pulse duration and fall time are fixed by the Snap-Off diode D61, and the two clipping lines. The Strobe Generator parts layout and circuit board construction are carefully controlled during manufacture to ensure proper strobe pulses being sent to the Sampling Gate.

Sampling Gate

The Sampling Gate (called the Sampling Bridge in other Tektronix sampling circuitry) connects the input signal to the Preamplifier only during the short time when each sample is taken. The six diodes, D2A through D2F, form what is technically termed a traveling wave gate. It is the way the end of the Strobe Drive pulse travels through the gate that determines the step response of the sampler. In other Tektronix sampling bridges, the step response risetime is controlled by the strobe pulse duration. In the Type S-4, the step response risetime is controlled instead by the length of time it takes the end of the strobe pulse to travel through part of the Sampling Gate.

At the end of each Strobe pulse, part of the input signal is stored temporarily between Sampling Gate diodes and is then fed to the Preamplifier input at a rate much slower than the step response risetime. It is only the special traveling wave gate that has its electrical environment controlled for minimum reflections of fast pulse signals. All circuit parts that pass the sampled error signal (see the sampling unit manual section on Basic Sampling Principles for definition of error signal) to the Preamplifier handle only moderate rate-of rise signals. A special 10X (20 dB) 50 Ω attenuator helps serve as a high-quality, high-frequency termination to the input connector and the 50 Ω environment of the traveling wave gate.

Part of the input signal is continuously passed to the Trigger Amplifier Board and the Blow-by compensating and Trigger Pickoff circuit. The signal passes through the 10X attenuator directly to the Trigger Amplifier Board and is terminated in 50 Ω there.

Gate Bias

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

Blow-by and Trigger Pickoff

The primary function of the Blow-by and Trigger Pickoff circuit is to cancel capacitively-coupled unwanted signals that normally bypass the Sampling Gate. These unwanted signals are called "blow-by" signals.

The Type S-4 special traveling wave Sampling Gate contains two blow-by reducing diodes that minimize the unwanted capacitively-coupled signals. The special Sampling Gate construction and the blow-by circuit essentially cancel all of the unwanted signals that would otherwise distort the oscilloscope sampling display.

The Blow-by and Trigger Pickoff circuit receives an attenuated portion of the input signal and terminates the 10X attenuator that is located between the Sampling Gate and the Trigger Amplifier Board. The circuit amplifies and inverts the signal and applies it, as a blow-by correction signal,

through a small capacitor to the output side of the Sampling Gate blow-by limiting diodes. magnitude of the blow-by correction signal is adjusted during calibration by the Transient Response control.

The trigger pickoff function of the Blow-by and Trigger circuit provides an in-phase signal source for internally triggering the sampling sweep unit. Not all channels of all sampling units (in which the S-4 operates) couple the trigger pickoff signal to the sampling sweep unit. If the signal is not used, the sampling unit terminates the output in 50 Ω, allowing the circuit to remain functional for blow-by correction.

Preamplifier

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

CIRCUIT DESCRIPTION

Refer to the main schematic diagram during the following descriptions. The Type S-4 Sampling Head uses the power supplies of the indicator oscilloscope and associated sampling unit. Interconnections to the sampling unit circuits are by two rear connectors. The following description includes references to circuits in the sampling vertical unit and sampling sweep unit, all units forming one sampling system. Reference to diagrams and circuit descriptions in the instruction manuals for the other sampling units will help in gaining a full understanding of the circuit relationships.

Strobe Generator

The Strobe Generator circuits are all located on the right side Strobe circuit board. The generator contains two basic circuits, an Avalanche circuit that delivers fast push-pull pulses and the Snap-off diode and clipping lines circuit. Both circuits work together to produce the push-pull strobe pulses that drive the special traveling-wave Sampling Gate through two equal transmission lines. Both sets of circuitry are physically arranged over separate ground planes that are identified on the main schematic diagram. The two ground planes are connected together by R52 and R54, to damp out ringing between the two circuit areas at sample time.

The Avalanche Circuit converts the Strobe Drive pulses from the sampling unit to very fast push-pull pulses that drive the Snap-off diode to non-conduction.

The Strobe Drive pulse is transformer-coupled by T75 to the base and emitter of Avalanche transistor Q69. Two outputs are ac-coupled from Q69, one from the collector and the other from the emitter. The Avalanche Volts control adjusts the collector voltage of avalanche transistor Q69. The typical quiescent voltage at Q69 collector is about +15 volts. This voltage sets the amplitude of the signals that drive the Snap-off diode circuit and assures the normal avalanche action of Q69 when driven by the Strobe Drive signal. Before Avalanche conduction, there is a potential of about 60 volts between Q69 collector and emitter.

The negative Strobe Drive pulse is transformed into a hard forward bias signal to Q69. Normal avalanche action follows with the collector going negative and the emitter going positive. This fast-rise, push pull signal is capacitively coupled to the Snap-off circuit.

The Snap-off Circuit operates as a current switching circuit to apply some of the push-pull Avalanche current signal at snap-off time to the Sampling Gate. The circuit consists of a Snap-off Current control R57, Q55, Snap-off diode D61, two clipping lines and associated components. Between drive pulses from the Avalanche circuit, the Snap-off diode D61 is forward-biased by the current in Q55. The current value is set by the Snap-off Current control R57. The current in D61 is typically 20 mA. This forward current assures that D61 has many carriers within its junction region.

The push-pull signals from the Avalanche circuit cause D61 junction carriers to reverse direction as a heavy reverse current. This heavy reverse current stops suddenly as all the carriers clean out of the junction. As the reverse current "snaps" to a stop, the push-pull avalanche signals are suddenly coupled into the clipping lines by C52 and C54 and toward the Sampling Gate by R51-C51 and R53-C53. The fast-rise step which appears at each clipping line input is propagated down the line. About 50 ps later the steps reach the short circuited ends of each clipping line. The step is then reflected, equal in amplitude and opposite in polarity, back to the input end of each clipping line. This cancels the signals moving toward the Sampling Gate. This action results in a positive Strobe pulse being delivered to P53, and a negative Strobe pulse being delivered to P51.

The clipping lines have a surge impedance of approximately 10 Ω with a very good short circuit at the shorted ends. The high quality of the short, and the line low impedance causes the reflected signal to stop the Strobe pulses very rapidly. Such rapid ending of the Strobe pulse and the characteristics of the traveling wave Sampling Gate causes each sampling diode to turn off in approximately 10 ps.

Ringing of the Snap-off diode and the clipping lines is mainly prevented by R50 which is directly across the lines

ends. Ringing is also limited to some degree by the two equal resistors R60 and R62 that are in DC series connection with the Snap-off diode D61. The primary function of R60-R62, however, is to provide a DC path for D61 forward conduction while at the same time allowing the Avalanche signals to pass on into the clipping lines and Sampling Gate. As the Avalanche pulses end and as both the Avalanche and Snap-off circuits recover for another sample, R60-R62 re-establish the correct quiescent charges on C63 and C64. C59 assures a very low impedance AC path for the ground side of R60 so that R60 and R62 will both have the same affect upon the circuit.

Another technique for minimizing Strobe ringing is that of R51 and R53 being in series with the output lines to the Sampling Gate. The output connectors that connect the Strobe board to the Sampler board have a 50 Ω characteristic impedance. R51 and R53 raise the Clipping lines 10 Ω impedance drive to 50 Ω to properly match the connections. Thus, at the end of the Strobe pulse, reflections back from the Sampling Gate are reverse terminated. These resistors and the resistors discussed in the preceeding paragraph all assure that there is no possibility of double strobing of the Sampling Gate due to ringing of the Strobe Generator circuits.

Two separate ground planes are identified on the main schematic diagram between the Avalanche and Snap-off circuits. Two resistors connect the two ground plane ends together to damp any natural ringing when the case is off. Ringing can occur without R52 and R54 because the two ground planes are connected together at the instrument front and rear through the Sampler board. Component layout is organized so the strobe signal ground currents balance to zero at the center of the Sampling Gate, and thus do not contribute unwanted currents to the input signal. Q69 circuit is capacitively isolated from both ground planes as much as possible, with its primary signal output path being through C63-C64 and C52-C54. There is a small third terminal capacitance to ground between the two windings of T75, but it is not large enough to disturb the balanced drive from Q69 to D61.

Sampling Gate and Gate Bias Circuits

The Sampling Gate consists of six series diodes, D2 A through F, and four resistors all mounted on a ceramic substrate inside the input circuit holder. See Fig. 3-1 during the following discussion.

The signal that arrives at J1 travels right on through the Sampling Gate area to a 3 mm 50 Ω 10X (20 db) attenuator. Output of the attenuator feeds the Trigger and Blow-by Compensation circuit where it is terminated in 50 Ω. When not being strobed, D2C and D2D present a very small value of capacitance to the input signal. When the diodes conduct due to Strobe current, the input line is coupled to the traveling wave gate.

Gate Biasing

Quiescent condition of the Sampling Gate diodes is controlled by the Gate Bias circuit. D2A, D2B, D2E and D2F are each reverse biased about 0.5 volts by D20, D23, D25 and D28. D2C and D2D are reverse biased about 1.2 volts each, a total of about 2.45 V is developed across the parallel combination of R24-C25 of the Gate Bias circuit. The Gate Bias circuit receives its current from the two 50 V supplies and R30-R31-R32-R33 and R34 of the Gate Balance control circuit. The diodes of the Gate Bias circuit are used as 0.5-volt Zener diodes. R2A-R2F with C24 and R2B-R2E with C25 isolate the traveling wave gate segments from the Preamp and Bias circuits R21-R26 conduct DC bias potentials to the gate but allow a sampled error signal to drive C24 and the Preamplifier input.

Except for the very short strobed conduction time (about 125 ps), the Sampling Gate diodes do not conduct. A portion of the input signal is coupled through stray capacitances to the Preamplifier input, and disturbs the normal sampling display. This effect is known as "blow-by".

Blow-by Correction

The basic risetime of the traveling wave Sampling Gate is 25 ps. In this extremely short interval of time, only a very small amount of charge can be collected in one sample. What small charge is collected, is called the error signal and is amplified by the Preamplifier and the sampling unit circuits. The Preamplifier has a shaped frequency response best suited to amplifying each sample's small charge and delivering a proper error signal to the sampling unit.

It is impossible to build a sampling gate without a path for blow-by displacement currents. These currents cause the Preamplifier to respond to a part of some input signals and distort the display. The Type S-4 Preamplifier responds to signals in the 0.5 to 3 MHz bandpass region. Signals much higher or lower in frequency are not amplified. Those blow-by signals in the Preamplifier bandpass region that do get through the Sampling Gate are virtually eliminated by the Blow-By correction amplifier Q10.

Blow-by rejection in the Sampling Gate is assured by the double differentiation networks that have very fast RC times. They are located between the signal input and the Preamplifier. The first differentiation network is formed by reverse biased diodes D2C and D2D and their respective resistors to ground (see Fig. 3-1), R2B and R2E. The second network is formed by diodes and resistors D2B, D2E and R21, R26, respectively. All the Sampling Gate diodes

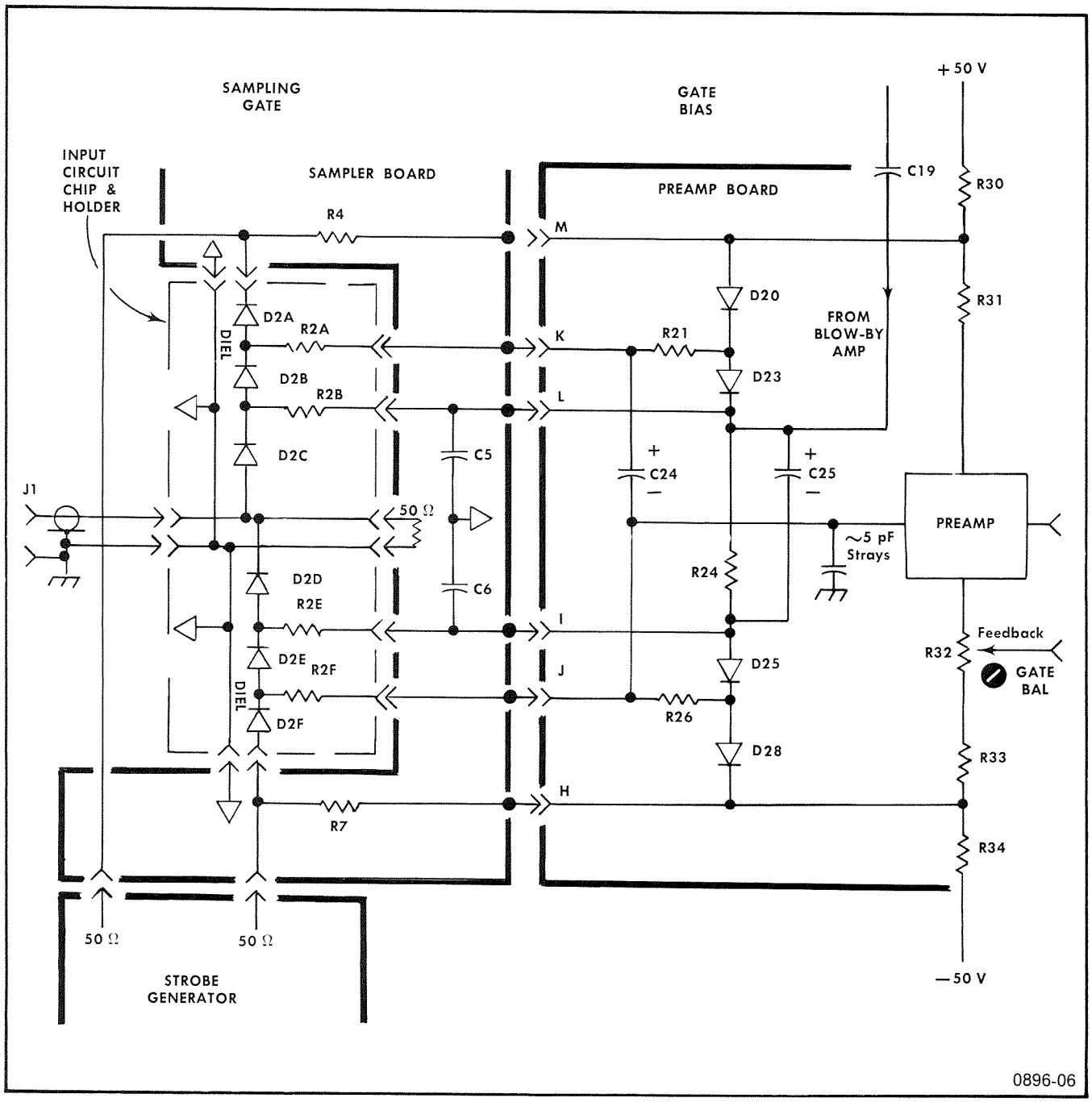


Fig. 3-1. Traveling wave Sampling Gate and Gate Bias circuit components, with input signal blow-by differentiating paths shown by dotted lines.

are normally non-conducting and are therefore very small capacitors. the differentiating networks eliminate all but about 5% of the possible blow-by effects. The Blow-By correction amplifier feeds an inverted replica of the input signal into the Sampling Gate output, and a small quantity of charge passes through C19 to cancel most of the remaining blow-by signal.

Traveling Wave Sampling Gate

Push-pull strobe pulses from the Strobe Generator cause the six Sampling Gate diodes to conduct for about 125 ps. While the diodes are conducting, the signal at the input connector propagates down the diode transmission paths as well as toward the 10X attenuator, R3. As the fast falling strobe pulse end begins to propagate into the diode trans-

mission paths, the diodes are quickly switched off (into reverse bias), one set after another. First, diodes D2A and D2F turn off, then D2B and D2E, and finally D2C and D2D. Turn off time of the diode sets is controlled by the mechanical spacing and thereby the propagation time between sets. The Sampling Gate risetime is determined by these propagation times, and is thus not heavily influenced by the strobe pulse amplitude or duration. The sampling process is thus one of trapping signal charge between sets of diodes, in particular, between set D2A-D2F and the set D2B and D2E. The risetime is very close to the double transit time between sets.

Once the signal charge trapping process has taken place at the strobe pulse end, the Preamplifier begins to receive the trapped charge by conduction through resistors R2A and R2F (See Fig. 3-2). The Preamplifier input capacitance is much larger than the capacitance of the transmission line segments between the diode sets, causing practically all of the trapped charge to finally transfer to the Preamplifier input. The transfer time constant is approximately 10 nanoseconds.

Because of the carefully adjusted balance of the plus and minus strobe signals (set by the physical position of R51 and R53 in the Strobe Generator), the Preamplifier receives only the trapped signal charge and nothing from the Strobe Generator.

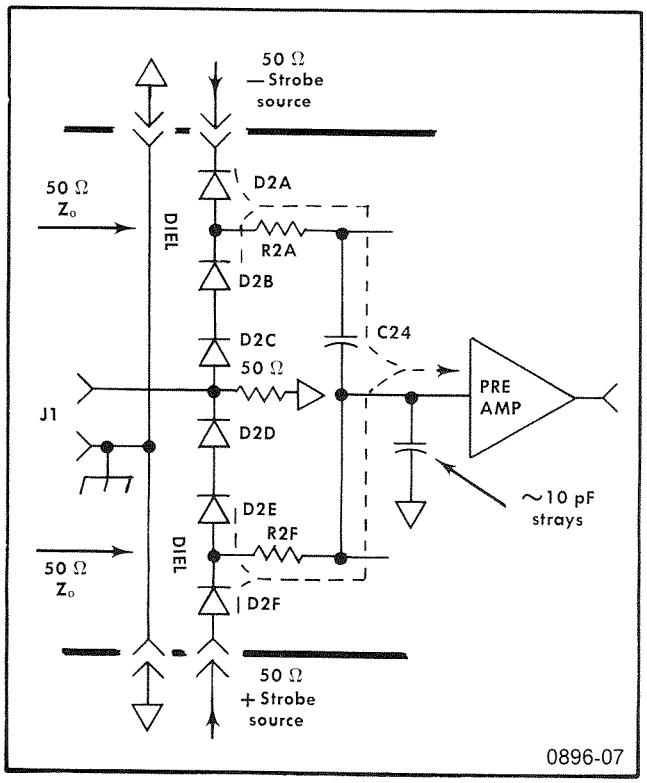


Fig. 3-2. Error-signal source and path to Preamp shown by dotted lines.

Preamplifier

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

Input transistor Q36 operates as a very high input impedance, high-gain inverting amplifier. Temperature compensation for Q36 is accomplished by thermistor R38. A total of 4.4 mA channel current passes from the +50 volt supply through R36, Q36, R38 and R40 to the −50 volt supply. C39 assures that Q36 AC gain is high, while its DC gain is less than 1.

Q43 and Q46 are connected as an operational amplifier with a very low output impedance at Q46 emitter. The output is coupled by C50 to the 90 Ω input resistance of the Post Amplifier in the sampling unit. R37 and R39 provide temperature compensation to stabilize loop gain. D41 protects Q43 base from high negative voltage if Q46 is removed from its socket.

Current in R42 with DC negative feedback by R48 sets the output DC voltage level of the amplifier at about 7.3 volts. Negative AC feedback from the emitter of Q46 through C49 and Gain control R49 to Q43 base controls the AC gain of the Preamplifier. Gain control R49 allows the AC feedback to be adjusted, thereby adjusting the gain. The AC gain is adjusted during calibration so that the sampling head has the correct amplitude output signal to the sampling unit Post Amplifier.

The Type S-4 sampling efficiency is less than 2%. With a low sampling efficiency, the Preamplifier positive and negative signal output impedance must both be low. Q46 assures a low output impedance for positive-going output pulses, and D43 assures a low output impedance for negative-going output pulses. D43 conducts only for large negative output signals that fall at a rate faster than Q46 emitter can follow. Q46 emitter remains a low output impedance for small negative output signals.

Components not already mentioned above include: C47 and R46 that both prevent parasitic oscillations of Q46, and C45-C46 that decouple the +15-volt supply for both low and high frequency current pulses of Q46.

Blow-by and Trigger Pickoff

The Blow-by and Trigger Pickoff circuits consist of Q10, Q14 and associated components connected as a common-

emitter paraphase amplifier. The primary purpose of the circuit is to cancel unwanted high frequency capacitively-coupled signals that bypass the Sampling Gate. The secondary purpose is to provide a trigger pickoff signal to the sampling unit for internal triggering of the sampling sweep unit.

Input signal to the Blow-by and Trigger Pickoff circuit is a portion of the Type S-4 input signal. The signal is fed to the base of Q10 through R3. R11 terminates the 50 Ω impedance of the input and assures no reflections back onto the input circuit. The output from Q10 collector feeds an AC coupled signal to the output side of the Sampling Gate, cancelling the blow-by signal. The output from Q14 collector feeds a DC coupled trigger pickoff signal to the sampling unit for use by the sampling sweep unit.

Feedback Limiting

The Preamplifier input is the input terminal of an integrating pulse amplifier that includes the sampling unit Post Amplifier, AC Amplifier, Memory Gate and Memory Amplifier. Feedback from the Memory Amplifier output is DC coupled to the Type S-4 Preamplifier input through the sampling unit Feedback Attenuator and the Type S-4 Gate Bal control.

As a sample is taken, the error signal is amplified and converted to a DC signal for both the CRT and the feedback that arrives through pins 2 and B of the sampler board. The maximum feedback is limited to approximately ±1.2 volts by two resistive dividers and D80 and D83. The limiting is to prevent excessive feedback voltge from reaching the Sampling Gate when the sampling unit Units/Div switch is changed between positions. In certain conditions of operation, the excessive feedback can cause the Sampling Gate to go into a mode of conduction that holds the CRT beam off screen. By limiting the feedback amplitude, overdriven displays will leave the CRT screen but will return just as soon as the overdrive is removed. Without the limiting, an overdrive signal could cause the display to disappear.

PERFORMANCE CHECK AND CALIBRATION

This performance check and calibration procedure for the Type S-4 Sampling Head requires the use of the test equipment listed below. The test equipment specifications given are the minimum acceptable for the particular use of each item. If other test equipment is substituted, it must meet or exceed the stated requirements. All test equipment must be correctly calibrated.

Table 4-1
TEST EQUIPMENT REQUIRED

Description	Requirements	Example
Oscilloscope Mainframe	for sampling Plug-ins	7000 Series Mainframe
Sampling plug-in Vertical	for S-4 sampling Head	7S11
Sampling Horizontal Plug-in	for use with sampling Vertical	7T11
Test Oscilloscope	DC to 30 MHz, 0.5 V/div vertical sensitivity	2213A
10X probe	for use with test oscilloscope	P6120
Signal/Pulse Generator	Pulse rise time 70 ps or or less, amplitude approximately 20 mV into 50 Ω. Trigger 180 mV positive going at least 75 ns in advance of pulse with risetime of ≤400 ps. Square wave outputs of 1 μs and 1 ns with 100 mV and 1.0 V amplitude into 50 Ω.	Tektronix Type 284
Pulse Generator	rise time 25 ps or less, amplitude ≥200 mV into 50 Ω with 180 mV positive going trigger at least 75 ns in advance of the fast pulse.	Tektronix Type S52
Rigid Coax line, 3 mm connectors	Test Procedures	Tektronix Part No. 015-1015-00
GR874 to 3 mm adapter plug		Tektronix Part No. 015-1007-00
GR874 to 3 mm adapter jack		Tektronix Part No. 015-1008-00
50 Ω 2X coaxial attenuator, GR874 connectors		Tektronix Part No. 017-0080-00
Special variable attenuator with GR connectors	Response not guaranteed	Tektronix Part No. 067-0511-00
bnc 50 Ω cable approximately 40 inches long.	(2 required)	Tektronix Part No. 012-0057-01
bnc to bsm cable approximately 18 inches long		Tektronix Part No. 012-0127-00
Special 3 foot extender cable for sampling head		Tektronix Part No. 012-0124-00

Table 4-1 (cont)

Description	Requirements	Example
Clip lead to bnc adapter		Tektronix Part No. 013-0076-00
DC Bridge	For measuring 50 Ω ±5 Volts maximum across 50 Ω resistor accurate within ±0.5%	
RMS line voltage meter	±3% at input line voltage range	
Test sampling oscilloscope	For checking strobe kickout.	7000 series with 7T11, 7S11, and a type S-2 sampling head.

PRELIMINARY PROCEDURE

1. Check the 50 Ω DC Input Resistance. With the sampling head separated from the sampling unit, use a DC Resistance Bridge and measure the DC input resistance. Connect one lead to the input connector outer conductor, and the other lead to the center conductor. Be sure the bridge does not apply more than ±5 volts to the input terminals.

The Type S-4 input resistance must be 50 Ω, ±5%, for a resistance reading of 47.5 Ω to 52.5 Ω.

2. Setting up the equipment.

a. Assembly the indicator oscilloscope system. Place the type 7S11 into the right vertical compartment of the indicator oscilloscope, and the Type 7T11 into the horizontal compartment. Install an operating sampling head into the Type 7S11 compartment.

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

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

d. Connect the Type 284 Square Wave Output connector to the sampling head input. Use a 5 ns signal delay 50 Ω coaxial cable with GR 874 connectors. Connect the Type 284 Trigger Output connector to the sampling sweep unit External Trigger input (50 Ω) connector, using a BNC 50 Ω coaxial cable.

Set the Type 284 Period at 100 ns Square Wave and the Amplitude at 1 volt. Using the Type 284 as both a time and amplitude reference adjust both the vertical and the horizontal unit screwdriver adjustable Gain controls for proper deflection factor of each unit. Remove sampling head from the 7S11.

e. Install the Type S-4 onto the special three foot extender cable. Connect the other end of the cable into the 7S11 sampling head compartment. Allow a five minute warm up of the system.

NOTE

The case should be in place unless access to internal controls is necessary.

f. Set the controls as listed following Fig. 4-1.

Sampling Unit (Both channels)

Dot Response	Midrange
Unit/Div	100
Variable	Cal
Up	Pushed in
Position	Midrange
DC Offset	0 volts at Offset Out

Sampling Sweep Unit

Scan	Rep
Sequential	Pushed in
Time/Div	50 ns
Swp Range	0.5 μs
Variable	Cal
Time Position controls	Fully clockwise
Trig Sensitivity	Stable Display
Trigger Polarity	+
Trigger Source	Ext
Scan	Mid-range

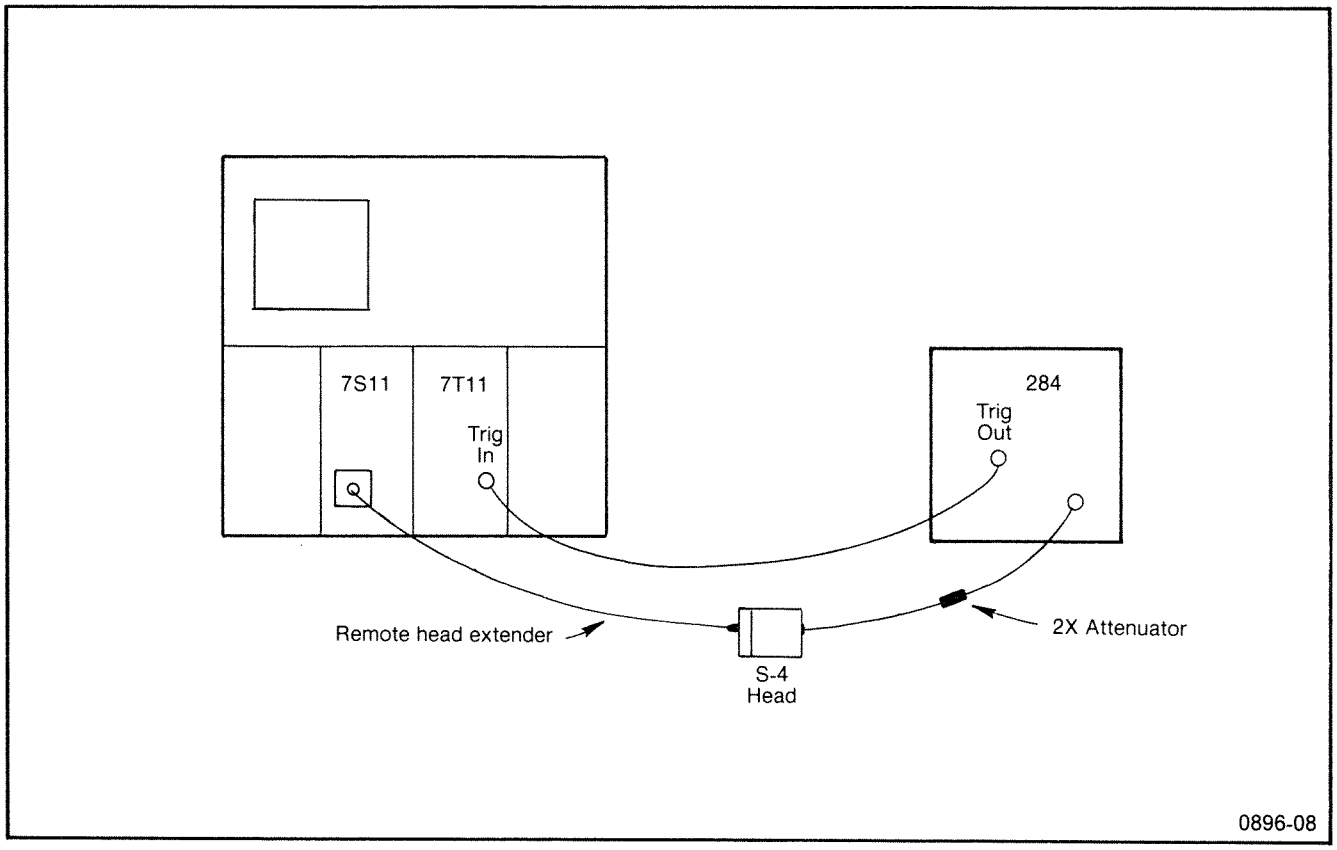


Fig. 4-1. Initial equipment setup.

Type 284

Mode	Square Wave
Period	100 ns
Square Wave Amplitude	1.0 V
Lead Time	75 ns

Test Oscilloscope

Triggering	+ Int, AC
Time/Div	0.2 μs
Vertical	
With 10× Probe	1.0 V/Div, AC

PERFORMANCE CHECK AND CALIBRATION PROCEDURE

1. Check Ability to Produce a CRT Display

a. Connect the Type 284 Square Wave Output signal to the Type S-4 as shown in Fig. 4-1. Use a 2× GR attenuator at the Type 284 Output connector and a GR to 3 mm adapter to the Type S-4 input connector.

b. Check the CRT for a normal square wave display. If the display is normal, proceed to step 3. If there is no display, perform step 2.

2. Check Strobe Operation

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

b. Remove the Type S-4 case. First, remove the four round-head screws, visible at the back casting, then slide the cover off by gently pulling it away from the front casting and input connector.

c. Reconnect the extender cable to the Type S-4. Use care to properly align the Trigger Pickoff connector.

d. Check for proper strobe operation by connecting a 10× probe from the test oscilloscope to the emitter of Avalanche transistor Q69. Amplitude of the waveforms is affected by adjustment of Avalanche Volts control R66. Check the waveforms at the collector of Q69 and at the Primary of T75 (Pin E of the Strobe Board). Typical displays are shown in Fig. 4-2.

3. Adjust Avalanche Volts and Snap-Off Current

Avalanche Volts control R66 alters the strobe pulse amplitude and risetime. These affect the display noise, balance,

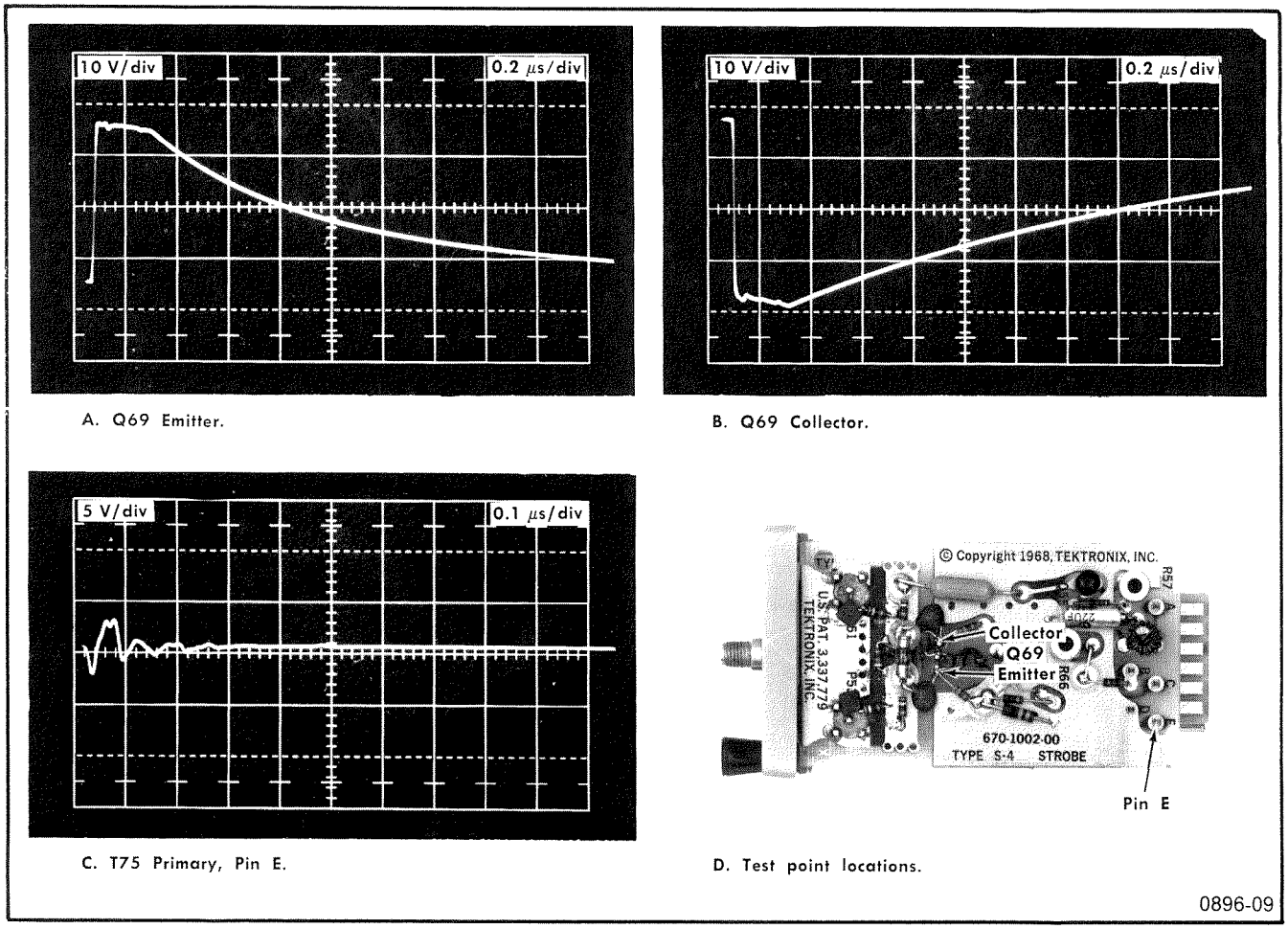


Fig. 4-2. Typical displays for Q69 operation.

and dot transient response. Snap-Off control R57 affects display noise, balance, and strobe kick-out.

a. Disconnect the 2× GR attenuator from the Type 284. Leave the attenuator and adapter attached to the Type S-4.

b. Set the Type 7T11 Trigger Sensitivity control for a free-running trace.

c. Set Avalanche Volts control R66 (see Fig. 4-3) and Snap-Off Current control R57 to midrange.

d. Turn the Avalanche Volts control R66 clockwise into the free-run position. The trace will become very noisy. Turn R66 counterclockwise about 30° or more from the free-run position.

e. Set Snap-Off Current control R57 for the minimum amount of current to center the trace on the CRT. This will appear as the first nulling as the trace moves on the CRT with clockwise rotation of R57.

f. Fine adjustment of the controls is made for maximum loop gain and best dot transient response linearity. Connect the Type 284 Square Wave Output to the Type S-4 Input connector through the 2× attenuator and 3 mm to GR adapter.

g. Set the sampling sweep unit to Int. Trig. and the sweep rate to 20 ns/div and obtain a double triggered display. The display may show greater than unity loop gain as a double trace. See Fig. 4-5.

h. Set the Avalanche Volts, R66, and the Snap-Off Current, R57, controls for maximum loop gain (two traces on

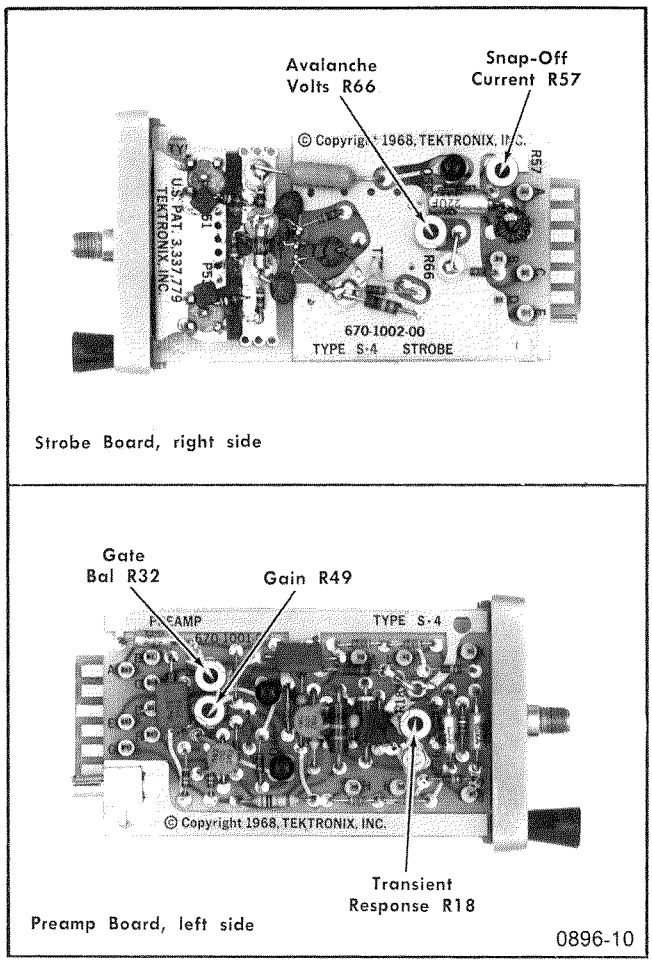


Fig. 4-3. Type S-4 internal control locations.

the square wave) and linearity (difference at upper and lower trace separations should be equal).

i. Disconnect the 2× attenuator from the Type 284 and Type S-4.

4. Check or Adjust Strobe Kickout

NOTE

Strobe kickout needs to be checked only if the Sampling Gate substrate assembly or Strobe Board have been replaced or R57 or R66 has been adjusted.

a. Install the extender in the 7S11 and attach the Type S-4. Connect the Type S-4 Input connector through a 3 mm to GR adapter to the sampling test oscilloscope.

b. Connect the Type 284 Trigger Output to the indicator oscilloscope sampling sweep unit Trigger Input 50 Ω connector with a BNC cable. Set the Type 284 Mode switch to Pulse Output.

c. Connect the 7T11 Pulse Out connector through a BNC cable to the External Trigger Input 50 Ω connector on the sampling test oscilloscope.

d. Set the indicator oscilloscope sampling sweep unit controls as follows:

Time Position	Midrange
Time/Div	5 ns
Range	50 ns
Display Mode	Manual
Manual Scan	Midrange
Trigger Sensitivity	Fully clockwise
Stability	Fully counterclockwise
Polarity	+
Trig	Ext 50 Ω

e. Set the sampling test oscilloscope as follows:

Sampling Sweep Unit

Time/Div	5 ns
Time Position	Clockwise
Trigger Source	Ext
Slope	+
Sweep Mode	Ref
Trigger Sensitivity	10 o'clock

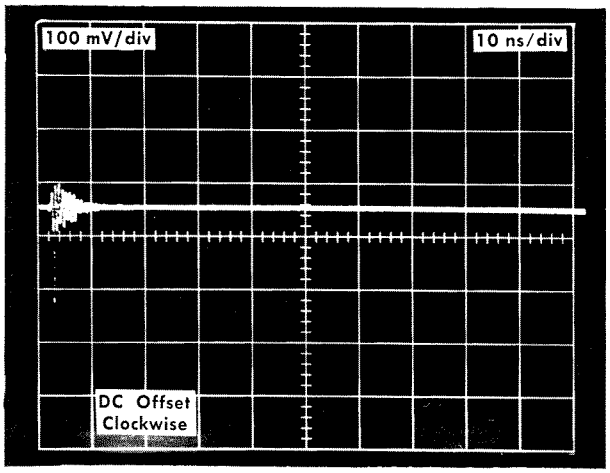
Sampling Unit

Millivolts/Div	50
DC Offset	Centered display
Other controls	Optional

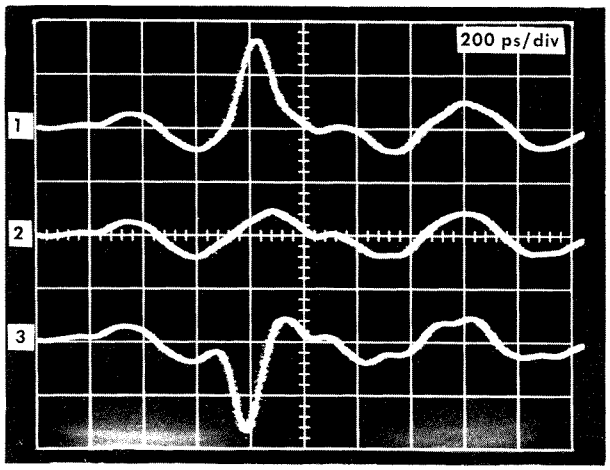
Adjust the indicator oscilloscope sampling sweeps MAN SCAN and TIME POSITION to display kickout on the sampling test oscilloscope.

f. Set the indicator oscilloscope sampling unit Units/Div switch to 2 and rotate the DC Offset control. The sampling test oscilloscope CRT display should show a spike in the ringing portion, positive for counterclockwise rotation and negative for clockwise rotation. This identifies the Strobe kickout. Place the ringing portion in the first division with the Time Position/control, see Fig. 4-4.

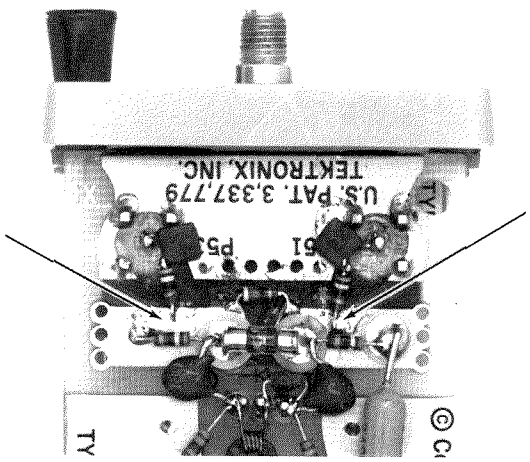
g. Change the sampling test oscilloscope sweep rate to 200 ps/div. Fig. 4-4 shows the sampling unit (1) DC Offset



A. Locating the ringing portion.



B. DC Offset control for Strobe kickout location.



C. Location of the solder points.

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Fig. 4-4. Strobe kickout from the Type S-4 Input connector.

control counterclockwise, (2) DC Offset control set for minimum of both strobes, and (3) DC Offset control set clockwise. Set the indicator unit DC Offset control for minimum amplitude of both strobes.

h. Set the indicator sampling unit Units/Div switch to 100 and check the kickout. Amplitude up to a 50 mV peak is acceptable.

i. Reduce the kickout amplitude by moving the solder point on the clipping lines of R51 or R53. Since the solder points are at ground potential, the CRT display is observed as the lead is heated with a small soldering iron and moved with a soldering tool. Keep the solder points as close to R50 as possible. Fig. 4-4 shows the solder points on the clipping lines.

j. Set the sampling test oscilloscope at 1 ns/div.

k. Set the indicator oscilloscope sampling unit Units/Div switch to 2 and the DC Offset control fully clockwise.

l. Check that the kickout occurs within 1.2 ns of the beginning of the ringing portion. If not, readjust the Snap-Off Current control. To place the kickout within 1.2 ns of the beginning of the ringing.

The case on the Type S-4 may change the kickout amplitude from that observed with the case off. Desired minimum is with the case on the Type S-4 and several attempts may have to be made.

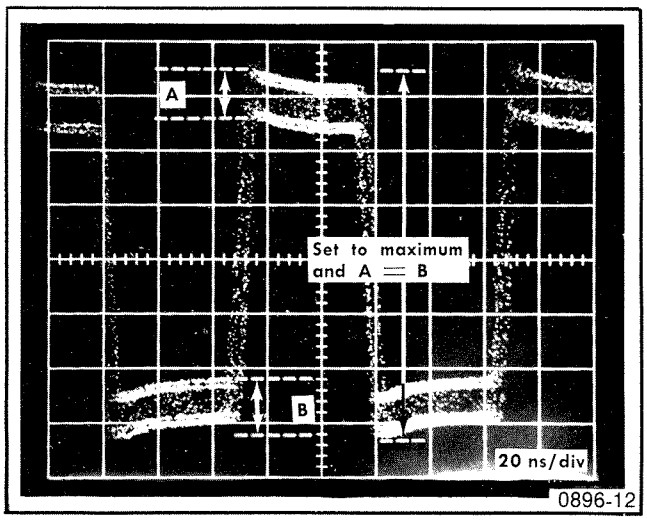


Fig. 4-5. Fine adjustment of Avalanche Volts and Snap-Off Current.

5. Adjust Gate Bal

Gate Bal control R32 introduces an internal offset voltage to the feedback loop to cancel normal error signals in the sampling loop, including normal unbalance in the traveling wave gate. R32 is adjusted (with DC Offset at zero) to cancel most of the vertical trace shift as the Units/Div switch setting is changed.

a. Set the sampling unit DC Offset control for zero volts at the Offset Out jack.

b. Observe the trace as the sampling unit Units/Div switch is operated through its ranges and adjust Gate Bal control R32 for no more than one division of vertical shift of the trace. This adjustment varies with changes in the extender cable and when the Type S-4 case is removed or replaced. The Gate Bal control should be readjusted each time the equipment configuration is changed (cable moved or Type S-4 cover removed or replaced).

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

6. Check Dot Transient Response

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

a. Connect the Type 284 Square Wave Output connector to the Type S-4 input connctor with the 2× GR attenuator or variable attenuator and 3 mm to GR adapter.

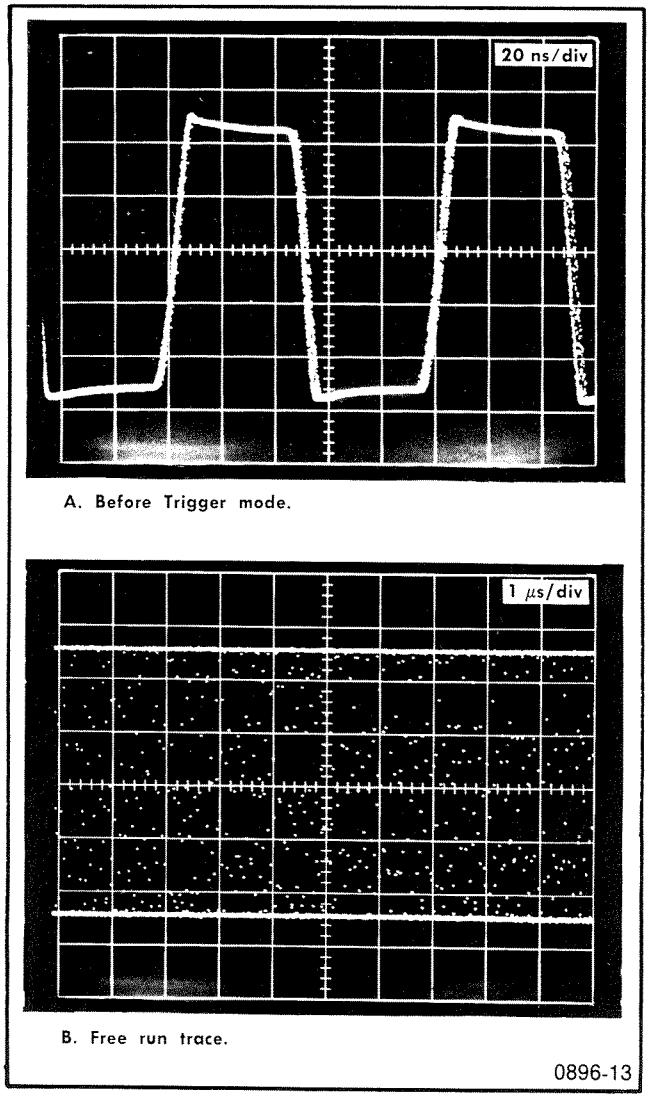
b. Connect the coaxial cable from the Type 284 Trigger Output to the sampling sweep Trigger Input connector.

c. Set the Type 284 Period switch to 100 ns sampling. Set the 7T11 Range switch to .5 μs, the Time/div to 20 ns.

d. Set the sampling unit Units/Div switch to 100 and free run the sampling sweep unit at 0.5 μs/div.

e. Set the sampling unit Dot Response so the top of the square wave is at unity loop gain (one trace). The bottom of the square wave can show two traces, but the dot response overshoot or undershoot must not be greater than 5%, or 0.25 major division on the graticule (see Fig. 4-6).

If the dot response overshoots or undershoots more than 5%, perform step 7 (perform Step 7 for a complete recalibration.)



A. Before Trigger mode.

B. Free run trace.

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Fig. 4-6. Dot Transient Response check.

7. Adjust Gain

Gain control R49 changes the feedback loop gain.

a. Use the same setup as the preceding steps. Set the sampling unit Dot Response control to its electrical midpoint. The electrical midpoint is found by watching the changes in the display with greater or less than unity loop gain and setting the Dot Response control half-way between maximum loop gain and minimum loop gain.

b. Adjust Gain control R49 for unity loop gain as shown in Fig. 4-6.

Fine adjustment of Avalanche Volts control R66 and Snap-Off Current control R57 for the best dot transient re-

sponse with minimum noise may correct a dot response overshoot or undershoot in excess of the 5% tolerance. Sampling gate replacement may cause unbalanced response. See step 4 for adjustment of strobe pickoff resistors R51 and R53.

8. Check Maximum Operating Signal Voltage

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

a. Connect the Type 284 Square Wave Output to the Type S-4 through a 3 mm to GR adapter and the solid coaxial 3 mm line.

b. Connect the Type 284 Trigger Output to the sampling sweep Trigger Input.

c. Set the sampling unit Units/Div switch to 20. Set the Type 284 Period switch to 1 μs and the Amplitude switch to 100 mV.

d. Set the sampling sweep unit for a 200 ns/div sweep, and obtain a stable display. Observe the top and bottom portions of the display.

e. Change the Units/Div switch to 200 and the Type 284 Amplitude switch to 1.0 V.

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

A distorted Square Wave display may be caused by Gate unbalance. Check step 5, Adjust Gate Bal, or replace the substrate assembly, see the Maintenance section.

g. Remove the 3 mm GR adapter and the solid coaxial 3 mm line.

9. Check Displayed Noise (Tangential)

NOTE

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

Requirement—Tangential noise will be not greater than 5 mV, with the case on the Type S-4.

a. Connect the Type 284 Square Wave Output to the Type S-4 Input connector with the 2× GR attenuator, variable attenuator, and the 3 mm to GR adapter. Set the 284 to 100 mV and 100 ns period.

b. Set the sampling unit Units/Div switch to 10 and the Variable control to Cal.

c. Set the 7T11 sweep range to 5 μs, the time/div to .5 μs sweep and the Trigger Sensitivity control clockwise for free run operation. Disconnect the coaxial cable to the Trigger Input connector.

d. Refer to Fig. 4-7 for displays of the following noise measurement procedure.

(1) Obtain a display of two traces.

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

(3) Change the Type 284 Amplitude switch to 1.0 V, 10 times the signal amplitude. The display now has tangential deflection factor of 1.5 mV/div.

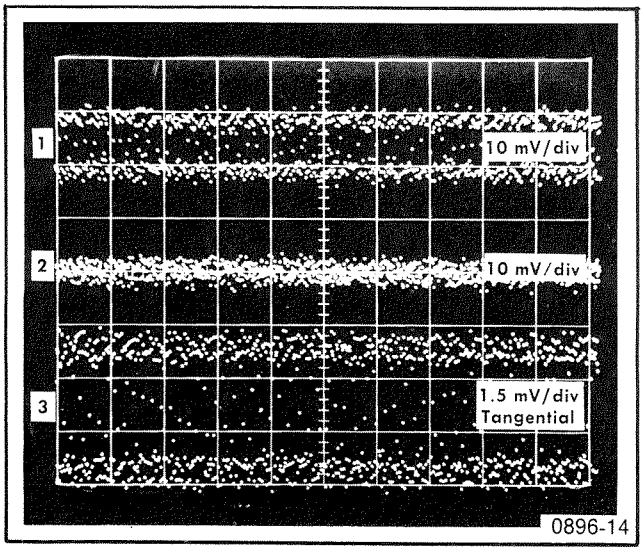


Fig. 4-7. Triple exposure of Tangential noise measurement.

Tangential deflection factor per division is equal to the Units/Div setting of 10 mV divided by 2, times 3 divided by 10 = 1.5 mV/div.

The 5 mV tangential display noise limit includes 3.33 graticule divisions (3) of Fig. 4-7. Check that the bottom edges of the two traces are not more than 3.33 divisions apart. Waveform (3) measures as 3.6 mV tangential noise.

Determining Tangential Noise Deflection Factor.

The noise displays of Fig. 4-7 have a noise deflection factor based upon the signal amplitude, the sampling unit Units/Div setting, the fact that the final trace separation is twice the RMS noise, and that the tangential noise is 3 times the RMS noise. The square wave signal amplitude that makes two traces appear as one sets the trace separation to twice the RMS noise. The procedure used here then permits a noise deflection factor to be determined by dividing the input mV/div deflection factor by 2 (trace separation is 2 times the RMS noise), multiplying by 3 (tangential noise is 3 times the RMS noise) and then dividing by 10 (the signal amplitude change factor).

e. Disconnect the Type S-4 from the Type 284.

10. Check Risetime

Requirement—The 10% to 90% risetime is equal to or less than 25 ps, displayed as 35 ps or less using the Type S52 Pulse Generator 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.

Install another 7S11 in the left vert.

a. Install the Type S-4 in the sampling unit right 7S11 without the extender.

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

c. Connect the Type S-52 on the extender in the left 7S11 sampling unit. Connect the Pulse Output to the rigid coaxial line and to the Type S-4 Input connector. Connect the BSM to BNC cable from the Type S-52 Petrig Out connector to the sampling sweep unit 50 Ω Trigger Input connector.

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

e. Measure the risetime as follows:

(1) Mark reference points at maximum rate of change, the break points shown in Fig. 4-8.

(2) Mark the centers of the 0% zone and 100% zone (the specified system risetime, 35 ps), 35 ps from the reference break points, shown in Fig. 4-8.

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

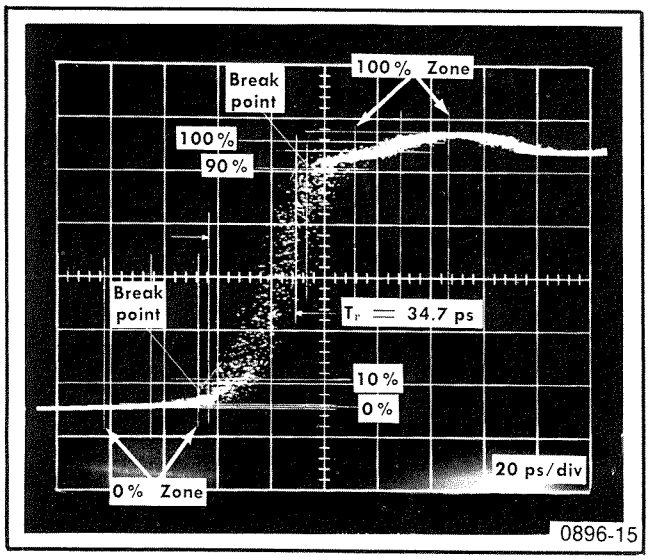


Fig. 4-8. Combination of Type S-4 and Type S-52 risetime measurement.

(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.

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

g. Use the same display and setup for the pulse flatness deviation check, step 10.

11. Check Pulse Flatness Deviation

Requirement—Pulse will deviate from the flat;

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

Between 400 ps and 25 ns after step, 0%, +10% or less, total less than 10% peak to peak;

After 25 ns, +2%, −2% or less, total less than 4% peak to peak.

The Type S-52 is used to determine pulse flatness deviation during the first 400 ps and the Type 284 is used after the first 400 ps.

Measurement of the pulse flatness deviation during the first 400 ps 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, as in the check of risetime.

a. Use the same setup as in step 10 and set the 100% zone on a graticule line. Change the sampling sweep unit sweep rate to 50 ps/div 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% (total of 20% peak to peak) during the first 400 ps, see Fig. 4-9A. 10% is a half division.

c. Disconnect the Type 52 from the rigid coaxial line.

d. Connect the Type 284 Pulse Output connector to the Type S-4 Input connector through a 3 mm to GR adapter and the 3 mm rigid coaxial line. Set the Type 284 Mode switch to Pulse Output. Connect the Type 284 Trigger Output to the sampling sweep unit 50 Ω Trigger Input connector through a BNC coaxial cable.

e. Set the sampling sweep unit sweep rate to 100 ns/div (Range switch to 5 μs, Time/div to 100 μs push random button and obtain a stable display.

f. Use the sampling sweep unit Time Position control to place the rising portion of the pulse one division from the left edge of the graticule. Set the sampling unit Variable Units/Div control for 5 divisions between the 0% amplitude and the 100% amplitude level. See Fig. 4-9B. Use the point 50 ns before the pulse as 0% and the point 500 ns after the pulse as 100%.

g. Change the Units/Div switch (without moving the Variable control) to 20 or a signal amplitude now 4% per division.

h. Position the trace bottom at the 100% (500 ns after pulse rise) amplitude point on the center graticule line.

i. Check the pulse flatness deviation from 25 ns after pulse rise through end of the pulse. (The Time Position control may be used.) See Fig. 4-9C.

j. Check that the pulse flatness deviation is not more than +2%, −2% (total of 4% peak to peak). If the deviation is more than specified, perform step 12, Adjust Transient Response.

k. Set the sampling sweep unit sweep rate to 5/ns.

l. Reposition the rising portion of the pulse one division from the left edge of the graticule. Check the pulse flatness deviation from 400 ps to 25 ns after the pulse rise. See Fig. 4-9D.

m. Check that the pulse flatness deviation is not more than 0%, +10% or total 10% peak to peak. Use the same setup to perform the Transient Response adjustment. If the pulse flatness deviation is within specifications, disconnect the Type 284 with the rigid coaxial line from the Type S-4 and remove the BNC coaxial cable from the sampling sweep Trigger Input and proceed to step 13.

12. Adjust Transient Response

Transient Response control R18 adjusts the magnitude of the blow-by correction signal; it does not change risetime.

a. Use the same setup as the pulse flatness deviation check, parts d through j.

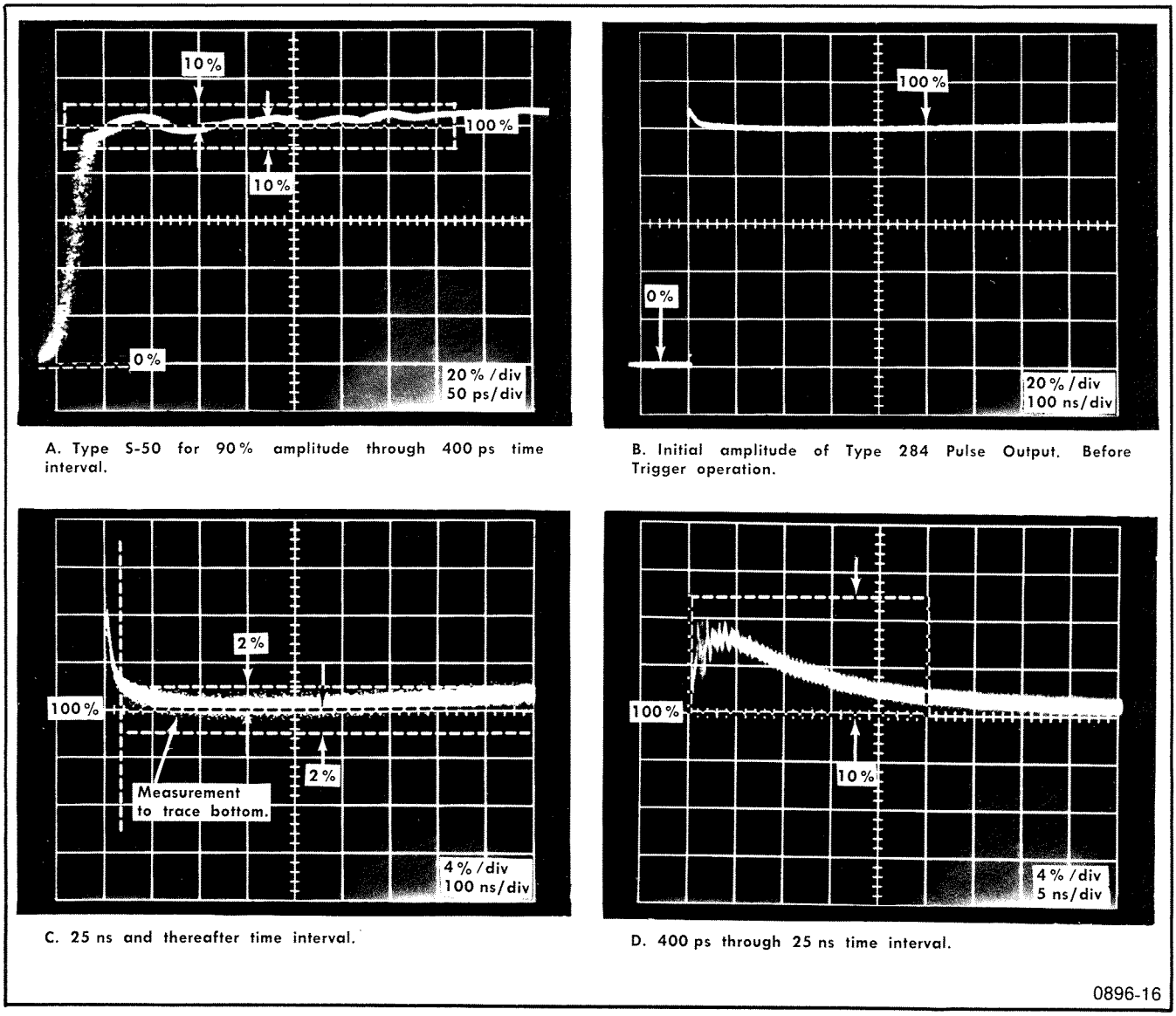


Fig. 4-9. Check of pulse flatness deviation.

b. Adjust Transient Response R18 so the pulse flatness does not deviate more than +2% or −2%, total 4% peak to peak, in the interval following 25 ns after the pulse rise. See Fig. 4-9C.

c. Disconnect the Type 284 with the rigid coaxial line from the Type S-4 Input and remove the BNC coaxial cable to the sampling sweep unit Trigger Input connector.

13. Check Baseline Shift With Repetition Rate Change

Requirement—A no signal-trace will not shift vertically more than 10 mV when the sampling sweep unit external trigger rate is changed from 30 Hz to 50 Hz.

a. Use the test oscilloscope as a trigger rate generator. Drive the sampling sweep unit external trigger input with the front panel +Gate signal (+20 volts peak). Connect the + Gate to the Type 7T11 connector and trigger on the − polarity of the signal.

Set the test oscilloscope sweep controls for a free run sweep. To obtain a 30 Hz trigger signal, set the Time/Div switch to 2 ns and the Variable time/div control to a position about mid range. To obtain a 50 kHz trigger signal, set the Time/Div switch to 20 μs and the Variable time/div control to a position midrange.

b. Connect the 3 mm to GR adapter and 2× GR attenuator on the Type S-4 Input connector.

c. Set the sampling sweep unit for an external triggered sweep rate of 50 ns/div (to ensure that the shortest trigger circuit holdoff period is obtained and that the triggering rate can actually follow the external triggering signal repetition rate).

d. Set the sampling unit Units/Div switch to 10. Connect the external trigger rate generator signal to the sampling sweep unit and obtain a triggered sweep at either 30 Hz or 50 kHz repetition rate. Set the sampling unit DC Offset control to place the trace at one of the graticule lines.

e. Change the trigger rate generator through its ranges to the other frequency limit and check that the CRT trace does not move up or down farther than a total of one division.

f. If the trace moves too far, check the avalanche transistor, Q69. This requires starting the procedure at step 1.

g. Disconnect the Trigger Input cable from the test oscilloscope.

MAINTENANCE

Introduction

This section is a maintenance guide for the Type S-4 Sampling Head. Some circuit testing and repair suggestions are included. See the Circuit Description for additional circuit details if a problem exists that is not covered here. Parts ordering, disassembly and reassembly information is also included.

To remove the Type S-4 Sampling 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.

Parts Removal and Replacement

All parts used in the Type S-4 can be purchased directly through your Tektronix Field Office or Representative, although standard electronic items may be obtained locally. Replacements for the special parts used in the Type S-4 should be ordered from Tektronix since these parts are either manufactured or selected by Tektronix to satisfy a particular requirement. Before purchasing or ordering, consult the Electrical or Mechanical Parts List to determine the value, tolerance and ratings required.

NOTE

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

Transistor Replacement. Cut the leads of a replacement transistor to the same length as the transistor removed and bend the leads as necessary. The lead configurations of the transistors used in the Type S-4 are shown in Fig. 5-1. Two transistors on the Trigger Amp circuit board (Q10 and Q14) have soldered leads. Field-effect transistor Q36 mounting has an arrow at the tab position.

Leadless Capacitors. There are leadless ceramic capacitors soldered directly to the circuit board. Care must be taken when replacing these capacitors as they crack easily. The type of solder used must be electronic grade 60/40 or 63/38 solder with good cold-flow characteristics.

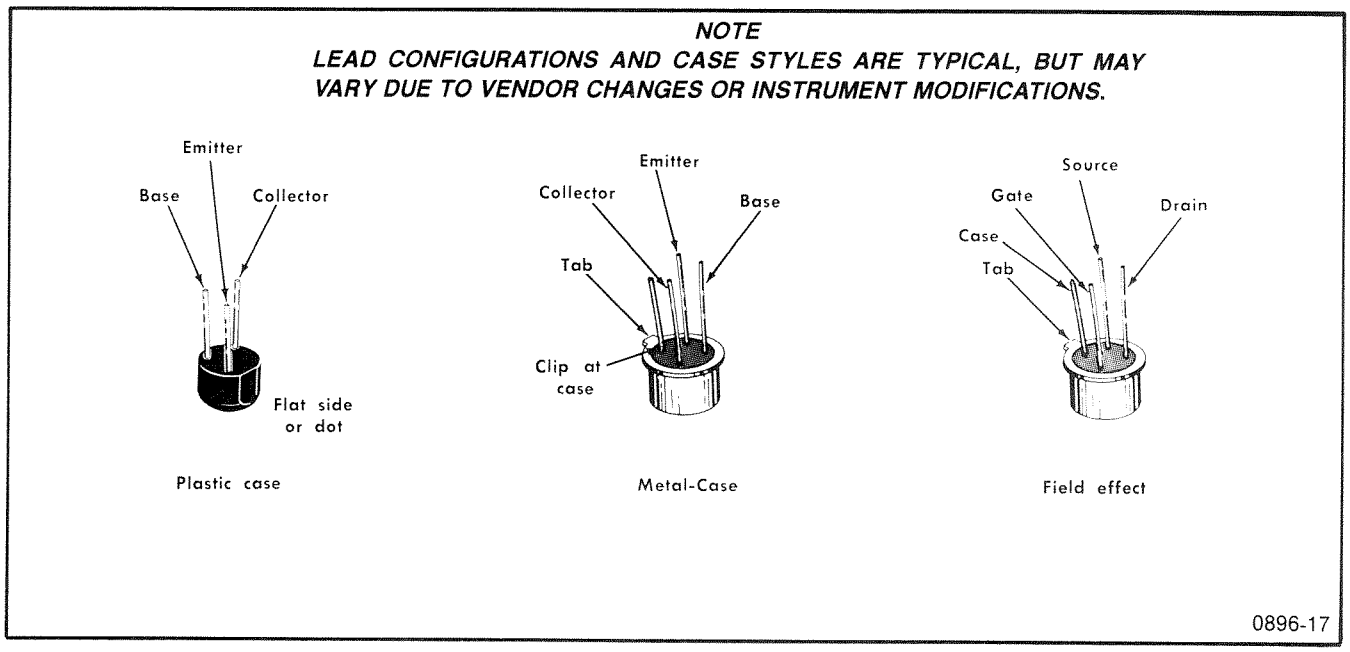


Fig. 5-1. Lead configuration of transistors in the Type S-4.

Solder the leadless capacitor into place by positioning the part and applying heat to the adjacent plated area. Solder leads to the leadless capacitor by applying heat to the leads. Excess solder on either side of the capacitor can lead to a shorted circuit.

Removal and Replacement of Snap-off Diodes. The Snap-off diode is mounted in small metal clips, as shown on the circuit board illustration.

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

The Strobe Board and the Preamp Board are removed by gently pulling outward from the Sampler Board. The Preamp Board holds the pretrigger output connector, P17, and a coaxial cable from the Trigger Amp Board soldered to the junction of R17 and R18. For replacement, align the connectors and pin contacts and ease the boards into position. Pin connectors should not protrude beyond the clamps.

Remove the Sampler Board as in Fig. 5-2 and as follows:

1. Loosen, but do not remove, the threaded nut on the Input connector with a 5/16 inch wrench.

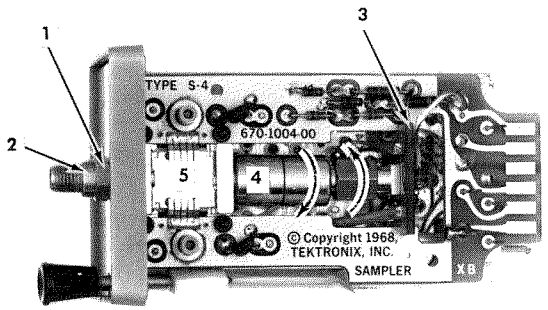
2. Loosen the Input connector with a 7/32 inch wrench. Remove the Input connector with the fingers.

3. Unsolder the −12.2 volt lead to the Trigger Amp Board.

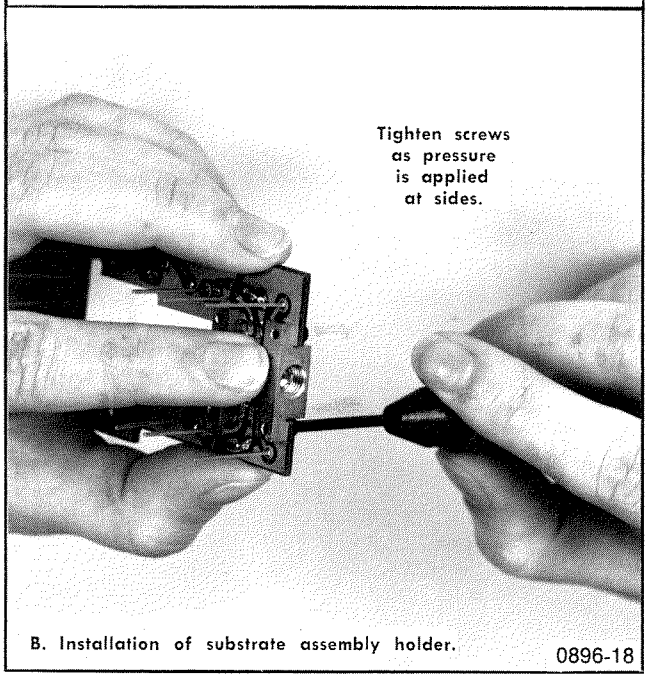
4. Loosen, but do not remove, the 5/16 nut holding the Trigger Amp Board. The Trigger Amp Board is wired to the Sampler Board and to the Preamp Board.

5. Remove the attenuator by unscrewing it from the substrate assembly (right hand thread) and then slide both the attenuator and the Trigger Amp Board to the rear.

6. Remove the substrate assembly, bracing it with a finger as in Fig. 5-2B, by removing the hexagonal screws with a 3/64 inch Allen wrench. Lift the substrate assembly away from the Sampler Board.



A. Removal of Sampler Board and mounted assemblies.



B. Installation of substrate assembly holder. 0896-18

Fig. 5-2. Sampler Board removal and reassembly.

NOTE

Do not touch the gold plated areas on the substrate, which are visible at the sides, due to the possiblilty of contamination from natural body oils.

Replacement of the mounted assemblies and the Sampler Board follows:

1. Place the substrate assembly on the Sampler Board between the pins, which prevent forward or backward movement, and brace the substrate assembly as the hexagonal screws are screwed in approximately half a turn. Apply pressure at the Sampler board sides, see Fig. 5-2B, and tighten the front screws. The substrate should orient itself for best electrical contact. Then tighten the rear screws and release the pressure.

2. Install the attenuator and Trigger Amp Board.

3. Tighten the coupling nut. Solder the −12.2 volt lead to the board. The Preamp Board may be placed into position at this time.

4. Place the front panel so the Input connector will align with the substrate assembly. Make sure the plastic locking pawl is positioned with the flat surface facing downward. Finger tighten the connector. Tighten the Input connector with a 7/32 inch wrench to 10 in-lbs, estimated, if no torque wrench is available. Tighten the locking nut with a 5/16 inch wrench to 15 in-lbs.

Replacement of the Sampling Gate substrate assembly or of the Strobe Board may cause a system unbalance, resulting in strobe kickout from the Input connector. This condition is corrected by resoldering R51 or R53 (possibly both) to a different point on the clipping lines. See the Performance Check/Calibration Procedure.

Checking Sampling Gate Diodes

A dynamic check of the condition of the forward characteristics of the sampling gate diodes can be quickly made by following the procedure outlined in Section 4, step f, of this manual. In this check, the diodes are checked for both + and − strobe pulse conduction. If either the + or the − strobe pulse is not found in this dynamic check, then further static checks can be performed on the gate, as outlined below. If both strobe polarities are observed, the other circuits of the sampling head should be checked for problems, leaving the sampling gate till last.

The Sampling Gate diodes can be specially checked by the use of a transistor characteristic curve tracer, such as the Tektronix Type 576. DO NOT USE AN OHMMETER TO CHECK THE SAMPLING GATE DIODES.

Once it has been decided to check the Sampling Gate diodes, refer to Fig. 5-3 for both the Sampling Gate circuit and test points used in the procedure listed below. The pro-

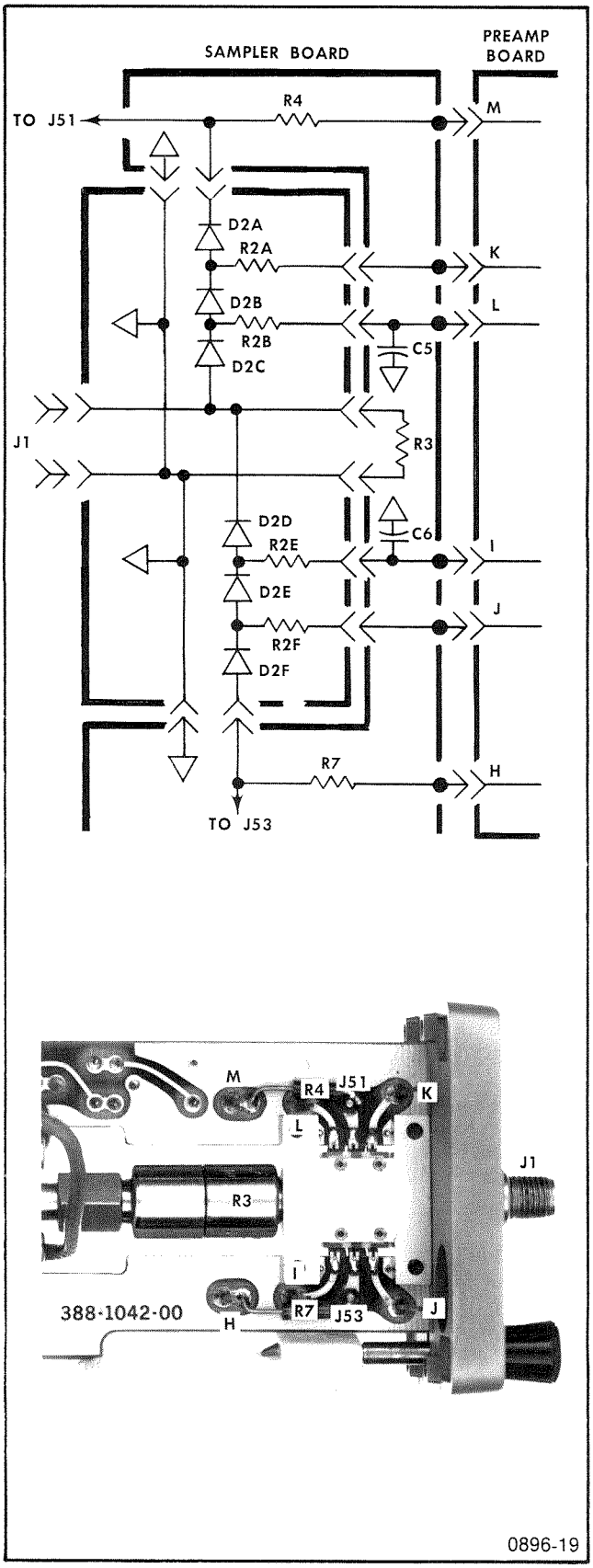


Fig. 5-3. Sampling Gate circuit and test points for checking the diodes.

cedure outlines a method of checking forward conduction in groups of three, and reverse leakage on an individual basis.

1. Remove the sampling head case and the Preamplifier board. Leave the attenuator and Strobe Board in place.

2. Refer to Fig. 5-3 for testpoints that must be used for checking D2A, D2B and D2C in one group of D2D, D2E and D2F in a second group. For the first group, the curve tracer positive lead is to be attached to J53. Attach the negative lead of the first group to J51. When checking the second group ground the negative lead. These polarity connections test each group of three diodes for their forward conduction in the curve tracer first quadrant as shown in Fig. 5-4.

3. Set the Type 576 controls:

Vertical Current Collector MA	1 mA/Div
Horizontal Volts/Div Collector Volts	1
Peak Volts	15
Polarity	+
VARIABLE COLLECTOR SUPPLY	For no-load 5 divisions
Dissipation Limiting Resistor	140 Ω
Base Step Generator Controls	Optional, not used.
Sloping Panel Controls Grounding Sw	Emitter Grounded
Selector Sw	Left or Right, whichever side has had clip leads attached for the test.
Both Position Controls	Dot at Graticule center.

4. Attach two leads to terminals of the Type 576 sloping front panel. Small clip leads or meter leads with banana tips on one end and prongs on the other end will do. Attach one lead to an E connection and the other to the C connection above the E post. Place the selector switch so it points toward the side where the test leads are connected.

5. Connect the E lead to the Sampling Gate terminal J51 and the C lead to ground. The Type 576 display should now be like the first quadrant display of Fig. 4-4. If the display shows slightly more than 1.2 volts flat display and then a rising portion like Fig. 5-4, the three diodes D2A, D2B and D2C are operating correctly in the forward direction. Check

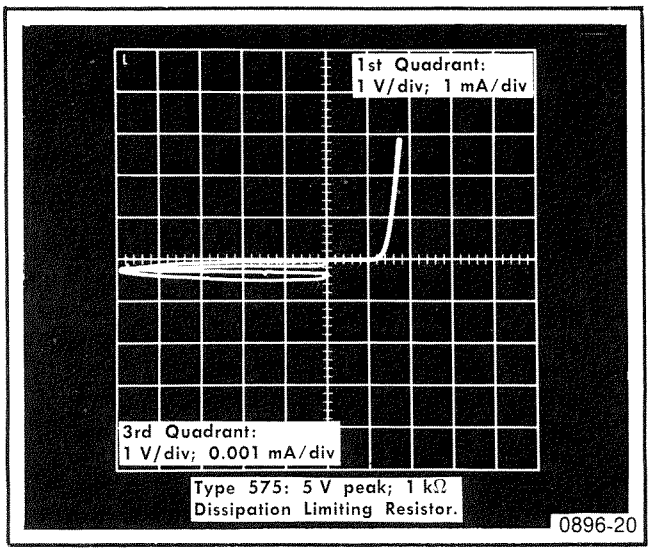


Fig. 5-4. Type 576 Characteristic curves of forward and reverse voltage conduction of D2A, D2B and D2C. Do not use more than 5 volts peak.

the other three diodes forward conduction before measuring either set reverse leakage.

6. Move the test leads so the E lead is touching the sampling head ground and the C lead is touching J53. The display should be the same as that in the first quadrant of Fig. 5-4.

7. To check the reverse leakage of a diode, change the Type 576 controls:

Vertical Current Collector mA	1 μA
Vertical Position	No-load trace at graticule centerline.
Applied Voltage Polarity	—

8. The set-up of part 7 gives a vertical deflection factor of 0.001 mA/Div, and will probably include some hum loops as shown in the third quadrant of Fig. 5-4.

Connect the leads to check each individual diode reverse leakage. Checking reverse leakage of three in series might not given an indication that one is bad. Any one diode that shows any discernible leakage (negative movement of Type 576 trace) is cause to reject a whole Sampling Gate assembly.

Test points are listed in Table 5-1 for all six diodes.

Table 5-1
Individual Sampling Gate diode test terminals for reverse leakage checking

Diode	Terminals +	Terminals −
D2A	J51	K
D2B	K	L
D2C	L	Ground
D2D	Ground	I
D2E	I	J
D2F	J	J53

Major Circuits and Parts Locations

The remainder of this section includes photographs of sections of the Type S-4. Major circuit ares are identified. All components mounted on circuit boards are identified by circuit numbers.

Replacing the Sampling Head Case

To replace the case on the sampling head, align the body so that the hole in the side appears over the Gate Bal control at the rear of the Preamp Board. Check that the upper and lower corners of the Preamp and Strobe boards are aligned with the channels in the sampling head body which contain the zigzag springs. Push the body gently forward until it contacts the front panel. In attaching the rear casting, be sure that the hole at one side of the casting fits over the trigger pickoff signal output connector. Insert the four long mounting bolts and tighten them securely.

Repackaging for Shipment

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

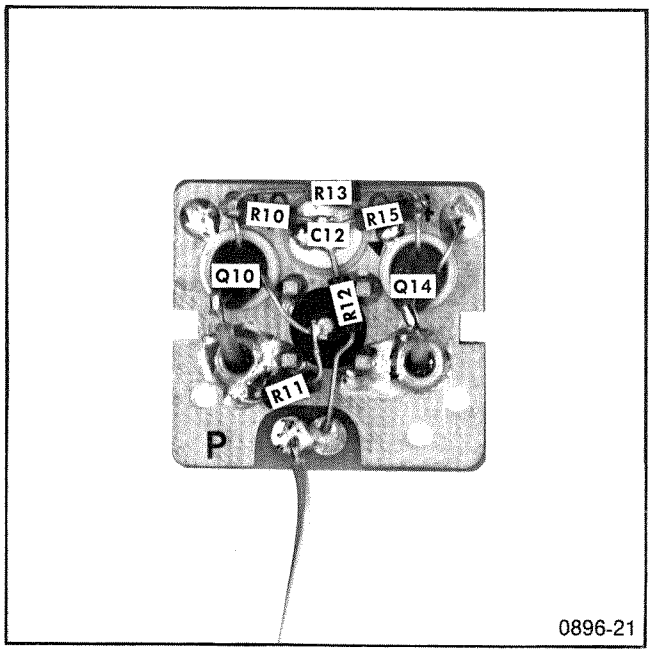
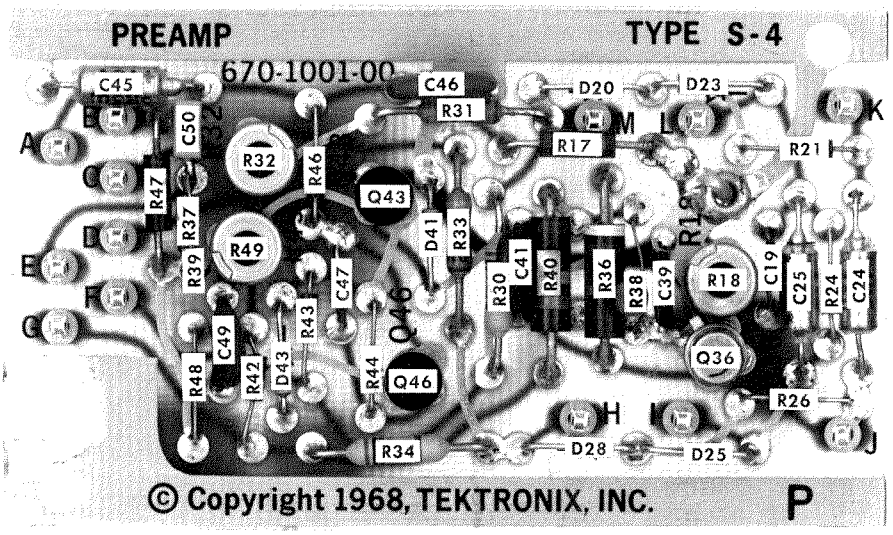


Fig. 5-5. Trigger Amp circuit board.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

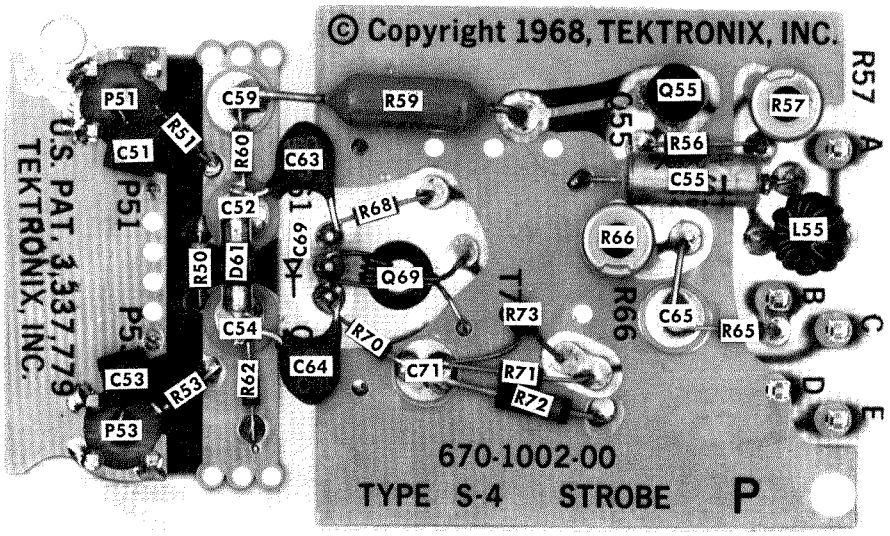
Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.



0896-22

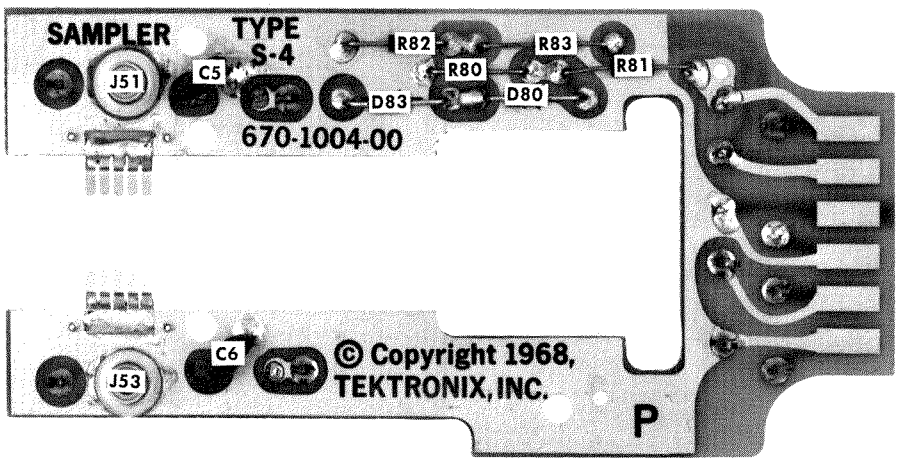
Fig. 5-6. Preamp circuit board.



R52, R54, and Q69 mounted on underside.

0896-23

Fig. 5-7. Strobe circuit board.



R4 and R7 mounted on underside.

0896-24

Fig. 5-8. Sampler circuit board.

OPTIONS

There are no options at this time.

REPLACEABLE ELECTRICAL PARTS

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 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.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

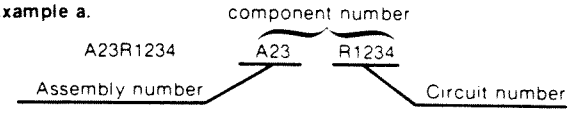
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

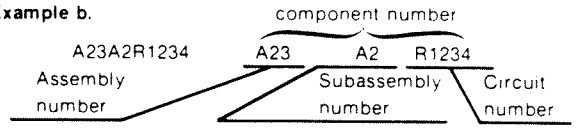
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g. assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD.PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
18203	ENGELMANN MICROWAVE CO.	SKYLINE DR.	MONTVILLE, NJ 07045
22229	SOLITRON DEVICES, INC., SEMICONDUCTOR GROUP	8808 BALBOA AVENUE	SAN DIEGO OPERS, CA 92123
26805	OMNI SPECTRA INC., MICROWAVE CONNECTOR DIV.	140 FOURTH AVE	WALTHAM, MA 02154
50101	GHZ DEVICES, INC.	16 MAPLE ROAD	SOUTH CHELMSFORD, MA 01824
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				ASSEMBLIES		
A1	670-1001-00	B010100	B07204	CKT BOARD ASSY:PREAMPLIFIER	80009	670-1001-00
A1	670-1001-01	B072050		CKT BOARD ASSY:PREAMPLIFIER	80009	670-1001-01
A2	670-1002-00	B010100	B05999	CKT BOARD ASSY:STROBE	80009	670-1002-00
A2	670-1002-01	B060000		CKT BOARD ASSY:STROBE	80009	670-1002-01
A3	670-1004-00			CKT BOARD ASSY:SAMPLER	80009	670-1004-00
A4	670-1003-00			CKT BOARD ASSY:TRIGGER TAKEOFF	80009	670-1003-00
				A1 PREAMPLIFIER		
A1	670-1001-00	B010100	B07204	CKT BOARD ASSY:PREAMPLIFIER	80009	670-1001-00
A1	670-1001-01	B072050		CKT BOARD ASSY:PREAMPLIFIER	80009	670-1001-01
A1C19	283-0136-00			CAP.,FXD,CER DI:10PF,5%,50V	51642	A100050-NP0-100J
A1C24	290-0188-00			CAP.,FXD,ELCTLT:0.1UF,10%,35V	56289	162D104X9035BC2
A1C25	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
A1C39	283-0051-00			CAP.,FXD,CER DI:0.0033UF,5%,100V	56289	1C20C0G332J100B
A1C41	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A1C45	290-0246-00			CAP.,FXD,ELCTLT:3.3UF,10%,15V	56289	162D335X9015CD2
A1C46	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
A1C47	283-0066-00			CAP.,FXD,CER DI:2.5PF,20%,200V	72982	8101-047C0J259D
A1C49	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
A1C50	283-0155-00	B010100	B02999	CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
A1C50	283-0005-00	B030000		CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
A1D20	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
A1D23	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
A1D25	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
A1D28	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
A1D41	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1D43	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1Q36	151-1012-00			TRANSISTOR:SILICON,FE,N-CHANNEL	22229	F1585
A1Q43	151-0224-00			TRANSISTOR:SILICON,NPN	07263	SA24850
A1Q46	151-0224-00			TRANSISTOR:SILICON,NPN	07263	SA24850
A1R17	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A1R18	311-0643-00			RES.,VAR,NONWIR:50 OHM,10%,0.50W	73138	82-33-2
A1R21	317-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.125W	01121	BB2245
A1R24	317-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.125W	01121	BB3935
A1R26	317-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.125W	01121	BB2245
A1R30	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A1R31	321-0253-00			RES.,FXD,FILM:4.22K OHM,1%,0.125W	91637	MFF1816G42200F
A1R32	311-0609-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	73138	82-26-1
A1R33	321-0253-00			RES.,FXD,FILM:4.22K OHM,1%,0.125W	91637	MFF1816G42200F
A1R34	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A1R36	301-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.50W	01121	EB9125
A1R37	317-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A1R38	307-0127-00			RES.,THERMAL:1K OHM,10%	50157	2D1596
A1R39	307-0122-00			RES.,THERMAL:50 OHM,10%	50157	3D1515

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R40	301-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
A1R42	317-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.125W	01121	BB2245
A1R43	317-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.125W	01121	BB2235
A1R44	317-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.125W	01121	BB1225
A1R46	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A1R47	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A1R48	317-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.125W	01121	BB3035
A1R49	311-0607-00	B010100	B07204	RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	82-25-2
A1R49	311-0644-00	B072050		RES.,VAR,NONWIR:20K OHM,10%,0.50W	73138	82-34-1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A2 STROBE		
A2	670-1002-00	B010100	B05999	CKT BOARD ASSY:STROBE	80009	670-1002-00
A2	670-1002-01	B060000		CKT BOARD ASSY:STROBE	80009	670-1002-01
A2C51	283-0154-00			CAP..FXD,CER DI:22PF,5%,50V	72982	8111B061C0G220J
A2C52	283-0135-00			CAP..FXD,CER DI:100PF,5%,500V	91418	JK101J501959
A2C53	283-0154-00			CAP..FXD,CER DI:22PF,5%,50V	72982	8111B061C0G220J
A2C54	283-0135-00			CAP..FXD,CER DI:100PF,5%,500V	91418	JK101J501959
A2C55	290-0134-00			CAP..FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
A2C59	283-0121-00			CAP..FXD,CER DI:0.001UF,20%,200V	56289	40C73A5
A2C63	283-0103-00			CAP..FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
A2C64	283-0103-00			CAP..FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
A2C65	283-0121-00			CAP..FXD,CER DI:0.001UF,20%,200V	56289	40C73A5
A2C69	283-0140-00			CAP..FXD,CER DI:4.7PF,5%,50V	72982	8101E003A479C
A2C71	283-0121-00			CAP..FXD,CER DI:0.001UF,20%,200V	56289	40C73A5
A2D61	152-0335-00	B010100	B05999	SEMICOND DEVICE:SILICON,SNAP-OFF	80009	152-0335-00
A2D61	152-0335-01	B060000		SEMICOND DEVICE:SILICON,SNAP-OFF,40V	50101	GC20279
A2L55	120-0382-00			XFMR,TOROID:14 TURNS,SINGLE	80009	120-0382-00
A2P51	131-0582-00			CONN,RCPT,ELEC:SNAP-ON FEMALE,MODIFIED	98291	52-052-0049
A2P53	131-0582-00			CONN,RCPT,ELEC:SNAP-ON FEMALE,MODIFIED	98291	52-052-0049
A2Q55	151-0224-00			TRANSISTOR:SILICON,NPN	07263	SA24850
A2Q69	153-0556-00			TRANSISTOR:SILICON,5V,SEL	80009	153-0556-00
A2R50	317-0470-00			RES..FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
A2R51	317-0390-00			RES..FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A2R52	317-0101-00			RES..FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A2R53	317-0390-00			RES..FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A2R54	317-0101-00			RES..FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A2R56	317-0271-00			RES..FXD,CMPSN:270 OHM,5%,0.125W	01121	BB2715
A2R57	311-0607-00			RES..VAR,NONWIR:10K OHM,10%,0.50W	73138	82-25-2
A2R59	308-0243-00			RES..FXD,WW:240 OHM,5%,3W	91637	CW2BB240R0J
A2R60	317-0390-00			RES..FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A2R62	317-0390-00			RES..FXD,CMPSN:39 OHM,5%,0.125W	01121	BB3905
A2R65	317-0101-00			RES..FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A2R66	311-0644-00			RES..VAR,NONWIR:20K OHM,10%,0.50W	73138	82-34-1
A2R68	317-0332-00			RES..FXD,CMPSN:3.3K OHM,5%,0.125W	01121	BB3325
A2R70	317-0332-00			RES..FXD,CMPSN:3.3K OHM,5%,0.125W	01121	BB3325
A2R71	317-0202-00			RES..FXD,CMPSN:2K OHM,5%,0.125W	01121	BB2025
A2R72	315-0124-00			RES..FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
A2R73	307-0124-00			RES..THERMAL:5K OHM,10%	50157	1D1618
A2T75	120-0544-00			XFMR,TOROID:	80009	120-0544-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A3 SAMPLER		
A3	670-1004-00			CKT BOARD ASSY:SAMPLER	80009	670-1004-00
A3C5	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
A3C6	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
A3D80	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3D83	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3J51	131-0391-01			CONNECTOR,RCPT.:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0119
A3J53	131-0391-01			CONNECTOR,RCPT.:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0119
A3R4	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R7	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R80	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A3R81	317-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.125W	01121	BB1525
A3R82	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
A3R83	317-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.125W	01121	BB1825
				A4 TRIGGER TAKEOFF		
A4	670-1003-00			CKT BOARD ASSY:TRIGGER TAKEOFF	80009	670-1003-00
A4C12	283-0121-00			CAP.,FXD,CER DI:0.001UF,20%,200V	56289	40C73A5
A4L10	276-0543-00			SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
A4L14	276-0543-00			SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
A4L15	276-0543-00	B061638		SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
A4P3	131-0663-00			CONN,RCPT,ELEC:3MM CKT BD MT	26805	2062-0000
A4P17	131-0565-00			CONN,RCPT,ELEC:SUBMIN COAX,MALE INNER COND	71785	DM53742-5038
A4P17	----- -----			(PART OF 175-1042-XX)		
A4Q10	151-0212-00			TRANSISTOR:SILICON,NPN	04713	SRF 518
A4Q14	151-0212-00			TRANSISTOR:SILICON,NPN	04713	SRF 518
A4R10	317-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
A4R11	317-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.125W	01121	BB5105
A4R12	317-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.125W	01121	BB5115
A4R13	317-0360-00			RES.,FXD,CMPSN:36 OHM,5%,0.125W	01121	BB3605
A4R15	317-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.125W	01121	BB1025
				CHASSIS PARTS		
AT1	119-0178-00			ATTENUATOR,FXD:50 OHM,DC-18GHZ,FEEDTHRU	18203	A719A
D2	155-0001-00			MICROCIRCUIT,DI:GATE,SPL PKG	80009	155-0001-00
J1	131-0631-01			CONN,RCPT,ELEC:3MM TYPE FEMALE	22229	2992-6012
R2	----- -----			(PART OF D2)		

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

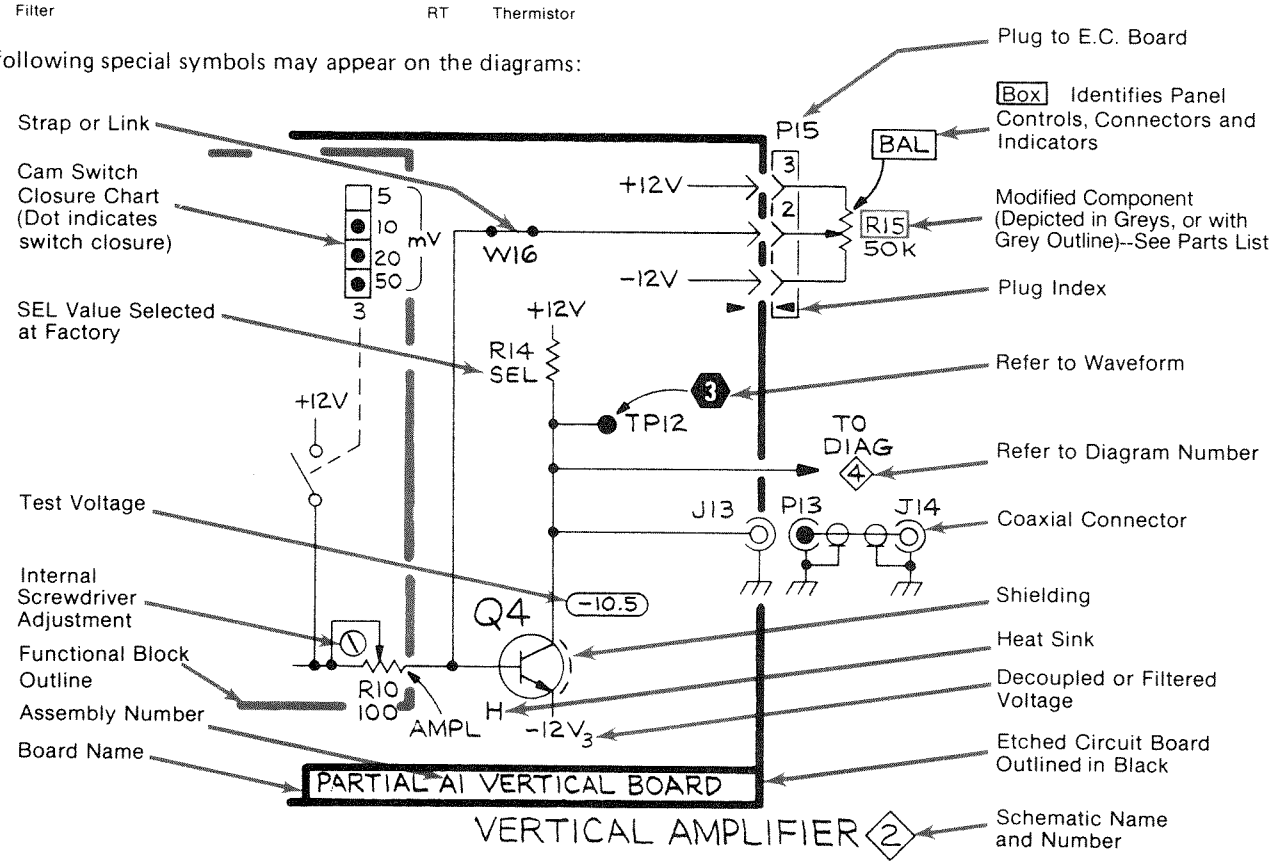
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

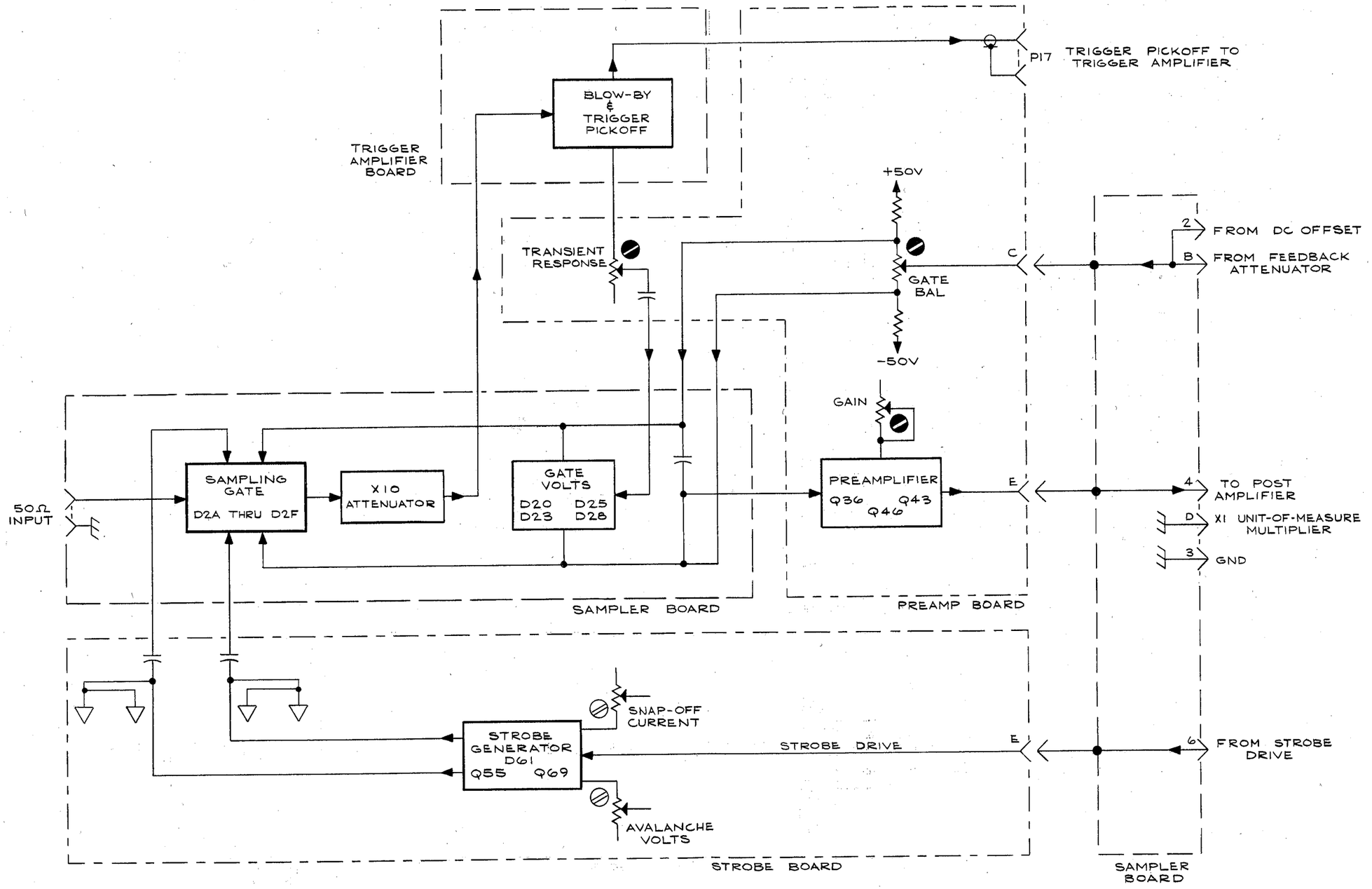
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:



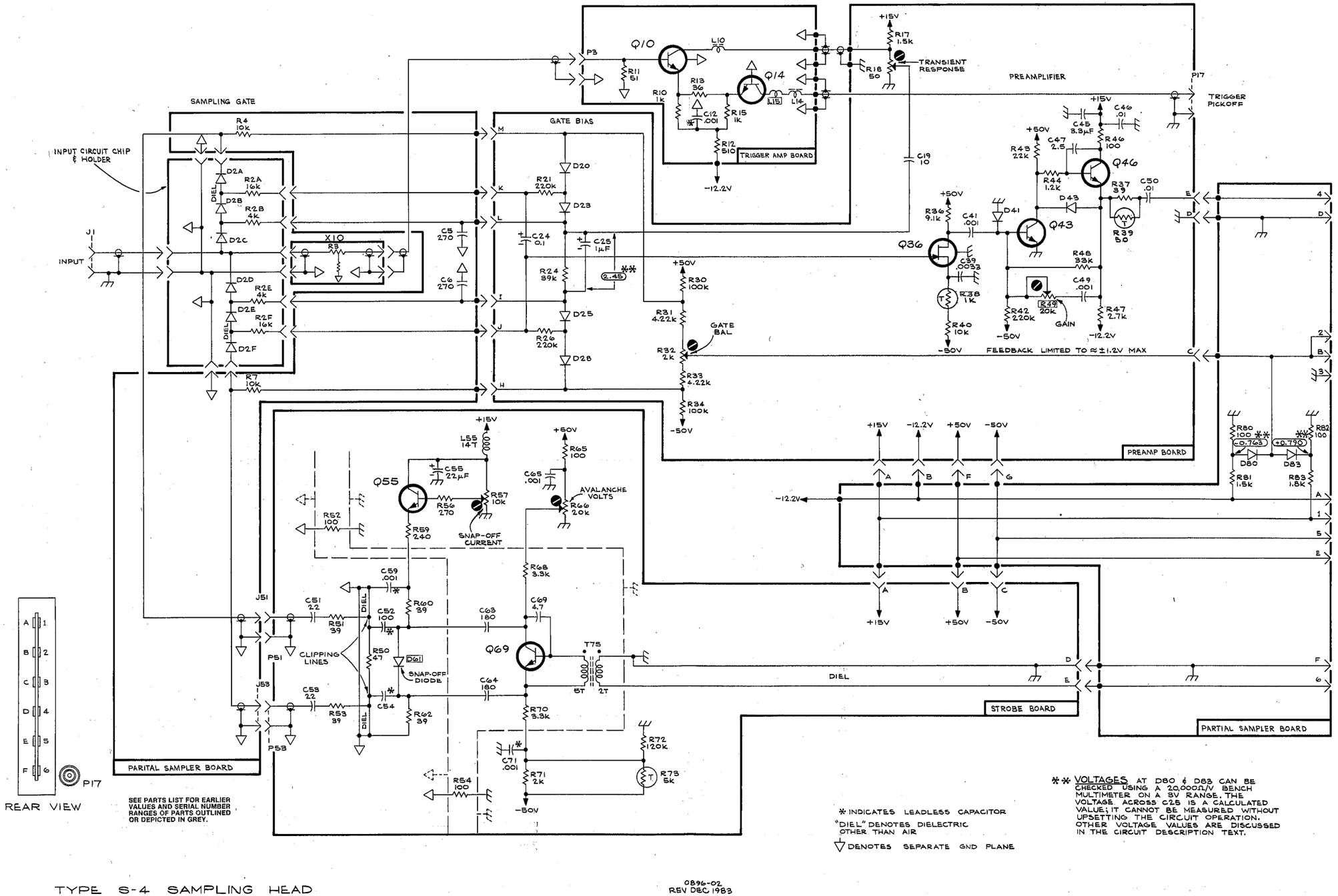
REV DEC 1983



TYPE S-4 SAMPLING HEAD

0896-01
REV DEC 1983

BLOCK DIAGRAM



TYPE S-4 SAMPLING HEAD

0896-02
REV DEC 1983

REPLACEABLE MECHANICAL PARTS

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 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.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

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.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear 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. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000AH	STANDARD PRESSED STEEL CO., UNBRAKO DIV.	8535 DICE ROAD	SANTA FE SPRINGS, CA 90670
00287	C.E.M. COMPANY, INC.	24 SCHOOL	DANIELSON, CT 06239
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
00929	MICROLAB/FXR	10 MICROLAB ROAD	LIVINGSTON, NJ 07039
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
16179	OMNI SPECTRA, INC.	24600 HALLWOOD CT.	FARMINGTON, MI 48024
18203	ENGELMANN MICROWAVE CO.	SKYLINE DR.	MONTVILLE, NJ 07045
22229	SOLITRON DEVICES, INC., SEMICONDUCTOR GROUP	8808 BALBOA AVENUE	SAN DIEGO OPERS, CA 92123
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
26805	OMNI SPECTRA INC., MICROWAVE CONNECTOR DIV.	140 FOURTH AVE	WALTHAM, MA 02154
31104	ARMSTRONG TOOL MFG. CO.	304 GLENWOOD AVE.	MUNCIE, IN 47304
74868	BUNKER-RAMO CORP., THE AMPHENOL RF DIV.	33 E. FRANKLIN ST.	DANBURY, CT 06810
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83486	ELCO INDUSTRIES, INC.	1103 SAMUELSON ROAD	ROCKFORD, IL 61101
95077	SOLITRON/MICROWAVE DIV., SOLITRON DEVICES, INC.	P. O. BOX 278, COVE ROAD	PORT SALERNO, FL 33492
T0175	UNITED MICROWAVE PRODUCTS, INC.	1805 W. 205TH ST #303	TORRANCE, CA 90501

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	386-1337-04	B010100	B039999	1	PANEL,REAR:	80009	386-1337-04
	386-1337-11	B040000	B073699	1	PANEL,REAR:	80009	386-1337-11
	386-1337-09	B073700		1	PANEL,REAR:	80009	386-1337-09
					**********(ATTACHING PARTS)**********		
-2	211-0141-00			4	SCREW,MACHINE:4-40 X 3.250,PNH,SST	83486	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-3	380-0125-00			1	HSG,SAMPLING HD:ALUMINUM	80009	380-0125-00
-4	333-1097-00			1	PANEL,FRONT:	80009	333-1097-00
					**********(ATTACHING PARTS)**********		
-5	220-0531-02			1	NUT,PLAIN,HEX.:0.25-36 X 0.312 INCH,STL	80009	220-0531-02
					**********(END ATTACHING PARTS)**********		
-6	105-0338-00			1	LATCH ASSEMBLY:SAMPLING HEADS	80009	105-0338-00
-7	386-1338-09			1	SUBPANEL,FRONT:	80009	386-1338-09
-8	----- -----			1	CKT BOARD ASSY:PREAMP(SEE A1 REPL)		
-9	136-0263-01	B010100	B061479	13	.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	85861-2
	136-0263-07	B061480		13	.SOCKET,PIN TERM:U/W 0.025 SQ PIN	22526	ORD BY DESCR
-10	136-0252-07			10	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-11	175-1042-00			1	CABLE ASSY,RF:50 OHM COAX,3.75 L	80009	175-1042-00
	----- -----			-	(PART OF A4 ASSEMBLY)		
-12	----- -----			1	CKT BOARD ASSY:STROBE(SEE A2 REPL)		
-13	136-0252-07			6	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-14	136-0263-04	B010100	B061479	5	.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
	136-0263-07	B061460		5	.SOCKET,PIN TERM:U/W 0.025 SQ PIN	22526	ORD BY DESCR
-15	----- -----			2	.CONN,RCPT,ELEC:SNAP-ON FEMALE(SEE A2P51,		
	----- -----				.P53 REPL)		
-16	----- -----			1	CKT BOARD ASSY:SAMPLER(SEE A3 REPL)		
-17	214-1081-00			4	.PIN,SPRING:0.187 L X 0.034 OD,SST	00287	031X187MDP
-18	131-0591-00			12	.CONTACT,ELEC:0.835 INCH LONG	22526	47352
-19	131-0594-00			3	.POST,BDG,ELEC:BLACK	22526	47356
-20	----- -----			2	.CONN,RCPT:50 OHM,COAX,SNAP-ON MALE		
	----- -----				.(SEE A3J51,A3J53 REPL)		
-21	131-0631-00	B010100	B074059	1	.CONN,RCPT,ELEC:3MM TYPE FEMALE	22229	2992-6012
	131-0631-01	B074060		1	.CONN,RCPT,ELEC:SMA JACK TO SPCL END CONFI	T0175	ORD BY DESCR
-22	----- -----			1	MICROCIRCUIT,DI:GATE,SPL PKG(SEE D2 REPL)		
					**********(ATTACHING PARTS)**********		
-23	211-0162-00			4	SCREW,MACHINE:2-56 X 0.188 INCH,SCH,SST	000AH	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-24	----- -----			1	ATTENUATOR,FXD:50 OHM(SEE AT1 REPL)		
-25	----- -----			1	CKT BOARD ASSY:TRIGGER TAKEOFF(SEE A4 REPL		
-26	----- -----			1	.CONN,RCPT,ELEC:(SEE A4P3 REPL)		
-27	131-0555-00			4	CONTACT,ELEC:GROUNDING,PH BRZ ALBALOY PL	80009	131-0555-00
	195-0063-00			1	LD FR,MICROCKT:	80009	195-0063-00
	195-0064-00			1	LD SET,STBSCP C:	80009	195-0064-00
	198-2708-00			1	WIRE SET,ELEC:	80009	198-2708-00
	334-1523-00			1	PLATE,IDENT:BLANK	80009	334-1523-00

FIG. 1 EXPLODED

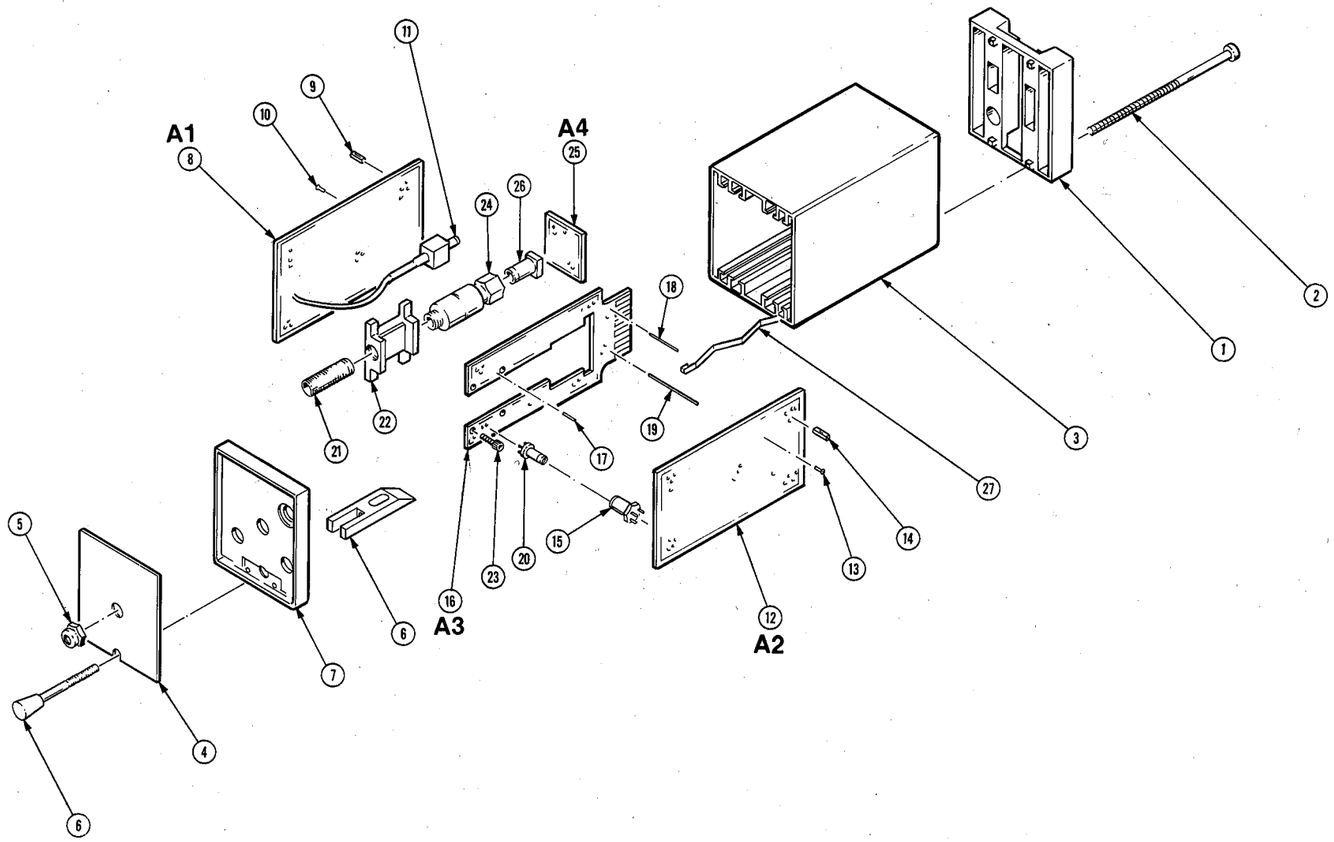
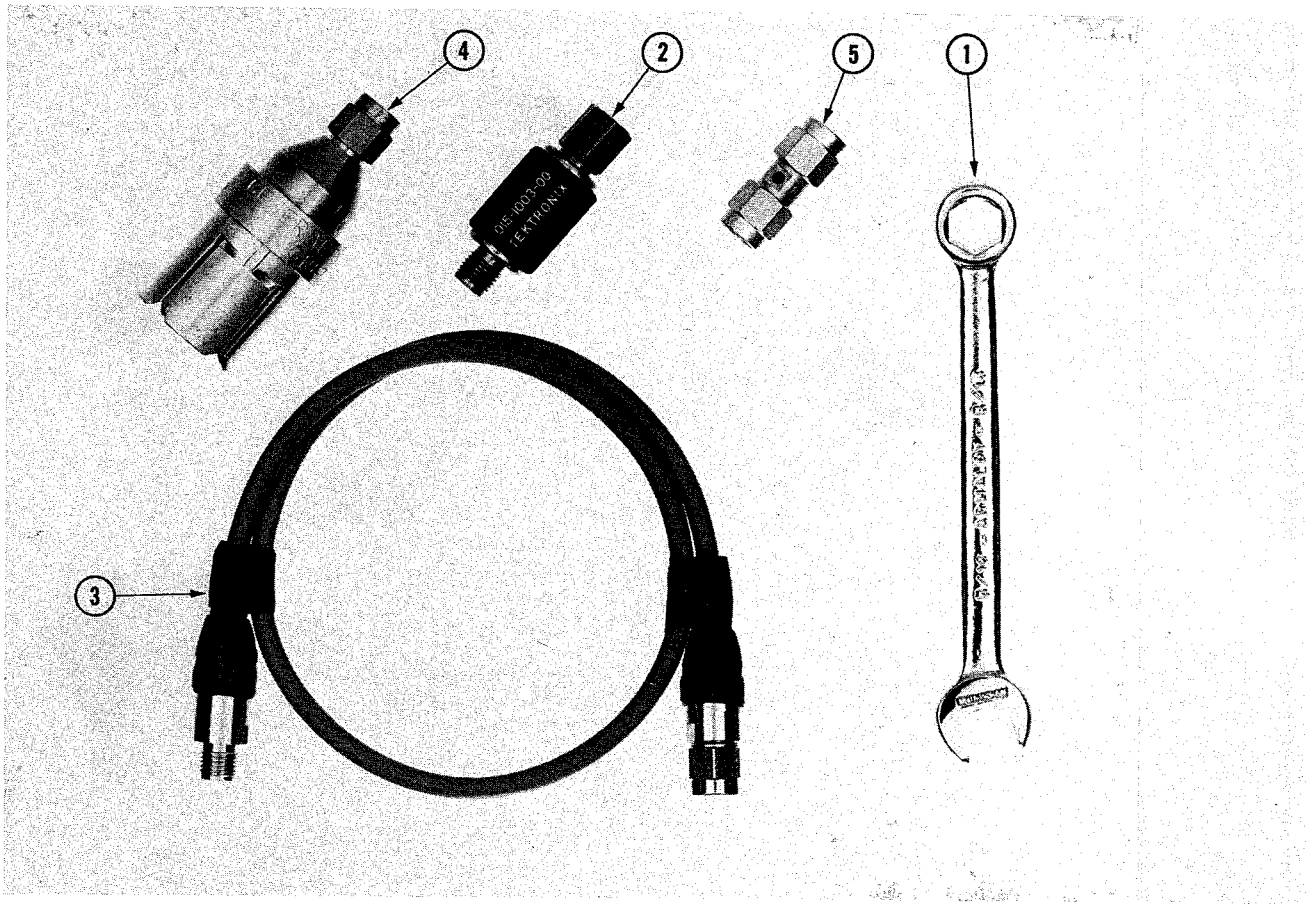


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						STANDARD ACCESSORIES		
2-1	003-0247-00			1		WRENCH,BOX AND:	31104	1159
-2	015-1003-00			1		ATTENUATOR,FXD:	18203	ORD BY DESCR
-3	015-1005-00			1		CABLE ASSY,RF:50 OHM,2 NS	74868	C2008
-4	015-1007-00			1		ADAPTER,CONN:	16179	21220
-5	015-1011-00			1		ADAPTER,CONN:SMA MALE TO SMA MALE	16179	2081-6001
	070-0896-01			1		MANUAL,TECH:INSTR,S-4	80009	070-0896-01
						OPTIONAL ACCESSORIES		
	015-1001-00			1		ATTENUATOR,FXD:	80009	015-1001-00
	015-1002-00			1		ATTENUATOR,FXD:	18203	A751AS
	015-1004-00			1		TERM.,COAX:50 OHM,0.5W,SERIES SMA CONN	18203	T128CS
	015-1006-00			1		CABLE ASSY,RF:	02660	ORD BY DESCR
	015-1008-00			1		ADAPTER,CONN:	16179	21210
	015-1009-00			1		ADAPTER,CONN:	16179	3082-2241-00
	015-1010-00			1		ADAPTER,CONN:	26805	2081-4002-00
	015-1012-00			1		ADAPTER,CONN:	16179	217SF
	015-1013-00			1		ADAPTER,CONN:	26805	2046-4003-00
	015-1014-00			1		PWR DIVIDER,RES:	00929	DA-C38
	015-1015-00			1		DELAY LINE,ELEC:	80009	015-1015-00
	015-1016-00			1		ADAPTER,CONN:	95077	2996-6001


4
2
5
1
3
DIS-1003-00
TEKTRONIX

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. 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 following this page, your manual is correct as printed.