# TYPE

## 79-02A DUAL TRACE PLUG-IN

**Instruction Manual**

**Serial No.** ____________________

This Plug-In Module is designed for use with the Fairchild Type 766H/F Series Oscilloscope.

FAIRCHILD
INSTRUMENTATION
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Manual No. 6704 5512

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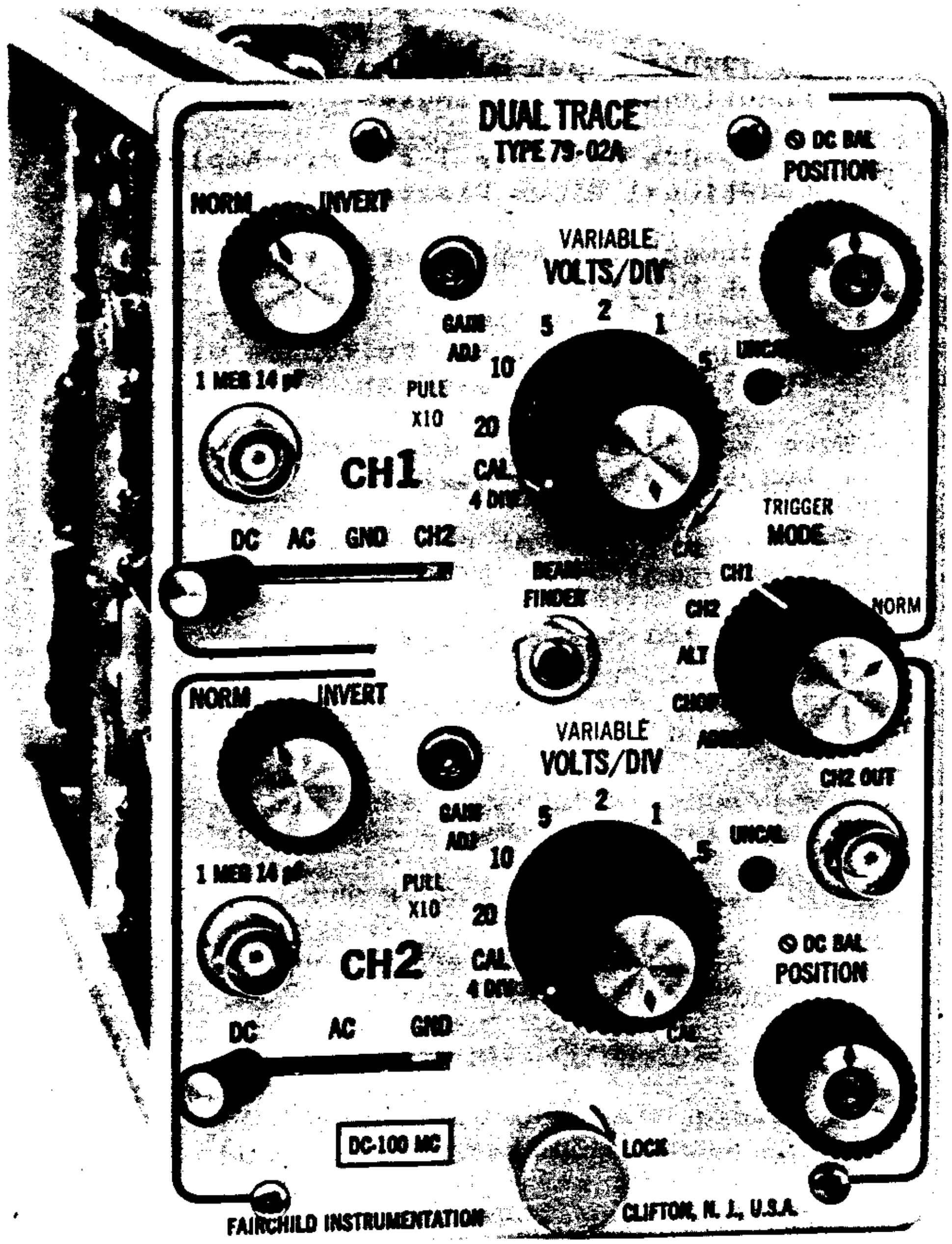



FIGURE 1-1. TYPE 79-02A DUAL TRACE 100 MC AMPLIFIER PLUG-IN

# SECTION 1

# TECHNICAL SUMMARY

## 1-1. INTRODUCTION

The Type 79-02A Amplifier is a dual-channel amplifier and is provided with two basic amplifier sensitivities and bandwidths for X1 and X10 calibrated operation as follows:

100 millivolts/division sensitivity with a dc to 100 megacycle bandwidth.

10 millivolts/division sensitivity with a dc to 90 megacycle bandwidth.

Operation of this plug-in unit enables the user to obtain two vertical signals on the screen simultaneously or to display either channel individually.

The VARIABLE gain control, located concentrically with the VOLTS/DIV switch, has a range of greater than 2-1/2 to 1. This VARIABLE gain control provides continuous overlap between steps of the attenuator (VOLTS/DIV) switch. A detented stop position is provided when the VARIABLE gain control is set to CAL.

A MODE switch is provided which enables the selection of either Channel 1 or Channel 2 for separate display or the combination of both channels for dual display. In addition, ALTernate or CHOPped modes of operation are available. Use of the Polarity Inversion switch may give Channel 1 minus Channel 2 or Channel 2 minus Channel 1 presentation when MODE switch is set to ADDED.

The Type 79-02A Amplifier is intended for use in the Y cavity of the Type 766H/F Series Oscilloscopes.

## 1-2. FEATURES

- 100 Mc bandwidth at 100 mv/div sensitivity
- 10 mv/div sensitivity with 90 Mc bandwidth
- Solid state circuitry
- Cascading feature converts instrument from dual trace to a high-gain, single trace unit; 1 mv/div sensitivity with 30 Mc bandwidth nominal.

FEATURES (concluded)

- Front-panel GAIN ADJ control is provided for each channel to normalize gain between channels
- Polarity Inversion switch enables subtraction of two signals when operating in the Added mode
- Ground position on Input Selector switch provides ground reference on base line without necessity of grounding input of instrument
- Provides equivalent dual-beam scope operation when used with Fairchild Type 74-17A Automatic Display Time Base Plug-in unit

1-3. TECHNICAL SUMMARY (Specifications)

The electrical characteristics of the Type 79-02A Amplifier are listed in the Performance Specification which follows.

# SPECIFICATIONS

## Y AMPLIFIER

### Bandwidth

Direct Coupled:

X1: DC to approximately 100 megacycles.

X10: DC to approximately 90 megacycles.

Capacitively Coupled:

X1 or X10: Low-frequency cutoff is 16 cycles.

Rise Time:

X1: 3.8 nanoseconds or less.

X10: 4.2 nanoseconds or less.

NOTE: Rise time of Test Generator should be 0.4 nsec or better.

### Sensitivity

Cal X1: 100 millivolts/div. to 20 volts/division in 8 steps of 1, 2, and 5 sequence when VARIABLE gain control is set to CAL; accurate to within ±3% when set on any one step.

Cal X10: 10 millivolts/division to 2 volts/division in 1,2 and 5 sequence.

Uncal, X1 or X10: Continuously variable from 10 millivolts/div. to 50 volts/div. The VARIABLE gain control permits 2-1/2 to 1 continuous sensitivity adjustments between the attenuator steps and extends the 20 volts/div. range to 50 volts/div.

### Output Range

Six divisions of vertical output scan (D3 and D4 CRT plates) is available. Overshoot and preswing are each 3% at 4-division scan.

### Input Impedance

1 megohm shunted by 14 pf.

### Input Selector Switch

Channel 1 is provided with a 4-position lever switch which permits selection of a-c or d-c coupling, Channel 2 output or ground. Channel 2 is provided with a 3-position lever switch providing selection of a-c or d-c coupling and ground. The GND position provides base line reference and disconnects input signal.

### Polarity Inversion

Separate two-position rotary switch for each channel provides selection of either NORMal or INVERTed input signal.

### Calibration

Calibrator signal (line frequency square wave) is applied directly to the input of the Y Amplifier to standardize gain when VOLTS/DIV switch is set to CAL. (Cal: 4 divisions; valid only in the X1 position.)

## SPECIFICATIONS (Concluded)

### Y AMPLIFIER

Signal Delay

A 185-nanosecond balanced distributed bifilar helical delay line is provided. This delay is sufficient to view baseline and the leading edge of a fast rise-time signal for internal triggering of the time base.

Internal Trigger

A two-position switch provides a trigger pick-off after switch stage (Ch 1 and Ch 2) or a trigger pick-off from Channel 2 only.

The internal trigger output signal is referenced to ground when the trace is positioned to screen center via factory adjustment of the Trig DC LEVEL control.

High Sensitivity Amplifier

An internal connection from Channel 2 output connector to Channel 1 input connector can provide a series connection of the Channel 1 and Channel 2 amplifiers. It should be noted that only when the channels are set up for X10 operation is the cascading feature useful.

Available sensitivity is 1 mv/div and bandwidth is dc to 25 Mc in this mode. 30 Mc nominal.

Operational Modes

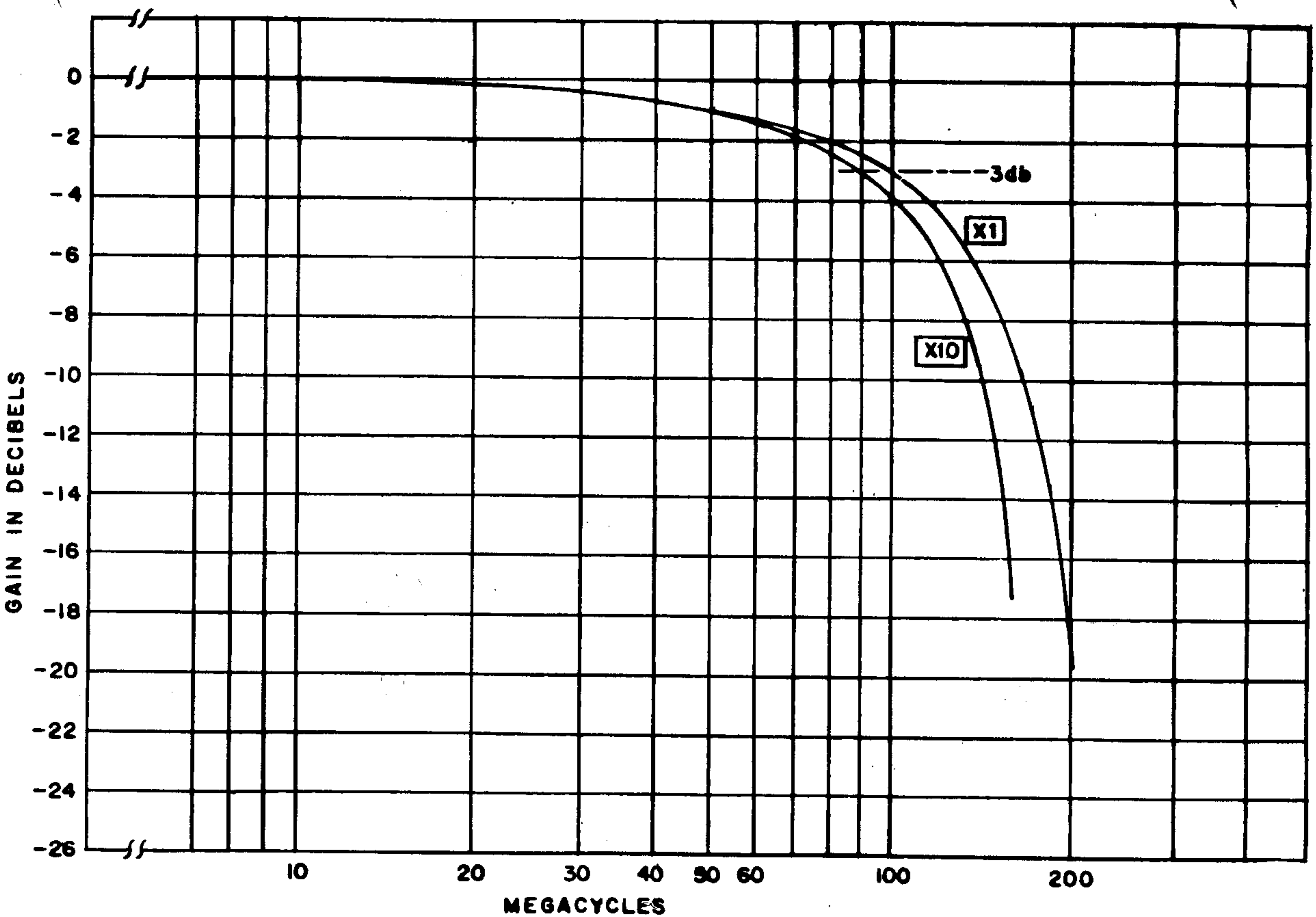
The following displays are available:

1. Ch 1 only
2. Ch 2 only
3. Ch 1 & Ch 2 switched alternately
4. Ch 1 & Ch 2 time shared (chopped)
5. Ch 1 & Ch 2 (Invert switch permits Ch 1 - Ch 2 or Ch 2 - Ch 1 presentation)
6. Cascaded operation.

In chopped operation, two chopping rates, 100 Kc and 1 Mc, are available and selected by an internal switch. Switching transients are automatically blanked.

Beam Finder

A spring-loaded push-button switch is provided to facilitate location of beam when it is positioned off screen.




TYPE 79-02A NOMINAL FREQUENCY RESPONSE CURVE

# SECTION 2

# OPERATING INSTRUCTIONS

## 2-1. FIRST TIME OPERATION (Figures 2-1 to 2-3)

The Type 79-02A Dual Trace Amplifier Plug-in is inserted in the Y cavity (left-hand side) and assume that the Type 74-03A Time Base Plug-in (other Fairchild X Plug-ins may be used) is inserted in the X cavity (right-hand side) of the H/F Series Main Frame Oscilloscopes. The H/F Series Oscilloscopes is provided with the Type 7062 CRT Termination Network to accommodate the Type 79-02A. In the instructions which follow, capital letters within the text indicate front-panel controls, connectors or settings.

Note: For proper performance, make certain the Type 79-02A is installed only in the Y cavity of the H/F Series Main Frame Oscilloscope.

The following illustrations are designed to aid the operator in becoming familiar with the oscilloscope:

Figure 2-1. Function of Type 79-02A Dual Channel controls
Figure 2-2. Function of Type 79-02A Input Channel Switching Facilities
Figure 2-3. Type 79-02A Calibrator Display

The remaining paragraphs of this section are provided as a guide to extend the operator's skill in using the instrument.

## 2-2. APPLYING A SIGNAL

The signal (or signals) to be displayed is applied to either (or both) input connector on the front panel. To insure proper performance, the signal should be applied through a shielded cable, with the shield connected to the chassis of both the oscilloscope and the signal source.

The Fairchild Types 7994B and 7999B Accessory Probes are available for use with the Type 79-02A Amplifier.

## 2-3. DC BALANCE ADJUSTMENT

If the DC balance of the Type 79-02A Amplifier is not properly adjusted, the reference trace on the screen will be depositioned when the VARIABLE control is rotated. To properly adjust the DC BAL front-panel screwdriver control for Channel 1, proceed as follows:

1. Set the MODE switch to CH 1 and the Input Selector switch to GND.
2. Set the VOLTS/DIV switch to 0.1 position and rotate the VARIABLE control to its minimum gain setting.
3. Adjust the Time Base Plug-in controls for automatic sweep to obtain a reference trace on the screen.

4. Adjust the POSITION control on each plug-in, to place the trace at center of screen (reference line).

5. Rotate the VARIABLE control right and left throughout its range observing the direction that the trace shifts vertically.

6. Adjust the front-panel DC BAL screwdriver control to bring the trace back to center of screen.

   Note: Do not change the POSITION control settings.

7. Continue adjusting the DC BAL control while rotating the VARIABLE control back and forth, until there is minimum displacement of the trace when the VARIABLE control is rotated throughout its range.

8. Repeat preceding steps for Channel 2 using pertinent controls.

   Note: If the adjustment range of the front-panel DC BAL control is insufficient, refer to Section 5, Maintenance and Recalibration, for the complete Coarse and Fine Balance adjustment procedure.

## 2-4. SETTING GAIN OF DUAL-TRACE AMPLIFIER

Whenever the Type 79-02A Amplifier is removed from the Main Frame and inserted in another, the front-panel screwdriver GAIN ADJ control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities.

To properly normalize the gain between channels or between the Plug-in unit and the Main Frame, proceed as follows:

1. Set both Channel 1 and Channel 2 VOLTS/DIV switches to CAL and turn both VARIABLE controls to CAL (fully cw).

2. Push in both VARIABLE controls (X1 position).

3. Set MODE switch to CH 1 and TRIGGER switch to NORM.

4. Adjust the Sweep controls for auto sweep and line triggering.

5. Set MODE switch to ALT and adjust sweep rate for 2 milliseconds/division.

6. Adjust Channel 1 GAIN ADJ front-panel screwdriver control for 4 divisions of vertical deflection.

7. Position the traces one on top of the other.

8. Adjust Channel 2 GAIN ADJ control until only one trace may be observed (traces are superimposed).

**VOLTS/DIV**

One of two identical attenuators:

Calibrated X1 operation: from 100 mv/div to 20 volts/div

Calibrated X10 operation: from 10 mv/div to 2 volts/div. (In this mode, simply divide the knob setting by 10.)

**NORM/INVERT**

One of two identical switches: selects polarity of incoming signal. In NORM position, retains polarity of incoming signal; in INVERT position, reverses polarity of displayed waveform

**POSITION**

One of two identical controls: used to position the trace vertically


**VARIABLE**

One of two identical controls: provides a 1:2-1/2 variable adjustment permitting minimum sensitivity and overlap of the VOLTS/DIV setting. A detented stop position is provided in CAL setting. Increases amplifier gain by X10 when VARIABLE control is pulled out

**GAIN ADJ**

One of two identical screwdriver controls: normalizes interchannel gain and the gain between Plug-in and Main Frame

**INPUT**

One of two identical BNC connectors: used to applying external signals to the associate channel amplifier via the MODE switch

**DC BAL**

One of two identical screwdriver controls: when properly adjusted minimizes depositioning of the pattern when VARIABLE control is used

FIGURE 2-1. FUNCTION OF TYPE 79-02A DUAL CHANNEL CONTROLS

## 2-5. INPUT SELECTOR SWITCH

Each channel is provided with an Input Selector switch which provides the following common functions:

- AC or DC coupling of input signal
- Ground reference positions

Channel 1 Input Selector switch is provided with an additional position labeled CH 2. In this position, an internal connection from the output of Channel 2 amplifier is automatically connected in series with the input of Channel 1 amplifier. This technique converts the plug-in from its normal 100 Mc dual trace function to a high gain single trace amplifier with a 50 Mc bandwidth and a sensitivity of 1 millivolt/division.

The Input Selector switch permits choice of retaining the DC level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input. If it is desired to display both the ac and dc components of a signal, set this switch to DC. Thus, the position of the display at any instant is a function of the instantaneous signal voltage with respect to ground.

There are times when it is neither necessary nor desirable to display the dc component of the input waveform. A capacitor placed in series with the input connector will exclude the dc component while simultaneously permitting the ac component to be displayed. This is accomplished when the Input Selector switch is set to AC. The effect of the dc component is now excluded from the display.

It should be noted that when the Input Selector switch is set to the AC position, the lowest frequency limit (3 db) of the Amplifier is about 16 cycles. Therefore, some low-frequency distortion and loss of amplitude will occur if the pattern on display contains frequency components below the specified cut-offs. Use of a 10:1 Attenuator Probe brings the low frequency response to 1.6 cycles.

When using the dual-trace features of the Type 79-02A, you may desire to invert the displayed waveform. In the NORM position of the Polarity Inversion switch, the displayed waveform will have the same polarity as the applied signal. When the switch is set to INVERT, the displayed waveform will be inverted. In other words, a positive-going pulse will be displayed as a negative-going pulse.

**INPUT SELECTOR**

A four-position slide switch: enables selection of AC or DC coupling. Grounds amplifier input in GND position. In CH 2 position, connects Channel 2 output to input of Channel 1

**TRIGGER**

Switch: provides a choice of two internal trigger sources: Either Channel 2 signal or the composite signal driving the vertical deflection plates may be selected


**MODE**

Switch: used to select the channels in the following manner:

1. CH 1 ONLY
2. CH 2 ONLY
3. CH 1 & CH 2 switched alternately
4. CH 1 & CH 2 time-shared (Chopped)
5. Added: algebraic sum of Channels 1 and 2

**INPUT SELECTOR**

A three-position slide switch: enables selection of AC or DC coupling. Grounds amplifier input in GND position

**CH 2 OUT**

BNC connector: used to make available CH 2 preamplifier output through a 5K-ohm isolating resistor

FIGURE 2-2. FUNCTION OF TYPE 79-02A INPUT CHANNEL SWITCHING FACILITIES

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.

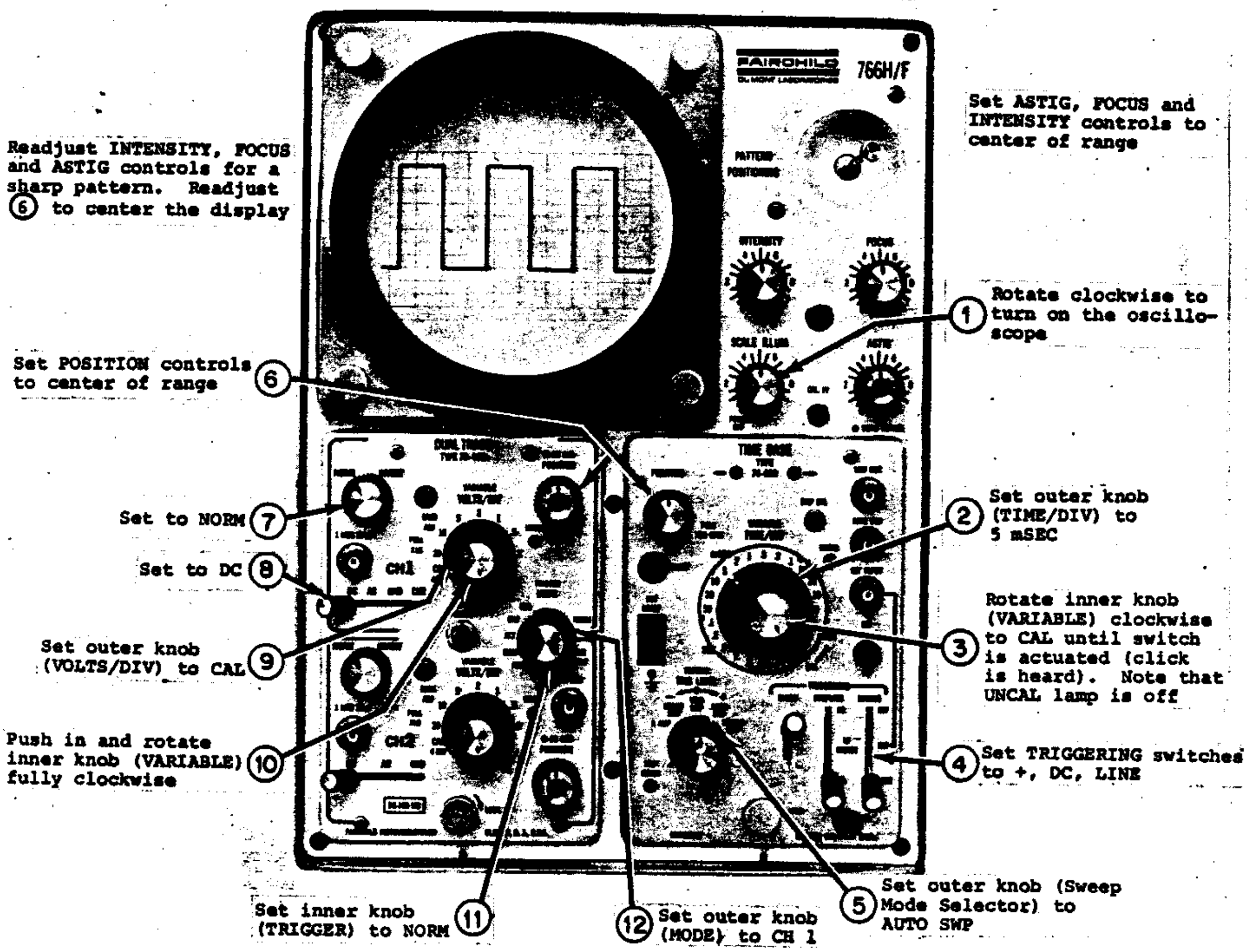



FIGURE 2-3. TYPE 79-02A CALIBRATOR DISPLAY

**INPUT SELECTOR**

A four-position slide switch: enables selection of AC or DC coupling. Grounds amplifier input in GND position. In CH 2 position, connects Channel 2 output to input of Channel 1


**TRIGGER**

Switch: provides a choice of two internal trigger sources: Either Channel 2 signal or the composite signal driving the vertical deflection plates may be selected

**MODE**

Switch: used to select the channels in the following manner:

1. CH 1 ONLY
2. CH 2 ONLY
3. CH 1 & CH 2 switched alternately
4. CH 1 & CH 2 time-shared (Chopped)
5. Added: algebraic sum of Channels 1 and 2

**INPUT SELECTOR**

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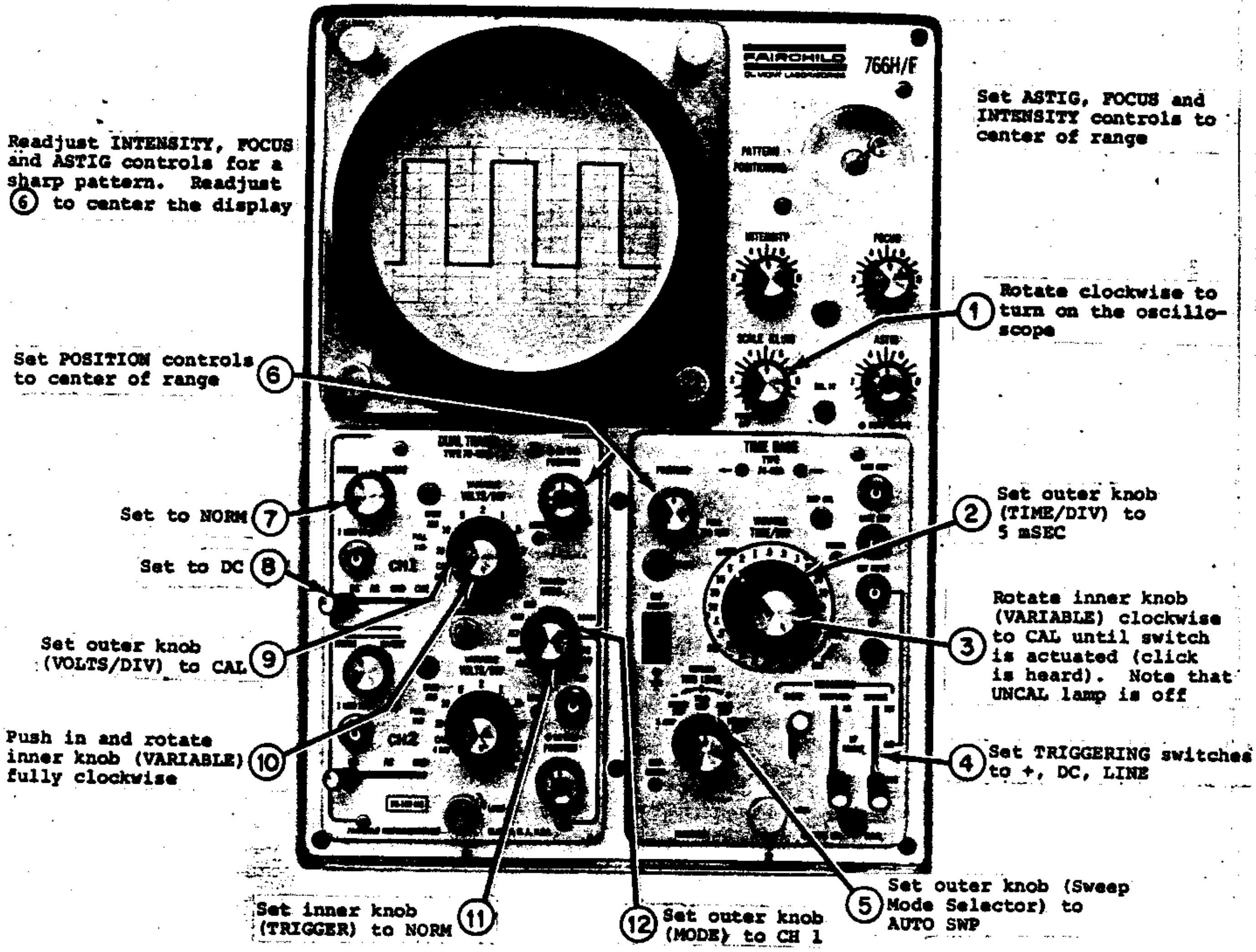



FIGURE 2-3. TYPE 79-02A CALIBRATOR DISPLAY

## 2-6. OBTAINING A DISPLAY

To use the Type 79-02A Amplifier to obtain a display, proceed as follows:

1. Signals to be observed are connected to the Type 79-02A Amplifier through the Channel 1 and/or Channel 2 BNC connector via shielded cable or an Attenuator Probe.

2. Establish a common ground between the oscilloscope chassis and the signal source.

3. To display a single trace with the Type 79-02A Amplifier, simply apply the signal to either Input connector and set the MODE switch to the corresponding channel.

4. To display two signals simultaneously, connect a signal to each Input connector and set the MODE switch to ALT or CHOP. The chopped position is used when it is desired to reduce the "flickering" of the display when observing input signal data at slow sweep speeds (below 1 millisecond/div). External triggering of the Time Base or CH 2 ONLY triggering is to be preferred in chopped position to prevent the sweep from triggering on the "chopping" signal. In general, the CHOP position is used with lower sweep rates and the ALT position with higher sweep rates.

   Two chopping rates, 100 Kc and 1 Mc, are available, selected by an internal slide switch. Switching transients are automatically blanked.

5. To display the algebraic sum of two signals, connect a signal to each Input connector and set the MODE switch to ADDED (Ch + Ch 2).

6. To display the algebraic difference of two signals, apply a signal to each Input connector and set the MODE switch to ADDED. For Ch 1 minus Ch 2 presentation, set Channel 1 Polarity Inversion switch to NORM and Channel 2, Polarity Inversion switch to INVERT. For Ch 2 minus Ch 1 presentation, set Channel 1 Polarity Inversion switch to INVERT, Channel 2 Polarity Inversion switch to NORM.

8. Adjust the appropriate Time Base Plug-in controls to obtain a stable display of the pattern.

9. Set the VOLTS/DIV switch and POSITION control to obtain the desired size display positioned on screen.

NOTE: Whenever the Type 79-02A Amplifier is removed from the Main Frame and inserted in anchor, certain high-frequency adjustments must be taken to take advantage of the full possible bandwidth of the Type 79-02A Amplifier.

To make adjustments, proceed as follows:

1. Connect the Type 79-02A Amplifier into the test equipment system described in Figure 5-2 on page 5-12 of the Instruction Manual.

2. Follow the instructions outlined in paragraph 5-15 a,b, and c as described on pages 5-11 through 5-15 inclusive.

## 2-7. CABLING TECHNIQUES IN THE NANOSECOND REALM

### a. INTRODUCTION

The purpose of this brief discussion is to point out the problems which may be encountered when one is trying to couple a signal from a source to a 100-megacycle oscilloscope over a transmission line.

If signal fidelity is to be maintained, cabling techniques and use of Passive Attenuator Probes which were satisfactory for microsecond rise-time measuring instruments, may, prove to be inadequate for application in the nanosecond realm. Since the oscilloscope is generally used as a remote monitoring device, it is necessary to transmit the signal that is to be observed some distance from the source to the load... the load being the vertical input of the oscilloscope. The two most common types of transmission lines employed in high-frequency real-time oscilloscopes are (1) the coaxial cable and (2) the high impedance passive probe.

The transmission line must be designed and connected so as to prevent ringing, reflections, and standing waves which would cause pulse deterioration. By insuring that the oscilloscope system is properly connected to the source, the operator is not only guaranteed optimum results, but time is conserved by obtaining the proper waveform the first time.

In the discussion to follow, the end of the transmission line to which power is applied is called the receiving or generator end; and the end at which power is received is called the receiving or load end.

b. EFFECT OF IMPROPER TERMINATION (Figure 2-4)

Let us first consider the 50-ohm coaxial cable as a transmission link between some 50-ohm signal source and an oscilloscope. Assume that we have a 50-ohm generator which develops a.4-nanosecond rise time pulse and that it is desired to view this pulse on the oscilloscope using the Fairchild Type 79-02A 100 Mc Dual Trace Amplifier Plug-In. We must then transmit this pulse from the generator to the oscilloscope without degrading the signal. Under these conditions, no mismatch exists at the source; however, at the load end of the coaxial which is connected directly to the oscilloscope input, the line sees one megohm shunted by 14 pf of capacity. Due to the mismatch at the oscilloscope, a reflected voltage is transmitted from the mismatch back to the generator where the energy will be dissipated in the 50-ohm load. See Figure 2-4.

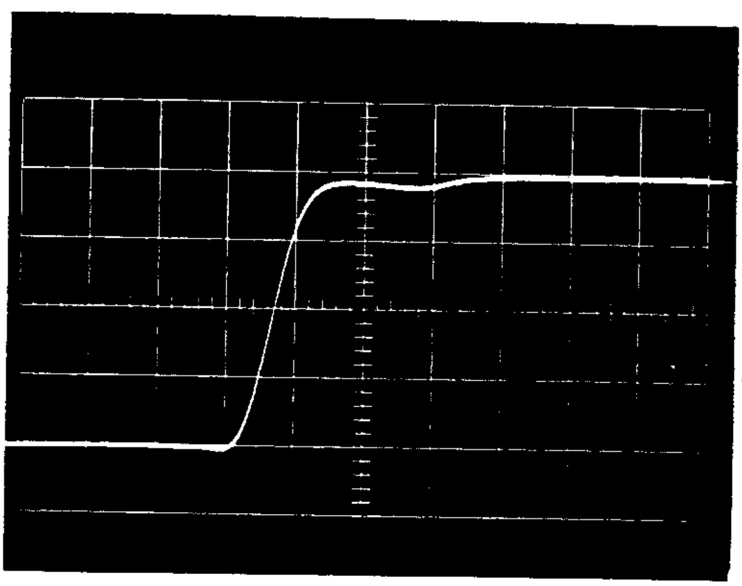


Figure 2-4.

.4-nanosecond rise time pulse from a 50-ohm source thru a 42-inch 50-ohm unterminated coax to the Type 79-02A Dual Trace 100 Mc Amplifier

c. EFFECT OF SOURCE AND LOAD TERMINATION (Figure 2-5)

Let us examine more closely the effects of mismatch on improper termination. When a mismatch occurs within the system, there will be a reflected voltage. This reflected voltage is a product of the input signal voltage and the coefficient of reflection which can be designated as the parameter ($\rho$). If the load impedance is much greater than the cable impedance, then $\rho \to 1$. If the load impedance approaches infinity, then the signal as viewed will be twice the output of the generator, and conversely if the load impedance is equal to zero, a short circuit exists and the signal output will be zero. When the transmission line at the load end sees a mismatch which is not a perfect open circuit, reflections occur causing signal deterioration. In order to obtain optimum response and pulse fidelity, it is necessary to terminate the load end of the line in its characteristic impedance. See Figure 2-5. The line is now terminated at both ends.

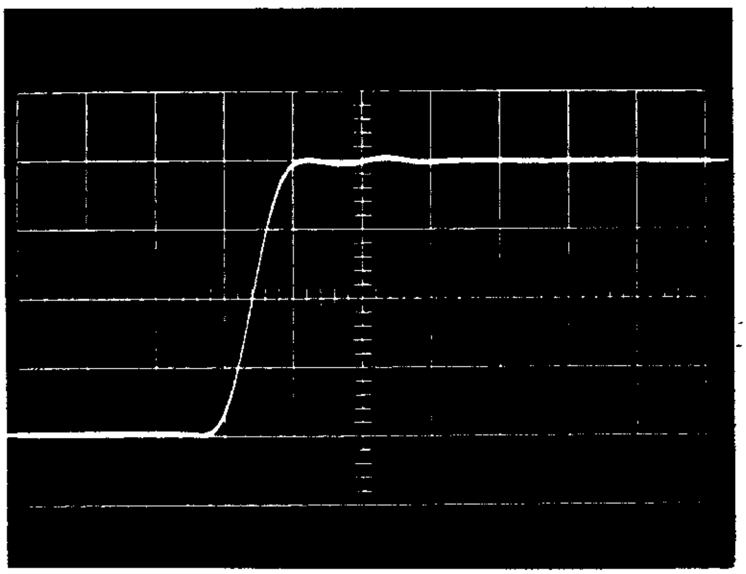


Figure 2-5.

.4-nanosecond rise time pulse from a 50-ohm source thru a 42-inch 50-ohm terminated coax to the Type 79-02A Dual Trace 100 Mc Amplifier

It can be seen that the reflection which was apparent in Figure 2-4 has been removed and the rise time has improved.

By terminating the load end of the transmission line, the reflection due to mismatch at the load end has been minimized and at the same time the bandwidth of the system has been improved.

d. EFFECT OF CABLE LENGTH ON PULSE RESPONSE (Figures 2-6 to 2-8)

Whenever the length of the unterminated cable is increased, the bandwidth of the system is reduced due to the increased cable capacity which the generator must drive. When both the sending and receiving ends of the transmission line are terminated in the characteristic impedance, the generator sees a resistive load, and therefore is no longer required to drive the line capacity. The reduction in signal amplitude is not paramount if the primary objective is the improvement to system response and pulse fidelity. See Figure 2-6.

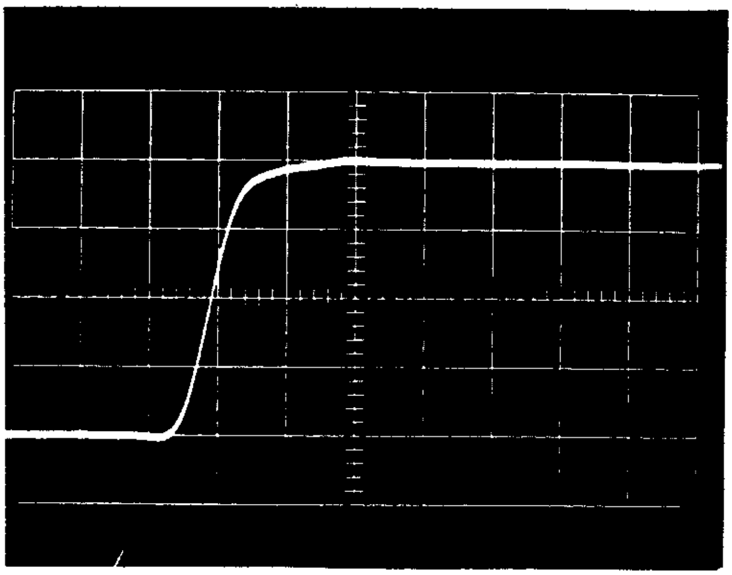


Figure 2-6.

4-nanosecond rise time pulse from a 50-ohm source thru a 6-inch 50-ohm unterminated coax to the Type 79-02A dual trace 100 Mc Amplifier.

This shows an improvement over Figure 2-4 where a 42" unterminated cable was used. However the response and pulse fidelity is not of the quality shown in Figure 2-5 where a properly terminated line was used.

In the previous example, Figure 2-6, it was assumed that the generator end of the coax was properly terminated in the characteristic impedance of the line and the load end (scope input) was unterminated.

The pulse response will be adversely affected when both ends of the coaxial cable are not properly terminated. Reflections will occur due to the mismatching and the duration of the reflection will be determined by the length of cable between the points of mismatch.

In illustrative examples, Figures 2-7 and 2-8, a three-nanosecond pulse was coupled from a 50-ohm source into different lengths of unterminated 75-ohm coaxial cable to the Type 79-02A Amplifier. The positive overshoot is due to the mismatch at the load end (scope input) and the negative reflection is caused by the mismatch at the source or generator end. The duration of the reflection is longer in Figure 2-7 than in Figure 2-8 due to the longer length of cable used. The application of minimum loss matching pads in Figures 2-7 and 2-8 would have improved pulse fidelity, but at the expense of signal amplitude.

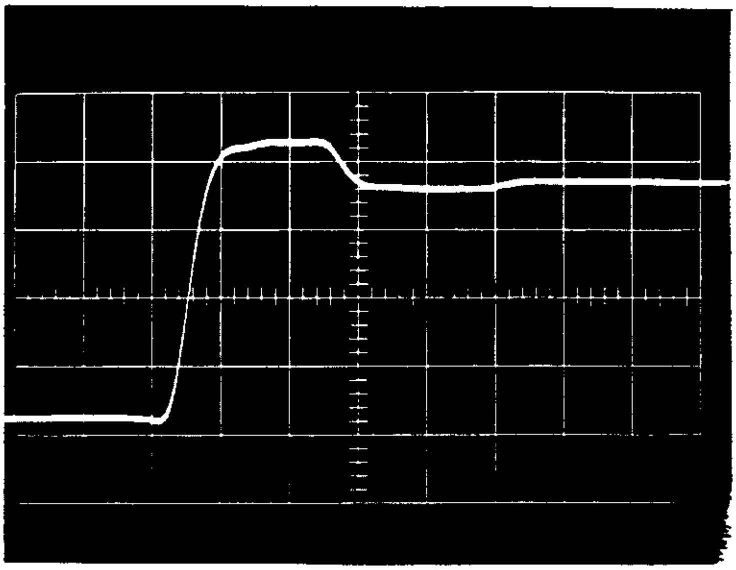
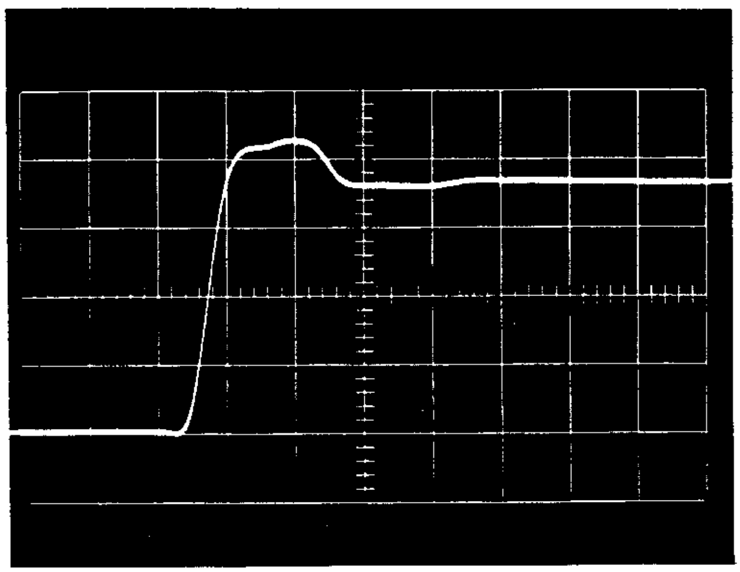


Figure 2-7.

.4-nanosecond pulse from a 50-ohm source into a 72-inch length of 75-ohm cable to the Type 79-02A Dual Trace 100 Mc Amplifier

Figure 2-8.

.4-nanosecond pulse from a 50-ohm source into a 42-inch length of 75-ohm cable to the Type 79-02A Dual Trace 100 Mc Amplifier



The use of coaxial cable will find its widest application in systems work where low impedance outputs are used. Quality coaxial cables are available in the range from 50 to 150 ohms.

In the case of circuits where impedances in the order of kilohms are found, standard coaxial cables are unsuitable for a transmission line because of their low impedance and capacitive loading effects. For these applications, a high impedance passive probe is recommended. Passive attenuator probes will generally reduce bandwidth and slow the display system rise time. Consider the effect of probe loading and response in your measurements. See paragraph entitled "Use of Probes."

e. SUMMARY OF CABLING TECHNIQUES

The ideas developed in the preceding paragraphs may be recapitulated as follows.

1. In broadband applications, it is necessary to terminate a coaxial cable with a resistance equal to its characteristic impedance. This is done to prevent standing waves or ringing (high-frequency damped oscillations).

2. To avoid erroneous results, the operator should simulate the actual operating conditions of the equipment being tested. For example, the equipment should work into a load impedance equal to that which it will see in actual use.

3. Consider the effect of loading upon the signal source due to the input impedance of the oscilloscope. The input impedance can be represented by a resistance shunted by a capacitance. The effective value of this impedance is indicated in the Specifications. However, the operator should be aware that even with a few feet of cable in the input circuit, the loading capacitance on the circuit under investigation might be greater than 100 pf.

4. There are cases when connecting the input of the oscilloscope to a signal source, the effect of loading the source is not negligible. To minimize this loading and therefore obtain a valid measurement, a probe may be used in the manner described in the paragraph entitled "Use of Probes."

5. Care must be exercised when applying a fast rise, high-frequency signal to the Input connector. It will be necessary to match and properly terminate the coaxial cable applying the signal to the oscilloscope or ringing on the rising and falling portion of the waveform will result.

f. CABLING FOR RACK-MOUNTING SYSTEMS

For rack-mounting systems, observe the following precautions if long, shielded cables are used.

1. It may be desirable to ground long shielded leads only at one end to avoid circulation currents. Even microamperes of extraneous currents in the shielded braid can cause unwanted distortions.

2. Use cable with insulation over the shielded braid so that the cable does not accidentally touch ground.

3. Use off-ground insulated bulkhead feed-thru connectors where applicable.

4. Do not pass cables near strong AC magnetic fields.

5. Long shielded input cables may also induce parasitic oscillations. It is suggested that a 100-ohm to 1000-ohm, 1/2 watt resistor be connected in series with the center conductor near or at the oscilloscope input terminals.

6. Use a resistance at least twice that required to just stop the parasitic oscillations. Too large a value may reduce the bandwidth of the system.

## 2-8. USE OF PROBES

### a. INTRODUCTION

An attenuator probe reduces both the capacitive and resistive loading caused by the oscilloscope.

Simultaneously, while isolating the oscilloscope from the signal source, it reduces the effective sensitivity of the instrument. In other words, the displayed waveform will be reduced in amplitude by the attenuation factor of the probe.

When using the probe to sample signals from a tuned, matched, or otherwise critical circuit, capactive loads may cause erroneous readings. In these cases it may be necessary to remove capacity and resistance from the circuit under observation. When the observations and adjustments are completed, capacitance and resistance precisely equal to that of the probe impedance, should be added to the circuit after the probe is removed from the circuit. This substitution will equalize loading and restore the operating characteristics of the circuit under observation to the same conditions as when probe measurements were made.

When using the attenuator probe to make amplitude measurements, multiply the observed amplitude of the display by the attenuation factor marked on the probe.

### b. TYPE 7994B PROBE

As is the case where any probe is used with an oscilloscope, the over-all system bandwidth and response is reduced and there will be a certain degree of loading. The amount of loading introduced by the probe will be determined by the characteristics of the circuit under test and the input resistance and capacitance of the probe.

The Fairchild Type 7994B Probe is basically an unterminated high-frequency probe which has been designed wo work with the Type 79-02A 100 Mc Amplifier Plug-in as a system. At low frequencies, the probe together with the input of the oscilloscope appears as a compensated divider. However, when using the probe to monitor nanosecond pulses, the reactive components and line losses become important factors.

Since the probe is used unterminated, the design must be such that no reflections or ringing will occur to cause signal deterioration. The lead inductance of the center conductor at high frequencies becomes a critical factor in the probe design. Since the cable is unterminated and has inductance and capacitance, it is necessary that a resistance wire be used as a center conductor. This resistance is carefully selected so that the cable is critically damped. In the Fairchild Type 7994B Probe, there is a termination network located at the scope end of the probe. This network consists of reactive and resistive components and is used to adjust the response at high frequencies.

There is a limitation as to the length of cable that can be used in the probe without severely restricting the bandwidth of system, assuming that we desire to maintain the same input impedance in the probe. The Fairchild Type 7994B is a 3-1/2 foot probe with an input impedance of 10 megohms and 7 picofarads which will provide a 78 Mc system bandwidth when used with the Type 79-02A Dual Trace 100 Mc Amplifier.

c. EFFECT OF PROBE GROUND LEAD ON PULSE RESPONSE (Figures 2-9 to 2-11)

The most common problem encountered when using a high-frequency probe is the introduction of high-frequency ringing due to the use of an excessively long ground lead. When using the Type 7994B Probe to monitor fast-rise pulses, a ground lead as short as possible should be employed. See Figures 2-9 to 2-11. Optimum pulse response is shown in Figure 2-11. The ringing observed in Figures 2-9 and 2-10 is due to excitation of a resonant circuit made up of the ground lead inductance of the probe input capacity.

It is obvious from the foregoing that the pulse response and bandwidth can be greatly exaggerated due to improper grounding of the probe. Correct use of the probe and an understanding of its capabilities and limitations will insure the display of true information on the oscilloscope.

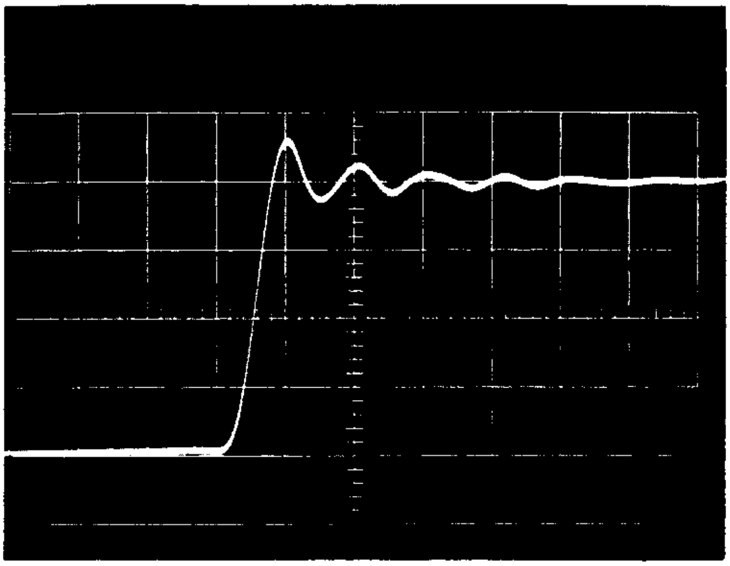


Figure 2-9.

Pulse response when using 6-inch ground lead on Type 7994B Probe

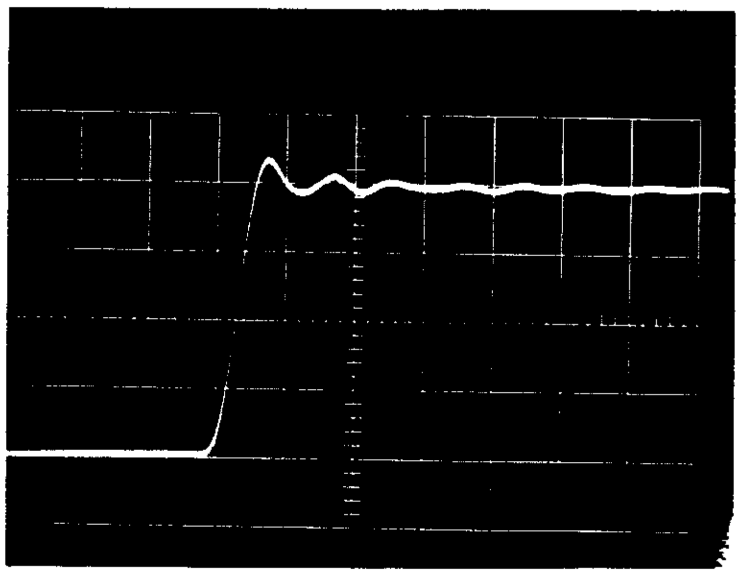


Figure 2-10.

Pulse response when using 3-inch ground lead on Type 7994B Probe

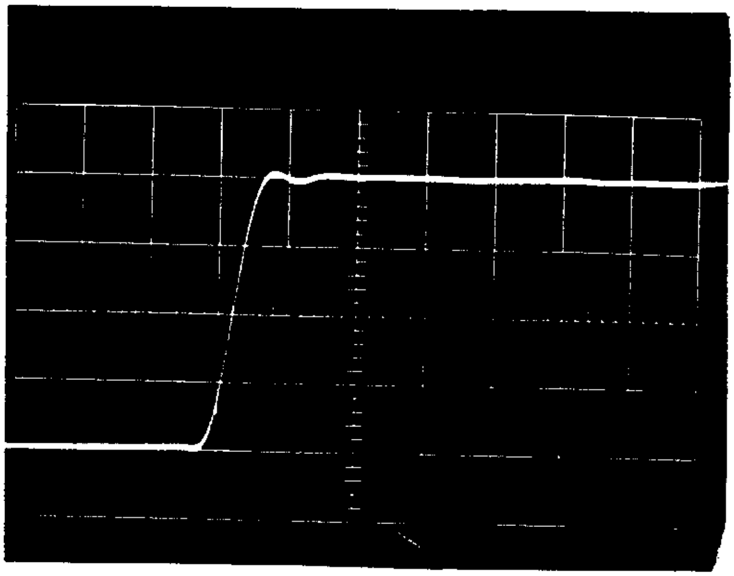


Figure 2-11. Pulse response using nose ground lead (an extremely short lead that connects directly to probe tip). Note that optimum pulse fidelity is achieved when using the nose ground on the Type 7994B Probe.

c. PROBE ADJUSTMENT

The Type 7994B Accessory Probe has an attenuation factor of 10 to 1. The maximum voltage that may be applied to this probe is 600 volts DC plus peak AC. Voltages in excess of this value (either DC volts or peak AC volts) may cause damage to components inside of the probe housing.

IMPORTANT: Before using the probe, always check its adjustment.

An adjustable capacitor in the probe compensates for variations in input capacitance from one unit to another. To insure accuracy in pulse and transient measurements, check the probe adjustment frequently. To check the probe, proceed as follows:

1. Connect the Probe to Input BNC connector on the Type 79-02A and apply the probe tip to the 1V CAL pin jack on the Main Frame. Set Input Selector switch to DC.

2. Adjust the oscilloscope to display several cycles of the calibrator waveform.

3. Adjust the variable capacitor in the body of the probe for a flat-top trace on the screen.

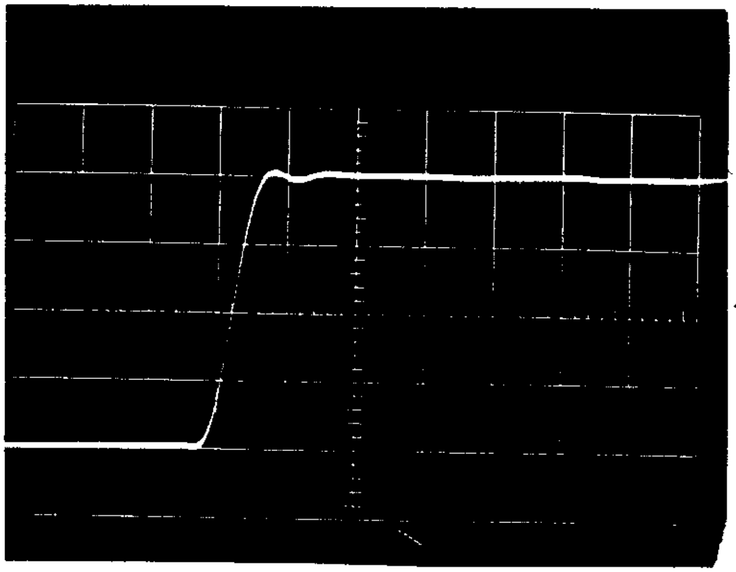
4. To preserve the waveform of the signal being displayed, clip the probe ground lead to the chassis of the equipment being tested. Select a short, clean, ground point near the probe input connection.

2-9. DUAL-TRACE OPERATION

Using the Type 79-02A Dual Trace Plug-in unit with the Main Frame, makes it possible to view two different time-shared vertical input signals displayed against one time base. The electronic switch will alternately accept either the Channel 1 or Channel 2 signal when the MODE switch is set to ALT. Each channel retains individual control of sensitivity, position, polarity, etc. Should the sweep rate be so low that the display has excessive flicker, the MODE switch may be set to CHOP position. The electronic switch will now chop the signals at either a 100Kc or 1Mc rate. Chopping rate is selected by an internal toggle switch. Switching transients will automatically be blanked for a clean, undistorted display.

The dual-trace display applications include comparisons of the input and output of amplifiers, multivibrators, shaping circuits, comparative phase and time delay measurements, etc.

Do not use normal internal triggering when in the chopped mode, since the sweep will trigger on the switching transients rather than on the signal. CHANNEL 2 ONLY triggering should be used.



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2. Adjust the oscilloscope to display several cycles of the calibrator waveform.

3. Adjust the variable capacitor in the body of the probe for a flat-top trace on the screen.

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The dual-trace display applications include comparisons of the input and output of amplifiers, multivibrators, shaping circuits, comparative phase and time delay measurements, etc.

Do not use normal internal triggering when in the chopped mode, since the sweep will trigger on the switching transients rather than on the signal. CHANNEL 2 ONLY triggering should be used.

## 2-10. DUAL TRACE TRIGGERING

### a. INTRODUCTION

For simplicity, dual-trace triggering may be categorized as follows:

1. External triggering using alternate or chopped modes of operation.
2. Internal triggering (NORM or CH 2 ONLY) using the alternate mode.
3. Internal triggering (CH 2 ONLY) using the chopped mode.

### b. EXTERNAL TRIG USING CHOP OR ALT MODES

For dual-trace operation, it is preferable to trigger the time base with an external signal which bears a fixed time relationship to the applied signal. One of the applied signals may normally be employed as the external triggering signal. When this technique is used, a stable display is more readily obtained, and the true time or phase relationship of the two signals is discernible.

In low frequency applications, one of the applied signals may be used as the external triggering signal. In general, useful stable displays may be obtained by this technique without excessively loading the signal source. However, in high-frequency applications, such a method for deriving the triggering signal loads down the signal source resulting in an unsatisfactory display. Therefore, a minimum-loading method must be used for obtaining the external trigger. For example, if the Fairchild Type 781A Time-Mark Generator is the signal source, use the TRIGGER OUT pulse from this generator to externally trigger the oscilloscope.

### c. INTERNAL TRIG USING ALT MODE

Internal triggering of the time base may be used if the time or phase relationship between the two signals is not critical. In alternate mode of operation, the signal applied to the Type 79-02A internally triggers the Time Base Module, which in turn switches the channels at the completion of each sweep cycle during the retrace intervals.

Hence, it is important to set the Time Base TRIG LEVEL control to a point where the sweep can trigger on the signal applied to each channel. If one of the applied signals possesses a smaller amplitude than the other, then the TRIG LEVEL control must be set for reliable triggering on the smaller amplitude signal.

Also, to avoid triggering on the change in dc positioning level between channels, set the Time Base Coupling switch to ACF or LF REJECT, when in the NORMAL trigger position.

As an alternative, the Type 79-02A may be set up for single channel internal triggering in the alternate mode by setting the TRIGGER switch to CH 2 ONLY.

d. INTERNAL TRIG USING CHOP MODE

For dual-trace chopped-mode operation, use CH 2 ONLY mode for reliable internal triggering. The advantages of internal triggering on CH 2 ONLY over the use of external sync trigger are:

- Increased sensitivity with effectiveness of using external trigger.
- Decreased loading.
- Minimum cabling to the oscilloscope.
- Two effective external trigger inputs.

2-11. SETTING UP AMPLIFIER FOR GREATER INPUT SENSITIVITY

The Type 79-02A Dual Trace Amplifier may be set up to provide an input sensitivity of 1 millivolt/division with an accompanying reduction in bandwidth. This is accomplished by setting the CH 1 INPUT SELECTOR switch in the CH 2 position. The output from Channel 2 pre-amplifier is now in series with the input of Channel 1 amplifier.

Next, apply the desired signal to Channel 2 Input connector. Set the TRIGGER switch to NORM and the MODE switch to CH 1. The maximum over-all input sensitivity will now be 1 millivolt/division. The front panel GAIN ADJ screwdriver control may require slight readjustment to achieve this sensitivity. Application of this technique for achieving greater sensitivity causes the system to have lower bandwidth and slower rise time. A nominal 30 Mc bandwidth and a rise time of 14 nanoseconds may be expected from cascaded amplifier operation.

2-12. VOLTAGE MEASUREMENTS

Note: When making voltage measurements, make sure there is a common ground between the oscilloscope and the signal source.

a. GENERAL

The Type 766H/F Family of Oscilloscopes may be used to measure the voltage of the input signal by using the calibrated VOLTS/DIV setting and observing the height of the display on the screen in graticule divisions.

When making voltage measurements, use full scale vertical deflection to insure maximum accuracy. Also, it is important to remember that the width of the trace may be an appreciable part of the over-all measurement.

This is particularly true when you are measuring signals of small amplitude or when stray signal pickup has broadened the trace. The operator should consistently make all measurements from one side of the trace. If the top side of the trace is used for one reading, it should be used for all subsequent readings.

b. MEASURING PEAK-TO-PEAK VOLTAGES (Figure 2-12)

The procedure employed for all voltage measurements is basically the same. The VARIABLE control must be set to CAL. The Specific examples that follow are intended to show the general procedure. These examples may be adapted to fit any particular application.

To measure the AC component of the signal on display, set the Input Selector switch to AC. In this position, only the AC components of the input signal are displayed on the screen. However, when the AC components of the input is of very low frequency, set the Input Selector switch to DC to prevent errors.

To make measurements, proceed as follows:

1. Using the calibrated scale, measure the vertical deflection in graticule divisions from the positive peak to the negative peak of the waveform.

2. Multiply the vertical dimension obtained in step 1 by the VOLTS/DIV switch setting to obtain the indicated voltage.

3. Multiply the indicated voltage obtained in step 2 by the attenuation factor of the probe, if one is used, to obtain the actual peak-to-peak voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/DIV switch is set to 0.1. Assume that the vertical distance between the peaks of the waveform measures 4 graticule divisions. Now, this graticule dimension of 4 is multiplied by the VOLTS/DIV setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, if a 10:1 Attenuator Probe is used. This gives 4 volts as the peak-to-peak voltage of the display waveform.

Note: Always make sure that the VARIABLE control is set to CAL when making measurements.

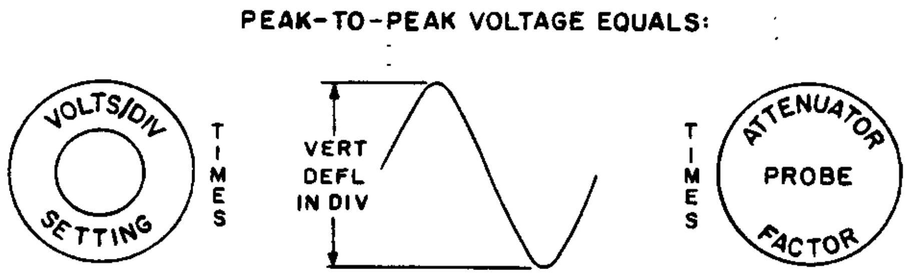



FIGURE 2-12. PEAK-TO-PEAK VOLTAGE MEASUREMENTS

c. MEASURING INSTANTANEOUS VOLTAGES WITH RESPECT TO A REFERENCE POTENTIAL (Figure 2-13)

The technique used for measuring instantaneous voltages with respect to a reference point, is virtually the same as that described for peak-to-peak voltage measurements. The difference is that now a reference point must be established on the screen of the oscilloscope. Since voltage measurements with respect to ground are the most common, the procedure which follows, establishes ground as the reference point. The same general technique may be used for instantaneous measurements with respect to any other potential, just so long as that potential is employed to establish the reference point.

To make measurements, proceed as follows:

1. Set the Input Selector switch to DC.

2. Adjust the appropriate Time Base Plug-in controls to obtain a reference trace.

3. To establish the reference point, touch the probe tip to the ground terminal on the oscilloscope (or to the desired source potential, if a point other than ground is used). Vertically position the trace to a convenient point on the screen. This point should be chosen so that it lies on one of the major horizontal scale divisions. The chosen horizontal scale line, which is now coincident with the trace, is the reference line from which all voltage measurements are to be made.

4. Disconnect the probe tip from ground and connect it to the signal source without disturbing the POSITION control.

5. Adjust the oscilloscope controls for a suitable and stable display.

6. Using the calibrated scale, measure the number of graticule divisions from the desired point on the waveform to the pre-established reference line set up in step 3.

7. Multiply the graticule dimension obtained in step 6 by the VOLTS/DIV switch setting to obtain the indicated voltage. Make sure that the VARIABLE control is set to CAL.

8. Multiply the indicated voltage obtained in step 7 by the attenuation factor of the probe used to obtain the actual instantaneous voltage.

   For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/DIV switch is set to 0.1. Assume that the vertical distance between the desired point on the waveform to the pre-established reference line is 4 graticule divisions. Now, multiply this vertical deflection of 4 graticule divisions by the VOLTS/DIV setting of 0.1 to give 0.4 volts. Next, multiply this result by 10, the attenuation factor of the probe. This shows that the instantaneous voltage with respect to ground to be 4 volts. Since the voltage point is above the reference line, the indicated polarity is positive.

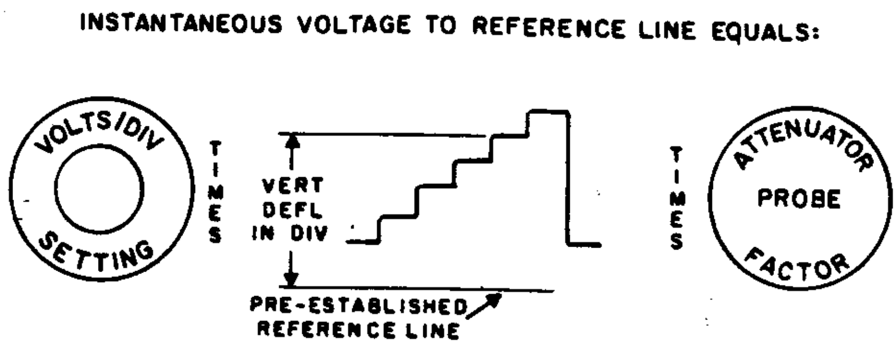



Figure 2-13. Instantaneous Voltage Measurement with Respect to a Reference Potential.

## 2-14 MEASURING SHORT RISE TIMES (Figure 2-14)

The response of an amplifier or other electronic device to a step function input signal is a measure of the ability of the device to pass signals without distortion. In general, the response of the device can be measured by comparing the rise time of the output signal with the rise time of the input signal. In the ideal case, the signal would be passed with zero change of rise time, indicating all signals would be passed without distortion. Further, if two devices yield identical rise times for the same step function input, they can be expected to provide similar responses to all types of waveforms.

The rise time is defined as the time between 10% and 90% of the amplitude.

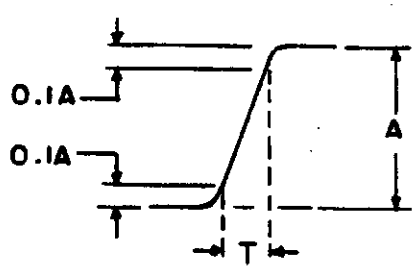



Figure 2-14.
Rise Time Sketch

To measure rise time, connect the circuit under investigation with a 50-ohm cable RG-8A/U, terminated with a 50-ohm pad to the input of the oscilloscope. The rise time of the circuit is expressed in the form:

$$t_p = \sqrt{(t_o)^2 - (t_a)^2}$$

Where: $t_p$ = actual pulse rise time

$t_o$ = observed rise time of pulse displayed on oscilloscope

$t_a$ = amplifier rise time

Once the amplifier rise time is known (see Specifications) the rise time of any pulse may be calculated.

The display of the pulse should be within the quality square of 6 divisions to avoid saturation of the output circuits and related distortion of the pulse response.

# SECTION 3

## FUNCTIONAL BLOCK DIAGRAMS

Functional Block Diagrams are provided as follows:

Figure 3-1. Type 79-02A Input Circuit, Simplified Functional Block Diagram

Figure 3-2. Type 79-02A Channels 1 & 2 Pre-Amplifiers, Simplified Functional Block Diagram

Figure 3-3. Type 79-02A X10 Amplifiers, Functional Block Diagram

Figure 3-4. Type 79-02A Electronic Switching Circuit, Functional Block Diagram

Figure 3-5. Type 79-02A Y Deflection Amplifier, Functional Block Diagram

Figure 3-6. Type 79-02A Trigger Amplifiers, Functional Block Diagram

Refer to Figure 5-1 in the Maintenance and Recalibration Section for the over-all system block diagram.

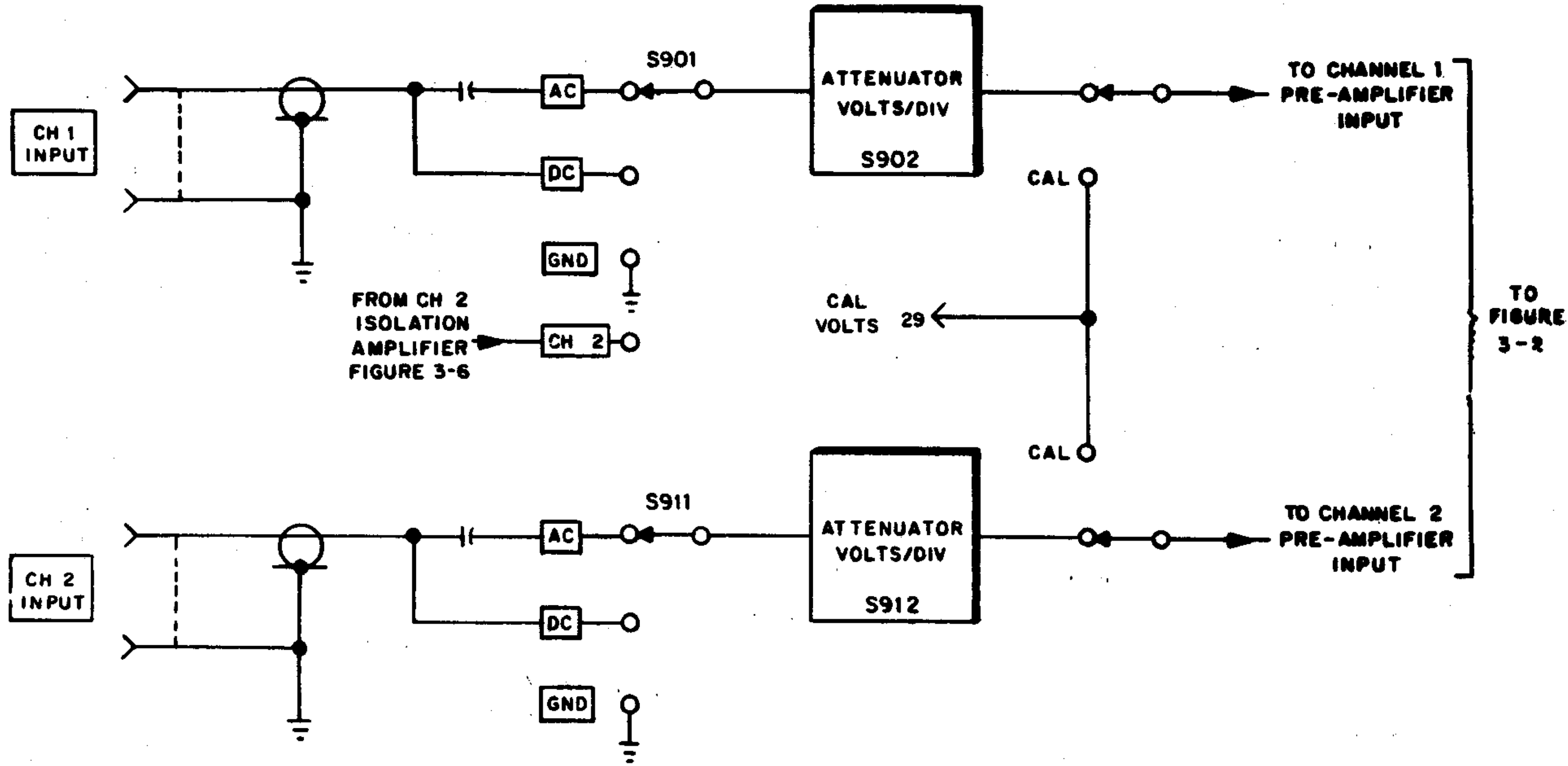



FIGURE 3-1. TYPE 79-02A INPUT CIRCUIT, SIMPLIFIED FUNCTIONAL BLOCK DIAGRAM

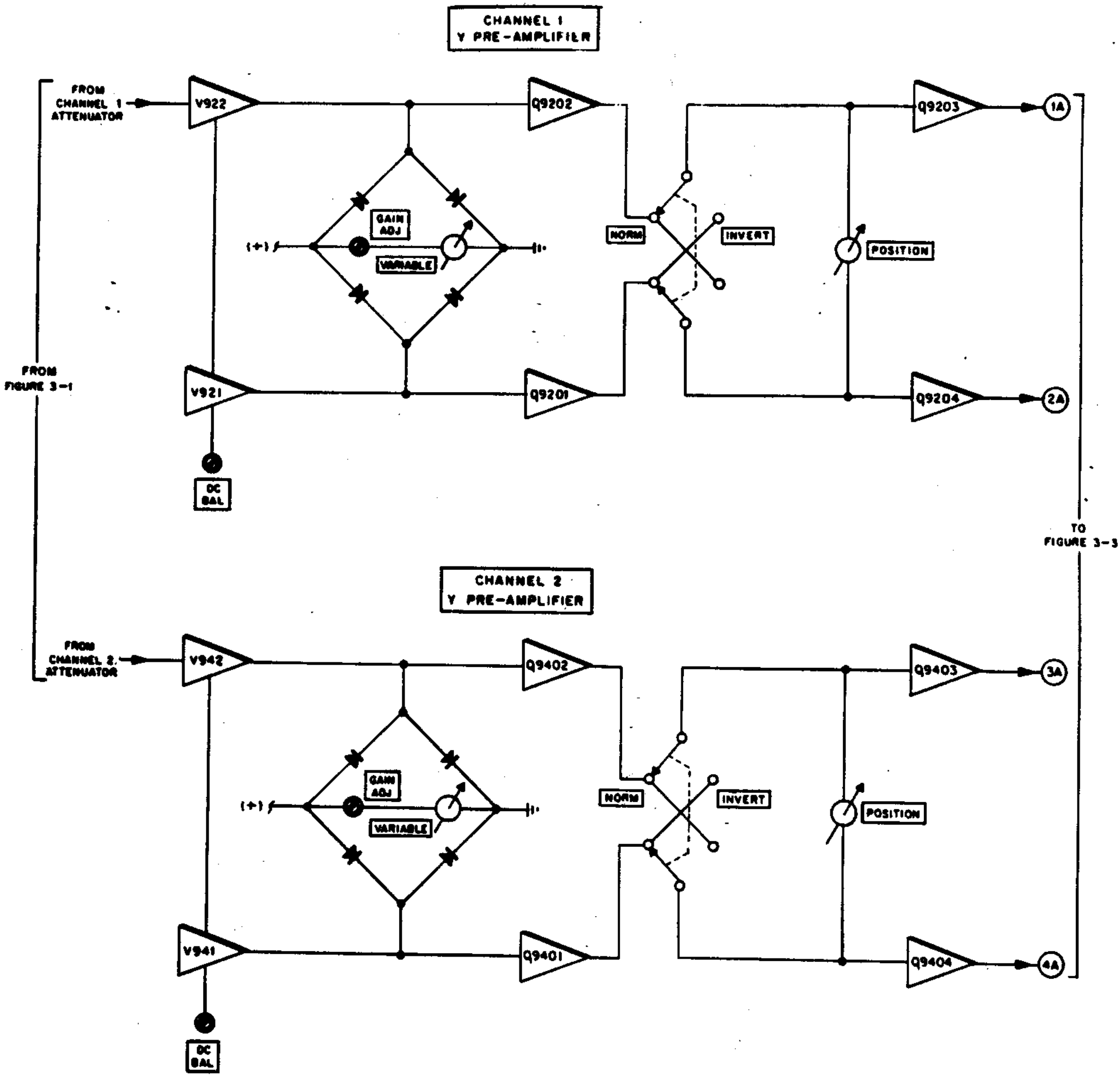



FIGURE 3-2. TYPE 79-02A CHANNELS 1 & 2 PRE-AMPLIFIERS, FUNCTIONAL BLOCK DIAGRAM

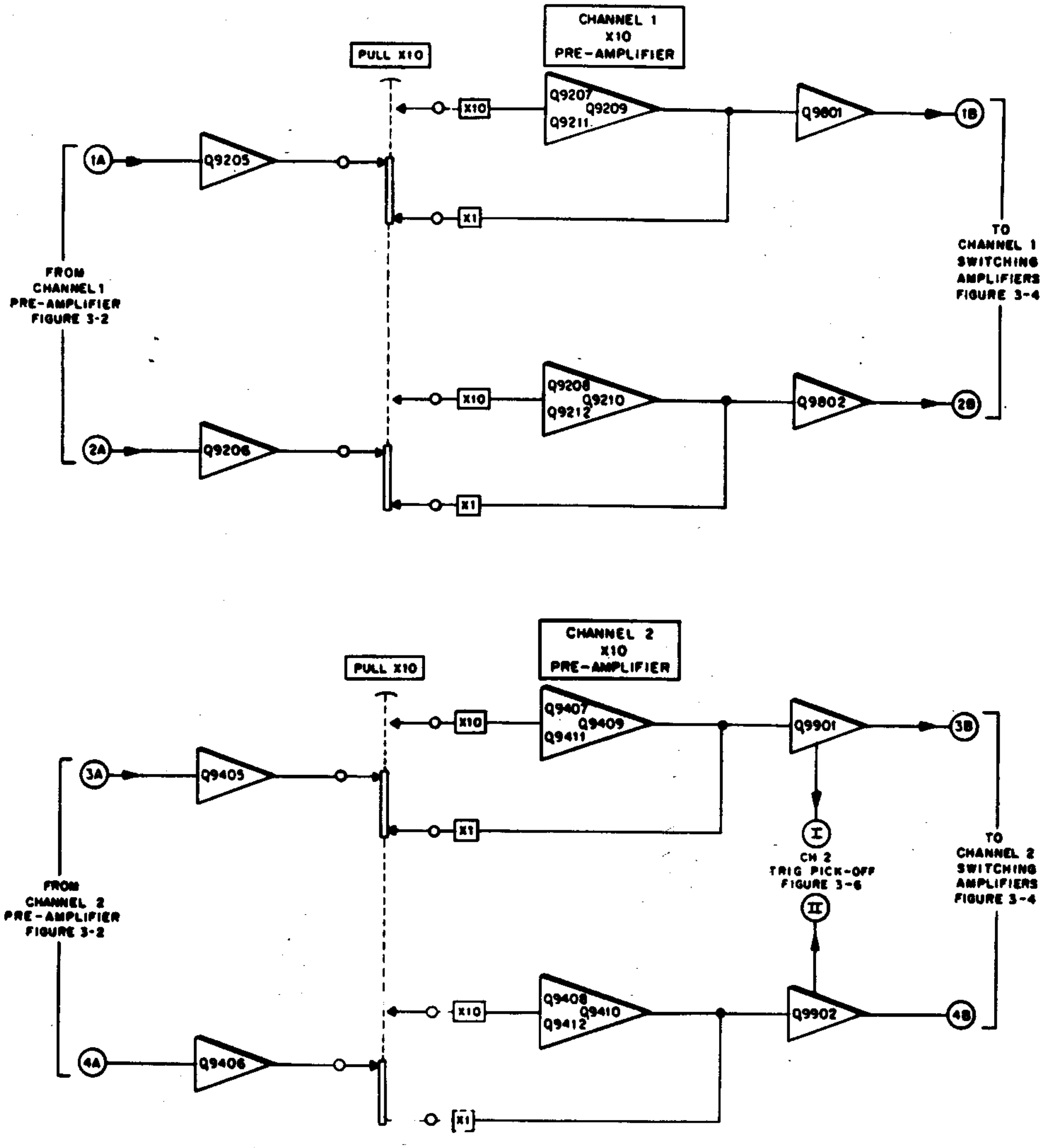



FIGURE 3-3. TYPE 79-02A X10 AMPLIFIERS, FUNCTIONAL BLOCK DIAGRAM

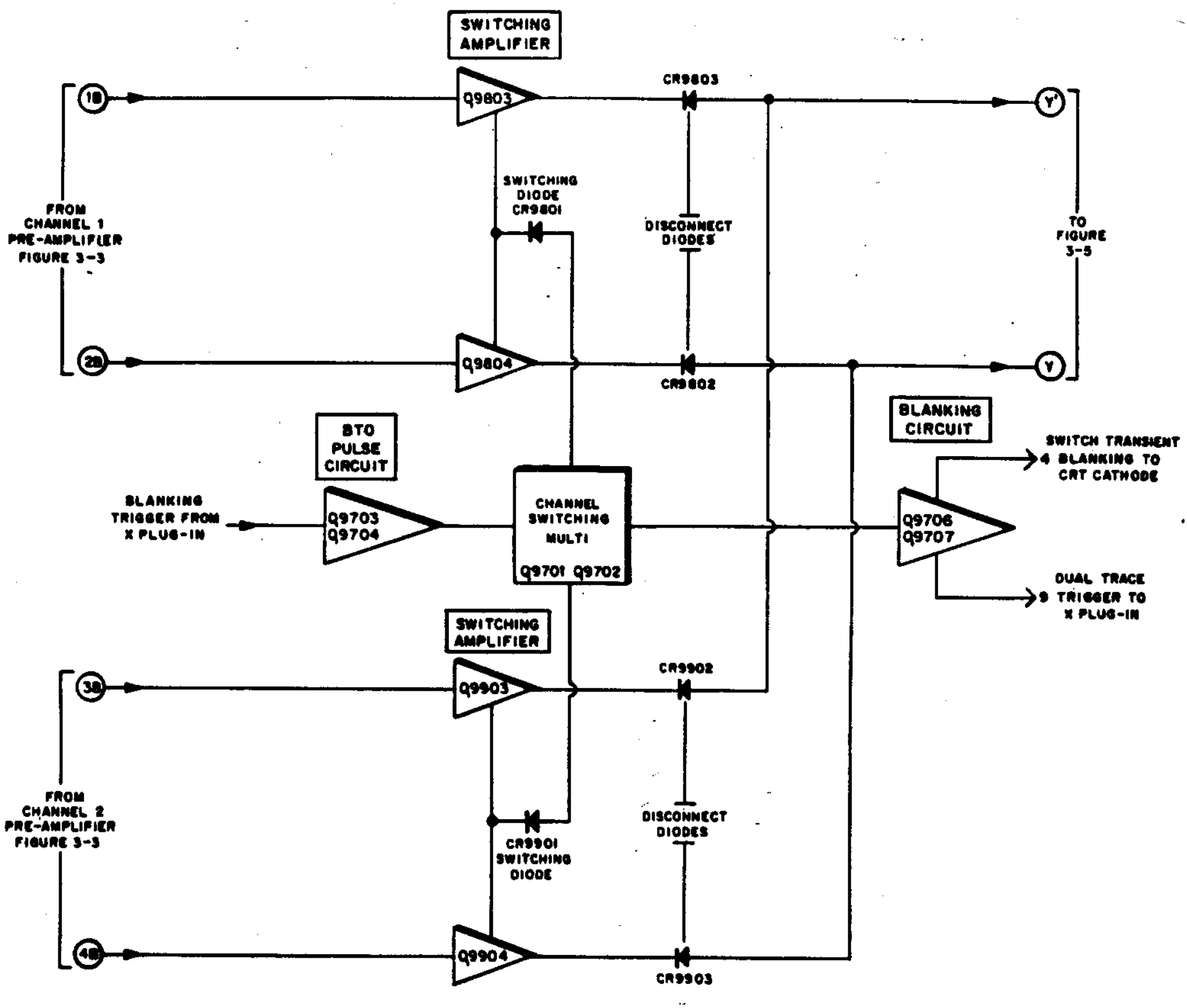



FIGURE 3-4. TYPE 79-02A ELECTRONIC SWITCHING CIRCUIT FUNCTIONAL BLOCK DIAGRAM

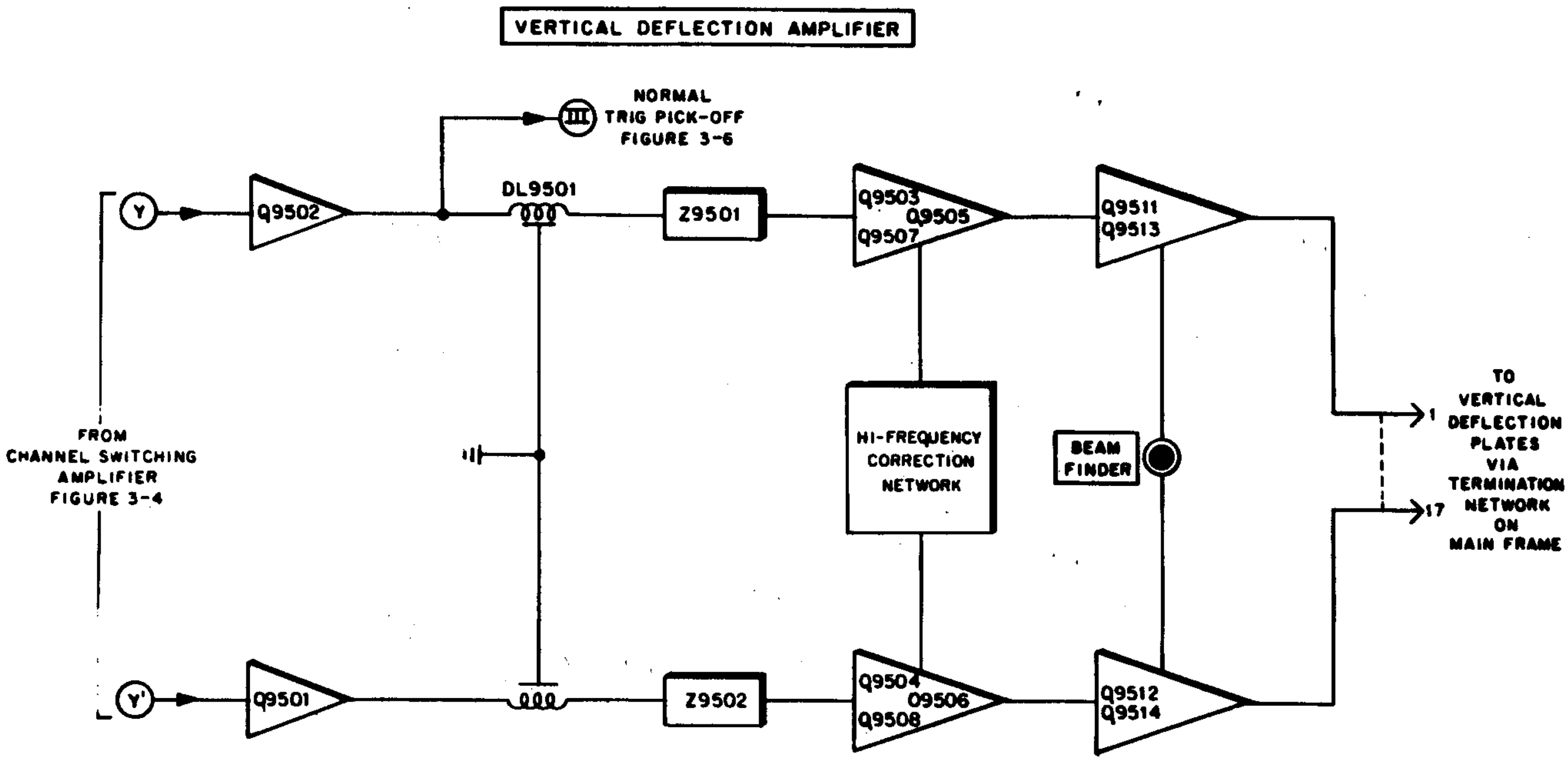



FIGURE 3-5. TYPE 79-02A Y DEFLECTION AMPLIFIER
FUNCTIONAL BLOCK DIAGRAM

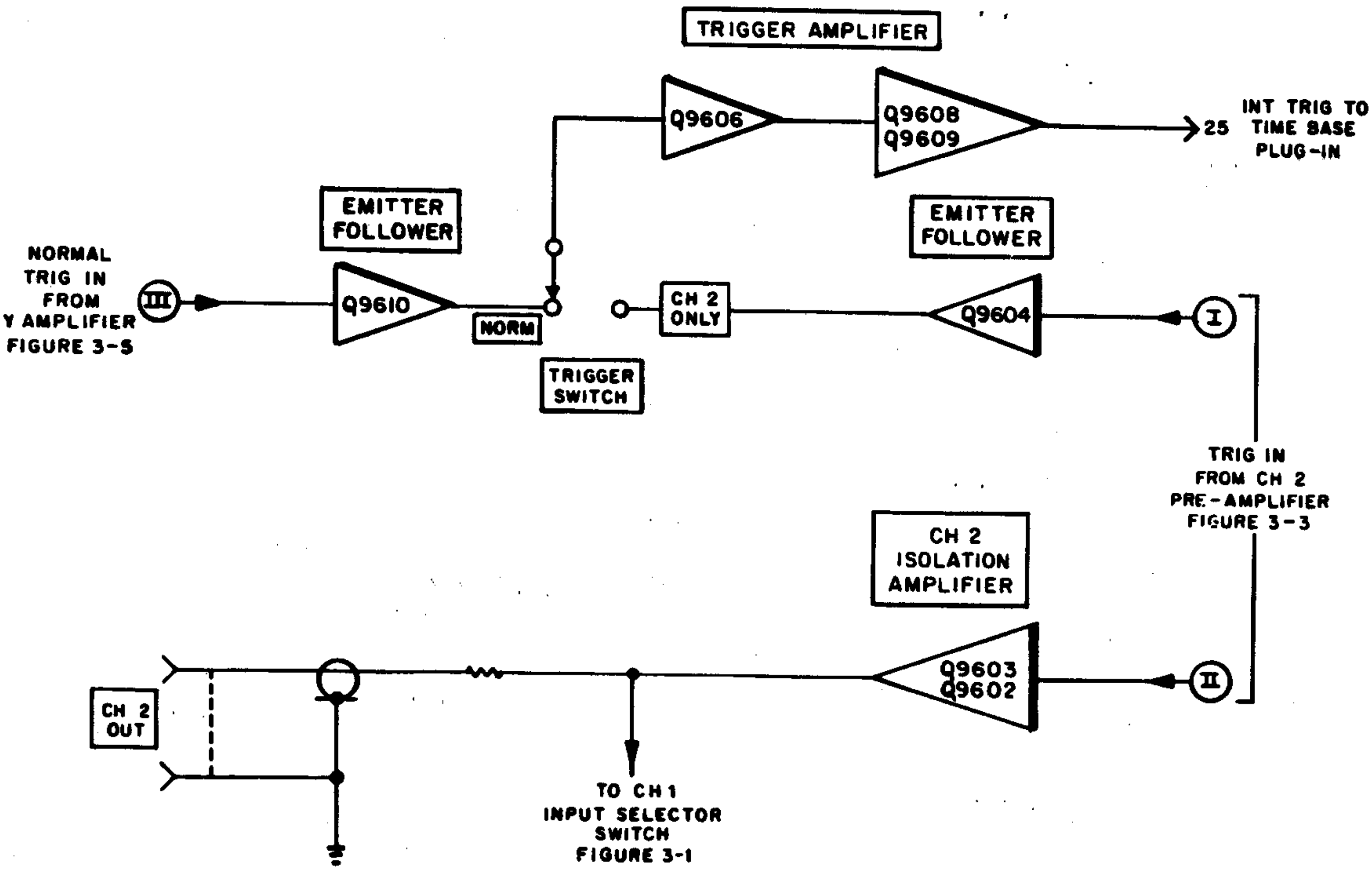



FIGURE 3-6. TYPE 79-02A TRIGGER AMPLIFIERS, FUNCTIONAL BLOCK DIAGRAM

# SECTION 4

# PERFORMANCE ASSURANCE TEST

## 4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5, for list of test equipment required.

All tests are performed with a representative Type 766H/F Series Main Frame Oscilloscope and a Time Base Plug-in. Both of the plug-in units must be normalized to the Main Frame before starting tests. This is accomplished by adjusting the front-panel screwdriver SWP CAL and GAIN ADJ control as described in the appropriate plug-in Instruction Manuals. Allow 30 to 60 minutes of warmup time before making any adjustments.

**NOTE**

If this Plug-in module is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If after performing all the tests outlined in the paragraphs to follow, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

## 4-2. CHECKING DC BALANCE ADJUSTMENT

1. Set the MODE switch to CH 1 and the Input Selector Switch to GND.

2. Set the VOLTS/DIV switch to 0.1 position and rotate the VARIABLE control to its minimum gain setting.

3. Set the Time Base Plug-in controls for automatic triggering to obtain a reference trace on the screen.

4. Adjust the POSITION control, on each plug-in, to center the trace on screen (reference line).

5. Rotate the VARIABLE control right and left throughout its range observing the direction the trace shifts vertically.

6. Adjust the front-panel DC BAL screwdriver control to bring the trace back to center of screen.

   Note: DO NOT CHANGE THE POSITION CONTROL SETTINGS.

7. Continue adjusting the DC BAL control while rotating the VARIABLE control back and forth, until there is minimum displacement of the trace when the VARIABLE control is rotated throughout its range.

8. Repeat Channel 1 balance adjustments for Channel 2 using pertinent controls.

   Note: If the adjustment range of the front-panel DC BAL control is insufficient, refer to Section 5, Maintenance and Recalibration, for the complete Coarse and Fine Balance adjustment procedure.

## 4-3. CHECKING SENSITIVITY OF CHANNELS 1 & 2

1. Set both Channel 1 and Channel 2 VOLTS/DIV switches to CAL and turn both VARIABLE controls to CAL (fully cw).

2. Push in both VARIABLE controls to set up the amplifier for X1 operation.

3. Set MODE switch to CH 1 and TRIGGER switch to NORM.

4. Adjust Time Base unit for LINE triggering and for a sweep rate of 10 msec/div and observe 6 cycles of calibrator waveform at 60-cycle line. (5 cycles for 50-cycle line.)

5. Set MODE switch to ALT.

6. Check range of Channel 1 GAIN ADJ front-panel screwdriver control. It should control the amplitude of the calibrator signal providing at least 4.1 cm of deflection peak-to-peak. Set Channel 1 GAIN ADJ control for 4 divisions of vertical deflection.

7. Position the trace one on top of the other.

8. Adjust Channel 2 GAIN ADJ control until only one trace may be observed (traces are superimposed).

4-4. CHECKING FAST RISE TIME OF CHANNELS 1 AND 2

1. Connect a Fairchild Type 791A Square-Wave Generator equipped with a Type 7911A Fast Rise Adapter, to the Type 79-02A. Connection should be through a 3-db pad and a 50-ohm cable, terminated in a 50-ohm pad with the Adapter connected to the oscilloscope.

2. Set both Channel 1 and Channel 2 VOLTS/DIV switches to 0.5 and turn both VARIABLE controls to CAL (fully cw).

3. Push in the VARIABLE control to the X1 position.

4. Set MODE switch to CH 1 and TRIGGER switch to NORM.

5. Set the SOURCE IMPEDANCE switch on the Square Wave Generator to 50Ω, OUTPUT AMPLITUDE control at maximum and FREQUENCY dial set to 1 Mc. Observe 4 divisions of positive rise on the oscilloscope.

   Note: The overshoot, or preswing should be less than 0.25 division and ringing less than 0.1 division.

   Rise time (10% to 90%) should be 3.8 nanoseconds or less. This includes the rise time of the Type 7911A Fast Rise Adapter.

4-5. CHECKING MODE SWITCH

1. Set MODE switch to CH 1 and operate Channel 1 POSITION control to check vertical displacement of the display.

2. Set MODE switch to CH 2 and operate Channel 2 POSITION control to check vertical displacement of the display.

3. Set MODE switch to ALT and operate both POSITION controls checking that they control their respective displays.

4. Set MODE switch to CHOP and operate both POSITION controls checking that they control their respective displays.

5. Set MODE switch to ADDED and operate either POSITION control checking that either one controls the display.

4-6. CHECKING CHOPPED OPERATION

1. Set the internal CHOP RATE switch (Figure 5-11) to 100 Kc on the Type 79-02A chassis and the front panel MODE switch to CHOP.

2. Adjust Time Base Plug-in for a sweep rate of 5 uSEC/DIV and INT Triggering.

3. Position both base lines on the screen.

4. Check that the total time for blanking and unblanking for each channel is less than 15 microseconds and that the switching transients are blanked.

5. Set the CHOP RATE switch to 1 Mc.

6. Adjust Time Base Plug-in for a sweep rate of 0.5 uSEC/DIV.

7. Check that the total time for blanking and unblanking for each channel is less than 1.5 microseconds and that the switching transients are blanked.

# SECTION 5

# MAINTENANCE AND RECALIBRATION

## 5-1. INTRODUCTION (Figure 5-1)

This section of the Instruction Manual contains service information and procedures for internal adjustments. Refer to Figure 5-1 for an over-all functional block diagram of the Type 79-02A system.

## 5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings and the factory part number for all electrical components used in the instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of Fairchild to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Fairchild representative maintains a limited number of spare parts. Also, the factory may be asked to airship replacement parts on a rush basis.

## 5-3. SERVICING HINTS

General maintenance and trouble shooting information is given in the Type 766H/F Series Oscilloscope Instruction Manual. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble in this Plug-in Module.

In trouble-shooting a Plug-in Unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

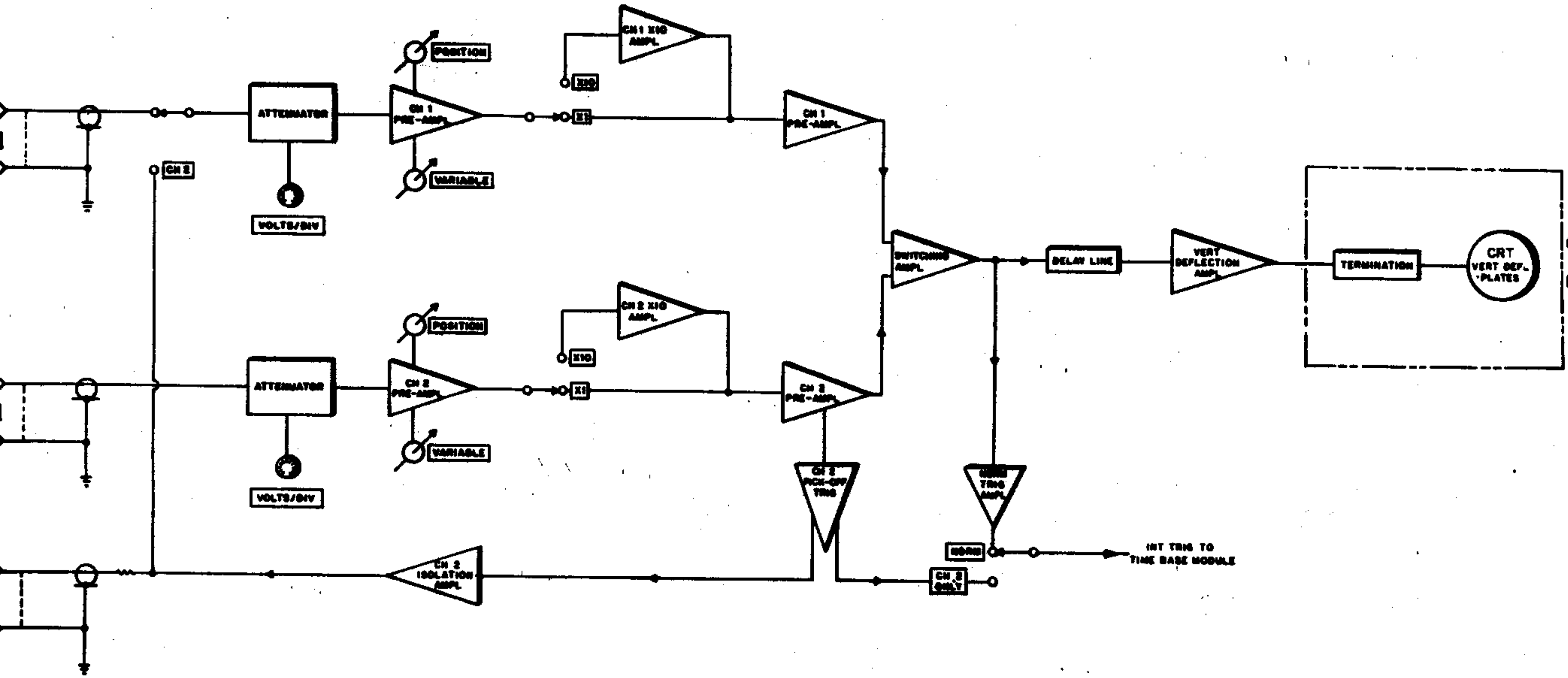



FIGURE 5-1 TYPE 79-02A OVER-ALL SYSTEM BLOCK DIAGRAM

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble shooting this unit, refer to the system block diagram in this Section and also to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate the Plug-in after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper performance of the Plug-in unit, the following suggestions are recommended:

1. The Type 4294 Extension Cable for remote operation of the plug-in from the oscilloscope is available as an accessory. This plug-in extender will be helpful for routing maintenance and recalibration. Do not use this extension for HF alignments; instead, remove the Main Frame side cover.

2. A Type 766H/F Test Oscilloscope is recommended for localizing troubles, especially when servicing a Type 79-02A inserted in a Type 766H/F Oscilloscope. To check waveforms, use a high-impedance probe while trouble shooting.

3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

4. When using accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the instrument itself.

5. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by voltage measurement. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

6. Electron tubes, semiconductors, and service adjustments are identified on photographs located in this Section of the manual.

## 5-4. GAINING ACCESS TO CHASSIS

Since the Plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

> **WARNING**
>
> WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

Note: Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in this instrument may be damaged if over-voltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

## 5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

### a. INTRODUCTION

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115V/230V $\pm 2\%$.

To set up the Amplifier Plug-in unit for calibration, insert the Amplifier Plug-in and Time Base Plug-in into the Main Frame. The Time Base Plug-in module and Main Frame must be fully tested and certified units.

b. TEST EQUIPMENT REQUIRED (Equivalent may be substituted)

| Equipment | Description |
|---|---|
| Oscilloscope | Fully certified and tested Type 766H/F Main Frame |
| X Plug-in | Type 74-03A Time Base |
| Volt-ohmmeter | Simpson Model 260; 20K ohms/volt sensitivity |
| Square Wave Generator | Fairchild Type 791A |
| Fast Rise Adapter | Fairchild Type 7911A |
| Square Wave Generator | Tektronix Type 105A |
| Capacitance Standardizer | Fairchild Type 7012A (1M, 14 pf) |
| Micromiker | Kaylab Model 402B |
| Extension Cable for Remote Operation of Plug-in | Fairchild Type 4294 |
| Alignment Tools | Fairchild Type 7013 Tool Kit |
| 50-ohm Termination | |
| 93-ohm Termination | |
| 50-ohm Cable | Fairchild Type 7082 |
| Pads, Attenuator | GR 20 db (2); GR 3 db (1); GR 6 db (1) |
| Standard Amplitude Calibrator | Ballantine Type 420 |

Turn on the power and allow 30 minutes of warm up time.

5-6. GAS COMPENSATION ADJUSTMENTS R9201 (R9401)

Note: Channel 2 adjustments are designated by reference symbols in parenthesis.

Undesirable voltages are developed at the grids on V922 and (V942) due to leakage currents. These potentials are nulled by the proper adjustments of the GAS COMP potentiometers R9201 and (R9401). To adjust, proceed as follows:

1. Preset both Channel 1 and Channel 2 front-panel controls as indicated.

| Control | Settings |
|---|---|
| VOLTS/DIV | 0.1 |
| VARIABLE | CAL X1 (fully cw, pushed in) |
| NORM-INVERT | NORM |

2. Set up the Time Base controls for automatic triggering.

3. Adjust the GAS COMP potentiometer R9201 for no depositioning of the trace while switching Channel 1 Input Selector slide switch from GND to AC.

4. Repeat step 3 for Channel 2 adjusting(R9401).

5-7. DC AND BRIDGE BAL ADJUSTMENT R9206 (R9406) AND R9220 (R9420)

If the dc balance of the Type 79-02A Amplifier is not properly adjusted, the reference trace on the screen will be depositioned when the VARIABLE control is rotated. To properly adjust, proceed as follows:

1. Preset both Channel 1 and Channel 2 front-panel controls as indicated.

| Control | Settings |
|---|---|
| Input Selector | GND |
| VOLTS/DIV | 0.1 |
| VARIABLE | CAL X1 (fully cw, pushed in) |
| NORM INVERT | NORM |
| GAIN ADJ | fully cw |
| DC BAL | centered |

2. Set the MODE switch to Channel 1 and the TRIGGER switch to NORM.

3. Adjust Time Base controls for automatic Triggering to obtain a reference trace on the screen.

4. Adjust the POSITION controls to set reference trace to center of screen.

5. Adjust the COARSE DC BAL internal control R9206 (R9406) for minimum depositioning of the trace while rotating Channel 1 VARIABLE control back and forth throughout its range.

6. Set CH 1 VOLTS/DIV switch to CAL.

7. Adjust the DIODE LEVEL control R9220 (R9420) for maximum amplitude of the calibrator signal.

8. Reset the VOLTS/DIV switch to the 0.1 position.

9. Readjust the COARSE DC BAL internal control while rotating the front panel VARIABLE control back and forth throughout its range. Continue adjusting until there is min depositioning of the trace when the VARIABLE control is rotated throughout its range.

10. Pull the VARIABLE control out to the X10 setting and continue adjusting the COARSE DC BAL control until there is min depositioning of the trace when the VARIABLE control is rotated.

11. Trim up the front panel DC BAL control.

    Note: Proper adjustment of the COARSE DC BAL control will leave the front panel DC BAL control set to center of its range.

12. Set the MODE switch to CH 2 and repeat balance procedure using pertinent Channel 2 controls shown in ( ).

## 5-8. INVERT BALANCE ADJUSTMENT R9231 (R9431)

The NORM-INVERT switch is properly adjusted when there is no depositioning of the trace while switching the Polarity switch from NORM to INVERT and vice versa. To properly adjust proceed as follows:

1. Set the Input Selector switch S901 (S911) to GND, VOLTS/DIV switch to 0.1 position and VARIABLE control pushed in for X1 operation.

2. Adjust the Time Base controls for automatic triggering.

3. Adjust the internal INVERT BAL control R9231 (R9431) until there is no depositioning of the trace when the front panel Polarity switch is operated back and forth from NORM to INVERT and vice versa.

4. Make a final check of the balance beyond the delay <u>only</u> if the CRT is changed.

   a. Connect a voltmeter (Simpson or equivalent), set to the most sensitive range, between P9001, Pins 1 and 17.

   b. Short the bases of Q9503 and Q9504 together.

   c. Check meter for a reading of zero volts $\pm$1V, and that trace falls within $\pm$0.2 divisions of the vertical center of the CRT.

      If it does not, either resistor R9517 or R9518, located in the emitters of Q9503 and Q9504 should be tailored by shunting with a much larger resistor.

5. Repeat this procedure for Channel 2 using pertinent controls shown in ( ).

5-9. X10 LEVEL ADJUSTMENT R9263 (R9463)

The X10 LEVEL internal control is properly adjusted when there is no depositioning of the trace while switching from X1 to X10 amplifier operation. To properly adjust proceed as follows:

1. Rotate the X10 CAL internal control R9254 (9454) fully counterclockwise for minimum gain.

2. Connect a voltmeter, Simpson or equivalent, set on the 50V scale across the collectors of transistors Q9211 and Q9212 (Q9411 and Q9412).

3. Adjust the CH 1 POSITION control for zero reading on the voltmeter.

4. Connect the voltmeter from either the collector of transistor Q9211 or Q9212 (Q9411 or Q9412) to ground and note meter reading.

5. Pull the CH 1 VARIABLE control out for X10 operation.

6. Adjust the internal X10 LEVEL control R9263 (R9463) for the same voltage reading obtained for X1 operation in Step 4.

7. Disconnect the voltmeter and push in CH 1 VARIABLE control.

8. Repeat this procedure for Channel 2 adjusting pertinent controls shown in ( ).

## 5-10. OUTPUT CURRENT ADJUSTMENT (R9545)

1. Set the MODE switch to CH 2 and the TRIGGER switch to NORM.

2. Connect a voltmeter, Simpson or equivalent, set on the 50V scale across the collectors of transistors Q9511 and 9514.

3. Adjust the CH 2 POSITION control for zero reading on the voltmeter.

4. Connect the voltmeter from collector of transistor Q9511 to the +100V buss.

5. Adjust OUTPUT CURRENT ADJ internal control R9545 for a meter reading of 15 volts.

6. Connect the voltmeter from collector of transistor Q9514 to the +100V buss and again adjust the OUTPUT CURRENT ADJ control for a meter reading of 15 volts.

7. Repeat Steps 4 through 6 until maximum balance of the output current is obtained.

## 5-11. GAIN ADJUSTMENTS R9227 (R9427)

Whenever the Type 79-02A Dual Trace Amplifier is removed from one Main Frame to another the front-panel GAIN ADJ screwdriver control must be reset. To properly normalize the gain between the plug-in and the Main Frame, proceed as follows:

1. Set CH 1 and CH 2 VOLTS/DIV switches fully counter-clockwise to CAL.

2. Push in and turn CH 1 and CH 2 VARIABLE controls and turn them fully clockwise to CAL position.

3. Set the MODE switch to CH 1 and the TRIGGER switch to NORM.

4. Set the Time Base controls for AUTO SWP and LINE triggering.

5. Set the MODE switch to ALT and adjust sweep rate for 2 milliseconds/division.

6. Adjust CH 1 GAIN ADJ control for 4 divisions of vertical deflection.

7. Position the traces one on top of the other.

8. Adjust CH 2 GAIN ADJ control until trace is super-imposed on CH 1 trace.

5-12. X10 CAL ADJUSTMENT R9254 (R9454)

1. Set the following front-panel controls for CH 1 and CH 2 as indicated.

| Control | Settings |
|---|---|
| VOLTS/DIV | 0.1 |
| VARIABLE | CAL (fully cw) |
| Input Selector | AC |
| TRIGGER | NORM |

2. Set the MODE switch to CH 1.

3. Adjust the Time Base controls for automatic triggering.

4. Apply a 0.4 volt peak-to-peak signal from a Ballentine Type 420 Calibrator to CH 1 Input connector J9001. Observe 4 divisions of vertical deflection. If necessary adjust CH 1 VARIABLE control to obtain precisely 4 divisions of deflection.

5. Adjust the Calibrator for a 0.04 volt output.

6. Pull out the CH 1 VARIABLE control for X10 operation.

7. Adjust the X10 CAL internal control R9254 (R9454) for 4 divisions of deflection.

8. Set the MODE switch to CH 2 and repeat above procedure adjusting pertinent Channel 2 controls.

5-13. TRIGGER DC LEVEL ADJUSTMENT R9618, R9619

1. With no signal input, adjust the oscilloscope to obtain a trace centered on the screen.

2. Set TRIGGER switch to NORM and MODE switch to CH 1 position.

3. Connect a voltmeter from J9001-25 to ground.

4. Adjust NORM TRIG ADJ internal control R9618 for zero reading on the meter.

5. Set the TRIGGER switch to CH 2 ONLY position, MODE switch to CH 2 and center trace on screen using channel 2 POSITION control.

6. Adjust CH 2 TRIG ADJ internal control R9619 for zero reading on the meter.

5-14. CHANNEL 2 OUTPUT LEVEL ADJUSTMENT R9614

1. With no signal input, adjust the oscilloscope to obtain a trace centered on screen.

2. Set the TRIGGER switch to CH 2 ONLY and MODE switch to CH 2.

3. Connect a voltmeter from CH 2 OUT connector to ground.

4. Adjust CH 2 OUTPUT LEVEL ADJ internal control R9614 for zero reading on the meter.

5-15. HIGH FREQUENCY ADJUSTMENTS (Figures 5-2 to 5-4)

a. CHANNEL 1 AND 2 AMPLIFIERS (X1 Operation)

1. Connect the output from a Fairchild Type 791A Square Wave Generator through a 50-ohm cable and a Type 7911A Fast Rise Step Generator and BNC Tee terminated in 50-ohm to the CH 1 Input connector on the Type 79-02A plug-in. See Figure 5-2.

2. Set the SOURCE IMPEDANCE switch on the Type 791A to 50-ohms and the FREQUENCY control to 1 megacycle.

3. Preset the following CH 1 and CH 2 panels controls as indicated.

| Control | Settings |
|---|---|
| VOLTS/DIV | 0.1 |
| VARIABLE | CAL X1 (fully cw, pushed in) |
| POLARITY | NORM |
| Input Selector | DC |
| MODE | CH 1 |
| TRIGGER | NORM |

4. Set the Time Base triggering controls for negative SLOPE, LF REJECT COUPLING, and INT SOURCE.

5. Adjust the output of the square wave generator to give 4 divisions of vertical deflection.

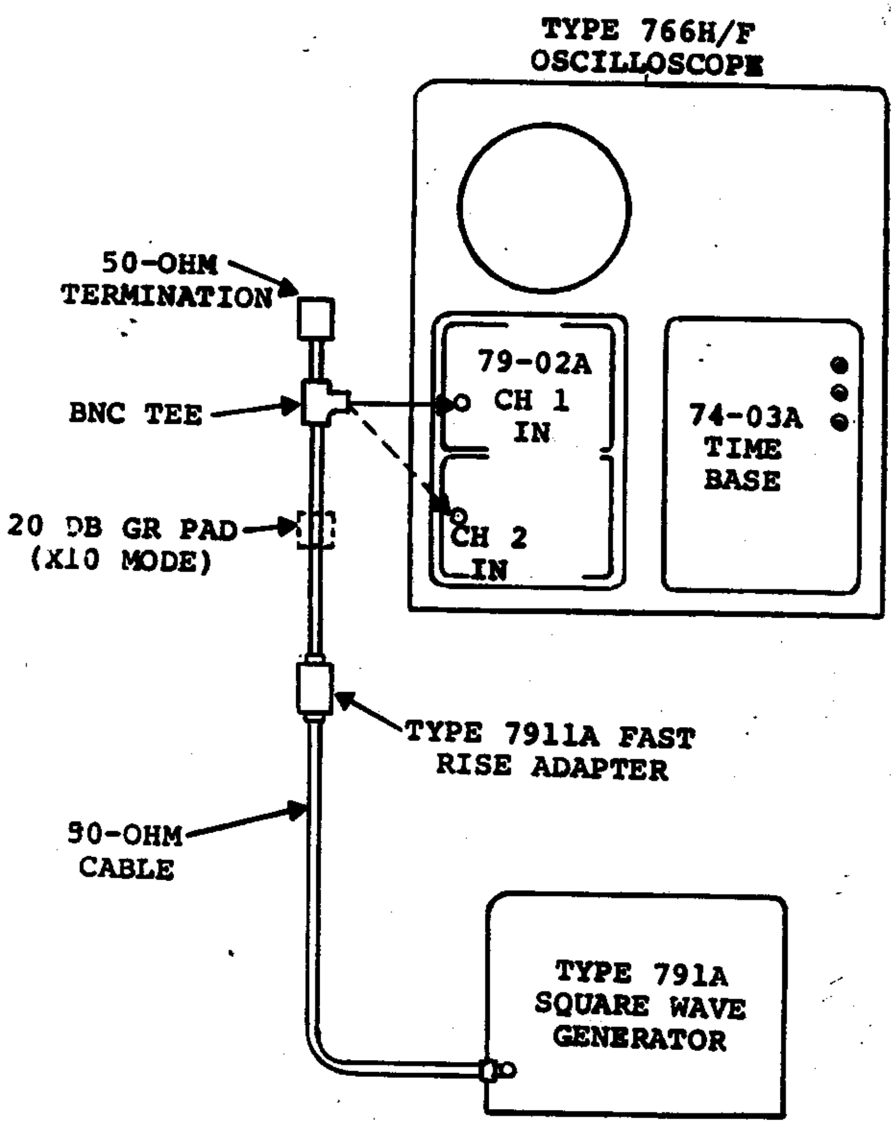



FIGURE 5-2. TEST SETUP FOR ADJUSTING HIGH FREQUENCY TRIMMERS

6. Adjust high-frequency trimmer C9804, the RC combination R9807 and C9806 and trimmers C9508, C9212 and C9512 for optimum flatness of the square wave. Capacitor C9804 and the RC combination R9806 and C9806 are adjusted for the long time constants, C9508 and C9212 for the overshoot and C9512 to smooth out the waveshape after initial over and undershoot. See Figures 5-3a and 5-3b for typical waveshapes and Figure 5-4 for location of high-frequency adjustment.

   Note: Adjusting trimmer capacitor C9508 will create two peaks, one of which will give a cleaner top but slower rise time. Backing off from this setting will bring down the peak and speed the rise time until a point is reached where the peak again begins to rise and have a hint of a ring. This is the proper setting.

b. DELAY LINE TERMINATION R9511, C9501

When the preceding adjustments in paragraph 5-15a have been made, a small step and bump may be noticed about 0.4 microseconds from the start of the pulse. The step may appear either above or below the top of the pulse after the termination bump and is due to misalignment of the delay line termination. To align the step and minimize the bump use the same test setup procedure described in paragraph 5-15a and proceed as follows:

1. Adjust the DELAY LINE ADJ control R9511 to reduce step until the trace is in line on each side of the termination bump. See Figure 5-3c.

2. Adjust the delay line trimmer capacitor C9501 to minimize termination bump. See Figure 5-3d.

3. Set the VOLTS/DIV switch to CAL and check gain calibration. Trim up with GAIN ADJ control if necessary.

4. Reset Channel 1 VOLTS/DIV switch to 0.1.

5. Readjust Channel 1 high-frequency trimmer C9804, the RC combination R9807 and C9806, and trimmer C9212 for optimum flatness of the square wave.

6. Disconnect the square wave generator from Channel 1 and connect it to the Channel 2 Input connector. See Figure 5-2.

7. Set MODE switch to Channel 2.

8. Adjust Channel 2 high-frequency trimmer C9904, the RC combination R9907 and C9906 and trimmer C9412 for optimum flatness of the square wave.

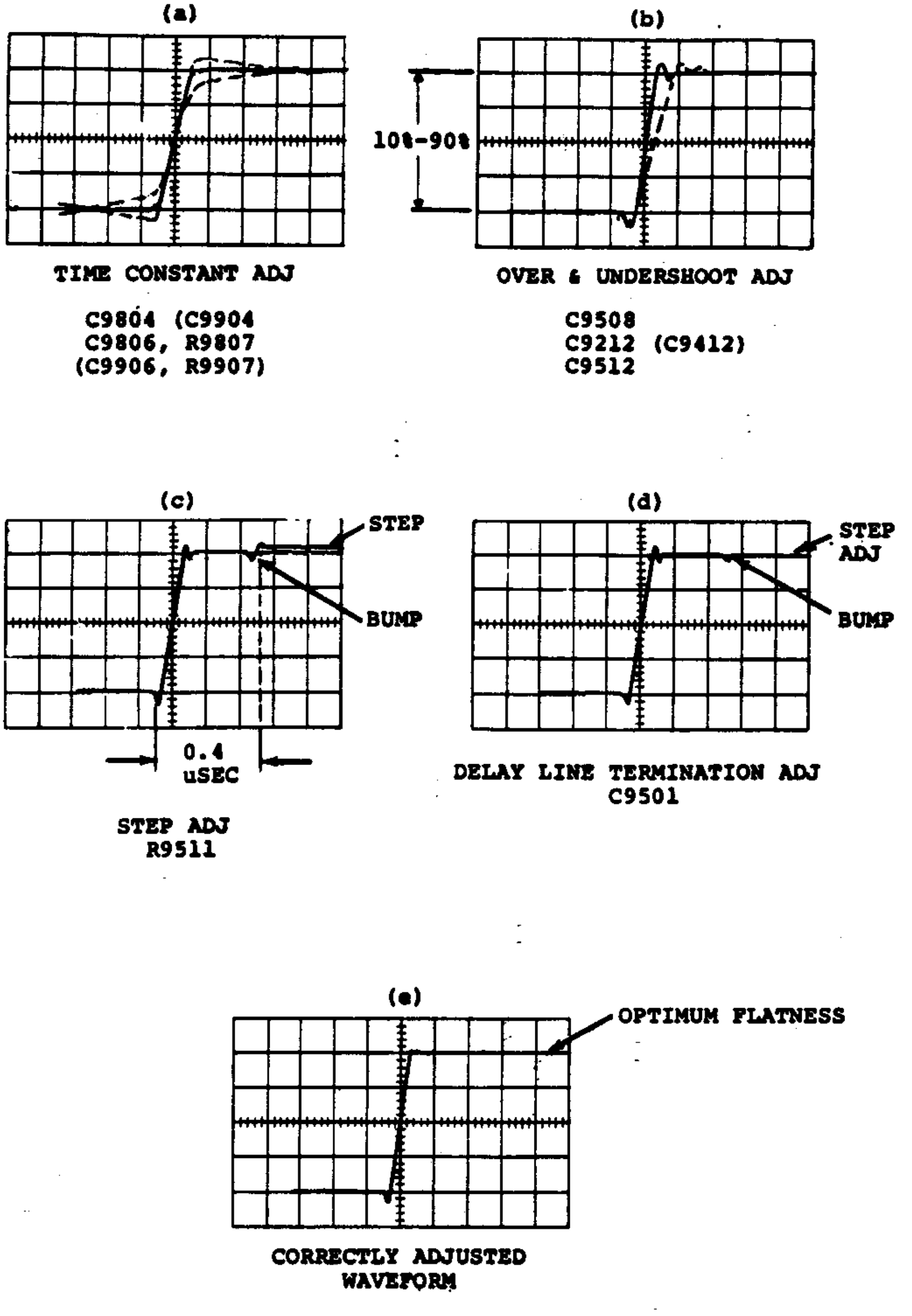



FIGURE 5-3. APPEARANCE OF WAVEFORM WHEN MAKING HIGH FREQUENCY ADJUSTMENTS

Note: Do not readjust trimmer capacitors C9508 and C9512 unless absolutely necessary. If readjustment is necessary, work back and forth between channels until the best compromise is reached. See Figure 5-3e.

c. CHANNELS 1 AND 2 AMPLIFIERS (X10 Operation)
C9210 (C9410), C9213 (C9413), C9214 (C9414)

Trimmer capacitors specified above are provided to improve the amplifier performance in the X10 range. To align the X10 amplifier proceed as follows:

1. Referring to the test setup shown in Figure 5-2, insert a 20 db General Radio pad between the output of the Type 7911A Generator and to CH 1 Input connector.

2. Pull out CH 1 VARIABLE knob for X10 operation, and set MODE switch to CH 1.

3. Adjust trimmer capacitor C9210 (C9410), C9213 (C9413), C9214 (C9414) for optimum flatness of the square wave.

   Note: Trimmers C9213 (C9413) should be aligned in the same manner as C9508. See reference paragraph 5-15a, step 6 and the relevant note.

4. Check the rise time of the displayed waveshape at the 10% to 90% points. It should measure less than 3.8 nanoseconds in X1 mode and less than 4.2 nanoseconds in the X10 mode. The permissable overshoot and undershoot should be less than 0.15 divisions out of 4 divisions. The termination bump should be less than one trace width in amplitude.

5. Switch the generator to Channel 2 Input and set MODE switch to Channel 2. Repeat this procedure for Channel 2 using pertinent controls shown in ( ).

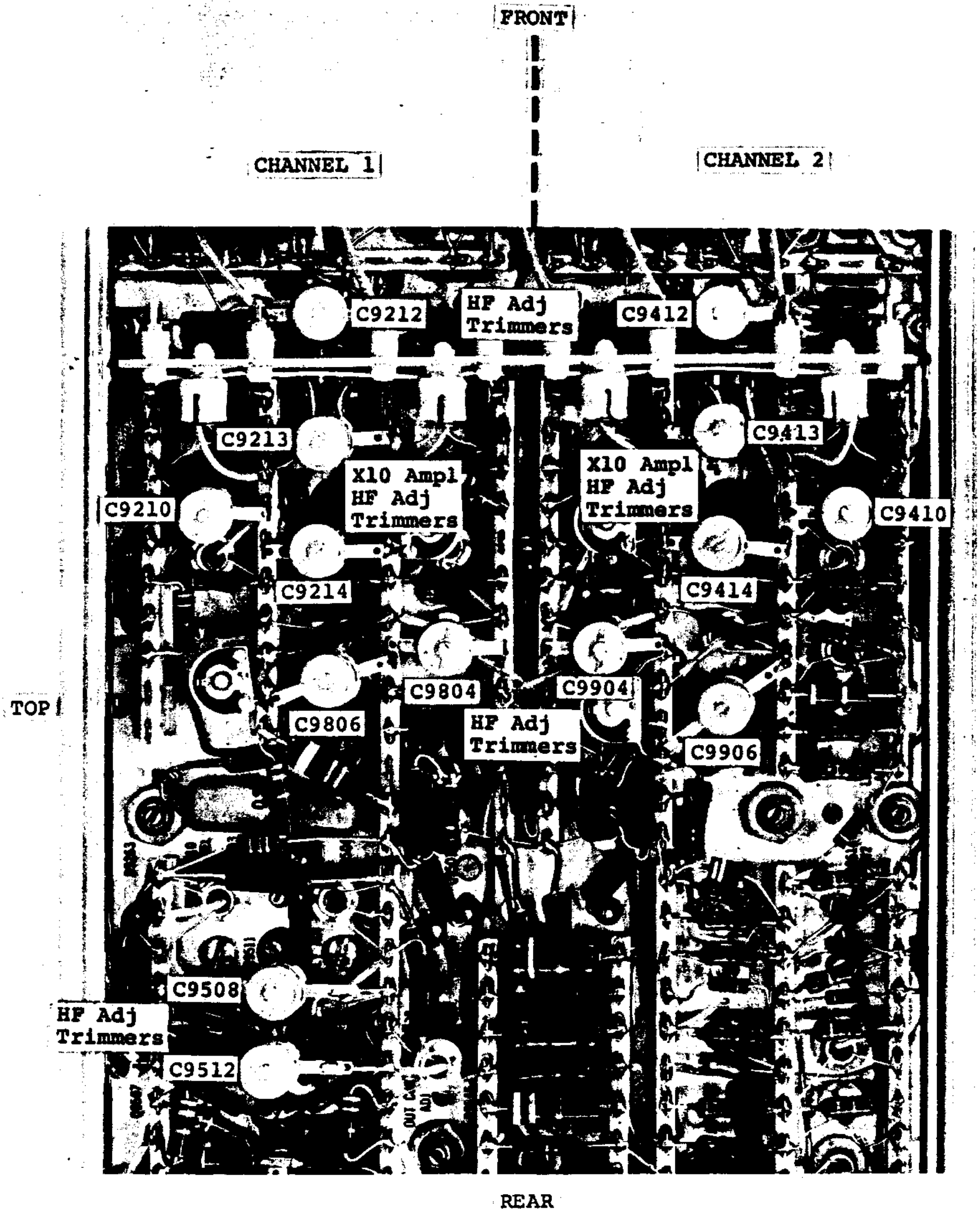



FIGURE 5-4. LEFT SIDE VIEW SHOWING HF TRIMMERS

## 5-16. INPUT CAPACITANCE STANDARDIZATION AND ATTENUATOR ADJUSTMENT (Figures 5-5 to 5-7)

The attenuators are factory aligned and should not be touched unless there is positive indication that they require adjustment. If adjustment is necessary, follow the steps as outlined making reference to Table 5-1. Reference symbols in ( ) pertain to Channel 2.

The input capacitance standardization and attenuator adjustments are interdependent; therefore, both tests must be performed in the same procedure. The need for readjustment is normally indicated by distortion of fast-rising waveforms on one or more of the most sensitive ranges of this plug-in unit.

Standardization of the input capacitance of this Y plug-in unit requires the use of a 14-picofarad Capacitance Standardizer. To properly adjust the input capacitance and the attenuators of this plug-in unit, proceed as follows:

1. Connect a Capacitance Meter directly to Channel 1 Input BNC connector on the Type 79-02A Plug-in.

2. Set the VOLTS/DIV switch to 0.1 and the Input Selector switch to DC and the VARIABLE gain control fully ccw.

3. Adjust input capacity trimmer C9202 (C9402) for a meter reading of 14 pf; then disconnect meter.

4. Connect a Type 7012A Capacitance Standardizer to Channel 1 Input BNC on the Type 79-02A plug-in.

5. Apply the output from a Fairchild Type 791A Square Wave Generator through a RG-8A/U 50-ohm cable, through the Capacitance Standardizer to the Input BNC connector or the Type 79-02A. See hook-up shown in solid lines in Figure 5-5.

6. Set the Square Wave Generator to 5Kc and adjust the Time Base controls for a display of several cycles.

7. Adjust the Type 7012A Capacitance Standardizer for best flat top. See Figure 5-6 for proper waveshape and Figure 5-7 for for location of trimmers.

8. Disconnect the Capacitance Standardizer from the test setup.

   Note: Do not readjust the setting of the Standardizer, it will be used later in this procedure.

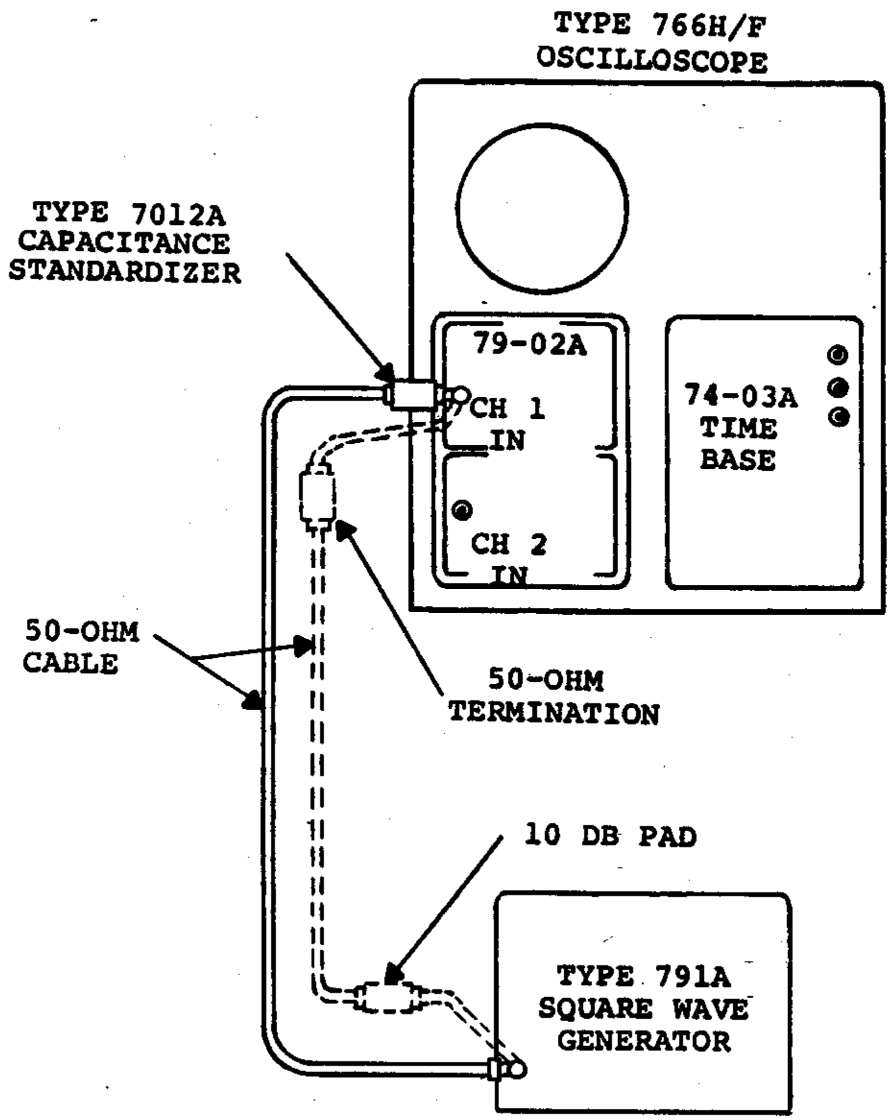
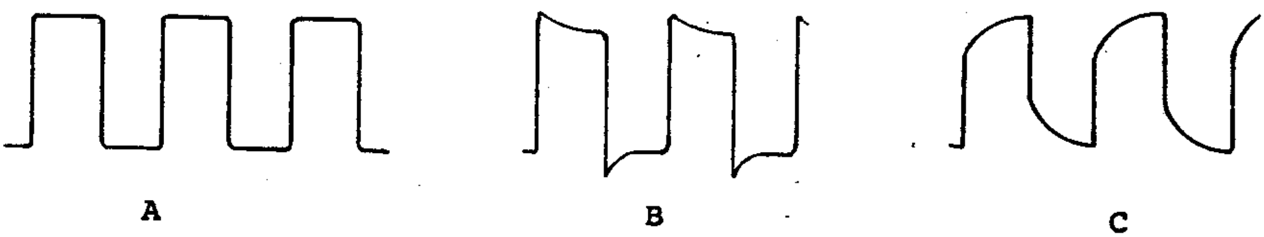



FIGURE 5-5. TEST SETUP FOR ADJUSTING INPUT CAPACITANCE AND VOLTS/DIV TRIMMERS

9. Apply the 5 Kc generator output through a General Radio 10 db pad and through a 50-ohm cable terminated in 50-ohms to the CH 1 Input connector on the Type 79-02A. See hook-up shown in dotted lines in Figure 5-5.

10. Set the VOLTS/DIV switch to 0.2 and the VARIABLE gain control to CAL. Adjust the generator to obtain 5 divisions of vertical deflection of the square wave pattern.

11. Adjust the attenuator frequency compensation trimmers indicated in Table 5-1 for maximum flatness of the positive peaks of the square wave.




A: Proper Adjustment

B, C: Improper Adjustment

FIGURE 5-6. STANDARDIZING THE INPUT CAPACITANCE

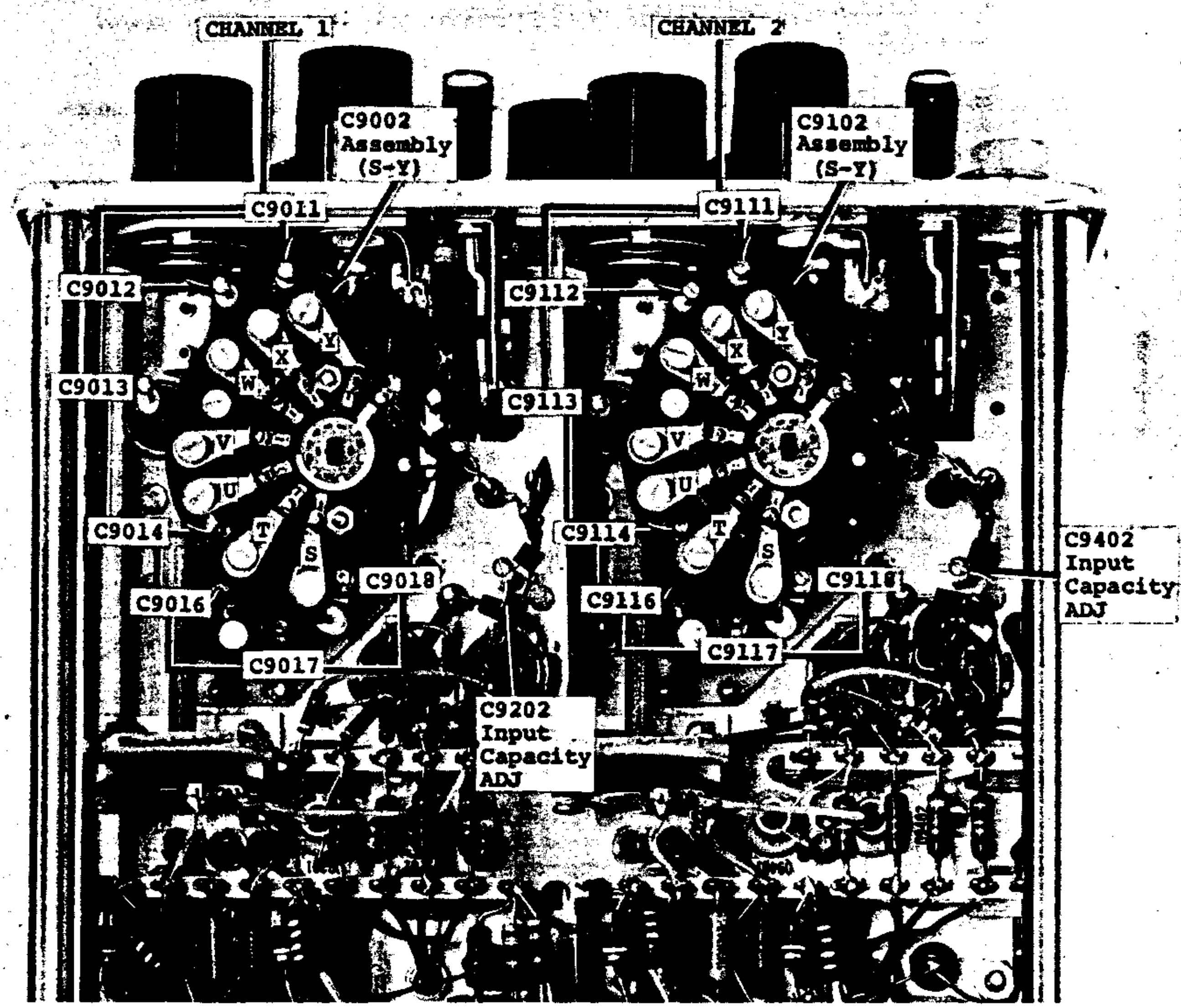



FIGURE 5-7. LEFT SIDE VIEW SHOWING CHANNEL 1 AND CHANNEL 2 ATTENUATOR ADJUSTMENTS

TABLE 5-1

ATTENUATOR COMPENSATION TRIMMERS

| VOLTS/DIV Setting | Trimmers | Location |
|---|---|---|
| 0.2 | C9018 (C9118) | Figure 5-7 |
| 0.5 | C9017 (C9117) | Figure 5-7 |
| 1.0 | C9016 (C9116 | Figure 5-7 |
| 2.0 | C9014 (C9114) | Figure 5-7 |
| 5.0 | C9013 (C9113) | Figure 5-7 |
| 10 | C9012 (C9112)* | Figure 5-7 |
| 20 | C9011 (C9111)* | |

*Note: If trimmers for the 10 and 20 VOLTS/DIV settings do not have sufficient range, dress resistors R9200 (R9400) 27 ohm and R9003 (R9103) 10 ohm away from each other.

( ) denotes CH 2.

Disconnect the 10 db pad and attenuator from the setup and reconnect the capacitance standardizer. See hook-up shown in solid lines in Figure 5-5. Continue adjustments given below:

| VOLTS/DIV Setting | Trimmers | Location (Figure 5-7) |
|---|---|---|
| 0.2 | C9002 (C9102) | S |
| 0.5 | C9002 (C9102) | T |
| 1 | C9002 (C9102) | U |
| 2 | C9002 (C9102) | V |
| 5 | C9002 (C9102) | W |
| 10 | C9002 (C9102) | X |
| 20 | C9002 (C9102) | Y |

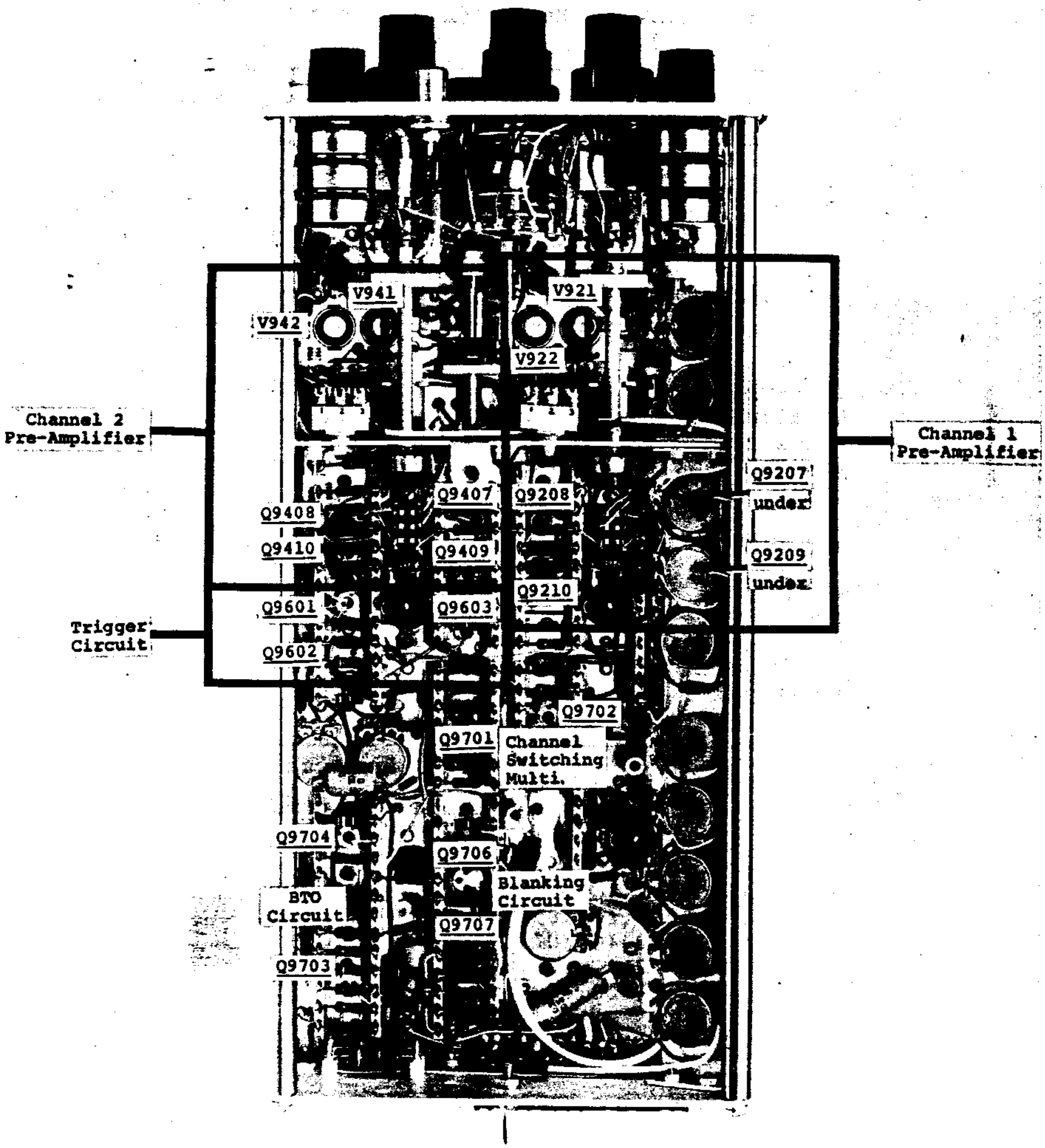



FIGURE 5-8. RIGHT SIDE VIEW SHOWING NUVISTORS AND TRANSISTORS

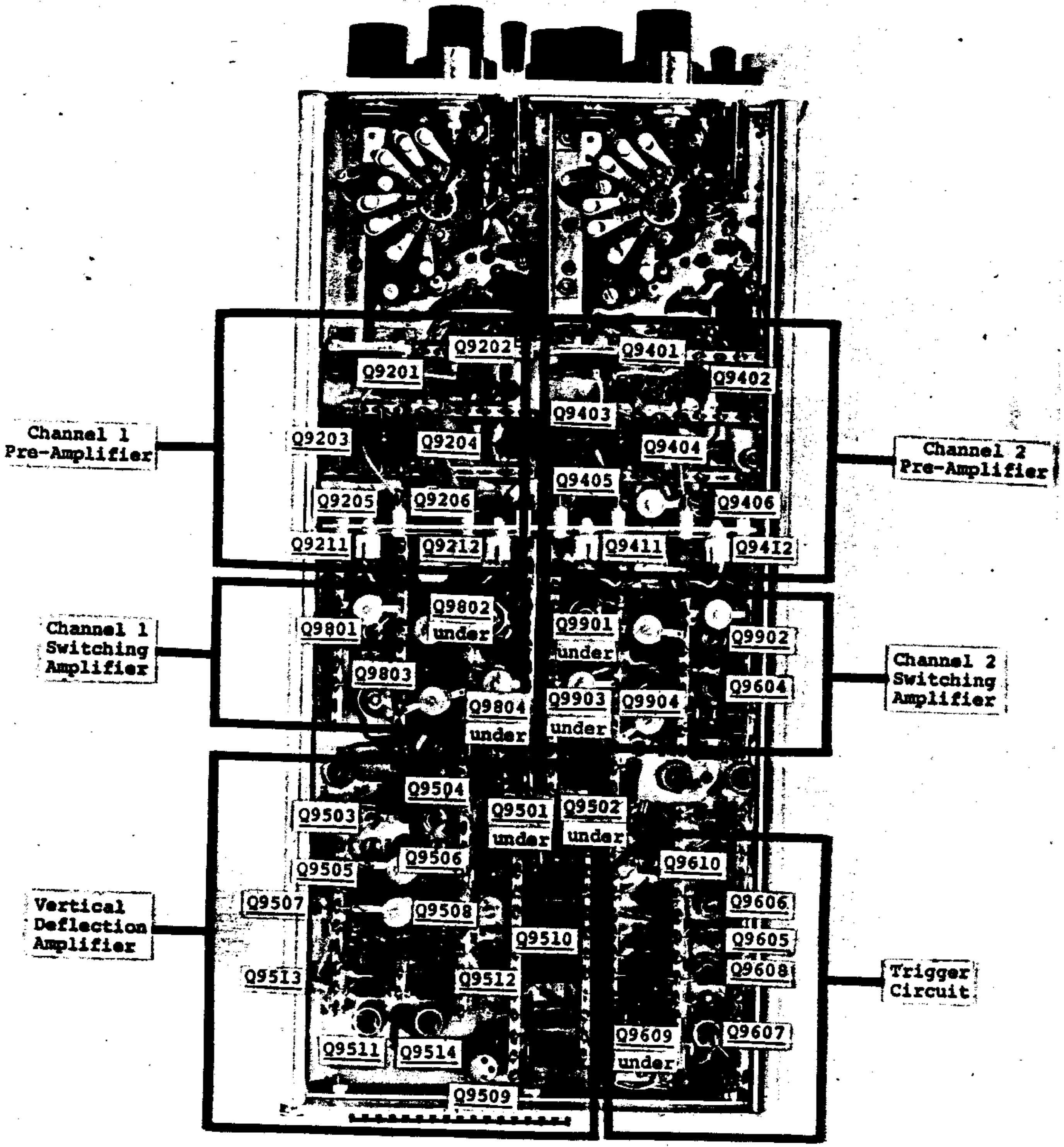
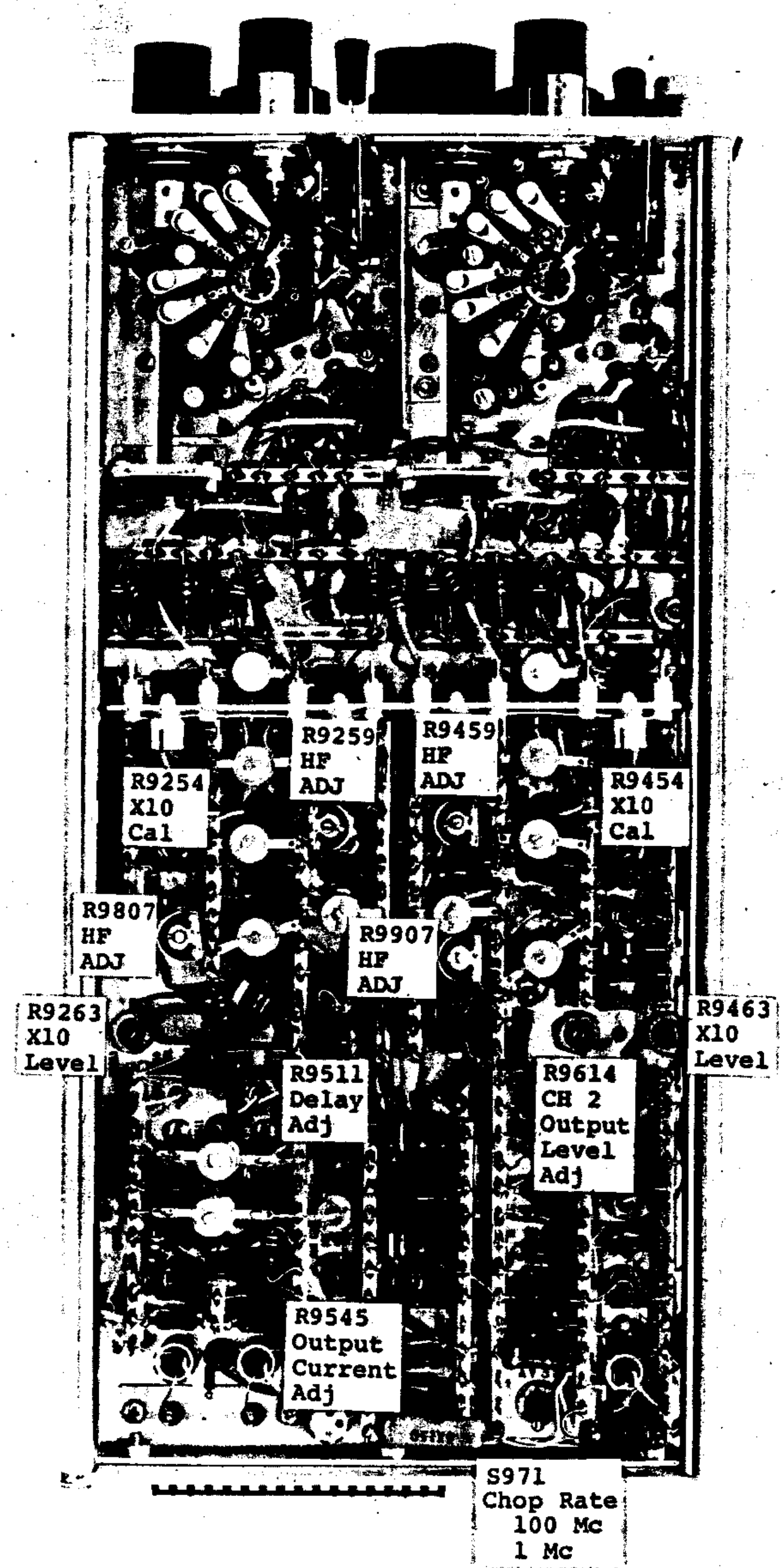



FIGURE 5-9. LEFT SIDE VIEW SHOWING TRANSISTORS


R9259 HF ADJ
R9459 HF ADJ
R9254 X10 Cal
R9454 X10 Cal
R9807 HF ADJ
R9907 HF ADJ
R9263 X10 Level
R9463 X10 Level
R9511 Delay Adj
R9614 CH 2 Output Level Adj
R9545 Output Current Adj
S971 Chop Rate 100 Mc 1 Mc

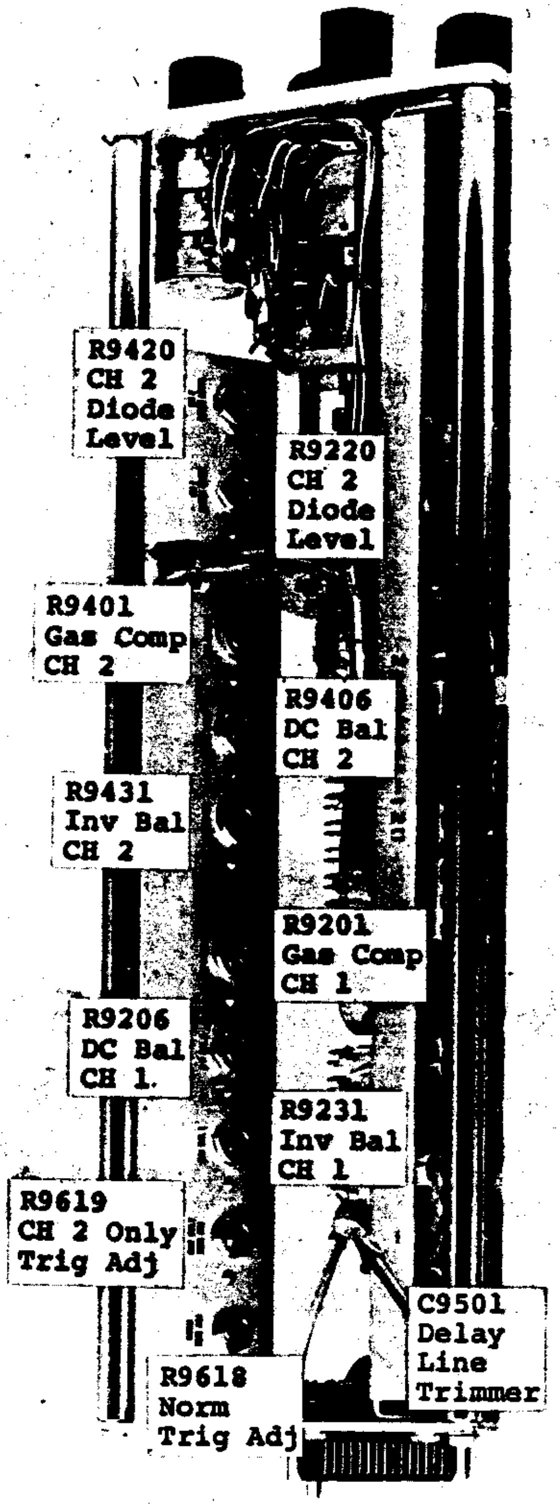



FIGURE 5-11. TOP VIEW SHOWING DELAY LINE TRIMMER AND POT ADJUSTMENTS

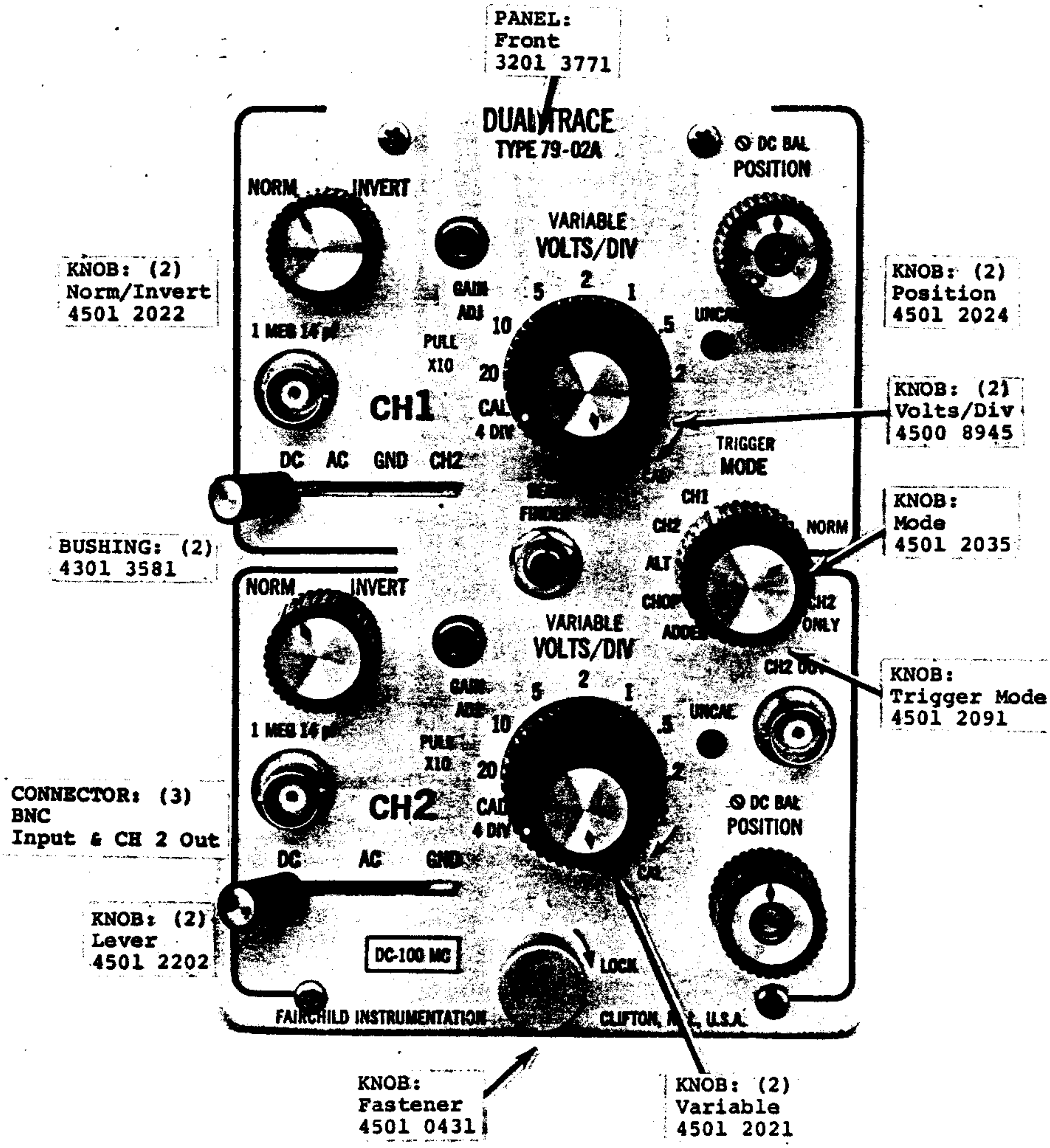



FIGURE 6-1. FRONT PANEL REPLACEABLE PARTS

# SECTION 6

## ELECTRICAL PARTS LIST AND SCHEMATIC

### CAPACITORS

Notes: 1. All capacitors are fixed, ceramic and 500V unless otherwise specified; pf denotes picofarads.

2. GMV denotes Guaranteed Minimum Value.

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| C9001 | 0327 2390 | plastic, 0.0047 uf, ±10%, 600V | GDE | 663UW |
| C9002 | | assembly consisting of: | | |
| | 3506 7032 | plate, cap, adjust | | |
| | 3005 7832 | spring contact | | |
| | 3005 7842 | spring contact | | |
| | 3005 7852 | spring contact | | |
| | 6091 1731 | sc MSPH 4-40 x 1/4 | | |
| C9011 to C9013 | 0327 3920 | variable, 0.2-1.5 pf,600V | ERC | 570-000 |
| C9014 | 0319 1071 | variable, plastic, 0.65-3.5 pf | ABD | |
| C9016 to C9018 | 0319 1071 | variable, plastic, 0.65-3.5 pf | ABD | |
| C9019 | 0313 9750 | mica, 250 pf, ±10% | ERC | 654-006 |
| C9021 | 0326 3060 | mica, 130 pf, ±10% | ERC | 654-006 |
| C9022 | 0313 9720 | mica, 50 pf, ±10% | ERC | 654-006 |
| C9023 | 0327 4020 | 10 pf | ERC | 301 |
| C9024 | 0327 4010 | 8.2 pf | ERC | 301 |
| C9101 | 0327 2390 | plastic, 0.0047 uf, ±10%, 600V | GDE | 663UW |
| C9102 | | assembly consisting of: | | |
| | 3506 7032 | plate, cap, adjust | | |
| | 3005 7832 | spring contact | | |
| | 3005 7842 | spring contact | | |
| | 3005 7852 | spring contact | | |
| | 6091 1731 | sc, MSPH, 4-40 x 1/4 | | |
| C9111 to C9113 | 0327 3920 | variable, 0.2-1.5 pf, 600V | ERC | 570-000 |
| C9114 | 0319 1071 | variable, plastic, 0.65-3.5 pf | ABD | |
| C9116 to C9118 | 0319 1071 | variable, plastic, 0.65-3.5 pf | ABD | |
| C9119 | 0313 9750 | mica, 250 pf, ±10% | ERC | 654-006 |
| 9121 | 0326 3060 | mica, 130 pf, ±10% | ERC | 654-006 |
| C9122 | 0313 9720 | mica, 50 pf, ±10% | ERC | 654-006 |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | CAPACITORS (Continued | | |
| C9123 | 0327 4020 | 10 pf | ERC | 301 |
| C9124 | 0327 4010 | 8.2 pf | ERC | 301 |
| C9201 | 0310 1270 | 1000 pf, 1000V | RMC | B |
| C9202 | 0327 3920 | variable, 0.2-1.5 pf, 600V | ERC | 570-000 |
| C9203 | 0319 1060 | 0.01 uf, 150V | CPG | DDM |
| C9204 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9205 | 0316 7180 | 3.9 pf | ERC | NPO331 |
| C9206 | 0319 1060 | 0.01 uf, 150V | CPC | DDM |
| C9207 | 0316 7180 | 3.9 pf | ERC | NPO331 |
| C9208 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9210 | 0326 9490 | variable, 2-8 pf, 200V | ERC | 538 |
| C9211 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9212 | 0326 9490 | variable, 2-8 pf, 200V | ERC | 538 |
| C9213 to C9214 | 0326 9480 | variable, 9-35 pf, 100V | ERC | 538 |
| C9215 | 0316 7240 | 6.8 pf | ERC | NPO331 |
| C9216 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9217 to C9218 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9219 | 0316 7410 | 22 pf, ±5% | ERC | NPO331 |
| C9221 to C9223 | 0326 7880 | plastic, 0.22 uf,±10%,200V | AMX | C296AB |
| C9224 | 0319 2420 | composition, 1.5 pf, ±5% | STC | GA |
| C9226 | 0319 2420 | composition, 1.5 pf, ±5% | STC | GA |
| C9281 | 0326 4550 | 2000 pf, GMV | ERC | 841 |
| C9301 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9302 | 0326 7860 | plastic, 0.1 uf, ±10%, 200V | AMX | C296AB |
| C9303 to C9304 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9306 to C9307 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9308 | 0326 7880 | plastic, 0.22 uf, ±10%, 200V | AMX | C296AB |
| C9401 | 0310 1270 | 1000 pf, 1000V | RMC | B |
| C9402 | 0327 3920 | variable, 0.2-1.5 pf, 600V | ERC | 570-000 |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **CAPACITORS (Cont.)** | | |
| C9403 | 0319 1060 | 0.01 μf, 150V | CPC | DDM |
| C9404 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9405 | 0316 7180 | 3.9 pf | ERC | NPO331 |
| C9406 | 0319 1060 | 0.01 μf, 150V | CPC | DDM |
| C9407 | 0316 7180 | 3.9 pf | ERC | NPO331 |
| C9408 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C | | | | |
| C9410 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9411 | 0319 0450 | 1000 pf | ERC | 538 |
| C9412 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9413 to C9414 | 0326 9480 | Variable, 9-35 pf, 100V | ERC | 538 |
| C9415 | 0316 7240 | 6.8 pf | ERC | NPO331 |
| C9416 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9417 to C9418 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9419 | 0316 7410 | 22 pf, ±5% | ERC | NPO331 |
| C9424 | 0319 2420 | Composition, 1.5 pf, ±5% | STC | GA |
| C9426 | 0319 2420 | Composition, 1.5 pf, ±5% | STC | GA |
| C9481 | 0326 4550 | 2000 pf, GMV | ERC | 841 |
| C9500 | 0316 7110 | 2.2 pf | ERC | NPO331 |
| C9501 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9502 to C9503 | 0316 7290 | 1.5 pf | ERC | NPO331 |
| C9504 | 0319 0450 | 1000 pf | SPG | 50C1A1 |
| C9505 | 0316 7110 | 2.2 pf | ERC | NPO331 |
| C9506 | 0326 4500 | 470 pf | ERC | 831 |
| C9507 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9508 | 0326 9480 | Variable, 9-35 pf, 100V | ERC | 538 |
| C9509 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9510 | 0319 1050 | 0.2 uf, 150V | CRL | DDM |
| C9511 | 0319 0450 | 1000 pf | SPG | 505C1A1 |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **CAPACITORS** (Continued) | | |
| C9512 | 0326 9490 | variable, 2-8 pf, 200V | ERC | 538 |
| C9513 | 0319 1060 | 0.01 uf, 150V | CPC | DDM |
| C9514 to C9515 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9516 | 0316 7460 | 33 pf, ±5% | ERC | |
| C9517 | 0317 3310 | 100 pf, ±10% | CPC | |
| C9518 | 0319 2380 | composition, 0.68 pf, ±5% | STC | GA |
| C9519 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9600 | 0316 0350 | 47 pf, ±5% | EIA | |
| C9601 | 0316 7410 | 22 pf, ±5% | ERC | NPO331 |
| C9602 | 0319 1050 | 0.02 uf, 150V | CPC | DDM |
| C9603 | 0316 7410 | 22 pf, ±5% | ERC | NPO331 |
| C9604 | 0317 4010 | 750 pf, ±10% | EIA | |
| C9605 to C9606 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9607 | 0319 1050 | 0.02 uf, 150V | CPC | DDM |
| C9608 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9609 | 0326 8520 | 680 pf, ±10%, 1000V | RMC | JF |
| C9610 | 0316 0360 | 51 pf, ±5% | EIA | |
| C9611 | 0316 7350 | 12 pf, ±5% | ERC | NPO331 |
| C9612 | 0319 1050 | 0.02 uf, 150V | CPC | DDM |
| C9613 | 0326 4550 | 2000 pf, GMV | ERC | 831 |
| C9614 | 0313 3850 | composition, 1.5 pf, ±10% | STC | GA |
| C9615* | 0315 2100 | 10 pf, ±10% | ERC | NPO331 |
| C9616 | 0316 7390 | 18 pf, ±5% | ERC | NPO331 |
| C9617 | 0316 7450 | 30 pf, ±5% | ERC | NPO331 |
| C9700 | 0316 0360 | 51 pf, ±5% | EIA | |
| C9701 | 0315 1530 | 33 pf | ERC | NPO338 |
| C9702 | 0316 7410 | 22 pf | ERC | NPO331 |
| C9703 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9704 | 0316 7410 | 22 pf | ERC | NPO331 |
| C9705 | 0326 7860 | plastic, 0.1 uf, 200V | AMX | C296AB |
| C9706 | 0315 1530 | 33 pf | ERC | NPO338 |
| C9707 to C9708 | 0319 1060 | 0.01 uf, 150V | CPC | DDM |
| C9709 | 0326 7860 | plastic, 0.1 uf, ±10%,200V | AMX | C206AB |
| C9710 | 0319 1060 | 0.01 uf, 150V | CPC | DDM |
| C9711 | 0317 3310 | 100 pf, ±10% | CPC | |
| C9712 | 0326 7860 | plastic, 0.1 uf, 200V | AMX | C296AB |
| C9713 | 0327 4580 | 3000 pf | ERC | |
| C9714 | 0317 3820 | 220 pf, ±10% | EIA | |
| C9715 | 0319 1060 | 0.01 uf, 150V | CPC | DDM |

*TEST OPTION

| ymbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **CAPACITORS (Cont.)** | | |
| C9716 | 0316 7280 | 10 pf | ERC | NPO331 |
| C9717 | 0319 1050 | 0.02 μf, 150V | CPC | DDM |
| C9718 | 0319 1060 | 0.01 μf, 150V | CPC | DDM |
| C9719 | 0326 7860 | Plastic, 0.1 μf, 200V | AMX | C296AB |
| C9721 | 0326 4520 | 1000 pf, GMV | ERC | 831 |
| C9801 | 0316 7410 | 22 pf, ±5% | ERC | NOP331 |
| C9802 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9804 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9805 | 0319 2420* | Composition, 1.5 pf, ±5% | STC | GA |
| C9805 | 0319 2480* | Composition, 2.7 pf, ±5% | STC | GA |
| C9806 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9901 | 0316 7410 | 22 pf, ±5% | ERC | NPO331 |
| C9902 | 0319 0450 | 1000 pf | SPG | 505C1A1 |
| C9904 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9905 | 0319 2420* | Composition, 1.5 pf, ±5% | STC | GA |
| C9905 | 0319 2480 | Composition, 2.7 pf, ±5% | STC | GA |
| C9906 | 0326 9490 | Variable, 2-8 pf, 200V | ERC | 538 |
| C9907 | 0313 3580** | Composition, 2 pf, ±5% | JEF | JM5/32 |
| | | **SEMI-CONDUCTORS** | | |
| CR9221 | 2600 6910 | Diode, FD841 | FCI | |
| CR9222 & CR9223 | 2600 3041 | Diode, IN830(CR9222 & CR9223 Matched Pair) | ABD | |
| CR9224 & CR9225 | 2600 3041 | Diode, IN830 (CR9224 & CR9225 Matched Pair) | ABD | |
| CR9421 | 2600 6910 | Diode, FD841 | FCI | |
| CR9422 & CR9423 | 2600 3041 | Diode, IN830 (CR9422 & CR9423 Matched Pair) | ABD | |
| CR9424 & CR9425 | 2600 3041 | Diode, 1N830(CR9424 & CR9425 Matched Pair) | ABD | |

*Selected by Test Dept.
**Test Option

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **SEMI-CONDUCTORS** (Concluded) | | |
| CR9501 | 2600 6990 | diode, 1N752 | HOF | |
| CR9601 to CR9604 | 2600 6910 | diode, FD841 | FCI | |
| CR9605 | 2600 8910 | diode, 1N756A | FCI | |
| CR9700 to CR9706 | 2600 6910 | diode, FD841 | FCI | |
| CR9801 to CR9803 | 2600 6910 | diode, FD841 | FCI | |
| CR9901 to CR9903 | 2600 6910 | diode, FD841 | FCI | |
| | | **DELAY LINE** | | |
| DL9501 | 8800 2401 | delay line | ABD | |
| | | **LAMPS** | | |
| DS9201 | 1200 3960 | glow neon (UNCAL) | GE | NE2 |
| DS9401 | 1200 3960 | glow neon (UNCAL) | GE | NE2 |
| | | **HYBRID COILS** | | |
| HY9000 to HY9002 | 2110 1560 | bead ferroxcube | FER | |
| HY9003 to HY9004 | 2110 1590 | bead ferroxcube | FER | |
| HY9005 to HY9010 | 2110 1560 | bead ferroxcube | FER | |
| HY9100 to HY9102 | 2110 1560 | bead ferroxcube | FER | |
| HY9105 | 2110 1560 | bead ferroxcube | FER | |
| HY9200 to HY9204 | 2110 1560 | bead ferroxcube | FER | |
| HY9206 to HY9209 | 2110 1560 | bead ferroxcube | FER | |
| HY9211 to HY9212 | 2110 1560 | bead ferroxcube | FER | |
| HY9301 to HY9302 | 2110 1560 | bead ferroxcube | FER | |
| HY9303 to HY9304 | 2110 1590 | bead ferroxcube | FER | |
| HY9306 | 2110 1590 | bead ferroxcube | FER | |
| HY9400 to HY9404 | 2110 1560 | bead ferroxcube | FER | |
| HY9407 to HY9409 | 2110 1560 | bead ferroxcube | FER | |
| HY9411 to HY9412 | 2110 1560 | bead ferroxcube | FER | |
| HY9413 to HY9414 | 2110 1590 | bead ferroxcube | FER | |
| HY9416 to HY9419 | 2110 1590 | bead ferroxcube | FER | |
| HY9511 to HY9512 | 2110 1590 | bead ferroxcube | FER | |
| HY9501 to HY9505 | 2110 1560 | bead ferroxcube | FER | |
| HY9506 to HY9509 | 2110 1590 | bead ferroxcube | FER | |
| HY9600 | 2110 1590 | bead ferroxcube | FER | |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | HYBRID COILS (Concluded) | | |
| HY9601 to HY9604 | 2110 1560 | bead ferroxcube | FER | |
| HY9606 to HY9607 | 2110 1590 | bead ferroxcube | FER | |
| HY9701 to HY9703 | 2110 1560 | bead ferroxcube | FER | |
| | | ELECTRICAL CONNECTORS | | |
| J9001 | 0904 4541 | connector, MODIFIED (CH 1) | CAN | |
| J9101 | 0904 4541 | connector, MODIFIED (CH 2) | CAN | |
| J9601 | 0905 9940 | receptacle, BNC, rf, female, 1 contact (CH 2 OUT) | CAN | |
| P9001 | 0905 7340 | plug, general purpose, male, 32 contacts | APH | 26 159 32 |
| | | COILS | | |
| L9701 | 2110 1820 | RF, F, 39 UH ±5% | SWW | 43901 |
| | | TRANSISTORS | | |
| Q9201 to Q9204 | 2600 3084<br>2600 7700 | DU#12A (Selected)<br>DU#12A | FI | |
| Q9205 to Q9208 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9209 to Q9210 | 2600 3084<br>2600 7700 | DU#12A (Selected)<br>DU#12A | FI | |
| Q9211 to Q9212 | 2600 8690<br>2600 8680 | DU#30<br>alternate, 2N2894 | FCI | |
| Q9401 to Q9404 | 2600 3084<br>2600 7700 | DU#12A (Selected)<br>DU#12A | FI | |
| Q9405 to Q9408 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9409 to Q9410 | 2600 3084<br>2600 7700 | DU#12A (Selected)<br>DU#12A | FI | |
| Q9411 to Q9412 | 2600 8690<br>2600 8680 | DU#30<br>alternate, 2N2894 | FCI | |
| Q9501 to Q9508 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | TRANSISTORS (Continued) | | |
| Q9509 | 2600 7270<br>2600 7250 | DU#6A<br>alternate, 2N1893 | FCI | |
| Q9510 | 2600 8500 | 2N2218 | FCI | |
| Q9511 | 2600 2791 | 2N2218 | ABD | |
| Q9512 to Q9513 | 2600 8400<br>2600 8390 | DU#28<br>alternate, 2N3013 | FCI | |
| Q9514 | 2600 2791 | 2N2218 | ABD | |
| Q9601 | 2600 7070<br>2600 7050 | DU#2A<br>alternate, 2N915 | FCI | |
| Q9602 | 2600 8580<br>2600 8560 | DU#37A<br>alternate, 2N3072 | FCI | |
| Q9603 to Q9605 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9606 | 2600 7420<br>2600 7400 | DU#9A<br>alternate, 2N869 | FCI | |
| Q9607 | 2600 7460<br>2600 7450 | DU#10<br>alternate, 2N1711 | FCI | |
| Q9608 | 2600 7420<br>2600 7400 | DU#9A<br>alternate, 2N869 | FCI | |
| Q9609 to Q9610 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9701 to Q9702 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9703 | 2600 7070<br>2600 7050 | DU#2A<br>alternate, 2N915 | FCI | |
| Q9704 | 2600 3071<br>2600 8190 | DU#14A (Selected)<br>DU#14A | FI | |
| Q9706 | 2600 8570<br>2600 8560 | DU#37<br>alternate, 2N3072 | FCI | |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **TRANSISTORS (Concluded)** | | |
| Q9707 | 2600 7070 | DU#2A | FCI | |
| | 2600 7050 | alternate, 2N915 | | |
| Q9801 to Q9804 | 2600 3071 | DU#14A (Selected) | FI | |
| | 2600 8190 | DU#14A | | |
| Q9901 to Q9904 | 2600 3071 | DU#14A (Selected) | FI | |
| | 2600 8190 | DU#14A | | |

**RESISTORS**

Note: All resistors are fixed, film, ±5%, and 1/2W. Values are in ohms unless otherwise specified. K = thousand, M = million.

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| R9001 | 0235 4460 | composition, 220, 1/4W | ALB | CB |
| R9003 | 0235 4140 | composition, 10, 1/4W | ALB | CB |
| R9004 | 0235 4340 | composition, 68, 1/4W | ALB | CB |
| R9006 | 0236 7840 | 178K, ±1% | CGW | NS20 |
| R9007 | 0236 7940 | 226K, ±1% | CGW | NS20 |
| R9008 | 0237 5660 | 995K, ±1%, 1/8W | TEX | CD1/8R |
| R9009 | 0237 5540 | 5.03K, ±1%, 1/8W | TEX | CD1/8R |
| R9011 | 0237 5650 | 990K, ±1%, 1/8W | TEX | CD1/8R |
| R9012 | 0237 5550 | 10.1K, ±1%, 1/8W | TEX | CD1/8R |
| R9013 | 0237 5640 | 980K, ±1%, 1/8W | TEX | CD1/8R |
| R9014 | 0237 5560 | 20.4K, ±1%, 1/8W | TEX | CD1/8R |
| R9016 | 0237 5630 | 950K, ±1%, 1/8W | TEX | CD1/8R |
| R9017 | 0237 5570 | 52.6K, ±1%, 1/8W | TEX | CD1/8R |
| R9018 | 0237 5620 | 900K, ±1%, 1/8W | TEX | CD1/8R |
| R9019 | 0237 5580 | 111K, ±1%, 1/8W | TEX | CD1/8R |
| R9021 | 0237 5610 | 800K, ±1%, 1/8W | TEX | CD1/8R |
| R9022 | 0237 5590 | 250K, ±1%, 1/8W | TEX | CD1/8R |
| R9023 | 0237 5600 | 500K, ±1%, 1/8W | TEX | CD1/8R |
| R9024 | 0237 5670 | 1M, ±1%, 1/8W | TEX | CD1/8R |
| R9101 | 0235 4460 | composition, 220, 1/4W | ALB | CB |
| R9102 | 0234 8010 | 150 | CGW | C20 |
| R9103 | 0235 4140 | composition, 10, 1/4W | ALB | CB |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **RESISTORS (Cont.)** | | |
| R9104 | 0235 4340 | Composition, 68, 1/4W | ALB | CB |
| R9106 | 0236 7840 | 178K, ±1% | CGW | NS20 |
| R9107 | 0236 7940 | 226K, ±1% | CGW | NS20 |
| R9108 | 0237 5660 | 995K, ±1%, 1/8W | TEX | CD1/8R |
| R9109 | 0237 5540 | 5.03K, ±1%, 1/8W | TEX | CD1/8R |
| R9111 | 0237 5650 | 990K, ±1%, 1/8W | TEX | CD1/8R |
| R9112 | 0237 5550 | 10.1K, ±1%, 1/8W | TEX | CD1/8R |
| R9113 | 0237 5640 | 980K, ±1%, 1/8W | TEX | CD1/8R |
| R9114 | 0237 5560 | 20.4K, ±1%, 1/8W | TEX | CD1/8R |
| R9116 | 0237 5630 | 950K, ±1%, 1/8W | TEX | CD1/8R |
| R9117 | 0237 5570 | 52.6K, ±1%, 1/8W | TEX | CD1/8R |
| R9118 | 0237 5620 | 900K, ±1%, 1/8W | TEX | CD1/8R |
| R9119 | 0237 5580 | 111K, ±1%, 1/8W | TEX | CD1/8R |
| R9121 | 0237 5610 | 800K, ±1%, 1/8W | TEX | CD1/8R |
| R9122 | 0237 5590 | 250K, ±1%, 1/8W | TEX | CD1/8R |
| R9123 | 0237 5600 | 500K, ±1%, 1/8W | TEX | CD1/8R |
| R9124 | 0237 5670 | 1M, ±1%, 1/8W | TEX | CD1/8R |
| R9200 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9201 | 0107 5960 | Variable, composition, 100K, ±20% (GAS COMP) | CTS | 65 |
| R9202 | 0234 8690 | 100K | CGW | C20 |
| R9203 | 0237 5670 | 1M, ±1%, 1/8W | TEX | CD1/8R |
| R9204 | 0234 7970 | 100, | CGW | C20 |
| R9206 | 0107 5960 | Variable, composition, 1/4W 100K, ±20% (COARSE DC BAL) | CTS | 65 |
| R9207 | 0107 2952 | Variable, 100K/ 100K/ 100K, ±20%, (DC BAL/POSITION) | ABD | |
| R9208 | 0235 5180 | Composition, 240K, 1/4W | ALB | CB |
| R9209 | 0203 1170 | Composition, 750K, | ALB | EB |
| R9211 | 0203 1300 | Composition, 2.7M | ALB | EB |
| R9212 | 0234 8520 | 20K, | CGW | C20 |
| R9213 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |

## RESISTORS (Cont.)

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| R9214 | 0203 0100 | Composition, 27 | ALB | EB |
| R9216 | 0235 4380 | Composition, 100, 1/4W | ALB | CB |
| R9217 | 0235 2350 | 3.9K, ±2%, 1W | CGW | C32 |
| R9218 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9219 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9226 | 0234 8340 | 3.6K | CGW | C20 |
| R9221 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9222 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9223 & R9224 | 0235 0670 | 3K, ±2% | CGW | C20 |
| R9225 | 0235 0730 | 5.1K, ±2% | CGW | C20 |
| R9220 | 0107 5930 | Variable, composition, 3K, ±20% (BRIDGE BAL) | CTS | 65 |
| R9227 | 0109 3620 | Variable, composition, 5K, ±20%, 1/4W (GAIN ADJ) | CTS | 200 |
| R9228 | 0107 3041 | Variable, composition, 10K, ±20%, 1/8W (VARIABLE) | ABD | |
| R9229 | 0234 8730 | 150K | CGW | C20 |
| R9230 | 0234 8560 | 30K | CGW | C20 |
| R9231 | 0107 5950 | Variable, composition, 50K, ±20%, (BAL INVERT) | CTS | 65 |
| R9232 | 0236 5490 | 634 , ±1% | CGW | NS20 |
| R9233 | 0234 8560 | 30K, | CGW | C20 |
| R9234 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9235 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9236 & R9237 | 0236 4890 | 150, ±1% | CGW | NS20 |
| R9238 | 0234 8040 | 200, | CGW | C20 |
| R9239 | 0237 8550 | 1.33K, ±1%, 1W | IRC | CES |
| R9240 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9241 | 0203 0120 | Composition, 33 | ALB | EB |
| R9242 & R9243 | 0234 8150 | 560, | CGW | C20 |
| R9244 | 0234 8450 | 10K, | CGW | C20 |
| R9246 | 0234 8450 | 10K, | CGW | C20 |
| R9247 & R9248 | 0235 0840 | 15K, ±2% | CGW | C20 |
| R9249 | 0235 0480 | 470, ±2% | CGW | C20 |
| R9251 | 0235 0480 | 470, ±2% | CGW | C20 |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **RESISTORS (Cont.)** | | |
| R9252 & R9253 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9254 | 0107 2658 | Variable, 250, ±20%, 1/4W (X10 CAL CH 1) | ABD | |
| R9256 & R9257 | 0236 6500 | 7.15K, ±1% | CGW | NS20 |
| R9258 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9259 | 0109 3970 | Variable, composition, 500, 1/10W (HF ADJ) | CRL | 601-1 |
| R9261 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9262 | 0203 0120 | Composition, 33, | ALB | EB |
| R9263 | 0107 5920 | Variable, composition, 1K, ±20% (X10 LEVEL CH 1) | CTS | 65 |
| R9264 | 0234 9040 | 910, 1W | CGW | C32 |
| R9265 | 0234 8440 | 9.1K | CGW | C20 |
| R9266 & R9267 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9268 & R9269 | 0236 5330 | 432, ±1% | CGW | NS20 |
| R9270 | 0234 8440 | 9.1K | CGW | C20 |
| R9271 | 0236 5330 | 432, ±1% | CGW | NS20 |
| R9272 | 0234 7920 | 62 | CGW | C20 |
| R9273 & R9274 | 0236 4340 | 40.2, ±1% | CGW | NS20 |
| R9280 | 0236 6560 | 8.25K, ±1% | CGW | NS20 |
| R9281 | 0236 6840 | 16.2K, ±1% | CGW | NS20 |
| R9282 & R9283 | 0235 4140 | Composition, 10, 1/4W | ALB | CB |
| R9284 | 0234 8540 | 24K | CGW | C20 |
| R9285 | | Test Option | | |
| R9286 | 0234 8570 | 33K | CGW | C20 |
| R9287 | | Test Option | | |
| R9288 | 0234 8570 | 33K | CGW | C20 |
| R9289 | 0234 8540 | 24K | CGW | C20 |
| R9291 | 0234 8340 | 3.6K | CGW | C20 |
| R9292 | 0234 8480 | 13K | CGW | C20 |
| R9293 & R9294 | 0211 8640 | Wirewound, 4.7 | IRC | BW1/2 |
| R9295 | 0203 1530 | Composition, 10, ±10% | ALB | EB |
| R9301 & R9302 | 0237 0740 | 430, 2W | CGW | C42S |
| R9303 | 0203 0000 | Composition, 10 | ALB | EB |
| R9304 | 0234 8260 | 1.6K | CGW | C20 |
| R9306 | 0203 0000 | Composition, 10 | ALB | EB |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
| --- | --- | --- | --- | --- |
| | | **RESISTORS (Cont.)** | | |
| R9400 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9401 | 0107 5960 | Variable, composition, 100K, ±20% (GAS COMP) | CTS | 65 |
| R9402 | 0234 8690 | 100K | CGW | C20 |
| R9403 | 0237 5670 | 1M, ±1%, 1/8W | TEX | CD1/8R |
| R9404 | 0234 7970 | 100 | CGW | C20 |
| R9406 | 0107 5960 | Variable, composition, 100K, ±20%, 1/4W (COARSE DC BAL) | CTS | 65 |
| R9407 | 0107 2952 | Variable, 100K/100K/100K, ±20% (DC BAL/POSITION) | ABD | |
| R9408 | 0235 5180 | 240K, 1/4W | ALB | CB |
| R9409 | 0203 1170 | Composition, 750K | ALB | CB |
| R9411 | 0203 1300 | Composition, 2.7M | ALB | EB |
| R9412 | 0234 8520 | 20K | CGW | C20 |
| R9413 | 0235 4300 | Composition, 47, 1/4W | ALB | AB |
| R9414 | 0203 0100 | Composition, 27 | ALB | EB |
| R9416 | 0235 4380 | Composition, 100, 1/4W | ALB | CB |
| R9417 | 0235 2350 | 3.9K, ±2%, 1W | CGW | C32 |
| R9418 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9419 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9426 | 0234 8340 | 3.6K | CGW | C20 |
| R9421 | 0235 4240 | Composition, 27, 1/4W | ALB | CB |
| R9422 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9423 & R9424 | 0235 0670 | 3K, ±2% | CGW | C20 |
| R9425 | 0235 0730 | 5.1K, ±2% | CGW | C20 |
| R9420 | 0107 5930 | Variable, composition, 3K, ±20% (BRIDGE BAL) | CTS | 65 |
| R9427 | 0109 3620 | Variable, composition, 75K, ±20%, 1/4W (GAIN ADJ) | CTS | 200 |
| R9428 | 0107 3041 | Variable, composition, 10K, ±20%, 1/8W (VARIABLE) | ABD | |
| R9429 | 0234 8730 | 150K | CGW | C20 |
| R9430 | 0234 8560 | 30K | CGW | C20 |
| R9431 | 0107 5950 | Variable, composition, 50K, ±20% (INVERT BAL) | CTS | 65 |
| R9432 | 0236 5490 | 634, ±1% | CGW | NS20 |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|

RESISTORS (Cont.)

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| R9433 | 0234 8560 | 30K | CGW | C20 |
| R9434 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9435 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9436 & R9437 | 0236 4890 | 150, ±1% | CGW | NS20 |
| R9438 | 0234 8040 | 200 | CGW | C20 |
| R9439 | 0237 8550 | 1.33K, ±1%, 1W | IRC | CES |
| R9440 | 0235 4300 | Composition, 47, 1/4W | ALB | CB |
| R9441 | 0203 0120 | Composition, 33 | ALB | EB |
| R9442 & R9443 | 0234 8150 | 560 | CGW | C20 |
| R9444 | 0234 8450 | 10K | CGW | C20 |
| R9446 | 0234 8450 | 10K | CGW | C20 |
| R9447 & R9448 | 0235 0840 | 15K, ±2% | CGW | C20 |
| R9449 | 0235 0480 | 470, ±2% | CGW | C20 |
| R9451 | 0235 0480 | 470, ±2% | CGW | C20 |
| R9452 & R9453 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9454 | 0107 2658 | Variable, 250, ±20%, 1/4W (X10 CAL CH 2) | ABD | |
| R9456 & R9457 | 0236 6500 | 7.15K, ±1% | CGW | NS20 |
| R9458 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9459 | 0109 3970 | Variable, composition, 500, 1/10W (HF ADJ) | CRL | 601-1 |
| R9461 | 0236 6400 | 5.62K, ±1% | CGW | NS20 |
| R9462 | 0203 0120 | Composition, 33 | ALB | EB |
| R9463 | 0107 5920 | Variable, composition, 1K, ±20% (X10 LEVEL CH 2) | CTS | 65 |
| R9464 | 0234 9040 | 910, 1W | CGW | C32 |
| R9465 | 0234 8440 | 9.1K | CGW | C20 |
| R9466 & R9467 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9468 & R9469 | 0236 5330 | 432, ±1% | CGW | NS20 |
| R9470 | 0234 8440 | 9.1K | CGW | C20 |
| R9471 | 0236 5330 | 432, ±1% | CGW | NS20 |
| R9472 | 0234 7920 | 62 | CGW | C20 |
| R9473 & R9474 | 0236 4340 | 40.2, ±1% | CGW | NS20 |
| R9480 | 0236 6560 | 8.25K, ±1% | CGW | NS20 |
| R9481 | 0236 6840 | 16.2K, ±1% | CGW | NS20 |
| R9482 & R9483 | 0235 4140 | Composition, 10, 1/4W | ALB | CB |
| R9484 | 0234 8540 | 24K | CGW | C20 |
| R9485 | | Test Option | | |
| R9486 | 0234 8570 | 33K | CGW | C20 |
| R9487 | | Test Option | | |
| R9488 | 0234 8570 | 33K | CGW | C20 |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | RESISTORS (Continued) | | |
| R9489 | 0234 8540 | 24K | CGW | C20 |
| R9491 | 0234 8340 | 3.6K | CGW | C20 |
| R9492 | 9234 8480 | 13K | CGW | C20 |
| R9501 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9502 & R9503 | 0237 8690 | 1.87K, ±1%, 1W | CGW | C6 |
| R9504 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9505 | 0235 4920 | composition, 20K, 1/4W | ALB | CB |
| R9506 & R9507 | 0236 4260 | 33.2, ±1% | CGW | NS20 |
| R9508 | 0234 8530 | 22K | CGW | C20 |
| R9509 | 0234 8170 | 680 | CGW | C20 |
| R9511 | 0107 3241 | variable, composition, 5K, ±20%, 1/4W (DELAY LINE ADJ) | ABD | |
| R9512 | 0234 8170 | 680 | CGW | C20 |
| R9513 & R9514 | 0236 4760 | 110, ±1% | CGW | NS20 |
| R9515 | 0203 0090 | composition, 24 | ALB | EB |
| R9516 | 0203 0110 | composition, 30 | ALB | EB |
| R9517 & R9518 | 0237 9050 | 4.42K, ±1%, 1W | CGW | C6 |
| R9519 | 0236 5280 | 383, ±1% | CGW | NS20 |
| R9520 | 0236 4360 | 42.2, ±1% | CGW | NS20 |
| R9521 | 0203 0120 | composition, 33 | ALB | EB |
| R9522 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9523 | 0236 4890 | 150, ±1% | CGW | NS20 |
| R9524 | 0236 5490 | 634, ±1% | CGW | NS20 |
| R9525 | 0236 4360 | 42.2, ±1% | CGW | NS20 |
| R9526 & R9527 | 0236 5140 | 274, ±1% | CGW | NS20 |
| R9528 | 0237 0730 | 390, 2W | CGW | C42S |
| R9529 | 0235 0670 | 3K, ±2% | CGW | C20 |
| R9530 | 0237 0760 | 510, ±2%, 2W | CGW | C42S |
| R9531 | 0235 0580 | 1.2K, ±2% | CGW | C20 |
| R9532 | 0234 9180 | 3.6K, 1W | CGW | C32 |
| R9533 & R9534 | 0234 8080 | 300 | CGW | C20 |
| R9535 | 0203 3080 | composition, 22, 1W | ALB | GB |
| R9536 | 0222 4690 | wirewound, 150, 5W | WDL | X |
| R9537 | 0234 8520 | 20K | CGW | C20 |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | RESISTORS (Continued) | | |
| R9538 & R9539 | 0235 2350 | 3.9K, ±2%, 1W | CGW | C32 |
| R9540 | 0234 7910 | 56 | CGW | C20 |
| R9541 | 0203 3150 | composition, 43, 1W | ALB | GB |
| R9542 | 0234 8750 | 56, 1W | CGW | C32 |
| R9543 | 0235 4140 | composition, 10, 1/4W | ALB | CB |
| R9544 | 0203 0120 | composition, 33 | ALB | EB |
| R9545 | 0107 5910 | variable, composition, 500, ±20%, (OUTPUT CURR.ADJ) | CTS | 65 |
| R9546 | 0234 8250 | 1.5K | CGW | C20 |
| R9547 | 0203 0120 | composition, 33 | ALB | EB |
| R9548 | 0235 4140 | composition, 10, 1/4W | ALB | CB |
| R9549 | 0234 8370 | 4.7K | CGW | C20 |
| R9551 to R9554 | 0235 0300 | 82, ±2% | CGW | C20 |
| R9600 | 0234 8200 | 910 | CGW | C20 |
| R9601 | 0234 8380 | 5.1K | CGW | C20 |
| R9602 | 0236 4690 | 93.1, ±1% | CGW | NS20 |
| R9603 & R9604 | 0203 1610 | composition, 47, ±10% | ALB | EB |
| R9605 | 0234 7970 | 100 | CGW | C20 |
| R9606 | 0234 7920 | 62 | CGW | C20 |
| R9607 | 0237 7180 | 49.9, 1W, ±1% | CGW | C20 |
| R9608 | 0234 8310 | 2.7K | CGW | C20 |
| R9609 | 0234 8360 | 4.3K | CGW | C20 |
| R9610 | 0234 8270 | 1.8K | CGW | C20 |
| R9611 | 0234 8420 | 7.5K | CGW | C20 |
| R9612 | 0234 8460 | 11K | CGW | C20 |
| R9613 | 0234 8200 | 910 | CGW | C20 |
| R9614 | 0107 5910 | variable, composition,500, ±20% (CH 2 OUTPUT LEVEL) | CTS | 65 |
| R9615 | 0234 8290 | 2.2K | CGW | C20 |
| R9616 | 0234 8360 | 4.3K | CGW | C20 |
| R9617 | 0234 8530 | 22K | CGW | C20 |
| R9618 | 0107 5910 | variable, composition,500, ±20% (NORMAL TRIG ADJ) | CTS | 65 |
| R9619 | 0107 5910 | variable, composition, 500, ±20% (CH 2 ONLY TRIG ADJ) | CTS | 65 |
| R9620 | 0234 8190 | 820 | CTS | 65 |
| R9621* | 0234 8140 | 510 | CGW | C20 |
| R9622 | 0234 8450 | 10K | CGW | C20 |
| R9623 | 0234 8410 | 6.8K | CGW | C20 |
| R9624 | 0234 8210 | 1K | CGW | C20 |
| R9625 | 0235 4440 | composition, 180, 1/4W | ALB | CB |



*Test Option

## RESISTORS (Cont.)

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| R9626 | 0234 8020 | 160 | CGW | C20 |
| R9627 | 0234 8450 | 10K | CGW | C20 |
| R9628 | 0234 8280 | 2K | CGW | C20 |
| R9629 | 0234 7990 | 120 | CGW | C20 |
| R9630 | 0234 8140 | 510 | CGW | C20 |
| R9631 | 0234 8460 | 11K | CGW | C20 |
| R9632 | 0203 0150 | Composition, 43 | ALB | EB |
| R9633 | 0234 8140 | 510 | CGW | C20 |
| R9634 | 0234 8270 | Composition, 1.8K | CGW | C20 |
| R9636 | 0237 0770 | 560, 2W | CGW | C42S |
| R9637 | 0234 8450 | 10K | CGW | C20 |
| R9638 | 0234 8430 | 8.2K | CGW | C20 |
| R9639 | 0234 8460 | 11K | CGW | C20 |
| R9641 | 0234 8450 | 10K | CGW | C20 |
| R9642 | 0236 5670 | 976, ±2% | CGW | NS20 |
| R9643 | 0236 5420 | 536, ±2% | CGW | NS20 |
| R9644 | 0237 0940 | 3K, 2W | CGW | C42S |
| R9646 | 0234 8040 | 200 | CGW | C20 |
| R9700 | 0236 7200 | 38.3K, ±1%, | CGW | NS20 |
| R9701 | 0234 8320 | 3K | CGW | C20 |
| R9702 | 0234 9030 | 820, 1W | CGW | C32 |
| R9703 | 0203 1170 | Composition, 750K | ALB | EB |
| R9704 | 0234 8450 | 10K | CGW | C20 |
| R9705 | 0234 8210 | 1K | CGW | C20 |
| R9706 | 0234 8400 | 6.2K | CGW | C20 |
| R9707 | 0234 8490 | 15K | CGW | C20 |
| R9708 & R9709 | 0234 8450 | 10K | CGW | C20 |
| R9710 | 0234 8400 | 6.2K | CGW | C20 |
| R9711 | 0234 8660 | 75K | CGW | C20 |
| R9712 | 0234 9030 | 820, 1W | CGW | C32 |
| R9713 | 0234 8320 | 3K | CGW | C20 |
| R9714 | 0203 0060 | Composition, 18 | ALB | EB |
| R9715 | 0236 6980 | 22.6K, ±1% | CGW | NS20 |
| R9716 | 0235 0540 | 820, ±2% | CGW | C20 |
| R9717 | 0236 6260 | 4.02K, ±1% | CGW | NS20 |

| Symbol | Part Number | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **RESISTORS (Continued)** | | |
| R9718 | 0236 6920 | 19.6K, ±1% | CGW | NS20 |
| R9719 | 0234 7970 | 100 | CGW | C20 |
| R9720 | 0236 6720 | 12.1K, ±1% | CGW | NS20 |
| R9721 | 0235 0830 | 13K, ±2% | CGW | C20 |
| R9722 | 0235 0610 | 1.6K, ±2% | CGW | C20 |
| R9723 | 0234 8520 | 20K | CGW | C20 |
| R9724 | 0234 8270 | 1.8K | CGW | C20 |
| R9726 | 0234 8290 | 2.2K | CGW | C20 |
| R9727 | 0234 8310 | 2.7K | CGW | C20 |
| R9728 | 0234 7910 | 56 | CGW | C20 |
| R9729 | 0234 7950 | 82 | CGW | C20 |
| R9731 | 0203 1600 | composition, 39 | ALB | EB |
| R9732 | 0234 8590 | 39K | CGW | C20 |
| R9733 | 0234 8440 | 9.1K | CGW | C20 |
| R9734 | 0234 8270 | 1.8K | CGW | C20 |
| R9735 | 0203 0160 | composition, 47 | ALB | EB |
| R9736 | 0234 9070 | 1.2K, 1W | CGW | C32 |
| R9737 | 0203 1610 | composition, 47, ±10% | ALB | EB |
| R9738 | 0236 6060 | 2.49K, ±1% | CGW | NS20 |
| R9739 | 0236 7020 | 24.9K, ±1% | CGW | NS20 |
| R9741 | 0234 8260 | 1.6K | CGW | C20 |
| R9742 | 0234 8340 | 3.6K | CGW | C20 |
| R9743 | 0236 6860 | 16.9K, ±1% | CGW | NS20 |
| R9744 | 0236 6570 | 8.45K, ±1% | CGW | NS20 |
| R9746 | 0203 0070 | composition, 20 | ALB | EB |
| R9801 & R9802 | 0234 8130 | 470 | CGW | C20 |
| R9803 | 0203 0120 | composition, 33 | ALB | EB |
| R9804 | 0234 8360 | 4.3K | CGW | C20 |
| R9806 | 0234 8360 | 4.3K | CGW | C20 |
| R9807 | 0109 3600 | var., composition, 1K, .1W | CRL | 601-1 |
| R9808 | 0234 8330 | 3.3K | CGW | C20 |
| R9809 | 0236 5010 | 200, ±1% | CGW | NS20 |
| R9811 | 0236 5010 | 200, ±1% | CGW | NS20 |
| R9812 | 0237 8990 | 3.83K, ±1%, 1W | CGW | V6 |
| R9813 & R9814 | 0236 3090 | 200K | CGW | C20 |

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **RESISTORS (Cont.)** | | |
| R9816 | 0234 8520 | 20K | CGW | C20 |
| R9817 | 0236 6710 | 11.8K, ±1% | CGW | NS20 |
| R9818 | 0236 6760 | 13.3K, ±1% | CGW | NS20 |
| R9901 & R9902 | 0234 8130 | 470 | CGW | C20 |
| R9903 | 0203 0120 | Composition, 33 | ALB | EB |
| R9904 | 0234 8360 | 4.3K | CGW | C20 |
| R9905* | 0235 4720 | Composition, 3K, 1/4W | ALB | CB |
| R9906 | 0234 8360 | 4.3K | CGW | C20 |
| R9907 | 0109 3600 | Variable, composition, 1K | CRL | 601-1 |
| R9908 | 0234 8330 | 3.3K | CGW | C20 |
| R9909 | 0236 5010 | 200, ±1% | CGW | NS20 |
| R9911 | 0236 5010 | 200, ±1% | CGW | NS20 |
| R9912 | 0237 8990 | 3.83K, ±1%, 1W | CGW | C6 |
| R9913 & R9914 | 0236 3090 | 200K | CGW | C20 |
| | | **SWITCHES** | | |
| S901 | 0501 7461 | Lever, 1 section, 4 positions (INPUT SEL CH 1) | ABD | |
| S902 | 0501 7433 | Rotary, 3 sections, 9 positions (VOLTS/DIV) | ABD | |
| S911 | 0501 7451 | Lever, 1 section, 3 positions (INPUT SEL CH 2) | ABD | |
| S912 | 0501 7433 | Rotary, 3 sections, 9 positions (VOLTS/DIV) | ABD | |
| S920 | 0107 3041 | Part of R9228 (VARIABLE, GAIN CH 1) | | |
| S921 | 0501 7621 | Switch Section, Rotary (NORM CH 1) | ABD | |



*Test Option

| Symbol | Part No. | Description | Vendor Code | Vendor Type |
|---|---|---|---|---|
| | | **SWITCHES (Cont.)** | | |
| S922A & S922B | 0503 2390 | Slide, DPDT (PULL X10 CH 1) | COW | 126 |
| S940 | 0107 3041 | Part of R9428 | ABD | |
| S941 | 0501 7621 | Switch Section, Rotary (NORM CH 2) | ABD | |
| S942A & S942B | 0503 2390 | Slide, DPDT (PULL X10 CH 2) | COW | 126 |
| S950 | 0503 2550 | Push, SPST (BEAM FINDER) | GRY | 32 |
| S960 | 0501 7442 | Rotary, 2 sections 2/5 positions (TRIG MODE) | ABD | |
| S970 | | Part of S960 (MODE) | | |
| S971 | 0503 2490 | Toggle, SPST (CHOP RATE) | ALCO | MST105D |
| | | **TRANSFORMER** | | |
| T9701 | 2001 4841 | BTO | ABD | |
| | | **ELECTRON TUBES** | | |
| V921 & V922 | 2501 4060 | 8056 | RCA | NUVISTOR |
| V941 & V942 | 2501 4060 | 8056 | RCA | NUVISTOR |
| | | **NETWORKS** | | |
| Z9201 & Z9202 | 8800 2426 | Peaking | ABD | |
| Z9401 & Z9402 | 8800 2426 | Peaking | ABD | |
| Z9501 & Z9502 | 8800 2422 | Peaking | ABD | |
| Z9503 | 8800 2424 | Peaking | ABD | |
| Z2050 | 8700 1871 | Termination CRT | FCIC | 7062 |

# LIST OF RECOMMENDED VENDORS

| CODE | NAME |
|---|---|
| ABD | Du Mont Laboratories |
| AER | Aerovox Corporation |
| AHH | Arrow-Hart & Hegeman Electric Company |
| ALB | Allen-Bradley Company |
| ALC | Allied Control |
| ALCO | Alco Electronic Products |
| ALD | Alden Products Company |
| AMA | Amatan Electronic Hardware |
| AMP | Amp Inc. |
| AMR | Amperite Company, Inc. |
| AMX | Amperex Electronics Products, Inc. |
| APC | American Phenolic Corporation |
| APH | Amphenol Electronics Corporation |
| ARC | Arco Electronics Inc. (Elmenco) |
| AST | Astron Corporation |
| AUT | Automatic Metal Products Corporation |
| BNS | Bourns Inc. |
| BUR | Burndy Engrg. Company |
| BUS | Bussmann Mfg. Company |
| CAN | Cannon Electric Company |
| CBS | CBS-Hytron Division of CBS |
| CDE | Cornell-Dubilier Electric Corporation |
| CGW | Corning Glass Works |
| CH | Cutler-Hammer, Inc. |
| CHC | Chester Cable Corporation |
| CHM | Chatham Electronics |
| CIN | Cinch Manufacturing Company |
| CLS | Clarostat Mfg. Co., Inc. |
| COC | Continental Carbon (Division of Wirt Company) |
| COW | Continental-Wirt Electronics Corporation |
| CPC | C. P. Clare & Company |
| CRL | Centralab, Division of Globe-Union, Inc. |
| CST | Chicago Standard Transformer Corporation |
| CTC | Cambridge Thermionic Corporation |
| CTS | Chicago Telephone Supply Corporation |
| DAG | Dage Electric Company, Inc. |
| DAL | Dale Products, Inc. |
| DLC | Dialight Corporation |
| DRK | Drake Mfg. Company |
| EBY | Hugh H. Eby, Inc. |
| EDL | Edal Industries |
| EIA | Any manufacturer meeting EIA standards |
| ELC | Electra Manufacturing Company |
| ELD | Eldema Corporation |
| ELM | Elmenco |
| EMC | Electro Motive Mfg. Company |
| EMW | Elmwood Sensors, Inc. |
| ERC | Erie Technological Products, Inc. |
| ESX | Essex Electronics |
| FCI | Fairchild Camera and Instrument Corporation |
| FER | Ferroxcube Corporation of America |
| GDE | Good-All Electric Mfg. Company |
| GE | General Electric Company |
| GEN | General Instrument Corporation |
| GEP | General Products Corporation |
| GRC | General Radio Company |
| GRY | Grayhill, Inc. |
| GUD | The Gudeman Company |
| HAM | The Hammarlund Manufacturing Co. Inc. |
| HON | Honeywell |
| HOP | Hopkins Engineering Company |
| HP | Hewlett-Packard Company |
| IRC | International Resistance Company |
| IRP | International Rectifier Corporation |
| ITT | International Telephone and Telegraph Corporation |
| JEF | Jeffers Electronics, Inc. |
| JHN | E. F. Johnson Company |
| JWM | J. W. Miller Company |
| KUL | Kulka Electric Mfg. Co. Inc. |
| KXM | Klixon Metals and Control Corporation |
| LED | Ledex Inc. |
| LEE | Leecraft Mfg. Company |
| LIN | Line Electric |
| LFI | Littlefuse, Inc. |
| MAL | P. R. Mallory & Company, Inc. |
| MCR | Micro Switch (Division of Minneapolis-Honeywell Regulator Co.) |
| MIC | Micamold Electronics Mfg. Corporation |
| MIL | Miller Electric Company |
| MOV | M-O Valve Company Ltd. |
| MOT | Motorola Semiconductor Products, Inc. |
| MUC | Mucon Corporation |
| MUL | Mullard Limited |
| MUT | The Muter Company |
| NYT | New York Transformer Company, Inc. |
| OAK | Oak Mfg. Company |
| PHC | Philco Corporation |
| PHI | Philips Electronic Tube Division |
| PLS | Plastoid Corporation |
| POT | Potter & Brumfield, Inc. |
| PRC | Precision Resistor Co., Inc. |
| PYR | Pyramid Electric Company |
| RCA | Radio Corporation of America |
| RMC | Radio Materials Corporation |
| ROY | Royal Electric Corporation, Inc. |
| RTN | Rotron Mfg. Company |
| SIG | Signalite Inc. |
| SIL | Silicon Transistor Corporation |
| SLT | Sealectro Corporation |
| SOL | Solitron Devices, Inc. |
| SPG | Sprague Electric Company |
| STC | Stackpole Carbon Company |
| STW | Standard Winding Company |
| SUM | Summit Coil Company |
| SWT | Switchcraft Inc. |
| SWW | Stanwyck Winding Company |
| SYL | Sylvania Electric Products, Inc. |
| SYN | Syntronic Instruments, Inc. |
| TEC | Transistor Electronics Corporation |
| TEX | Texas Instruments, Inc. |
| THC | Thermal Control, Inc. |
| TOR | Torrington Mfg., Company |
| TRS | Tresco, Inc. |
| TRU | Tru-Ohm Products |
| TUG | Tung-Sol Electric Inc. |
| UCN | Ucinite Company |
| UTC | United Transformer Company |
| VIC | The Victoreen Instrument Company |
| WDE | Wood Electric Corporation |
| WDL | Ward Leonard Electric Company |
| WES | Weston Electrical Instrument Corporation |
| WYN | Welwyn International Inc. |

# INSTRUMENT WARRANTY AND SERVICE NOTICE

## WARRANTY

The Scientific Instrument Department warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Fairchild, the Instrument is determined to be defective in workmanship or material, Fairchild will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Fairchild shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Fairchild be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Fairchild service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Fairchild's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Fairchild or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

## REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

## CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

## SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

**FAIRCHILD**
Instrumentation
Scientific Instrument Dept.
750 Bloomfield Avenue, Clifton, New Jersey

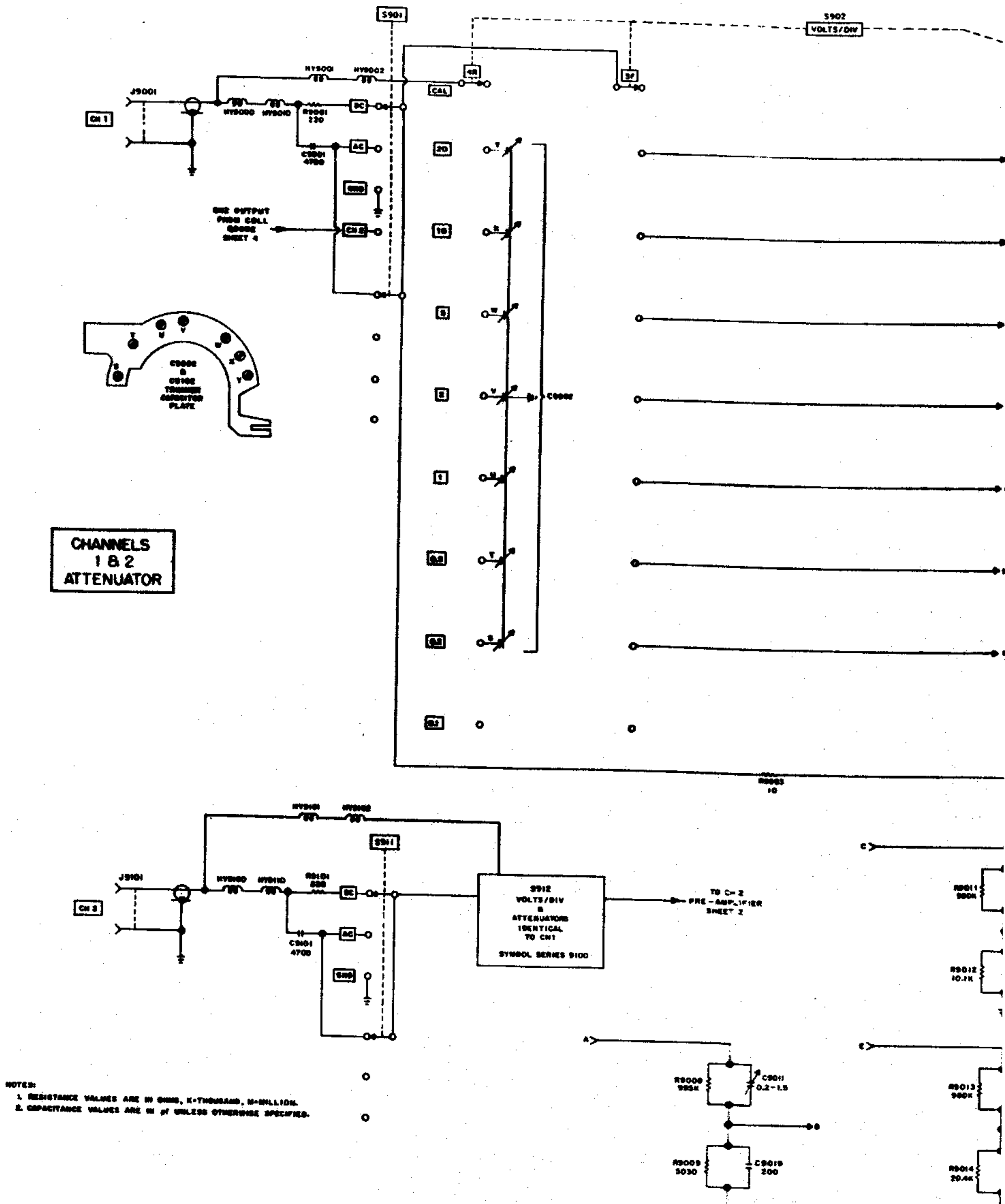
The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

## REPLACEMENT PARTS

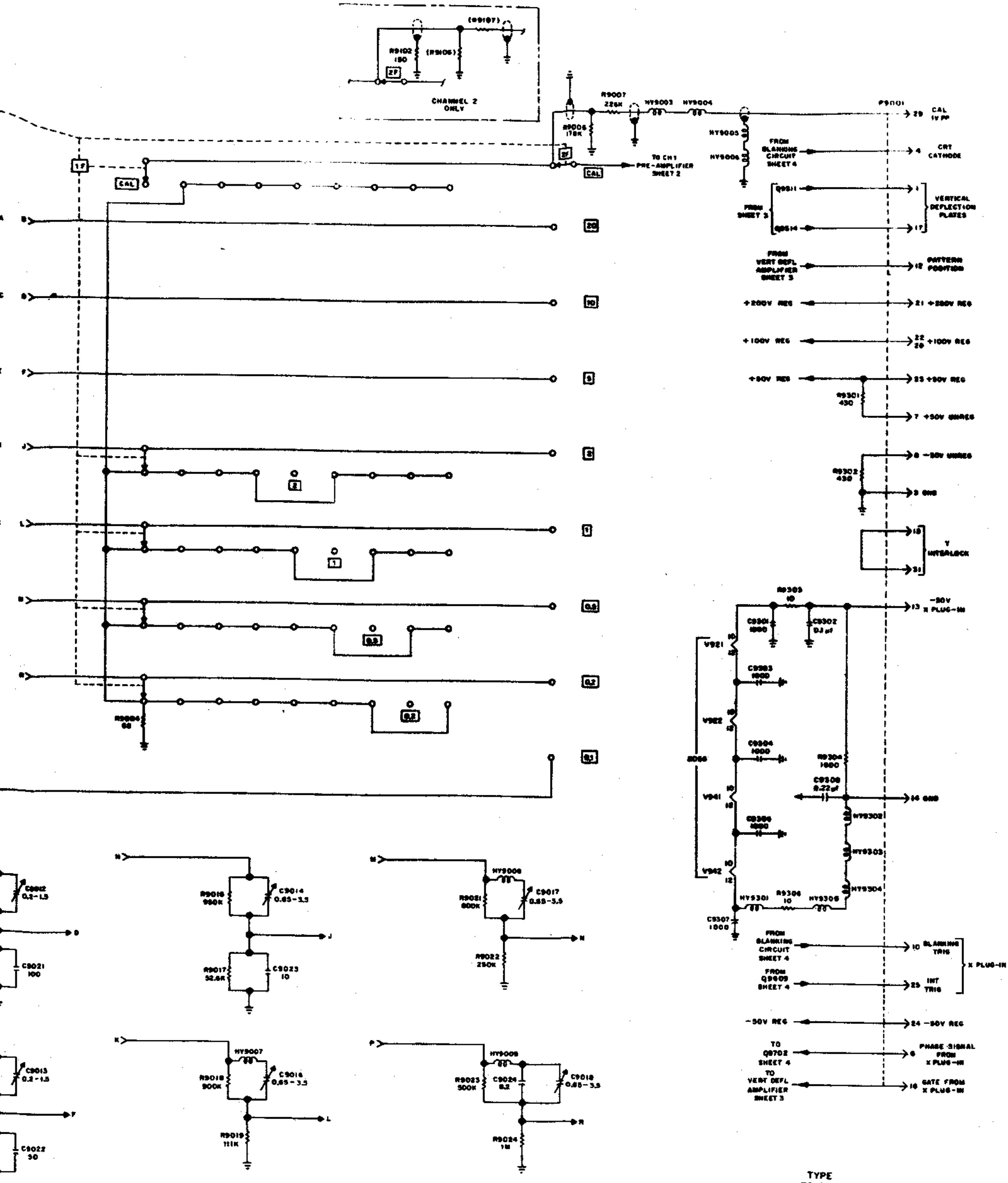
If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Fairchild part number for all electrical components used in the Instrument. This will help to expedite service.

## PATENT NOTICE

Manufactured under one or more U. S. Patents owned or controlled by Fairchild Camera and Instrument Corporation, 750 Bloomfield Avenue, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.

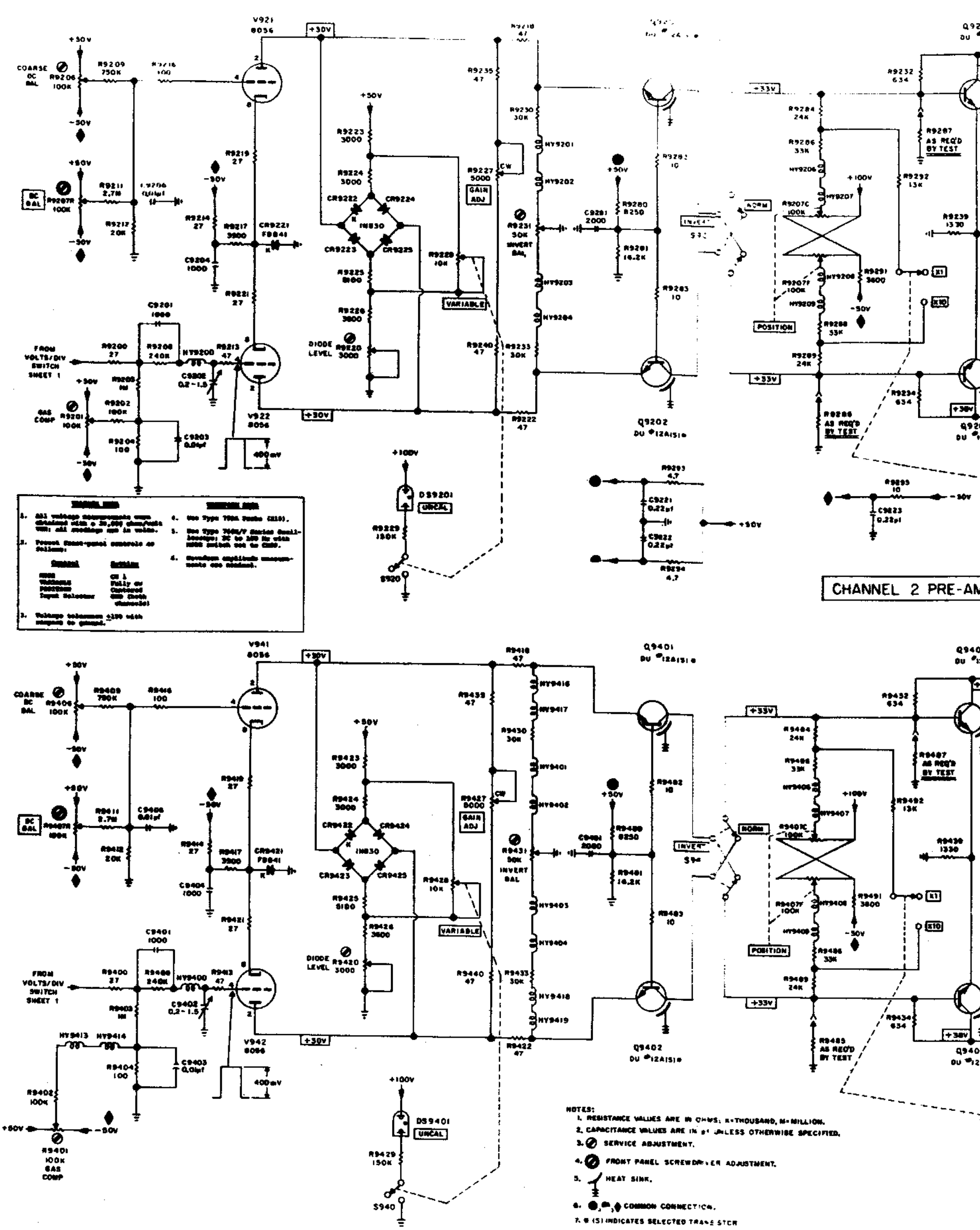


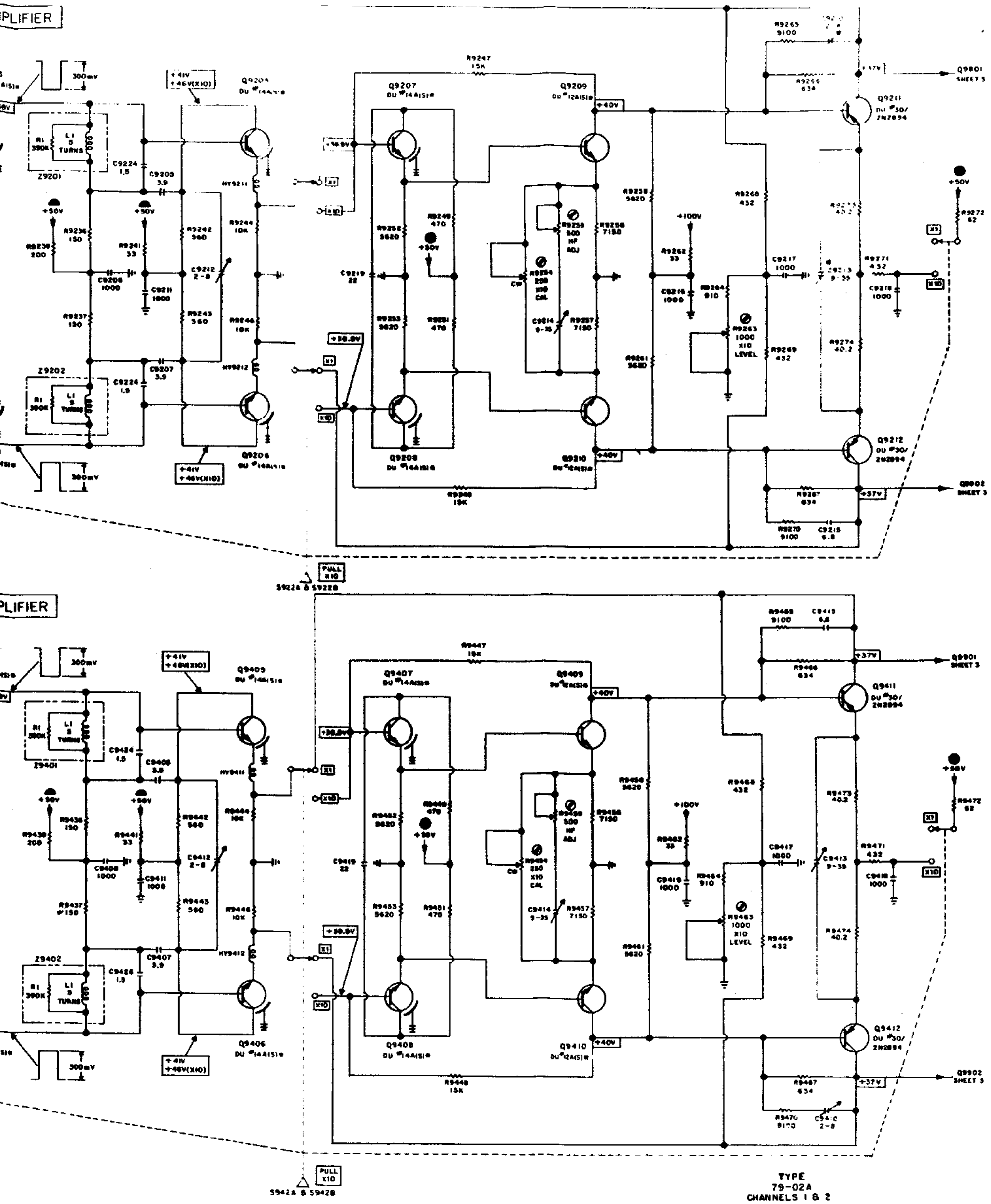

NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.



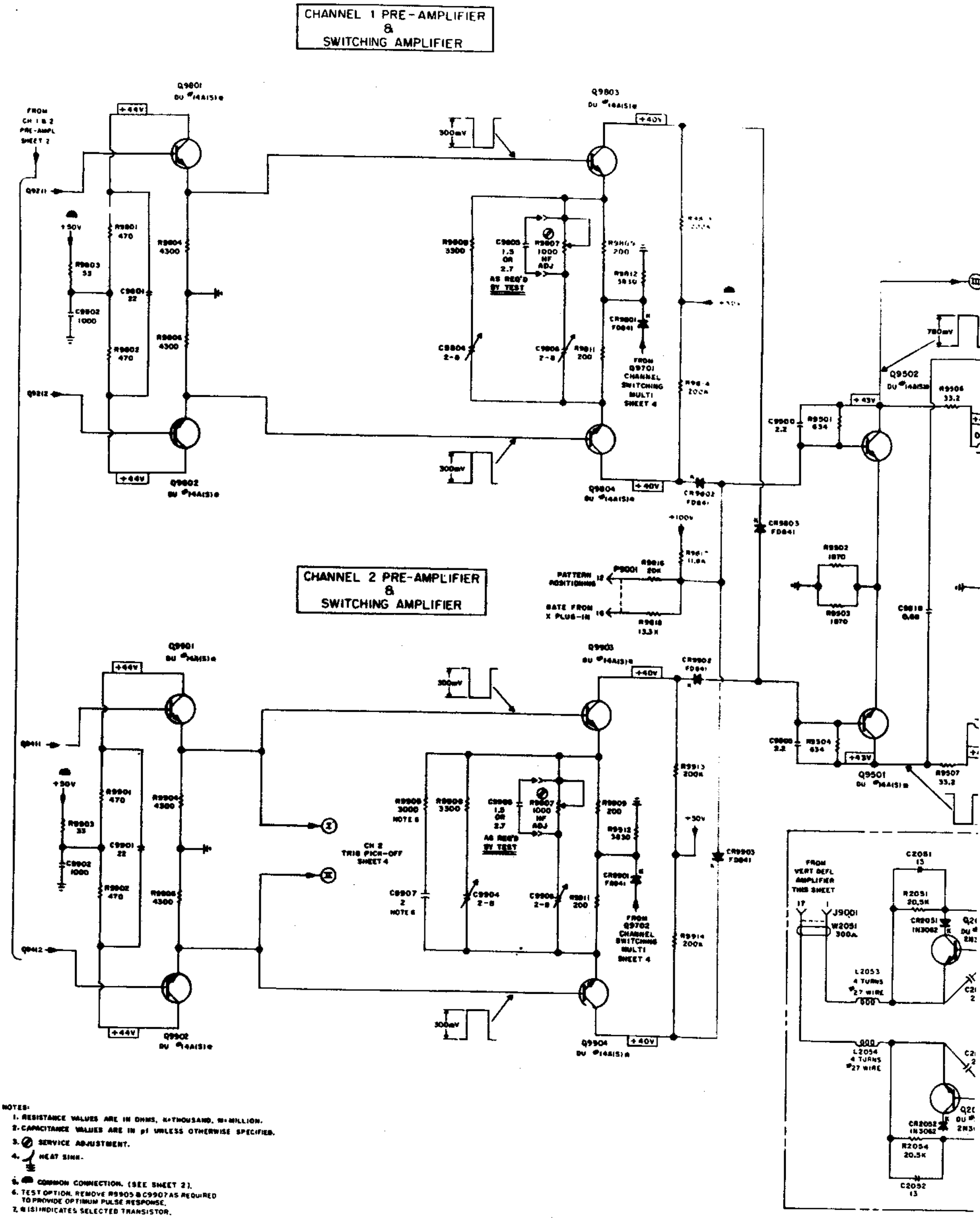

TYPE
79-02A
CHANNELS 1 & 2
ATTENUATORS
SHEET 1 OF 4

CHANNEL 1 PRE-A





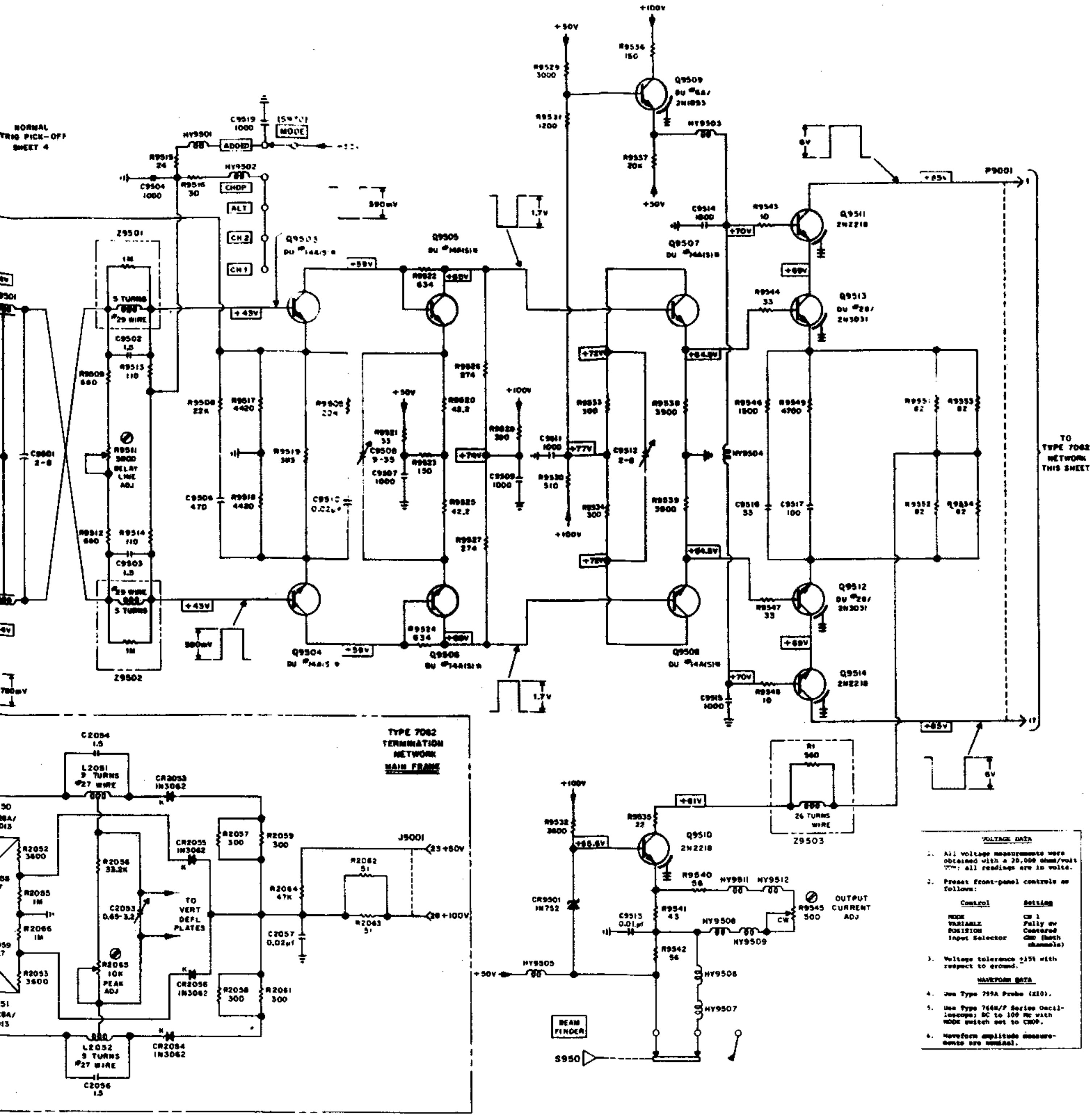

TYPE
79-02A
CHANNELS 1 & 2
PRE-AMPLIFIERS
SHEET 2 OF 4



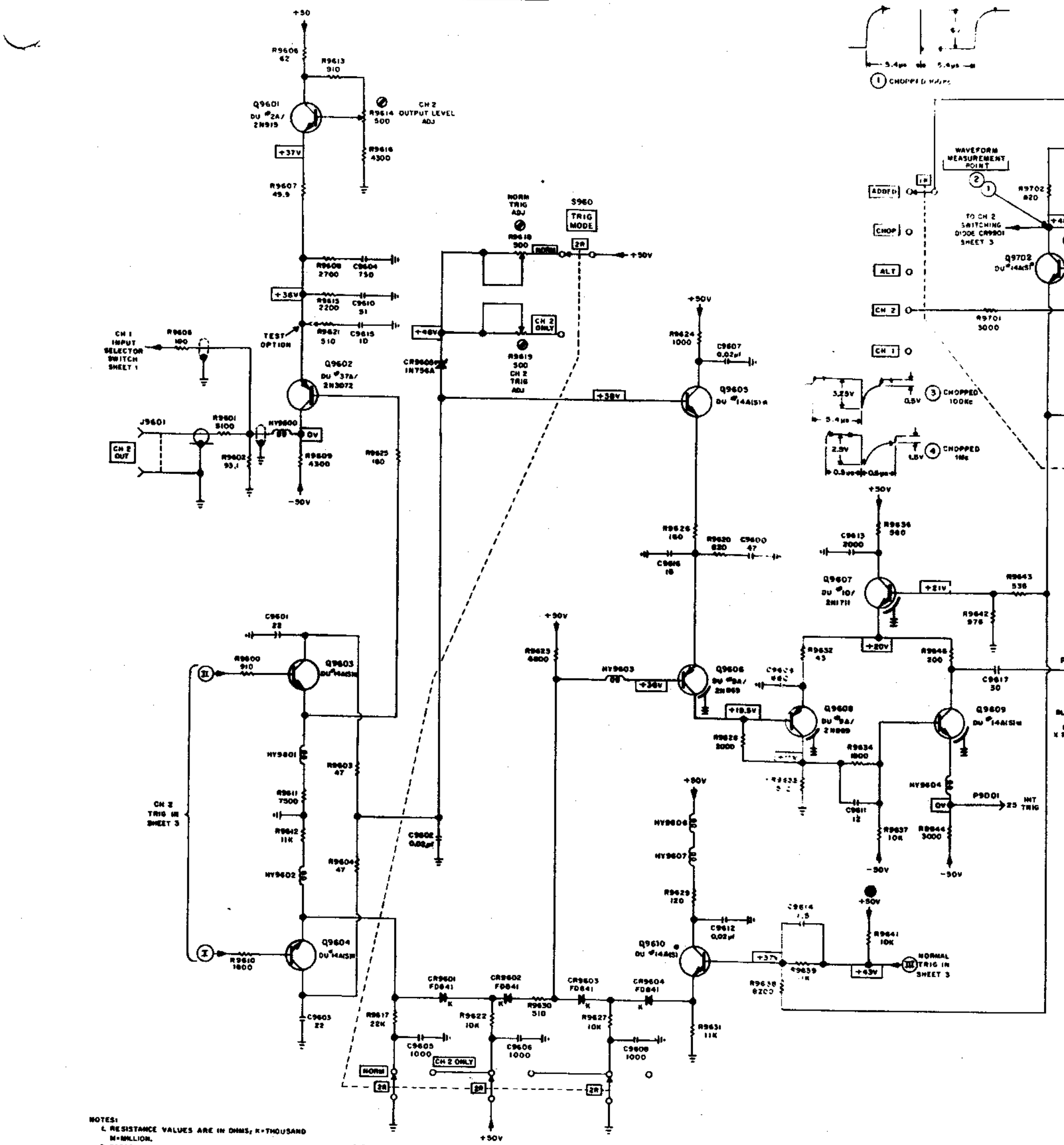

NOTES:

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK.
5. COMMON CONNECTION. (SEE SHEET 2).
6. TEST OPTION. REMOVE R9905 & C9907 AS REQUIRED TO PROVIDE OPTIMUM PULSE RESPONSE.
7. # (S) INDICATES SELECTED TRANSISTOR.

VERTICAL DEFLECTION AMPLIFIER

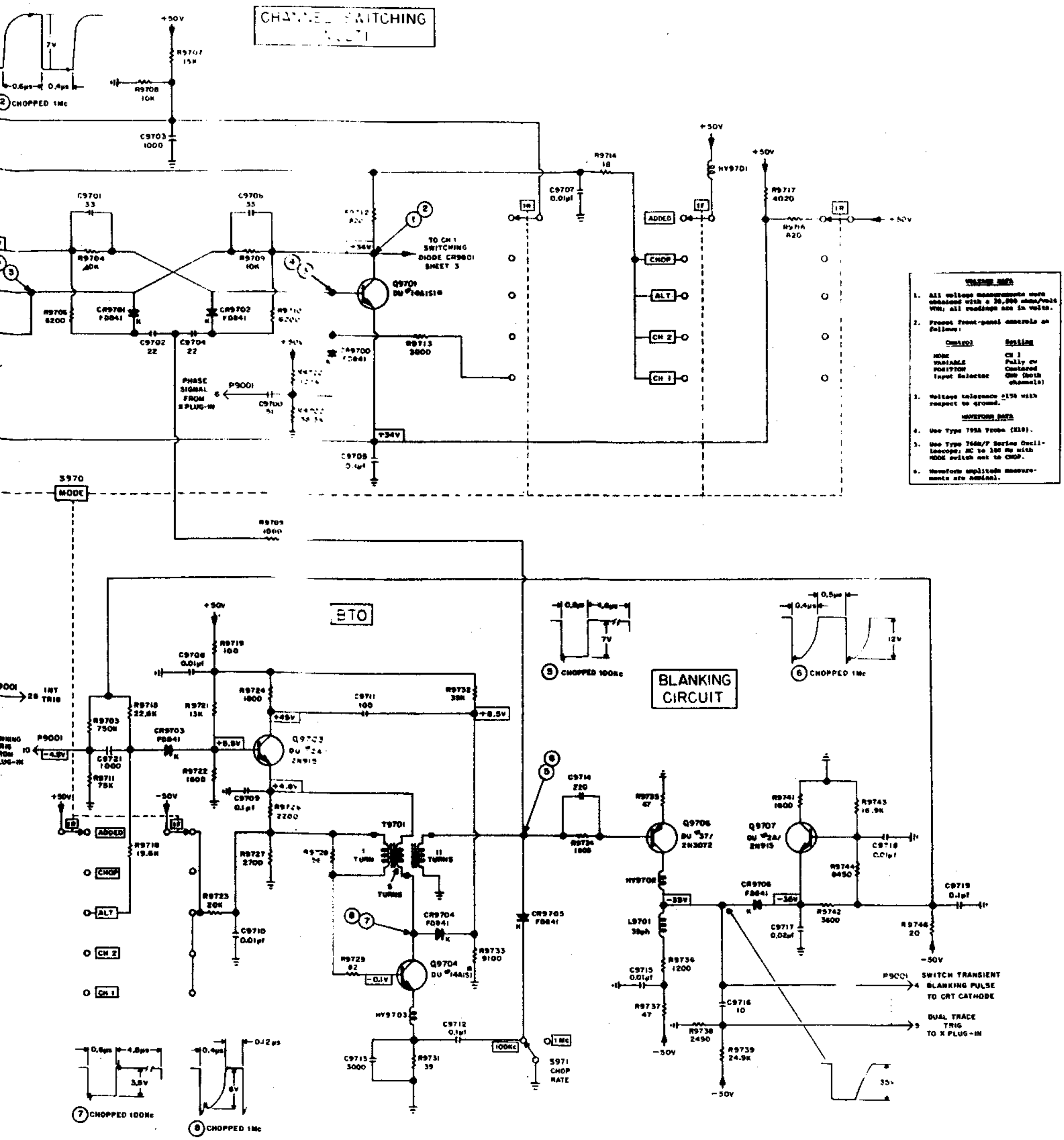


# TRIGGER CIRCUIT




NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND M=MILLION.
2. CAPACITANCE VALUE ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. SERVICE ADJUSTMENT.
4. HEAT SINK.
5. ● COMMON CONNECTION. (SEE SHEET 3)

6 # (S) INDICATES SELECTED TRANSISTOR.




TYPE
79-02A
TRIGGER
&
BLANKING
CIRCUIT
SHEET 4 OF 4

ADDENDUM

FOR

TYPE 79-02A DUAL TRACE PLUG-IN
Reference Manual Part Number 6704 5512

The following S numbers have been assigned to the selected transistors used in this unit.

A. PARTS LIST REVISIONS

| Symbol | Part Number | Description |
|---|---|---|
| Q9205 to Q9208 | CHANGE: | |
| Q9405 to Q9408 | | |
| Q9501, Q9502 | 2600 3071 | DU14A Selected |
| Q9603, Q9604 | 2600 8190 | DU14A |
| Q9704 | | |
| Q9801 to Q9804 | TO READ: | |
| Q9901 to Q9904 | | |
| | 2600 3071 | Transistor S19128 Sel |
| | 2600 3072 | Alternate transistor S19926 Sel. |
| Q9503 to Q9508 | CHANGE: | |
| Q9605 | | |
| Q9609, Q9610 | 2600 3071 | DU14A Selected |
| Q9701, Q9702 | 2600 8190 | DU14A |
| | TO READ: | |
| | 2600 3071 | Transistor S19128 Sel. |

B. SCHEMATICS

Sheet 2, change Q9205, Q9206, Q9207, Q9208, Q9405, Q9406, Q9407, Q9408 from DU14A to S19128 (S) or S19926 (S).

Sheet 3, change Q9801, Q9802, Q9803, Q9804, Q9901, Q9902, Q9903, Q9904, Q9501, Q9502 from DU14A to S19128 (S) or S19926 (S). Change Q9503, Q9504, Q9505, Q9506, Q9507, Q9508 from DU14A to S19128 (S).

Sheet 4, change Q9605, Q9609, Q9610, Q9701, Q9702 from DU14A to S19128 (S). Change Q9603, Q9604, Q9704 from DU14A to S19128 (S) or S19926 (S).

# ADDENDUM
# FOR
# TYPE 79-02A DUAL TRACE PLUG-IN
(Reference Manual Part Number 6704 5512)

## A. PURPOSE

The following change was made to improve the pulse response and to eliminate compression of signal when positioning signal off-screen vertically.

## B. PARTS LIST REVISIONS

In Section 6 make the following changes:

1. Change part number of transistors Q9201 thru Q9204 and Q9401 thru Q9404 from 26003084 to 26003111.
2. Change part number and value of resistor R9523 from 02364890, 150 ohms, to 02364720, 100 ohms.
3. Delete networks, peaking, Z9201, Z9202, Z9401 and Z9402.
4. Add coils L9201, L9202, L9401 and L9402, part number 21019511 and description "coil, 85 nanohenries."
5. Add the following part number and description for transistors Q9209, Q9210, Q9409 and Q9410: "26003111, alternate DU#12A (selected)."

## C. SCHEMATIC REVISIONS

1. On schematic "Channel 1 and 2 Preamplifiers" sheet 2 of 4, make the following changes:
   a. Delete reference designations Z9201, Z9202, Z9401 and Z9402 and dashed rectangle.
   b. Delete reference "R1, 390K" and "L1, 5 turns."
   c. Delete R1 resistor symbol.
   d. To remaining coil symbols add reference designations and values as follows:

| Before | After |
|---|---|
| Z9201, Z9202 | L9201, L9202 85 nh |
| Z9401, Z9402 | L9401, L9402 85 nh |

2. On schematic "Vertical Deflection Amplifier" sheet 3 of 4, change resistor value of R9523 from 150 ohms to 100 ohms.

ADDENDUM

FOR

TYPE 79-02A DUAL TRACE PLUG-IN
(Reference Manual Part Number 6704 5512)

A. **PURPOSE**

The following change was made to change CH 1 Input Selector switch to eliminate oscillations when tandem operating the amplifiers for greater input sensitivity.

B. **TEXT REVISIONS**

1. On Page 1-3 under "Input Selector Switch" heading, change to read as follows:

   ...Each channel is provided with a 3-position lever switch which permits selection of DC or AC coupling and ground. The GND position provides a base line reference and disconnects the input signal. ...

2. On Page 1-4 under "High Sensitivity Amplifier", change "an internal connection" etc. to read "an external connection" etc.

3. On Page 2-4 under paragraph 2-5 delete first major paragraph referencing channel 1 input selector switch.

4. On Page 2-22, paragraph 2-11 change first paragraph to read as follows:

   ...The Type 79-02A Dual Trace Amplifier may be set up to provide an input sensitivity of 1 millivolt/division with an accompanying reduction in bandwidth to 25 MHz. This is accomplished by interconnecting the CH 2 OUTput connector to CH 1 input connector through a short length of coaxial cable and setting the channels for X10 operation by pulling the VARIABLE controls (Pull X10) out. The output of CH 2 amplifier is now connected in series with the input of CH 1 amplifier. ...

5. Delete reference to CH 2 at CH 1 Input Selector switch, Figures 1-1, 2-1, 2-2, 2-3, 3-1, 3-6 and 6-1.

6. In Figure 6-1 change front panel part number to 3201 3772.

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## C. PARTS LIST REVISIONS

In Section 6 make the following changes:

DELETE:

| Symbol | Part Number | Description | Code | Type |
|---|---|---|---|---|
| C9615* | 0315 2100 | 10 pf, ±10% | ERC | NPO 331 |
| R9602 | 0236 4690 | 93.1, ±1% | CGW | NS 20 |
| R9605 | 0234 7970 | 100 | CGW | C20 |
| R9625 | 0235 4440 | composition, 180, 1/4W | ALB | CB |
| R9621* | 0234 8140 | 510 | CGW | C20 |
| S901 | 0501 7461 | lever, 1 section, 4 pos. | FC1 | |

ADD:

| Symbol | Part Number | Description | Code | Type |
|---|---|---|---|---|
| C9618 | 0319 1070 | 0.005 uf, 150V | | |
| R9602 | 0236 4720 | 100, 1% | | |
| R9625 | 0235 4460 | 220 | | |
| S901 | 0501 7451 | lever, 1 section, 3 pos. | FC1 | |

## D. SCHEMATIC REVISIONS

1. On Schematic "CH 1 and 2 Attenuators", sheet 1 of 4, delete CH 2 position from S901 and reference to CH 2 output.

2. On Schematic "Trigger & Blanking Circuit", sheet 4 of 4:

   a. Delete resistor R9605, its connection and reference

   b. Delete resistor R9621, capacitor C9615 and reference to test option

   c. Change resistor R9602 value from 93.1 to 100

   d. Change resistor R9625 value from 180 to 220

   e. Add capacitor C9618, 0.005 uf in parallel with resistor R9601.