DUAL-TRACE CALIBRATED PREAMP TYPE 53/54C

INSTRUCTION MANUAL

TEKTRONIX, INC.
MANUFACTURERS OF CATHODE-RAY AND VIDEO TEST INSTRUMENTS

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VARIABLE
VOLTS/CM
POLARITY
NORMAL INVERTED
VERTICAL POSITION
CHANNEL A
CALIBRATED
DC
AC
TEKTRONIX
GAIN ADJ.
DC BAL.
MODE
A ONLY
B ONLY
CHOPPED
ALTERNAT
TYPE 53/54C PLUG-IN UNIT
DUAL-TRACE
CALIBRATED PREAMP
CHANNEL B
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

GENERAL DESCRIPTION

GENERAL

The Type 53/54C Dual-Trace Unit contains two identical amplifier channels that can be electronically switched either by the oscilloscope sweep or at a free-running rate of approximately 100 kc. When amplifier switching is triggered by the oscilloscope sweep, the two signals to be compared appear on alternate sweeps. Because the sweeps are identical, and time-delay characteristics of the two amplifier channels are closely controlled, time comparisons accurate within 1 mμsec can be made.

Stationary display of two signals unrelated in frequency can be accomplished by internal triggering of the sweep alternately by the two signals. In free-running operation, switching occurs at a rate of approximately 100 kc, making it possible to view two simultaneous transients. Transients of as little as one-millisecond duration can be well delineated, with about one hundred elements in each trace. For many purposes, shorter transients can be adequately observed.

Either amplifier channel can be used separately without electronic switching, making the Type 53/54C also useful in all single-trace applications within its frequency-response and sensitivity capabilities. Maximum flexibility is obtained by providing separate positioning, sensitivity, and polarity-inverting controls for each channel.

TYPE 53/54C SPECIFICATIONS

Operating Modes

The two amplifier channels can be displayed alternately at a rate of approximately 100 kc, alternately every other sweep, or either channel can be used separately.

Amplifier Sensitivity

Basic deflection factor — .05 v/cm, ac or dc.

Nine calibrated sensitivities — .05 v/cm to 20 v/cm, accurate within 3% when set on any one step.

Amplifier Transient Response

With 541 or 545, rise time .015 μsec.

With 531 or 535, rise time .032 μsec.

With 532, rise time .070 μsec.

Amplifier Frequency Response

With 541 or 545, 3 db down at approximately 24 mc.

With 531 or 535, 3 db down at approximately 11 mc.

With 532, 3 db down at approximately 5 mc.

Input Impedance

1 megohm shunted by 20 μμf; with P410 probe 10 megohms, 7.5 μμf

Physical Characteristics

Construction — Aluminum alloy chassis. Finish — Photo-etched anodized panel. Weight — 4½ lbs.

FUNCTIONS OF CONTROLS AND CONNECTORS

CHANNEL A
CHANNEL B — Signal input to the A-channel or B-channel amplifier.

DC — AC — Slide switch to provide either ac or dc coupled input into the amplifiers.

VOLTS/CM — Nine-position switch used to select the calibrated vertical-deflection sensitivities.

VARIABLE — Potentiometer concentric with the **VOLTS/CM** switch to provide continuously variable attenuation between the calibrated sensitivities and to extend the attenuation to a sensitivity of 50 v/cm.

POLARITY — Two-position switch to provide optional in-phase or out-of-phase output.

VERTICAL POSITION — Potentiometer to provide for shifting the position of the trace vertically.

GAIN ADJ. — Screwdriver adjustable potentiometer to permit the gain of the amplifier to be accurately set.

DC BAL. — Screwdriver adjustable potentiometer to provide for setting the **VARIABLE** attenuator dc levels so the trace does not shift position when the attenuation is varied.

MODE — Four-position switch to allow either amplifier to be used independently, to provide for switching the two amplifiers at an arbitrary rate, or to synchronize the switching with the oscilloscope's sweep.

FIRST-TIME OPERATION

Plug the unit into a 540- or 530-Series Oscilloscope and turn the power on. Allow the instrument to reach operating temperature, about 2 to 3 minutes and free-run the sweep at 1 millisecond/cm. Turn the **MODE** switch to **A ONLY** and the A-channel **POLARITY** and **AC-DC** switches to **NORMAL** and **DC** respectively. Position the trace to about +2 cm with the A-channel **VERTICAL POSITION** control.

Turn the **MODE** switch to **B ONLY** and the B-channel **POLARITY** and **AC-DC** switches to **NORMAL** and **DC** respectively. Position the trace to about −2 cm with the B-channel **VERTICAL POSITION** control.

Now turn the **MODE** switch to **CHOPPED.** Two traces will appear on the crt screen. Notice that the A-channel **VERTICAL POSITION** control moves the upper trace and the B-channel **VERTICAL POSITION** control moves the lower trace. Increase the sweep speed to 100 microsecond/cm and notice that each trace is composed of many short-duration elements. The two channels are being switched at approximately 100 kc so that each channel conducts for about 5 μsec and then is cut off while the other channel conducts for an equal time.

Now turn the **MODE** switch to the **ALTERNATE** position. There are still two traces on the crt screen but the traces are no longer chopped into small bits. For each sweep cycle one channel is conducting and the other is cut off. The channels are switched at the end of each sweep cycle.

GENERAL OPERATION

Either of the two identical amplified channels can be used independently by turning the **MODE** switch to **A ONLY** or **B ONLY** and connecting the signal to be observed to the appropriate input. The following remarks apply equally well to either amplifier channel.

Use of Probe

The Type P410 probe, furnished with the 540-Series Oscilloscopes, is designed to preserve the transient response of this unit. This probe introduces no ringing but causes an additional frequency-response loss of less than 1 db at 24 mc. The Type P410 probe has a 10-to-1 attenuation ratio.

The Type P510A probe is not suitable for use with the Type 53/54C Plug-In Unit and 540-Series Oscilloscope combination to observe fast-rising pulses. This probe tends to ring at about 50 mc and the wide passband of the 53/54C — 540-Series combination will display any ringing that may occur.

Be sure to check the adjustment of the probe when you first connect it to a plug-in unit or oscilloscope. The probe compensation is a function of the shunt input capacitance of the particular plug-in unit or oscilloscope that you use the probe with. If the compensation is incorrect the frequency response will be affected. Touch the probe tip to the calibrator output connector and display several cycles of the calibrator waveform. If the top and bottom of the displayed square wave are not flat, adjust the trimmer capacitor located either inside the probe body or inside the box at the other end of the cable to achieve correct square-wave response.

Input Coupling

It is sometimes undesirable to display the dc level of the waveform being observed. Placing the **AC-DC** switch in the **AC** position inserts a capacitor in series with the input so the dc component of the waveform is blocked and only the ac component is displayed. The low-frequency response is about 2 cps when ac coupling is used.

Output Polarity

It will be desirable to invert the displayed waveform at times, particularly when using the dual-trace feature of the 53/54C. The **POLARITY** switch has two positions. In the **NORMAL** position the displayed waveform will have the same polarity as the input signal. In the **INVERTED** position the displayed waveform will be turned upside down; that is, a positive-going pulse will be displayed as a negative-going pulse.

DC Balance Adjustment

After the plug-in unit has been in use for a period of time you will notice that the trace will change position as the **VARIABLE** control is rotated. This is caused by tube ageing and the resultant shift in operating potentials. To correct this condition rotate the **VARIABLE** control back and forth and adjust the **DC BAL** control until the trace position is no longer affected by rotation of the **VARIABLE** control.

Gain Adjustment

Ageing of the tubes will also affect the gain of the plug-in unit. Display a calibrator waveform of 0.2 volt peak to peak with the **VOLTS/CM** switch in the .05 position. Adjust the **GAIN ADJ** control until the displayed waveform is 4 graticule divisions in amplitude. Make sure the **VARIABLE** control is turned full right to the **CALIBRATED** position before making this adjustment.

Positioning Adjustment

The VERT POS RANGE control balances the dc output level so the full range of the front-panel positioning controls can be utilized. This control is accessible when the left side panel is removed. Center the trace in both the **A ONLY** and **B ONLY** positions of the **MODE** switch. Note the settings of the **VERTICAL POSITION** controls. Adjust the VERT POS RANGE control so both the A-channel and B-channel **VERTICAL POSITION** controls are approximately centered when the displayed trace is centered.

DUAL-TRACE OPERATION

Generally, two types of operation will be performed using the dual-trace function of the 53/54C; the observation of repetitive waveforms and the observation of single transients. The two types of operation are fundamentally different so we will examine them in the order stated.

Repetitive Signals

Connect the two signals to be compared to the two signal inputs and turn the **MODE** switch to **A ONLY.** Set the sweep up for triggered operation and adjust the **VOLTS/CM** and **VERTICAL POSITION** controls as necessary to display the waveform. Turn the **MODE** switch to **B ONLY** and adjust the corresponding controls as necessary to display the other waveform. Now turn the **MODE** switch to **ALTERNATE.** If necessary, touch up the oscilloscope's sweep triggering controls to obtain a stable image. Both waveforms will now be displayed on the crt screen. As the control of each amplifier is independent you can position, attenuate, or invert the signals as necessary to compare their shape, relative amplitudes, etc.

Use the **AC FAST** triggering mode and **ALTERNATE** sweeps for **INT**ernal triggering on signals having components above 10 kc. For lower-frequency signals, use the **AC SLOW** triggering mode. In the **AC FAST** position, an rc filter is inserted into the circuit allowing it to recover quickly from the dc level changes encountered with the **ALTERNATE** sweep. To compare the phase difference between two signals, you should trigger externally using the reference signal as the trigger signal.

Single Transients

When it is necessary to observe a single transient at two parts of a circuit another procedure must be followed. In the foregoing case, one of the signals triggers the sweep and that amplifier remains conducting for the sweep duration. At the end of the sweep the amplifiers are switched and the other signal then triggers the sweep and that amplifier remains conducting for the sweep duration. Each of the signals is being displayed every other sweep cycle. If you attempted to observe a single transient in this manner the transient will pass through whichever amplifier happens to be conducting and will trigger the sweep. This will display the transient as seen by whichever amplifier is conducting but when the amplifiers are switched at the end of that sweep there will be no further signal to trigger another sweep until the next transient occurs. The problem here is to be able to observe the transient using both amplifiers during a single sweep cycle.

Turn the **MODE** switch to **CHOPPED.** Now the two amplifiers are being switched on and off independently of any signal. The switching rate is approximately 100 kc so each amplifier is conducting for about 5 μsec and then is cut off while the other amplifier conducts for an equal length of time. In this case the sweep is being triggered by the switching waveform, particularly if the two traces are positioned very far apart, as the switching waveform is equivalent to a 100-kc square wave. It will usually be very difficult if not impossible to trigger the sweep internally from the signal so the sweep controls should be set for external triggering. Review the OPERATING INSTRUCTIONS section of the oscilloscope's instruction manual for the proper procedure for external triggering of the sweep.

Now the two signals to be observed can be connected to the two inputs and both waveforms will be displayed during one sweep cycle. Transients as short as 1 msec duration can be well delineated, with about 100 elements in each trace. As before, the independent control of each amplifier will allow you to position, attenuate, or invert the waveforms so they can be easily compared.

CIRCUIT DESCRIPTION

AMPLIFIERS

The Type 53/54C Plug-In Unit consists of two identical amplifier channels and a channel-switching multivibrator. The following description of the amplifiers applies equally well to either channel.

Input Coupling and Attenuation

The signal to be displayed is applied to the input cathode follower V3053 (V4053) by way of the **AC-DC** switch and the **VOLTS/CM** switch. The **AC-DC** switch is a two-position slide switch that shorts out C3003 (C4003) in the **DC** position so the input is dc coupled. In the **AC** position of this switch the signal must pass thru C3003 (C4003) so the dc component of the signal is blocked.

The **VOLTS/CM** switch is a 9-position rotary switch that selects the various frequency-compensated rc attenuator sections. The basic sensitivity of the unit is .05 volts/cm. This sensitivity is reduced by the eight individually selected attenuator sections to give nine fixed calibrated sensitivities.

Input Stage

The input stage consists of the cathode follower V3053 (V4053) and the cathode-coupled phase inverters V3083 and V3263 (V4083 and V4263). The control-grid dc level of V3083 (V4083) is established by the dc connection to the cathode of V3053 (V4053). The control-grid dc level of V3263 (V4263) is adjustable by means of the **DC BAL** control so that the dc level of the cathodes of V3083 and V3263 (V4083 and V4263) can be made equal. Any dc level difference between these two cathodes would act as a signal and cause the trace to shift position when the **VARIABLE** control is rotated. The **VARIABLE** gain control establishes the amount of cathode coupling and thus allows the stage gain to be varied over about a 2½ to 1 range.

The GAIN ADJ control permits the basic gain of the unit to be accurately set to agree with the front-panel calibration.

Polarity and Positioning

With the **POLARITY** switch in the **NORMAL** position the displayed waveform will have the same polarity as the input signal. Placing the **POLARITY** switch in the **INVERTED** position reverses the signal-grid connection of V3303 and V3343 (V4303 and V4343) and turns the displayed waveform upside down. Rotation of the **VERTICAL POSITION** control forces one plate of the input stage toward a higher potential and the opposite plate toward a lower potential. The resulting dc level shift moves the trace vertically.

Amplifier Stage and Output CF

The signal is further amplified by V3303 and V3343 or V4303 and V4343, depending on which channel is conducting. V3303 and V4303 have a common plate load and likewise V3343 and V4343. Since one amplifier is always cut off while the other is conducting, the shunt loading effect is negligible.

V3503 is the output cathode follower that provides a low-impedance source for driving the oscilloscope's vertical amplifier. The POSITIONING ADJ control located in the grid circuit of the output cf permits the trace to be centered vertically under no-signal conditions.

SWITCHING CIRCUIT

A Only, B Only

V3703 is a multivibrator that is controlled by the **MODE** switch. With the **MODE** switch in the **A ONLY** or **B ONLY** position the multivibrator is held in one of its two possible states by returning one grid to a positive voltage and the other grid to a negative voltage. For example, in the **A ONLY** position the grid of V3703A is held positive and this half of the multivibrator conducts while the grid of V3703B is held negative and this half is cut off. While V3703A is conducting the cathode is above ground which causes V3903A to conduct and in turn pulls the grid of V3953B toward ground lowering the plate voltage of V4083 and V4263. This reduced plate voltage cuts off the following stage (V4303 and V4343) and the B-channel amplifier is held in a non-conducting state. The converse is true of the A-channel amplifier. The grid of V3903B is near ground potential and with reduced plate current the plate of V3903B and consequently the grid of V3953A are permitted to become more positive providing plate voltage for V3083 and V3263 and the A-channel amplifier then conducts.

Chopped

Turning the **MODE** switch to the **CHOPPED** position returns both grids of the multivibrator to a positive voltage and the multivibrator free runs at a rate determined by the time constant of the grid circuits. The two amplifiers are alternately cut off and allowed to conduct at the free-running rate of the multivibrator.

Alternate

Turning the **MODE** switch to the **ALTERNATE** position returns both grids of the multivibrator to a negative potential and it is then bistable. At the end of each sweep cycle a negative-going trigger is generated and is coupled to the multivibrator through the Trigger Coupling Diode V3803. Each trigger causes the multivibrator to "flip" from one stable state to the other. This alternately switches the amplifiers on and off but now the switching rate is determined by the sweep repetition rate.

PARTS ORDERING AND REPLACEMENT

Instruction Manual

A Tektronix instruction manual usually contains hand-made changes to diagrams and parts lists, and sometimes text. These changes are in general appropriate only to the instrument the manual was prepared for. These hand-made corrections show changes to the instrument that have been made after the printing of the manual.

There is a serial number on the frontispiece and on the warranty page of this manual. This is the serial number of your instrument. Be sure the manual number matches the instrument number when you order parts.

NOTE

Always include the instrument type AND SERIAL NUMBER in any correspondence regarding the instrument.

Standard Components

Tektronix will supply replacement components at current net prices. However, since most of the components are standard electronic and radio parts you can probably obtain them locally faster than we can ship them to you from the factory in Portland, Oregon. Be sure to consult the instruction manual to see what tolerances are required.

Selected Components

We specially select some of the components, whose values must fall within prescribed limits, by sorting through our regular stocks. The components so selected will have standard RETMA color coding showing the value and tolerance of the stock they were selected from, but they will not in general be replaceable from dealer's stocks.

Checked Tubes

To obtain maximum reliability and performance we check some of the vacuum tubes in our instruments for such characteristics as microphonics, balance, transconductance, etc. We age other tubes to stabilize their characteristics. Since there are no well defined standards of tube performance we have established our own arbitrary standards and have developed equipment to do this checking. These checked tubes can be purchased through our local Field Engineering Offices or directly from the factory in Portland, Oregon.

Tektronix Manufactured Parts

Tektronix manufactures almost all of the mechanical parts and some of the components used in the instrument. If you order a mechanical part be sure to describe the part completely to prevent any unnecessary delay in filling your order. When you have any questions about mechanical parts or Tektronix manufactured components contact our nearest Field Engineering Office or write to the Field Engineering Department at the factory in Portland, Oregon.

GENERAL INFORMATION

Color Coding

We use color coded wires in the instruments to help identify the various circuits. These wires will be either a solid color or will be a solid color (including black and white) with one or more colored stripes. The colored stripes are "read" in the same manner as the RETMA resistor color code. In the case of multiple stripes the wide stripe is read first.

Wires carrying positive regulated-power-supply voltages are white and the stripes indicate the supply voltage. For example, the +225-v supply bus will be coded red-red-brown (2-2-1) giving two significant figures and the decimal multiplier.

The negative-supply bus wires are black and the stripes indicate the supply voltage. For example, our most common negative-supply volttage is —150 v and is carried by a black wire coded brown-green-brown (1-5-1).

The mains-voltage leads to the power transformer are yellow and coded brown-brown-brown (1-1-1).

The tube heater leads are white and coded 6-1, 6-2, 6-3, etc., not to indicate that the voltages are different but to differentiate between circuits.

In other respects the color coding will vary from instrument to instrument. In general all signal-carrying leads are white and coded with a single colored stripe. In a few places where the number of leads exceeded the capabilities of single-stripe coding we have used solid-color leads.

Soldering Precaution

The solder used on the ceramic terminals of this instrument must contain a small percentage of silver. Repeated use of ordinary tin-lead solder will dissolve the fused bond of silver that makes the solder adhere to the porcelain, especially if the soldering iron is quite hot.

A quantity of the silver-bearing solder that we use at the factory is attached to each major instrument having ceramic strips. This solder, containing approximately 3% silver, is not readily available through regular channels. If you need additional silver-bearing solder for maintenance purposes you can purchase it from Tektronix in one-pound spools.

ADJUSTMENT PROCEDURE

The following outline is based on the adjustment procedure used in our test department here at the factory. Ordinarily, adjustment in the field will consist of touching up some of the dc level and balance controls as outlined in the OPERATING INSTRUCTIONS, but if a readjustment of the transient response is ever necessary there is a certain sequence that should be followed.

The input capacitance of the unit is accurately set to 20 $\mu\mu$f at the factory. This insures that a properly adjusted probe can be used interchangeably with other units having 20-$\mu\mu$f input capacitance. To preserve this feature, you will need to do **one** of these things: (1) use a CS-20 Input-Capacitance Standardizer, (2) calibrate a P400-Series probe against a plug-in unit known to be in correct adjustment, or (3) measure the input capacitance with a Type 130 L,C meter or with a capacitance bridge.

Peaking Coils

As a preliminary adjustment, set all peaking-coil slugs so that the top of each slug is flush with the bottom turn of the winding. (As an emergency measure, these settings alone are adequate for approximately correct results.)

For complete calibration of the peaking coils, plug the Type 53/54C unit into a 540-Series oscilloscope known to be in correct adjustment. Have the cabinet or side panels removed. If the oscilloscope is not of recent manufacture, you will have to drill the side panel of the plug-in-preamplifier compartment within the oscilloscope, to provide access to the adjustments of the Type 53/54C unit. A source of square waves or pulses having a rise time not longer than 3 millimicroseconds is needed. The repetition rate should preferably be 1 kc or more. It is essential that this source be terminated in accordance with the manufacturer's specifications.

Turn the **MODE** switch to **A ONLY**, the **VOLTS/CM** switch to **0.05**, and the **VARIABLE** control full right to the **CALIBRATED** position.

The peaking coils affect the rise and leading corner of the square wave and should be adjusted for a square corner with no overshoot.

1. Adjust L3523 and L4413.
2. Adjust L3313 and L3353.
3. Adjust L3073 and L3253.

Move the square-wave source to the **CHANNEL B** input connector and set the B-channel controls as you previously set the A-channel controls.

1. Adjust L4313 and L4353.
2. Adjust L4073 and L4253.

If after adjustment one channel seems to have a better response than the other try a slightly different setting of L3523 and L4413, which are common to both channels, and then repeat steps 2 and 3 of the A-channel adjustment and steps 1 and 2 of the B-channel adjustment. You will have to experiment with the settings of L3523 and L4413 to find which setting will give the best balance of response.

Input Attenuators

There are two types of adjustments to be made. Each adjustment requires a Type 105, or other square-wave source having a rise time not longer than 0.025 μsec. The source must be terminated according to the manufacturer's specifications. One type of adjustment is made to compensate the attenuators so the ac attenuation is equal to the dc attenuation. This involves a moderately short time constant. Misadjustment can be recognized as a slight rounding or overshoot at the leading corner of the square wave.

The other type of adjustment is made to get equal input capacitances at all positions of the attenuator. Misadjustment can be recognized as a downward or upward slope over about the first one-quarter of the square wave.

First compensate the A-channel attenuators. Connect the probe to the **CHANNEL A** input connector and connect the square-wave source to the probe. Display four or five cycles of a 1-kc square wave. Set the **VOLTS/CM** switch to **.05** and adjust C3023 for a flat top on the square wave. Remove the probe and connect the square-wave source to the input connector. Adjust the listed capacitors for a square corner on the square wave.

VOLTS/CM	Capacitor
.1	C4823C
.2	C4833C
.5	C4843C
1	C4853C
2	C4863C
5	C4873C
10	C4883C
20	C4893C

Connect the probe to the **CHANNEL A** input connector and connect the square-wave source to the probe. Adjust the input capacitance with the **VOLTS/CM** switch in the positions shown.

VOLTS/CM	Capacitor
.1	C4823B
.2	C4833B
.5	C4843B
1	C4853B

2	C4863B
5	C4873B
10	C4883B
20	C4893B

Repeat the above operations with the B-channel amplifier. Move the square-wave source to the **CHANNEL B** input connector with the probe in place and adjust C4023 for a flat top on the square wave. The **VOLTS/CM** switch should be in the **.05** position. Remove the probe and compensate the attenuator.

VOLTS/CM	Capacitor
.1	C4923C
.2	C4933C
.5	C4943C
1	C4953C
2	C4963C
5	C4973C
10	C4983C
20	C4993C

Insert the probe and adjust the input capacitance.

VOLTS/CM	Capacitor
.1	C4923B
.2	C4933B
.5	C4943B
1	C4953B
2	C4963B
5	C4973B
10	C4983B
20	C4993B

ABBREVIATIONS

Cer.	ceramic	m	milli or 10^{-3}
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	kilohm or 10^3 ohms	v	working volts dc
meg	megohm or 10^6 ohms	Var.	variable
μ	micro or 10^{-6}	w	watt
μμ	micromicro or 10^{-12}	WW	wire wound

GMV guaranteed minimum value

DUAL TRACE PREAMP

Capacitors

C3003	.1 μf	PT	Fixed	600 v	20%	285547
C3013	.01 μf	Cer.	Fixed	250 v	GMV	283003
C3023	.7–3 μμf	Tub.	Var.	500 v		281027
C3033	150 μμf	Cer.	Fixed	500 v	10%	281524
C3223	.005 μf	Cer.	Fixed	500 v	GMV	283001
C3253	47 μμf	Cer.	Fixed	500 v	20%	281518
C3633	.005 μf	Cer.	Fixed	500 v	GMV	283001
C3653	.001 μf	Cer.	Fixed	500 v	GMV	283000
C3673	.001 μf	Cer.	Fixed	500 v	GMV	283000
C3713	47 μμf	Cer.	Fixed	500 v	10%	281519
C3743	12 μμf	Cer.	Fixed	500 v	±1.2 μμf	281506
C3753	12 μμf	Cer.	Fixed	500 v	±1.2 μμf	281506
C3763	47 μμf	Cer.	Fixed	500 v	10%	281519
C4003	.1 μf	PT	Fixed	600 v	20%	285547
C4013	.01 μf	Cer.	Fixed	250 v	GMV	283003
C4023	.7–3 μμf	Tub.	Var.	500 v		281027
C4033	150 μμf	Cer.	Fixed	500 v	10%	281524
C4073	47 μμf	Cer.	Fixed	500 v	20%	281518
C4223	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4503	.01 μf	Cer.	Fixed	500 v	GMV	283002
C4513	.01 μf	Cer.	Fixed	500 v	GMV	283002
C4563	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4573	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4583	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4593	.005 μf	Cer.	Fixed	500 v	GMV	283001

Inductors

L3073	.5–1 μh	Var.	114043
L3083	.75 μh	Fixed	108072
L3253	.5–1 μh	Var.	114043
L3263	.75 μh	Fixed	108072
L3303	.75 μh	Fixed	108072
L3313	.9–1.6 μh	Var.	114051
L3343	.75 μh	Fixed	108072
L3353	.9–1.6 μh	Var.	114051
L3523	Special		114042
L3653	0.3 μh	Fixed	108112
L3673	0.3 μh	Fixed	108112
L4073	.5–1 μh	Var.	114043
L4083	.75 μh	Fixed	108072
L4253	.5–1 μh	Var.	114043
L4263	.75 μh	Fixed	108072

Inductors (Continued)

L4303	.75 μh	Fixed	108072
L4313	.9–1.6 μh	Var.	114051
L4343	.75 μh	Fixed	108072
L4353	.9–1.6 μh	Var.	114051
L4413	Special		114042

Resistors

R3013	1 meg	½ w	Fixed	Prec.	1%		309014
R3023	1 meg	½ w	Fixed	Comp.	10%		302105
R3033	33 Ω	½ w	Fixed	Comp.	10%		302330
R3043	47 Ω	½ w	Fixed	Comp.	10%		302470
R3053	47 Ω	½ w	Fixed	Comp.	10%		302470
R3063	22 k	2 w	Fixed	Comp.	10%		306223
R3083	470 Ω	½ w	Fixed	Comp.	5%		301471
R3093	27 Ω	½ w	Fixed	Comp.	10%		302270
R3113	5.6 k	1 w	Fixed	Comp.	5%		303562
R3123	650 Ω	Special				VARIABLE	311103
R3133	5.6 k	1 w	Fixed	Comp.	5%		303562
R3143	8 k	5 w	Fixed	WW	5%		308053
R3153	10 k	2 w	Var.	WW	20%	GAIN ADJ.	311015
R3213	20 k	2 w	Var.	Comp.	20%	DC BAL.	311018
R3223	22 k	1 w	Fixed	Comp.	10%		304223
R3233	560 Ω	½ w	Fixed	Comp.	10%		302561
R3243	100 k	½ w	Fixed	Comp.	10%		302104
R3263	470 Ω	½ w	Fixed	Comp.	5%		301471
R3303	47 Ω	½ w	Fixed	Comp.	10%		302470
R3313	100 k	½ w	Fixed	Comp.	10%		302104
R3323	2x100 k	2 w	Var.	Comp.	20%	VERTICAL POSITION	311028
R3343	47 Ω	½ w	Fixed	Comp.	10%		302470
R3353	100 k	½ w	Fixed	Comp.	10%		302104
R3503	1.8 k	1 w	Fixed	Comp.	10%		304182
R3513	8.2 k	1 w	Fixed	Comp.	5%		303822
R3523	400 Ω	Special					310518
R3543	100 k	½ w	Fixed	Comp.	10%		302104
R3603A	6 k	5 w	Fixed	WW	5%		308052
R3603B	6 k	5 w	Fixed	WW	5%		308052
R3623	5.6 k	2 w	Fixed	Comp.	10%		306562
R3633	5.6 k	1 w	Fixed	Comp.	10%		304562
R3643	100 k	½ w	Fixed	Comp.	10%		302104
R3653	8.2 k	1 w	Fixed	Comp.	5%		303822
R3663	2x100 k	2 w	Var.	Comp.	20%	Positioning Adj.	311051
R3673	8.2 k	1 w	Fixed	Comp.	5%		303822
R3703	33 k	2 w	Fixed	Comp.	10%		306333
R3713	160 k	½ w	Fixed	Comp.	5%		301164
R3723	220 k	½ w	Fixed	Comp.	10%		302224
R3753	220 k	½ w	Fixed	Comp.	10%		302224
R3763	160 k	½ w	Fixed	Comp.	5%		301164
R3773	33 k	2 w	Fixed	Comp.	10%		306333
R3803	470 Ω	½ w	Fixed	Comp.	10%		302471
R3813	100 Ω	½ w	Fixed	Comp.	10%		302101
R3823	200 k	½ w	Fixed	Comp.	5%		301204
R3853	200 k	½ w	Fixed	Comp.	5%		301204
R3863	100 Ω	½ w	Fixed	Comp.	10%		302101
R3873	470 Ω	½ w	Fixed	Comp.	10%		302471
R3903	4.7 k	½ w	Fixed	Comp.	10%		302472
R3913	100 Ω	½ w	Fixed	Comp.	10%		302101
R3933	68 k	1 w	Fixed	Comp.	10%		304683

Resistors (Continued)

R3963	4.7 k	½ w	Fixed	Comp.	10%		302472
R3973	100 Ω	½ w	Fixed	Comp.	10%		302101
R4013	1 meg	½ w	Fixed	Prec.	1%		309014
R4023	1 meg	½ w	Fixed	Comp.	10%		302105
R4033	33 Ω	½ w	Fixed	Comp.	10%		302330
R4043	47 Ω	½ w	Fixed	Comp.	10%		302470
R4053	47 Ω	½ w	Fixed	Comp.	10%		302470
R4063	22 k	2 w	Fixed	Comp.	10%		306223
R4083	470 Ω	½ w	Fixed	Comp.	5%		301471
R4093	27 Ω	½ w	Fixed	Comp.	10%		302270
R4113	5.6 k	1 w	Fixed	Comp.	5%		303562
R4123	650 Ω	Special				VARIABLE	311103
R4133	5.6 k	1 w	Fixed	Comp.	5%		303562
R4143	8 k	5 w	Fixed	WW	5%		308053
R4153	10 k	2 w	Var.	WW	20%	GAIN ADJ.	311015
R4213	20 k	2 w	Var.	Comp.	20%	DC BAL.	311018
R4223	22 k	1 w	Fixed	Comp.	10%		304223
R4233	560 Ω	½ w	Fixed	Comp.	10%		302561
R4243	100 k	½ w	Fixed	Comp.	10%		302104
R4263	470 Ω	½ w	Fixed	Comp.	5%		301471
R4303	47 Ω	½ w	Fixed	Comp.	10%		302470
R4313	100 k	½ w	Fixed	Comp.	10%		302104
R4323	2x100 k	2 w	Var.	Comp.	20%	VERTICAL POSITION	311028
R4343	47 Ω	½ w	Fixed	Comp.	10%		302470
R4353	100 k	½ w	Fixed	Comp.	10%		302104
R4413	400 Ω	Special					310518
R4433	8.2 k	1 w	Fixed	Comp.	5%		303822
R4503	27 Ω	½ w	Fixed	Comp.	10%		302270
R4513	27 Ω	½ w	Fixed	Comp.	10%		302270
R4523	3 k	5 w	Fixed	WW	5%		308062

Switches

SW3003	2 wafer	9 position	rotary	VOLTS/CM	260146
SW3013	single pole	double throw	slide	AC-DC	260145
SW3083	1 wafer	2 position	rotary	POLARITY	260148
SW3703	1 wafer	4 position	rotary	MODE	260147
SW4003	2 wafer	9 position	rotary	VOLTS/CM	260146
SW4013	single pole	double throw	slide	AC-DC	260145
SW4083	1 wafer	2 position	rotary	POLARITY	260148

Vacuum Tubes

V3053	6AK5	Input C. F.	154014
V3083	12AU6	Input Amplifier	154040
V3263	12AU6	Input Amplifier	154040
V3303	6AU6	Output Amplifier	154022
V3343	6AU6	Output Amplifier	154022
V3503	12AT7	Output C. F.	154039
V3703	12AT7	Switching Multivibrator	154039
V3803	6AL5	Trigger Coupling Diode	154016
V3903	12AT7	Amplifier	154039
V3953	12AT7	Switching C. F.	154039
V4053	6AK5	Input C. F.	154014
V4083	12AU6	Input Amplifier	154040
V4263	12AU6	Input Amplifier	154040
V4303	6AU6	Output Amplifier	154022
V4343	6AU6	Output Amplifier	154022

ABBREVIATIONS

Cer.	ceramic	m	milli or 10^{-3}
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	kilohm or 10^3 ohms	v	working volts dc
meg	megohm or 10^6 ohms	Var.	variable
μ	micro or 10^{-6}	w	watt
μμ	micromicro or 10^{-12}	WW	wire wound

GMV guaranteed minimum value

ATTENUATOR

Capacitors

C4823B	.7–3 μμf	Tub.	Var.	500 v		281027
C4823C	.7–3 μμf	Tub.	Var.	500 v		281027
C4823D	8 μμf	Cer.	Fixed	500 v	±0.5 μμf	281503
C4833B	.7–3 μμf	Tub.	Var.	500 v		281027
C4833C	.7–3 μμf	Tub.	Var.	500 v		281027
C4833D	3.3 μμf	Cer.	Fixed	500 v	¼ μμf	281534
C4833E	3.3 μμf	Cer.	Fixed	500 v	¼ μμf	281534
C4843B	.7–3 μμf	Tub.	Var.	500 v		281027
C4843C	.7–3 μμf	Tub.	Var.	500 v		281027
C4843D	2.2 μμf	Cer.	Fixed	500 v	±0.5 μμf	281500
C4843E	22 μμf	Cer.	Fixed	500 v	10%	281511
C4853B	.7–3 μμf	Tub.	Var.	500 v		281027
C4853C	.7–3 μμf	Tub.	Var.	500 v		281027
C4853E	47 μμf	Cer.	Fixed	500 v	10%	281519
C4863B	.7–3 μμf	Tub.	Var.	500 v		281027
C4863C	.7–3 μμf	Tub.	Var.	500 v		281027
C4863E	47 μμf	Cer.	Fixed	500 v	10%	281519
C4863F	47 μμf	Cer.	Fixed	500 v	10%	281519
C4873A	1 μμf	Cer.	Fixed	500 v	±0.2 μμf	281538
C4873B	.7–3 μμf	Tub.	Var.	500 v		281027
C4873C	.7–3 μμf	Tub.	Var.	500 v		281027
C4873E	250 μμf	Mica	Fixed	500 v	10%	283539
C4883A	1.0 μμf	Cer.	Fixed	500 v	±0.2 μμf	281538
C4883B	.7–3 μμf	Tub.	Var.	500 v		281027
C4883C	.7–3 μμf	Tub.	Var.	500 v		281027
C4883E	500 μμf	Mica	Fixed	500 v	10%	283541
C4893A	1.5 μμf	Cer.	Fixed	500 v	±0.5 μμf	281526
C4893B	.7–3 μμf	Tub.	Var.	500 v		281027
C4893C	.7–3 μμf	Tub.	Var.	500 v		281027
C4893E	750 μμf	Mica	Fixed	500 v	10%	283540
C4923B	.7–3 μμf	Tub.	Var.	500 v		281027
C4923C	.7–3 μμf	Tub.	Var.	500 v		281027
C4923D	10 μμf	Cer.	Fixed	500 v	10%	281504
C4933B	.7–3 μμf	Tub.	Var.	500 v		281027
C4933C	.7–3 μμf	Tub.	Var.	500 v		281027

Capacitors (Continued)

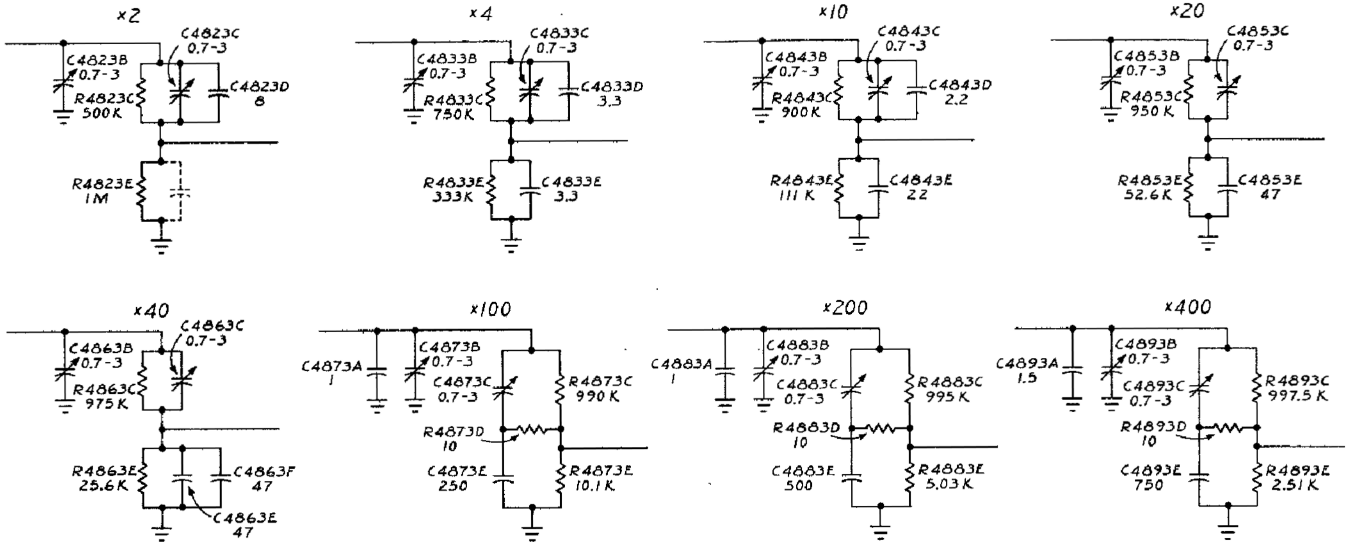
C4933D	3.3 μμf	Cer.	Fixed	500 v	± ¼ μμf	281534
C4933E	3.3 μμf	Cer.	Fixed	500 v	± ¼ μμf	281534
C4943B	.7–3 μμf	Tub.	Var.	500 v		281027
C4943C	.7–3 μμf	Tub.	Var.	500 v		281027
C4943D	2.2 μμf	Cer.	Fixed	500 v	± 0.5 μμf	281500
C4943E	22 μμf	Cer.	Fixed	500 v	10%	281511
C4953B	.7–3 μμf	Tub.	Var.	500 v		281027
C4953C	.7–3 μμf	Tub.	Var.	500 v		281027
C4953E	47 μμf	Cer.	Fixed	500 v	10%	281519
C4963A	1 μμf	Cer.	Fixed	500 v	± 0.2 μμf	281538
C4963B	.7–3 μμf	Tub.	Var.	500 v		281027
C4963C	.7–3 μμf	Tub.	Var.	500 v		281027
C4963E	47 μμf	Cer.	Fixed	500 v	10%	281519
C4963F	47 μμf	Cer.	Fixed	500 v	10%	281519
C4973A	1.5 μμf	Cer.	Fixed	500 v	± 0.5 μμf	281526
C4973B	.7–3 μμf	Tub.	Var.	500 v		281027
C4973C	.7–3 μμf	Tub.	Var.	500 v		281027
C4973E	250 μμf	Mica	Fixed	500 v	10%	283539
C4983A	1.5 μμf	Cer.	Fixed	500 v	± 0.5 μμf	281526
C4983B	.7–3 μμf	Tub.	Var.	500 v		281027
C4983C	.7–3 μμf	Tub.	Var.	500 v		281027
C4983E	500 μμf	Mica	Fixed	500 v	10%	283541
C4993A	2.2 μμf	Cer.	Fixed	500 v	± 0.5 μμf	281500
C4993B	.7–3 μμf	Tub.	Var.	500 v		281027
C4993C	.7–3 μμf	Tub.	Var.	500 v		281027
C4993E	750 μμf	Mica	Fixed	500 v	10%	283540

Resistors

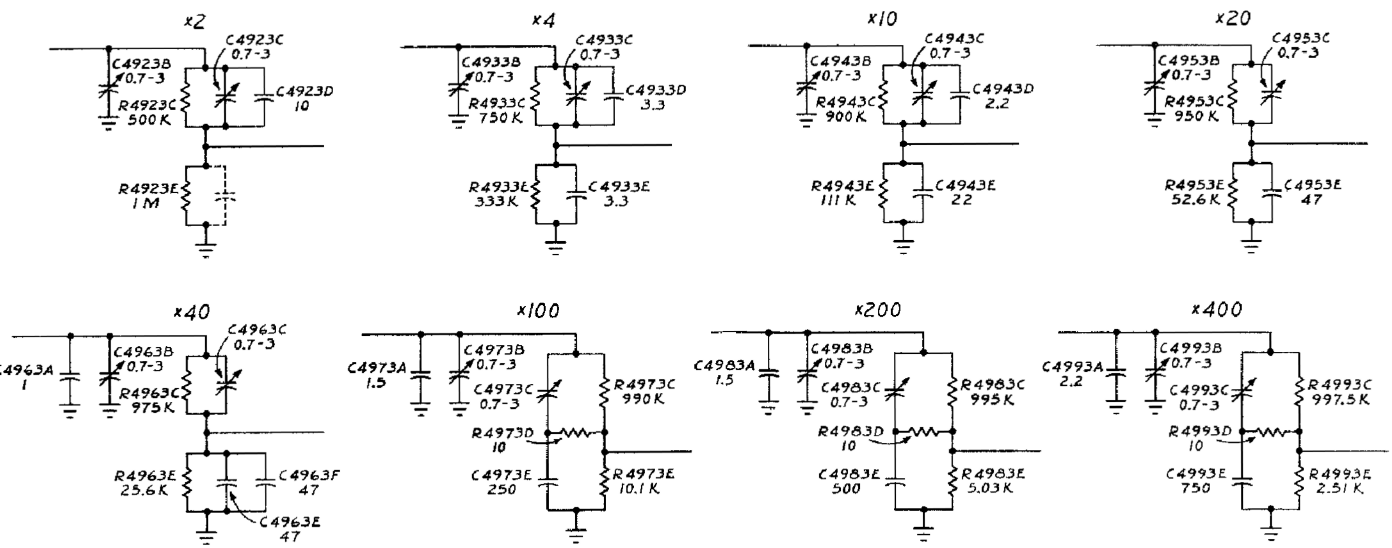
R4823C	500 k	½ w	Fixed	Prec.	1%	309003
R4823E	1 meg	½ w	Fixed	Prec.	1%	309014
R4833C	750 k	½ w	Fixed	Prec.	1%	309010
R4833E	333 k	½ w	Fixed	Prec.	1%	309053
R4843C	900 k	½ w	Fixed	Prec.	1%	309111
R4843E	111 k	½ w	Fixed	Prec.	1%	309046
R4853C	950 k	½ w	Fixed	Prec.	1%	309143
R4853E	52.6 k	½ w	Fixed	Prec.	1%	309137
R4863C	975 k	½ w	Fixed	Prec.	1%	309144
R4863E	25.6 k	½ w	Fixed	Prec.	1%	309136
R4873C	990 k	½ w	Fixed	Prec.	1%	309013
R4873D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4873E	10.1 k	½ w	Fixed	Prec.	1%	309034
R4883C	995 k	½ w	Fixed	Prec.	1%	309146
R4883D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4883E	5.03 k	½ w	Fixed	Prec.	1%	309134
R4893C	997.5 k	½ w	Fixed	Prec.	1%	309147
R4893D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4893E	2.51 k	½ w	Fixed	Prec.	1%	309133
R4923C	500 k	½ w	Fixed	Prec.	1%	309003
R4923E	1 meg	½ w	Fixed	Prec.	1%	309014
R4933C	750 k	½ w	Fixed	Prec.	1%	309010
R4933E	333 k	½ w	Fixed	Prec.	1%	309053

R4943C	900 k	½ w	Fixed	Prec.	1%	309111
R4943E	111 k	½ w	Fixed	Prec.	1%	309046
R4953C	950 k	½ w	Fixed	Prec.	1%	309143
R4953E	52.6 k	½ w	Fixed	Prec.	1%	309137
R4963C	975 k	½ w	Fixed	Prec.	1%	309144
R4963E	25.6 k	½ w	Fixed	Prec.	1%	309136
R4973C	990 k	½ w	Fixed	Prec.	1%	309013
R4973D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4973E	10.1 k	½ w	Fixed	Prec.	1%	309034
R4983C	995 k	½ w	Fixed	Prec.	1%	309146
R4983D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4983E	5.03 k	½ w	Fixed	Prec.	1%	309134
R4993C	997.5 k	½ w	Fixed	Prec.	1%	309147
R4993D	10 Ω	½ w	Fixed	Comp.	10%	302100
R4993E	2.51 k	½ w	Fixed	Prec.	1%	309133

CHANNEL A



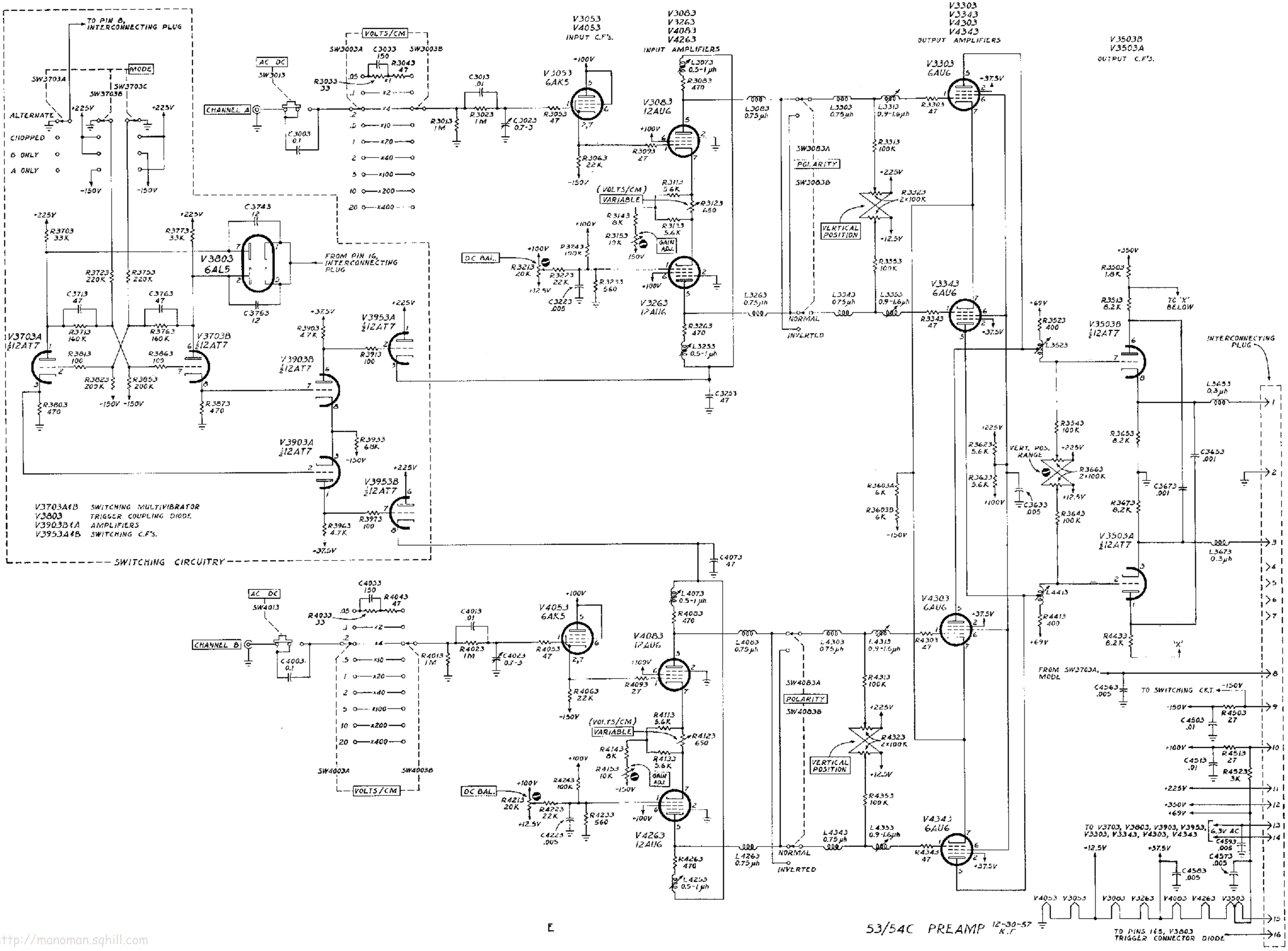
CHANNEL B



C

53/54C ATTENUATION NETWORKS

4-19-57
KF



TO PIN 8, INTERCONNECTING PLUG
MODE
SW3703A
SW3703B
SW3703C
ALTERNATE
CHOPPED
B ONLY
A ONLY
+225V
-150V
V3803
6AL5
FROM PIN 16, INTERCONNECTING PLUG
V3703A ½12AT7
V3703B ½12AT7
V3903A ½12AT7
V3903B ½12AT7
V3953A ½12AT7
V3953B ½12AT7
V3703A&B SWITCHING MULTIVIBRATOR
V3803 TRIGGER COUPLING DIODE
V3903B&A AMPLIFIERS
V3953A&B SWITCHING C.F'S.
SWITCHING CIRCUITRY
AC DC
SW3013
CHANNEL A
VOLTS/CM
SW3003A
SW3003B
V3053
V4053
INPUT C.F'S.
V3053 6AK5
V3083
V3263
V4083
V4263
INPUT AMPLIFIERS
V3083 12AU6
V3263 12AU6
(VOLTS/CM) VARIABLE
GAIN ADJ.
DC BAL.
SW3083A
POLARITY
SW3083B
NORMAL
INVERTED
VERTICAL POSITION
V3303
V3343
V4303
V4343
OUTPUT AMPLIFIERS
V3303 6AU6
V3343 6AU6
V3503B
V3503A
OUTPUT C.F'S.
V3503B ½12AT7
V3503A ½12AT7
TO 'X' BELOW
INTERCONNECTING PLUG
VERT. POS. RANGE
AC DC
SW4013
CHANNEL B
SW4003A
SW4003B
VOLTS/CM
V4053 6AK5
V4083 12AU6
V4263 12AU6
(VOLTS/CM) VARIABLE
GAIN ADJ.
DC BAL.
SW4083A
POLARITY
SW4083B
NORMAL
INVERTED
VERTICAL POSITION
V4303 6AU6
V4343 6AU6
FROM SW3703A, MODE
TO SWITCHING CKT.
TO V3703, V3803, V3903, V3953, V3303, V3343, V4303, V4343
6.3V AC
TO PINS 1&5, V3803 TRIGGER CONNECTOR DIODE
53/54C PREAMP 12-30-57 K.F
E

ABBREVIATIONS USED IN OUR PARTS LISTS

Cer.	ceramic	m	milli
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	thousands of ohms	v	working volts dc
meg	megohms	Var.	variable
μ	micro	w	watt
$\mu\mu$	micromicro	WW	wire wound
GMV	guaranteed minimum value		

ABBREVIATIONS USED IN OUR CIRCUIT DIAGRAMS

Resistance values are in ohms. The symbol k stands for thousands. A resistor marked 2.7 k has a resistance of 2,700 ohms. The symbol M stands for million. For example, a resistor marked 5.6 M has a resistance of 5.6 megohms.

Unless otherwise specified on the circuit diagram, capacitance values marked with the number 1 and numbers greater than 1 are in $\mu\mu$f. For example, a capacitor marked 3.3 would have a capacitance of 3.3 micromicrofarads. Capacitance values marked with a number less than 1 are in μf. For example, a capacitor marked .47 would have a capacitance of .47 microfarads.

Inductance values marked in mh are in millihenrys. Inductance values marked in μh are in microhenrys.

Your instrument **WARRANTY** appears on the reverse side of this sheet.

IMPORTANT

Include the INSTRUMENT TYPE and the above SERIAL NUMBER in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your questions or fill your order with the least delay possible.

WARRANTY

All Tektronix instruments are fully guaranteed against defective materials and workmanship for one year. Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them prepaid (via air if requested) as soon as possible, usually within 24 hours.

Tektronix transformers, manufactured in our own plant, carry an indefinite warranty.