

DUAL-TRACE CALIBRATED PREAMP TYPE CA

INSTRUCTION MANUAL

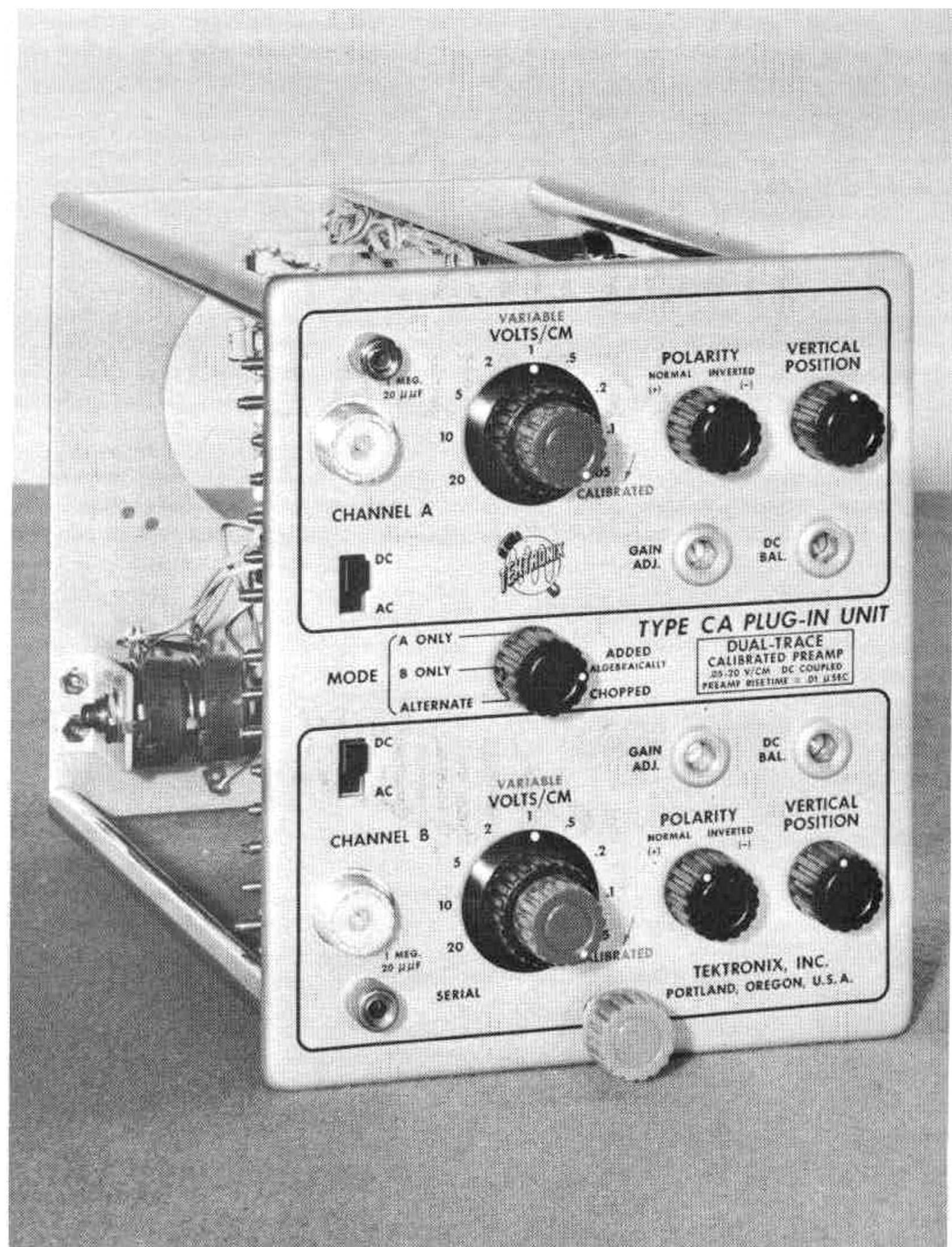


TEKTRONIX, INC.
MANUFACTURERS OF CATHODE-RAY AND VIDEO TEST INSTRUMENTS

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070-014

TYPE CA SERIAL NUMBER 101884



The Type CA Unit

GENERAL DESCRIPTION

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The Type CA 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 μ sec 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 CA 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.

By placing the MODE switch in the ADDED ALGEBRAICALLY position the output of both channels may be combined, adding or subtracting according to the settings of the polarity switches.

TYPE CA SPECIFICATIONS

Operating Modes

Channel A only.

Channel B only.

Electronic switching at 100 kc (chopped).

Electronic switching on alternate sweeps.

Both channels combined at output ($A \pm B$).

With Type 531, 535, 536, risetime 0.035 μ sec., dc to 10 mc.

With Type 532, 0.07 μ sec., dc to 5 mc.

With Type 541, 543, 545, risetime 0.015 μ sec., dc to 24 mc.

With Type 551, risetime 0.016 μ sec., dc to 22 mc.

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.

Input Impedance

1 megohm shunted by 20 μ f; with P410 probe 10 megohms, 7.5 μ f.

Amplifier Transient Response

With Type 533, risetime 0.023 μ sec., to 15 mc.

Physical Characteristics

Construction—Aluminum alloy chassis. Finish—Photo-etched anodized panel. Weight—4 $\frac{1}{2}$ lbs.

FUNCTIONS OF CONTROLS AND CONNECTORS

CHANNEL A. CHANNEL B. Signal input of 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 attenu-

ator dc levels so the trace does not shift position when the attenuation is varied.

MODE. Five position switch to allow either amplifier to be used independently, to provide for switching the two amplifiers at an arbitrary rate, to synchronize the switching with the oscilloscope's sweep, or to provide for adding the outputs of the amplifiers algebraically.



CIRCUIT DESCRIPTION

AMPLIFIERS

The Type CA 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 V3323 (V4323) by way of the AC-DC switch and the VOLTS/CM switch. The AC-DC switch is a two-position slide switch that bypasses C3300 (C4300) in the DC position so the input is dc coupled. In the AC position of this switch the signal must pass thru C3300 (C4300) 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 sensitivity of the unit is .05 volts/cm. The input voltage is reduced by the eight individually selected attenuator sections to give nine fixed calibrated ranges.

Input Stage

The input stage consists of the cathode follower V3323 (V4323) and the cathode-coupled phase inverters V3334 and V3354 (V4334 and V4354). The control-grid dc level of V3334 (V4334) is established by the dc connection to the cathode of V3323 (V4323). The control-grid dc level of V3354 (V4354) is adjustable by means of the DC BAL control so that the dc level of the cathodes of V3334 and V3354 (V4334 and V4354) 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 $2\frac{1}{2}$ 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 V3364 and V3374 (V4364 and V4374) and inverts the displayed waveform. 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 V3364 and V3374 or V4364 and V4374, depending on which channel is conducting. V3364 and V4364 have a common plate load and likewise V3374 and V4374. Since one amplifier is always cut off while the other is conducting, the shunt loading effect is negligible.

V4383 is the output cathode follower that provides a low-impedance source for driving the oscilloscope's vertical amplifier. The VERT. POS. RANGE 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

V3375 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 V3375A is held positive and this half of the multivibrator con-

ducts while the grid of V3375B is held negative and this half is cut off. While V3375A is conducting the cathode is above ground which causes V3384B to conduct and in turn pulls the grid of V3393B toward ground lowering the plate voltage of V4334 and V4354. This reduced plate voltage cuts off the following stage (V4364 and V4374) and the B-channel amplifier is held in a non-conducting state. The converse is true of the A-channel amplifier. The grid of V3384A is near



ground potential and with reduced plate current the plate of V3384A and consequently the grid of V3393A are permitted to become more positive providing plate voltage for V3334 and V3354 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 V3382. 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 repetition rate.

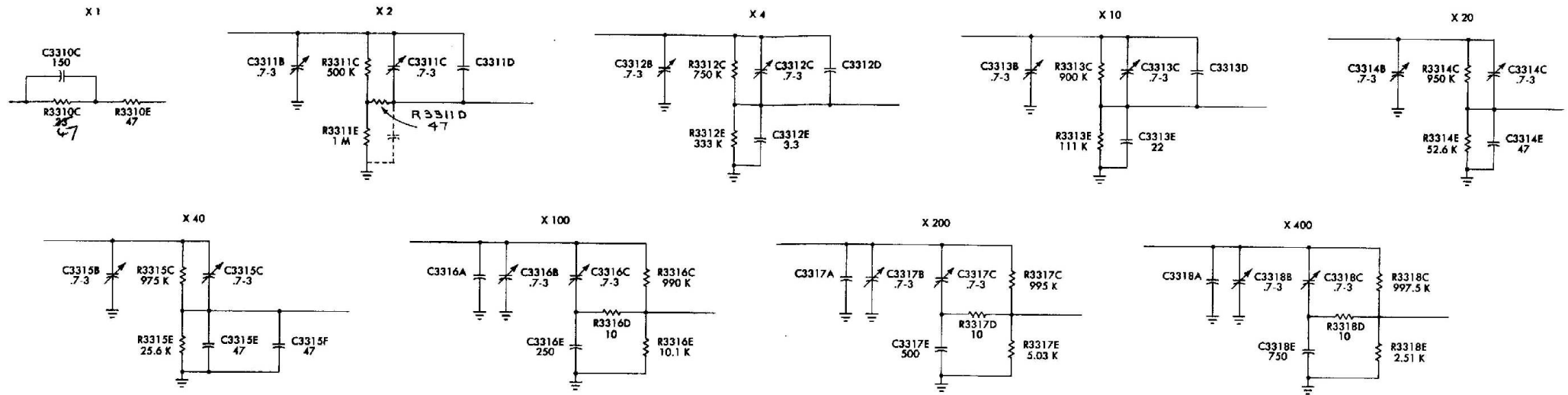
Added Algebraically

Turning the MODE switch to the **ADDED ALGEBRAICALLY** position returns both grids of the multivibrator to -150 volts. Both sides of the multivibrator (V3375) are held sufficiently negative so that incoming triggers have no effect on the multivibrator grids. The cathodes of both halves of the multivibrator follow the grids down, driving V3384A and V3384B to cut off. With V3384A and V3384B cut off the plate voltage rises, carrying the grids of the following stage, V3393A and V3393B with it. The cathodes of V3393A and V3393B follow the grids up. Plate voltage for the input amplifier stages of both channels is supplied by the cathodes of either V3393A or V3393B. When the cathodes are up, both amplifier channels conduct equally in the absence of any signal.

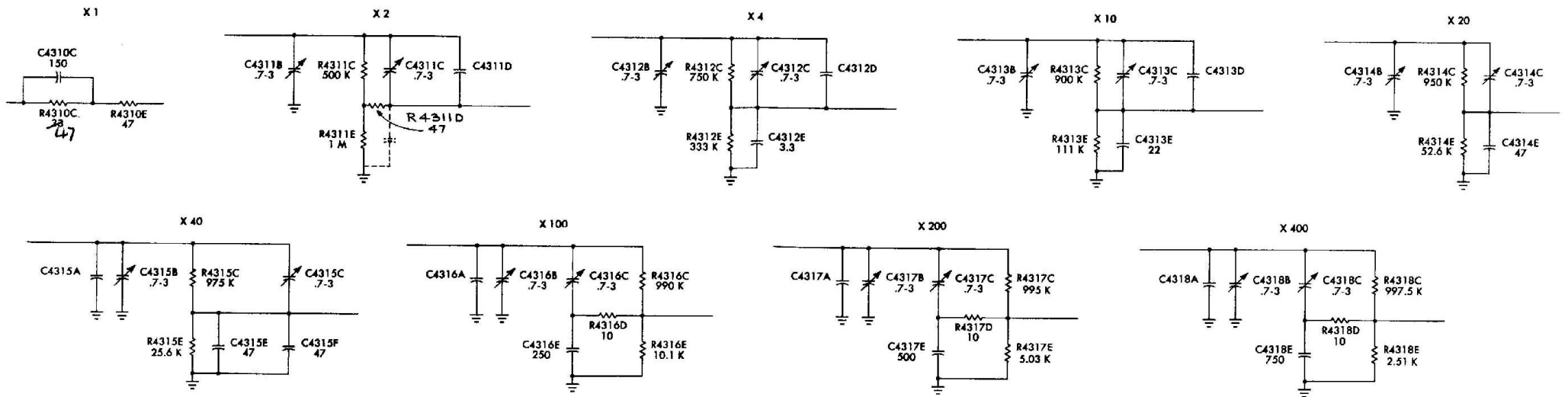
Under the conditions described above signals applied to both inputs will be amplified equally by either channel. Algebraic addition of the signal occurs at the grids of the output stage, V4383. In phase input signals add, out of phase input signals subtract, at the grid of each tube if the polarity switches are at the same setting.



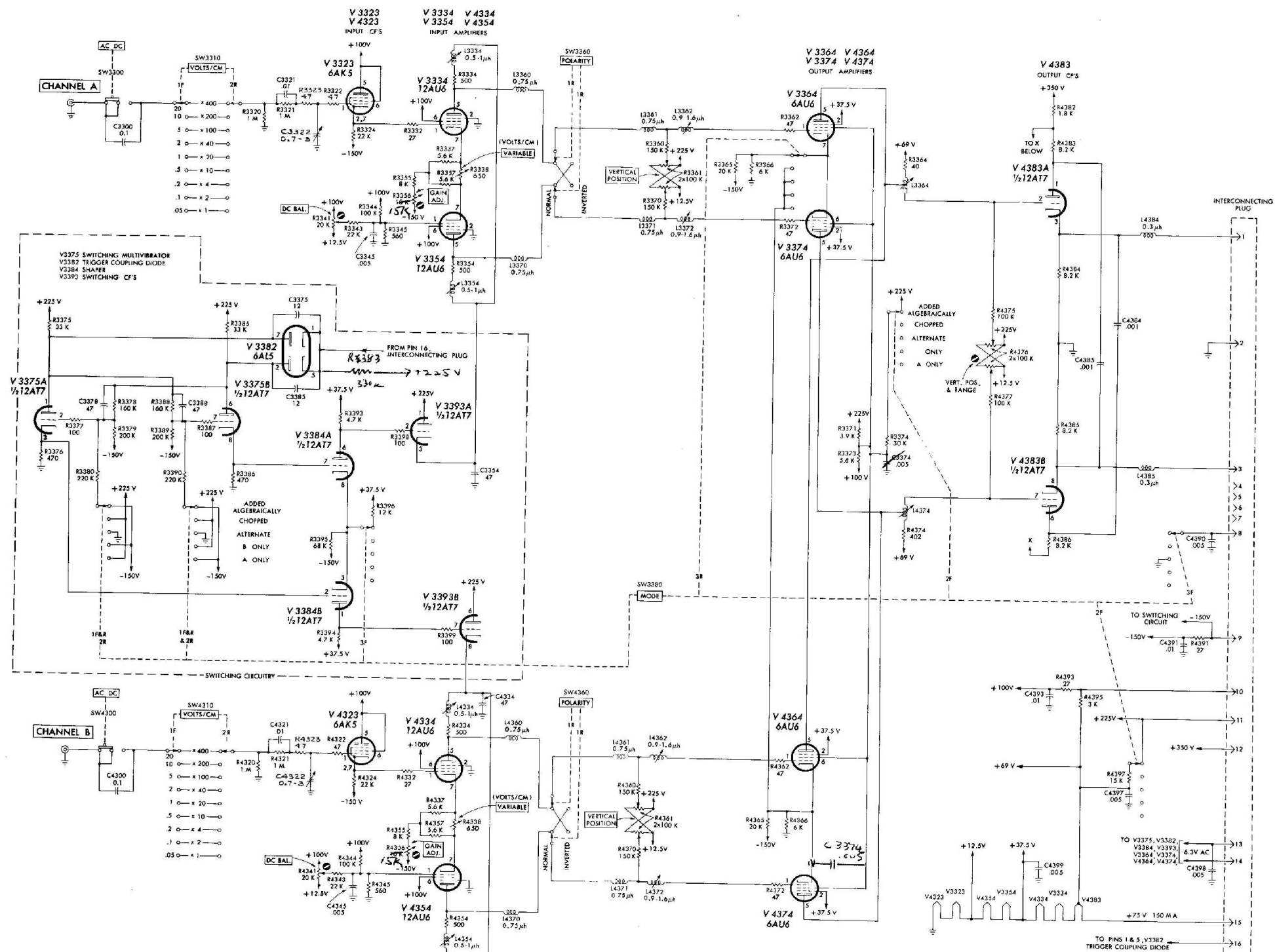
CHANNEL A



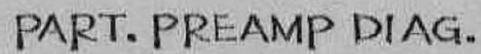
CHANNEL B



PARTS SHOWN WITHOUT VALUES ARE
SELECTED COMPONENTS.
SEE PARTS LIST.



R3383	Add	330 k	1/4 w	Comp.	10%	316-334
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