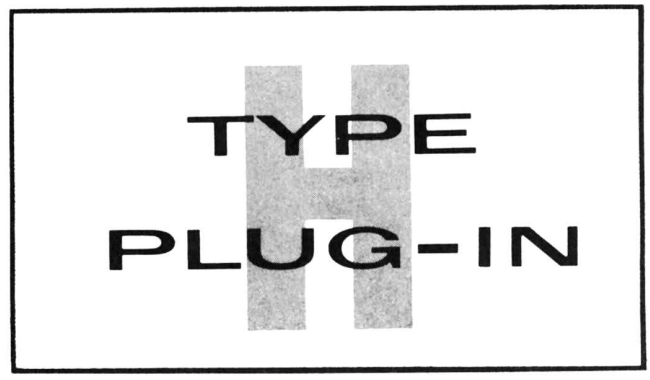
# INSTRUCTION MANUAL

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*Tektronix International A.G.*
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070-272


TYPE H
PLUG-IN UNIT
SERIAL
WIDE-BAND
CALIBRATED PREAMP
VERTICAL
POSITION
INPUT A
GAIN ADJ.
INPUT
SELECTOR
DC
AC
AC
DC
VARIABLE
VOLTS/CM
INPUT B
COARSE
DC
BAL.
FINE
CALIBRATED
TEKTRONIX, INC.
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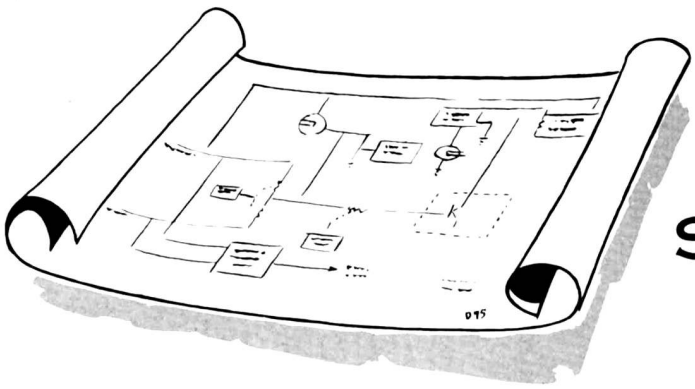
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.



# SECTION 1

# SPECIFICATIONS

The Type H Plug-In Unit is a dc-coupled, high gain, wide-band, calibrated preamplifier, designed for use with Tektronix 530-, 540-, and 550 Series oscilloscopes.

TRANSIENT RESPONSE AND PASSBAND

| | Risetime | Passband | |
|---|---|---|---|
| With Instrument Type | INPUT SELECTOR switch in any position | INPUT SELECTOR switch in either DC position | INPUT SELECTOR switch in either AC position |
| 541/541A<br>543/543A<br>545/545A<br>555 | .023 μsec | DC to 15 Mc | 2 cps to 15 Mc<br>.2 cps to 15 MC with P410 Probe or P6000 Probe |
| 551 | .025 μsec | DC to 14 Mc | 2 cps to 14 Mc<br>.2 cps to 14 MC with P410 Probe or P6000 Probe |
| 531/531A<br>533/533A<br>535/535A | .031 μsec | DC to 11 Mc | 2 cps to 11 Mc<br>.2 cps to 11 Mc with P410 Probe or P6000 Probe |
| 536 | .037 μsec | DC to 9.5 Mc | 2 cps to 9.5 Mc<br>.2 cps to 9.5 Mc with P410 Probe or P6000 Probe |
| 532 | .07 μsec | DC to 5 Mc | 2 cps to 5 Mc<br>.2 cps to 5 mc with P410 Probe or P6000 Probe |

Your instrument was adjusted at the factory for optimum transient response. The above table summarizes the risetime and approximate passbands available when the plug-in is used in combination with various oscilloscopes.

## Deflection Factor

.005 v/cm to 20 v/cm, in twelve fixed calibrated steps.

.005 v/cm to 50 v/cm, continuously variable.

## Step Attenuator (VOLTS/CM Switch)

A front-panel adjustment is provided for setting the gain of the amplifier. When this adjustment is accurately set, with the VOLTS/CM switch in the .005 position, the vertical-deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

## Maximum Allowable Combined DC and Peak AC Input

Voltage: 600 v.

## Input Characteristics

Input of plug-in unit: 1 megohm shunted by 47 $\mu\mu$f.

Input of Type P6000 Probe: 10 megohm shunted by 11.5 $\mu\mu$f.

Input of Type P6017 Probe: 10 megohm shunted by 14 $\mu\mu$f.

Input of Type P410 Probe: 10 megohm shunted by 8$\mu\mu$f.

## Mechanical

Construction: Aluminum-alloy chassis.
Finish: Photoetched, anodized panel.
Weight: 3 1/2 lbs.

## Front-Panel Controls

THE GAIN ADJ. CONTROL is a screwdriver front-panel control for setting the gain of the plug-in unit and thereby the calibration of the VOLTS/CM switch.

THE INPUT SELECTOR SWITCH is a 4-position switch to select AC or DC coupling from either input connector.

THE INPUT CONNECTORS (Input A, Input B,) coaxial connections for accepting waveforms to be displayed on the oscilloscope screen.

THE DC BALANCE CONTROLS (COARSE and FINE) are front-panel screwdriver controls to be adjusted by the operator to prevent a vertical shift in the crt displays when the VARIABLE CONTROL is rotated.

THE VERTICAL POSITION CONTROL is used to position the trace vertically on the face of the oscilloscope screen.

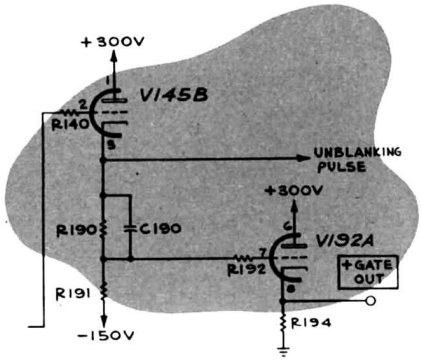
THE VOLTS/CM SWITCH provides fixed calibrated vertical-deflection factors when the associated VARIABLE control is set to CALIBRATED. The VARIABLE control provides continuously variable (uncalibrated) vertical deflection factors between those provided on the VOLTS/CM switch.

## Accessories

2-Instruction Manuals.

# SECTION 3

# CIRCUIT DESCRIPTION




The Type H Plug-In Unit is a wide-band, fast-rise preamplifier with dc-coupling over its full sensitivity range. It provides a maximum deflection factor of 5 mv/cm, dc-coupled, with excellent transient response, and may be used with any Tektronix 530-, 540-, or 550-Series oscilloscope. It consists of two stages of push-pull amplification, each followed by a cathode-follower.

## Input Circuit

The Type H Preamplifier Plug-In Unit requires an input-signal voltage of .005 volts, peak-to-peak, to produce one centimeter of calibrated deflection on the crt of the oscilloscope. To satisfy this condition, yet make the unit applicable to larger input voltages, a precision attenuation network is employed ahead of the amplifier circuits.

When the VOLTS/CM SWITCH is in the .005 position, the signal is coupled " straight through" (that is, without attenuation) to the grid of V3854, one-half of the Input Amplifier stage. For settings of the VOLTS/CM switch between .01 and 20, the Attenuators are switched into the circuit so that the input signal voltage to the Input Amplifier is always .005 v for each centimeter of crt deflection when the VARIABLE knob is in the CALIBRATED position.

The Attenuators are frequency-compensated voltage dividers. For dc and low-frequency signals they are resistance dividers, and the degree of attenuation is determined by the resistance values. The impedance of the capacitors, at dc and low frequencies, is so high that their effect in the circuit is negligible. As the frequency of the input signals increases, however, the impedance of the capacitors decreases and their effect in the circuit becomes pronounced. For high-frequency signals the impedance of the capacitors is so low, compared to the resistance of the circuit, that the Attenuators become capacitance dividers.

In addition to providing the proper degree of attenuation, the resistance values of the Attenuators are chosen so as to provide the same input resistance (1 megohm) regardless of the setting of the VOLTS/CM switch. Moreover, the variable capacitor, at the input to each Attenuator, provides a means of adjusting the input capacitance so that it is also the same value (47 picofarads) for all settings of the switch.

Two INPUT connectors, with more than 60-db isolation between them, are provided on the Type H Plug-In Unit. By means of the INPUT SELECTOR switch, either connector (INPUT A or INPUT B) can be switched into the circuit. In addition either INPUT connector can be ac- or dc-coupled to the Attenuator circuits, depending on the setting of the INPUT SELECTOR switch. In the AC positions of the switch, the signal is coupled through capacitors. In the DC positions the coupling capacitor is bypassed with a direct connection.

## Input Amplifier

The Input Amplifier (V3854-V4854) is a cathode-coupled phase inverter stage. That is, it converts a single-ended input signal to a push-pull output signal. The input signal is applied to the grid of V3854. R3846 is the input grid resistor. (This resistor becomes a part of each attenuation network when the VOLTS/CM switch is turned away from the .005 position). R3850, bypassed by C3850, prevents the grid from drawing excessive current (in the event the stage is overdriven) when DC input-coupling is used. R3851 is a suppressor for parasitic oscillations.

The time constant network R3855, R3856 and C3855, located in the cathode circuit of

V3854, compensates for the tendency of cascaded amplifiers to produce a rolloff at the leading corner of fast-rise pulses. R3856 provides compensation for optimum results.

V4854 operates as a grounded-grid amplifier; its input signal is developed across the cathode resistors R3857-R3858. The signal produced at the plate of V4854 is equal in amplitude, but opposite in polarity, to the signal developed at the plate of V3854. Hence, a push-pull output signal is produced in the plate circuit of the Input Amplifier Stage.

In addition to furnishing one-half of the push-pull output signal from the Input Amplifier stage, V4854 also couples a manually adjustable dc voltage from the DC BAL controls to the grid of V3863B. The function of this dc voltage will be explained a bit later.

The peaking coils in both plate circuits of the Input Amplifier compensate the stage for the high-frequency attenuation produced by the tube and stray capacitance in the circuit. The variable inductors (L3853-L4853) provide a means for adjusting the stage for optimum transient response.

The first C.F. stage, V3863, serves two important functions: The grid circuits present a high-impedance, low-capacitance load to the Input Amplifier; the cathode circuits provide the necessary low-impedance to drive the input capacitance of the Output Amplifier. The interstage peaking coils, L3871 and L4871, provide peaking for the leading edge of fast vertical signals.

## Output Amplifier

The Output Amplifier stage (V3874-V4874) contains two gain adjustments. The VARIABLE control R3878 (front-panel adjustment) regulates the gain over a 2 1/2 to 1 range by varying the degeneration in the cathode circuit. The GAIN ADJ. R3880 (screw-driver adjustment) varies the current flowing through the tubes. This varies the transconductance of the tubes and thus regulates the gain. The GAIN ADJ. control is adjusted so that the amount of crt deflection agrees with the setting of the VOLTS/CM switch, when the VARIABLE knob is turned full right (CW) to the CALIBRATED position.

In order that there will be no vertical shift of the crt beam as the VARIABLE control is adjusted, the voltages at the cathodes of the Output Amplifier must remain equal and constant. When the VARIABLE control is turned full right to the CALIBRATED position there is zero resistance between the two cathodes, and the cathode voltages will of course be equal. As the control is turned away from the CALIBRATED position, however, the resistance between the two cathodes will increase. If no provisions were made to insure that the cathode voltages remain constant, the added resistance could produce a difference in potential between the two cathodes which would result in a vertical shift of the crt beam. By means of the DC BAL. controls, however, the voltage at the cathode of V4874 can be adjusted to equal the voltage at the cathode of V3874, when the VARIABLE control is adjusted for maximum resistance. The DC BAL. controls comprised of R4832 and R4831 (COARSE), R4834 and R4835 (FINE), together with R4841 and R4842, form a divider to set the voltage at the grid of V4854. This dc voltage is coupled through the cathode follower V3863B to the grid, and then to the cathode of V4874. When these controls are properly adjusted, the cathodes of the Output Amplifier will remain at the same potential as the VARIABLE control is rotated, and no vertical shift of the crt beam will result.

(Note: The DC BAL. controls are actually used to balance the entire vertical deflection system in the oscilloscope. Their precise function is to insure that the dc potential between the vertical deflection plates does not vary as the VARIABLE control is rotated through its range. However, if the main Vertical Amplifier in the oscilloscope, and the Output C.F. in the plug-in unit are in the proper state of balance, the DC BAL. controls may be adjusted so that the potentials at the cathodes of the Output Amplifier remain equal and constant as the VARIABLE control is rotated.)

Additional high-frequency compensation occurs in the plate circuits of the Output Amplifier. A fixed amount of compensation is provided by L3873 and L3891 in one plate circuit, and by L4873 and L4891 in the other. The variable inductors L3874 and L4874, and the variable capacitors C3873 and C4873, provide a means for adjusting the compensation for optimum results.

Vertical positioning of the crt beam is accomplished through the action of the VERTICAL POSITION control R3885 (front-panel adjustment) and the VERT. POS. RANGE control R3886 (screwdriver adjustment). These control circuits are identical, so a description of one will be applicable to the other. The VERT. POS. RANGE control is a dual control, connected between +225 v and ground. It is connected electrically so that as the voltage between ground and the movable arm in one increases, the voltage between ground and the movable arm in the other decreases. The voltage at each arm of the control can vary a maximum of 225 volts, as the control is adjusted. This 225-volt variation is attenuated by a factor of 330 to 1.6 (the ratio of R3887 to R3874 on one side, and the ratio of R4887 to R4874 on the other) so that the maximum variation in voltage at the grids of V3893 is about 1 volt. This change in grid voltage at the Output C.F. stage will be reflected as a change in vertical deflection-plate voltage at the crt, since direct coupling is used between these two points. The VERT. POS. RANGE control is adjusted to center the crt beam vertically when the VERTICAL POSITION control is set to midscale.

The Output C.F. stage operates much the same as the First C.F. stage. That is, it provides a high-impedance, low-capacitance load to the Output Amplifier, and provides the necessary low impedance to drive the capacitance of the Interconnecting Plug and the input capacitance of the main Vertical Amplifier in the oscilloscope.

There is additional "leading edge" peaking in this stage. Peaking coils L3896 and L4896 form a series-resonant circuit, in their respective circuits, with the stray capacitance. These series circuits are damped by the cathode impedance of each side of V3893. Due to the fairly large cathode resistors employed (9.1K), the cathode impedance is approximately equal to the reciprocal of the transconductance of the tube (1/Gm). By varying the current through the tube, the H.F. PEAKING control (R3897) can vary the transconductance, thereby varying the effect of the peaking circuits. Cross-coupling capacitors C3894 and C4894 also contribute to the high-frequency response of the stage. These capacitors tend to provide a 180-degree phase differential between the signals developed in the cathode circuit, even though the grid signals may not be 180 degrees out of phase.

## Heater Circuit

The heaters in the Type H Plug-In Unit are supplied with direct current from the +100-volt regulated supply. This prevents the possibility of 60-cycle cathode modulation, which might result if the heaters were supplied with alternating current.

Power for the heater circuit (+75 v at 150 ma) is obtained from pin 15 of the Interconnecting Plug. The manner in which this power is obtained from the +100-volt regulator is shown in Fig. 3-1. For those instruments employing Delaying Sweep, the heaters of two of the tubes in the Delaying Sweep Generator are connected in series with the heater circuit of the Plug-In unit to provide the necessary 25-volt drop. In those instruments employing only one Sweep Generator, a resistor connected between the heater string and the +100-volt bus provides the necessary drop.

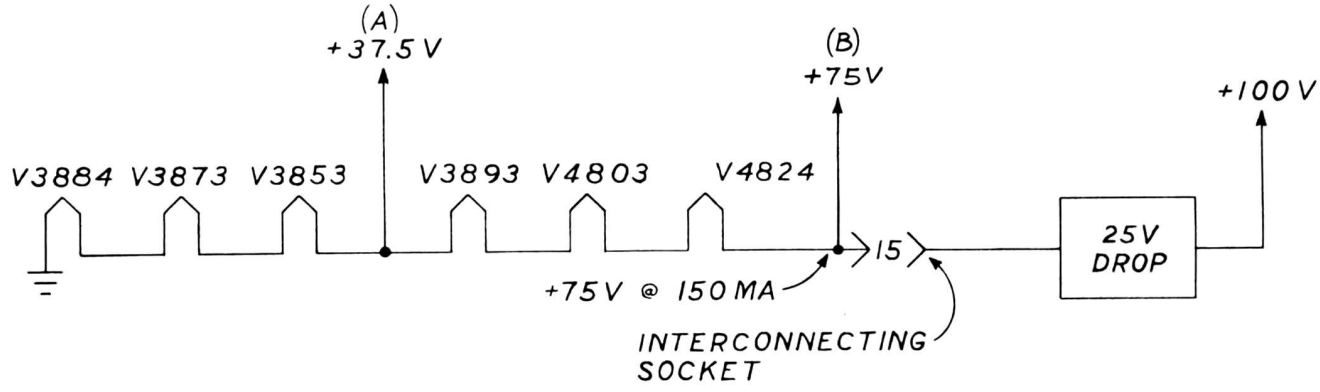



Fig. 3-1. Heater Circuit.

The heater circuit also provides a constant voltage source for the amplifier tubes; point (A) provides +37.5 volts for the plate circuit of the Input Amplifier, and point (B) provides +75 volts for the plate circuit of the Output Amplifier. The heater circuit does not supply any current for the amplifier tubes; it simply acts as a low-impedance divider to "fix" the voltage at points (A) and (B).

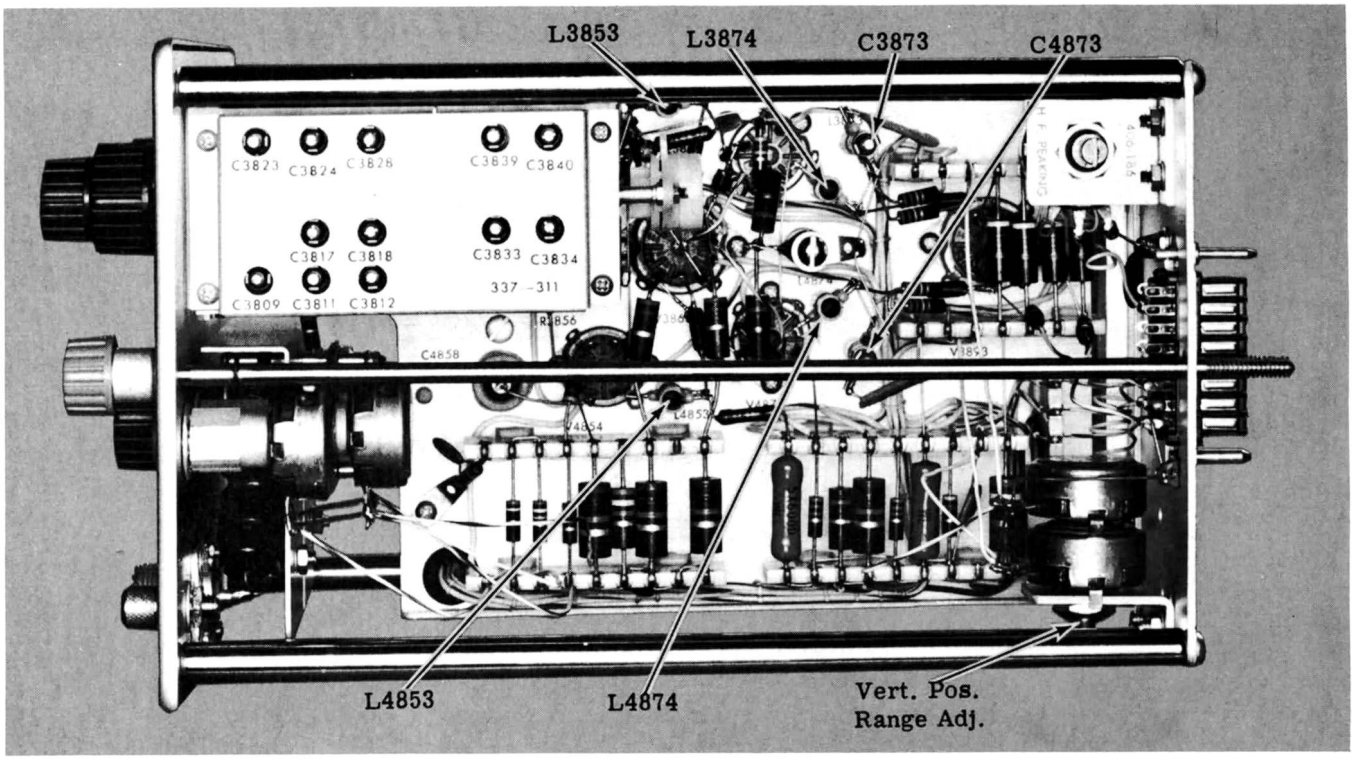



Fig. 5-6. Bottom view of Type H Unit (SN 1790-10,000) showing the location of adjustments.

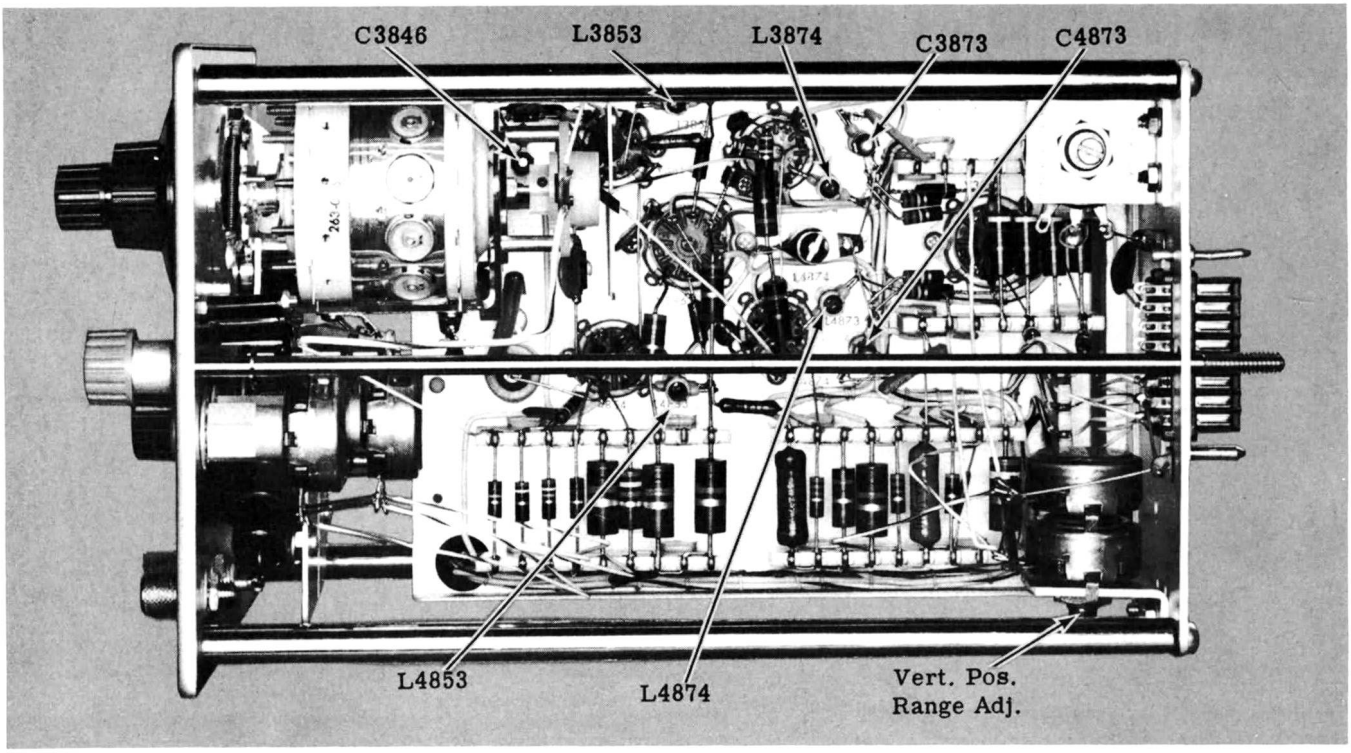



Fig. 5-7. Bottom view of Type H Unit (SN 10,001-10,769) showing the location of the turret and components.

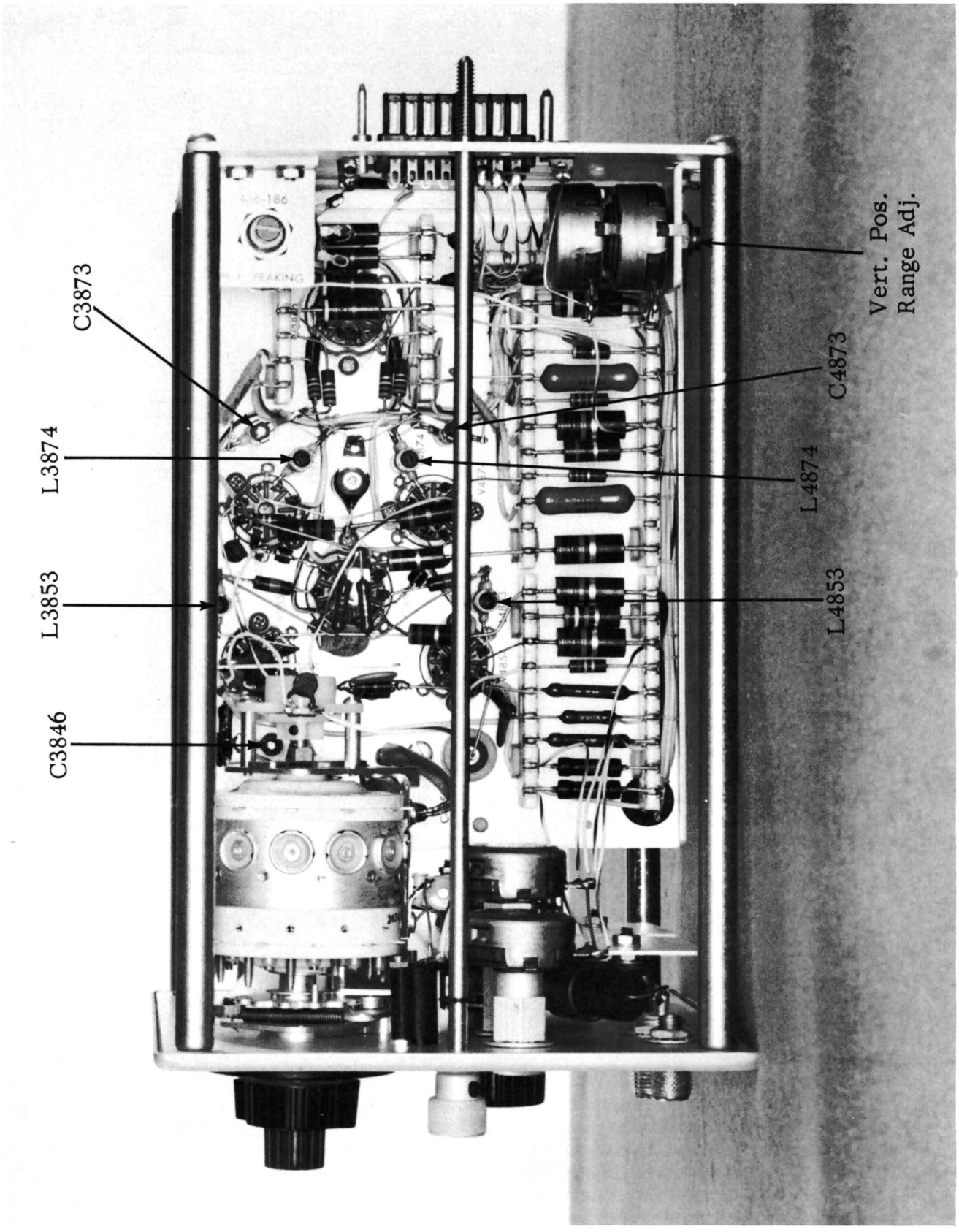
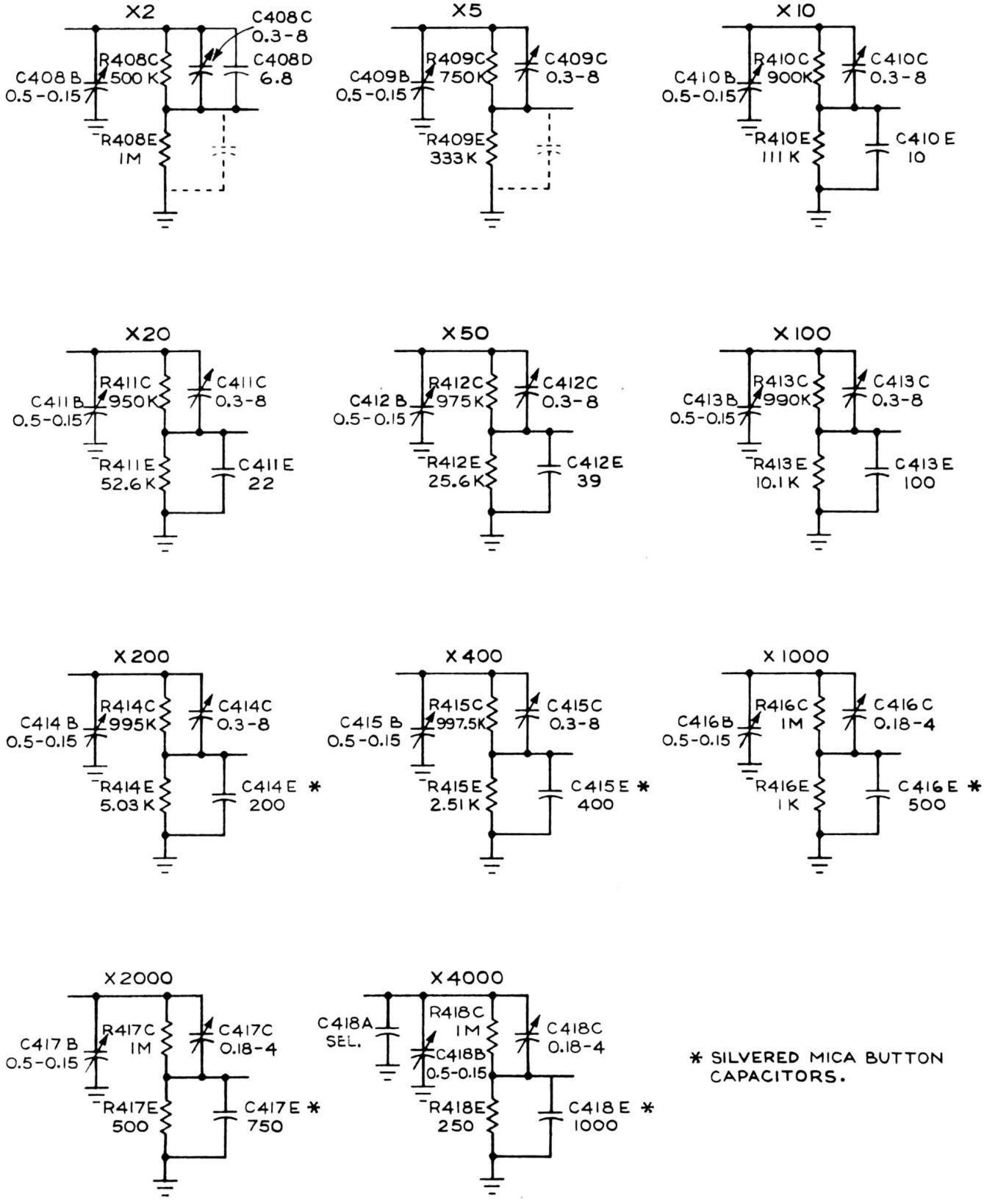



Fig. 5-8. Bottom view of Type H Unit (SN 10,770-up) showing the location of the turret and components.

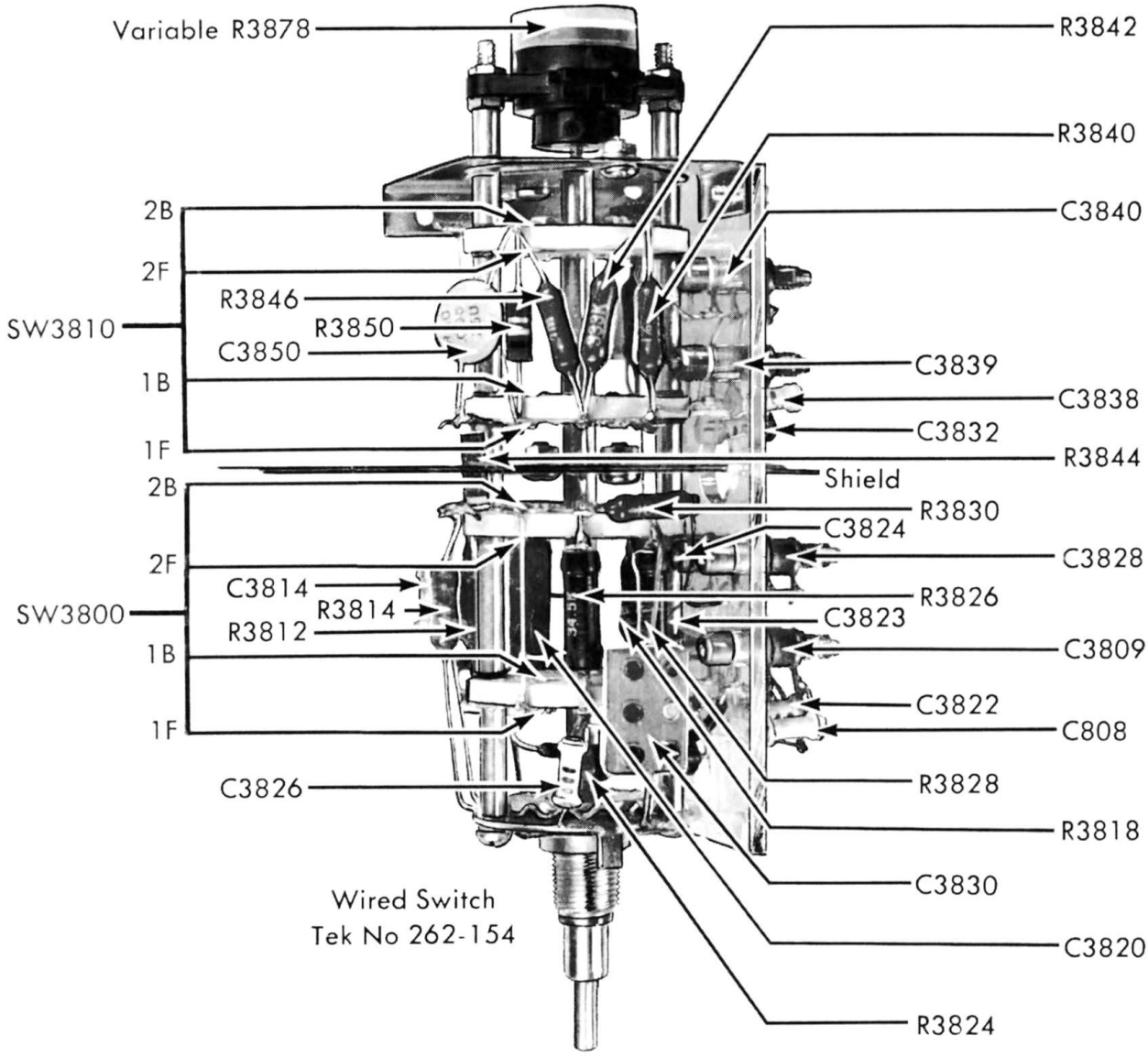



* SILVERED MICA BUTTON CAPACITORS.

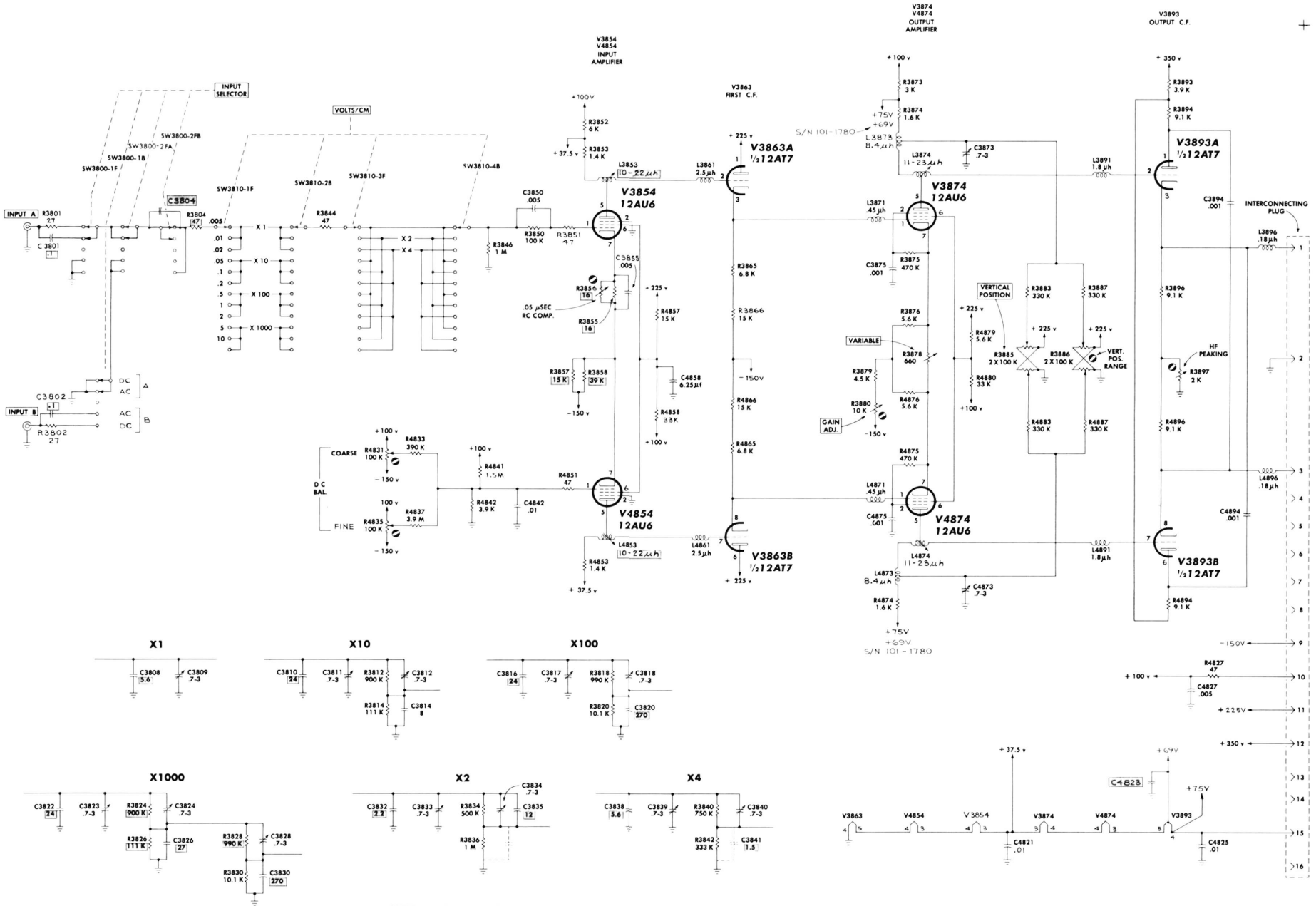
AC

# H TURRET ATTENUATOR

S/N 10,001 -UP




**VOLTS/CM SWITCH AND VARIABLE CONTROL**

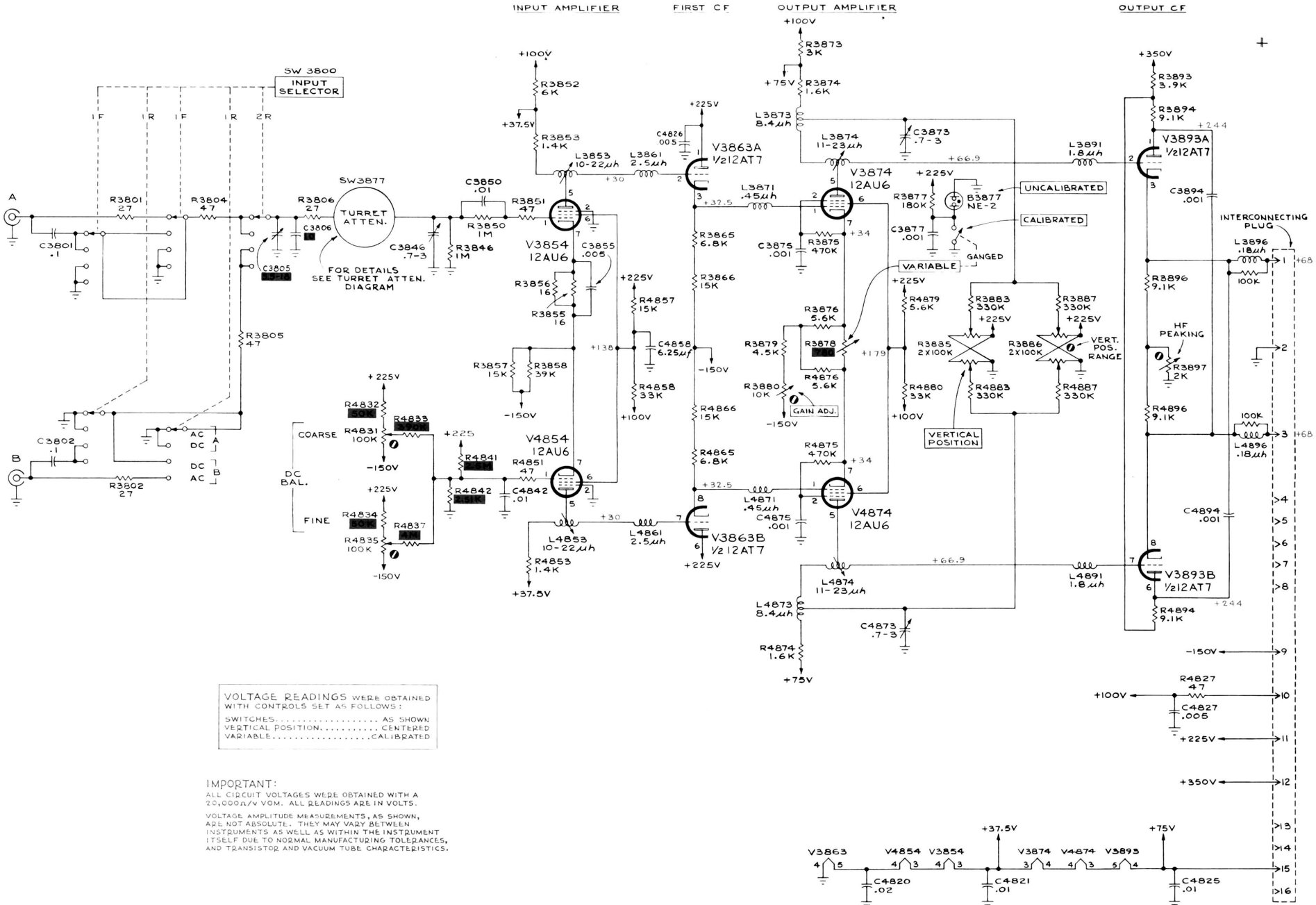



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED [ ]

2 - 16 - 61

TYPE H PREAMP

S/N 101 - 10,000


INPUT AMPLIFIER
FIRST CF
OUTPUT AMPLIFIER
OUTPUT CF
SW 3800
INPUT SELECTOR
1F 1R 1F 1R 2R
SW3877
TURRET ATTEN.
FOR DETAILS SEE TURRET ATTEN. DIAGRAM
V3854 12AU6
V4854 12AU6
V3863A 1/2 12AT7
V3863B 1/2 12AT7
V3874 12AU6
V4874 12AU6
V3893A 1/2 12AT7
V3893B 1/2 12AT7
UNCALIBRATED
CALIBRATED
VARIABLE
GANGED
B3877 NE-2
GAIN ADJ.
VERTICAL POSITION
VERT. POS. RANGE
HF PEAKING
INTERCONNECTING PLUG
COARSE
FINE
DC BAL.
AC DC A
DC AC B
+100V
+225V
+350V
+75V
+37.5V
-150V
+34
+32.5
+30
+66.9
+244
+138
+179
+68
VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
SWITCHES..... AS SHOWN
VERTICAL POSITION..... CENTERED
VARIABLE..... CALIBRATED
IMPORTANT:
ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.
VOLTAGE AMPLITUDE MEASUREMENTS, AS SHOWN, ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES, AND TRANSISTOR AND VACUUM TUBE CHARACTERISTICS.
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH RED TINT BLOCKS
AD5
MRH
10-12-61
TYPE H PREAMP
S/N 10,001-UP

TYPE H PLUG-IN
MOD 6491 (1)

| | | | | |
|---|---|---|---|---|
| V3854<br>V4854 | Change to | 12AU6 | Selected Pair | 157-076 |
| V3874<br>V4874 | Change to | 12AU6 | Selected Pair | 157-078 |