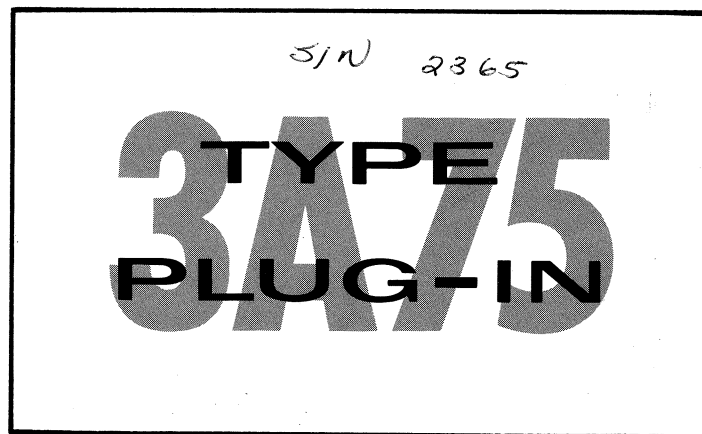


INSTRUCTION MANUAL

Serial Number 2365

PRIOR TO SERIAL NUMBER 1120 THE TYPE 3A75 WAS REFERRED TO AS TYPE 75. The 3A75 Plug-in is interchangeable with the 75 and this manual also applies to the type 75 as far as operation and calibration are concerned.



Tektronix, Inc.

S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix

Tektronix International A.G.

Terrassenweg 1A • Zug, Switzerland • PH. 042-49192 • Cable: Tekintag, Zug Switzerland • Telex 53.574

070-275

Copyright © 1961. New material copy-
right © 1962 by Tektronix, Inc., Beaverton,
Oregon. Printed in the United States of
America. All rights reserved. Contents of
this publication may not be reproduced in
any form without permission of the copy-
right owner.



WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.



Fig. 1. Type 3A75 Amplifier

TYPE 3A75 AMPLIFIER

INTRODUCTION

The Tektronix Type 3A75 Amplifier is a wide-band amplifier designed for use with the Tektronix Type 561 and Type 565 Oscilloscopes. It has a bandpass of dc to 4 megacycles (risetime of approximately 90 nanoseconds). Sensitivity is

variable in nine calibrated steps from 0.05 volt per division to 20 volts per division, and is continuously variable (uncalibrated) between steps and to about 50 volts per division. Accuracy is within 3% at each of the calibrated steps. The input impedance of the module is one megohm paralleled by 47 picofarads at all sensitivity settings.

Operating Instructions

Throughout the instructions that follow, it is assumed, unless otherwise noted, that the Type 3A75 is inserted in the left-hand (Y-axis) opening of a Type 561 Oscilloscope, or in either opening of a Type 565 Oscilloscope, thereby providing vertical deflection of the oscilloscope trace. If it is inserted in the right-hand (X-axis) opening of the Type 561 Oscilloscope, it will provide horizontal deflection of the trace and the instructions must be interpreted accordingly. It is further assumed that there is a time-base module in the X-axis opening of a Type 561 Oscilloscope.

Signal Connections

The signal to be displayed is applied to the INPUT connector on the front panel of the module. For best results, the signal should be applied through a shielded cable, with the shield connected to the chassis of both the oscilloscope and the signal source. When displaying high-frequency signals, it may also be necessary to terminate the shielded cable in its characteristic impedance to prevent resonance effects and "ringing" (high-frequency damped oscillations). All leads should be kept as short as possible, especially in high-frequency work.

High-impedance attenuator probes are available for use with the Type 3A75 Amplifier. These probes reduce the resistive and capacitive loading effect of the amplifier and, at the same time, attenuate the signal to allow display of larger signals than would otherwise be possible. These probes and other accessories are described in the Accessories section of the oscilloscope manual.

Input Coupling Selection

If it is desired to display both the ac and dc components of a signal, place the AC-DC-GND. switch in the DC position. In this case, the position of the trace at any instant is a function of the instantaneous signal voltage with respect to ground.

If you wish to display a relatively small ac signal which is riding on top of a relatively large dc signal, place the AC-DC-GND. switch in the AC position. Then the dc component is blocked by a capacitor in the input circuit, and only the ac component will be displayed. However, when the AC-DC-GND. switch is in the AC position, the lower frequency limit (3-db point) of the amplifier is about 2 cps (0.2 cps if you are using a 10X attenuator probe). Therefore, some low-frequency distortion and loss of amplitude will occur if you display signals with frequency components below this frequency. (This distortion will be noted if you

display the 60-cps calibrator signal without an attenuator probe when the AC-DC-GND. switch is in the AC position.)

Placing the AC-DC-GND. switch in the GND. position grounds the input of the amplifier in the module; it does not ground the applied signal.

Displaying a Signal

To display a signal with the Type 3A75 Amplifier, proceed as follows:

1. Apply the signal, preferably through a shielded cable or an attenuator probe, to the INPUT connector.
2. Establish a common ground between the chassis of the oscilloscope and the signal source. This can be done by connecting the ground clip of a Tektronix attenuator probe to signal ground.
3. Set the AC-DC-GND. switch as desired, in accordance with the previous discussion on Input Coupling Selection.
4. Adjust the time-base controls to obtain a stable display of the signal.
5. Set the VOLTS/DIV. switch and the POSITION control so that the display is placed as desired on the graticule.

Probe Compensation

If an attenuator probe is used, its capacitance must be compensated to that of the module for best signal response. To compensate a Tektronix attenuator probe, proceed as follows:

1. Display several cycles of the oscilloscope Calibrator signal on the screen, using the attenuator probe.
2. Adjust the variable capacitor in the body of the probe for best square-wave response as shown in Fig. 2, center.

Gain and DC Balance Adjustments

Any time you move the Type 3A75 Amplifier from one oscilloscope opening to another you must adjust the gain to compensate for differences in deflection plate sensitivities. This may also need to be done if you change the module in the other opening, since the differences in average deflection plate voltages between modules affects the overall deflection sensitivity of the crt. To properly set the gain of the Type 3A75 Amplifier, proceed as follows:

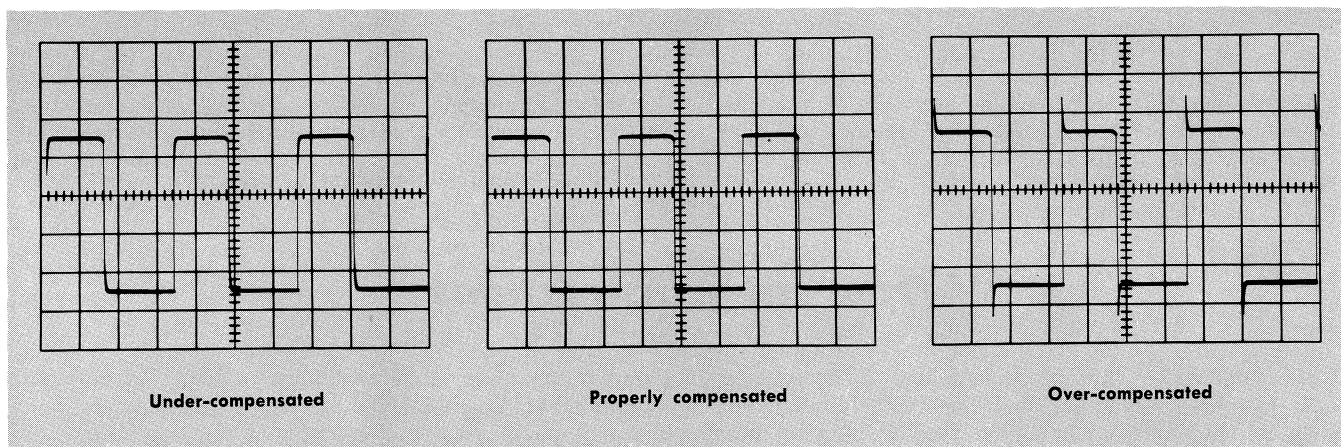


Fig. 2. Probe compensation waveforms.

1. Set the AC-DC-GND. switch to DC, the VOLTS/DIV. switch to .05, and the VARIABLE control fully clockwise (to the CALIBRATED position).

2. Apply a 0.2-volt Calibrator signal and adjust the front-panel GAIN ADJ. adjustment for a deflection of exactly 4 graticule divisions on the screen; or, display a 0.1-volt Calibrator signal and adjust the front-panel GAIN ADJ. adjustment for a deflection of exactly two graticule divisions. (The former is preferred, but the Type 565 Oscilloscope Calibrator does not produce a 0.2-volt signal.)

If the dc balance of the module is not properly set, the position of the trace will shift as the VARIABLE control is rotated. To properly adjust the dc balance of the Type 3A75, proceed as follows:

1. Set the AC-DC-GND. switch to GND.
2. Set the time-base controls to produce a free-running trace on the screen of the oscilloscope.
3. With the POSITION control of the Type 3A75, position the trace to the center of the graticule.
4. Set the DC BAL. adjustment to the point where there is no movement of the trace as the VARIABLE control is rotated back and forth between the ends of its range.

Voltage Measurements

NOTE

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

To measure the potential difference between two points on a signal (such as peak-to-peak ac volts), measure the vertical distance, in graticule divisions, between the two points and multiply by the setting of the VOLTS/DIV. switch and the attenuation factor, if any, of the probe. Make sure the VARIABLE control is set fully clockwise (to the CALIBRATED position).

To measure the dc level at a given point on a waveform, proceed as follows:

1. Set the AC-DC-GND. switch to GND. Make sure the VARIABLE control is set fully clockwise (to the CALIBRATED position).

2. Position a free-running trace so that it lies along one of the horizontal graticule lines. This line will be used as a ground reference line. If the voltage you plan to measure is positive, set the ground reference line toward the bottom of the graticule; if the voltage you plan to measure is negative, set it toward the top of the graticule. Do not adjust the POSITION control of the Type 3A75 after the reference line has been established.

3. Set the AC-DC-GND. switch to DC. (If the position of the trace shifts by more than 1 minor graticule division, see Troubleshooting, "DC Reference Level Shift.")

4. Apply the signal to the INPUT and adjust the time-base controls to obtain a stable display.

5. Measure the distance, in graticule divisions, from the ground reference line established in step 2 to the point you wish to measure.

6. Multiply this distance by the setting of the VOLTS/DIV. switch and the attenuation factor, if any, of the probe. This is the dc level of the point measured.

You can reestablish your ground reference line at any time merely by placing the AC-DC-GND. switch to GND. and setting the time-base controls for a free-running trace; you do not need to disconnect the probe from the signal source. If desired, you can establish a reference other than ground by setting the AC-DC-GND. switch to DC, connecting the signal probe to the desired reference voltage, and positioning the trace as described in step 2 of the foregoing procedure.

You can adjust the module for a set of deflection factors other than those selected by the VOLTS/DIV. switch, if desired, through the use of the VARIABLE control. This will be a convenience when you wish to compare some voltage or signal to a given reference. To establish a new set of deflection factors, apply the desired reference signal to the INPUT connector, and set the VOLTS/DIV. switch and the VARIABLE control for the desired number of divisions of deflection on the screen. Divide the amplitude of the reference

signal by the number of divisions of deflection, and divide this result by the setting of the VOLTS/DIV. switch. This results in a sensitivity correction factor. You can now obtain the true sensitivity in volts per division at any setting of the VOLTS/DIV. switch by multiplying the switch setting by the sensitivity conversion factor, as long as the VARIABLE control has not been moved from its original setting.

For example, suppose you have applied a reference signal of 32 volts, have set the VOLTS/DIV. switch to 5, and

the VARIABLE control for a deflection of 4 divisions. The true sensitivity at this setting is $32 \text{ volts} \div 4 \text{ divisions}$, or 8 volts per division. The sensitivity conversion factor is $8 \text{ volts per division} \div 5 \text{ volts per division}$, or 1.6. The true sensitivity at any setting of the VOLTS/DIV. switch now is 1.6 times the setting of the switch. For example, when the VOLTS/DIV. switch is set to .1, the true sensitivity is 0.16 volt per division. A signal which produces 6 divisions of deflection at this setting is 0.96 volt in amplitude.

Circuit Description

The Type 3A75 Amplifier is basically a two-stage amplifier. The Input Amplifier, V434 and V534, is a cathode-coupled paraphase amplifier which converts the single-ended input to a push-pull output. The nominal gain of the Input Amplifier is about 24—that is, a single-ended input signal of one millivolt produces a push-pull output signal of 24 millivolts. The Output Amplifier, V454 and V554, is a straight push-pull amplifier with a nominal gain of about 16 to 18, depending upon the setting of the front-panel GAIN ADJ. adjustment. Cathode followers V423 and V443 isolate the stages from the INPUT connector and from each other.

Attenuators

When the gain of the Output Amplifier is properly set, a 0.05-volt signal at the grid of the Input Amplifier (pin 2 of V434) produces one division of deflection on the crt screen. A network of attenuators between the INPUT connector and the Input Amplifier attenuates the applied signal to produce the proper amount of signal at the Input Amplifier. The attenuators are selected by the VOLTS/DIV. switch. If, for example, the VOLTS/DIV. switch is set at 2, the signal is applied through the X10 and X4 attenuator to provide 40X attenuation. Then a 2-volt signal at the INPUT connector will produce 0.05 volt of signal at the Input Amplifier, which will produce 1 division of deflection on the screen.

The attenuators are both resistive and capacitive dividers which, when properly calibrated, provide equal attenuation at all frequencies from dc to over 4 megacycles. They also provide a constant input impedance of one megohm paralleled by 47 picofarads at all settings of the VOLTS/DIV. switch.

Input Amplifier

The Input Amplifier converts the single-ended input signal at the grid of V434 to a push-pull output signal. This is accomplished as follows:

A signal appearing at the grid of V434 tends to produce an in-phase reproduction of the signal at its cathode. Since the cathodes of V434 and V534 are commonly coupled, equal signals appear at both cathodes. The grid of V534, however, is held at a fixed voltage, which results in a 180° phase relationship between the grid-to-cathode signals of V434 and V534—that is, as the grid-to-cathode voltage of V434 moves in a negative direction, the grid-to-cathode

voltage of V534 moves in a positive direction, and vice versa. This, then, results in a push-pull output signal.

The VARIABLE control, R437, decreases the gain of the Input Amplifier by introducing degeneration into the cathode circuit (when the VARIABLE control is set fully clockwise, R437 has zero resistance). The DC BAL. adjustment provides the means of setting the dc level at the cathode of V534 exactly equal to that of V434 when R437 is set above zero resistance. This compensates for any difference in the values of R436 and R536 and in tube characteristics. When the DC BAL. adjustment is properly set, there will be no shift in the position of the trace as the VARIABLE control is rotated.

The input capacitance of V434 changes slightly with the setting of the VARIABLE control. The input cathode follower, V423A, isolates the INPUT connector from the Input Amplifier so that this change in capacitance is not reflected back to the attenuators to upset the high-frequency attenuation.

The OUTPUT PLATE VOLTAGE LEVEL adjustment, R537, by controlling the current through the Input Amplifier tubes, sets the dc levels throughout the amplifier. Although this adjustment has some effect on the gain of the amplifier, this is not its primary purpose. Its primary purpose is to allow for differences in the operating characteristics of the Input Amplifier tubes while maintaining the dc operating level of the Output Amplifier at the center of its dynamic range.

The RC networks R439-C439 and R539-C539 compensate for dc shift, or "slump", in the Input Amplifier tubes. This condition, characteristic to some degree of most pentodes, causes the Gm of the tubes to be slightly less at extremely low frequencies (dc to a fraction of a cycle per second) than at middle and high frequencies. The RC networks reduce the plate loads by about 3% at frequencies over about 1 cps to compensate for the drop in stage gain below this frequency.

L435 and L535 are peaking coils which widen the band-pass of the stage. At the frequencies at which the peaking takes place, C435 and C535 present a very low impedance to the signals, so both L435 and L535 may be considered as single center-tapped coils, with the center taps connected to the plates of the tubes. Thus, at high frequencies, the plate circuit of each amplifier tube looks approximately like Fig. 3.

The LR networks in the plate circuit further improve the high-frequency response.

At low frequencies, the plate circuit of each Input Amplifier tube looks approximately like Fig. 4.

Type 3A75 Amplifier

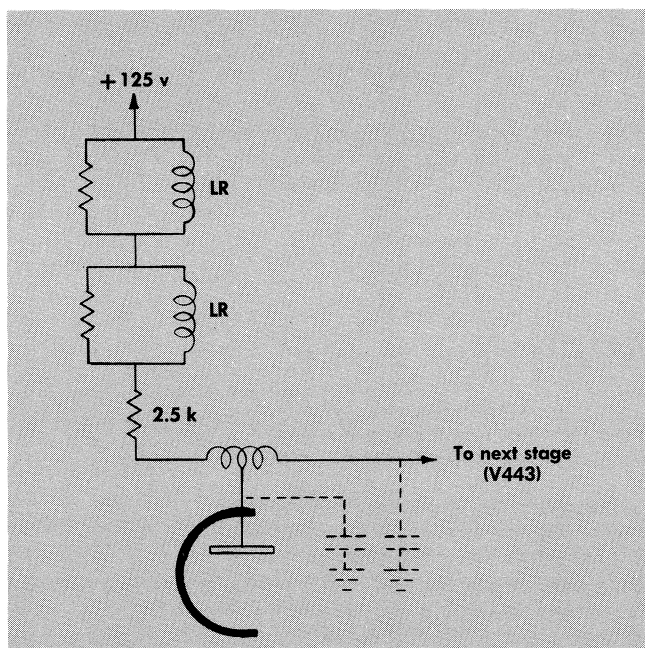


Fig. 3. Equivalent Input Amplifier plate circuit at high frequencies.

At low frequencies, the plate load of each tube is approximately 2.5 k. The drop in signal at the next stage due to the voltage-divider action of the 6.8-k and 390-k resistors is less than 2%. The purpose of the 6.8-k resistor is to allow greater positioning voltage swing (about 10 volts) at the grids of V443 than would otherwise be feasible if the positioning voltages had to be developed across the 2.5-k plate load only.

Output Amplifier

The gain of the Output Amplifier is adjustable by means of the GAIN ADJ., R557, in the common cathode circuit.

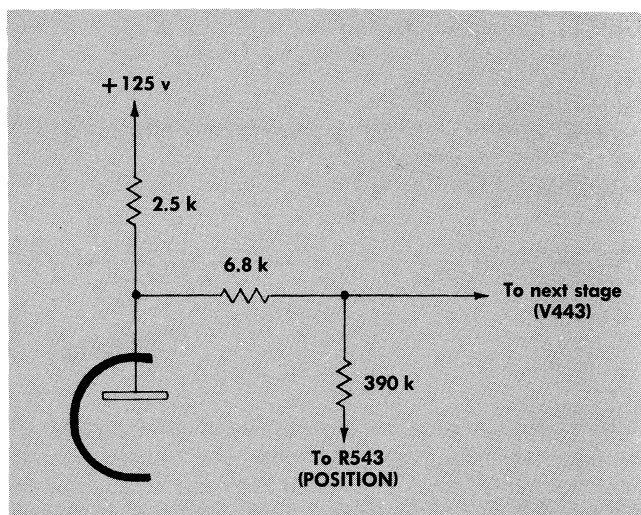


Fig. 4. Equivalent Input Amplifier plate circuit at low frequencies.

This adjustment allows for differences in deflection sensitivities of cathode-ray tubes.

D456 and D457 improve the linearity of the Output Amplifier near the ends of its dynamic range by shunting the cathode-coupling resistor, R457, on large signals. V463A also improves the linearity of the Output Amplifier by maintaining a constant dc level at the screens of V454 and V554 regardless of the screen currents in the tubes. Peaking coils L450, L451, L452, L550, L551, and L552 improve the high-frequency response of the Output Amplifier.

The trigger-pickoff cathode follower, V463B, couples a sample of the signal at the plate of V454 to the time-base circuitry for internal triggering. The signal amplitude at the cathode of V463B is approximately 4 volts for each division of deflection on the crt screen.

Troubleshooting

General maintenance and troubleshooting information is contained in the Type 560-Series Oscilloscope instruction manuals. In the following discussion, it is assumed that you have read that information and have isolated trouble to the Type 3A75 module by procedures described there.

Normally, trouble in the Type 3A75 will produce one of four effects in the oscilloscope display. These are: no display, insufficient deflection, signal distortion, and dc reference level shift. The following troubleshooting information is divided according to these symptoms and will, in most cases, enable you to isolate the trouble to a given stage or portion of the amplifier. When the trouble has been so isolated, you should first change the tube or tubes in that stage. If this does not eliminate the trouble, check the rest of the stage or circuit by voltage and resistance measurements. Typical voltages at various points in the module are shown on the schematic diagram at the rear of this manual. In most cases, resistance measurements will be

point-to-point checks whose values can be approximated from the schematic diagram. You will need to insert the Type 3A75 module in the right-hand oscilloscope opening and remove the right-hand side panel to make the voltage and resistance measurements. It is not necessary to have a module in the other opening to obtain the voltage readings given on the schematic diagram.

No Display

If you cannot position the display onto the screen, there is an imbalance in the module—that is, there is a significant dc voltage difference between the two sides of the push-pull circuits. First, set the POSITION control to mid-range and check the setting of the DC BAL. adjustment according to the procedure described in the Operating Instructions. If this does not eliminate the trouble, set the

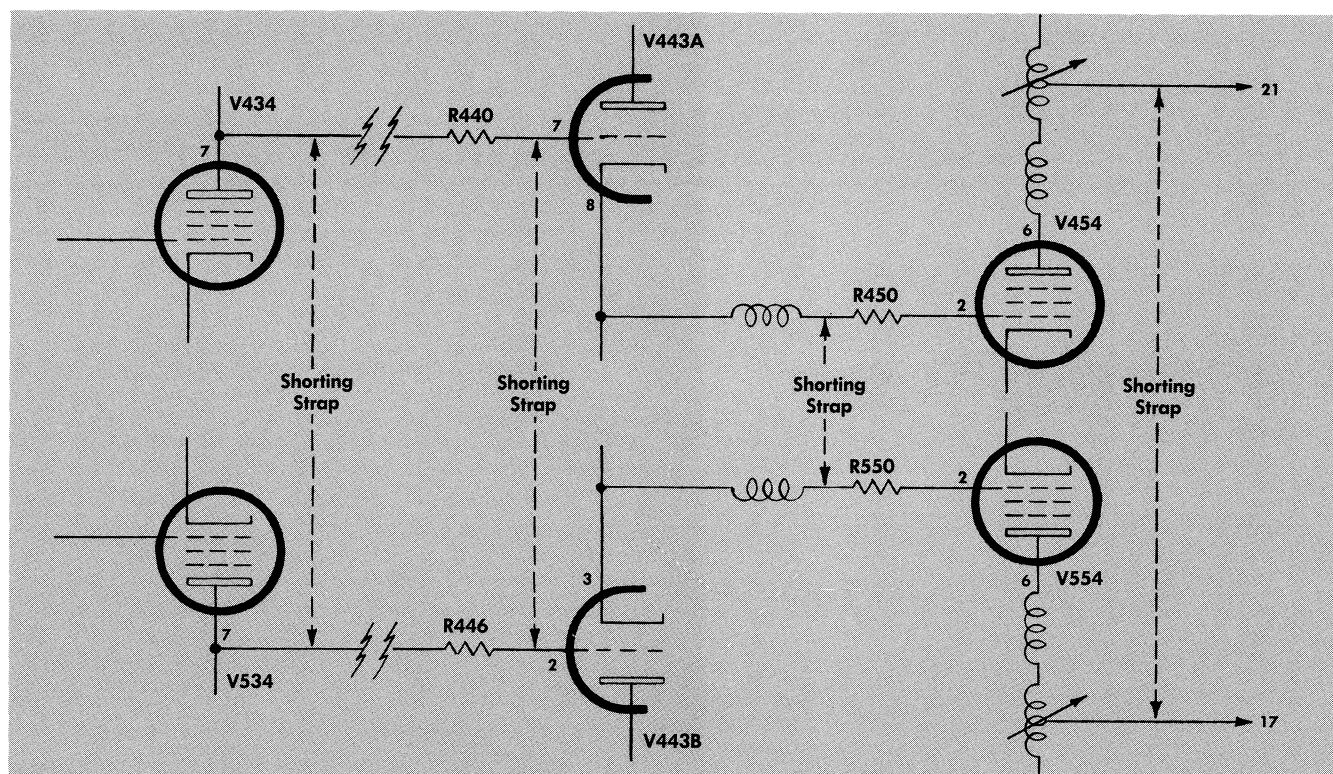


Fig. 5. Shorting points for isolating dc imbalance.

POSITION control to midrange and, with an insulated shorting strap, short between the pairs of points shown in Fig. 5, starting at the right and working toward the left. As you short between each pair of points, you should obtain a spot or trace on the screen. When you short between a pair of points and do not obtain a spot or trace, the trouble is between that pair of points and the next pair to the right.

If you still do not obtain a spot or trace when you short between the plates of V434 and V534, the trouble is between there and the input (or in the dc balance circuit). Due to a possible mismatch between V434 and V534, you may not obtain a spot or trace on the screen when you short their grids together even if the two tubes are good. Therefore, you must check the rest of the circuit by comparing voltages at corresponding points in the two sides of the circuit. If any of the voltages differ significantly from each other or from those shown on the schematic diagram, the trouble is in that portion of the circuit.

Insufficient Deflection

If insufficient deflection is noted in only certain positions of the VOLTS/DIV. switch, the trouble is a defective component in one of the attenuation networks or in the switch. If insufficient deflection is noted in all positions of the VOLTS/DIV. switch, the trouble is probably in one of the amplifier stages. In this case, rotate the POSITION control. If normal positioning range exists, the trouble is in the Input Amplifier or in the Input Cathode Followers.

Signal Distortion

Signal distortion—the amplification of some frequencies more than others—is almost always caused by faulty tubes (assuming the module is properly calibrated and the signal probe is properly compensated).

High-frequency distortion—where the high frequencies are attenuated or amplified more or less than the middle and low frequencies—will usually show up as undershoot or overshoot on a square wave, as shown in the "Under-compensated" and "Over-compensated" waveforms in Fig. 2. Low-frequency distortion—where the low frequencies are attenuated or amplified more or less than the middle and high frequencies—will usually show up as a slope in the top and bottom of a square wave. A certain amount of high-frequency distortion is normal beyond the specified upper-frequency limit of the amplifier, and a certain amount of low-frequency distortion is normal when you are displaying waveforms with very-low-frequency components and have the AC-DC-GND. switch in the AC position. It is only when this distortion becomes excessive in the normal frequency range of the instrument that it constitutes a trouble.

Low-frequency distortion is usually caused by a change in the time constant of the input coupling circuit. This, in turn, is usually caused by a tube becoming gassy and drawing grid current. Therefore, when low-frequency distortion is encountered, check all the tubes in the module (V423, V434, and V534 first).

In all cases of high-frequency distortion, you should first check the compensation of the probe, if one is used, and

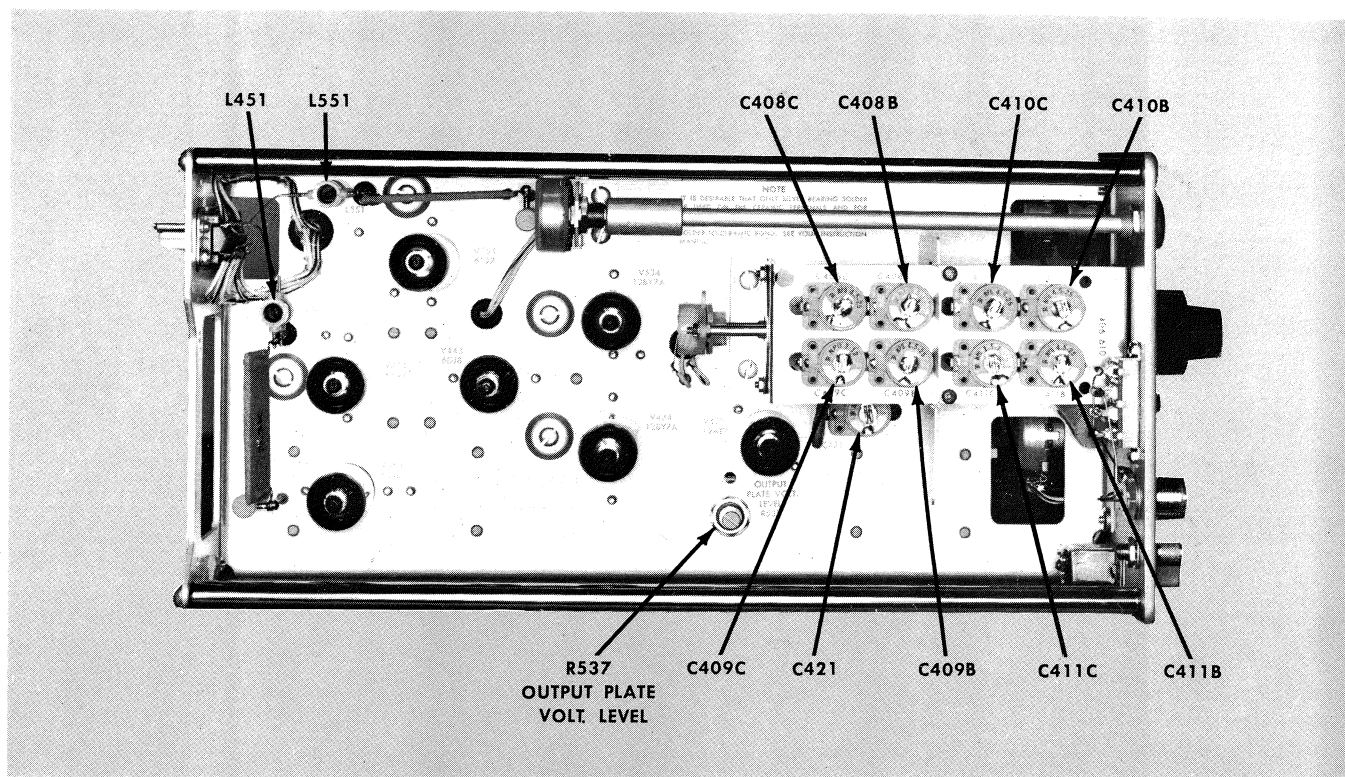


Fig. 6. Left side of Type 3A75 Amplifier showing location of internal adjustments.

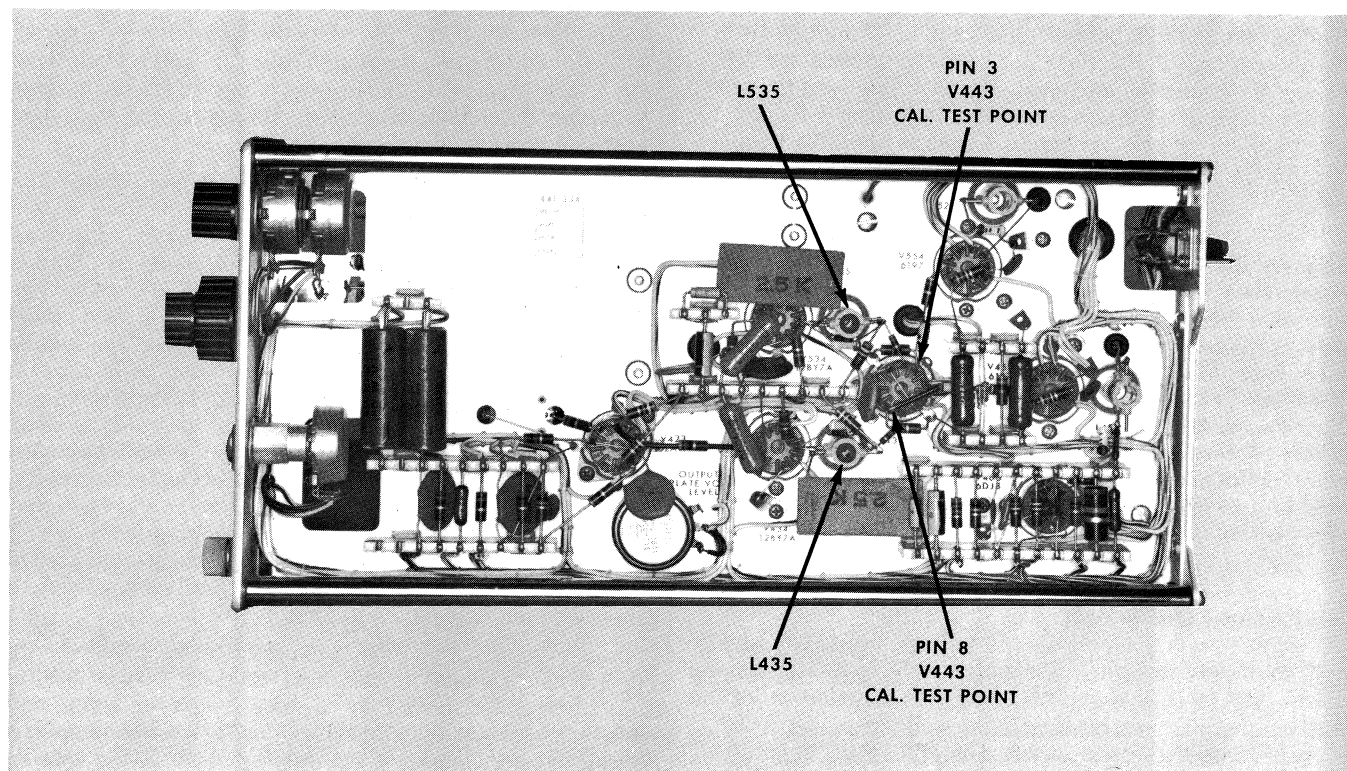


Fig. 7. Right side of Type 3A75 Amplifier showing location of internal adjustments.

then check the frequency compensation of the attenuators and the amplifier stages, as described in the Calibration section of this manual. If this does not cure the trouble, check all the tubes in the module.

DC Reference Level Shift

If, when the VOLTS/DIV. switch is set at .05, the position of a no-signal trace (or spot) changes by more than 1 minor graticule division as the AC-DC-GND. switch is moved

from GND. to DC, V423A is probably gassy and should be replaced.

If this condition occurs and cannot be immediately corrected, satisfactory measurement of dc levels can be accomplished by establishing the zero reference line with the AC-DC-GND. switch in the DC position and the signal probe connected to signal ground (see Operating Instructions, "Voltage Measurements"). In this case, you should establish the zero reference line each time you move the VOLTS/DIV. switch.

Calibration

To maintain the high degree of accuracy of the Type 3A75 Amplifier, we recommend that it be calibrated after each 500 hours of operation or about every six months, whichever is sooner. It should not require more frequent calibration. However, if tubes or other components are replaced, the calibration of the instrument should be checked and adjusted as necessary.

Calibration of the Type 3A75 is performed with the module inserted in the left-hand opening of a Type 561 or Type 565 Oscilloscope. If you are using a Type 561 Oscilloscope, you will need to have a time-base module in the right-hand opening. Complete calibration consists of the OUTPUT PLATE VOLTAGE LEVEL adjustment, standardization of the input capacity, frequency compensation of the attenuator circuits, and frequency compensation of the amplifier stages. Any of the adjustments may be performed individually or out of sequence as long as all of the steps in a given procedure are performed.

Figs. 6 and 7 show the locations of the internal adjustments referred to in the calibration procedures.

Equipment Required

The following equipment is required for a complete calibration of the Type 3A75 Amplifier.

1. DC voltmeter capable of measuring 180 volts.
2. Square-wave generator with a risetime of 45 nanoseconds or less and frequency outputs of about 1 kc and 400 kc; output amplitude should be variable up to at least 50 volts peak-to-peak (Tektronix Type 105 Square-Wave Generator recommended).
3. Coaxial cable with matching termination resistor (Tektronix Type P52 coaxial cable and 50-ohm terminating resistor recommended).
4. 47-picofarad capacitance standardizer (Tektronix Type CS 47 recommended), or a capacitance meter capable of measuring 47 picofarads (Tektronix Type 130 L-C Meter recommended) and an attenuator probe with adjustable capacitance.
5. Test oscilloscope with a sensitivity of at least 50 millivolts per division and a sweep rate of 1 microsecond or less per division (Tektronix Type 530-, 540-, 550-, or 580-Series Oscilloscope with suitable plug-in unit recommended).

6. Low-capacitance calibration tools (Tektronix part no. 003-000 and 003-301 recommended).

Preliminary Setup

Insert the Type 3A75 into the left-hand opening of the oscilloscope and, after warm-up, set the GAIN ADJ. and DC BAL. adjustments as described in the Operating Instructions of this manual.

Output Plate Voltage Level Adjustment

Center a free-running trace or spot vertically on the screen and short the vertical deflection plates of the cathode-ray tube together.

CAUTION

Be careful not to short the deflection plates to the metal shield around the crt as it could damage components in the oscilloscope.

Connect the dc voltmeter between ground and the shorted deflection plate pins. Adjust the OUTPUT PLATE VOLTAGE LEVEL adjustment for a reading of +180 volts on the meter. Disconnect the meter and the shorting strap.

Amplifier Frequency Compensation

Proper frequency compensation of the amplifier is important when the module is to amplify frequencies near the upper limit of its bandpass (4 mc). Improper frequency compensation in the amplifier will normally be indicated by poor response at the high frequencies. Unless the need for amplifier compensation has been established, it is best not to attempt to make these adjustments. Set the OUTPUT PLATE VOLTAGE LEVEL adjustment before performing this procedure.

To frequency compensate the amplifier stages of the Type 3A75, proceed as follows:

1. Remove the Type 3A75 from the oscilloscope and preset L435, L535, L451, and L551 so that the tops of the slugs are flush with the tops of the plastic coil forms.
2. Reinsert the Type 3A75 and set the VOLTS/DIV. switch to .05 and the AC-DC-GND. switch to DC.

Type 3A75 Amplifier

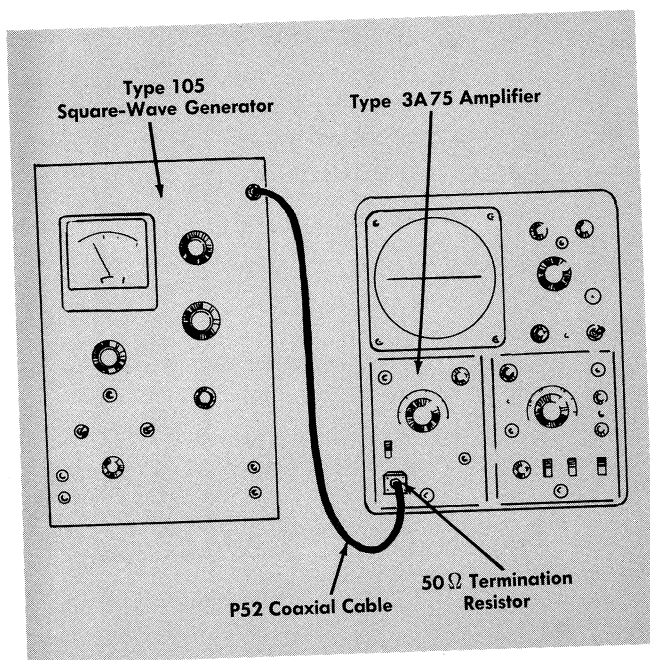


Fig. 8. Tektronix Type 105 Square-Wave Generator connected to the Type 3A75 for amplifier frequency compensation.

3. Connect the 400-kc output of the square-wave generator through the coaxial cable and matching termination resistor to the INPUT connector of the Type 3A75. (Fig. 8 shows the Tektronix Type 105 Square-Wave Generator properly connected to the Type 3A75 for this step.)

4. Set the time-base controls to display several cycles of the square wave, and adjust the output amplitude of the square-wave generator for four or five divisions of deflection on the screen. (You may have to adjust the VARIABLE control on the Type 3A75 module to obtain the proper deflection.) The display will be an overpeaked square wave.

5. Center the display on the screen with the POSITION controls.

6. Alternately adjust L451 and L551 in equal increments until the most evenly rounded leading corners on the square-wave are obtained (see Fig 9). L451 and L551 both will probably need to be turned about six complete clockwise turns before the proper display is obtained; both slugs should be at very nearly the same depth at the conclusion of this step.

7. Insert the Type 3A75 module into the right-hand oscilloscope opening. (Maintain the same signal connections between the Type 3A75 module and the square-wave generator.)

8. Connect the probe of the test oscilloscope to pin 3 of V443 and note the "ringing waveform" that is superimposed on the leading corners of the square wave as displayed on the test oscilloscope.

9. Adjust L535 for minimum ringing and optimum square-wave appearance on the positive half-cycles in the test oscilloscope display (see Fig. 10).

10. Connect the probe of the test oscilloscope to pin 8 of V443, and adjust L435 for minimum ringing and optimum square-wave appearance on the negative half-cycles in the test oscilloscope display (see Fig. 11). There is slight interaction between steps 9 and 10; they should be repeated to obtain the optimum settings.

11. Disconnect the test oscilloscope probe and move the Type 3A75 module to the left-hand oscilloscope opening. (Maintain the same signal connections between the Type 3A75 and the square-wave generator.)

12. Again adjust the time-base controls as necessary to obtain a stable display.

13. The displayed waveform on the oscilloscope screen should be a square wave with slightly rounded leading corners. If they are a bit underpeaked or overpeaked, adjust L451 and L551 in small and equal increments for the most evenly rounded leading corners; see Fig. 9(a). Very little adjustment, if any, of L451 and L551 should be necessary.

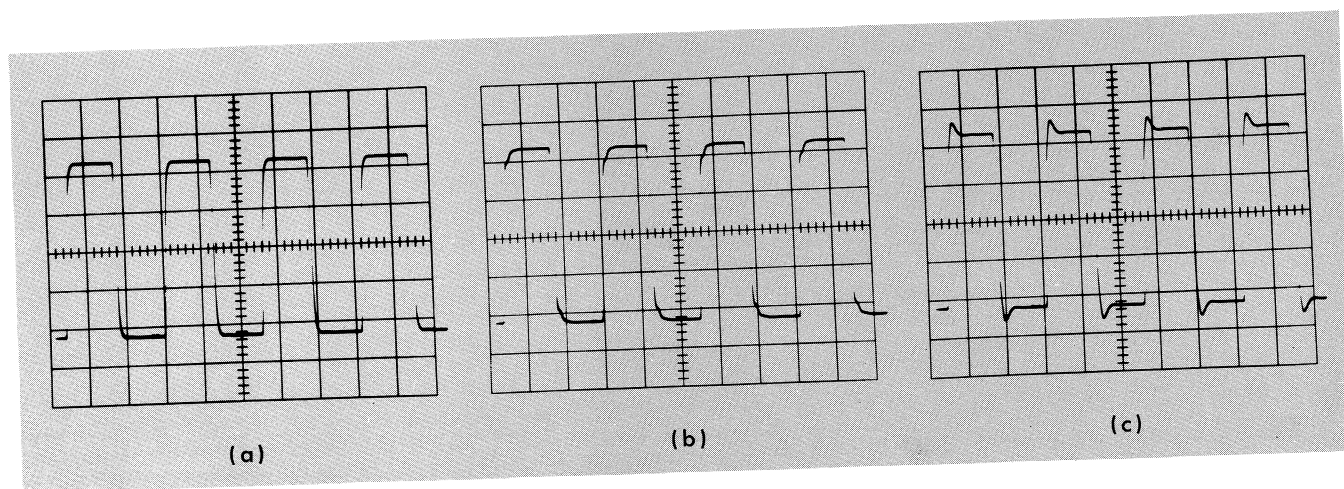


Fig. 9. Amplifier frequency compensation. (a) L451 and L551 properly set; (b) and (c), L451 and L551 improperly set.

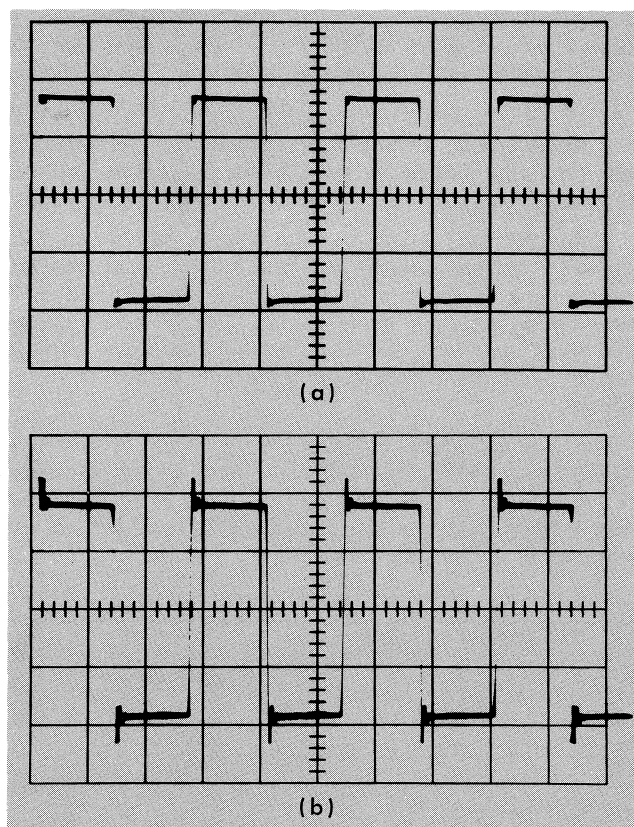


Fig. 10. Amplifier frequency compensation (waveform at pin 3, V443). (a) L535 properly set — minimum ringing and optimum square-wave appearance on positive half-cycles. (b) L535 improperly set — excessive ringing on waveform.

14. Disconnect the square-wave generator and the termination resistor from the Type 3A75 module.

Input Capacitance Standardization and Attenuator Frequency Compensation ←

The input capacitance standardization and attenuator frequency compensation interact so both must be performed in the same procedure. The need for either or both of these calibrations is normally indicated by distortion of fast-rising waveforms on one or more sensitivity ranges of the module.

Standardization of the input capacitance of the module requires the use of a 47-picofarad capacitance standardizer. If you do not have such a standardizer, you can make an attenuator probe into one by performing these five steps. (If you have a 47-picofarad standardizer, you may skip these five steps and go immediately to the procedure following them.)

1. Set the VOLTS/DIV. switch to .05 and the AC-DC-GND. switch to DC.

2. With the oscilloscope turned on, measure the input capacitance at the INPUT connector. With a low-capacitance screwdriver, adjust C421 for a reading of 47 picofarads on the capacitance meter.

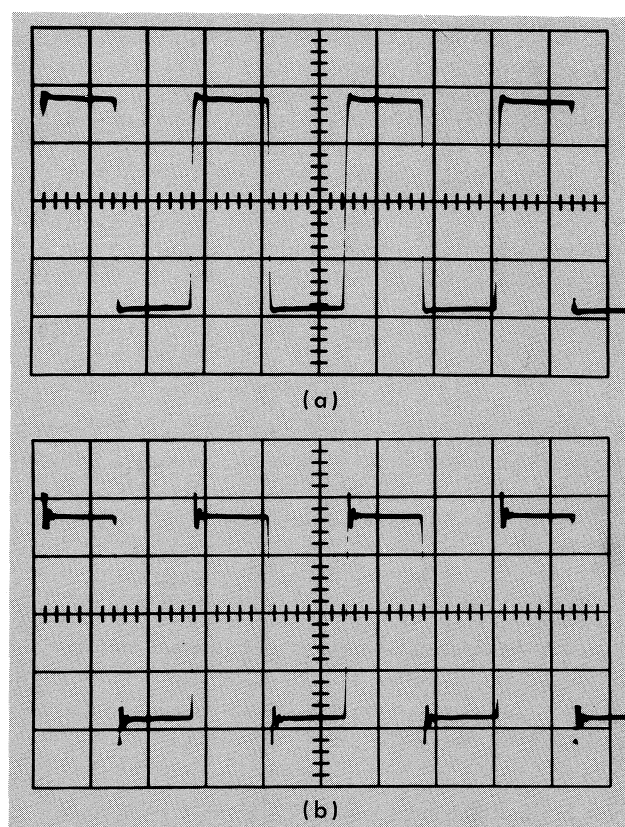


Fig. 11. Amplifier frequency compensation (waveform at pin 8, V443). (a) L435 properly set — minimum ringing and optimum square-wave appearance on negative half-cycles. (b) L435 improperly set — excessive ringing on waveform.

3. Connect the attenuator probe to the INPUT connector and touch the probe tip to the 1-kc output of the square-wave generator.

4. Adjust the oscilloscope controls to display several cycles of the square-wave signal.

5. Adjust the variable capacitor in the body of the probe to obtain the best square-wave response (no undershoot or overshoot).

Your probe is now standardized to perform as a 47-picofarad capacitance standardizer. You may use it as such in the following procedure to set the input capacitance of the module on all of the other sensitivity ranges. (Do not adjust the probe further during the procedure.)

To properly set the input capacitance and attenuator frequency compensation of the Type 3A75 Amplifier, proceed as follows:

1. Connect the 1-kc output of the square-wave generator through the coaxial cable and the 47-picofarad capacitance standardizer (or the standardized probe) to the INPUT connector of the Type 3A75 module. (Fig. 12 shows the Tektronix Type 105 Square-Wave Generator properly connected to the Type 3A75 for this step.)

Type 3A75 Amplifier

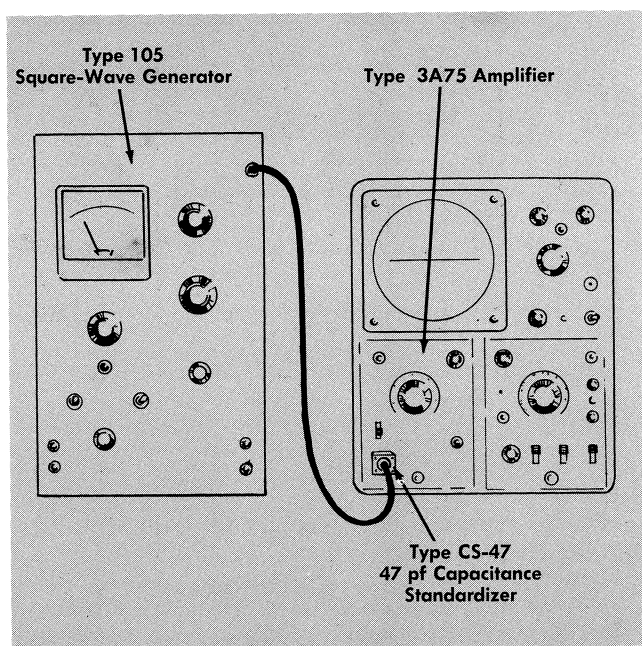


Fig. 12. Tektronix Type 105 Square-Wave Generator connected to the Type 3A75 Amplifier for input capacitance standardization.

2. Set the VOLTS/DIV. switch on the Type 3A75 to .05 and the AC-DC-GND. switch to AC.

3. Adjust the time-base controls on the oscilloscope to display several cycles of the square wave. You may use the VARIABLE control to get the entire signal on the screen, if necessary.

4. Adjust C421 for the best square-wave response. (If you used this module to standardize the probe, you will not need to adjust C421.)

5. Set the VOLTS/DIV. switch to each of the positions shown in the first column of Table 1, and adjust the corresponding capacitors for the best square-wave response at each setting. As you move the VOLTS/DIV. switch, adjust the output amplitude of the square-wave generator to maintain at least four divisions of deflection on the screen, if possible.

You may adjust the capacitors listed at any VOLTS/DIV. setting given in Table 1 without upsetting the adjustment of those listed at any other setting; there is no interaction among them. However, if you adjust C421, you will need to readjust all of the capacitors listed in the table.

TABLE 1

VOLTS/DIV. Setting	Adjust
.1	C408B, C408C
.2	C409B, C409C
.5	C410B, C410C
5	C411B, C411C

6. Disconnect the square-wave generator and the capacitance standardizer from the oscilloscope.

PARTS LIST AND DIAGRAM

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.


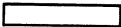
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

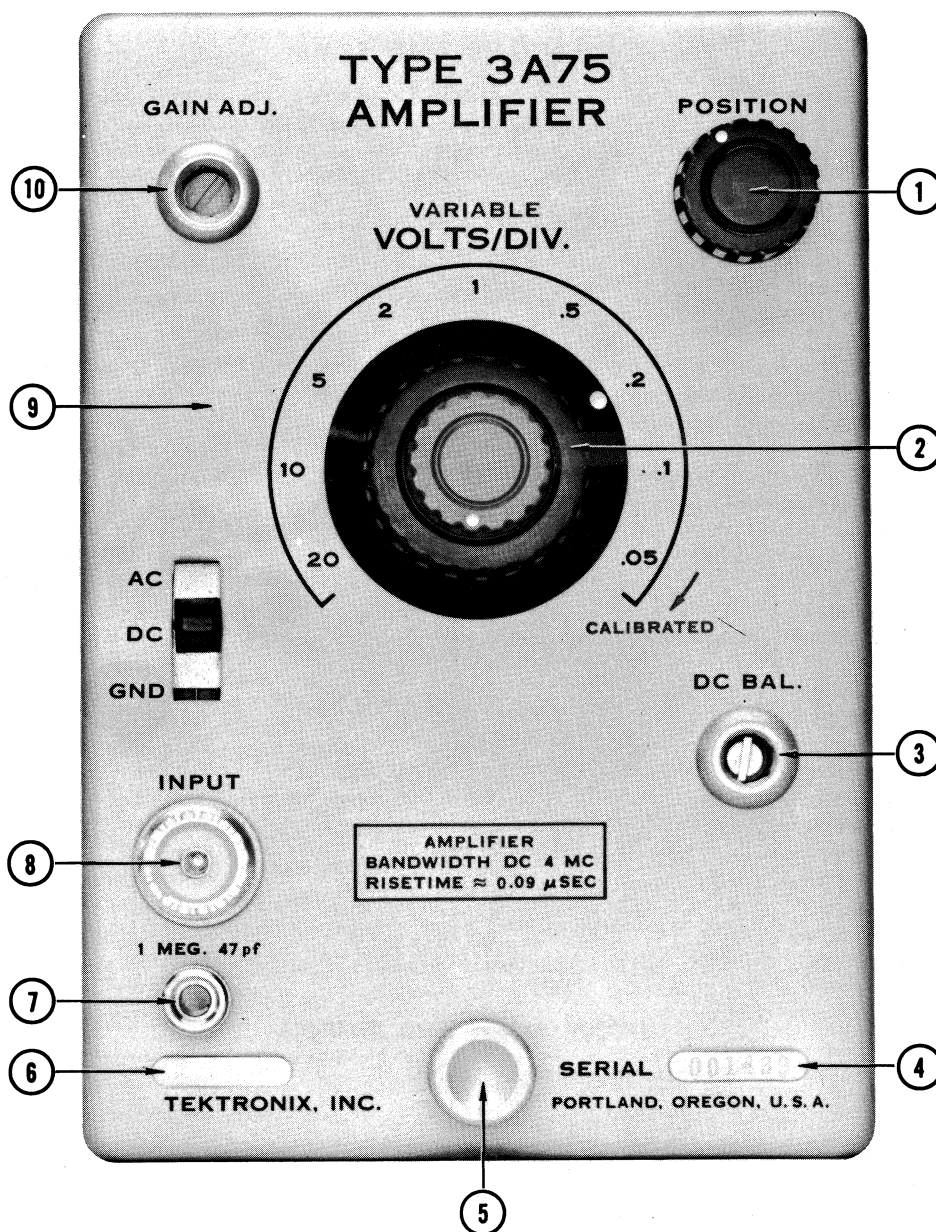
ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10 ⁶)
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10 ⁻⁶
cm	centimeter	n	nano, or 10 ⁻⁹
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10 ⁻¹²
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10 ⁹	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10 ¹²
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10 ³)	w/	with
kc	kilocycle	w/o	without
m	milli, or 10 ⁻³	WW	wire-wound
mc	megacycle		

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

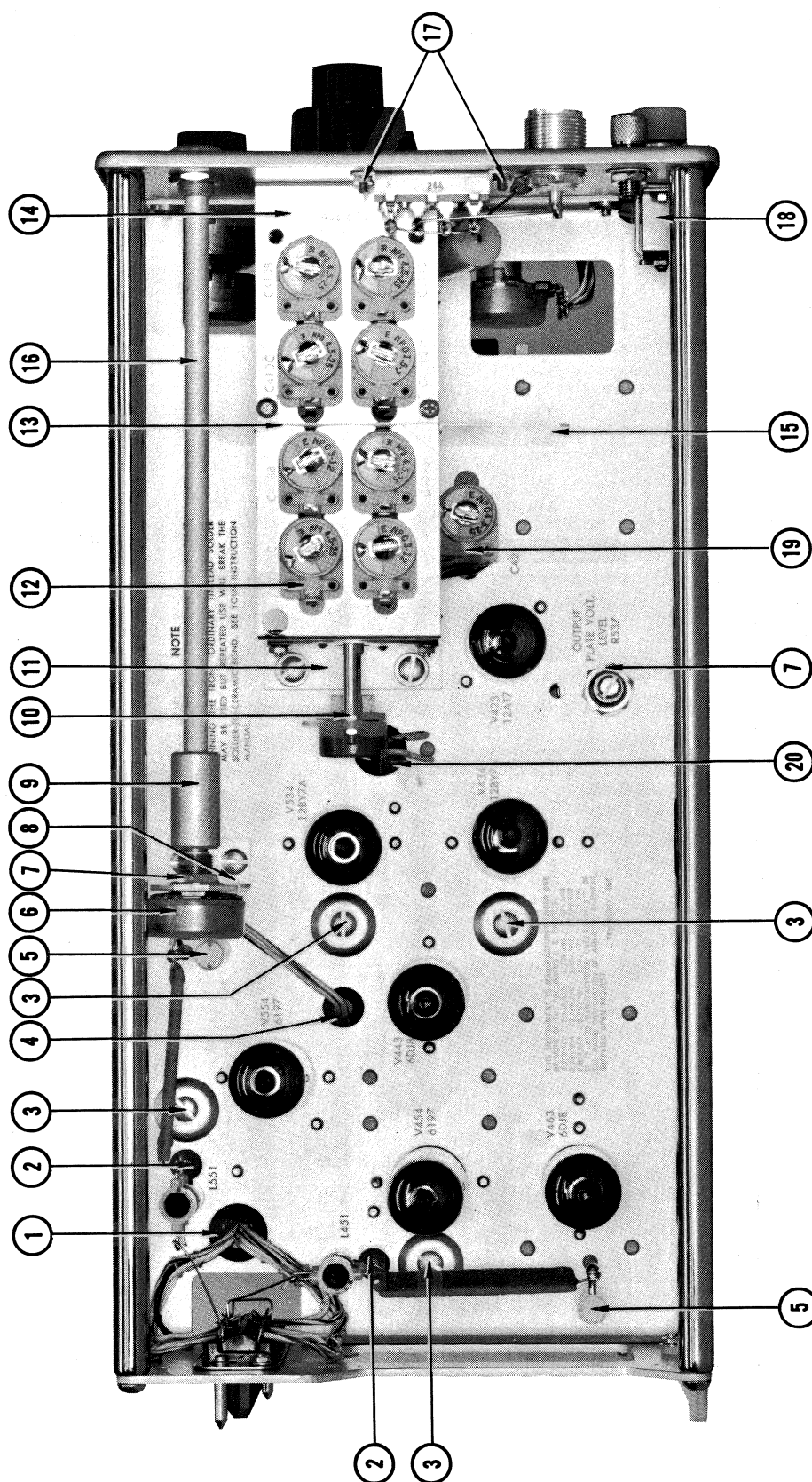
FRONT



FRONT

REF. NO.	PART NO.	SERIAL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	366-044	101	1119	1	KNOB, small black, POSITION
	366-113	1120		1	KNOB, small charcoal, POSITION
	210-419			1	NUT, shoulder, $\frac{3}{8}$ -32
	210-902			1	WASHER, flat, .470 ID x $2\frac{1}{32}$ OD
	210-012			1	LOCKWASHER, int. $\frac{3}{8}$ x $\frac{1}{2}$
2	366-058	101	1119	1	KNOB, large black, VOLTS/DIV.
	366-144	1120		1	KNOB, large charcoal, VOLTS/DIV.
	366-038			1	KNOB, small red, VARIABLE
3	358-010			1	BUSHING, $\frac{3}{8}$ -32 x $\frac{9}{16}$
	210-013			1	LOCKWASHER, int, $\frac{3}{8}$ x $1\frac{1}{16}$
	210-494			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$
4	334-679			1	TAG, metal serial no. insert
5	366-109			1	KNOB, plug-in securing
6	334-829	1120		1	TAG, metal blank mod. insert
7	129-035			1	POST, binding, assembly
					Consisting Of:
	355-507			1	STEM, adapter
	200-103			1	CAP
	210-455			1	NUT, hex, $\frac{1}{4}$ -28 x $\frac{3}{8}$
	210-011			1	LOCKWASHER, int, $\frac{1}{4}$
8	131-081			1	CONNECTOR, chassis mt., coaxial, 1 contact, female
	210-241			1	LUG, ground, $1\frac{5}{16}$ long
9	333-621	101	1119	1	PANEL, front (type 75)
	333-729	1120		1	PANEL, front (type 3A75)
	387-577			1	PLATE, front subpanel
10	358-010			1	BUSHING, $\frac{3}{8}$ -32 x $\frac{9}{16}$
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$

LEFT SIDE



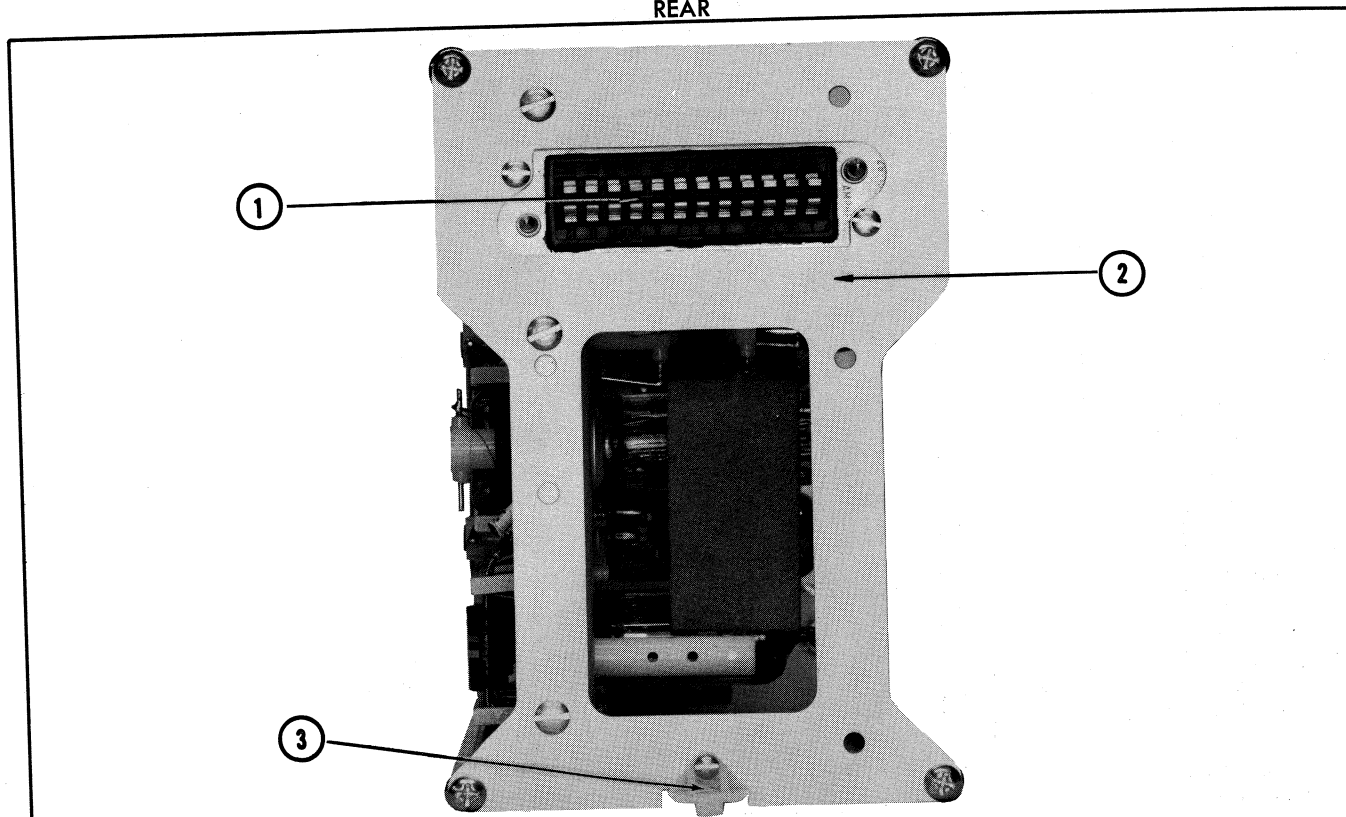
LEFT SIDE

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	348-005			1	GROMMET, rubber, $\frac{1}{2}$
2	348-002			2	GROMMET, rubber, $\frac{1}{4}$
3	211-507			4	SCREW, 6-32 x $\frac{5}{16}$ BHS (coil mounting)
	210-006			4	LOCKWASHER, int. #6
4	348-003			1	GROMMET, rubber, $\frac{5}{16}$
5	385-040			2	ROD, nylon
					Mounting Hardware For Each: (not included)
	213-041			1	SCREW, thread cutting, 6-32 x $\frac{3}{8}$ Truss HS phillips
6	200-247			1	CAP, pot, poly.
7	210-413			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ (pot mounting)
	210-840			2	WASHER, .390 ID x $\frac{9}{16}$ OD
8	406-684			1	BRACKET, gain adjust., pot
					Mounting Hardware: (not included)
	211-504			2	SCREW, 6-32 x $\frac{1}{4}$ BHS
9	376-007			1	COUPLING
					Includes:
	213-005			2	SCREW, set, 8-32 x $\frac{1}{8}$ HSS
10	262-482			1	SWITCH, VOLTS/DIV., wired
					Includes:
	260-158			1	SWITCH, VOLTS/DIV., unwired
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$ (pot mounting)
11	406-683			1	BRACKET, switch support
					Mounting Hardware: (not included)
	211-504			2	SCREW, 6-32 x $\frac{1}{4}$ BHS
	210-803			2	WASHER, 6L
12	214-153			8	FASTENER, snap, double pronged
13	337-423			1	SHIELD, attenuator bracket
					Mounting Hardware:
	213-035			2	SCREW, thread cutting, 4-40 x $\frac{1}{4}$ PHS phillips
14	406-610			1	BRACKET, attenuator mtg.
					Mounting Hardware:
	211-008			2	SCREW, 4-40 x $\frac{1}{4}$ BHS
	210-004			2	LOCKWASHER, int. #4
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$
15	337-424			1	SHIELD, attenuator switch
					Mounting Hardware:
	211-008			2	SCREW, 4-40 x $\frac{1}{4}$ BHS
	210-004			2	LOCKWASHER, int. #4
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$
					Mounting Hardware For Switch: (not included)
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$
16	384-215			1	ROD, extension
17	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$ (slide switch mounting)
18	214-052			1	FASTENER, pawl right, w/stop
					Mounting Hardware: (not included)
	210-004			2	LOCKWASHER, int. #4
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$
19	214-153			1	FASTENER, snap, double pronged
20	348-004			1	GROMMET, rubber, $\frac{3}{8}$

RIGHT SIDE

REF. NO.	PART NO.	SERIAL NO.		Q T Y.	DESCRIPTION
		EFF.	DISC.		
1	124-087			2	STRIP, ceramic, $\frac{3}{4} \times 3$ notches
	361-007			2	SPACER, nylon, molded
2	441-334			1	CHASSIS
					Mounting Hardware: (not included)
	211-504			3	SCREW, 6-32 x $\frac{1}{4}$ BHS
	211-538			2	SCREW, 6-32 x $\frac{5}{16}$ FHS 100° phillips slot
3	384-566			4	ROD, frame, spacing
4	210-201			6	LUG, solder, SE 4
	213-044			6	SCREW, thread cutting, 5-32 x $\frac{3}{16}$ PHS phillips
5	136-072			5	SOCKET, 9 pin UHF miniature
					Mounting Hardware For Each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x $\frac{3}{16}$ PHS phillips
6	348-031			2	GROMMET, poly snap-in
7	211-504			2	SCREW, 6-32 x $\frac{1}{4}$ BHS (coil mounting)
8	124-088			2	STRIP, ceramic, $\frac{3}{4} \times 4$ notches
	361-007			4	SPACER, nylon, molded
9	124-091			2	STRIP, ceramic, $\frac{3}{4} \times 11$ notches
	361-007			4	SPACER, nylon, molded
10	136-015			2	SOCKET, STM9G
					Mounting Hardware For Each: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x $\frac{3}{16}$ PHS phillips
11	179-509	101	1339	1	CABLE, harness
	179-739	1340		1	CABLE, harness
12	124-090			3	STRIP, ceramic, $\frac{3}{4} \times 9$ notches
	361-007			6	SPACER, nylon, molded
13	200-247			1	CAP, pot, poly.

REAR



REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	131-149			1	CONNECTOR, chassis mt., 24 contact, male Mounting Hardware: (not included)
	211-008			2	SCREW, 4-40 x 1/4 BHS
	210-004			2	LOCKWASHER, int. #4
	210-406			2	NUT, hex, 4-40 x 3/16
2	387-581			1	PLATE, rear Mounting Hardware: (not included)
	212-044			4	SCREW, 8-32 x 1/2 RHS
3	351-037			1	GUIDE, plug-in Mounting Hardware: (not included)
	211-013			1	SCREW, 4-40 x 3/8 FHS
	210-004			1	LOCKWASHER, int. #4
	210-406			1	NUT, hex, 4-40 x 3/16

PARTS LIST

TYPE 3A75

Values are fixed unless marked variable.

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

Ckt. No.	S/N Range	Description				Tektronix Part Number
C400	.1 μ f	PTM	600 v			285-587
C407	270 pf	Cer.	500 v	10%		281-543
C408B	3-12 pf					281-007
C408C	4.5-25 pf					281-010
C408D	4.7 pf	Cer.	500 v	± 1 pf		281-501
C409B	4.5-25 pf					281-010
C409C	3-12 pf					281-007
C410B	4.5-25 pf					281-010
C410C	4.5-25 pf					281-010
C410E	150 pf	Mica	500 v	10%		283-508
C411A	12 pf	Cer.	500 v	± 1.2 pf		281-505
C411B	4.5-25 pf					281-010
C411C	1.5-7 pf					281-005
C411E	250 pf	Mica	500 v	5%		283-543
C420	.02 μ f	Discap	600 v			283-006
C421	4.5-25 pf					281-010
C426	.01 μ f	Discap	150 v			283-003
C435	390 pf	Cer.	500 v			281-551
C439	20 μ f	EMT	150 v			290-008
C441	.02 μ f	Discap	600 v			283-006
C453	.01 μ f	Discap	150 v			283-003
C460	.005 μ f	Discap	500 v			283-001
C464	1.5 pf	Cer.	500 v	± 0.5 pf		281-526
C468	.02 μ f	Discap	150 v			283-004
C471	.1 μ f	Discap	500 v			283-008
C473	.01 μ f	Discap	500 v			283-002
C475	.02 μ f	Discap	600 v			283-006
C477	.1 μ f	Discap	500 v			283-008
C479	.01 μ f	Discap	150 v			283-003
C530	.01 μ f	Discap	100 v			283-012
C535	390 pf	Cer.	500 v			281-551
C539	20 μ f	EMT	150 v			290-008
C552	1.5 pf	Cer.	500 v	± 0.5 pf		281-526
C553	.01 μ f	Discap	150 v			283-003

Diodes

D456	Germanium	DR 746	152-007
D457	Germanium	DR 746	152-007

Inductors

			Tektronix Part Number
L435	A 12-21 μ h B13-24 μ h	Var.	*114-139
L450	4.5 μ h		*108-231
L451	180-350 μ h	Var.	*114-138
L452	13 μ h		*108-233
L535	A 12-21 μ h B13-24 μ h	Var.	*114-139
L550	4.5 μ h		*108-231
L551	180-350 μ h	Var.	*114-138
L552	13 μ h		*108-233
LR432	9.25 μ h		*108-232
LR433	3.25 μ h		*108-230
LR532	9.25 μ h		*108-232
LR533	3.25 μ h		*108-230

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R407	22 Ω	$\frac{1}{2}$ w				302-220
R408C	500 k	$\frac{1}{2}$ w	Prec.	1%		309-140
R408E	1 meg	$\frac{1}{2}$ w	Prec.	1%		309-148
R409C	750 k	$\frac{1}{2}$ w	Prec.	1%		309-141
R409E	333 k	$\frac{1}{2}$ w	Prec.	1%		309-139
R410C	900 k	$\frac{1}{2}$ w	Prec.	1%		309-142
R410E	111 k	$\frac{1}{2}$ w	Prec.	1%		309-138
R411C	990 k	$\frac{1}{2}$ w	Prec.	1%		309-145
R411E	10.1 k	$\frac{1}{2}$ w	Prec.	1%		309-135
R418	27 Ω	$\frac{1}{2}$ w				302-270
R419	1 meg	$\frac{1}{2}$ w	Prec.	1%		309-148
R420	100 k	$\frac{1}{2}$ w				302-104
R421	47 Ω	$\frac{1}{2}$ w				302-470
R423	39 k	$\frac{1}{2}$ w				302-393
R426	47 Ω	$\frac{1}{2}$ w				302-470
R428	39 k	$\frac{1}{2}$ w				302-393
R430	47 Ω	$\frac{1}{2}$ w				302-470
R434	2.5 k	5 w	Mica Pl.	1%		*310-522
R435	6.8 k	$\frac{1}{4}$ w		5%		315-682
R436	4.5 k	5 w	WW	5%		308-092
R437	355 Ω		Var.	WW	VARIABLE	Use *311-290
R439	82 k	$\frac{1}{2}$ w				302-823
R440	33 Ω	$\frac{1}{4}$ w				316-330
R442	15 k	$\frac{1}{2}$ w				302-153
R446	33 Ω	$\frac{1}{4}$ w				316-330
R448	15 k	$\frac{1}{2}$ w				302-153
R450	47 Ω	$\frac{1}{2}$ w				302-470
R451	3.5 k	10 w	Mica Pl.	1%		*310-584
R452	470 Ω	2 w		5%		305-471
R453	470 k	$\frac{1}{2}$ w				302-474
R456	2 k	5 w		WW	5%	308-091

X1340-up

Resistors (continued)

Tektronix
Part Number

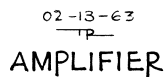
R457	101-1339	33 Ω	Selected nominal value				301-330
R457	1340-up	27 Ω	Selected nominal value				301-270
R460		100 Ω	$\frac{1}{2}$ w				302-101
R462		510 k	$\frac{1}{2}$ w			5%	301-514
R463	101-1339	240 k	$\frac{1}{2}$ w			5%	301-244
R463	1340-up	150 k	$\frac{1}{2}$ w			5%	301-154
R464	101-1339	400 k	$\frac{1}{4}$ w		Prec.	1%	319-004
R464	1340-up	333 k	$\frac{1}{4}$ w		Prec.	1%	319-072
R465	101-1339	180 k	$\frac{1}{2}$ w		Prec.	1%	309-279
R465	1340-up	174 k	$\frac{1}{2}$ w		Prec.	1%	309-151
R467		47 Ω	$\frac{1}{2}$ w				302-470
R468		1 k	$\frac{1}{2}$ w				302-102
R469		15 k	2 w				306-153
R471		27 Ω	$\frac{1}{2}$ w				302-270
R473		1 k	3 w		WW		308-077
R475		100 Ω	$\frac{1}{2}$ w				302-101
R477		27 Ω	$\frac{1}{2}$ w				302-270
R478		68 k	$\frac{1}{2}$ w				302-683
R479		100 k	$\frac{1}{2}$ w				302-104
R521		1 meg		Var.		DC BAL.	311-184
R523		1 meg	$\frac{1}{2}$ w				302-105
R524		10 k	$\frac{1}{2}$ w				302-103
R530		47 Ω	$\frac{1}{2}$ w				302-470
R534		2.5 k	5 w		Mica Pl.	1%	*310-522
R535		6.8 k	$\frac{1}{4}$ w			5%	315-682
R536		4.5 k	5 w		WW	5%	308-092
R537		1 k		Var.		Output Pl. V. Level	311-006
R539		82 k	$\frac{1}{2}$ w				302-823
R541		390 k	$\frac{1}{2}$ w			5%	301-394
R543		2 x 220 k		Var.		POSITION	311-031
R545		390 k	$\frac{1}{2}$ w			5%	301-394
R550		47 Ω	$\frac{1}{2}$ w				302-470
R551		3.5 k	10 w	Mica Pl.		1%	*310-584
R553		470 k	$\frac{1}{2}$ w				302-474
R556		2 k	5 w		WW	5%	308-091
R557		200 Ω		Var.		GAIN ADJ.	311-178

Switches

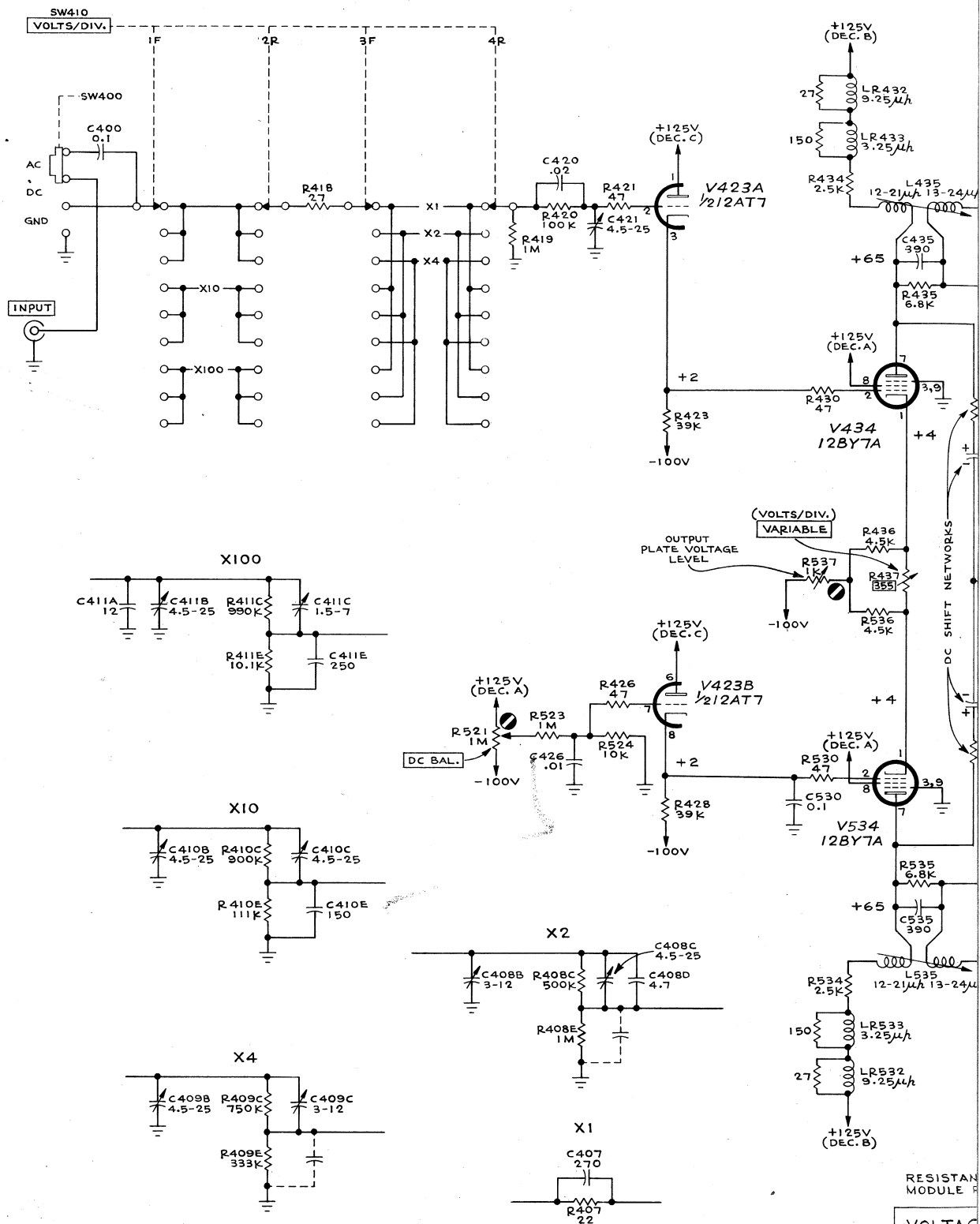
					Unwired	Wired
SW400	101-1119	Slide	AC/DC		260-251	
SW400	1120-up	Slide	AC/DC		260-450	
SW410		Rotary	VOLTS/DIV		*260-158	*262-482

Vacuum Tubes

V423	12AT7	154-039
V434	12BY7	154-047
V443	6DJ8	154-187
V454	6197	154-146
V463	6DJ8	154-187
V534	12BY7	154-047
V554	6197	154-146



INPUT AMPLIFIERS



MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.