Errata

Title & Document Type: 1402A Dual Trace Amplifier Operating and Service Manual

Manual Part Number: 01402-90903

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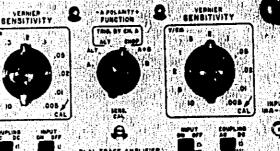
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DUAL TRACE AMPLIFIER 1402A

CHANNEL'A



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HEWLETT . PACKARD

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OPERATING AND SERVICE MANUAL

II/P Part No. 01402-90903

MODEL 1402A DUAL TRACE AMPLIFIER

SERIALS PREFIXED: 709-

(See Section I for instruments with other Serial Prefixes.)

Copysight HEWLETS PACKARD COMPANY 1981 SOI PAGE MILL BOAD, PALO ALLO, CALIFORNIA, U.S.A.

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Model 1402A

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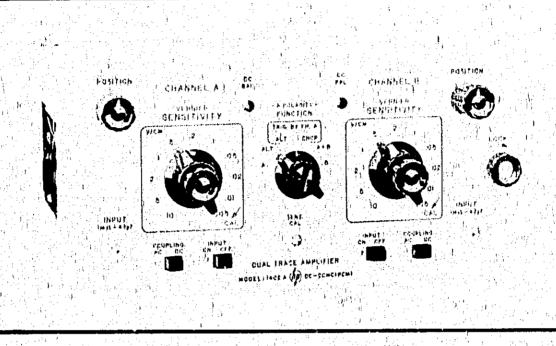


Figure 1-1, Model 1402A Dual Trace Amplifier

Table 1-1. Specifications

MODE OF OPERATION:

à

- 1, Channel A alone,
- 2. Channel B alone,
- 3. Channel A and Channel B displayed on alternate sweeps,
- 4. Chainel A and Channel B displayed by switching at approximately 100 kc, with trace blanking during switching.
- 5. Channel A and Channel B added algebraically; polarity of Channel A may be inverted to obtain differential operation.

SENSITIVITY:

Each channel has sensitivities from 5 mv/cm to 10 v/cm in 11 calibrated ranges in a 1, 2, 5 sequence. Vernier allows continuous adjustment between calibrated ranges and extends minimum sensitivity to at least 25 v/cm. Attenuator accuracy 13%.

BANDWIDT nt; (6 cm reference signal) DC coupled; de to 20 me. AC coupled: 2 cps to 20 me. RISE TIME: Less than 20 usec with 6 cm step input.

SIGNAL DELAY:

Signal is delayed so that leading edge of fast rise signals is visible at start of sweep.

COMMON MODE REJECTION:

(In B-A mode). At least 40 db on 5, 10, and 20 my/cm ranges, at least 30 dbon 50 my/cm to 10 v/cm. Sine wave common mode signal not to exceed 150 cm (e.g., 150 volts on l v/cm range) or a frequency of 500 kc.

INPUT IMPEDANCE: 1 megohim shunted by 43 pf.

MAXIMUM INPUT; 600 volts (de + peak ne).

WEIGHT: Net, 6 lbs. (2,7 kg). Shipping, 8 lbs. (3, 6 kg).

POWER: Supplied by oscilloscope,

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SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The p Model 1402A Dual Trace Amplifier, Figure 1-1, is a 20-Mc DC-coupled amplifier plug-in unit which has been designed for use with p Model 140-series oscilloscopes. It contains dual amplifying channels for amplification of two separate input signals, and a function control which determines the presentation of the signal on the screen of the oscilloscope cathode-ray tube. The amplified signals from the Model 1402A are applied directly to the deflection plates of the CRT. Power is supplied to the plug-in unit by the oscilloscope.

1-3. The Model 1402A provides the Model 140-series oscillostopes with calibrated sensitivities from 5 millivolts per centimeter to 10 volts per centimeter, DC colpling is available at all sensitivities, with provision for AC coupling at the input. The Model 1402A may be used in either vertical or horizontal plug-in compartments of the Model 140A Oscilloscope, and sensitivity is the same horizontally as vertically, Front-panel gain adjustments are provided to calibrate the sensitivity for both amplifier channels, Frequency-compensated probes are available for use with the Model 1402A (see Paragraph 1-5).

1-4. In dual trace operation, the two signals are presented on the screen either on alternate sweeps of the time base (ALT) or alternately on the same sweep (CHOP) at a chopped rate of approximately 100 kc. Except for special cases such as single-shot highspeed phenomena, these two modes accommodate all dual-trave applications. Internal triggering uses the Channel A signal; optionally the combined signal may by selected for triggering in the ALTernate mode. In single trace operation, either one of the signals is presented while the opposite channel is switched off. Algebraic addition (A+B) presents the sum of the two inp it signals. Dual X-Y displays also are possible (see Figure 3-8)

1-5. PROBES.

1-6. Frequency-compensated probes are recommended for measuring in high impedance circuits, or for reducing signal voltage applied to the Model 1402A. The 10:1 Divider Probes, Model 10001A/B (30 Mc) and Model 10003A (50 Mc), provide an effective input impedance of 10 megohms shunted by 10 pf. The 50:1 Divider Probe, Model 10002A/B (30 Mc), provides an effective input impedance of 0 megohms shunted by 2.5 pf. The calibrator on the front panel of the oscilloscope provides a square wave which may be used for the probe compensation adjustment described in the Operating Note supplied with the Probe.

1-7. MANUAL IDENTIFICATION AND CHANGES.

1-8. Information in this manual applies directly to Model 1402A instruments with a serial prefix of 709-(see manual title page). The serial prefix of an rinstrument is the first three digits (i. e. those before the dash, as in 000-00000) of the serial number stamped on a plate attached to the rear panel. Appendix I, Manual Changes, provides information to adapt this manual to an instrument with any serial prefix lower than 709-. Serial prefixes of 525- and below are covered in another manual, hp Part No. 01402-09001. Any errors in this manual when it was printed are called Errata, and these corrections (if any) will appear on the separate change sheet included with this manual.

1-9, SCOPE OF MANUAL.

1-10. This manual supplies operating and maintenance instructions for the $\frac{1}{2}$ Model 1402A Dual Trace Amplifier. The information in this manual supplements the manuals for the $\frac{1}{2}$ Model 140-series oscilloscopes. If a time base or other plag-in unit is used in combination with the Model 1402A refer also to the manual for that plug-in.

SECTION II

2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. If extranal damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is a packed. Check the instrument for external damage such as broken controls or connectors, and dents or scratches on the panel surfaces. If damage is evident, see Paragraph 2-4 for recommended claim procedure and repackaging information. If the shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. If the instrument appears undamaged, perform the electrical check given in the following paragraph. 2-3. ELECTRICAL CHECK. Check the electrical performance of the Model 1402A as soon as possible after receipt. Paragraphs 5-3 through 5-12 contain performance check procedures which will verify instrument operation within the specifications listed in Table 1-1. This check is also suitable for incoming quality control inspection. If the Model 1402A does not perform within the specifications when received, refer to Paragraph 2-4 for recommended claim procedure and repackaging information.

2-4. CLAIMS AND REPACKAGING.

2-5. If physical damage is evident, or if the instrument does not meet specifications when received,

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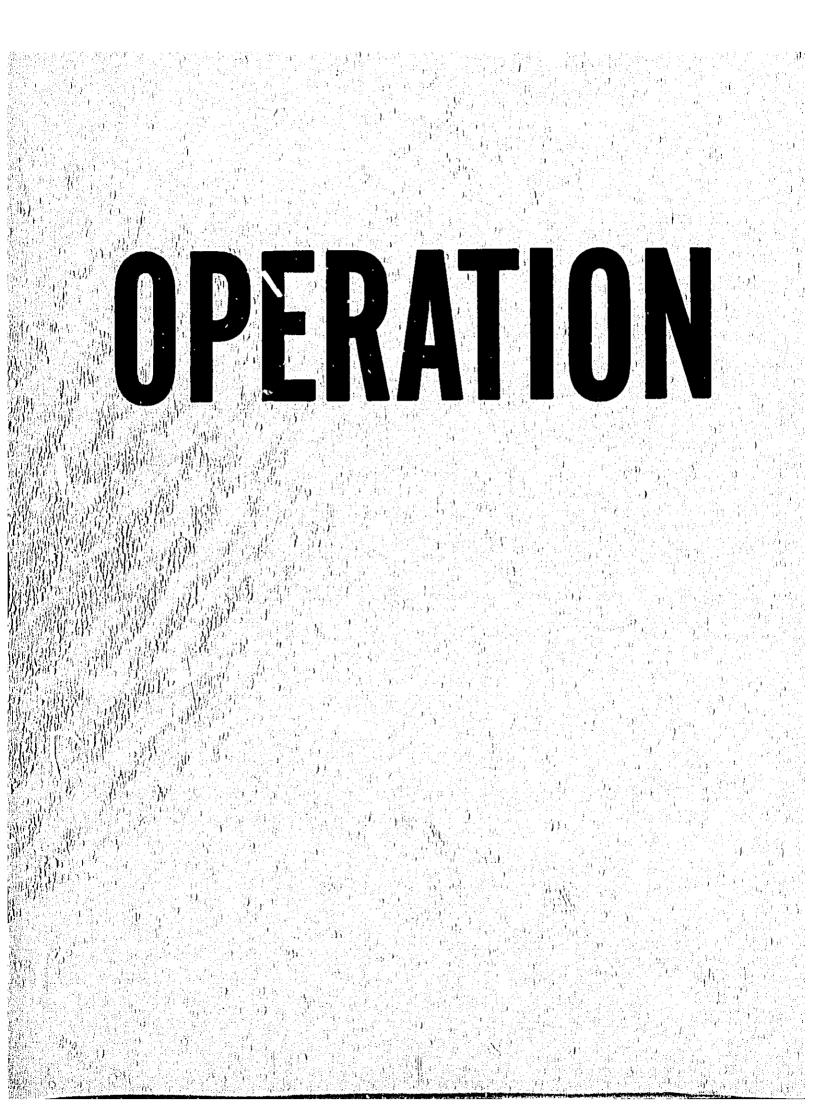
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notify the carrier and the nearest Hewlett-Packard Sales/Service Office (see list at rear of this manual). The Sales/Service Office will arrange for repairor replacement without waiting for settlement of a claim with the carrier.

2-6. The original shipping carton and packing material, with the exception of the accordion-pleated pads, should be used for reshipment. The accordion-pleated pads are fatigued with one use and are not reusable. The Hewlett - Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packaging material is not available or is not reusable. Materials used should include: (1) a double-walled carton (check with a freight carrier for test strength required), (2) heavy paper or sheets of cardboard to protect all instrument surfaces; use extra material around projecting parts of the instrument, (3) at least four inches of tightlypacked shock-absorbing material surrounding the instrument. Close the carton securely with durable shipping tape. If the instrument is to be shipped to a 4 Sales Service Office for repair, attach a tag showing owner, model, serial number, and repairs required.

2-7. PREPARATION FOR USE.

2-8. The Model 1402A' is an amplifier plug-in unit for the Model 140-series Oscilloscopes. In the Model 140A Oscilloscope the Model 1402A can be used in either plug-in compartment, but it is normally used as a vertical amplifier in the lower plug-in compartment, while the upper compartment is used for the sweep plug-in unit. To install the Model 1402A, slide the unit into the appropriate compartment in the oscilloscope front panel. Lock the plug-in in place to ensure good electrical and mechanical connection. All necessary power for the Model 1402A is supplied by the oscilloscope.



SECTION III OPERATING INSTRUCTIONS

3-1, INTRODUCTION.

3-2. The Model 1402A Dual Trace Amplifier contains two amplifier channels, with provision for display of either or both signals on the cathode-ray tube of a Model 140-series oscilloscope. With the exception of FUNCTION, A POLARITY, and SENS CAL, all controls and inputs are duplicated: one set for Channel A at left, the other for Channel B at right. Figure 3-2 lists the functions of the controls and connectors.

3-3. OPERATING PROCEDURES.

3-4. Figures 3-3 through 3-8 give step-by-stepoperating instructions for the Model 1402A. These instructions are keyed to individual controls. Additional information on the various modes of presentation it given in Paragraphs 3-6 through 3-13. The DC Balance and Sensitivity Calibration adjustments, Figures 3-3 and 3-4, are to be made before using the Model 1402A. Sensitivity calibration should be checked each time the Model 1402A is transferred from one compartment to the other, or from one oscilloscope to another. The Model 1402A may be used in either vertical or horizontal plug-in compartments of the Model 140A oscilloscope; however, chopped blanking takes place only when the Model 1402A is used in the lower (vertical) compartment.

3-5. MODES OF PRESENTATION.

3-6, SINGLE CHANNEL, Either Channel A or Channel B may be displayed by switching the FUNCTION control fully counterclockwise (A) or fully clockwise (B). In either position the unused channel is switched off, so that it is not necessary to disconnect input signal. When internal triggering is used, time base triggering is from the signal displayed.

3-7. ALTERNATE. In ALTernate operation, the Model 1402A connects the output of one channel to the CRT for the duration of one sweep, and the output of the other channel for the duration of the next sweep. Alternate operation is intended for comparing signals which require fast sweep speeds. Although the sweep may be triggered by an external trigger signal which is synchronized with both vertical signals, internal triggering may be used, each sweep being triggered by the signal of the channel which is about to be presented. This mode is useful, when two signals unrelated in time are to be displayed. See also Paragraph 3-8.

3-8. ALTERNATE, TRIG BY CH. A. This more is similar to the alternate mode of operation described in paragraph 3-7, except that internal sweep triggering is from the Channel A signal only. This method of triggering permits accurate time comparisons between the two signals. 3-9. CHOPPED. In CHOPped operation the Model 1402A switches channels at a rate of approximately 100 kc, so both signals appear during each sweep. Chopped operation is intended for comparing signals which require sweep speeds below about 50 microseconds per centimeter, that is, sweep speeds which are low compared to the 100-kc switching rate. This type of operation permits precise time comparisons because both signals are displayed on the same sweep. When internal triggering is used, the Channel A signal is used to trigger the time base. Switching transients are blanked when the Model 1402A is used in the vertical. (lower) compartment of the Model 140A oscilloscope.

3-10, ALGEBRAIC ADDITION. In A+B operation, the sum of in-phase signals applied to Channels A and B is presented on screen; or, in the case of out-of-phase (differential) signals, the difference of the two signals is presented. Differential (B-A) operation is obtained by switching A POLARITY to negative (-). The B-A mode presents the sum of out-of-phase (differential) signals, or the difference of in-phase signals. Common-mode rejection may be improved by slight adjustment of one sensitivity VERNIER or the other to null the common-mode signal seen on the screen. Use only one VERNIER in order to maintain a calibrated display.

3-11. DUAL X-Y. Two independent X-Y displays may be presented on the CRT of the Model 140A Oscilloscope by using two Model 1402A plug-ins, or one Model 1402A and another 1400-series dual-trace vertical amplifier. Operating instructions are given in Figure 3-8. For X-Y measurement above 10 kc the delay line of the Model 1402A may cause phase-shift errors greater than 2° when used with a 1400-series plug-in that does not contain a delay line. Two Model 1402A's, however, are matched closely enough that less than 2° of phase shift beyond 100 kc is assured, and less than 3° to 1 Mc is typical.

3-12. If higher-frequency X-Y operation is desired, the following modification and adjustments must be per-formed.

a. Disconnect the delay line in both Model 1402A's.

b. Connecta 10-26 ohm, 1/4 watt resistor between the L402/R408 junction and L404/R415 junction in both Model 1402A's. Refer to Figure 5-14.

c. Connect a 10-20 ohm, 1/4 watt resistor between the L401/R407 junction and L403/R411 junction in both Model 1402A's:

NOTE

Jumpering the amplifier leads with these resistors damps oscillation tendencies. Section III Paragraphs 3-13 to 3-15

d. Install the Model 1402A's in the Model 140A, and insert the same high-frequency signal into both units using Channel A or B functions.

e. Adjust C433, C441, and C461 in the lower Model 1402A, as necessary, between the 1-10 Mc band for minimum phase shift on a 45° line display. C461 is dominant through the 1-4 Mc band, C441 from 4/to 8 Mc, and C433 above 8 Mc, although all three interact to some extent.

The maximum signal sizes to minimize distortion are 10×10 cm for signals below 10 Mc, and 6×6 cm (centered) for signals above 10 Mc. When these limits are observed, the 1402A X-Y operation may typically be less than 3° of phase shift or distortion through 20 Mc.

3-13. When normal use of the Model 1402A's is again desired; remove the resistors installed above, and reconnect the delay lines. The Model 1402A in the upper compartment should still be calibrated. The Model 1402A in the lower compartment must be recompensated for high frequency performance, using the procedure supplied in Paragraph 5-25.

3-14. BANDWIDTH.

3-2

3-15. The bandwidth specification of the Model 1402A is 20 megacycles, referenced to a low frequency display of 6 centimeters. Linearity is such that the 6cm display may be positioned anywhere over the 10 x 10 cm area of the CRT graticule without significant distortion or loss of bandwidth. Figure 3-1 illustrates a typical bandwidth curve.

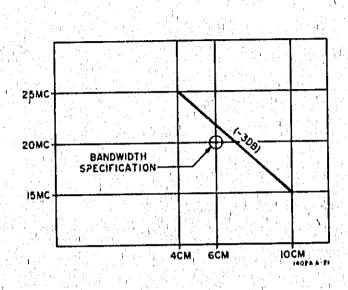
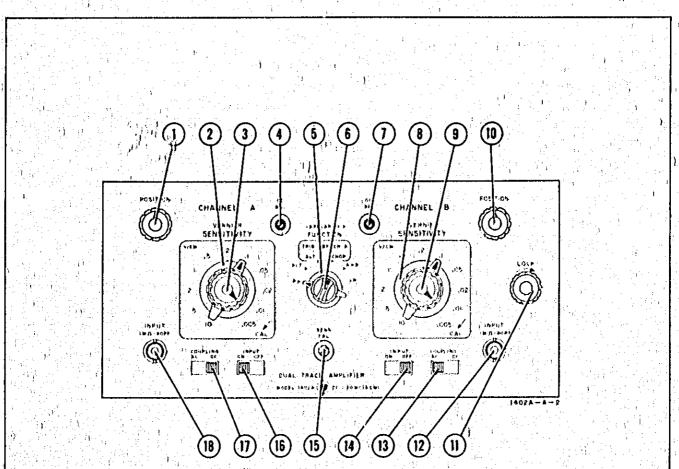


Figure 3-1: Model 1402A Bandwidth

Section III Figure 3–2



- 1. Positions Channel A trace vertically on CRT.
- 2. Selects sensitivity of Channel A.

Model 1402A

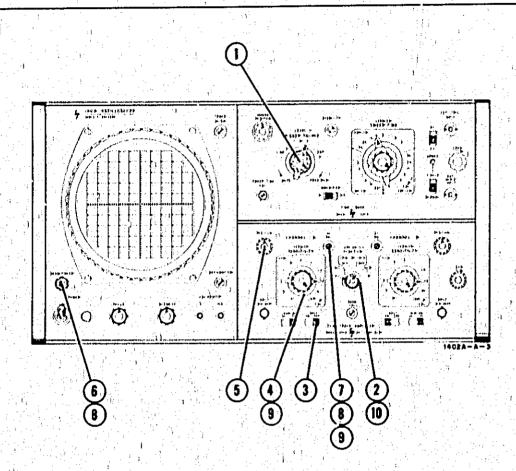
- 3. Provides continuous adjustment between steps of SENSITIVITY switch.
- 4. Balances Channel A amplifier to prevent vertical shift of trace when sensitivity is changed.
- 5. Selects signals displayed, mode of display, and signal (Channel A or combined) to be used for internal triggering.
- 6. Determines polarity of Channel A display.
- 7, Balances Channel B amplifier,
- 8. Selects sensitivity of Channel B.
- 9. Provides continuous adjustment between steps of SENSITIVITY.

- 10. Positions Channel B trace vertically on CRT.
- 11. Locks plug-in unit in place, and
- 12. Signal input connector for Channel B.
- 13. Selects AC coupling or DC coupling at Channel B input,
- 14. Connects' (ON) or disconnects (OFF) signal to Channel B.
- 15. Calibrates sensitivity of the Model 1402A.
- 16, Connects or disconnects signal to Channel A.
- 17. Selects AC coupling or DC coupling at Channel A input,
- 18. Signal input connector for Channel A.

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Figure 3-2, Controls and Connectors

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- 1. Set LEVEL to FREE RUN.
- 2, Select Chanrel A.
- 3. Set INPUT to OFF.

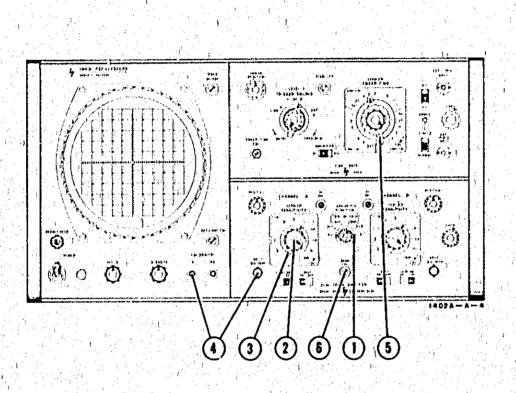
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3-4

- 4. Set Channel A SENSITIVITY to .02 V/CM.
- 5. Center Channel A POSITION control.
- 6. Depress BEAM FINDER switch.
- 7. Adjust DC BAL to center trace.
- 8. Release BEAM FINDER and recenter trace with DC) BAL.
- 9. Adjust DC BAL for no vertical shift as SENSI-TIVITY is varied between .02 V/CM and .005 V/CM.
- 10. Select Channel B and repeat steps 3 through 9, using corresponding Channel B controls.

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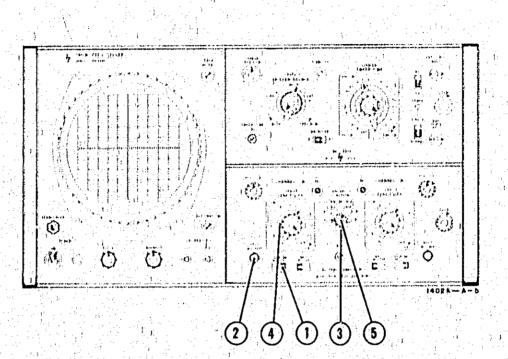


- 1. Select Channel A.
- 2. Set Channel A VERNIER to CAL

- ia

- 3. Set Channel A SENSITIVITY to ,1 V/CM.
- 4. Connect IV CALIBRATOR to Channel A INPUT.
- 5. Set SWEEP TIME to display a convenient number of cycles.
- 6. Adjust SENS CAL for exactly 10 centimeters of vertical deflection.

Figure 3-4. Sensitivity Calibration



1, Set COUPLING to DC if DC coupling is desired, or to AC to block large DC components.

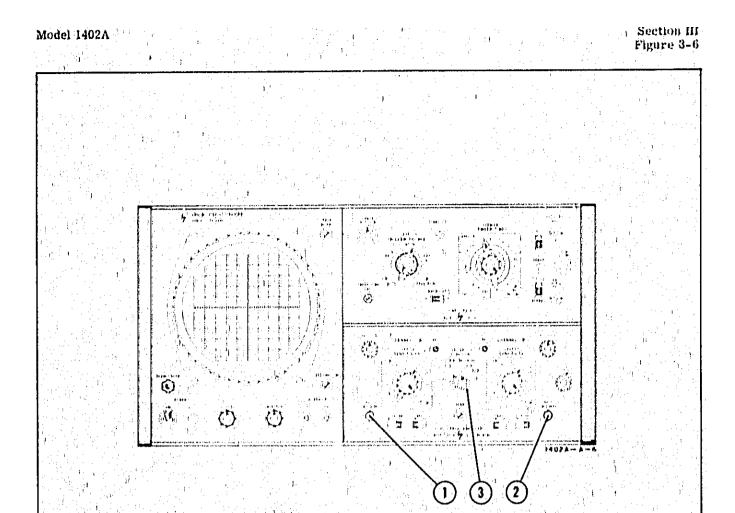
- 2. Connect signal to INPUT.
- 3. Select Channel A (or B),
- 4, Set SENSITIVITY to the desired range. For calibrated sensitivity, set VERNIER to CAL.
- 5. Set A POLARITY to (+) for normal positive-up presentation, or to (-) if inverted display is desired. (This control is effective for Channel A only.)

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1. Connect one signal to Channel A INPUT, and sat Channel A controls as desired (procedure shown in Figure 3-5).

2. Connect second signal to Channel B INPUT and set Channel B controls as desired.

3. Select CHOP for display of both signals during the same sweep, or ALT for display of signal on alternate sweeps. (Chopped operation is suitable for slower sweep rates; alternate operation for fast sweep rates.)

Note

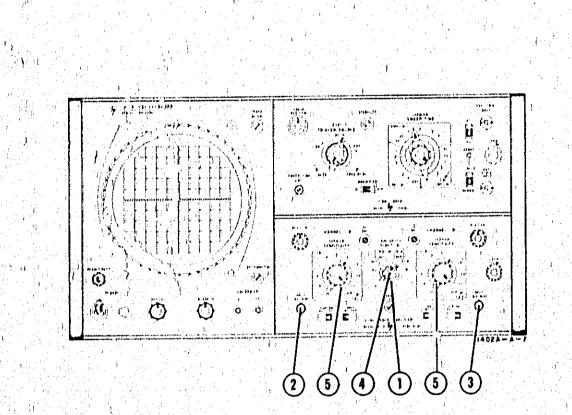
Internal triggering in the mode shown is on both channels (alternately); the next two clockwise positions of the FUNCTION control use the Channel A signal only,

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Model 1402A



Select AiB, 1.

Section III Figure 3-7

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3-8

Connect one signal to Channel A INPUT. 2. 2.1

Connect second signal to Channel B INPUT, 3,

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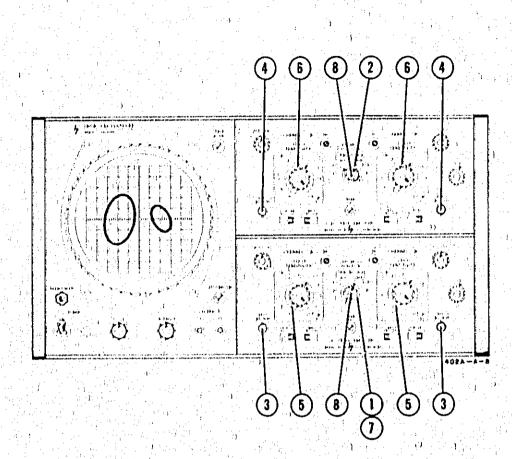
Set A POLARITY TO (+). 4.

Set SENSITIVITY switches as desired, with iden-5, tical settings for best results.

Note

Differential (B-A) operation is obtained by setting A POLARITY to (-) in Step 4.

Figure 3-7. Algebraic Addition



- 1. Set FUNCTION of vertical (lower) Model 1402A plug-in to CHOP.
- 2. Set FUNCTION of horizontal (upper) Model 1402A plug-in to ALT.
- 3. Connect Y (vertical) signals to Channel AINPUT and Channel B INPUT of vertical (lower) plug-in.
- 4, Connect X (horizontal) signals to Channel A INPUT and Channel B INPUT of horizontal (upper) plug-in,
- 5. Adjust vertical sensitivities for desired Ydeflection.
- 6. Adjust horizontal sensitivilies for desired Xdeflection.

- 7. If necessary, switch vertical (lower) FUNC-TION control out of and into CHOP until desired comparison of X and Y signals is obtained (Channels A with A and B with B, or A with B and B with A). Use POSITION controls to identify which channels are being compared,
 - 8, The A POLARITY switches can be used to reverse Channel A signals in both plug-ins:

Note "

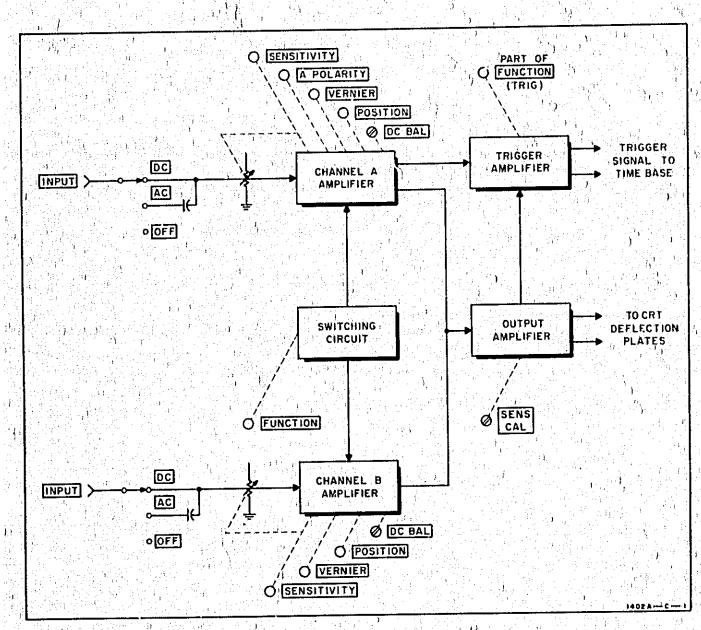
Two signals applied to a Model 1402A (set to CHOP) may also be compared with one signal applied to a single-channel plug-in in the other compartment,

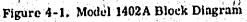
3-9

Figure 3-8. Dual X-Y Operation for Two Independent Displays

1;

4-0





j.



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Model 1402A

Section IV Paragraphs 4-1 to 4-11

SECTION IV

4-1. OVERALL DESCRIPTION.

4-2. The h Model 1402A Dual Trace Amplifier contains five basic circuits; two independent differential amplifiers (Channels' A and B), an output amplifier, a switching circuit, and a trigger amplifier. The relationship of these circuits is shown in the block diagram, Figure 4-1. The input signal for each channel is DC-coupled or AC-coupled through an input attenuator to the amplifiers, or may be disconnected (OFF). No input attenuation is used on the three most sensitive ranges. With the exception that a polarityreversing switch is provided for Channel A only, the two input amplifier channels are essentially identical. The switching circuit turns on either or both channels for one of the five modes of presentation selectable by the FUNCTION control (A, ALT, CHOP, A+B, or Signal from either or both Channel A and Chan-**B**). nel Bais applied to the differential output amplifier, which drives the deflection plates of the oscilloscope enthode-ray tube. A part of the FUNCTION switch is used to select either Channel A signal or the combined signal from the output amplifier for application to the trigger amplifier. The differential signal from the trigger amplifier is connected through the oscilloscope to a time base plug-inunit for sweep triggering. The single sensitivity calibration control, SENS CAL, is located in the output amplifier; the two input channels do not require separate front-panel gain adjustments, since these circuits are very insensitive to aging and temperature effects.

4-3, CIRCUIT DETAILS.

4-4. Refer to the schematic diagrams throughout the following circuit descriptions, Channel B operation is similar to Channel A, except as noted in the Channel A description.

4-5. CHANNEL A.

4-6. The signal is AC- or DC-coupled through S101Å and S101B to the input attenuator. On the two most sensitive settings of the attenuator, two switch wafers are used to bypass the attenuator sections, and the change of sensitivity is accomplished in the amplifier, The next (.02) position also uses no input attenuation. The remaining less sensitive ranges switch in one or two of the four attenuator networks, which provide attenuation ratios of 2.5:1 (R111/R112), 5:1 (R113/ R114); 10:1 (R101/R102), 100:1 (R103/R104). Variable capacitors in these networks are adjusted to maintain these ratios for high frequencies by capacitive division.

4-7: Input overload protection is provided by R120, V102, and CR101. DC BAL control R140 adjusts the DC level in the lower half of the amplifier, so that with no input signal the emitters of Q103 and Q104 will be at the same voltage. Thus when amplifier gain is changed (by operating SENSITIVITY control), the position of the trace will not shift. The VERNIER control R140, when rotated counterclockwise, reduces signal amplitude by shanting signal around the bases of Q103 and Q104. R150C calibrates amplifier gain for all ranges of SENSITIVITY except .01 and .005, which are calibrated (after R150C is correctly set) by R150A and R150B respectively. The output of differential amplifier Q103/Q104 can be reversed in Channel A by S103. POSITION control R170A/B varies the DC level at the output of the Channel A circuit for positioning of the display on the CRT, Signal is coupled through switching diodes CR110 and CR113 (when these diodes are switched on) to the output amplifier,

4-B, SWITCHING CIRCUIT.

4-9. The switching circuit consists of a blocking oscillator, a blanking pulse amplifier, and a multivibrator. The switching circuit applies either cutoff blas or conducting blas to the switching diodes at the output of each amplifier channel (CR110 through CR113, and CR210 through CR213) and thus determines which channel is on at agiven time. Figure 4-2 is a simplified diagram of the switching circuit,

4-10, BLOCKING OSCILLATOR, Depending on the position of FUNCTION switch S301, Blocking Oseillator Q301 can be astable, monostable, or disabled. When the emitter of Q301 is returned through R307 to the +100 volt supply (CHOP function), the circuit is permitted to oscillate with a free-running frequency of about 200 kilocycles. The positive-going voltage at the collector is coupled through C821 to switch the multivibrator; since the multivibrator must switch twice for a full cycle, multivibrator frequency is 100 kc. When the emitter of Q301 is returned to ground (ALT function), the circuit is biased off in a monostable condition and will produce a pulse each time the negative-going gate signal is received through C301 and CR301, Thus in the ALTernate mode, the multivibrator switches once for each sweep of the time base. Opening the emitter lead in the A, A-B, and B positions disables the circuit for these tunctions.

4-11 NBLANKING PULSE AMPLIFIER. The posttive-going partion of the pulse from the blocking oscillator has no effect on Q302; the negative backswing, however, turns this transistor on, producing a positive pulse which blanks the CRT beam. Transients caused by switching in the CHOPped mode thus do not appear in the CRT screen. The time period between the start of the blocking oscillator pulse and the negativegoing backswing is about 205 panoseconds, which corresponds to the signal delay introduced in the output amplifier. Thus blanking starts at the same time as any transient which may appear. CR303, is reversebiased in CHOP mode, but in all other positions is forward-biased to ground undesirable blanking transients.

Section IV Paragraph 4-12

4-12. MULTIVIBRATOR, Transistors Q303 and Q304 are connected in a bistable multivibrator circuit, Depending on the position of the FUNCTION switch the multivibrator may be switched by positive triggers from Blocking Oscillator Q301 (ALT or CHOP), locked in either of its two stable states (A or B), or disabled (A+B). Figure 4-2 illustrates signal conditions for ALTernate operation at a time when Q303 has been switched on (output niore negative) and Q304 has been cut off (output more positive). With these output voltages, CR111 and CR112 are forward-biased, which shorts Channel A signal. The current of Channel A output transistors Q103 and Q104 flows through Q303 of the multivibrator, Diodes CR110 and CR113 are reverse-biased, which disconnects Channel A output from the output amplifier. Channel A is therefore "off", In Channel B, diodes CR211 and CR212 are biased off and CR210 and CR213 are fowardbiased, which permits signal from Channel B output transistors Q203 and Q204 to be coupled to the output

amplifier. Channel B is therefore "on". When the next sweep starts, a positive trigger from Q301 reverses the states of Q303 (off) and Q304 (on). This reverse-binses the four diodes which were on (CR111, CR112, CR210, and CR213), and forward-biases those which were off (CR110, CR113, CR211, and CR212), Thus Channel A is switched on and Channel B is switched off, and for each following successive sweep, the two channels will be switched alternately on and off. In CHOP mode, the channels are switched at a 100-ke rate, as determined by the free-running rate of the blocking oscillator. In the A position of the FUNCTION switch, -12.6 volts is applied through R332 to CR211 and CR212, which forward-biases these diodes and reverse-biases CR210 and CR213. The multivibrator is disabled by R334 which limits current available to Q303 and Q304, and the output of Q303 is near ground (less negative than when conducting). Diodes CR111 and CR112 are therefore reversebiased, and Channel A signal is coupled through CR110

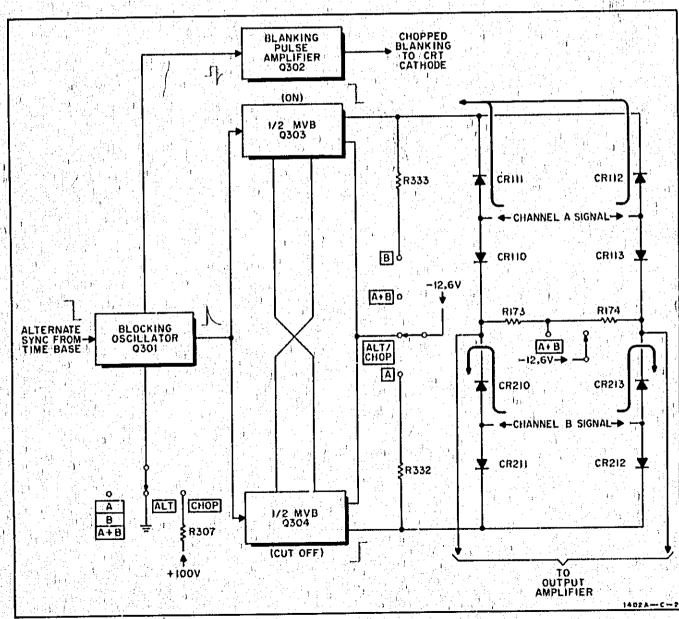


Figure 4-2. Switching Circuit Simplified

Model 1402A

and CR113 to the output amplifier. In the B position of the FUNCTION switch, the reverse situation holds true, with -12, 6 volts being applied through R333. In the A+B mode the multivibrator is also held inoperative by R334, and -12, 6 volts is applied to the junction of R173 and R174, which forward-biases CR110 CR113, CR210, and CR213 while reverse-biasing CR111, CR112, CR211, and CR212. The signals of both channels are thus added and applied to the output amplifier.

4-13, OUTPUT AMPLIFIER.

4-14. Signals from Channel A or Channel B (or both in A+B mode) are amplified by common base amplifiers Q401/Q402 and are applied to delay lines DL401 and DL402. The purpose of the delay introduced by these lines is to permit starting of the sweep trace in advance of the display of a vertical signal. Thus if a fast-rise vertical signal is also used to trigger the sweep, the entire pulse rise will be displayed on the CRT screen. Trigger pickoff is ahead of the delay lines, at the junctions of R401/R402 and R405/R406, Position Adjustment R409 sets DC levels to be the same in both halves of the output amplifier. Adjustment is made by centering the trace with no DC differential input to Q401/Q402. SENS CAL control R423 adjusts signal degeneration between the bases of Q405 and Q406, and is set for calibrated sensitivity of the Model 1402A. High-frequency adjustments C433, C441, and C461 adjust high-frequency gain in the third, fourth, and sixth stages respectively. Each of the three adjustments provides frequency compensation of a different time constant, and the adjustment having the longest time constant, C461, should be adjusted first, Diodes CR451, CR452, CR461, and CR462 are normally reverse-biased, and provide voltage overload protection for V401A/B, V402, and V403 by elamping the enthodes of these tubes to +12, 6 volts. Output Plate Voltage adjustment R460 adjusts the voltage applied to the deflection plates for optimum focus operation of the CRT. The BEAM FINDER switch, located on the oscilloscope front panel, reduces current available to output tubes V402 and V403 by allowing R474 to be inserted in series with the eathode supply, Withstage current thus reduced, the difference in CRT deflection plate voltages will be small enough to locate the trace on screen, regardless of signal amplitude or the setting of POSITION controls,

4-15 TRIGGER AMPLIFIER.

4-16, Differential signal from Channel A is applied to Q501 and Q502, and differential signal from the output amplifier (which may be either Channel A or Channel B signal, or both) is applied to Q503 and Q504, A part of FUNCTION switch S301 selects

Section IV Paragraphs 4-13 to 4-18

either one of these trigger sources (Channel A only for the two dual trace functions designated TRIG BY CH. A. or the combined signal for the four remaining positions) and the signal is AC-coupled through C511 and C512 to differential amplifier Q505/Q506, Slightly less sensitive triggering may be noted on TRIG BY CH. A ALT when using the 5 and 20 millivolt settings of the SENSITIVITY control. Sync Bal adjustment R514 balances the differential signal applied to the time base. The output of the second differential ampliffer, Q507/Q508 is applied through emitter followers Q509 and Q510 to the time base plug-in. Diode CR541 is reverse-blased in all function positions except CHOP, effectively disconnecting C541 and C542. In CHOP position CR541 is forward-biased, which places C541 and C542 across the output of Q507 and Q508. This reduces the bandwidth of the stage and prevents switching transients from being applied to the time base triggering circuit. Extended handwidth is not required in the CHOP mode since, this type of display is suitable only for vertical signals considerably below the 100-ke chopping rate. The calibrator voltage divider, shown on the trigger amplifier schematic, divides the 1-yolt line-frequency calibrator voltage to calibrated voltages of 120 millivolts, 60 millivolts, and 30 millivolts. These voltages are available at terminal posts on the trigger amplifier board for use in checking sensitivity calibration (see paragraph 5-23 for recommended procedure in making sensitivity adjustment),

4-17, DUAL X-Y SWITCHING,

4-18, When two Model 1402A amplifiers are used for dual X-Y measurements, the vertical plug-in (lower compartment of the Model 140Å) is used in CHOP MODE. The frequency of the blocking oscillator in this plug-in (about 200 kc) determines the switching rate of bothamits, and provides chopped blanking to the CRT in the oscilloscope. The blocking oscillator waveform is applied through the oscilloscope to the hase of the blocking oscillator in the horizontal plugin. The horizontal plug-in (upper compartment of the Model 140A) is used in ALT mode, and since the blocking oscillator is in the monostable condition, it is triggered by the 200-ke switching waveform received from the vertical plug-in, and thus switches at the same rate. Because the multivibrators in the two Model 1402A's will not always be in the same state when the first chopping pulse is 'received, the selection of channels for X-Y comparison is random (not selectable from the front panel). However, by operating the FUNCTION switch of the vertical plugin out of and into CHOP a few times, the desired X and Y channels can be caused to switch on together, thus permitting comparison of Channel A with A and B with B, or A with B and B with A,



Section V Table 5-1

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Model 1402A

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•	Ċ,	Table	5-1	, E	Equipment	Rer	uired for	Tests	nnd	Adjustments

Instrument Type	Recommended Model	Required Characteristics	Required for	, Ref Para
1. Signal Generator	Textronix Type 190	Frequency 50 ke to 20 Me; output 1v - 2v	Common-Mode Rejection Check; Bandwidth Check	5-0 5-11
2. Voltmeter Calibrator	<i>lp</i> 738AR	AC output 50 my to 100 v p-p; accuracy ±0.5%	Sensitivity Check	5-10
3, Pulse Generator	Tektronix Type 107	Output 250 mv; rise time less than 5 ns; frequency 400 kc	Rise Time Check; High Frequency Adjustment	5-12 5-25
4. Square Waye Generator	A 211A	Frequency 10 kc; output 0.2 v	Attenuator Compensation Adjustment	5-24
5. DC Volt- meter	67 412A	Full-scale range 1v, 100 v; accuracy 1%; floating common lead	DC Level Adjustment; Trigger Amplifier Balance Adjustment	5-22 5-26
6, Audio Oscillator	<i>∳</i> ≩200CD	Output 3y p-p; frequency 400 cps,	Sensitivity Adjustment	5-23
7. L-C Meter	Tektronix Type 130	To indicate 43 pf	Input Capacity Adjustment	5-24

MAINTENANCE

5-1. INTRODUCTION.

Model 1402A

5-2 This section covers maintenance, troubleshooting, and adjustment of the Model 1402A Dual Trace Amplifier. The performance check (Paragraphs 5-3 through 5-12) may be used at incoming inspection or after adjustments have been made to verify that the instrument meets its specifications (Table 1-1),

5-3. PERFORMANCE CHECK,

5-4. The performance check is intended to determine whether or not the instrument is operating within its specifications, all adjustment is required, refer to Paragraph 5-13. To check calibrator accuracy and other specifications for the oscilloscope, refer to the oscilloscope manual.

5-5, TEST EQUIPMENT.

5-6, 'Test equipment recommended for the performance check is listed in Table 5-1, items 1 through 3. Similar instruments having the listed characteristics may be substituted.

5-7, PROCEDURE,

5-8. Install the Model 1402A in the desired plug-in compartment of an # Model 140-series oscilloscope, depending on whether the plug-in is intended for use as a horizontal or a vertical amplifier. In the following performance check procedure it is assumed that the lower (vertical) compartment of the Model 140A is being used to test the Model 1402A.

5-9, COMMON-MODE REJECTION.

a, Set:	FUNCTION , , , , , , , , , , , , , , , , , , ,	н н Эн э	•	ALT
	A POLARITY			
	VERNIER (both)		•	CAL
는 것 같아?	Channel A and B SENSITIVITY	٠	٠	⊤_(0, 2 _

b. Apply a 500 kilocycle signal from the Signal Generator (see Table 5-1) to both Channel A and Channel B INPUT connectors,

c. Adjust Signal Generator output for 10-cm display on both traces.

e. Display height should not be greater than I centimeter.

f. Set Channel A and B SENSITIVITY to , 01.

g. Display height should not be greater than 2 centimeters.

h. Set: FUNCTION ALT Channel A and B SENSITIVITY . . . 0. 1

I. Adjust Signal Generator output for 10-cm display on both traces.

J. Sel: FUNCTION , A+B Channel A and B SENSITIVITY . . . 0.005 k. Display height should not be greater than 2 centimeters,

5-10. SENSITIVITY:

n, Sett	FUNCTION ,	• •	•	٠,	•		•	•	• •	•	٠,	_} ∴ A
9	SENSITIVITY	(Δ)	•	.,		÷	٠	با		- 1 •	, 0.	0.02
	VERNIER (A)	+ +	٠	٠	Þ		•	•	È i		÷.	CAL

b. Connect Voltmeter Calibrator output to Channel A INPUT,

e. Check all SENSITIVITY ranges by setting Voltmeter Calibrator and SENSITIVITY controls as shown in Table 5-2. Vertical deflection in each case should be 10 cm ±0, 3 cm.

d, Repeat Steps a through c for Channel B.

Table 5-2,	Sensitiv	vity	Check
------------	----------	------	-------

SENSITIVITY	Calibrator Output					
10 V/CM	100 VOLTS					
5	50					
2 1 .5 2	20 10 5					
.1	1					
.05	15					
.02	2					
•01	, 1					
•005	, 05					

5-11, BANDWIDTH.

a, Set:	FUNCTION .	941	1:		1. 	, , A
	SENSITIVITY	(A) ,				, 0,005
	VERNIER (A)		, • •	a de la	1	CAL

b. Apply a 1 Mc signal from Signal Generator to Channel A INPUT, Use a 50-ohm load across output of Signal Generator.

c. Adjust Signal Generator amplitude for 6 cm deflection.

d. Change frequency to 20 Me. Vertical deflection should be 4.2 cm or greater.

e. Repeat Steps a through d for Channel B.

Note:

When a Model 1402A is installed for the first time in a Model 140A Oscilloscope with a serial prefix of 407-, 413-, 425-, or 437-, proceed as follows to obtain full bandwidth and rise time.

(1) Remove variable capacitor C1 from the Model 140A.

(2) Readjust C461 in Model 1402A for optimum flat top on pulse,

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Model 1402A

Section V Paragraphs 5-12 to 5-18

5-12, RISE TIME.

b.

5-2

a. Connect Pulse Generator to Channel A INPUT, Attacha 50-ohm loadacross output of Pulse Generator.

Sett	FUNCTION	A
	SENSITIVITY (A)	0,02
	VERNIER	, , CAL
	SWEEP TIME 0.	5 USEC/CM
	Sweep MAGNIFIER	

c. Obtain a 6-cm step. Rise time from 10% to 90% points on pulse should be tess than 18 nanoseconds,

Note

When a Model 1402A is installed for the first time in a Model 140A Oscilloscope with a serial prefix of 407-, 413-, 425-, or 437-, proceed as follows to obtain full bandwidth and rise time.

(1) Remove variable capacitor C1 from the Model 140A

(2) Readjust C461 in Model 1402A for optimum flat top on pulse.

5-13, ADJUSTMENTS.

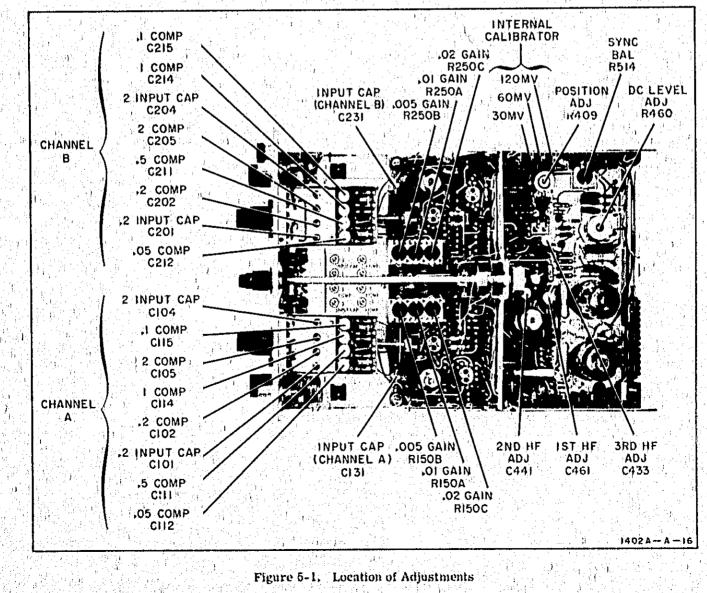
5-14, Paragraphs 5-17 to 5-26 give the adjustment procedure for the Model 1402A. If difficulty is encountered in making any adjustment, refer to Paragraph 5-27 for troubleshooting procedures.

5-15. EQUIPMENT NEEDED FOR ADJUSTMENTS. Testlequipment recommended for the adjustment procedure is listed in Table 5-1, items 3 through 7. Similar instruments having the listed characteristics may be substituted.

5-16, LOCATION OF ADJUSTMEN'TS. Figure 5-1 shows the location of all internal adjustments in the Model 1402A.

5-17, PRELIMINARY PROCEDURE,

5-18. Install the Model 1402A in the lower compartment of the oscilloscope. If a Model 140A Oscilloscope is used, install another plug-in, preferably a time base such as the Model 1420A or Model 1421A, in the upper compartment. Turn on the instrument and allow several minutes for warmup.



Model 1402Å

) Section V Paragraphs 5-10 to 5-26

5-19, DC BALANCE ADJUSTMENT.

5-20. Adjust DC BAL to eliminate trace shift when SENSITIVITY is switched between , 005 V/CM and , 02 V/CM. Perform for both channels,

5-21, POSITION ADJUSTMENT.

n. Set: FUNCTION + + + + + + + + + + CHOP POSITION controls + + + + + 12 O'clock

b. Center both traces about center of screen with Position Adj R409.

5-22, DC LEVEL ADJUSTMENT,

a, Short the plates of V402 and V403 together and measure the voltage between this short and the +250 volt supply. This may be done by clipping one voltmeter lead to pins 12 and 24 (together) of P1, the 24pin connector in the Model 140A, and the other voltmeter lead to the +250 volt supply.

b. Set the voltage to 79 volts with DC Level Adj R460.

5.23, SENSITIVITY ADJUSTMENT.

a. Set;	SENSITIVITY	÷.	• • .	i F∑F, F	<u>)</u> (), 02	V/CM	
	VERNIER			1 (34)	in an ar ∎		CAL	
	INPUT (Channel A)	Í.	ы ² н	n File a			, ON	
	INPUT (Chinnel B)		$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$		•		, OFF	

b. Connect 0. 1yp-p signal from Voltmeter Cali-

e. Turn SENS CAL completely clockwise.

d. Set. 02 Gain adjustment for about 6 cm deflection.

ei Adjust SENS CAL for exactly 5 cm deflection.

1. Change signal input to 0, 2v p-p and readjust SENS CAL for 10 cm deflection. Change signal input to 0, lv p-p.

g. Set SENSITIVITY to . 01 V/CM.

h. Set , 01 Gain adjustment for 10 em deflection,

1. Change signal input to 0, 05y p-p.

j. Set SENSITIVITY to . 005 V/CM.

k. Set, 005 Gain adjustment for 10 cm deflection.

Set	: FUNCTION .		• •		•	ŧ÷.		•	i.	• •	A B
et generalise Angeleration	A POLARITY	. °. ▶	•.•		s Fri	*		ં		→ 1,	(-) :
-	A&B SENSITIV	71')	ΓY.				; • •	•		, 02	.V/CM
	INPUT (Chann	eľ	B)	12				- 1	12		ON

n. Apply 3v p-p-400 cps sine wave to both Channel A&B inputs.

p. Adjust Channel B , 02 Gain adjustment for minimum deflection.

q. Change sine wave amplitude to 2y p-p.

r. Set SENSITIVITY to . 01 V/CM.

s., Set Channel B., 01 Gain adjustment for minimum deflection.

t. Change sine wave amplitude to Iv p-p.

u. Set SENSITIVITY to . 005 V/CM.

m.

y, Set Channel B , 005 Gain adjustment for minimum deflection,

5-24. INPUT CAPACITY AND ATTENUATOR COMPENSATION ADJUSTMENT.

Note

Adjustments are given for Channel A with corresponding Channel B adjustments in parentheses, e.g. C131 (231), Perform adjustments for Channel A, then repeat for Channel B when instructed.

a. Set SENSITIVITY to . 02 V/CM.

b. Connect: L-C Meter to Channel A INPUT and indjust C131 (231) for 43 pf. Repeat for Channel B.

e, Apply 10 ke square wave to Channel A INPUT. Obtain a pattern 10 cm high, and make the adjustments indicated in Table 5-3, Repeat for Channel B.

d. Connect L-C Meter to Channel A INPUT and adjust C101 (C201) with SENSITIVITY at .2, and C104 (C204) with SENSITIVITY at 2 for 43 pf.

Table 5-3, Attenuator Adjustment

SENSITIVI	TY (V/CM)	Capacitor
1	.05 1 2 5	C112 (212) C115 (215) C102 (202) C111 (211) C114 (214) C105 (205)

5-25. HIGH FREQUENCY ADJUSTMENTS,

a. Set: SENSITIVITY (A), \dots 0.02 V/CM VERNIER (A), \dots CAL FUNCTION

b. Connect 400 kc Pulse Generator signal to Channel A INPUT through 50-ohm termination.

c. Obtain a 6 cm deflection and adjust C461, C441, and C433 for optimum flat top on pulse.

Note

When a Model 1402A is installed for the first time in a Model 140A Oscilloscope with a serial prefix of 407-, 413-, 425-, or 437-, proceed as follows to obtain full bandwidth and rise time.

(1) Remove variable capacitor C1 from the Model 140A.

(2) Readjust C461 in Model 1402A for optimum flat top on pulse,

5-26. TRIGGER AMPLIFIER BALANCE,

n. Measure the DC voltage between the output leads of the trigger amplifier. This may be done at the ends of R551 and R552 which are connected to, the black and white conx leads.

b. Set this voltage to zero with Syne Bal adjustment R514. Should be 0 ± 5 volt.

Model 1402A

Section V Paragraphs 5-27 to 5-30

Table 5-4, Troubleshooting for Unbalance

		OUTPUT AMPLIFIER	
Step	Short Together	Effort	Common Fault (or Procedure)
1	Pins 3 and 8 of V401	Trace centers	Proceed to next step
		Trace does not center,	V402, or V403, or CR461 or CR462
2	Pins 2 and 7 of V401	Trace centers	Proceed to next step
		Trace does not center	V401 or CR451 or CR452
3	Junction of R431 and Q405	Trace centers	Proceed to next step
	Collector to Junction of R436 and Q406 Collector	Trnce does not center	Q407 or Q408
4	Junction of R421 and R422	Trace centers	Proceed to next step
р. •	Junction of R425 and R424	Trace does not center	, Q405 or Q406
±5	Junction of R411 and L405	Trace centers	Proceed to next step
	to Junction of R415 and L406	Trace does not center	Q403 or Q404
	na an an an an an Araban an Araban Araban an Araban an A	INPUT AMPLIFIERS	
6	Dase of Q103	Trace Centers	Proceed to next step
	Base of Q104 (Center both POSITION controls)	channel before making a channel checks normal, the transistors (Q103/Q1 where the trace does not on both channels the trac (1) either (or both) mate Q203/Q204), or (2) inco	ter on one channel, check the other component replacement. If only one the "Common Fault" is then one of 104 or Q203/Q204) in the channel center. If the trace fails to center uble may be one of the following: tched transistor pair (Q103/Q104 or orrect switching circuit levels (see mmon-base stage, Q401/Q402, in
		t me output temperature	
7	Base of Q101	Trace centers	Proceed to next step
7	Base of Q101 to Base of Q102		Proceed to next step Q101 or Q102
7 8	to	Trace centers	

5-27. TROUBLESHOOTING.

5-4

5-22. The following paragraphs outline procedures for locating and clearing problems in the Model 1402A. Be sure that the trouble cannot be cleared by making an adjustment. Waveforms and DC voltage levels are shown with the schematic diagrams.

5-29. LOW AMPLIFIER GAIN. Whenever overall gain is too low to be adjusted properly with the SENS CAL control, waveforms for the D Model 140A 10V

CALIBRATOR signal are provided for troubleshooting. To locate the trouble, trace the calibrator signal from the input through each successive stage, using the test points and waveforms (1 through 11) provided with the schematics until the faulty stage is located, Switching from Channel A to Channel B will aid in determining whether the trouble is in the output amplifier or one of the input amplifiers.

5-30. UNBALANCE. Unbalance in a differential amplifier is generally caused by malfunction of a component(s) on one side of stage of the amplifier and

Model 1402A

SWITCHING	CONDITIONS	TROUBI	Leshooting Proci	EDURE
Operates	Does Not Operate	Check	¹ Condition	Repnir Procedure
Chop, Alt	A, B, or A+B	DC Volinges at Test Points 20 and 21 (see Table 5-6)	Voltages in error	Check for good switch connections and solder joints,
A, B, A+ B ALT and		n, Waveforms at Test Point	No signal	Replace Q301
	Chop	19 (transistor case and collector are tied together)	Signal present	Proceed to b,
		b, Waveforms at test point 20 or 21	(1) No signal	(2) Replace Q303 and/or Q304
			(3) Still no signal	(4) Trace signal through multivibrator circuit,
A, B, A+B and Chop		Waveforms at Test Point 23	No Signal	Check Time Base plug-in and J1/P1 connections,
			Signal present	Replace CR301
	No blanking in CHOP position	Waveform at Test Point 22 (Pin 15 of J1 in 140A)	Signal present	 n. Check Z Axis switch on rear panel of 140A for INT position; b. If still not operating check for good donnec- tions on switch, c. If still not operating replace switch,
			No Signal	 n. Remove CR303, b. If signal appears replace CR303, e. If still no signal proceed to d.
			d, No Signal	e, Replace Q302
		n an an Anna an Anna Anna Anna Anna Anna	f, Still no signal	g, Trace signal through circuit,

Table 5-5, Switching Troubleshooting

can be isolated to either input amplifier or to the output amplifier by setting the FUNCTION control first to one channel and then to the other. If balance is possible on one channel and not the other the unbalance is not in the output amplifier and unnecessary steps can be eliminated.

5-31. IMPROPER SWITCHING OPERATION. Table 5-5 is provided for step-by-step troubleshooting. Troubleshooting voltages are listed in Table 5-6.

5-32. INSUFFICIENT TRIGGER AMPLITUDE. Insufficient amplitude of the trigger signal can be caused either by low gain in the input amplifier or in the trigger amplifier, Input amplifier gain can be checked by procedures in Paragraph 5-29. Low gain in the trigger amplifier can be located by tracing a Model 140A 10V CALIBRATOR signal connected to either input, through each stage of amplification using test point waveforms (12 - 17) provided with the trigger 01959-2 amplifier schematic. Waveforms at Test Points 18 and 19 are also provided for troubleshooting when Channel A signal is used for triggering.

5-33. ADJUSTMENTS FOLLOWING COMPONENT REPLACEMENT.

5-34. Table 5-7 lists adjustments to be made after replacement of tubes, transistors, or diodes.

5-35. SERVICING ETCHED CIRCUIT BOARDS.

5-36. Etched circuit boards used in the Model 1402A have components on one side of the board with a plated conductive layer of metal through component holes. It Service Note M-20D also contains useful information on etched circuit repair. The important steps and considerations are:

a. Use a low heat (37 to 47.5 witts, less than 800° F

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Section V

idling temperature), slightly bent chisel tip (1/10 to 1/8 inch diameter) soldering iron, and a small diameter; high tin content solder. If a rosin solder is used, clean the area thoroughly after soldering.

b. Components may be removed by placing the soldering iron on the component lead on either side of the board, and pulling up on the lead. If heat is applied to the component side of the board, greater care is required to avoid damage to the component (especially true for diodes). If heat damage may occur, grip the lead with a pair of pliers to provide a heat sink between the soldering iron and component,

e. If a component is obviously damaged or faulty, clip the leads close to the component and then unsolder the leads from the board.

d. Large components such as potentiometers and tube sockets may be removed by rotating the soldering iron from lead to lead and applying steady pressure to lift the part free (the alternative is to clip the leads of a damaged part).

e, Since the conductor part of the etched circuit bourd is a metal-plated surface, covered with solder, use care to avoid overheating and lifting the conductor from the board. A conductor may be cemented back in place with a quick-drying acetate base cement (use sparingly) having good insulating properties. Another method for repair is to solder a section of good conduction wire along the damaged area,

f. Clear the solder from the circuit board hole before inserting a new component lead. Heat the solder in the hole, remove the iron, and quickly insert a pointed non-metallic object, such as a toothpick.

g. Shape the new component leads and ellp to proper length. Insert the leads in the holes and apply heat and solder, preferably on the conductor side.

Table 5-6, Switching Circuit Troubleshooting Voltages

ſ	FUNCTION	DC Voltage at Test Point 20	DC Voltages at Test Point 21
	Á	-2.5	-4, 1
	Alt	-3,1	-3, 1
	Alt	-3.1	-3, 1
	CHOP	-3, 1	-3,1
	A+B	-1, 1	-1,1
	B	-4, 1	-2,5

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Component	Function	Adjustment	Ref Para,
	INPUT AMPLIFIERS		
V102, 202,	Grid Overload Neon Lamp	None	
V101, 201	Cathode Follower	Input Capacity , 005, , 01, , 02 Gain DC BAL	5-24 5-23 5-10
Q101, 102, 201, 202	Emitter Follower	005, 01, 02 Gnin DC BAL	5-23 5-19
Q103, 104, 203, 204	Differential Amplifier (replace in pairs)	.005, .01, .02 Gain DC BAL	5-23 5-10
CR111, 112, 211, 212	Gating Diode	None	
CR110, 113, 210, 213	Isolation Diode	None	
	OUTPUT AMPLIFIER		
Q401, 402	Amplifier	DC BAL SENS CAL Position Adj.	5-19 5-23 5-21
Q403, 404	Emitter Follower	DC BAL SENS CAL	5-10 5-23
Q405, 406	1st Differential Amplifier	DC BAL SENS CAL 1st, 2nd, 3rd HF Adj.	5-10 5-23 5-25
Q407, 408	2nd Differentini Amplifier	DC BAL SENS CAL 1st, 2nd, 3rd HF Adj.	5-19 5-23 5-25
V401	Cathoxle Follower	DC BAL SENS CAL Ist, 2nd, 3rd HF Adj.	5-19 5-23 5-25
V402, 403	Output Differential Amplifier	DC BAL SENS CAL Ist, 2nd, 3rd HF Adj.	5-19 5-23 5-25
CR451, 452, 461, 462	Transient Protection Diode	None	
	TRIGGER IPLIFIER		
Q501, 502, 503, 504	Emitter Follower	None	
Q505, 506, 507, 508	Differential Amplifier	Syne Bal	5-26
Q509, 510	Emitter Follower	Syne Bal	5-26
CR541	Chop Operation H. F. Transient Diode	None	
CR301, 302, 304, 305 CR303 Q301 Q302 Q303, 304	SWITCHING CIRCUIT Clipper Diode Blocking Diode Blocking Oscillator Blanking Pulse Amplifier Multivibrator	None None None None None	

Table 5-7. Adjustments Following Component Replacement

Section V Figure 5-2

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C B D Α 2 R231 -de 2.4 i) *C232 PR285 GRID GRID REF REF V202 CR485 DESIG DEGIG LOC LOC C258 C231 R150B R150C R151 1052 2 C)31 A1610A16A6A6A7A1610A1AAA20 ō THE 12 C132 C131 C134 0202 ZĂ OED) C135 C140 1153 11151 R203 Į, 105 105 106 105 105 **icí**5) R162 11163 C152 C153 C231 C232 (2) 64. 10 71 480 ۵ 10172 10175 3 **HZ36** C233 C234 C234 C236 C255 C255 0.6 D251 R246)117))123) <u>с</u>в - ВІ **CH102 R24B** Ri264 1.22 112 112 18232 18233 R272 C253 A2 C253 A2 C485 C2 C485 C2 CHOUC5 1234 08892 11216 C3 111 CR110/C5 CR111/C5 9503 16242 10243 A1 |11 ì R271 4 CR112 C6 CH113 C5 11234 11245 11245 11247 11248 11260A 11260B 11260 11260 11262 11262 11263 0 C11201 C3 C11202 C3 310 312 CR214 C4 10 10 10 10 10 10 4òr CRADA CH212 C3 CH213 C4 102 101 A3 A3 A3 A3 A3 C3 C3 5 THE REPORT OF THE PARTY OF THE R)71 D504)1262 12263 11264 11264 11271 66 113 114 R272 R401 63 194)(402)(402 А¥ 14 12104 12105 12105 12105 12181 12185 **Ř146** GR 6 14 0161 R[72] 135 CHO2 R153 R153 1691 - C'f 18902 5 C'f 1115 11141 11141 1603 1604 (0) (0) C163 R807 10142 AB 10142 AB 10143 BB 10143 BB 101445 CB 101445 CB 10145 JB 10145 JB 10145 BT 10145 BT
 16504
 C4

 18505
 C5

 18506
 C5

 18507
 C3

 18508
 C3

 19508
 C3

 1952
 A3

 1952
 A2

 XV104
 133

 XV202
 142
 150 7 1602 R152 2508 R148 - 86 R159A A5 C 8) M B D A 1402A-A-22

Figure 5-2, Component Locations on Input Amplifier Board A9

. Model 1402A -

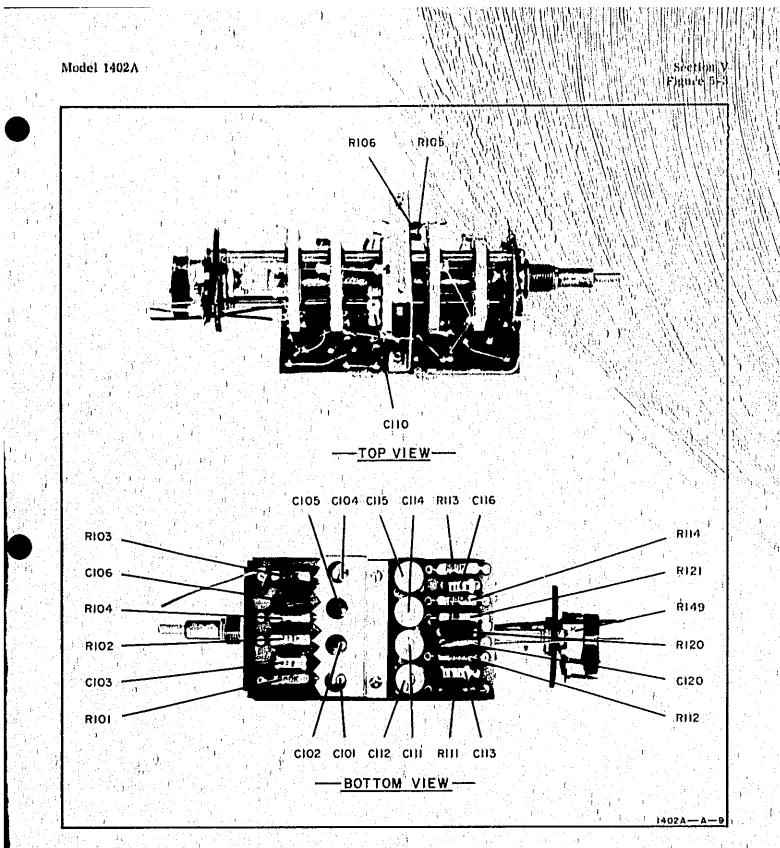


Figure 5-3, Component Locations on Channel A Sensitivity Switch

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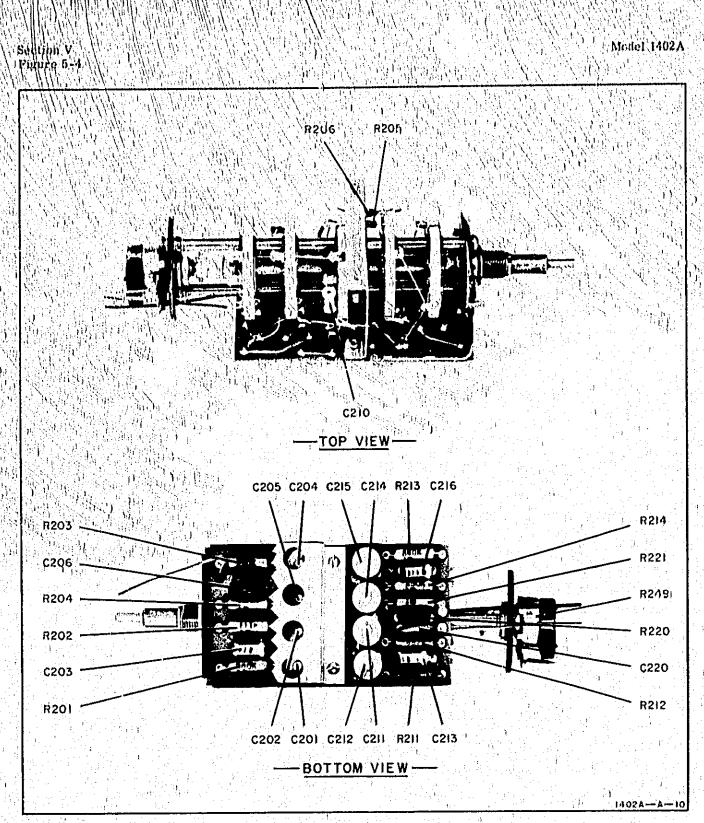
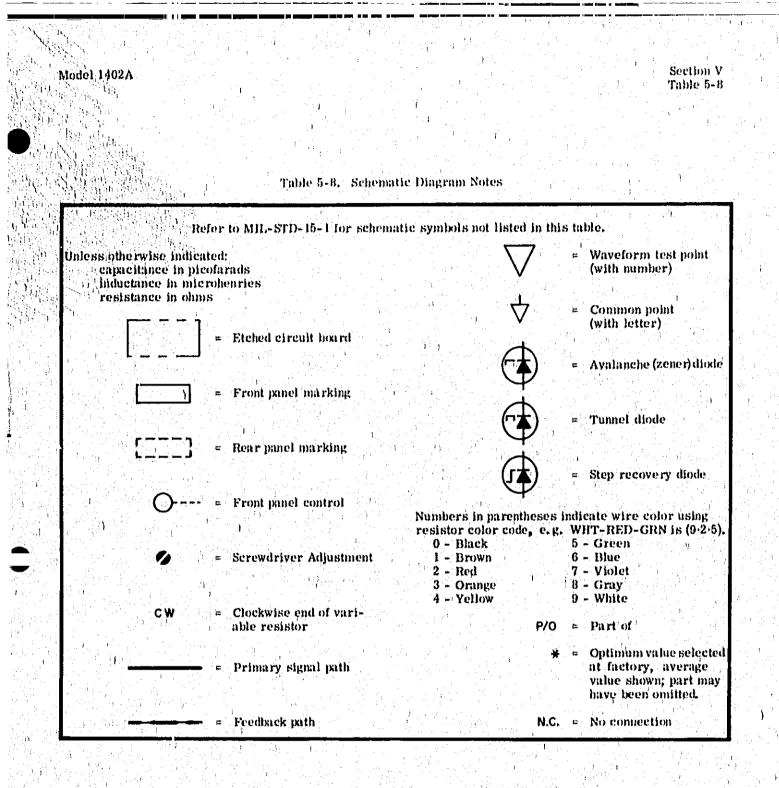


Figure 5-4, Component Locations on Channel B Sensitivity Switch



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Table 5-9. Conditions for Wayeform Mensurement iii Channel A, Channel B, Output, and Trigger Amplifiers (Test Points'i through 18)

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Model 1402A settings:

FUNCTION		合理:				Λ.
SENSITIVIT	Ŷ	· • • • • • • • • • •	р в в ю в р р 1951 — — — — — — — — — — — — — — — — — — —		2.0,02	V/CM
COUPLING				6, 6 6 6 61	r i s s s s s	, DC
INPUT		• • • • •				
VERNIER .	* * * *	*** * *	* * * * * *	* * * * *	• • • • • • •	CAL

Connect 120 my calibrator signal (see Figure 5-1 to Channel A INPUT, 45

Test Oscilloscope settings:

TRIGGER SOURCE	+ EXT
LEVEL	AUTO
SWEEP TIME 2 MS	EC/CM
Connect 10V CALIBRATOR of Model 140A to exte	rnal 👘 👘
trigger input of Test Oscilloscope.	en generalen. Sen er sen er sen

Test points are indicated for upper half of differential stages only. Square wave signal in the lower half is the same but inverted.

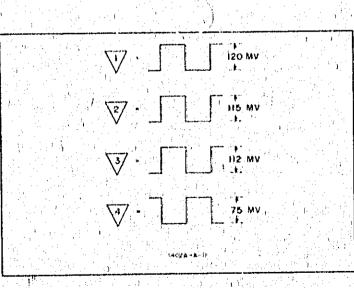
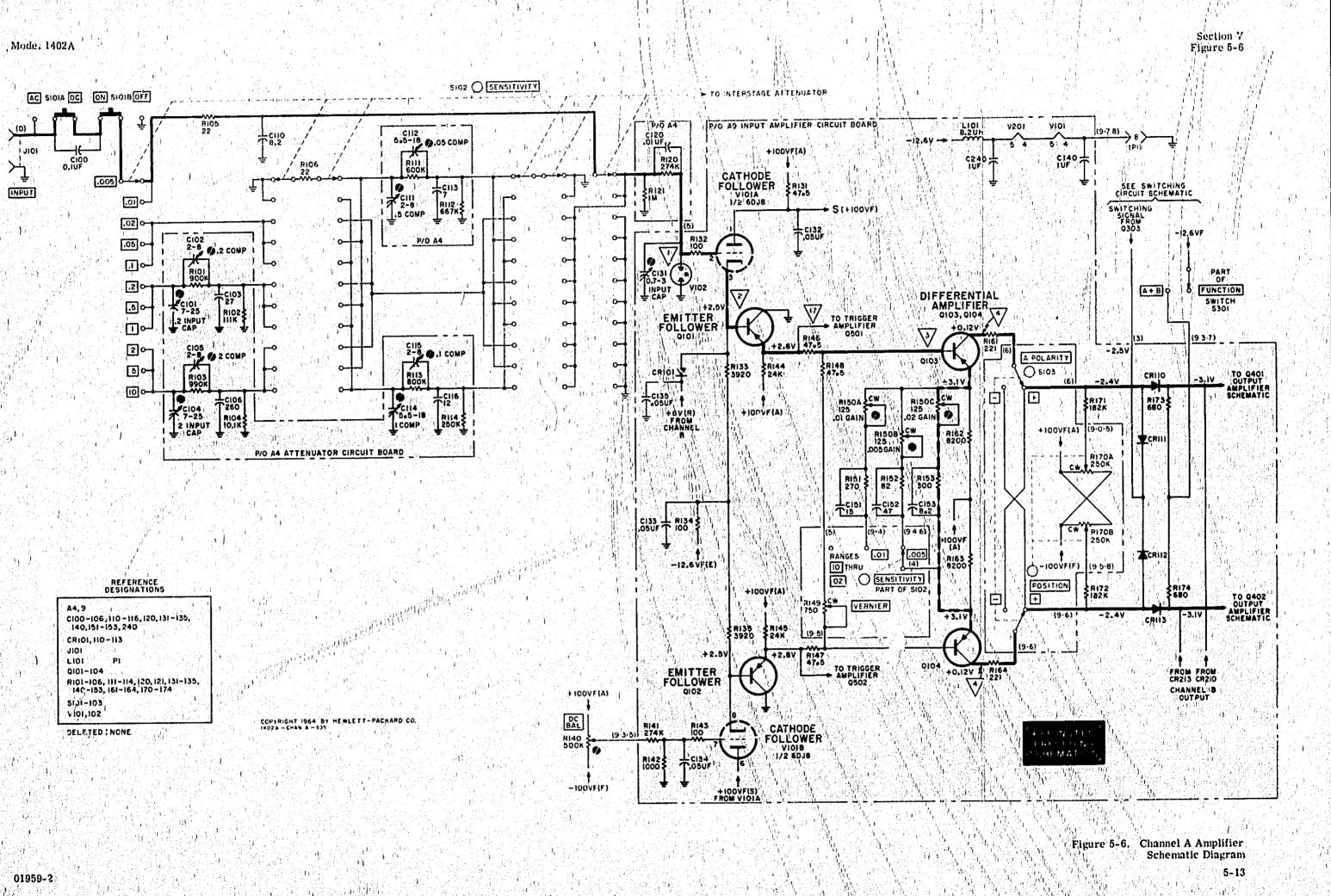
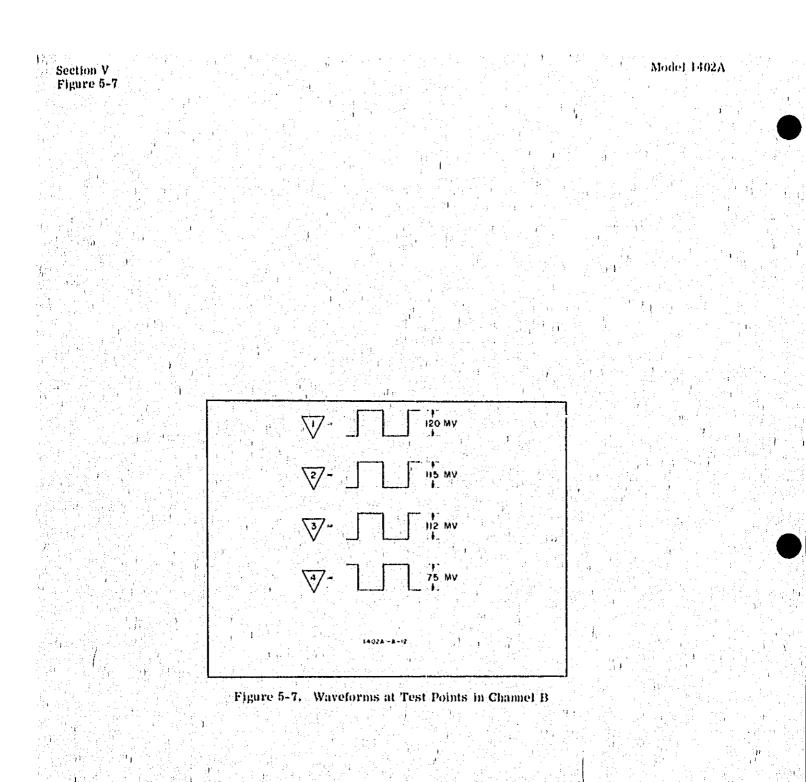


Figure 5-5. Waveforms at Test Points in Channel A

Mode, 1402A



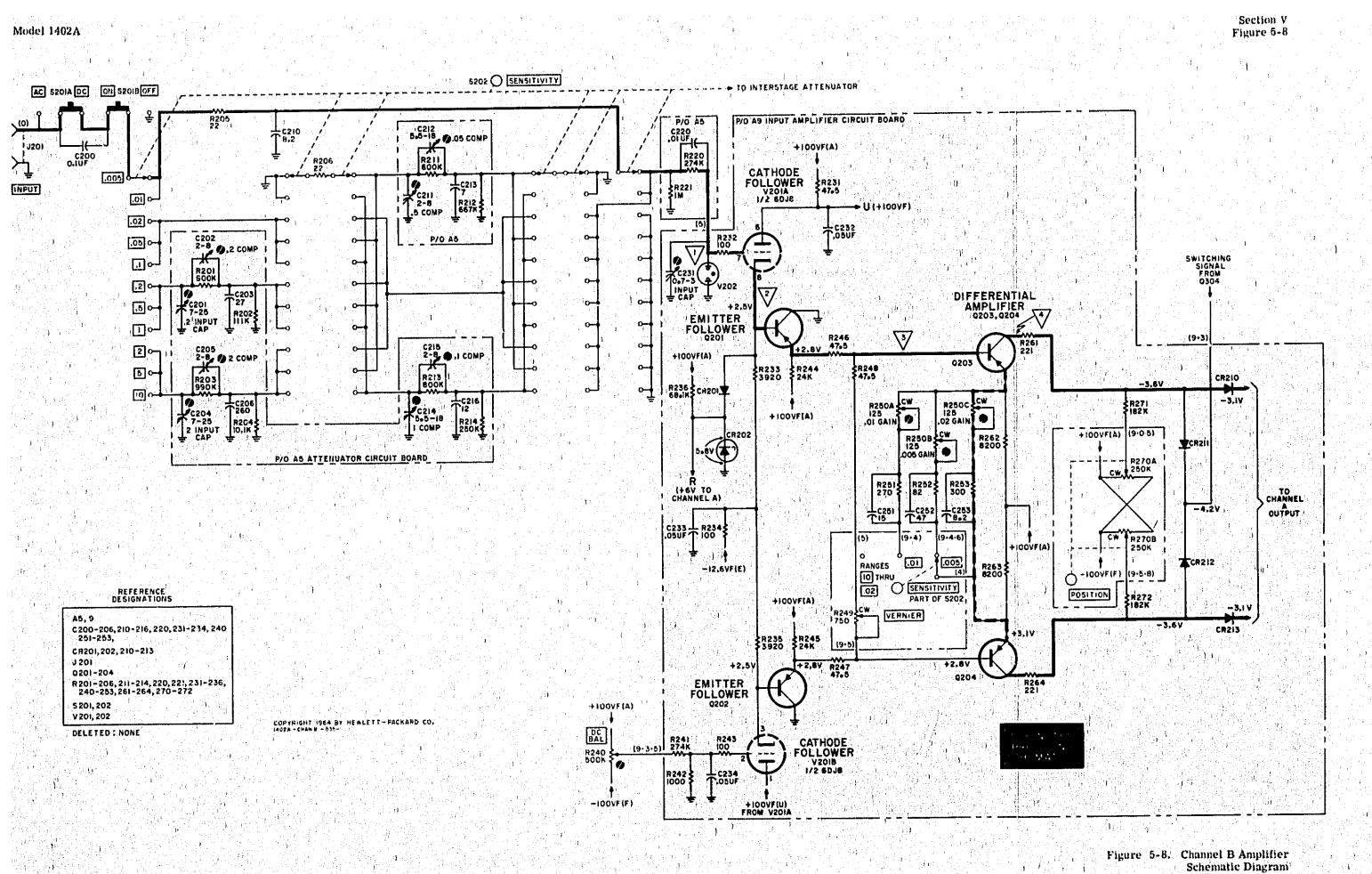


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Section V Figures 5-9 and 5-10

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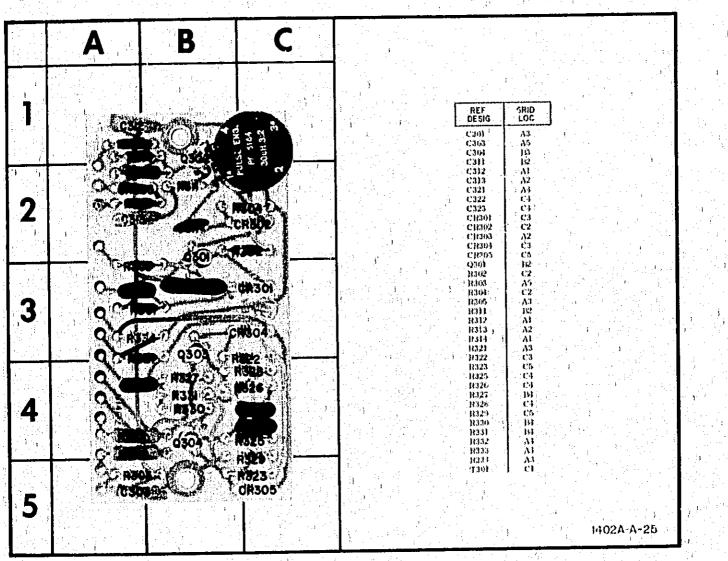


Figure 5-9. Component Locations on Switching Circuit Board A2

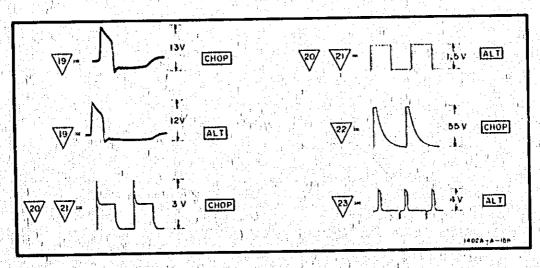


Figure 5-10. Waveforms at Test Points in Switching Circuit

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Model 1402A

T301

 ∇ (030) 470 (9-2-6) CR301 R301 3010

REFERENCE DESIGNATIONS A2 C301-305,311-313,321-323 CR301-305 3 5 Þ) 0301-304 R301-308, 311-315, 321-323, 325-334

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530) 1301 DELETED : C302, 305 R306

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A2 SWITCHING CIRCUIT BOARD +100VF(A)-+

 $\overline{\mathbb{V}}$ R302 BLOCKING OSCILLATOR R305 C304 0 R308, IM MULTIVIBRATOR Q303, Q304 归 -1007--0+- JA ALT ALT R 307 CHOP .i9 A+B $\overline{\mathbb{V}}$ в 0 PART OF 5301 FUNCTION O

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C311 4700

2R311 21000

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R304

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-12,6V

-12,6V

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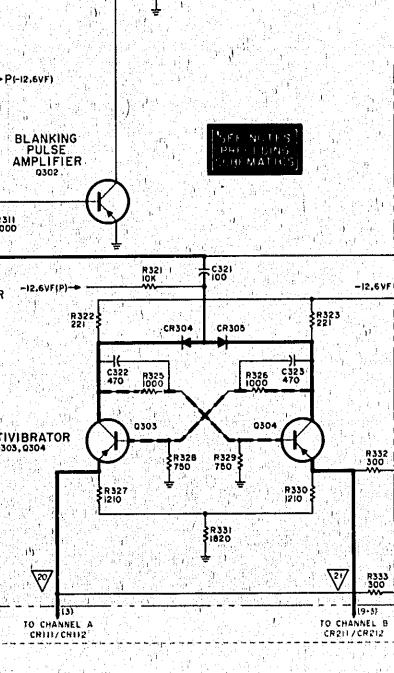
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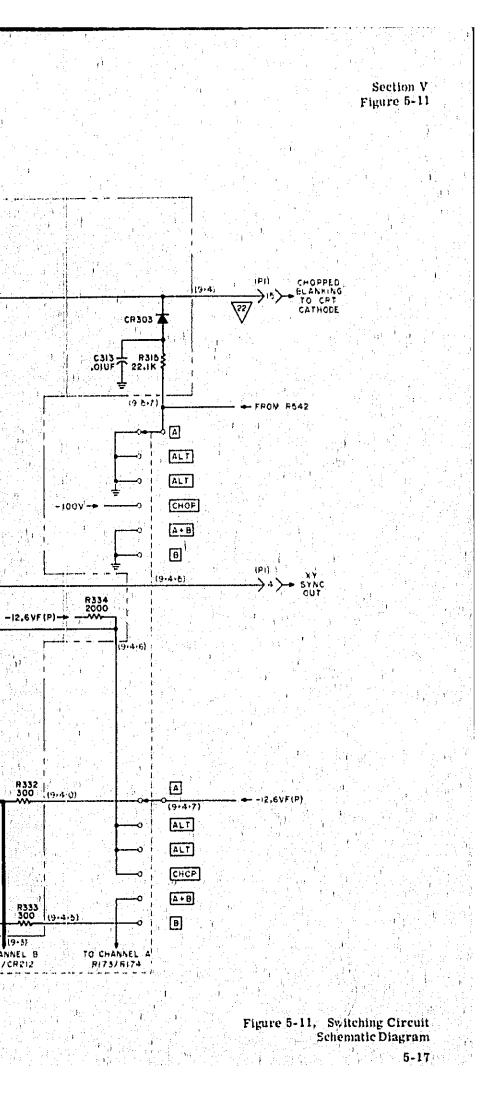
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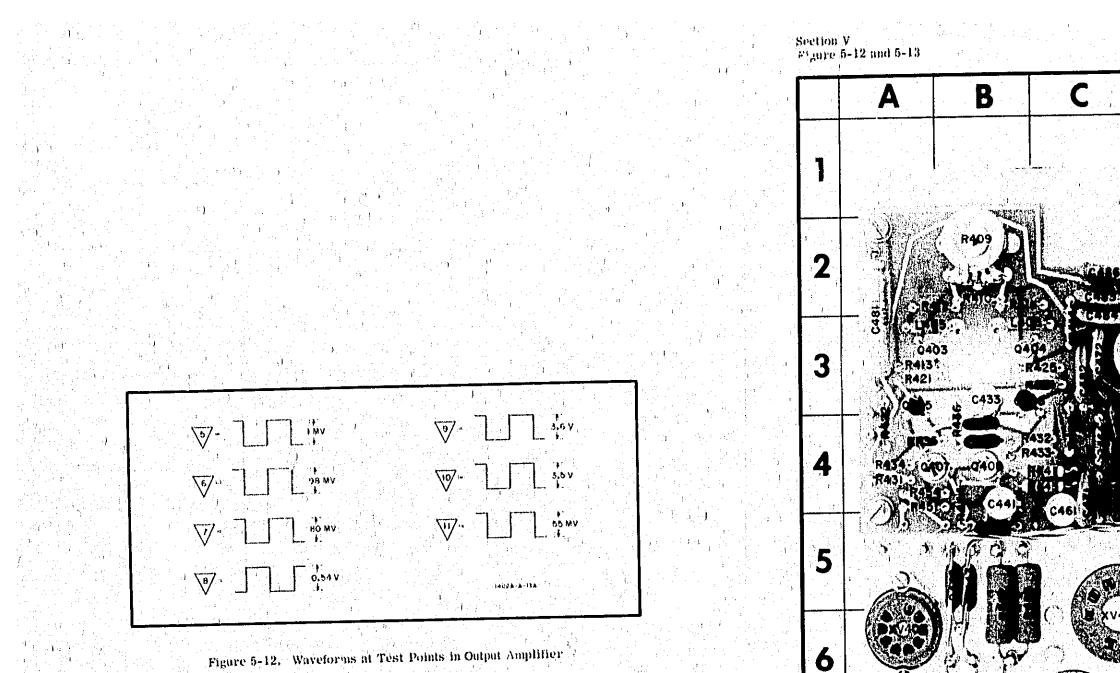
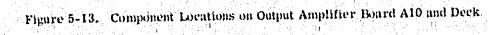


Figure 5-12. Waveforms at Test Points in Output Amplifier



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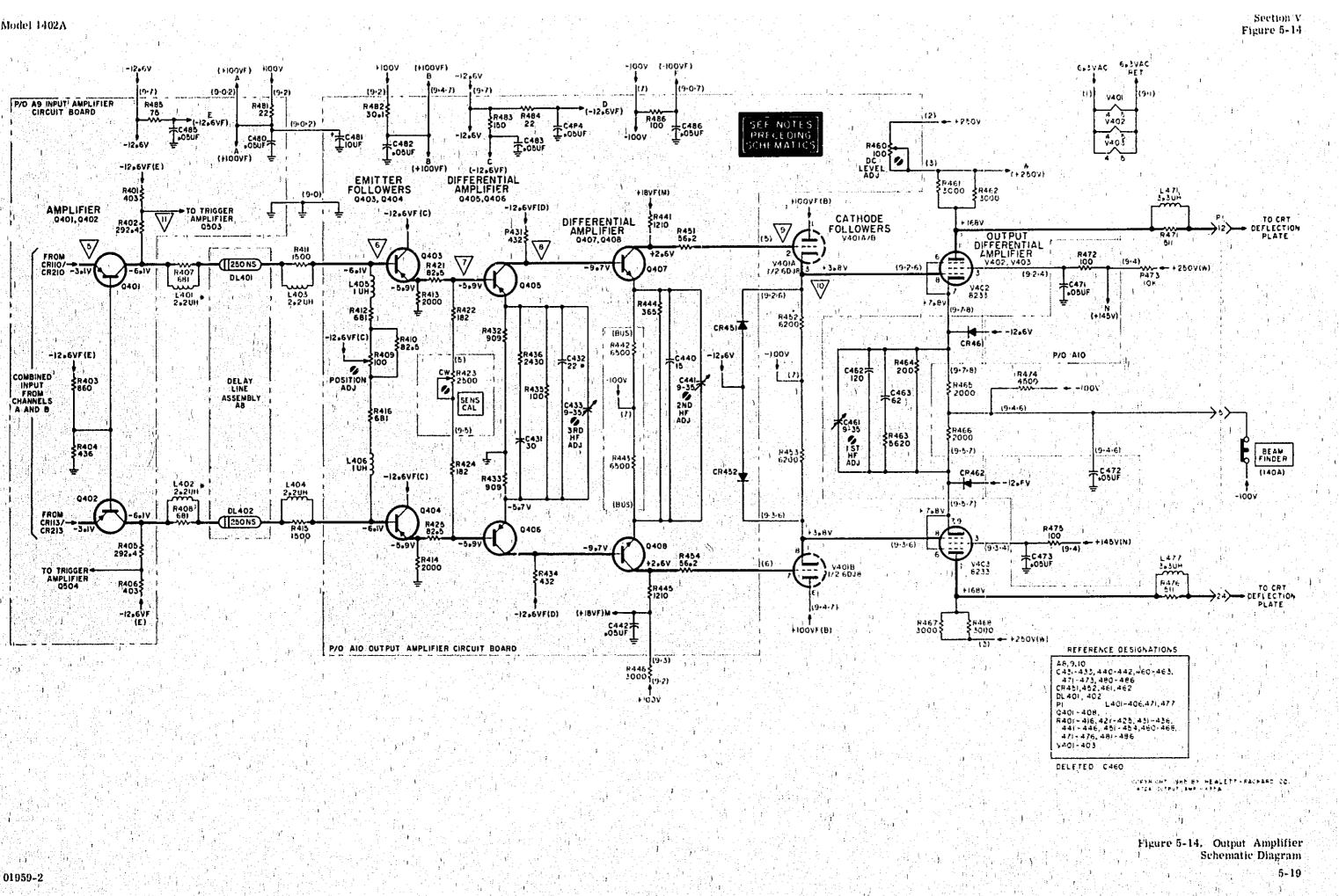
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~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	BFF	GRID	REF	GRID	
	REF	GRID	DESIG	GRID LOC	
	0331 C132	1)4 1)4	2 2 8125 2 18451 2 1 18452	60 A4 64	
	C433 C434 C432	B3 () () B4 () () () D4 (R433. R434	M J.	
	C460 C461	385 C3	18435 18436	AI 14	
	C462 C463, C471	C4 C4 C4)?431 1442 1443	C4 115 115	
C 0 00 2	C472 C473	C3 1	2 R444 R445)M C4	
4. 19 19 19 19 19 19 19 19 19 19 19 19 19	C361 C482	- <u>A3</u> - C3	146 1451 1452	A7 A3 195	
\$ 2	C483 C483 C488	C2 C3 132	R453 R454	B5 A4	
		1 1)† 2 C3 - 1 1	R460 R161	103 107	
23. A.	CR46 CR46 L405		10462 10463 10464	DH	
	L406 Q403	риг 193 АЗ	17465 R165	- 187 - 197 - 197	
	10103 Q105	В3 Д3 10	R465 R465 R472	D6 D6 C4	
	Q408 Q407 Q407	193	11474 1474	A7 187	
103.	1910 19309	112 - 1 112 - 1	18475 18482	C1 (1) C3 (1) C3 (1)	
a 7/	18312 18313 18413 18414	A2 A2 C3	1463 1464 17 1464	D2 F	
672	H116 H1121	132 A1	XV401 XV402	A6 C7	
	10124) 10124	A4 31	XV 403	, €.95 . 2	
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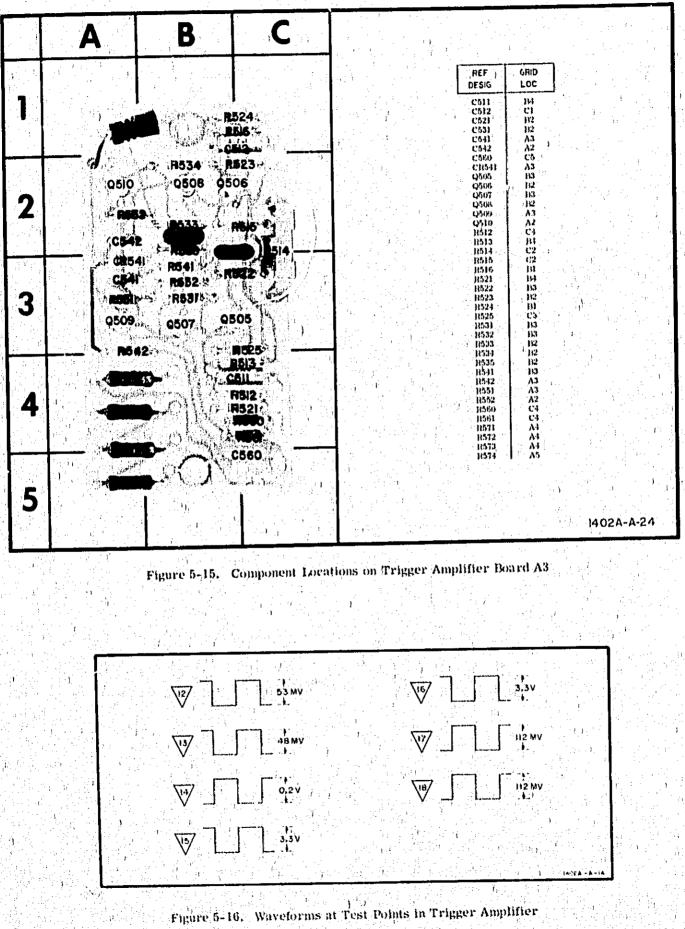
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Model 1402A



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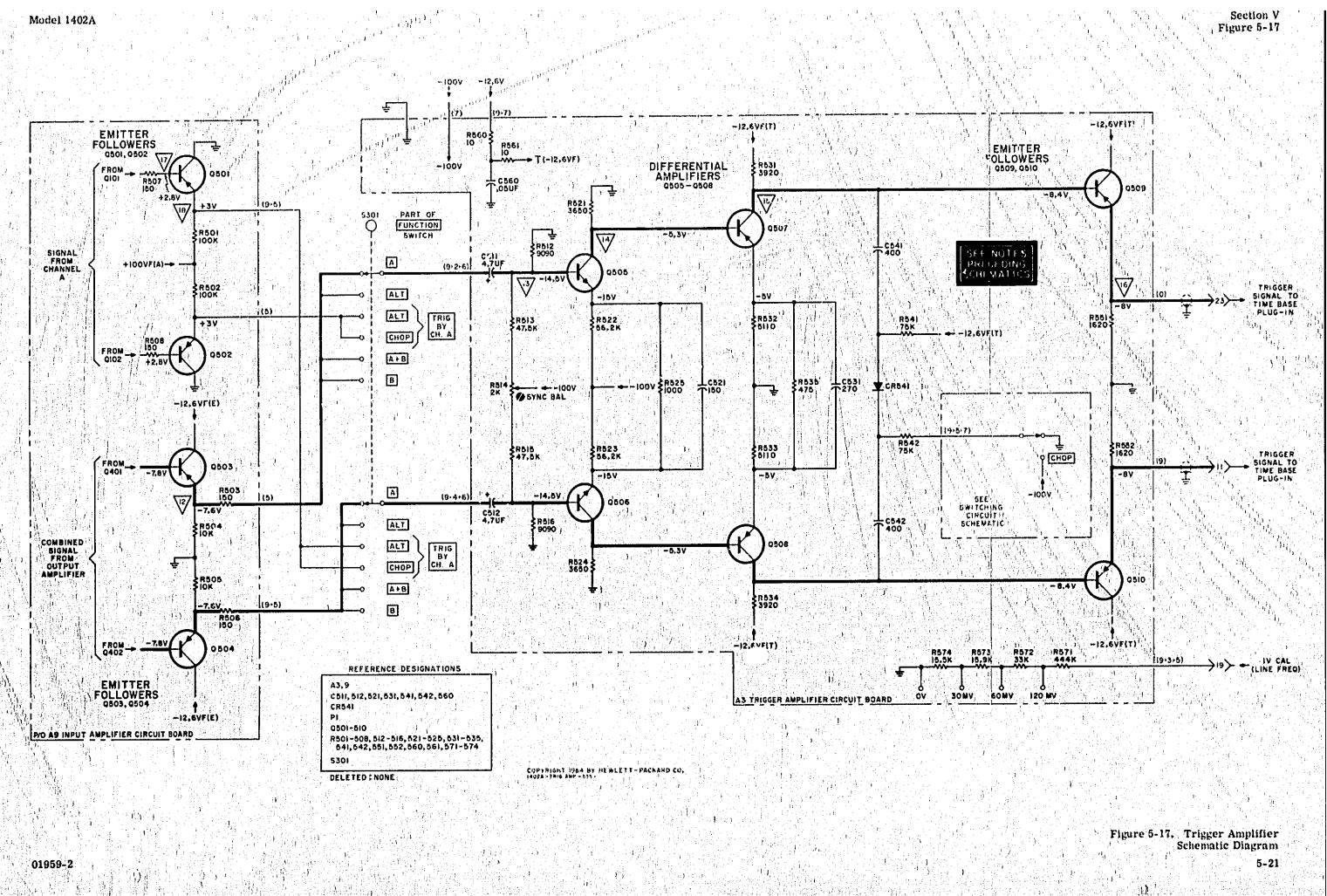
Section V Figures 5-15 and 5-16



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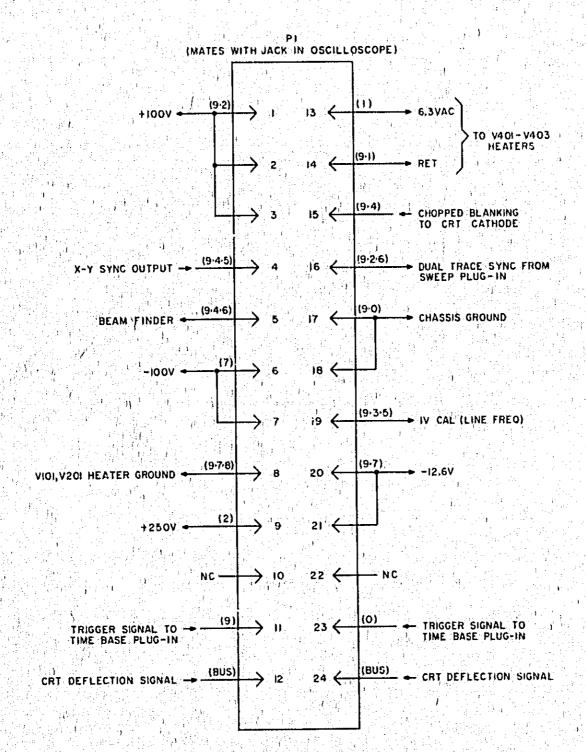


Figure 5-18. Interconnection Play Schematic Diagram

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14024-6-4



Model 1402A

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION,

6-2. This section contains information for ordering replaceable parts for the instrument. Table 6-1 lists reference designators and abbreviations that are used in the Table 6-2 component descriptions. Table 6-2 lists the parts in alpha-numerical order of their reference designations (massigned designators are not listed) and provides the following information for each item:

a, hp Part Number.

b. Total quantity (TQ) used in instrument; given only first time the part number is listed.

c. Description of part (vefer to Table 6-1).

d, Typical manufacturer of the part in a five-digit code, except for Hewlett-Packard Company; see code list of manufacturer's, Table 6-3, for name,

e, Manufacturer's part number,

6-3. Parts not identified by a reference designation are listed at the end of Table 6-3, under miscellaneous.

6-4. ORDERING INFORMATION

6-5. To order replacement parts from the Hewlett-Packard Company, address the order or inquiry to the nearest Hewlett-Packard Sales/Service Office (see list of addresses at rear of this manual) and supply the following information:

a, hp Part Number of Item(s).

b. Model number and eight-digit serial number of instrument.

6-6. To order a part not listed in Table 6-2, provide, the following information:

a. Model number and eight-digit serial number of instrument.

b. Description of part including function and location,

6.7. To order a part from a manufacturer other than the Hewlett-Packard Company, provide the complete , art escription and the manufacturer's part number from Table 6-2.

Table 6-1, List of Reference Designators and Abbreviations.

		a da ser de la composición de la compos	a farmer a state of the state o	MP	nichanical part	TB 1	teriainal board
	assembly motor		mise electronic part	D D	Ding	rp -	test joint
	ennettor	i fi	filter	0	transistor	×	vacaum tabe, neon
• p { } { } { } { } { } { } { } { } { } {	complete)	lack	n a l	resistor	이 없는 것이 있는	: bulb, photocell, etc.
R H	diote at a state of the second	K	rolay	RT	thermistor	. W	wabbe to a factor
).).	delay line	\mathbf{i}	Inductor	8	switch	8 .	Sinket
)S	device signaling (lamp)	- M	meter.	- Tr	transformer	۲	erystat
		na sa Nasila setek Nasila setek	ADDREVIATIC	<u>)NS</u>	 And Andrew California 		
	imperes	GE	Rernanium	N/C	normally closed	RMO	ruck mount only
.F.C	"automatic trequency control	GL	RIADA	NE	be ob 1	RMS \cdots	right-membershare
MPL -	amplifier	GRD	ground(e.)	NEPL	mekel plate	А. (В.)	
			henries	N/O	mormally open	S-B	slow-blow
3, F, O, -	heat frequency oscillator	HEX =	hexagonal	- SPO	> negative positive zero	SCR	VC. NO.M
E CU SE	beryllium copper		mercury		 (zero temperature: 322) 	5) SE	selennin
311 1 1 1	binder head		Hewlett-Packard	an in Arti	amelingiant)	SECT	scepon(a) is a st
JP	brindpring			NRFR -	🗄 not recommendal for 🖓	SEMICO	
IRS	brass		hour(s)		🔄 tield replacement 👘 👘	5)	t silicon's 🔬 👘 🗄
WO DP4	incloud wave oscillator	e a JR E a strad	intermediate treq	ST NSR 1998	not separately a log	SIL	silver
9.200	计第一部分子 经济利益 计算法分子 化合金	THE IMPORT	impregnated	요즘 영습 문화	replaceable	51.	slubs
CW . A	counter-clockwise a	INCD	meamlescent	집은 고려한		SPL 👘	special (
ER «	ceramic	ISCL =	(a)abada(5)	OND -	order by description	SST	stajulens steel
2MO 👘	endinet mount only	INS	Insulation(ed)	- OH	oval head	SR	spht ring
OEF .	enefficient	INT .	internal data de la	OX I	paide	STL -	steel
:OM +	common			9			a da gara a c
COMP 316	composition (Contraction)	κ	kito + 1000	94 (P. 67) - 24	n peak a state of the state	1 'TA	tantalum
CONN	connector	문화전화관문제		SaPC (Aby	printed eincult of the second	(11) (11)	time delay
2P	cudmium plate	E LIN A SE	bnear taper	PF y	picolaruds	_'TGL	beggle
CRT =	epthode-ray tube	LK WASH.	lock washer		10 ⁻¹² farads	<u>ግ</u> በ ፦	Hitanapun
CW N	elnekwize	Sector Sec	logarithmic taper	🦾 E.J. BRZ -		TOL	pholerance parts
영문 문화	이 가슴을 통해 좋아 다 가슴 부가 들었는데?	1 PF	low pass filter	PDL P	Phillips of the state	TRIM F	trimmer
DEPC	deposited carbon			ાગપ	peak inverse voltage	TWT	Traveling wave tub
OR		an Marada 🗛	milli v 10 ⁺³	₽/O = 1 •	part of least 1 been a	férgé é dour	
분간 함께 나	승규는 것이 같은 것이 있는 것이 없는 것이 없이 않이	MEG	meg = 10 ⁶	- POLY	polystyrene" and a set	₩	- miero e 10-6
ELECT ¥	electrulytic	METELMA		PORC 3	porcelain		
ENCAP	encapsulated	New MFR 2004	manufacturer	POS *	(a)neitien	YAR :	variable
EXT	esternal	MINAT	niniature	el por el	- potentiumeter	VIX:W =	le working volts
	신영영 방송 문화 같은 것이 많은	MOM +	nomentary	PP>	prak-to-peak		t da ser altra da s
P	Lirails	M'ru (mounting (- PT	- point - in a second second	W	and the second
FH 👘	that head	MY S	"my)ar"	RECT	rielifier	₩ .	white Lot to be a set
FIL - +	fillister heut	에서 이 가지 않는		a HF/ala	indus treductica in the	WW S	tauxiwaniw :
FXD -	fixed second second second	N	nanio (10+ ⁰)	- 1 BB *	round houd	W I)	althout the

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Ref Desig	hp Part No,	185	'nQ	Description (See Table 6-1,)	Mir	A Mir Part No.
2 3 4 5	01402-66502 01402-66503 01402-66504 01402-66504			A: switching circuit board A: trigger amplifier circuit board A: attenuator circuit board A: attenuator circuit board		
6 7 8 0 10 100 100 101 101 2103 2104 2105	01402-63401 01402-63401 01402-61501 01402-66505 01402-66506 0170-0022 0121-0114 0121-0060 0150-0115 0121-0114 0121-0060		1 1 1 1 2 4 8 2	 A: attenuator channel A (includes A4) A: attenuator channel B (includes A5) A: delay line input amplifier circuit board output amplifier circuit board fxd my 0, 1 of 20% 600vdcw var cer 7-25pf var cer disk 2-8pf 300vdcw txd cer 27pf 10% 500vdcw var cer disk 2-8pf 300vdcw 	h p hp hp hp 09134 hp hp 71590 hp hp	Type 24 CC20 TCN 27
2106 2110 2111 2112 2113	0140-0223 0150-0062 0121-0060 0121-0061 0150-0074		2442	C: fxd mica 260pf 1% 300vdcw C: fxd cer 8, 2pf ±, 25pf 500vdcw C: yar cer disk 2-8pf 300vdcw C: yar cer disk 5, 5 - 18pf 300vdcw C: fxd cer 7pf ±, 5pf 500vdcw	04062 72082 hp hp 72982	RDM15F261F3C 301-011-C0HO-829C 301-000-COHO-709D
2114 2115 2116 2120 2131	0121-0061 0121-0060 0160-0132 0150-0012 0132-0006		232	C: var cer disk 5, 5-18pf 300vdcw C: var cer disk 2-8pf 300vdcw C: fxd cer 12pf 5% 500vdcw C: fxd cer 0.01 uf 20% 1000vdcw C: var resolite 0, 7-3pf 350vdcw	bp hp 72082 56289 72082	301-000-COGO-120J 29C214A3 535-034-4R
2132 2133 2134 2135 2140	0150-0052 0150-0052 0150-0052 0150-0052 0150-0052 0160-0127		20 2	C; Ixd cer 0, 05µf 20% 400vdew C; fxd cer 1µf 20% 25vdew	56289 56289 56289 56289 56289 56289	83C17A 33C17A 33C17A 33C17A 5C13
C151 C152 C153 C200 C201	0150-0064 0150-0116 0150-0062 0170-0022 0121-0114		22	C: 1xd cer 15pf 5% 500vdcw C) fxd cer 47pf 10% 500vdcw C) fxd cer 8, 2-4, 25pf 500vdcw C: fxd my 0, 01pf 20% 600vdcw C: var cer 7-25pf	72982 71590 72082 09134 hp	301-011-COGO-1503 CC20 TCN 47 301-011-COHO-8290 Type 24
7202 2203 7204 7205 7206 7210 7211 7212 7213 7214 7215 7215	0121-0060 0150-0115 0121-0114 0121-0060 0140-0223 0150-0062 0121-0061 0150-0074 0121-0061 0121-0061 0121-0060 0160-0132			C: var cer disk 2-8pf 300vdew C: fxd cer 27pf 10% 500vdew C: var cer 7-25pf C: var cer 7-25pf C: var eer disk 2-8pf 300vdew C: fxd mien 260pf 1% 300vdew C: fxd cer 8, 2pf 1, 25pf 500vdew C: var cer disk 2-8pf 300vdew C: var cer disk 5, 5-18pf 300vdew C: var cer disk 2-8pf 300vdew C: var cer disk 2-8pf 300vdew C: fxd cer 12pf 5% 500vdew	hp 71590 hp hp 040d2 72982 hp hp 72982 hp hp hp 72982	
220 2231 2232 2233 2234 2234	0150-0012 0132-0006 0150-0052 0150-0052 0150-0052 0150-0127			C: Ixd cer 0, 01 of 20% 1000vdcw C: var rexolite 0. 7-3pf 350vdcw C: Ixd cer 0, 05 f 20% 400vdcw C: fxd cer 0, 05 f 20% 400vdcw C: Ixd cer 0, 05 f 20% 400vdcw C: Ixd cer 0, 05 f 20% 400vdcw C: fxd cer 1 f 20% 25vdcw	56280 72982 56280 56289 56289 56289	29C214A3 535-034 4R 33C17A 33C17A 33C17A 5C13
C251 C252 C253	0150-0064 0150-0116 0150-0062			C: fxd cer 15pf 5% 500ydew C: fxd cyr 47pf 10% 500ydew C: fxd cer 8, 2 pf 1, 25pf 500ydew	72892 71590 72982	301-011-COGO-150) CC20 TCN-17 301-011-COHO-8290

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Section VI Table 6-2

- 1 Table 6-2. Replaceable Parts (Cont'd)

Ref Desig	hp Part No.	RS	ΤQ	(See Table 6-1;)	Mfr	Mfr. Part So
C301 C303	0140-0149 0150-0052		3	C: Ixd mica 470pf 5% 300vdew C: Ixd cer 0, 05uf 20% 400vdew	04062 56289	RDM15F471J3S 33C17A
C304	0140-0154		1	Ct fxd mica 1300pf 5% 500v/lew	04062	RDM20F132J5S
C311 C312	0150-0075		1	C: Ixd eer 4700pf +100%-20% 500vdew C: Ixd eer 0, 05pf 20% 400vdew	72082 56289	851-000-X5UO-4 33C17A
C313	0150-0012			C: fxd cer 0, 01pf 20% 1000ydew	56289	20C214A3
C321	0140-0176		1	C: fxd micn 100pf 2% 300vdew	04062	RDM15F101G3C
C322	0140-0149			C: fxd mica 470pf 5% 300vdew	04062	RDM15F47LJ35
C323 C431	0140-0149 0140-02C3			C: fxd mien 470pf 5% 300vdew C: fxd mien 30pf 5% 500vdew	04062	RDM15F47h13S DM15E300J 500V
C432	0140-0145		i	C: fxd mica 22pf 5% 500vdew	04062	RDM15C2201
C433	0121-0046		3	C; var cer D-35pf 500vdew	hp	
C440	0140-0202		1	C: fxd mien 15pf 5% 500vdew	hp	
C441 C442	0121-0046 0150-0052			Ct var cer 9-35pf 500vdew Ct Ixd cer 0.05pf 20% 400vdew	hp 56280	33C17A
C461	0121-0046			C: var cer 0-35pf 500vdew	bp .	
C462	0140-0216		- 1 - 1)	C; Ixd micn 120pf 2'5 300vdcw	04062) RDM15F121G3C
C463	0140-0205		_! 1 _	C: fxd mien 62pt 5% 300vdew	04062	RDM15E620J3C
C471 C472	0150-0052	ļ		C; fxd cer 0, 05µf 20% 400vdcw C; fxd cer 0, 05µf 20% 400vdcw	56289 56289	33C17A 33C17A
C473	0150-0052			C: Ixd cer 0.05µI 20% 400vdcw	56289	33C17A 11 1 1
C4B0	0150-0052			C; fxd cer 0, 05; f 20% 400vdcw	56289	33C17A
C481	0180-0089		1	C: fxd elect 10/f -10'h +100'h 150ydcw	56289	30D106G150DF4
C482 C483	0150-0052 0150-0052	181		C: Ixd cer 0. 05 if 20% 400vdcw C: Ixd cer 0. 05 if 20% 400vdcw	56289 56289	33C17A 33C17A
C484	0150-0052			C; fxd cer 0.05 ff 20% 400vdcw	56289	33C17A
C485	0150-0052			C: fxd cer 0.05pf 20% 400ydew	56289	33C17A
C486	0150-0052	с, j.		C: Ixd cer 0. 05#1 20% 400vdew	56289	33C17A
C511 C512	0180-0100	1.5	2	C: fxd elect TA 4.71f 10% 35vdew C: fxd elect TA 4.71f 10% 35vdew	56289 56289	150D475X0035B2 150D475X0035B2
C521	0140-0106	1	1	C: fxd mica 150pf 5% 300vdew	04062	RDM15F15LJ3C
C531	0140-0206		1	C: ixd mien 270pt 5% 500vdew	04062	RDM15F271J5C
C541	0150-0071		2	C: fxd cer 400pf 5% 500vdcw	56289	19C FORMULATI 28
C542	0150-0071	na Anto Anno Anto Anno Anto		C: fxd eer 400pf 5% 500vdcw	56289	19C FORMULATI
C560	0150-0052			C: fxd eer 0, 05µf 20% 400vdew	56289	28 33C17A
CR101	1901-0040		10	CR: si	in the second second	
CR110	1901-0040			CREEKING FOR SHELL FRANK FOR FOR SHELL FRANK FOR SHELL FRANK	bp .	an an an taon an
CRIII CRII2)	1901-0040 1901-0040			CR: si CR: si	bp bp	
CR113	1901-0040			CR: S	hp	
CR201	1901-0040		\hat{R}_{1}	CR: st	hp	
CR202	1902-0034		1	CR: avalanche 5, By 10% 400mw	hp	
CR210 CR211	1901-0040 1901-0040			CR: s) and the second s	hp hp	
CR212	1901-0040			CR: st	hp	
CR213	1901-0040			CR: si	hp	
CR301 CR302	1910-0016 1910-0016		5	CR: ge	hp	
CR302	1901-0025		1	CR: ge CR: si	hp hp	
CR304	1910-0016			CR: ge	hp	

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Table 6-2, Replaceable Parts (Cont'd)

Ref Destg	hp Part No.	RS	тQ	Description (See Table 6-1,)	MIT	Mir Part No.
CR305 CR451 CR452 CR461 CR462	1910-0016 1901-0096 1901-0096 1901-0096 1901-0096 1901-0096			CR: si CR: si CR: si CR: si CR: si	hp hp hp	
CR541 DL401 DL402 J101 J201	1910-0016 1250-0118 ¹ 1250-0118	0	2	CR; ge NSR (P/O AB) NSR (P/O AB) J: Connector-BNC J; Connector-BNC	hp 91737 91737	8427 8427
L101 L401 L402 L403 L404	0140-0105 9140-0142 9140-0142 9140-0142 9140-0142 9140-0142	1		L: coil-RF fxd 8,2 i.h L: coil-fxd RF 2,2 i.h	99800 hp hp hp hp	1537-34
L405 L406 L471 L477 P1	9140-0096 9140-0096 9140-0111 9140-0111 1251-0055	1 1 0	2 2 1	L: coll-fxd RF 1i.h L: coll-fxd RF 1i.h L: coll-fxd RF 3.3i.h L: coll-fxd RF 3.3i.h P; conn-24-contact male	hp bp hp hp	
Q101 Q102 Q103	1853-0015 1853-0015 5080-0415	4	4 2	Q: transistor si PNP 2N3640 Q: transistor si PNP 2N3640 Q: transistor, selected, matched pair (includes Q104)	07263 07263 hp	2N3640 2N3640
Q104 Q201	1853-0015			NSR (P/O Q103) Q: transistor si PNP 2N3640	07263	2N3640
Q202 Q203	1853-0015 5080-0445			Q: transistor si PNP 2N3640 Q: transistor, selected, matched pair (includes Q204) NSR (P/O Q203)	07263 hp	2N3640
Q204 Q301 Q302	1850-0158 1850-0103	5	5 1	Q: transistor PNP ge 2N2635 Q: transistor 2N2100	01205 01295	2N2635 2N2190
Q303 Q304 Q401 Q402 Q403	1850-0158 1850-0158 1850-0158 1850-0158 1850-0158 1850-0099	2	2	Q: transistor PNP ge 2N2635 Q: transistor ge 2N964 PNP	01205 01295 01295 01295 01295 04713	2N2635 2N2635 2N2635 2N2635 2N2635 2N964
Q404 Q405 Q406 Q407 Q408	1850-0099 1850-0137 1850-0137 1854-0091 1854-0091	2	2	Q: transistor ge 2N964 PNP Q: transistor PNP ge 2N976 Q: transistor PNP ge 2N976 Q: transistor PNP ge 2N976 Q: transistor NPN si 2N3137 Q: transistor NPN si 2N3137	04713 56289 56289 56289 5p bp	2N964 2N976 2N976
Q501 Q502 Q503 Q504 Q505	1853-0009 1853-0009 1850-0119 1850-0119 1850-0119 1854-0005	6 2 2	6 2 2	Q: transistor si PNP Q: transistor si PNP Q: transistor PNP ge EIA 2N963 Q: transistor PNP ge EIA 2N963 Q: transistor PNP ge EIA 2N963 Q: transistor 2N708 NPN si	hp hp 04713, 04713 07263	2N963 2N963 2N708
Q506 Q507 Q508 Q509 Q510	1854-0005 1853-0009 1853-0009 1853-0009 1853-0009 1853-0009			Q: transistor 2N708 NPN si Q: transistor si PNP, Q: transistor si PNP Q: transistor si PNP Q: transistor si PNP Q: transistor si PNP	07263 hp hp hp hp	2N708

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Ref Desig	hp Part No.	Its	ΫQ	Description (See Table 6-1,)	i Mir	Mfr Part No.
R101 R102 R103 R104 R105	0727-0231 0727-0212 0727-0212 0727-0271 0727-0158 0683-2205		2 2 2 2 2 5	R: fxd depe 000k ohm 1% 1/2w 1 R: fxd depe 111k ohm 1% 1/2w R: fxd depe 090k ohm 1%1/2w R: fxd effm 10.1k ohm 1% 1/2w R: fxd effm 10.1k ohm 1% 1/2w R: fxd comp 22 ohm 5% 1/4w	hp hp hp hp 01121	CB2205
R106 R111 R112 R113 R114	0683-2205 0727-0246 0727-0249 0727-1009 0727-0226	1 1 1	2222	R: fxd c5mp 22 ohm 5% 1/4w R: fxd iepe 600k ohm 1% 1/2w R: fxd depe 667k ohm 1% 1/2w R: fxd depe 800k ohm 1% 1/2w R: fxd depe 800k ohm 1% 1/2w R: fxd depe 250k ohm 1% 1/2w	01121 hp hp hp hp	CB2205
R120 R121 R131 R132 R133	0757-0475 0727-0276 0757-0393 0757-0401 0757-0435	1 1 2 3 2	4 2 8 11 6	R: fxd met flm 274k ohm 1% 1/8w R: fxd depe 1 meg ohm 1% 1/2w R: fxd met flm 47,5 ohm 1% 1/8w R: fxd met flm 100 ohm 1% 1/8w R: fxd met flm 3,92k ohm 1% 1/8w	hp hp hp hp	
R134 R135 R140 R141 R142	0757-0401 0757-0435 2100-0423 0757-0475 0757-0280	1 2	2 7	R: fxd met fim 100 ohm 1% 1/8w R: fxd met fim 3, 92k ohm 1% 1/8w R: var comp lin 500k ohm 20% 1/5w R: fxd met fim 274k ohm 1% 1/8w R: fxd met fim 1k ohm 1% 1/8w	hp hp hp hp hp	
R143 R144 R145 R146 R147	0757-0401 0758-0073 0758-0073 0757-0393 0757-0393	1	5	R: fxd met flm 100 ohm 1% 1/8w R: fxd met flm 24k ohm 5% 1/2w R: fxd met flm 24k ohm 5% 1/2w R: fxd met flm 24k ohm 5% 1/2w R: fxd met flm 47,5 ohm 1% 1/8w R: fxd met flm 47,5 ohm 1% 1/8w	hp hp hp hp hp	
R148 R140 R150 R151 R152	0757-0393 2100-0948 2100-0947 0758-0028 0758-0026	1 1 1 1	2 2 2 2 2	R: fxd met flm 47, 5 ohm 1% 1/8w R: var comp 750ohm 20% 20cwlog 1/4w R: var comp 3x125 ohm 30% lin 1/4w R: fxd met flm 270 ohm 5% 1/2w R: fxd met flm 82 ohm 5% 1/2w	hp hp hp hp	
R153 R161 R162 R163 R164	0758-0016 0757-0282 0811-1574 0811-1574 0757-0282	121	2 6 4	R: fxd met fim 3000hm 5% 1/2w R: fxd met fim 221 ohm 1% 1/8w R: fxd ww 8200 ohms 1% 3w R: fxd ww 8200 ohms 1% 3w R: fxd ww 8200 ohms 1% 3w R: fxd met fim 221 ohm 1% 1/8w	hp hp hp hp hp	
R170 R171 R172 R173 R174	2100-0950 0757-0471 0757-0471 0727-0085 0727-0085	1	2 4 2	R: var comp 2x250k ohms lin ganged 20% R: fxd met flm 182k ohms 1% 1/4w R: fxd met flm 182k ohms 1% 1/4w R: fxd depe 680 ohm 1% 1/2w R: fxd depe 680 ohm 1% 1/2w	hp hp hp hp	
R201 R202 R203 R204 R205	0727-0261 0727-0212 0727-0271 0727-0158 0683-2205			R: fxd depc 000k ohm 1% 1/2w R: fxd depc 111k ohm 1% 1/2w R: fxd depc 000k ohm 1% 1/2w R: fxd depc 000k ohm 1% 1/2w R: fxd cfim 10, 1k ohm 1% 1/2w R: fxd comp 22 ohm 5% 1/4w	bp hp hp bjs 01121	СВ 2205
R206 R211 R212 R213 R214	0683-2205 0727-0246 0727-0249 0727-1009 0727-0226			R: fxd comp 22 ohm 5% 1/4w R: fxd depc 600k ohm 1% 1/2w R: fxd depc 667k ohm 1% 1/2w R: fxd depc 667k ohm 1% 1/2w R: fxd depc 800k ohm 1% 1/2w R: fxd depc 250k ohm 1% 1/2w	01121 hp hp hp	CB 2205
R220 R221	0757-0475 0727-0276			R: fxd met flm 274k ohm 1% 1% R: fxd depe 1 megohm 1% 1/2w	hp hp	

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Table 6-2, Replaceable Parts (Cont'd)

Ref Desig hp	Part No. BS	ing.	Description (See Table 6-1.)	Mfr	MIT Part No.
R231 0 R232 0	757-0303 757-0401 757-0435		R: fxd met f1m 47,5 ohm 1% 1/8w R: fxd met f1m 100 ohm 1% 1/8w R: fxd met f1m 3,92k ohm 1% 1/8w	hp hp hp	
R235 0 R236 0 R240 2 R241 0 R242 0 R243 0 R243 0 R244 0 R245 0 R246 0	757-0401 757-0435 757-0461 100-0423 757-0475 757-0280 757-0401 758-0073 758-0073 757-0393 757-0393		 R: fxd met fim 100 ohm 1% 1/8w R: fxd met fim 3, 92k ohm 1% 1/8 w (14) R: fxd met fim 68, 1k ohm 1% 1/8 w (14) R: fxd met fim 68, 1k ohm 1% 1/8w R: var comp lin 500k ohm 20% 1/5w R: fxd met fim 274k ohm 1% 1/8w R: fxd met fim 100 ohm 1% 1/8w R: fxd met fim 100 ohm 1% 1/8w R: fxd met fim 24k ohm 5% 1/2w R: fxd met fim 27, 5 ohm 1% 1/8w R: fxd met fim 47, 5 ohm 1% 1/8w 	hp hp hp hp hp hp hp	
R249 2 R250 2 R251 / 2	757-0393 100-0948 100-0947 758-0028 758-0026		R: fxd met ffm 47.5 phm 1% 1/8w R: vnr.comp 750 phm 20% 20cwlog 1/4w R: var comp 3x125 phm 30% lin 1/4w R: fxd met ox 270 phm 5% 1/2w R: fxd met flm 82 phm 5% 1/2w	hp hp hp hp hp hp	
R261 () R262 () R263 () R264 ()	758-0016 9757-0282 9811-1574 9811-1674 9757-0282		R;) fxd met film 300 ohm 5'h 1/2w R; fxd'met film 221 ohni 1% 1/8w R; fxd 24k 3', 3w H; fxd 24k 3', 3 R; fxd 24k 3', 3 R; fxd met film 221 ohm 1'h 1/8w	hp hp hp hp hp	
R270 2 R271 (R272 (R301 (R302 (R303 (R304 (R305) (R305) (R307 (R308) (2100-0950)757-0471)757-0471)757-0273)757-0408)757-0301)757-0280)757-0280)757-0459)757-0344)757-0344		R: wir comp 2 \pm 250k ohms tin ganged 20% R: fxd wet fam 182k ohms 1/5 1/4w R: fxd met fam 182k ohms 1/5 1/4w R: fxd met fan 182k ohms 1/5 1/4w R: fxd met fan 3,01k ohm 1/5 1/8w R: fxd met fan 243 ohm 1/5 1/8w R: fxd met fan 39,2 ohm 1/5 1/8w R: fxd met fan 1k ohm 1/5 1/8w R: fxd met fan 1k ohm 1/5 1/8w R: fxd met fan 825 ohm 1/5 1/8w R: fxd met fan 56.2k ohm 1/5 1/8w	hy hp hp hp hp hp hp hp hp hp	
R313 R314 R315 R321 R322 R323 R325 R326 R327 R326 R327 R328 R329 R330 R331 R331 R331 R331	0757-0401 0758-0073 0757-0455 0757-0450 0757-0450 0757-0282 0757-0282 0757-0280 0757-0280 0757-0280 0757-0280 0757-0280 0757-0280 0757-0280 0757-0280 0757-0280 0757-0420 0757-0420 0757-0420 0757-0420 0757-0420 0757-0420 0757-0420 0757-0420 0757-0420 0757-0428 0757-0429 0727-0065 0757-0283	11133	 R: fxd met fim 100 ohm 1[*]/₁₀1/8.x R: fxd met fim 24k ohm 5% 1/2w R: fxd met fim 36/5k ohm 1[*]/₂ 1/8w R: fxd met fim 22.1k ohms 1[*]/₂ 1/8w R: fxd met fim 22.1k ohms 1[*]/₂ 1/8w R: fxd met fim 22.1 ohm 1[*]/₂ 1/8w R: fxd met fim 221 ohm 1[*]/₂ 1/8w R: fxd met fim 221 ohm 1[*]/₂ 1/8w R: fxd met fim 121 ohm 1[*]/₂ 1/8w R: fxd met fim 122 ohm 1[*]/₂ 1/8w R: fxd met fim 121 ohm 1[*]/₂ 1/8w R: fxd met fim 121 ohm 1[*]/₂ 1/8w R: fxd met fim 1.21k ohm 1[*]/₂ 1/8w R: fxd met fim 750 ohm 1[*]/₂ 1/8w R: fxd met fim 750 ohm 1[*]/₂ 1/8w R: fxd met fim 1.21k ohm 1[*]/₂ 1/8w 	hp hp hp hp hp hp hp hp hp hp hp hp	
R401 R402 R403 R404	0727-0072 0727-0083 0727-0092 0727-0074 0727-0063		R: fxd depe 403 ohm 1'5.1/2w R: fxd depe 292, 4 ohm 1'5 1/2w R: fxd depe 850 ohm 1'5 1/2w R: fxd depe 436 ohm 1'5 1/2w R: fxd depe 202, 4 ohm 1'7 1/2w	ip bp bp	

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Section VI

Table 6-2 E. Star

	1. 医小脑的 医输出性 化合合物 化合合物 化合合物 计正式分子 机合成分子 网络新闻 计分子的 人名
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	Table 6-2. Replaceable Parts (Cont'd)
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Ref Desig	hp Part No.	3	ΤQ	Description (See Table 5-1,)	Mr	MIP Part No.	
R406 R407 R408 R409 R410	0727-0072 0757-0419 0757-0419 2100-0108 0757-0399		4 4 7 4 1 4 3 1 3 1 4 3 1 4 1 4 1 4 1 4 1 4 1	R: fxd depe 403 ohm 1% 1/2w R: fxd met flm 681 ohm 1% 1/8w R: fxd met flm 681 ohm 1% 1/8w R: fxd met flm 681 ohm 1% 1/8w R: var comp iin 100 ohn 30%,0,15w R: fxd met flm 82,5 ohm 1% 1/8w	hp hp hp hp		
R411 R412 R413 R413 R414 R415	0757-0427 0757-0419 0757-3283 0757-3283 0757-0283 0757-0427		2 	R: fxd met f1m 1.50k ohm/17/1/8w R: fxd met f1m 081 ohm 1% 1/8w R: fxd met f1m 2k ohm 1% 1/8w R: fxd met f1m 2k ohm 1% 1/8w R: fxd met f1m 2k ohm 1% 1/8w R: fxd met f1m 1.50k ohm 1% 1/8w			
R416 R421) R422 R423 R424 , R424	0757-0419 0757-0399 0757-0406 2100-0067 0757-0406 0757-0406 0757-0399			R: fxd met fim 681 ohm 1/5 1/8w R: fxd met fim 82, 5 ohm 1/5 1/8w R: fxd met fim 182 ohm 1/5 1/8w R: fxd met fim 82, 5 ohm 1/5 1/8w			
R431 R432 R433 R434 R435	0757-0414 0757-0422 0757-0422 0757-0422 0757-0414 0757-0401		22	R: fxd met ilm 432 ohm 1'5 1/8w R: fxd met flm 009 ohm 1'5 1/8w R: fxd met flm 009 ohm 1'5 1/8w R: fxd met flm 432 ohin 1'5 1/8w R: fxd met flm 100 ohm 1'5 1/8w R: fxd met flm 100 ohm 1'6 1/8w			
R436 R441 R442 R443 R443 R444	0757-0431 ,0757-0734 ,0811-1573 0811-1573 0757-0412		122	R: fxd met flm 2: 43k ohm 1% 1/8w R: fxd met flm 1: 21k phm 1% 1/4w R: fxd ww 6500 ohm 1% 3w R: fxd ww 6500 ohm 1% 3w R: fxd ww 6500 ohm 1% 3w P: fxd met flm 365 ohm 1% 1/8w	hp.s.i hp.s.i hp.s.i hp.s.i hp.si		
R445 M446 H451 R452 R453	0757-0734 0811-0391 0757-0395 0698-3387 0698-3387		122	R: fxd met fim 1,21k ohm 1% 1/4w R: fxd ww 3k ohm 1% 56 R: fxd met fim 56,2 ohm 1% 1/8w R: fxd met ox 6200 ohm 5% 3w R: fxd met ox 6200 ohm 5% 3w	hp hp hp hp hp		
R454 R460 R461 R462 R463	0757-0335 2100-0750 0815-0047 0615-0047 0757-0200			R; fxd mét fim 56. 2 ohn 175 1/8w R; var ww 100 ohn 205 2w R; fxd ww 3k ohn 575 10w R; fxd ww 3k ohn 575 10w R; fxd ww 3k ohn 575 10w R; fxd met in 5,62k ohn 1% 1/8w	bp hp		
R464 R465 R466, R467 R468	0757-0407 0814-0004 0814-0004 0815-0047 0815-0047		1	R: fxd met fim 200 ohm 1% 1/8w R: fxd ww 2k ohm 2% 7w R: fxd ww 2k ohm 2% 7w R: fxd wy 3k ohm 5% 10w R: fxd ww 3k ohm 5% 10w	bp 56289 56289 hp		다신 모습은 것
R471 R472 R473 R473 R474 R475	0757-0416 0757-0401 0767-0008 0767-0022 0757-0401		2	R: fxd met fim 511 ohm 1% 1/8w R: fxd met fim, 100 ohm 1% 1/8w R: fxd met ox fim 10k ohm 5% 3w R: fxd met fim 4500 ohm 5% 3w R: fxd met fim 100 ohm 1% 1/8w	нр чр бр 07115 ару	 A. S. MOTO AND AND AND ADDRESS AND ADDRES	
R476 R481 R482 R483 R483 R484	0757-0416 0686-2205 0757-0388 0757-0284 0683-2205		1	R: 1xd met flm 511 ohm 1% 1/8w R: 1xd comp 22 ohm 5% 1/2w R: 1xd met flm 30.1 ohm 1% 1/8w R: 1xd met flm 150 ohm 1% 1/8w R: 1xd comp 22 ohm 5% 1/2w	- Bp bp 01121	EB 2205 1000 000000000000000000000000000000000	
R485 R486	0757-0398 0757-0401			R: fxd met fim 75 chm 1% 1/8w	hp		

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Table 6-2, Replaceable Parts (Cont'd)

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Desig R501 R502 R503 R504 R505 R506 R507 R506 R507 R508 R512 R513 R514 R513 R514 R515 R516 R516 R521	0757-0465 0757-0284 0757-0284 0757-0442 0757-0284 0757-0284 0757-0284 0757-0288 0757-0288 0757-0288 0757-0457 2100-0834 0757-0457 0757-0288	1 2 1 2 1 2 1 2	R: fxd met flm 100k ohm 1% 1/8w R: fxd met flm 100k ohm 1% 1/8w R: fxd met flm 100k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9. 00k ohm 1% 1/8w R: fxd met flm 9. 00k ohm 1% 1/8w	bp bp hp hp hp hp hp hp hp	
R502 R503 R504 R505 R506 R507 R508 R512 R513 R513 R514 R515 R516 R521	0757-0465 0757-0284 0757-0442 0757-0284 0757-0284 0757-0284 0757-0284 0757-0288 0757-0288 0757-0457		R: fxd met flm 100k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9.00k ohm 1% 1/8w	hp hp hp hp hp hp hp hp hp hp hp hp hp h	
R503 R504 R505 R507 R508 R512 R513 R514 R515 R516 R521	0757-0284 0757-0442 0757-0284 0757-0284 0757-0284 0757-0284 0757-0288 0757-0288 0757-0457	1 2	R: ixd met flm 150 ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9.00k ohm 1% 1/8w	hp hp hp hp hp hp	
R504 R505 R507 R508 R512 R513 R514 R515 R516 R516 R521	0757-0442 0757-0442 0757-0284 0757-0284 0757-0284 0757-0288 0757-0288 0757-0457 2100-0834 0757-0457	1 2	R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9.00k ohm 1% 1/8w	hp hp hp hp hp	
R505 R506 R507 R508 R512 R513 R514 R515 R516 R521	0757-0442 0757-0284 0757-0284 0757-0284 0757-0288 0757-0288 0757-0457 2100-0834 0757-0457	1 2	R: fxd met flm 10k ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9.00k ohm 1% 1/8w	b) b) b)	
R507 R508 R512 R513 R514 R515 R516 R521	0757-0284 0757-0284 0757-0288 0757-0457 2100-0834 0757-0457	1 2	R: fad met flm 150 ohm 1% 1/8w. R: fad met flm 150 ohm 1% 1/8w R: fad met flm 9.00k ohm 1% 1/8w	hp hp hp	
R507 R508 R512 R513 R514 R515 R516 R521	0757-0284 0757-0284 0757-0288 0757-0457 2100-0834 0757-0457	1 2	R: fad met flm 150 ohm 1% 1/8w. R: fad met flm 150 ohm 1% 1/8w R: fad met flm 9.00k ohm 1% 1/8w	qrf qrf	
R508 R512 R513 R514 R515 R516 R521	0757-0284 0757-0288 0757-0457 2100-0834 0757-0457	1 2	R: fxd met flm 150 ohm 1% 1/8w R: fxd met flm 9.00k ohm 1% 1/8w	hp	
R512 R513 R514 R515 R516 R521	0757-0457 2100-0834 0757-0457	1 2	R: fxd met flm 9.00k ohm 1% 1/8w R: fxd met flm 47.5k ohm 1% 1/8w		
R514 R515 R516 R521	2100-0834 0757-0457		R: fxd met flm 47.5k ohm 1% 1/8w	. [∂np] ∈ (L	
R515 R516 R521	0757-0457	1 1			
R516 R521			R: var comp 2k ohm 20% 1/4w	hp	
R521	0757-0288		R: Ixd met flm 47.5k ohm 1% 1/8w	hp	
		1	R: fxd met flm 9. 09k ohm 11/2 1/8w	hp	and the later of the
	0757-6434	1 2	R: fxd met fim 3, 65k ohm 1% 1/8w	hp hp	
R522	0757-0459		R: fxd met flm 56.2k ohm 1% 1/8w		
R523	0757-0459		R: fxd met flm 56, 2k ohm 1% 1/8w	si hp si Shp si	
R524	0757-0434		R: fxd met flm 3, 65k ohm 1/3 1/8w R: fxd met flm 3k ohm 1/3 1/8w	hp	na se transforma de la companya de Esta de la companya d
R525 R531	0757-0280		R: fxd met flm 3, 92k ohm 1% 1/8w	hp	
R532	0757-0438	1 2	R: fxd met fim 5, 11k 1% 1/8w	bp	
R533	0757-0438		R: fxd met fim 5. 11k 1% 1/8w	bp	
R534	0757-0435		R: fxd met flm 3. 92k ohm 1% 1/8w	hp	
R535	0757-0415	1 1	R: fxd met flm 475 ohm 1% 1/8w	bp -	
R541	0757-0462	1 2	R: fxd met flm 75, 0 ohms 1% 1/Bw	n y n hý st	
R542	0757-0462		R: fxd met flm 75, 0 ohms 1% 1/Bw	hp	p.
R551	0757-0428	1 2	R: fxd met flm 1. 62k ohm 13 1/8w	hp	
R552	0757-0428		R: fxd met flm 1, 62k ohm 1% 1/8w	np 👘	
R560	0683-1005	1 2	R: fxd comp 10 ohm 5% 1/4w	01121	CB 1005
R561	0683-1005		R: 1xd comp 10 ohm 5% 1/4w	01121	CB 1005
R571	0727-1008		R: 1xd depc 444k ohm 1/2'5 1/2w	hp	
R572	0727-1007	1.1	R: 1xd depc 33k ohm 1/2% 1/2w	hp	
R573	0727-1006	1 1	R: fxd depc 15.9k ohm 1/2% 1/2w	bp	
R574	0727-1005	1 1	R: Ixd depe 15.5k ohm 1/2%1/2w	hp	6603 JM (special
S101 S102	3101-0040	1 2	S: slide, dpdt 2-section (channel A) NSR (P/O A6)	42100	ooos ant (special
			化碱酸盐 机基本分散 化合物合金 化乙基乙基合金 法法法法		
S103	3100-0840	0 1	S: rotary, 2-section, 2 position (polarity)	hp	agon the formulat
S201	3101-0040		S: slide, dpdt 2-section (channel B) NSR (P/O A7)	42190	, 6603 JM (special
S202 S301	3100-0839	0 1	S: rotary, 1-section, 6-position (function)	hp	
T301	9130-0034	1 1	T: pulse	01961	PE 5164
V101	5080-0424	3 3	V; uged 6DJB	hp	
V101	2140-0008	2 2	V: neon NE2	24455	NE2
V201	5080-0424	1. T	V; aged 6DJB	hp. A	
V202	2140-0008		V: neun NE2	24455	NE2
V401	5080-0424		Vr nged 6DJB	hp - s	
V402	1923-0061	2 2	V: electron EIA type 8233	73445	8233
V403	1923-0061		V: electron EIA type 8233	73445	8233
XV101	1200-0058	0 2	XV: electron 9-pin miniature	91662	3901 PHSPTD
XV201	1200-0058		XV: electron 9-pin miniature	91662	3901 PHSPTD
XV401	1200-0008	0 1	XV: electron 9-pin miniature	71785	121-25-11-055
XV402	1200-0146	0 2	XV: 9 pin magnoval	71785	149-19-11-070
XV403	1200-0146		XV: 9 pin magnovol	71785	1/19-10-11-070
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– Table 6-2,	Replaceable	Parts (Cont'd)
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Ref Desig	hp Part No,	RS	ΊQ	Description (Sce Table 6-1,)	Mfr	Mir Part No.	
				MISCEL (.ANEOUS			
	0340-0038 0340-0039 0340-0060 0370-0084 0370-0088		22 22 2 2 1	Terminal: feed thru Bushing: feed thru Insulating Receptable: tefton (on A10) Knob: blk w/arrow (position) Knob: blk plug-in latch (lock)	hp 98291 bp bp	FT-E-16	
	0370-0099 0370-0102 0370-0113 0370-0114 1390-0035		1 1 2 2 1	Knob: blk concentric (function) Knob: red w/arrow (polarity) Knob: blk concentric (sensitivity) Knob: red w/arrow (vernier) Fastener: lock (front panel)	hp hp hp hp hp		
	5000-0401 5000-0405 5000-0535 5000-0536 01402-01205		1 1 1	Spring: ground (rear panel), Panel: rear (includes P1 and ground spring) Gusset: right Gusset: left Bracket: left side	hp hp hp hp hp		
	01402-01206 01402-00103 01402-00201 01402-00202		1 1 1	Bracket: right side Deck: output amplifier Panel: front Panel: hub, front (includes S101, S102, and lock fastener)	hp hp hp hp		
	01402-00602 01402-01204 01402-04101 01402-04102 01402-04102		2 1 1 2 1	Shield: attenuator Bracket: switch Cover: delay line Cover: attenuator Box: delay line	hp hp hp hp hp		
	01402-23201 01402-44101 01402-61603 01402-61606		1 4 1 1	Coupling: sens cal Insulator: transistor (on A9) Cable: trigger amplifier Cable: main harness	hp hp hp hp		
			144 14 14 14 14 14 14 14 14 14 14 14 14				
				ter in a second se			
					11 S. A. L.		
1959-4			ri a A		ganne Spiere	6-9 2011 - 100 - 1	
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Model 1402A

Table 6-3. Code List of Manufacturers

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The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks]14-1 (Name, to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page, Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the 114 Handbooks. - 1 j

Code

 M. Mandelliner M. Mandelliner M. K. Marker, M. M. Schlar, M. M. Karlin, J. M. K. Marker, K. M. Schlar, M. M. Schlar,	Code			Code		Address
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Subbalance of Magnetic Controls Co. 0577 subtalance of Magnetic Controls Co. 00212 Teres inc. Darrisse, Cam 0212 00213 Teres inc. Darrisse, Cam 0212 00213 Gallack Line. Value Spirze 0212 00214 Arcust Radio Con Bestlon. 1 00215 Arcust Radio Con Bestlon. 1 00216 Gallack Con Destlon. 1 00217 Arcust Radio Con Destlon. 1 00216 Gallack Con Destlon. 1 00217 Arcust Radio Con Destlon. 1 00218 Gallack Con Destlon. 1 00219 Gallack Con Destlon. 1 00211 Gallack Con Destl						s, Long Island, N.Y.
 Die Bernschaft, Durenstein, Comm. 00221 Marzin Park Prinzipper Communication Constant, Calibra Communication, Communi		1. Subsidiary of Magnetic	Controls Col.	05723	Hetro-Tel Coip	
 00116 Michine Ce, Inc. Vally: Stream, N. Y. 00116 Guiles Mart, E. Lander, N. J. 00127 Anz, Inc. N. J. Barthan J. C. Anders, N. J. 00128 Anzien C. D. Pressed C. Y. Cetti 00128 Anzien K. J. Componential C. J. J. Componential C. J. Inc. Network C. C. Patterins, Y. C. Anzen, N. J. 00129 Anzien C. D. Patters, N. C. Barthan, N. J. 00130 Anzien Electric Co. Patters D. Patters, S. C. G. M. J. 00140 General Electric Co. Patters D. M. Barthan, N. J. 00100 General Electric Co. Patters D. Ministra, M. J. 00100 General Electric Co. Ministra, M. J. 00130 Anzen Electric Co. Ministra, M. J. 00130 Anzen Podatis D. G. Ministra, M. J. 00130 Anzen Podatis D. M. Barthan, M. J. 00130 Anzen Podatis D. M. Landar, Calif. 00130 Anzenck Cop. Anzenty Hills, Calif. 00130 Anzenck Cop. Stat Class, Calif. 00130 Anzenck Cop. Stat Class, Calif. 00131 Transiste Transister M. Calif. 00130 Anzenck Cop. Stat Class, Class. 00131 Transister Transister M. Calif. 00130 Anzenck Cop. Castar, Class. 00131 Transister Transister. Jone Stat. Class. 00131 Transister Breaders A. J. Calif. 00130 Anzenck Cop. Castar, Class. 00130 Anzenck Cop. Stat. Class. Class. 00130 Anzenck Cop. Stat. Class. Class. 00130 Anzenck Cop. Castar, Class. 00130 Anzenck Cop. Stat. Class. Class. 00130 Anzenck Cop. Castar, Class. 00131 Transister Bread						
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00531 Sangane Limit Co. Pickens, S.C. 00565 Ges Expressing Co. Eis Angeles, Calif. 00575 Microlab let. Livingston, H.J. 00575 Microlab let. Livingston, H.J. 00585 Ges Expressing Co. Eas Angeles, Calif. 00597 Microlab let. Livingston, H.J. 01000 General Electric Co. Expaction Dup. 01003 Faiter Product So. Expaction Dup. 01015 Transition Idal Dir. Electric Co. 01025 Alter Product So. Billeauer, N.R. 01031 Transition Idal Dir. Electric Co. 01031 Transition Idal Dir. Co.	00815		Buthneton, Wis N	· · ·		Penneook, #.H.
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Address Manufacturer No. 12881 Metes Electionics Colp. Claff, N.J 12930 Della Semiconductor Inc. 12954 Dickson Electionics Colp. henpoit Beach, Calif. Scoltsdale, Anzona 13103 Theimoliay 13396 Telefunken (SmbH) Dattas, Teras Hanover, Geimany 13835 Midland wright Div, of Pacific Industries, Inc. Kansas City, Kansas Newbury Park, Calif, -14095 Sem-Tech 14193 Callt, Resistne Corp. 14298 American Companents, Inc. Santa Monica, Calif. Conshehothen, Pa. \$4433 STT Semitonductor, A Div. of Int. Telephone West Palm Beath, Fla. A Felegraph Corp. 16453 Hewlett Pachard Company Loveland, Colo 14655 Cornell Dublier Flectite Corp. Newath, N. J. Coining, N.Y. 14674 Corning Glass Works 50. Pasadena, Calif. San Jose, Calif. 15203 Webster Electionics Co. New Yolk, N.Y 15291 Adjustable Bushing Co. N. Hallywood, Calif. 15558 Micron Electronics Gaiden Cily, Long Island, N.Y. 15566 Androbe Inst. Cold. Lynbinds, N.Y. 15777 Twentieth Century Coll Spling Co. Santa Clara, Catit, MI View Calif. ISATA Ameleo Inc. 15909 Daven Div. Thomas A. Edison Ind. Loison inu. Long Island City,¹ N. Y. Spruce Panel, N. C. NeGraw-Edison Co. 16037 Spluce Pine Mica Co. Debrait, 181. 16179 Omni-Spectra Inc. 16352 Computer Diade Corp. Lody, N.J. 16688 ideal Pret, Meter Co., Int. Broaklyn, M.Y. De Jul Meter Div. 15758 Delco Radio Div. of G.M. Corp. . Bohemo, Inc. Canoga Park, Calif. 17109 Thermonetics Inc. 17474 Tranes Company Nountain View, Calif. Abton, Ohio 17675 Hamlin Metal Products Corp Angstinhm Pres. Inc. 1/145 No. Hollynood, Calif. 18042 Power Design Pacific Inc. Pate Alto, Calif. 1.5 18476 Ty-Cat Mig Co., Inc. Hallistan, Wass 18486 TRW Efect, Comp. Div. Des Plaines, 111 Nt. Kinco, H Y 18583 · Curtis Instrument, Inc. 18873 E.r. DuPant and Co., Inc. 18911 Durant Wig, Co. Wilmington, Del. Helmauben, Wib. 19315 Bundin Corp., The Eelipse Paintes Div. Teterboro, N. J 1950D Thomas A. Edison Industries, Div. of NcGraw-Edison Co. Webt Orange,: N.) 19644 LRCIElectronics Hallebeads, N.Y. 19701 Electra Mig. Co. Independence. Kansas 20183 General Altonics Corp. Philadelphia, Pa Long Island City, N.Y. 21226 Executone, Inc. Fainis Beating Co. , The New Britain, Cons 21335 N. Chicago; Uf. 21520 Fansteet Metallulgical Colp 23783 Billish Radio Electronics Ltd - Washington, D.C. 24455 G. E. Lanp Division Nela Pask, Cleveland, Uhio 24655: Genetal Radio Co. West Cancold, Mass 26365 Giles Reproduces Corp. 'New Rochelle, N.Y. 76462 Ginbet Eile Co. of America, Inc. Callaladt, M.J. 26397 Hamilton Watch Co. Lançastes, ; p. Palo Alto, Cal-). 28480 Hewlett Pachard Co. Owensbeip, h 33173 G.E. Receiving Tube Dept. 35434 Lectrahm Inc. 36196 Stanwych Coll Products Ltd. Chickles III. ł Hankesbury, Untario, Canada 37947 P. R. Mailory & Co., Jul Indianapolis, Ind. 39543 Nechanical Indistries Prod. Cv. Akion, Ohio 40970 Miniature Precision Beatings, Inc. - Bebne, N.H. a3950 C.A. hoigin Colt. Epglemood, Colo Canden, h. J. Canden, h. J. Bover, h. H. Eld, Tekys EBNYT, JAPAN HILF (Market HILF) JAPAN (Market HIL Fiem) SC Handbogh Supplements

H\$-1 Dated JULY 1965 14-2 Dated NOV 1962- B_{1} der

01959-3

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Table 6-3, Code List of Manufacturers (Cont'd)

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	An alf an	Code No.	Manufachurer Address	Code	Nonufacturer
Code No.	Manufacturer Address			F4033	Wegen Division of Seasines Clark Ca
	승규는 영국에서 가지 않는 것이 같이 많다.	22964	Robert W. Hadrey Co. Lob Angeles, Calif.		We president in the
	Onmite Mig. Co. Skanie, III		Elle Technological Pleasels, Inc. Elle, Pari Hansen Min : Co. Inc. Princetan, Ind.		Schnitzer Alloy Products Co. Ebenseth, b ;
	Penn Eng & Htg. Coip. Doylestown, Pa		Hanzen Mig. Co., Inc. Printetan, Ing		times telephoto Rausment
	Polarsid Corp. Combinder, Vass. Prevision Thermometer & Inst. Co.		Helphot Div. ut Beckman inst., Inc.	60)))	Exectionic Industries Association Any bland
48629	Prevision Thermometer & Inst. Co. Scuthampton, Pa.	13140	Fulleiton, Calif	1.1.1	Tube meeting ElA Standards Mathington DC
Janak	Wistowaye & Power Tube Day, Kaltham, Rass.	ก่าวรั	Hughes Products Division of Hughes	60707	Biniman Smitch Die Wason Effertreines Corp
	Rowan Controller Co. Apatministes, Hd.		Alicraft Collection hengust Beach, Calif.		Bailingist Com Bailes Brankloimst Com hen York, h.Y.
	Sanbolo Company	71445	Amperen Electronic Cp., Liv. of haith American		Dified Franklaim, FCorp
	Shalleinas Mig. Co. Seina, h. C.		Phillips Co., Inc. Hicksville, N.Y.		B kins int Riverbide, Calif
	Simpson Electric Co. Chicago, Ill	73506	Bradley Semiconductor Colp		Arin Div. of Robertshan Control's Co
	Sonotone Colp. Elfisiont, N.Y.	73559	Cailing Electric, Inc	CANTE	Columbus, Ohii
	Raytheon Co, Commercial Apparatus &	大百万月日	Tircly \$ Mig. Co. Trenton, N.F.		All Stat Finducts inc Defiance, Chi
	Systems Div. Sny Notwalk, Conn.	73682	George R. Garrelt Co., Die WSL		Avery Adhesive Laber Colp Neniovia, Calif.
66137	Spaulding Fibre Co., inc		Industries Ins Philadelphia, Pa.		Hammarlund Ed: , Inc
	Sprague Electric Co. hollh Adams, Hass.	13334	Federal Screw Products Inc. Chicago, III.		Stevent, Amold, Co., Inc. Boblen, Mass
	Teles, Inc	- 73743	Fischer Special Mig. Co. Cincinnale, Ohio		International Instruments Inc Olange, Conn
59710	Thomas & Betts Co. 19 Elizabeth, N. J		Genelal Industries Co., The Eligina, Ohio		Grayhilt Co. LaGtange, Ill
6074)	Triplett Electrical Inst. Co. Bluilton, Ohio		Goshen Stamping & Look Co. Gashen, Ind.		ftigd Transformet Chip
61775	Union Switch and Signat, Div. of the second second		JED Electronics Colp. Brocklyn, N.Y.		winchestes Elec. Die Latten Ind. Inc.
a statutu	Westinghouse Air Brake Co Pittsburgh, Pa		Jennings Radio Mig. Colp. San Jobe, Calif.		Oabuilly, Conn
	Universal Electric Co Onobso, Mich.		Signalite Inty	81349	Webstary Specification
	Waid-Leonard Electric Co. Mt. Vernan, N.Y.		(). H. Wangs, and Sons Winchester, Mass.	E1483	International Bertifter Colp. El Segundo, Calif
	"Westein Etecliic Co., Inc		indistrial Condenser Corp. Chicago, Ils		Airpan Electionics, Inc. Cambridge, Habb
	weston lost, inc. weston-Newaik	14868	H.F. Products Division of Amphenot Bolg Electionics Core Danbury, Conn.	81660	Barry Controls, Div Barry Bright Colp.
66295	witteh Mtg. Co. Chicago HI			line i t	Watertaun, Mabb
66346	Revere Wollansak Div, Minn, Wining &				Caites Precibion Elektrit Co. Skohre, III
	Ntg. Co. St. Paul, Minn		6 5 1 1 1	82047	Spette Faraday for, - Copper Hewilt
	Allen Mig. Co. Haelford, Conn		CTS Knights Inc		Electric Div Hoboken, M J
10318	Alimetal Sciew Product Lo., Inc. Gaiden City, N.Y.		Lens Einstne Wig. Co. Chicago, 119.	87347	Jelleis Riectionics Division of Speer Calbon Co. Du Bols, Pa
			Littletube, Inc. Des Plaines, III,		
			Lord Hig. Co. Ene, Pa.	B2179	- Fasichild Camera & Inst. Curdi ; Delense Prod, Division Chilton, H. J
			C. W. Mainedet San Francisco, Labit,	49.70	
	Belden Mig. Co. 1. Chicago, 11. Bird Electronic Corp. Cleveland, Ohio.		James Hillen Mig Da , Int Malden, Nass		Maguilo Indukties, Inc. Gleenwich, Conn Sylvania Riechti Prad. Inc.)
	Binbacti Radio Co. New York, N.Y.		J.W. Miffes Co. Los Angeles, Calif.	07713	Electionic Bube (uis)ag : Empatium, Pa
	Boston Gras Wolks Divi of Wertay Co		Cinch Honadnoch, Div. of United Call	3116	Asticn Coip. Last hewaik, Hailison, h. J
i i i kaar	pt Texas Quincy, Mabs		Fastenur Corp. 1 San Luandin, Calif.		Snitcherate Inc. Chicago, III
21215	Bud Radio, Int. Willoughby, Ohio	76545	Muntier Electise Co. Cleveland, Ohio		Netals & Confroty Inc. Spenser Products
	Cantor Fastener Calp. Patamus, N 3		hational Union Newath, N. 2		Milebrio, Wash
	Cardwell Condenses Celp	76854	Oak Manufacturing Do. Civital Lake, Bl.	82768	Phillips Advance Control Co Joliet, III
	Lindenburst L. R. N. Y.	83011	Bendia Corp., The		Research Pigitatts Corp
71400	Bussmann Mrg. Div. at McGraw-Edition Co.		Bendix Pacific Div. H. Hollywood, Calify ;		Rotron Mig. Co., inc
	St. Lauis, Nu.		Pacific Metals Co. San Francisco, Calif.		Vestor Electionic Co
271436	Chicago Condenses Colp. Chicago, Bl.	., m n	Phanastran Instrument and Electronic Co.	83953	western washer Hig., Cp
	Calif. Spring Co., Inc. Pico-Riveta, Calif.		South Pasadena, Calif.	81058	Care Fustenes Comments of Standard Cambindge, Hass
71450	Elkhaft, Ind	. 71752	Philadelphia Strek and Wire Colp	8 3086	Nen Banpphile Balt Brating slot, 200 - 200
	i ITE Cannon Electric Inc. Los Angeles, Calif		Philadelphia, Pa		Pyterbutough, h. H
2.0.71471	Cinema Plant, H. O Div. Aeroven Colb.	2///347	American Machine & Foundry Co. Polter A Brumheid Div. Princeton, Ind	: B3175	Teneral intliument Colp , 1 apacitor Div
	Buidant, Calif.			·	Dailington, S.C.
	C.P. Clain & Co. Chicago, IIr		TRW Electionic Components Div, Campen, N. J.		LTE wire and Cahle Dix. Los Angeles, Cali
71590	Fentralad Div, ot Blate Union inc.	11018	Generat instrument Corp., Rectifies Div Brooklyn, N.Y.		Victory Engineering Carp Springtreid, h
	en de la companya de	Same	Arsistance Piquets Co. Hattisburg, Pa.		Bendin Corp., Red Bank Live - Hed Bank, N. J.
JIII	5 Competiziat Plastics Co. Chicogo, III		Rubbeitratt Coip, of Calif. Toitance, Calif.		Hubbell Corp Wundelein, 11 - Smith, Herman H., Inc. Blocklyn, 16 1
11100	Cornish Wife Co.; The hew York, M.Y.	77707	Shakeproul Division of illinois tous werks		
	Coto Coll Co., Inc. Providence, R. L.		Elgin, 11t.		Central Sciew Cu. Chicago, II
	Chicago Miniature Lamp Works Chicago, III.	78781	Signal Indicator Colp. New York, N.Y.	I DISCIEL	Gavits wire and Cable Co Div. at Am, race Curo Broakherd, Mabi
1115	B. A.D. Smith Calp., Clawley Diy.		Strutheis Dunn Inc. Pitnan, N. J.		- Div, of Amirace Curp
	West Diange, H. J.		Thompson Biener & Co. Chicago, Ill	01221	Painteld h
(), (1)6	5 Cinch Mig, Co., Howard B. Jonies Div. Chickgo, III.		Thiley Mig. Co. San Francipeo, Calif.		union Calbide Corp. Consumer Pind Div.
			Stackpole Carbon Co. St. Watys, Pa.	b 31 + (New York, N. 1
	6 Dow Corning Corp		Standars Thomson Corp. Baltham, Mast.	6171	r Hode's Eng and Mig . Inc. Huntington In-
/ / 	a John Ly. Fast Co., Der, Victorien Instit. Co.		Tinneiman Products, Inc. Cleveland, Ohio		E Lavo Sciures Co. Fostus M
1447	Chicago, III		Transtaimes Engineers San Gabriek, Calik		Aeronautical last & Radio Co. Lod. h
	B Dialight Corp. Brooklyn, N.Y.	18947	hentonville, Hass.		Aico Electronics Inc. Great heck, A. 1
	6 Indiana General Corp., Electronico Div	79136	Waldes hohinogr Inci Lung Island City, N. Y.		A 3 Diesenes Co Inc. San Francisco, Cali
1447	Keabby, N. J.		Verdet figut, Inc. Hattfold, Conn.		TRB Capacitet Die
	9 Generat Instrument Corp., Cap. Div Rewais, N. S.		Wenco Hig. Cu. Chicago, III.		5 Saikes Tarzian, int Bicomington, in
	A - Matteria bis sebasa an an bas an ba a sa	19122	Continentalimit Electronich Corp. 3		& Bennton Wolding Campany Beenton, N.
7216	5 Diake Mig. Co. Chisago, III.		ing an the second construction Philodelphia, Part	1.	
7276 7282	5 Diake Mig. Co. 5 Hu, 3, Eby Inc. Philadelphia, Pa.			. 1 . 	
7276 7282	5 Drake Mrg. Co. 5 Hu, 4, Eby Inc. Philadelphia, Paul		ing an the second construction Philodelphia, Part	1.	

Handbook Supprements Dates JURY 1965 Dates NUN, 1962 H\$~1 14-2

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Model 1402A

Table 6-3, Code List of Manufacturers (Cont'd)

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Code		Code Ho	Manu
No.	Manufacturer	Address	÷., i
19 A.		1. L. 1. 1. 1. 1. 54133	Gene
		incisco, Calif. 38144	
85474		incisco, Culif.	Ct Ct
85660	Koiled Kalds, Inc.	tanden, Conn. Sklat	្រុះព្រ
85911	Seamless Rubber Co.	Chicago III.	
86)97	Chilton Pietraion Products Co., Inc.	- 1964 - 1974 - 1941 - 1941 - 1941 - 194	l Tune
1111		n Heights, PA	i Cuin
		Daylon, Ohio	. É
E6684	Radio Corp. at America, Electronic	94777	t doubl
1.61	Camp. & Devices Day	Hanjaba, N. J. 🔅 94319	a tind
87034	Sharen Industries	naneim, Catit	
872)6	Philes Corporation (Lansdate Divis)	on) 94330	a Malie.
a des			310W S
87473			
	3an P 1	meisch, Catil 9469	
87664			G G POI
87230		ovidence, R.J.	i ini.
	Cutter-Hammer, fic.	. Lincoln, III 95231 I. Paul. Winn - 95231	
65220			
	Federal Telephone & Radio Colp	i Clitton, N.J	
88698	General Mills, Inc.		
		Chicago, 117. 5527	
82662	United Flansformer Ub.		
90313	US Rubbes Co., Consumer Ind & P	Passait, N.J. 9535	
			2 Dage
		ancisco, Calif. 9598	
31345		Elitan'n (Calif. 9598.	
		Chicago, III. 9606.	
		Illetol / Mass. 9609	- N
		olumbus, Nebr. 9676	
	Elto Colp Wil	ian Glave, Pa. 9529	
		ikelveld, Nass. 9633	
91827		od City, Calif. 5534	
9)88		Chicago, 10 9650	
	Honeywell Inc., Nicto Smith Divi-	9746	
31313	Unterhein die Finnen beiten beite	Freepolt, 10. 9753	
91361	Nahm-Bios. Spring Co.	Dakland, Calil. 9791	
2130		eabody, Mass 9798	
92367		achesles, h. r.	C
92196			
92603		9815	
		ariytown, h Y. 9822	0- Hew
	Sylvania Electric Pind Inc.		9 A
33336		Woburn, Mass. 9877	B. Mici
		len York, N. Y. 9879	1. Seal
		Manstield, Obio	4 - E
		vingston, N. J.	

ode	h	Address
)	Manufacturer	MOGIFEE
132	General Cable Corp.	Bayonhe, N.J.
144	Reviteon Co , Comp. Div.,	
	Ctmp. Operations	Quincy, Wass
114B	Sejentific Electronics Produt	
1190	Britaniiz Fissianiiza Linoas	Loveland, Colo
ыİ	Tung Sol Electric, Inc.	benatk, h. ?
197	Curnus wright Corp. Electron	East Paletson, N.J.
		Chester, Po
111	douth Chester Colp.	
i ti b	f Fru-Ohm Products Nemcor Co	
	an a	Huntington, Ind.
	Wite Cloth Products, Inc.	Belindod, ill.
1662	Worcester Pressed Aluminum	
A.	i that she is a second	1. Wolrester, Wass.
1695		Chicago, Jik
5023,	George A. Philbrick Repeatel	hels, Inc.
	고 있는 것 같은 것 같은 것 같은 것 같은 것 같이 없다.	Boston, Wass
5236	Allies Products Corp.	Miami, Fla. L
238	Continental Connector Corp.	Woodside, N.Y.
1263	Leetralt Mig. Co., Inc.	Long Island, N.Y.
5264	Leico Electionich, Inc.	Buibanh, Calif.
5765	National Coil Co.	Sheridan, Wyo.
5275	Vilramon, Jor.	Bridgepall, Conn.
5348	Gordos Cerp,	Bloomfield, N.J.
5354	Helhade Mig Co,	Chicago, III.
5712	Dage Electic Co., Inc.	Franklin, Jod
5984	Siemen Mig. Co.	Wayne, jil
5987	Weckesser Co.	Chicago, Jik.
5067	Huggins Laboratories	Sunnyvale, Calif.
6095	HE Q Div, of Astovas Corp.	Olean, N.Y.
6716	Thaidarson-Weissnet Inc.	Mt. Carmel, [1].
5296	Solar Manulactuting Co.	Los Angeles, Calif.
6330	Carlton Stren Co.	Chicago, 11).
634)	Niciowave Associates, Inc.	Builington, Wass.
6501	Eatel Transformer Co.	Dakland, Calif.
7464	Industrial Retaining Bing Co.	
7539	Automatic & Precision Mig.	Englewood, N.J.
,,,,, 1919	Reon Resistor Corp.	Yonkeis, N.Y.
/ <i>7/7</i> 7983	Lillon System Inc. ,- Adler-Wi	
1283		New Rochelle, N.Y.
	Commun, Dir.	Jamaica, N. Y.
8]¥]	R-Tioncis, Inc. Rubber Tech, Inc.	Gardena, Cabit.
8159		ey Div.
0220	Henlett Packard Co., Mosel	
		Pabadena, Calit,
87)B		So. Pasadena, Calil,
8291	Sealectic Corp.	Namaroneck, N.Y.
1.1		
	and the second	

Code No.	Manufacturer	Address
98376		Buthank, Cafil.
98721	General Hills Inc. ;"Electroni	es Diy.
111		- Minneapolis, Winn-
98734	Paeco Div. of Hentell Packa	ld Co
		Pato Alto, Call.
38821	North Hills Electionics, Inc.	Glen Cove, h. Y.
98975	International Electronic Rese	aich Colp
1 A. 1	lan series de la serie	Burbank, Calif.
39109	Columbia Technical Corp.	New York, N.Y.
59311	Valian Associates	Pato Alto, Calif.
99378	Allee Cuip	Winchester, 6'955.
99514		s Div
12.5		San Marino, Calif.
10166	Control Switch Divisium, Con	itiols Co.
· · · ·	of Amelica	El Segundo, Calif
59800	Delevan Electionics Corp	East Autora, N.Y.
99848	Wilco Corporation	📜 Indianapolis, Ind.
93934	Renbrandt, Inc.	Baston, Mass.
99542	Hollman Electronics Corp.	
	Semiconductor Div.	🗄 🔄 Et Nonte, Calif.
	Technology instrument Corp.	of Calif.
	 (48) 1 (47) 	:Newbury Path, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

Nashington, DOCAB ETA Nashington, DOCAB Piesikion Instrumeit Components Co. Van Nuys, GBOHM Rubber Eng. & Development Haynard, GBOHM A ''N'' D Mig. Co. Dakhand, GBORM Coo.from Dakhand, DOGM Cooliton Bailington,	1.11	ist ind , int.	Mateo Took and Die Westein Coil Div. of J	0000F COCOM
DOCAB Bithish Radio Electronics Ltd DOCAB ETA Bithish Components Co OCOBB Frecision Instrume,it Components Co Van Nuys, GSONW Rubber Eng & Development Haymard, GDONN A "No" D Mig Co. San Jose, GDOQO Coo.from Dakiana, GDOW Baithigh, DOCAB ETA			Willow Exclose Disdue	
DOCAB ETA E DOGBB Fresilion Instrument Components Co. Van Nuys, GONW Rubber Eng & Development Haynaid, GOONN A "N" D Mig Co. San Jose, DOCQO Coo.from Dakland, DOCM California Eastein Lab Builington,		ld i i		
000BB Frecision Instrument Components Co. Van Muss. COONN A "N" D Mg Co. San Jose. 0000Q Coolfor Dakland. DOWN California Eastein Lab Builingtón.	ngland		ETA	DOCAB
CONMM Rubber Eng. & Development (Haynard, ODDNN A 'Ne' D Mig. Co. San Jose, ODCQQ Cooliton Dakland, Dakland, Builington,	· · ·	nents Co.	Pierition Instrument i	
COONN A "N" D Mig. Co. San Jose, COCOO Coolicon Dakiand, COONN Catiloinia Eastein Lab Builington,	Cob) i	 Van Nuys, 		
00000 Cooliton Dakland, 000m California Eastein Lab Builington,	Cabl	Haynatd,	Rubber Eng. & Devel	680MW
poown California Eastein Lab Bullington,	Cahl.	- San Jose,	A "N" D MIE. Co.	COONN
DOOWN Catitoinia Eastein Lab Bullington,	Cabl-	Dakland,	Coaliton	00000
This is a set a set of a set and a set of the set of th	Cabl	Ballington	Califoinia Eastein La	
DOOLA 2'S R. Sully Co. Los valeiro,	j € ah)	Los Angeles,	S.B. Smith Co	DOOYY

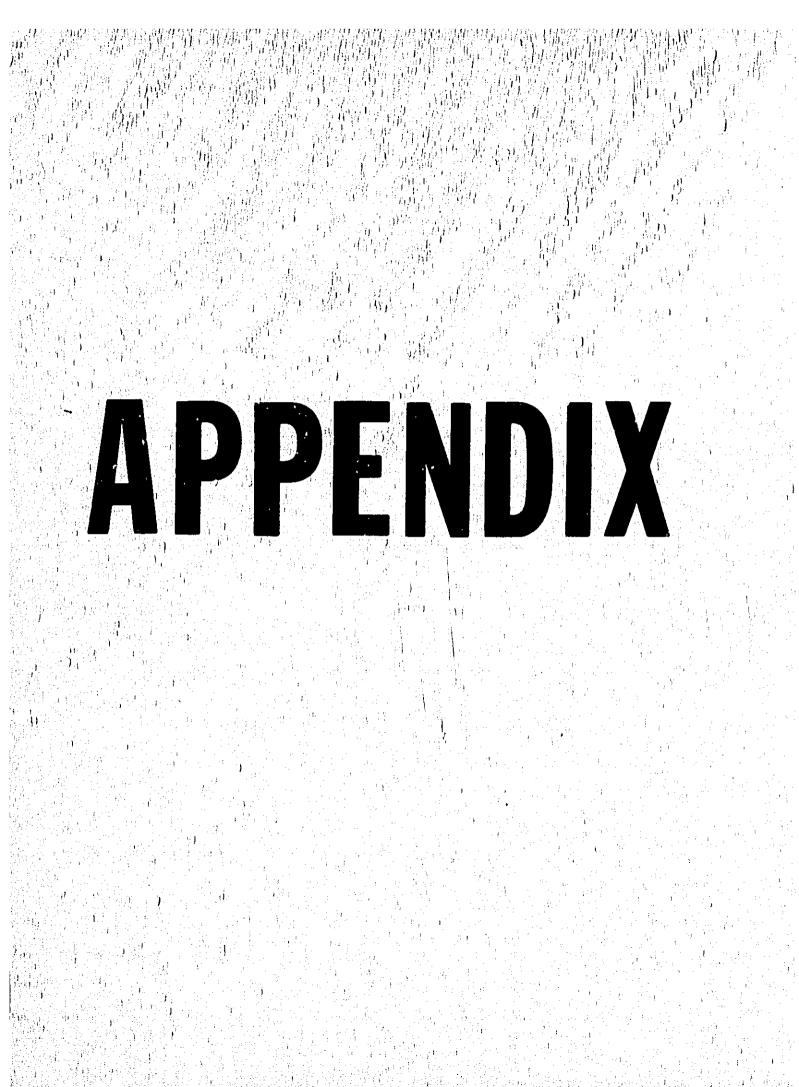
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Handboch Supplements Dated JURY 1965 Dated NOV, 1967 FSC. Hk-} H4-2



APPENDIX I MANUAL CHANGES

Appendix I contains all information required to adapt this manual to Model 1402A Vertical Amplifiers manufactured prior to the ones covered by this manual. Check your instrument's serial prefix located on the plate at the back of the instrument. If the serial prefix does not match the serial prefix given on the front page of this manual, find the serial prefix in the table and make the required changes. For information on Errata, refer to the change sheet supplied with this manual. All changes described herein adapt the standard instrument as manufactured, and do not apply to units subsequently modified in the field. Serial

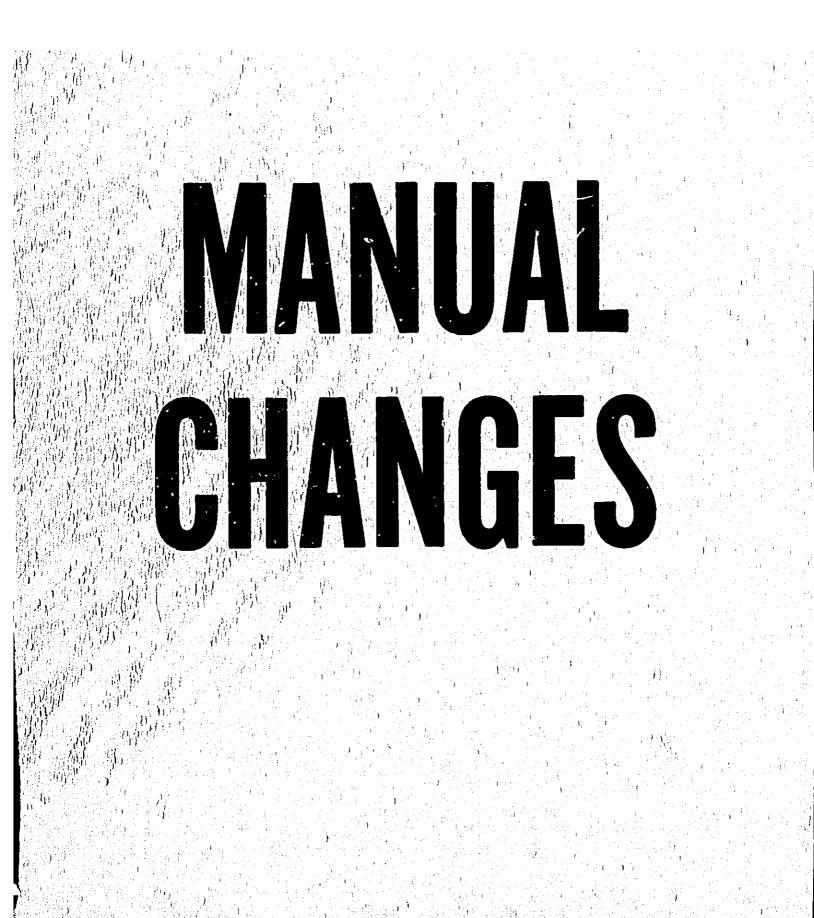
Instrument Serial Prefix	Make Changes
ə35-	

prefixes 525- and below are covered in another manual, hp Part No. 01402-99001.

CHANGE 1

Table 6-2,

A2: enange to hp Part No. 01402-66502.
A3: change to hp Part No. 01402-66503.
MISCELLANEOUS,
Bracket: left side; delete.
Bracket: right side; delete.
Bracket: switch; change to hp Part No. 01402-01203.
Gusset: left side; change to hp Part No. 01402-0101.
Gusset: right side; change to hp Part No. 01402-00101.



MANUAL CHANGES

MODEL 1402A

DUAL TRACE AMPLIFIER

Manual Serials Prefixed: 709-Manual Printed: MARCH 1967

Make all changes listed below as Errata. Check the following table for your instrument serial prefix and/or serial number and make listed change(s) to the manual:

Serial Prefix or Number Make Changes Serial Prefix or Number		Make Changes
716-		
	 A second s	The second second second second

ERRATA

Page 1-0, Table 1-1, Page 5-15, Figure 5-8, 2241 Add to BANDWIDTH specification; R249: Relocate 'CW' note to opposite end of resistor, In a Model 143A Oscilloscope, Page 5-16, Figure 5-9, Replace with attached Figure 5-9. DC coupled: dc to 15 MHz AC coupled: 2 Hz to 15 MHz △ Page 5-17, Figure 5-11, Page 3-2, Paragraph 3-15, R332: Change value to 301. Add: When used in a Model 143A Oscilloscope R333: Change value to 301. the bandwidth specification is 15 MHz. Page 5-18, Figure 5-13, On the grid locator, delete C460 at B5 and add C440 Page 5-1, Paragraph 5-11, step d, Change: d. Change frequency to 20 MHz (in Model at B5. 143A change frequency to 15 MHz). Vertical On the photograph, reverse CR461 and CR462. deflection should be 4.2 divisions or greater. Page 5-19, Figure 5-14, Page 5-2, Paragraph 5-12c, Add asterisk (*) adjacent to C462 to show optimum Add following to note at end of paragraph: value selected at factory, typical value shown. When a Model 1402A is installed for the first Page 5-20, Figure 5-15, time in a Model 143A or 143S, proceed as follows Replace with attached Figure 5-15. to obtain full bandwidth and rise time: Page 5-21, Figure 5-17. (1) Replace C462 in Model 1402A with a larger R573: Change value to 15.6K. fixed capacitor (nominal value 200 pF). R574: Change value to 15.4K. (2) Readjust C461, C441, and C433 in Model Page 5-22, Figure 5-18, 1402A for optimum flat top on pulse. Delete connection between pins 20 and 21. Label pin 20 'NC' (no connection). Label pin 21 -12.6V . Pase 5-3, Paragraph 5-25, Under step c: Change Note to read: Note 1. Table 6-2, ADD: Note 2. A2: Change to HP Part No. 01402-66507. With Model 1402A installed in a 143-series A3: Change to HP Part No. 01402-66508. mainframe, the range of C461, C441, and C110, C153, C210, C253: Change to HP Part No. C433 may not be sufficient to make proper 0160-2255, C:fxd cer 8.2 pF 500vdcw, Mfr Code 72982, Mfr Part No. 301-000-COHO-829C. adjustment in step c. In this case, replace C462 with a capacitor of approximately i C151, C251: Change to HP Part No. 0160-2261, 200 pF. Then rerun this adjustment. C:fxd cer 15 pF 5% 500vdcw, Mfr Code 72982, Mfr Part No. 301-NPO-15PF Page 5-8, Figure 5-2, C462: Add to description column (factory selected) C251: Change Ac to A3. Page 5-13, Figure 5-6, value). R149: Relocate 'CW' note to opposite end of resistor. Q302: Change to HP Part No. 1853-0080, TSTR: R173 and R174: Change value to 698 ohms. SI PNP, Mfr 80131, Mfr Part No. 2N4888.



19 November 1974 Δ = Latest additions to this change sheet. This change sheet supersedes all prior change sheets for this manual. Supplement A for 01402-90903

ERRATA (Cont'd)

Table 6-2 (Cont'd),

- Q501, Q502: Change to HP Part No, 1853-0016; Q: pnp Si; Mfr HP Preferred replacement,
- △ R101: Change to HP Part No. 0698--6400, R:fxd met flm 900k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698--6400.
- △ R102: Change to HP Part No, 0757–0049, R:fxd met fim 111k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757–0049.
- △ R103: Change to HP Part No. 0757–0057, R;fxd met.flm 990k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757–0057.
- △ R104: Change to HP Part No. 0757-0040, R:fxd met fim 10.1k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757-0040.
- △ R111: Change to HP Part No. 0698–4077, R:fxd met flm 600k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698–4077.
- △ R112: Change to HP Part No. 0698–6684, R:fxd met flm 667k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698–6684.
- △ R113: Change to HP Part No. 0698–6654, R:fxd met flm 800k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698–6654.
- △ R121: Change to HP Part No. 0757–0059, R:fxd met flm 1 megohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757–0059.
 - R173 and R174: Change to HP Part No. 0727-0088, R:fxd depc 698 ohms 1% 1/2w, Mfr HP.
- △ R201: Change to HP Part No. 0698-6400, R:fxd met fim 900k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698-6400.
- △ R202: Change to HP Part No. 0757-0049, R:fxd met fim 111k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757-0049.
- △ R203: Change to HP Part No. 0757--0057, R:fxd met flm 990k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757--0057.

Revision A

Table 6-2 (Cont'd),

- △ R204: Change to HP Part No. 0757-0040, R:fxd met fim 10.1k ohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757-0040.
- △ R211: Change to HP Part No. 0698-4077, Rtfxd met flm 600k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698-4077.
- △ R212: Change to HP Part No. 0698–6684, R:fxd met fim 667k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698–6684.
- △ R213: Change to HP Part No. 0698–6654, Rtfxd met flm 800k ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0698–6654,
- △ R221: Change to HP Part No. 0757-0059, R:fxd met flm 1 megohm 1% 1/2w, Mfr 28480, Mfr Part No. 0757-0059.
- △ R332: Change to HP Part No. 0757-0334, R:fxd met flm 301 ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0757-0334,
- △ R333: Change to HP Part No. 0757-0334, R:fxd met flm 301 ohm 1% 1/4w, Mfr 28480, Mfr Part No. 0757-0334.
- Δ R481: Change to HP Part No. 0698–5884, R:fxd met flm 22 ohm 5% 1/4w, Mfr 28480, Mfr Part No. 0698–5884.
- △ R573: Change to HP Part No. 0698-4006, R; fxd met fim 15.6k ohm 1% 1/8w, Mfr 28480, Mfr Part No. 0698-4006.
- Δ R574: Change to HP Part No. 0698–3540, R:fxd met flm 15.4k ohm 1% 1/8w, Mfr 28480, Mfr Part No. 0698–3540.
 - V101, V201, V401: Change to HP Part No. 5080---0410.

Miscellaneous:

Add: HP Part No. 01420-01202; Bracket, cable. Add: HP Part No. 175A-141C; Plate insulator.





Model 1402A Page 3/5

CHANGE 1

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Table 6-2, R 149, R 249: Change to HP Part No. 2100-2293; same description and Mfr. ρ^{j}

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OPTION 090

Model 1402A Option 090 is identical to the standard instrument except for the addition of two HP Model 10012A or 10012B Probes.



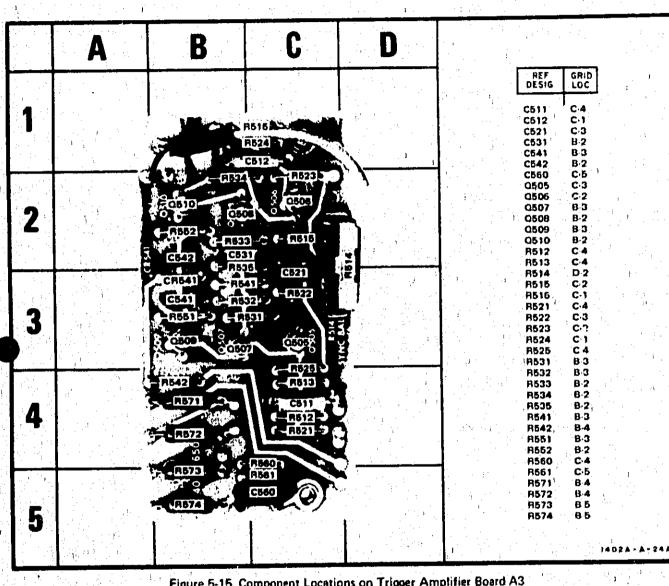


Figure 5-15, Component Locations on Trigger Amplifier Board A3

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				C303 B-5 C304 B-3 C311 B-2 C312 B-1 C313 B-2	R305 B3 R311 B2 R312 B1 R313 B2
3	1000 M	HOLI IIIII		C321 B4 C322 C4 C323 C4 CR301 C3	R315 B 2 R321 B 3 R322 C 4 R323 C 5
				CR302 C 2 CR303 B 2 CR304 C 3 CR305 C 5 Q301 B 2	H326 C 4 H327 B 4 H328 C 4 H329 C 5
4	<u>(6521</u>			O302 B-2 O303 B-3 O304 B-4 R301 B-3 R302 C-2	R331 B4 R332 B5 R333 B4
	CIESTI			R303 B 5	
5			and the second sec		

Figure 5-9. Component Locations on Switching Circuit Board A2