



OPERATING AND SERVICE MANUAL

-hp- Part No. 00461-90006

MODELS 461A/462A WIDEBAND AMPLIFIERS

Serials Prefixed: 946- (461A)
947- (462A)

Appendix C, Manual Backdating Changes,
adapts manual to Serial Numbers:
946-03115 and below (461A)
947-01160 and below (462A)

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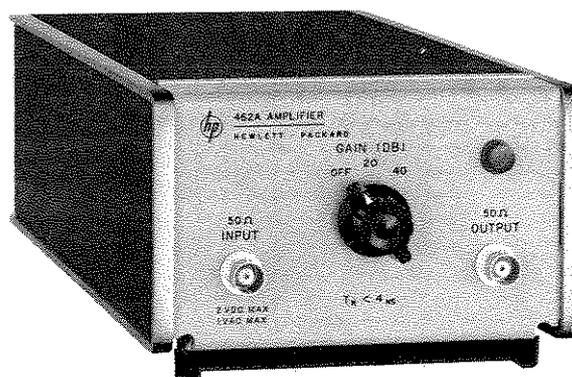
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Model 461A
Wide Band Amplifier



Model 462A
Wide Band Amplifier

Figure 1-1. Hewlett-Packard Model 461A/462A
Wideband Amplifier

SECTION I

GENERAL INFORMATION

1-1. GENERAL INFORMATION.

1-2. The -hp- Model 461A Wide Band Amplifier is used primarily where flatness is important. The -hp- Model 462A Wide Band Amplifier is used primarily where rise time is important. The Model 461A frequency response is ± 1 dB from 1 kHz to 150 MHz. The Model 462A rise and fall times are less than 4 nanoseconds. Either 40 dB or 20 dB gain can be selected with the front panel GAIN (DB switch). The Models 461A and 462A are shown in Figure 1-1. The specifications for both instruments are given in Table 1-1.

1-3. Since the Models 461A and 462A are nearly identical, this manual will discuss the instruments in terms of the Model 461A. The Model 462A will be mentioned only when its operation differs from that of the Model 461A.

1-4. ACCESSORIES AVAILABLE.

1-5. The -hp- 11048C 50-ohm feedthrough termination is an available accessory that is connected at the output of the Model 461A. The feedthrough termination should be used to ensure that the Model 461A is operating into its rated impedance in the event the instrument is connected to a device with an impedance greater than 50 ohms.

Table 1-1. Specifications.

MODEL 461A	MODEL 462A
Frequency Range: 1 kHz to 150 MHz.	Pulse Response: Leading Edge and Trailing Edge Rise Time: Less than 4 nanoseconds Overshoot: Less than 5%
Frequency Response: ± 1 dB, 1 kHz to 150 MHz when operating into a 50 ohm resistive load (500 kHz reference).	Pulse Overload Recovery: Less than 1 μ s for 10 times overload.
Gain at 500 kHz: 40 dB ± 0.5 dB; or 20 dB ± 1.0 dB, selected by front panel switch (inverting). <i>(20dBm)</i>	Pulse Duration for 10% Droop: 30 μ s.
Input Impedance: Nominal 50 ohms.	Equivalent Input Noise Level: Less than 40 μ V in 40 dB position when loaded with 50 ohms.
Maximum Input: 1 volt rms or 2 volts p-p pulse.*	Input Impedance: Nominal 50 ohms.
Maximum dc Input: ± 2 Volts.*	Maximum Input: 1 volt rms or 2 volts p-p pulse.*
Maximum Output: 1/2 volt rms into 50 ohm resistive load. <i>+6.29dBm</i>	Maximum dc Input: ± 2 Volts.*
Equivalent Wideband Input Noise Level: Less than 40 μ V in 40 dB position when loaded with 50 Ω .	Gain: 20 or 40 dB selected by front panel switch (inverting).
Distortion: Less than 5% at maximum output and rated load.	Maximum Output: 1 volt peak-to-peak into 50 ohm resistive load. <i>+10dBm</i>
Overload Recovery: Less than 1 microsecond for 10 times overload.	Delay: 12-14 nanoseconds.

*For the protection of the input circuitry.

Table 1-1. Specifications (Cont'd)

GENERAL	
Power Supply: 115 or 230 V +/-10%, 48 to 440Hz, 5 watts.	Weight: Net: 4 lbs (1,8 kg). Shipping: 5 lbs (2,3 kg.). Accessory Furnished: Detachable power cord.
Dimensions: 5 1/8 in. (13 cm) wide, 3 in. (7,6 cm) high, 11 in. (27,9 cm) deep.	Accessory Available: -hp- 11048C, 50 ohm feedthrough termination.

1-6. INSTRUMENT IDENTIFICATION.

1-7. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within the series. If a letter is included with the serial number, it identifies the country in which the instrument was

manufactured. If the serial prefix of your instrument differs from the one on the title page of this manual, a change sheet will be supplied to make this manual compatible with newer instruments or the backdating information in Appendix C will adapt this manual to earlier instruments. All correspondence with Hewlett-Packard should include the complete serial number.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 461A Amplifier. Included are initial inspection procedures, power and grounding requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks and scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 461A can be operated from any source of 115 or 230 volts (+/-10%), at 48 to 440 Hertz. With the instrument disconnected from the ac power source, move the 115/230 V slide switch on the rear panel until the desired line voltage appears. Power dissipation is 5 watts maximum.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-10. INSTALLATION.

2-11. The Model 461A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 55° C (131° F) or the relative humidity exceeds 95%.

2-12. BENCH MOUNTING.

2-13. The Model 461A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. The Model 461A may be rack mounted by using an adapter frame (-hp- Part No. 5060-0797). The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office locations.)

2-16. REPACKAGING FOR SHIPMENT.

2-17. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-18 if the original container is to be used; 2-19 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

Section II

Models 461A/462A

2-18. If original container is to be used, proceed as follows:

- a. Place instrument in original container if available. If it is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.
- b. Ensure that container is well sealed with strong tape or metal bands.

2-19. If original container is not to be used, proceed as follows:

- a. Wrap instrument in heavy paper or plastic before placing in an inner container.
- b. Place packing material around all sides of instrument and protect panel face with cardboard strips.
- c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.
- d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE" etc.

SECTION III OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 461A can be used to faithfully amplify signals in the 1KHz to 150 MHz range. Gain settings of 20 dB or 40 dB may be selected with the front panel GAIN (DB) switch. The Model 461A will operate within specifications only when its output is terminated in 50 ohms.

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. Figure 3-1 describes the function of all the controls and indicators on both the front and rear panel.

3-5. OPERATING INSTRUCTIONS.

3-6. Figure 3-2 contains the operating instructions for the Model 461A. Each instruction is keyed to a drawing of the front panel.

3-7. IMPEDANCE MATCHING.

3-8. Both the input impedance and the output impedance of the Model 461A are 50 ohms. The Model 461A output must be connected to a 50 ohm load if it is to operate within specifications. If the input impedance of the load is not 50 ohms, a terminating impedance of 50 ohms must be

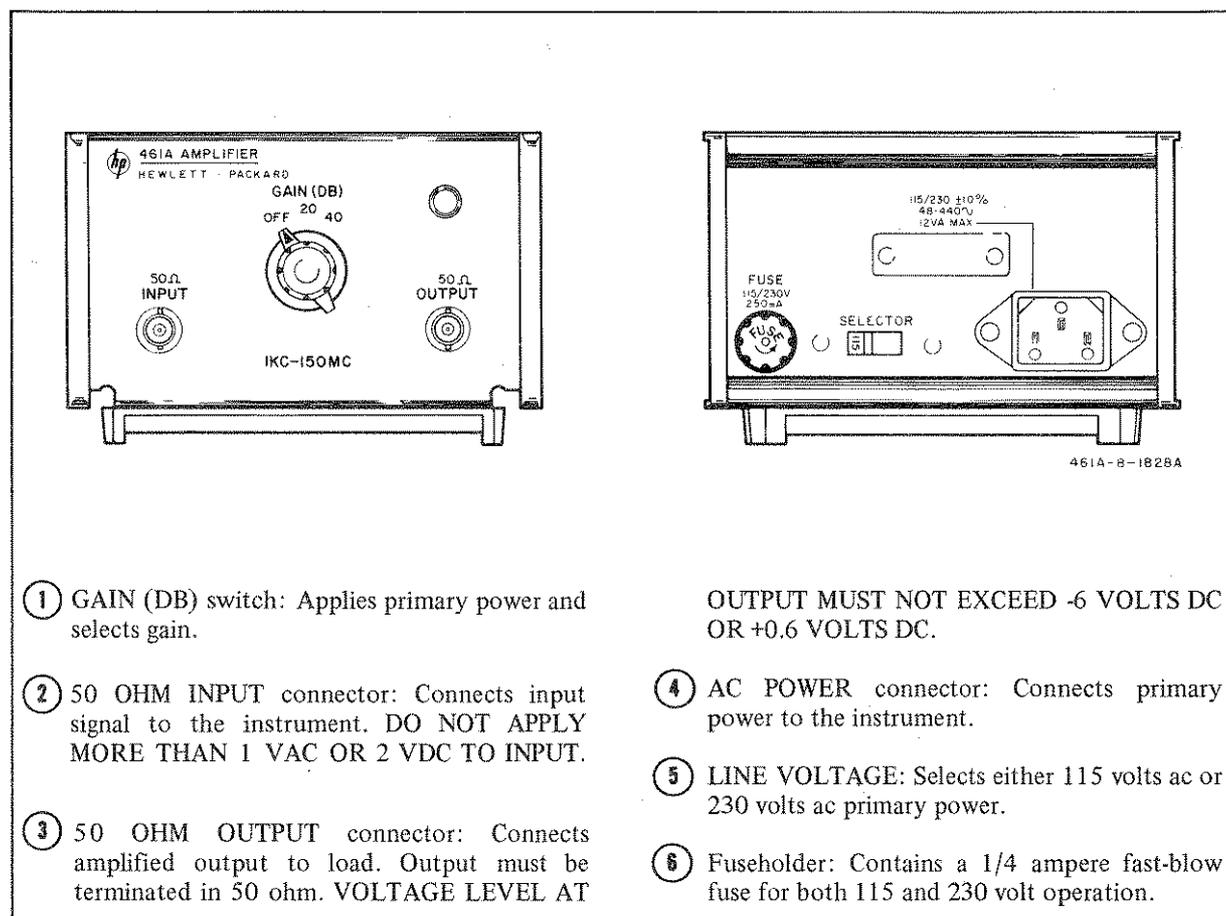


Figure 3-1. Front and Rear Panel Description

connected across the Model 461A output. The -hp- Model 11048C 50 ohm Feedthrough Termination is recommended for this purpose. The Model 11048C may be easily connected in series with the Model 461A output.

3-9. CASCADING AMPLIFIERS.

3-10. The Model 461A will amplify small signals in the 5 to 50 millivolt range to an amplitude of 0.5 volts with minimum distortion. Three 651A's or 652A's can be cascaded with a minimum input of 40 microvolts. For protection of the first instrument, a

diode voltage limiter with two diodes in parallel (see Figure 3-3) can be used. To protect the diodes at high voltages a 500 ohm resistor must be placed in series with the input signal. In doing this a ten to one attenuation is obtained for the first amplifier. Therefore the first amplifier must be set to 40 dB gain while the other two should be set to 20 dB gain. The second two amplifier inputs are protected by the clipped output of the preceding amplifier. Should larger output signals be desired, the Model 461A's can be cascaded with other amplifiers. Concerning frequencies from 10 MHz to 150 MHz, the -hp- 230A Power Amplifier can be used in the fourth cascade position.

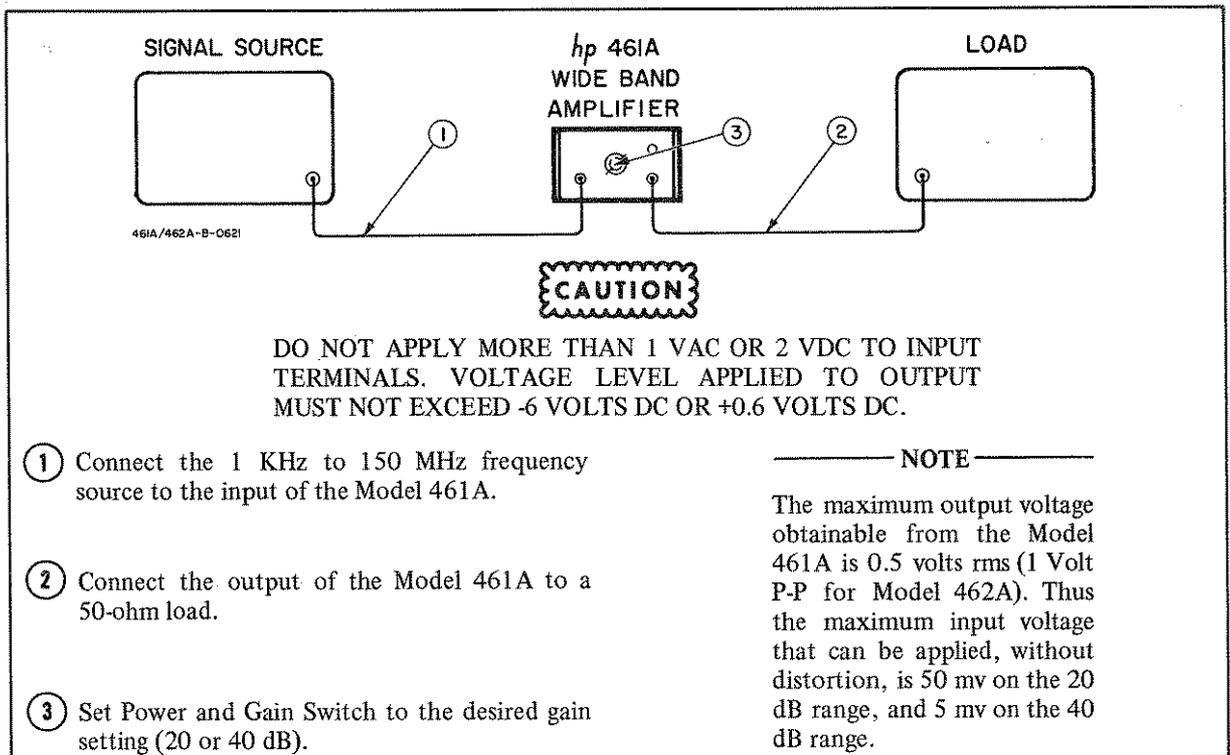


Figure 3-2. Operating Instructions

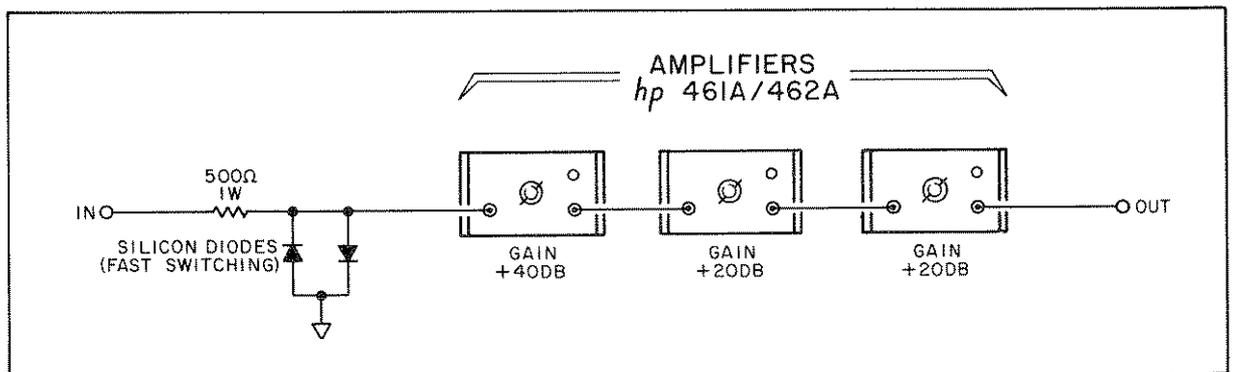


Figure 3-3. Cascading 461A or 462A Amplifiers with Input Protective Circuit

SECTION IV

THEORY OF OPERATION

4-1. GENERAL DESCRIPTION.

4-2. The Models 461A and 462A Amplifiers are essentially identical. In the Model 462A some of the component values are changed slightly to improve its pulse response. In this section both instruments will be presented in terms of the Model 461A.

4-3. Figure 4-1 shows a simplified block diagram of the Model 461A. The amplifier is a five stage, stagger-tuned, cascaded amplifier with emitter follower input and output stages. The gain is switched from 40 dB to 20 dB by attenuating the input by 20 dB. The power supply is a conventional series regulated supply with +15 volt and -15 volt outputs.

4-4. AMPLIFIER CIRCUITS.

4-5. Figure 5-12 shows the schematic diagram of the Model 461A. A3Q3 is the input emitter follower, matching the 50 ohm input impedance to the input impedance of the amplifier. Transistors A3Q4

through A3Q8 constitute a five stage, RC coupled, cascaded amplifier. Each stage has a gain of 8.4 dB. 2 dB is lost in the input and output emitter followers, giving the amplifier a total gain of 40 dB.

4-6. Each stage has an LR feedback circuit with an adjustable inductor. The feedback circuit in each stage controls the overall gain of the amplifier at a different frequency, so the amplifier must be stagger-tuned. There is some interaction between the stages at certain frequencies. A3Q9 is the output emitter follower, and it matches the amplifier output to a 50 ohm output impedance.

4-7. POWER SUPPLY.

4-8. The power supply generates +15 volts and -15 volts bias supply to the amplifiers. Breakdown diode A2CR3 establishes a 15 volt reference. Control transistor A2Q2 detects differences between the reference voltage and the supply output, and its output controls the series regulator Q1.

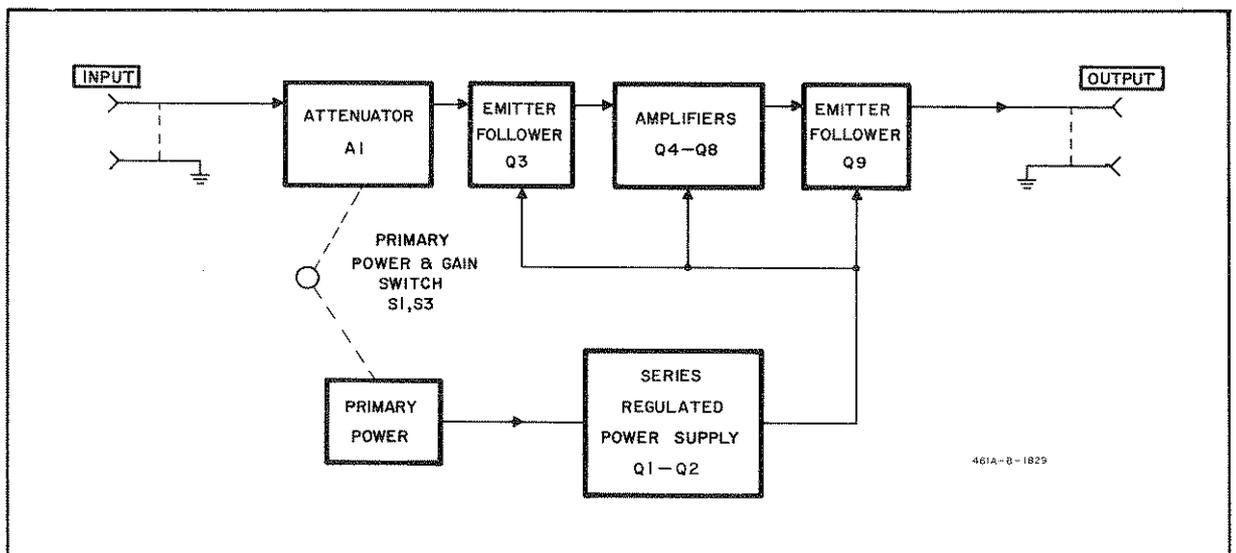


Figure 4-1. Simplified Block Diagram

Table 5-1. Test Equipment Required

INSTRUMENT TYPE	CRITICAL SPECIFICATIONS	USE	RECOMMENDED MODEL
Wide Range Oscillator	Output: 0.5 volts Impedance: 50 ohms Freq. Range: 1 kHz to 10 MHz Level: 0.5% Distortion: less than 0.5%	Low Freq. Response and Gain Check	-hp- Model 654A Test Oscillator
Logarithmic Voltmeter	Accuracy: +/-1% reading to +/-5% reading Freq. Range: 1kHz to 10 MHz DB range: -80 dB to +50 dB	Calibration, Low Freq. Response and Gain Check	-hp- Model 400EL AC Voltmeter
Attenuator	Attenuation: 20 dB Accuracy: 0.1 dB (1 kHz to 150 MHz)	Gain Check Freq. Response Check and Calibration	-hp- Model 8491A Option 20 with known accuracy
Attenuator	Attenuation: 40 dB Accuracy: 0.1 dB (1 kHz to 150 MHz)	Gain Check Freq. Response Check and Calibration	-hp- Model 8491A Option 40 with known accuracy
Distortion Analyzer	Freq. Range: 1 kHz to 500 kHz Sensitivity: Measure 5% Distortion Accuracy: +/-3%	Distortion Check	-hp- Model 331 A, 333A or 334A Distortion Analyzer
RF Millivoltmeter	Freq. Range: 500 kHz to 150 MHz Accuracy: from +/-3% to +/-5% f.s. DB Range: -50 to +20 dBm	Frequency Response Check and Calibration	-hp- Model 3406A RF Sampling Voltmeter
Multimeter including DC Voltmeter	Accuracy: +/-1% of full scale Input Resistance greater than 10 Megohm	Power Supply Checks and Troubleshooting	-hp- Model 412A Volt-Ohm-Ammeter
Signal Generator Sweeper	Freq. Range: 100 kHz to 110 MHz Output: 0.5 V Flatness: 0.20 dB over full range Impedance: 50 ohms	High Freq. Response Check and Adjustment	-hp- Model 8601A Generator/Sweeper
Oscilloscope	Bandwidth: dc to 50 MHz with horizontal magnifier Sensitivity: 0.005V/cm to 20V/cm	Pulse Droop Calibration and Overload Check	-hp- Model 180C Oscilloscope with 1801A and 1820A plug-ins

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. This section uses the following sequence: Performance Checks, Cabinet Removal, Calibration Procedure, Troubleshooting, and Repair.

5-3. TEST EQUIPMENT REQUIRED.

5-4. The critical specifications and suggested test equipment needed in the performance and calibration procedures are given in Table 5-1.

5-5. PERFORMANCE CHECKS.

5-6. The performance checks are in-cabinet procedures that are used to check the instrument against its specification. These procedures can be used as periodic maintenance, after repair or incoming and outgoing quality control checks. The performance checks should be conducted before any attempt is made to calibrate the instrument. A Performance Check Test Card is provided at the end of this section for recording the performance of the instrument during the performance checks. The card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check.

Table 5-1. Test Equipment Required (Cont'd)

INSTRUMENT TYPE	CRITICAL SPECIFICATIONS	USE	RECOMMENDED MODEL
Pulse Generator	Impedance: 50 ohms Leading and Trailing Edge: less than 1 ns Overshoot and Ringing: less than 5% peak Pulse Width: 30 ns	Pulse response and calibration	-hp- Model 8004A Pulse Generator
Square Wave Generator	Frequency: 500 kHz Amplitude: 1 V p-p into 50 ohms	Pulse droop check and overload check	-hp- Model 209A Oscillator (square wave output)
Frequency Doubler	Input Impedance: 50 ohms Freq. Range: 1 MHz to 80 MHz input	High frequency response adjustment	-hp- Model 10515A Frequency Doubler
50 ohm Coaxial Termination	Frequency range: 1 kHz to 150 MHz Termination: 50 ohms	Frequency Response Adjustment	-hp- Model 11048C 50 ohm feedthrough load
RF Detector	Frequency range: 1 MHz to 160 MHz SWR: 1.3	High Frequency Response Adjustment	-hp- Model 8471A RF Detector
Sampling Oscilloscope	Frequency: to GHz range Rise Time: less than 350 ps Dual Vertical Channels Amplitude: 0.5 volts for 50 ohm input	Pulse Response and Delay Checks	-hp- 180C with 1810A/1815A/B Oscilloscope with Sampling Time base and Vertical Plug-ins

(Table 5-1 cont'd on page 5-2)

5-7. Checks for the Models 461A and 462A are provided. The heading of each paragraph indicates whether the procedure is applicable to one or both instruments.

**5-8. 500 kHz GAIN CHECK (461A AND 462A);
OUTPUT VOLTAGE CHECK (461A).**

NOTE

An -hp- Model 651B or 652A Oscillator can be used in place of the 654A if the output of the oscillator is monitored by the ac voltmeter at each change of frequency and the oscillator output is adjusted each time to the reference level.

- a. Connect the test equipment as in Figure 5-1; connect the oscillator with the 50 ohm load to the ac voltmeter (position A).
- b. Set the oscillator frequency to 500 kHz and the oscillator amplitude to read 0 dB on the -10 dB range of the ac voltmeter.
- c. Connect the ac voltmeter as in Figure 5-1, position B, using the 40 dB attenuator and the 40 dB GAIN range of the 461A.
- d. The ac voltage readings in position A and B should differ by +/-0.5 dB or less.
- e. (461A only). With the test setup as in Figure 5-1, position B, slowly increase the

Table 5-1. Test Equipment Required (Cont'd)

INSTRUMENT TYPE	CRITICAL SPECIFICATIONS	USE	RECOMMENDED MODEL
Variable Line Transformer	Output Voltage: to 127 V ac (or 253 V ac)	Power Supply Check	Superior Electric Powerstat 3PF116 (for 115 V line) 3PF216 (for 230 V line)
Decade Attenuator	Attenuation: 60 dBm in 10 dB steps Impedance: 50 ohms Frequency: 1 kHz to 150 MHz	Pulse Response and Delay Check	-hp- 355D VHF Coaxial Attenuator
BNC "T" Adapter	UG-274 B/U	Pulse Response and Delay Check	-hp- 1250-0781
Male BNC to Male BNC Adapter	UG-491A/U	Calibration and Frequency Response	UG-491A/U
BNC Male to Probe Jack Adapter	Used with 1410A Oscilloscope plug-in	Pulse Response and Delay Check	-hp- 10011B (2 each)
BNC to type GR-874 Adapter	Used with 1410A Oscilloscope plug-in	Pulse Response and Delay Check	-hp- 0874-9700
Type N Male to BNC Adapter	UG-1034/U	Calibration, Frequency Response and Gain Check	-hp- 1250-0067 Adapter
BNC to Type N Female Adapter	UG-349A/U	Calibration, Frequency Response and Gain Check	-hp- 1250-0077 Adapter

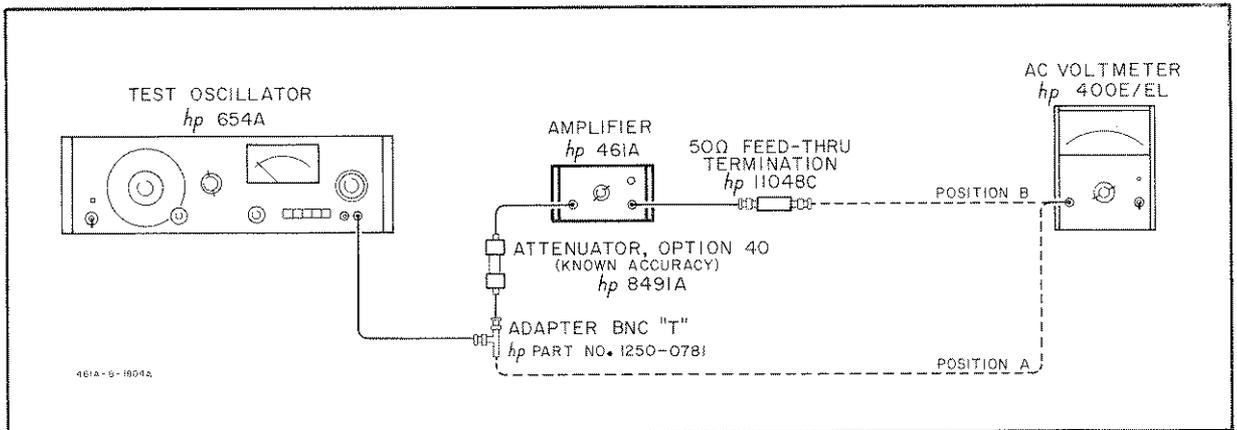


Figure 5-1. Gain Check Setup

amplitude of the oscillator until 0.5 volts is read on the ac voltmeter. This verifies that the 461A will produce an output of 0.5 volts rms.

- f. (461A and 462A). Decrease the oscillator's amplitude to minimum and change the 40 dB attenuator to the 20 dB attenuator.
- g. Repeat steps a through c using the 20 dB attenuator and the 20 dB GAIN range of the 461A.
- h. The ac voltage readings in position A and B should differ by +/-1 dB or less.

5-9. LOW FREQUENCY RESPONSE CHECK (461A).

- a. Connect the 461A as in Figure 5-1, position B using the 40 dB attenuator and the 461A on the 40 dB GAIN range.
- b. Set the oscillator frequency to 500 kHz and adjust its amplitude to read 0 dB on the -10 dB range of the ac voltmeter.

- c. Change the oscillator frequency from 1 kHz to 10 MHz and at each frequency measure the voltage at position A and B (this eliminates the frequency response error of the ac voltmeter).

- d. The ac voltmeter readings at position A and B should not vary more than +/-1 dB for any one frequency.

- e. Record the error at 2 MHz for use in paragraph 5-12. The reference for high frequency response must be at 500 kHz.

5-10. DISTORTION CHECK (461A).

- a. Connect the 461A as in Figure 5-2, with the Distortion Analyzer connected as in position A.
- b. Set the oscillator frequency to 500 kHz and amplitude to minimum.
- c. Set the distortion analyzer's FUNCTION switch to VOLTMETER and METER RANGE to 1 volt.

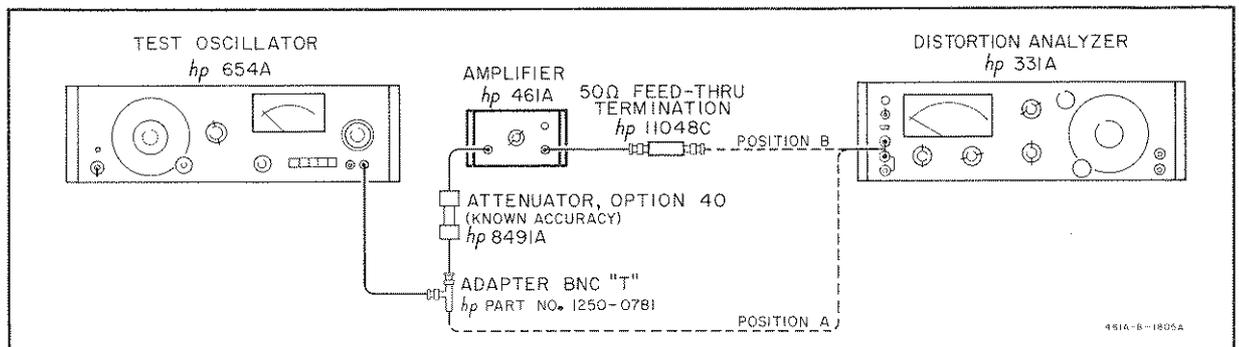


Figure 5-2. Distortion Check Setup

- d. Adjust the output amplitude of the oscillator for a 0.5 volt reading on the meter.
- e. Measure the distortion of the oscillator (Figure 5-2, position A).
- f. Connect the Distortion Analyzer as in Figure 5-2, position B.
- g. Measure the distortion. The difference in this distortion measurement and that in step e should be less than 5%.

5-11. NOISE CHECK (461A and 462A).

- a. Disconnect the input signal from the 461A.
- b. Terminate with 50 Ω load (-hp- 11048C).
- c. Connect the output of the 461A to an RF Voltmeter.
- d. Place the 461A GAIN (DB) control to 40 dB.
- e. The RF Voltmeter should indicate 4 millivolts or less.

5-12. HIGH FREQUENCY RESPONSE CHECK (461A).

- a. Connect the 461A as in Figure 5-3, position B, using the 40 dB attenuator and turning the signal generator output to minimum.

NOTE

Use short cables and eliminate cables entirely when possible.

- b. Adjust the signal generator frequency to 1

MHz (2 MHz from the frequency doubler) and the 461A GAIN (DB) control to 40 dB.

- c. Increase the amplitude of the signal generator to read 0 dB on the 0 dB range of the RF Voltmeter (include the variation from the 500 kHz reference as recorded in paragraph 5-9, step e).
- d. Connect the ac voltmeter as in Figure 5-3, position A. Record the voltmeter reading for an input reference level.
- e. Change the signal generator to 10 MHz and adjust the signal generator output to the reference level in step d.
- f. Connect as in position B. The ac voltmeter must read the reference at 500 kHz (0 dB on the 0 dB range) ± 1 dB or less.
- g. Repeat steps e and f for frequencies of 25 MHz, 50 MHz and 75 MHz (50, 100 and 150 MHz output of the frequency doubler).
- h. If the frequency response is not within specifications refer to the calibration procedure paragraph 5-23.
- j. Connect the circuit in Figure 5-3 using the 20 dB attenuator and placing the 461A in the 20 DB GAIN position. Repeat steps b through g. If the frequency response is not within ± 1 dB refer to Troubleshooting paragraph 5-31 and Table 5-2.

5-13. PULSE RESPONSE CHECK (462A).

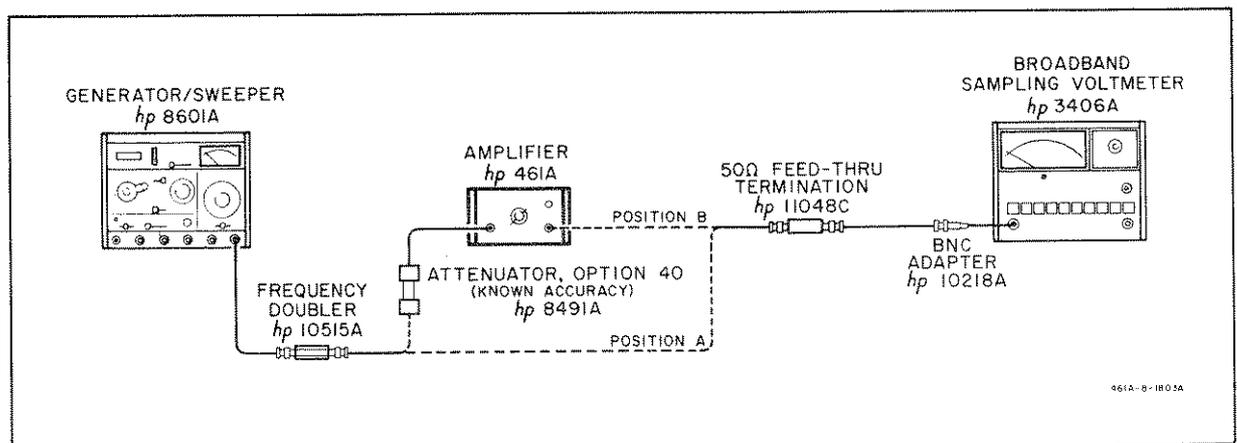


Figure 5-3. High Frequency Response Check

- a. Connect the 462A as shown in Figure 5-4, position A.
- b. Set the Pulse Generator as follows:
 Trigger Source . . . INT. FREQ. .1 to 1 MHz.
 Pulse width 30 ns
 Attenuator 10
 Pulse polarity PLUS (+)
- c. Connect the pulse output to the input of the attenuator.
- d. Set the attenuator to 20 dB and connect the output of the attenuator to the vertical input channel A. Use a BNC to GR type 874 adapter and internally trigger the sweep.
- e. Set the Oscilloscope Sampling Timebase Plug-in as follows:
 Main/Delay switch MAIN
 Main Sweep Trigger slope . . . PLUS (+) (located at top right)
 Int/Ext switch INT.
 Time/cm 10 ns
 Sweep Multiplier2
 Sync pulse ON
- f. Adjust the vertical and horizontal position for one pulse and adjust trigger level for optimum trace.
- g. Adjust vertical millivolts/cm for a 10 cm pulse. The pulse width should be 6 cm (5ns/cm).
- h. Observe the rise time, fall time and flatness of the input pulse.

- j. Check the rise time and fall time in ns (time from 10% to 90% of the leading or trailing edge of the pulse (the middle 8 cm). If this is greater than 1 ns call it TR₁ for the formula in step m.
- k. Connect the 462A as in Figure 5-4, position B. Increase the attenuator to 60 dB and set the 462A GAIN (DB) control to 40 dB. Reverse the polarity of the input pulse to eliminate readjustment of the oscilloscope.
- m. Measure the rise time and fall time of the 462A output pulse (TR₂) as in step j. If the rise time of the input pulse was less than 1 ns, the output rise time must not exceed 4 ns. Otherwise, apply the following formula:

$$\text{Rise time of the 462A} \\ (TR_0) = \sqrt{(TR_2)^2 - (TR_1)^2}$$

The overshoot and undershoot of the output pulse should exceed that observed on the input pulse by less than 5%.

- n. If the output pulse is not within specifications, refer to paragraph 5-26 for calibration procedure.

5-14. PULSE DELAY TIME CHECK. (462A).

- a. Connect the 462A as shown in Figure 5-5.
- b. Connect the pulse generator to the attenuator and set the controls as in paragraph 5-13, step b.

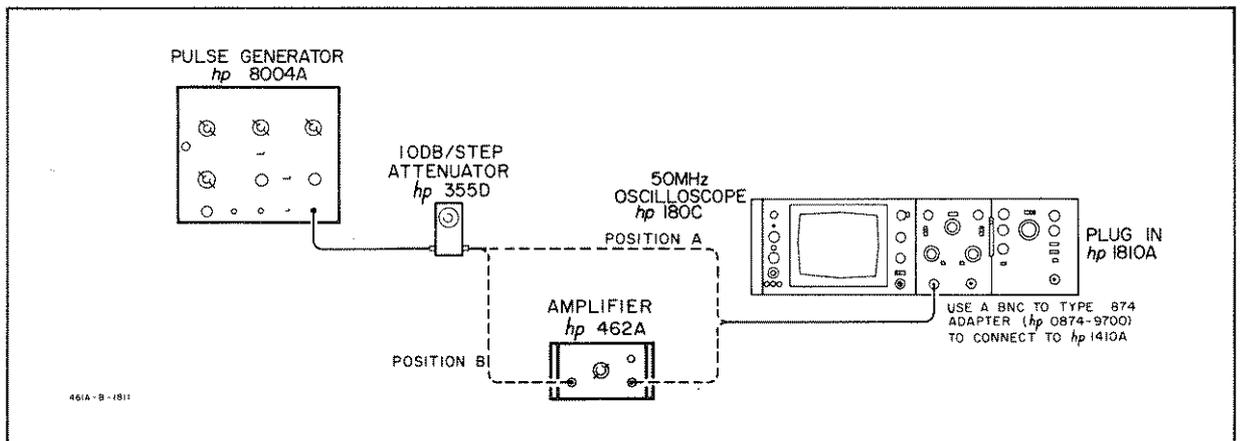


Figure 5-4. Pulse Response Check Setup

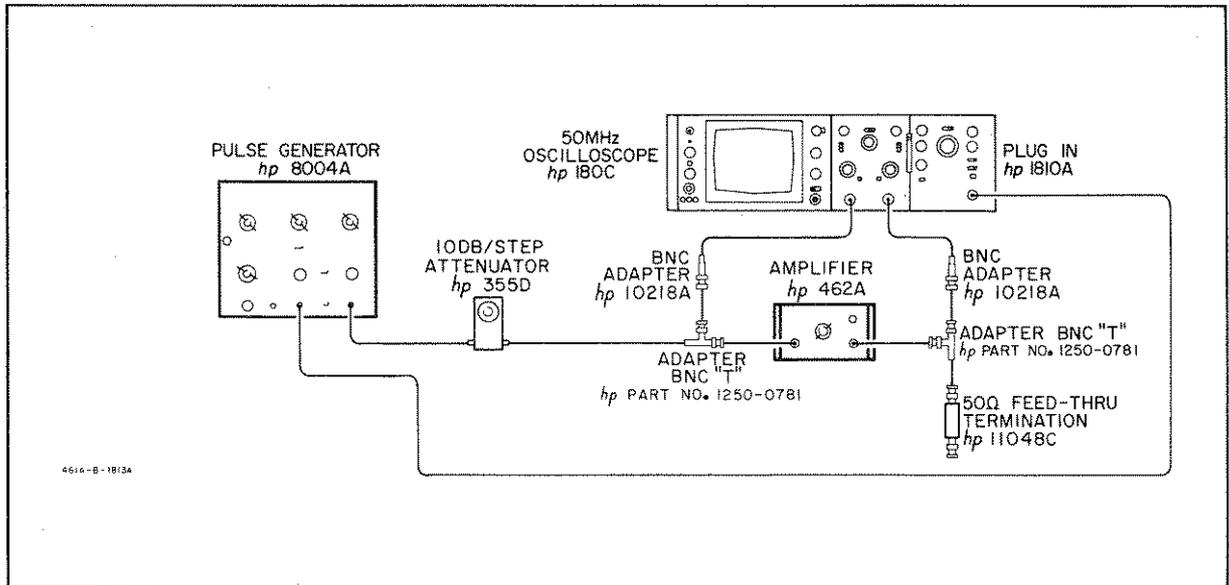


Figure 5-5. Pulse Delay Check Setup

- Connect the probe of the oscilloscope, channel A, to the output of the attenuator through an adapter and a BNC "T". Set the attenuator to 60 dB.
 - Use an external trigger from the pulse generator and adjust trigger Mode and slope for a pulse on the oscilloscope.
 - Connect the output of the 462A to the probe of the oscilloscope, channel B, through a 50 ohm load. Adjust both pulse widths to 3 cm so that 1 cm on the scope will be 10 ns.
 - The midpoint of the leading edges of the input pulse and the output pulse should differ by 12 to 14 ns.
- With the 462A connected as in Figure 5-5, channel "B", increase the amplitude of the pulse generator until a 1 volt peak-to-peak pulse is observed on the oscilloscope. This verifies the maximum output of the 462A Pulse Amplifier.

5-16. PULSE DURATION CHECK (462A).

5-15. MAXIMUM OUTPUT CHECK (462A).

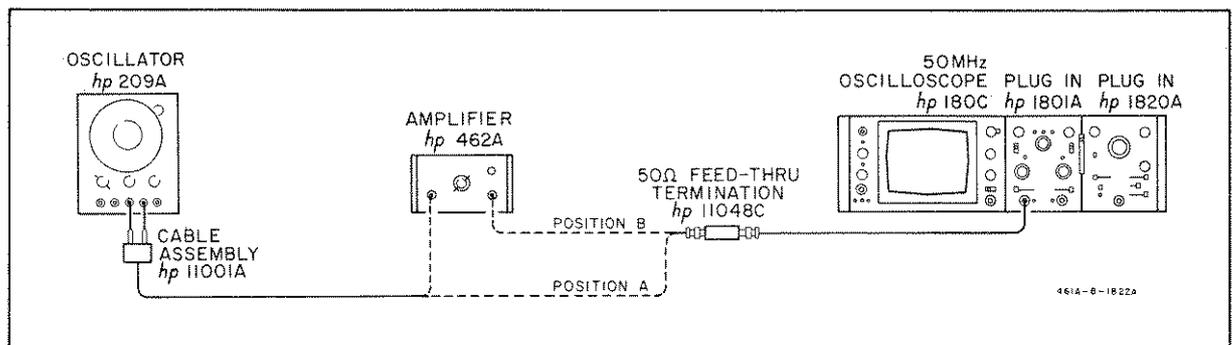


Figure 5-6. Pulse Duration Check

the 462A to 40 dB gain. The pulse must have less than 10% more droop than that observed in step b. Observe the pulse droop at both 20 dB and 40 dB gain of the 462A. (Dual trace can be used on the oscilloscope to show input and output simultaneously.)

5-17. OVERLOAD RECOVERY CHECK (461A and 462A).

NOTE

The maximum output of the 461A is 0.5V rms or 1.4 volt peak-to-peak. The maximum output of the 462A is 1 volt peak-to-peak. Using these values, the maximum input signal, without clipping, is 0.14 volts peak-to-peak for the 20 dB GAIN range and 0.014 volts peak-to-peak on the 40 dB GAIN range for the 461A. For the 462A the maximum input is 0.1 volt peak-to-peak on the 20 dB GAIN range and 0.01 volt

peak-to-peak on the 40 dB GAIN range. For specifications on overload recovery, 10 times these voltages should be the input voltage and recovery time should be less than 1 us.

- a. Connect the circuit as in Figure 5-6, position A.
- b. Adjust the square wave generator for a 1 us pulse (500 kHz) at 1 volt peak-to-peak as observed on the oscilloscope. Overshoot or ringing on the 461A input signal will show up on the output and it is not contributed by the amplifier.
- c. Connect the circuit as in Figure 5-6, position B, with the 461A or 462A in the 20 dB GAIN position. The base line, or level after the pulse, should be restored within 1 us after the trailing edge of the pulse. (Dual channels of the oscilloscope can be used to show input and output pulses simultaneously).

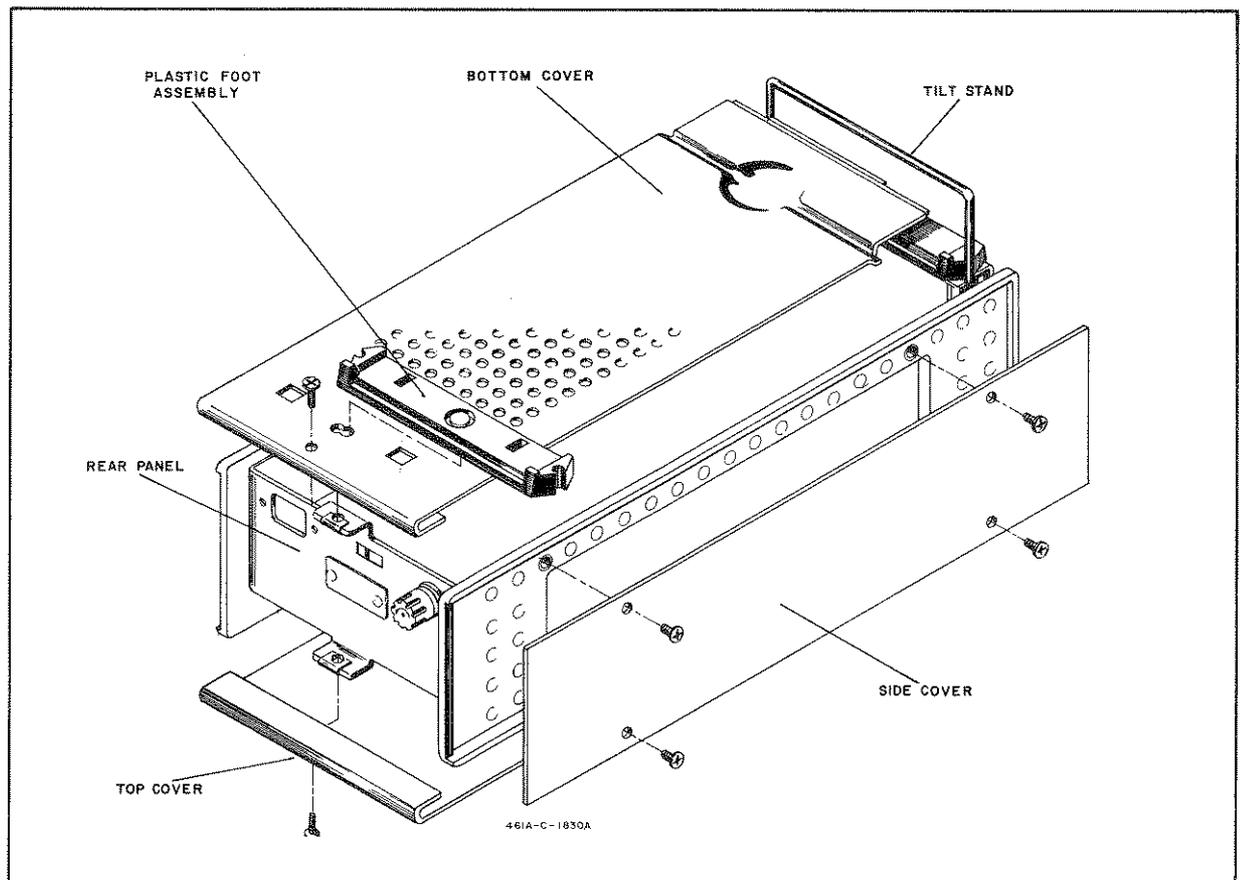


Figure 5-7. Panel Removal and Replacement

5-18. PANEL REMOVAL AND REPLACEMENT.

5-19. The Model 461A contains top, bottom and two side panels. For maintenance and calibration, only top or bottom covers need be removed. Side panel removal will be necessary only when replacing front or rear panel etc. Panel removal is illustrated in Figure 5-7.

- a. Remove ac power from the Model 461A.
- b. Remove the 6/32 screws that hold the panel in place.
- c. Remove the panel.
- d. When replacing the panel, simply reverse the order.

5-20. CALIBRATION PROCEDURE.

5-21. The following is a complete test and adjustment procedure and should be made only if it has been determined that the -hp- Model 461A is out of adjustment as determined by Paragraph 5-5, Performance Check. Indiscriminate adjustment of the internal controls to "refine" settings may actually cause difficulty. Calibration procedures for the Models 461A and 462A are provided. The heading of each paragraph indicates whether the procedure is applicable to one or both instruments.

5-22. POWER SUPPLY (461A and 462A).

- a. Remove top and bottom covers from Model 461A cabinet (refer to Figure 5-7).
- b. Connect Model 461A to a Variable Transformer. Set line voltage to 115 volts.
- c. Connect common lead of DC Voltmeter (-hp- Model 412A) to -hp- Model 461A chassis ground and VOLTS probe to terminal No. 6 of Transformer T1 (red wire). Refer to Figure 5-10.
- d. The DC Voltmeter should indicate +15 +/-2 volts.
- e. Vary input line voltage with variable transformer from 103 to 127 volts. DC Voltmeter reading should not change by more than 0.5 volts from the reading observed in step d.
- f. Connect VOLTS probe of DC Voltmeter to emitter of Q1 (yellow wire).

- d. The DC Voltmeter should indicate +15 +/-2 volts.
- e. Vary input line voltage with variable transformer from 103 to 127 volts. DC Voltmeter reading should not change by more than 0.5 volts from the reading observed in step d.
- f. Connect VOLTS probe of DC Voltmeter to emitter of Q1 (yellow wire).
- g. DC Voltmeter should indicate -15 volts +/-2 volts.
- h. Vary input line voltage with variable transformer from 103 to 127 volts. DC Voltmeter reading should not change by more than 0.5 volts from the reading observed in step g.
- j. Measure the ac voltage (-hp- Model 400EL) between emitter of Q1 and ground; ripple voltage must be less than 1 mv for any rated line voltage.

5-23. GAIN CALIBRATION (461A and 462A).

- a. Connect the 461A as shown in Figure 5-1, using the 40 dB attenuation.
- b. Connect the ac voltmeter to position "A" and adjust the output of the oscillator for a reading on the ac voltmeter of -10 dB.
- c. Connect the ac voltmeter to position "B" and set the 461A to the 40 GAIN (DB) position.
- d. The ac voltmeter should read -10 dB +/-0.5 dB. If not, change the value of A3R18 until the ac voltmeter does read -10 dB +/-0.5 dB. The value of A3R18 is typically 4.7 ohm to 13 ohm. To increase the amplitude, decrease the size of A3R18 and vice versa. If A3R18 will not correct the gain, change the value of A3R29 in like manner. Refer to page 5-13 for possible resistor values.
- e. Change the 461A to the 20 GAIN (DB) position. The ac voltmeter should read -30 dB +/-1.0 dB. If the 20 dB position is out of tolerance, refer to Table 5-2.

5-24. FREQUENCY RESPONSE CALIBRATION (461A).

NOTE

The test equipment in Figure 5-3 must be used for an accurate check and for a final adjustment for high frequency response. L2 through L6 should not have to be adjusted unless some component is changed in the feedback path. If the coils have to be adjusted, carefully peel away the cement, turn the coil with a plastic tuner and when the alignment is finished, cement the coils again with Duco cement. Refer to Figure 5-11 for location of coils.

- a. Connect the test setup as in Figure 5-3 and repeat paragraph 5-12, steps a through g.
- b. If the amplitude is slightly out of specifications at 50 MHz (25MHz on the Generator/Sweeper) adjust L2. From 75 MHz to 120 MHz adjust L3 and L4. If the amplitude rolls off approximately 5 dB at 100 MHz (50 MHz on Generator/Sweeper), refer to Troubleshooting Tips, Table 5-2.
- c. If the amplitude is slightly out of specifications from 120 MHz to 150 MHz adjust L5 and L6 (Repeat step g paragraph 5-12 several times until flatness is obtained.)
- d. When the frequency response is within specification on the 461A GAIN 40 dB position change the attenuator to 20 dB and

the 461A GAIN (DB) control to 20 dB position. Repeat step g, paragraph 5-12. If the amplitude falls off at 120 MHz to 150 MHz, refer to Troubleshooting Tips, Table 5-2.

5-25. PRELIMINARY FREQUENCY RESPONSE ALIGNMENT.

NOTE

This procedure should only be used when the high frequency response is completely out of alignment and not quickly adjustable by paragraph 5-24.

- a. Connect the 461A as shown in Figure 5-8. Set the 8601A Generator/Sweeper as follows:

Frequency 80 MHz (Doubled)
 Sweep Video
 Sweep Mode fast
 Sweep Mode vernier . . completely clockwise
 Adjust output level to value used in paragraph 5-12, step c. (Approximately 0.3 volts).

- b. 1. Set the 180A/1801A/1820A Oscilloscope as follows:

2. Connect the 8601A Sweep out to Horizontal EXT input.
 AC/DC switch DC
 Magnifier X5
 Display EXT Sens

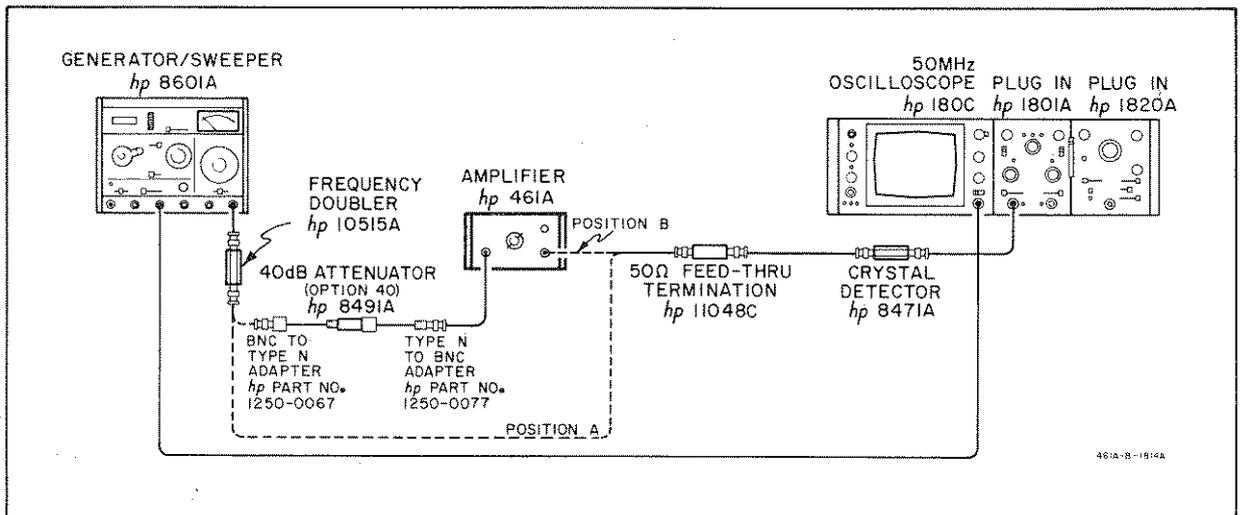


Figure 5-8. Preliminary Frequency Response Calibration Setup

3. Adjust Horizontal position to start sweep at left at side of display.
 4. Adjust sweep length for 8 cm (20 MHz per cm).
 5. Set vertical display to A.
 6. Adjust A position for a display at bottom of the screen.
 7. Set the polarity switch to "+ up".
- c. Connect the circuit as in Figure 5-8, position A. Draw the sweep trace on the face of the oscilloscope.
 - d. Connect the circuit as in Figure 5-8, position B. (Slight variations are due to the cut-off frequency of the 461A.) Adjust the coils L2 through L6 as described in paragraph 5-24 making the trace correspond as near as possible to the trace on the oscilloscope. Work back and forth between the coils as there is an intermingled effect between coils.
 - e. When the scope trace and the mark on the scope correspond as nearly as possible, recheck Gain calibration Paragraph 5-23, steps a thru e and Frequency Response calibration Paragraph 5-24, steps a thru d.

Main/Delay switch MAIN
 Main Sweep Trigger-
 Slope PLUS (located at top right)
 Int/Ext switch INT
 Trigger Level/Mode
 control AUTO
 Time/cm 10 ns
 Sweep Magnifier 2
 Sync pulse On

- f. Adjust the vertical and horizontal position for one pulse (adjust trigger level for optimum trace).
- g. Adjust vertical millivolts/cm for a 10 cm pulse. The pulse width should be 6 cm (5 ns/cm).
- h. Observe the rise time fall time (middle 8 cm of height) and flatness of the input pulse. If the rise time is greater than 1 ns apply formula paragraph 5-13, step m to the resultant rise time on the scope.
- j. Connect the 462A as in position B of Figure 5-4. Change the attenuator to 60 dB and set the 462A to 40 dB gain. Reverse the polarity of the pulse generator as the 462A output is of opposite polarity.

5-26. PULSE RESPONSE CALIBRATION (462A).

- a. Connect the Model 462A as shown in Figure 5-4, position A.
- b. Set the Pulse Generator as follows:
 Trigger Source ... INT. FREQ. .1 to 1 MHz
 Pulse width 30 ns
 Attenuator 10
 Pulse polarity PLUS
- c. Connect the pulse output to the input of the attenuator.
- d. Set the attenuator to 20 dB and connect the output of the attenuator to the vertical input channel A. Use a BNC to GR type 874 adapter and internally trigger the sweep.
- e. Set the Oscilloscope Sampling Timebase Plug-in as follows:

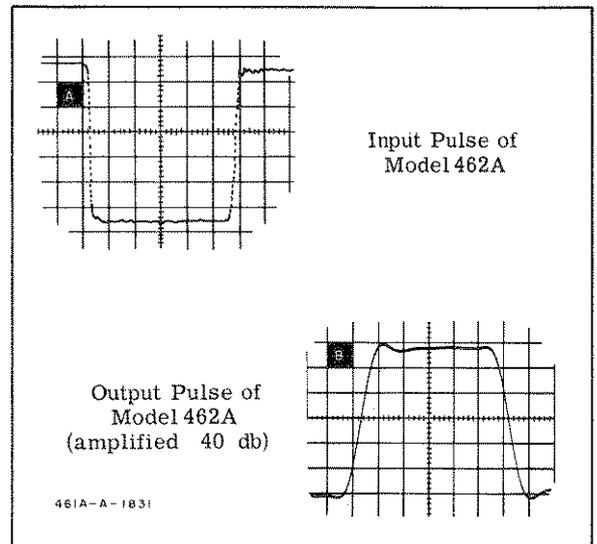


Figure 5-9. Input and Output Pulses of 462A

- k. Make slight amplitude adjust if necessary on oscilloscope and repeat step h. If the rise time is too long (4 ns or result of formula paragraph 5-13) adjust L2 to increase the pulse amplitude and decrease rise time.

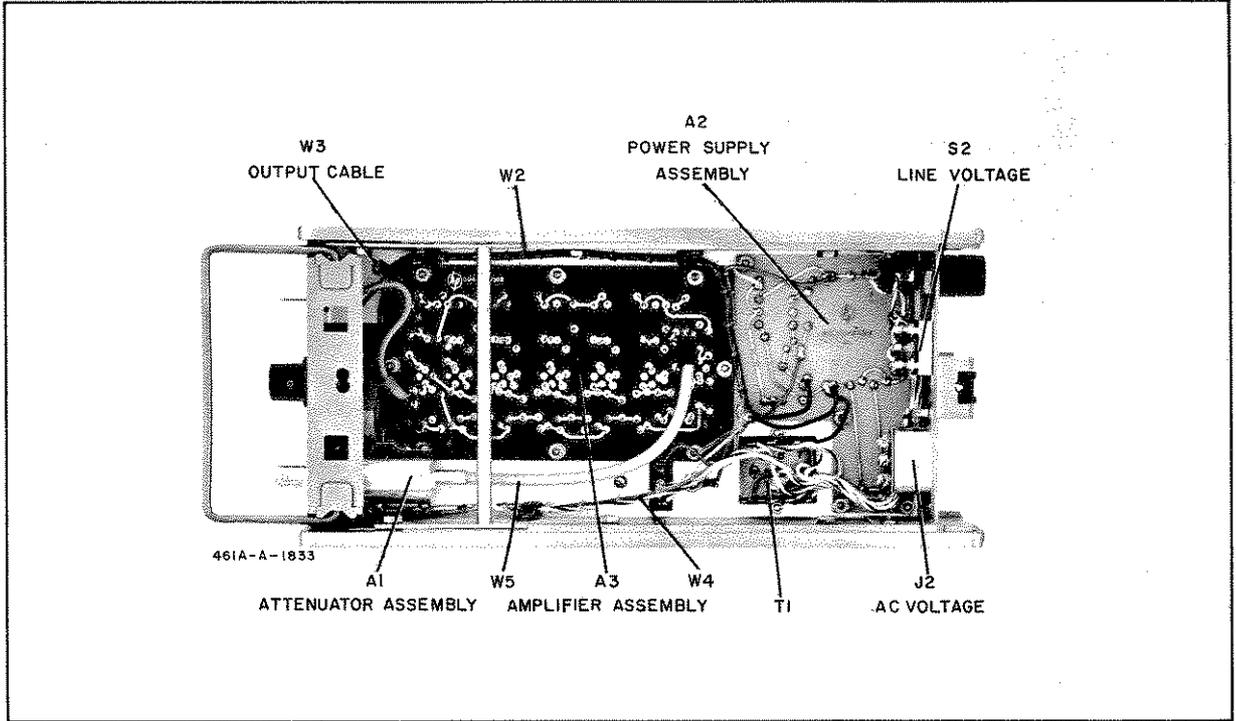


Figure 5-10. Bottom View

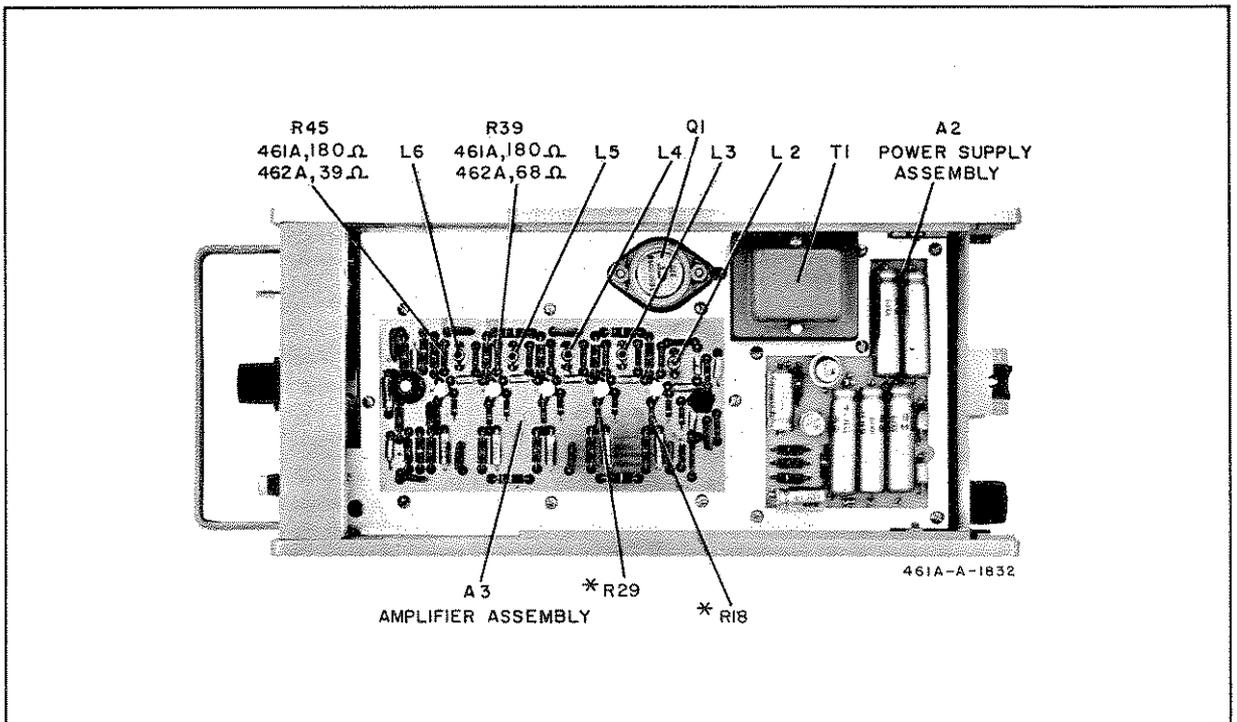


Figure 5-11. Top View

- m. Adjust L3, L4, L5 and L6 for maximum flatness and minimum ringing.
- n. Change the 462A to 20 dB gain and change to attenuator to 40 dB. Observe the pulse shape for specifications.

5-27. ETCHED CIRCUIT BOARDS.

5-28. The Model 461A uses both plated-through and single-sided etched circuit board types. Power supply assembly A2 uses the single-sided etched circuit board. The amplifier assembly A3 uses the plated-through type.

5-29. When replacing a component on the plated-through type of etched circuit board, the component can be soldered from either side of the board. When replacing a component on the single-sided board, the component should be soldered from the conductor side.

5-30. Regardless which type of etched circuit board is used, the following rules should be followed:

- a. Avoid applying excessive heat when soldering on the circuit board. Use a 37 to 50 watt pencil tip soldering iron.
- b. To remove a damaged component, clip the component lead near the component. Then apply heat and remove the lead with a straight upward motion.
- c. Use a toothpick to free eyelet of solder before installing a new component.
- d. Solder from the conductor side of the board to insure good connections between the eyelet and the conductor.

5-31. TROUBLESHOOTING PROCEDURE.

- a. This procedure should only be performed when the 461A or 462A can not be calibrated according to procedure in paragraphs 5-20 through 5-26.

- b. Start with a thorough visual inspection. Look for burned out or loose components, loose connections, or any other similar condition which suggests a source of trouble.
- c. Inspect the test setup being used when symptoms of malfunction were observed to be certain the source of trouble is not external to Amplifier.
- d. Rotate Model 461A GAIN control to 20 dB to determine if malfunction is isolated to Attenuator; Amplitude of signal at base of Q3 should decrease by a factor of 10.
- e. Check power supply as outlined in Paragraph 5-22.
- f. Check dc levels identified on the schematic diagram, Figure 5-12.
- g. Using an AC Voltmeter (-hp- Model 400EL), check the gain of transistors Q4 thru Q8, typically 8.4 dB per stage. 2 dB gain is lost in the input and output emitter followers leaving 40 dB gain for the Amplifier.

————— NOTE —————

Gain of Q4 is controlled by the value of R18* and Gain of Q5 is controlled by the value of R29* (4.7 to 13 ohms).

- h. The R-L feedback Network and capacitors are responsible for the high frequency performance and should be checked if difficulty is encountered at high frequencies.
- j. Refer to Troubleshooting Hints, Table 5-2 for possible causes of the trouble.
- k. If Gain, flatness and noise is within specifications the distortion should be satisfactory, unless too large an input signal is applied, resulting in clipping of the output.
- m. Perform Calibration and Performance Check Procedures after repair is completed.

Table 5-2. Troubleshooting Tips (461A and 462A)†

TROUBLE	PROBABLE CAUSE
1. No output	Check power supply (possibly CR3) Check Q3, R9, Q4 and Q5
2. 20 dB position intermittent	Check GAIN switch for good contact
3. Gain not correct	Check DC voltages listed on Schematic Fig. 5-12 Check AC gain of each stage (8.4 dB) Check Q3, Q4 and R18. (Refer to Paragraph 5-23)
4. Flatness	Q3, low frequency; Q7, Q8, high frequency
5. Small roll off at high end	Change size of C26* (range: 10 pF to 22 pF) Increase capacitance to increase amplitude Check for shorted or open coil (adjustment has no effect on flatness)
6. Frequency response at high end on 40 dB not corrected by L6 or C26*	Check C31
7. Rolls off 5 dB at 100 MHz	Check C31 and Q8
8. Frequency response at high end is low on 20 dB but 40 dB range is flat	Add C35* in attenuator (A1)
9. Output drops off at high temperatures	Check Q4
10. Noise on 40 dB range	Check Q3 and Q4
11. Noise on both ranges	Check ground connection to chassis
12. Intermittent noise	Check Q1
13. Blow fuse	Check B+ and B- to ground greater than 2 k-ohm Check A2CR3, A2C7 and Q1
14. Pulse rise time too long (coils have little effect)	Check Q8 and then Q4
15. Excessive distortion	Check for clipping (use oscilloscope) Decrease input signal. Observe

† For instruments prefixed 346-, 347-, 414-, 418- or 421- also refer to Backdating Changes, Appendix C.

Possible Resistor Values for A3R18* and A3R29*

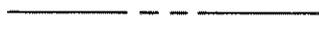
Resistor fixed	4.7 ohm	5%	1/2W	-hp- Part No. 0698-0001
Resistor fixed	5.6 ohm	5%	1/4W	-hp- Part No. 0683-0565
Resistor fixed	6.8 ohm	5%	1/4W	-hp- Part No. 0683-0685
Resistor fixed	8.2 ohm	5%	1/4W	-hp- Part No. 0683-0825
Resistor fixed	9.1 ohm	5%	1/4W	-hp- Part No. 0698-5839
Resistor fixed	10.0 ohm	5%	1/4W	-hp- Part No. 0683-1005
Resistor fixed	11.0 ohm	1%	1/4W	-hp- Part No. 0757-0490
Resistor fixed	12.1 ohm	1%	1/4W	-hp- Part No. 0757-0491

SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:

RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS

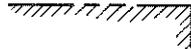
3.  DENOTES ASSEMBLY.

 DENOTES MAIN SIGNAL PATH.

 DENOTES FEEDBACK PATH.

4.  DENOTES FRONT PANEL MARKING.

 DENOTES REAR PANEL MARKING.

5.  DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.

6. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.

7. NOT INCLUDED IN MODEL 462A.

8. MAKE THE FOLLOWING VALUE CHANGES FOR MODEL 462A:

R17 TO 180 OHM R39 TO 68 OHM
R24 TO 180 OHM R45 TO 39 OHM
R31 TO 120 OHM

9. S1 IS CAM ACTIVATED BY S3 IN THE 20 DB POSITION.

10. Q4 HAS A GROUNDED SHIELD. TERMINAL ARRANGEMENT IS AS SHOWN:



11. FOR SELECTION OF R18* SEE PARAGRAPH 5-23.

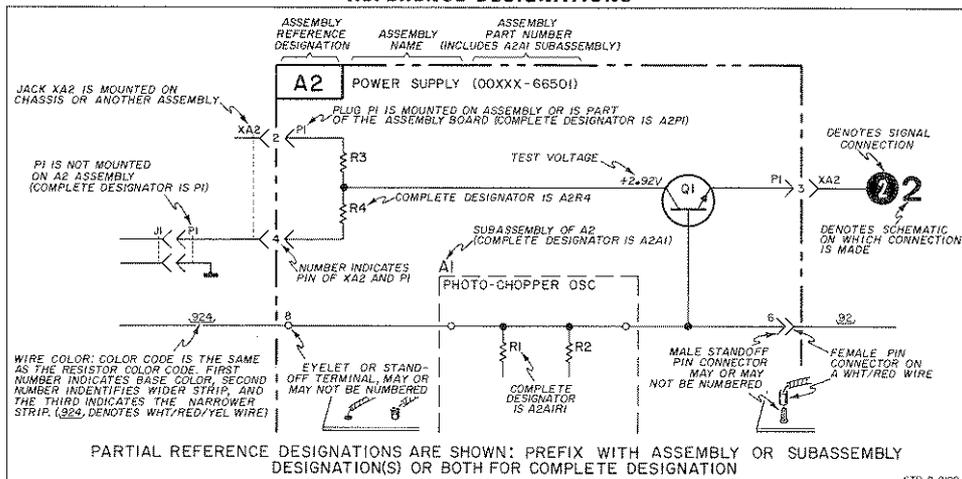
12. FOR INSTRUMENTS PREFIXED 346-, 418-, 347-, 421-, SEE BACKDATING CHANGES, APPENDIX C.

13.  DENOTES INDUCTANCE FROM FERRITE BEADS.

14.  DENOTES OUTER CHASSIS (FRAME) GROUND.

15.  DENOTES ASSEMBLY GROUND (ON BOARD).

REFERENCE DESIGNATIONS



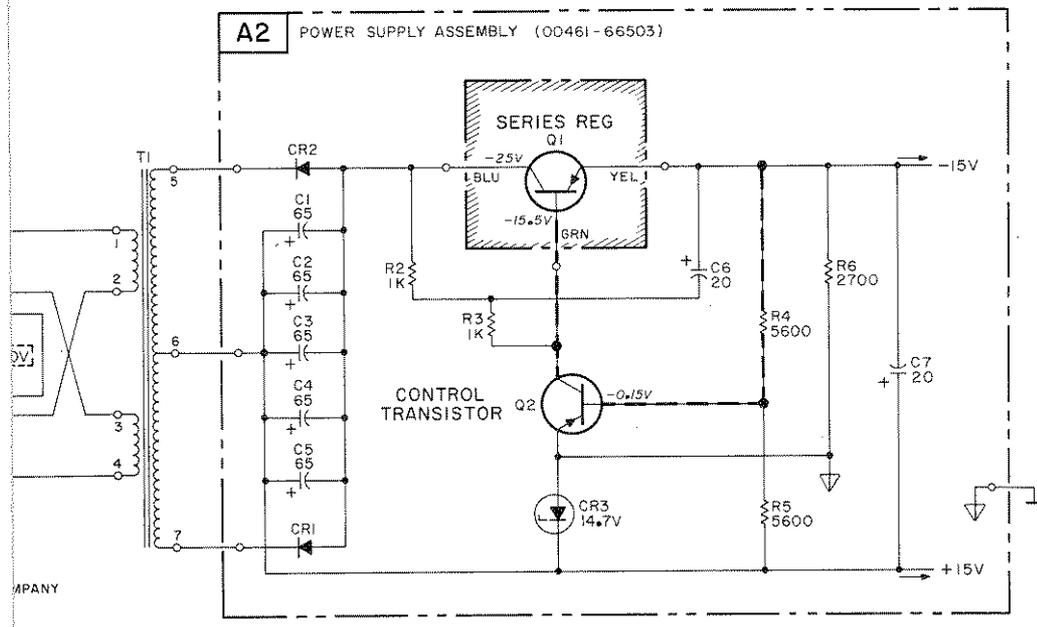
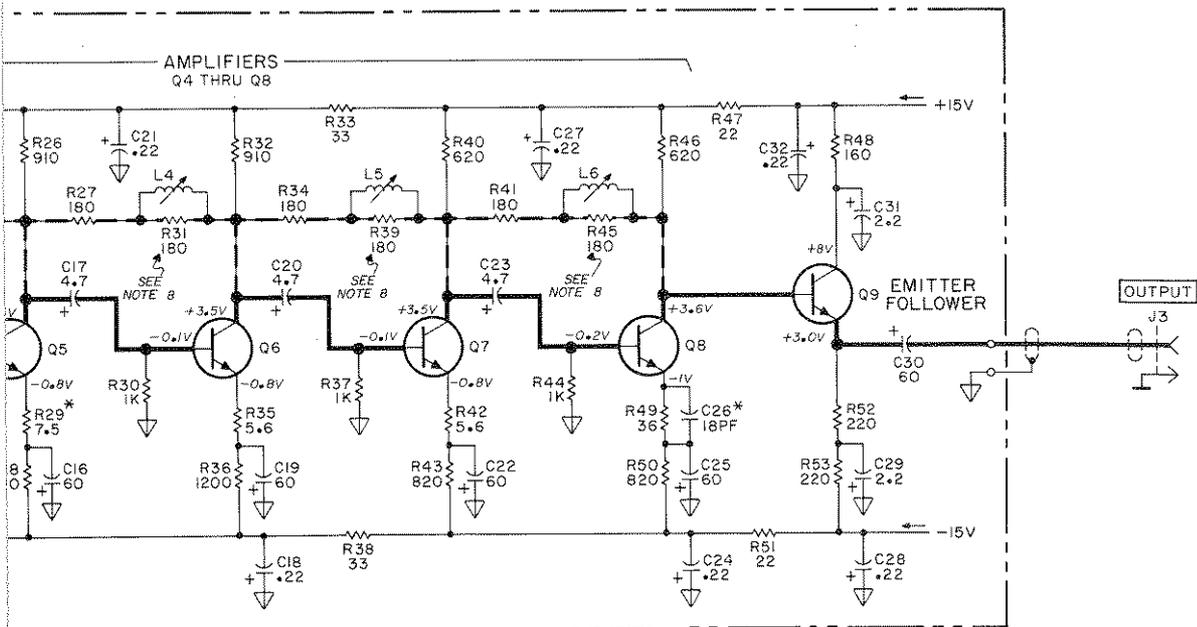


Figure 5-12. Schematic Diagram of Model 461A/462A

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 461A or 462A.
Wideband or Pulse Amplifier
Serial No. _____

Test performed by _____
Date _____

GAIN: (461A, 462A)	a) 40 dB +/-0.5 dB b) 20 dB +/-1.0 dB	_____ _____
OUTPUT VOLTAGE: (461A) (462A)	0.5 volts rms 1 volt p-p	_____
DISTORTION: (461A)	less than 5% maximum output rated load	_____
NOISE: (461A, 462A)	less than 4 mV at 40 dB	_____
FREQUENCY RESPONSE: (461A)	a) Low end, +/-1 dB 1 kHz to 10 MHz b) High end, +/-1 dB 10 MHz to 150 MHz	_____ _____
OVERLOAD RECOVERY: (461A, 462A)	less than 1 us	_____
PULSE RESPONSE: (462A) Rise Time: Pulse Duration for 10% Droop: Delay:	less than 4 ns 30 us 12 to 14 ns	_____ _____ _____

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

- a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.
- b. Descriptions of the part. (See list of abbreviations below.)
- c. Typical manufacturer of the part in a five-digit code. (See Appendix for list of manufacturers.) Parts that are manufactured by Hewlett-Packard are identified by the abbreviation -hp-.
- d. Manufacturer's part number.

- e. An exploded view of the attenuator with reference designators identifying the name and -hp- part number.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-5. NON-LISTED PARTS.

6-6. To obtain a part that is not listed, include:

- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

ABBREVIATIONS					
Ag	..... silver	Hz	..... hertz (cycle(s) per second)	NPO	..... negative positive zero (zero temperature coefficient)
Al	..... aluminum	ID	..... inside diameter	ns	..... nanosecond(s) = 10 ⁻⁹ seconds
A	..... ampere(s)	imp	..... impregnated	nsr	..... not separately replaceable
Au	..... gold	incd	..... incandescent		
C	..... capacitor	ins	..... insulation(ed)	Ω	..... ohm(s)
cer	..... ceramic	kΩ	..... kilohm(s) = 10 ³ ohms	old	..... order by description
coef	..... coefficient	kHz	..... kilohertz = 10 ³ hertz	OD	..... outside diameter
com	..... common	L	..... inductor	p	..... peak
comp	..... composition	lin	..... linear taper	pA	..... picoampere(s)
conn	..... connection	log	..... logarithmic	pc	..... printed circuit
dep	..... deposited	log	..... logarithmic taper	pF	..... picofarad(s) 10 ⁻¹² farads
DPDT	..... double-pole double-throw	mA	..... milliampere(s) = 10 ⁻³ amperes	p/o	..... peak inverse voltage
DPST	..... double-pole single-throw	MHz	..... megahertz = 10 ⁶ hertz	pos	..... part of position(s)
elect	..... electrolytic	MΩ	..... megohm(s) = 10 ⁶ ohms	poly	..... polystyrene
encap	..... encapsulated	met flm	..... metal film	pot	..... potentiometer
F	..... farad(s)	manf	..... manufacturer	p-p	..... peak-to-peak
FET	..... field effect transistor	ms	..... millisecond	ppm	..... parts per million
fxd	..... fixed	mtg	..... mounting	prec	..... precision (temperature coefficient, long term stability and/or tolerance)
GaAs	..... gallium arsenide	mV	..... millivolt(s) = 10 ⁻³ volts	R	..... resistor
GHz	..... gigahertz = 10 ⁹ hertz	μF	..... microfarad(s)	Rh	..... rhodium
gd	..... guarded	μV	..... microvolt(s) = 10 ⁻⁶ volts	rms	..... root-mean-square
Ge	..... germanium	my	..... Mylar®	rot	..... rotary
grd	..... ground(ed)	nA	..... nanoampere(s) = 10 ⁻⁹ amperes	Se	..... selenium
H	..... henry(ies)	NC	..... normally closed	sect	..... section(s)
Hg	..... mercury	Ne	..... neon	SI	..... silicon
		NO	..... normally open		

DECIMAL MULTIPLIERS					
Prefix	Symbols	Multiplier	Prefix	Symbols	Multiplier
tera	T	10 ¹²	centi	c	10 ⁻²
giga	G	10 ⁹	milli	m	10 ⁻³
mega	M or Meg	10 ⁶	micro	μ	10 ⁻⁶
kilo	K or k	10 ³	nano	n	10 ⁻⁹
hecto	h	10 ²	pico	p	10 ⁻¹²
deka	da	10	femto	f	10 ⁻¹⁵
deci	d	10 ⁻¹	atto	a	10 ⁻¹⁸

DESIGNATORS					
A	..... assembly	FL	..... filter	Q	..... transistor
B	..... motor	HR	..... heater	QCR	..... transistor-diode
BT	..... battery	IC	..... integrated circuit	R	..... resistor
C	..... capacitor	J	..... jack	Rt	..... thermistor
CR	..... diode	K	..... key	S	..... switch
DL	..... delay line	L	..... inductor	T	..... transformer
DS	..... lamp	M	..... meter	TB	..... terminal board
E	..... misc electronic part	MP	..... mechanical part	TC	..... thermocouple
F	..... fuse	P	..... plug	TP	..... test point
				TS	..... terminal strip
				U	..... microcircuit
				V	..... vacuum tube, neon bulb, photo cell, etc.
				W	..... cable
				X	..... socket
				XDS	..... fuseholder
				XF	..... fuseholder
				Y	..... crystal
				Z	..... network

STD-B-2734

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	00462-63401	1	Assembly: Attenuator (461A and 462A) (These two assemblies are identical except where stated. Reference Designator is from Exploded View.)	-hp-	

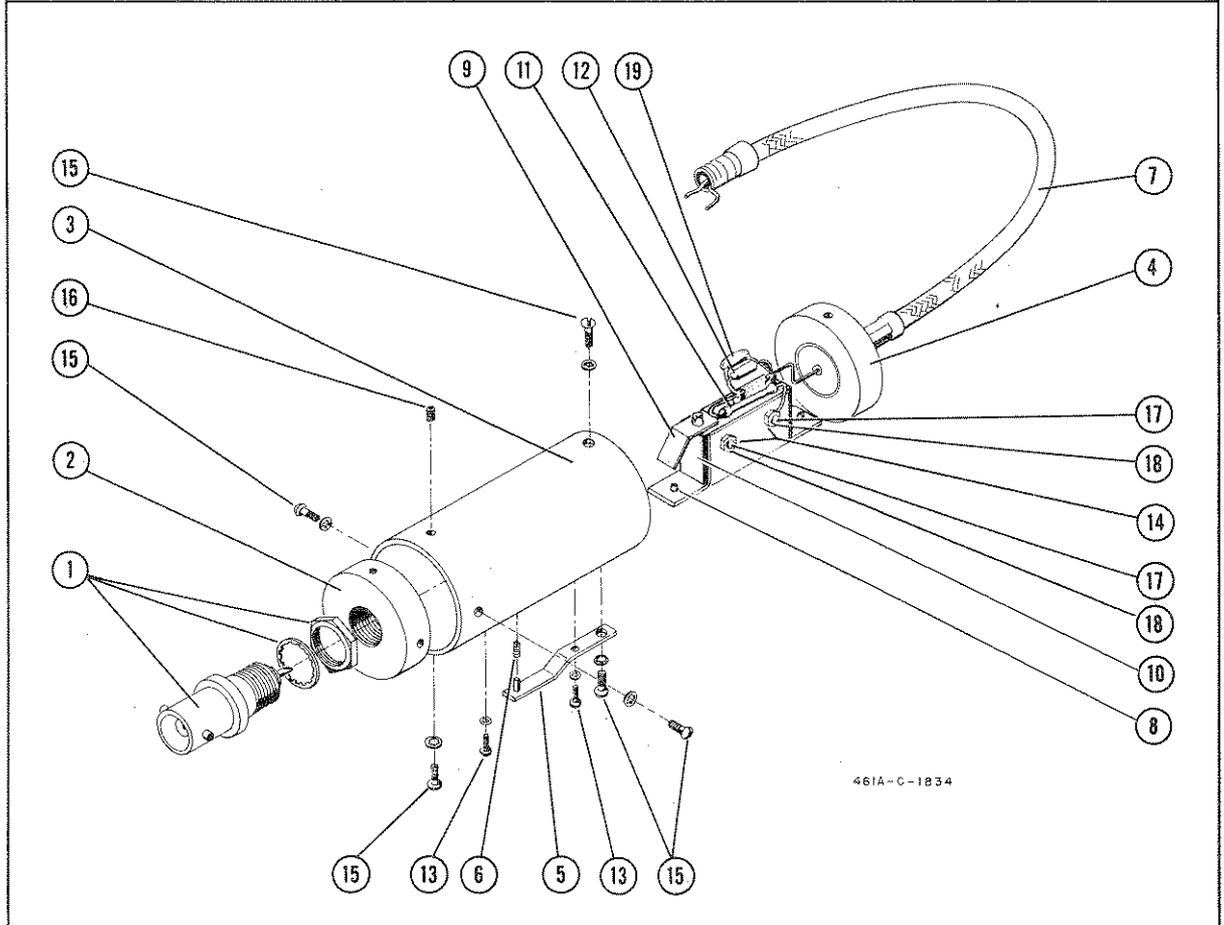


Figure 6-1. Exploded View of A1 Attenuator

1	1250-0049	1	Input connector (rubber ring is not used)	-hp-	
2	00461-23402	1	Can front	-hp-	
3	00461-23401	1	Can body	-hp-	
4	00461-23403	1	Can rear	-hp-	
5	00461-69101	1	Spring assembly	-hp-	
6	1460-0159	1	Compression spring		
7(W5)	00461-61604	1	Cable	-hp-	
8	00461-01202	1	Switch bracket	-hp-	
9	00461-09102	1	Contact spring	-hp-	
10(S3)	3102-0006	1	Switch: micro SPDT pin plunger	91929	22SM261
11(R7)	0757-0356	1	R: fxd met flm 499 ohms +/- 1% 1/8 W (462A only)	14674	NA55
11(R7)	0698-4123	1	R: fxd flm 499 ohms +/- 1% 1/8 W (461A only)	91637	CMF-1/10-32 T-1
12(R8)	0724-0060	1	R: fxd C flm 55 ohms +/- 1% 1/4 W (462A only)	91637	DCT1/4
12(R8)	0698-4384	1	R: fxd flm 54.9 ohms +/- 1% 1/8 W (461A only)	91637	CMF-1/10-32 T-1
13	0520-0005	2	Screw: 56 x 3/16 round head	73734	obd
14	2190-0014	1	Washer: internal lock no.2	78189	1902-00-00-2480
15	2200-0004	4	Washer and screw: 4-40 round head	83385	obd
16	3030-0007	4	Set screw: 40 x 1/8 socket head	70276	obd
17	0520-0022	2	Screw: 56 x 3/8 round head	73734	obd
18	0610-0002	2	Nut: 56	-hp-	
19(C35*)	0150-0029	1	C: fxd 1 pf +/- 10% 500 vdcw (461A only)	78488	GA1J0PF

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A2	00461-66503	1	Assembly: Power (461A and 462A) (Contains C1 thru C7, CR1 thru CR3, Q2 and R2 thru R6)	-hp-	
C1 thru C5	0180-0149	5	C: fxd elect 65 uF 60 vdcw	56289	Type 30D obd
C6	0180-0045	1	C: fxd elect 20 uF 0.25 vdcw	56289	Type 30D obd
C7	0180-0049	1	C: fxd elect 20 uF 50 vdcw	56289	30D198A1
CR1,CR2	1901-0158	2	Diode: Si piv 200 V	04713	SR1358-3
CR3	1902-0202	1	Diode: reference 14.7 V +/-5%	-hp-	
Q2	1853-0012	1	TSTR: Si PNP 2N2904	01295	2N2904A
R2,R3	0687-1021	2	R: fxd comp 1 kilohm +/-10% 1/2 W	01121	EB1021
R4,R5	0686-5625	2	R: fxd comp 5.6 kilohm +/-5% 1/2 W	01121	EB5625
R6	0687-2721	1	R: fxd comp 2.7 kilohm +/-10% 1/2 W	01121	EB2721
A3	00461-66502	1	Assembly: Amplifier (461A only)	-hp-	
A3	00462-66502	1	Assembly: Amplifier (462A only) (Contains C8 thru C32, L1 thru L14, Q3 thru Q9 and R9 thru R53). These two assemblies are identical except where stated.	-hp-	
C8 thru C10	0180-0155	5	C: fxd Ta elect 2.2 uF +/-20% 20 vdcw	56289	150D225X0020A2
C11	0180-0309	5	C: fxd Ta elect 4.7 uF +/-20% 10 vdcw	56289	150D475X0010A2
C12 thru C13	0160-0170	8	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C14	0180-0106	6	C: fxd Ta elect 60 uF +/-20% 6 vdcw	56289	150D606X0006B2
C15	0180-0309	5	C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C16	0180-0106	5	C: fxd elect 60 uF +/-20% 6 vdcw	56289	150D606X0006B2
C17	0180-0309	5	C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C18	0160-0170	5	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C19	0180-0106	5	C: fxd Ta elect 60 uF +/-20% 6 vdcw	56289	150D606-0006B2
C20	0180-0309	5	C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C21	0160-0170	5	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C22	0180-0106	5	C: fxd Ta elect 60 uF +/-20% 6 vdcw	56289	150D606X0006B2
C23	0180-0309	5	C: fxd Ta elect 4.7 uF +/-20% 10 vdcw	56289	150D475X0010A2
C24	0160-0170	5	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C25	0180-0106	5	C: fxd Ta elect 60 uF +/-20% 6 vdcw	56289	150D606X0006B2
C26*	0160-0178	1	C: fxd mica 27 pF +/-5% 250 V	-hp-	
C27,C28	0160-0170	5	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C29	0180-0155	5	C: fxd Ta elect 2.2 uF +/-20% 20 vdcw	56289	150D225X0020A2
C30	0180-0106	5	C: fxd Ta elect 60 uF +/-20% 6 vdcw	56289	150D606X0006B2
C31	0180-0155	5	C: fxd Ta elect 2.2 uF +/-20% 20 vdcw	56289	150D225X0020A2
C32	0160-0170	5	C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
L1	00461-86001	1	Coil: compensating	-hp-	
L2	00461-86002	1	Coil: variable 1.2 uH	-hp-	
L3	00461-86003	1	Coil: variable 0.4 uH	-hp-	
L4	00461-86004	1	Coil: variable 0.2 uH	-hp-	
L5	00461-86005	1	Coil: variable 0.2 uH	-hp-	
L6	00461-86006	1	Coil: variable 0.1 uH	-hp-	
Q3	1853-0034	1	TSTR: Si PNP	04713	SM3197
Q4	1854-0073	1	TSTR: NPN 2N3478	86684	2N3478
Q5 thru Q7	1854-0305	3	TSTR: Si NPN	04713	SS98
Q8	1854-0009	1	TSTR: NPN Si 2N709	-hp-	
Q9	1854-0554	1	TSTR: Si NPN	07263	3010 obd
R9	1205-0018	1	Heat dissipator for Q9	05820	NF-203
R10	0724-0061	1	R: fxd C film 59 ohms +/-1% 1/4 W	19701	DC1/4A
R11,R12	0684-1821	1	R: fxd comp 1.8 kilohms +/-10% 1/4 W Not assigned	01121	CB1821
R13	0683-8215	1	R: fxd comp 820 ohms +/-5% 1/4 W	01121	CB8215
R14	0683-3025	1	R: fxd comp 3 kilohm +/-5% 1/4 W	01121	CB3025
R15	0683-1815	8	R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R16	0684-1021	5	R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R17	0683-2415	2	R: fxd comp 240 ohms +/-5% 1/4 W (461A only)	01121	CB2415
R17	0683-1815	1	R: fxd comp 180 ohms +/-5% 1/4 W (462A only)	01121	CB1815
R18*	0683-1815	1	See Padding List on Page 5-13		
R19	0686-1125	1	R: fxd comp 1.1 kilohms +/-5% 1/2 W	01121	EB1125
R20	0686-1525	1	R: fxd comp 1.5 kilohms +/-5% 1/2 W	01121	EB1525
R21	0683-1815	1	R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R22	0684-1021	1	R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R23	0687-3301	4	R: fxd comp 33 ohms +/-10% 1/2 W	01121	EB3301
R24	0683-2415	1	R: fxd comp 240 ohms +/-5% 1/4 W (461A only)	01121	CB2415
R24	0683-1815	1	R: fxd comp 180 ohms +/-5% 1/4 W (462A only)	01121	CB1815
R25	0687-3301	1	R: fxd comp 33 ohms +/-10% 1/2 W	01121	EB3301
R26	0686-9115	2	R: fxd comp 910 ohms +/-5% 1/2 W	01121	EB9115

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
R27	0683-1815	2	R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R28	0686-1225		R: fxd comp 1.2 kilohms +/-5% 1/2 W	01121	EB1225
R29* R29* R29*	0684-1021		See Padding List on Page 5-13		
R30			R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R31		0683-1815	R: fxd comp 180 ohms +/-5% 1/4 W (461A only)	01121	CB1815
R31		0683-1215	R: fxd comp 120 ohms +/-5% 1/4 W (462A only)	01121	CB1215
R32	0686-9115	1	R: fxd comp 910 ohms +/-5% 1/2 W	01121	EB9115
R33	0687-3301		R: fxd comp 33 ohms +/-10% 1/2 W	01121	EB3301
R34	0683-1815		R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R35	0683-0565		R: fxd comp 5.6 ohms +/-5% 1/4 W	01121	CB0565
R36	0686-1225		R: fxd comp 1.2 kilohms +/-5% 1/2 W	01121	EB1225
R37	0684-1021		R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R38	0687-3301		R: fxd comp 33 ohms +/-10% 1/2 W	01121	EB3301
R39	0683-1815	2	R: fxd comp 180 ohms +/-5% 1/4 W (461A only)	01121	CB1815
R39	0683-6805		R: fxd comp 68 ohms +/-5% 1/4 W (462A only)	01121	CB6805
R40	0680-6215	2	R: fxd comp 620 ohms +/-5% 1/2 W	01121	EB6215
R41	0683-1815	2	R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R42	0683-0565		R: fxd comp 5.6 ohms +/-5% 1/4 W	01121	CB0565
R43	0686-8215	1	R: fxd comp 820 ohms +/-5% 1/2 W	01121	CB8215
R44	0684-1021		R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R45	0683-1815	1	R: fxd comp 180 ohms +/-5% 1/4 W (461A only)	01121	CB1815
R45	0683-3905		R: fxd comp 39 ohms +/-5% 1/4 W (462A only)	01121	CB3905
R46	0686-6215	2	R: fxd comp 620 ohms +/-5% 1/2 W	01121	EB6215
R47	0687-2201	2	R: fxd comp 22 ohms +/-10% 1/2 W	01121	EB2201
R48	0686-1615	1	R: fxd comp 160 ohms +/-10% 1/2 W	01121	EB1615
R49	0683-3605	1	R: fxd comp 36 ohms +/-5% 1/4 W	01121	CB3605
R50	0686-8215	1	R: fxd comp 820 ohms +/-5% 1/2 W	01121	EB8215
R51	0687-2201		R: fxd comp 22 ohms +/-10% 1/2 W	01121	EB2201
R52, R53	0758-0015	2	R: fxd met film 220 ohms +/-5% 1/2 W	07115	C20
CHASSIS MOUNTED COMPONENTS					
C33, C34	0160-3333	1	C: fxd dual 0.005 uF +/-20% 250 vacw	56289	36C219A
DS1	1450-0419	1	Pilot light neon	08717	858-R
F1	2110-0004	30	Fuse: 115 V 1/4 A (Fast-Blo)	75915	AB-Cat-312-250
L15, L16	9170-0016		Beads: ferrite	-hp-	
Q1	1853-0063	1	TSTR: Si PNP selected	-hp-	
	1200-0043	1	Insulator for Q1	26365	obd
	1200-0081	1	Bushing for Q1	26365	974 Special
R1	0687-3331	1	R: comp 33 kilohms +/-10% 1/2 W	01121	EB3331
S1	3100-0759	1	Switch: rotary (GAIN)	76854	obd
	0370-0104	1	Knob for S1	-hp-	obd
S2	3101-1234	1	Switch: slide dpdt (power)	42190	4633
T1	9100-0277	1	Transformer	-hp-	
W1	8120-1348	1	Cable: power	70903	KH4147
W2	00461-61601	1	Cable assembly: power supply	-hp-	
W3	00461-61602	1	Cable assembly: output	-hp-	
W4	00461-61603	1	Cable assembly: transformer	-hp-	
XF1	1400-0084	1	Fuseholder: extractor post type	75915	342014
J1	1250-0118	1	Connector: input female	95712	30384-1
J2	1251-2357	1	Connector: power 3 pin male	60427	H10611G 3L
J3	1250-0083	1	Connector: output female	95712	30624-1
MISCELLANEOUS					
	1400-0116	3	Clamp: plastic cable W2 W4	08717	obd
	1490-0031	1	Stand: tilt	-hp-	
	2370-0020	8	Screw: sideplate mounting 6-32 Phillips head 3/16	83385	obd
	5000-0700	2	Cover: side †	-hp-	
	5000-0711	1	Cover: bottom 5 x 11 SMT	-hp-	
	00461-00203	1	Panel: rear	-hp-	
	5020-0700	2	Spacer	-hp-	
	5040-0700	2	Hinge	-hp-	
	5060-0700	2	Assembly frame	-hp-	
	5060-0709	1	Top cover †	-hp-	
	5060-0727	2	Foot assembly: 1/3 module	-hp-	
	00461-90005	1	Manual	-hp-	
	00462-00202	1	Panel: Front	-hp-	
	00461-00201	1	Panel: Front	-hp-	
	5000-8559	2	Cover: side	-hp-	
	5000-8571	1	Cover: bottom	-hp-	
	5060-8555	1	Cover: top	-hp-	

† These parts are painted with the original 461A/462A colors, i.e. light gray/blue gray. When ordering replacement parts in the old color specify option A85 for the front panel and option Y98 for the covers.

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (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 H4 Handbooks.

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
00000	U. S. A Common	Any supplier of U. S.	05347	Ultronix, Inc.	San Mateo, Cal.	11236	CTS of Berne, Inc.	Berne, Ind.
00136	McCoy Electronics	Mount Holly Springs, Pa.	05397	Union Carbide Corp., Elect.		11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
00213	Sage Electronics Corp.	Rochester, N. Y.	05574	Viking Ind. Inc.	Canoga Park, Cal.	11242	Bay State Electronics Corp.	Waltham, Mass.
00287	Cemco, Inc.	Danielson, Conn.	05593	Icorex Electro-Plastics Inc.	Sunnyvale, Cal.	11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
00334	Humidial	Colton, Calif.	05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio	11314	National Seal	Downey, Cal.
00348	Mictron, Co., Inc.	Valley Stream, N. Y.	05624	Barber Colman Co.	Rockford, Ill.	11453	Precision Connector Corp.	Jamaica, N. Y.
00373	Garlock Inc.	Cherry Hill, N. J.	05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N. Y.	11534	Duncan Electronics Inc.	Costa Mesa, Cal.
00656	Aerovox Corp.	New Bedford, Mass.	05729	Metro-Tel Corp.	Westbury, N. Y.	11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N. J.
00779	Amp. Inc.	Harrisburg, Pa.	05783	Stewart Engineering Co.	Santa Cruz, Cal.	11717	Imperial Electronic, Inc.	Buena Park, Cal.
00781	Aircraft Radio Corp.	Boonton, N. J.	05820	Wakefield Engineering Inc.	Wakefield, Mass.	11870	Melabs, Inc.	Palo Alto, Cal.
00809	Crown, Ltd.	Whitby, Ontario, Canada	06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.	12136	Philadelphia Handle Co.	Camden, N. J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.	06090	Raychem Corp.	Redwood City, Cal.	12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
00853	Sasagawa Electric Co., Pickens Div.	Pickens, S. C.	06175	Bausch and Lomb Optical Co.	Rochester, N. Y.	12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N. M.
00886	Goe Engineering Co.	City of Industry, Cal.	06402	E. T. A. Products Co. of America	Chicago, Ill.	12697	Clarostat Mfg. Co.	Dover, N. H.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.	06540	Anatome Electronic Hardware Co., Inc.	New Rochelle, N. Y.	12728	Elmar Filter Corp.	W. Haven, Conn.
00929	Microlab Inc.	Livingston, N. J.	06555	Besede Electrical Instrument Co., Inc.	Penacook, N. H.	12859	Nippon Electric Co., Ltd.	Tokyo, Japan
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N. Y.	06666	General Devices Co., Inc.	Indianapolis, Ind.	12881	Metex Electronics Corp.	Clark, N. J.
01009	Alden Products Co.	Brockton, Mass.	06751	Components Inc., Ariz. Div.	Phoenix, Arizona	12930	Delta Semiconductor Inc.	Newport Beach, Cal.
01121	Allen Bradley Co.	Milwaukee, Wis.	06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.	12954	Dickson Electronics Corp.	Scottsdale, Arizona
01255	Litton Industries, Inc.	Beverly Hills, Cal.	06900	Varian Assoc. Etmac Div.	San Carlos, Cal.	13019	Aircro Supply Co., Inc.	Wichita, Kansas
01281	TRW Semiconductors, Inc.	Lawndale, Cal.	07088	Kelvin Electric Co.	Van Nuys, Cal.	13061	Wilco Products	Detroit, Mich.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas	07088	Kelvin Electric Co.	Van Nuys, Cal.	13103	Thermolloy	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio	07126	Digitran Co.	Pasadena, Cal.	13327	Solttron Devices Inc.	Tappan, N. Y.
01538	Small Parts Inc.	Los Angeles, Cal.	07137	Transistor Electronics Corp.	Minneapolis, Minn.	13396	Teletuken (Gmbh)	Hanover, Germany
01589	Pacific Relays, Inc.	Van Nuys, Cal.	07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N. Y.	13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
01670	Gudebrod Bros. Silk Co.	New York, N. Y.	07149	Filmoban Corp.	New York, N. Y.	14099	Sem-Tech	Newbury Park, Cal.
01930	Amerock Corp.	Rockford, Ill.	07233	Cinch-Graphik Co.	City of Industry, Cal.	14193	Calif. Resistor Corp.	Santa Monica, Cal.
01960	Pulse Engineering Co.	Santa Clara, Cal.	07256	Silicon Transistor Corp.	Carle Place, N. Y.	14298	American Components, Inc.	Conshohocken, Pa.
02114	Ferroxcube Corp. of America	Saugerties, N. Y.	07261	Arnat Corp.	Culver City, Cal.	14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
02116	Wheelock Signals, Inc.	Long Branch, N. J.	07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.	14493	Hewlett-Packard Company	Lowland, Colo.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Cal.	07322	Minnesota Rubber Co.	Minneapolis, Minn.	14655	Cornell Dublier Electric Corp.	Newark, N. J.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.	07327	Bircher Corp. The	Monterey Park, Cal.	14674	Corning Glass Works	Corning, N. Y.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N. J.	07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.	14752	Electro Cube Inc.	San Gabriel, Cal.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.	07700	Technical Wire Products Inc.	Cranford, N. J.	14960	Williams Mfg. Co.	San Jose, Cal.
02777	Hopkins Engineering Co.	San Fernando, Cal.	07829	Bodine Elect. Co.	Chicago, Ill.	15106	The Sphere Co., Inc.	Little Falls, N. J.
02875	Nudson Tool & Die	Newark, N. J.	07910	Continental Device Corp.	Hawthorne, Cal.	15203	Webster Electronics Co.	New York, N. Y.
03296	Hydon Molding Corp.	Springfield, N. J.	07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.	15237	Scionics Corp.	Northridge, Cal.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N. Y.	07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N. J.	15291	Adjustable Bushing Co.	N. Hollywood, Cal.
03705	Apex Machine & Tool Co.	Dayton, Ohio	08145	U. S. Engineering Inc.	Los Angeles, Cal.	15558	Micron Electronics	Garden City, Long Island, N. Y.
03797	Eldema Corp.	Compton, Calif.	08289	Blinn, Delbert Co.	Pomona, Cal.	15566	Amprobe Inst. Corp.	Lynbrook, N. Y.
03818	Parker Seal Co.	Los Angeles, Cal.	08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada	15631	Cabletronics	Costa Mesa, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.	08524	Deutsch Fastener Corp.	Los Angeles, Cal.	15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.	08664	Bristol Co., The	Waterbury, Conn.	15801	Fenwal Elect. Inc.	Framingham, Mass.
03954	Singer Co., Diehl Div., Pinderne Plant	Sumerville, N. J.	08717	Sloan Company	Sun Valley, Cal.	15818	Amelco Inc.	Mountain View, Cal.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona	16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
04013	Tarus Corp.	Lambertville, N. J.	08727	National Radio Lab. Inc.	Paramus, N. J.	16179	Omni-Spectra Inc.	Detroit, Ill.
04062	Arco Electronic Inc.	Great Neck, N. Y.	08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc.	Lowell, Mass.	16352	Computer Diode Corp.	Lodi, N. J.
04217	Essex Wire	Los Angeles, Cal.	08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio	16554	Electroid Co.	Union, N. J.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.	08984	Mel-Rain	Indianapolis, Ind.	16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
04354	Precision Paper Tube Co.	Wheeling, Ill.	09026	Babcock Relays Div.	Costa Mesa, Cal.	16688	Ideal Prec. Meter Co., Inc.	Brooklyn, N. Y.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.	09097	Electronic Enclosures Inc.	Los Angeles, Calif.	16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.	09134	Texas Capacitor Co.	Houston, Texas	17109	Thermonetics Inc.	Canoga Park, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.	09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.	17474	Tranex Company	Mountain View, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona	09250	Electro Assemblies, Inc.	Chicago, Ill.	17675	Hainlin Metal Products Corp.	Akron, Ohio
04732	Filttron Co., Inc. Western Div.	Culver City, Cal.	09353	C & K Components Inc.	Newton, Mass.	17745	Angstrom Prec. Inc.	No. Hollywood, Cal.
04773	Automatic Electric Co.	Northlake, Ill.	09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada	17856	Siliconix Inc.	Sunnyvale, Cal.
04796	Sequoia Wire Co.	Redwood City, Cal.	09795	Pennsylvania Florocarbon	Clifton Heights, Penn.	17870	McGraw-Edison Co.	Manchester, N. H.
04811	Precision Coil Spring Co.	El Monte, Cal.	09922	Barnay Corp.	Norwalk, Conn.	18042	Power Design Pacific Inc.	Palo Alto, Cal.
04870	P. M. Motor Company	Westchester, Ill.	10214	General Transistor Western Corp.	Los Angeles, Cal.	18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.	10411	Ti-Tal, Inc.	Berkeley, Cal.	18324	Signetics Corp.	Sunnyvale, Cal.
05008	Twentieth Century Plastics, Inc.	Los Angeles, Cal.	10646	Carborundum Co.	Niagara Falls, N. Y.	18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.				18486	TRW Elect. Comp. Div.	Des Plaines, Ill.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N. Y.	71482	C. P. Clare & Co.	Chicago, Ill.	78452	Thompson-Bremer & Co.	Chicago, Ill.
19701	Electra Mfg. Co.	Independence, Kansas	71590	Centralab Div. of		78471	Tilley Mfg. Co.	San Francisco, Cal.
20183	General Atronics Corp.	Philadelphia, Pa.		Globe Union Inc.	Milwaukee, Wis.	78488	Stackpole Carbon Co.	St. Marys, Pa.
21226	Executone, Inc.	Long Island City, N. Y.	71616	Commercial Plastics Co.	Chicago, Ill.	78493	Standard Thomson Corp.	Waltham, Mass.
21355	Fahrlr Bearing Co., The	New Britian, Conn.	71700	Cornish Wire Co., The	New York, N. Y.	78553	Tinnerman Products, Inc.	Cleveland, Ohio
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.	71707	Colo Coid Co., Inc.	Providence, R. I.	78790	Transformer Engineers	San Gabriel, Cal.
23020	General Reed Co.	Metuchen, N. J.	71744	Chicago Miniature Lamp Works	Chicago, Ill.	78947	Ucinite Co.	Newtonville, Mass.
23042	Texscan Corp.	Indianapolis, Ind.	71785	Cinch Mfg. Co.		79135	Waldes Kohinor Inc.	Long Island City, N. Y.
33753	British Radio Electronics Ltd.	Washington, D.C.	71984	Howard B. Jones Div.	Chicago, Ill.	79142	Welder Root, Inc.	Hartford, Conn.
24455	G. S. Lamp Division, Nela Park	Cleveland, Ohio	72136	Dow Corning Corp.	Midland, Mich.	79251	Wenco Mfg. Co.	Chicago, Ill.
24655	General Radio Co.	West Concord, Mass.		Electro Motive Mfg. Co., Inc.		79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.	72619	Dialight Corp.	Brooklyn, N. Y.	79963	Zierick Mfg. Corp.	New Rochelle, N. Y.
26365	Gries Reproducer Corp.	New Rochelle, N. Y.	72656	Indiana General Corp., Electronics Div.	Keasby, N. J.	80031	Mepco Division of Sessions Clock Co.	Morristown, N. J.
26462	Grobet File Co. of America, Inc.	Carlstadt, N. Y.	72699	General Instrument Corp., Cap Division	Newark, N. J.	80033	Prestlo Corp.	Toledo, Ohio
26831	Compac/Hollister Co.	Hollister, Cal.	72765	Hugh H. Eby Inc.	Philadelphia, Pa.	80120	Schnitzer Alloy Products Co.	Elizabeth, N. J.
26992	Hamilton Watch Co.	Lancaster, Pa.	72825	Gudemco Co.	Chicago, Ill.	80131	Electronics Industries Association	Standard tube or semi-conductor device, any manufacturer.
29480	Hewlett-Packard Co.	Palo Alto, Cal.	72962	Elastic Stop Nut Corp.	Union, N. J.	80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
28520	Heyman Mfg. Co.	Kenilworth, N. J.	72964	Robert M. Hadley Co.	Los Angeles, Cal.	80223	United Transformer Corp.	New York, N. Y.
30917	Instrument Specialties Co., Inc.	Little Falls, N. J.	72982	Erie Technological Products, Inc.	Erie, Pa.	80248	Oxford Electric Corp.	Chicago, Ill.
33173	G. E. Receiving Tube Dept.	Owensboro, Ky.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.	80294	Bourns Inc.	Riverside, Cal.
35434	Leetron Inc.	Chicago, Ill.	73076	H. M. Harper Co.	Chicago, Ill.	80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada	73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Cal.	80486	All Star Products Inc.	Defiance, Ohio
36287	Cunningham, W. H. & Hill, Ltd.	Toronto, Ontario, Canada	73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.	80509	Avery Label Co.	Monrovia, Cal.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.	73445	Amperex Elect. Co.	Hicksville, L. I., N. Y.	80583	Hammarlund Co., Inc.	Mars Hill, N. C.
39543	Mechanical Industries Prod. Co.	Akron, Ohio	73506	Bradley Semiconductor Corp.	New Haven, Conn.	80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
40920	Miniature Precision Bearings, Inc.	Keene, N. H.	73559	Carling Electric, Inc.	Hartford, Conn.	80813	Dimco Gray Co.	Dayton, Ohio
40931	Honeywell Inc.	Minneapolis, Minn.	73586	Circle F Mfg. Co.	Trenton, N. J.	81030	International Inst. Inc.	Orange, Conn.
42190	Muter Co.	Chicago, Ill.	73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.	81073	Grayhill Co.	LaGrange, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.	73734	Federal Screw Products, Inc.	Chicago, Ill.	81095	Triad Transformer Corp.	Venice, Cal.
44655	Omnite Mfg. Co.	Skokie, Ill.	73743	Fischer Special Mfg. Co.	Cincinnati, Ohio	81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.	73793	General Industries Co., The	Elyria, Ohio	81349	Military Specification	
47904	Polaroid Corp.	Cambridge, Mass.	73846	Goshen Stamping & Tool Co.	Goshen, Ind.	81483	International Rectifier Corp.	El Segundo, Cal.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.	73899	JFD Electronics Corp.	Brooklyn, N. Y.	81541	Airpax Electronics, Inc.	Cambridge, Maryland
49956	Microwave & Power Tube Div.	Waltham, Mass.	73905	Jennings Radio Mfg. Corp.	San Jose, Cal.	81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
52090	Rowan Controller Co.	Westminster, Md.	73957	Groove-Pin Corp.	Ridgefield, N. J.	82042	Carter Precision Electric Co.	Skokie, Ill.
52983	HP Co., Med. Elec. Div.	Waltham, Mass.	74276	Signalite Inc.	Neptune, N. J.	82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N. J.
54294	Shallross Mfg. Co.	Selma, N. C.	74455	J. H. Wims and Sons	Winchester, Mass.	82116	Electric Regulator Corp.	Norwalk, Conn.
55026	Simpson Electric Co.	Chicago, Ill.	74861	Industrial Condenser Corp.	Chicago, Ill.	82142	Jeffer's Electronics Division of Speer Carbon Co.	Du Bois, Pa.
55933	Sonotone Corp.	Elmsford, N. Y.	74868	R. F. Products Division of Amphinol-Borg Electronic Corp.	Danbury, Conn.	82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N. J.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.	74970	E. F. Johnson Co.	Waseca, Minn.	82209	Magurie Industries, Inc.	Greenwich, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N. Y.	75042	International Resistance Co.	Philadelphia, Pa.	82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa.
56289	Sprague Electric Co.	North Adams, Mass.	75263	Keystone Carbon Co., Inc.	St. Marys, Pa.	82376	Astron Corp.	East Newark, Harrison, N. J.
58474	Superior Elect. Co.	Bristol, Conn.	75378	KTS Knights, Inc.	Sandwich, Ill.	82389	Switchcraft, Inc.	Chicago, Ill.
59446	Telex Corp.	Tulsa, Okla.	75382	Culka Electric Corp.	Mt. Vernon, N. Y.	82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
59730	Thomas & Betts Co.	Elizabeth, N. J.	75318	Lenz Electric Mfg. Co.	Chicago, Ill.	82768	Phillips-Advance Control Co.	Joliet, Ill.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio	75915	Littelfuse, Inc.	Des Plaines, Ill.	82866	Research Products Corp.	Madison, Wis.
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.	76005	Lord Mfg. Co.	Erie, Pa.	82877	Rikon Mfg. Co., Inc.	Woodstock, N. Y.
62119	Universal Electric Co.	Owosso, Mich.	76210	C. W. Marwedel	San Francisco, Cal.	82893	Vecton Electronic Co.	Glendale, Cal.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N. Y.	76433	General Instrument Corp., Micamold Division	Newark, N. J.	83058	Carr Fastener Co.	Cambridge, Mass.
64959	Western Electric Co., Inc.	New York, N. Y.	76487	James Millen Mfg. Co., Inc.	Malden, Mass.	83086	New Hampshire Ball Bearing, Inc.	Peterborough, N. H.
65092	Weston Inst. Inc. Weston-Newark	Newark, N. J.	76493	J. W. Miller Co.	Los Angeles, Cal.	83125	General Instrument Corp., Capacitor Div.	Darlington, S. C.
66295	Witteck Mfg. Co.	Chicago, Ill.	76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.	83148	ITT Wire and Cable Div.	Los Angeles, Cal.
66346	Minnesota Mining & Mfg. Co.		76530	Fastener Corp.	Cleveland, Ohio	83186	Victory Eng. Corp.	Springfield, N. J.
70276	Allen Mfg. Co.	Hartford, Conn.	76545	Mueller Electric Co.	Cleveland, Ohio	83298	Bendix Corp., Red Bank Div.	Red Bank, N. J.
70309	Allied Control	New York, N. Y.	76703	National Union	Newark, N. J.	83315	Hubbell Corp.	Mundelein, Ill.
70318	Allmetal Screw Product Co., Inc.	Garden City, N. Y.	76854	Oak Manufacturing Co.	Crystal Lake, Ill.	83324	Rosan Inc.	Newport Beach, Cal.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.	77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.	83330	Smith, Herman H., Inc.	Brooklyn, N. Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.	77076	Pacific Metals Co.	San Francisco, Cal.	83332	Tech Labs	Palisades Park, N. J.
70563	Amperite Co., Inc.	Union City, N. J.	77221	Phaostran Instrument and Electronic Co.	So. Pasadena, Cal.	83385	Central Screw Co.	Chicago, Ill.
70674	ADC Products Inc.	Minneapolis, Minn.	77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.	83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
70903	Belden Mfg. Co.	Chicago, Ill.	77342	American Machine & Foundry Co.	Princeton, Ind.	83594	Burrroughs Corp., Electronic Tube Div.	Plainfield, N. J.
70998	Bird Electric Corp.	Cleveland, Ohio	77630	Potter & Brumfield Div.	Princeton, Ind.	83740	Union Carbide Corp., Consumer Prod. Div.	New York, N. Y.
71002	Birnbach Radio Co.	New York, N. Y.	77638	TRW Electronic Components Div.	Camden, N. J.	83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
71034	Bliley Electric Co., Inc.	Erie, Pa.	77764	General Instrument Corp., Rectifier Division	Brooklyn, N. Y.	83821	Loyd Scruggs Co.	Festus, Mo.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.	77969	Rubbercraft Corp. of Calif.	Torrance, Cal.	83942	Aeronautical Inst. & Radio Co.	Lodi, N. J.
71218	Bud Radio, Inc.	Willoughby, Ohio	78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.	84171	Arco Electronics Inc.	Great Neck, N. Y.
71279	Cambridge Thermionics Corp.	Cambridge, Mass.	78277	Sigma	So. Braintree, Mass.	84396	A. J. Glesener Co., Inc.	San Francisco, Cal.
71286	Camloc Fastener Corp.	Paramus, N. J.	78283	Signal Indicator Corp.	New York, N. Y.	84411	TRW Capacitor Div.	Ogallala, Neb.
71313	Cardwell Condenser Corp.	Lindenhurst, L. I., N. Y.	78290	Struthers-Dunn Inc.	Pitman, N. J.			
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.						
71436	Chicago Condenser Corp.	Chicago, Ill.						
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.						
71450	CTS Corp.	Elkhart, Ind.						
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.						
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.						

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CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
94870	Sarkes Tarzian, Inc.	Bloomington, Ind.	91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.	96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
85454	Boonton Molding Company	Boonton, N.J.				96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
85471	A. B. Boyd Co.	San Francisco, Cal.	91961	Nahm-Bros. Spring Co.	Oakland, Cal.	96296	Solar Mfg. Co.	Los Angeles, Cal.
85474	R. M. Bracamonte & Co.	San Francisco, Cal.	92180	Tru-Connector Corp.	Peabody, Mass.	96396	Microswitch, Div. of	
85660	Koiled Kords, Inc.	Hamden, Conn.	92367	Elgeet Optical Co., Inc.	Rochester, N.Y.			
85911	Seamless Rubber Co.	Chicago, Ill.	92607	Tensolite Insulated Wire Cor., Inc.		96330	Carlton Screw Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.				96341	Microwave Associates, Inc.	Burlington, Mass.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.	92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.	96501	Excel Transformer Co.	Oakland, Cal.
86579	Precision Rubber Products Corp.	Dayton, Ohio	92966	Hudson Lamp Co.	Kearney, N.J.	96508	Xcelite, Inc.	Orchard Park, N.Y.
86684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.	96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
86928	Seastrom Mfg. Co.	Glendale, Cal.	93369	Robbins & Myers Inc.	Pallisades Park, N.J.	96881	Thomson Ind. Inc.	Long Island, N.Y.
87034	Marco Industries	Anaheim, Cal.	93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio	97339	Automatic & Precision Mfg.	Englewood, N.J.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.	93632	Waters Mfg. Co.	Culver City, Cal.	97379	Rcon Resistor Corp.	Yonkers, N.Y.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.	93923	G. V. Controls	Livingston, N.J.	97983	Liton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.	94137	General Cable Corp.	Bayonne, N.J.	98141	R-Tronics, Inc.	Jamaica, N.Y.
87930	Tower Mfg. Corp.	Providence, R.I.	94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.	98159	Rubber Teck, Inc.	Gardena, Cal.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.	94148	Scientific Electronics Products, Inc.	Loveland, Colo.	98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.	94154	Wagner Elect. Corp., Tang-Sol Div.	Newark, N.J.	98278	Microdot, Inc.	So. Pasadena, Cal.
88698	General Mills, Inc.	Buffalo, N.Y.	94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N.J.	98291	Sealectro Corp.	Mamaronech, N.Y.
89231	Graybar Electric Co.	Oakland, Cal.	94222	South Chester Corp.	Chester, Pa.	98376	Zero Mfg. Co.	Burbank, Cal.
89473	G. E. Distributing Corp.	Schenectady, N.Y.	94330	Wire Cloth Products, Inc.	Bellwood, Ill.	98410	Etc Inc.	Cleveland, Ohio
89479	Security Co.	Detroit, Mich.	94375	Automatic Metal Products Co.	Brooklyn, N.Y.	98731	General Mills Inc., Electronics Div.	
89665	United Transformer Co.	Chicago, Ill.	94682	Worncster Pressed Aluminum Corp.		98734	Paeco Division of Hewlett-Packard Co.	
90030	United Shoe Machinery Corp.	Beverly, Mass.						
90179	U. S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.	94696	Magnecraft Electric Co.	Chicago, Ill.	98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.	95023	George A. Philbrick Researchers, Inc.	Boston, Mass.	98978	International Electronic Research Corp.	Burbank, Cal.
90763	United Carr Fastener Corp.	Chicago, Ill.	95146	Alco Elect. Mfg. Co.	Lawrence, Mass.	99109	Columbia Technical Corp.	New York, N.Y.
90970	Bearing Engineering Co.	San Francisco, Cal.	95236	Althes Products Corp.	Dania, Fla.	99313	Varian Associates	Palo Alto, Cal.
91146	ITT Cannon Elect. Inc.	Salem Div., Salem, Mass.	95238	Continental Connector Corp.	Woodside, N.Y.	99378	Atlee Corp.	Winchester, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.	95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.	99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.	95265	National Coil Co.	Sheridan, Wyo.	99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
91418	Radio Materials Co.	Chicago, Ill.	95348	Cordos Corp.	Bloomfield, N.J.	99800	Delevan Electronics Corp.	East Aurora, N.Y.
91506	Augat Inc.	Attleboro, Mass.	95375	Vitramon, Inc.	Bridgeport, Conn.	99848	Wilco Corporation	Indianapolis, Ind.
91637	Dale Electronics, Inc.	Columbus, Nebr.	95384	Arnold Engineering Co.	Marengo, Ill.	99928	Branson Corp.	Whippany, N.J.
91662	Elco Corp.	Willow Grove, Pa.	95566	Dage Electric Co., Inc.	Franklin, Ind.	99942	Rembrandt, Inc.	Boston, Mass.
91673	Epiphone Inc.	New York, N.Y.	95984	Stemon Mfg. Co.	Wayne, Ill.	99957	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.	95987	Weckesser Co.	Chicago, Ill.		Technology-Instrument Corp. of California	Newbury Park, Cal.
91827	K F Development Co.	Redwood City, Cal.	96087	Microwave Assoc., West, Inc.	Sunnyvale, Cal.			
91886	Malco Mfg., Inc.	Chicago, Ill.						

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

0000F	Malco Tool and Die	Los Angeles, Calif.	000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado	000QQ	Cooltron	Oakland, Cal.
0000Z	Willow Leather Products Corp.	Newark, N.J.	000MM	Rubber Eng. & Development	Hayward, Cal.	000WW	California Eastern Lab	Burlington, Cal.
000AB	ETA	England	000NN	A "N" D Mfg. Co.	San Jose, Cal.	000YY	S. K. Smith Co.	Los Angeles, Cal.
000BB	Precision Instrument Comp. Co.	Van Nuys, Cal.						

SALES & SERVICE OFFICES

UNITED STATES

ALABAMA

P.O. Box 4207
2003 Byrd Spring Road S.W.
Huntsville 35892
Tel: (205) 881-4591
TWX: 810-726-2204

ARIZONA

2336 E. Magnolia St.
Phoenix 85034
Tel: (602) 252-5061
TWX: 910-951-1330
5737 East Broadway
Tucson 85716
Tel: (602) 298-2313
TWX: 910-952-1162

CALIFORNIA

1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000
3539 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1262
TWX: 910-409-2170
1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-5590
TWX: 910-373-1280
2220 Watt Ave.
Sacramento 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
San Diego 92123
Tel: (714) 275-3200
TWX: 910-335-2000

COLORADO

7965 East Prentice
Englewood 80110
Tel: (303) 774-3455
TWX: 910-935-0705

CONNECTICUT

508 Tolland Street
East Hartford 06108
Tel: (203) 289-9094
TWX: 710-425-9418

FLORIDA

P.O. Box 24210
2806 W. Oakland Park Blvd.
Ft. Lauderdale 33307
Tel: (305) 751-2020
TWX: 510-955-4099
P.O. Box 20007
Herndon Station 32814
621 Commonwealth Avenue
Orlando
Tel: (305) 841-3970
TWX: 810-850-6113

GEORGIA

P.O. Box 28224
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890
5500 Howard Street
Smyrna 30075
Tel: (312) 877-0400
TWX: 910-223-3613

ILLINOIS

3839 Meadows Drive
Indianapolis 46205
Tel: (317) 546-4891
TWX: 810-341-3263

INDIANA

11131 Colorado Ave.
Kansas City 64137
Tel: (816) 763-8000
TWX: 910-771-2087

MISSOURI

2459 University Avenue
St. Paul 55114
Tel: (612) 645-9461
TWX: 910-563-3734

MINNESOTA

11131 Colorado Ave.
Kansas City 64137
Tel: (816) 763-8000
TWX: 910-771-2087

MISSOURI

2812 South Brentwood Blvd.
St. Louis 63144
Tel: (314) 962-5000
TWX: 910-760-1670

NEW JERSEY

11131 Colorado Ave.
Kansas City 64137
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Telex: 034-8461



MANUAL BACKDATING CHANGES

MODELS 461A/462A

WIDE BAND AMPLIFIER

Manual Serial Prefixed: 606- (461A), 551- (462A)
-hp- Part No. 00461-90004

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Number	Make Manual Changes	Instrument Serial Number	Make Manual Changes
346- (461A)	1, 2, 3, 4	347- (462A)	1, 2, 3, 4
418- (461A)	2, 3, 4	421-, 414- (462A)	2, 3, 4
606- (461A)	3, 4	551- (462A)	3, 4
946-03115 and below	4	947-01160 and below	4

CHANGE NO.1 Change C11, C15, C17, C20, and C23 to -hp- Part No. 0180-0155, 2.2 uF. For better low frequency response use current values.

CHANGE NO.2 Change Q4, Q5, Q6, Q7 and Q8 to -hp- Part No. 1854-0031. Change R24 to 330 ohms, -hp- Part No. 0683-3315. Change R31 to 240 ohms, -hp- Part No. 0683-0565. If any one of these transistors fail, replace all transistors (Q4 through Q8), R24 and R31 with current type and value. Recalibrate the 461A/462A as described in Section V of this manual.

CHANGE NO. 3 Change C33 and C34 to 0.01 uF (0150-0119).
Change S2 part number to 3101-0033.
Change J2 part number to 1251-0148.
Change W1 part number to 8120-0078.

CHANGE NO. 4 Change DS1 part number to 1450-0048.