Errata

Title & Document Type: **461A / 462A Wideband Amplifiers Operating and Service Manual**

Manual Part Number: **00461-90006**

Revision Date: **January 1975**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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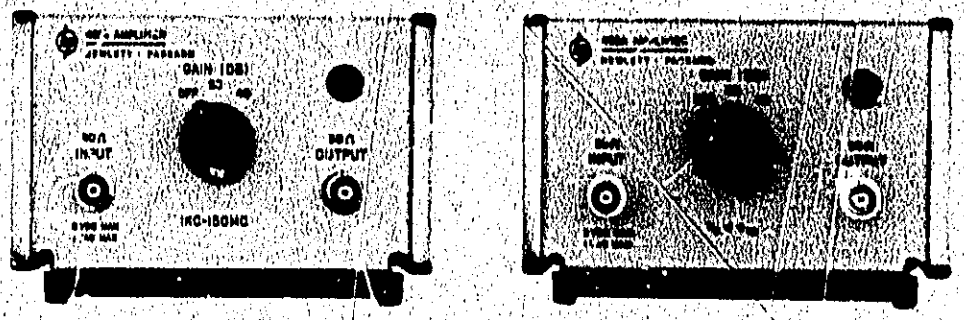
Agilent Technologies

OPERATING AND SERVICE MANUAL

HP 461A/462A

WIDEBAND AMPLIFIER

461A/462A



HEWLETT PACKARD

HP 461A/462A

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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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)

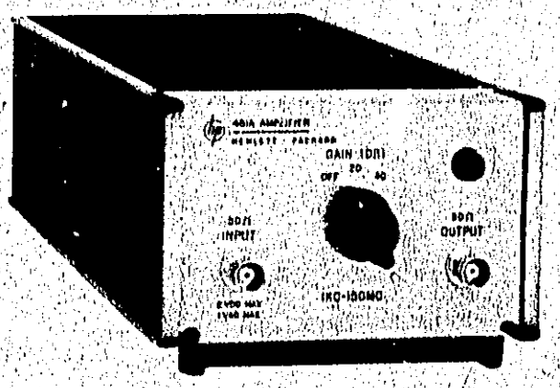
Revised: January 1975

Printed: January 1972

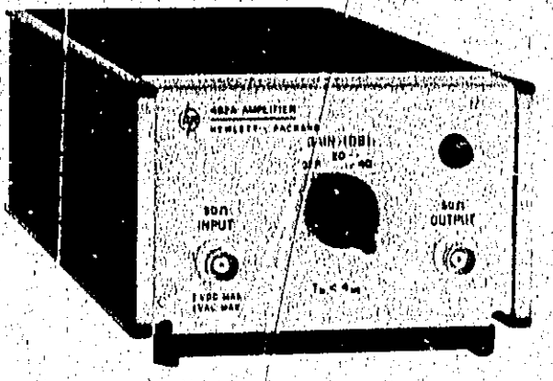
TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS



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 us 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).	Pulse Duration for 10% Droop: 30 us.
Input Impedance: Nominal 50 ohms.	Equivalent Input Noise Level: Less than 40 uV 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.	Maximum dc Input: +/-2 Volts.*
Equivalent Wideband Input Noise Level: Less than 40 μV 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.
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 440 Hz, 5 watts.	Weight: Net: 4 lbs (1,8 kg). Shipping: 5 lbs (2,3 kg.).
Dimensions: 5 1/8 in. (13 cm) wide, 3 in. (7,6 cm) high, 11 in. (27,9 cm) deep.	Accessory Furnished: Detachable power cord.
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 compatable with newer instruments or the backdating information in Appendix C will adapt this manual to earlier instruments. All corresponcence with Hewlett-Packard should include the complete serial number.

INSTALLATION

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 mars 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 isntrument 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.

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.

OPERATION

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.

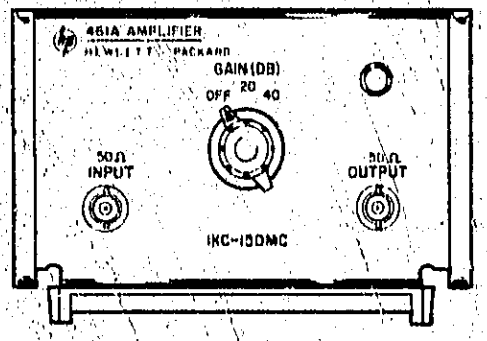
3-4. Figure 3-1 describes the function of all the controls and indicators on both the front and rear panel.

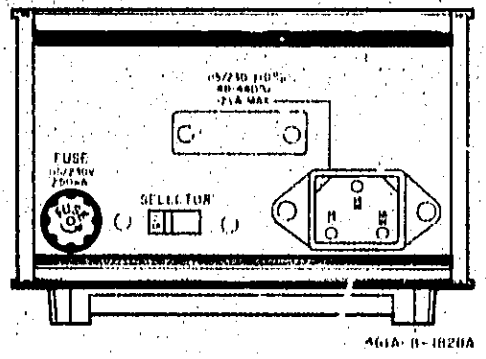
3-5. OPERATING INSTRUCTIONS.

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





(1) GAIN (DB) switch: Applies primary power and selects gain.

(2) 50 OHM INPUT connector: Connects input signal to the instrument. DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT.

(3) 50 OHM OUTPUT connector: Connects amplified output to load. Output must be terminated in 50 ohm. VOLTAGE LEVEL AT OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0.6 VOLTS DC.

(4) AC POWER connector: Connects primary power to the instrument.

(5) LINE VOLTAGE: Selects either 115 volts ac or 230 volts ac primary power.

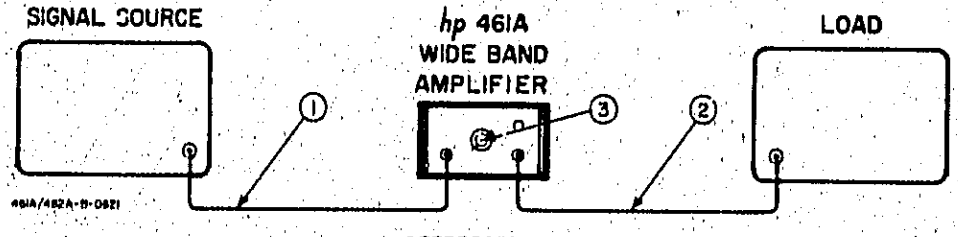
(6) Fuseholder: Co s a 1/4 ampere fast-blow fuse for both 115 and 230 volt operation.

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.



CAUTION

DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT TERMINALS. VOLTAGE LEVEL APPLIED TO OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0.6 VOLTS DC.

(1) Connect the 1 KHz to 150 MHz frequency source to the input of the Model 461A.

(2) Connect the output of the Model 461A to a 50-ohm load.

(3) Set Power and Gain Switch to the desired gain setting (20 or 40 dB).

NOTE

The maximum output voltage obtainable from the Model 461A is 0.5 volts rms (1 Volt P-P for Model 462A). Thus the maximum input voltage that can be applied, without distortion, is 50 mv on the 20 dB range, and 5 mv on the 40 dB range.

Figure 3-2. Operating Instructions

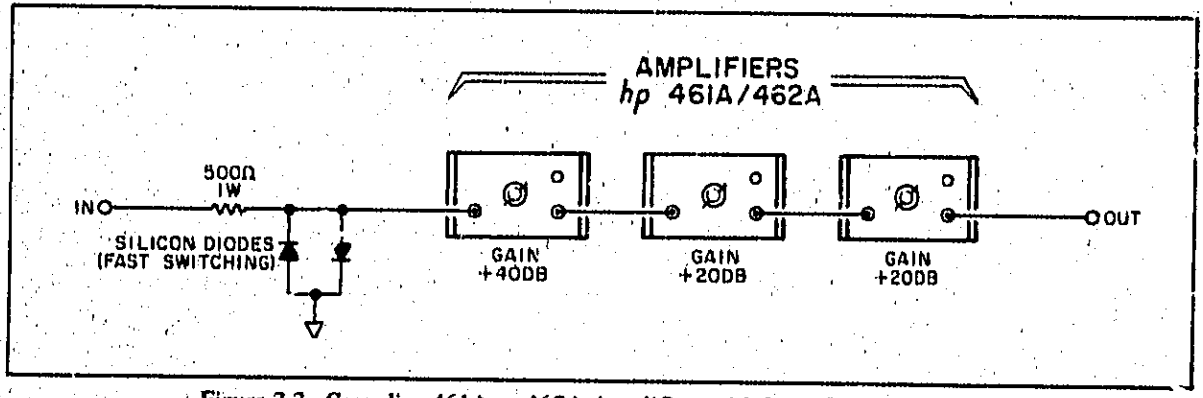


Figure 3-3. Cascading 461A or 462A Amplifiers with Input Protective Circuit

THEORY

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 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.

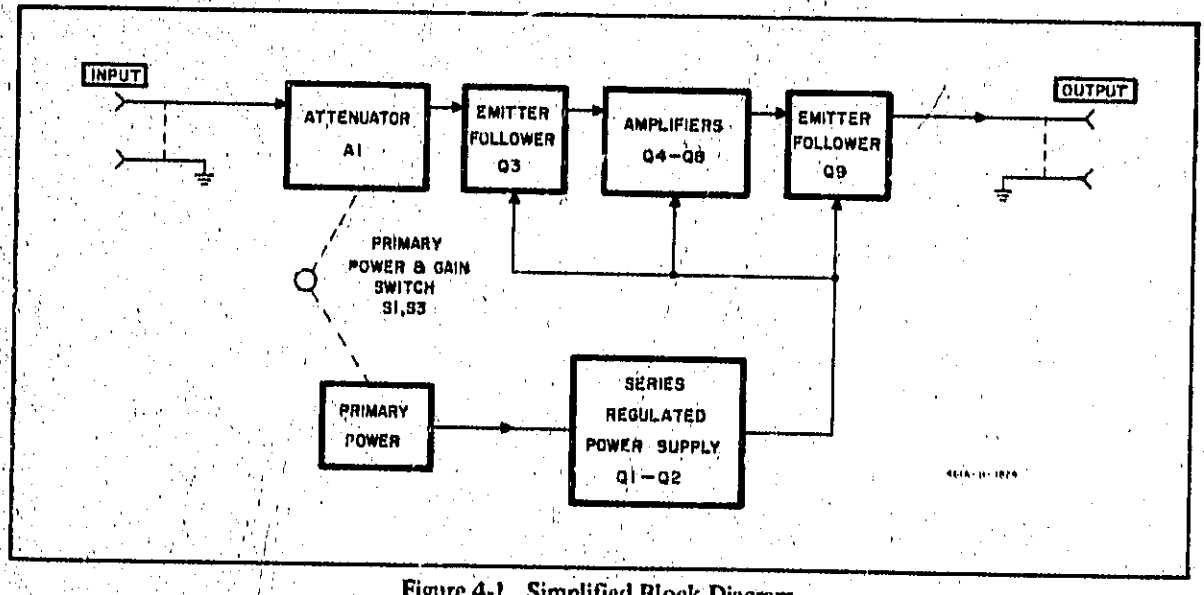


Figure 4-1. Simplified Block Diagram

MAINTENANCE

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 331A, 333A or 334A Distortion Analyzer
RF Millivolt-meter	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 5 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- 1001B (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

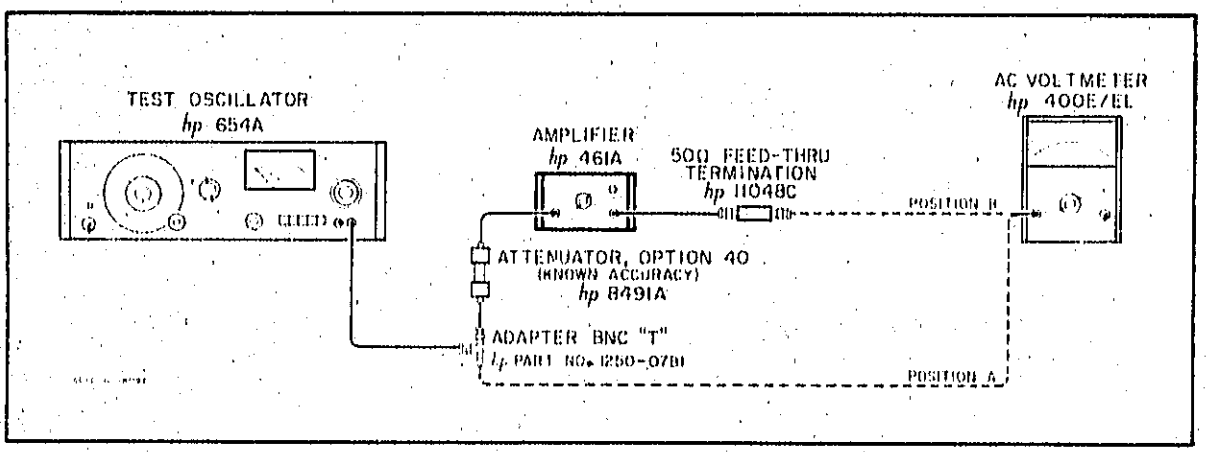


Figure 5-1. Gain Check Setup

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 e 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.

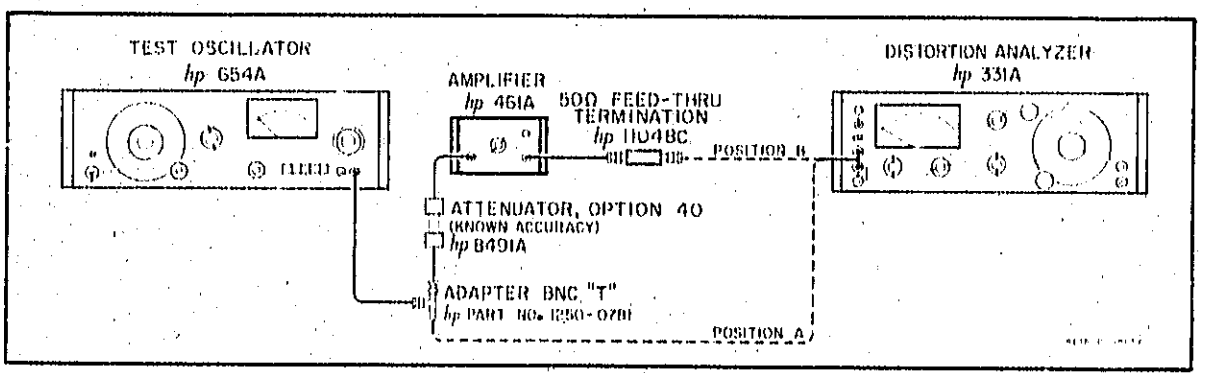


Figure 5-2. Distortion Check Setup

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 50Ω 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).

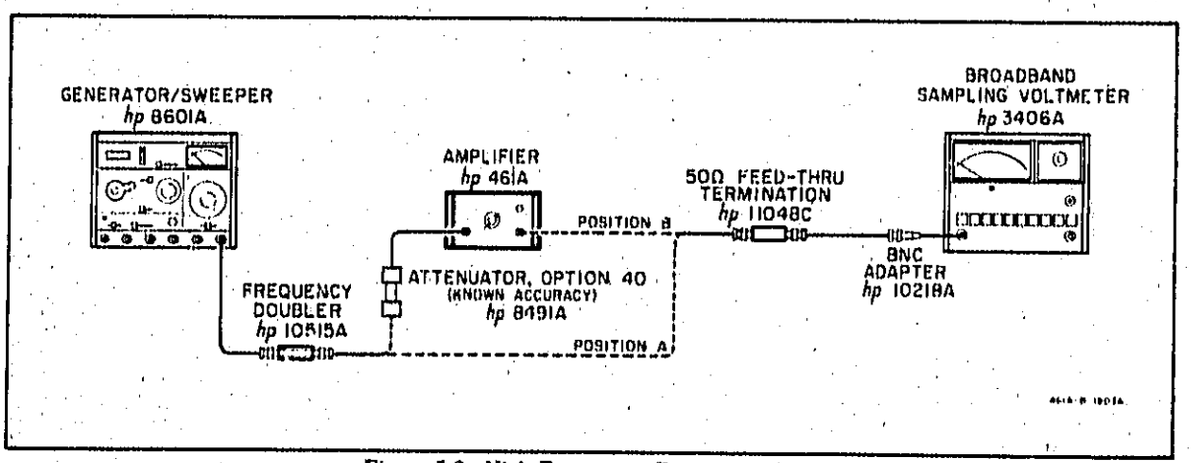


Figure 5-3. High Frequency Response Check

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 Multiplier 2
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 TR_1 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 (TR_2) 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.

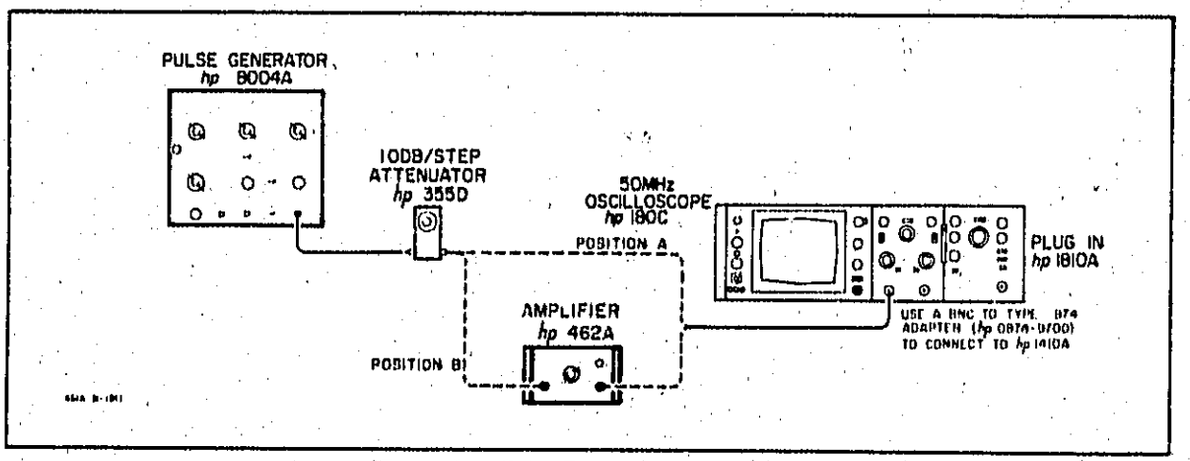


Figure 5-4. Pulse Response Check Setup

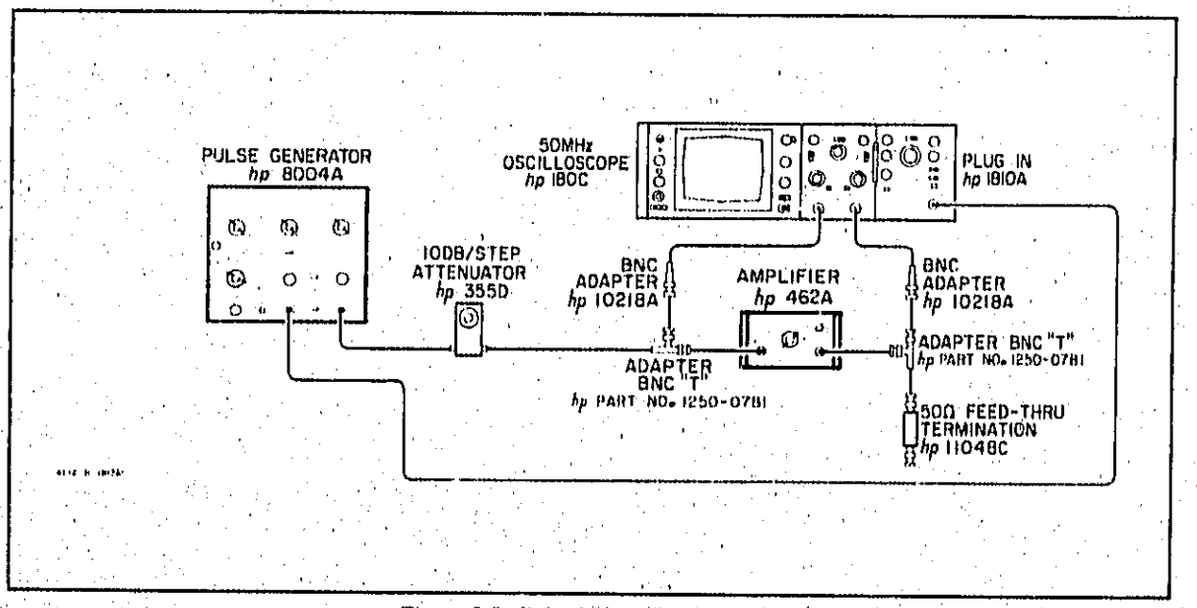


Figure 5-5. Pulse Delay Check Setup

c. 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.

d. Use an external trigger from the pulse generator and adjust trigger Mode and slope for a pulse on the oscilloscope.

e. 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.

f. The midpoint of the leading edges of the input pulse and the output pulse should differ by 12 to 14 ns.

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

a. 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).

a. Connect the 462A as in Figure 5-6, position A.

b. Adjust the square wave generator for a 30 us pulse (16.6 kHz) displayed on the oscilloscope with less than 0.01 volts peak-to-peak voltage. Observe the flatness of the pulse.

c. Connect the circuit as in Figure 5-6, position B, keeping all leads as short as possible. Set

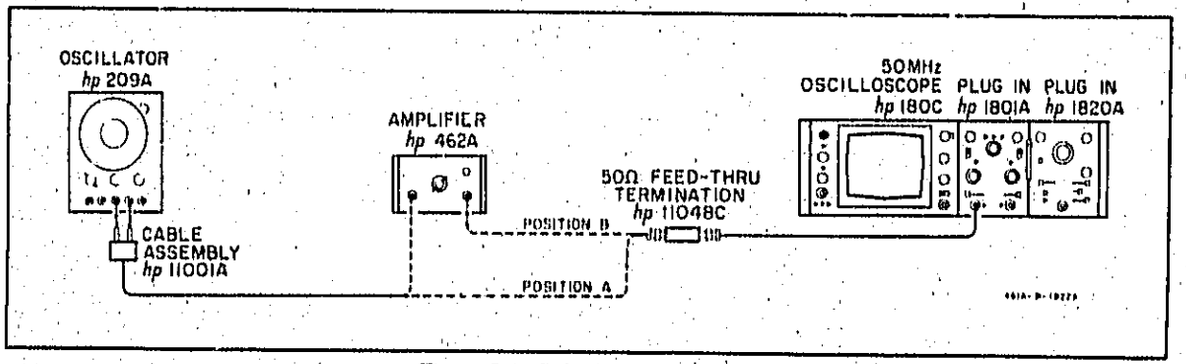


Figure 5-6. Pulse Duration Check

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).

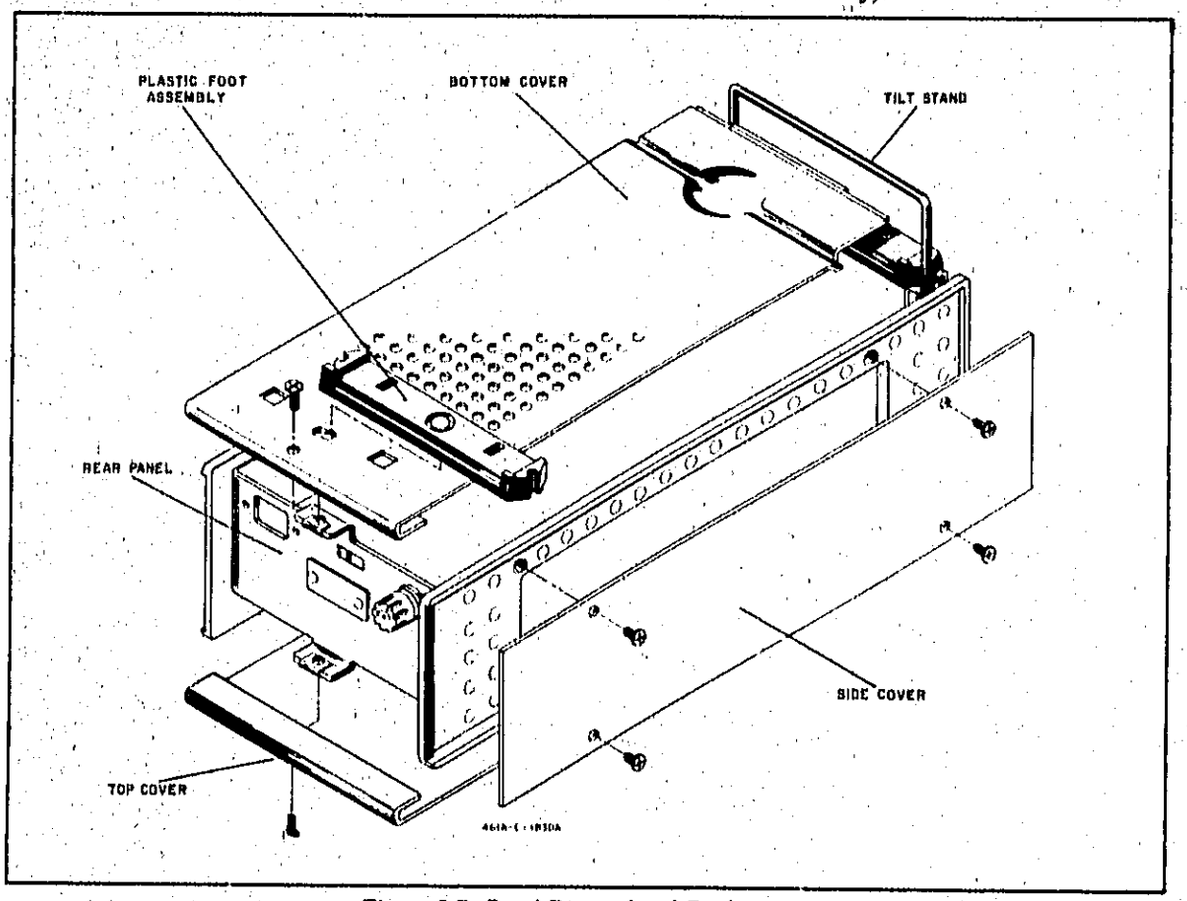


Figure 5-7. Panel Removal and Replacement

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 e. (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 ..... ×5
Display ..... EXT Sens

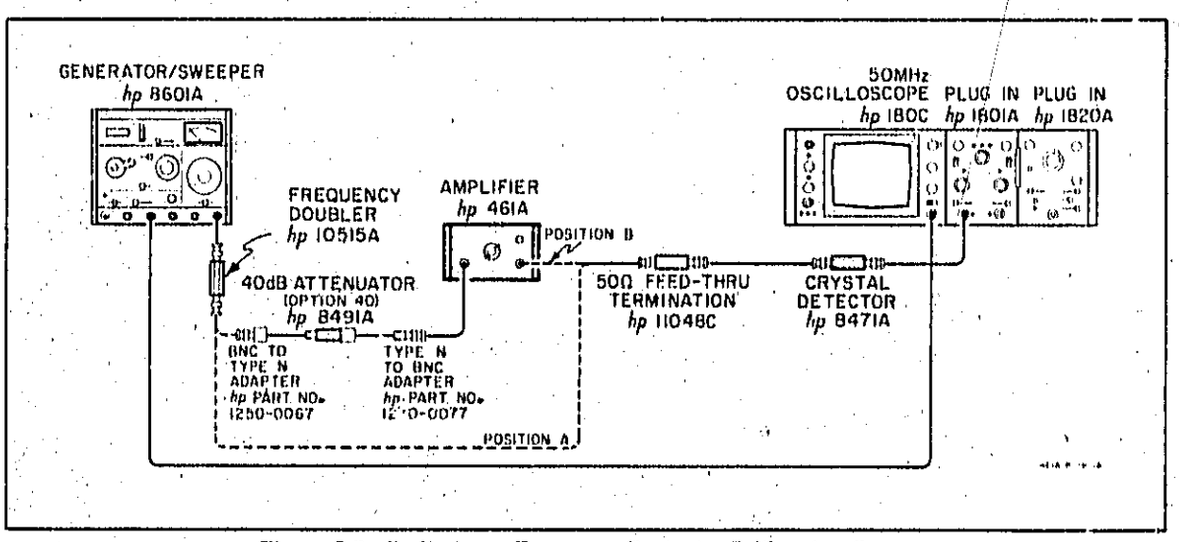


Figure 5-8. Preliminary Frequency Response Calibration Setup

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 h thru e and Frequency Response calibration Paragraph 5-24, steps a thru d.

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:

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.

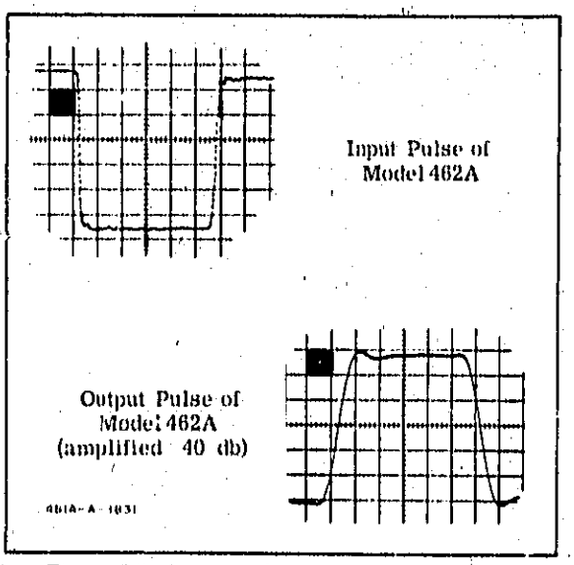


Figure 5-9. Input and Output Pulses of 462A

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.

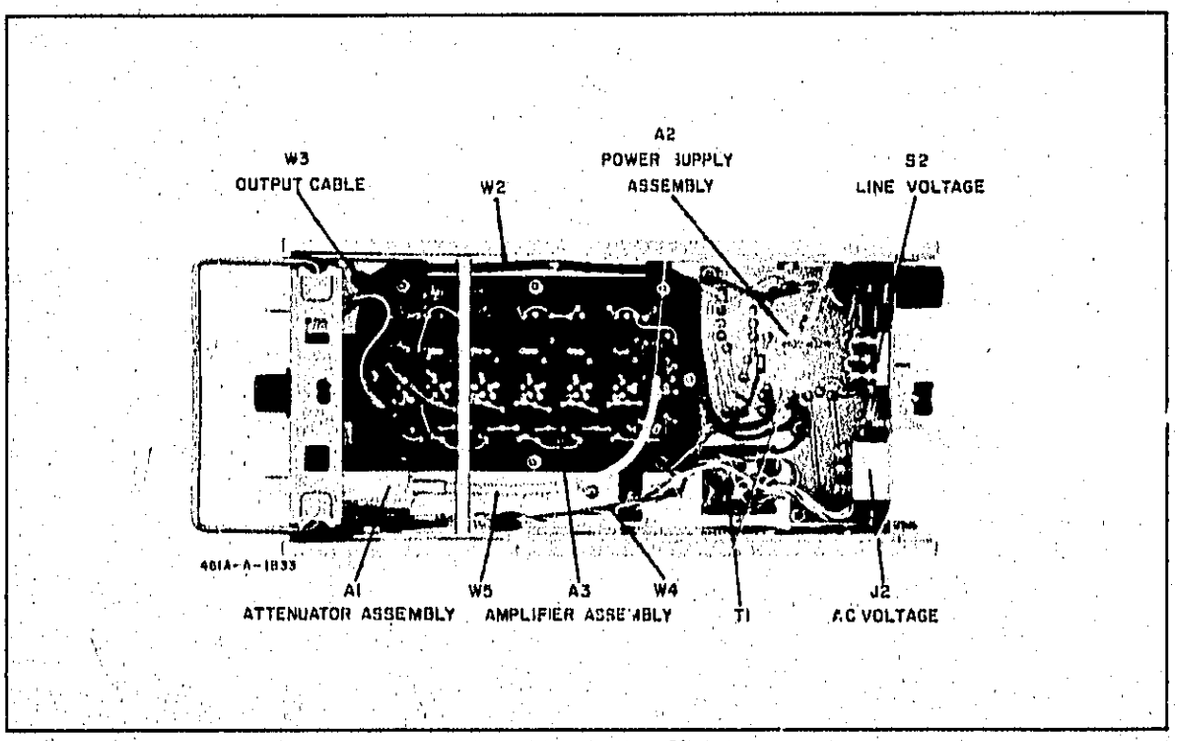


Figure 5-10. Bottom View

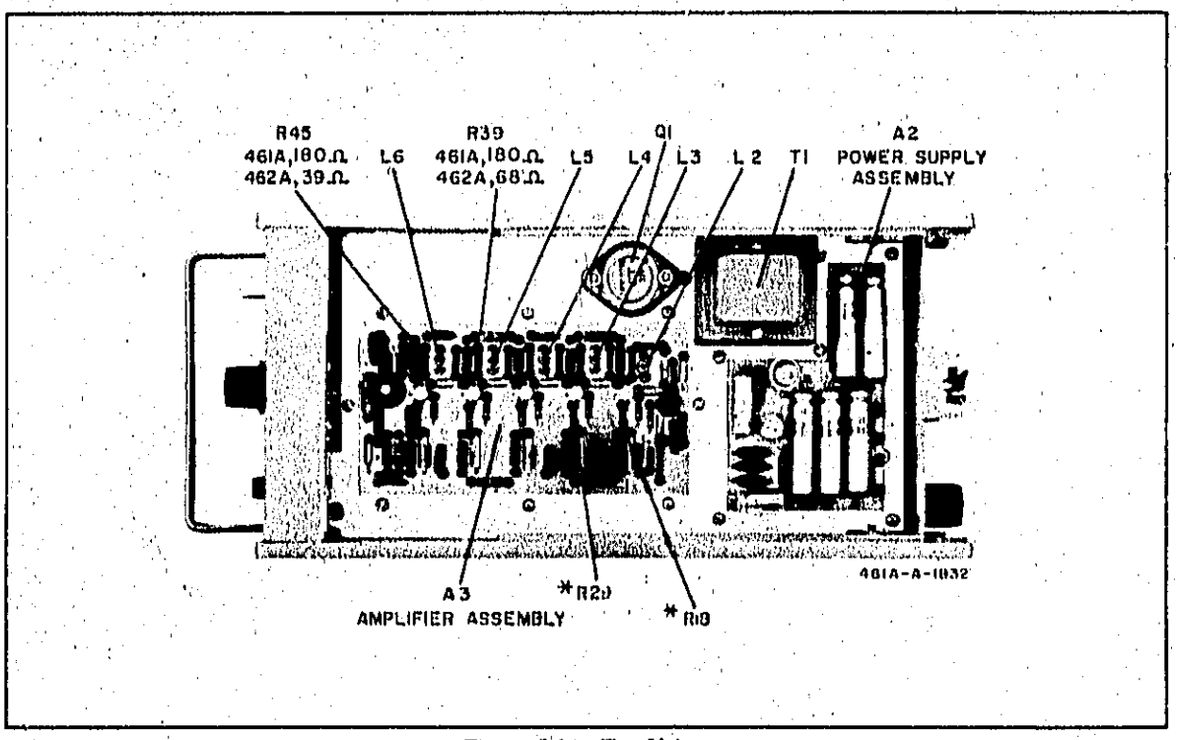


Figure 5-11. Top Veiw

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 ' at 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

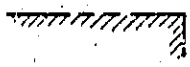
3. ——— DENOTES ASSEMBLY.

   ——— 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.

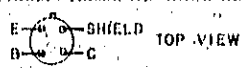
7. NOT INCLUDED IN MODEL 462A.

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.

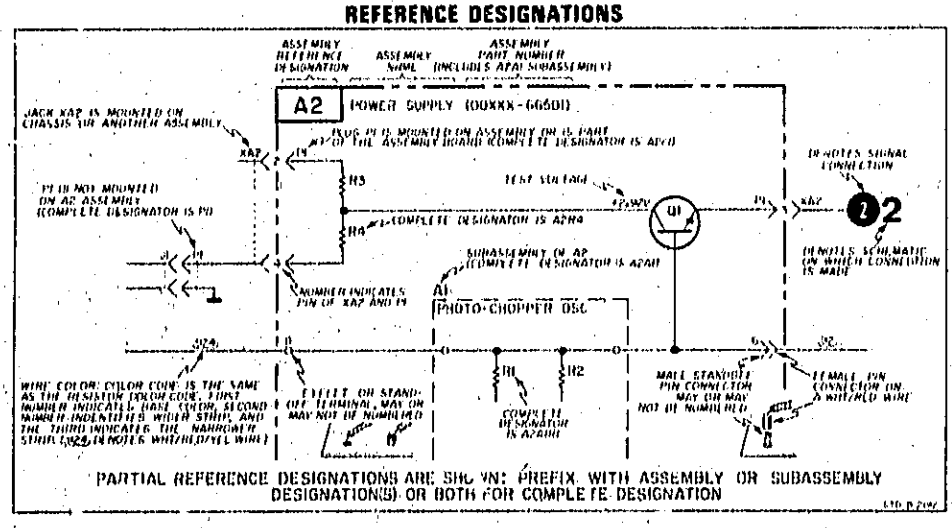
12. FOR INSTRUMENTS PREFIXED 346-, 418-, 347-, 421-, SEE BACKDATING CHANGES, APPENDIX C.

13. Ω DENOTES INDUCTANCE FROM FERRITE BEADS.

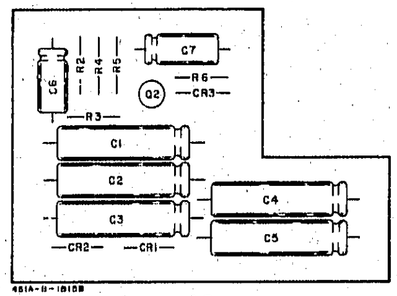
14. ⊥ DENOTES OUTER CHASSIS (FRAME) GROUND.

15. ⏚ DENOTES ASSEMBLY GROUND (ON BOARD).

REFERENCE DESIGNATIONS

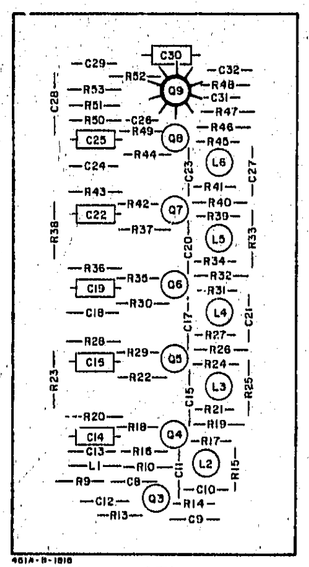


PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION



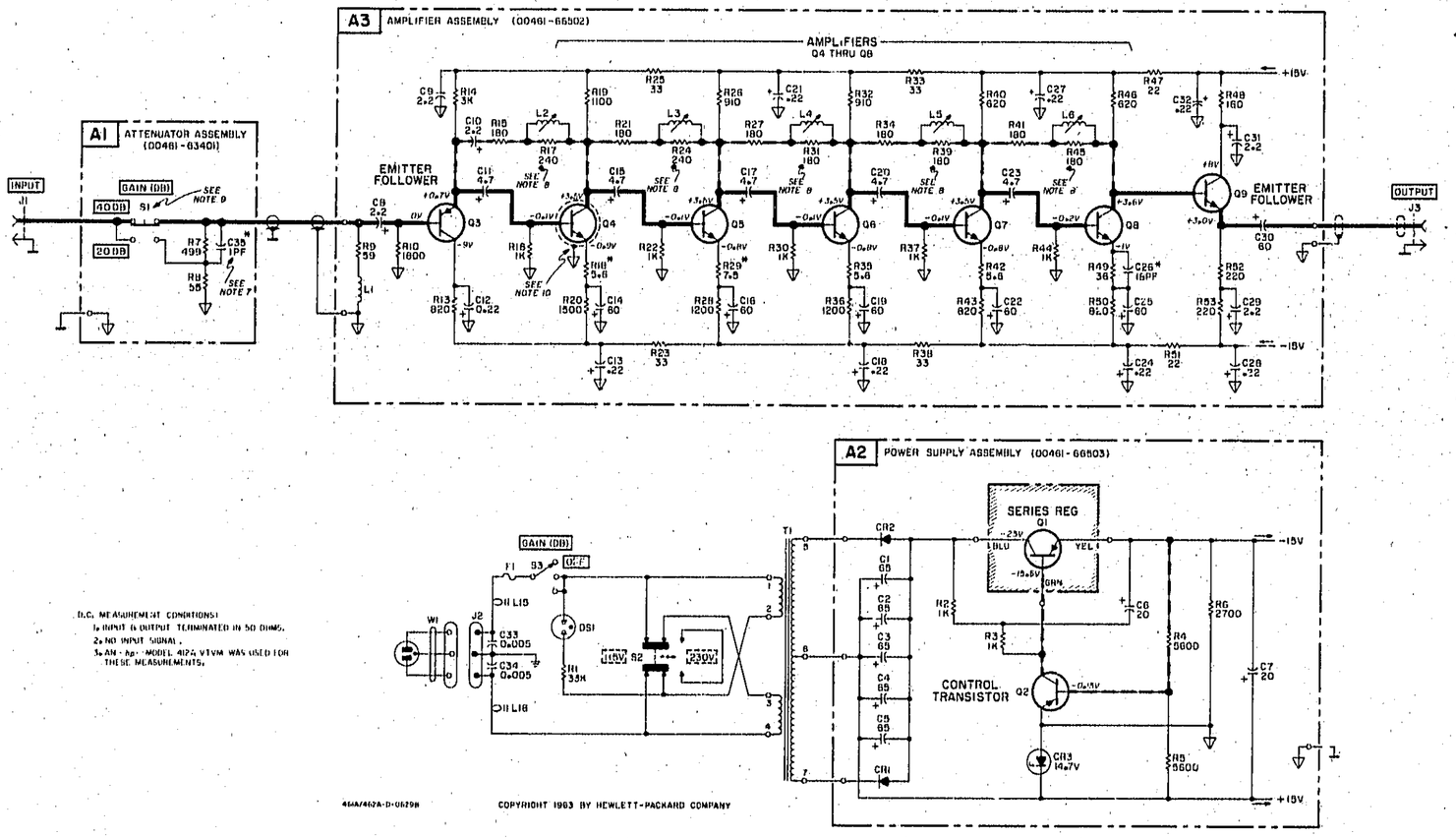
A2

hp Part No. 00461-66503



A3

hp Part No. 00461-66502



D.C. MEASUREMENT CONDITIONS:
1. INPUT & OUTPUT TERMINATED IN 50 OHMS.
2. NO INPUT SIGNAL.
3. AN - Ag - MODEL 412A VTVM WAS USED FOR THESE MEASUREMENTS.

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	 _____ _____ _____

PARTS LIST

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.

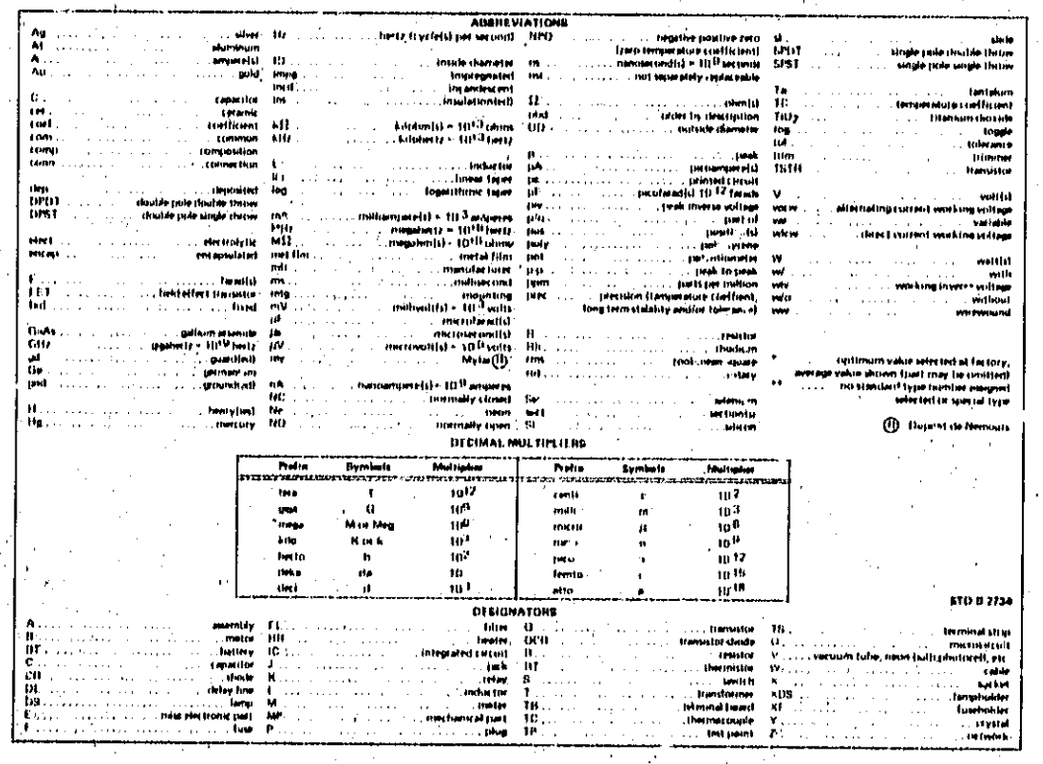


Table 6-1. Replaceable Parts

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

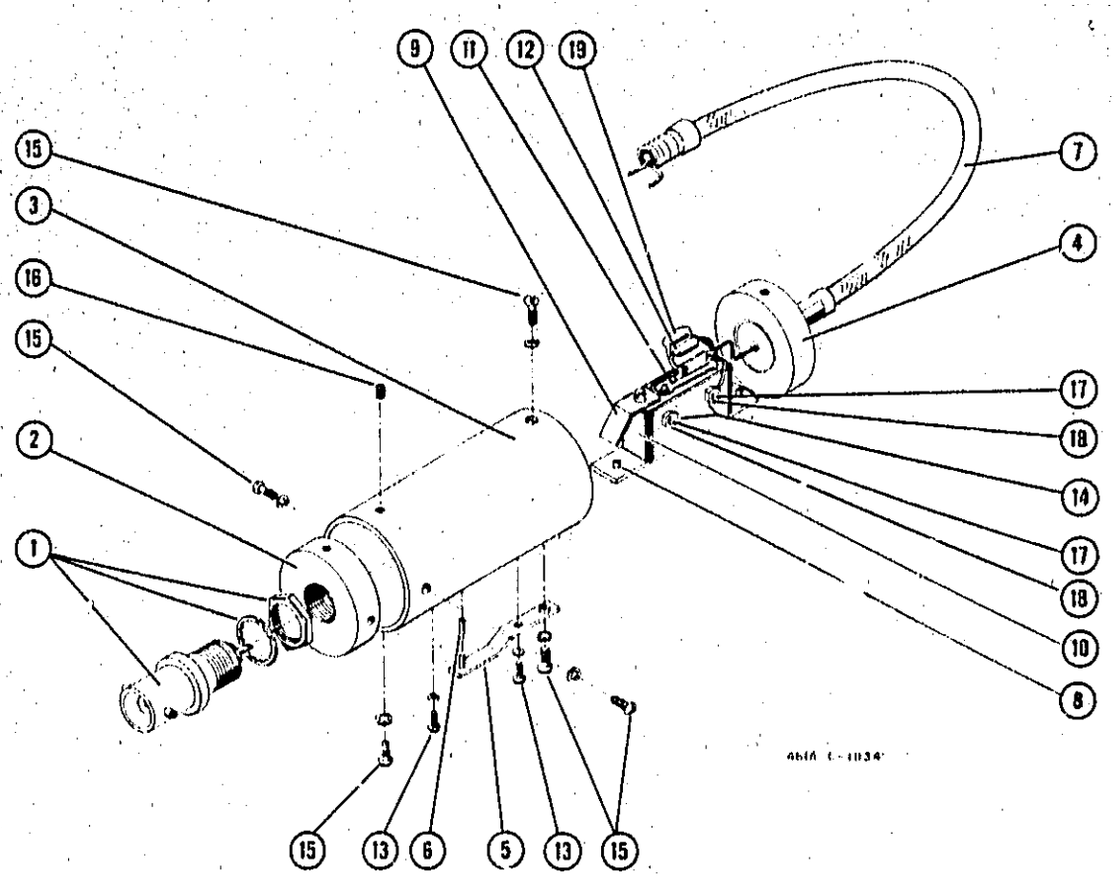


Figure 6-1. Exploded View of A1 Attenuator

1	1250-0749		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	1460-0169		1	Compression spring		
7(W5)	00461-81604		1	Cable	hp	
8	00461-01202		1	Switch bracket	hp	
9	00461-09102		1	Contact spring	hp	
10(S3)	3102-0066		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 1-1
12(R8)	0724-0060		1	R: fxd C flm 55 ohms +/-1% 1/4 W (462A only)	91637	DC1/4
12(R8)	0698-4384		1	R: fxd flm 54.9 ohms +/- 1 % 1/8 W (461A only)	91637	CMF-1/10-32 1-1
13	0520-0905		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	GA1JBPF

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 55 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	SR1368-3
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: C6 thru C32, L1 thru L14, Q3 thru Q9 and R9 thru R53). These two assemblies are identical except where stated.	hp	
C6 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 68 uF +/-20% 6 vdcw	56289	150D686X0006B2
C15	0180-0309			C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C16	0180-0106			C: fxd elect 68 uF +/-20% 6 vdcw	56289	150D686X0006B2
C17	0180-0309			C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C18	0160-0170			C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C19	0180-0106			C: fxd Ta elect 68 uF +/-20% 6 vdcw	56289	150D686 0006B2
C20	0180-0309			C: fxd Ta elect 4.7 uF 10 vdcw	56289	150D475X0010A2
C21	0160-0170			C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C22	0180-0106			C: fxd Ta elect 68 uF +/-20% 6 vdcw	56289	150D686X0006B2
C23	0180-0309			C: fxd Ta elect 4.7 uF +/-20% 10 vdcw	56289	150D475X0010A2
C24	0160-0170			C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C25	0180-0106			C: fxd Ta elect 68 uF +/-20% 6 vdcw	56289	150D686X0006B2
C26*	0160-0178		1	C: fxd mica 27 pF +/-5% 250 V	hp	
C27,C28	0160-0170			C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
C29	0180-0155			C: fxd Ta elect 2.2 uF +/-20% 20 vdcw	56289	150D225X0020A2
C30	0180-0106			C: fxd Ta elect 68 uF +/-20% 6 vdcw	56289	150D686X0006B2
C31	0180-0155			C: fxd Ta elect 2.2 uF +/-20% 20 vdcw	56289	150D225X0020A2
C32	0160-0170			C: fxd cer 0.22 uF +80% -20% 25 vdcw	56289	5C9A
L1	00461-66001		1	Coil: compensating	hp	
L2	00461-66502		1	Coil: variable 1.2 uH	hp	
L3	00461-66003		1	Coil: variable 0.4 uH	hp	
L4	00461-66004		1	Coil: variable 0.2 uH	hp	
L5	00461-66005		1	Coil: variable 0.2 uH	hp	
L6	00461-66006		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	1854-0395		3	TSTR: Si NPN	04713	S59B
Q8	1854-0009		1	TSTR: NPN Si 2N709	hp	
Q9	1854-0554		1	TSTR: Si NPN	07263	3010 obd
	1205-0018		1	Heat dissipator for Q9	05820	NF-203
R9	0724-(A61		1	R: fxd C film 59 ohms +/-1% 1/4 W	19701	CC1/4A
R10	0684-1821		1	R: fxd comp 1.8 kilohms +/-10% 1/4 W	01121	CB1821
R11,R12				Not assigned		
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			R: fxd comp 180 ohms +/-5% 1/4 W (462A only)	01121	CB1815
R18*				See Padding List on Page 6-13		
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			R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R22	0684-1021			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			R: fxd comp 240 ohms +/-5% 1/4 W (461A only)	01121	CB2415
R24	0683-1815			R: fxd comp 180 ohms +/-5% 1/4 W (462A only)	01121	CB1815
R25	0687-3301			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			R: fxd comp 180 ohms +/-5% 1/4 W	01121	CB1815
R28	0686-1225		2	R: fxd comp 1.2 kilohms +/-5% 1/2 W	01121	EB1225
R29* } R29* }				See Padding List on Page 6-13		
R30	0684-1021			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		1	R: fxd comp 120 ohms +/-5% 1/4 W (462A only)	01121	CB1215
R32	0686-9115			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			R: fxd comp 180 ohms +/-5% 1/4 W (461A only)	01121	CB1815
R39	0683-6805		2	R: fxd comp 68 ohms +/-5% 1/4 W (462A only)	01121	CB6805
R40	0686-8215		2	R: fxd comp 820 ohms +/-5% 1/2 W	01121	EB8215
R41	0683-1815			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		2	R: fxd comp 820 ohms +/-+/-5% 1/2 W	01121	CB8215
R44	0684-1021		1	R: fxd comp 1 kilohm +/-10% 1/4 W	01121	CB1021
R45	0683-1815			R: fxd comp 180 ohms +/-5% 1/4 W (461A only)	01121	CB1815
R46	0683-3905		1	R: fxd comp 39 ohms +/-5% 1/4 W (462A only)	01121	CB3905
R46	0686-8215		2	R: fxd comp 820 ohms +/-5% 1/2 W	01121	EB8215
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			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	0758-0016		2	R: fxd met flm 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	2110-0014			Fuse: 115 V 1/4 A (Fast-Blo)	75915	AB-Cat-312-250
L15,L16	0170-0016		30	Beads: ferrite	-hp-	
Q1	1853-0063		1	TSTR: Si PNP selected	-hp-	
	1200-0043		1	Insulator for Q1	28365	obd
	1200-0081		1	Bushing for Q1	28365	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	00427	H10B11G-3L
J3	1250-0083		1	Connector: output female	95712	30024-1
				MISCELLANEOUS		
	1400-0118		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-	
	00461-00703		1	Panel: rear	-hp-	
	5020-0710		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
00000	U.S.A Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Comco, Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Mictron, Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Cruven, Ltd.	Whitby, Ontario, Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co. Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Allen Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Gudebrod Bros. Silk Co.	New York
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferrocube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Voraline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03200	Nylon Molding Corp.	Springfield, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03707	Eldema Corp.	Compton, Calif.
03810	Parker Seal Co.	Los Angeles, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taylus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Knaex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filton Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04798	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Cal.
05397	Union Carbine Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
05618	Cosmo Plastic (c/o Elvcirical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05726	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
07380	Varian Assoc. Etmac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07120	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07140	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp, The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Cal.
08289	Elinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08604	Bristol Co., The	Waterbury, Conn
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc	Lowell, Mass.
08800	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind, Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09705	Pennsylvania Fluorocarbon	Hillton Heights, Penn.
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11238	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11314	National Seal	Downey, Cal.
11453	Precision Connector Corp.	Jamaica, N.Y.
11536	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc.	Palo Alto, Cal.
12136	Philadelphia Handle Co.	Camden, N.J.
12301	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Rimar Filter Corp	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13010	Airco Supply Co., Inc.	Wichita, Kansas
13041	Wilco Products	Detroit, Mich.
13103	Thermoloy	Dallas, Texas
13527	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (Umbil)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14103	Calif. Resistor Corp	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
14493	Hewlett-Packard Company.	Loveland, Colo.
14655	Cornell Dubilier Electric Corp	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14936	Williams Mfg. Co.	San Jose, Cal.
15108	The Sparre Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics.	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Frowal Elect. Inc.	Framingham, Mass.
15818	Ameiro Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16544	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16698	Ideal Prec. Meter Co., Inc., De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranpo Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18478	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18505	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison	West Orange, N.J.
19589	Conrac	Baldwin Park, Cal.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
19644	LHC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21220	Excelsior, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fanstee1 Metallurgical Corp.	N. Chicago, Ill.
23020	General Reed Co.	Metuchen, N.J.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division, Nela Park	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
26305	Grien Reproducer Corp.	New Rochelle, N.Y.
26462	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compar/Hollister Co.	Hollister, Cal.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co	Palo Alto, Cal.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Sanwyrk Coil Products, Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
40931	Honeywell Inc.	Minneapolis, Minn.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	HP Co., Med. Elec. Div	Waltham, Mass.
54294	Shalleross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
56474	Superior Elect. Co.	Bristol, Conn.
56446	Telex Corp.	Tulsa, Okla.
56730	Thomas & Betts Co.	Elizabeth, N.J.
56741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston Newark	Newark, N.J.
66295	Wilkor Mfg. Co	Chicago,
66340	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71210	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Cambe Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71468	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.

Code No.	Manufacturer	Address
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71709	Cornish Wire Co., The	New York, N.Y.
71707	Cole Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72110	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Goldenan Co.	Chicago, Ill.
72902	Elastic Stop Nut Corp.	Union, N.J.
72904	Robert M. Hadley Co.	Los Angeles, Cal.
72962	Erie Technological Products, Inc.	Erie, Pa.
73061	Ransom Mfg. Co., Inc	Pepperell, Ind.
73070	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst. Inc.	Fullerton, Cal.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.
73446	Amperex Elect. Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73650	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George B. Carroll Co., Div. Mfg. Industries, Inc.	Philadelphia, Pa.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73840	Goshen Stamping & Tool Co.	Goshen, Ind.
73909	JFD Electronics Corp	Brooklyn, N.Y.
73995	Jennings Radio Mfg. Corp.	San Jose, Cal.
73957	Greaves-Pin Corp.	Ridgefield, N.J.
74276	Stewpte Inc.	Neptune, N.J.
74455	J.W. Winn, and Sons	Winchester, Mass.
74901	Industrial Condenser Corp.	Chicago, Ill.
74969	R.I. Products Division of Amphenol-Borg Electronic Corp.	Duxbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Cal.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Cal.
76530	Cinch-Monadnock, Div. of United-Carr Fastener Corp.	San Leandro, Cal.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.
77075	Pacific Metals Co.	San Francisco, Cal.
77221	Photocon Instrument and Electronic Co.	So. Pasadena, Cal.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Division	Brooklyn, N.Y.
77764	Resistance Products Co	Harrisburg, Pa.
77909	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.

Code No.	Manufacturer	Address
78452	Timken-Roller Bearing Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Cal.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78709	Transformer Engineers	San Gabriel, Cal.
78947	Reliable Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Verter Rod, Inc	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Standard tube or semiconductor device, any manufacturer.	
80207	Quinmax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Cal.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81038	International Inst. Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Cal.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Mil Specification	Washington, D.C.
81483	International Rectifier Corp.	El Segundo, Cal.
81541	Augat Electronics, Inc.	Cambridge, Maryland
81866	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82114	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82210	Sylvania Electric Prod., Inc., Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Garrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82706	Phillips-Advance Control Co	Joliet, Ill.
82866	Research Products Corp	Madison, Wis.
82877	Bolton Mfg. Co. Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal.
82964	Cam Fastener Co.	Cambridge, Mass.
83006	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITC Wire and Cable Div.	Los Angeles, Cal.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Bobbell Corp.	Mendelein, Ill.
83324	Rosan Inc	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83501	Borroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp., Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Lovel Scruggs Co.	Penton, Mo.
83842	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Cal.
84411	TRW Capacitor Div.	Ogallala, Neb.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
04070	Barker Turzian, Inc.	Bloomington, Ind.
05454	Boonton Molding Company	Boonton, N.J.
05471	A. B. Boyd Co.	San Francisco, Cal.
05474	R. M. Bracamonte & Co.	San Francisco, Cal.
05660	Rolled Cords, Inc.	Camden, Conn.
05911	Seamless Rubber Co.	Chicago, Ill.
06174	Pabst Bearing Co.	Los Angeles, Calif.
06197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
06570	Precision Rubber Products Corp.	Dayton, Ohio
06664	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
06926	Beamtron Mfg. Co.	Glendale, Cal.
07034	Marco Industries	Anaheim, Cal.
07216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
07473	Western Fibrous Glass Products Co.	San Francisco, Cal.
07604	Van Waters & Rogers Inc.	San Francisco, Cal.
07930	Tower Mfg. Corp.	Providence, R.I.
08140	Cutler-Hammer, Inc.	Lincoln, Ill.
08220	Gould-National Batteries, Inc.	St. Paul, Minn.
08698	General Mills, Inc.	Buffalo, N.Y.
08931	Graybar Electric Co.	Oakland, Cal.
08973	G.E. Distributing Corp.	Schenectady, N.Y.
08979	Security Co.	Detroit, Mich.
09065	United Transformer Co.	Chicago, Ill.
09030	United Shoe Machinery Corp.	Beverly, Mass.
09179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
09305	Belleville Specialty Tool Mfg., Inc.	Belleville, Ill.
09763	United Carr Fastener Corp.	Chicago, Ill.
09970	Bearing Engineering Co.	San Francisco, Cal.
01130	ITT Cannon Elect., Inc., Salem Div.	Salem, Mass.
01260	Connor Spring Mfg. Co.	San Francisco, Cal.
01345	Miller Dial & Nameplate Co.	El Monte, Cal.
01418	Radio Materials Co.	Chicago, Ill.
01608	Augat Inc.	Attleboro, Mass.
01637	Dale Electronics, Inc.	Columbus, Nebr.
01662	Bird Corp.	Willow Grove, Pa.
01673	Epiphone Inc.	New York, N.Y.
01737	Greenar Mfg. Co., Inc.	Wakefield, Mass.
01827	R & D Development Co.	Redwood City, Cal.
01880	Malco Mfg., Inc.	Chicago, Ill.
01929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
01961	Nahm-Bros. Spring Co.	Oakland, Cal.
02180	Tru-Connector Corp.	Peabody, Mass.
02367	Elgeet Optical Co., Inc.	Rochester, N.Y.
02607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
02702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
02660	Hudson Lamp Co.	Kearney, N.J.
03332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
03814	Rotating & Myers Inc.	Palisades Park, N.J.
03815	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
03832	Waters Mfg. Co.	Culver City, Cal.
03920	G.V. Controls	Livingston, N.J.
04137	General Cable Corp.	Bayonne, N.J.
04144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
04148	Scientific Electronics Products, Inc.	Loveland, Colo.
04184	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
04197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
04222	South Chester Corp.	Chester, Pa.
04330	Wire Cloth Products, Inc.	Belwood, Ill.
04375	Automatic Metal Products Co.	Brooklyn, N.Y.
04562	Worcester Pressed Aluminum Corp.	Worcester, Mass.
04606	Mogenrall Electric Co.	Chicago, Ill.
05023	George A. Philbrick Researchers, Inc.	Boston, Mass.
05140	Alco Elect. Mfg. Co.	Lawrence, Mass.
05230	Allen Products Corp.	Dania, Fla.
05288	Continental Connector Corp.	Woodside, N.Y.
05263	Gerrard Mfg. Co., Inc.	Long Island, N.Y.
05265	National Coil Co.	Sheridan, Wyo.
05275	Vitramon, Inc.	Bridgeport, Conn.
05348	Gavion Corp.	Bloomfield, N.J.
05354	Methode Mfg. Co.	Rolling Meadows, Ill.
05550	Arnold Engineering Co.	Marengo, Ill.
05712	Dage Electric Co., Inc.	Franklin, Ind.
05984	Stemon Mfg. Co.	Wayne, Ill.
05987	Weckesser Co.	Chicago, Ill.
06067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
06085	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
06256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
06296	Solar Mfg. Co.	Los Angeles, Cal.
06396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
06530	Curtiss Screw Co.	Chicago, Ill.
06541	Microwave Associates, Inc.	Burlington, Mass.
06581	Excel Transformer Co.	Oakland, Cal.
06666	Xcelite, Inc.	Orchard Park, N.Y.
06735	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
06981	Thompson Ind. Inc.	Long Island, N.Y.
07404	Industrial Retaining Ring Co.	Irvington, N.J.
07530	Automatic & Precision Mfg.	Englewood, N.J.
07979	Beon Resistor Corp.	Yonkers, N.Y.
07983	Litton System Inc., Adler-Ventron Commun. Div.	New Rochelle, N.Y.
08141	H-Tronics, Inc.	Jamaica, N.Y.
08159	Rubber Teck, Inc.	Gardena, Cal.
08220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
08278	Microdot, Inc.	So. Pasadena, Cal.
08293	Dealectro Corp.	Manamouth, N.Y.
08370	Zero Mfg. Co.	Burbank, Cal.
08410	Ric Inc.	Cleveland, Ohio
08731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
08734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
08821	North Hills Electronics, Inc.	Glen Cove, N.Y.
08978	International Electronic Research Corp.	Burbank, Cal.
09109	Columbia Technical Corp.	New York, N.Y.
09213	Varian Associates	Palo Alto, Cal.
09378	Allen Corp.	Winchester, Mass.
09515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
09707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
09800	Dolevan Electronics Corp.	East Aurora, N.Y.
09848	Wilco Corporation	Indianapolis, Ind.
09928	Bramson Corp.	Whippany, N.J.
09934	Reinhardt, Inc.	Boston, Mass.
09943	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
09957	Technology Instrument Corp. of California	Newbury Park, Cal.

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

0000P	Malco Tool and Die	Los Angeles, Calif.	0000H	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado
0000Z	Willow Leaf or Products Corp.	Newark, N.J.	0000M	Rubber Eng. & Development	Hayward, Cal.
0000H	BTA	England	0000N	A "N" D Mfg. Co.	San Jose, Cal.
0000U	Precision Instrument Comp. Co.	Van Nuys, Cal.	0000X	Coolfrom	Oakland, Cal.
			0000W	California Eastern Lab	Burlington, Cal.
			0000Y	S.K. Smith Co.	Los Angeles, Cal.

BACK DATING MANUAL CHANGES

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
346- (461A)	1, 2, 3, 4
418- (461A)	2, 3, 4
606-(461A)	3, 4
946-03115 and below	4

Instrument Serial Number	Make Manual Changes
347-(462A)	1, 2, 3, 4
421-, 414- (462A)	2, 3, 4
551-(462A)	3, 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.

MANUAL CHANGES

MANUAL CHANGES

-hp- MODEL 461A/462A

WIDEBAND AMPLIFIERS

Manual Part Number 00461-90006

New or Revised Item

CHANGE NO. 1 for Serial Numbers:
461A - 0946A05118 and Above.
462A - 0947A01681 and Above.

Page 5-4. Change 00461-00203 to 00461-00205.

CHANGE NO. 2 for Serial Number 0946A05191 and Above (461A).

Page 5-14, Schematic Note 8. Add: R41 to 180 ohm.

Page 5-15/5-16. Change A3R41 and A3R45 to 160.

Page 6-3. After A3L4 and A3L5 descriptions, add "(462 only)". Also add L4, L5; 00461-86006; Coil: Variable 0.1 μH (461 only).

Page 6-4. Change A3R41 and A3R45 to 0683-1615, 160 ohms, (461A only).

CHANGE NO. 3 for all Serial Numbers.

Page 5-3. Change Paragraph 5-10 as follows:

5-10. DISTORTION CHECK (461A).

a. Connect the 461A as shown in Figure 5-2.

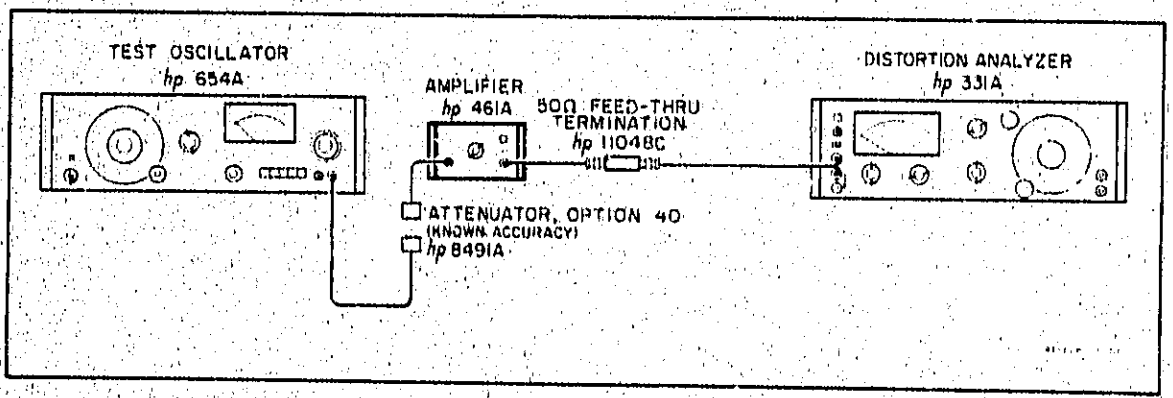
b. Set the 461A GAIN (DB) switch to 40.

c. Set the 654A frequency to 500 kHz and minimum OUTPUT AMPLITUDE.

d. Set the 331A to measure RMS VOLTS using the 1 VOLT METER RANGE. Adjust the 654A OUTPUT for a 0.5 volt indication on the 331A Meter.

e. Measure the signal distortion in percentage. The distortion must be less than 5%.

Revise Figure 5-2 as shown:



CHANGE NO. 4 Applies to Serial Numbers 0946A05341 and greater for the Model 461A, and Serial Numbers 0947A01721 and greater for the Model 462A.

Page 6-4. Change the Part Number of the "Insulator for Q1" from 1200-0043 to 0340-0680.

CHANGE NO. 5 Applies to Serial Numbers 0946A05501 and greater for the Model 461A, and Serial Numbers 0947A01751 and greater for the Model 462A.

Page 5-15/5-16, Power Supply (A2) Assembly Schematic. Change the value of R4 from 5600 to 5100.

Page 6-3, Reference Designator A2R4. Change Part Number and Description from 0686-5525, R:Fxd Comp 5.6 kilohm ± 5% ½ W to 0686-5125, R:Fxd 5.1 kilohm ± 5% ½ W.
Delete the relative MFR and MFR. Part Number references.

CHANGE NO. 6 Applies to Serial Numbers 0946A04761 and Above for the Model 461A.

Page 5-15/5-16. On the schematic diagram change the following capacitor values:

Ref. Desig.	From	To
C9, C10	2.2 μF	6.8 μF
C21, C27, C32	.22 μF	2.2 μF

Page 6-3, Table 6-1. Change the following Part Numbers:

Ref. Desig.	From	To
C9, C10	0180-0155	0180-1701
C21, C27, C32	0160-0170	0160-0128

CHANGE NO. 7 for all Serial Numbers.

Page 1-1, Table 1-1. Change the Frequency Response Specification to: ± 1 dB, 1 kHz to 150 MHz when operating into a 50 Ω resistive load.

Page 5-2. Change Paragraph 5-8 as follows:

5-8. 50 kHz Gain Check (461A); Output Voltage Check (461A).

b. Set the oscillator to 50 kHz and oscillator amplitude to read 0 dB on the −10 dB range of the ac voltmeter.

Page 5-3. Change Paragraph 5-9(b) and (e) as follows:

b. Set the oscillator frequency to 50 kHz and adjust its amplitude to read 0 dB on the −10 dB range of the ac voltmeter.

e. Record the error at 2 MHz for use in Paragraph 5-12. The reference for high frequency response must be 50 kHz.

Page 5-4. Change Paragraph 5-12(c) and (f) as follows:

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 50 kHz reference as recorded in Paragraph 5-9, Step e.)

f. Connect as in position B. The ac voltmeter must read the reference at 50 kHz (0 dB on the 0 dB range ± 1 dB or less.

ERRATA.

Page 3-2, Paragraph 3-10. The second sentence should read: "Three 461A's or 462A's can be cascaded with a minimum input of 40 microvolts".

Page 8-4, Table 8-1.

a. Delete XF1, 1400-0084, Fuseholder. Add the following:

hp Part No.	TQ	Description
2110-0564	1	Fuseholder
2110-0566	1	Cap-Fuseholder
2110-0569	1	Nut-Fuseholder
1400-0080	1	Washer

b. Add to the Miscellaneous List:

hp Part No.	TQ	Description
2260-0001	2	Nut-Hex

Page 5-8, Paragraph 5-23(b). Steps d, e and f are printed twice. Delete the second set on top right column.

Page 5-8, Paragraph 5-23(b). Change Step b to read: Connect the ac voltmeter to position "A" and adjust the output of the oscillator for a reading on the ac voltmeter of −10 dB at 50 kHz.

CHANGE NO. 8 Applies to Serial Number 0948A00588 and Above.

Page 8-4, Table 8-1. Change Q1 to 1853-0305.

Page 8-3, Table 8-1.

a. Change R4 to 0698-3279, Resistor-Fxd 4.99 k ohms.

b. Change R5 to 0757-0200, Resistor-Fxd 5.62 k ohms 1%.

c. L5 should be 00461-86005.

CHANGE NO. 9 Applies to Serial Number 0948A00521 and Greater for the Model 461A, and Serial Numbers 0947A01788 and Greater for the Model 462A.

Page 8-4. Change the Part Numbers of L15, 16 to 9140-0179 (Coil: 22 UH) Qty 2. Add to Miscellaneous Parts -hp- Part Number 0360-1668 (Term Strip for L15, L16) Qty 1.

CHANGE NO. 10 Applies to all Serial Numbers.

Page 8-4. Change the Part Number of the "Insulator for Q1" from 0340-0580 to 0340-0583, Reference Change No. 4.