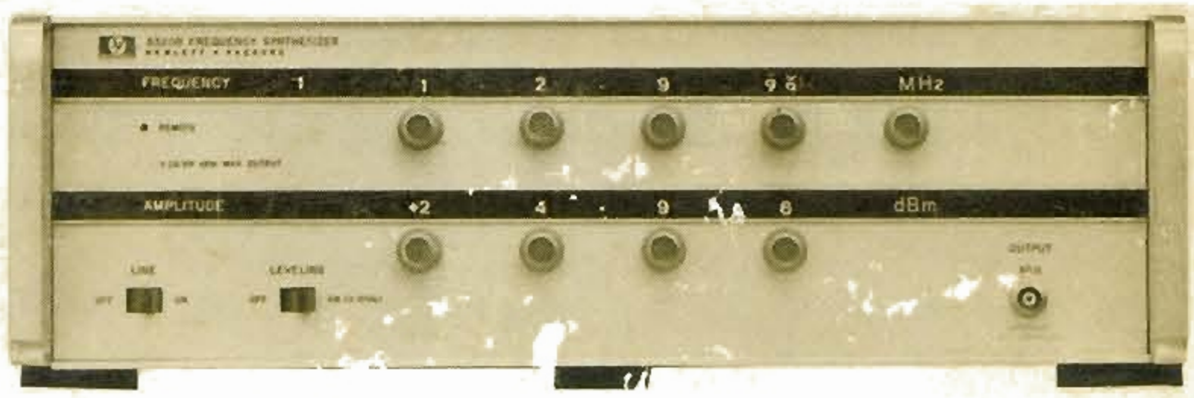
OPERATING AND SERVICE MANUAL

FREQUENCY SYNTHESIZER
3320A/B



HEWLETT hp PACKARD

HEWLETT hp PACKARD

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

Manual Part No. 03320-90001
Microfiche Part No. 03320-90051

MODEL 3320A/B
FREQUENCY SYNTHESIZER

The main body of this instruction manual applies to

Serial Number 1138A-00276 (Model 3320A)
1319A-00691 (Model 3320B)

and higher. Any changes made in instruments having serial numbers higher than the above number will be found in a "Manual Changes" supplement supplied with this manual. Be sure to examine this supplement for any changes which apply to your instrument and record these changes in the manual. Backdating information for instruments with lower serial numbers will be found in Section VIII.

P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

Printed: August 1973

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains general information about the Model 3320A/B Frequency Synthesizer. A general description plus information on specifications, accessories, and instrument identification is given.

1-3. SPECIFICATIONS.

1-4. Table 1-1 is a complete list of the Model 3320A/B critical specifications that are governed by tolerances. Table 1-2 contains general information that describes the operating characteristics of the 3320A/B.

1-5. Any change in the specifications due to manufacturing, design, or traceability to the U.S.National Bureau of Standards will be covered by revised pages in this manual. This manual supercedes all previous information concerning specifications of the 3320.

1-6. DESCRIPTION.

1-7. The Hewlett-Packard Model 3320A/B Frequency Synthesizer provides accurate and stable frequencies from 0.001 Hz to 12.9999 MHz. Frequency selection is by three controls that provide three digits of resolution plus an

Table 1-1. Specifications.

Frequency accuracy
Vernier Out: ± 0.001% of setting for 6 mo. 0°C to 55°C.
Vernier In: ± 0.01% of range for 6 mo, 0°C to 55°C.

Frequency stability
Long term: ± 10 parts in 10^6 of setting per year (Vernier Out) with ambient temperature reference. Optional high stability crystal reference oven available (Option 002).

Signal to phase noise (integrated). > 40 dB in 30 kHz band, excluding ± 1 Hz, centered on carrier.10 MHz range, Vernier Out. Improves on lower frequency ranges.

Spurious: > 60 dB down.

Harmonic distortion: with output frequencies > 0.1% of range at full output amplitude any harmonically related signal will be less than the following specified levels.
- 60 dB with output from 5 Hz to 100 kHz.
- 50 dB with output from 100 kHz to 1 MHz.
- 40 dB with output from 1 MHz to 13 MHz.

3320A AMPLITUDE SECTION

Amplitude: maximum 2 V rms ± 10% open circuit.
maximum 1 V rms ± 10% into 50 Ω.

Frequency response: ± 2 dB over total range.

3320B AMPLITUDE SECTION

Amplitude accuracy (absolute): ± 0.05 dB at 10 kHz and +26.99 dBm (20°C to 30°C).

Attenuator accuracy (10 kHz reference): ± 0.02 dB/10 dB step.

Frequency response (10 kHz reference):

3320B ATTENUATOR SETTINGS (dBm)		SPECIFICATION (dB)	
Standard	Option 001	LEVELING OFF	LEVELING ON (> 10 Hz)
+ 26.99 to - 3.00	+ 24.99 to - 5.00	± 0.5	± 0.05
- 3.01 to - 23.00	- 5.01 to - 25.00	± 0.5	± 0.1
- 23.01 to - 53.00	- 25.01 to - 55.00	± 0.5	± 0.2
- 53.01 to - 69.99*	- 55.01 to - 69.99**	± 0.5	± 0.4

* - 73.00 dBm, remote control.
** - 75.00 dBm, remote control.

Table 1-2. General Information.

Frequency range: 0.01 Hz to 13 MHz in 7 ranges.

Frequency ranges:
10 MHz
1000 kHz
100 kHz
10 kHz
1000 Hz
100 Hz } Optional
10 Hz }

30% overrange on all ranges.

Frequency resolution:

Range	Vernier Out (local or remote)	Vernier In (local)	Vernier In (remote)
10 MHz	10 kHz	10 Hz	1 kHz
1000 kHz	1 kHz	1 Hz	100 Hz
100 kHz	100 Hz	0.1 Hz	10 Hz
10 kHz	10 Hz	0.01 Hz	1 Hz
1000 Hz	1 Hz	1 mHz	0.1 Hz
100 Hz	0.1 Hz	0.1 mHz	0.01 Hz
10 Hz	0.01 Hz	0.01 mHz	0.001 Hz

Internal frequency standard: 20 MHz ambient temperature crystal. Optional 5 MHz reference crystal oven available (Option 002).

Phase locking: the 3320A/B may be phase locked with a 200 mV to 2 V rms signal that is any subharmonic of 20 MHz from 1 MHz through 10 MHz (e.g., 1 MHz, 2 MHz, 2.5 MHz, 5 MHz, 10 MHz). BNC female connector.

Rear panel output: front or rear panel output is available. Can be easily changed by routing internal cable to front or rear female BNC connectors. No degradation of performance for rear panel output.

Auxiliary outputs

Tracking output: 20 MHz to 33 MHz offset signal. Tracks main output with 20 MHz offset. Rear panel female BNC, > 100 mV rms/50 Ω.

1 MHz reference output: sine wave, rear panel female BNC, > 220 mV rms/50 Ω (> 0 dBm/50 Ω).

Low level output: same frequency as main output but remains between 50 mV rms and 158 mV rms (into 50 Ω) depending on main output level setting. May be used as counter output if wanted. Rear panel female BNC, sine wave.

3320A AMPLITUDE SECTION

Amplitude range: 0 dBm to + 13 dBm range through 3/4 turn front panel control (not programmable).

Output impedance: 50 Ω.

3320B AMPLITUDE SECTION

Amplitude range: + 26.99 dBm (1/2 watt) to - 69.99 dBm (- 73.00 dBm under remote control) into 50 Ω. (+ 26.99 dBm = 5 V rms into 50 Ω).

Amplitude resolution: 0.01 dB.

Output impedance: 50 Ω.

GENERAL 3320A/B

Operating temperature: 0°C to 55°C.

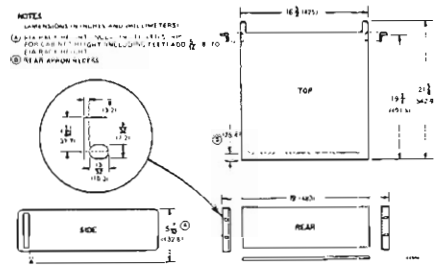
Storage temperature: - 40°C to + 70°C.

Power requirements: 115 V or 230 V ± 10%, 48 Hz to 63 Hz, < 110 W, (400 Hz operation on special basis).

Weight

3320A: 45 lb. (20,4 kg).
Shipping: 59 lb (26,7 kg).
3320B: 47 lb. (21,3 kg).
Shipping: 61 lb. (27,5 kg).

Outline drawing:



OPTIONS

75 Ohm Output Impedance
Option 001 3320A/B

Attenuation and output referenced to 75 Ω.

Amplitude range (3320B only): + 24.99 dBm to - 69.99 dBm (- 75.00 dBm under remote control) into 75 Ω. (3320A only): - 2 dBm to + 11 dBm into 75 Ω.

Reference Crystal Oven*
Option 002 3320A/B

5 MHz crystal in temperature stabilized oven.

Long term stability: ± 1 part in 10^8/day.
± 1 part in 10^7/mo.

Frequency accuracy: ± 1 part in 10^7 of setting per month.

For field installation order accessory kit HP 11237A.

Parallel BCD Remote Control*
Option 003 3320A Only

Allows digital remote control of frequency only on 3320A. Digital control of output level is not available on 3320A. The most significant digit of the Vernier may be programmed thus giving four digits, plus 30% overrange, control of frequency in seven ranges (two are optional).

Control lines required: 24 plus remote line.

Logic levels: TTL, "1" state low, non-isolated.

Frequency switching and settling time: ± 0.01% range, 15 ms, ± 0.001% range, 60 ms.

For field installation order accessory kit HP 11238A.

Parallel BCD Remote Control*
Option 004 3320B Only

Allows full digital remote control of frequency and amplitude. (1) Four digits of frequency, overrange, frequency range, Vernier In/Out, four digits of amplitude, and leveling loop response times are all controlled digitally. All front panel controls, except line switch, are disabled in remote.

Control lines required: 40 plus remote line.

Logic levels: TTL, "1" state low, non-isolated.

Frequency switching and settling time: ± 0.01% range, 15 ms; ± 0.001% range, 60 ms.

Amplitude switching and settling time: < 1.5 s to rated accuracy.

For field installation order accessory kit HP 11238B.

Table 1-2. General Information (cont'd).

GPIB Remote Control*
Option 007 3320B Only

Allows bit-parallel word-serial digital remote control of all functions. (1) A 3320B with this option will recognize an address and then accept instructions in a serial fashion. Instructions are in a 7-bit parallel ASCII code. Due to the addressing feature, up to ten 3320B's (with this option) may be programmed from one programmer. The HP 3260A Marked Card Programmer may be used as a programmer for this option.

This option requires 8 digital input lines for full control. (1) Seven of the eight are programming input lines and one is a data command line.

Full digital isolation is standard with this option.

Timing: max of 5 μs per word required to input program data.

Logic level requirements: (same as parallel BCD remote). Switching and settling times for frequency and amplitude are the same as with the parallel BCD remote option. For field installation, order accessory kit HP 11239B.

Logic Level Requirements for All Digital Remote Control Options.

State	Requirements
"Low" (logical "1")	0 V to 0.4 V (5 mA max.) or contact closure to ground through < 80 ohms.
"High" (logical "0")	+ 2.4 V to + 5 V or removal of contact closure to ground.

100 Hz and 10 Hz Ranges*
Option 006 3320A/B

Adds two lower frequency ranges, 100.0 Hz and 10.00 Hz, yielding greater resolution for low frequency outputs (see resolution section of specifications). These two ranges are fully programmable if digital remote options are installed.
For field installation order accessory kit HP 11240A.

*Field installable.

(1) Except last vernier digit and line switch.

overrange digit, and a vernier control that provides two digits of resolution. A range control provides five ranges of 1000 Hz, 10 kHz, 100 kHz, 1000 kHz, and 10 MHz. The output frequencies are derived from a precision single frequency source by an indirect synthesis technique.

1-8. In the 3320A, the output amplitude is selected by a 0–13 dBm continuous potentiometer. Maximum output voltage is 1 V rms into 50 Ω. The 3320B has a range of +26.99 dBm to -69.99 dBm with a resolution of 0.01 dB. The output amplitude can be selected in steps of 0.01 dB, 0.1 dB, 1.0 dB, or 10 dB. Maximum output voltage of the 3320B is 5 V rms into 50 Ω.

1-9. OPTIONS.

1-10. The 3320A/B series of instruments include a total of nine options. These options are as follows:

3320A Options	3320B Options	Description
001	001	75 Ω Output Impedance
002	002	Reference Crystal Oven
003	004	Parallel BCD Remote Control
006	006	100 Hz and 10 Hz Ranges
	007	GPIB Remote Control

1-11. The 3320B Option 007, GPIB (General Purpose Interface Bus) Remote Control utilizes a seven line data bus, a three line transfer bus, and four additional control bus lines to manage the flow of information over the data bus and the transfer bus. Data information is transferred in an ASCII (American Standard Code for Information Interchange) code. For more information concerning this and other options, refer to Table 1-2, Section III, or your local Sales and Service Office.

1-12. ACCESSORIES SUPPLIED.

1-13. Accessories supplied with the 3320A/B are listed in Table 1-3.

Table 1-3. Accessories Supplied.

-hp- Model or Part No.	Qty	Description
03320-84401	1	Rack Mounting Kit
11235A	1	GPIB Adapter

1-14. ACCESSORIES AVAILABLE.

1-15. Accessories available for the 3320A/B are listed in Table 1-4.

Table 1-4. Accessories Available.

-hp- Model or Part No.	Description
3260A	Marked Card Programmer
11237A	Option 002 Kit
11238A	Option 003 Kit (A only)
11238B	Option 004 Kit (B only)
11239B	Option 007 Kit (B only)
11240A	Option 006 Kit
11048C	50 Ω Feedthrough
11094B	75 Ω Feedthrough (Opt. 001 only)

1-16. INSTRUMENT AND MANUAL IDENTIFICATION.

1-17. This manual applies to instruments with the serial number prefix shown on the title page. If changes have been made in the instrument since this manual was printed, a "Manual Changes" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Backdating information in Section VIII adapts the manual to instruments with serial number prefixes lower than those shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 3320A/B Frequency Synthesizer. Included are initial inspection procedures, power and grounding requirements, environmental information, power cord information, interfacing 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 or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit, and the electrical performance should be tested using the procedure outlined in Paragraph 5-7. If there is damage or deficiency, see the warranty inside the front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The 3320 can be operated from any source of 115 V ± 10% at 48 to 66 Hz. The power receptacle on the rear panel contains the switch for selecting 115 V or 230 V operation and the input power fuse. The instrument leaves the manufacturer with the 115 V/230 V switch in the 115 V position. It is necessary to set the switch in the 230 V position when operating from a 230 V source. Use the following procedure and Figure 2-1 for setting the 115 V/230 V switch:

a. Disconnect power cord and slide the cover to the left to gain access to the fuse compartment (Figure 2-1a).

b. Remove the Line Fuse by pulling outward on the Fuse Puller (Figure 2-1b).

c. With the Fuse Puller positioned as shown (Figure 2-1c), set the 115 V/230 V Selector Switch to the position that corresponds with the line voltage to be used.

d. Replace the Line Fuse using a 3 A, 250 V for 115 V operation or a 1.5 A, 250 V for 230 V operation.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 3320A/B is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable 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 pigtail on the adapter to power line ground.

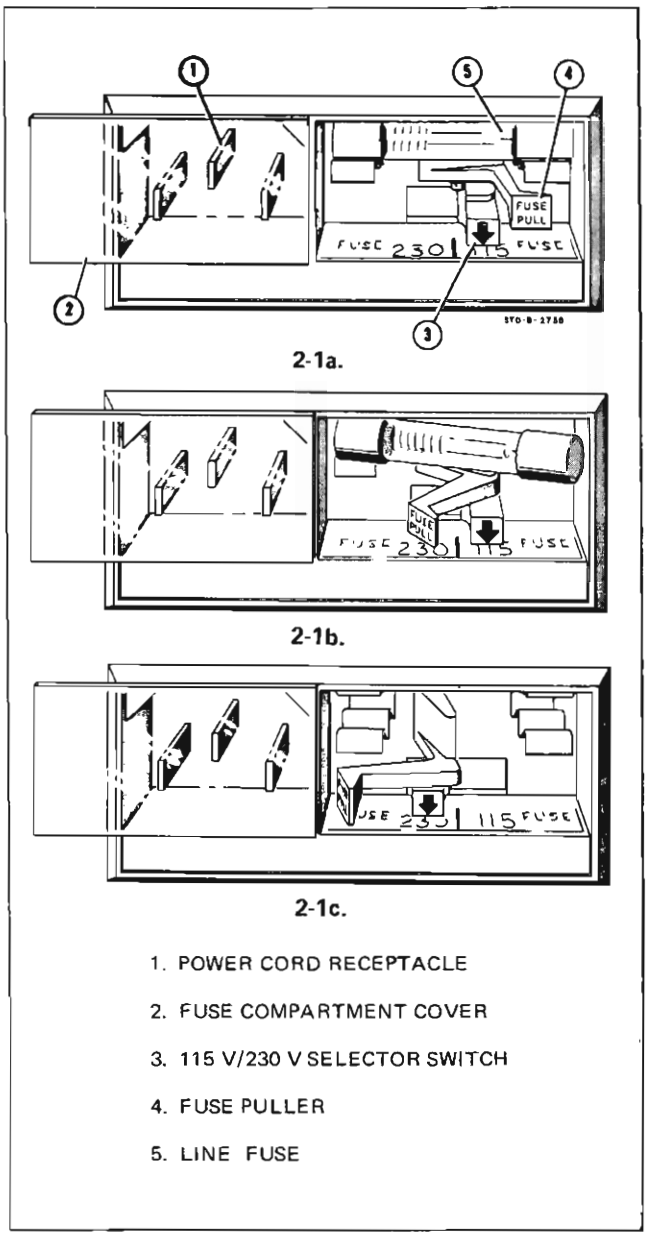


Figure 2-1. Power Module.

2-10. ENVIRONMENTAL REQUIREMENTS.

2-11. The Model 3320A/B is equipped with a cooling fan mounted on the rear panel. The instrument should not be mounted in any manner which would obstruct the flow of air into the rear panel and out the perforated covers. The filters for the cooling fan can be removed and replaced or flushed with soapy water. Two extra filters are furnished as spares. The Model 3320A/B should not be operated where the ambient temperature range exceeds 0° C to 55° C (32° F to 131° F) or stored where the ambient temperature range exceeds - 40° C to 70° C (- 40° F to 158° F).

2-12. REPACKAGING FOR SHIPMENT.

2-13. The following paragraphs contain a general guide for repackaging the instrument for shipment. Refer to Paragraph 2-14 if the original container is to be used; 2-15 if it is not. If you have any questions, contact your nearest -hp- Sales and Service Office (See Appendix B for office locations).

2-14. Place the instrument in the original container with appropriate packing material and seal well with strong tape or metal bands.

2-15. If the original container is not to be used, proceed as follows:

a. Wrap the instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of the instrument and protect the panel face with cardboard strips.

c. Place the instrument and the inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark the shipping container "DELICATE INSTRUMENT", "FRAGILE", etc.

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 and full serial number.

2-16. POWER CORDS AND RECEPTACLES.

2-17. Figure 2-2 illustrates the standard power receptacle (wall outlet) configurations that are used throughout the United States and in other countries. The -hp- part number shown directly above each receptacle drawing is the part number for a 3320 power cord equipped with the appropriate mating plug for that receptacle. If the appropriate power cord is not included with the instrument, notify the nearest -hp- Sales and Service Office and a replacement cord will be provided. The 3320 power cord, power input receptacle and mating connectors meet the safety standards set forth by the International Electrotechnical Commission (IEC).

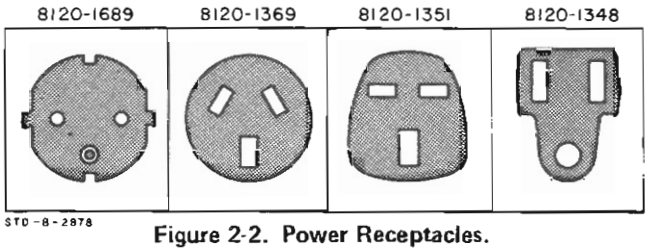


Figure 2-2. Power Receptacles.

2-18. INTERFACING.

2-19. Remote BCD Options.

2-20. The 3320A Option 003 and the 3320B Option 004 are designed for remote programming from an external BCD source. The remote input/output connector is shown in Figure 2-3. A complete description of the input/output signals and logic levels is given in Section III.

2-21. An interfacing connector (-hp- Part Number 1251-3056) and two connector covers (-hp- Part Number 10513-4001) are supplied for external connections. This connector can be wired to contribute to the user's application. A field installation kit (-hp- Part Number 11238A for the 3320A, or 11238B for the 3320B) is available for converting a standard 3320A or 3320B to a BCD remote controlled option. Installation instructions are supplied with the kit.

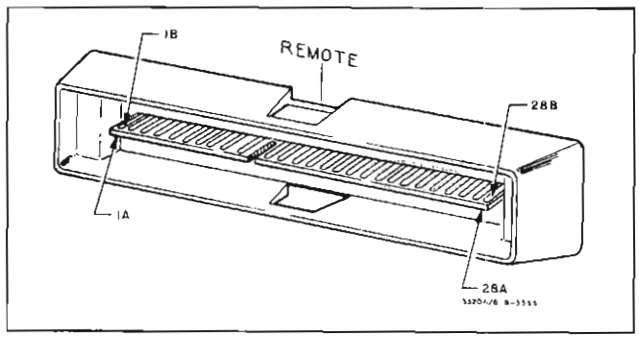


Figure 2-3. BCD Remote Connector.

2-22. Remote GPIB Option.

2-23. The 3320B Option 007 is designed for remote programming from an external GPIB (General Purpose Interface Bus, see Paragraph 1-11) source. The remote input/output connector is shown in Figure 2-4. A complete description of the input/output signals and logic levels required is given in Section III.

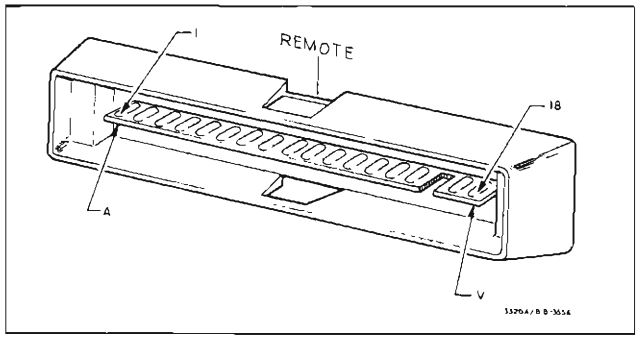


Figure 2-4. GPIB Remote Connector.

2-24. Remote programming sources for the 3320B Option 007 include the -hp- Model 3260A Marked Card Programmer, the -hp- 9800 series Calculators, and the -hp- 2100 series computers. The -hp- 11235A Adapter must be used to interface all -hp- GPIB sources to the 3320B remote input.

2-25. There are three GPIB bus cables available (See Table 2-1). Up to 15 instruments may be connected in parallel using these cables; however, the following two restrictions must be observed.

1. When more than two instruments are connected to the bus, the cable length added for each additional instrument cannot exceed six feet per unit.

2. The total cable length to all units cannot exceed 51 feet.

The cables are listed with their respective lengths, in Table 2-1. A typical bus system is shown in Figure 2-5.

Table 2-1. GPIB Bus Cables.

Accessory Number	Length
10631A	3 ft.
10631B	6 ft.
10631C	12 ft.

2-26. The -hp- Model 3260A Marked Card Reader supplies its own interface cable. If the card reader cable is -hp- Part No. 03260-61607, an 11235A Adapter must be used to interface the card reader to the 3320B. If the card reader cable is -hp- Part No. 03260-61605, the 11235A Adapter is not required. However, the following card reader cable modification must be performed for proper operation.

3260A CABLE (03260-61605) MODIFICATION

(For use with 3320B Option 007)

1. Remove the four screws holding the cover on the interface card on the end of the W1 Cable.

2. Move the violet wire to pin 8.

3. Move the white wire to pin 18.

4. Move the key from pin J to pin T.

5. Replace the screws and covers.

6. The modification is complete.

2-27. The -hp- 9800 series Calculators can be interfaced to the 3320B using the -hp- 11144A Interface Card, a 10631A/B/C GPIB bus cable, and the 11235A Adapter.

2-28. The -hp- Model 2114, 2115, 2116 or 2100 computers can be interfaced using the -hp- Model 59310 Interface Kit. The 59310 kit includes an interface cable, a computer I/O card, and computer programming instructions. An -hp- 11235A Adapter must be used to interface the cable supplied with the 59310 kit to the 3320B.

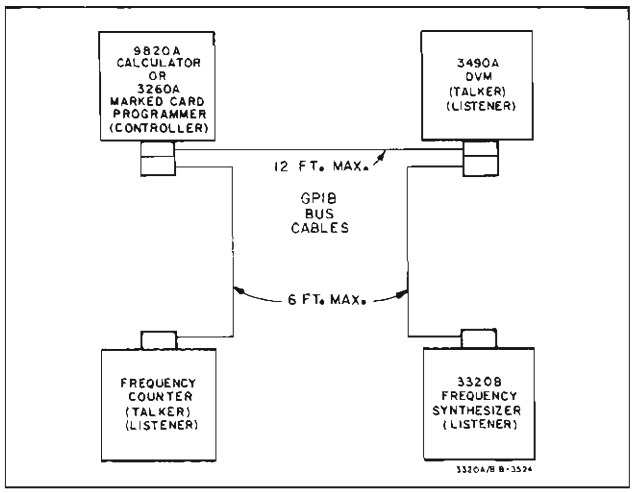
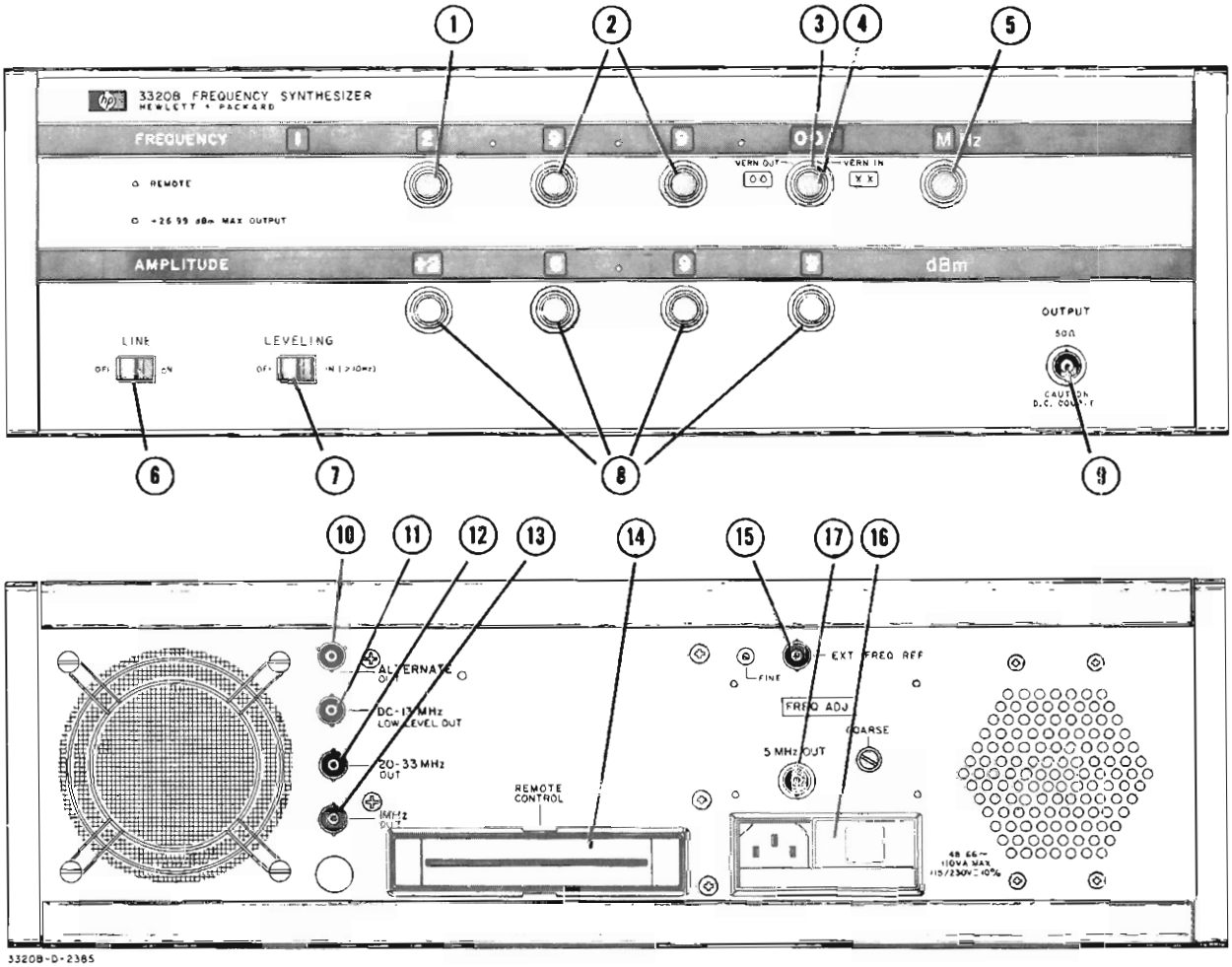


Figure 2-5. Typical GPIB Bus System.



(1) Frequency control for most significant digit of output frequency. Also controls overrange digit (Paragraph 3-7).

(2) Frequency controls for second and third significant digit of output frequency (Paragraph 3-7).

(3) Vernier: Controls two least significant digits of frequency (Paragraph 3-7).

(4) VERN IN/VERN OUT: Turns vernier oscillator on or off (Paragraph 3-7).

(5) RANGE: Controls range of frequency. 5 ranges in standard instrument - 1000 Hz, 10 kHz, 100 kHz, 1000 kHz, 10 MHz (Paragraph 3-7).

(6) LINE: Power on/off control.

(7) LEVELING: Controls the amplitude stability. Short loop for < 10 Hz. Long loop for > 10 Hz (Paragraph 3-12).

(8) AMPLITUDE: Sets output amplitude from + 26.99 dBm to - 69.99 dBm (Paragraph 3-9).

(9) Output jack: 3320A = 1 V rms into 50 ohms. 0-13 dB continuous adjustment. 3320B = 5 V rms into 50 ohms. + 26.99 dBm = -69.99 dBm, 0.01 dB resolution.

(10) Rear output: Same output as front panel output jack. Must move cable connector to rear jack from front jack. (See Section VIII, Manual Backdating)

(11) LOW LEVEL OUTPUT: Comes through 30 dB pad from output amplifier. Amplitude follows electronic attenuator setting (9.99 dB).

(12) 20–33 MHz: Output from Mixer board. Indicates selected frequency out of Frequency Generating portion of Synthesizer (tracks front panel with 20 MHz offset).

(13) 1 MHz: Divided output of Reference Oscillator out of Reference Phase Lock board.

(14) Remote input connector for options 003, 004, and 007 (BCD and GPIB) (Paragraphs 3-14, 3-17).

(15) External Phase Lock: Input for Reference 5 MHz External Oven or External Phase Lock Signal.

(16) Ac power input: Includes input power assembly.

(17) Option 002 Reference Oscillator. 5 MHz crystal oscillator output and adjustments.

Figure 3-1. Controls, Indicators, and Connectors.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains information necessary for operation of the -hp- Model 3320A/B Frequency Synthesizer. Included are descriptions and identification of front and rear panel controls, indicators and connectors, operating instructions, and remote programming information.

3-3. CONTROLS, INDICATORS and CONNECTORS.

3-4. A brief description of each control, indicator and connector is given in Figure 3-1. Controls, indicators and connectors requiring additional information are referenced to descriptive paragraphs within this section.

3-5. FRONT PANEL OPERATION.

3-6. The following paragraphs contain information for setting frequency, amplitude and leveling. Also included is information on remote programming and input/output connectors.

3-7. Frequency.

3-8. The 3320A/B provides five digits of frequency resolution plus an overrange digit. The frequency is determined by the position of the RANGE control, the two Vernier controls (VERN IN/VERN OUT and vernier frequency), and the three FREQUENCY controls. The three FREQUENCY controls set the three most significant digits and the overrange digit. The RANGE control places the decimal point. The vernier controls allow the operator to adjust two additional digits of frequency from 00 to 99. When the vernier control is in the VERN OUT position, these additional digits are always 00. Table 3-1 shows the control settings for maximum output in each of the five range positions.

Table 3-1. Frequency Control Settings.

Range	Frequency Digits (MAX)	Vernier Digits (MAX)
Hz	1299.	99
kHz	12.99	99
kHz	129.9	99
kHz	1299.	99
MHz	12.99	99

3-9. Amplitude.

3-10. The 3320A output amplitude is adjusted by a 0–13 dB potentiometer. Maximum output voltage for the 3320A is 1 V rms into 50 ohms or 2 V rms open circuit.

3-11. The 3320B output amplitude is adjusted by four front panel AMPLITUDE controls. Output levels from +26.99 dBm to -69.99 dBm with a resolution of 0.01 dB are obtainable. Each amplitude control operates independently, allowing changes of 0.01 dB, 0.1 dB, 1 dB or 10 dB in the output level. Maximum output voltage is 5 V rms into 50 ohms or 10 V rms open circuit.

3-12. Leveling.

3-13. The 3320B frequency response is determined by the position of the LEVELING control. For frequencies below 10 Hz, the LEVELING control should be in the OFF position. This prevents the thermopile in the leveling loop from responding to the instantaneous value of the output sinewave. For frequencies above 10 Hz, the thermopile will respond only to the true rms value of the output frequency, therefore, the LEVELING control should be in the ON (> 10 Hz) position.

3-14. REMOTE BCD PROGRAMMING.

3-15. The 3320A Option 003 and 3320B Option 004 can be remotely programmed with an 8-4-2-1 BCD code. All functions of the 3320A can be programmed with the exception of amplitude, the last vernier digit, and the power switch. All functions of the 3320B can be programmed with the exception of the last vernier digit and the power switch. There is no internal storage capability, therefore, the program lines must be held until the program is changed. Figure 3-2 shows the BCD input connector and the signal inputs for each pin. Paragraphs 3-16 through 3-33 explain each input/output signal. Logic levels for the BCD input/outputs are as follows:

State	Requirements
L = LOW (logical "1")	0 V to 0.4 V (5 mA max.) or contact closure to ground through <80 ohms.
H = HIGH (logical "0")	+ 2.4 V to + 5 V or removal of contact closure to ground.

3-16. Remote Enable.

3-17. The signal input labeled REN controls the remote/local mode of operation (REN LOW = remote, REN HIGH = local). When the 3320A/B is programmed to the remote mode, the front panel controls have no effect.

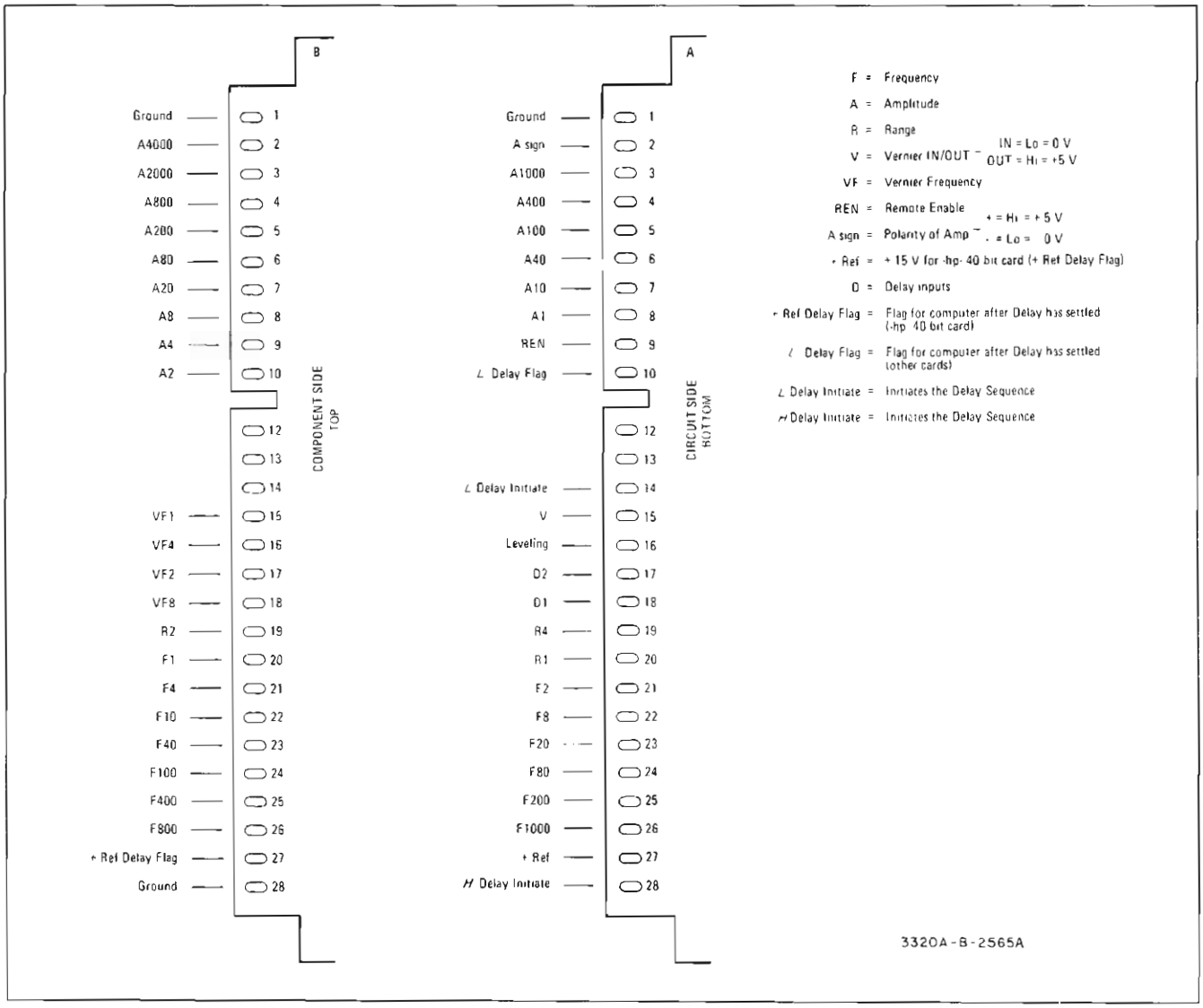


Figure 3-2. BCD Input Connector.

3-18. 3320B Amplitude.

3-19. The 16 signal inputs prefaced A control the four amplitude digits and the sign of the amplitude. The inputs representing each digit are as follows:

A1, A2, A4, A8 — least significant digit of amplitude

A10, A20, A40, A80 — second significant digit of amplitude

A100, A200, A400, A800 — third significant digit of amplitude

A1000, A2000, A4000 — most significant digit of amplitude

A sign — polarity of amplitude

Each digit is programmed by applying an 8-4-2-1 BCD code representing the digit desired. The three least significant digits can be selected from 0 to 9. The most significant digit can be selected from 0 to 7. The A sign input determines the polarity of the amplitude. For a + dBm the input level must be HIGH. For a - dBm the input level must be LOW.

CAUTION

When remote programming is used, the minimum output is -73.00 dBm (-75.00 dBm Option 001). If the 3320B is programmed for a lower level, the output voltage increases.

Example amplitude program:

desired amplitude = - 12.34 dBm

LSD	2 nd SD
A1 = H	A10 = L
A2 = H	A20 = L
A4 = L	A40 = H
A8 = H	A80 = H

3 rd SD	MSD and Sign
A100 = H	A1000 = L
A200 = L	A2000 = H
A400 = H	A4000 = H
A800 = H	A sign = L

3-20. Frequency.

3-21. The 13 signal inputs prefaced F control the three most significant frequency digits plus the overrange digit. The inputs representing each digit are as follows:

F1, F2, F4, F8 — least significant digit of frequency

F10, F20, F40, F80 — second significant digit of frequency

F100, F200, F400, F800 — most significant digit of frequency

F1000 — overrange digit

Each digit is programmed by applying an 8-4-2-1 BCD code representing the digit desired. All frequency digits can be selected from 0 to 9. The overrange digit can be either a 0 or a 1. **NOTE:** *Although the maximum frequency of the 3320A/B is specified as 12.99 MHz, it is possible to program a higher frequency. However, the response is not specified and will deteriorate.*

Example frequency Program:

desired frequency = 12.34 MHz *

LSD	2 nd SD
F1 = H	F10 = L
F2 = H	F20 = L
F4 = L	F40 = H
F8 = H	F80 = H

3 rd MSD	Overrange
F100 = H	F1000 = L
F200 = L	
F400 = H	
F800 = H	

* MHz RANGE programmed (See Paragraph 3-24).

3-22. Vernier.

3-23. The signal input prefaced V and the four signal inputs prefaced VF control the vernier in/out and the vernier frequency. Programming conditions for vernier in/out are HIGH = out and LOW = in. Only the first vernier digit can be remotely programmed. Programming is accomplished by applying an 8-4-2-1 BCD code representing the digit desired.

3-24. Range.

3-25. The three signal inputs prefaced R control the position of the range switch. Each position is designated by a number. There are five range positions available (seven in the 3320A/B Option 006). Programming is accomplished by applying a 4-2-1 BCD code representing the number for the range position desired. The following list identifies the range position by number and respective range:

0 = 10 Hz
1 = 100 Hz } Option 006
2 = 1000 Hz
3 = 10 kHz
4 = 100 kHz
5 = 1000 kHz
6 = 10 MHz

3-26. Leveling.

3-27. The signal input labeled Leveling controls the leveling mode of operation (leveling HIGH = ON (> 10 Hz), leveling LOW = OFF). The programmed frequency (or group of frequencies) must be considered when selecting the leveling mode. If a frequency of 10 Hz or less is programmed, the leveling should be programmed OFF. This will eliminate any distortion of the 3320B output caused by the leveling loop (see Paragraph 3-12). If a frequency greater than 10 Hz is programmed, the leveling should be programmed ON (> 10 Hz).

3-28. Delay and Response.

3-29. The two signal inputs prefaced D and the signal input/outputs labeled Delay Flag, L Delay Initiate, H Delay Initiate, + Ref. and + Ref. Delay Flag control the delay and response time of the 3320A/B.

3-30. The delay is simply an internal clock which counts for the time interval programmed by the D1 and D2 inputs. During the count sequence, the clock outputs a flag to the

external controller. This flag can be monitored to determine the accuracy which the 3320A/B frequency and the 3320B amplitude has settled. Table 3-2 lists the delay codes, the clock time interval and the tolerances to which the frequency and amplitude have settled. Figure 3-3 shows the timing sequence of the delay.

3-31. The delay sequence is started by programming a Delay Initiate (data strobe). Two Delay Initiate inputs are available. If the strobe output from the external controller is HIGH true, the H Delay Initiate input must be used. If the strobe output from the controller is LOW true, the L Delay Initiate input must be used.

NOTE

The H Delay Iniate input is not TTL compatible. It may require a minimum of +4 V applied to this input to initiate the delay sequence.

3-32. There are also two delay flag (Holdoff Flag) outputs available. The L Delay Flag output is standard LOW true TTL logic. When it is necessary to have a HIGH true delay flag, the positive reference voltage from the external controller (such as the -hp- 12556A 40 bit BCD Interface Card) can be applied to the + Ref. input. The + Ref. Delay Flag will be held at the + Ref. potential while the delay sequence is in progress. When the delay sequence is completed, the + Ref. Delay Flag will go LOW.

3-33. When the 3320B is programmed for a low frequency (below 1000 Hz) and the leveling is ON (> 10 Hz), the output can become distorted due to the response of the 3320B amplitude section. This response can be slowed to eliminate the distortion. This is accomplished by programming a delay code of 3. With all other delay codes, the response is in the fast mode. When the 3320B is in the local mode, the response is always in the slow mode.

NOTE

When going from local to remote, the response is automatically set to the fast mode (delay code 0) Therefore, if low frequencies are programmed, the response should be set to the slow mode (delay code 3).

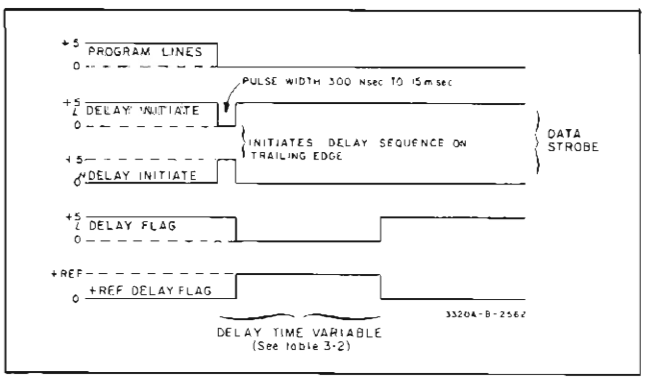


Figure 3-3. BCD Timing Sequence.

Table 3-2. Amplitude and Frequency Settling Times.

Delay Code	Time Interval	% of Range Frequency Tolerance	Amplitude Tolerance
0	15 ms	.01	– –
1	60 ms	.001	– –
2	300 ms	– –	1 %
* 3	1500 ms	– –	within rated accuracy

* Response in slow mode (See Paragraph 3-33).

3-34. REMOTE GPIB PROGRAMMING.

3-35. The GPIB (General Purpose Interface Bus) remote control option permits the Model 3320B to operate on a single data/control bus with several other instruments. A typical GPIB bus system is shown in Figure 4-8. Each bus contains eight data lines and seven control lines. The ASCII (American Standard Code for Information Interchange) code format is used to transfer data on the eight data lines.

3-36. A total of 15 instruments may be connected in parallel to the bus. Each instrument on the bus is assigned an address (or addresses) so that it can be selected individually by an external controller. This enables the external controller to determine which instruments will be communicating on the bus at any given time. An instrument will have a listen address if it can receive data, a talk address if it can transmit data, or both a listen and a talk address if it can both receive and transmit data. For example, the 3320B GPIB option has only a listen address, which allows the controlling instrument to instruct the 3320B to receive programming information as outlined in the following paragraphs.

Table 3-3. Addressing Codes.

Address	40	20	10	4	2	1
40	1	0	0	0	0	0
41	1	0	0	0	0	1
42	1	0	0	0	1	0
43	1	0	0	0	1	1
44	1	0	0	1	0	0
45	1	0	0	1	0	1
46	1	0	0	1	1	0
47	1	0	0	1	1	1
50	1	0	1	0	0	0
51	1	0	1	0	0	1
52	1	0	1	0	1	0
53	1	0	1	0	1	1
54	1	0	1	1	0	0
55	1	0	1	1	0	1
56	1	0	1	1	1	0
57	1	0	1	1	1	1
60	1	1	0	0	0	0
61	1	1	0	0	0	1
62	1	1	0	0	1	0
63	1	1	0	0	1	1
64	1	1	0	1	0	0
65	1	1	0	1	0	1
66	1	1	0	1	1	0
67	1	1	0	1	1	1
70	1	1	1	0	0	0
71	1	1	1	0	0	1
72	1	1	1	0	1	0
73	1	1	1	0	1	1
74	1	1	1	1	0	0
75	1	1	1	1	0	1
76	1	1	1	1	1	0

3-37. The listen address for the 3320B is normally the ASCII character 3, octal code 063, but may be changed by means of internal jumper wires on the GPIB Input Assembly (A37). Instructions for changing the address are given in Note 2, Figure 7-14. Table 3-3 lists the different addresses which can be assigned.

3-38. A principal advantage of the GPIB bus system is that all information is routed over the same 15 lines. For this reason standard cables are used to connect each instrument to the bus. Section II lists the GPIB bus cables available.

3-39. For convenience and brevity, each GPIB bus signal line is identified by a mnemonic, which is an abbreviation of the signal name. Table 3-4 lists the seven control lines and eight data lines used on the GPIB bus.

Table 3-4. GPIB Bus Signal Mnemonics.

Mnemonic	Signal Name
DAC	Data Accepted
DAV	Data Valid
MRE	Multiple Response Enable
REN	Remote Enable
RFD	Ready For Data
SRQ	Service Request
EOP	End Output
DI01	
DI02	
DI03	
DI04	Data Input/Output
DI05	bits 1 through 8.
DI06	
DI07	
DI08	

3-40. An H preceding a mnemonic indicates that the signal is HIGH true, L indicates LOW is true. For example, L DAV indicates that a LOW true signal is required for a data Valid signal. All GPIB lines are LOW true except H RFD and H DAC, which are HIGH true. Table 1-2 lists the signal levels required.

NOTE

In the 3320B the Data Input/Output bit 8 (DI08) and Service Request (SRQ) are not used (no connections).

3-41. All 3320B front panel functions are programmable with the exception of the last vernier digit and the line. Table 3-5 lists each of the functions and the octal codes, the ASCII character for each code, and the seven bit binary code for each octal code. The binary code is applied to the seven Data Input lines on the remote input/output connector. Figure 3-4 shows the remote connector pin numbers and the input/output signals for each pin.

Table 3-5. ASCII Programming Codes.

Character	Octal	Binary	
?	077	0111111	*Address clear
A	101	1000001	Amplitude preface
C	103	1000011	Command (initiates delay)
D	104	1000100	Delay code preface
F	106	1000110	Frequency preface
K	113	1001011	Vernier "IN"
M	115	1001101	Vernier "OUT"
R	122	1010010	Range preface
V	126	1010110	Vernier preface
+	053	0101011	Polarity of amplitude
-	055	0101101	Polarity of amplitude
0	060	0110000	Digits for address*; amplitude, frequency, vernier, etc.
1	061	0110001	
2	062	0110010	
3	063	0110011	
4	064	0110100	
5	065	0110101	
6	066	0110110	
7	067	0110111	
8	070	0111000	
9	071	0111001	
	054	0101100	Function execute
I	111	1001001	Local enable

*Address and clear must be accompanied by an MRE. On the 3260A Card Reader, MRE = 200 (address = 267, clear = 277).

Range Codes

Character	Range	
0	10 Hz	optional (A6 assembly)
1	100 Hz	
2	1000 Hz	
3	10 kHz	
4	100 kHz	
5	1000 kHz	
6	10 MHz	

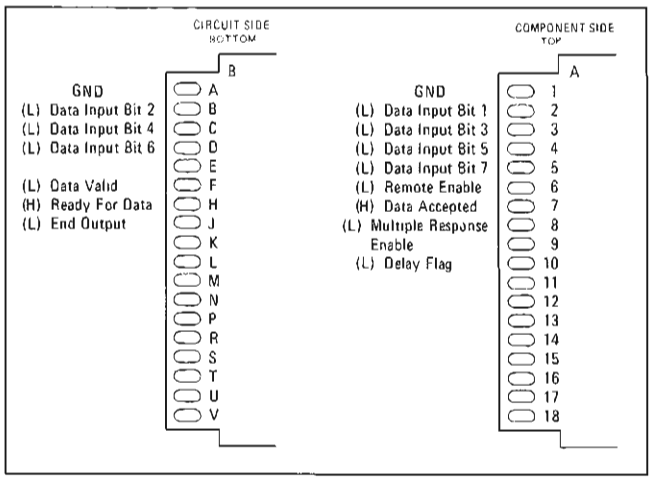


Figure 3-4. GPIB Input Connector.

3-42. The first step in GPIB programming is to address the 3320B. Addressing is accomplished by applying the address code to the data line, setting the MRE (Multiple Response Enable) LOW, and setting DAV (Data Valid) LOW. An example program is listed in Table 3-6. The 3320B does not

have to be in the remote mode to be addressed. Conversely, it must be addressed before it can be put into the remote mode.

NOTE

When power is initially applied the 3320B may or may not be addressed. This is why the "Address Clear" command (ASCII ?) is recommended prior to addressing any instrument(s) on the GPIB Bus.

3-43. To put the 3320B into the remote mode (after it has been addressed) set the REN (Remote Enable) LOW, MRE HIGH, apply the Function Execute code (ASCII comma) to the data lines, and set DAV LOW. The REN can be set LOW at any time prior to the Function Execute (ie., while addressing) but the 3320B will not go into the remote mode until the Function Execute and L DAV is applied. The Function Execute can be applied during the function programming sequence (See Notes, Table 3-6).

Table 3-6. GPIB Programming.

Example: 5.0 kHz frequency Vernier Out, - 5.00 dBm Amplitude 60 ms delay.

Instruction	State or Octal Code	Binary Codes DI07	DI06	DI05	DI04	DI03	DI02	DI01
		100	40	20	10	4	2	1
MRE	LOW							
Clear	077*	0	1	1	1	1	1	1
Address	063	0	1	1	0	0	1	1
REN	LOW							
MRE	HIGH							
R	122	1	0	1	0	0	1	0
4	064	0	1	1	0	1	0	0
,	054	0	1	0	1	1	0	0
F**	106	1	0	0	0	1	1	0
5	065	0	1	1	0	1	0	1
0	060	0	1	1	0	0	0	0
,	054	0	1	0	1	1	0	0
m	115	1	0	0	1	1	0	1
A	101	1	0	0	0	0	0	1
-	055	0	1	0	1	1	0	1
5	065	0	1	1	0	1	0	1
0	060	0	1	1	0	0	0	0
0	060	0	1	1	0	0	0	0
,	054	0	1	0	1	1	0	0
D	104	1	0	0	0	1	0	0
1	061	0	1	1	0	0	0	1
,	054	0	1	0	1	1	0	0
C	103	1	0	0	0	0	1	1

*Each code applied to the data lines must be followed by a DAV LOW.

**Instrument goes to remote mode at this time.

3-44. When power is initially applied, the 3320B may go to the remote mode for a few seconds, then to the local mode even if REN is held LOW. It will remain in the local mode until the address and a Function Execute is programmed.

3-45. When programmed to the remote mode, the condition of the 3320B output depends on the position of a jumper wire on the A38 assembly (See Figure 7-14). If there is a jumper wire between points A and B on the A38 assembly, the 3320B will go to the conditions listed below:

FREQUENCY ..... 800 Hz
RANGE ..... 1000 Hz
AMPLITUDE ..... - 69.00 dBm
VERNIER ..... OUT/0 Hz
DELAY ..... 1500 ms
LEVELING ..... ON(> 10 Hz)

If there is no jumper between points A and B on the A38 assembly, the 3320B will go to the previously remote programmed conditions when programmed to the remote mode. The 3320B leaves the factory with no jumper.

3-46. The second step in GPIB programming is the function programming. This is accomplished by applying the ASCII code, representing the information desired, to the seven data lines and strobing the information into the 3320B. The LDAV is the strobe pulse. Each seven bit code applied to the data lines must be accompanied by an LDAV. The programming information for each 3320B function is applied in two parts, the preface command representing the function (ie., V for Vernier) and the desired digits for that function (ie., 99 for a Vernier setting of 99). After each preface command and the digits have been strobed into the 3320B, they must be followed by a Function Execute.

3-47. If all functions have been programmed and it is desired to reprogram a specific function, it is only necessary to reprogram that function. When frequency or amplitude is programmed the instrument assumes the leading zeros. Loading sequence of the digits programmed are from right to left. If an amplitude polarity is not programmed, the instrument assumes a + polarity. Figure 3-5 shows an example program using a marked card for the 3260A Marked Card Programmer. The 3260A does not handshake. The strobe marks on the right edge of the card represent the DAV. The 200 bit on the card represents the MRE.

3-48. Handshake.

3-49. The Data Valid (DAV), Ready for Data (RFD), and Data Accepted (DAC) signals form a "handshake" sequence, controlling the timing for data transfer on the Data lines. When an address code or a programming instruction is applied to the seven data lines, the external controller must set the DAV LOW. This indicates to the 3320B that data is available on the data lines. If the 3320B is not processing previous data, the RFD will be HIGH and the DAC will be LOW. Approximately three microseconds after the DAV is set LOW by the external controller, the 3320B will set DAC HIGH and RFD LOW. The DAC indicates to the controller that the 3320B has accepted the data and is processing it. The RFD signal indicates to the external controller that the 3320B is not ready for more data. When the 3320B has set

RFD LOW and DAC HIGH, the external controller can remove the DAV and the data from the data lines and replace it with new data. The cycle repeats until all programming is completed. Figure 3-6 shows the timing relationship between the DAV, RFD, and DAC signals.

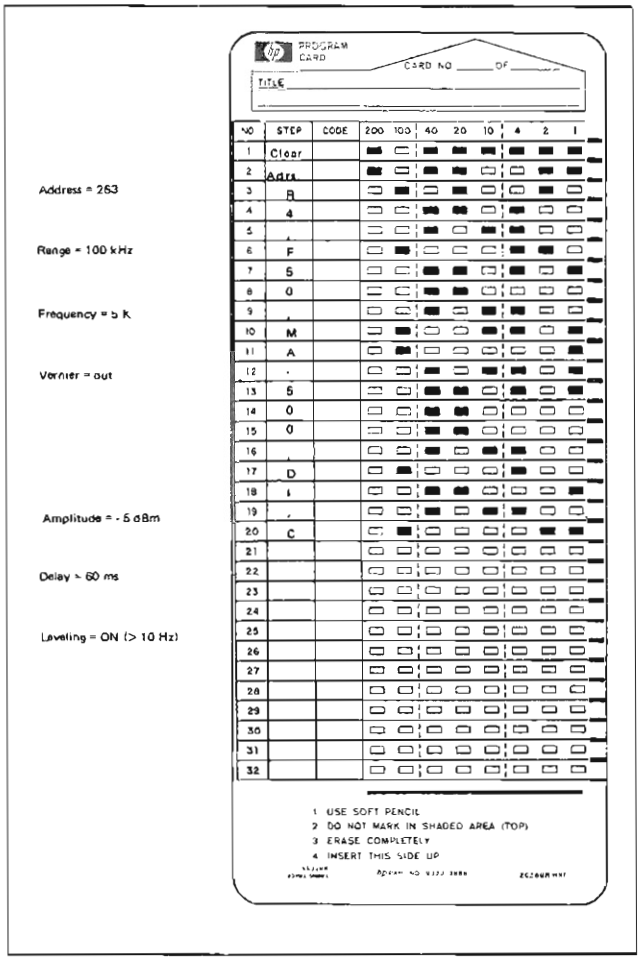


Figure 3-5. Programming Example.

3-50. It is not necessary for the external controller to monitor the RFD or DAC signals. However, if these signals are not monitored, the external controller must wait approximately three microseconds before removing the LDAV and the data from the data lines and applying new data, and approximately two microseconds before setting DAV LOW again. This ensures the 3320B has had time to accept and process the previous data.

3-51. The RFD line is also controlled by the delay programmed (See Paragraph 3-52). As soon as a Delay Initiate code (Octal code 103) is programmed, the RFD will remain LOW for the length of time programmed by the delay. If the RFD signal is monitored, the user can be sure the 3320B amplitude and frequency has settled to the desired tolerance when the RFD goes HIGH.

3-52. Delay Flag.

3-53. The delay is generated by an internal clock which counts for the time internal programmed on the data lines. At the end of the count sequence, the clock outputs a flag to the external controller (delay flag or RFD). This flag can be monitored to determine the accuracy which the 3320B frequency and amplitude has settled. Table 3-7 lists the delay codes, the clock time interval, and the tolerances which the frequency and amplitude have settled. The programmed delay code must be followed by a Delay Initiate (ASCII character C). This code initiates the delay sequence. The Delay Initiate code does not have to be followed by a Function Execute code.

Example: To program a delay of 60 ms,

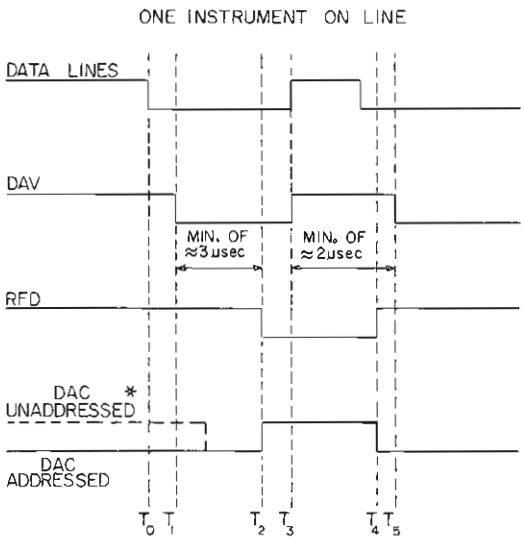
ASCII Programming Characters	D - delay preface 1 - delay code (60 ms) , - Function Execute C - Delay Initiate

Table 3-7. Settling Times.

Remote Control		3320 Operation			
Frequency of Operation	Delay Code	Leveling Mode	Settling Time	Frequency Tolerance (% of Range)	Amplitude Tolerance
⩾1000 Hz	0	On	15 ms	.01	-
	1	On	60 ms	.001	-
	2	On	300 ms		1%
10 Hz ⩽ f ⩽1000 Hz	3*	On	1500 ms		**
⩽10 Hz	4	Off	15 ms	.01	-
	5	Off	60 ms	.001	-
	6	Off	300 ms		1%
	7	Off	1500 ms		**

* Use delay code 3 to eliminate distortion caused by low frequency and leveling on.

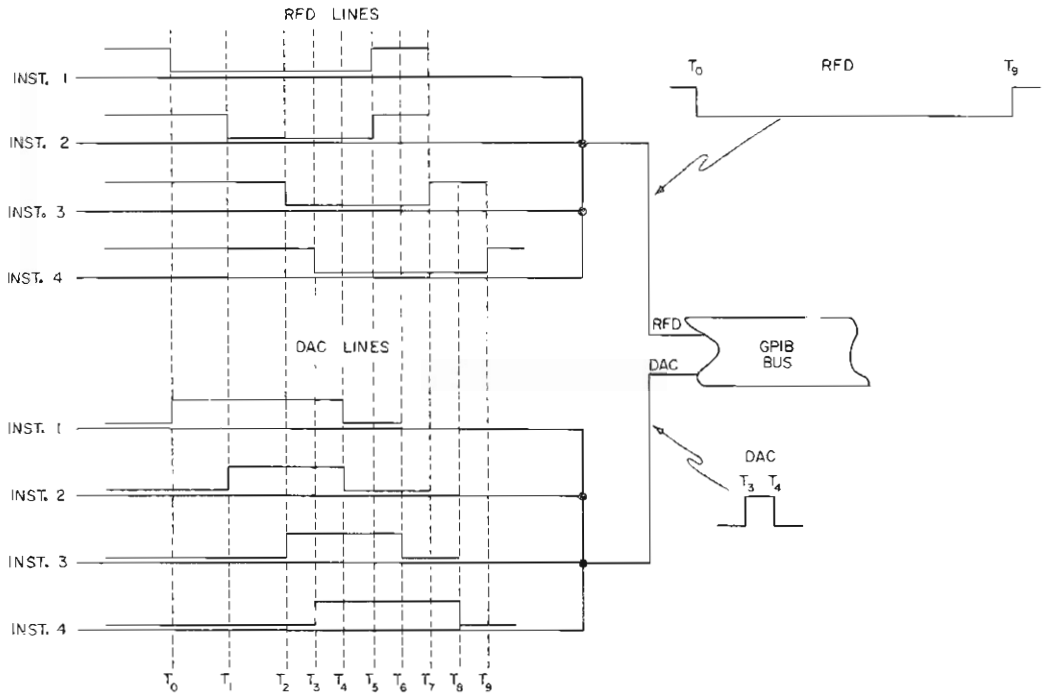
** Denotes amplitude within rated accuracy.



* DAC goes LOW when instrument is addressed.

T_2 - T_3 = Determined by how fast controller sets DAV HIGH.

T_2 - T_4 = Determined by delay if programmed.



T_0 = Fastest instrument is ready for data.

T_3 = Slowest instrument has accepted data and the data can be removed.

T_4 = Fastest instrument has accepted data.

T_9 = Slowest instrument has processed data and new data can be programmed.

All lines wire or'ed means a low on line. 1 or 2 or 3 or 4 will hold output low.

Figure 3-6. Handshake Timing Diagram.

3-54. When the 3320B is programmed for a low frequency (below 1000 Hz) and the leveling is ON (> 10 Hz), the output can become distorted due to the response time of the amplitude section. The response can be slowed to eliminate this distortion by programming a delay code of 3. With all other delay codes the response is in the fast mode.

3-55. The delay code programmed also controls the leveling mode of operation (Delay Codes 0–3, LEVELING ON (> 10 Hz), Delay Code 4–7, LEVELING OFF). The programmed frequency (or group of frequencies) must be considered when selecting the leveling mode. If a frequency of 10 Hz or less is programmed, the leveling should be programmed OFF. This will eliminate any distortion of the 3320B output caused by the leveling loop (See Paragraph 3-12). If a frequency greater than 10 Hz is programmed, the leveling should be programmed ON (> 10 Hz).

3-56. End Output.

3-57. The End Output (EOP) signal allows the external controller to terminate all activity on the GPIB bus lines. When this line is set low by the controller, the 3320B and all other instruments paralleled to the bus lines, will set all data lines, MRE, DAV, RFD, and DAC HIGH.

3-58. REFERENCE CRYSTAL OVEN.

3-59. The 3320A/B Option 002 is a standard instrument with an oven controlled, 5 MHz, reference crystal oscillator. The signal from the 5 MHz oscillator is applied to the reference phase lock assembly to phase lock the 20 MHz VCXO. The result is an increase in 3320A/B output frequency accuracy and stability (See Table 1-2). An Option 002 Field Installation Kit is obtainable by ordering Accessory Kit 11237A.

3-60. For operation, connect a short jumper cable between the 5 MHz OUT and EXT FREQ REF (both on rear panel). A circuit diagram for the Option 002 is shown in Figure 3-7.

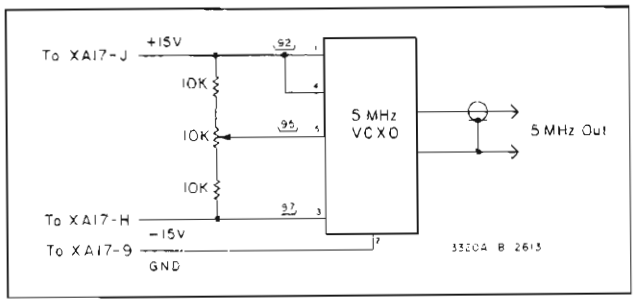


Figure 3-7. Option 002 Circuit Diagram.

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains the theory of operation for the 3320A/B. Included is a general description, a simplified block description, a functional block description, and basic circuit theory on unique circuits.

4-3. GENERAL DESCRIPTION.

4-4. The -hp- Model 3320A/B Frequency Synthesizer provides a wide range of accurate and stable frequencies with variable amplitude settings. The frequency range is from 0.001 Hz to 12.9999 MHz. Five digits of frequency resolution plus an overrange is provided in five ranges. The 3320A amplitude is variable from 0 dBm to 13 dBm into 50 ohms by a front panel potentiometer. The 3320B amplitude is variable from +26.99 dBm to -69.99 dBm into 50 ohms in steps of 0.01 dB, 0.1 dB, 1 dB or 10 dB.

4-5. Options available which increase the flexibility of the 3320A/B are as follows:

OPTION	DESCRIPTION
001	75 ohm output
002	A high stability reference oscillator. (Increases frequency stability and accuracy.)
003,004	BCD remote programming.
006	Two extra ranges (100 Hz and 10 Hz) to increase the low frequency resolution to 0.00001 Hz.
007	GPIB remote programming.

The discussion on theory in this section will include these options where applicable.

4-6. SIMPLIFIED BLOCK DIAGRAM.

4-7. Introduction.

4-8. The 3320A/B can be divided into four basic sections: controller, frequency, amplitude, and reference (see Figure 4-1). The signal out of the 3320A/B is developed in the frequency section and applied to the amplitude section where it is translated down in frequency and the level is determined. Both frequency and amplitude are referenced to a crystal oscillator in the reference section. In the 3320B, both frequency and amplitude are controlled by BCD signals from the controller section. In the 3320A, the frequency only is controlled by BCD signals from the controller. The amplitude of the 3320A is controlled by a 0–13 dBm front panel potentiometer. The BCD signals from the controller are, in turn, controlled by front panel switch settings or GPIB remote programming.

4-9. Controller Section.

4-10. The controller section of the 3320A/B processes information from the front panel controls or the remote inputs into BCD codes for controlling the frequency in the 3320A/B and amplitude in the 3320B. As shown in the Controller Configuration diagram (Figure 7-6), the complexity of the controller section varies with the 3320 Model and Options. Refer to Paragraph 4-19 for a detailed block discussion of each controller type.

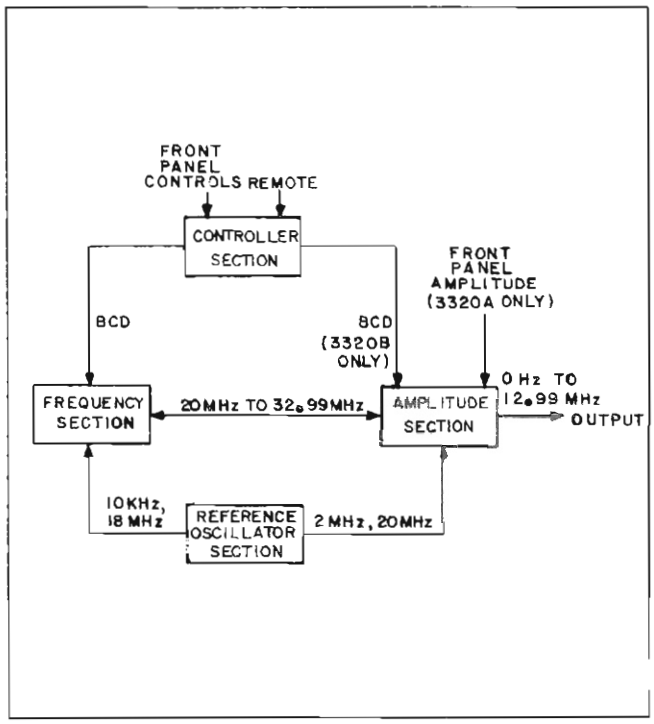


Figure 4-1. Simplified 3320A/B Block Diagram.

Table 4-1. 3320A/B Ranges.

Range Position	Range Dividers Used	Frequency Applied to Amplitude Section
10 MHz	0	20 MHz to 32.99 MHz
1000 kHz	1	20 MHz to 21.299 MHz
100 kHz	2	20 MHz to 20.1299 MHz
10 kHz	3	20 MHz to 20.01299 MHz
1000 Hz	4	20 MHz to 20.001299 MHz
100 Hz } Option	5	20 MHz to 20.0001299 MHz
10 Hz } 006 only	6	20 MHz to 20.00001299 MHz

4-11. Frequency Section.

4-12. The 3320A/B signal is developed in the frequency section by an indirect synthesis technique. This method uses a voltage tuned oscillator (VTO) phase-locked to a standard reference oscillator (see Figure 4-2). The VTO frequency then becomes as stable and accurate as the reference oscillator. The output of the VTO (20 MHz to 32.99 MHz) is applied to a range switch. If the range switch is in the MHz position, the VTO output is applied directly to the amplitude section. If the range switch is in any position other than the MHz position, the output of the VTO is applied to a series of range dividers. Table 4-1 lists the range positions, the number of range dividers used on each range switch position, and the output frequencies of each range divider. Each range divider uses a divide and mix technique to increase the resolution while decreasing the maximum output frequency of the 3320A/B.

4-13. Amplitude Section.

4-14. The 3320A amplitude and the three least significant digits of the 3320B amplitude are controlled by amplitude modulating a 20 MHz signal from the reference oscillator. this signal is mixed with the signal from the frequency section. The 3320B also has a 10 dB/step attenuator at the output for 90 dB of level control.

4-15. Reference Section.

4-16. There are two frequency references in the 3320A/B; the 20 MHz Reference Oscillator and the Vernier Oscillator (see Figure 4-3). When the VERN IN/OUT control is in the VERN IN position, the Vernier Oscillator is the source for the VTO and phase-lock circuitry. The 20 MHz Reference Oscillator is the source for the range dividers and the 3320A/B amplitude section. This allows the operator to adjust the last two digits of the 3320A/B output frequency by adjusting the frequency of the Vernier Oscillator. When the VERN IN/OUT control is in the VERN OUT position, the 20 MHz Reference Oscillator is the source for all 3320A/B circuits.

4-17. FUNCTIONAL BLOCK DESCRIPTION.

4-18. The functional block description is broken into four parts: frequency section, amplitude section, controller section, and reference section. For illustration assistance, refer to the Functional Block Diagrams (Figures 7-5 and 7-7), the Controller Configuration (Figure 7-6), and the schematics in Section VII.

4-19. Controller Section.

4-20. The following is a functional block description of the various controller sections used in the 3320A/B synthesizers. The controller processes information from the front panel or remote input, into a BCD format for controlling the frequency and amplitude sections as shown in Figure 4-1. The complexity of the controller section increases from front panel control only, as in the 3320A standard, to

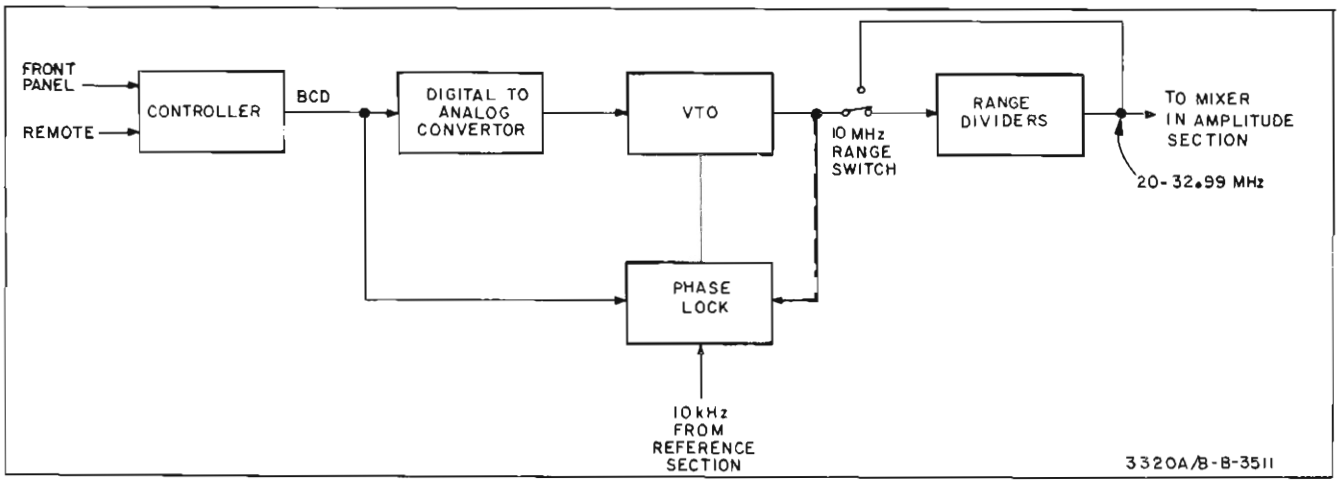


Figure 4-2. Frequency Generation.

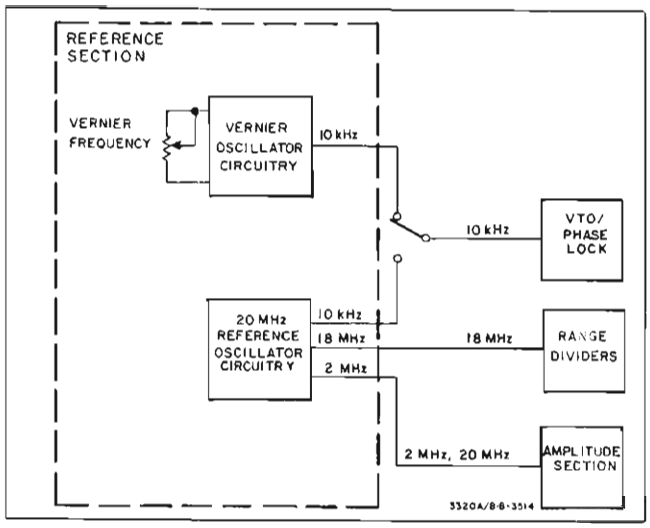


Figure 4-3. Reference Sources.

GPIB control, as in the 3320B Option 007. The various 3320A/B controller sections are shown in the controller Configuration diagram, Figure 7-6. Each controller is discussed in the following paragraphs.

4-21. 3320A Standard Controller. The controller for the standard Model 3320A is shown in Figure 4-4. The BCD codes representing the front panel frequency, range, leveling and vernier in/out settings are converted in the A20 assembly and applied to the frequency section. The amplitude setting is controlled manually by the amplitude potentiometer on the front panel.

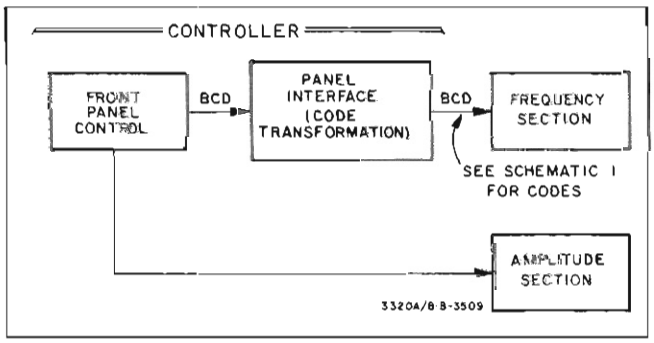


Figure 4-4. 3320A Standard Controller.

4-22. 3320B Standard Controller. The controller for the standard Model 3320B consists of the front panel and the panel interface assembly as shown in Figure 4-5. The BCD data representing the front panel frequency setting is converted in the panel interface block and applied to the frequency sections. The BCD data representing the front panel amplitude setting is added to a preset BCD number in the panel interface assembly. This addition provides the proper BCD code for controlling the amplitude section. Since the 3320B output is calibrated in dBm, the magnitude of the preset BCD number depends on the output impedance of the 3320B.

4-23. 3320A BCD Option 003. The 3320A Option 003 controller is shown in Figure 4-6. Option 003 can be controlled from the front panel or remotely with parallel BCD lines as outlined in Section III of this manual. In local control (front panel) the BCD code representing the frequency, range, and vernier in/out setting are converted in the BCD control circuits. The converted BCD code from the BCD control circuits is applied to the frequency section through the A22 Cable Board. In remote control mode the BCD information from the remote lines is converted in the BCD control circuits and applied to the frequency section. The Delay Flag shown in Figure 4-6 remains low for the amount of delay time programmed per Section III. The amplitude setting for Model 3320A Option 003 is controlled manually by the front panel potentiometer.

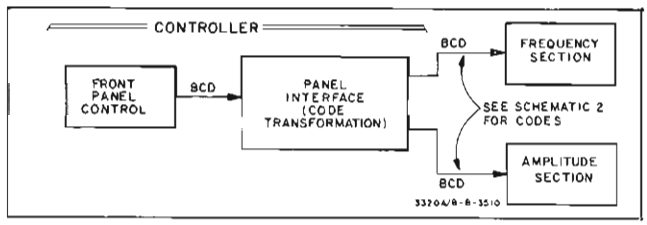


Figure 4-5. 3320B Standard Controller.

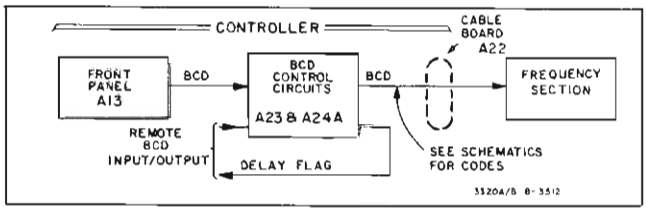


Figure 4-6. 3320A BCD Controller.

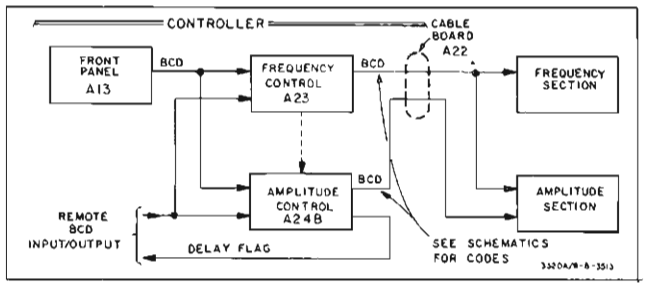


Figure 4-7. 3320B BCD Controller.

4-24. 3320B BCD Option 004. The 3320B Option 004 controller is shown in Figure 4-7. Option 004 can be controlled from the front panel or remotely with parallel BCD lines as outlined in Section III of this manual. In local control the BCD data from the front panel is processed by A23 and A24B assemblies as shown in Figure 4-7. In remote control mode the BCD data from the remote input lines is processed by A23 and A24B.

4-25. The frequency control block (A23) converts the BCD codes representing frequency, range, leveling, and vernier in/out settings into appropriate BCD codes for controlling the frequency and amplitude leveling. The BCD data representing the amplitude setting is added to a preset BCD number in the amplitude control block (A24). This

addition provides the proper BCD code for controlling the amplitude sections. Since the 3320B output is calibrated in dBm, the magnitude of the preset BCD number depends on the output impedance of the 3320B. The delay flag shown in Figure 4-7 remains low for the amount of delay time programmed. Although the delay flag(s) comes from the A24B assembly, the actual timing is performed by the A23 assembly as indicated by the dotted line in Figure 4-7.

4-26. 3320B GPIB Option 007. The GPIB (General Purpose Interface Bus) remote control option permits the Model 3320B to operate on a single data/control bus with several other instruments. A typical GPIB bus system is shown in Figure 4-8. A total of 15 instruments may be connected in parallel to the bus. Each instrument on the bus is assigned an address (or addresses) so that it can be selected individually by an external controller. This enables the external controller to determine which instruments will be communicating on the bus at any given time. An instrument will have a listen address if it can receive data, a talk address if it can transmit data, or both a listen and a talk address if it can both receive and transmit data. For example, the 3320B GPIB option has only a listen address, which allows the controlling instrument to instruct the 3320B to receive programming information as outlined in Paragraph 3-34. The listen address for the 3320B is normally the ASCII character 3, octal code 063, but may be changed as outlined in Section III. The 3320B GPIB option is directly compatible with the -hp- 9800 series calculators. The -hp- 3260A Marked Card Programmer may also be used as the remote controller.

4-27. GPIB Bus Connections. A principal advantage of the GPIB bus system is that all information is routed over the same 15 lines. For this reason standard cables (which may be various lengths) are used to connect each instrument to the bus. The cable contains eight data lines and seven control lines. Section III of this manual describes the function of each GPIB bus line. Section II lists the GPIB bus cables available.

4-28. For convenience and brevity, each GPIB bus signal line is identified by a mnemonic, which is an abbreviation of the signal name. Table 4-2 lists the seven control lines and eight data lines used on the GPIB bus.

Table 4-2. GPIB Bus Signal Mnemonics.

Mnemonic	Signal Name
DAC	Data Accepted
DAV	Data Valid
MRE	Multiple Response Enable
REN	Remote Enable
RFD	Ready For Data
SRQ	Service Request
EOP	End Output
DIO1	Data Input/Output bits 1 through 8.
DIO2	
DIO3	
DIO4	
DIO5	
DIO6	
DIO7	
DIO8	

4-29. An H preceding a mnemonic indicates that the signal is HIGH true, L indicates LOW is true. For example, L DAV indicates that a LOW true signal is required for a data Valid signal. All GPIB lines are LOW true except H RFD

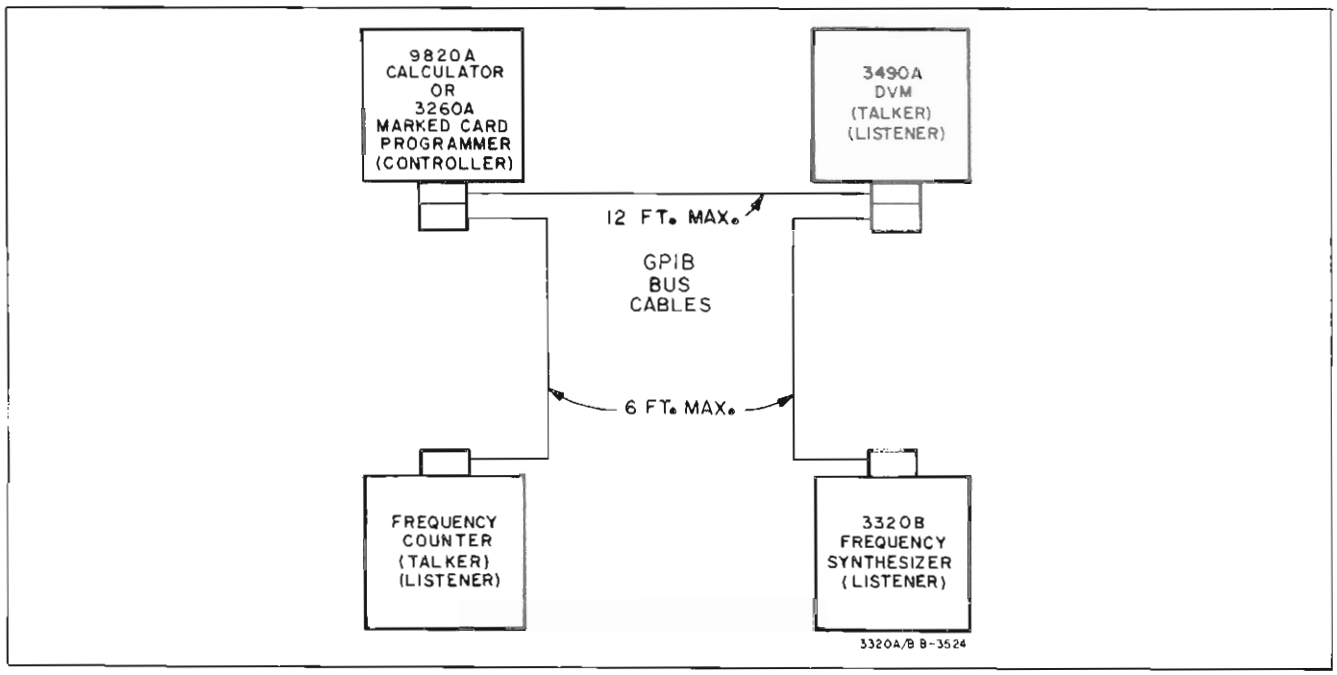


Figure 4-8. Typical GPIB Bus System.

and H DAC, which are HIGH true. Table 1-2 lists the signal levels required.

NOTE

In the 3320B the Data Input/Output bit 8 (DIO8) and Service Request (SRQ) are not used (no connections).

4-30. GPIB Basic Theory and Operation. The 3320B GPIB circuits employ both combinational and sequential logic to convert the ASCII data input into parallel BCD data for controlling the various settings of frequency and amplitude. A black diagram of the GPIB circuits is shown in Figure 4-9.

4-31. By means of the GPIB control lines, each appropriate ASCII character on the data lines is accepted by the Input Circuit. As each data character is accepted, a Data Accepted Signal (H DAC) is supplied back to the remote controller to indicate that the data has been accepted. After a data character has been processed, RFD is allowed to go HIGH, indicating to the remote controller that the 3320B is ready for new data.

4-32. To provide isolation, each ASCII character and various control data is transferred to the controller block by means of pulse transformers or photo-couplers. The controller decodes the ASCII character into a "Preface Command" or "Numerical Data". For example, if the ASCII characters A, 1, 2, 3 and 4 were accepted by the Input Circuit in sequence, the first character A would be decoded in the controller and applied to the Latches (storage registers) as an Amplitude Preface Command. The next four ASCII characters, being numerals, would be decoded as numerical data and applied to the Latches prefaced by the earlier Amplitude Preface Command.

4-33. The Latches and associated circuits function primarily as a series to parallel converter. It converts the preface commands and the serial numerical data from the controller into stored parallel BCD data.

4-34. The main function of the BCD Circuits is to process the BCD format used for controlling the frequency and amplitude sections.

4-35. The BCD data for the frequency setting is converted to 9's complement and applied directly to the frequency section of the 3320B. The 9's complement of a number is a number which, when added to the first number, equals nine. For example, the 9's complement of a BCD 2 is a BCD 7 since 2 + 7 = 9. The BCD data for the amplitude settings is added to a preset BCD number in the BCD Circuits. This BCD addition provides the proper BCD numbers for controlling the amplitude reference and 10 dB/step attenuator in the amplitude section of the 3320B. Since the 3320B output is calibrated in dBm, the magnitude of the preset BCD number depends on the output impedance of the 3320B.

4-36. In addition to processing the amplitude and frequency data, the BCD circuit also processes the remaining programmable parameters such as vernier frequency, leveling and delay. The delay flag shown in Figure 4-9 holds the GPIB RFD LOW for the amount of delay time programmed.

NOTE

A more detailed functional block diagram of all the assemblies (A37, A38, A25, A23 and A24B) used in the GPIB controller is shown in Figure 7-5.

4-37. Reset Conditions. When power is first applied to the 3320B, Reset and Clear signals from the controller block reset the latches to the turn on conditions given in Section III. However, the Reset signal also clears the Remote Flip–Flop, forcing the 3320B into local (front panel) control. Local control is automatic when power is initially applied even if the REN is held LOW.

4-38. Addressing the 3320B. When the MRE is LOW, the Input Circuit waits for the DAV to go LOW indicating that the data information is valid. When L DAV is received, the information on the data lines, LDIO1 through LDIO7, are compared to the 3320B address. If they match, the 3320B is addressed and the DAC signal is allowed to go HIGH to indicate that the address has been accepted.

NOTE

When power is initially applied the 3320B may or may not be addressed. This is why the "Address Clear" command (ASCII ?) is recommended prior to addressing any instrument(s) on the GPIB Bus.

4-39. Remote Programming. After the 3320B has been

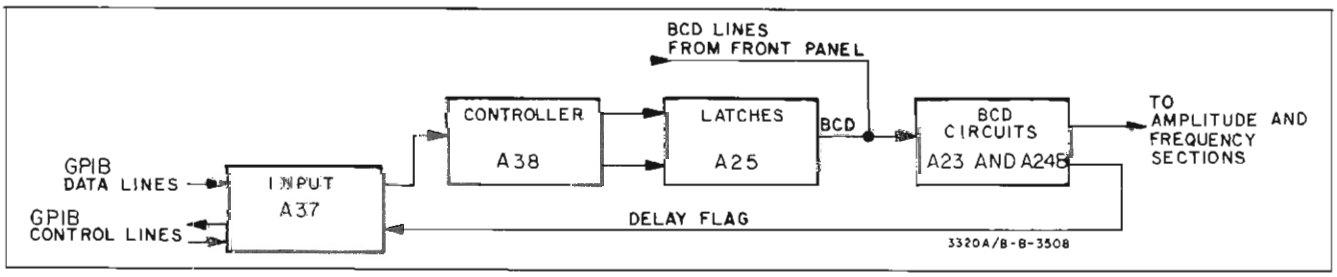


Figure 4-9. GPIB Controller.

addressed to listen, it may be placed into the remote control mode. Remote control is selected by REN and applying a "Function Execute" command (ASCII comma) to the data lines. The 3320B will not go into remote mode by simply holding REN LOW. The 3320B will remain in local mode until a Function Execute command (ASCII comma) is received on the data lines. This Function Execute command must follow the programming of each preface command (parameter) as discussed in Section III. The first Function Execute in a programming sequence sets the Remote Flip–Flop to the remote mode, and transfers any prefaced data to the Latches. Any following Function Execute command simply transfers the prefaced data to the Latches.

NOTE

The 3320B must be addressed before it can be placed in remote control.

4-40. Local Control. In local control, the BCD circuits process the BCD data coming from the front panel settings (switch closures to ground). The input, controller and latch circuits have no function during local control. The 3320B GPIB option may be put into local control by one of the following methods:

1. Initially applying power.
2. By giving a "Local Enable" command (ASCII Character 1) during remote control.
3. By controlling the REN.

NOTE

Some "special" 3320B instruments have a front panel switch to control the REN and force local control. For more information, see notes on Schematic No. 6.

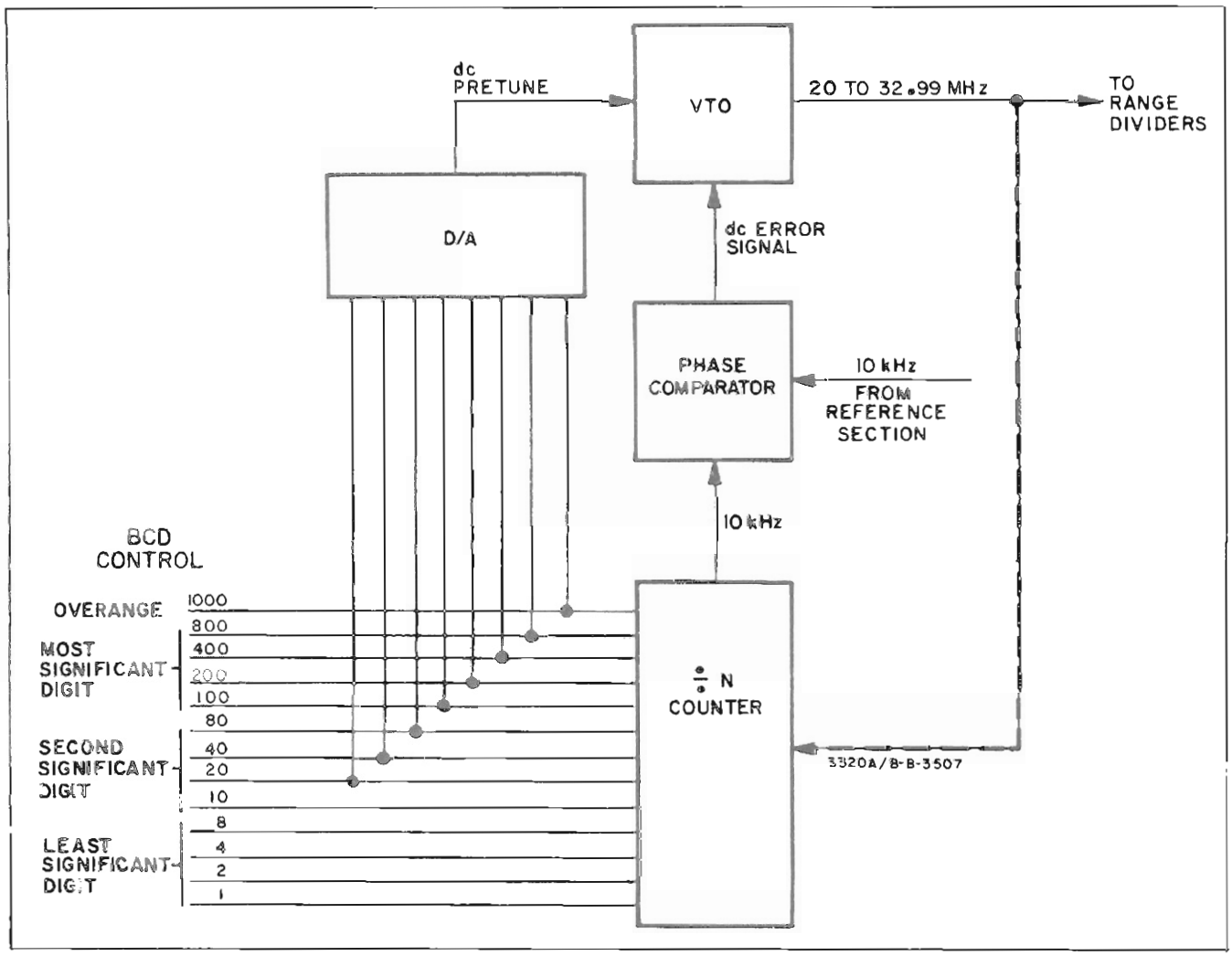


Figure 4-10. VTO and Phase Lock Loop.

4-41. Frequency Section.

4-42. The frequency section of the 3320A/B is composed of a BCD controlled voltage tuned oscillator (VTO), phase locked to a 10 kHz reference signal, and six range dividers, including Option 006 (see Figure 4-2).

4-43. The output frequency of the frequency section is variable from 20 MHz to 32.99 MHz with the vernier in/out control in the vernier out position. With the vernier in/out control in the vernier in position, two more additional digits are variable via the vernier oscillator making the output frequency of the frequency section 20 MHz to 32.9999 MHz. In the following discussion, the frequencies given are considered to be with the vernier in/out in the vernier out position. Refer to Paragraph 4-60 for a discussion of the vernier oscillator.

4-44. VTO, Phase-Lock Circuitry. The BCD signal, from the controller section, for the overrange digit and the two most significant digits of 3320A/B output frequency, is applied to a D/A converter on the VTO assembly (see Figure 4-10). The D/A converter converts the BCD signal to a dc voltage which is applied to the VTO as a pretune voltage. This sets the VTO close to the desired frequency.

4-45. Precise frequency control is achieved by phase-locking the output of the VTO to a 10 kHz reference signal from the reference oscillator. This is accomplished by applying the output of the VTO to a ÷ N counter. The ÷ N number is controlled by the same BCD signal which pretuned the VTO plus the BCD signal for the remainder of the frequency digits. This signal sets the ÷ N counter in such a manner that the counter will divide the output of the VTO to 10 kHz (refer to Paragraph 4-70 for a detailed discussion on the ÷ N counter). The 10 kHz output from the ÷ N counter is applied to a phase comparator where it is compared to a 10 kHz signal from the reference oscillator. Any difference in phase between the two signals will be developed as a dc voltage. This dc voltage is applied to the VTO to correct its frequency.

4-46. Range Dividers. The output signal of the VTO is applied either to the amplitude section or to a series of range dividers, depending on the position of the range control. Seven ranges are available on the 3320A/B, including Option 006. Table 4-1 lists the range positions, the number of range dividers used for each position, and the output frequency of each range divider.

4-47. With the range control in the 10 MHz position, the output of the VTO (20 MHz to 32.99 MHz) is applied directly to the amplitude section. In the amplitude section, the signal is mixed with 20 MHz and the difference frequency (0 Hz to 12.99 MHz) is available at the 3320A/B output jack.

4-48. With the range switch in any position other than the MHz position, the output of the VTO is applied to one or more of the range dividers. Each divider uses a divide and mix technique to increase the resolution of the output signal by one decade while decreasing the maximum frequency by one decade (see Figure 4-11). For example, if the range control is placed in the 1000 kHz position, the VTO output (20 MHz to 32.99 MHz) is divided by 10 (2 MHz to 3.299 MHz) and mixed with 18 MHz from the reference section. The sum of these two signals (20 MHz to 21.299 MHz) is applied to the amplitude section. This signal is mixed with 20 MHz in the amplitude section, and the difference frequency (0 Hz to 1299 kHz) is available at the 3320A/B output jack.

4-49. Amplitude Section.

4-50. 3320A Amplitude. The 3320A output signal is variable from 0 dBm to 13 dBm, into 50 ohms, by a front panel potentiometer. The potentiometer applies a dc voltage to a modulator to amplitude modulate a 20 MHz signal from the reference section (see Figure 4-12). The leveled (amplitude modulated) 20 MHz is applied to a mixer where it is mixed with the 20 MHz to 32.99 MHz from the frequency section. The difference frequency out of the mixer (0 Hz to 12.99 MHz) is amplified, filtered, and amplified again before it is applied to the 3320A output.

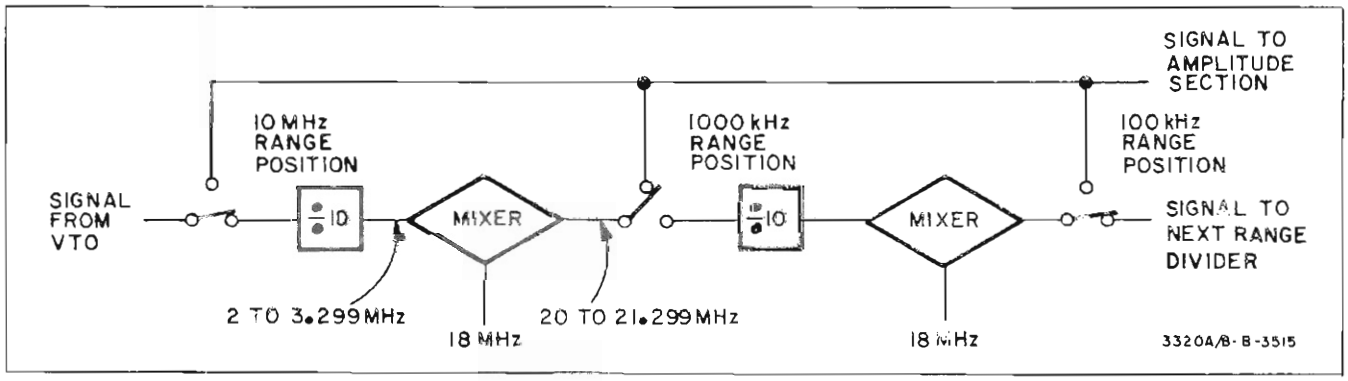


Figure 4-11. Range Dividers.

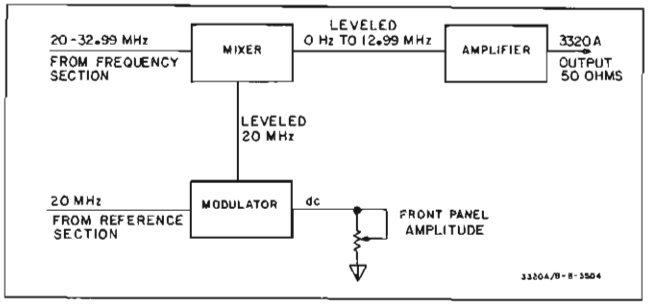


Figure 4-12. 3320A Amplitude Section.

4-51. 3320B Amplitude. The 3320B output signal is variable from +26.99 dBm to -69.99 dBm (-73.00 dBm in remote mode) into 50 ohms. The three least significant digits are controlled by amplitude modulating the 20 MHz from the reference section with a dc voltage and applying the modulated 20 MHz to the output mixer (see Figure 4-13). The most significant digit is controlled by a 10 dB/step attenuator at the 3320B output.

4-52. The dc voltage used to modulate the 20 MHz signal originates in the D/A converter assembly (A11). The D/A converter consists of a counter, clocked with a 2 MHz signal from the Reference Oscillator, and a series of FET switches controlling the charge and discharge of a capacitor (see Figure 4-14). The BCD signal from the controller section determines the length of time the counter counts. At T_0, switch A is closed allowing C_1 to charge to 10 V. Switch A is opened and switch B is closed allowing C_1 to discharge through R_1. When the counter has counted the length of time allowed by the BCD signal, switch B is opened and switch C is closed. The dc voltage remaining on C_1 is transferred to holding capacitor, C_2. From C_2, the dc level is applied to the Modulator as a pretune dc, and the Leveling assembly.

4-53. The Leveling assembly consists of a thermopile circuit and a comparator (see Figure 4-13). The signal applied to the thermopile circuit is determined by the position of the LEVELING control. When the LEVELING control is in the ON position, the 3320B output is applied to the thermopile circuit. When the LEVELING control is in the OFF position, the 20 MHz from the modulator is applied to the thermopile circuit. The thermopile circuit detects the signal and applies the dc to the comparator. This dc is compared to the dc from the D/A converter. Any difference in the two dc levels is applied to the modulator

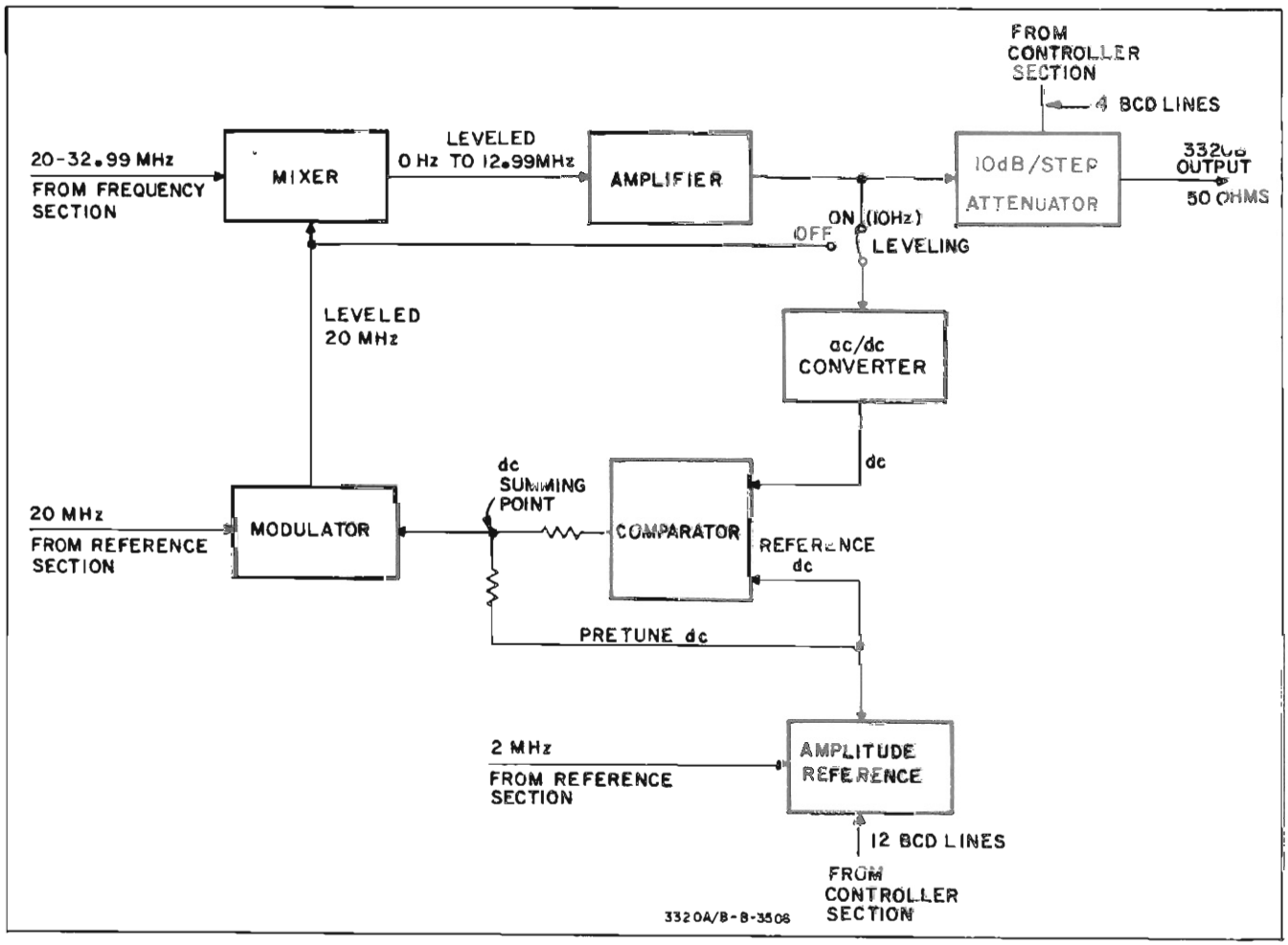


Figure 4-13. 3320B Amplitude Section.

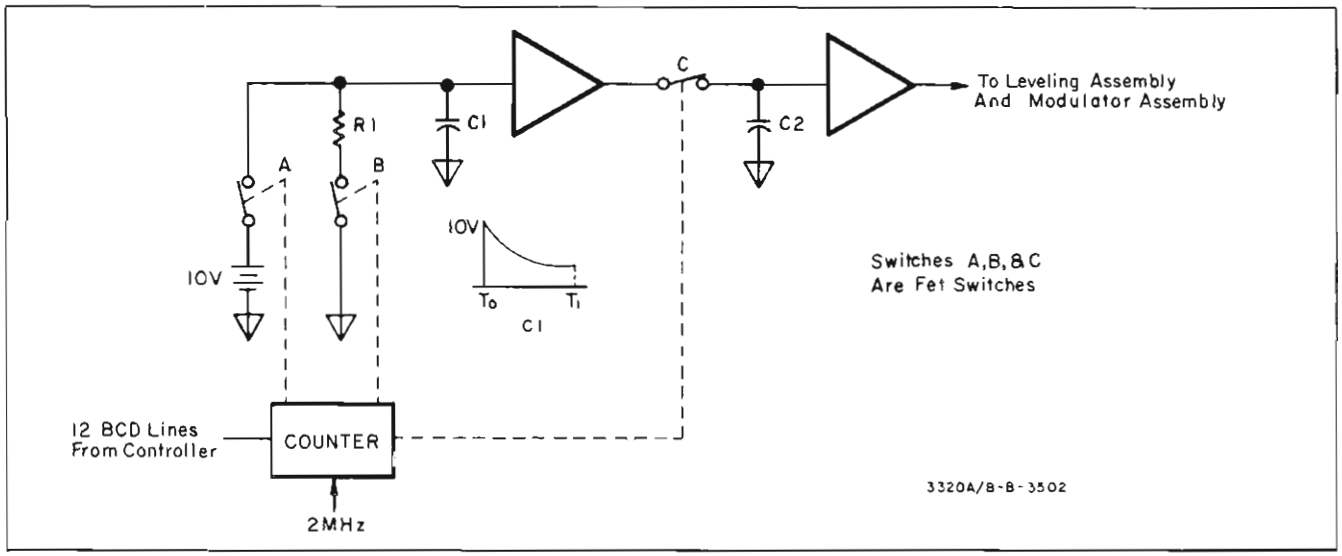


Figure 4-14. Simplified Amplitude Reference.

to correct the amplitude of the leveled 20 MHz. See Paragraph 4-63 for a detailed discussion of the thermopile circuitry.

4-54. The leveled 20 MHz is applied to a mixer where it is mixed with the 20 MHz to 32.99 MHz from the frequency section. The difference frequency out of the mixer (0 Hz to 12.99 MHz) is amplified, filtered, and amplified again before it is applied to a BCD controlled 10 dB/step attenuator assembly.

4-55. The 10 dB/step attenuator is capable of switching in up to 90 dB of attenuation in 10 dB steps. The leveled 20 MHz is capable of applying 9.99 dB of attenuation in 0.01 dB, 0.1 dB, or 1 dB steps. These two attenuators work in conjunction to cover the 3320B range of +26.99 to -69.99 dBm. At +26.99 dBm, both attenuators are applying 0 dB of attenuation. When attenuation is added, the first 9.99 dB is from the leveled 20 MHz. Then at +16.99 dBm, the 10 dB/step attenuator will supply 10 dB of attenuation and the leveled 20 MHz is back to 0 dB of attenuation. This operation continues through the attenuation range to -69.99 dBm. The switching points of the 10 dB/step attenuator below 0 dBm is -3.01 dBm, -13.01 dBm, -23.01 dBm, etc.

4-56. Reference Section.

4-57. The reference section of the 3320A/B consists of two voltage controlled crystal oscillators; a vernier oscillator, which is switched in and out with the vernier control, and a

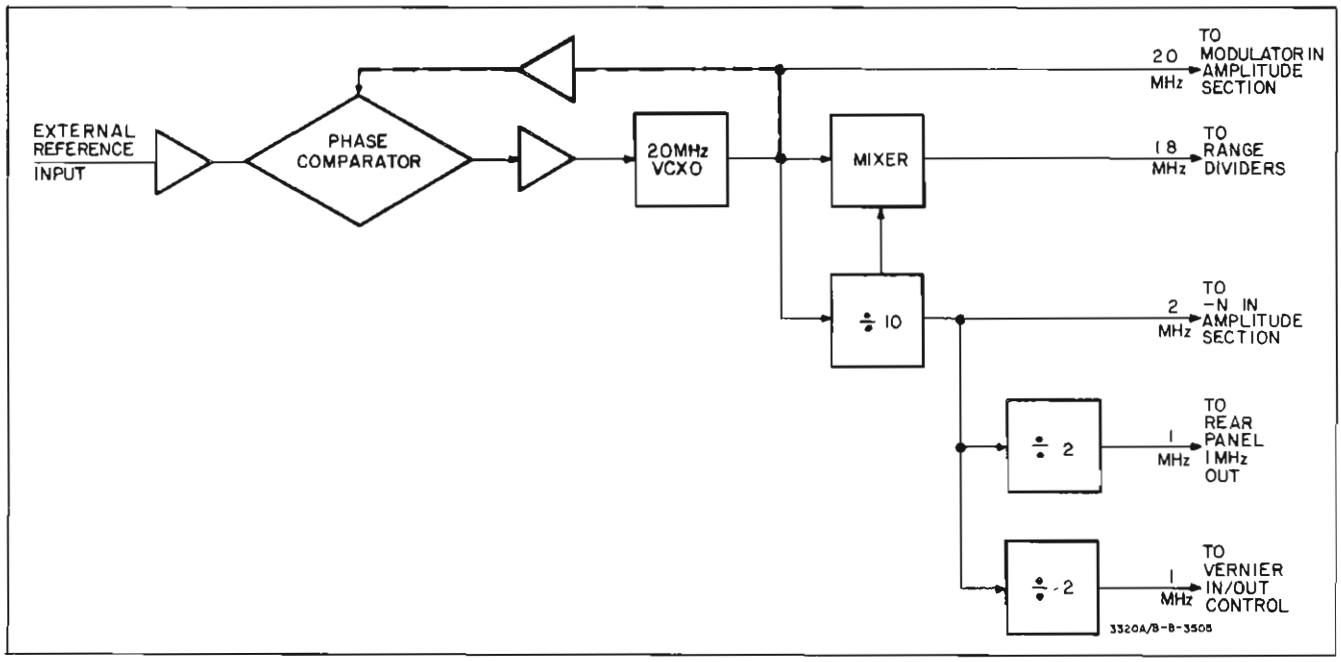


Figure 4-15. Reference Section.

20 MHz oscillator. The vernier oscillator can be used to vary the last two digits of the 3320A/B output frequency. The 20 MHz oscillator can be phase–locked to an external reference source.

4-58. 20 MHz Reference Oscillator. There are four frequencies supplied by the 20 MHz Reference Oscillator; 20 MHz, 18 MHz, 2 MHz, and 1 MHz (see Figure 4-15). The 20 MHz signal is applied to the amplitude section level control modulator directly from the 20 MHz oscillator. The 20 MHz signal is also applied to a ÷ 10 circuit and a mixer circuit on the 20 MHz Reference Oscillator assembly. The 2 MHz signal out of the ÷ 10 is applied to the mixer and mixed with the 20 MHz signal. The difference frequency of 18 MHz is applied to the range dividers in the frequency generating section. The 2 MHz from the ÷ 10 circuit is also applied to the ÷ N Variable Modulus Counter in the amplitude section and to two ÷ 2 circuits on the 20 MHz Reference Oscillator assembly. The 1 MHz from one of the ÷ 2 circuits is applied to the rear panel 1 MHz OUT jack. The 1 MHz from the second ÷ 2 circuit is applied to the VERN IN/OUT control. With the VERN IN/OUT control in the VERN OUT position, the 1 MHz is applied to a ÷ 100 circuit on the Vernier Oscillator assembly. The 10 KHz from the ÷ 100 circuit is applied to the phase–lock loop in the frequency generating section.

4-59. A phase–lock circuit is provided for phase locking an external frequency reference to the 20 MHz oscillator. The external frequency reference, such as the 5 MHz oven stabilized reference oscillator (Option 002) is applied to a phase comparator on the Phase–Lock assembly. Here, it is compared to a portion of the 20 MHz output. Any difference in phase between the two signals will create a dc voltage which is applied to the 20 MHz oscillator to change its output frequency.

4-60. Vernier Oscillator. The Vernier Oscillator is a 10 MHz voltage controlled crystal oscillator. The output of the oscillator is applied to a ÷ 10 circuit (see Figure 4-16). The 1 MHz from the ÷ 10 circuit is applied to the VERN IN/OUT control. With the VERN IN/OUT control in the VERN IN position, the 1 MHz from the ÷ 10 circuit is applied to a ÷ 100 circuit. The 10 KHz from the ÷ 100 circuit is applied to the phase–lock loop in the frequency generating section.

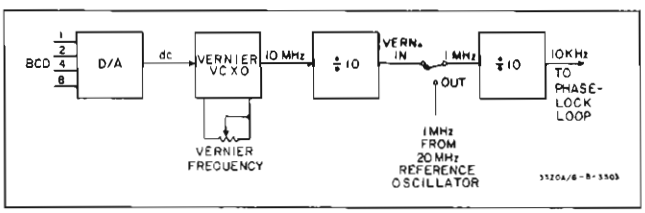


Figure 4-16. Vernier Oscillator.

4-61. The Vernier Oscillator can be tuned by either a front panel vernier control or by remote programming. The front panel control allows the 10 MHz from the oscillator to be varied which in turn varies the 10 kHz reference to the phase–lock loop in the frequency section. Varying the 10 kHz reference will vary the last two digits of the 3320A/B output frequency (Vernier digits) from 00 to 99. Remote programming allows the most significant of these two digits to be varied from 0 to 9. Remote programming can be accomplished by the BCD remote programming Option 003 for the 3320A model or by the BCD remote programming Option 004 or ASCII remote programming Option 007 in the 3320B. With all programming options, a BCD 8–4–2–1 signal is applied to a D/A converter on the Vernier Oscillator assembly. The dc voltage from the D/A is applied to the oscillator to vary its output frequency.

4-62. UNIQUE CIRCUITS.

4-63. 3320B Thermopile Circuitry.

4-64. When the 3320B LEVELING is ON (> 10 Hz), the AC/DC converter monitors the output of the power amplifier (see Figure 4-13). The converter converts this signal to a dc voltage which is compared to a dc amplitude reference. The resulting difference voltage is amplified by the comparator. The comparator output changes the level of the 20 MHz output of the Modulator. This, in turn, changes the level out of the mixer and the power amplifier. The level change out of the power amplifier is monitored by the converter and allows the converter output to approach the amplitude reference level.

4-65. When the 3320B LEVELING circuit is off, the AC/DC converter monitors the 20 MHz output of the Modulator (see Figure 4-13). The AC/DC converter converts this signal to a dc voltage which is compared to a dc amplitude reference. The resulting difference voltage is amplified by the comparator and used to adjust the 20 MHz output of the Modulator. When the LEVELING circuit is off, the Mixer and Power Amplifier are not included in the amplitude leveling loop.

4-66. AC/DC Converter. A simplified diagram of the AC/DC converter is shown in Figure 4-17. The converter utilizes a thermopile and responds to the RMS value of the input signal. The input signal drives a resistive load which is the heater element for the thermopile. The extremely flat frequency response of the thermopile allows the leveling loop to function effectively over a very broad frequency range.

4-67. An increased signal level into the converter causes point 2 to go more positive which will cause point 3 to go more positive. This increased voltage at 3 increases the voltage at 4. This causes point 4 to approach the same voltage as point 2. Since the thermopiles are matched, the RMS voltage at point 1 is very nearly equal to the dc level at point 3 (1 volt ac at point 1 yields 1 volt dc at point 3).

4-68. Protection Circuits. A simplified diagram of the AC/DC converter and the associated protection circuits are shown in Figure 4-18. The protection circuits are designed to protect the thermopile and Output Amplifier from overvoltage caused by instrument malfunction or by accidental application of voltage to the output terminals. If the

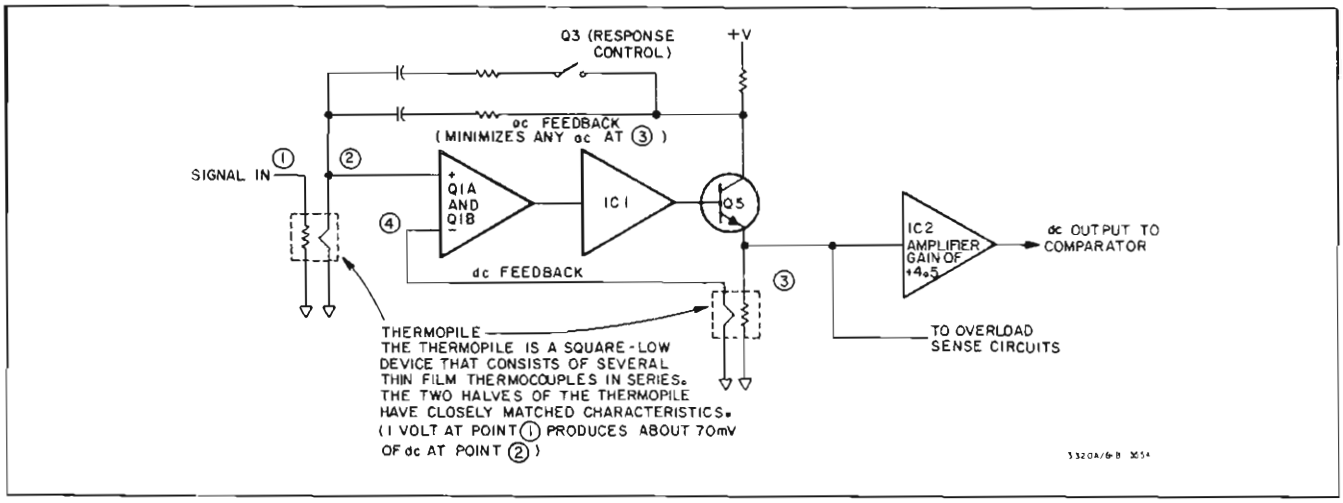


Figure 4-17. AC/DC Converter In The Amplitude Section.

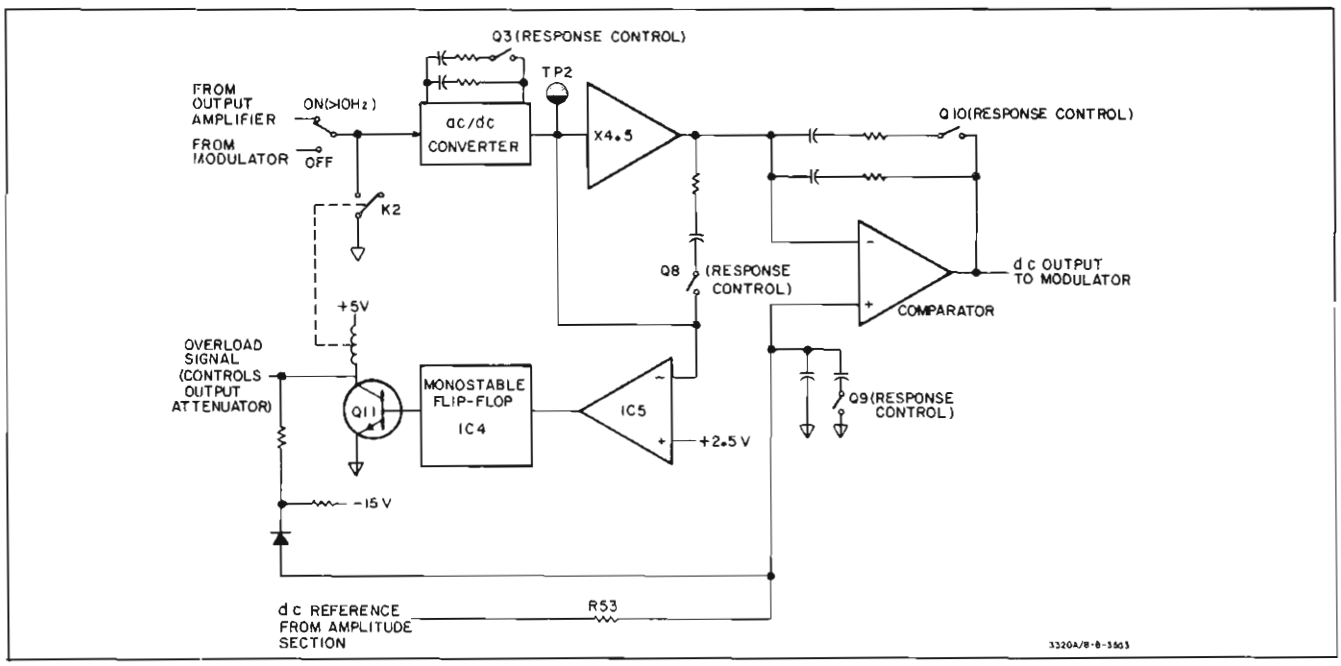


Figure 4-18. AC/DC Converter With Overload Circuits.

voltage at TP2 exceeds about +2.5 volts, IC5 sets the Monostable Flip–Flop. This causes K2 to close shorting the converter input to ground and the output attenuator to provide at least 40 dB of attenuation. While the Monostable Flip–Flop is set, the voltage at TP2 approaches 0 volts. At the end of 5 seconds, the Monostable returns to its normal state. If the overload condition still exists, the Monostable is set again. The resistor and diode between the output of Q11 and the dc reference pulls the dc reference line negative during overload. This reduces the 20 MHz signal out of the Modulator.

4-69. The response is set to SLOW for the standard 3320B. This requires the four response control switches shown in Figure 4-18 to be closed. Options 003, 004 and 007 allow the response to be remotely programmed to FAST. FAST response requires these four switches to be open.

4-70. The ÷ N Counter.

4-71. Refer to Figure 4-10 for the block diagram of the VTO Phase Lock Loop containing the ÷ N Counter. The purpose of the VTO Phase Lock Loop is to provide an output frequency to the amplitude section. The range of the output frequency from the VTO depends on the position of the vernier control switch:

Vernier	VTO Output
In	20 to 32.9999 MHz
Out	20 to 32.99 MHz

The actual output frequency depends on the frequency setting selected.

NOTE

For the following discussion, the vernier in/out control is considered to be in the **out** *position.*

4-72. The function of the ÷ N Counter in the VTO Phase Lock Loop is to divide the output of the VTO (20 to 32.99 MHz) by some number N. The number N is determined by the BCD control lines from the controller. The output of the ÷ N Counter is compared with the 10 kHz reference signal from the frequency reference section. If the output of the ÷ N Counter is not equal to the 10 kHz reference signal, an error signal is generated to tune the VTO to the proper frequency. When the output of the ÷ N is exactly 10 kHz, the Loop is phase locked to the 10 kHz reference and the VTO will be tuned to the correct frequency. When a new frequency is selected, a different ÷ N number is set by the BCD control lines. At the same time, the D/A converter pretunes the VTO to a frequency close to the required output and then the Phase Lock Loop tunes the VTO to the required frequency. When the loop is phase locked, the output of the ÷ N counter is 10 kHz and the frequency of the VTO is given by the following formula:

VTO frequency = N x 10 kHz

Where N = ÷ N number between 2000 and 3299

Since the 3320A/B uses Range Dividers to provide additional resolution, the output of the VTO always varies between 20 MHz and 3299 MHz independent of RANGE setting. The ÷ N number varies between 2000 and 3299 at each range setting as shown in Table 4-3.

4-73. The ÷ N Counter utilizes three presettable decade counters and the control circuits shown in Figure 4-19. The presettable counters and the A Flip–Flop are set to a "preset" number by the BCD control lines. The counter starts counting the VTO cycles starting with the preset number. The ÷ N Counter counts up to a maximum number of 3999 (Sense No.). Each time the 3999 number is reached, a completed pulse is supplied to the Phase Comparator.

The basic sequence of operation for the ÷ N Counter is:

1) Load Preset Number (from BCD control lines).

2) Count VTO frequency until counter reaches 3999 (maximum count).

3) Provide output pulse to Phase Comparator.

4) Repeat cycle.

Since the maximum number that the counter can achieve is 3999, the preset number may be determined by subtracting the N number from 3999 (preset = 3999 - N), for example:

Maximum frequency (any range)
VTO = 32.99 MHz
N = 3299
Preset Number = 0700 = 3999 - 3299

Minimum frequency (0 Hz)
VTO = 20.00 MHz
N = 2000
Preset Number = 1999 = 3999 - 2000

If the VTO frequency is unknown, proceed as follows:

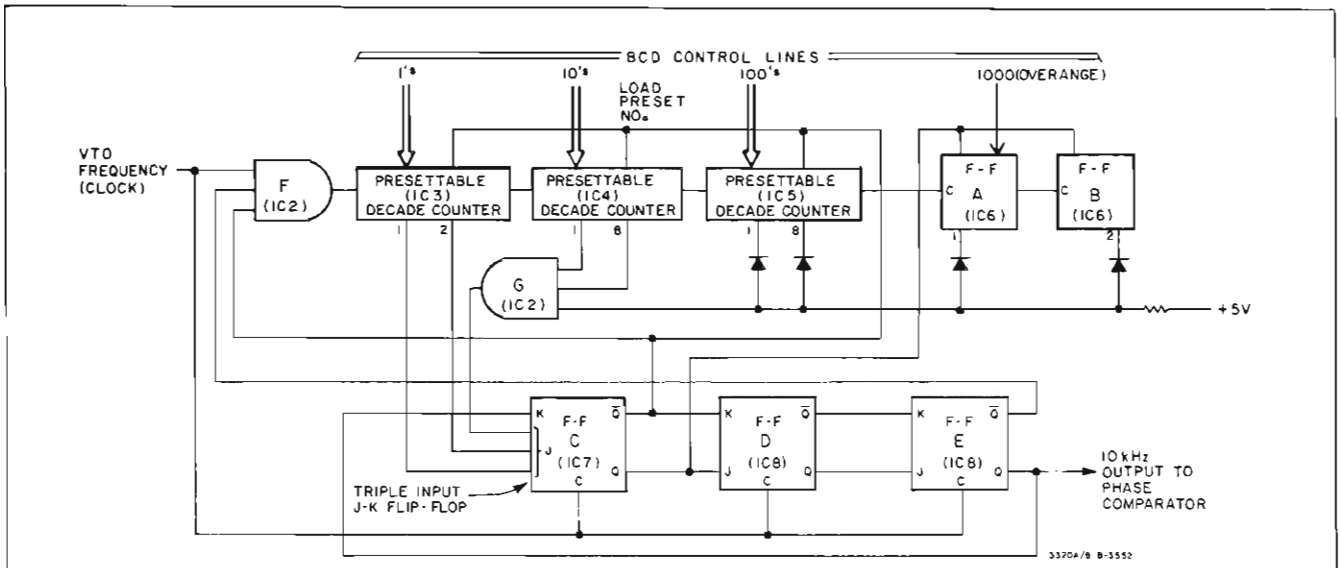
1. To determine the VTO frequency, add 20 MHz to the desired output frequency.

2. To determine the N number, divide the VTO frequency by 10 kHz. This number is always between 2000 and 3299.

3. To determine the preset number, subtract the N number from 3999. This number is always between 0700 and 1999.

Table 4-3. Frequency Setting vs. ÷ N Number.

FREQUENCY RANGE/SETTING					F_{VTO}	÷N
10 MHz	1000 kHz	100 kHz	10 kHz	1000 Hz	(A3TP3)	Number
0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	20 MHz	2000
5 MHz	500 kHz	50 kHz	5 kHz	500 Hz	25 MHz	2500
10 MHz	1000 kHz	100 kHz	10 kHz	10000 Hz	30 MHz	3000
12.99 MHz	1299 kHz	129.9 kHz	12.99 kHz	1299 Hz	32.99 MHz	3299



Counting Sequence	Flip–Flops B	Flip–Flops A	Presettable Decade Counters IC5	IC4	IC3 BCD 2	IC3 BCD 1	Flip–Flops C	D	E	Gates F	G	Remarks
Preset Number	0	*	*	*	*	*	0	0	0	Enabled	Disabled	Start of Cycle
Preset + 1	†	†	†	†	†	†						
.	.	.	.	.	.	.						
.	.	.	.	.	.	.						
.	.	.	.	.	.	.						
3990	1	1	9	9	0	0					Enabled	Gate G Enabled
.	1	1	9	9	0	1						
.	1	1	9	9	1	0						
3993	1	1	9	9	1	1	0	0	0	Enabled	Enabled	
3994	0	*	*	*	*	*	1	0	0	Disabled	Disabled	Counters and F-F 1 are preset. F-F B is cleared.
3995	0	*	*	*	*	*	1	1	0			
3996	0	*	*	*	*	*	1	1	1			Output to phase comparator goes high
3997	0	*	*	*	*	*	0	1	1			
3998	0	*	*	*	*	*	0	0	1	Disabled		
3999	0	*	*	*	*	*	0	0	0	Enabled	Disabled	Output to phase comparator goes low and cycle repeats

* Set to preset number
† Preset number + 1

Figure 4-19. ÷ N Control Logic Diagram.

An example of how the preset number is determined by the BCD control lines is shown in Table 4-4.

4-74. The table in Figure4-19 shows the counting sequence for the ÷ N Counter. When the counter reaches 3990, Gate G is enabled. At 3993, all three J inputs at Flip–Flop C are high. At 3994, Gate F is disabled but the count continues by clocking Flip–Flops C, D, and E until 3999 is reached. At 3996, the output to the phase comparator goes high and remains high until 3999 is reached.

Table 4-4. Preset Number.

Title	Overrange Digit	Most Significant Digit	2nd Most Significant Digit	3rd Most Significant Digit
Frequency Control Digits	1	2	6	5
BCD Code of Frequency Control Digits	1	0010	0110	0101
Code to ÷N Counter	1	0111*	0011*	0100*
Preset Number	0	7	3	4

*The required preset number is the 9's compliment of the corresponding Frequency Control Digits

Summation of table:
N = 3999 - 734 = 3265
VTO Frequency = 3265 x 10 kHz - 32.650000 MHz

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains the information necessary for maintenance of the Model 3320A/B Frequency Synthesizer. Included is a list of test equipment required, in-cabinet performance tests for standard and options, adjustment procedures for standard and options, and front panel disassembly procedures.

5-3. TEST EQUIPMENT.

5-4. The test equipment required for the maintenance of the 3320A/B is listed in Table 5-1. If the recommended model is not available, use a substitute that meets the required characteristics.

NOTE

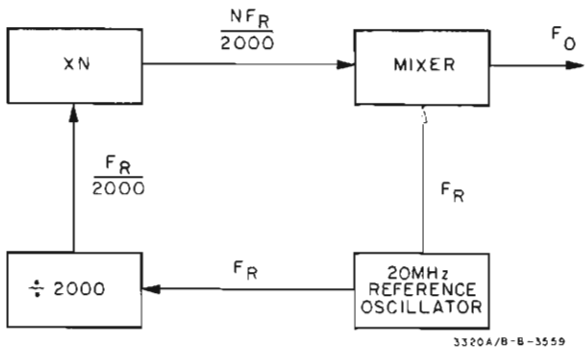
To insure proper stabilization of all circuitry, allow a 30-minute warmup period before beginning any performance tests or adjustment procedures.

5-5. PERFORMANCE TESTS.

5-6. The following performance tests compare the 3320A/B performance with the list of specifications given in Table 1-1. These tests may be used for incoming inspection, periodic maintenance, or to verify specifications after repair. A Performance Test Card is provided at the end of this section for recording the performance of the instrument during the performance tests. The card may be removed from the manual as a permanent record. If the instrument fails to meet any of its specifications, perform the adjustment procedures outlined in Paragraph 5-27. During the performance test, periodically vary the line voltage ± 10% with a power line transformer to insure proper operation at various ac line voltages. When checking the performance of Option 001, use a 75 ohm to 50 ohm adapter on the output of the 3320A/B (excluding Paragraphs 5-17 and 5-21). Refer to Figure 5-7 for part numbers and diagram of 75 ohm to 50 ohm adapter.

5-7. Frequency Accuracy, Vernier Out.

5-8. This performance test insures the 3320A/B meets the Frequency Accuracy performance specifications listed in Table 1-1 when the vernier control is in the out position. The output frequency of the 3320A/B is derived from the 20 MHz Oscillator as follows:



The XN circuitry is controlled by a phase lock loop. If either the ÷ 2 K or the XN number is incorrect, the loop will not lock. The following formula can be used to derive F_O:

$$F_O = \frac{NF_R}{2000} - F_R = F_R\frac{(N-2000)}{2000} = F_R\,(K)$$

If $F_O = F_R(K)$ and if the phase lock loop is locked up, any frequency error in F_O must be due to F_R (20 MHz). This performance test measures the accuracy of the 20 MHz Reference Oscillator and the output of the 3320A/B to insure phase lockup. The Frequency Accuracy specification listed in Table 1-1 with the Vernier out is ± 0.001% of setting.

a. Connect an electronic counter to the 1 MHz output jack on the 3320A/B rear panel. The counter indication should be 1.000000 MHz ± 10 Hz.

b. Connect the counter to the 3320A/B front panel OUTPUT jack.

c. Set the 3320A/B RANGE to MHz and FREQUENCY to 12.22. Set VERN IN/OUT to VERN OUT. The counter indication should be 12.220000 MHz ± 122 Hz.

d. Set the 3320A/B FREQUENCY to 1.10. The counter indication should be 1.100000 MHz ± 11 Hz.

e. Set the 3320A/B FREQUENCY to 00.01. Set the counter TIME BASE to .1 μs and FUNCTION to PERIOD AVERAGE 10 K. The counter indication should be 100.00000 μs ± 1 ns.

5-9. Frequency Accuracy, Vernier In.

5-10. The 3320A/B uses two unrelated reference oscillators to derive the output frequency when the vernier control is

Table 5-1. Test Equipment Required.

Instrument Type	Required Characteristics	Recommended Model
Electronic Counter	Frequency: dc to 33 MHz Time Base: .1 μsec to 10 sec Period Average: 1 to 100 K Output: 100 kHz, 1 MHz, 10 MHz (rear panel) 10 MHz (front panel) Sensitivity: 1 mV	-hp- Model 5245L with 5261A plug-in
Wave Analyzer	Frequency: 20 Hz to 16 MHz Amplitude: 100 μV to 30 V B.W.: 10 Hz Outputs: Recorder Dynamic Range: > 70 dB	-hp- Models 312A and 3590A (with 3593A plug-in)
ac Voltmeter	Range: 7.000 mV ± 70 μV to 5 V ± 25 mV Frequency: 50 Hz to 100 kHz	-hp- Model 3450A
ac Voltmeter	Dynamic Range: 100 dB B.W.: 1 Hz	-hp- Model 403A
Oscilloscope	Dual channel (Ch. B. Trigger); Frequency: dc to 13 MHz Accuracy: ± .1% of setting	-hp- Model 180A (with 1801A and 1820A plug-ins.)
dc Voltmeter	Voltage Range: 100 mV to 30 V Accuracy: ± 0.05%	-hp- Model 3450A
Spectrum Analyzer	Frequency: 10 MHz to 48 MHz Response: ± 0.5 dB	-hp- Model 8553B/8552A (in 141S display)
Attenuator	Attenuation: 20 dB in 10 dB steps Accuracy: ± 0.01 dB	-hp- Model 355D with known error
Attenuator	Attenuator: 10 dB in 1 dB steps	-hp- Model 355C
Thermocouple	Input: 3 V rms Output: 7.0 mV dc Input Impedance: 50 ohms and 75 ohms	-hp- Model 11049A -hp- Model 11049-H01 (for Option 001)
Double Balanced Mixer	Frequency: 100 kHz to 13 MHz	-hp- Model 10534A
Low Pass Filter	Frequency: 150 kHz	See Figure 5-4
Low Pass Filter	Frequency: 15 kHz	See Figure 5-5
Feed thru Termination	Impedance: 50 ohms ± 0.2% 75 ohms ± 0.2%	-hp- Model 11048C -hp- Model 11094C
Resistors	10 ohm (2 each) 100 ohm (1 each) 10 kilohm (1 each)	-hp- Part No. 0757-0489 -hp- Part No. 0757-0178 -hp- Part No. 0757-0340
Capacitors	.0068 μF (1 each) 1300 pF (1 each) .012 μF (1 each) 1600 pF (1 each)	-hp- Part No. 0160-0159 -hp- Part No. 0160-2221 -hp- Part No. 0160-0301 -hp- Part No. 0160-2223
Coil	150 μh (1 each)	-hp- Part No. 9100-1639
Oscillator	Signal to Noise Ratio: > 60 dB down Spurious: > 80 dB down Frequency: 5 MHz and 1 MHz	-hp- 105A/B
Frequency Doubler	Frequency: 5 MHz Impedance: 50 ohms	-hp- Model 10515A

in the IN position. This performance test insures the instrument meets the Frequency Accuracy specifications listed in Table 1-1. The specification is 0.01% of range.

a. Connect an electronic counter to the 3320A/B front panel OUTPUT jack.

b. Set the 3320A/B RANGE to MHz, VERN IN/OUT to VERN IN, and FREQUENCY to 00.0150. The counter indication should be 15.000 kHz ± 1.0 kHz.

c. Set the 3320A/B FREQUENCY to 12.9999. The counter indication should be 12.9999 MHz ± 1.0 kHz.

d. Step the RANGE to each of the lower positions. The counter indication in Step c should be divided by 10 with each step.

5-11. Harmonic Distortion.

5-12. This performance test insures the 3320A/B meets the Harmonic Distortion specification listed in Table 1-1. The specification is divided into three frequency ranges: - 60 dB from 5 Hz to 100 kHz, - 50 dB from 100 kHz to 1 MHz, and - 40 dB from 1 MHz to 13 MHz.

3320A:

a. Connect the equipment as shown in Figure 5-1.

b. Set the 3320A front panel controls as follows:

AMPLITUDE . . . . . Full CW
VERN IN/OUT . . . . . VERN IN
RANGE . . . . . 100 kHz
FREQUENCY 010.0

c. Set the 355D to 10 dB, the 355C to 3 dB, and adjust the wave analyzer for a 0 dBm meter indication at 10 kHz.

d. Tune the wave analyzer to the second, third, and fourth harmonics of the 10 kHz signal. Harmonic levels should be at least 60 dB below the reference level set in Step c.

e. Repeat Steps c and d for the following FREQUENCY and RANGE settings:

RANGE	FREQUENCY	Specifications
100 kHz	129.9	- 50 dB
1000 kHz	0150	- 50 dB
1000 kHz	1299	- 40 dB
10 MHz	04.00	- 40 dB

f. Exchange the wave analyzer with a spectrum analyzer.

g. Set the 3320A FREQUENCY to 7.00. Adjust the spectrum analyzer to display the 7.00 MHz reference signal and the second, third, and fourth harmonics.

h. The harmonic signals should be at least 40 dB below the 7.00 MHz reference.

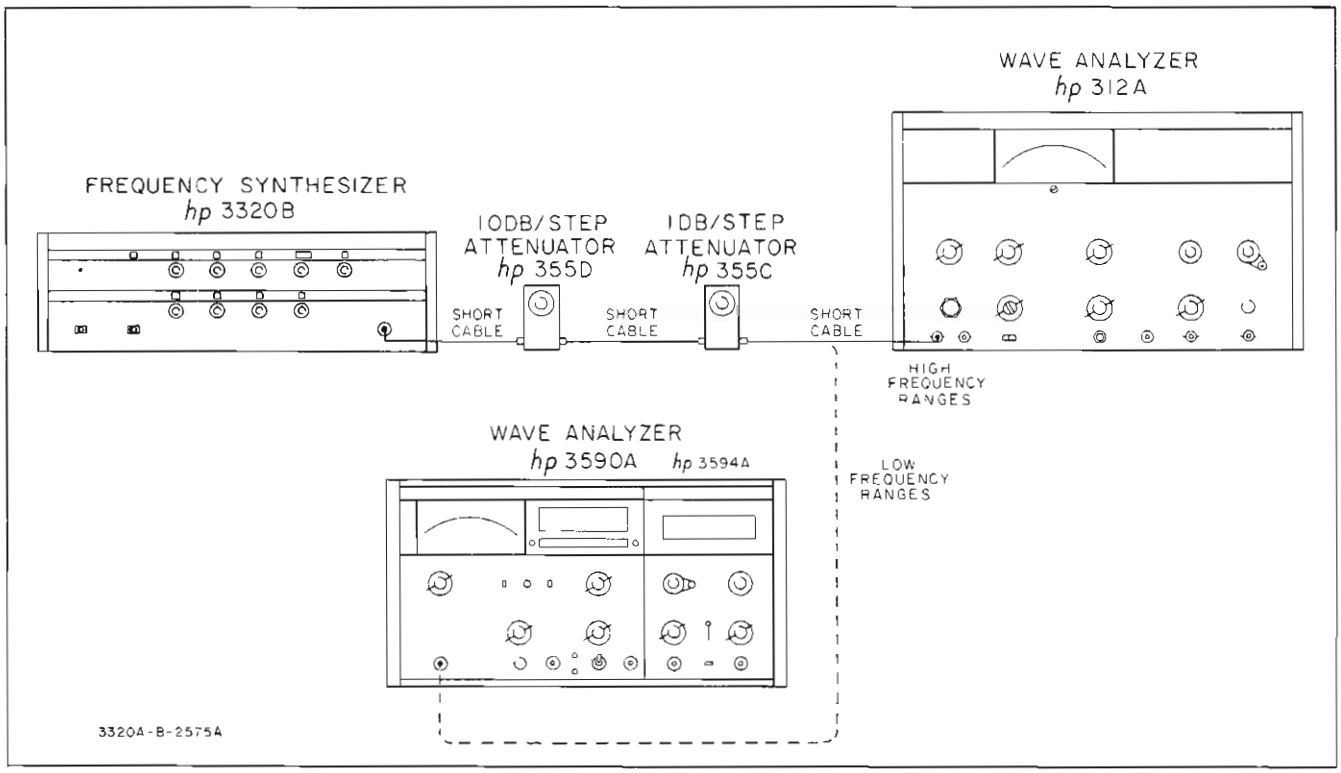


Figure 5-1. Harmonic Distortion.

i. Repeat Steps g and h for the frequency of 12.99 MHz.

3320B:

a. Use same procedure as 3320A with the following exceptions:

(1) In Step b, set AMPLITUDE to + 26.99 dBm (+ 24.99, Option 001) and LEVELING to OFF.

(2) In Step c, set 355D to 20 dB and 355C to 7 dB.

5-13. Spurious.

5-14. This performance test insures the 3320A/B meets the Spurious (short term stability) specification listed in Table 1-1. The specification is > 60 dB below the selected output or - 110 dBm into 50 ohms, whichever is greater. A wave analyzer is used to check random spurious and 2, 1 spurious. The 2, 1 spurious is generated by the mixing action used to develop the 3320A/B output frequency (See Figure 5-2). The 2, 1 spurious is equal to $2F_2 - F_1$. For example, if the 3320A/B is programmed for an output frequency of 8 MHz, F_1 = 28 MHz and $2F_2 - F_1$ = 40 MHz - 28 MHz = 12 MHz = 2, 1 spurious. 10 kHz and 60 Hz sidebands are checked at 10 MHz by mixing the 3320A/B output frequency to 100 kHz and 10 kHz and monitoring the sidebands with a wave analyzer.

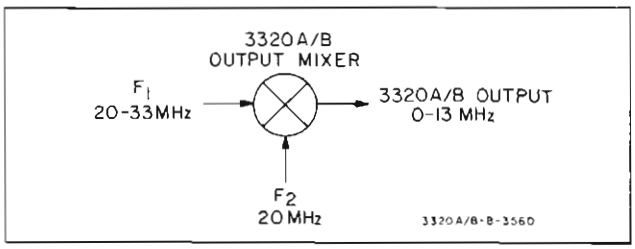


Figure 5-2. 3320 Output Section.

a. Connect a wave analyzer to the 3320A/B front panel OUTPUT jack. The 3590A wave analyzer with the 3593A or 3594A plug-in will cover the lower frequencies of the 3320A/B. The 312A wave analyzer will cover the upper frequencies.

b. Set the LEVELING ON (> 10 Hz) (3320B) and adjust the 3320A/B AMPLITUDE and the wave analyzer for a convenient reference level on the wave analyzer meter.

c. Tune the wave analyzer through the entire frequency range of the 3320A/B. The wave analyzer meter indication should be > 60 dB below the reference set in Step b or - 110 dBm, whichever is greater.

NOTE

The 2, 1 spurious for a 3320A/B output frequency of 13 MHz is 7 MHz (40 MHz - 33 MHz). In Step c above, be sure to check at 7 MHz with the wave analyzer.

d. Connect the equipment as shown in Figure 5-3 (insure the 5 MHz oscillator is at 5,000,000.0 Hz).

CAUTION

DO NOT EXCEED THE RATED INPUT OF MIXER.

e. Set the 3320A/B RANGE to 10 MHz and FREQUENCY to 10.10. In 3320B, set LEVELING to ON (> 10 Hz).

f. Adjust the amplitude of the 3320A/B and the wave analyzer to 0.1 V meter indication at 100 kHz.

g. Tune the wave analyzer to 90 kHz, 80 kHz, 70 kHz, and 60 kHz. Meter indications for 10 kHz sidebands should be > 60 dB below the reference set in Step f or - 110 dBm, whichever is greater.

h. Set the 3320A/B FREQUENCY to 10.01 and repeat Step f for 10 kHz.

i. Tune the wave analyzer to 10.060 kHz, 10.120 kHz, 10.240 kHz, and 10.300 kHz. Meter indications for the 60 Hz sidebands should be > 60 dB below the reference set in Step f or - 110 dBm, whichever is greater.

5-15. Signal To Phase Noise.

5-16. This performance test insures the 3320A/B meets the Signal to Phase Noise specifications listed in Table 1-1. The specification for signal to phase noise is > 40 dB down in a 30 kHz band, excluding ± 1 Hz centered on carrier. This test uses a 5 MHz oscillator, with a frequency doubler, as a reference frequency. The output of the 3320A/B and the reference frequency are mixed and the difference signal is applied to a wideband ac voltmeter. When the 5 MHz oscillator is tuned slightly off frequency, the phase of the 3320A/B output signal will drift slightly. As the 3320A/B output and the reference oscillator drift through phase quadrature, the ac voltmeter will peak. This peak value is the maximum phase noise.

a. Connect the 5 MHz oscillator to a counter and adjust the frequency for 5,000,000.0 Hz.

b. Connect the equipment as shown in Figure 5-4.

CAUTION

DO NOT EXCEED THE RATED INPUT OF MIXER.

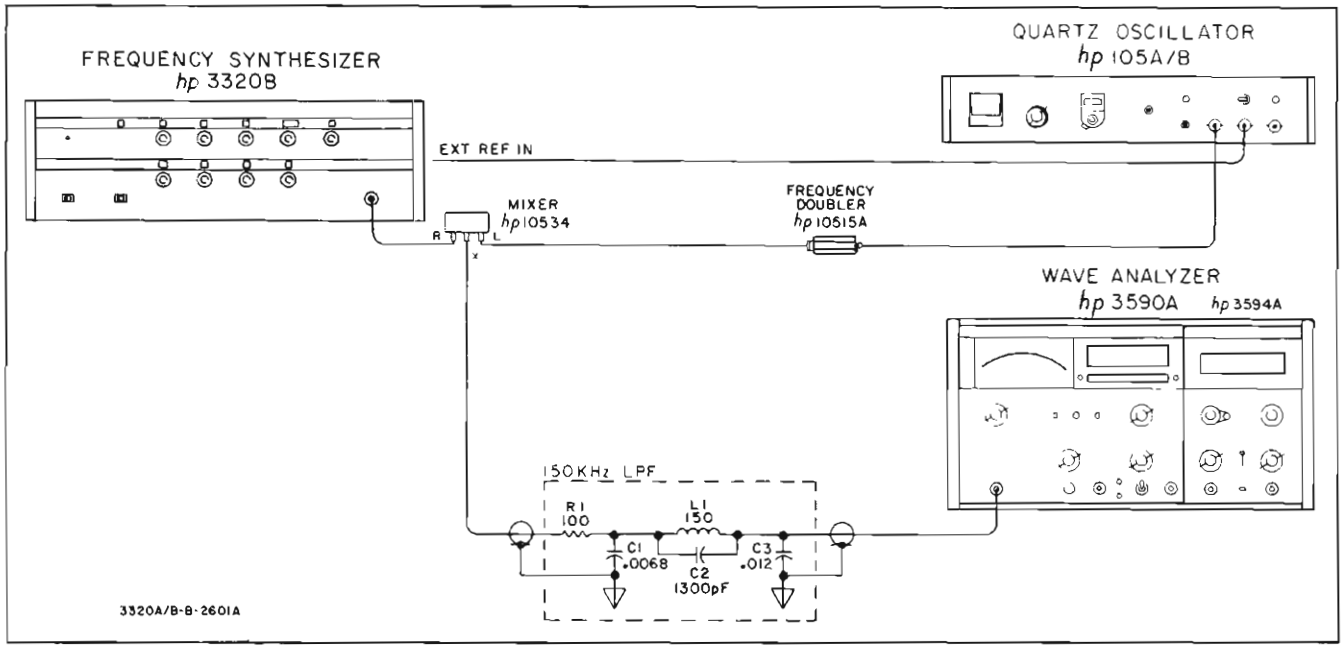


Figure 5-3. Spurious.

c. Set the 3320A/B RANGE to 10 MHz, FREQUENCY to 10.01, and VERN IN/VERN OUT to OUT. Adjust the 3320A/B amplitude for a convenient reference level on the ac voltmeter.

d. Set the oscilloscope DISPLAY to ALT B Trigger and adjust for a convenient display of both channels. The channel A signal will not lock.

e. Set the 3320A/B FREQUENCY to 10.00. Adjust the frequency of the 5 MHz oscillator until the channel A display on the oscilloscope is drifting *very* slowly.

f. Ground the Channel B input terminal on the oscilloscope and adjust the display for a convenient reference. Set the input terminal to dc.

g. Disconnect Channel B of the oscilloscope from point A (Figure 5-4) and connect to point B.

h. The oscilloscope display on Channel B should drift through 0 Vdc when the 3320A/B signal and the reference oscillator signal are in phase quadrature. The indication on the ac voltmeter, when the Channel B oscilloscope display is at 0 Vdc, should be $>$ 40 dB below the reference set in Step c.

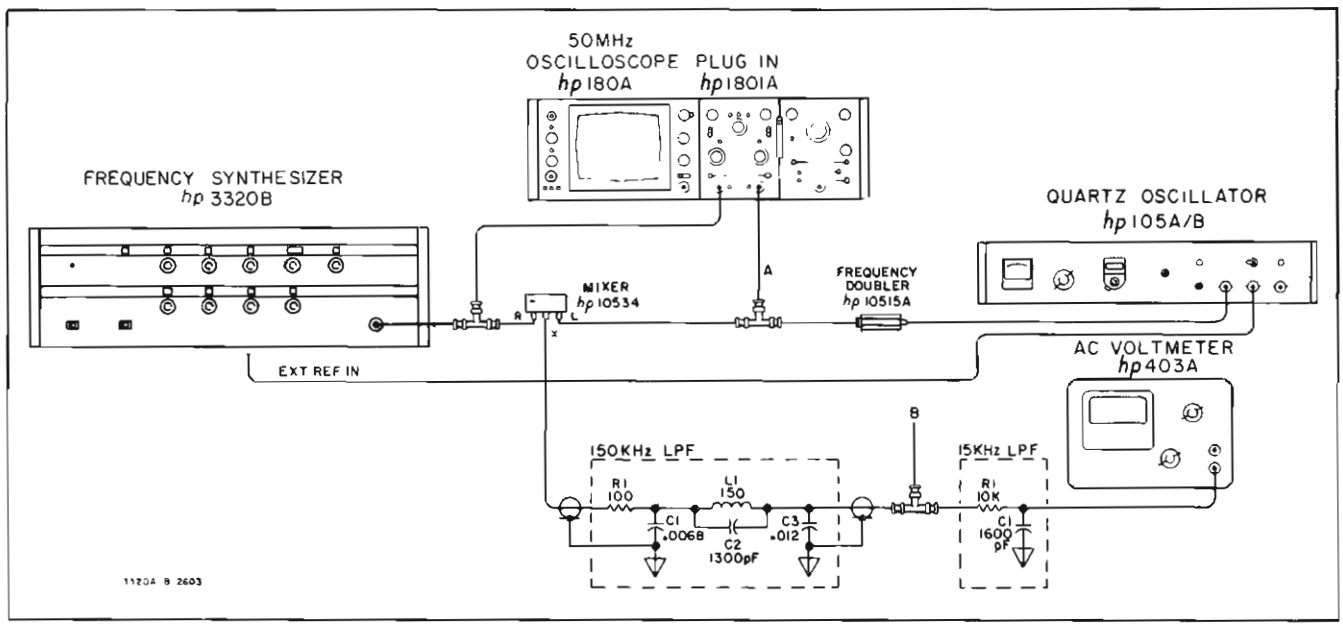


Figure 5-4. Signal to Phase Noise.

5-17. Amplitude Accuracy, Absolute.

5-18. This performance test insures the 3320A/B meets the absolute amplitude accuracy specifications listed in Table 1-1. The specifications are:

3320A Standard and Option 001:
1 V rms ± 10% into 50 ohms (75 ohms, Option 001).
2 V rms ± 10% open circuit.

3320B Standard:
5.0 V rms ± 0.5% into 50 ohms.
10.0 V rms ± 0.5% open circuit.

3320B Option 001:
4.86 V rms ± 0.5% into 75 ohms
9.73 V rms ± 0.5% open circuit.

3320A:

a. Connect an ac voltmeter to the 3320A front panel OUTPUT jack through a 50 ohm load (75 ohm load, Option 001).

b. Set the AMPLITUDE full clockwise. The ac voltmeter indication should be 1 V rms ± 0.1 V rms.

c. Remove the 50 ohm load (75 ohm load, Option 001). The ac voltmeter indication should be 2 V rms ± 0.2 V rms.

3320B:

a. Set the 3320B front panel controls as follows:

AMPLITUDE (3320B Standard) . . . + 26.99 dBm
(3320B, Option 001) . + 24.99 dBm
VERN IN/OUT . . . . . VERN OUT
RANGE . . . . . 10 kHz
FREQUENCY 10.00
LEVELING . . . . . .ON (> 10 Hz)

b. Connect an ac voltmeter to the 3320B front panel OUTPUT jack through a 50 ohm load (75 ohm load, Option 001). The ac voltmeter indication should be 5.000 V rms ± 0.025 V rms (4.863 V rms ± 0.024 V rms, Option 001).

c. Remove the 50 ohm load (75 ohm load, Option 001). The ac voltmeter indication should be 10.000 V rms ± 0.05 V rms (9.726 V rms ± 0.048 V rms, Option 001).

5-19. 3320A Frequency Response, 0.01 Hz - 13 MHz. 3320B Frequency Response, 0.01 Hz - 10 Hz.

5-20. This performance test insures the 3320A meets the Frequency Response specification listed in Table 1-1 over its entire frequency range. This test also insures the 3320B meets the Frequency Response specification listed in Table 1-1 from 0.01 Hz to 10 Hz. The specification for the 3320A is ± 2 dB. The specification for the 3320B is ± 0.5 dB (referenced to 10 kHz). The total frequency response specification for the 3320B covers all frequencies at all settings of the 10 dB output level attenuator. To test total frequency response of the 3320B perform this test; Frequency Response, 10 Hz - 13 MHz, Paragraph 5-21; and 3320B Output Attenuator Frequency Response, Paragraph 5-25.

3320A:

a. Connect an oscilloscope to the 3320A front panel OUTPUT jack.

b. Set the 3320A AMPLITUDE full CW, VERN IN/OUT to VERN OUT, RANGE to 10 kHz, and FREQUENCY to 10.00.

c. Ground the input terminal of the oscilloscope and adjust the vertical position control to position the sweep at center. Set the input terminal to dc and adjust the vertical gain for 8 cm display.

d. Set the oscilloscope vertical position control so the positive peaks of the display are on the center line.

e. Set the 3320A front panel controls to the positions listed in Table 5-2. The peaks on the oscilloscope display should not vary more than 1 cm positive and 0.8 cm negative.

Table 5-2. 3320A Frequency Response (0.01 Hz - 13 MHz).

RANGE	FREQUENCY	VERN IN/OUT
10 MHz	12.99	OUT
10 MHz	00.01	OUT
1000 kHz	1299.	OUT
1000 kHz	0001.	OUT
100 kHz	129.9	OUT
100 kHz	000.1	OUT
10 kHz	12.99	OUT
10 kHz	00.01	OUT
1000 Hz	1299.	OUT
1000 Hz	0001.	OUT
1000 Hz	0000.99	IN
1000 Hz	0000.50	IN
1000 Hz	0000.10	IN

3320B:

a. Connect an oscilloscope to the 3320B front panel OUTPUT jack.

b. Set the 3320B front panel controls as follows:

AMPLITUDE (Standard) . . . . . + 26.99 dBm
(Option 001) . . . . + 24.99 dBm
VERN IN/OUT . . . . . VERN IN
RANGE . . . . . 10 kHz
FREQUENCY 10.00
LEVELING . . . . . OFF

c. Perform Steps c and d of the 3320A section of this performance check.

d. Set the 3320B FREQUENCY, RANGE, and Vernier to the positions listed in Table 5-3. The peaks on the oscilloscope should not vary more than ± 0.2 cm.

Table 5-3. 3320B Frequency Response (0.01 Hz - 10 Hz).

RANGE	FREQUENCY	Vernier
1000 Hz	0010	00
1000 Hz	0005	00
1000 Hz	0001	00
1000 Hz	0000	99
1000 Hz	0000	55
1000 Hz	0000	10
1000 Hz	0000	01

5-21. 3320B Frequency Response, 10 Hz - 13 MHz.

5-22. This performance test insures the 3320B meets the Frequency Response specifications listed in Table 1-1 with the 10 dB attenuator in the straight through position. The specification is ± 0.05 dB (referenced to 10 kHz).

a. Set the 3320B front panel controls as follows:

AMPLITUDE (Standard) ..... + 26.99 dBm
(Option 001) .... + 24.99 dBm
VERN IN/OUT ..... VERN OUT
RANGE ..... 10 kHz
FREQUENCY 10.00
LEVELING .....ON (> 10 Hz)

b. Connect the equipment as shown in Figure 5-5.

c. Adjust the AMPLITUDE of the 3320B for a 7.000 mV ± 10 μV indication on the dc voltmeter.

NOTE

Do not change the setting of the 3320B 10 dB attenuator.

d. Set the 3320B RANGE and FREQUENCY to the positions listed in Table 5-4. The dc voltmeter indication should not vary more than ± 70 μV. Multiply the dc voltmeter indications by 71.5 to transpose the errors to mV indications. Record these adjusted indications. These readings will be used in the 3320B Output Attenuator Frequency Response performance test.

Table 5-4. 3320B Frequency Response (10 Hz - 13 MHz).

RANGE	FREQUENCY
10 MHz	12.99
10 MHz	00.01
1000 kHz	1299
1000 kHz	0001
100 kHz	129.9
100 kHz	000.1
10 kHz	12.99
10 kHz	00.01
1000 Hz	1299
1000 Hz	0010

5-23. 3320B Attenuator Accuracy, 10 kHz.

5-24. This performance test insures the 3320B meets the attenuator accuracy specification listed in Table 1-1. The specification is ± 0.02 dB/10 dB step, 10 kHz, referenced to the straight-through position of the output attenuator. This specification is accumulative as attenuation is added to the output. The tolerance for each added step is equal to the tolerance of the previous step plus 0.02 dB. The output of the 3320B is applied to a wave analyzer through a calibrated attenuator. The wave analyzer detects the 3320B output signal and applies the detected signal to a dc voltmeter. The dc voltmeter indications are recorded for later use in determining the 3320B output attenuator frequency response.

a. Connect the equipment as shown in Figure 5-6.

NOTE

This performance test uses a 355A 10 dB attenuator with a known accuracy on the 0 dB and 10 dB settings. The error in the attenuator must be considered in determining the error of the 3320B.

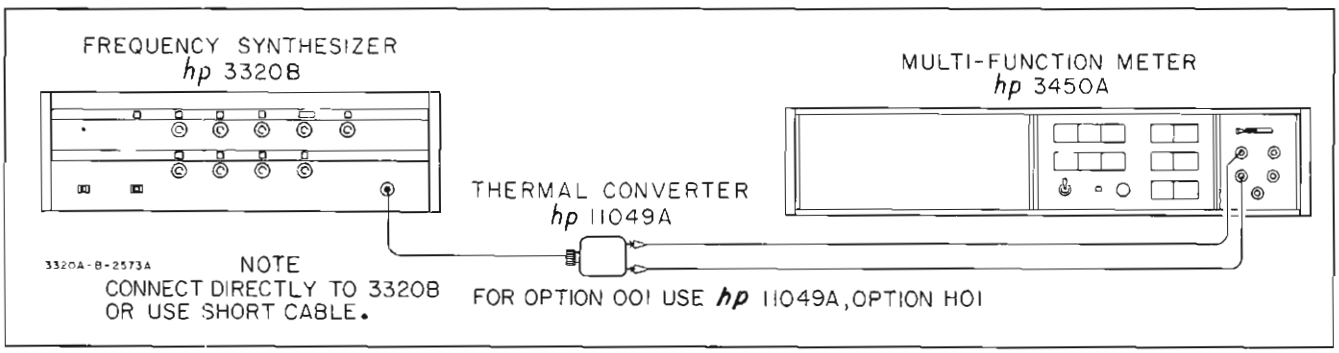


Figure 5-5. 3320B Frequency Response (10 Hz - 13 MHz).

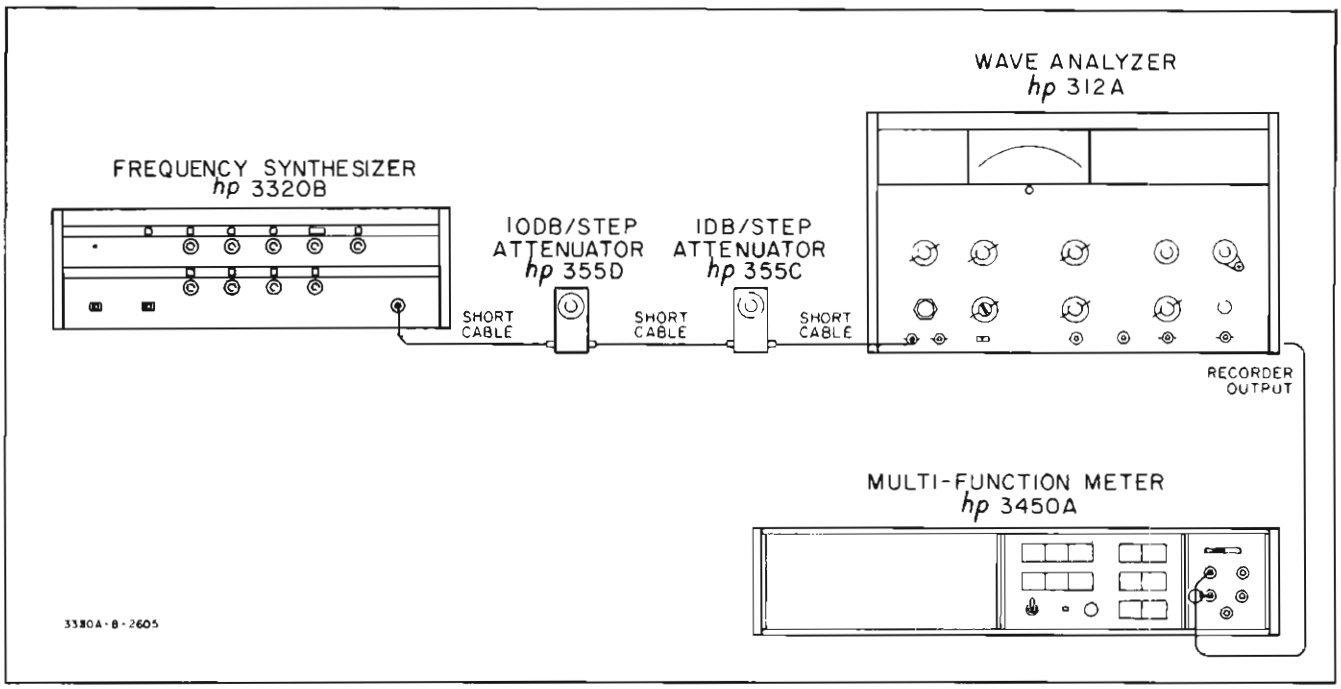


Figure 5-6. 3320B Attenuator Accuracy.

b. Set the 3320B front panel controls as follows:

AMPLITUDE (Standard) ..... + 25.00 dBm
(Option 001) .... + 24.00 dBm
VERN IN/OUT ..... VERN OUT
RANGE ..... 10 kHz
FREQUENCY 10.00
LEVELING .....ON (> 10 Hz)

c. Set the 355D to 10 dB and adjust the 355C and the wave analyzer for a 1.000 V dc indication on the dc voltmeter.

d. Set the 3320B AMPLITUDE to + 15.00 dBm (+ 14.00 dBm, Option 001). Set the 355D to 0 dB and record the difference between the dc voltmeter indication and the reference set in Step c.

e. Set the 355D to 10 dB and down range the wave analyzer 10 dB. Adjust the 355C and the wave analyzer for a 1.000 V dc indication on the dc voltmeter.

f. Set the 3320B AMPLITUDE to + 5.00 dBm (+ 4.00 dBm, Option 001) and set the 355D to 0 dB. Algebraically add and record the difference between the dc voltmeter indication and the reference set in Step e to the difference recorded in Step d.

g. Repeat Steps e and f for the remaining attenuator settings listed in Table 5-5. In Step f, algebraically add to the previously recorded difference instead of the difference recorded in Step d.

h. Specifications for each position of the output attenuator are as follows:

Attenuator (dBm)		Specification (mV)
Standard	Option 001	(accumulative)
+ 15.00	+ 14.00	± 2
+ 5.00	+ 4.00	± 4
- 5.00	- 6.00	± 6
- 15.00	- 16.00	± 8
- 25.00	- 26.00	± 10
- 35.00	- 36.00	± 12
- 45.00	- 46.00	± 14
- 55.00	- 56.00	± 16
- 65.00	- 66.00	± 18

5-25. 3320B Attenuator Frequency Response.

5-26. This performance test insures the 3320B meets the Frequency Response specifications listed in Table 1-1 at all positions of the 3320B 10 dB output attenuator. All specifications are referenced to 10 kHz. The specifications are listed again in Table 5-6. The last three digits of amplitude (i.e. 6.99 digits in + 26.99 dBm) are controlled by electronic attenuation in the 3320B Output Section. Frequency Response is not affected by this attenuation, therefore, this performance test evaluates only the most significant digit (10 dB attenuator). Each step of the attenuator is measured and the measurement recorded for a specific frequency, using the previous step as a reference, until all steps have been measured at that frequency. Then the procedure is repeated at another frequency. When all steps have been measured at all desired frequencies, the recorded information is used in conjunction with the recorded information in Paragraph 5-21 and 5-23 to determine the frequency response of the 10 dB attenuator.

Table 5-5. Output Attenuator.

3320B Attenuator (dBm)		355D (dB)	Wave Analyzer (dBm)
Standard	Option 001		
+ 25.00 (Ref)	+ 24.00 (Ref)	10	+ 10
+ 15.00	+ 14.00	0	Record dc Voltmeter Indication
+ 15.00 (Ref)	+ 14.00 (Ref)	10	0
+ 5.00	+ 4.00	0	Record dc Voltmeter Indication
+ 5.00 (Ref)	+ 4.00 (Ref)	10	- 10
- 5.00	- 6.00	0	Record dc Voltmeter Indication
- 5.00 (Ref)	- 6.00 (Ref)	10	- 20
- 15.00	- 16.00	0	Record dc Voltmeter Indication
- 15.00 (Ref)	- 16.00 (Ref)	10	- 30
- 25.00	- 26.00	0	Record dc Voltmeter Indication
- 25.00 (Ref)	- 26.00 (Ref)	10	- 40
- 35.00	- 36.00	0	Record dc Voltmeter Indication
- 35.00 (Ref)	- 36.00 (Ref)	10	- 50
- 45.00	- 46.00	0	Record dc Voltmeter Indication
- 45.00 (Ref)	- 46.00 (Ref)	10	- 60
- 55.00	- 56.00	0	Record dc Voltmeter Indication
- 55.00 (Ref)	- 56.00 (Ref)	10	- 70
- 65.00	- 66.00	0	Record dc Voltmeter Indication

a. Connect the equipment as shown in Figure 5-6.

NOTE

This performance test uses a 355D 10 dB attenuator with a known accuracy on the 0 dB and 10 dB settings. The error in the attenuator should be used in determining the error of the 3320B.

b. Set the 3320B front panel controls as follows:

AMPLITUDE (Standard) ..... + 25.00 dBm
(Option 001) .... + 24.00 dBm
VERN IN/OUT ..... VERN OUT
RANGE ..... 10 kHz
FREQUENCY 10.00
LEVELING ..... ON (> 10 Hz)

c. Set the 355D to 10 dB and adjust the 355C and wave analyzer for a 1.000 V dc indication on the dc voltmeter.

d. Set the 3320B AMPLITUDE to + 15.00 dBm (+ 14.00 dBm, Option 001). Set the 355D to 0 dB and record the difference between the dc voltmeter indication and the reference set in Step c.

Table 5-6. 3320B Frequency Response.

3320B ATTENUATOR SETTINGS (dBm)		SPECIFICATION (dB)	
Standard	Option 001	LEVELING OFF	LEVELING ON (> 10 Hz)
+ 26.99 to - 3.00	+ 24.99 to - 5.00	± 0.5	± 0.05
- 3.01 to - 23.00	- 5.01 to - 25.00	± 0.5	± 0.1
- 23.01 to - 53.00	- 25.01 to - 55.00	± 0.5	± 0.2
- 53.01 to - 69.99 *	- 55.01 to - 69.99 **	± 0.5	± 0.4

* - 73.00 dBm, remote control.
** - 75.00 dBm, remote control.

e. Repeat Steps c and d for settings listed in Table 5-5.

NOTE

The Attenuator settings marked Ref. in Table 5-5 are the settings used in Step c.

f. Repeat Steps c, d, and e for frequencies listed in Table 5-4.

NOTE

The reference frequency for the frequency response specification is 10 kHz. Due to the amount of error in the test equipment used, the frequency response of a specific attenuator step cannot be determined by comparing directly to 10 kHz on that step (See Step g).

g. To determine the frequency response of each step, the recorded indications of Step d are compared as follows:

(1) For the + 15.00 dBm (+ 14.00, Option 001) step frequency response, use the following formula:

A = B + C - D where

A = The relationship of the recorded error (Step d), measured at a specific frequency, to 10 kHz.

B = The recorded error (Step d)

C = The adjusted error at the same frequency as B recorded in Paragraph 5-21, Step d.

D = The recorded error at 10 kHz measured on the + 15.00 dBm attenuator step in Paragraph 5-23, Step d.

Example:

B = The recorded error at 1 MHz (Step d) = + 2 mV.

C = The adjusted error at 1 MHz recorded in Paragraph 5-21, Step d = - 1 mV.

D = The recorded error at 10 kHz measured on the + 15.00 dBm (+ 14.00, Option 001) attenuator step in Paragraph 5-23, Step d = - 1 mV.

A = 2 mV + (- 1 mV) - (- 1 mV) = 2 mV - 1 mV + 1 mV = 2 mV. Indicates 1 MHz is 2 mV positive in respect to 10 kHz on the + 15.00 dBm attenuator step.

(2) Once the frequency response for the + 15.00 dBm (+ 14.00, Option 001) attenuator step has been calculated, it must be used in the formula, A = B + C - D, for C. The procedure (Step g (1)) will then be repeated for the + 5.00 dBm attenuator step.

(3) Repeat the procedure (Step g (1)) for each of the remaining steps of the attenuator using the calculations of the preceeding steps for C in the formula.

(4) The frequency response specifications are as follows:

3320B Attenuator Settings (dBm)		Specification
Standard	Option 001	LEVELING ON (> 10 Hz)
+ 26.99 to - 3.00	+ 24.99 to - 5.00	± 5 mV
- 3.01 to - 23.00	- 5.01 to - 25.00	± 12 mV
- 23.01 to - 53.00	- 25.01 to - 55.00	± 23 mV
- 53.01 to - 69.99 *	- 55.01 to - 69.99 **	± 45 mV

* 73.00 dBm, remote control.
** 75.00 dBm, remote control.

h. Repeat steps b through e with the LEVELING OFF, FREQUENCY 00.05, and RANGE 1000 Hz. The specification is ± 60 mV on all attenuator settings.

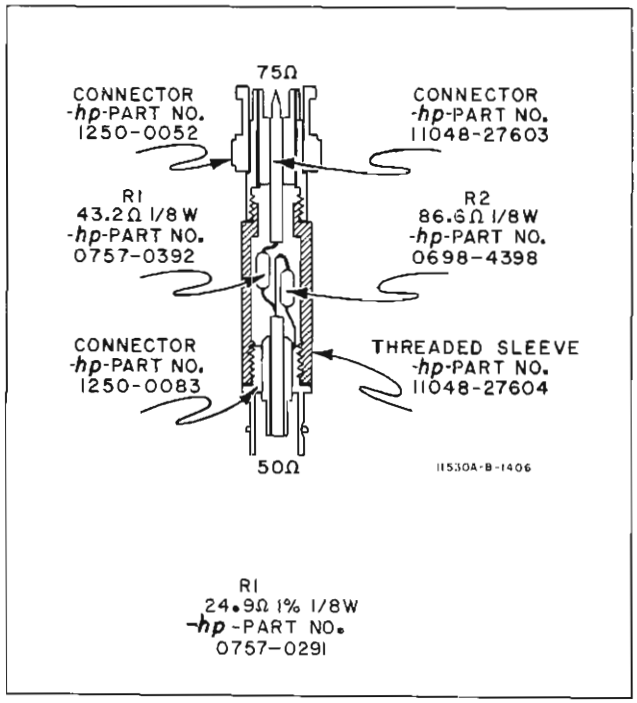


Figure 5-7. 50 Ohm To 75 Ohm Adapter.

5-27. ADJUSTMENT PROCEDURES.

5-28. The following is a complete adjustment procedure for the 3320A/B. This procedure should be conducted only if the 3320A/B has failed the performance tests. If proper performance cannot be achieved by the adjustment procedures, refer to the troubleshooting procedures, Section VII.

5-29. Power Supply.

5-30. This adjustment procedure sets the + 15 V dc supply and checks the voltages of the - 15 V dc, ± 5 V dc, and ± 30 V dc supplies.

a. Connect a dc voltmeter between A17 pin L (+ 15 V dc) and A17 pin 10 (ground).

b. Adjust A17R23 (+ 15 V adjust) for 14.950 V dc to 15.050 V dc.

c. Connect the dc voltmeter to the following pins and insure each voltage is within the tolerances shown.

A17 pin 14 ..... 5.000 to 5.300
A17 pin p ..... 5.000 to 5.300
A17 pin 7 ..... - 4.850 to - 5.370
A17 pin 8 ..... - 14.8 to - 15.2

d. Connect the dc voltmeter ground to A17 pin 4. Check the following voltages to insure they are within the tolerances shown.

A17 pin B ..... 29.125 to 30.875
A17 pin C ..... - 28.800 to - 31.200

5-31. Reference Oscillator.

5-32. This adjustment procedure sets the 20 MHz Reference Oscillator by monitoring the 1 MHz output on the rear panel of the 3320A/B. It also sets the External Reference Phase Lock circuitry.

NOTE

If the 3320A/B being adjusted is an Option 002, steps b and c of this performance test do not need to be performed. If the 3320A/B being adjusted is not an Option 002, step a of this performance test does not need to be performed.

a. Disconnect the short cable between the EXT FREQ REF and the 5 MHz OUT on the 3320A/B rear panel. Connect the electronic counter to the 5 MHz OUT and adjust the COURSE and FINE adjustments on the 3320A/B rear panel for 5,000,000 Hz. Reconnect the short cable between the EXT FREQ REF and the 5 MHz OUT. Connect the oscilloscope to A7TP1

b. Connect the oscilloscope to A7TP1. Connect the rear panel output of the counter to the EXT FREQ REF input on the rear panel of the 3320A/B.

c. Set the counter rear panel MODE to INT STD FREQ and OUTPUT STD FREQ to 10 MHz.

d. Adjust A8C4 (20 MHz ADJUST) until the display on the oscilloscope is a sinewave > 6 V p-p.

e. Ground the oscilloscope input and adjust trace for center of display. Set oscilloscope input to dc and readjust A8C4 for 0 V dc with no sinewave on oscilloscope display.

f. Connect the counter to the 1 MHz OUT on the rear panel of the 3320A/B. Counter indication should be 1 MHz ± 1 Hz.

5-33. VTO Linearity.

5-34. This adjustment procedure sets the VTO for a linear output over the 3320A/B frequency range.

a. Connect the dc voltmeter to A3TP2. Set the 3320A/B FREQUENCY to 12.99 and adjust A3R38 (PRETUNE ADJUST) for a voltmeter indication of - 10 V dc ± 0.3 V dc.

b. Connect the dc voltmeter to A3TP1. Set the 3320A/B FREQUENCY from 00.99 to 12.99 in 1 MHz steps. The dc voltmeter indication should not be more negative than - 4V dc on each frequency setting.

5-35. Vernier.

5-36. This adjustment procedure sets the Vernier Oscillator for a 10 kHz swing (VTO output) on the front panel Vernier.

a. Set the 3320A/B FREQUENCY TO 12.99, RANGE to 10 MHz, VERN IN/VERN OUT to VERN IN.

b. Connect the dc voltmeter to A1TP1. Adjust A1R1 (DC REF ADJ) for a dc voltmeter indication of - 6.06 V dc ± 0.02 V dc.

c. Connect the counter to the 3320A/B rear panel L.O. OUTPUT (20-33 MHz). Set the 3320A/B FREQUENCY to 0000, adjust A1R50 for 20 MHz ± 100 Hz.

d. Connect the oscilloscope to A1TP2 through a 6.8 pF capacitor. Adjust A1C3 (10 MHz LEVEL ADJUST) for maximum signal on oscilloscope display. Display should be > 250 mV p-p.

e. Set the 3320A/B Vernier to 99. Adjust A1R34 (10 kHz ADJUST) for 20,010,000 Hz to 20,010,075 Hz indication on the counter.

f. Set the 3320A/B Vernier to 50. Adjust A1R50 (5 kHz ADJUST) for 20,004,950 Hz to 20,005,050 Hz indication on the counter.

g. Set the 3320A/B Vernier to 00. Adjust A1C6 (0 Hz ADJUST) for 19,999,950 Hz to 20,000,000 Hz indication on the counter.

h. Repeat steps e, f, and g until all limits are met.

i. Set the 3320A/B Vernier to 99, FREQUENCY to 12.99. If necessary readjust A1R34 (10 kHz ADJUST) for 33,000,000 Hz to 33,000,100 Hz indication on the counter.

5-37. Amplitude Reference, 3320B.

5-38. This adjustment procedure sets the reference dc level from the D/A Converter.

a. Connect the dc voltmeter to A11TP1.

b. Set the 3320B AMPLITUDE to 16.99 dBm (-5.01 dBm, Option 001). Adjust A11R10 (REFERENCE ADJUST) for 10.0000 V dc ± 0.0005 V dc (9.729 V dc ± 0.005 mV dc, Option 001) indication on the dc voltmeter.

c. Set the 3320B AMPLITUDE to 17.00 dBm (-5.00 dBm, Option 001). Adjust A11R16 (DECAY ADJUST) for 3.1659 V dc ± 0.0002 V dc (3.0801 V dc ± 0.002 V dc, Option 001) indication on the dc voltmeter.

5-39. Carrier Balance.

5-40. This adjustment procedure sets the output of the Mixer for minimum carrier signal feed thru and maximum common mode rejection.

a. Set the 3320A/B FREQUENCY to 0100, RANGE to 1000 Hz, and LEVELING to OFF (3320B).

b. Connect the ac voltmeter to A10TP1. Adjust A10R37 (AC SIGNAL NULL) for a null indication on the ac voltmeter (< 100 mV ac).

c. Remove the brown cable from the Pre-Amp output on the A10 assembly. Move the green cable from the 20-30 MHz out on the A10 assembly to the Pre-Amp output jack.

d. Connect the spectrum analyzer through the 355D attenuator to the 3320A/B rear panel L.O. OUTPUT (20-33 MHz).

NOTE

Set 355D attenuator to 20 dB before connecting to 3320A/B.

e. Set the 3320A/B FREQUENCY to 12.99 and RANGE to 10 MHz.

f. Adjust A10R31 (CARRIER NULL) for minimum amplitude of the 32.99 MHz signal on the spectrum analyzer display.

g. Return the green cable to the 20-33 MHz jack on the A10 assembly. Replace the brown cable to the Pre-Amp output on the A10 assembly.

5-41. Amplitude.

5-42. This adjustment procedure sets the amplitude section of the 3320A/B for minimum temperature drift, minimum dc offset, and proper output voltage level.

3320B:

a. Set the 3320B FREQUENCY to 10.00, RANGE to 10 K, and AMPLITUDE to +17.00 dBm (+ 15.00 dBm, Option 001). Remove the red cable from the 20 MHz input on the A12B assembly. Remove the clear cable from the 0-13 MHz input on the A12B assembly. Short A12BTP2 to ground with a jumper cable.

b. Using jumper cables connect a 5 ohm resistor (two 10 ohm resistors in parallel) between A12BTP1 and ground. Connect Channel A input of the oscilloscope across the 5 ohm resistor.

c. Set the oscilloscope INPUT to dc and VOLTS/DIV to .1 (.01 if 10:1 divider probe is used). Adjust oscilloscope display for a convenient reference.

d. Adjust A12BR10 (OFFSET ADJUST) until there is a noticeable (approximately 1.5 cm) dc level shift (either up or down) on the oscilloscope display then readjust A12BR10 in the opposite direction until the dc level on the oscilloscope display is on the threshold of shifting back.

e. Remove the 5 ohm resistor and all jumper cables. Replace the red cable to the 20 MHz input and the clear cable to the 0-13 MHz input on the A12B assembly.

f. Connect the dc voltmeter to the 3320B front panel output jack.

g. Set the 3320B AMPLITUDE to +26.99 dBm (+ 24.99 dBm, Option 001).

h. Adjust A10R45 (DC OFFSET) for a 0 V dc ± 2 mV dc indication on the dc voltmeter.

i. Connect the ac voltmeter through a 50 ohm load (75 ohm load, Option 001) to the 3320B front panel output jack.

j. Set the 3320B FREQUENCY to 10.00, RANGE to 10 kHz, AMPLITUDE to +26.99 dBm (+ 24.99 dBm, Option 001), and LEVELING to ON (> 10 Hz).

k. Adjust A12BR30 (+5 V ADJ) for 5.000 V ac ± 0.001 V ac (4.8646 V ac ± 0.0012 V ac, Option 001) indication on the ac voltmeter. If A12BR30 does not have enough range remove A1BAR2 (thermocouple), rotate it 180°, and replace it back on the A12B assembly. Repeat adjustment of A12BR30.

l. Set the 3320B AMPLITUDE to +17.00 dBm (+15.00 dBm, Option 001) and adjust A12BR34 (1.583 V ADJ) for 1.583 V ac ± 0.001 V ac (1.540 V ac ± 0.002 V ac, Option 001) indication on the ac voltmeter.

3320A:

a. Connect the dc voltmeter to the 3320A front panel output jack. Set the 3320A AMPLITUDE Full C W.

b. Remove the brown cable from the input of the A12A assembly. Connect a jumper cable between A12A J1 and ground.

c. Adjust A12AR11 (DC OFFSET) for 0 V dc ± 2 mV dc indication on the dc voltmeter.

d. Remove the shorting cable from A12A J1 and replace the brown cable. Adjust A10R45 (DC OFFSET) for a 0 V dc ± 2 mV dc indication on the dc voltmeter.

e. Connect the ac voltmeter through a 50 ohm load (75 ohm load, Option 001) to the 3320A front panel output jack.

f. Adjust A9AR52 (AMPLITUDE ADJUST) for 1.000 V ac ± 0.1 V ac indication on the ac voltmeter.

5-43. Harmonics, 3320B.

5-44. This adjustment procedure sets the harmonic level of the 3320B output signal to a minimum.

a. Connect the spectrum analyzer through the 355D (set to 40 dB) attenuator to the 3320B front panel output jack.

b. Set the 3320B FREQUENCY to 12.99, RANGE to 10 MHz, AMPLITUDE to +26.99 dBm (+24.99 dBm, Option 001), and LEVELING to ON (> 10 Hz).

c. Adjust A14R55 (BIAS ADJUST) until the third harmonic of the 12.99 MHz signal is approximately 42 dB below the 12.99 MHz fundamental on the spectrum analyzer display.

5-45. Leveling, 3320B.

5-46. This adjustment procedure sets the 3320B output signal for equal ac levels when switching from LEVELING OFF to LEVELING ON (> 10 Hz).

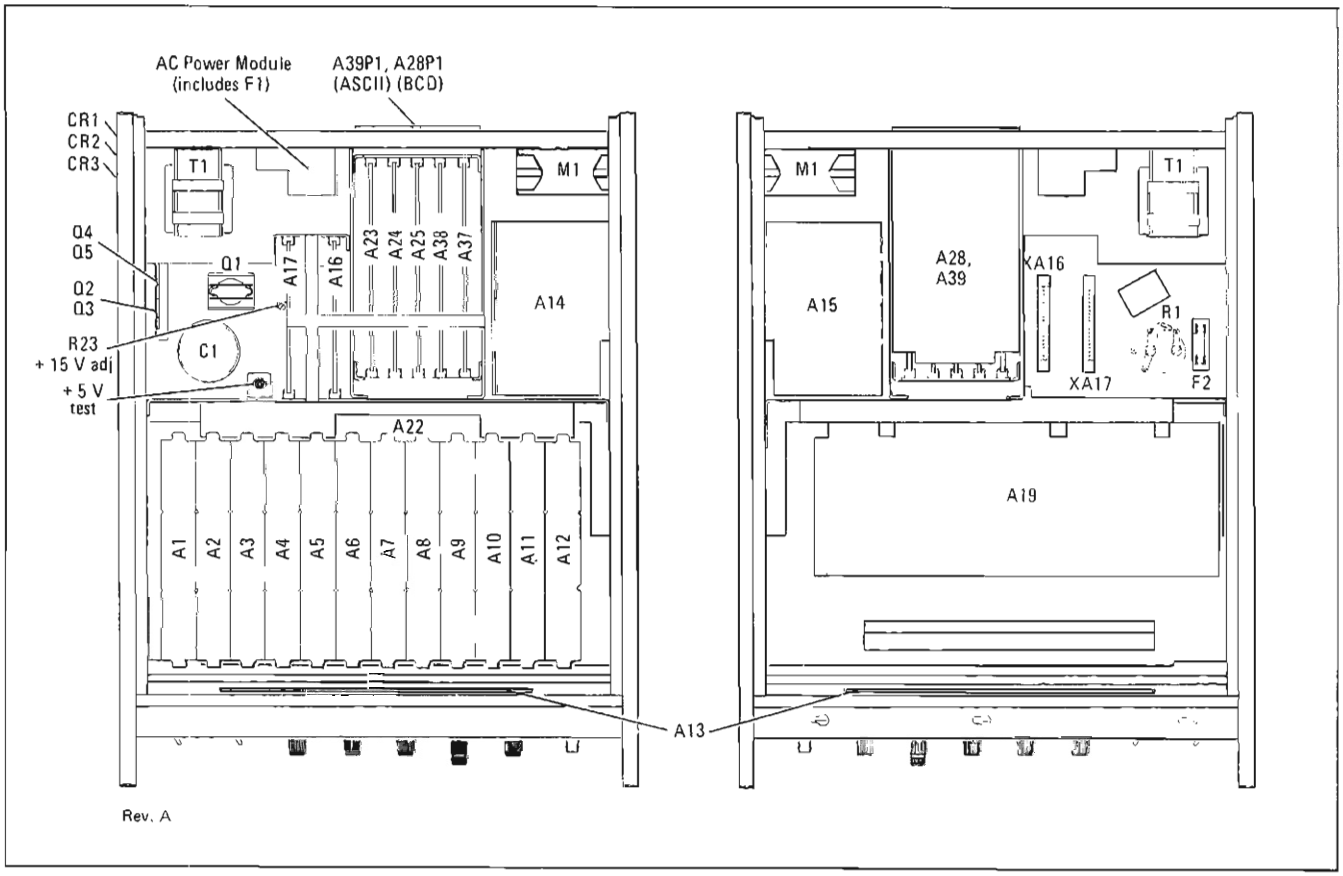


Figure 5-8. Chassis Mounted Components.

a. Connect the ac voltmeter to the 3320B front panel output jack.

b. Set the 3320B FREQUENCY to 10.00, RANGE to 10 kHz, AMPLITUDE to + 16.99 dBm (+ 14.99 dBm, Option 001), and LEVELING to ON (> 10 Hz). Record the ac voltmeter indication.

c. Set the 3320B LEVELING to OFF and adjust A9BC24 (LEVELING OFF ADJUST) to the same ac voltmeter indication as recorded in step b ± 10 mV ac.

5-47. Transient Response, 3320B.

5-48. This adjustment procedure sets the 3320B Leveling loop transient response.

a. Connect the dc voltmeter to A12BTP3.

b. Set the 3320B FREQUENCY to 10.00, RANGE to 10 kHz, and AMPLITUDE to + 16.99 dBm (+ 14.99 dBm, Option 001). Record dc voltmeter indication.

c. Set 3320B AMPLITUDE to + 17.99 dBm (+ 15.99 dBm, Option 001). Adjust A9BR27 (PRETUNE ADJUST) for the same dc voltmeter indication as recorded in step b.

d. Adjusting A9BR27 effects the voltage indication at + 16.99 dBm. Repeat steps b and c until the two indications are within ± 200 mV dc.

GENERAL MAINTENANCE INFORMATION

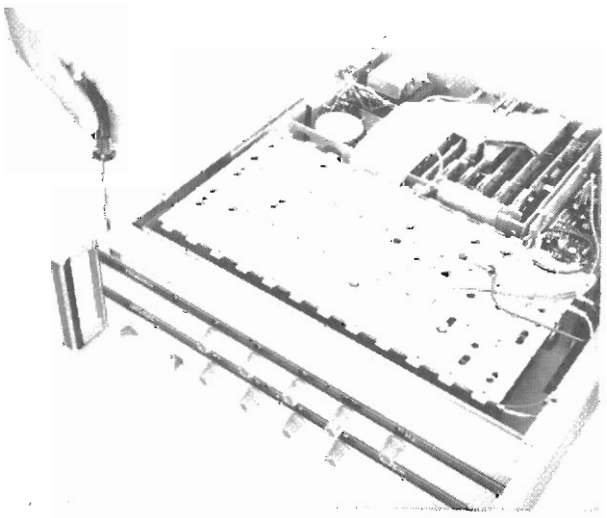
5-49. GENERAL MAINTENANCE INFORMATION.

5-50. The following paragraphs contain information on front panel removal, front panel disassembly and front panel assembly. Also included is a cam positioning information for 50 ohm and 75 ohm instruments.

5-51. Front Panel Removal.

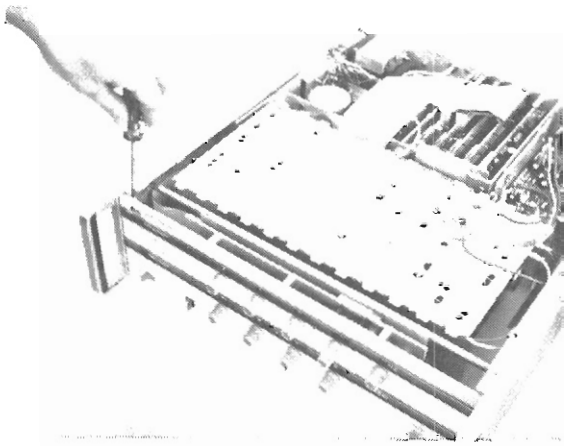
5-52. The following procedure provides information for removing the 3320A/B front panel.

Step A



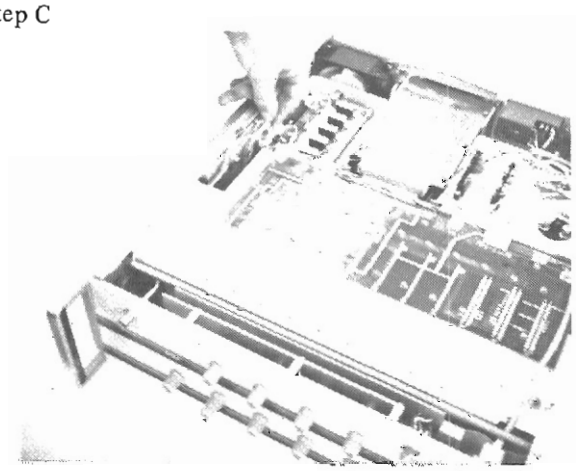
Remove top and bottom covers, MP21 and MP25.

Step B



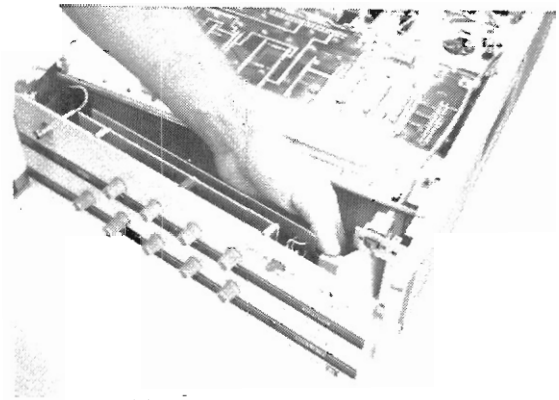
Remove four screws holding front panel to side castings.

Step C



Turn instrument upside down and remove the output cable at J9.

Step D

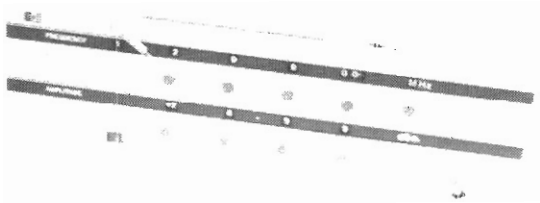


Remove the ribbon cable from the A13 Switch Assembly and remove the front panel.

5-53. Front Panel Disassembly.

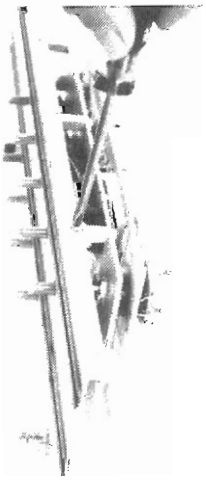
5-54. The following procedure provides information for disassembling the 3320A/B front panel. This will allow replacement of the switch wafers on the A13 Switch Assembly. On earlier 3320A/B instruments the switch wafers were not replaceable. Refer to the backdating Section VIII for serial number breakdown for the earlier instruments.

Step A



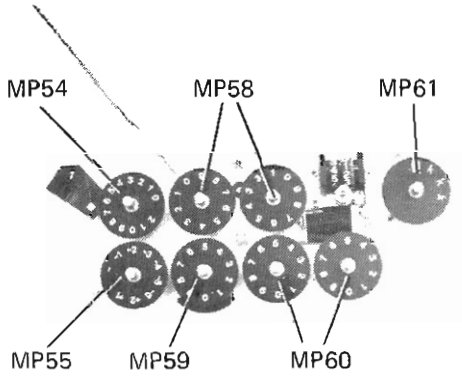
Remove front panel knobs and leveling switch.

Step B



Remove the six screws holding the front panel to the A13 Switch Assembly. Unsolder decimal indicator wires (Note wire colors and destinations).

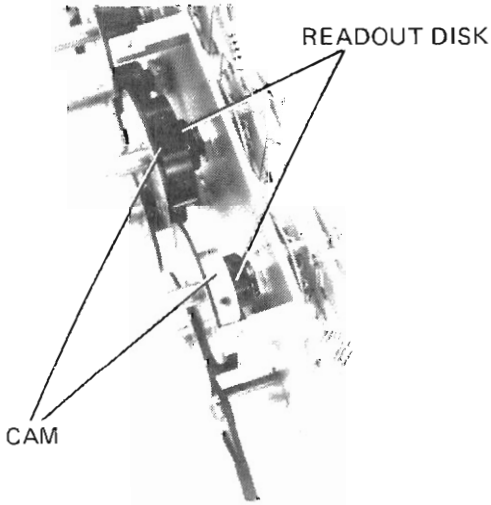
Step C



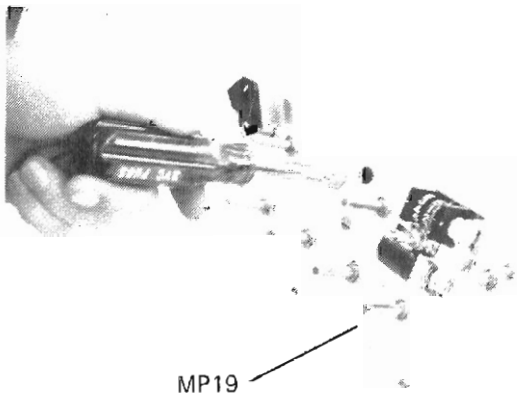
Remove Readout Disks (MP54, MP55, MP58 - 2 each, MP59 - 3 each, MP60).

NOTE

MP54, MP55, MP59 and MP61 Readout Disks have cams mounted on them. Do not loosen the Allen screws on the cams.



Step D



Remove mounting nuts holding A13 Switch Assembly to MP19.

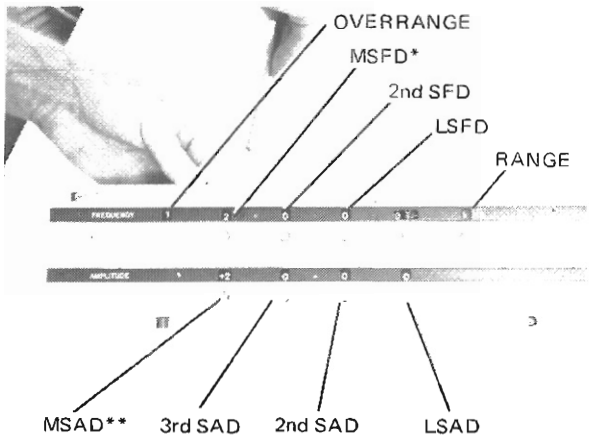
5-55. Front Panel Assembly.

5-56. The following procedure provides information for assembling the 3320A/B front panel.

Step A

Replace MP19 with locking nuts. (See Paragraph 5-54, Step D). Slide Readout Disks onto switch shafts. (Do not tighten Allen screws). Replace and fasten front panel. (See Paragraph 5-54, Step B).

Step B



* Most significant frequency digit.
** Most significant amplitude digit.

Set the frequency, Range and amplitude switches as follows:

MSFD . . . . . CW
2nd SFD, LSFD, 3rd SAD,
2nd SAD, LSAD . . . . . gap in rotor blade is up. (See Figure below).
MSAD . . . . . CW
Range . . . . . CW, then CCW one position.

Hold Readout Disks in positions listed in Table 5-7 and tighten Allen screws.

NOTE

Maintain approximately 1/16 inch clearance between Readout Disk and front panel. This will prevent scratching of Readout Disks when they are rotated.

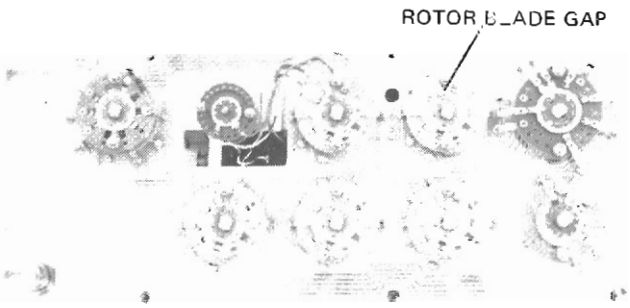


Table 5-7. Readout Disks Positions.

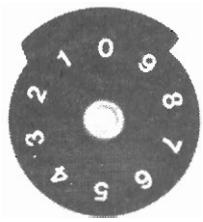
Readout Disk	Number In Front Panel Window
Overrange, MSFD *	12
2nd SFD	0
LSFD	0
Range	3rd K (next to M)
MSAD	+ 2
3rd SAD	0
2nd SAD	0
LSAD	0

* On MSFD and overrange digit, rotate the Readout Disk until the cam trips the overrange flag for a 1 in the overrange window. Continue to rotate the Readout Disk until a 2 appears in the MSFD window.

5-57. Impedance Cam Settings.

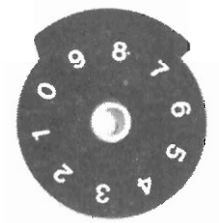
5-58. The following procedures indicate the proper positioning of the impedance cams. These cams are located on the 2nd SAD Readout Disk (See Paragraph 5-56, Step B). Proper positioning of this cam prevents the amplitude controls from being set higher than the maximum output dBm. The maximum output for the standard 3320B is + 26.99 dBm. The maximum output for the 3320B Option 001 is + 24.99 dBm.

Standard 3320B:

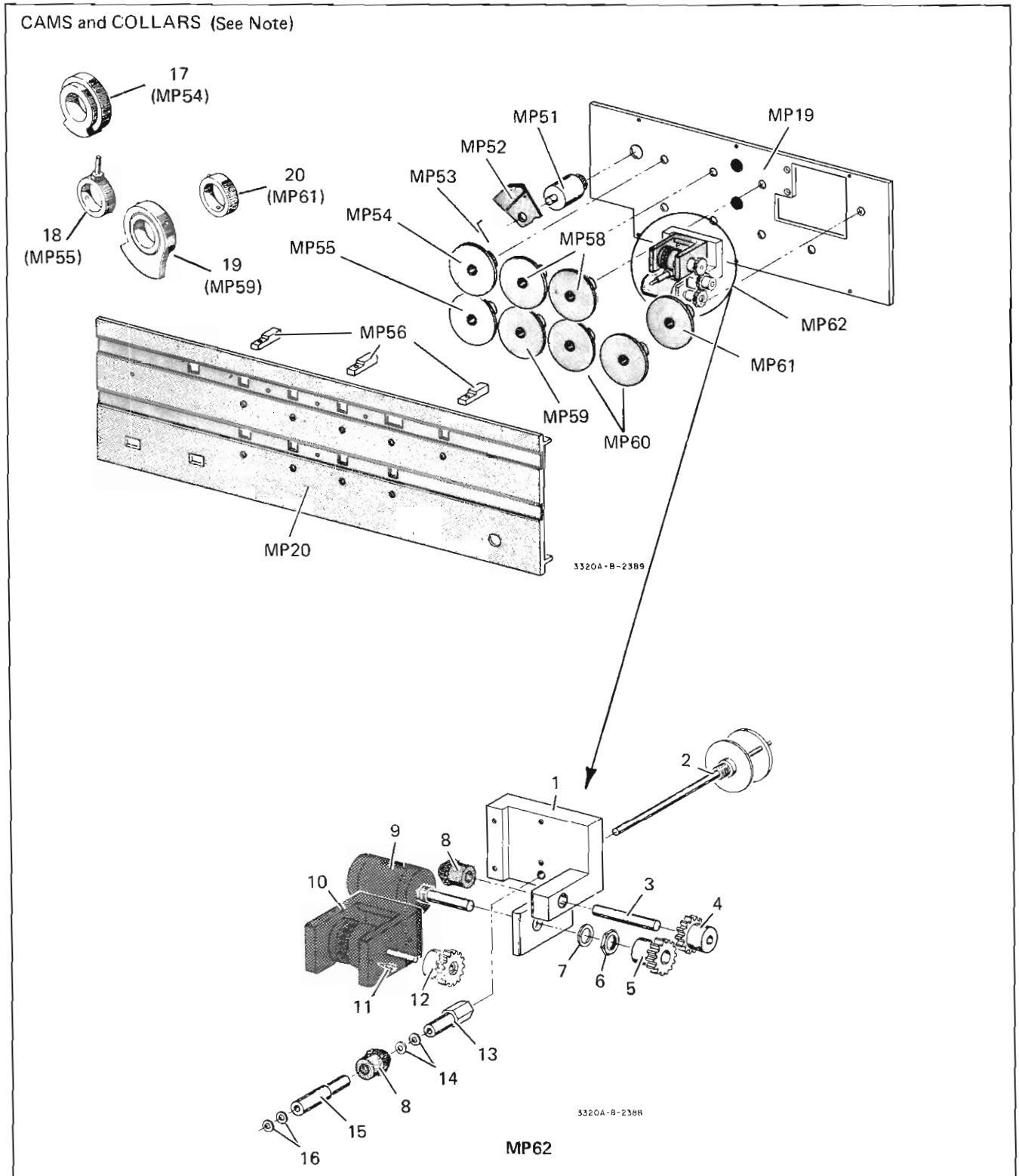


Loosen Allen screws on cam, position cam as shown above, tighten Allen screws.

3320B Option 001:



Loosen Allen screws on cam, position cam as shown above, tighten Allen screws.



NOTE: Cams and collars (parts 17, 18, 19, 20) fit on Readout Disks noted in parenthesis).

Figure 5-9. Front Panel and Vernier Control Mechanical Parts.

PERFORMANCE TEST CARD

Hewlett-Packard Model 3320A/B
Frequency Synthesizer

Serial No. _____

Test Performed By _____

Date _____

Frequency Accuracy

Vernier Out			
1 MHz	.9999990 MHz	_____	1.0000010 MHz
12.22 MHz	12.219878 MHz	_____	12.220122 MHz
1.10 MHz	1.099989 MHz	_____	1.100011 MHz
00.01 MHz	99.99900 μs	_____	100.00100 μs
Vernier In			
00.0150 MHz	14.000 kHz	_____	16.000 kHz
12.9999 MHz	12.9989 MHz	_____	13.0009 MHz
1000 kHz Range		_____	
100 kHz Range		_____	
10 kHz Range		_____	
1000 Hz Range		_____	

Harmonic Distortion

10 kHz	_____	> - 60 dB
129.9 kHz	_____	> - 50 dB
150 kHz	_____	> - 50 dB
1299 kHz	_____	> - 40 dB
4 MHz	_____	> - 40 dB
7 MHz	_____	> - 40 dB
12.99 MHz	_____	> - 40 dB

Spurious _____ > - 60 dB or - 110 dBm

Signal to Phase Noise _____ > - 40 dB

3320A Amplitude Accuracy

50 Ohm load	0.9 V rms	_____	1.1 V rms
Open circuit	1.8 V rms	_____	2.2 V rms

3320B Amplitude Accuracy

50 Ohm load	4.975 V rms	_____	5.025 V rms
Open circuit	9.95 V rms	_____	10.05 V rms

Frequency Response

3320A	- 0.8 cm	_____	+ 1 cm
3320B, 0.01 Hz–10 Hz	- 0.2 cm	_____	+ 0.2 cm
3320B, 10 Hz–13 MHz	6930 μV dc	_____	7070 μV dc

Adjusted Errors:

12.99 MHz	.01 MHz	1299 kHz	1 kHz	129.9 kHz	.1 kHz	12.99 kHz	.01 kHz	1299 Hz	10 Hz

Attenuator Accuracy, 3320B

+ 15.00 dBm	0.998 V dc	_____	1.002 V dc
+ 5.00 dBm	0.996 V dc	_____	1.004 V dc
- 5.00 dBm	0.994 V dc	_____	1.006 V dc
- 15.00 dBm	0.992 V dc	_____	1.008 V dc
- 25.00 dBm	0.990 V dc	_____	1.010 V dc
- 35.00 dBm	0.988 V dc	_____	1.012 V dc
- 45.00 dBm	0.986 V dc	_____	1.014 V dc
- 55.00 dBm	0.984 V dc	_____	1.016 V dc
- 65.00 dBm	0.982 V dc	_____	1.018 V dc

Attenuator Frequency Response, 3320B

Record Readings (Step d):

	12.99 MHz	.01 MHz	1299 kHz	1 kHz	129.9 kHz	.1 kHz	12.99 kHz	.01 kHz	1299 Hz	10 Hz
+ 15										
+ 5										
- 5										
- 15										
- 25										
- 35										
- 45										
- 55										
- 65										

Calculated Error (Step g):

	12.99 MHz	.01 MHz	1299 kHz	1 kHz	129.9 kHz	.1 kHz	12.99 kHz	.01 kHz	12.99 Hz	10 Hz	Specification
+ 15											± 5 mV
+ 5											± 5 mV
- 5											± 12 mV
- 15											± 12 mV
- 25											± 23 mV
- 35											± 23 mV
- 45											± 23 mV
- 55											± 45 mV
- 65											± 45 mV

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 -hp- part number of each part, 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. Description of the part. See list of abbreviations below.

c. Typical manufacturer of the part in a five-digit code. See Appendix A for a list of manufacturers.

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. See Appendix B for a list of office locations. Identify parts by their Hewlett-Packard part numbers. Rebuilt boards can be purchased at a reduced price on an exchange basis. See Page 6-31 for a list of 3320A/B rebuilt boards and their part numbers. For more information contact your local Hewlett-Packard Field Office.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

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

ABBREVIATIONS

Ag ..... silver
Al ..... aluminum
A ..... ampere(s)
Au ..... gold

C ..... capacitor
cer ..... ceramic
coef ..... coefficient
com ..... common
comp ..... composition
conn ..... connection

dep ..... deposited
DPDT ..... double-pole double-throw
DPST ..... double-pole single-throw

elect ..... electrolytic
encap ..... encapsulated

F ..... farad(s)
FET ..... field effect transistor
fxd ..... fixed

GaAs ..... gallium arsenide
GHz ..... gigahertz = 10^{+9} hertz
gd ..... guard(ed)
Ge ..... germanium
gnd ..... ground(ed)

H ..... henry(ies)
Hg ..... mercury

Hz ..... hertz (cycle(s) per second)

ID ..... inside diameter
impg ..... impregnated
incd ..... incandescent
ins ..... insulation(ed)

kΩ ..... kilohm(s) = 10^{+3} ohms
kHz ..... kilohertz = 10^{+3} hertz

L ..... inductor
lin ..... linear taper
log ..... logarithmic taper

mA ..... milliampere(s) = 10^{-3} amperes
MHz ..... megahertz = 10^{+6} hertz
MΩ ..... megohm(s) = 10^{+6} ohms
met flm ..... metal film
mfr ..... manufacturer
ms ..... millisecond
mtg ..... mounting
mV ..... millivolt(s) = 10^{-3} volts
μF ..... microfarad(s)
μs ..... microsecond(s)
μV ..... microvolt(s) = 10^{-6} volts
my ..... Mylar®

nA ..... nanoampere(s) = 10^{-9} amperes
NC ..... normally closed
Ne ..... neon
NO ..... normally open
NPO ..... negative positive zero (zero temperature coefficient)
ns ..... nanosecond(s) = 10^{-9} seconds
nsr ..... not separately replaceable

Ω ..... ohm(s)
obd ..... order by description
OD ..... outside diameter

p ..... peak
pA ..... picoampere(s)
pc ..... printed circuit
pF ..... picofarad(s) = 10^{-12} farads
piv ..... peak inverse voltage
p/o ..... part of
pos ..... position(s)
poly ..... polystyrene
pot ..... potentiometer
p-p ..... peak-to-peak
ppm ..... parts per million
prec ..... precision (temperature coeffient, long term stability and/or tolerance)

R ..... resistor
Rh ..... rhodium
rms ..... root-mean-square
rot ..... rotary

Se ..... selenium
sect ..... section(s)
Si ..... silicon
sl ..... slide
SPDT ..... single-pole double-throw
SPST ..... single-pole single-throw

Ta ..... tantalum
TC ..... temperature coefficient
TiO_2 ..... titanium dioxide
tog ..... toggle
tol ..... tolerance
trim ..... trimmer
TSTR ..... transistor

V ..... volt(s)
vacw ..... alternating current working voltage
var ..... variable
vdcw ..... direct current working voltage

W ..... watt(s)
w/ ..... with
wiv ..... working inverse voltage
w/o ..... without
ww ..... wirewound

* ..... optimum value selected at factory, average value shown (part may be omitted)
** ..... no standard type number assigned selected or special type

® Dupont de Nemours

DECIMAL MULTIPLIERS

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

STD-8-2734

DESIGNATORS

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

Table 6-1. Replaceable Parts.

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	03320-66501	1	BOARD ASSY:VERNIER OSCILLATOR	28480	03320-66501
A1C1	0160-2009	8	C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A1C2	0140-0193	1	C:FXD MICA 82 PF 5%	28480	0140-0193
A1C3	0121-0436	2	C:VAR AIR 2.4-24.5 PF	74970	189-509-105
A1C4	0150-0093	120	C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1C5	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1C6	0121-0432	2	C:VAR AIR 1.7-14.1 PF	74970	189-505-105
A1C7	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1C8	0180-1746	29	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C9	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C10	0180-1746		C: FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
† A1C11	0150-0046	3	C FXD 68 PF	78488	Type GA
A1C12	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C13	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C14	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A1C15	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1CR1	1901-0040	57	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR2	0122-0059	4	DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A1CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1IC1	1826-0043	27	IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A1IC2	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A1IC3	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A1IC4	1820-0584	24	IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A1IC5	1820-0751	6	IC:DIGITAL	01295	SN74196N
A1IC6	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A1IC7	1820-0751		IC:DIGITAL	01295	SN74196N
A1IC8	1820-0751		IC:DIGITAL	01295	SN74196N
A1IC9	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A1L1	9140-0180	1	COIL/CHOKE 2.70 UH 10%	28480	9140-0180
A1L2	9100-1621	1	COIL/CHOKE 18 UH 10%	28480	9100-1621
A1L3	9140-0107	9	COIL:FXD RF 27 UH 10%	99800	1840-38
A1L5	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A1L6	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A1L7	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A1Q1	1853-0020	10	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q2	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q3	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q4	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q5	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q6	1854-0019	16	TSTR:SI NPN	28480	1854-0019
A1Q7	1854-0019		TSTR:SI NPN	28480	1854-0019
A1Q8	1854-0019		TSTR:SI NPN	28480	1854-0019
A1Q9	1854-0404	21	TSTR:SI NPN	28480	1854-0404
A1Q10	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q11	1854-0404		TSTR:SI NPN	28480	1854-0404
A1R1	2100-2489	1	R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A1R2	0698-3382	1	R:FXD MET FLM 5.49K OHM 1% 1/8W	19701	MF4C T-0
A1R3	0698-3279	16	R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R4	0757-0452	1	R:FXD MET FLM 27.4K OHM 1% 1/8W	28480	0757-0452
A1R5	0757-0441	1	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A1R6	0757-0289	3	R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A1R7	0757-0442	22	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R8	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R9	0757-0283	10	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R10	0698-4479	3	R:FXD FLM 14K OHM 1% 1/8W	28480	0698-4479
A1R12	0698-3259	5	R:FXD FLM 7.87K OHM 1% 1/8W	28480	0698-3259
A1R13	0698-3259		R:FXD FLM 7.87K OHM 1% 1/8W	28480	0698-3259
A1R14	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R15	0698-4479		R:FXD FLM 14K OHM 1% 1/8W	28480	0698-4479
A1R16	0698-4480	2	R:FXD MET FLM 15.8K OHM 1% 1/8W	28480	0698-4480
A1R17	0698-4480		R:FXD MET FLM 15.8K OHM 1% 1/8W	28480	0698-4480
A1R18	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R19	0698-4479		R:FXD FLM 14K OHM 1% 1/8W	28480	0698-4479
A1R20	0698-3160	3	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R21	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R23	0698-3558	2	R:FXD MET FLM 4.02K OHM 1% 1/8W	28480	0698-3558
A1R24	0698-4489	1	R:FXD FLM 28K OHM 1% 1/8W	28480	0698-4489
A1R25	0757-0460	2	R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A1R26	0757-0460		R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A1R27	0698-4473	3	R:FXD FLM 8.06K OHM 1% 1/8W	28480	0698-4473
A1R28	0757-0459	2	R:FXD MET FLM 56.2K OHM 1% 1/8W	28480	0757-0459
A1R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R30	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R32	0698-3519	1	R:FXD MET FLM 12.4K OHM 1% 1/8W	28480	0698-3519
A1R33	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R34	2100-3103	2	R:VAR CERMET 10K OHM 10% TYPE P 3/4W	28480	2100-3103

† See Section VIII, Manual Backdating.

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R35	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R36	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R37	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R38	0757-0401	4	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R39	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R40	0757-0430	2	R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430
A1R41	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R42	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R43	0698-4486	1	R:FXD MET FLM 24.9K OHM 1% 1/8W	28480	0698-4486
A1R44	0757-0459		R:FXD MET FLM 56.2K OHM 1% 1/8W	28480	0757-0459
A1R45	0698-4473		R:FXD FLM 8.06K OHM 1% 1/8W	28480	0698-4473
A1R46	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R47	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R48	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1R49	0757-0290	2	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A1R50	2100-3103		R:VAR CERMET 10K OHM 10% TYPE P 3/4W	28480	2100-3103
A1R51	0698-4435	2	R:FXD FLM 2.49K OHM 1% 1/8W	28480	0698-4435
A1R53	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R54	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R55	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R56	0684-1051	3	R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A1R57	0757-0280	10	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
† A1R58			UNASSIGNED		
A1R59	0684-1051		R:FXD COMP 1MEGOHM 10% 1/4W	01121	CB 1051
A1R60	0684-3321	4	R:FXD COMP 3300 OHM 10% 1/4W	01121	CB3321
A1R61	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A1TP1	08443-00041	4	TEST POINT	28480	08443-00041
A1TP2	08443-00041		TEST POINT	28480	08443-00041
A1Y1	0410-0437	1	CRYSTAL:QUARTZ	28480	0410-0437
A2	03320-66502	1	BOARD ASSY:N- SAMPLER	28480	03320-66502
A2C1	0180-1702	1	C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X00C6R2-DYS
A2C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C3	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C4	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C5	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C6	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C7	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C11	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A2C12	0150-0084	21	C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A2C13	0180-0194	1	C:FXD TA 150 UF 10% 15VDCW	56289	150D157X9015S2-DYS
A2C14	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A2C15	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A2C16	0160-0194	1	C:FXD MY 0.015 UF 10%	56289	192P15392-PTS
A2C17	0160-2229	1	C:FXD MICA 3000 PF 5%	28480	0160-2229
A2C18	0160-2199	3	C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A2C19	0160-2291	1	C:FXD MY 0.18 UF 10% 80VDCW	56289	192P1849R8-PTS
A2C21	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A2C22	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A2C23	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A2C24	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A2C25	0170-0040	1	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A2C26	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
† A2CR1	1910-0016		DIODE:GER 50 MA 60 WIV	93332	D2361
† A2CR2	1910-0016		DIODE:GER 50 MA 60 WIV	93332	D2361
† A2CR3	1910-0016		DIODE:GER 50 MA 60 WIV	93332	D2361
† A2CR4	1910-0016		DIODE:GER 50 MA 60 WIV	93332	D2361
A2CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR6	1901-0050	8	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A2CR7	1901-0053	3	DIODE:SILICON 30VDCW	07263	FD3444
A2CR8	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A2CR9	1901-0053		DIODE:SILICON 30VDCW	07263	FD3444
A2CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR12	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A2CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR14	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A2IC1	1820-0370	1	IC:TTL QUAD 2-INPT NAND GATE	01295	SN447B
† A2IC2	1820-0686	1	IC:TTL TRIPLE 3-INPT AND GATE	01295	SN24654
A2IC3	1820-0751		IC:DIGITAL	01295	SN74196N
A2IC4	1820-0751		IC:DIGITAL	01295	SN74196N
A2IC5	1820-0751		IC:DIGITAL	01295	SN74196N
A2IC6	1820-0752	1	IC:DIGITAL TTL	01295	SN33586
A2IC7	1820-0469	1	IC:DIGITAL TTL HI-SPEED F/F	01295	SN19234
† A2IC8	1820-0895	1	IC:DIGITAL TTL DUAL J-K FF	04713	SC9150PK

† See Section VIII, Manual Backdating

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2IC9	1826-0066	1	IC: LINEAR	07263	SL22486
A2L1	9100-1618	8	COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
† A2L2			NOT ASSIGNED		
A2L3	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A2L4	9100-1629	3	COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A2L5	9140-0137	1	CHOKE/COIL:FXD 1000 UH 5%	28480	9140-0137
A2Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A2Q3	1854-0354	7	TSTR:SI NPN	28480	1854-0354
A2Q2	1853-0203	27	TSTR:SI PNP	28480	1853-0203
A2Q5	1854-0404		TSTR:SI NPN	28480	1854-0404
A2Q4	1854-0404		TSTR:SI NPN	28480	1854-0404
A2Q6	1854-0404		TSTR:SI NPN	28480	1854-0404
A2R1	0683-2715	1	R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A2R2	0683-3315	7	R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R3	0683-5125	17	R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A2R4	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A2R5	0683-2025	14	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R6	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R7	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
† A2R8			NOT ASSIGNED		
† A2R9	0683-1015	16	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R11	0683-1535	7	R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A2R12	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R13	0683-1015	4	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R14	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R15	0698-6745	1	R:FXD FLM 22 OHM 5% 1/8W	28480	0698-6745
A2R16	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A2R17	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A2R18	0698-4123	7	R:FXD MET FLM 499 OHM 1% 1/8W	28480	0698-4123
A2R19	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A2R21	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A2R22	0757-0346	8	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A2R23	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A2R24	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A2R25	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A2R26	0757-0438	8	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A2R27	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A2R28	0698-3497	1	R:FXD FLM 6.04K OHM 1% 1/8W	28480	0698-3497
A2R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A2R31	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A2R32	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A2R33	0757 0438		R:FXD MET FLM 5.11 K OHM 1% 1/8 W	28480	0757 0438
A2R34	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A2R35	0757-0442		R. FXD MET FLM 10 K OHM 1% 1/8 W	19701	MF4C T-0
A2T1	9100-1393	1	TRANSFORMER: TOROID	28480	9100-1293
A3	03320 66503	1	BOARD ASSY: VTO	28480	03320-66503
A3C1	0180-0291	21	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A3C2	0160-0157	1	C:FXD MYLAR 4700 PF 10% 200VDCW	56289	192P47292-PTS
A3C3	0140-0200	2	C:FXD MICA 390 PF 5% 300VDCW	00853	RDM15F391J3S
A3C4	0160-0207	3	C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A3C5	0160-0207		C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A3C6	0170-0063	1	C:FXD MY 0.020 UF 10% 400VDCW	56289	148P170A-PUM
A3C8	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A3C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C10	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A3C12	0160-2199		C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A3C13	0160-2199		C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A3C14	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C15	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C16	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C17	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C18	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C19	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C20	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C21	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A3C22	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A3C23	0180-0374	7	C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A3C24	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A3C25	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A3C26	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	28480	0150-0093
A3CR1	1901-0518	2	DIODE:HOT CARRIER	28480	1901-0518
A3CR2	1901-0518		DIODE:HOT CARRIER	28480	1901-0518
A3CR3	0122-0059		DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A3CR4	0122-0059		DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A3IC1	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A3IC2	1820-0306	1	INTEGRATED CIRCUIT	28480	1820-0306
A3IC3	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043

† See Section VIII, Manual Backdating.

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3IC4	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A3L1*	9140-0096	4	COIL:FXD RF 1 UH	28480	9140-0096
A3L4	9140-0179	2	COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A3L3	9140-0098	2	COIL:FXD RF 2.2 UH	28480	9140-0098
A3L5	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A3L6	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A3P1	1250-1314	4	CONNECTOR:RF COAX,CENTER CONTACT	98291	52-054-0000
A3Q1	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q2	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q3	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q4	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q5	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q6	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q7	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q8	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q9	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q10	1853-0010	10	TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A3Q11	1854-0345	6	TSTR:SI NPN	80131	2N5179
A3Q12	1854-0345		TSTR:SI NPN	80131	2N5179
A3Q13	1854-0345		TSTR:SI NPN	80131	2N5179
A3Q14	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q15	1854-0404		TSTR:SI NPN	28480	1854-0404
A3Q16	1954-0404		TSTR:SI NPN	28480	1854-0404
A3Q17	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A3R1	0683-6825	11	R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R2	0683-7535	10	R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R3	0683-5145	2	R:FXD COMP 510K OHM 5% 1/4W	01121	CB 5145
A3R4	0683-5145		R:FXD COMP 510K OHM 5% 1/4W	01121	CB 5145
A3R5	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R6	0683-7535	5	R:FXD COMP 75 K OHM 5% 1/4 W	01121	CB 7535
A3R7	0683-2045	1	R:FXD COMP 200K OHM 5% 1/4W	01121	CB 2045
A3R8	0683-3045	1	R:FXD COMP 300K OHM 5% 1/4W	01121	CB 3045
A3R9	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R10	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R12	0683-1045	6	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A3R13	0683-1545	3	R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A3R14	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R15	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R16	0757-0465	2	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A3R17	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A3R18	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R19	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R20	0698-3228	4	R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A3R22	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A3R23	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R24	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R25	0757-0449	9	R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A3R26	0757-0453	2	R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A3R27	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R28	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3R30	0757-0446		R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A3R32	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R33	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A3R34	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3R35	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3R36	0698-3162	1	R:FXD MET FLM 46.4K OHM1% 1/8W	19701	MF4C T-0
A3R37	0757-0445	1	R:FXD FLM 13K OHM 1% 1/8W	28480	0757-0445
A3R38	2100-2521	2	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A3R39	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R40	0683-2215	1	R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A3R41	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A3R42	0757 0273		R:FXD MET FLM 3.01 K OHM 1% 1/8 W	75042	CEA T-0
A3R43	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A3R44	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R45	0757-0437	2	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A3R46	0757-0420	1	R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A3R47	0757-0410	1	R:FXD MET FLM 301 OHM 1% 1/8W	28480	0757-0410
A3R48	0757-1094	2	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A3R49	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A3R50	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A3R52, R53	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A3R54	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A3R55	0757-0447	4	R:FXD FLM 16.2K OHM 1% 1/8W	28480	CMF-1/10-32 T-1

Table 6-1. Replaceable Parts (cont d).

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R56	0757-0442		R FXD FLM 10K OHM 1% 1/8W	91637	CMF-1/10-32 T-1
A3R57	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A3R58	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
A3R59	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A3R60	0683-3915	2	R:FXD COMP 390 OHM 5% 1/4W	01121	CB 3915
A3R62	0683-3915		R:FXD COMP 390 OHM 5% 1/4W	01121	CB 3915
A3R63	0683-3325	8	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A3R64	0683-1025	56	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A3R65	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A3R66	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A3R67	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A3R68	0683-1625	1	R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625
A3R69	0683-4325	4	R:FXD COMP 4300 OHM 5% 1/4W	01121	CB 4325
A3R70	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A3R71	0683-5115	14	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A3R72	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A3R73	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A3R74	0683-6225	1	R:FXD COMP 6200 OHM 5% 1/4W	01121	CB 6225
A3R75	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A3R76	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A3R77	0683-2425	7	R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A3R78	0683-2015	8	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A3R79	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A3R80	0757-0451	1	R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
A3R81	0698-4473		R:FXD FLM 8.06K OHM 1% 1/8W	28480	0698-4473
A3R82	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A3R83	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A3R84	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A3R85	0757 0447		R FXD FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A4	03320-66504	1	BOARD ASSY RNG DIV	28480	03320-66504
A4A1	03320-62701	1	FILTER ASSY	28480	03320-62701
A4A2	03320-62702	2	FILTER ASSY	28480	03320-62702
A4C1	0150-0050	47	C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C3	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C4	0160-0939	2	C: FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A4C5	0160-0938	9	C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A4C6	0160-2035	2	C:FXD MICA 750 PF 5% 300VDCW	00853	RDM15F751J3S
A4C7	0160-0939		C: FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A4C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C10	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C11	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C12	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C13	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C14	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C15	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C16	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C17	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C18	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C19	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C20	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C21	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C22	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C23	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C24	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C25	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C26	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C27	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C28	0160-2009		C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A4C29	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A4C30	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A4C31	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C32	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C33	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C34	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C35	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C36	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C37	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C38	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C39	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C40	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C41	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C42	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C43	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C44	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4C45	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A4C46	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C47	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A4C48	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A4C49	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A4IC1	1820-0450	5	IC: DIGITAL	18324	N8290A
A4IC2	1820-0427	5	IC:LINEAR MODULE	04713	SC8232GK
A4IC3	1826-0058	8	IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A4IC4	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A4IC5	1820-0450	4	IC:DIGITAL TTL	18324	N8290A
A4IC6	1820-0427		IC: LINEAR MODULE	04713	SC8232GK
A4IC7	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A4IC8	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A4L1	9100-3248	2	COIL:FXD 10 UH	28480	9100-3248
A4L2	9100-3248		COIL:FXD 10 UH	28480	9100-3248
A4L3	9100-3247	3	COIL:FXD 15 UH	28480	9100-3247
A4L4	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A4L5	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A4L6 THRU L11	9170 0016		FERRITE BEADS	28480	9170 0016
A4P1	1250-1314		CONNECTOR RF COAX, CENTER CONTACT	98291	52-054 0000
A4Q1	1853-0203		TSTR:SI PNP	28480	1853 0203
A4Q2	1853-0203		TSTR:SI PNP	28480	1853-0203
A4Q3	1854-0009	6	TSTR:SI NPN	80131	2N709
A4Q4	1854-0071	18	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4Q6	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A4Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4Q8	1853-0203		TSTR:SI PNP	28480	1853-0203
A4Q9	1853-0203		TSTR:SI PNP	28480	1853-0203
A4Q10	1854-0009		TSTR:SI NPN	80131	2N709
A4Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4Q13	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A4Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4R1	0683-6215	30	R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R2	0683-5625	10	R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
† A4R3	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
† A4R4	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R5	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R7	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A4R8	0683-8215		R:FXD COMP 820 OHM 5% 1/4 W	01121	CB 6215
A4R9	0683 4715		R FXD COMP 470 OHM 5% 1/4 W	01121	CB 6215
A4R10	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A4R11	0683-6815	1	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A4R12	0683-7505	1	R:FXD COMP 75 OHM 5% 1/4W	01121	CB 7505
A4R13	0683-2225	8	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A4R14	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A4R15	0683-1125	10	R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A4R16	0683-3615	1	R:FXD COMP 360 OHM 5% 1/4W	01121	CB 3615
A4R17	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R18	0683-1315	9	R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A4R19	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R20	0683-4715	5	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A4R21	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A4R23	0683-3325	13	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A4R24	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A4R25	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R26	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R27	0683-4735	6	R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A4R28	0683-6835	4	R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A4R29	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A4R30	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R31	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A4R32	0683-2735	9	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A4R33	0683-7525	7	R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A4R34	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A4R35	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R36	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A4R37	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A4R38	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R39	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R40	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R41	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A4R42	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R43	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215

† See Section VIII, Manual Backdating

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R44	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A4R45	0683-9115	3	R:FXD COMP 910 OHM 5% 1/4W	01121	CB 9115
A4R46	0683-1115	3	R:FXD COMP 110 OHM 5% 1/4W	01121	CB 1115
A4R48	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A4R47	0683-4325		R:FXD COMP 4300 OHM 5% 1/4W	01121	CB 4325
A4R49	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A4R50	0683-7515	4	R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A4R51	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R52	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A4R53	0683-2425		R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A4R54	0683-8215	5	R:FXD COMP 820 OHM 5% 1/4W	01121	CB 8215
A4R55	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A4R57	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A4R58	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A4R59	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R60	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R61	0683-4735		R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A4R62	0683-6835		R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A4R63	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A4R64	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A4R65	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A4R66	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A4R67	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A4R68	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A5	03320-66505	1	BOARD ASSY: RNG DIV	28480	03320-66505
A5A1, A2	03320-62702		FILTER ASSY	28480	03320-62702
A5C1	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C3	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C4			NOT ASSIGNED		
A5C7	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A5C5	0160-2009		C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A5C6	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A5C8	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C10	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C11	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C12	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C13	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C14	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C15	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C16	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C17	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C18	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C19	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C20	0150-0050		C:FXD CER 1000 PF +80 20% 1000 VDCW	56289	C067B102E102ZS26-CDH
A5C21	0150-0093		C:FXD CER 0.01 UF +80-20% 100 VDCW	72982	801-K800011
A5C22	0150-0050		C:FXD CER 1000 PF +80-20% 1000 VDCW	56289	C067B102E102ZS26-CDH
A5C23	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C24	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102F102ZS26-CDH
A5C25	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C26	0150-0050		C:FXD CER 1000 PF +80 20% 1000 VDCW	56289	C067B102E102ZS26-CDH
A5C27	0160-2009		C:FXD MICA 820 PF 5% 300 VDCW	00853	RDM15F821J3C
A5C28	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A5C29	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A5C30	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C31	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C32	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C33	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C34	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C35	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C36	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C37	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C38	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C39	0150 0093		C:FXD CER 0.01 UF +80-20% 100 VDCW	72982	801 K800011
A5C40	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C41	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C42	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C43	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C44	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A5C45	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C46	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZS26-CDH
A5C47	0180-1746		C:FXD ELECT 15 UF 10% 20 VDCW	28480	0180-1746
A5C48	0180-1746		C:FXD ELECT 15 UF 10% 20 VDCW	28480	0180-1746
A5IC1	1820-0450		IC: DIGITAL TTL	18324	N8290A
A5IC2	1820-0427		IC: LINEAR MODULE	04713	SC8232GK
A5IC3	1826-0058		IC: LINEAR VIDEO AMPLIFIER	18324	NE 501A

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5IC4	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A5IC5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A5IC6	1820-0427		IC:LINEAR MODULE	04713	SC8232GK
A5IC7	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A5IC8	1826-0058		IC:LINEAR VIDEO AMPLIFIER	18324	NE 501A
A5L1	9100-3247		COIL:FXD 15 UH	28480	9100-3247
A5L2	9100-3247		COIL:FXD 15 UH	28480	9100-3247
A5L3	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A5L4	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A5L6 THRU L11	9170-0016	7	BEAD:MAGNETIC SHIELDING	02114	56 590-65/3B
A5P1	1250-1314		CONNECTOR RF COAX,CENTER CONTACT	98291	52-054 0000
A5Q1	1853-0203		TSTR:SI PNP	28480	1853-0203
A5Q2	1853-0203		TSTR:SI PNP	28480	1853-0203
A5Q3	1854-0009		TSTR:SI NPN	80131	2N709
A5Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q6	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A5Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q8	1853-0203		TSTR:SI PNP	28480	1853-0203
A5Q9	1853-0203		TSTR:SI PNP	28480	1853-0203
A5Q10	1854-0009		TSTR:SI NPN	80131	2N709
A5Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q13	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A5Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5R1	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R2	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A5R3	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A5R4	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R5	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R7	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A5R8	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R9	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R10	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R11	0683-9115		R:FXD COMP 910 OHM 5% 1/4W	01121	CB 9115
A5R12	0683-1115		R:FXD COMP 110 OHM 5% 1/4W	01121	CB 1115
A5R13	0683-4325		R:FXD COMP 4300 OHM 5% 1/4W	01121	CB 4325
A5R14	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R15	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A5R16	0683-7515		R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A5R17	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R18	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A5R19	0683-2425		R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A5R20	0683-8215		R:FXD COMP 820 OHM 5% 1/4W	01121	CB 8215
A5R21	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A5R23	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R24	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A5R25	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R26	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R27	0683-4735		R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A5R28	0683-6835		R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A5R29	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A5R30	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R31	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A5R32	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A5R33	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A5R34	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A5R35	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R36	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A5R37	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A5R38	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R39	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R40	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R41	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A5R42	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R43	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R44	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R45	0683-9115		R:FXD COMP 910 OHM 5% 1/4W	01121	CB 9115
A5R46	0683-1115		R:FXD COMP 110 OHM 5% 1/4W	01121	CB 1115
A5R47	0683-4325		R:FXD COMP 4300 OHM 5% 1/4W	01121	CB 4325
A5R48	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R49	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A5R50	0683-7515		R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R51	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R52	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A5R53	0683-2425		R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A5R54	0683-8215		R:FXD COMP 820 OHM 5% 1/4W	01121	CB 8215
A5R55	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A5R57	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R58	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A5R59	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R60	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R61	0683-4735		R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A5R62	0683-6835		R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A5R63	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A5R64	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A5R65	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A5R66	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A5R67	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A5R68	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6 (OPTION 006)	03320-66505		IDENTICAL TO A5. REFER TO A5 PARTS LIST	28480	03320-66505
A7	03320-66507		PC ASSEMBLY: PHASE LOCK	28480	03320-66507
A7C1	0180 1746	4	C. FXD 15 UF 10% 20 VDCW	56289	150D156X9020B2-DYS
A7C2	0140-0190	1	C: FXD MICA 39 PF 5%	72136	RDM15E390J3C
A7C3	0160 0763	1	C: FXD MICA 5 PF 10%	72136	RDM15C050K5S
A7C4, C5	0150-0093	9	C. FXD 01 UF +80% -20% 100 VDCW	91418	TA obd
A7C6	0140-0200		C: FXD 390 PF 5%	00853	RDM15F391J3S
A7C7, C8	0150 0093		C: FXD 01 UF +80% -20% 100 VDCW	91418	TA obd
A7C9	0160-0205	1	C. FXD MICA 10 PF 5%	72136	RDM15C100J5S
A7C11, C12	0150-0093		C. FXD 01 UF +80% -20% 100 VDCW	91418	TA obd
A7C14, C15	0150-0093		C FXD 01 UF +80% -20% 100 VDCW	91418	TA obd
A7C16	0180-0291	1	C FXD 1 UF 10% 35 VDCW	56289	150D105X9035A2 DYS
A7C17	0140-0190		C.FXD 39 PF 5%	72316	RDM15E390J3C
A7C20, C21	0180-1746		C FXD 15 UF 10% 20 VDCW	56289	150D156X9020B2 DYS
A7C22	0150-0093		C FXD 01 UF +80% -20% 100 VDCW	91418	TA obd
A7C23	0170-0066	1	C FXD MYLAR 10% .027 UF 200 VDCW	56289	192P27392-PTS
A7C24	0160-0155	1	C FXD .0033 UF 200 VDCW	56289	5C13C-CML obd
A7C25, C26	0160-2221	2	C. FXD MICA 1300 PF 5%	72136	RDM19F132J3C
A7C27	0180 1746		C FXD 15 UF 10% 20 VDCW	56289	150D156X9020B2 DYS
A7CR1 THRU CR6	1901-0040	6	DIODE: SI 50 MA 2 PF 2 NS 30 V	07263	FDG1088
† A7IC1	1820 092319	1	IC: QUAD 2 INPUT NOR GATE	04713	SC7527PK
A7IC2, IC3	1826 0043	2	IC: LINEAR OP AMP	12040	SL12795
A7IC4	1820-0595	1	IC: DUAL DIGITAL	12040	DM74L73N
A7L1	9100 3314	1	COIL: MOLDED	28480	9100-3314
A7L2 THRU L4	9140 0179	4	COIL MOLDED CHOKE	28480	9140 0179
A7L6	9100 3315	1	COIL. MOLDED	28480	9100 3315
A7L7	9140 0179		COIL: MOLDED CHOKE	28480	9140-0179
A7L8	9100-3313	1	COIL MOLDED	28480	9100 3313
A7J1, J2	1250-1195	2	CONNECTOR: R F	98291	52 053 0000
A7Q1	1853-0203	1	TSTR SI PNP	04713	SS5651
A7Q2	1854-0009	1	TSTR	04713	SS7376K
A7Q3	1854-0019	1	TSTR. SI NPN	04713	S-6516
A7 Q4 THRU Q6	1854-0071	3	TSTR. SI NPN	01295	SKA1124
A7R1	0683-1525	1	R: FXD COMP 1500 Ω 5% 1/4 W	01121	CB1525
A7R2	0683 1025	5	R. FXD COMP 1000Ω 5% 1/4 W	01121	CB1025
A7R3	0683-1315	1	R: FXD COMP 130 Ω 5% 1/4 W	01121	CB1315
A7R4	0683-4315	1	R FXD COMP 430 Ω 5% 1/4 W	01121	CB4315
A7R5, R6	0683-2015	2	R. FXD COMP 200 Ω 5% 1/4 W	01121	CB2015
A7R7	0683-5115	1	R: FXD COMP 510 OHM 5% 1/4 W	01121	CB5115
A7R8 R9	0683 1515	2	R FXD COMP 150 OHM 5% 1/4 W	01121	CB1515
A7R12, R13	0683-2725	2	R. FXD COMP 2700 OHM 5% 1/4 W	01121	CB2725
A7R14, R15	0683-1235	2	R. FXD COMP 12 K OHM 5% 1/4 W	01121	CB1235
A7R16	0683 2025	4	R: FXD COMP 2000 OHM 5% 1/4 W	01121	CB2025
A7R17	0683-5125	3	R: FXD COMP 5100 OHM 5% 1/4 W	01121	CB5125
A7R20	0683 1035	2	R FXD COMP 10 KOHM 5% 1/4 W	01121	CB1035
A7R21	0683 1025		R FXD COMP 1000 OHM 5% 1/4 W	01121	CB1025
A7R22	0683-1805	1	R: FXD COMP 18 OHM 5% 1/4 W	01121	CB1805
A7R23	0683 1045	1	R: FXD COMP 100 K OHM 5% 1/4 W	01121	CB1045
A7R24	0683-5125		R: FXD COMP 5100 OHM 5% 1/4 W	01121	CB5125
A7R25	0683-2035	1	R. FXD COMP 20 K OHM 5% 1/4 W	01121	CB2035
A7R26	0683-1625	1	R: FXD COMP 1600 OHM 5% 1/4 W	01121	CB1625
A7R27	0683-2025		R: FXD COMP 2000 OHM 5% 1/4 W	01121	CB2025
A7R28	0683-9115	1	R: FXD COMP 910 OHM 5% 1/4 W	01121	CB9115
A7R29	0683-3605	1	R: FXD COMP 36 OHM 5% 1/4 W	01121	CB3605
A7R30	0683-2025		R: FXD COMP 2000 OHM 5% 1/4 W	01121	CB2025
A7R31	0683-1025		R: FXD COMP 1000 OHM 5% 1/4 W	01121	CB1025
A7R32	0683-3325	1	R: FXD COMP 3300 OHM 5% 1/4 W	01121	CB3325
A7R33	0683-0275	1	R: FXD COMP 2.7 OHM 5% 1/4 W	01121	CB27G5

† See Section VIII, Manual Backdating

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7 R34	0683 1025		R: FXD COMP 1000 OHM 5% 1/4 W	01121	CB1025
A7 R35, R36	0683-1055	2	R: FXD COMP 1 MEGOHM 5% 1/4 W	01121	CB1055
A7 R37	0683-4325	1	R: FXD COMP 4300 OHM 5% 1/4 W	01121	CB4325
A7 R38	0683 2225	1	R: FXD COMP 2200 OHM 5% 1/4 W	01121	CB2225
A7 R39	0683 5125		R: FXD COMP 5100 OHM 5% 1/4 W	01121	CB5125
A7 R40	0683-1035		R: FXD COMP 10 K OHM 5% 1/4 W	01121	CB1035
A7 R41	0683 1025		R: FXD COMP 1000 OHM 5% 1/4 W	01121	CB1025
A7 R42	0683-2025		R FXD COMP 2000 OHM 5% 1/4 W	01121	CB2025
A7 R43	0683 3005	1	R FXD COMP 30 OHM 5% 1/4 W	01121	CB3005
A7 T1	9100-1362	2	TRANSFORMER, TOROID	28480	9100-1362
A7 T2	9100 1361	1	TRANSFORMER TOROID	28480	9100-1361
A7 T3	9100-1362		TRANSFORMER TOROID	28480	9100 1362
A8	03320-66508	1	BOARD ASSY:REFERENCE OSCILLATOR	28480	03320-66508
A8C1	0150-0122	7	C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C2	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A8C3	0160-0181	1	C:FXD MICA 30PF 5% 300VDCW	14655	RDM15E300J3S
A8C4	0121-0436		C:VAR AIR 2.4-24.5 PF	74970	189-509-105
A8C5	0160-2322	1	C:FXD MICA 18 PF 5% 100VDCW	00853	RDM15C180J1S
A8C6	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C7	0160-2203	1	C:FXD MICA 91 PF 5%	72136	RDM15F910J3C
A8C8	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C10	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C11	0160-2209		C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A8C12	0140-0179	2	C:FXD MICA 1000 PF 2%	28480	0140-0179
A8C13	0140-0179		C:FXD MICA 1000 PF 2%	28480	0140-0179
A8C14	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C15	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C16	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C17	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C18	0140-0222	3	C:FXD MICA 240 PF 1% 300VDCW	28480	0140-0222
A8C19	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C20	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C21	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C22	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C23	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C24	0140-0222		C:FXD MICA 240 PF 1% 300VDCW	28480	0140-0222
A8C25	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C26	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C27	0140-0222		C:FXD MICA 240 PF 1% 300VDCW	28480	0140-0222
A8C28	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C29	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C30	0150-0122		C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M
A8C31	0140-0210	1	C:FXD MICA 270 PF 5%	28480	0140-0210
A8C32	0160-2225	1	C:FXD MICA 2000 PF 5% 300VDCW	72136	RDM19F202J3C
A8C33	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C34	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C35	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C36	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C37	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C38	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C39	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C40	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
† A8C41			UNASSIGNED		
† A8C42			UNASSIGNED		
† A8C43			UNASSIGNED		
† A8C44			UNASSIGNED		
† A8C45			UNASSIGNED		
† A8C46			UNASSIGNED		
A8C47	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A8C48	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A8C49	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A8C50	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A8CR1	0122-0059		DIODE:VOLTAGE VARIABLE CAPACITANCE	28480	0122-0059
A8IC1	1820-0450		IC:DIGITAL TTL	18324	N8290A
A8IC2	1820-0427		IC:LINEAR MODULE	04713	SC8232GK
† A8P1			UNASSIGNED		
A8L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179

† See Section VIII, Manual Backdating.

Table 6-1. Replaceable Parts (cont d)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8L2	9100-1620	3	COIL:MOLDED CHOKE 15.0 UH 10%	28480	9100-1620
A8L3	9140-0088	4	COIL:RF 0.33 UH 5%	95265	N8-0.37 PS
A8L4	9140-0088		COIL:RF 0.33 UH 5%	95265	N8-0.37 PS
A8L5	9140-0088		COIL:RF 0.33 UH 5%	95265	N8-0.37 PS
A8L6	9140-0088		COIL:RF 0.33 UH 5%	95265	N8-0.37 PS
† A8L7			UNASSIGNED		
A8L8	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A8L9	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A8L10	9140-0107		COIL:FXD RF 27 UH 10%	99800	1840-38
A8L11	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A8Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A8Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A8Q3	1853-0203		TSTR:SI PNP	28480	1853-0203
A8Q4	1853-0203		TSTR:SI PNP	28480	1853-0203
A8Q5	1854-0009		TSTR:SI NPN	80131	2N709
A8Q6	1854-0009		TSTR:SI NPN	80131	2N709
A8Q7	1854-0019		TSTR:SI NPN	28480	1854-0019
A8Q8	1854-0019		TSTR:SI NPN	28480	1854-0019
A8Q9	1853-0203		TSTR:SI PNP	28480	1853-0203
A8Q10	1853-0203		TSTR:SI PNP	28480	1853-0203
A8Q11	1853-0203		TSTR:SI PNP	28480	1853-0203
A8Q12	1853-0203		TSTR:SI PNP	28480	1853-0203
† A8Q13			UNASSIGNED		
† A8Q14			UNASSIGNED		
A8R1	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R2	0757-0442		R FXD MET FLM 10.0 K OHM 1% 1/8 W	28480	0757-0442
A8R3	0757-0453		R: FXD MET FLM 30.1 K OHM 1% 1/8 W	28480	0757-0453
A8R4	0698-3499	2	R:FXD FLM 40.2K OHM 1% 1/8W	28480	0698-3499
A8R5	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R6	0683-1535		R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A8R7	0683-3035	2	R:FXD COMP 30K OHM 5% 1/4W	01121	CB 3035
A8R8	0683-3035		R:FXD COMP 30K OHM 5% 1/4W	01121	CB 3035
A8R9	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R10	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R11	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A8R12	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R13	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A8R14	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A8R15	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R16	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R17	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R18	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A8R19	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A8R20	0683-1035	5	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A8R21	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A8R22	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R23	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R24	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A8R25	0683-9125	1	R:FXD COMP 9100 OHM 5% 1/4W	01121	CB 9125
A8R26	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A8R27	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A8R28	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A8R29	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A8R30	0683-1315		R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315
A8R31	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A8R32	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A8R33	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A8R34	0683-4705	9	R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R35	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R36	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A8R37	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A8R38	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A8R39	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A8R40	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R41	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A8R42	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A8R43	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A8R44	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R45	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R46	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R47	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R48	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R49	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R50	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R51	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125

† See Section VIII, Manual Backdating.

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8R52	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A8R53	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R54	0683-6215		R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A8R55	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R56	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R57	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R58	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R59	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A8R60	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A8R61	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
† A8R62			UNASSIGNED		
† A8R63			UNASSIGNED		
† A8R64			UNASSIGNED		
† A8R65			UNASSIGNED		
† A8R66			UNASSIGNED		
† A8R67 THRU R71			UNASSIGNED		
† A8T1			UNASSIGNED		
A8Y1	0410-0438	1	CRYSTAL QUARTZ	28480	0410-0438
A9A (3320A ONLY)	03320-66533	1	PC ASSY: MODULATOR A9A IS IDENTICAL TO A9B WITH THE FOLLOWING EXCEPTIONS:	28480	03320-66533
A9C1 THRU A9C17			NOT ASSIGNED		
A9C24			NOT ASSIGNED		
A9C32			NOT ASSIGNED		
A9C35	0180 1746		C: FXD ELECT 15 UF 10% 20 VDCW	56289	150D156X9010B2 DYS
A9IC1 THRU A9IC5			NOT ASSIGNED		
A9Q1 THRU A9Q5			NOT ASSIGNED		
A9R1 THRU A9R23			NOT ASSIGNED		
A9R43	0698 3557				
A9R44	0683-3315		R: FXD FLM 806 OHM 1% 1/8 W	14674	C4T 0 obd
A9R45	0698 4448		R: FXD COMP 330 OHM 5% 1/4 W	01121	CB3315
			R. FXD FLM 294 OHM 1% 1/8 W	14674	C4T 0 obd
A9R47			NOT ASSIGNED		
A9R51	0698-3510		R FXD FLM 453 OHM 1% 1/8 W	72136	MF4C T 0 obd
A9R52	2100-2489 7		R:VAR COMP 5K OHM 10% 1/2W	28480	2100-2489
A9B (3320B ONLY	03320 66509	1	PC ASSY: MODULATOR	28480	03320-66509
A9C1	0180-0374		C. FXD TANT. 10 UF 10% 20 VDCW	56289	150D106X9010B2-DYS
A9C2	0180 1735	4	C FXD ELECT 0.22 UF 10% 35 VDCW	28480	0180 1735
A9C3	0180 1735		C: FXD ELECT 0.22 UF 10% 35 VDCW	28480	0180-1735
A9C4	0180 0374		C FXD TANT. 10 UF 10% 20 VDCW	56289	150D106X9020B2-DYS
A9C5	0180-0373	1	C: FXD ELECT 0.68 UF 10% 35 VDCW	56289	150D684X9035A2-DYS
A9C6	0180 1743	3	C. FXD ELECT 0.1 UF 10% 35 VDCW	56289	150D104X9035A2-DYS
A9C7	0160-0154	2	C: FXD MICA MY 0.0022 UF 10% 200 VDCW	56289	192P22292-PTS
A9C8	0160 0154		C FXD MICA MY 0.0022 UF 10% 200 VDCW	56289	192P22292-PTS
A9C9	0180-1743		C FXD ELECT 0.1 UF 10% 35 VDCW	56289	150D104X9035A2-DYS
A9C10	0160 0159	1	C FXD MY 0.0068 UF 10% 200 VDCW	56289	192P68292 PTS
A9C11	0180-1743		C FXD ELECT 0.1 UF 10% 35 VDCW	56289	150D104X9035A2 DYS
A9C13	0150 0093		C FXD CER 0.01 UF + 80 - 20% 100 VDCW	72982	801 K800011
A9C14	0150-0093		C FXD CER 0.01 UF + 80 20 % 100 VDCW	72982	801 K800011
A9C15	0150-0093		C: FXD CER 0.01 UF + 80 20 % 100 VDCW	72982	801-K800011
A9C16	0160-2201	1	C FXD MICA 51 PF 5%	72136	RDM15E510J1C
A9C17	0150 0093		C: FXD CER 0.01 UF + 80 20% 100 VDCW	72982	801 K800011
A9C18	0140-0191	1	C. FXD MICA 56 PF 5% 300 VDCW	19701	RDM15E560J 300 V
A9C19	0150-0093		C: FXD CER 0.01 UF + 80 20% 100 VDCW	72982	801 K800011
A9C20	0150-0093		C. FXD CER 0.01 UF + 80 20% 100 VDCW	72982	801-K800011
A9C21	0180 1746		C FXD ELECT 15 UF 10% 20 VDCW	28480	0180-1746
A9C22	0150-0093		C FXD CER 0.01 UF + 80 - 20% 100 VDCW	72982	801-K800011
A9C23	0150 0093		C: FXD CER 0.01 UF + 80 20% 100 VDCW	72982	801-K800011
A9C24	0121-0432		C VAR AIR 1.7-14.1 PF	74970	189-505-105
A9C25	0160-0958		C FXD MICA 390 PF 5% 300 VDCW	00853	RDM15F391J3S
A9C26	0160-2150	1	C.FXD MICA 33 PF 5%	28480	0160-2150
A9C27	0160-0378	2	C: FXD MICA 27 PF 5%	72136	RDM15E270J5S
A9C28	0160 2202	2	C. FXD MICA 75 PF 5%	28480	0160-2202
A9C29	0160-0196	1	C FXD MICA 24 PF 5% 300 VDCW	04062	RDM15C240J3S
A9C30	0160-2202		C FXD MICA 75 PF 5%	28480	0160 2202
A9C31	0160 0378		C. FXD MICA 27 PF 5%	72136	RDM15E270J5S
A9C32	0180-1746		C FXD ELECT 15 UF 10% 20 VDCW	28480	0180 1746
A9C33	0180 1746		C: FXD ELECT 15 UF 10% 20 VDCW	28480	0180-1746
A9C34, A9C35	0150-0093		C. FXD CER 0.01 UF +80 - 20% 100 VDCW	72982	801-K800011
A9CR1	1901-0040		DIODE: SILICON 30 MA 30 WV	07263	FDG1088
A9CR2	1901-0040		DIODE: SILICON 30 MA 30 WV	07263	FDG1088
A9IC1	1826-0043		IC LINEAR OPERATIONAL AMPLIFIER	28480	1826 0043
A9IC2	1826-0043		IC: LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A9IC3	1826-0043		IC: LINEAR OPERATIONAL AMPLIFIER	28480	1826 0043
A9IC4	1826-0043		IC: LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A9IC5	1826-0043		IC: LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A9IC6	1821-0001	1	TRANSISTOR ARRAY: SI NPN	02735	CA3046
A9J1	1250-1195	5	CONNECTOR, RF SUB-MINIATURE SERIES	98291	52 053-0000

† See Section VIII, Manual Backdating.

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9L1	9140-0096		COIL: FXD RF 1 UH	28480	9140-0096
A9L2	9140-0096		COIL: FXD RF 1 UH	18480	9140 0096
A9L3	9140-0107		COIL: FXD RF 27 UH 10%	99800	1840 38
A9L4	9140-0096		COIL: FXD RF 1 UH	18480	9140-0096
A9L5	9140 0111		COIL: FXD RF 3.3 UH	28480	9140-0111
A9L6	9140-0112	2	COIL. FXD RF 4.7 UH	28480	9140-0112
A9L7	9140-0111	2	COIL. FXD RF 3.3 UH	28480	9140-0112
A9L8	9140-0107		COIL FXD RF 27 UH 10%	99800	1840 38
A9Q1	1854 0071		TSTR SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
A9Q2	1853-0020		TSTR: SI PNP (SELECTED FROM 2N3702)	28480	1853 0020
A9Q3	1854 0071		TSTR. SI NPN (Selected from 2N3704)	28480	1853-0071
A9Q4	1855 0081	4	TSTR: Si FET	80131	2N5245
A9Q5	1855-0081		TSTR SI FET	80131	2N5245
A9Q6	1853-0066	2	TSTR: SI PNP	80131	2N4250
A9Q7	1854-0019		TSTR: SI NPN	28480	1854-0019
A9Q8	1854-0019		TSTR SI NPN	28480	1854 0019
A9Q9	1854-0019		TSTR. SI NPN	28480	1854-0019
A9Q10	1853 0066		TSTR. SI PNP	80131	2N4250
A9R1	0698 3518	5	R: FXD FLM 7.32 K OHM 1% 1 / 8 W	28480	0698 3518
A9R2	0698 3518		R FXD FLM 7.32 K OHM 1% 1/8 W	28480	0698 3518
A9R3	0757-0463	2	R: FXD MET FLM 82.5 K OHM 1% 1/8 W	28480	0757-0463
A9R4	0757-0280		R FXD MET FLM 1 K OHM 1% 1/8 W	28480	0757 0280
A9R5	0757-0444		R FXD MET FLM 12.1 K OHM 1% 1/8 W	28480	0757 0444
A9R6	0698 4307	4	R. FXD FLM 14.3 K OHM 1% 1/8 W	28480	0698 4307
A9R7	0698-4482	2	R FXD FLM 17.4 K OHM 1% 1/8 W	28480	0698-4482
A9R8	0698 3259		R: FXD FLM 7.87 K OHM 1% 1/8 W	28480	0698-3259
A9R9, A9R10	0683 2735		R FXD COMP 27 K OHM 5% 1/4 W	01121	CB2735
A9R11	0683-4755		R. FXD COMP 4.7 MEGOHM 5% 1/4 W	01121	CB 475E
A9R12, A9R13	0683-2735		R. FXD COMP 27 K OHM 5% 1/4 W	01121	CB2735
A9R14	0683-4755		R FXD COMP 4.7 MEGOHM 5% 1/4 W	01121	CB4755
A9R15	0683 2735		R FXD COMP 27 K OHM 5% 1/4 W	01121	CB2735
A9R16, A9R17	0698-3518		R: FXD FLM 7.32 K OHM 1% 1/8 W	28480	0698 3518
A9R18	0757-0463		R FXD MET FLM 82.5 K OHM 1% 1/8 W	28480	0757-0463
A9R19	0757 0280		R: FXD MET FLM 1 K OHM 1% 1/8 W	28480	0757-0280
A9R20	0757-0444		R: FXD MET FLM 12.1 K OHM 1% 1/8 W	28480	0757 0444
A9R21	0698 4307		R FXD FLM 14.3 K OHM 1% 1/8 W	28480	0698-4307
A9R22	0698 4482		R. FXD FLM 17.4 K OHM 1 % 1/8 W	28480	0698-4482
A9R23	0698 3259		R: FXD FLM 7.87 K OHM 1% 1/8 W	28480	0698-3259
A9R24	0683-4725	2	R. FXD COMP 4700 OHM 5% 1/4 W	01121	CB4725
A9R25	0698 3493	1	R: FXD FLM 4.12 K OHM 1% 1/8 W	28480	0698-3493
A9R26	0757-0349	1	R FXD MET FLM 22.6 K OHM 1% 1/8 W	28480	0757-0349
A9R27	2100-2521		R VAR FLM 2000 OHM 10% LIN 1/2 W	28480	2100-2521
A9R28	0757 0273	3	R: FXD MET FLM 3.01 K OHM 1% 1/8 W	28480	0757 0273
A9R29	0698-4123		R FXD MET FLM 499 OHM 1% 1/8 W	28480	0698-4123
A9R30	0698 4123		R. FXD MET FLM 499 OHM 1% 1/8 W	28480	0698-4123
A9R31	0698 4123		R FXD MET FLM 499 OHM 1% 1/8 W	28480	0698-4123
A9R32	0757-0438		R FXD MET FLM 5.11 K OHM 1% 1/8 W	28480	0757-0438
A9R33	0698 4476	1	R FXD FLM 10.2 K OHM 1% 1/8 W	28480	0698-4476
A9R34	0698-4415	1	R. FXD FLM 165 OHM 1% 1/8 W	28480	0698-4415
A9R35	0757-0280		R FXD MET FLM 1 K OHM 1% 1/8 W	28480	0757 0280
A9R36	0757-0200	1	R: FXD MET FLM 5.62 K OHM 1% 1/8 W	28480	0757-0200
A9R38	0757-0281	3	R. FXD MET FLM 2.74 K OHM 1% 1/8 W	28480	0757-0281
A9R39	0683 4705		R. FXD COMP 47 OHM 5% 1/4 W	01121	CB 4705
A9R40	0757-0280		R: FXD MET FLM 1 K OHM 1% 1/8 W	28480	0757-0280
A9R41	0683-4705		R: FXD COMP 47 OHM 5% 1/4 W	01121	CB4705
A9R42	0757 0397	1	R FXD MET FLM 68.1 OHM 1% 1/8 W	28480	0757 0397
A9R43	0757-0426	2	R FXD FLM 1.3 K OHM 1% 1/8 W	28480	0757-0426
A9R44	0757-0346		R: FXD MET FLM 10 OHM 1% 1/8 W	28480	0757-0346
A9R45	0757-0415	1	R: FXD MET FLM 475 OHM 1% 1/8 W	28480	0757-0415
A9R46	0757-0384	3	R: FXD FLM 20 OHM 1% 1/8 W	28480	0757-0384
A9R47	0757-0398	2	R: FXD MET FLM 75 OHM 1% 1/8 W	28480	0757 0398
A9R48	0757-0277	13	R: FXD MET FLM 49.9 OHM 1% 1/8 W	28480	0757-0277
A10	03320-66510	1	BOARD ASSY: AMP	28480	03320-66510
A10C1	0160-2200	1	C: FXD MICA 43 PF 5%	72136	RDM15E430J3C
A10C2	0140-0202	1	C: FXD MICA 15 PF 5% 500VDCW	28480	0140-0202
A10C3	0140-0146	1	C: FXD MICA 82 PF 5% 300VDCW	14655	RDM15E820J3S
A10C4	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C5	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C6	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C7	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C8	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C10	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C11	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C12	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C14	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C15	0150-0093		C: FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C16	0180-0291		C: FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C17	0180-0197	5	C: FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10C18	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C20	0160-0157	3	C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A10C21	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C22	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A10C23	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A10C24	0150-0042	1	C:FXD TI 4.7 PF 5% 500VDCW	78488	TYPE GA
A10C25	0160-0488	1	C:FXD CER 10 PF 2% 500VDCW	71471	CN-1
A10C26	0160-3306	1	C:FXD MICA 25+/-0.5 PF 100VDCW	00853	RDM15C250D1C
A10C27	0160-0205	1	C:FXD MICA 10 PF 5%	28480	0160-0205
A10C28	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C30	0160-2009		C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A10C31	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C32	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C33	0140-0176	3	C:FXD MICA 100 PF 2%	28480	0140-0176
A10C34	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A10C35	0140-0198	1	C:FXD MICA 200 PF 5%	72136	RDM15F201J3C
A10C36	0160-0174	1	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A10C38	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A10C39	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A10C40	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C41	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A10C42	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A10C43	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A10C44	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A10C45	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A10CR1	1901-0044	9	DIODE:SILICON 20MA/1V	28480	1901-0044
A10CR2	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A10CR3	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A10IC1	1858-0015	1	IC HEX LIMITER	28480	1858-0015
A10IC2	1826-0062	1	IC HEX MIXER	28480	1826-0062
A10IC3	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A10IC4	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A10IC5	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A10J1	1250-1195		CONNECTOR:RF SUB-MINIATURE SERIES	98291	52-053-0000
A10J2	1250-1195		CONNECTOR:RF SUB-MINIATURE SERIES	98291	52-053-0000
A10L1	9140-0106	2	COIL:FXD 0.47 UH	28480	9140-0106
A10L2	9140-0098		COIL:FXD RF 2.2 UH	28480	9140-0098
A10L3	9140-0106		COIL:FXD 0.47 UH	28480	9140-0106
A10L4	9140-0114	6	COIL:FXD RF 10 UH	28480	9140-0114
A10L5	9100-1620		COIL:MOLDED CHOKE 15.0 UH 10%	28480	9100-1620
A10L6	9100-3316	1	COIL:FXD 5.6 UH	28480	9100-3316
A10L7	9100-3311	1	COIL:FXD 6.0 UH	28480	9100-3311
A10L8	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A10L9	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A10L10	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A10L11	9100-1620		COIL:MOLDED CHOKE 15.0 UH 10%	28480	9100-1620
A10P1	1250-1314		CONNECTOR:RF COAX,CENTER CONTACT	98291	52-054-0000
A10Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A10Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A10Q3	1854-0404		TSTR:SI NPN	28480	1854-0404
A10Q4	1854-0457	1	TSTR:SI NPN	28480	1854-0457
A10Q6	1853-0203		TSTR:SI PNP	28480	1853-0203
A10Q7	1854-0404		TSTR SI NPN	28480	1854-0404
A10Q8	1854-0019		TSTR:SI NPN	28480	1854-0019
A10Q9	1853-0203		TSTR:SI PNP	28480	1853-0203
A10R1	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A10R2	0757-0407	1	R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A10R3	0698-3498	1	R:FXD MET FLM 8.66K OHM 1% 1/8W	28480	0698-3498
A10R4	0757-0398		R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398
A10R5	0757-0388	1	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388
A10R6	0698-3434	1	R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
A10R7	0698-4420	1	R:FXD FLM 226 OHM 1% 1/8W	28480	0698-4420
A10R8	0698-4406	1	R:FXD FLM 115 OHM 1% 1/8W	28480	0698-4406
A10R9	0698-4433	1	R:FXD FLM 2260 OHM 1% 1/8W	28480	0698-4433
A10R10	0698-4445	1	R:FXD FLM 5.76K OHM 1% 1/8W	28480	0698-4445
A10R11	0698-3512	1	R:FXD FLM 1180 OHM 1% 1/8W	28480	0698-3512
A10R12	0698-4452	4	R:FXD FLM 374 OHM 1% 1/8W	28480	0698-4452
A10R13	0698-4123		R:FXD MET FLM 499 OHM 1% 1/8W	28480	0698-4123
A10R14	0698-4452		R:FXD FLM 374 OHM 1% 1/8W	28480	0698-4452
A10R16	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R17	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R18	0757-0434	1	R:FXD MET FLM 3.65K OHM 1% 1/8W	28480	0757-0434
A10R19	0698-3484	1	R:FXD FLM 6650 OHM 1% 1/8W	28480	0698-3484
A10R20	0698-4474	3	R:FXD FLM 8450 OHM 1% 1/8W	28480	0698-4474
A10R21	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A10R22	0698-4435		R:FXD FLM 2.49K OHM 1% 1/8W	28480	0698-4435
A10R23	0757-0427	2	R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10R24	0757-0408	1	R:FXD MET FLM 243 OHM 1% 1/8W	28480	0757-0408
A10R25	0757-0405	2	R:FXD FLM 162 OHM 1% 1/8W	19701	MF4C T 0
A10R26	0757 0405		R:FXD FLM 162 OHM 1% 1/8W	19701	MF4C T 0
A10R27	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A10R28	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A10R29	0757-0281		R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281
A10R30	0757-0317	1	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A10R31	2100-2574	1	R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A10R32	0698-4426	2	R:FXD FLM 1580 OHM 1% 1/8W	28480	0698-4426
A10R34	0757-0291	8	R:FXD FLM 24.9 OHM 1% 1/8W	28480	0757-0291
A10R35	1810-0078	1	RESISTIVE NETWORK	28480	1810-0078
A10R36	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A10R37	2100-3154	2	R:VAR 1K OHM 10% LIN	28480	2100-3154
A10R38	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A10R39	0757-0291		R:FXD FLM 24.9 OHM 1% 1/8W	28480	0757-0291
A10R40	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R41	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R42	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A10R44	C684-3911	4	R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A10R45	2100-3054	2	R:VAR CERMET 50K OHM 10% 3/4W	28480	2100-3054
A10R46	0698-4211	1	R:FXD FLM 158K OHM 1% 1/8W	28480	0698-4211
A10R47	0698-4508	1	R:FXD FLM 78.7K OHM 1% 1/8W	28480	0698-4508
A10R48	0757-0278	1	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A10R49	0698-3268	1	R:FXD FLM 11.5K OHM 1% 1/8W	28480	0698-3268
A10R50	0698-4457	1	R:FXD FLM 576 OHM 1% 1/8W	28480	0698-4457
A10R51	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R52	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R53	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R54	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A10R55	0698-3151	3	R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A10R56	C698-4369	1	R:FXD FLM 23.2 OHM 1% 1/8W	28480	0698-4369
A10R57	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A10R59	0757-0414	2	R:FXD FLM 432 OHM 1% 1/8W	28480	0757-0414
A10R60	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R61	C698-3558		R:FXD MET FLM 4.02K OHM 1% 1/8W	28480	0698-3558
A10R62	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R63	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R64	0684-5641	1	R:FXD COMP 560K OHM 10% 1/4W	01121	CB 5641
A10R65	0757-0437		R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A10R66	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R67	0684-5611	1	R:FXD COMP 560 OHM 10% 1/4W	01121	CB 5611
A10R68	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R69	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10R70	0698-4123		R:FXD MET FLM 499 OHM 1% 1/8W	28480	0698-4123
A10R72	C698-3262	3	R:FXD MET FLM 40.2 OHM 1% 1/8W	28480	0698-3262
A10R73	0698-3262		R:FXD MET FLM 40.2 OHM 1% 1/8W	28480	0698-3262
A10R74	C698-4123		R:FXD MET FLM 499 OHM 1% 1/8W	28480	0698-4123
A10R75	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A10T1	9100-1362		TRANSFORMER:TOROID	28480	9100-1362
A10T2	9100-1361	1	TRANSFORMER:TOROID	28480	9100-1361
A11	03320-66511	1	BOARD ASSY: D/A CONVERTER	28480	03320-66511
A11(Option 001)	03320-66540	1	BOARD ASSY:D/A CONVERTER	28480	03320-66540
A11C1	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A11C2	0160-0207		C. FXD MYLAR 0.01 UF 5% 200 VDCW	28480	0160-0207
A11C3	0160-0496	1	C:FXD MICA 22000 PF 1% 100VDCW	00853	RDM30F223F1C
A11C4	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C4185-CDH
A11C5	0170-0055	1	C:FXD MY 0.1UF 20% 200VDCW	56289	192P10402
A11C6	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A11C8	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A11C9	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A11C10	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A11C11	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A11C12	0150-0093		C:FXD CER 0.01 UF +80-20% 100 VDCW	72982	801-K800011
A11CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR3	1902-0048	1	DIODE:BREAKDOWN 6.81V 5%	04713	SZ10939-134
A11CR4	1902-0692	1	DIODE:TC REFERENCE 6.3V 1%	28480	1902-0692
A11CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11IC1	1820-0583	17	IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A11IC2	1820-0703	3	IC:DIGITAL TTL DECADE COUNTER	28480	1820-0703
A11IC3	1820-0703		IC:DIGITAL TTL DECADE COUNTER	28480	1820-0703
A11IC4	1820-0703		IC:DIGITAL TTL DECADE COUNTER	28480	1820-0703
A11IC5	1820-0595	7	IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A11IC6	1820-0207	4	IC:TTL MONOSTABLE MULTIVIBRATOR	28480	1820-0207
A11IC7	1820-0207		IC:TTL MONOSTABLE MULTIVIBRATOR	28480	1820-0207
A11IC8	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11IC9	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A11IC10	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A11L1, L2	9140-0137	2	COIL:FXD RF 1000 UH 5%	28480	9140-0137
A11L2	9140-0037		COIL:5MH	99848	35000-15-502
A11L3	9100-1618		COIL:MOLDED CHOKE 5.60 UH	28480	9100-1618
A11Q1	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A11Q2	1854-0351	5	TSTR:SI NPN	04713	2N3904
A11Q3	1855-0386	3	TSTR:FET N-CHANNEL	80131	2N4392
A11Q4	1854-0404		TSTR:SI NPN	28480	1854-0404
A11Q5	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A11Q6	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A11Q7	1854-0351		TSTR:SI NPN	04713	2N3904
A11Q8	1855-0386		TSTR:FET N-CHANNEL	80131	2N4392
A11Q9	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A11Q10	1854-0351		TSTR:SI NPN	04713	2N3904
A11Q11	1855-0386		TSTR:FET N-CHANNEL	80131	2N4392
A11R1	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A11R2	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A11R3	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A11R4	0683-1525	51	R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A11R5	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A11R6	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A11R8	0757-0274	1	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A11R9	0698-8026	1	R:FXD FLM 1.61K OHM 0.5% 1/8W	28480	0698-8026
A11R9 (Option 001)	0698-3202	1	R:FXD MET FLM 1.74K OHM 1% 1/8 W	28480	0698-3202
A11R10	2100-3095	1	R VAR CERMET 200 OHM 10% TYPE P 3/4W	28480	2100-3095
A11R11	0698-6670	1	R:FXD MET FLM 1K OHM 0.5% 1/8W	28480	0698-6670
A11R12	0683-3335	1	R:FXD COMP 33 K OHM 5% 1/4W	01121	CB 3335
A11R13	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11R15	0698-8027	1	R:FXD FLM 19.3K OHM 0.5% 1/8W	28480	0698-8027
A11R16	2100-3154		R:VAR 1K OHM 10% LIN	28480	2100-3154
A11R17	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A11R18	0698-4484	2	R:FXD FLM 19.1K OHM 1% 1/8W	28480	0698-4484
A11R19	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A11R20	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A11R21	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A11R22	0698-4484		R:FXD FLM 19.1K OHM 1% 1/8W	28480	0698-4484
A11R24	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A11R25	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A11R26	0683-5635	1	R:FXD COMP 56K OHMS 5% 1/4W	01121	CB 5635
A11R27	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11R28	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11R29	0683-2235	1	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A11R30	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A11R31	0698-4459	1	R:FXD FLM 634 OHM 1% 1/8W	28480	0698-4459
A12A (3320A ONLY)	03320-66518	1	AMPLIFIER ASSY	28480	03320-66518
A12 C1	0160-2198	4	C:FXD MICA 20 PF 5%	72136	RDM15C200J3C
A12 C2	0140-0176		C:FXD MICA 100 PF 2%	28480	0140-0176
A12 C3	0160-3691	1	C:FXD MICA 75 PF 1% 100VDCW	72136	RDM15E750F1S
A12 C4	0140-0218	2	C:FXD MICA 160 PF 2%	28480	0140-0218
A12 C5	0160-0205	2	C:FXD MICA 10 PF 5%	28480	0160-0205
A12 C6	0140-0228	2	C:FXD MICA 360 PF 1% 300VDCW	28480	0140-0228
A12 C7	0140-0226	2	C:FXD MICA 320 PF 1%	28480	0140-0226
A12 C8	0160-2198		C:FXD MICA 20 PF 5%	72136	RDM15C200J3C
A12 C9	0140-0220	2	C:FXD MICA 200 PF 1% 300VDCW	28480	0140-0220
A12 C10	0160-2009		C:FXD MICA 820 PF 5% 300VDCW	00853	RDM15F821J3C
A12 C12	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A12 C13	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A12 C14	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A12 C15	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A12 C16	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A12 C17	0180-2398	2	C:FXD ELECT 600 UF +75-10% 15VDCW	56289	39D607G015E14
A12 C18	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A12 C19	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A12 C20	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A12 C22	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A12 C23	0180-2398		C:FXD ELECT 600 UF +75-10% 15 VDCW	56289	39D607G015E14
A12 C24	0150-0121	2	C:FXD CER 0.1 UF +80-20% 50 VDCW	56289	5C5081-CM1
A12 C25	0150-0121		C:FXD CER 0.1 UF +80-20% 50 VDCW	56289	5C5081-CM1
A12 C26	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A12 CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12 CR7	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A12 CR8	1902-0554	2	DIODE BREAKDOWN:10V 1W	28480	1902-0554
A12 CR9	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A12 CR10	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A12 F1	2110-0027	1	FUSE:0.125A 250V	75915	312.125
A12 J1	1251-2969	6	CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A12 J2	1251-2969		CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A12 J3	1251-2969		CONNECTOR:PHONO, SINGLE JACK	27264	15-24-0501
A12 L1	9100-3319	2	COIL:FXD 0.74 UH	28480	9100-3319
A12 L2	9100-3318	4	COIL:FXD 0.58 UH	28480	9100-3318
A12 L3	9100-3318		COIL FXD 0.58 UH	28480	9100-3318
A12 L4	9170 0016		BEAD · MAGNETIC SHIELDING	02114	56-590 65A 1/38
A12 L5	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
A12 L6	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
A12 L7	9170-0016		BEAD·MAGNETIC SHIELDING	02114	56-590-65A 1/38
A12 L8, L9	9140-0180		COIL:FXD RF 2.7 UH 10%	99800	1537-22
A12 Q1	1854-0345		TSTR:SI NPN	80131	2N5179
A12 Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A12 Q3	1853-0203		TSTR:SI PNP	28480	1853-0203
A12 Q4	1854-0019		TSTR:SI NPN	28480	1854-0019
A12 Q5	1854-0053	1	TSTR:SI NPN	80131	2N2218
A12 Q6	1854-0345		TSTR:SI NPN	80131	2N5179
A12 Q7	1853-0203		TSTR:SI PNP	28480	1853-0203
A12 Q8	1853-0012	2	TSTR:SI PNP	80131	2N2904A
A12 R1	C757-0378	1	R:FXD MET FLM 11.0 OHM 1% 1/8W	28480	0757-0378
A12 R2	C698-4354	1	R:FXD FLM 11.8 OHM 1% 1/8W	28480	0698-4354
A12 R3	0698-3441	1	R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A12 R4	0757-0395	1	R:FXD MET FLM 56.2 OHM 1% 1/8W	28480	0757-0395
A12 R5	0698-4449	2	R:FXD MET FLM 309 OHM 1% 1/8W	91637	CMF-1/10-32 T-1 abd
A12 R6	0698 4380		R:FXD FLM 45.3 OHM 1% 1/8W	91637	CMF-1/10-32 T-1 abd
A12 R7	2100 2583	1	R. VAR CERMET 10 OHM 2% LIN 1/2 W	28480	2100-2383
A12 R8	0698-4380		R: FXD FLM 45.3 OHM 1% 1/8 W	91637	CMF-1/10-32 T-1
A12 R10	0684-4701		R: FXD COMP 47 OHM 10% 1/4 W	01121	CB4701
A12 R11	0757-0338	2	R:FXD MET FLM 1.00K OHM 1% 1/4W	28480	0757-0338
A12 R12	C698-4195	1	R:FXD MET FLM 1.02K OHM 1% 1/8W	28480	0698-4195
A12 R133	0684-8201	4	R.FXD COMP 82 OHM 10% 1/4W	01121	CB8201
A12 R14	0698-0082	1	R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A12 R15	0684-4701		R:FXD COMP 47 OHM 10% 1/4W	01121	CB 4701
A12 R16	0698-4452		R:FXD FLM 374 OHM 1% 1/8W	28480	0698-4452
A12 R17	C757-0284	3	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A12 R18	C757-0389	3	R:FXD FLM 33.2 OHM 1% 1/8W	19701	MF4C T-0
A12 R19	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A12 R20	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A12 R21	0757-0389		R:FXD FLM 33.2 OHM 1% 1/8W	19701	MF4C T-0
A12 R22	C698-4447	1	R:FXD MET FLM 280 OHM 1% 1/8W	28480	0698-4447
A12 R23	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A12 R24	C698-4452		R:FXD FLM 374 OHM 1% 1/8W	28480	0698-4452
A12 R25	0684-4701		R:FXD COMP 47 OHM 10% 1/4W	01121	CB 4701
A12 R26	0698-4449	1	R:FXD FLM 309 OHM 1% 1/8W	28480	0698-4449
A12 R27	0698-3259		R:FXD FLM 7.87K OHM 1% 1/8W	28480	0698-3259
A12 R28	0698-4471	2	R:FXD FLM 7.15K OHM 1% 1/8W	28480	0698-4471
A12 R29	0684-4701		R:FXD COMP 47 OHM 10% 1/4W	01121	CB 4701
A12 R30	C698-4465	1	R:FXD FLM 931 OHM 1% 1/8W	28480	0698-4465
A12 R31	C684-4721	3	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12 R32	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12 R33 OPTION 001	0757-0710		R:FXD FLM 73.2 OHM 1% 1/4W	01295	MC60 T-1
A12 R33 (Std)	0698-3228		R: FXD FLM 49.9 OHM 1% 1/8W	28480	0698-3228
A12 R34	0698-4428		R FXD FLM 1.69 K OHM 1% 1/8 W	91637	CMF 1/10-32 T-1 abd
A12 R35, R36	0684 4701		R: FXD COMP 47 OHM 10% 1/4 W	01121	CB4701
A12 R37, R38	0684 1001		R: FXD COMP 10 OHM 10% 1/4 W	01121	CB 1001
A12 B (3320B ONLY)	03320-66512	1	BOARD ASSY·DETECTOR	28480	03320-66512
A12 A1	03320-66701	1	TRANSISTOR ASSY	28480	03320-66701
A12 A2	0853-0017	1	THERMOCOUPLE	28480	0853-0017
A12 C1	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A12 C2	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A12 C3	0160-0182	1	C:FXD MICA 47PF 5% 300VDCW	14655	RDM15E470J3S
A12 C4	0160-0298	1	C:FXD MY 0.0015 UF 10% 200VDCW	56289	192P15292-PTS
A12 C5	0160-3183	1	C:FXD MY 0.47 UF 20% 50VDCW	84411	HEW 101
A12 C6	0170-0079	1	C:FXD MY 0.047UF 20% 50VDCW	84411	STYLE 3 TYPE 601PE
A12 C7	0160-0161	5	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A12 C8	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A12 C9	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A12 C10	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A12 C11	0160-3077		C:FXD MYLAR .027 UF 10% 100 VDCW	56289	225P2739W81-PWM
A12 C12	0160-3077		C:FXD MYLAR .027 UF 10% 100 VDCW	56289	225P2739W81-PWM
A12 C13	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A12 C14	0160-2611	2	C:FXD MY 1 UF 10% 50VDCW	84411	HEW 101
A12 C15	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12 C16	0160-2611		C:FXD MY 1 UF 10% 50VDCW	84411	HEW 101
A12 C17	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A12 C18	0180-0060	1	C:FXD AL ELECT 200 UF +75-10% 3VDCW	56289	30D207G003CC2-DSM
A12 C19	0160 2322		C:FXD MICA 18 PF 5% 100VDCW	00853	RDM15C180J15
A12 CR1, CR2	1901 0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR4	1902-0049	3	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A12 CR5	1901-0053		DIODE:SILICON 30VDCW	07263	FD3444
A12 CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR7	1902-0049		DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A12 CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A12 IC1	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A12 IC2	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A12 IC3	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A12 IC4	1820-0207		IC:TTL MONOSTABLE MULTIVIBRATOR	28480	1820-0207
A12 IC5	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A12 J1, J2	1251 2969	2	CONNECTOR PHONO	27264	15-24-0501
A12 K1	0490-0963	6	RELAY MULTI-REED	28480	0490-0963
A12 K2	0490-1015	1	RELAY: REED COIL 10 VA 250 V	15636	R2731-2
A12 Q1	1854-0404		TSTR:SI NPN	28480	1854-0404
A12 Q2	1853-0012		TSTR:SI PNP	80131	2N2904A
A12 Q3	1855-0368	4	TSTR:FET SI NPN N-CHANNEL	28480	1855-0368
A12 Q5	1854-0210	4	TSTR:SI NPN	80131	2N2222
A12 Q6	1854-0210		TSTR:SI NPN	80131	2N2222
A12 Q7	1854-0404		TSTR:SI NPN	28480	1854-0404
A12 Q8	1855-0368		TSTR:FET SI NPN N-CHANNEL	28480	1855-0368
A12 Q9	1855-0368		TSTR:FET SI NPN N-CHANNEL	28480	1855-0368
A12 Q10	1855-0368		TSTR:FET SI NPN N-CHANNEL	28480	1855-0368
A12 Q11	1854-0210		TSTR:SI NPN	80131	2N2222
A12 Q12	1854-0210		TSTR:SI NPN	80131	2N2222
A12 R1	0684-4721		R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721
A12 R2	0684-2231	2	R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A12 R3	0684-2231		R:FXD COMP 22K OHM 10% 1/4W	01121	CB 2231
A12 R4	0684-4731	4	R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A12 R5	0684-4751	4	R:FXD COMP 4.7 MEGOHM 10% 1/4W	01121	CB 4751
A12 R6	0684-2251		R:FXD COMP 2.2 MEGOHM 10% 1/4W	01121	CB 2251
A12 R7	0698-4499	1	R:FXD FLM 54.9K OHM 1% 1/8W	28480	0698-4499
A12 R8	0698-8004	2	R:FXD FLM 200K OHM 0.1% 1/8W	28480	0698-8004
A12 R10	2100-3056	2	R:VAR CERMET 5K OHM 10% TYPE P 3/4W	28480	2100-3056
A12 R12	0698-8004		R:FXD FLM 200K OHM 0.1% 1/8W	28480	0698-8004
A12 R13	0757-0472	2	R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A12 R14	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A12 R15	0684-4731		R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A12 R17	0698-4530	1	R:FXD FLM 232K OHM 1% 1/8W	28480	0698-4530
A12 R18	0757-0446		R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A12 R19	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12 R20	0698-4462	1	R:FXD FLM 768 OHM 1% 1/8W	28480	0698-4462
A12 R21	0757-0728	1	R:FXD MET FLM 619 OHM 1% 1/4W	28480	0757-0728
A12 R22	0757-0428	3	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A12 R23	0757-0427		R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A12 R24	0684-3331	1	R:FXD COMP 33K OHM 10% 1/4W	01121	CB 3331
A12 R25	0698-8005	1	R:FXD FLM 75 OHM .001% 1/8W	28480	0698-8005
A12 R27	0698-3228		R:FXD MET FLM 49.9 K OHM 1% 1/8W	19701	MF4C T-0 obd
A12 R28	0757-0270	3	R:FXD MET FLM 249K OHM 1% 1/8W	28480	0757-0270
A12 R29	0698-8007	1	R:FXD FLM 7.054K OHM .001% 1/8W	28480	0698-8007
A12 R30	2100-3122	1	R:VAR CERMET 100 OHM 10% 3/4W	28480	2100-3122
A12 R31	0698-8006	1	R:FXD FLM 1.772K OHM .001% 1/8W	28480	0698-8006
A12 R32	0698-3262		R:FXD MET FLM 40.2 OHM 1% 1/8W	28480	0698-3262
A12 R33	0698-3582	1	R:FXD MET FLM 41.2K OHM 1% 1/8W	28480	0698-3582
A12 R34	2100-3054		R:VAR CERMET 50K OHM 10% 3/4W	28480	2100-3054
A12 R35	0684-1221	1	R:FXD COMP 12 K OHM 10% 1/4W	01121	CB 1221
A12 R36	0684-1061		R:FXD COMP 10 MEGOHM 10% 1/4W	01121	CB 1061
A12 R37	0684-4751		R:FXD COMP 4.7 MEGOHM 10% 1/4W	01121	CB 4751
A12 R38	0684-4751		R:FXD COMP 4.7 MEGOHM 10% 1/4W	01121	CB 4751
A12 R39	0684-1021	2	R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A12 R40	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A12 R41	0698-3499		R:FXD FLM 40.2K OHM 1% 1/8W	28480	0698-3499
A12 R42	0684-4751		R:FXD COMP 4.7 MEGOHM 10% 1/4W	01121	CB 4751
A12 R43	0684-6811	1	R:FXD COMP 680 OHM 10% 1/4W	01121	CB 6811
A12 R44	0684-3311	1	R:FXD COMP 330 OHM 10% 1/4W	01121	CB 3311
A12 R45	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A12 R46	0684-4731		R:FXD COMP 47K OHM 10% 1/4W	01121	CB 4731
A12 R47	0684-1021		R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021
A12 R48	0698-3160		R: FXD MET FLM 31.6 K OHM 1% 1/8 W	28480	0698-3160
A12 R49	0698-3226		R:FXD MET FLM 6.49 K OHM 1% 1/8 W	28480	0698-3226
A12 R50	0684-6821	1	R: FXD MET COMP 6.8 K OHM 10% 1/4 W	01121	CB6821

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12R51	0684-4731		R: FXD COMP 47 K OHM 10% 1/4 W	01121	CB4731
A12R52	0684-1051		R: FXD COMP 1 MEGOHM 10% 1/4 W	01121	CB1051
A12R53	0757-0270		R: FXD MET FLM 249K OHM 1% 1/8 W	28480	0757-0270
A12R54	0684-1001	2	R FXD COMP 10 OHM 10% 1/4 W	01121	CB1001
A12R55	0684 1001		R: FXD COMP 10 OHM 10% 1/4 W	01121	CB1001
A13A (3320A ONLY)	03320-61902	1	PC ASSY: SWITCH	28480	
A13R1	0698-4416		R: FXD FLM 169 OHM 1% 1/8 W	91637	CMF 1/10 32 T-1 obd
	3130-0471		MSFD WAFER	28480	3130-0471
	3130-0473		MSFD: DETENT	28480	3130-0473
	3130-0472		2ND SFD: WAFER	28480	3130 0472
	3130-0477		2ND SFD DETENT	28480	3130-0477
	3130-0472		LSFD WAFER	28480	3130-0472
	3130-0477		LSFD, DETENT	28480	3130 0477
	3130-0474		RANGE TOP WAFER	28480	3130-0474
	3130-0475		RANGE: BOTTOM WAFER	28480	3130-0475
	3130-0478		RANGE: DETENT	28480	3130 0478
A13B (3320B ONLY)	03320-61901	1	PC ASSY: SWITCH	28480	03320-61901
A13R1	0698-4416		R: FXD FLM 169 OHM 1% 1/8 W	91637	CMF 1/10 32 T-1 obd
	3130-0471		MSFD, WAFER	28480	3130-0471
	3130-0473		MSFD, DETENT	28480	3130-0473
	3130-0472		2ND SFD: WAFER	28480	3130-0472
	3130-0477		2ND SFD: DETENT	28480	3130 0477
	3130-0472		LSFD: WAFER	28480	3130-0472
	3130-0477		LSFD, DETENT	28480	3130-0477
	3130-0476		MSAD WAFER	28480	3130 0476
	3130-0479		MSAD DETENT	28480	3130-0479
	3130-0472		3RD SAD WAFER	28480	3130-0472
	3130-0477		3RD SAD: DETENT	28480	3130-0477
	3130-0472		2ND SAD: WAFER	28480	3130-0472
	3130-0477		2ND SAD: DETENT	28480	3130-0477
	3130-0472		LSAD: WAFER	28480	3130-0472
	3130-0477		LSAD: DETENT	28480	3130-0477
	3130-0474		RANGE TOP WAFER	28480	3130-0474
	3130-0475		RANGE, BOTTOM WAFER	28480	3130-0475
	3130-0478		RANGE: DETENT	28480	3130-0478
A14 (3320B ONLY)	03320-66514	1	BOARD ASSY, POWER AMPLIFIER	28480	03320-66514
A14C1	0160-2198		C:FXD MICA 20 PF 5%	72136	RDM15C200J3C
A14C2	0160-0336	1	C:FXD MICA 100 PF 1%	28480	0160-0336
A14C3	0160-3520	1	C:FXD MICA 75 PF 1% 100VDCW	72136	RDM15E750F1C
A14C4	0140-0218		C:FXD MICA 160 PF 2%	28480	0140-0218
A14C5	0160-0205		C:FXD MICA 10 PF 5%	28480	0160-0205
A14C6	0140-0228		C:FXD MICA 360 PF 1% 300VDCW	28480	0140-0228
A14C7	0140-0226		C:FXD MICA 320 PF 1%	28480	0140-0226
A14C8	0160-2198		C:FXD MICA 20 PF 5%	72136	RDM15C200J3C
A14C9	0140-0220		C:FXD MICA 200 PF 1% 300VDCW	28480	0140-0220
A14C10	0140-0176		C:FXD MICA 100 PF 2%	28480	0140-0176

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14C11	0160-2228	1	C:FXD MICA 2700 PF 5%	28480	0160-2228
A14C12	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C13	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A14C14	0180-1846	2	C:FXD ELECT 2.2 UF 10% 35VDCW	56289	150D225X9035B2-DYS
A14C15	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C16	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
† A14C17			NOT ASSIGNED		
A14C18	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C19	0150-0015		C. FXD TI DIOX 2.2 PF 10% 500VDCW	78488	TYPE GA
A14C20	0150-0084		C: FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A14C21	0180-0116	2	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A14C22	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A14C23	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C24	0180-0376	3	C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
A14C25	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
A14C26	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C27	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
† A14C28			NOT ASSIGNED		
A14C29	0180-1846		C:FXD ELECT 2.2 UF 10% 35VDCW	56289	150D225X9035B2-DYS
A14C30	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C32	0150-0022		C.FXD TI DIOX 3.3 PF 10% 500VDCW	78488	TYPE GA
A14C33	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A14C34	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C35	0150-0084		C:FXD CER 0.1 UF +80-20% 100VDCW	56289	33C41B5-CDH
A14C36	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A14C37	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C38	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C39	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C40	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A14C41	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
A14C42	0160-3077		C. FXD MYLAR .027 UF 10% 100 VDCW	56289	225P2739WB1-PWM
A14CR1	1902-3205	3	DIODE BREAKDOWN:15.0V 5%	28480	1902-3205
A14CR2	1902-3205		DIODE BREAKDOWN:15.0V 5%	28480	1902-3205
A14CR3	1902-0556	2	DIODE:BREAKDOWN 20.0V 5% 1W	28480	1902-0556
A14CR4	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14CR5	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR14	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14CR15	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR18	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR19	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A14CR20	1902-0202	2	DIODE BREAKDOWN:15.0V 5% 1W	28480	1902-0202
A14CR22	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A14CR23	1902-0202		DIODE BREAKDOWN:15.0V 5% 1W	28480	1902-0202
A14CR24	1902-0556		DIODE:BREAKDOWN 20.0V 5% 1W	28480	1902-0556
A14CR25	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14CR26	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A14IC1	1820-0203	1	IC:OPERATIONAL AMPLIFIER	07263	SL8940

† See Section VIII, Manual Backdating

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14J1	1251-2969		CONNECTOR: PHONO, SINGLE JACK	27264	15-24-0501
A14J3	1251-2969		CONNECTOR: PHONO, SINGLE JACK	27264	15-24-0501
A14J4	1251-2969		CONNECTOR: PHONO, SINGLE JACK	27264	15-24-0501
A14L1	9100-3319		COIL:FXD 0.74 UH	28480	9100-3319
A14L2	9100-3318		COIL:FXD 0.58 UH	28480	9100-3318
A14L3	9100-3318		COIL:FXD 0.58 UH	28480	9100-3318
A14L4	9100-1619	1	COIL:MOLDED CHOKE 6.8 UH 10%	28480	9100-1619
A14L5 THRU L8	9170 0016		BEAD, MAGNETIC SHIELDING	28480	9170 0016
A14L8	9170 0016		BEAD: MAGNETIC SHIELDING	28480	9170-0016
A14J2	1250 1195		CONNECTOR, RF SUB-MINIATURE SERIES	98291	52 053 0000
† A14Q1	5080 9041		TSTR, SELECTED	28480	5080-9041
† A14Q2	5080 9041		TSTR, SELECTED	28480	5080 9041
A14Q3	1853 0010		TSTR SI PNP (SELECTED FROM 2N3251)	28480	1853 0010
A14Q4	1853 0312	2	TSTR SI PNP	04713	2N5160
A14Q5	1854 0531	2	TSTR SI NPN	28480	1854 0531
A14Q6	1854-0351		TSTR, SI NPN	04713	2N3904
A14Q7	1854-0039	4	TSTR:SI NPN	80131	2N3053
A14Q8	1854-0308	1	TSTR:SI NPN	80131	2N3553
† A14Q9	5080 9042	2	TSTR:SELECTED	28480	5080 9042
A14Q10	1854-0351		TSTR:SI NPN	04713	2N3904
A14Q11	1854-0531		TSTR:SI NPN	28480	1854-0531
A14Q12	1853-0312		TSTR:SI PNP	04713	2N5160
A14Q13	1853-0313	1	TSTR:SI PNP	04713	MM4019
A14Q14	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A14Q15	1853-0051	2	TSTR:SI PNP	80131	2N4037
† A14Q16	5080 9042		TSTR, SELECTED	28480	5080 9042
A14R1	0757 0277		R:FXD MET FLM 49.9 OHM 1% 1/8 W	28480	0757 0277
A14R2	0757-0442		R, FXD MET FLM 10.0 K OHM 1% 1/8 W	28480	0757 0442
A14R3	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R4	0757-0270		R:FXD MET FLM 249K OHM 1% 1/8W	28480	0757-0270
A14R5	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A14R6	0684-1521	2	R:FXD COMP 1500 OHM 10% 1/4W	01121	CB 1521
A14R7	0684-1521		R:FXD COMP 1500 OHM 10% 1/4W	01121	CB 1521
A14R8	0698-3518		R:FXD FLM 7.32K OHM 1% 1/8W	28480	0698-3518
A14R9	0698-4427	1	R:FXD FLM 1650 OHM 1% 1/8W	28480	0698-4427
A14R10	0683-0685	4	R:FXD COMP 6.8 OHM 5% 1/4W	01121	CB68G5
A14R11	0683-0685		R:FXD COMP 6.8 OHM 5% 1/4W	01121	CB68G5
A14R12			NOT ASSIGNED		
A14R13	0757-0394	3	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14R14	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A14R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R16	0757-0384		R:FXD FLM 20 OHM 1% 1/8W	28480	0757-0384
A14R17	0757-0291		R:FXD FLM 24.9 OHM 1% 1/8W	28480	0757-0291
A14R18	0757-0747	2	R:FXD FLM 5110 OHM 1% 1/4W	28480	0757-0747
A14R19	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A14R20	0698-4135	1	R:FXD MET FLM 8.87K OHM 1.0% 1/2W	28480	0698-4135
A14R21	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
† A14R22	0757 0277		R FXD FLM 49.9 OHM 1% 1/8 W	28480	0757 0277
A14R23	0698-4474		R:FXD FLM 8450 OHM 1% 1/8W	28480	0698-4474
A14R24	0698-3535	2	R:FXD MET FLM 1650 OHM 1.0% 1/2W	28480	0698-3535
A14R25	0687-1001	2	R:FXD COMP 10 OHM 10% 1/2W	01121	EB 1001
A14R26	0698-7985	2	R:FXD FLM 2 OHM 5% 1/4W	28480	0698-7985
A14R27	0698-0001	2	R:FXD COMP 4.7 OHM 5% 1/2W	01121	EB 4705
A14R28	0698-0001		R:FXD COMP 4.7 OHM 5% 1/2W	01121	EB 4705
A14R29	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A14R30	0757-0338		R:FXD MET FLM 1.00K OHM 1% 1/4W	28480	0757-0338
A14R32	0698-7990	4	R:FXD MET FLM 200 OHM .01% 1/2W	28480	0698-7990
A14R33	0698-7990		R:FXD MET FLM 200 OHM .01% 1/2W	28480	0698-7990
A14R34	0698-7990		R:FXD MET FLM 200 OHM .01% 1/2W	28480	0698-7990
A14R35	0698-7990		R:FXD MET FLM 200 OHM .01% 1/2W	28480	0698-7990
A14R36	0698-8008	1	R:FXD FLM 357 OHM	28480	0698-8008
A14R37	0698-4426		R:FXD FLM 1580 OHM 1% 1/8W	28480	0698-4426
A14R38	0698-8009	1	R:FXD FLM 95 OHM	28480	0698-8009
A14R39	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14R40	0684-3321		R:FXD COMP 3300 OHM 10% 1/4W	01121	CB 3321
A14R41	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A14R42	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R43	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14R44	0683-0685		R:FXD COMP 6.8 OHM 5% 1/4W	01121	CB68G5
A14R45	0683-0685		R:FXD COMP 6.8 OHM 5% 1/4W	01121	CB68G5
A14R46	0757-0384		R:FXD FLM 20 OHM 1% 1/8W	28480	0757-0384
A14R47	0757-0291		R:FXD FLM 24.9 OHM 1% 1/8W	28480	0757-0291
A14R48	0757-0747		R:FXD FLM 5110 OHM 1% 1/4W	28480	0757-0747
A14R49	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A14R50	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R52	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A14R53	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A14R55	2100-1984	1	R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
† A14R56	0757 0277		R FXD FLM 49.9 OHM 1% 1/8 W	28480	0757 0277
A14R57	0757-0277		R:FXD MET FLM 49.9 OHM 1% 1/8W	28480	0757-0277
A14R58	0698-7985		R:FXD FLM 2 OHM 5% 1/4W	28480	0698-7985
A14R59	0698-3535		R:FXD MET FLM 1650 OHM 1.0% 1/2W	28480	0698-3535
A14R60	0698-4474		R:FXD FLM 8450 OHM 1% 1/8W	28480	0698-4474

† See Section VIII, Manual Backdating

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14R61	0687-1001		R:FXD COMP 10 OHM 10% 1/2W	01121	EB 1001
A14R62	0698-7520	2	R:FXD FLM 3.01 OHM 1% 1/4W	28480	0698-7520
A14R63	0698-7520		R:FXD FLM 3.01 OHM 1% 1/4W	28480	0698-7520
A14R64	0757-0414		R:FXD FLM 432 OHM 1% 1/8W	28480	0757-0414
A14 R65	0698-8070	1	R: FXD FLM 1.3 OHM 5% 1/4 W	28480	0698-8070
A15 (3320B ONLY)	03320 66515	1	BOARD ASSY. ATTENUATOR	28480	03320-66515
A15 (Option 001)	03320-66556	1	BOARD ASSY ATTENUATOR	28480	03320-66556
A15C1	0180 0229	2	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180 0229
A15C2-C5	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A15C6	0160-3622		C:FXD MICA 1 UF 5%	72136	RDM15E102J1C
A15CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15IC1	1820-0586	9	IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A15IC2	1820-0256	1	IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P
A15J1	1250-1195		CONNECTOR:RF SUB-MINIATURE SERIES	98291	52-053-0000
A15 J2	1250-1339		CONNECTOR RF SUB-MINIATURE SERIES	98291	52-051-0000
A15K1, K2	0490-0963		RELAY:MULTI-REED	28480	0490-0963
A15K3	0490-0963		RELAY:MULTI-REED	28480	0490-0963
A15K4	0490-0963		RELAY:MULTI-REED	28480	0490-0963
A15K5	0490-0963		RELAY:MULTI-REED	28480	0490-0963
A15Q1	1854-0354		TSTR:SI NPN	28480	1854-0354
A15Q2	1854-0354		TSTR:SI NPN	28480	1854-0354
A15Q3	1854-0354		TSTR:SI NPN	28480	1854-0354
A15Q4	1854-0354		TSTR:SI NPN	28480	1854-0354
A15R1	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A15R2	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A15R3	0684-3911		R:FXD COMP 390 OHM 10% 1/4W	01121	CB 3911
A15R4	0684-1811	1	R:FXD COMP 180 OHM 10% 1/4W	01121	CB 1811
A15R5	0698-7984	8	R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698-7984
A15R6	0698-8258	4	R:FXD PREC FLM 247.5 OHM 1% 1/4W	01738	CMF-60 1,T9
A15R7	0698-7984		R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698 7984
A15R8	0698-8390	2	R:FXD FLM 96.25 OHM 0.1% 1/4W	28480	0698-8390
A15R9	0698-7982	1	R:FXD FLM 71.16 OHM 0.1% 1/4W	28480	0698-7982
A15R10	0698-8390		R:FXD FLM 96.25 OHM 0.1% 1/4W	28480	0698-8390
A15R12	0698-7984		R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698-7984
A15R13	0698-8258		R:FXD PREC FLM 247.5 OHM 1% 1/4W	01738	CMF 60 1, T9
A15R14	0698 7984		R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698 7984
A15R15	0698-7984		R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698-7984
A15R16	0698-8258		R:FXD PREC FLM 247.5 OHM 1% 1/4W	01738	CMF 60 1, T9
A15R17, R18	0698 7984		R:FXD FLM 61.1 OHM .01% 1/2W	28480	0698-7984
A15R19	0698-8258		R:FXD PREC FLM 247.5 OHM 1% 1/4W	01738	CMF-60-1, T9
A15R20	0698-7984		R: FXD FLM 61.1 OHM 01% 1/2 W	28480	0698-7984
A15R21(OPTION 001)	0698-8011	1	R FXD FLM 25 OHM 0.1% 1/4 W	28480	0698-8011
A16A (3320A ONLY)	03320 66534		PC ASSY: FILTER	28480	03320 66534
A16C1	0180-2395		C:FXD ELECT 3000 UF 10 + 75% 40 VDCW	56289	39D300
A16C2	0180-2395		C:FXD ELECT 3000 UF 10 + 75% 40 VDCW	56289	39D300
A16R1	0687-1231		R: FXD COMP 12 K OHM 10% 1/2 W	01121	EB1231
A16R2	0687-1231		R:FXD COMP 12 K OHM 10% 1/2 W	01121	EB1231
A16B (33208 ONLY)	03320-66516	1	BOARD ASSY:FILTER	28480	03320-66518
A16C1	0180-2395	2	C:FXD AL ELECT 3000 UF +75-10% 40VDCW	56289	39D300
A16C2	0180-2395		C:FXD AL ELECT 3000 UF +75-10% 40VDCW	56289	39D300
A16C3	0180-2396	2	C:FXD AL ELECT 1000 UF +75-10% 75VDCW	56289	39D108G075JP4
A16C4	0180-2396		C:FXD AL ELECT 1000 UF +75-10% 75VDCW	56289	39D108G075JP4
A16R1	0687-1231	2	R:FXD COMP 12K OHM 10% 1/2W	01121	EB 1231
A16R2	0687-1231		R:FXD COMP 12K OHM 10% 1/2W	01121	EB 1231
A16R3	0687-2231	2	R:FXD COMP 22K OHM 10% 1/2W	01121	EB 2231
A16R4	0687-2231		R:FXD COMP 22K OHM 10% 1/2W	01121	EB 2231
A17A (3320A ONLY)	03320-66535	1	PC ASSY. POWER SUPPLY A17A IS IDENTICAL TO A17B WITH THE FOLLOWING EXCEPTIONS.	28480	03320-66535
A17C4			NOT ASSIGNED		
A17C9 THRU C13			NOT ASSIGNED		
A17IC3			NOT ASSIGNED		
A17Q2			NOT ASSIGNED		
A17Q7 THRU Q13			NOT ASSIGNED		
A17R15 THRU R17			NOT ASSIGNED		
A17R33, R34			NOT ASSIGNED		
A17R39 THRU R50			NOT ASSIGNED		
A17B (3320B ONLY)	03320-66517	1	BOARD ASSY:POWER SUPPLY	28480	03320-66517
A17C1	0160-0299	1	C:FXD MY 1800 PF 10% 200VDCW	56289	192P18292-PTS
A17C2	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A17C3	0180-0309	1	C:FXD ELECT 4.7 UF 20% 10VDCW	56289	150D475X0010A2-DYS
A17C4	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A17C5	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A17C6	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A17C7	0180-1974	2	C:FXD TA 10 UF 10% 35VDCW	56289	150D106X9035R2-DYS
A17C8	0180-1974		C:FXD TA 10 UF 10% 35VDCW	56289	150D106X9035R2-DYS
A17C9	0180-0091	2	C:FXD ELECT 10 UF +50-10% 100VDCW	56289	30D106F100DC2-DSM
A17C10	0160-2204	2	C:FXD MICA 100PF 5%	72136	RDM15F101J3C

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17C12	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A17C13	0180-0091		C:FXD ELECT 10 UF +50-10% 100VDCW	56289	30D106F100DC2-DSM
A17CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR2	1902-3104	1	DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A17CR3	1884-0068	1	THRISTOR	28480	1884-0068
A17CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR6	1902-0049		DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A17CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR9	1902-0686	1	DIODE BREAKDOWN:6.2V 2%	04713	1N825
A17CR10	1902-3205		DIODE BREAKDOWN:15.0V 5%	28480	1902-3205
A17CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR13	1902-0579	1	DIODE BREAKDOWN:5.11V	28480	1902-0579
A17CR14	1901-0527	2	DIODE:CURRENT REGULATOR	28480	1901-0527
A17CR15	1902-3114	1	DIODE BREAKDOWN:6.19V 2%	28480	1902-3114
A17CR16	1901-0527		DIODE:CURRENT REGULATOR	28480	1901-0527
A17IC1	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A17IC2	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A17IC3	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A17IC4	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A17IC5	1826-0043		IC:LINEAR OPERATIONAL AMPLIFIER	28480	1826-0043
A17Q1	1854-0039		TSTR:SI NPN	80131	2N3053
A17Q2	1854-0039		TSTR:SI NPN	80131	2N3053
A17Q3	1854-0039		TSTR:SI NPN	80131	2N3053
A17Q4	1851-0017	1	TSTR:GE NPN	80131	2N1304
A17Q5	1853-0051		TSTR:SI PNP	80131	2N4037
A17Q6	1850-0062	1	TSTR:GE ALLOY JUNCTION	01295	GA 287
A17Q7	1854-0408	2	TSTR:SI NPN	28480	1854-0408
A17Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A17Q9	1854-0408		TSTR:SI NPN	28480	1854-0408
A17Q10	1853-0238	3	TSTR:SI PNP	28480	1853-0238
A17Q11	1853-0010		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0010
A17Q12	1853-0238		TSTR:SI PNP	28480	1853-0238
A17Q13	1853-0238		TSTR:SI PNP	28480	1853-0238
A17R1	0684-1821	2	R:FXD COMP 1800 OHM 10% 1/4W	01121	CB 1821
A17R2	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A17R3	0757-0429	3	R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A17R4	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A17R5	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A17R6	0684-1041	1	R:FXD COMP 100K OHM 10% 1/4W	01121	CB 1041
A17R7	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A17R8	0811-1200	2	R:FXD WW 0.10 OHM 10% 2W	28480	0811-1200
A17R9	0811-1200		R:FXD WW 0.10 OHM 10% 2W	28480	0811-1200
A17R10	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A17R12	0757-0429		R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A17R13	0698-3154	1	R:FXD MET FLM 4.22K OHM 1% 1/8W	19701	MF4C T-3
A17R14	0757-0430		R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430
A17R15	0757-0429		R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429
A17R16	0684-1821		R:FXD COMP 1800 OHM 10% 1/4W	01121	CB 1821
A17R17	0683-0275	3	R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A17R18	0811-3050	2	R:FXD WW 0.75 OHM 5% 1W	28480	0811-3050
A17R19	0698-3700	2	R:FXD FLM 715 OHM 1% 1/8W	28480	0698-3700
A17R20	0698-4307		R:FXD FLM 14.3K OHM 1% 1/8W	28480	0698-4307
A17R21	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A17R22	0698-4477	1	R:FXD MET FLM 10.5K OHM 1% 1/8W	28480	0698-4477
A17R23	2100-2633	1	R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A17R24	0698-4471		R:FXD FLM 7.15K OHM 1% 1/8W	28480	0698-4471
A17R25	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A17R26	0698-3279		R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3279
A17R27	0757-0426		R:FXD FLM 1.3K OHM 1% 1/8W	28480	0757-0426
A17R28	0811-3050		R:FXD WW 0.75 OHM 5% 1W	28480	0811-3050
A17R29	0698-3700		R:FXD FLM 715 OHM 1% 1/8W	28480	0698-3700
A17R30	0698-4307		R:FXD FLM 14.3K OHM 1% 1/8W	28480	0698-4307
A17R32	0757-0273		R:FXD MET FLM 3.01K OHM 1% 1/8W	28480	0757-0273
A17R33	0698-6678	4	R:FXD MET FLM 15K OHM 0.5% 1/8W	28480	0698-6678
A17R34	0698-6678		R:FXD MET FLM 15K OHM 0.5% 1/8W	28480	0698-6678
A17R35	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A17R36	0687-3301	1	R:FXD COMP 33 OHM 10% 1/2W	01121	EB 3301
A17R37	0687-2701	2	R:FXD COMP 27 OHM 10% 1/2W	01121	EB 2701
A17R38	0687-2701		R:FXD COMP 27 OHM 10% 1/2W	01121	EB 2701
A17R39	0683-0335	2	R:FXD COMP 3.3 OHM 5% 1/4W	01121	CB 0335
A17R40	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A17R42	0698-4157	1	R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A17R43	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A17R44	0698-4641	1	R:FXD FLM 3240 OHM 1% 1/4W	28480	0698-4641
A17R45	0757-0446		R:FXD MET FLM 15.0K OHM 1% 1/8W	28480	0757-0446
A17R46	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A17R47	0698-6678		R:FXD MET FLM 15K OHM 0.5% 1/8W	28480	0698-6678
A17R48	0698-6678		R:FXD MET FLM 15K OHM 0.5% 1/8W	28480	0698-6678

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17R49	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 27G5
A17R50	0683-0335		R:FXD COMP 3.3 OHM 5% 1/4W	01121	CB 0335
A17TP1	08443-00041		TEST POINT	28480	08443-00041
A17TP2	08443-00041		TEST POINT	28480	08443-00041
A18			NOT ASSIGNED		
A19	03320-66519	1	BOARD ASSY:MOTHER	28480	03320-66519
A19XA1	1251-2035	8	CONN:PC 30(2X15) CONTACTS	76530	65-716D
A19XA2	1251-2035		CONN:PC 30(2X15) CONTACTS	76530	65-716D
A19XA3	1251 2035		CONN PC 30 (2X15) CONTACTS	76530	65 716D
A19XA4	1251-1633	4	CONN:PC (1 x 15) 15 CONTACT	71785	252-15-30-310
A19XA5	1251-1633		CONNECTOR: PC (1 x 15) 15 CONTACT	71785	252-15-30-310
A19XA7, A8	1251-1633		CONNECTOR: PC (1 x 15) 15 CONTACT	71785	252-15-30-310
A19XA9	1251-2035		CONN: PC 30 (2 x 15) CONTACTS	76530	65 716D
A19XA10	1251-1633		CONNECTOR:PC (1 x 15) 15 CONTACT	71785	252-15-30 310
A19XA11	1251-2035		CONN:PC 30(2X15) CONTACTS	76530	65-716D
A19XA12	1251-1633		CONNECTOR:PC(1 X 15) 15 CONTACT	71785	252-15-30-310
A19XA20 (STD 3320A ONLY)	1251 1365		CONNECTOR P C (2X22) CONTACTS	71785	252 22 30-300
A19XA21 (STD 3320B ONLY)	1251 1365	5	CONN: PC 44 (2X22) CONTACTS	71785	252 22-30-300
A19XA22 (3320A/B OPT. 003 THRU007)	1251 1365		CONN PC 44 (2X22) CONTACTS		
A20 (STD 3320A ONLY)	03320 66520	1	BOARD ASSY INTERFACE A	28480	03320-66520
A20IC1	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A20IC2	1820-0598	3	IC:DIGITAL TTL QUAD 2-INPT EXCL OR GATE	28480	1820-0598
A20IC3	1820-0587	3	IC:TTL TRIPLE 3-INPT NAND GATE	28480	1820-0587
A20IC4	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A20IC5	1820-0777	5	IC : DIGITAL	01295	SN21819
A20R1	1810-0041	14	R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A20R2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A20R3	0683-2725	6	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A20R4	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A21 (STD 3320B ONLY)	03320-66521	1	BOARD ASSY: INTERFACE B	28480	03320-66521
A21IC1	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A21IC2	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A21IC3	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A21IC4	1820-0766	8	IC: MOS	28480	1820-0766
A21IC5	1820-0766		IC: MOS	28480	1820-0766
A21IC6	1820-0766		IC: MOS	28480	1820-0766
A21IC7	1820-0766		IC: MOS	28480	1820-0766
A21IC8	1820-0598		IC:DIGITAL TTL QUAD 2-INPT EXCL OR GATE	28480	1820-0598
A21IC9	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A21IC12	1820-0587		IC:TTL TRIPLE 3-INPT NAND GATE	28480	1820-0587
A21IC13	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A21IC14	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A21IC15	1820-0777		IC: DIGITAL	01295	SN21819
A21Q1	1853-0203		TSTR:SI PNP	28480	1853-0203
A21Q2	1855-0081		TSTR:SI FET	80131	2N5245
A21Q3	1853-0203		TSTR:SI PNP	28480	1853-0203
A21Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A21R1	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R3	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R4	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R5	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R6	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A21R7	0683-1535		R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A21R8	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A21R9	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A21R10	0683-2035	3	R:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035
A21R12	0683-8215		R:FXD COMP 820 OHM 5% 1/4W	01121	CB 8215
A21R13	0683-2425		R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A21R14	0683-1325	2	R:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A21R15	0683-1815	3	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A21R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A21R17	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A21R18	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A21R19	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A21R20	0683-1545		R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A21R21	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A22 (OPT. 003, 004, 007)	03320-66522		BOARD ASSY: CABLE	28480	03320-66522
A22IC1	1820-0777		IC: DIGITAL	01295	SN21819
A23 (OPT. 003, 004, 007)	03320-66523		BOARD ASSY:FREQUENCY	28480	00320-66523
A23C1	0160-0938		C:FXD MICA 1000 PF 5%	72136	RDM15E102J1C
A23C2	0180-0210	1	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A23C3	0180-0195	1	C:FXD ELECT 0.33 UF 20% 35VDCW	56289	150D334X0035A2-DYS
A23C4	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A23IC1	1820-0590	17	IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A23IC2	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC3	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC4	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC5	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC6	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC7	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC8	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC9	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A23IC10	1820-0586		IC:DIGITAL TTL HEX CONVERTER	28480	1820-0586
A23IC11	1820-0598		IC:DIGITAL TTL QUAD 2-INPT EXCL OR GATE	28480	1820-0598
A23IC12	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A23IC13	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A23IC14	1820-0600	2	IC:DIGITAL TTL DECADE COUNTER	28480	1820-0600
A23IC15	1820-0600		IC:DIGITAL TTL DECADE COUNTER	28480	1820-0600
A23IC16	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A23IC17	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A23IC18	1820-0207		IC:TTL MONOSTABLE MULTIVIBRATOR	28480	1820-0207
A23IC19	1820-0587		IC:TTL TRIPLE 3-INPT NAND GATE	28480	1820-0587
A23IC20	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A23IC21	1820-0595		IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A23Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A23R1	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A23R2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
† A23R3, R4	0683-2725		R: FXD COMP 2700 OHM 5% 1/4 W	01121	CB2725
A23R5	0683-3925	44	R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A23R6	2100-3056		R:VAR CERMET 5K OHM 10% TYPE P 3/4W	28480	2100-3056
A23R7	0683-1235	1	R:FXD COMP 12K OHM 5% 1/4W	01121	CB 1235
A23R8	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A23R9	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A23R10	0683-1825	1	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A23R11	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A24A (3320A OPT. 003 ONLY)	03320-66536		PC ASSY INVERTER	28480	00320-66536
A24IC1	1820 0471		IC TTL HEX INVERTER	01295	SN19235
A24R1	0683-5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB5115
A24R2	0683 5115		R. FXD COMP 510 OHM 5% 1/4 W	01121	CB5115
A24R3	0683-1815		R. FXD COMP 180 OHM 5% 1/4 W	01121	CB1815
A24R4	0683 1535		R FXD COMP 15 K OHM 5% 1/4 W	01121	CB1535
A24B (3320B OPT. 004, 007 ONLY)	03320-66524	1	BOARD ASSY-AMPLITUDE CONTROL	28480	03320-6652424
A24C1	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A24C2	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A24C3	0150-0093		C:FXD CER 0.01 UF +80-20% 100VDCW	72982	801-K800011
A24IC1	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC2	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC3	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC4	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC5	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC6	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC7	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC8	1820-0590		IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A24IC9	1820-0766		IC: MOS	28480	1820-0766
A24IC10	1820-0766		IC: MOS	28480	1820-0766
A24IC11	1820-0766		IC: MOS	28480	1820-0766
A24IC12	1820-0766		IC: MOS	28480	1820-0766
A24IC13	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A24IC14	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A24IC15	1820-0471	1	IC:TTL HEX INVERTER	28480	1820-0471
A24Q1	1853-0203		TSTR:SI PNP	28480	1853-0203
A24Q2	1855-0081		TSTR:SI FET	80131	2N5245
A24Q3	1853-0203		TSTR:SI PNP	28480	1853-0203
A24R1	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A24R2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A24R3	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A24R4	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A24R5	0683-1535		R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A24R6	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A24R7	0683-1545		R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A24R8	0683-7535		R:FXD COMP 75K OHM 5% 1/4W	01121	CB 7535
A24R9	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A24R10	0683-1815		R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A24R12	0683-2425		R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A24R13	0683-8215		R:FXD COMP 820 OHM 5% 1/4W	01121	CB 8215
A24R14	0683-2035		R:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035
A24R15	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A24R16	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A24R17	0683-1815		R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A24R18	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A24R19	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A24R53	0683-1535		R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A25 (3320B OPT. 007 ONLY)	03320-66525	1	PC ASSY, LATCH	28480	03320-66525
A25C1	0140-0232	1	C:FXD MICA 460 PF 1% 300VDCW	28480	0140-0232

† See Section VIII, Manual Backdating.

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A25C2	0140-0199	1	C:FXD MICA 240 PF 5%	28480	0140-0199
A25C3	0160-0363	1	C:FXD MICA 620PF 5%	28480	0160-0363
A25IC1	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A25IC2	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A25IC3	1820-0595		IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A25IC4	1820-0595		IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A25IC5	1820-0595		IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A25IC6	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A25IC7	1820-0584		IC: TTL QUAD NOR GATE	28480	1820-0584
A25IC8, C9	1820-0497	4	IC:DIGITAL 4-BIT RIGHT/LEFT	01295	SN19995
A25IC10	1820-0497		IC:DIGITAL 4-BIT RIGHT/LEFT	01295	SN19995
A25IC11	1820-0497		IC:DIGITAL 4-BIT RIGHT/LEFT	01295	SN19995
A25IC12	1820-0595		IC:TTL DUAL J-K MASTER SLAVE F/F	28480	1820-0595
A25IC13	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A25IC14	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A25IC15	1820-0583		IC:TTL QUAD 2-INPT NAND GATE	28480	1820-0583
A25IC17	1820-0584		IC:TTL QUAD 2-INPT NOR GATE	28480	1820-0584
A25IC18	1820-0656	10	IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC19	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC20	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC21	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC22	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC23	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC25	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC26	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC27	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25IC28	1820-0656		IC:DIGITAL TTL 4-BIT DATA SELECTOR	01295	SN14266
A25R1	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A25R2	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A25R3	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A28 (OPT 003, 004 ONLY)	03320-66528	1	BOARD ASSY:PAR LGC	28480	03320-66528
A28Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A28R1	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A28R2	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A28R3	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R4	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R5	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R6	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28 R7	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R8	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R9	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R10	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R11	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R12	0683 3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R13	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R14	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R15	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R16	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R17	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R18	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R19	0683 3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R20	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R21	0683 1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R22	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R23	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R24	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R27	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R28	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R29	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R30	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R31	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R32	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R33	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R34	0683 3925		R: FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R35	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R36	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R37	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R38	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R39	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R40	0683-3925		R: FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R41	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R42	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R43	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R44	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R45	0683 1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R46	0683-1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R47	0683-3925		R: FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R48	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R49	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A28R50	0683 1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R51	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R52	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R53	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R54	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R55	0683-3925		R· FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R56	0683 3925		R· FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R58	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R59	0683-1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R60	0683 3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R61	0683-3925		R· FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R62	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R63	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R64	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R65	0683 3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R66	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R67	0683-1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R68	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R69	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R70	0683 1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R71	0683-1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R72	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R73	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R74	0683 1525		R· FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R75	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R76	0683-1525		R. FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R77	0683-3925		R· FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R78	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R79	0683 3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R80	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R81	0683-1325		R. FXD COMP 1300 OHM 5% 1/4 W	01121	CB1325
A28R82	0683-1525		R: FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R83	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R84	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R85	0683 3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R86	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R87	0683-3925		R. FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R88	0683-1525		R FXD COMP 1500 OHM 5% 1/4 W	01121	CB1525
A28R89	0683-3925		R FXD COMP 3900 OHM 5% 1/4 W	01121	CB3925
A28R91	0683-7515		R· FXD COMP 750 OHM 5% 1/4 W	01121	CB7515
A28XA23	1251-1365		CONN· PC 44 (2X22) CONTACTS	71785	252-22 30 300
A28XA24	1251-1365		CONN. PC 44 (2X22) CONTACTS	71785	252-22-30-300
A37 (33208 OPT. 007 ONLY)	03320 66537		GPIB INPUT	28480	03320-66537
A37C1	0160 0990		C FXD MICA 100 pF 2 % 300 VDCW	72136	OBD
A37C2	0160 0363		C FXD MICA 620 pF 5 % 300 VDCW	72136	OBD
A37C3	0160-0938		C FXD MICA 1000 pF 5 % 300 VDCW	72136	OBD
A37C4	0160 0938		C FXD MICA 1000 pF 5 % 300 VDCW	72136	OBD
A37C5	0140-0198		C. FXD MICA 200 pF 5 %	72136	OBD
A37C6	0180 0104		C· FXD AL ELECT 200 UF -10 % +75 % 16 VDCW	56289	30D207G016DF2-DSM
A37C7	0180 0104		C· FXD AL ELECT 200 UF -10 % +75 % 16 VDCW	56289	30D207G016DF2-DSM
A37C8	0150-0012		C FXD CER 0.01 UF 20 % 1000 VDCW	56289	C023A102J103MS36-COR
A37CR1	1910 0016		DIODE GE 100 MA	14433	G718
A37CR2	1910 0016		DIODE· GE 100 MA	14433	G718
A37CR3	1910 0016		DIODE: GE 100 MA	14433	G718
A37CR4	1910-0016		DIODE GE 100 MA	14433	G718
A37CR5	1910-0016		DIODE: GE 100 MA	14433	G718
A37CR6	1910 0016		DIODE: GE 100 MA	14433	G718
A37CR7	1910 0016		DIODE· GE 100 MA	14433	G718
A37CR8	1910-0016		DIODE: GE 100 MA	14433	G718
A37CR9	1901-0158		DIODE· SI .75 A 200 V	04713	SR 1358-3
A37CR10	1901-0158		DIODE. SI .75 A 200 V	04713	SR 1358-3
A37CR11	1901 0158		DIODE: SI .75 A 200 V	04713	SR 1358-3
A37CR12	1901-0158		DIODE SI 75 A 200 V	04713	SR 1358 3
A37IC1	1820-0583		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT GATE	12040	SD12955
A37IC2	1820-0583		INTEGRATED CIRCUIT. DIGITAL QUAD 2-INPUT GATE	12040	SD12955
A37IC3	1820 0588		INTEGRATED CIRCUIT: DIGITAL DUAL 4-INPUT GATE	12040	SD12981
A37IC4	1820-0588		INTEGRATED CIRCUIT: DIGITAL DUAL 4-INPUT GATE	12040	SD12981
A37IC5	1820 0584		INTEGRATED CIRCUIT· DIGITAL QUAD 2- INPUT NOR GATE	12040	DM74L02N
A37IC6	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2 INPUT NOR GATE	12040	DM74L02N

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A37IC7	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A37IC8	1820-0583		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NAND GATE	12040	SD12955
A37IC9	1820-0586		INTEGRATED CIRCUIT: DIGITAL HEX INVERTER	12040	DM74L04N
A37IC10	1990 0312		PHOTO ISOLATOR	01295	OBD
A37IC11	1990 0312		PHOTO ISOLATOR	01295	OBD
A37Q1	1854-0354		TSTR SI NPN	04713	SS2077
A37Q2	1854-0354		TSTR SI NPN	04713	SS2077
A37Q3	1854 0009		TSTR. SI NPN 2N709	04713	SS376K
A37Q4	1853-0203		TSTR: SI PNP	04713	SS5651
A37Q5	1854 0354		TSTR: SI NPN	04713	SS2077
A37R1	1810 0136		R NETWORK FLM	91637	OBD
A37R2	0683 5115		R: FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R3	0683 5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R4	0683 5115		R: FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R5	0683-5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R6	0683-5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R7	0683-5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R8	0683-5115		R FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R9	0683-3025		R. FXD COMP 3 K OHM 5% 1/4 W	01121	CB 3025
A37R10	0683 6225		R: FXD COMP 6200 OHM 5% 1/4 W	01121	CB 6225
A37R11			NOT ASSIGNED		
A37R12	0683 3025		R: FXD COMP 3 K OHM 5% 1/4 W	01121	CB 3025
A37R13	0683 6225		R FXD COMP 6200 OHM 5% 1/4 W	01121	CB 6225
A37R14	0683 9115		R FXD COMP 910 OHM 5% 1/4 W	01121	CB 9115
A37R15	0683-6215		R FXD COMP 620 OHM 5% 1/4 W	01121	CB 6215
A37R16	0683-1025		R FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R17	0683 6215		R FXD COMP 620 OHM 5% 1/4 W	01121	CB 6215
A37R18	0683-5115		R: FXD COMP 510 OHM 5% 1/4 W	01121	CB 5115
A37R19	0683 1325		R FXD COMP 1300 OHM 5% 1/4 W	01121	CB 1325
A37R20	0683-1325		R FXD COMP 1300 OHM 5% 1/4 W	01121	CB 1325
A37R21	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R22	0683 1535		R FXD COMP 15 K OHM 5% 1/4 W	01121	CB 1535
A37R23			NOT ASSIGNED		
A37R24	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R25	0683-1535		R FXD COMP 15 K 5% 1/4 W	01121	CB 1535
A37R26	0683 3615		R: FXD COMP 360 OHM 5% 1/4 W	01121	CB 3615
A37R27	0683 1025		R. FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R28	0683 1035		R FXD COMP 10 K OHM 5% 1/4 W	01121	CB 1035
A37R29	0683-1025		R FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R30	0683-1535		R. FXD COMP 15 K 5% 1/4 W	01121	CB 1535
A37R31	0683 3025		R. FXD COMP 3 K OHM 5% 1/4 W	01121	CB 3025
A37R32	0683-6225		R FXD COMP 6200 OHM 5% 1/4 W	01121	CB 6225
A37R33	0683 3615		R FXD COMP 360 OHM 5% 1/4 W	01121	CB 3615
A37R34	0683-1035		R: FXD COMP 10 K OHM 5% 1/4 W	01121	CB 1035
A37R35	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A37R36	0683 3005		R FXD COMP 30 OHM 5% 1/4 W	01121	CB 3005
A37T1	9100 1238		XFMR PULSE	90095	2 WEMA
A37T2	9100 1238		XFMR PULSE	90095	2 WEMA
A37T3	9100-1238		XFMR PULSE	90095	2 WEMA
A37T4	9100-1238		XFMR: PULSE	90095	2 WEMA
A37T5	9100-1238		XFMR PULSE	90095	2 WEMA
A37T6	9100 1238		XFMR PULSE	90095	2 WEMA
A37T7	9100 1238		XFMR PULSE	90095	2 WEMA
A37T8	9100-1238		XFMR PULSE	90095	2 WEMA
A38 (3320B OPT. 007 ONLY)	03320-66538		GPIB CONTROL	28480	03320 66538
A38C1	0160-0938		C FXD MICA 1000 pF 5% 300 VDCW	72136	OBD
A38C2	0180-0291		C FXD TA 1 UF 10% 35 VDCW	56289	150D105X9035A2-DYS
A38C3	0160-0938		C: FXD MICA 1000 pF 5% 300 VDCW	72136	OBD
A38C4	0160-2207		C. FXD MICA 300 pF 5% 300 VDCW	72136	OBD
A38C5	0180-1746		C: FXD TA 15 UF 10% 20 VDCW	56289	150D156X902082 DYS
A38C6	0160-2207		C. FXD MICA 300 pF 5% 300 VDCW	72136	OBD
A38CR1	1910-0016		DIODE: GE 100 MA	14433	G718
A38CR2	1910-0016		DIODE: GE 100 MA	14433	G718
A38IC1	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC2	1820 0584		INTEGRATED CIRCUIT DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC3	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC4	1820 0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC5			NOT ASSIGNED		
A38IC6	1820-0584		INTEGRATED CIRCUIT. DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC7	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2 INPUT NOR GATE	12040	DM74L02N
A38IC8	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A38IC9	1820 0583		INTEGRATED CIRCUIT: DIGITAL QUAD 2 INPUT NAND GATE	12040	SD12955
A38IC10	1820 0595		INTEGRATED CIRCUIT: DIGITAL DUAL FLIP FLOP	12040	DM74L73N
A38IC11	1820-0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2-INPUT NOR GATE	12040	DM74L02N
A38IC12	1820 0777		INTEGRATED CIRCUIT: DIGITAL	01295	SN21819
A38IC13	1820 0777		INTEGRATED CIRCUIT: DIGITAL	01295	SN21819
A38IC14	1820-0777		INTEGRATED CIRCUIT: DIGITAL	01295	SN21819
A38IC15	1820-0586		INTEGRATED CIRCUIT: DIGITAL HEX INVERTER	12040	DM74L04N
A38IC16	1820 0584		INTEGRATED CIRCUIT: DIGITAL QUAD 2 INPUT NOR GATE	12040	DM74L02N
A38IC17	1820 0586		INTEGRATED CIRCUIT: DIGITAL HEX INVERTER	12040	DM74L04N
A38Q1	1853 0086		TSTR: SI PNP	04713	SPS3322
A38R1	0683-9115		R: FXD COMP 910 OHM 5% 1/4 W	01121	CB 9115
A38R2	0683-6215		R: FXD COMP 620 OHM 5% 1/4 W	01121	CB 6215
A38R3	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A38R4	0683 2035		R: FXD COMP 20 K 5% 1/4 W	01121	CB 2035
A38R5	0683-1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A38R6	0683 9115		R: FXD COMP 910 OHM 5% 1/4 W	01121	CB 9115
A38R7	0683-6215		R: FXD COMP 620 OHM 5% 1/4 W	01121	CB 6215
A38R8	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A38R9	0683-1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A38R10	0683 1025		R: FXD COMP 1 K OHM 5% 1/4 W	01121	CB 1025
A39 (3320B OPT. 007 ONLY)	03320-66539	1	PC ASSY: MOTHER	28480	03320-66539
A39XA23	1251-1365		CONN: PC 44 (2X22) CONTACTS	71785	252-22-30-300
A39XA24	1251 1365		CONN: PC 44 (2X22) CONTACTS	71785	252-22-30-300
A39XA25	1251 2035		CONN: PC 30 (2X15) CONTACTS	76530	65 7160
A39XA37	1251 2035		CONN: PC 30 (2X15) CONTACTS	76530	65 7160
A39XA38	1251 2035		CONN: PC 30 (2X15) CONTACTS	76530	65 7160
			CHASSIS MOUNTED COMPONENTS		
C1	0180-2397	1	C: FXD 18000 UF		
CR1, CR2	1901-0526	3	ASSY: DIODE BRIDGE SI 100 PIV 5A		
CR3*	1901-0526		ASSY: DIODE BRIDGE SI 100 PIV 5A		
F1 (110 V ac)	2110-0312	1	FUSE: 1A 250 V SLO BLO		
F1 (230 V ac)	2110-0202	1	FUSE: 0.50A 250 V SLO BLO	75915	313.500S
F2	2110-0055	1	FUSE: 4A 250 V NORMAL BLO		
J1 THRU J5	1250-1194		CONNECTOR: RF (SUBMIN)		
J6	1250-0252		CONNECTOR: RF		
J7 (3320A ONLY)	1250-0102		CONNECTOR: RF		
J8	1250-0252		CONNECTOR: RF		
J9	1250-1194		CONNECTOR: RF (SUBMIN)		
J10 (3320B ONLY)	1250-0102		CONNECTOR: RF		
J11			P/O 03320-61618 CABLE ASSY		
J12, J13	1250-0252				
J14			REM: I/O, (A28, OPT. 003, 004) (A39, OPT. 007)		
J15	1250-0118		CONNECTOR: RF		
LED1 THRU LED4	03320-68101		DECIMAL INDICATOR ASSEMBLY		
M1	3160 0248	1	FAN: TUB AXIAL		
Q1	1854-0063	1	TSTR: SI NPN 2N3055		
Q2	1854-0072	2	TSTR: SI NPN 2N3054		
Q3	1853-0052	2	TSTR: SI PNP 2N3740		
Q4*	1854-0072		TSTR: SI NPN 2N3054		
Q5*	1853-0052		TSTR: SI PNP 2N3740		
R1	0684-4711		R: FXD COMP 470 OHM 10% 1/4 W		
R2	2100-2217	1	R: VAR WW LIN 10 K OHM 5% 3 W		
R3	2100-3167	1	R: VAR 25 K OHM (3320A ONLY)		
S1	3101-0896	1	SWITCH: TOGGLE (POWER)		
S2	3100-2725	1	SWITCH: ROTARY (VERNIER)		
S3*	3101 1179	1	SWITCH: TOGGLE (LEVELING)		
T1	9100-3234	1	TRANSFORMER: POWER		
			CABLE ASSEMBLIES		
W1	03320-61601	1	FLAT CABLE ASSEMBLY (3320A/B STD AND OPTIONS 001, 002, 006)		
W2	03320-61602	1	FLAT CABLE ASSEMBLY (3320A/B OPTIONS 003 THRU 007 ONLY)		
	03320-61603	1	CABLE ASSEMBLY A (BROWN)		
	03320-61604	1	CABLE ASSEMBLY B (RED)		
	03320-61605	1	CABLE ASSEMBLY C (A12 TO A14 B MODEL ONLY)		
	03320-61606	1	CABLE ASSEMBLY D (4-COND. TO POWER SWITCH)		
	03320-61607	1	CABLE ASSEMBLY E (TO FRONT PANEL OUTPUT)		
	03320-61608	1	CABLE ASSEMBLY F (ORANGE)		
	03320-61610	1	CABLE ASSEMBLY H (GREEN)		
	03320-61611	1	CABLE ASSEMBLY I (BLUE)		
	03320-61612	1	CABLE ASSEMBLY J (VIOLET)		
	03320-61613	1	CABLE ASSEMBLY K (WHITE)		
(*) INDICATES PART ON B MODEL ONLY.	03320-61614	1	CABLE ASSEMBLY L (FROM A15)		
	03320-61618	1	CABLE ASSEMBLY (ALTERNATE OUTPUT)	28480	03320-61618

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			MISCELLANEOUS		
	5040-5932	1	COVER. MAIN POWER SWITCH		
	10513-4001	1	COVER. 18 PIN CONNECTOR (OPTION 003)		
	05216-4008	1	GUARD SOCKET (REMOTE CONTROL)		
	5040-1449	1	HINGE		
	1400-0008	1	HOLDER FUSE (F2)		
	05216-4007	1	HOUSING CONNECTOR (REMOTE CONTROL)		
	5040-0702	2	INSULATOR CONNECTOR (FOR J3)		
	03320-84401	1	KIT ACCESSORY INCLUDES THE FOLLOWING:		
	5020-7621	1	BRACKET		
	5020-7622	1	BRACKET		
	03320-66530	1	EXTENDER: PC		
	5040-6676	1	FILLER STRIP		
	03320-67703	1	FILTER ASSY: FAN		
	03320-90000	1	MANUAL. OPERATING AND SERVICE		
	Option 002 only				
	03320-61501	1	BRKT ASSY TERM CONSISTS OF	hp	
	03320-01209	1	BRKT TERM	hp	
	0757-0442	2	R: FXD FLM 10K OHM 1% 1/8 W	19701	MF4C T-0 obd
	2100-2488	1	R: VAR COMP 10K OHM 20% 1/2 W	01121	Type W
	0960-0164	1	CRYSTAL OVEN OSCILLATOR	75378	
	10502-6001	1	CABLE EXTERNAL PULSE	hp	
	1251 3056		56 PIN CONNECTOR (OPT. 003, 004)		
			MECHANICAL PARTS (REFER TO FIGURES 6-1 THRU 6-3)		
MP1	5060-8505	1	COVER TOP		
MP2	03320-00202 (3320A)	1	PANEL REAR		
	03320-00201 (3320B)	1	PANEL REAR		
MP3	03320-04115	1	COVER OVEN		
MP4	3160-0249	1	GRILLE FAN		
MP5	3150-0227	1	FILTER FAN		
MP6	3150-0228	1	SCREEN FILTER		
MP7	5000-8527	1	COVER REAR (RIGHT SIDE)		
MP8	5060-8737	2	RETAINER HANDLE		
MP9	5060-0222	2	ASSY HANDLE		
MP10	5000-8525	2	COVER FRONT SIDE		
MP11	5000-0051	2	PLATE FLUTED		
MP12	0490-0030	1	STAND TILT		
MP13	5060-0767	5	ASSY FOOT		
MP14	03320 24901	2	FRAME: SIDE		
MP15	03320-01202	1	BRACKET: PANEL (RIGHT SIDE)		
MP16	03320 24707	2	SPACER: BAR		
MP17	03320-24708	2	SPACER ROD		
MP18	5060-8513	1	COVER. BOTTOM		
MP19	03320-04301	1	PLATE SWITCH		
MP20			MP20, Front Panel Assembly Includes A13 Switch Assembly.		
	03320-60302	1	PANEL FRONT 3320A		
	03320-60304	1	PANEL FRONT 3320A (OPTION 001)		
	03320-60301	1	PANEL FRONT 3320B*		
	03320-60303	1	PANEL: FRONT 3320B (OPTION 001)*		
MP21	5020-6866	1	TRIM: BOTTOM		
MP22	0370-2257	8	KNOB RND		
MP23	0370-1092	1	KNOB 1/2 RND		
MP24	0370 1126	1	KNOB CONCENTRIC		
MP25	5020-6865	1	TRIM TOP		
MP26	03320-01203	1	BRACKET PANEL (LEFT SIDE)		
MP27	5000-8531	1	COVER. REAR (LEFT SIDE)		
MP28	03320-01206	1	BRACKET RECTIFIER		
† MP29	03320-61205	1	BRACKET: POWER SUPPLY		
MP30	03320-01208	1	STRAP RETAINER		
† MP31	03320-69536	1	REAR DECK ASSEMBLY INCLUDES.		
	03320-60112	1	DECK. POWER SUPPLY		
	03320-61204	1	BRACKET RIGHT		
	03320-61210	1	BRACKET: CONTROL FRONT		
	03320-61211	1	BRACKET. CONTROL REAR		
MP32	03320-00104	1	DECK AMP AND ATTEN		
MP33	03320-60101	1	ASSY GUSSET		
MP34	03320-00101	1	DECK: CARD NEST		
MP35	03320-00601	1	SHIELD		
MP36	03320-25501	11	EXTRU. CARD NEST (A1THRU A11)		
MP37	03320-61201 (3320A)	1	ASSY TSTR BRACKET		
	03320-61202 (3320B)	1	ASSY. TSTR BRACKET		
MP38	03320-04101	1	COVER CARD NEST (A1)		
MP39	03320-04102	1	COVER: CARD NEST (A2)		
MP40	03320-04103	1	COVER CARD NEST (A3)		
MP41	03320-04104	1	COVER CARD NEST (A4)		
MP42	03320-04105	1	COVER: CARD NEST (A5)		
MP43	03320-04106	1	COVER. CARD NEST (A6)		
MP44	03320-04107	1	COVER: CARD NEST (A7)		
MP45	03320-04108	1	COVER: CARD NEST (A8)		
MP46	03320-04109	1	COVER. CARD NEST (A9)		
MP47	03320-04110	1	COVER. CARD NEST (A10)		
MP48	03320-04111 (3320B)	1	COVER: CARD NEST (A11)		
MP49	03320-04119 (3320A)	1	COVER: CARD NEST (A11)		
MP50	03320-42301	1	EXTRU. CARD NEST (A12)		
MP51	03320-24705	1	SUPPORT: FLAG		
MP52	5040-5882	1	ASSY: FLAG		

† See Section VIII, Manual Backdating.

MECHANICAL PARTS (cont'd).

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP53	03320-29101	1	SPRING		
MP54	5040-5885	1	DISK: READOUT		
MP55	5040-5886	1	DISK: READOUT*		
MP56	03320-24704	6	SPACER		
MP57			NOT ASSIGNED		
MP58	5040-5884	2	DISK: READOUT		
MP59, MP60	5040-5887	3	DISK: READOUT*		
MP61	5040-5883	1	DISK: READOUT		
MP62	03320-61401	1	ASSY: VERNIER DRIVE (SEE FIGURE 6-3)		
1	03320-23501	1	SUPPORT GEAR		
2	3100-2725	1	SWITCH: ROTARY		
3	03320-23702	1	SHAFT: DRIVE GEAR		
4	1430-0757	1	GEAR: DRIVE		
5	5060-5991	1	GEAR: POT		
6	2950-0001	1	NUT: HEX 3/8 8RS		
7	2190-0016	1	WASHER: LOCK INT		
8	03320-22401	2	GEAR: BEVEL		
9	2100-2217	1	R: VAR WW LIN 10 K OHM 5% 3 W		
10	1140-0053	1	COUNTER		
11	1530-1638	1	POINTER		
12	1430-0741	1	GEAR: CENTER SPUR		
13	03320-24706	1	SPACER: GEAR		
14	2190-0378	2	WASHER: S.S		
15	03320-23701	1	SHAFT: BEVEL GEAR		
16	2190-0879	2	WASHER: NYLON		
17	5040-5878	1	CAM	28480	5040-5878
18	03320-26202	1	COLLAR	28480	03320-26202
19	5040-5946	1	CAM	28480	5040-5946
20	03320-26201	1	COLLAR	28480	03320-26201
	REBUILT ASSEMBLIES				
A1	03320-69501				
A2	03320-69502				
A3	03320-69503				
A4	03320-69504				
A5	03320-69505				
A7	03320-69507				
A8	03320-69508				
A9B	03320-69509				
A10	03320-69510				
A11	03320-69511				
A12B	03320-69512				
A14	03320-69514				
A15	03320-69515				
A17B	03320-69517				
A12A	03320-69518				
A21	03320-69521				
A23	03320-69523				
A24	03320-69524				
A25	03320-69525				
A26	03320-69526				
A27	03320-69527				
A9A	03320-69533				
A17A	03320-69535				

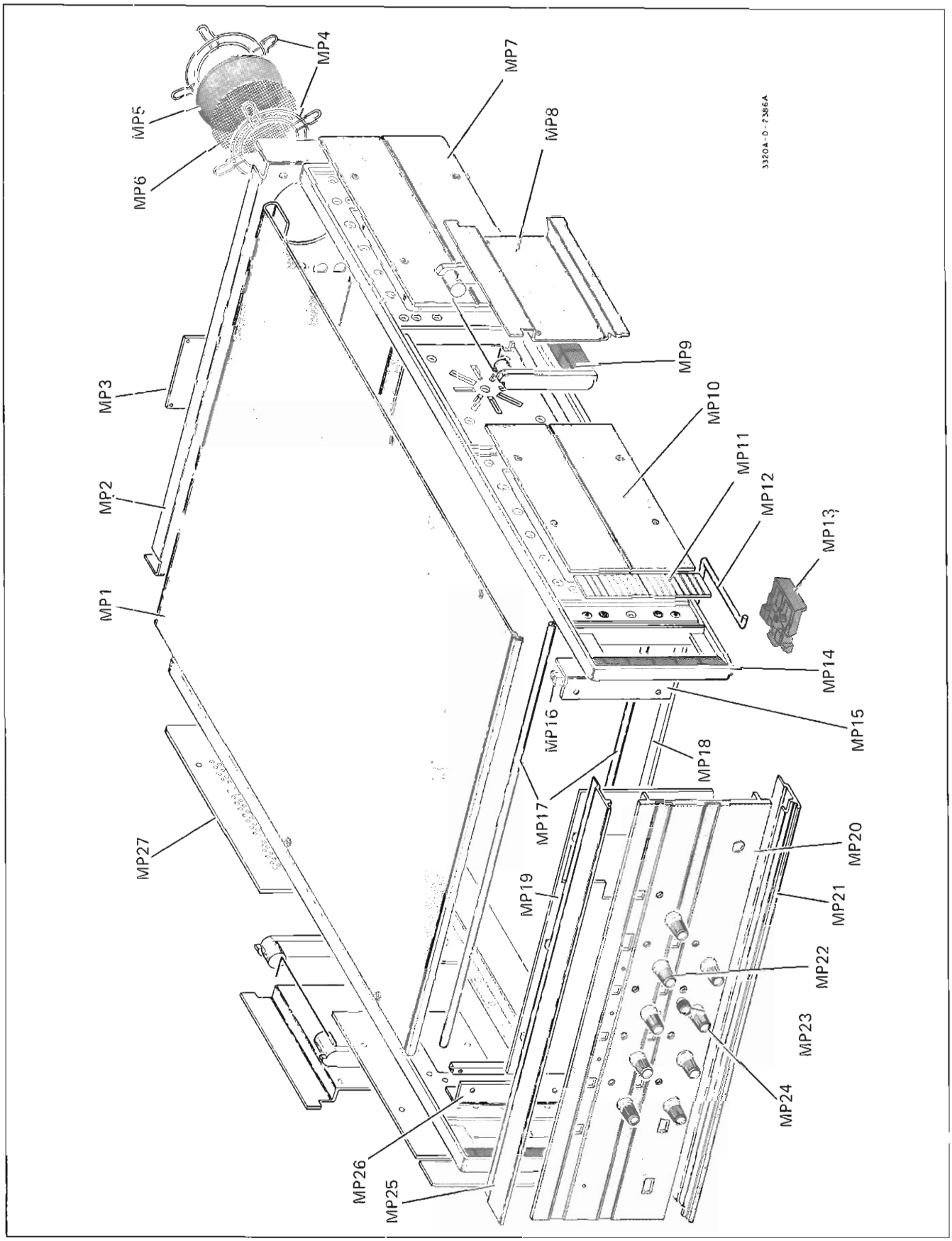
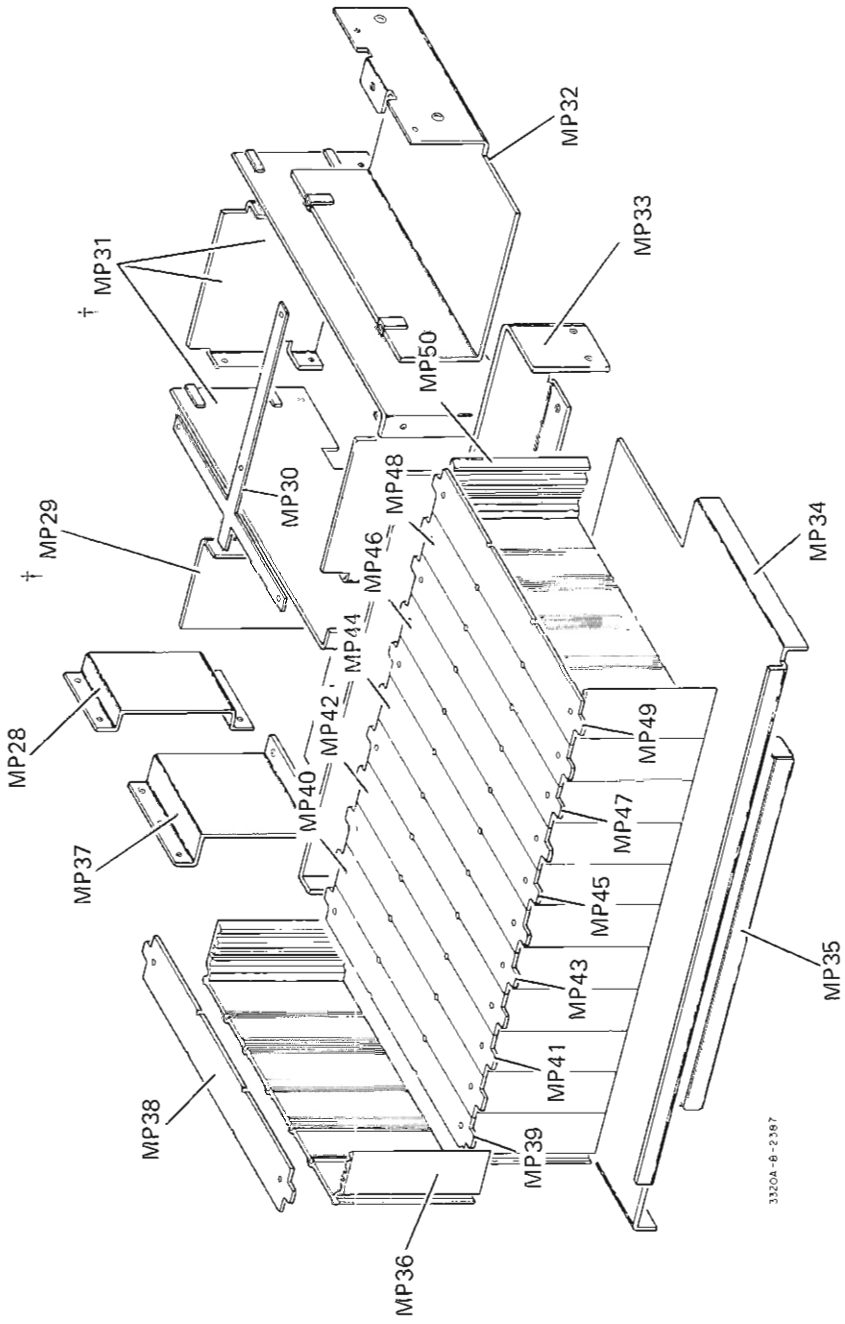


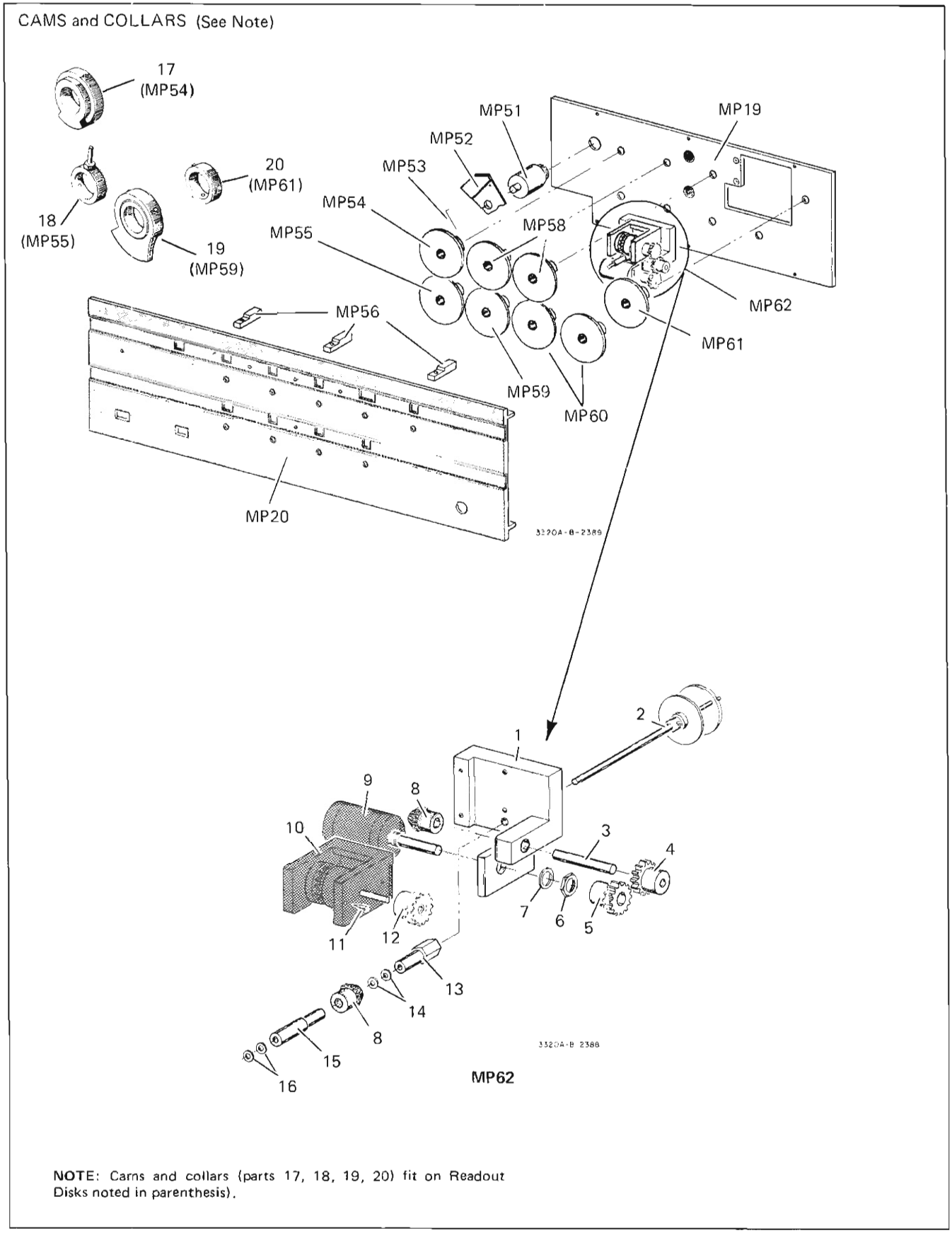
Figure 6-1. External Mechanical Parts.



† See Appendix C, Manual Backdating.

Rev. A - For Instrument Serial Numbers: 3320A - 1121A - 00111 and above.
3320B - 1122A - 00121 and above.

Figure 6-2. Internal Mechanical Parts.



NOTE: Cams and collars (parts 17, 18, 19, 20) fit on Readout Disks noted in parenthesis).

Figure 6-3. Front Panel and Vernier Control Mechanical Parts.

SECTION VII
CIRCUIT DIAGRAMS

7-1. INTRODUCTION.

7-2. This section of the manual contains troubleshooting information and ciruit diagrams for the 3320A/B Automatic Synthesizer. Included are troubleshooting trees, functional block diagrams, schematic diagrams and component location diagrams.

7-3. TROUBLESHOOTING.

7-4. The following troubleshooting information is designed to eliminate needless unrelated checks in locating instrument malfunctions. It should first be determined that a malfunction does exist and that it does not exist external to the 3320A/B. Before troubleshooting the 3320A/B, become familiar with the principles of operation (Section III) and the functional composition (Section IV) of the instrument.

7-5. To isolate the malfunction to an assembly, use the Block Diagrams (Figures 7-5, 7-6, 7-7) and/or the troubleshooting trees (Figures 7-1 through 7-4). To further isolate the malfunction to a component, use the schematic diagrams (Figures 7-9 through 7-32).

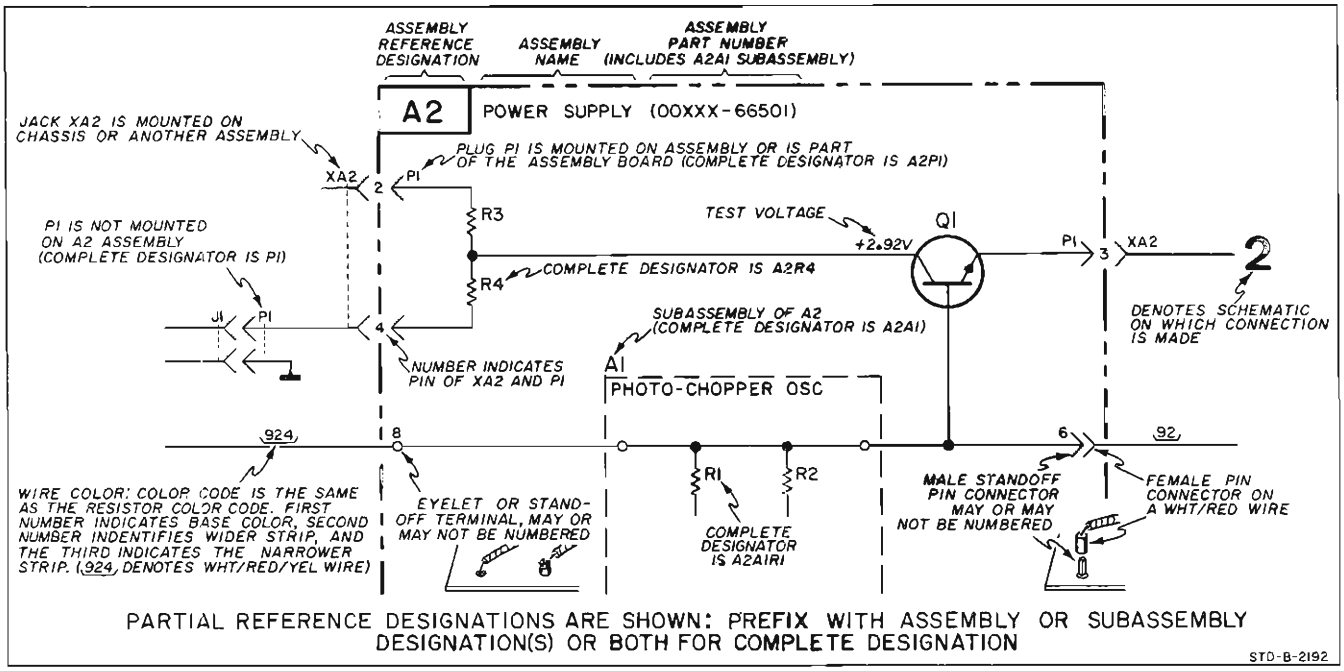
NOTE

Use the troubleshooting trees in the sequence in which they appear in the manual with one exception. The first troubleshooting tree, (Figure 7-1, System Component Isolation and GPIB Troubleshooting Tree) should be used for Option 007 (GPIB) 3320B instruments only. For standard instruments start the troubleshooting with Figure 7-2, Reference Frequency Troubleshooting Tree.

7-6. SCHEMATIC DIAGRAMS.

7-7. The schematic diagrams (Figure 7-9 through Figure 7-32) contained in this section show the detailed circuits of the 3320A/B. Components marked with an asterisk are those that are critical in value. The value of these components may vary from one instrument to another. The optimum value is selected at the factory. All options available with the 3320A/B are shown.

REFERENCE DESIGNATIONS



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.

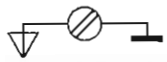
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN MICROHENRYS

3. DENOTES FLOATABLE CIRCUIT GROUND.

4. DENOTES ASSEMBLY CIRCUIT GROUND.

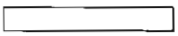
5. DENOTES CHASSIS CIRCUIT GROUND.

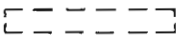
6. DENOTES POWER LINE GROUND.

7.  DENOTES SCREWDRIVER GROUND.

8.  DENOTES ASSEMBLY.

9. 2 DENOTES SIGNAL DESTINATION.

10.  DENOTES FRONT PANEL MARKING.

11.  DENOTES SIDE AND REAR PANEL MARKING.

12.  DENOTES SCREWDRIVER ADJUST.

13. (924) DENOTES WIRE COLOR; COLOR CODE SAME AS RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES BASE COLOR, SECOND NUMBER IDENTIFIES WIDER STRIP, THIRD NUMBER IDENTIFIES NARROWER STRIP.

    (e.g. (924) = WHITE, RED, YELLOW.)

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

15. SCHEMATIC DIAGRAMS INCLUDE ALL OPTIONS.

PROGRAM CARD — CARD NO. 1 OF 6

TITLE Diagnostic Card 1

NO.	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3	* 267									
4										
5	A	101								
6	+	053								
7	2	062								
8	6	066								
9	9	071								
10	9	071								
11	,	054								
12	R	122								
13	3	063								
14	.	054								
15	F	106								
16	1	061								
17	0	060								
18	9	071								
19	9	071								
20	,	054								
21	M	115								
22	.	054								
23	D	104								
24	3	063								
25	.	054								
26	C	103								
27										
28										
29										
30										
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

PROGRAM CARD — CARD NO. 2 OF 6

TITLE Diagnostic Card 2

NO	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3										
4	* 267									
5										
6	A	101								
7	--	055								
8	5	065								
9	9	071								
10	6	066								
11	6	066								
12	,	054								
13	R	122								
14	4	064								
15	.	054								
16	F	106								
17	7	067								
18	6	066								
19	6	066								
20	,	054								
21	K	113								
22	V	126								
23	8	070								
24	,	054								
25	D	104								
26	4	064								
27	.	054								
28	C	103								
29										
30										
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

PROGRAM CARD — CARD NO. 3 OF 6

TITLE Diagnostic Card 3

NO	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3										
4	267									
5										
6										
7										
8										
9										
0										
11										
12										
13										
14	K	113								
15										
16										
17										
18										
19										
20										
21										
22										
23										
24	V	126								
25	7	067								
26										
27	,	054								
28										
29										
30	-	065								
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

PROGRAM CARD — CARD NO. 4 OF 6

TITLE Diagnostic Card 4

NO	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

PROGRAM CARD — CARD NO. 5 OF 6

TITLE Diagnostic Card 5

NO	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3										
4										
5										
6	* 267									
7										
8	A	101								
9	+	053								
10	2	062								
11	6	066								
12	6	066								
13	6	066								
14	.	054								
15	F	106								
16	8	070								
17	0	060								
18	0	060								
19	.	054								
20	R	122								
21	3	063								
22	,	054								
23	K	113								
24	V	126								
25	7	067								
26	.	054								
27	D	104								
28	4	064								
29	,	054								
30	C	103								
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

PROGRAM CARD — CARD NO. 6 OF 6

TITLE Diagnostic Card 6

NO.	STEP	CODE	200	100	40	20	10	4	2	1
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										

1. USE SOFT PENCIL
2. DO NOT MARK IN SHADED AREA (TOP)
3. ERASE COMPLETELY
4. INSERT THIS SIDE UP

HP PART NO. 9320-3866

* This card is marked for addressing an instrument of address 67. If the address of your instrument is different, you should change the address on the cards to match your instruments internal address.

TABLE 1: PIN STATES ON XA25A AND XA25B AFTER INSERTING DIAGNOSTIC CARD NO. 1.

PIN NUMBERS ON XA25A	A	B	C	D	E	F	H	J	K	L	M	N	P	R	S		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
STATE	1	1	0	1	1	1	0	0	0	1	0	1	0	1	1		b	0	1	0	0	1	0	1	0	1	0	1	1	1	0

PIN NUMBERS ON XA 25B	P	R	S	13	14	15
STATE	1	1	0	1	0	1

1 HIGH VOLTAGE LIGHT ON
0 LOW VOLTAGE - LIGHT OFF

TABLE 2 PIN STATES ON XA25A AND XA25B AFTER INSERTING DIAGNOSTIC CARD NO 2

PIN NUMBERS ON XA25A	A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
STATE	0	0	1	0	0	0	1	1	1	0	1	0	1	0	1	1	1	0	1	1	0	1	0	1	0	1	0	0	0	1

PIN NUMBERS XA25B	M	N	P	R	S	11	12	13	14	15
STATE	1	0	0	0	1	1	1	0	1	0

1 HIGH VOLTAGE LIGHT ON
0 LOW VOLTAGE - LIGHT OFF

LOGIC DEFINITIONS (For Tables 3 thru 5)

1 = Light ON (high voltage)

0 = Light OFF (low voltage)

b = Burst of pulses (light blinking rapidly)

EXAMPLE

Code 1 0 1

1) 1 Means that before card is inserted logic probe light is ON.

2) 0 Means that sometime during the time the Card Reader is running the light goes OFF

3) 1 The light comes back ON This may occur before or after the Card Reader stops running.

LOGIC TROUBLESHOOTING PROCEDURE

A) Connect logic probe to connector pin designated in Logic Troubleshooting Table (Tables 3 thru 5) being used

B) Using the Logic Definitions listed above note the initial logic state indicated by the logic probe. This state should correspond with the first digit of the 3-digit code to be checked.

C) While observing the logic probe indication, insert the appropriate test card in the Card Reader.

D) While the Card Reader is running, the logic probe indication should correspond with the second digit of the code being checked

E) When the Card Reader has stopped running, the logic probe indication should correspond with the third digit of the code being checked.

F) If the logic probe indication is incorrect for any or all digits of a given code replace the board indicated in the Logic Troubleshooting Table

TABLE 3: PIN STATES ON XA37 BEFORE, DURING AND AFTER INSERTING DIAGNOSTIC CARD NO 4.

PIN NUMBERS	C	D	E	F	H	J	K	SHOULD THIS TEST FAIL REPLACE A37
STATE	0-b-0	0-b-0	0-b-0	0-b-0	0-b-0	0-b-0	0-b-0	

TABLE 4: PIN STATES ON X38 BEFORE, DURING AND AFTER INSERTING DIAGNOSTIC CARD NO 3

PIN NUMBERS	2	6	7	8	D	F	SHOULD THIS TEST FAIL REPLACE A38
STATE	0-1-0	0-1-0	0-1-0	1-0-1	0-1-0	0-b-0	

TABLE 5: PIN STATES ON X38 AFTER INSERTING DIAGNOSTIC CARD NO. 1.

PIN NUMBERS	3	4	5	C	E	S	SHOULD THIS TEST FAIL REPLACE A38
STATE	1-0-1	0-1-0	1-0-1	1-0-1	1-0-1	1-0-1	

TABLE 6. ALL PINS ARE ON XA37.

Connect logic probe to XA37 pin 9 Insert Diagnostic Card No. 6 and note the number of times the probe light blinks after the card is inserted. Repeat this sequence with the logic probe connected to each of the other pins listed in the table. In each case, the light should be ON initially and blink three times after the card is inserted. The only exceptions are pin 10 which should blink rapidly during the test and pin 11 which is always low when the card reader power switch is ON

PINS TO BE CHECKED AS INDICATED ABOVE									
3	4	5	6	7	8	9	10	11	R

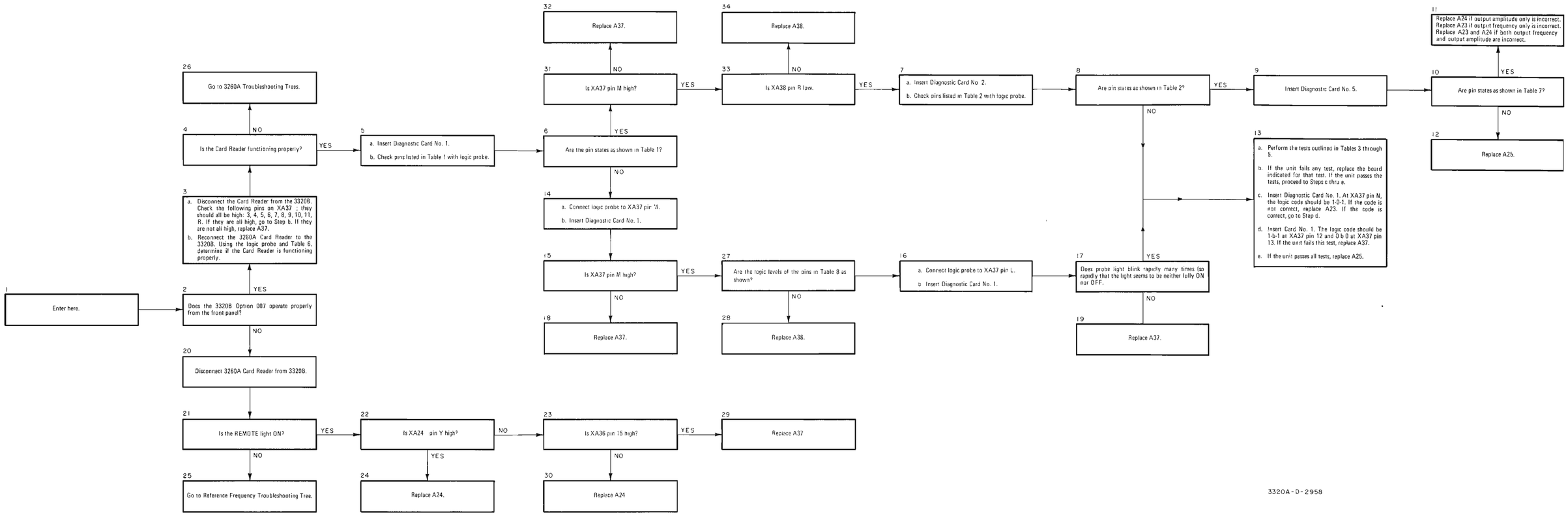
TABLE 7. PIN STATES ON XA25 AFTER INSERTING DIAGNOSTIC CARD NO. 5.

PIN NUMBERS ON XA25A	R	S	13	14
STATES	1	0	1	1

PIN NUMBERS ON XA25B	11	12	M	N
STATES	0	0	0	1

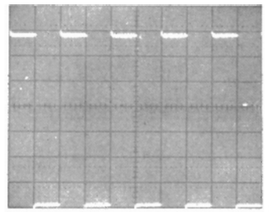
TABLE 8 PIN STATES ON XA38 AFTER INSERTING DIAGNOSTIC CARD NO. 1.

PIN NUMBERS ON XA38	8	H	R
STATES	1	1	0



3320A-D-2958

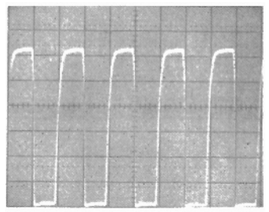
Figure 7-1. System Component Isolation And GPIB Troubleshooting Tree.



0 VOLTS

@ A1 PIN M (10 kHz)

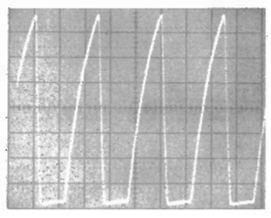
1 ** 10 kHz SIGNAL
SCOPE SETTINGS
TIME/DIV = 50 µs/CM
VOLTS/DIV = 0.05 VOLTS/DIV
VERT INPUT DC COUPLED
SLOPE +
ACF
INTERNAL TRIGGER



0 VOLTS

@ A7 PIN 15 (1 MHz)

2 ** 1 MHz SIGNAL
TIME/DIVISION = 0.5 µs /DIV
VOLTS/DIVISION = 0.05 VOLTS/DIV
VERT INPUT DC COUPLED
MODE AUTO
SLOPE +
ACF
INTERNAL TRIGGER



0 VOLTS

@ A7 PIN 10 (2 MHz)

3.** 2 MHz SIGNAL
SCOPE SETTINGS
TIME/DIVISION = 0.2 µs/DIV
VOLTS/DIVISION = 0.05 VOLTS/DIV
VERT. INPUT DC COUPLED
MODE - AUTO
SLOPE +
ACF
INTERNAL TRIGGER

*IF THERE IS AN ASTERISK BY A PIN NUMBER, THE MEASUREMENT IS TO BE MADE ON THE MOTHER BOARD (A19).

**All made with – 10 probe.

3320A-D-2564

ENTER HERE

CONNECT SCOPE TO A1 PIN M* SET VERN IN/VERN OUT TO VERN OUT

A1 A1 PIN M* (10 kHz) DOES COUNTER READ 100 µs ± 1 ns, AMPLITUDE AS IN FIGURE 1?

No

Yes

SET VERN IN/VERN OUT TO VERN IN, TURN VERNIER THROUGH FULL RANGE WHILE MONITORING FREQUENCY AT PIN 10. DOES FREQUENCY VARY FROM 10.000 kHz TO AT LEAST 10.003 kHz.?

No

Yes

REMOVE A2 FROM 3320A/3320B.

REPLACE A2 WITH NEW BOARD.

AT A1 PIN M* (10 kHz) a. DOES F VARY FROM 10.000 kHz TO AT LEAST 10.003 kHz? b. IS SIGNAL AS IN FIGURE 1?

No

Yes

REPLACE A1 WITH NEW BOARD.

CONNECT SCOPE TO A7 PIN 10* (2 MHz).

AT A7 PIN 10*, IS a. SIGNAL AS IN FIGURE 3? b. FREQUENCY = 2 MHz ± 20 Hz?

No

Yes

REMOVE A7 FROM 3320A/3320B.

REPLACE A7 WITH NEW BOARD.

AT A7 PIN 10* (2 MHz), IS SIGNAL a. 2 MHz ± 20 Hz? b. AS IN FIGURE 3, BUT 4.2 V p-p?

No

Yes

REMOVE A11 FROM 3320B.

REPLACE A11 WITH NEW BOARD.

AT A7 PIN 10* (2 MHz), IS a. FREQUENCY = 2 MHz ± 20 Hz? b. AS IN FIGURE 3, BUT 4.2 V p-p?

No

Yes

REPLACE A8 WITH NEW BOARD.

AT A7 PIN 15* (1 MHz), IS SIGNAL a. 1 MHz ± 10 Hz? b. AS IN FIGURE 2?

No

Yes

REMOVE A1 FROM UNIT.

REPLACE A1 WITH NEW BOARD.

AT A7 PIN 15* (1 MHz) IS SIGNAL a. 1 MHz ± 10 Hz? b. AS IN FIGURE 2 ONLY 3.9 VOLTS p-p?

No

Yes

REPLACE A7 WITH NEW BOARD.

AT A5 PIN 14* IS FREQUENCY = 18 MHz ± 180 Hz AMPLITUDE 400 mV p-p DC OFFSET = 0 VOLTS?

No

Yes

REMOVE A4 AND A5 FROM 3320A 3320B

DETERMINE FAULTY BOARD AND REPLACE A4 OR A5

AT A5 PIN 14* IS FREQUENCY = 18 MHz ± 180 Hz AMPLITUDE = 250 mV p-p DC OFFSET = 0 VOLTS?

No

Yes

REPLACE A8 WITH NEW BOARD

AT A8 PIN 3* IS FREQUENCY = 20 MHz ± 200 Hz, AMPLITUDE = 840 mV p-p DC OFFSET = + 1.25 VOLTS?

No

Yes

REMOVE A9 BOARD FROM UNIT

AT A8 PIN 3* (20 MHz) IS FREQUENCY = 20 MHz ± 200 Hz AMPLITUDE = 1 V p-p DC OFFSET = 1.25 VOLTS

No

Yes

REPLACE A8 WITH NEW BOARD

REPLACE A9 WITH NEW BOARD

GO TO FREQUENCY GENERATING SECTION, TROUBLE SHOOTING

Figure 7-2. Reference Frequency Troubleshooting Tree.

TABLE 1 RANGE SWITCH LOGIC.

(AVAILABLE ON MOTHER BOARD)

FREQUENCY SETTING	R2	R3	R4	R5	R6
1222 Hz on 1000 Hz Range	0 0 V	1 3.5 V	1 3.5 V	1 3.5 V	1 3.5 V
1 11 kHz on 10 kHz Range	1	0	1	1	1
11 1 kHz or 122 2 kHz on 100 kHz Range	1	1	0	1	1
111.00 kHz on 1000 kHz Range	1	1	1	0	1

TABLE 2. PRETUNE D/A AND COUNTER INPUTS

(AVAILABLE ON MOTHER BOARD)

Front Panel Frequency Setting	USED ON A2 AND A3									USED ONLY ON A2			
	1000	800	400	200	100	80	40	20	10	8	4	2	1
0111 Any Range	1 3.5 V	1 3.5 V	0 0 V	0 0 V	0	1	0	0	0	1	0	0	0
1222 Any Range	0	0	1	1	1	0	1	1	1	0	1	1	1

TABLE 3: FREQUENCY SWITCH LOGIC

(ALL PIN NUMBERS ARE LOCATED ON W2)

FREQUENCY SETTING	PINS ON W2															
	12	14	16	18	20	3	5	7	9	11	13	15	17	21	19	23
77.7 kHz	open	gnd	open	gnd	gnd	open	gnd	gnd	gnd	gnd	gnd	gnd	open	open	open	gnd
8.88 kHz	open	open	gnd	open	open	gnd	open	open	open	open	open	open	gnd	gnd	gnd	open
12.00 MHz	gnd															

TABLE 4

INSTRUCTIONS:

A If you are Troubleshooting the 3320B Option 007, you do not have A21 in the unit.

B If you arrived at this point via path (1), replace A23 with a new board.

C If you arrived at this point via path (2), check the pin numbers in Table after setting the appropriate frequencies.

Frequency	Pins on XA23A		
	L	8	9
10.00 kHz	1	1	0
100.00 kHz	0	0	1

If the unit passes these tests, replace A22.

If the unit fails these tests, replace A23.

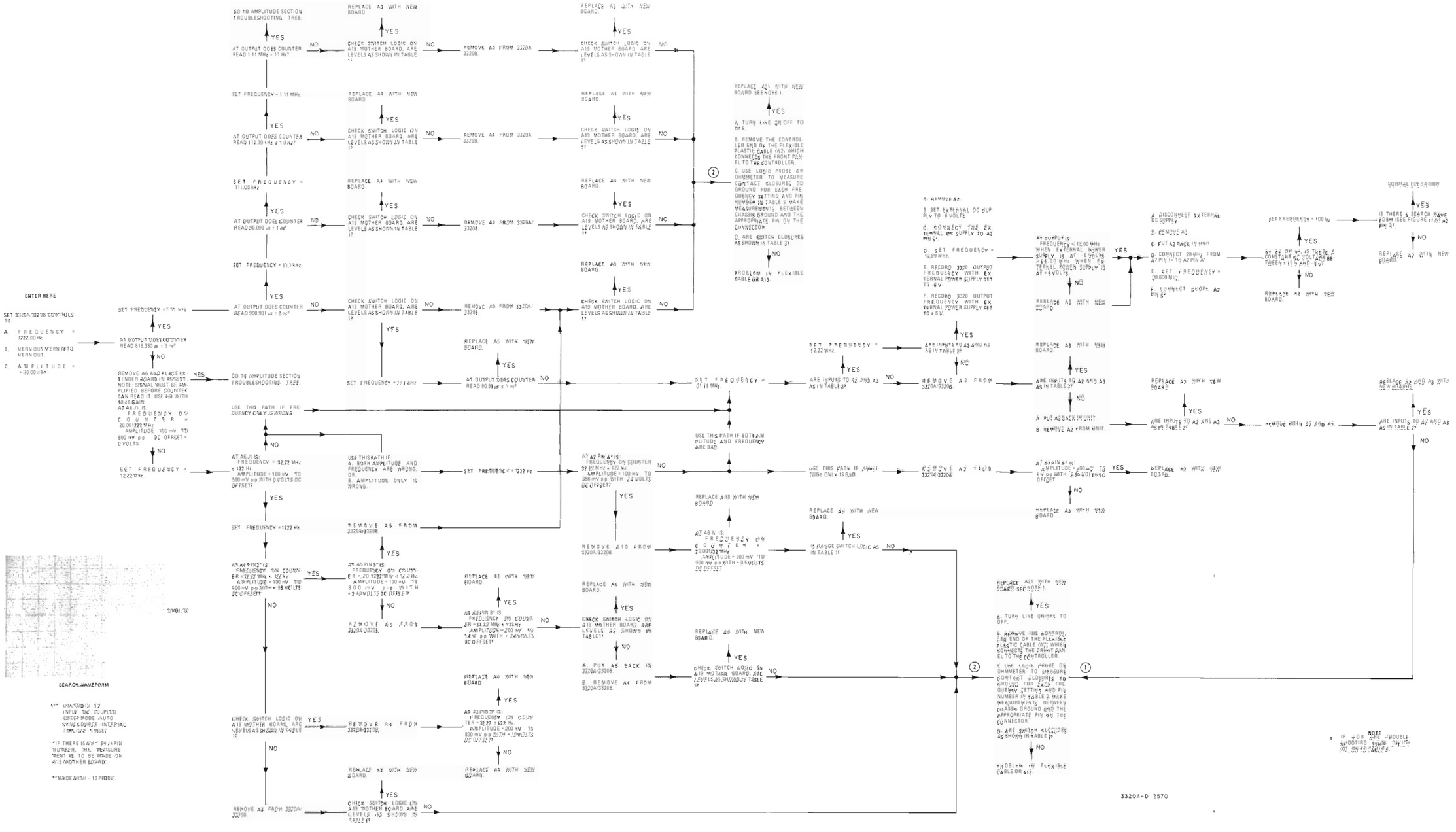


Figure 7-3. Frequency Generating Section Troubleshooting Tree.

TABLE 1 LOGIC WEIGHTS FOR A11 ON MOTHER BOARD

AMPLITUDE SETTING	LOGIC WEIGHTS											
	800	400	200	100	80	40	20	10	8	4	2	1
+ 25.00 dBm	5 V 1	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0	.25 V 0
+ 26.99 dBm	1	0	0	1	1	0	0	0	1	0	0	1
+ 23.66 dBm	0	1	1	0	0	1	1	1	0	1	1	0

TABLE 2. LOGIC FOR A15 LOGIC CONNECTOR

AMPLITUDE SETTING	LOGIC WEIGHTS			
	4	2	2	1
+ 25.00 dBm	- 3 V to - 5 V 1	- 3 V to - 5 V 1	- 3 V to - 5 V 1	- 3 V to + 5 V 1
65.00 dBm	0 V to + .6 V 0	0 V to + .6 V 0	0 V to + .6 V 0	0 V to + 0.6 V 0

TABLE 3. AMPLITUDE SWITCH LOGIC.
(ALL PIN NUMBERS ARE LOCATED ON W2)

AMPLITUDE SETTING	PINS ON W2															
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
+ 17.77 dBm	open	open	gnd	open	gnd	gnd	open	gnd	gnd	gnd	open	gnd	gnd	gnd	open	gnd
- 68.88	gnd	gnd	open	gnd	open	open	gnd	open	open	open	gnd	open	open	open	gnd	open

ENTER HERE

SET: AMPLITUDE TO 25.00 dBm.
FREQUENCY TO 10.00 kHz.
LEVELING ON.
CONNECT 50 OHM LOAD TO OUTPUT.

IS VOLTAGE AT OUTPUT 3.97 VOLTS RMS?
- YES → SET AMPLITUDE = 35.00 dBm. → IS OUTPUT .0039 V RMS?
  - YES → SET AMPLITUDE = 35.00 dBm.
  - NO → SET AMPLITUDE = +25.00 dBm.
- NO → CONNECT AC VOLTMETER TO REAR. OC - 13 MHz LOW LEVEL OUTPUT.

IS SIGNAL 248 mV RMS?
- YES → SET AMPLITUDE = +25.00 dBm.
- NO → CONNECT DC VTVM to A11TP1.

IS VOLTAGE - 7.9 VOLTS?
- YES → SET AMPLITUDE = -65.00 dBm.
- NO → A. REMOVE A12, FROM 33208. B. DISCONNECT ALL SELECTRO CABLES WITH A12. C. REMOVE A9 FROM 33208. → IS A11TP1 = -7.9 V DC?
  - NO → REMOVE A11 FROM 33208. → ARE LOGIC LEVELS AS IN TABLE 1?
    - YES → REPLACE A11 WITH NEW BOARD.
    - NO → SET AMPLITUDE = +25.00 dBm. → IS OUTPUT = 5.00 VOLTS RMS?
      - YES → SET AMPLITUDE = +26.99 dBm. → IS OUTPUT = 5.00 VOLTS RMS?
        - YES → SET AMPLITUDE = +29.66 dBm. → IS OUTPUT = 3.41 VOLTS RMS?
          - YES → NORMAL OPERATION.
          - NO → REPLACE A11 WITH NEW BOARD. → ARE LOGIC LEVELS AS IN TABLE 1?
            - YES → SET AMPLITUDE = +29.66 dBm. → IS OUTPUT = 3.41 VOLTS RMS?
            - NO → REMOVE A11 FROM 33208. → ARE LOGIC LEVELS AS IN TABLE 1?
              - YES → REPLACE A11 WITH NEW BOARD.
              - NO → A. TURN LINE ON/OFF TO OFF. B. REMOVE THE CONTROLLER END OF THE FLEXIBLE PLASTIC CABLE (W2) WHICH CONNECTS THE FRONT PANEL TO THE CONTROLLER. C. USE LOGIC PROBE OR OHM METER TO MEASURE CONTACT CLOSURES TO GROUND FOR EACH AMPLITUDE SETTING AND PIN NUMBER IN TABLE 3. MAKE MEASUREMENTS BETWEEN CHASSIS GROUND AND THE APPROPRIATE PIN OF W2 CONNECTOR. → ARE LOGIC LEVELS AS IN TABLE 3?
                - YES → REPLACE A21 WITH NEW BOARD. SEE NOTE 1.
                - NO → PROBLEM IS IN FRONT PANEL SWITCHES (A13) OR IN FLEXIBLE CABLE.

SET AMPLITUDE = -65.00 dBm. → CHECK THE LOGIC LEVELS ON THE CONNECTOR TO WHICH A15 IS CONNECTED. ARE THEY AS SHOWN IN TABLE 2?
- YES → CHECK THE LOGIC LEVELS ON THE CONNECTOR TO WHICH A15 IS CONNECTED. ARE THEY AS SHOWN IN TABLE 2?
- NO → REMOVE A15 BOARD FROM LOGIC CONNECTOR. → CHECK THE LOGIC LEVELS ON THE CONNECTOR FROM WHICH A15 WAS REMOVED. ARE THEY AS SHOWN IN TABLE 2?
  - YES → REPLACE A15 WITH NEW BOARD.
  - NO → REPLACE A16 WITH NEW BOARD.

A. TERMINATE OUTPUT IN 50 OHMS.
B. CONNECT DC VOLTMETER TO OUTPUT.
C. SET AMPLITUDE = +26.99 dBm
D. RECONNECT ALL A12 SELECTRO CABLES.

USE THIS PATH IF OUTPUT IS LESS THAN 5.0 VOLTS RMS.
- AT A12TP3 IS THE VOLTAGE GREATER THAN 5.5 VOLTS DC?
  - YES → A9 PIN J IS: FREQUENCY = 200 MHz ± 200 Hz. AMPLITUDE = 225 mV p-p? NOTE: BE SURE TO GROUND SCOPE A10 PIN 1.
    - YES → DISCONNECT BROWN WIRE AT TOP OF A10. NOTE: BE SURE TO CONNECT SCOPE GROUND TO METAL COVER OF A10. → AT SELECTRO ON TOP OF A10: PERIOD = 100 µs ± 1 ns; AMPLITUDE = 2.6 V p-p?
      - YES → REPLACE A14 WITH NEW BOARD.
      - NO → REPLACE A10 WITH NEW BOARD.
    - NO → REMOVE A10 FROM 33208. → AT A9 PIN J IS: FREQUENCY = 20 MHz ± 100 Hz. AMPLITUDE = 504 mV p-p?
      - YES → REPLACE A10 WITH NEW BOARD.
      - NO → REPLACE A9 WITH NEW BOARD.
  - NO → REPLACE A12 WITH NEW BOARD.

USE THIS PATH IF OUTPUT IS GREATER THAN 5.0 VOLTS RMS.
- AT A12TP3 IS VOLTAGE = 0 V DC TO 1 V DC?
  - YES
  - NO → REPLACE A12 WITH NEW BOARD.

IS VOLTAGE AT A11TP1 = 7.9 VOLTS DC?
- YES → PUT A9 BACK IN 33208. → IS A11TP1 = 7.9 V DC?
  - YES → PUT A12 BACK IN 33208. → IS A11TP1 = 7.9 V DC?
    - YES
    - NO → REPLACE A12 WITH NEW BOARD.
- NO → REPLACE A9 WITH NEW BOARD.

NOTE
1. IF THE UNIT YOU ARE TROUBLESHOOTING IS 3320B OPTION 007 (GPIB), YOU DO NOT HAVE A21 BE PLACE A24 WITH NEW BOARD.

3320A-D-2568

*IF THERE IS AN ASTERISK BY A PIN NUMBER, THE MEASUREMENT IS TO BE MADE ON THE MOTHER BOARD (A9).

Figure 7-4. Amplitude Section Troubleshooting Tree.

Table 1. Data Bit Decoder.

ASCII Character	INPUT* b7	b6	b5	b4	b3	b2	b1	OUTPUT or Preface Commands
0	0	1	1	X**	X	X	X	
1	0	1	1	—	—	—	—	
2	0	1	1	—	—	—	—	
3	0	1	1	—	—	—	—	
4	0	1	1	—	—	—	—	H Numerical No. Enable
5	0	1	1	—	—	—	—	(IC8 pin 1)
6	0	1	1	—	—	—	—	
7	0	1	1	—	—	—	—	
8	0	1	1	—	—	—	—	
9	0	1	1	—	—	—	—	
.	0	1	0	1	1	0	0	H Function Execute (XA 38 pin 6)
-	0	1	0	1	1	0	1	H - dBm (XA38 pin 7)
A	1	0	0	0	0	0	1	L Amplitude (XA38 pin C)
C	1	0	0	0	0	1	1	L Delay Initiate (XA38 pin S)
D	1	0	0	0	1	0	0	L Delay (XA38 pin 5)
F	1	0	0	0	1	1	0	L Frequency (XA38 pin 3)
I	1	0	0	1	0	0	1	H Local Enable (IC11 pin 10)
K	1	0	0	0	0	1	1	H Vernier In (XA38 pin D)
M	1	0	0	1	1	0	1	H Vernier Out (XA38 pin 4)
R	1	0	1	0	0	1	0	L RANGE (XA38 pin E)
V	1	0	1	0	1	1	0	L Vernier Digit (XA38 pin B)

* Positive True.
** X = Don't Care.

NOTE

This is a Functional Block Diagram of the GPIB and BCD Controller. The logic symbology shown is functional and may not agree with the conventional Logic shown on schematics. Two or more Logic gates may be combined into one gate on this diagram. The circle(s) on the inputs of the IC's indicates the logic level required not necessarily inversion. The circle "O" indicates a low logic level (0 V) required to perform the gate function.

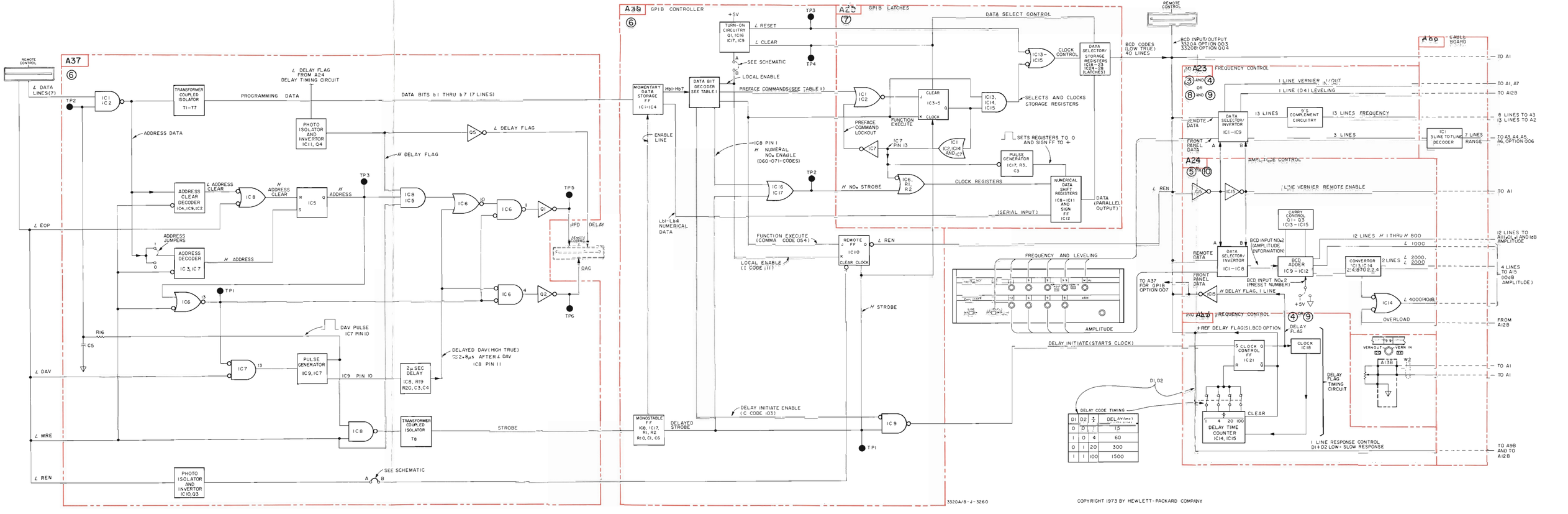
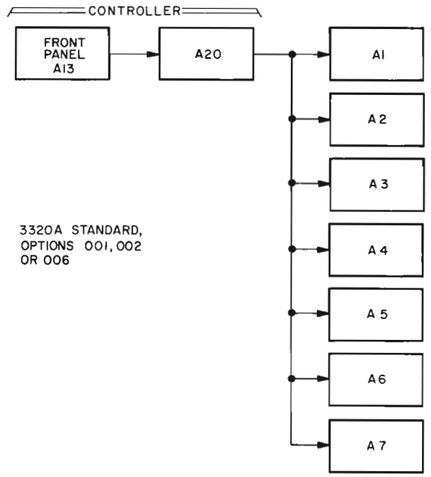
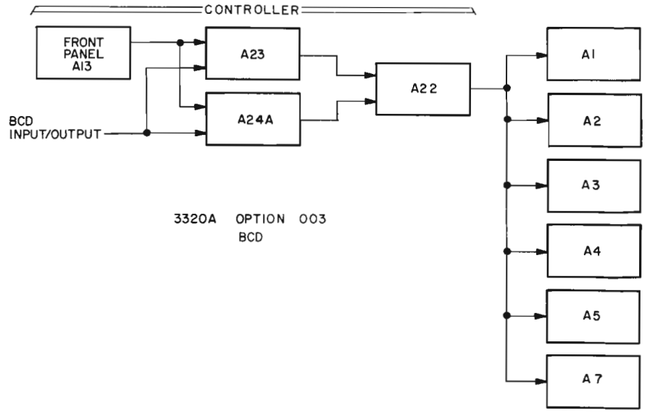


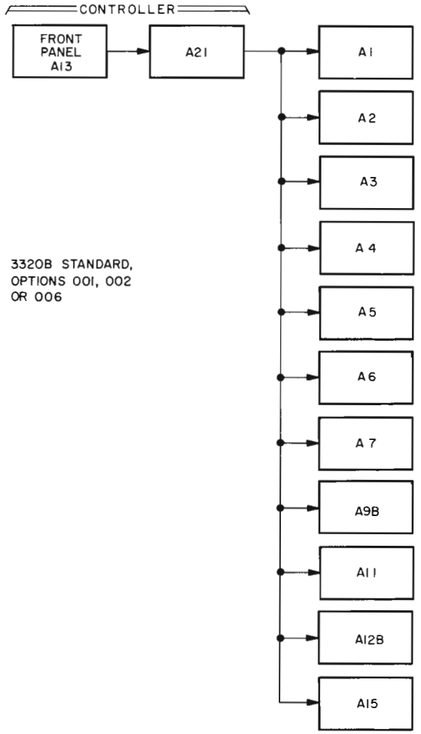
Figure 7-5. Controller Functional Block Diagram.



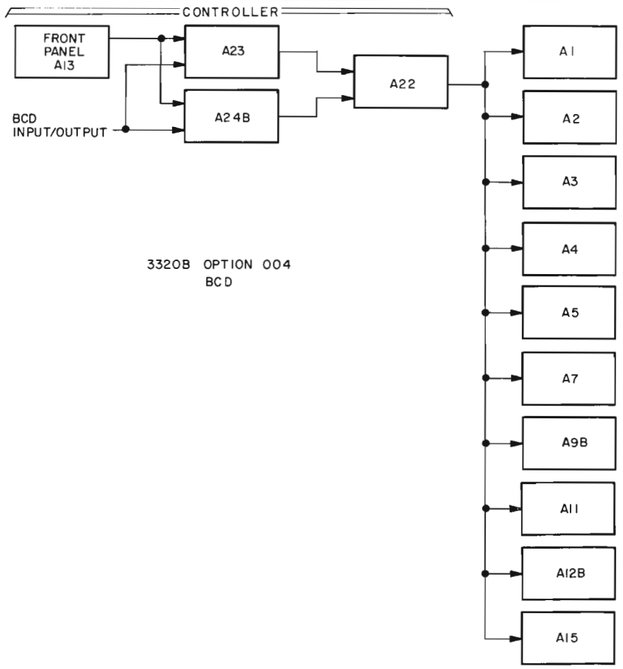
3320A STANDARD, OPTIONS 001, 002 OR 006



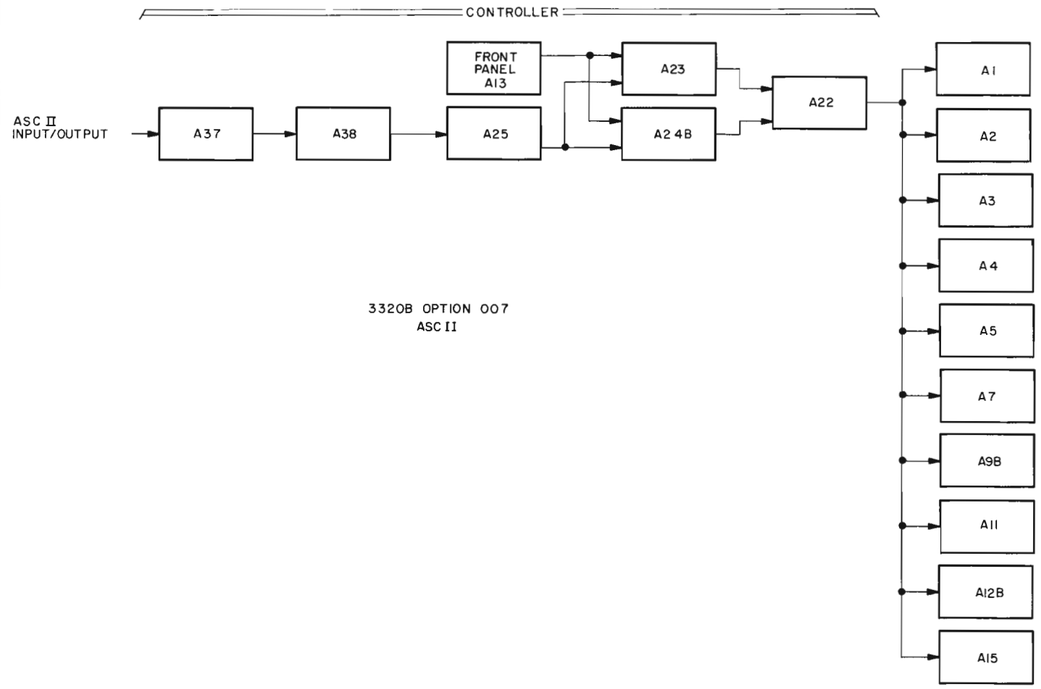
3320A OPTION 003
BCD



3320B STANDARD, OPTIONS 001, 002 OR 006



3320B OPTION 004
BCD



3320B OPTION 007
ASC II

3320A/B-J-3262

Figure 7-6. Controller Configurations.

NOTE 1: Circled number indicates schematic number for circuit shown.

NOTE 2: RESPONSE CONTROL: In local mode of operation, response is always in "slow" mode (switches closed). In remote mode response is in "fast" mode (switches open) unless programmed for "slow" mode. See Section III.

1 Troubleshooting Points For Functional Block Diagram

A1TP2 — 10 to 10.004 MHz; VERN at "00" (full ccw) ≈9999.9 MHz; VERN at "99" ≈10003.0 MHz.

A2TP1 — 10 kHz; see waveform:

A3TP3 — The VTO frequency varies between 20 MHz and 32.99 MHz depending on frequency setting.

FREQUENCY RANGE/SETTING					A3TP3
10 MHz	1000 kHz	100 kHz	10 kHz	1000 Hz	
0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	20 MHz
5 MHz	500 kHz	50 kHz	5 kHz	500 Hz	25 MHz
10 MHz	1000 kHz	100 kHz	10 kHz	1000 Hz	30 MHz

NOTE

Use a 10:1 probe and a counter with high sensitivity (-hp- 5245L with 5261A) when measuring frequency at A3TP3.

A7TP1 — > 6 V p-p when unlocked, see Reference Oscillator Adjustment procedure, Section V.

A8TP1 — 20 MHz, 1.7 V p-p.

A8TP5 — 18 MHz, 2 V p-p.

A11TP1 — + 10.000 V dc at + 16.99 dBm setting. + 3.1659 V dc at + 17.00 dBm setting. For 3320B with 50 Ω output only.

A12TP3 — On properly adjusted unit, typically + 2 V dc but must remain within ± .2 V with any amplitude change with LEVELING ON.

20-33 MHz Out (Rear Panel) — Tracks output frequency, 20 MHz plus front panel frequency setting. > 100 mV rms into 50 Ω.

Low Level Out (Rear Panel) — Same frequency as main output, between 50 mV and 158 mV rms into 50 Ω depending on amplitude level setting.

1 MHz Out (Rear Panel) — > 220 mV rms into 50 Ω.

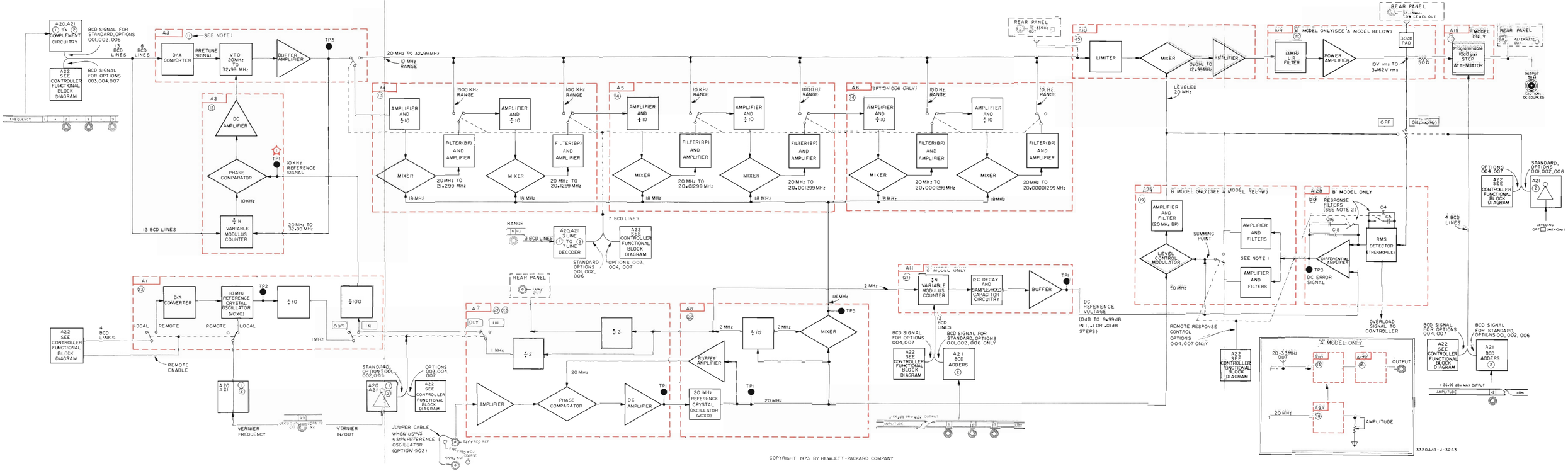
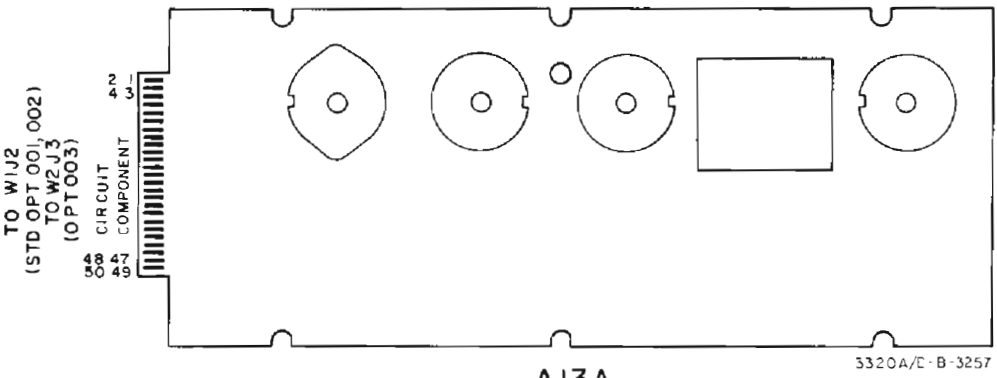


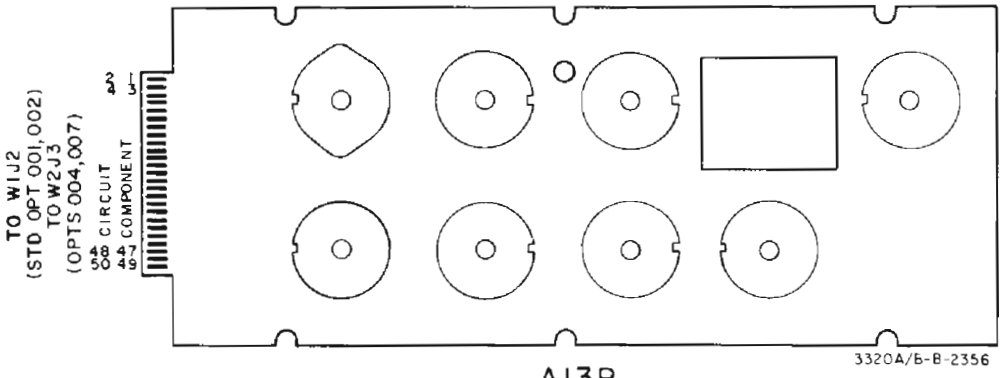
Figure 7-7. Analog Functional Block Diagram.



A13A

hp Part No. 03320-61902

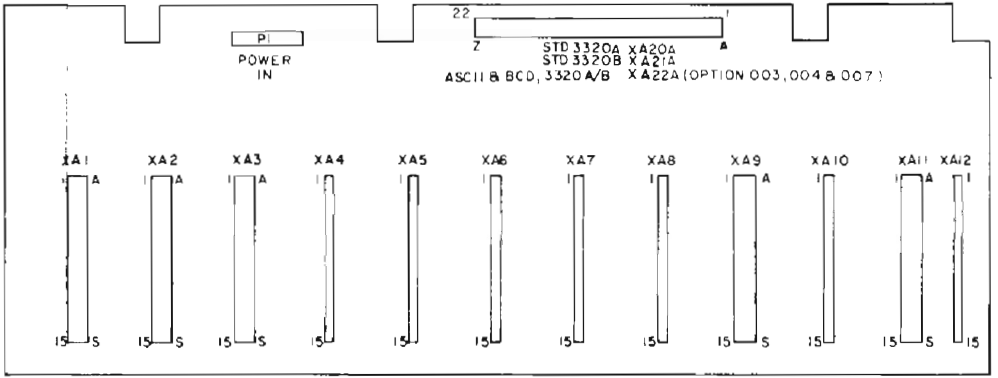
FRONT PANEL SWITCH ASSEMBLY



A13B

hp Part No. 03320-61901

FRONT PANEL SWITCH ASSEMBLY



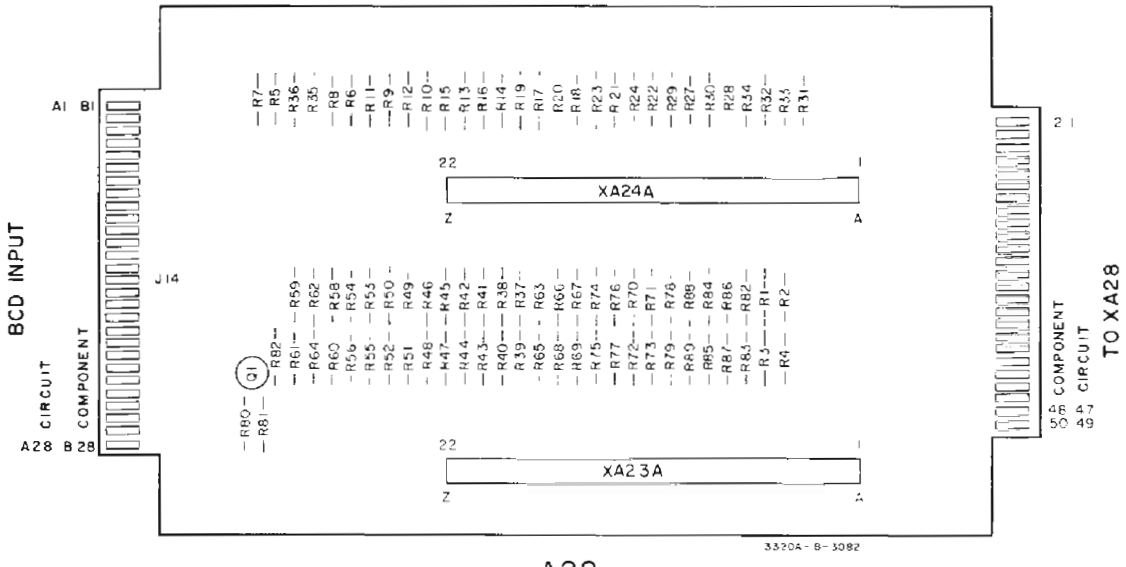
3320A/B-B-3259

A19

hp Part No. 03320-66519

Rev B

MOTHER BOARD

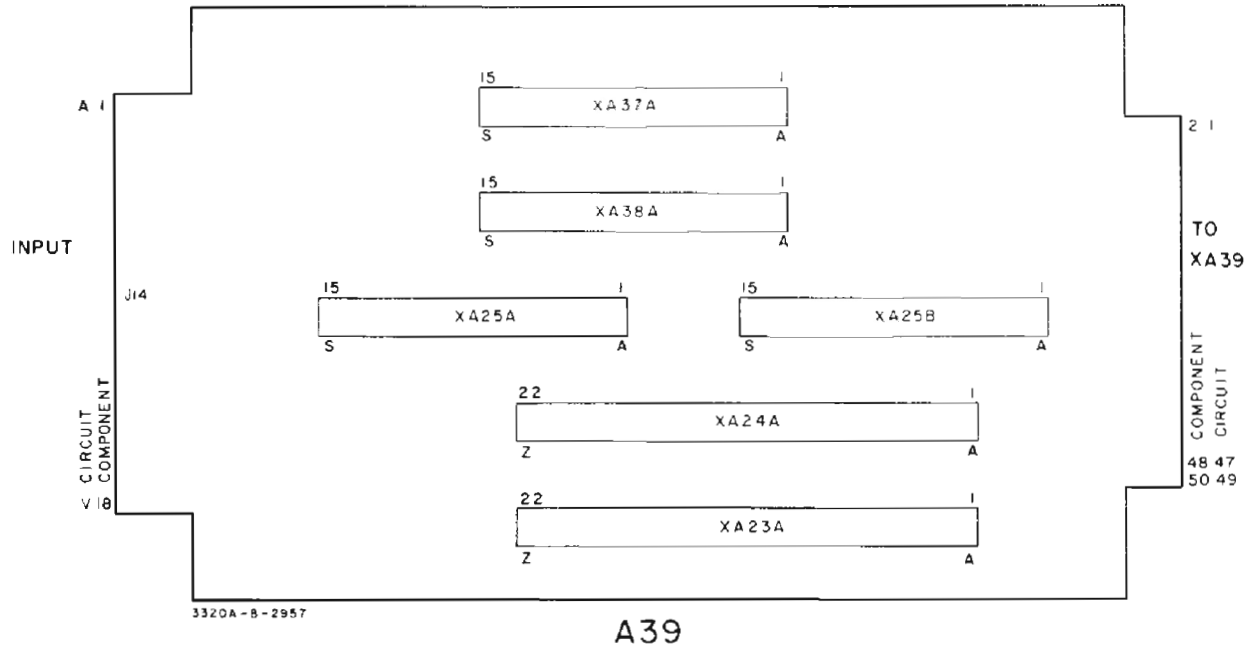


A28

hp Part No. 03320-66528

Rev A

BCD MOTHER BOARD ,OPTION 003 or 004

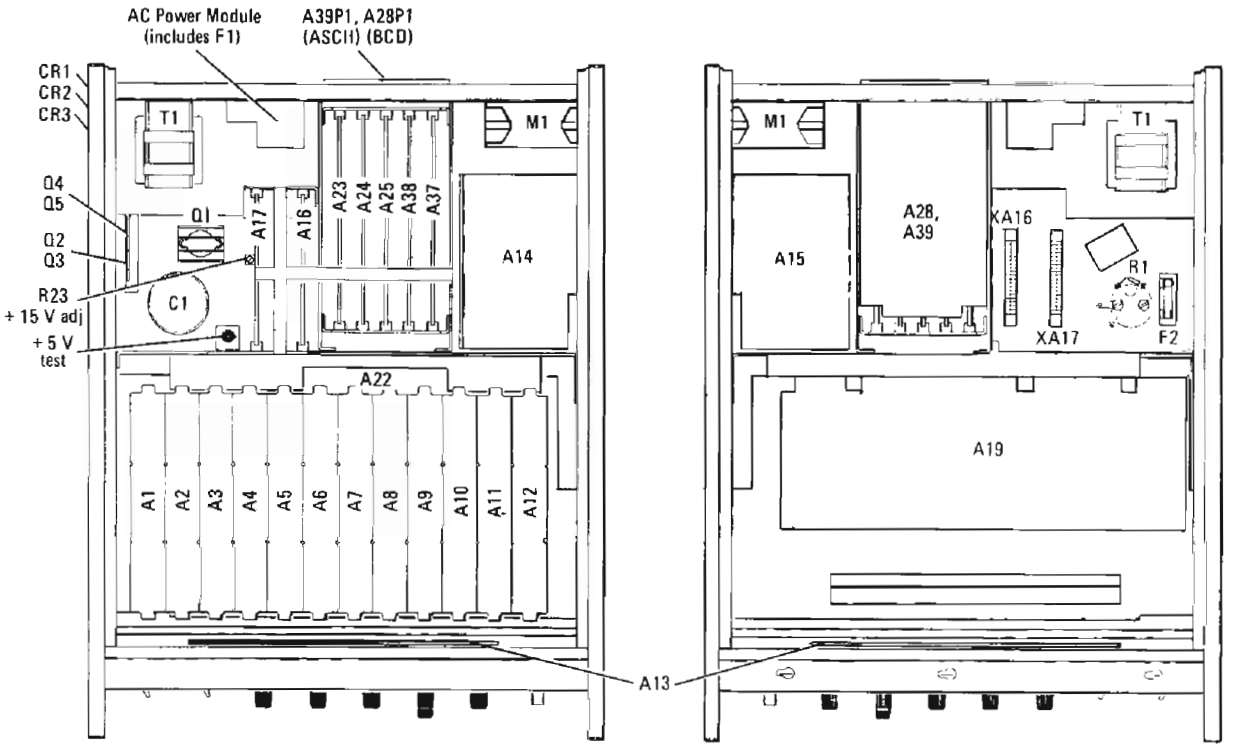


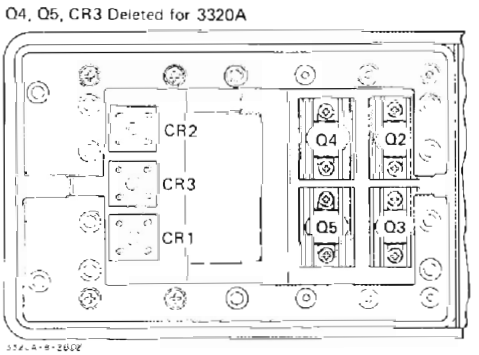
A39

hp Part No. 03320-66539

RevA

MOTHER BOARD, OPTION 007





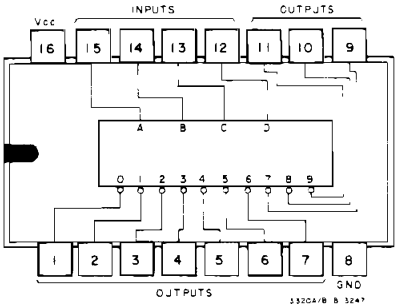
RIGHT SIDE VIEW

Figure 7-8. Common Assemblies, Top And Bottom View.

NOTE 1: 9's Complement Circuitry:

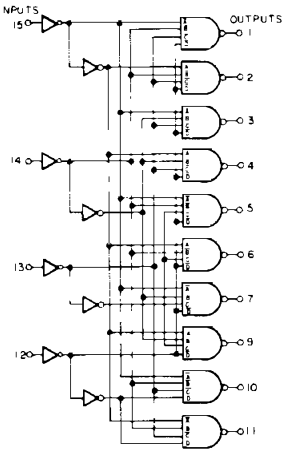
Digit	INPUT 1	2	4	8	9's COMPLEMENT 1	2	4	8
0	H	H	H	H	H	L	L	H
1	L	H	H	H	L	L	L	H
2	H	L	H	H	H	H	H	L
3	L	L	H	H	L	H	H	L
4	H	H	L	H	H	L	H	L
5	L	H	L	H	L	L	H	L
6	H	L	L	H	H	H	L	L
7	L	L	L	H	L	H	L	L
8	H	H	H	L	H	L	L	L
9	L	H	H	L	L	L	L	L

NOTE 2: On A20IC5, input at pin 12 is hard wired low, and output pins 9, 10, and 11 are not used (N/C).



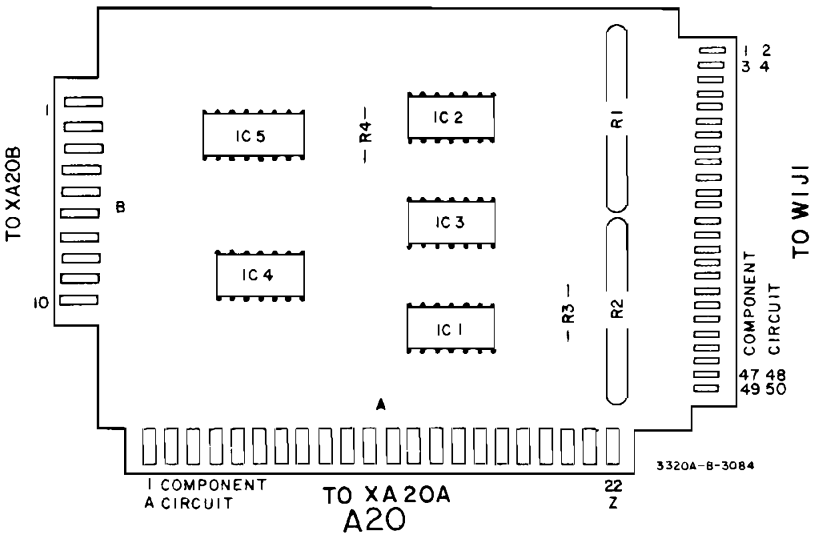
INPUT 12	13	14	15	DECIMAL OUTPUT 1	2	3	4	5	6	7	9	10	11
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	L	H	L	H	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H

NOTE 2: (Cont'd)

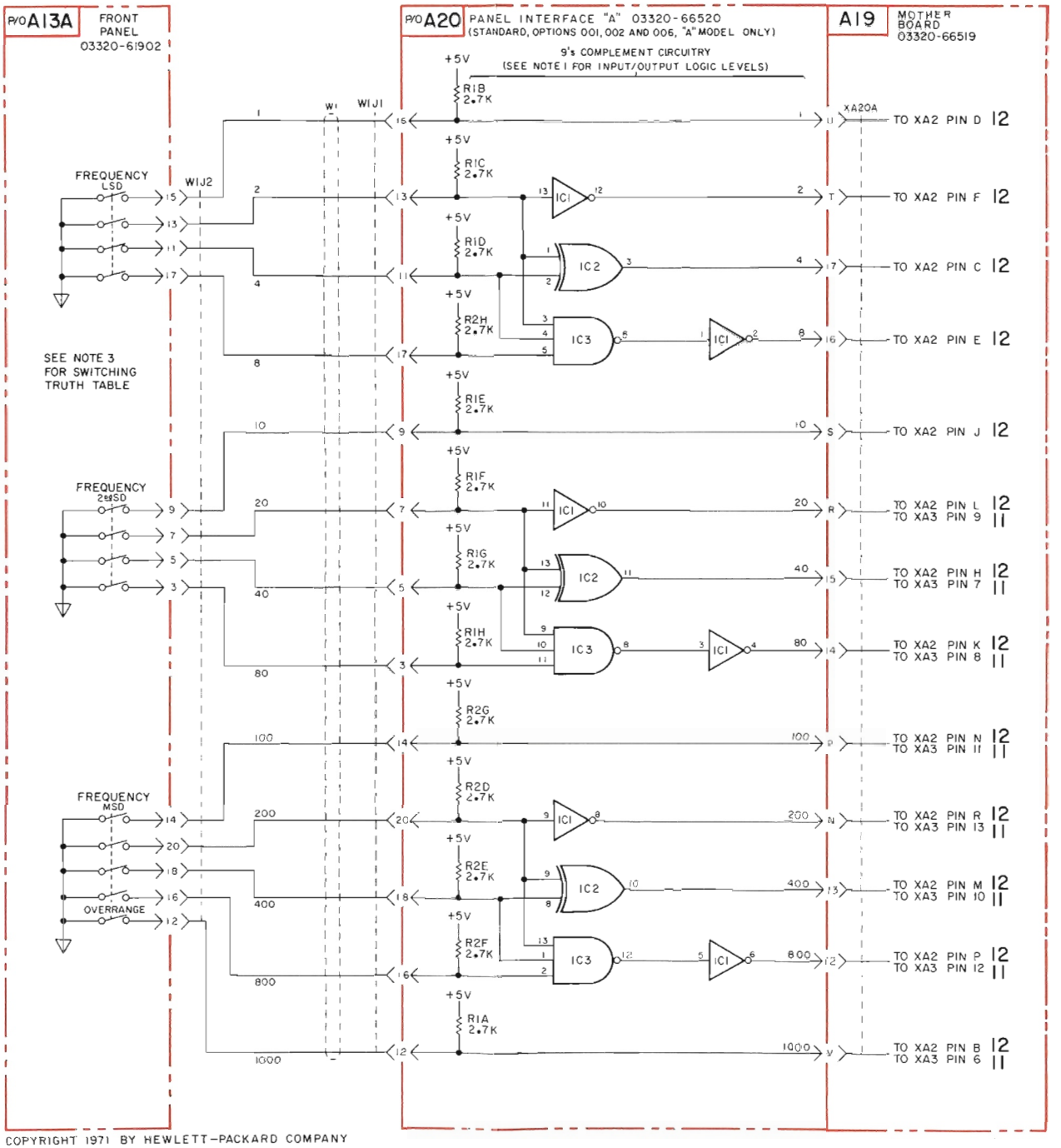


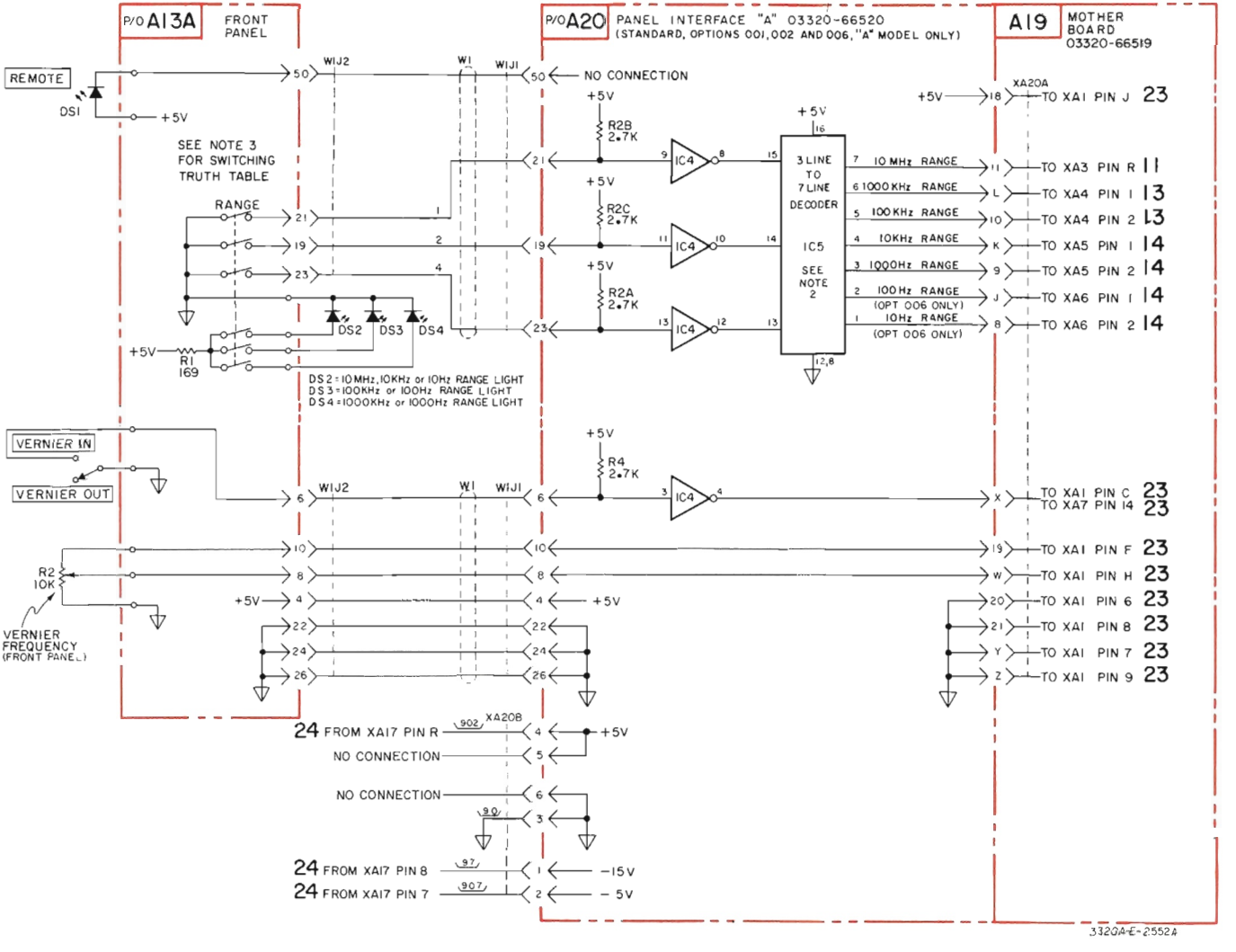
NOTE 3: BCD Low true logic, switch contact(s) to Ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1



hp Part No. 03320-66520 Rev A





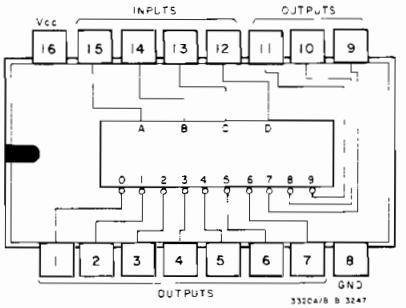
1

Figure 7-9. Panel Interface A20; 3320A Standard, Options 001, 002, 006.

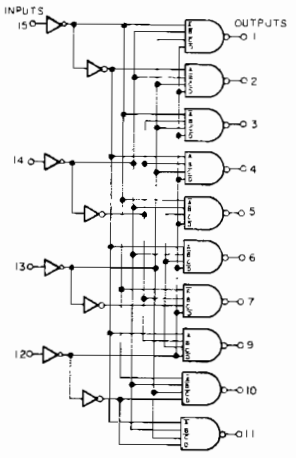
NOTE 1: 9's Complement Circuitry:

Digit	INPUT 1	2	4	8	9's COMPLEMENT 1	2	4	8
0	H	H	H	H	H	L	L	H
1	L	H	H	H	L	L	L	H
2	H	L	H	H	H	H	H	L
3	L	L	H	H	L	H	H	L
4	H	H	L	H	H	L	H	L
5	L	H	L	H	L	L	H	L
6	H	L	L	H	H	H	L	L
7	L	L	L	H	L	H	L	L
8	H	H	H	L	H	L	L	L
9	L	H	H	L	L	L	L	L

NOTE 2: On A21IC15, input at pin 12 is hard wired low, and output pins 9, 10, and 11 are not used (N/C).



INPUT 12	13	14	15	DECIMAL OUTPUT 1	2	3	4	5	6	7	9	10	11
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	L	H	L	H	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H



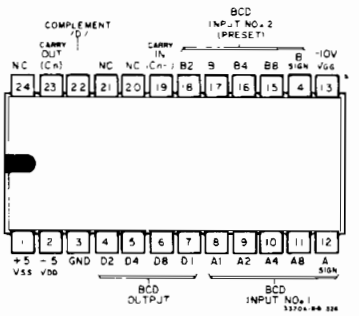
NOTE 3: BCD Low true logic, switch contact(s) to Ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

NOTE 4: IC4, 5, 6, or 7 operate as a BCD Adder. The two BCD Inputs (#1 and #2) are summed together and applied to the BCD Output. The BCD inputs and output lines are high true logic. A true signal on the A Sign input indicates a negative amplitude number (i.e., - 10.00 dBm). The BCD Input #2 is a "hard wired" input, preset by means of jumper wires on the pc assembly. See Note 5.

The Complement /D/ input controls the BCD output (D1, D2, D4, D8). With the Complement /D/ input high (≈+5 V) the direct BCD sum of inputs #1 and #2 are applied to the BCD Output. With the Complement /D/ input low (≈- 5 V) the 9's complement of the two inputs is applied to the BCD Output. The BCD Output lines have internal pull-up resistors.

Transistor Q1 inhibits a Carry-In signal to IC4 when the Amplitude Sign is positive. Transistors Q2, Q3 and IC8 control the level of the Complement /D/ input.



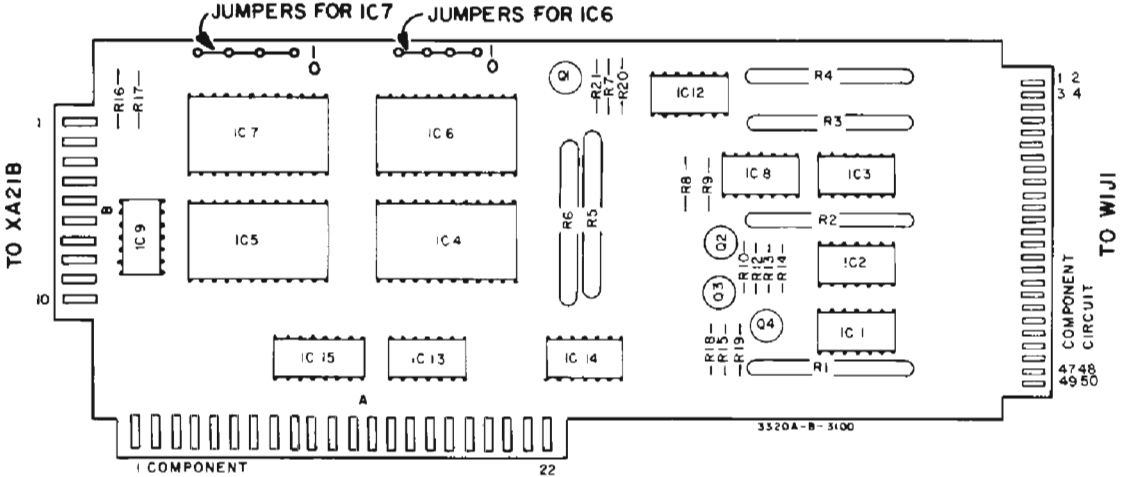
NOTE 5: Jumpers on the A21 Assembly for IC6 and IC7 are preset at the factory:

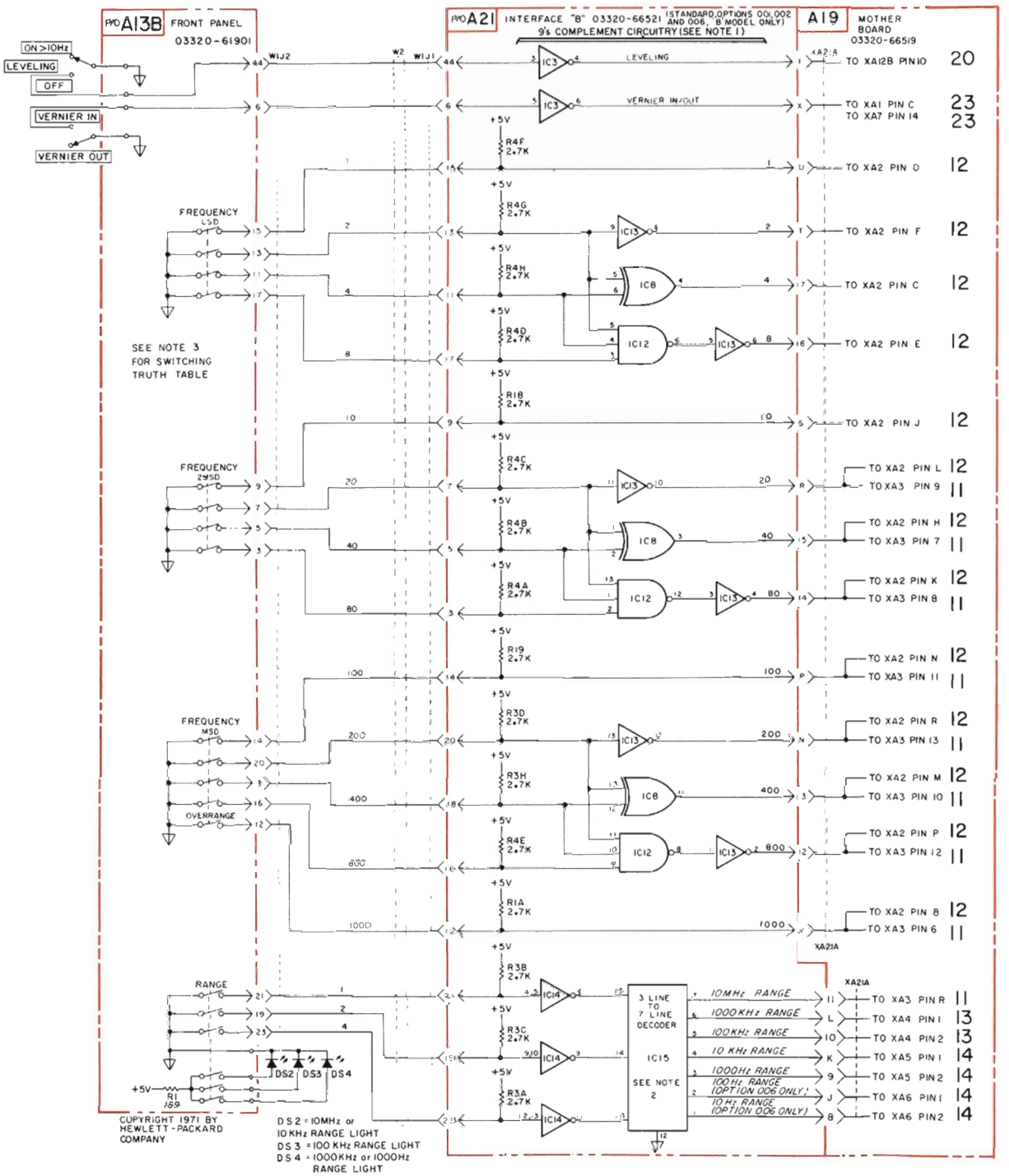
3320B STANDARD, 50Ω Impedance

IC7 Jumpered for BCD 7
IC6 Jumpered for BCD 3

3320B OPTION 001, 75Ω Impedance

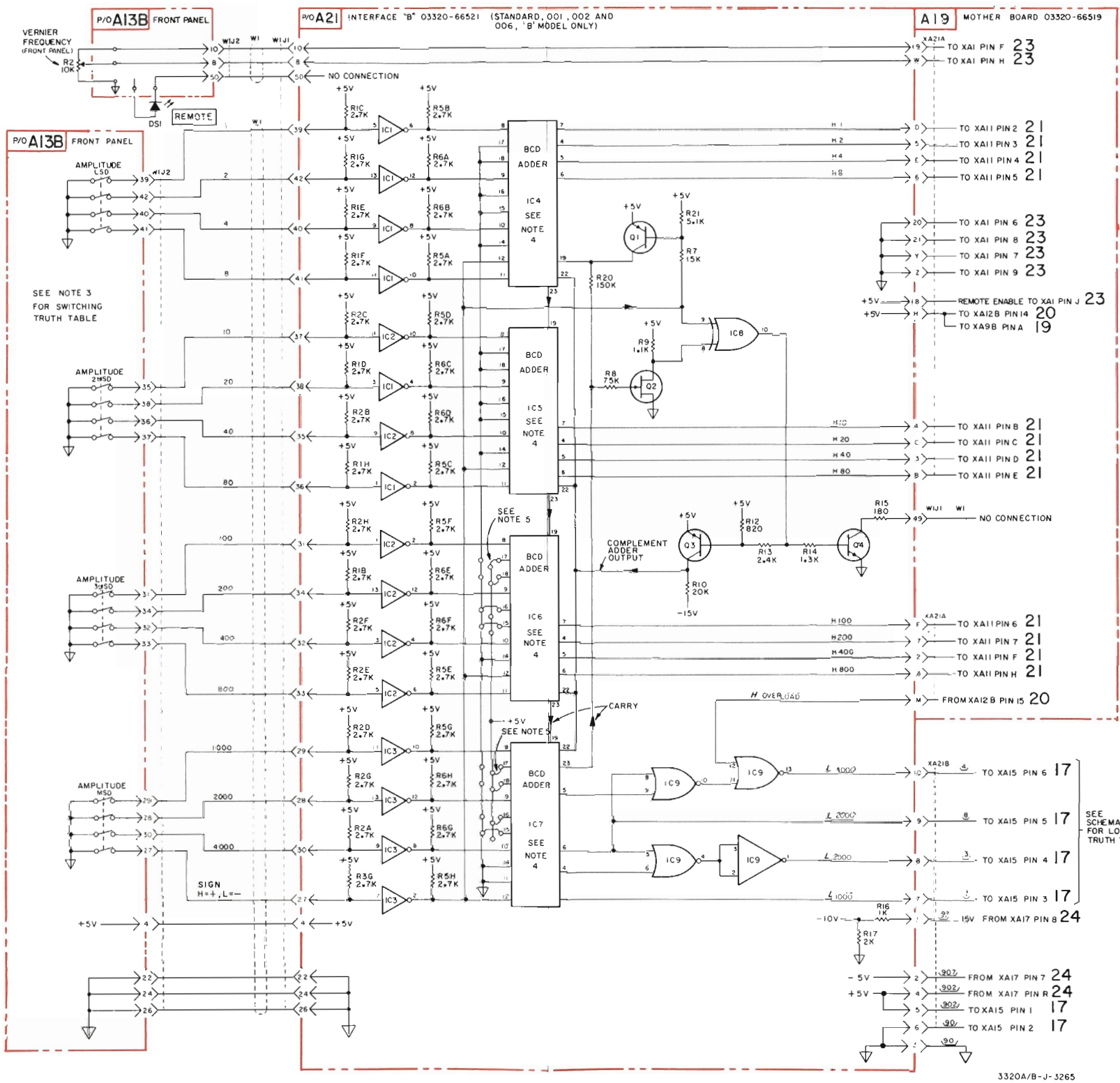
IC7 Jumpered for BCD 7
IC6 Jumpered for BCD 5


JUMPERS FOR IC7
JUMPERS FOR IC6
TO XA21B
TO WIJI
IC 7
IC 6
IC 5
IC 4
IC 9
IC 15
IC 13
IC 14
IC 12
IC 8
IC 3
IC 2
IC 1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
Q1
Q2
Q3
Q4
1 COMPONENT A CIRCUIT
22 Z
COMPONENT CIRCUIT
4748 4950
3320A-B-3100
TO XA21A
A21
hp Part No. 03320-66521
Rev B



2

Figure 7-10. Panel Interface A21; 3320B Standard, Options 001, 002, 006.



2

Figure 7-10. Panel Interface A21; 3320B Standard, Options 001, 002, 006.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

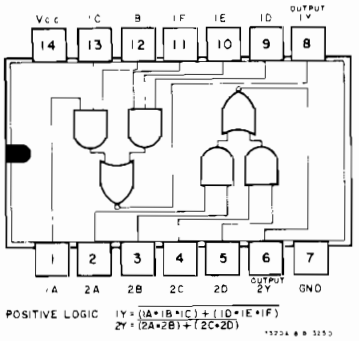
Example:

H Delay Flag — indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid — indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

In Local Mode (A Low, B High) the input on pins 9 and 10 is inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



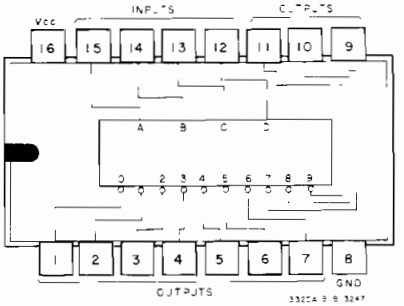
NOTE 3: BCD Low true logic, switch contact(s) to ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

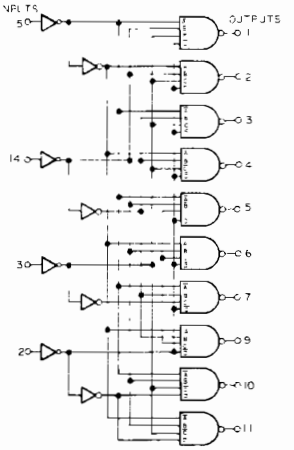
NOTE 4: 9's Complement Circuitry:

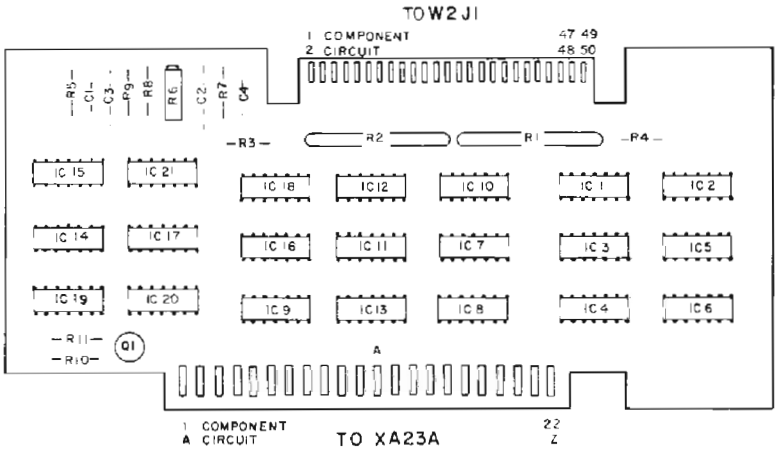
Digit	INPUT 1	2	4	8	9's COMPLEMENT 1	2	4	8
0	L	L	L	L	H	L	L	H
1	H	L	L	L	L	L	L	H
2	L	H	L	L	H	H	H	L
3	H	H	L	L	L	H	H	L
4	L	L	H	L	H	L	H	L
5	H	L	H	L	L	L	H	L
6	L	H	H	L	H	H	L	L
7	H	H	H	L	L	H	L	L
8	L	L	L	H	H	L	L	L
9	H	L	L	H	L	L	L	L

NOTE 5: On A22IC1, input at pin 12 is hard wired low, and output pins 9, 10, and 11 are not used (N/C).



INPUT 12	13	14	15	DECIMAL OUTPUT 1	2	3	4	5	6	7	9	10	11
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	L	H	L	H	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H

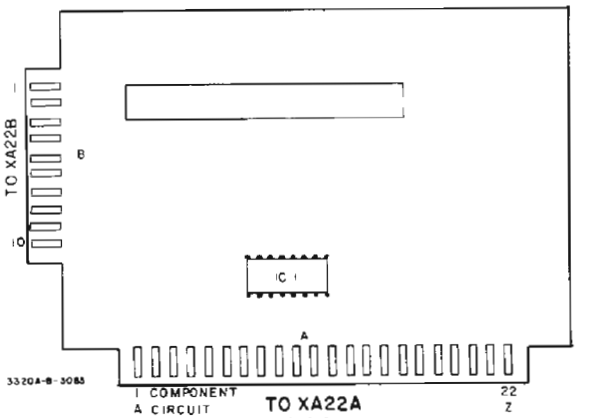




A23

hp Part No. 03320-66523

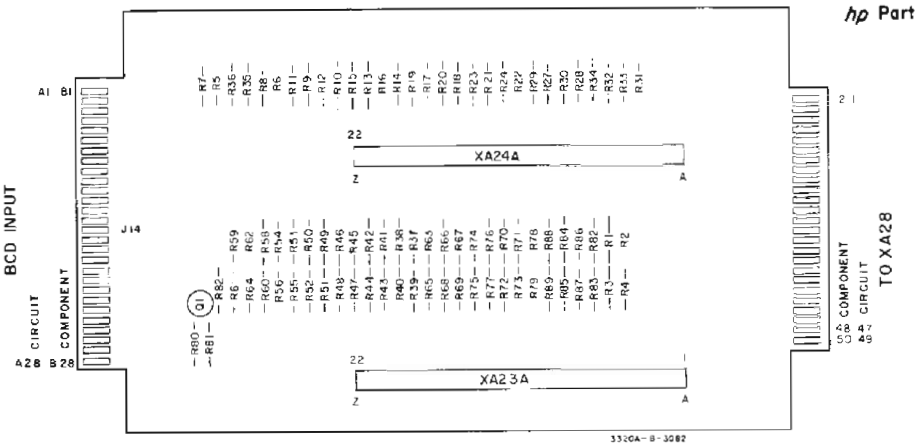
Rev B



A22

hp Part No. 03320-66522

Rev A

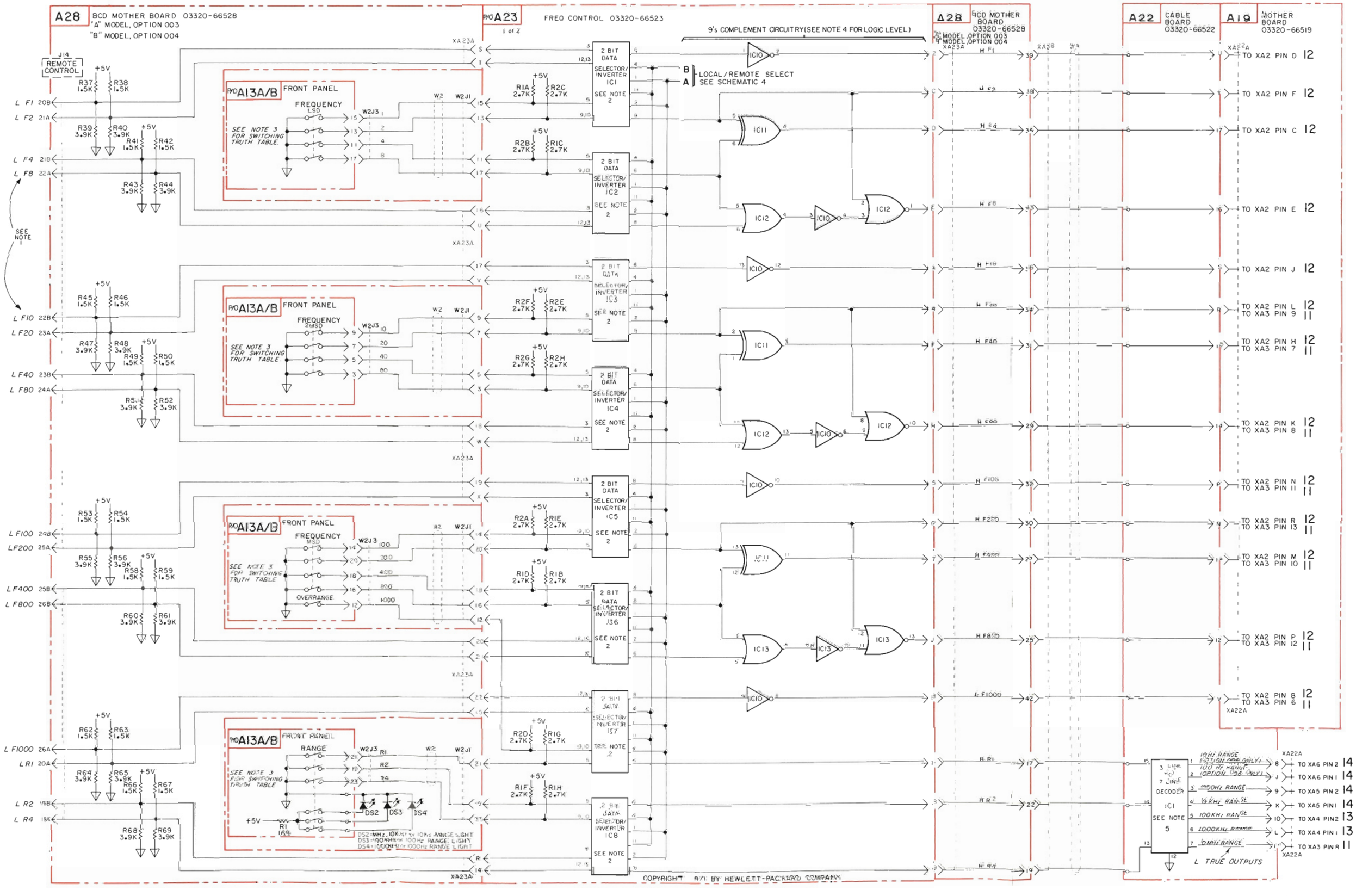


A28

hp Part No. 03320-66528

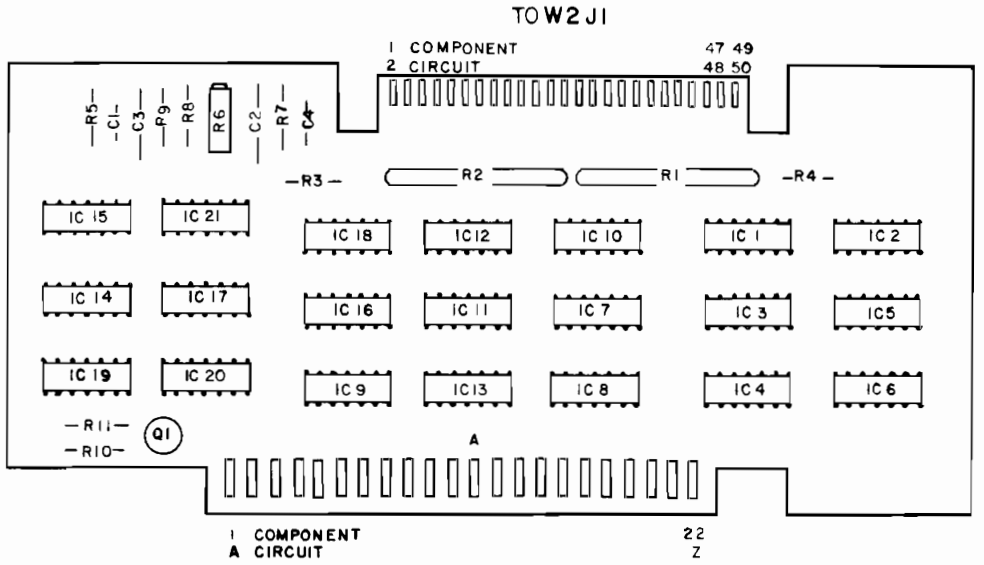
Rev A

BCD MOTHER BOARD ,OPTION 003 or 004



3320A-E-2560A **3**

Figure 7-11. BCD Frequency Control P/O A23; 3320A Option 003, 3320B Option 004.



3320A-B-2875

TO XA23A

A23

***hp* Part No. 03320-66523**

Rev B

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

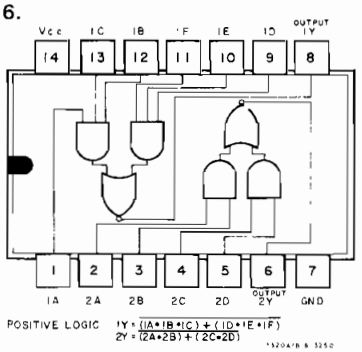
Example:

H Delay Flag — indicates the delay flag line should be +5 V when a delay flag signal is present.

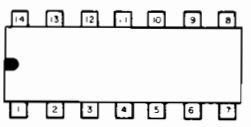
L Data Valid — indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

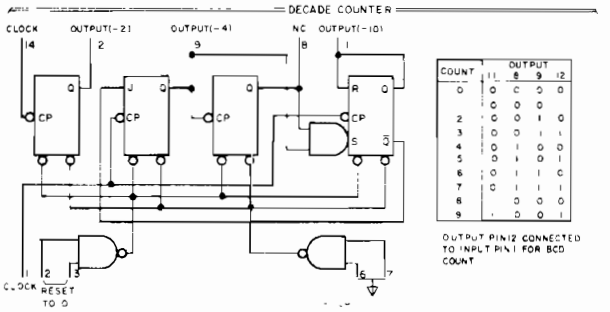
In Local Mode (A Low, B High) the input on pins 9 and 10 is Inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



NOTE 3: Logic diagram of IC is shown below.



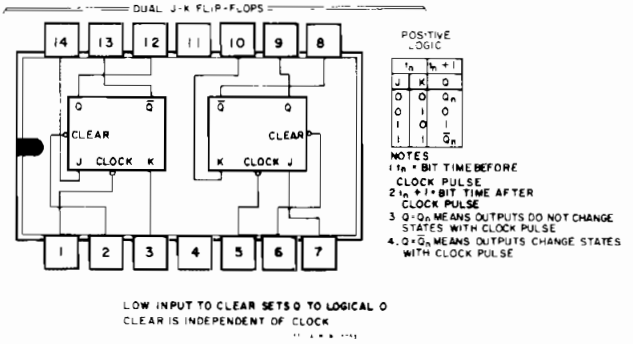
NOTE 3: (CONT'D)



NOTE 4: Local/Remote select lines from A24 Assembly:

Local mode A Low, B High
Remote mode A High, B Low

NOTE 5: Logic Diagram of IC is shown below.



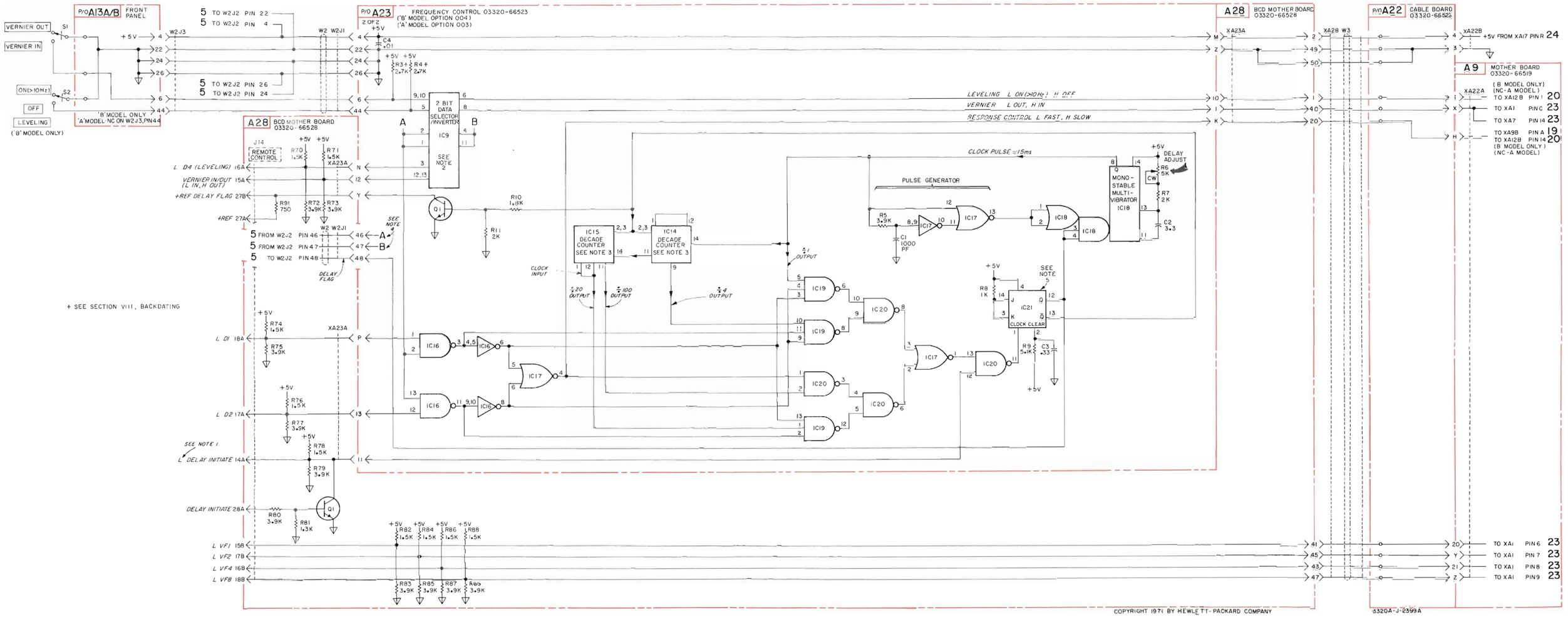


Figure 7-12. BCD Frequency Control P/O A23; 3320A Option 003, 3320B Option 004.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

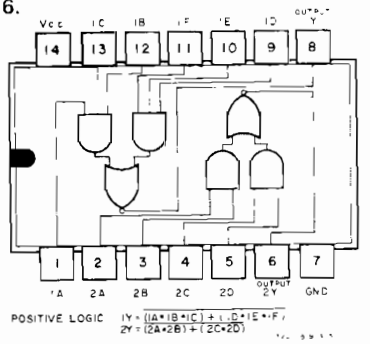
Example:

H Delay Flag – indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

In Local Mode (A Low, B High) the input on pins 9 and 10 is inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



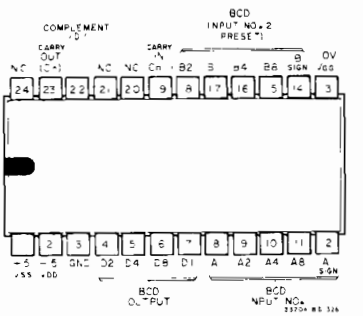
NOTE 3: BCD Low true logic, switch contact(s) to ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

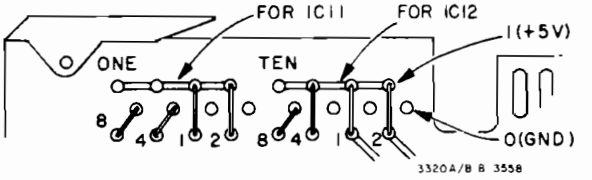
NOTE 4: IC9, 10, 11 or 12 operate as a BCD Adder. The two BCD Inputs (#1 and #2) are summed together and applied to the BCD Output. The BCD inputs and output lines are high true logic. A true signal on the A Sign input indicates a negative amplitude number (i.e., -10.00 dBm). The BCD Input #2 is a "hard wired" input, preset by means of jumper wires on the pc assembly. See Note 5.

The Complement /D/ input controls the BCD output (D1, D2, D4, D8). With the Complement /D/ input high (≈+5 V), the direct BCD sum of inputs #1 and #2 are applied to the BCD Output. With the Complement /D/ input low (≈-5 V), the 9's complement of the two inputs is applied to the BCD Output. The BCD Output lines have internal pull-up resistors.

Transistor Q1 inhibits a Carry-In signal to IC9 when the Amplitude Sign is positive. Transistors Q2, Q3 and associated circuits (IC13, 14 and 15) control the level of the Complement /D/ input.



NOTE 5: Jumpers on the A24B Assembly for IC11 and IC12 are preset at the factory:

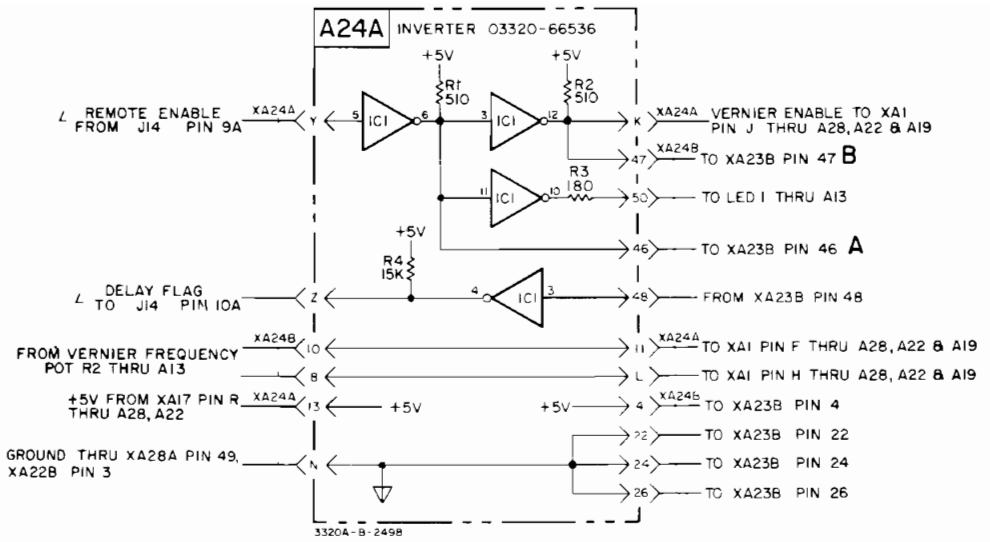


3320B STANDARD, 50 Ω Impedance
(Preset No. 73)

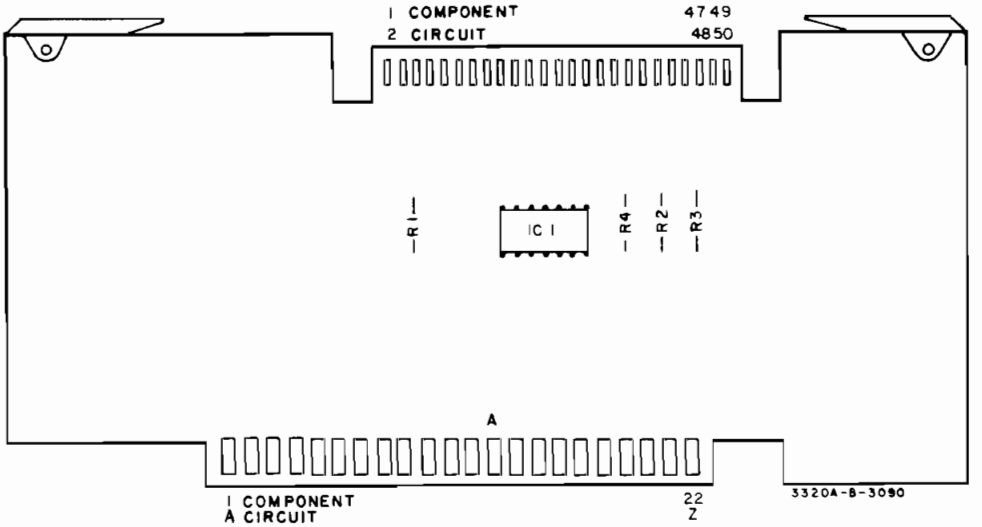
IC12 Jumpered for BCD 7
IC11 Jumpered for BCD 3

3320B OPTION 001, 75 Ω Impedance
(Preset No. 75)

IC12 Jumpered for BCD 7
IC11 Jumpered for BCD 5



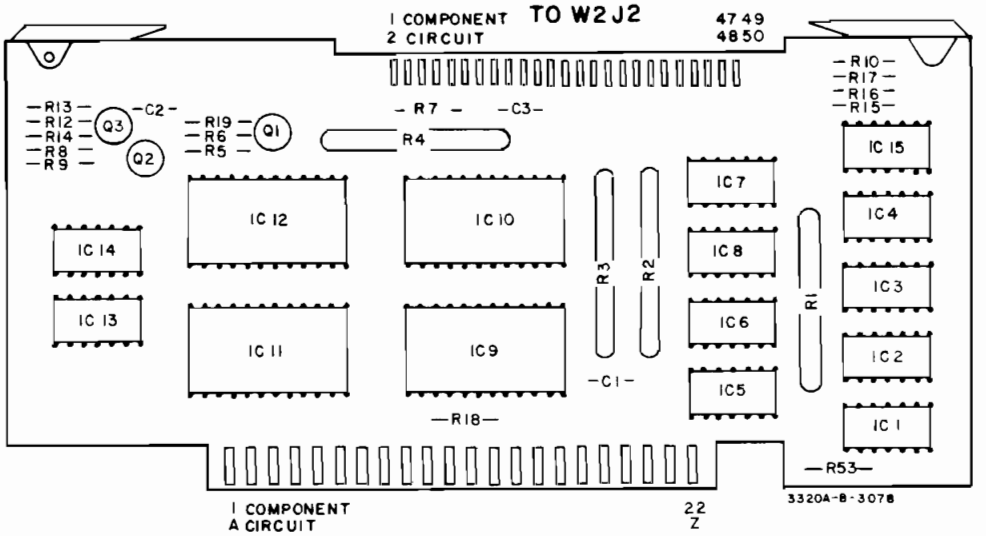
TO W2J2



TO XA24A A24A

hp Part No. 03320-66536

Rev A



TO XA24A A24B

hp Part No. 03320-66524

Rev A

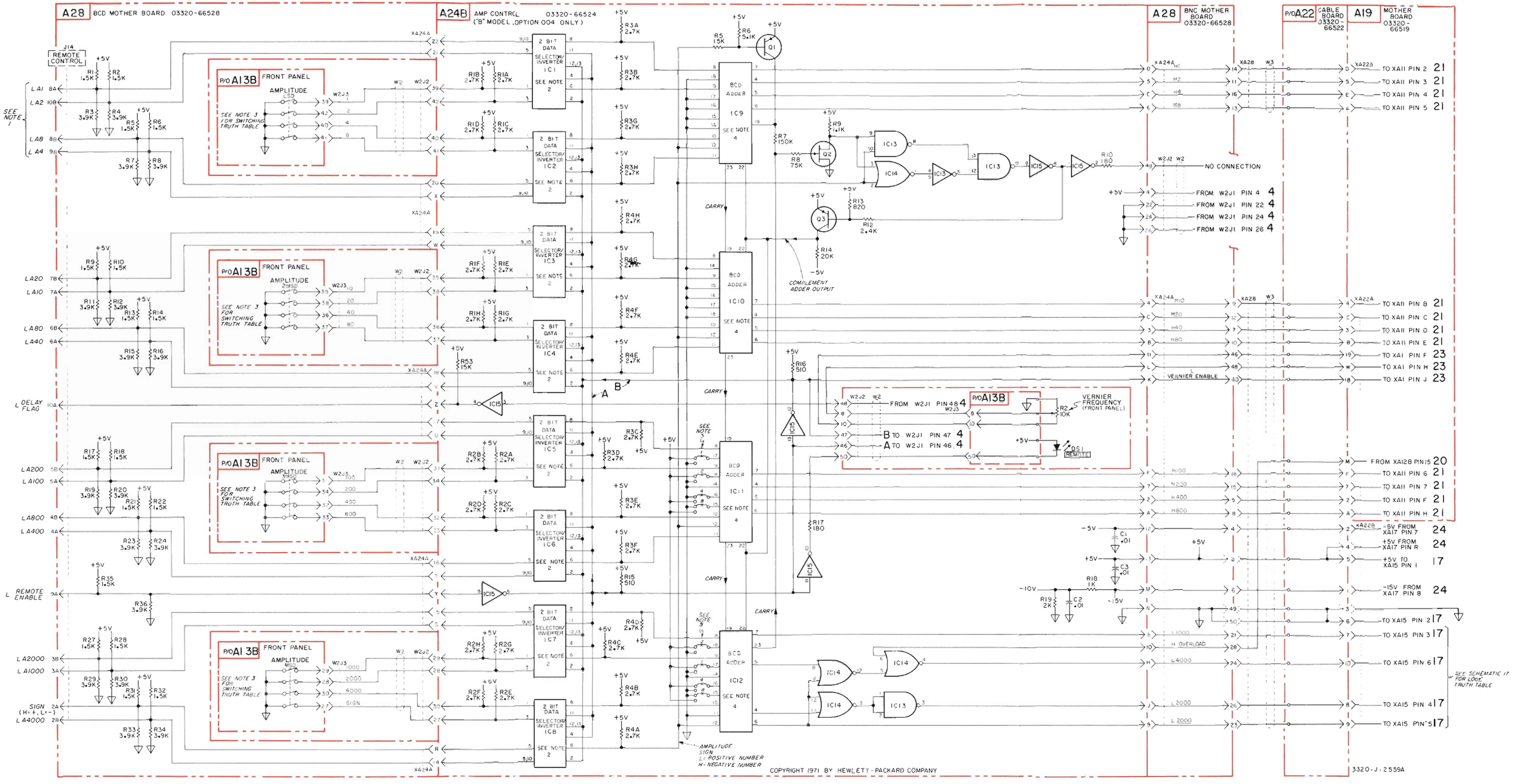


Figure 7-13. BCD Amplitude Control A24B, 3320B Option 004; Invertor A24A, 3320A Option 003.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

Example:

H Delay Flag – indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: Location of jumpers on A37 Assembly indicates GPIB Address of instrument. Instruments are shipped from factory with Address 63, jumpered in as shown on schematic. To change Address, move jumpers to desired number according to the following table:

BIT	WEIGHT
b1	1
b2	2
b3	4
b4	10
b5	20

Note: b6 (40 weight) is "hard-wired".
b7 (80 weight) is "hard-wired".

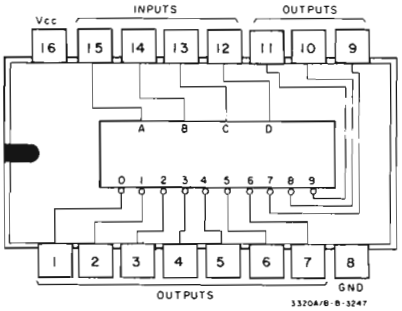
NOTE 3: Instruments are shipped from factory with jumper A-B on A37 Assembly connected. The jumper wire can be removed and a ground connected to B to inhibit remote enable.

If it is desired to control local or remote mode of the instrument with a switch, connect the switch to the S.W. REMOTE ENABLE point on the A39 Assembly. Grounding the S.W. REMOTE ENABLE point forces local mode. No connection (switch open) to the S.W. REMOTE ENABLE point will allow the instrument to be remotely programmed, as outlined in Section III, if jumper A-B is connected.

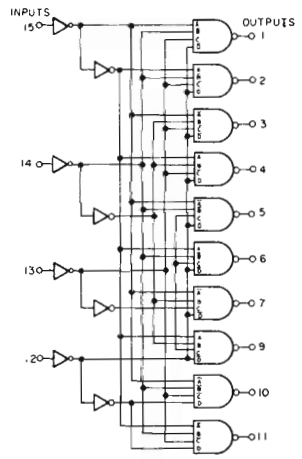
NOTE 4: Instruments are shipped from factory with jumper A-B on A38 Assembly removed (disconnected). With the jumper disconnected, the last remote program for amplitude, frequency, etc., is retained when changing from remote to local and then back to remote. If it is not desired to retain the last remote program, connect a jumper between points A and B. This will enable the Data Selector/Storage Registers on the A25 Assembly to be reset by the Local Enable Command to the initial remote turn-on condition listed below.

Frequency .....800 Hz
Range .....1000 Hz
Amplitude ..... -69.00 dBm
Vernier .....out/0 Hz
Delay .....1500 ms
Leveling .....ON (>10 Hz)

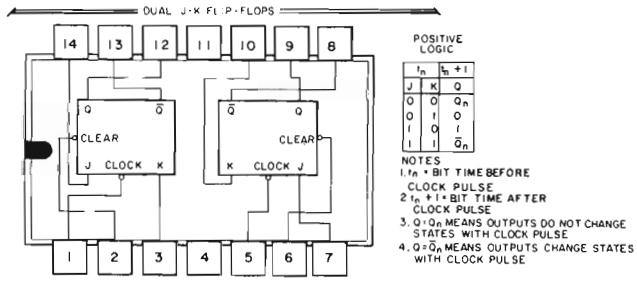
NOTE 5: The Logic diagram for a 4 Line to 10 Line Decoder is shown below. IC12, 13, 14 along with NOR gates IC6, 7, 11 and Inverter IC15 constitute a "data bit decoder". See Figure 7-5 for r truth table.



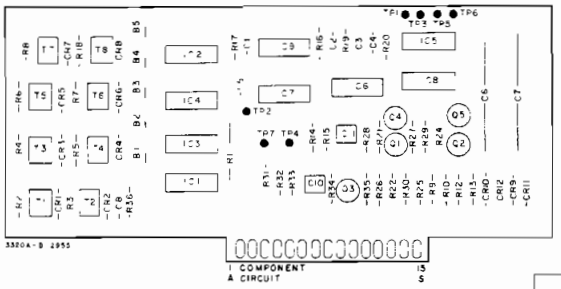
INPUT				DECIMAL OUTPUT									
12	13	14	15	1	2	3	4	5	6	7	9	10	11
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	L	H	L	H	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H



NOTE 6: Logic diagram of IC is shown below.



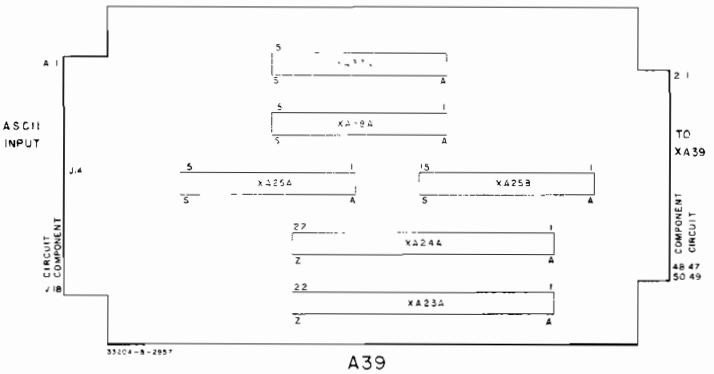
Low input to Clear sets Q to logical 0.
Clear is independent of Clock.



A37 TO XA37A

hp Part No. 03320-66537

Rev A

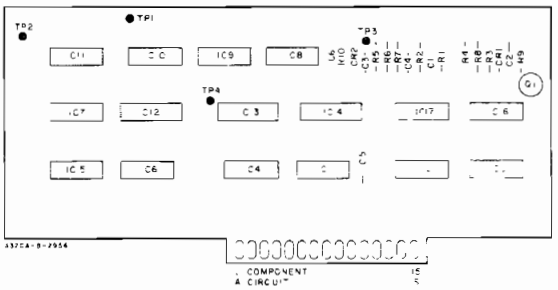


A39

hp Part No. 03320-66539

RevA

ASCII MOTHER BOARD, OPTION 007



A38 TO XA38A

hp Part No. 03320-66538

RevA

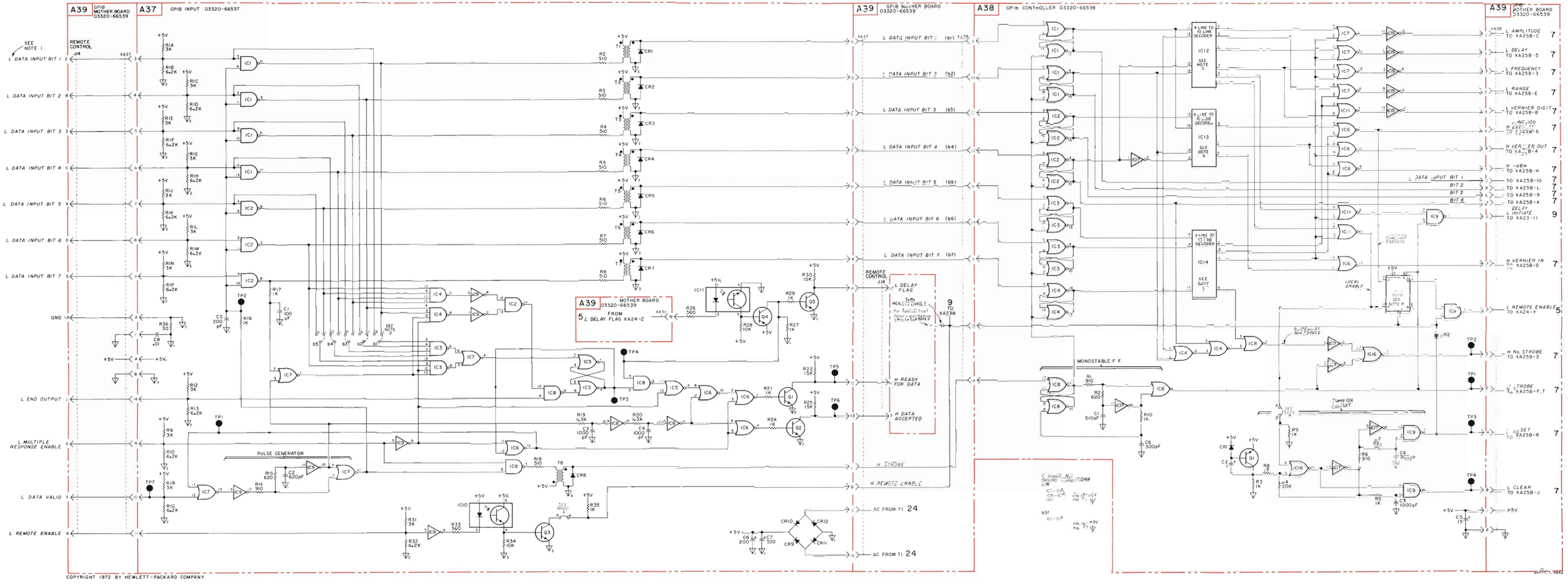


Figure 7-14. GPIB Input A37 And GPIB Controller A38, 3320B Option 007.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

Example:

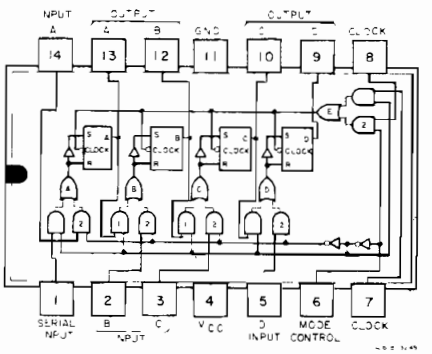
H Delay Flag – indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: IC8–IC11 are 4-bit Shift Registers. The mode of operation is controlled by the voltage level on mode control line, pin 6. When the mode control line is high (≈+5 V), the registers are reset by parallel loading of Inputs A, B, C and D. Inputs A, B, C and D are hard-wired to +5 V. When the mode control line is low (≈0 V) the Serial Input, pin 1, is enabled. These IC's are connected for serial-to-parallel conversion of the numerical data bits, b_1–b_4.

The "A" output of each IC represents the least significant digit. The "D" output of each IC represents the most significant digit.

All inputs and outputs are low true.

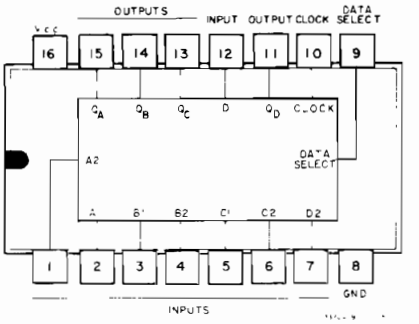


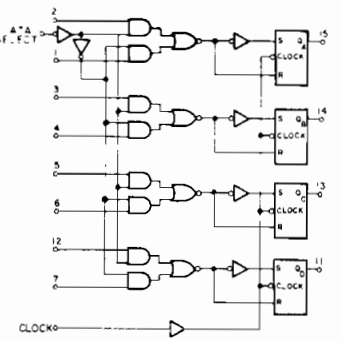
NOTE 3: IC18–IC23, and IC25–IC28 are 4-bit Data Selectors/ Storage Registers (latches). All inputs and outputs are BCD, low true. When L Clear (Data Select) input is low (≈0 V), input data A1, B1, C1, and D1 is applied to the respective outputs Q_A, Q_B, Q_C, and Q_D. When Data Select input is high, input data A2, B2, C2 and D2 is applied to the respective outputs. The selected input data is shifted to the output terminals on the negative-going edge of clock pulse.

Input data A1, B1, C1, and D1 is hardwired, as listed below, for the "initial turn on conditions" listed in Section III.

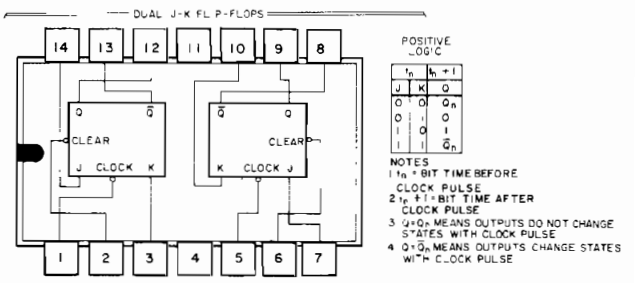
IC	PINS	WIRED	BCD OUTPUT
IC18	5, 12 2, 3	+5 V ⏚	3
IC19	2, 5, 12 3	+5 V ⏚	2
IC20–IC22	2, 3, 5, 12	+5 V	0
IC23	2, 3, 5 12	+5 V ⏚	8
IC25–IC26	2, 3, 5, 12	+5 V	0
IC27	3, 5 2, 12	+5 V ⏚	9
IC28	2 3, 5, 12	+5 V ⏚	- 6
IC4	Clear		VERN OUT

Input Data A2, B2, C2, and D2 is numerical data from shift registers IC8–IC11.





NOTE 4: Logic diagram of IC is shown below.

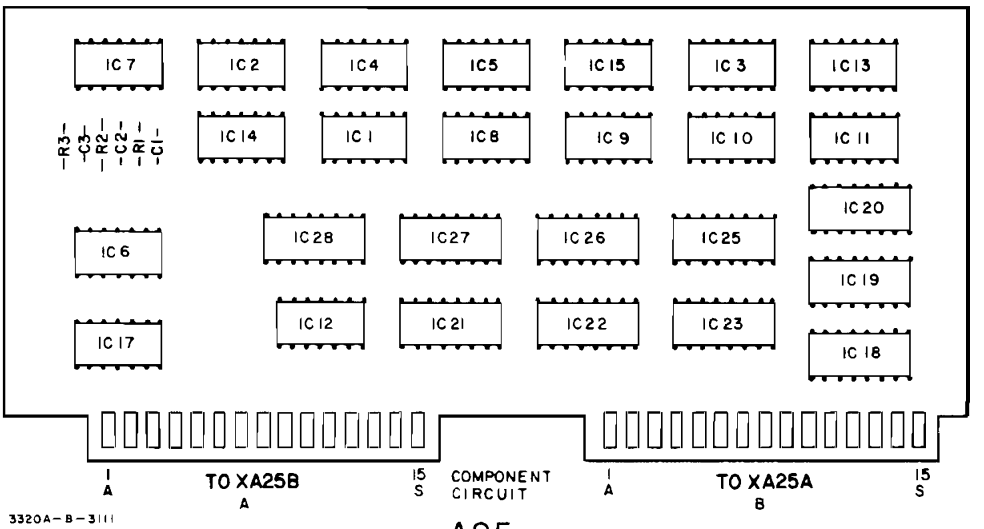


Low input to Clear sets Q to logical 0.
Clear is independent of Clock

BCD
UTPUT

- 6

ERN OUT
m shift registers



A25

hp Part No. 03320-66525

Rev A

ORE

AFTER

PUTS DO NOT CHANGE
OCK PULSE
PUTS CHANGE STATES
SE

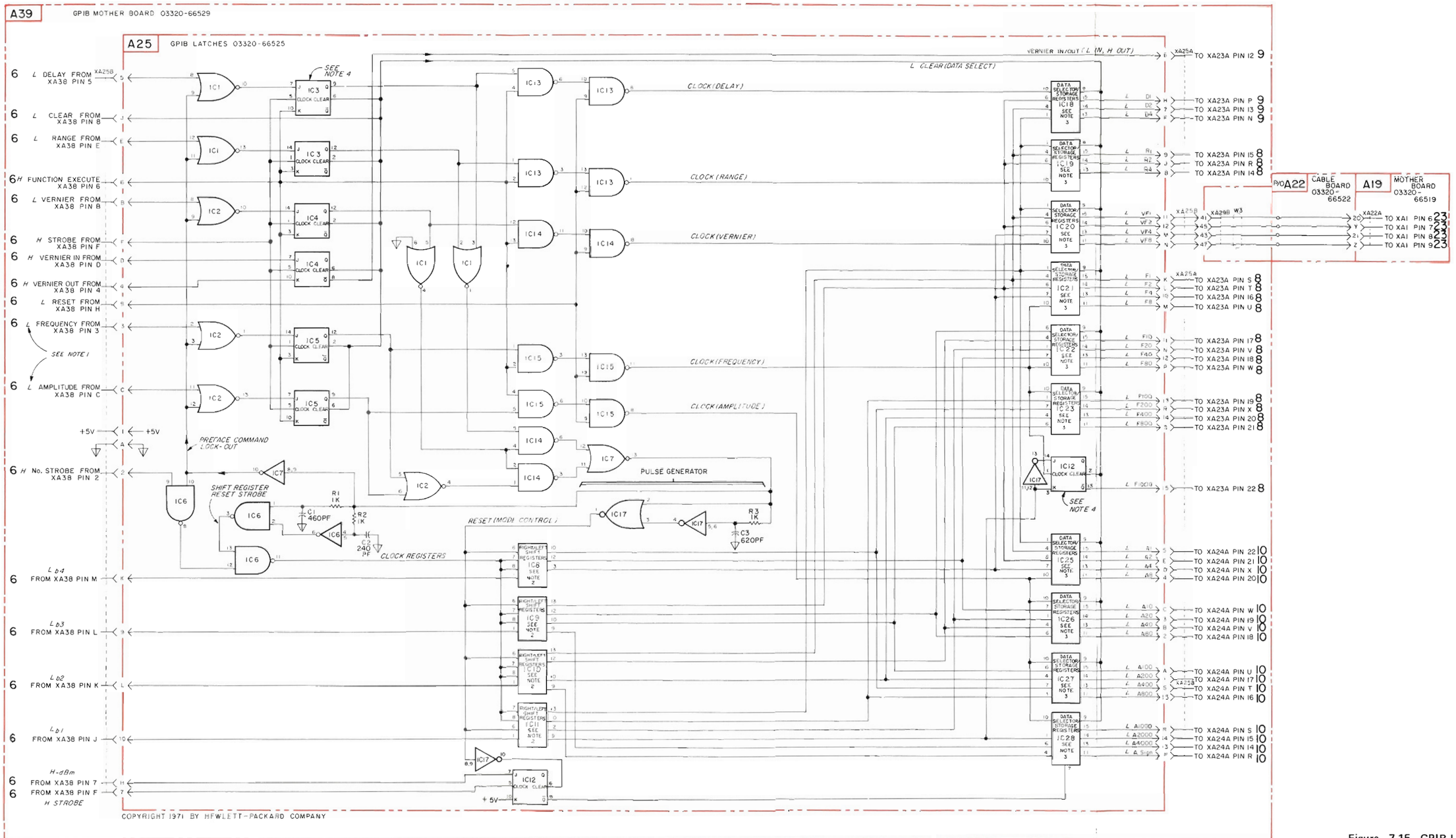


Figure 7-15. GPIB Latches A25, 3320B Option 007.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

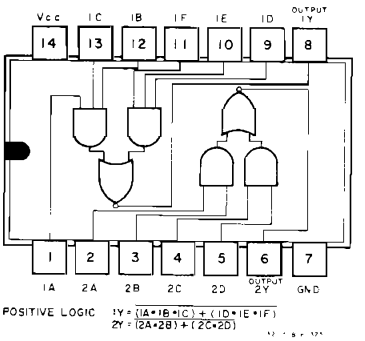
Example:

H Delay Flag – indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

In Local Mode (A Low, B High) the input on pins 9 and 10 is inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



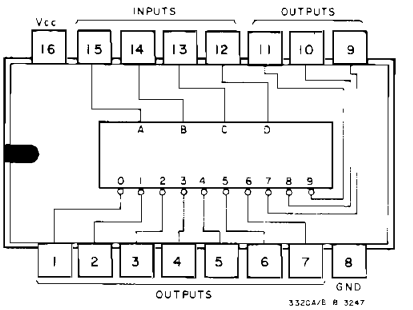
NOTE 3: BCD Low true logic, switch contact(s) to ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

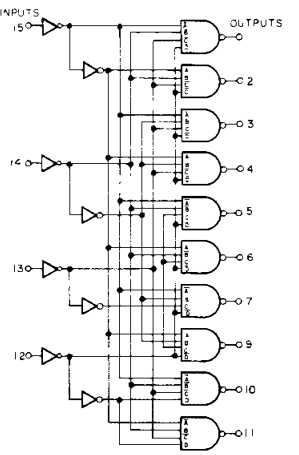
NOTE 4: 9's Complement Circuitry:

Digit	INPUT 1	2	4	8	9's COMPLEMENT 1	2	4	8
0	L	L	L	L	H	L	L	H
1	H	L	L	L	L	L	L	H
2	L	H	L	L	H	H	H	L
3	H	H	L	L	L	H	H	L
4	L	L	H	L	H	L	H	L
5	H	L	H	L	L	L	H	L
6	L	H	H	L	H	H	L	L
7	H	H	H	L	L	H	L	L
8	L	L	L	H	H	L	L	L
9	H	L	L	H	L	L	L	L

NOTE 5: On A22IC1, input at pin 12 is hard wired low, and output pins 9, 10, and 11 are not used (N/C).

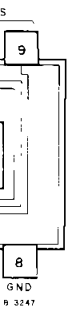


INPUT 12	13	14	15	DECIMAL OUTPUT 1	2	3	4	5	6	7	9	10	11
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	L	H	L	H	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H	H	H	H
H	H	L	L	H	H	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H

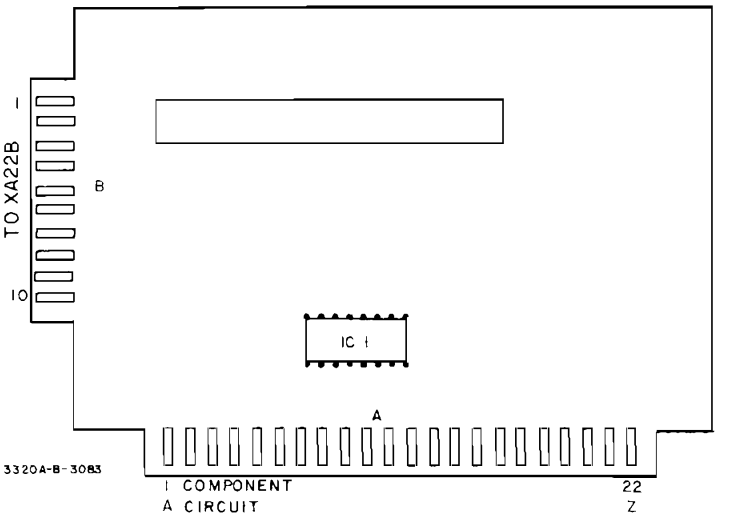


MPLEMENT		
2	4	8
	L	H
	L	H
H	H	L
H	H	L
	H	L
	H	L
H	L	L
H	L	L
	L	L
	L	L

ed low, and output



T			
7	9	10	11
H	H	H	H
H	H	H	H
H	H	H	H
H	H	H	H
H	H	H	H
H	H	H	H
H	L	H	H
H	H	L	H
H	H	H	L
H	H	H	H
H	H	H	H
H	H	H	H
H	H	H	H

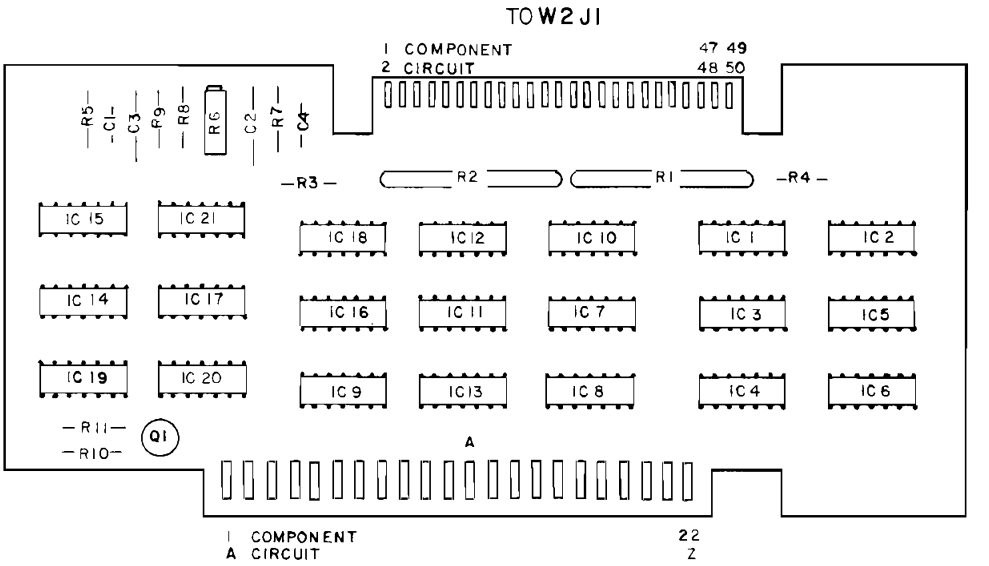


TO XA22A

A22

hp Part No. 03320-66522

Rev A



3320A-B-2875

TO XA23A

A23

hp Part No. 03320-66523

Rev B

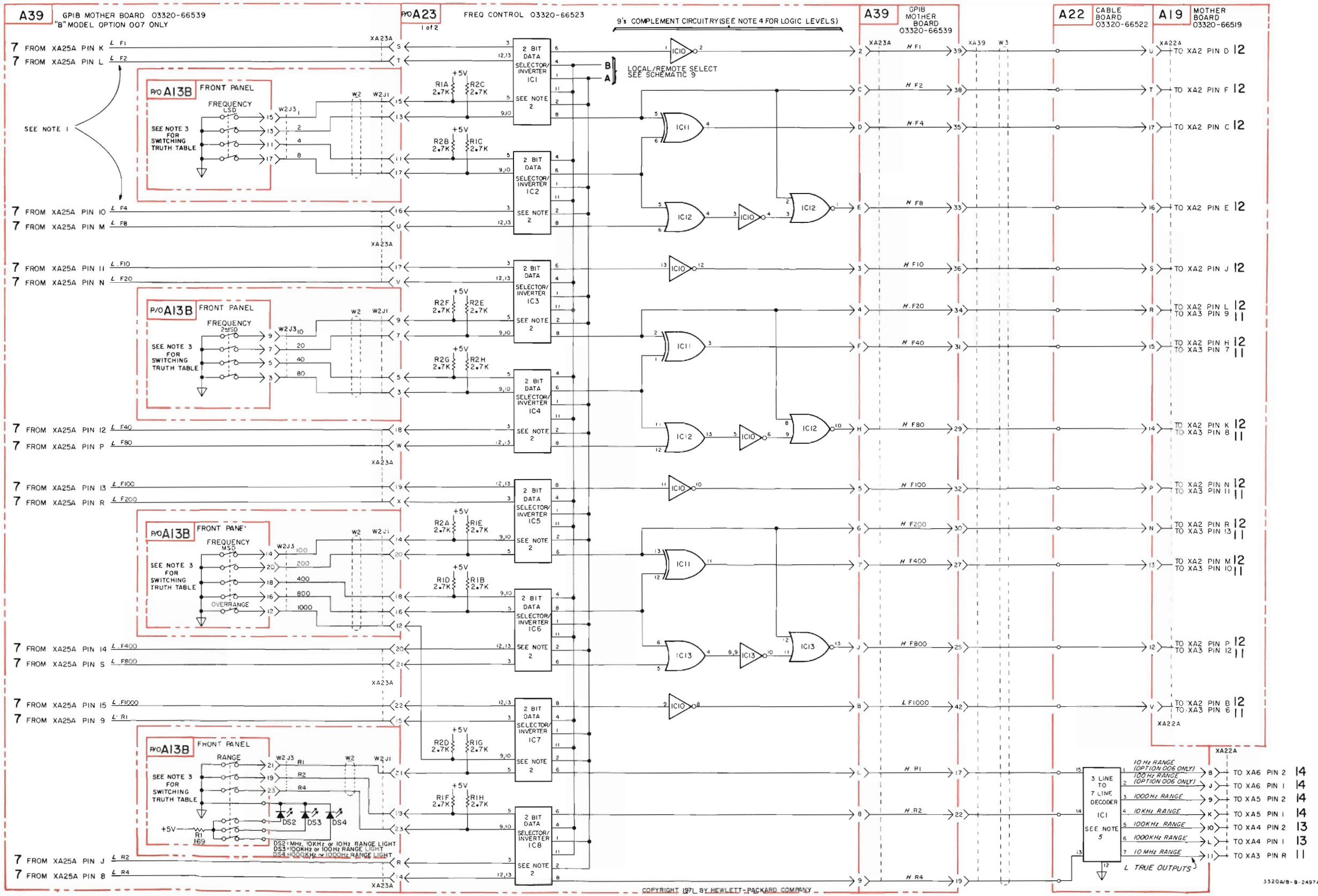
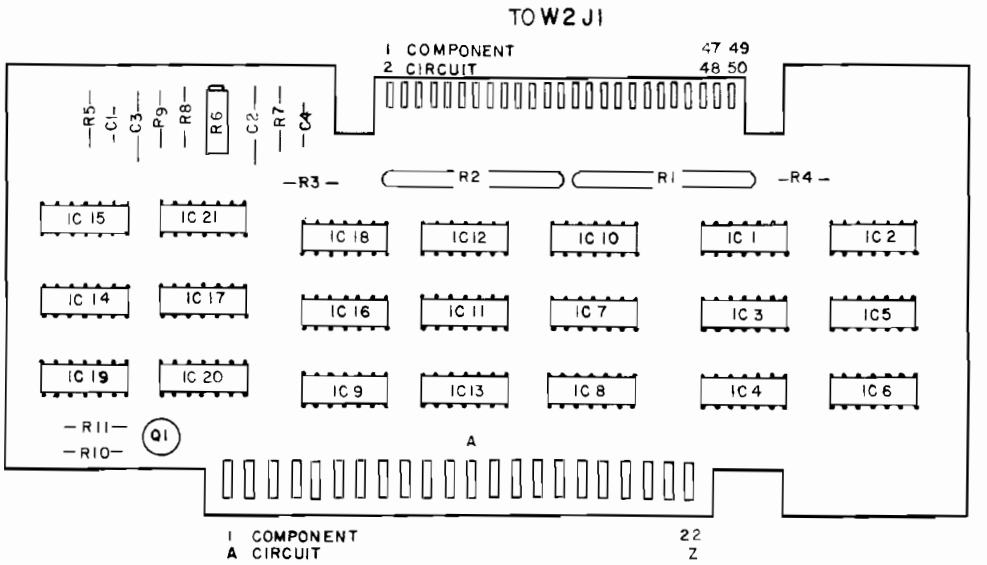


Figure 7-16. GPIB Frequency Control P/O A23, 3320B Option 007.



3320A-B-2875

TO XA23A

A23

hp Part No. 03320-66523

Rev B

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

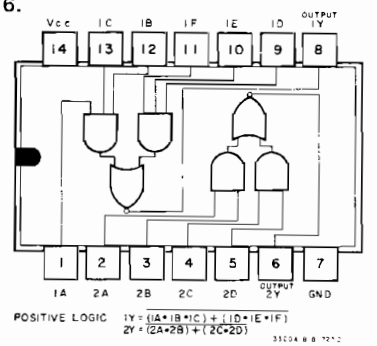
Example:

H Delay Flag — indicates the delay flag line should be +5 V when a delay flag signal is present.

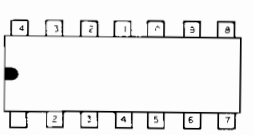
L Data Valid — indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

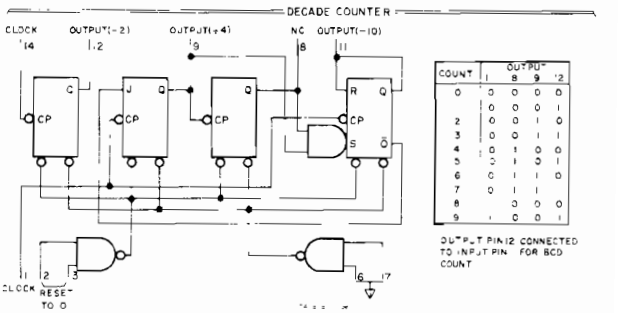
In Local Mode (A Low, B High) the input on pins 9 and 10 is inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



NOTE 3: Logic diagram of IC is shown below.



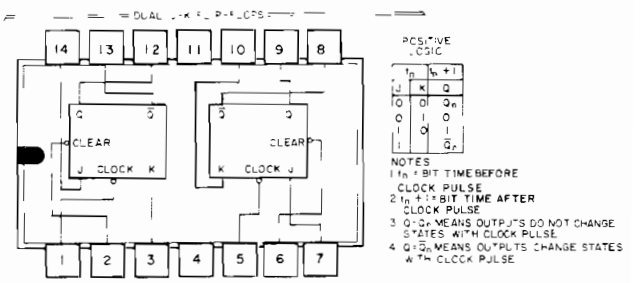
NOTE 3: (CONT'D.)



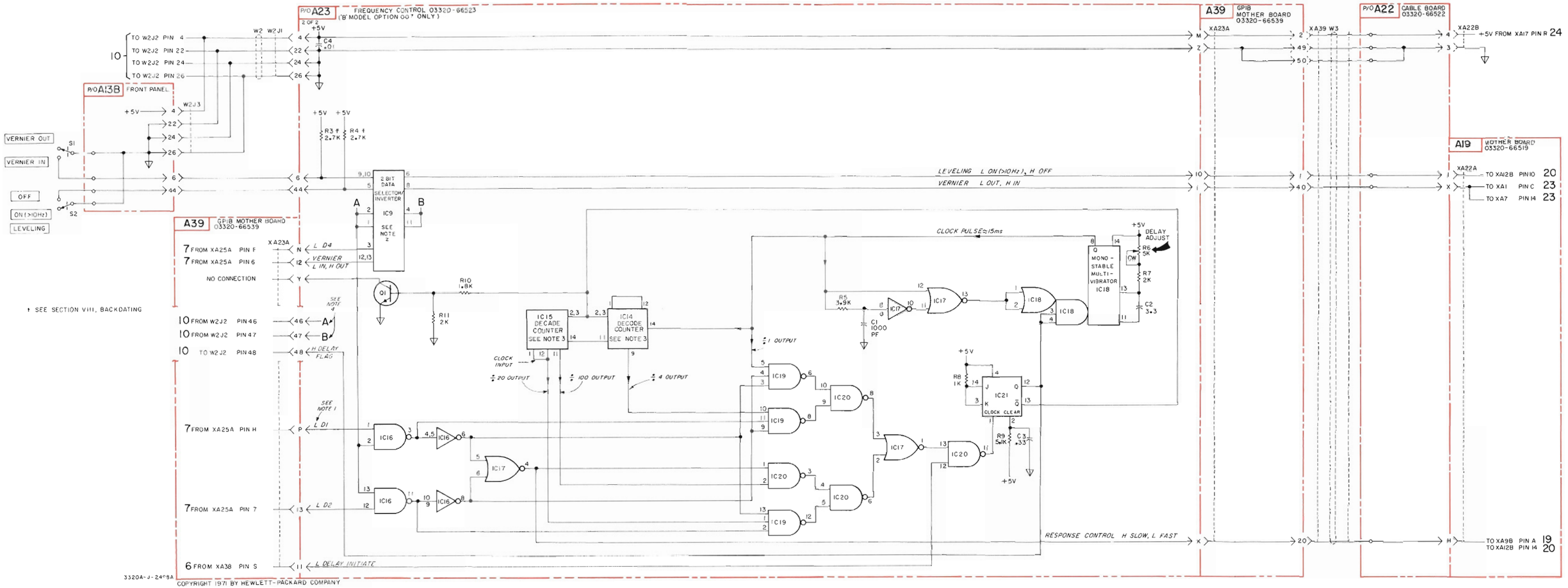
NOTE 4: Local/Remote select lines from A24 Assembly:

Local mode A Low, B High
Remote mode A High, B Low

NOTE 5: Logic Diagram of IC is shown below.



Low input to Clear sets Q to logical 0.
Clear is independent of Clock



9

Figure 7-17. GPIB Frequency Control P/O A23, 3320B Option 007.

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

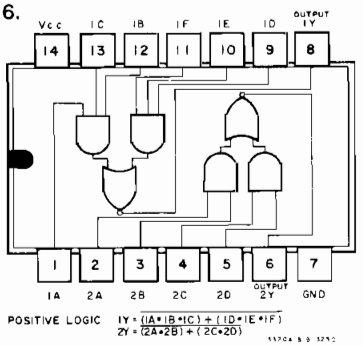
Example:

H Delay Flag – indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: In Remote Mode (A High, B Low) the input on pins 12 and 13 is inverted and applied to pin 8. The input on pin 3 is inverted and applied to pin 6.

In Local Mode (A Low, B High) the input on pins 9 and 10 is inverted and applied to pin 8. The input on pin 5 is inverted and applied to pin 6.



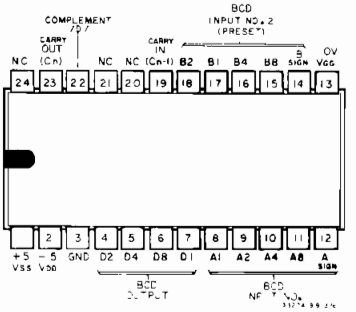
NOTE 3: BCD Low true logic, switch contact(s) to ground is true state.

Digit	CODE 1	2	4	8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

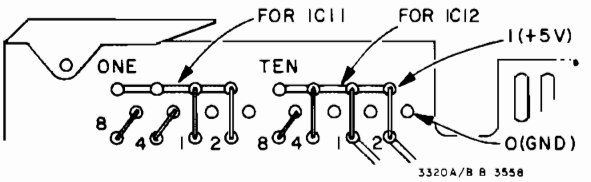
NOTE 4: IC9, 10, 11 or 12 operate as a BCD Adder. The two BCD Inputs (#1 and #2) are summed together and applied to the BCD Output. The BCD inputs and output lines are high true logic. A true signal on the A Sign input indicates a negative amplitude number (i.e., -10.00 dBm). The BCD Input #2 is a "hard wired" input, preset by means of jumper wires on the pc assembly. See Note 5.

The Complement /D/ input controls the BCD output (D1, D2, D4, D8). With the Complement /D/ input high (≈+5 V), the direct BCD sum of inputs #1 and #2 are applied to the BCD Output. With the Complement /D/ input low (≈-5 V), the 9's complement of the two inputs is applied to the BCD Output. The BCD Output lines have internal pull-up resistors.

Transistor Q1 inhibits a Carry-In signal to IC9 when the Amplitude Sign is positive. Transistors Q2, Q3 and associated circuits (IC13, 14 and 15) control the level of the Complement /D/ input.



NOTE 5: Jumpers on the A24B Assembly for IC11 and IC12 are preset at the factory:



3320B STANDARD, 50 Ω Impedance
(Preset No. 73)

IC12 Jumpered for BCD 7
IC11 Jumpered for BCD 3

3320B OPTION 001, 75 Ω Impedance
(Preset No. 75)

IC12 Jumpered for BCD 7
IC11 Jumpered for BCD 5

er. The two BCD
olied to the BCD
true logic. A true
mplitude number
d wired" input,
. See Note 5.

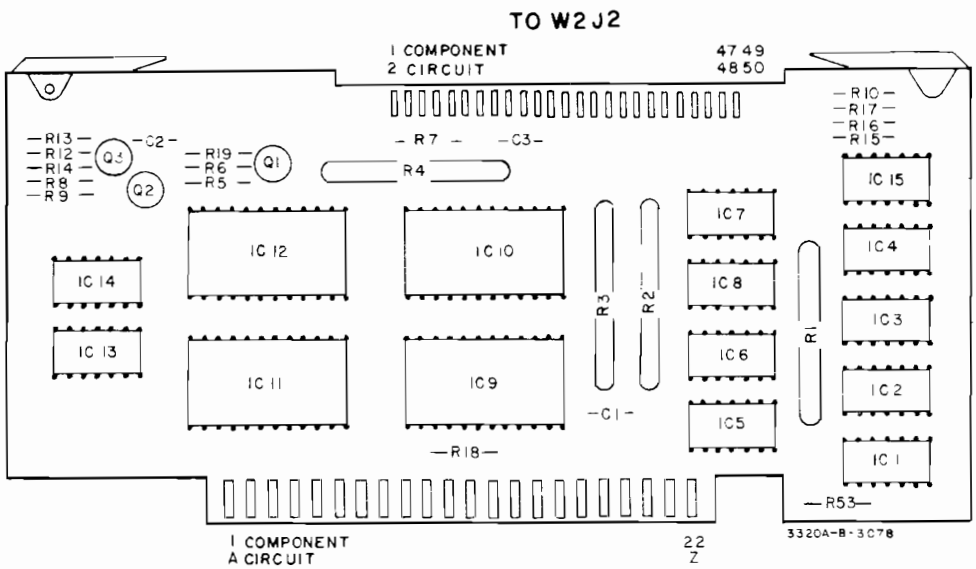
ut (D1, D2, D4,
, the direct BCD
Output. With the
ement of the two
utput lines have

n the Amplitude
ircuits (IC13, 14
ut.

11 and IC12 are

IC12
1(+5V)
0(GND)
A/B B 3558
ce

ce



TO XA24A A24B

hp Part No. 03320-66524

Rev A

A39 GPIB MOTHER BOARD 03320-66539
'B' MODEL OPTION 007 ONLY

A24B AMP CONTROL 03320-66524
'B' MODEL OPTION 007 ONLY

A39 GPIB MOTHER BOARD 03320-66539

P/O A22 CABLE BOARD 03320-66522

A19 MOTHER BOARD 03320-66519

P/O A13B FRONT PANEL
AMPLITUDE LSD
SEE NOTE 3 FOR SWITCHING TRUTH TABLE

P/O A13B FRONT PANEL
AMPLITUDE 2nd SD
SEE NOTE 3 FOR SWITCHING TRUTH TABLE

P/O A13B FRONT PANEL
AMPLITUDE 3rd SD
SEE NOTE 3 FOR SWITCHING TRUTH TABLE

P/O A13B FRONT PANEL
AMPLITUDE MSD
SEE NOTE 3 FOR SWITCHING TRUTH TABLE

P/O A13B
VERNIER FREQUENCY (FRONT PANEL)
DS1 (REMOTE LIGHT)

2 BIT DATA SELECTOR/INVERTER IC1 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC2 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC3 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC4 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC5 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC6 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC7 SEE NOTE 2
2 BIT DATA SELECTOR/INVERTER IC8 SEE NOTE 2

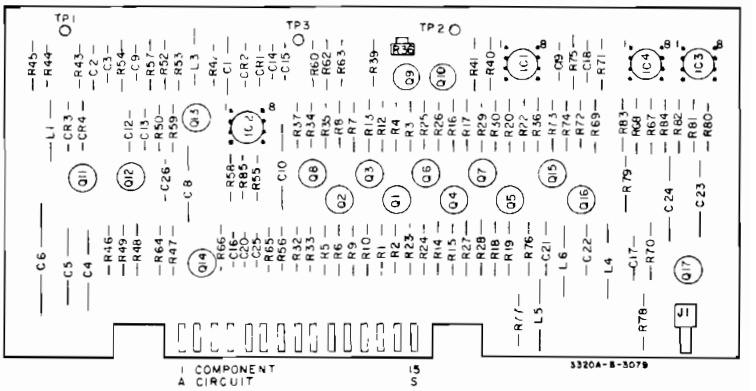
BCD ADDER IC9 SEE NOTE 4
BCD ADDER IC10 SEE NOTE 4
BCD ADDER IC11 SEE NOTE 4
BCD ADDER IC12 SEE NOTE 4

COMPLEMENT ADDER OUTPUT

AMPLITUDE SIGN
L = POSITIVE NUMBER
H = NEGATIVE NUMBER

10

Figure 7-18. GPIB Amplitude Control A24B, 3320B Option 007.



TO XA3 A3

hp Part No. 03320-66503

Rev C

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
1	XA20A	"A" Model – Standard, Options 001, 002, 006
2	XA21A	"B" Model – Standard, Options 001, 002, 006
3	XA22A	"A" Model – Option 003 "B" Model – Option 004
8	XA22A	"B" Model – Option 007

NOTE 2: Logic levels are high true (+ 5 V)
(9's complement of front panel settings)

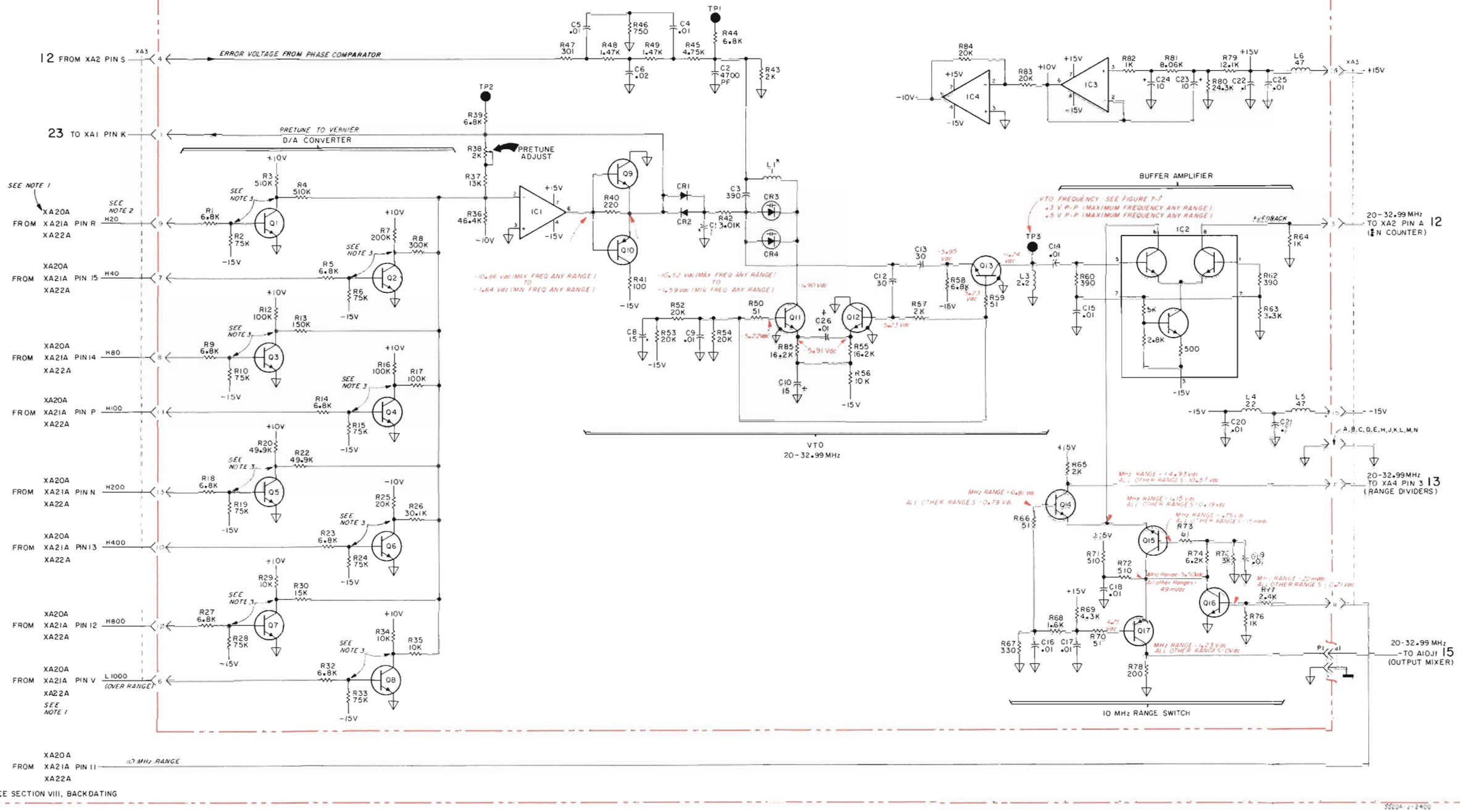
NOTE 3: DC voltage levels on the base and collector of transistors Q1 thru Q8 depend on logic level of base signal. Voltage levels versus logic levels are as follows:

Logic level high (true) . . . . . Base = 0.64 Vdc
Collector = 2.64 Vdc

Logic level low (false) . . . . . Base = -1.19 Vdc
Collector = -5.93 Vdc

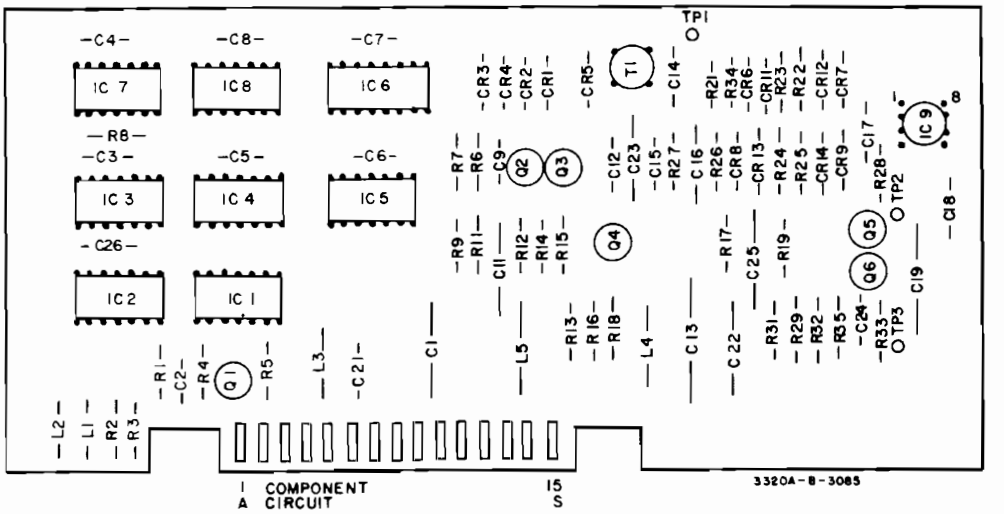
A19 MOTHER BOARD 03320-66519

A3 VTO 03320-66503



11

Figure 7-19. VTO A3.



TO XA2 A2

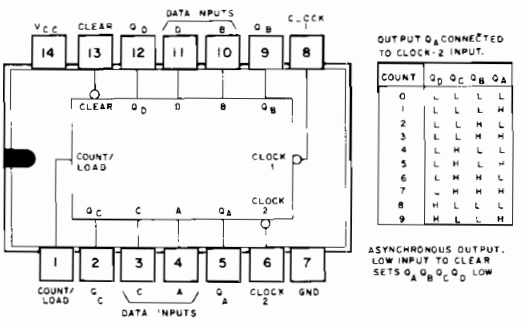
hp Part No. 03320-66502

Rev C

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

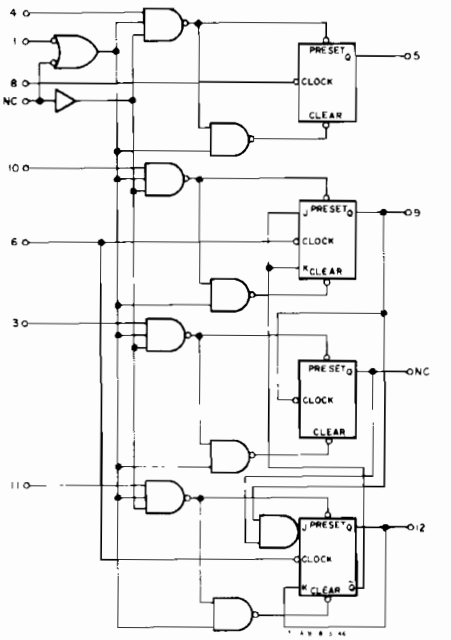
SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
1	XA20A	"A" Model – Standard, Options 001, 002, 006
2	XA21A	"B" Model – Standard, Options 001, 002, 006
3	XA22A	"A" Model – Option 003 "B" Model – Option 004
8	XA22A	"B" Model – Option 007

NOTE 2: IC3, IC4 and IC5 are programmable decade counters. The outputs are preset to any state (number) by placing a low on the Count/Load input and parallel loading the desired data (number) on the Data Inputs. The outputs will change to agree with the Data Inputs independently of the state of the clocks.

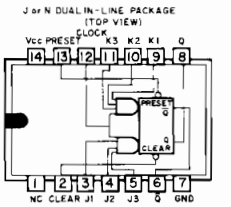


COUNT	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

NOTE 2: (CONT'D.)



NOTE 3: Logic diagram of IC is shown below.

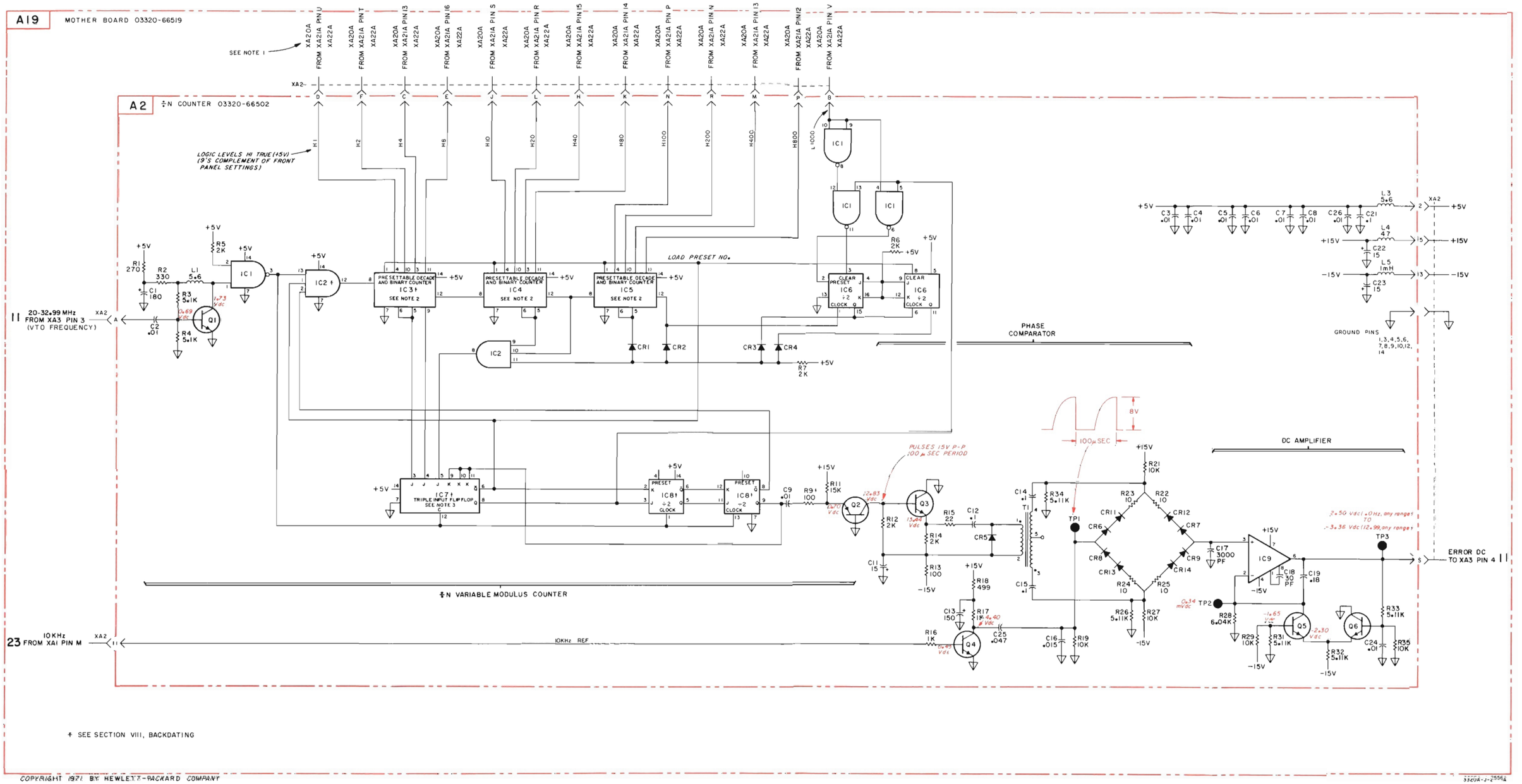


LOW INPUT TO PRESET SETS Q TO LOGICAL 1. LOW INPUT TO CLEAR SETS Q TO LOGICAL 0. PRESET AND CLEAR ARE INDEPENDENT OF CLOCK

POSITIVE LOGIC

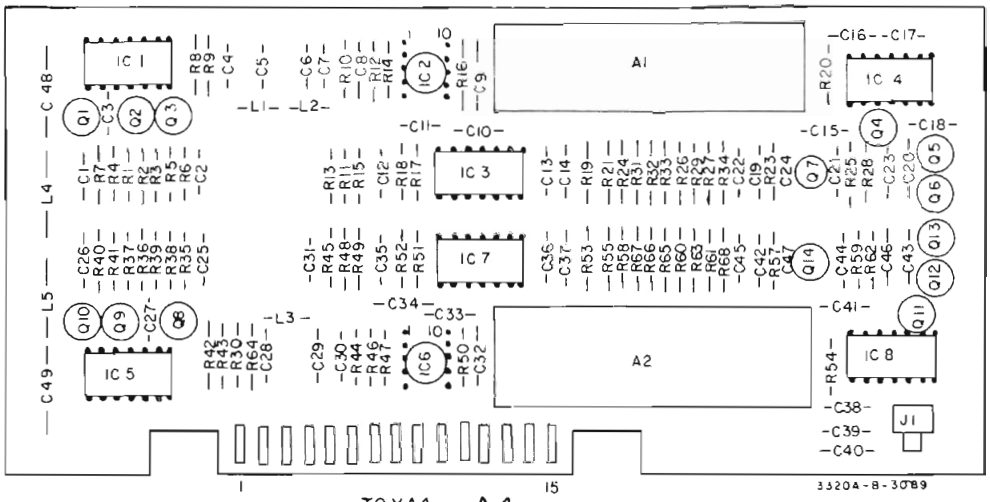
tn		tn+1
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q}_n$

NOTES
1. J=J1·J2·J3
2. K=K1·K2·K3
3. t_n = BIT TIME BEFORE CLOCK PULSE.
4. t_{n+1} = BIT TIME AFTER CLOCK PULSE.
5. $Q=Q_n$ MEANS OUTPUTS DO NOT CHANGE STATES WITH CLOCK PULSE.
6. $Q=\overline{Q}_n$ MEANS OUTPUTS CHANGE STATES WITH CLOCK PULSE.



12

Figure 7-20. ÷ N Counter A2.



TO XA4 A4

hp Part No. 03320-66504
Rev A

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
1	XA20A	"A" Model – Standard, Options 001, 002, 006
2	XA21A	"B" Model – Standard, Options 001, 002, 006
3	XA22A	"A" Model – Option 003 "B" Model – Option 004
8	XA22A	"B" Model – Option 007

1. DC voltages on Q1, Q2, Q3 measured with 3320A/B in 1000 kHz range position using high input resistance, low capacitance voltmeter (-hp- 412A).

2. Top voltage measured with 3320A/B in 1000 kHz range position.
Bottom voltage measured with 3320A/B in any other range position.

3. DC voltages on Q8, Q9, Q10 measured with 3320A/B in 100 kHz range position using high input resistance, low capacitance voltmeter (-hp- 412A).

4. Top voltage measured with 3320A/B in 100 kHz range position.
Bottom voltage measured with 3320A/B in any other range position.

5. .7 to .9 V p-p on 1000 kHz or 100 kHz range position.

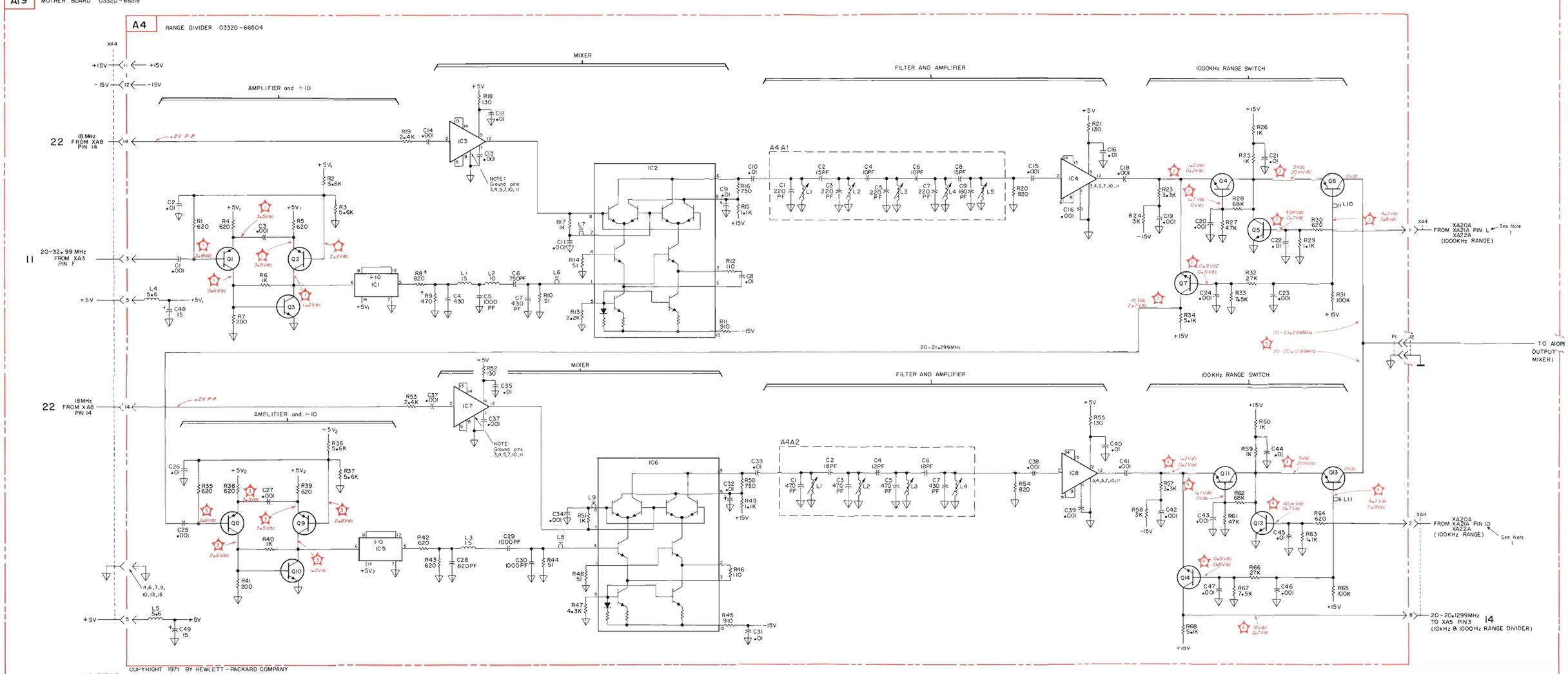
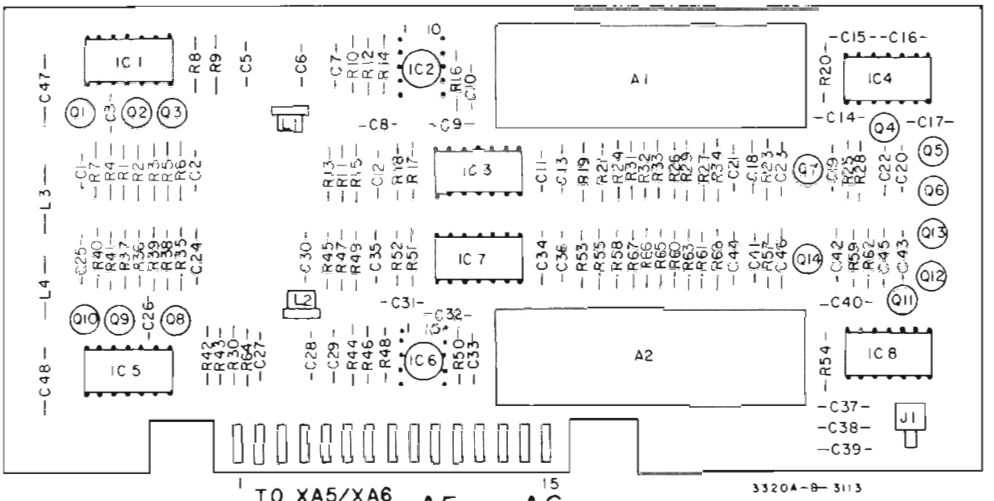


Figure 7-21. Range Divider A4.



A5 or A6

hp Part No. 03320-66505

Rev A

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
1	XA20A	"A" Model – Standard, Options 001, 002, 006
2	XA21A	"B" Model – Standard, Options 001, 002, 006
3	XA22A	"A" Model – Option 003 "B" Model – Option 004
8	XA22A	"B" Model – Option 007

1. DC voltages on Q1, Q2, Q3 measured with 3320A/B in 10 kHz (100 Hz for A6, Option 006) range position using high input resistance, low capacitance voltmeter (-hp- 412A).

2. Top voltage measured with 3320A/B in 10 kHz range (100 Hz range for A6, Option 006) position.
Bottom voltage measured with 3320A/B in any other range.

3. DC voltages on Q8, Q9, Q10 measured with 3320A/B in 1000 Hz (10 Hz for A6, Option 006) range position using high input resistance, low capacitance voltmeter (-hp-412A).

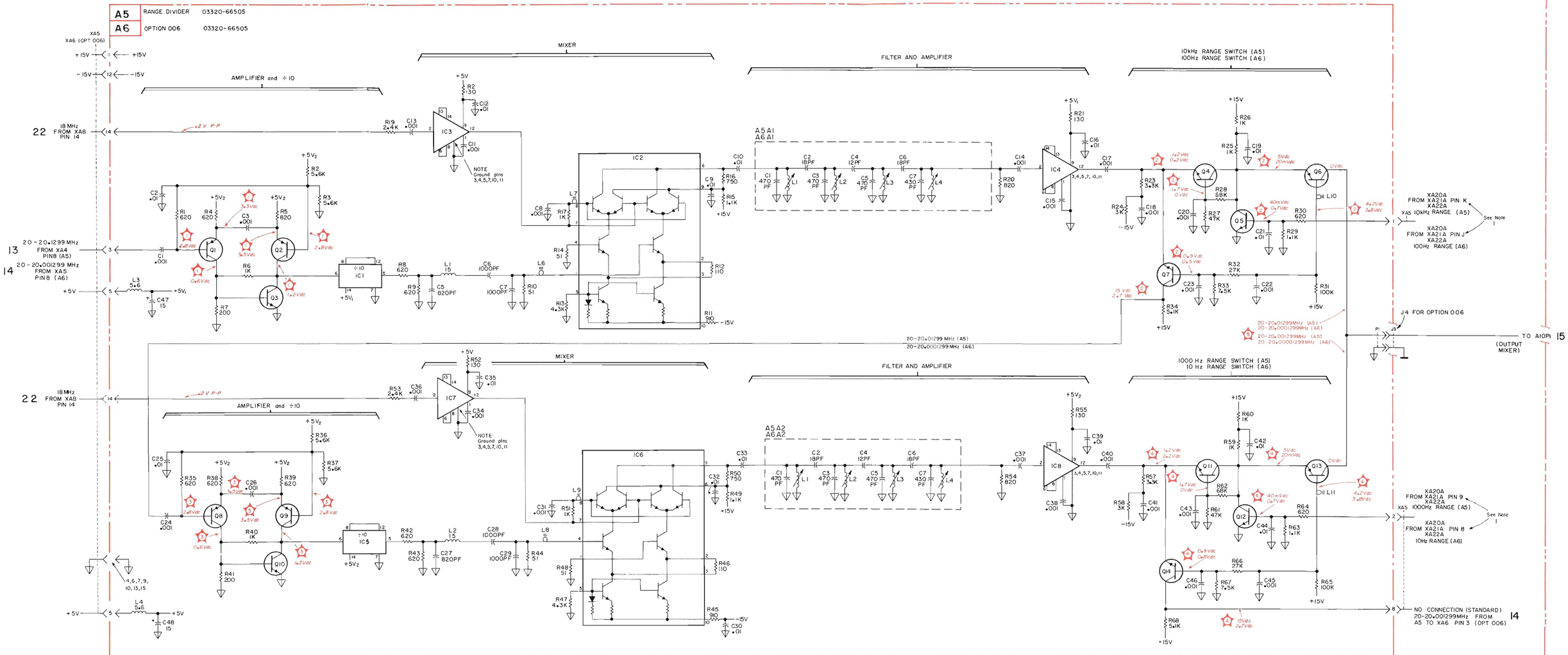
4. Top voltage measured with 3320A/B in 1000 Hz range (10 Hz range for A6, Option 006) position.
Bottom voltage measured with 3320A/B in any other range position.

5. .7 to .9 V p-p on 10 kHz and 1000 Hz ranges (100 Hz and 10 Hz ranges for A6, Option 006).

A19 MOTHER BOARD 03320-66519

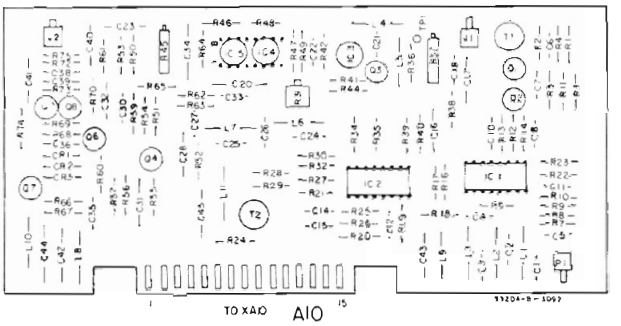
A5 RANGE DIVIDER 03320-66505

A6 OPTION 006 03320-66505



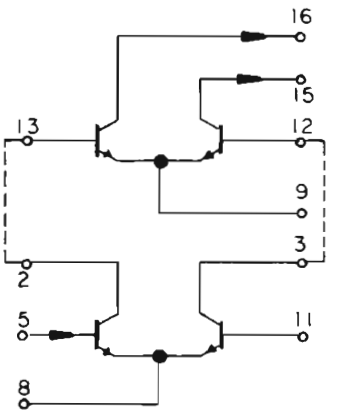
3320A-J-2258

Figure 7-22. Range Divider A5, 3320A/B Standard; Range Divider A6, 3320A/B Option 006.

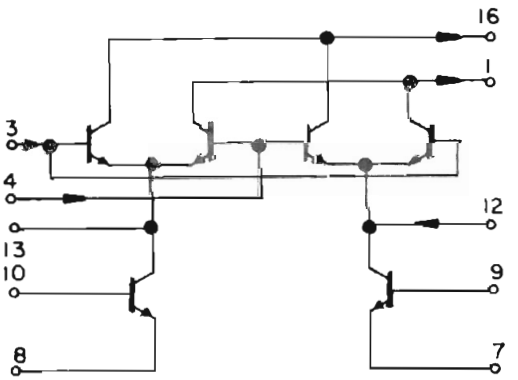


hp Part No 03320-66510
Rev B

NOTE 1: IC1 is a high frequency transistor array consisting of 4 transistors for use as a limiter. Circuit diagram is shown below.



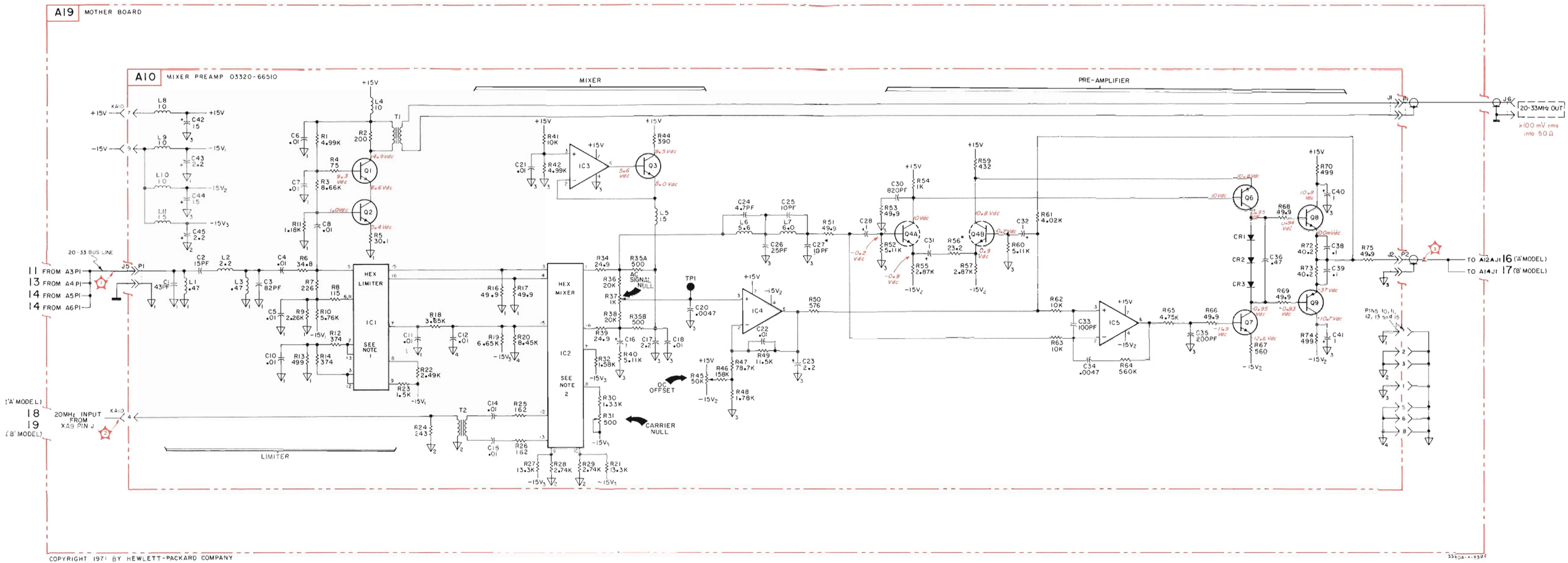
NOTE 2: IC2 is a high frequency transistor array consisting of 6 transistors for use as a mixer. Circuit diagram is shown below.



1. .3 to .9 V p-p varies with range setting.

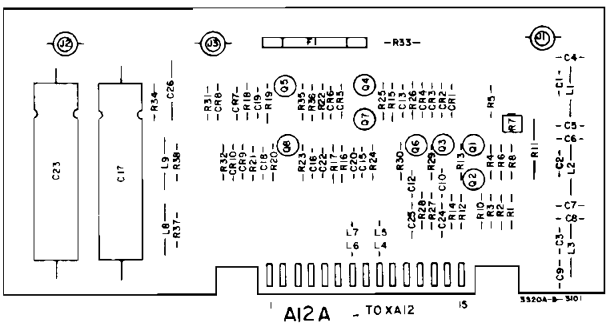
2. For 3320B with 50 Ω output voltage varies from ≈ .1 V p-p at + 17.00 dBm to ≈ .3 V p-p at + 16.99 dBm. NOTE: to prevent oscillations, make measure on bottom side of mother board with A10 in place.

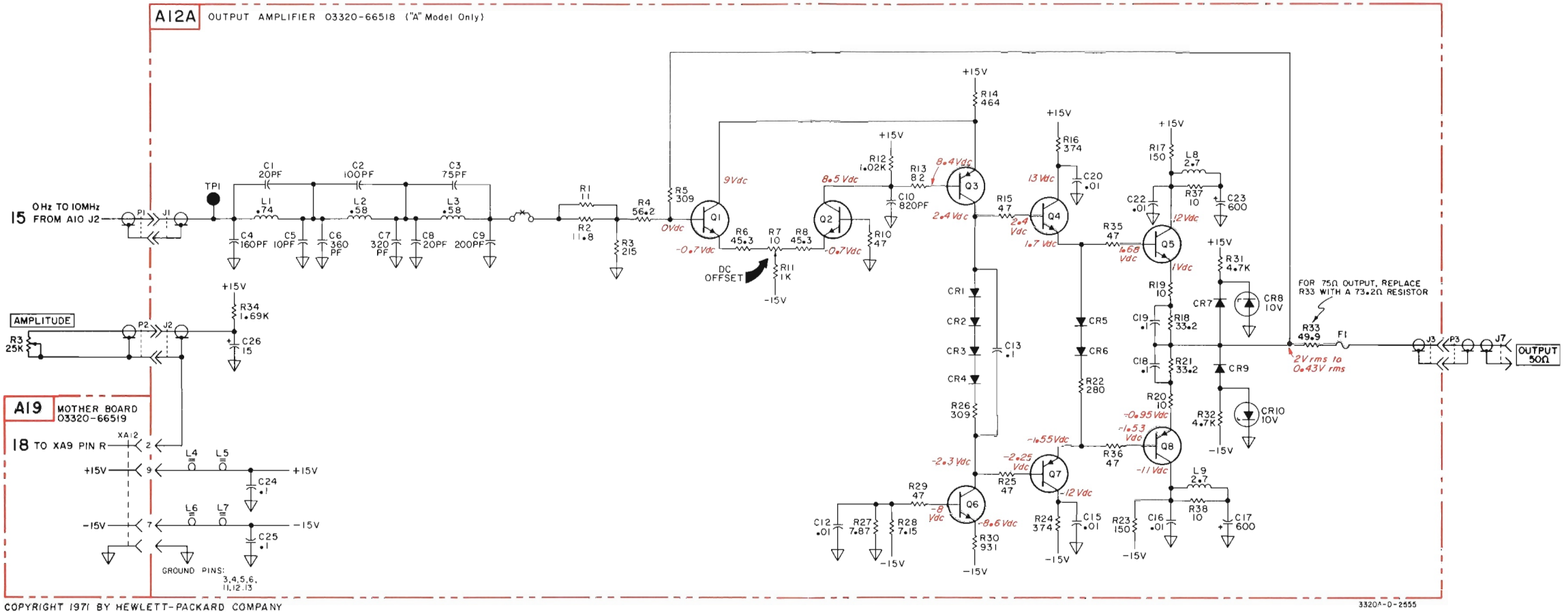
3. 0 Hz to 12.99 MHz. For 3320B with 50 Ω output, 3 V p-p at + 17.00 dBm. 5 V p-p at + 16.99 dBm. NOTE: with BRN (PRE AMP OUT) cable disconnected.



15

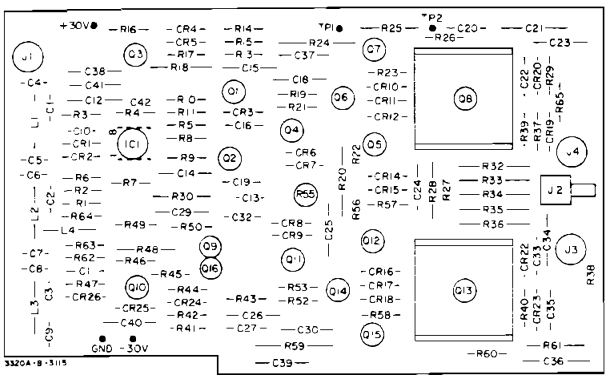
Figure 7-23. Mixer Preamp A10


A12A
TO XA12
hp Part No 03320-66518
Rev A



16

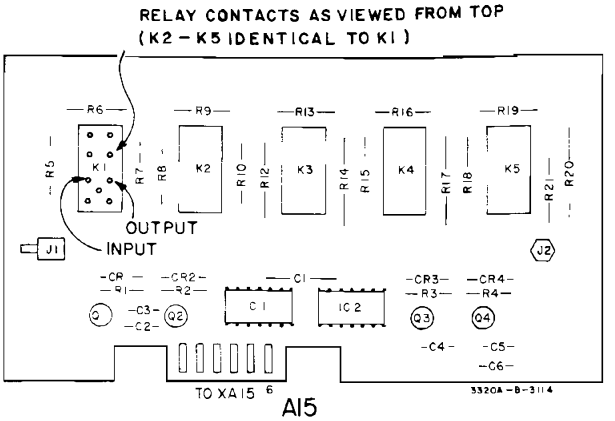
Figure 7-24. Power Amplifier A12A, 3320A.



A14

hp Part No. 03320-66514

Rev. A



A15

hp Part No. 03320-66515 (STANDARD)
03320-66556 (OPTION 001)
Rev D

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
2	XA21A	"B" Model – Standard, Options 001, 002, 006
5	XA22B	"B" Model – Option 004
10	XA22B	"B" Model – Option 007

NOTE 2: The Low Level Out varies with settings of amplitude controls. At maximum output (+ 26.99 dBm for 50 Ω, + 24.99 dBm for 75 Ω), the output is 158 mV. At all levels in 10 dB steps down from maximum output, the Low Level Out is 158 mV. See output level for standard (50 Ω) unit listed below.

NOTE 2: (CONT'D.)

AMPLITUDE	LOW LEVEL OUT
+ 26.99	158 mV
+ 17.00	50 mV
+ 16.99	158 mV
+ 7.00	50 mV
+ 6.99	158 mV
- 3.00	50 mV
- 3.01	158 mV
- 13.00	50 mV
- 13.01	158 mV
.	.
.	.
.	.

NOTE 3: To prevent oscillations on A14 Assembly, measure dc voltage levels with high input resistance, low capacitance voltmeter (-hp- 412A).

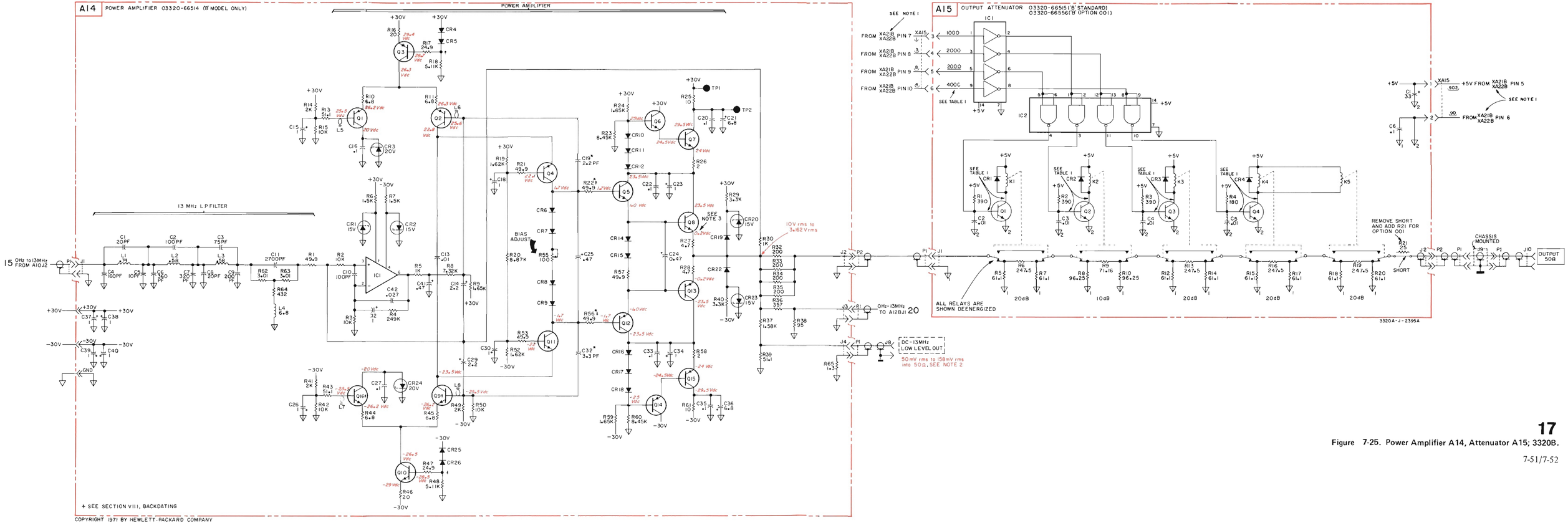
Table 1. Output Attenuator.

LOW signals (0 V) at inputs (pins 3, 4, 5, and 6) puts in attenuation by de-energizing respective reed relay(s). This attenuator provides 0 dB of attenuation when amplitude is set for maximum output (+ 26.99 for 50 Ω, + 24.99 for 75 Ω). Switching occurs in 10 dB steps down from maximum output. A truth table for various amplitude settings is listed below:

AMPLITUDE* SETTING	INPUT LINES (LOW true)				ATTENUATION (thru A15)	TRANSISTORS			
	4000	2000	2000	1000		Q1	Q2	Q3	Q4
+ 26.99	H	H	H	H	0 dB	–	–	–	–
+ 16.99	H	H	H	L	10 dB	–	X	–	–
+ 6.99	H	L	H	H	20 dB	X	–	–	–
- 3.01	H	L	H	L	30 dB	X	X	–	–
- 13.01	H	L	L	H	40 dB	X	–	X	–
- 23.01	H	L	L	L	50 dB	X	X	X	–
- 33.01	L	L	H	H	60 dB	X	–	–	X
- 43.01	L	L	H	L	70 dB	X	X	–	X
- 53.01	L	L	L	H	80 dB	X	–	X	X
- 63.01	L	L	L	L	90 dB	X	X	X	X

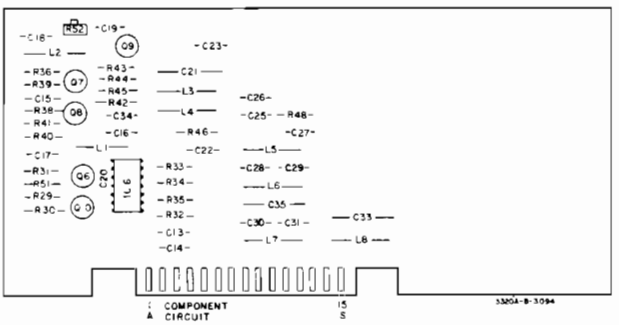
*For Standard 3320B (50 Ω output)

H = + 5 V, L = 0 V, – = transistor(s) ON, X = transistor(s) OFF



17

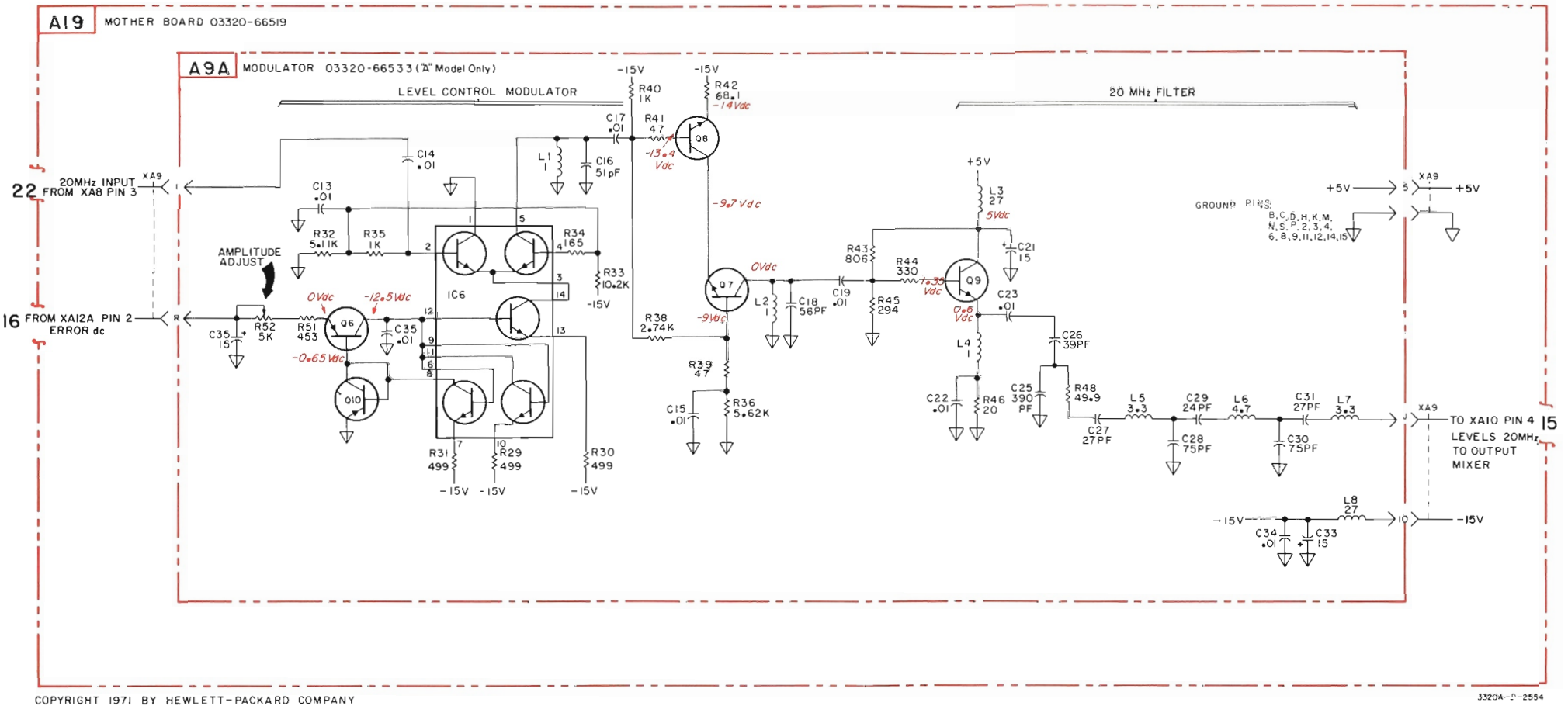
Figure 7-25. Power Amplifier A14, Attenuator A15; 3320B.



TOXA9 A9A

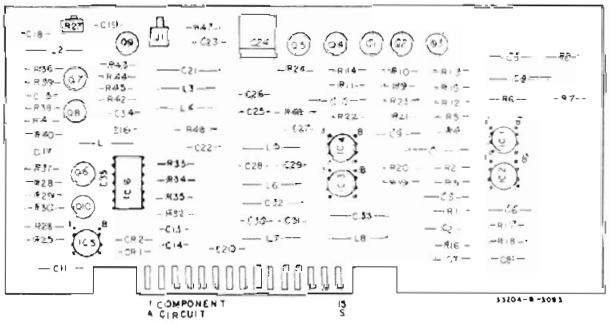
hp Part No. 03320-66533

Rev A



18

Figure 7-26. Modulator A9A, 3320A.



TO XA9 A9B

hp Part No. 03320-66509

Rev A

NOTE 1: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

Example:

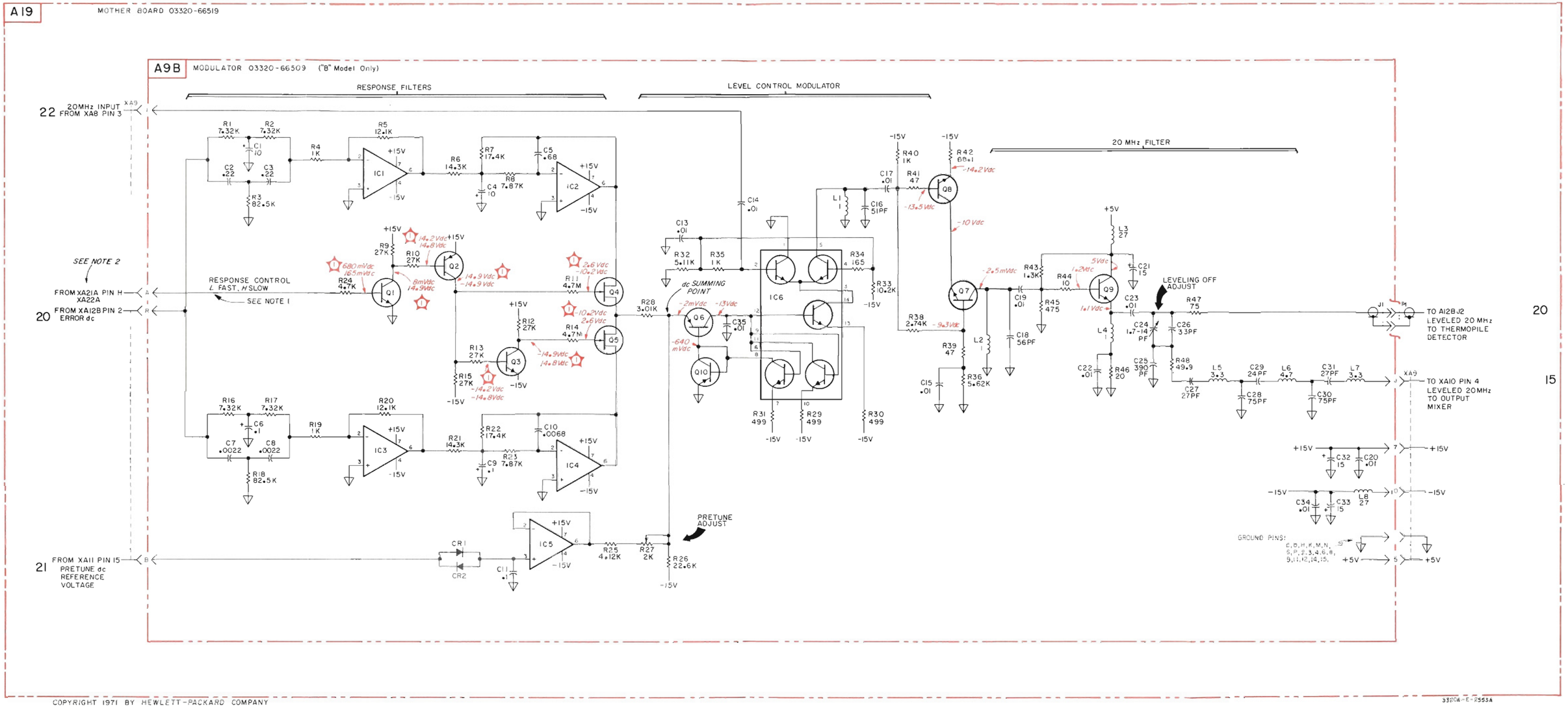
H Delay Flag — indicates the delay flag line should be +5 V when a delay flag signal is present.

L Data Valid — indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 2: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

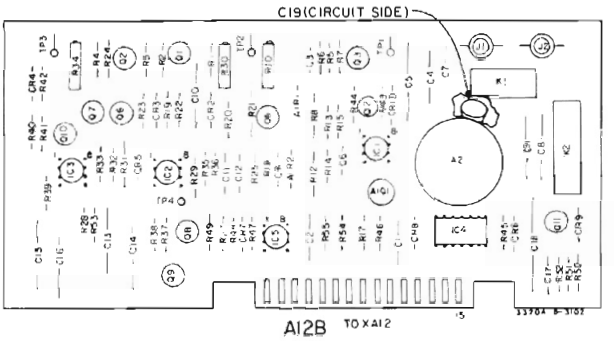
SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
2	XA21A	"B" Model — Standard, Options 001, 002, 006
4	XA22A	"B" Model — Option 004
9	XA22A	"B" Model — Option 007

(1) Top voltage for Response Slow.
Bottom voltage for Response Fast.
NOTE: In local mode response is always slow.



3320A-E-2553A

Figure 7-27. Modulator A9B, 3320B.



NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
2	XA21A	"B" Model – Standard, Options 001, 002, 006
4,5	XA22A	"B" Model – Option 004
9,10	XA22A	"B" Model – Option 007

NOTE 2: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicate the true state (signal present). Voltage levels for the H and L are:

H = + 5V
L = 0 V

Example:

H Delay Flag – indicates the delay flag line should be + 5V when a delay flag signal is present.

L Data Valid – indicates the data valid line should be 0 V when a data valid signal is present.

NOTE 3: IC4 is connected to function as a Monostable Flip-flop with negative edge triggering. The Q output will remain high for approximately 5 seconds. This IC is identical to Fairchild 9601.

1. Top voltage for Response Slow.
   Bottom voltage for Response Fast
   Note: in local mode response is always slow

2. Top voltage measured with BCD Inputs on A11 Assembly (Schematic 21) at 999%
   Bottom voltage measured with BCD Inputs on A11 Assembly at 000.
   See Schematic 21, Note 2.

3. Top voltage, Leveling ON.
   Bottom voltage, Leveling OFF.

4. Top voltage, normal operation.
   Bottom voltage, overload condition.

5. Typically + 2 V dc but must remain within ± .2 V dc with any change in amplitude setting with Leveling ON.

A19 MOTHER BOARD 03320-66519

A12B LEVELING 03320-66512 (Model "B" Only)

RESPONSE CONTROL H SLOW, L FAST — SEE NOTE 2

FROM XA21A PIN H XA22A — SEE NOTE 1

0-13 MHz FROM POWER AMPLIFIER

17 FROM A14J3

19 FROM A9BP1 LEVELED 20 MHz

LEVELING ON(>10Hz)

LEVELING OFF

CLOSED IN OVERLOAD CONDITION

LEVELING L ON(>10Hz),H OFF — SEE NOTE 2

H OVERLOAD

FROM XA21A PIN I XA22A — SEE NOTE 1

TO XA21A PIN M XA22A — SEE NOTE 1

21 FROM XA11 PIN 15 DC REFERENCE VOLTAGE

TO XA9B PIN R 19 DC ERROR

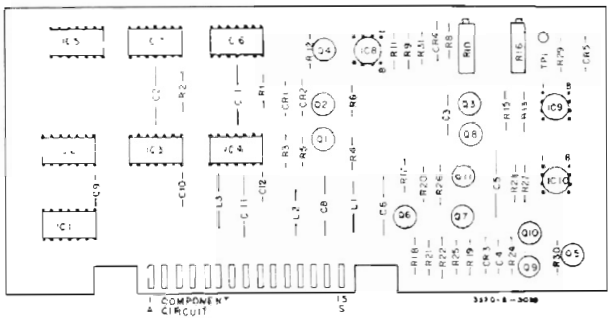
GND PINS 3,4,5,6

GND PINS 12,13

† SEE SECTION VIII, BACKDATING

20

Figure 7-28. Detector A12B, 3320B.



TO XA11 A11

hp Part No 03320-66511

Rev A

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
2	XA21A	"B" Model – Standard, Options 001, 002, 006
5	XA22A	"B" Model – Option 004
10	XA22A	"B" Model – Option 007

NOTE 2: Logic Signal levels for BCD INPUTS are indicated by the H preceding the BCD weighting. The H indicates the true state (signal present).

Voltage levels are:
H = +5 V
L = 0 V

The BCD INPUTS to the A11 Assembly varies with amplitude setting. The BCD INPUTS may be determined by subtracting the maximum amplitude setting (+26.99 for 50 Ω output) from the amplitude setting and then taking the 9's complement of the last three digits.

Example with + dBm setting:

max. amplitude	+26.99
subtract amplitude setting	-(+16.99)
	1000
9's complement of last 3 digits.	999

999 = BCD inputs to A11

The first digit (1 in these examples) controls the 10 dB step attenuator on the A15 assembly (Schematic 17).

Example with - dBm setting:

max. amplitude	+26.99
subtract amplitude setting	-(- 12.00)
	3899
9's complement	200

200 = BCD inputs to A11

NOTE 3: IC2, IC3 and IC4 are programmable decade counters. The outputs are preset to any state (number) by placing a low on the Count/Load input and parallel loading the desired data (BCD INPUT number) on the Data Inputs. The outputs will change to agree with the Data Inputs independently of the state of the clocks.

NOTE 4: IC6 and IC7 are connected to function as Monostable Flip–Flops with positive edge triggering. The Q output on IC6 will remain high for approximately 25 μsec. The Q output on IC7 will remain high for approximately 50 μsec. Identical to Fairchild Retriggerable Monostable Multivibrator 9601.

1. Top voltage with BCD INPUTS = 999, amplitude setting of + 16.99 dBm for 3320B with 50 Ω output.

   Bottom voltage with BCD INPUTS = 000 amplitude setting of + 17.00 dBm for 3320B with 50 Ω output.

2. Amount of capacitor, C3, discharge (Delay) varies with amplitude setting and may be observed with an oscilloscope:

   1. At maximum amplitude setting and at all levels 10 dB down from maximum amplitude, there is no discharge and the capacitor remains at + 10 V. Examples for 3320B with 50 Ω output:

Amplitude Setting	BCD INPUTS	Capacitor Discharge
+ 26.99	999	+ 10 V
+ 16.99	999	+ 10 V
+ 6.99	999	+ 10 V
- 3.01	999	+ 10 V
- 13.01	.	.
.	.	.
.	.	.
.	.	.

   2. Capacitor, C3, discharges from + 10 V to + 3.165 V at 9.99 dB down from maximum output. Or, any time the BCD INPUTS to A11 = 000.

3. For 3320B with 50 Ω output:
   + 10.000 V dc ± .002 V at + 16.99 dBm
   + 3.1659 V dc ± .0006 V at + 17.00 dBm

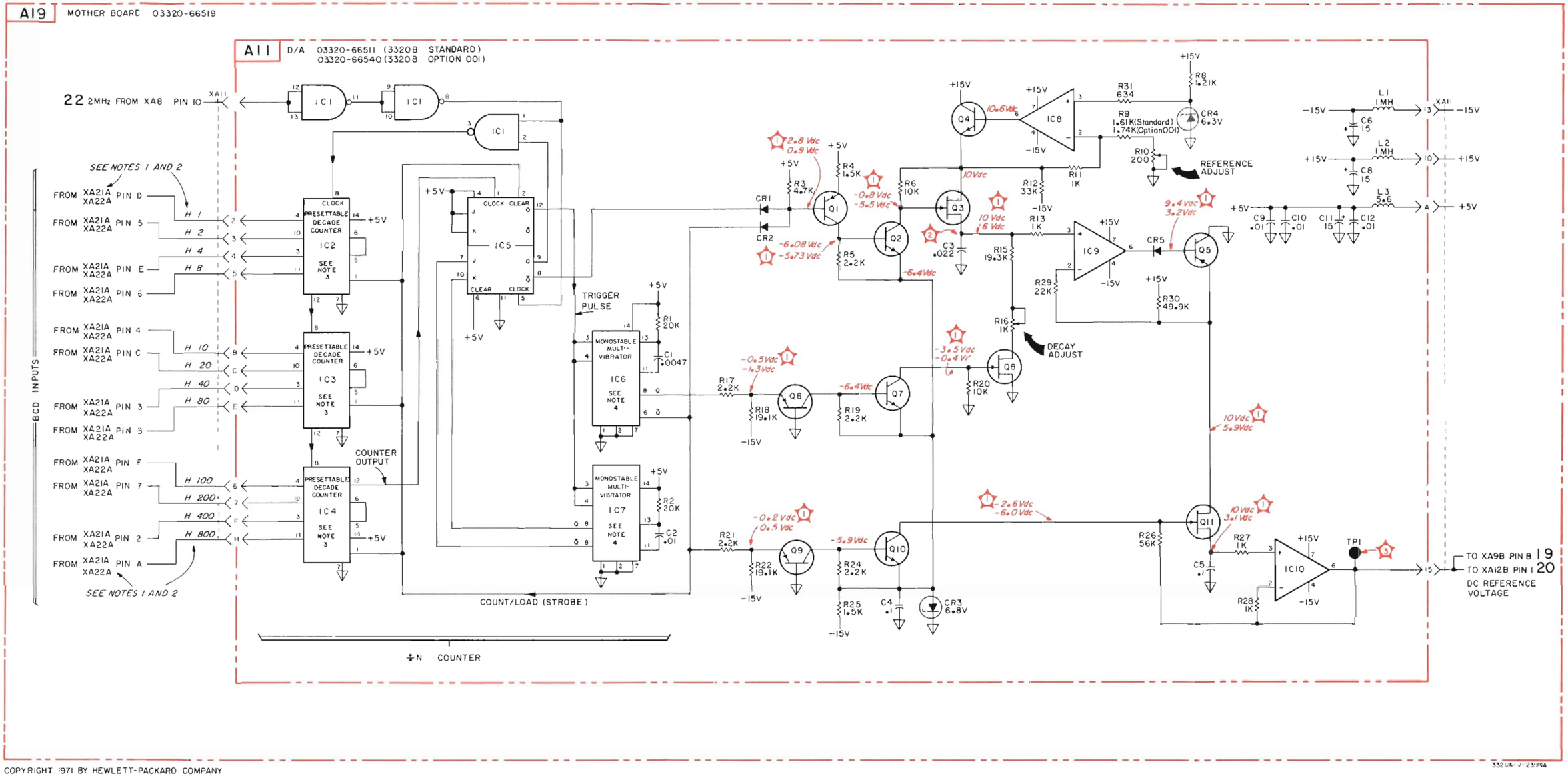
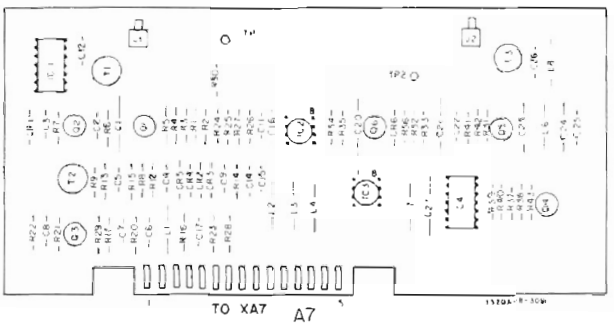
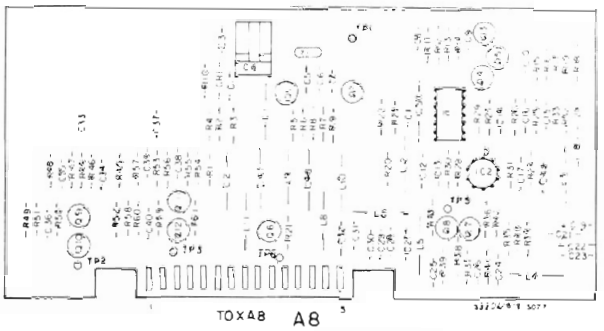


Figure 7-29. Amplitude Reference A11, 3320B.



TO XA7 A7

hp Part No. 03320-66507
Rev B



TO XA8 A8

hp Part No. 03320-66508
Rev B

NOTE 1: TP may be removed and a jack (-hp- Part No. 1250-1195) mounted in its place. A cable can be routed from this jack to the 3320A/B rear panel. This will provide an input to the varicaps for a dc voltage to control the frequency of the 20 MHz reference oscillator.

NOTE 2: Test point voltages measured with -hp- 180A Oscilloscope using 10:1 probe.
DC voltages measured with high input resistance, low capacitance voltmeter (-hp- 412A).

NOTE 3: DC voltages measured with no EXT. FREQ REF applied.

(1) A7TP1, > 6 V p-p when unlocked, see Reference Oscillator Adjustment procedure, Section V.

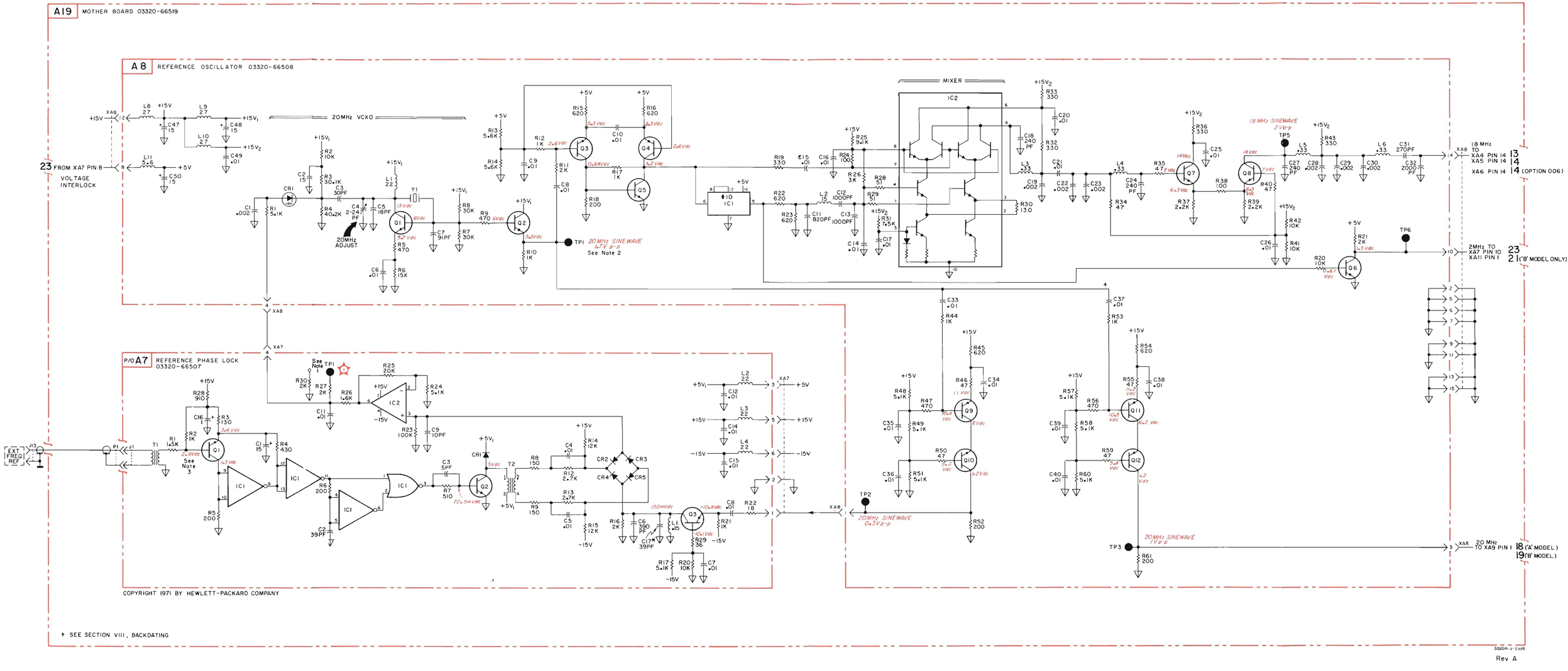
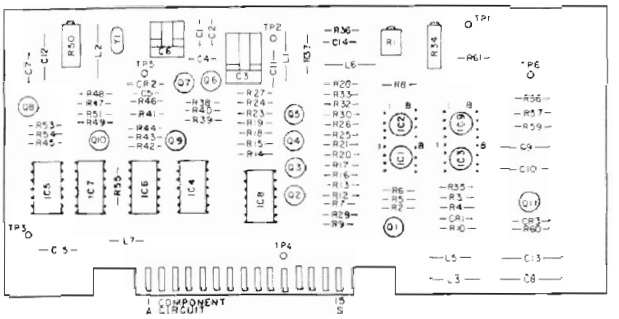


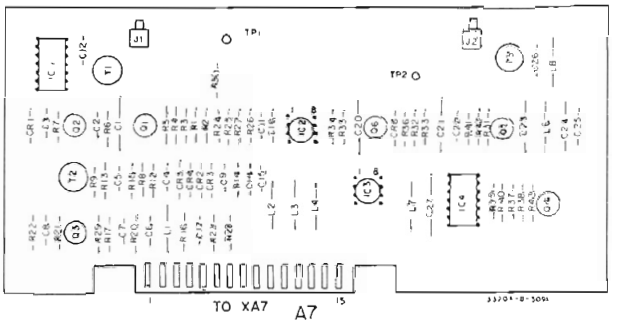
Figure 7-30. 20 MHz Reference Oscillator A8, Reference Phase Lock P/O A7.



TO XA1 A1

hp Part No. 03320-66501

Rev B



TO XA7 A7

hp Part No. 03320-66507

Rev B

NOTE 1: The following table lists the schematic number and connector number versus instrument type for controller board interfacing:

SCHEMATIC NUMBER	CONNECTOR NUMBER	INSTRUMENT TYPE
1	XA20A	"A" Model — Standard, Options 001, 002, 006
2	XA21A	"B" Model — Standard, Options 001, 002, 006
4,5	XA22A	"A" Model — Option 003 "B" Model — Option 004
7,9,10	XA22A	"B" Model — Option 007

NOTE 2: Logic signal levels are shown by the letters H or L preceding the name of the line. The H and L indicates the true state (signal present). Voltage levels for the H and L are:

H = +5 V
L = 0 V

Example:

H Delay Flag — indicates the delay flag line should be + 5 V when a delay flag signal is present.

L Data Valid — indicates the data valid line should be 0 V when a data valid signal is present.

1. Top voltage measured with 3320A/B in remote mode.
   Bottom voltage measured in local mode.
2. Top voltage measured with frequency controls set to 0000.
   Bottom voltage measured with frequency controls set to 1299.
3. Top voltage measured with respective VF input H.
   Bottom voltage measured with respective VF input L.
4. Top voltage measured with VERN IN (front panel)
   Bottom voltage measured with VERN OUT.

A19 MOTHER BOARD 03320-66519

A1 VERNIER 03320-66501

FROM XA20A PIN 19 XA21A XA22A
FROM XA20A PIN W XA21A XA22A
SEE NOTE 1 TO VERNIER POTENTIOMETER

DC REFERENCE ADJUST

PRETUNE FROM XA3 PIN 1

D/A CONVERTER

VERNIER OSCILLATOR

10KHz ADJUST

5KHz ADJUST

10MHz LEVEL ADJUST

QHz ADJUST

SEE NOTE 1 VERNIER ENABLE FROM XA20A PIN 18 XA21A XA22A

SEE NOTE 2 VF8

SEE NOTE 1 XA20A FROM XA21A PIN Z XA22A

SEE NOTE 1 XA20A FROM XA21A PIN 21 XA22A VF4

SEE NOTE 1 XA20A FROM XA21A PIN Y XA22A VF2

SEE NOTE 1 XA20A FROM XA21A PIN 20 XA22A VF1

VERNIER IN OUT (H IN, L OUT) XA20A FROM XA21A PIN X XA22A SEE NOTE 1

TO XA2 PIN 11 12 10kHz REFERENCE

GND PINS ARE 5, 6, 7, 8, 9, 11 & 12

P/O A7 REFERENCE PHASE DETECTOR 03320-66507

22 2MHz FROM XA8 PIN 10

VERNIER IN OUT (H IN, L OUT) XA20A FROM XA21A PIN X XA22A SEE NOTE 1

22 TO XA8 PIN 8

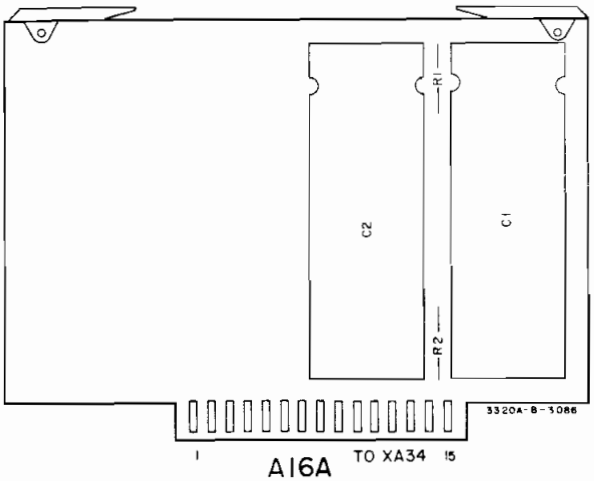
1 MHz

J11 1MHz OUT >220mV rms into 50Ω

SEE SECTION VIII, BACKDATING

3320A-J-2391A Rev A

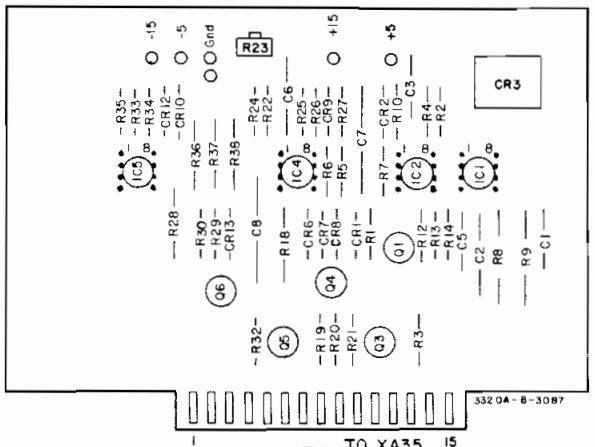
Figure 7-31. Vernier Reference Oscillator A1, Reference Phase Lock P/O A7.



A16A

hp Part No. 03320-66534

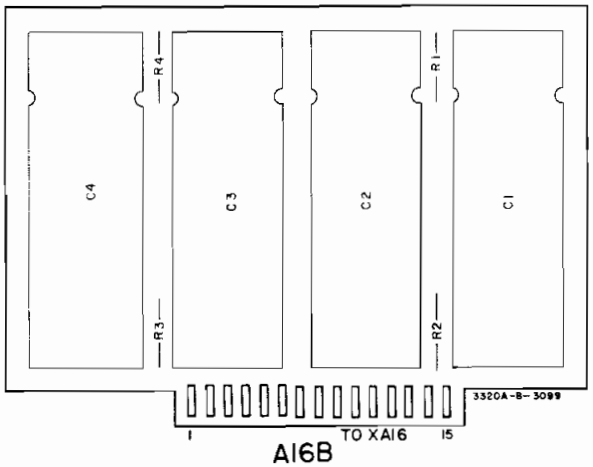
Rev A



A17A

hp Part No. 03320-66535

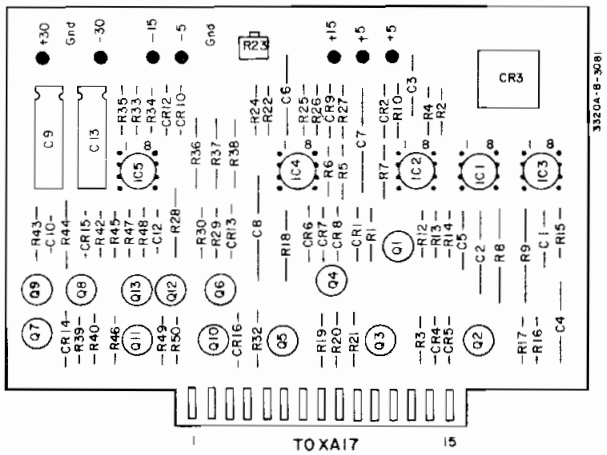
Rev A



A16B

hp Part No 03320-66516

Rev A



A17B

hp Part No. 03320-66517

Rev C

NOTE 1: Tolerances for power supply output voltages are as follows:

A17A/B pin 14 .....5.000 V dc to 5.300 V dc
A17A/B pin p .....5.000 V dc to 5.300 V dc
A17A/B pin L .....14.950 V dc to 15.050 V dc
A17A/B pin 8 ..... - 14.8 V dc to - 15.2 V dc
A17A/B pin 7 .....- 4.850 V dc to - 5.370 V dc
A17B pin B .....29.125 V dc to 30.875 V dc
A17B pin C ..... - 28.800 V dc to - 31.200 V dc

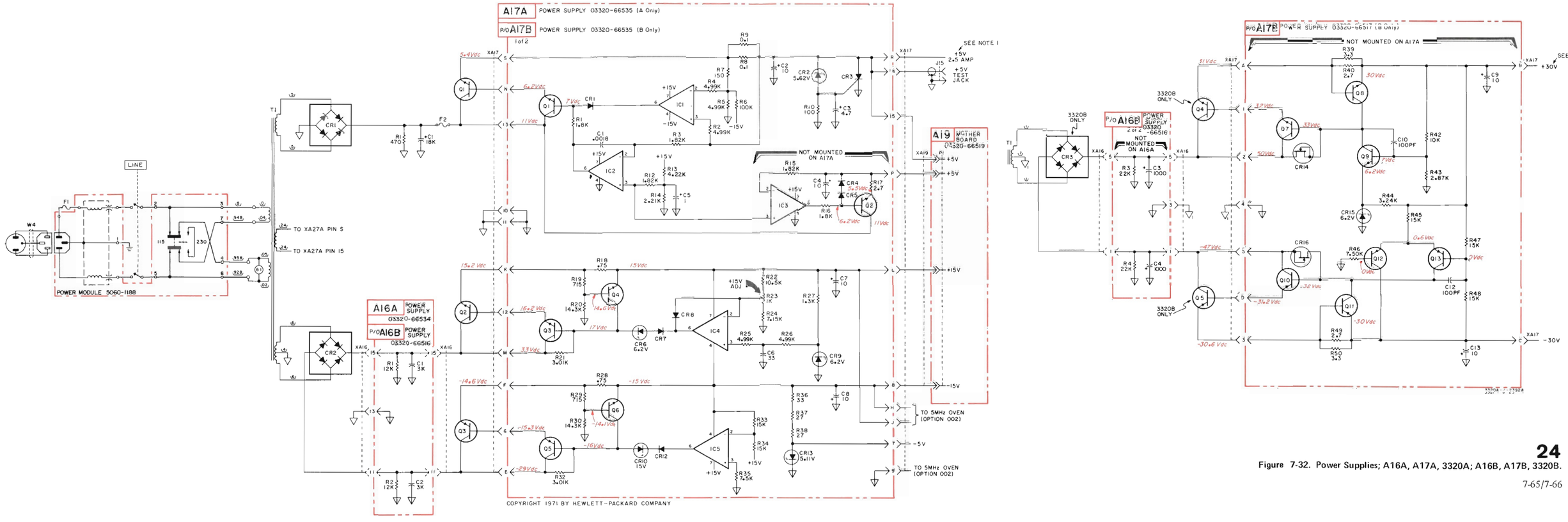


Figure 7-32. Power Supplies; A16A, A17A, 3320A; A16B, A17B, 3320B.

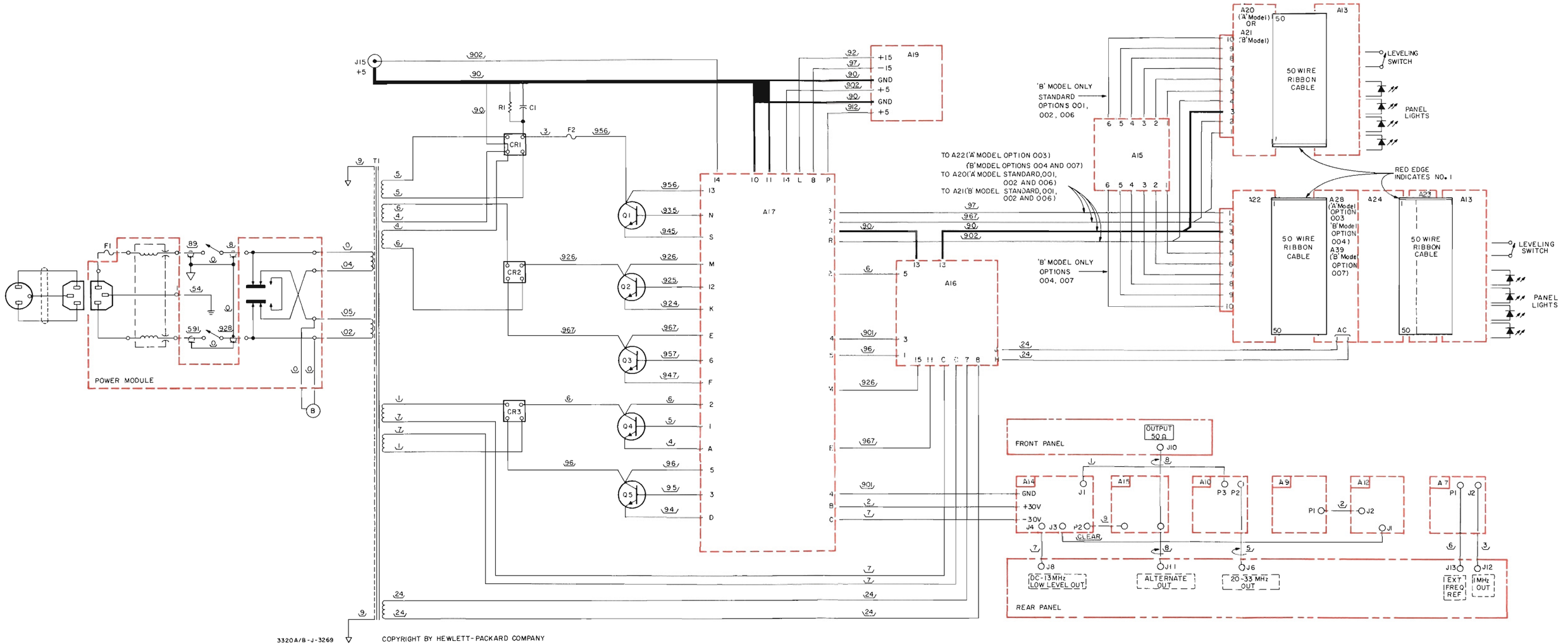


Figure 7-33. Wiring Diagram.

SECTION VIII
BACKDATING

8-1. INTRODUCTION.

8-2. This section contains backdating material which makes this manual applicable to instruments with serial numbers lower than the serial number listed on the title page. Each change has been keyed in the text or illustration with a dagger (†). This alerts the user to a change which may apply to his instrument. If this manual is to be used with an earlier instrument only, the changes which apply to that instrument may be entered into the text where applicable. Where component values in an instrument differ from the Replaceable Parts List, yet are not listed in the backdating section, the components should be replaced using the part number in this manual.

8-3. INSTRUMENT SERIAL NUMBER SEQUENCE.

8-4. Changes are listed in instrument serial number order (lower serial numbers first). However, when referring to the changes for a particular instrument, begin with the latest change and progress to the earliest change that applies to the serial number in question. Table 8-1 lists the serial numbers versus the changes.

8-5. CHANGE 1, FOR SERIAL NUMBERS 1121A-00110 AND BELOW (3320A), 1122A-00120 AND BELOW (3320B).

8-6. Make the following changes:

a. In table 6-1 and Figures 7-12 and 7-17 delete A23R3 and A23R4.

b. In Table 6-1 add the following components to the A8 assembly:

Designator	Description	Part Number
A8C41, C42, C43, C44	C: 0.01 μF 100 V	0150-0093
A8C45	C: 230 pF 500 V	0160-2005
A8C46	C: 680 pF 300 V	0140-0208
A8R62	R: fxd 1000 Ω 5%	0683-1025
A8R63	R: fxd 620 Ω 5%	0683-6215
A8R64, R68	R: fxd 47 Ω 5%	0683-4705
A8R65	R: fxd 470 Ω 5%	0683-4715
A8R66, R67, R69	R: fxd 5100 Ω 5%	0683-5125
A8R70	R: fxd 560 Ω 5%	0683-5615
A8R71	R: fxd 51 Ω 5%	0683-5105
A8Q13, Q14	TSTR: Si PNP	1853-0203
A8L7	Coil: RF	9140-0088
A8P1	Conn: RF	1250-1195
A8T1	TFMR: Toroid	9100-1362

c. In Table 6-1 make the following component changes:

Delete: A1C11, MP29
Add: A1R58, R: fxd 10 kΩ 1% 1/8 W 0757-0442
Change: A1R59 to R: fxd 10 kΩ 1% 1/8 W 0757-0442
MP31 to 03320-60102 1 each Assy: rear deck

d. In Figure 7-30 add the following circuitry to the A8 assembly:

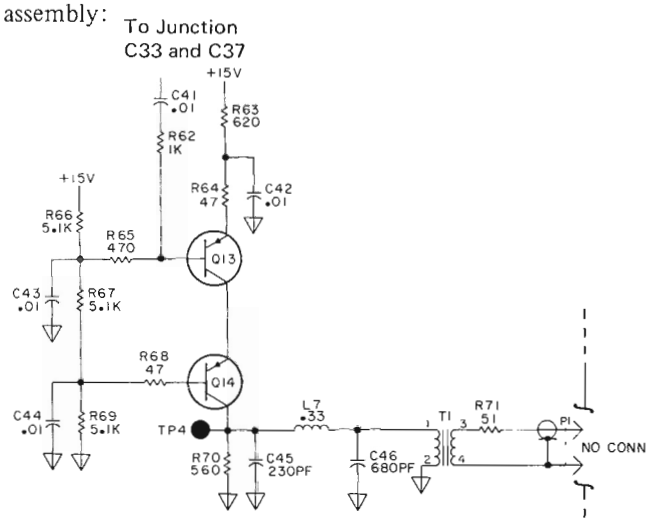


Table 8-1. Serial Number Index.

3320A		3320B	
Instrument Serial Number	Changes	Instrument Serial Number	Changes
1121A-00110 and below	1	1122A-00120 and below	1
1138A-00135 and below	4, 5	See Paragraph 8-7	2
1138A-00185 and below	7	See Paragraph 8-9	3
1138A-00275 and below	9	1139A-00200 and below	4
		1139A-00250 and below	5
		1139A-00340 and below	6
		1139A-00540 and below	7
		1139A-00590 and below	8
		1319A-00690 and below	9

e. In Figure 7-31 make the following circuit changes on the A1 assembly:

Delete: A1C11, A1R59

Add: A1R58 and A1R59, 10 kΩ, from pin 2 and pin 3 respectively of IC9 to ground

8-7. CHANGE 2, 3320B.

8-8. Prior to the 15 line GPIB, Option 007, the 3320B contained a 10 line GPIB, Option 005. This manual includes information for the Option 007. For information concerning the Option 005, order the Manual Insert Sheet 3320B-H18 or contact your local Sales and Service Office.

8-9. CHANGE 3, 3320B.

8-10. Change 3 is designed to improve the 3320B harmonic distortion and should be incorporated in all 3320B's.

a. In Table 6-1 the following component changes have been made:

Delete: A14C17, A14C28, C: fxd cer 0.1 μF, 0150-0084

b. In Figure 7-25 the following circuitry changes have been made:

Delete: A14C17, A14C28

Change: A15Q9A and A14Q9B to A14Q16 and A14Q9 respectfully.
A14R22 to 49.9 Ω
A14R56 to 49.9 Ω

8-11. CHANGE 4, FOR SERIAL NUMBERS 1138A-00135 AND BELOW (3320A), 1139A-00200 AND BELOW (3320B).

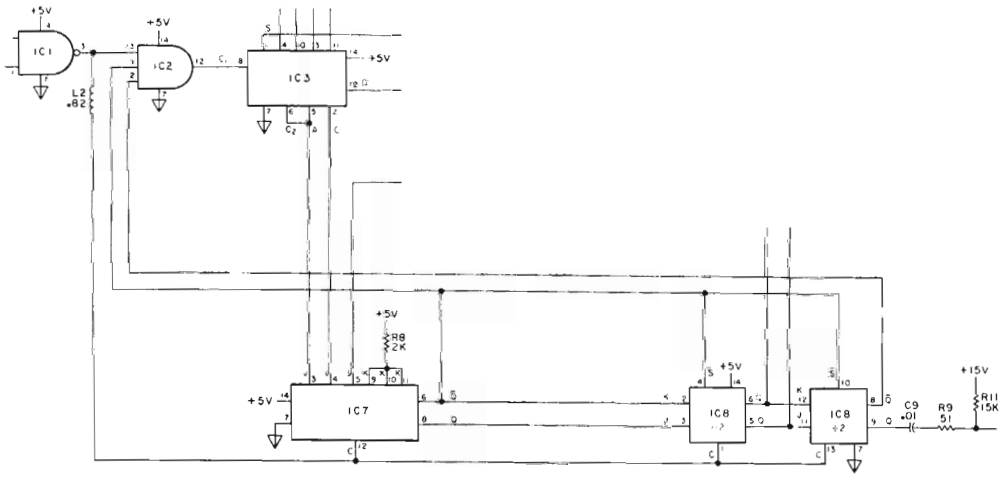
8-12. Make the following changes:

a. In Table 6-1 make the following component changes:

Add: A2L2, coil/choke: 0.82 μH, 9100-1614
A2R8, R: fxd comp 2000 ohm, 0683-2025

Change: A2CR1, A2CR2, A2CR3, A2CR4 to Diode: Si 50 mA 30 wv, 1901-0040.
A2IC2 to IC: TTL Triple 3-input AND Gate, 1820-0372.
A2IC8 to IC: Digital TTL Dual J-K FF, 1820-0451
A2R9 to R: fxd comp, 51 Ω, 0683-5105

b. In Figure 7-20 make the following circuitry changes:



8-13. CHANGE 5, FOR SERIAL NUMBERS 1138A-00135 AND BELOW (3320A), 1139A-00250 AND BELOW (3320B).

8-14. In Table 6-1 and Figure 7-21 make the following component changes:

Change:
A4R8 to 820 Ω, 0683-8215
A4R9 to 470 Ω, 0683-4715
A7IC1 to 1820-0923

8-15. CHANGE 6, FOR SERIAL NUMBERS 1139A-00340 AND BELOW (3320B).

8-16. In Table 6-1 and Figure 7-28 A12BC19 C: fxd 18 pF 100 V 0160-2322 has been added. This increases the output amplitude accuracy and stabilization. See Figure 7-28 for location.

8-17. CHANGE 7, FOR SERIAL NUMBERS 1138A-00185 AND BELOW (3320A), 1139A-00540 AND BELOW (3320B).

8-18. The A13A/B Switch Assembly in these instruments are not designed for the replacement of individual switch wafers and detents. If the A13A/B assembly fails in these instruments it is necessary to replace the front panel assembly with the new front panel assembly (MP20) listed in Table 6-1. The front panel assembly listed in Table 6-1 contains the latest A13A/B Switch Assembly. This assembly is designed for replacement of individual switch components. A disassembly/assembly procedure for the front panel assembly is outlined in Section V, Paragraph 5-49.

8-19. CHANGE 8, FOR SERIAL NUMBERS 1139A-00590 AND BELOW (3320B).

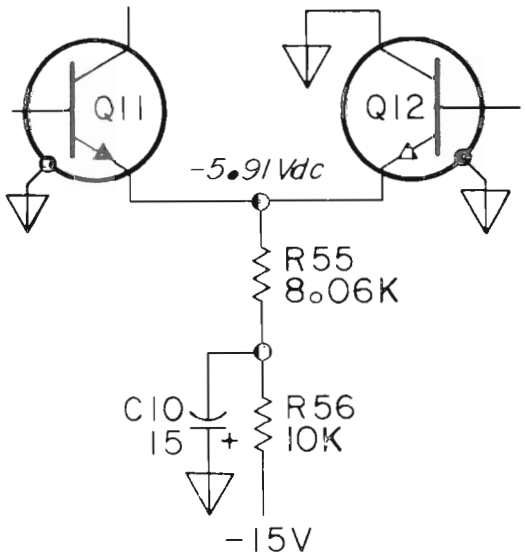
8-20. In Table 6-1 delete Cable Assembly 03320-61618.

8-21. CHANGE 9, FOR SERIAL NUMBERS 1138A-00275 AND BELOW (3320A), 1319A-00690 AND BELOW (3320B).

8-22. Make the following changes:

a. In Table 6-1 delete A3C26 and A3R85. Change A3R55 to R: fxd 8060 Ω 1% 0698-4473.

b. In Figure 7-19 Change A3Q11 and A3Q12 circuitry as follows:



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	Cemco, 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	Croven, 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	Alden 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, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube 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	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins EngineeringCo.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	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	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taruus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex 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	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	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.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	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.
06980	Varian Assoc. Etmac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07149	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	Blinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	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.
08806	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
09795	Pennsylvania Florocarbon Clifton 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.
11236	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.
11534	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.
12361	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	Elmar 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
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermolloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	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 Dublier Electric Corp	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sphere 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	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco 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.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	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	Tranex 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.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	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	Concoa	Baldwin Park, Cal.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fansteel 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.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/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	Stanwyck 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	Shallcross 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.
58474	Superior Elect. Co.	Bristol, Conn.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	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	Wittek Mfg. Co.	Chicago, Ill.
66346	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	Quincey, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc 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.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto 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.
72619	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	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Cal.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	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.
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL 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
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Cal.
73957	Groove-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronic Corp.	Danbury, 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	Littlefuse, 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	Phaostran 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.
77969	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.
78452	Thompson-Bremer & 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
78790	Transformer Engineers	San Gabriel, Cal.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, 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 semi-conductor device, any manufacturer.	
80207	Unimax 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	Arco 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
81030	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	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	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.
82116	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	Magurie Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rolton Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT 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	Hubbell Corp.	Mundelein, 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.
83594	Burroughs 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	Loyd Scruggs Co.	Festus, Mo.
83942	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
94870	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Cal.
85474	R.M. Bracamonte & Co.	San Francisco, Cal.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Cal.
87034	Marco Industries	Anaheim, Cal.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Cal.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89479	Security Co.	Detroit, Mich.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Cal.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91673	Epiphone Inc.	New York, N.Y.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Cal.
91886	Malco Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Pallisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Diania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind. Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Cal.
98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaronech, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Cal.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99957	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.

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

SALES & SERVICE OFFICES

UNITED STATES

ALABAMA
P.O. Box 4207
2003 Byrd Spring Road S.W.
Huntsville 35802
Tel: (205) 881-4591
TWX: 810-726-2204

ARIZONA
2336 E. Magnolia St.
Phoenix 85034
Tel: (602) 244-1361
TWX: 910-951-1330

5737 East Broadway
Tucson 85711
Tel: (602) 298-2313
TWX: 910-952-1162

CALIFORNIA
1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000
TWX: 910-592-1288

3939 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

6305 Arizona Place
Los Angeles 90045
Tel: (213) 649-2511
TWX: 910-328-6148

1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-6500
TWX: 910-373-1280

2220 Watt Ave.
Sacramento 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
San Diego 92123
Tel: (714) 279-3200
TWX: 910-335-2000

COLORADO
7965 East Prentice
Englewood 80110
Tel: (303) 771-3455
TWX: 910-935-0705

CONNECTICUT
12 Lunar Drive
New Haven 06525
Tel: (203) 389-6551
TWX: 710-465-2029

FLORIDA
P.O. Box 24210
2806 W. Oakland Park Blvd.
Ft. Lauderdale 33307
Tel: (305) 731-2020
TWX: 510-955-4099

P.O. Box 13910
6177 Lake Ellenor Dr.
Orlando, 32809
Tel: (305) 859-2900
TWX: 810-850-0113

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

HAWAII
2875 So. King Street
Honolulu 96814
Tel: (808) 955-4455

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-3613

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

LOUISIANA
P.O. Box 856
3239 Williams Boulevard
Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel: (301) 944-5400
TWX: 710-862-9157

P.O. Box 1648
2 Choke Cherry Road
Rockville 20850
Tel: (301) 948-6370
TWX: 710-828-9684

MASSACHUSETTS
32 Hartwell Ave.
Lexington 02173
Tel: (617) 861-8960
TWX: 710-326-6904

MICHIGAN
21840 West Nine Mile Road
Southfield 48075
Tel: (313) 353-9100
TWX: 810-224-4882

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

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

148 Weldon Parkway
Maryland Heights 63043
Tel: (314) 567-1455
TWX: 910-764-0830

***NEVADA**
Las Vegas
Tel: (702) 382-5777

NEW JERSEY
W. 120 Century Road
Paramus 07652
Tel: (201) 265-5000
TWX: 710-990-4951

1060 N. Kings Highway
Cherry Hill 08034
Tel: (609) 667-4000
TWX: 710-892-4945

NEW MEXICO
P.O. Box 8366
Station C
6501 Lomas Boulevard N.E.
Albuquerque 87108
Tel: (505) 265-3713
TWX: 910-989-1665

156 Wyatt Drive
Las Cruces 88001
Tel: (505) 526-2485
TWX: 910-983-0550

NEW YORK
6 Automation Lane
Computer Park
Albany 12205
Tel: (518) 458-1550
TWX: 710-441-8270

1219 Campville Road
Endicott 13760
Tel: (607) 754-0050
TWX: 510-252-0890

New York City
Manhattan, Bronx
Contact Paramus, NJ Office
Tel: (201) 265-5000
Brooklyn, Queens, Richmond
Contact Woodbury, NY Office
Tel: (516) 921-0300

82 Washington Street
Poughkeepsie 12601
Tel: (914) 454-7330
TWX: 510-248-0012

39 Saginaw Drive
Rochester 14623
Tel: (716) 473-9500
TWX: 510-253-5981

5858 East Molloy Road
Syracuse 13211
Tel: (315) 454-2486
TWX: 710-541-0482

1 Crossways Park West
Woodbury 11797
Tel: (516) 921-0300
TWX: 510-221-2168

NORTH CAROLINA
P.O. Box 5188
1923 North Main Street
High Point 27262
Tel: (919) 885-8101
TWX: 510-926-1516

OHIO
25575 Center Ridge Road
Cleveland 44145
Tel: (216) 835-0300
TWX: 810-427-9129

3460 South Dixie Drive
Dayton 45439
Tel: (513) 298-0351
TWX: 810-459-1925

1120 Morse Road
Columbus 43229
Tel: (614) 846-1300

OKLAHOMA
P.O. Box 32008
Oklahoma City 73132
Tel: (405) 721-0200
TWX: 910-830-6862

OREGON
17890 SW Boones Ferry Road
Tualatin 97062
Tel: (503) 620-3350
TWX: 910-467-8714

PENNSYLVANIA
2500 Moss Side Boulevard
Monroeville 15146
Tel: (412) 271-0724
TWX: 710-797-3650

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel: (215) 265-7000
TWX: 510-660-2670

RHODE ISLAND
873 Waterman Ave.
East Providence 02914
Tel: (401) 434-5535
TWX: 710-381-7573

***TENNESSEE**
Memphis
Tel: (901) 274-7472

TEXAS
P.O. Box 1270
201 E. Arapaho Rd.
Richardson 75080
Tel: (214) 231-6101
TWX: 910-867-4723

P.O. Box 27409
6300 Westpark Drive
Suite 100
Houston 77027
Tel: (713) 781-6000
TWX: 910-881-2645

231 Billy Mitchell Road
San Antonio 78226
Tel: (512) 434-4171
TWX: 910-871-1170

UTAH
2890 South Main Street
Salt Lake City 84115
Tel: (801) 487-0715
TWX: 910-925-5681

VIRGINIA
P.O. Box 6514
2111 Spencer Road
Richmond 23230
Tel: (703) 285-3431
TWX: 710-956-0157

WASHINGTON
433-108th N.E.
Bellevue 98004
Tel: (206) 454-3971
TWX: 910-443-2303

***WEST VIRGINIA**
Charleston
Tel: (304) 768-1232

WISCONSIN
9431 W. Beloit Road
Suite 117
Milwaukee 53227
Tel: (414) 541-0550

FOR U.S. AREAS NOT LISTED:
Contact the regional office nearest you: Atlanta, Georgia . . . North Hollywood, California . . . Paramus, New Jersey . . . Skokie, Illinois. Their complete addresses are listed above.

*Service Only

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd.
11748 Kingsway Ave.
Edmonton
Tel: (403) 452-3670
TWX: 610-831-2431

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd.
4519 Canada Way
North Burnaby 2
Tel: (604) 433-8213
TWX: 610-922-5059

MANITOBA
Hewlett-Packard (Canada) Ltd.
513 Century St.
Winnipeg
Tel: (204) 786-7581
TWX: 610-671-3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
2745 Dutch Village Rd.
Suite 206
Halifax
Tel: (902) 455-0511
TWX: 610-271-4482

ONTARIO
Hewlett-Packard (Canada) Ltd.
1785 Woodward Dr.
Ottawa 3
Tel: (613) 255-6180, 255-6530
TWX: 610-562-8968

Hewlett-Packard (Canada) Ltd.
50 Galaxy Blvd.
Rexdale
Tel: (416) 677-9611
TWX: 610-492-4246

QUEBEC
Hewlett-Packard (Canada) Ltd.
275 Hymus Boulevard
Pointe Claire
Tel: (514) 697-4232
TWX: 610-422-3022
Telex: 01-20607

FOR CANADIAN AREAS NOT LISTED:
Contact Hewlett-Packard (Canada) Ltd. in Pointe Claire, at the complete address listed above.

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina S.A.C.e.I
Lavalle 1171 - 3°
Buenos Aires
Tel: 35-0436, 35-0627, 35-0341
Telex: 012-1009
Cable: HEWPACK ARG

BRAZIL
Hewlett-Packard Do Brasil I.E.C. LTDA.
Rua Frei Caneca 1119
01307-**Sao Paulo** - 3, SP
Tel: 288-7111, 287-5858
Cable: HEWPACK Sao Paulo

Hewlett-Packard Do Brasil I.E.C. LTDA.
Praca Dom Feliciano 78
Salas 806/808
9000-Porto Alegre RS
Rio Grande do Sul (RS)-Brasil
Tel: 25-8470
Cable: HEWPACK Porto Alegre

Hewlett-Packard Do Brasil I.E.C. LTDA.
Rua da Matriz 29
2000-**Rio de Janeiro**, GB
Tel: 266-2643
Cable: HEWPACK Rio de Janeiro

BOLIVIA
Stambuk & Mark (Bolivia) LTDA.
Av. Mariscal, Santa Cruz 1342
La Paz
Tel: 40626, 53163, 52421
Telex: 3560014
Cable: BUKMAR

CHILE
Héctor Calcagni y Cia, Ltda.
Casilla 16.475
Santiago
Tel: 423 96
Cable: CALCAGNI Santiago

COLOMBIA
Instrumentación
Henrik A. Langebaek & Kier S.A.
Carrera 7 No. 48-59
Apartado Aéreo 6287
Bogota, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota
Telex: 44400INSTCO

COSTA RICA
Lic. Alfredo Gallegos Gurdián
Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San José

ECUADOR
Laboratorios de Radio-Ingenieria
Calle Guayaquil 1246
Post Office Box 3199
Quito
Tel: 212-496; 219-185
Cable: HORVATH Quito

EL SALVADOR
Electronic Associates
Apartado Postal 1682
Centro Comercial Gigante
San Salvador, El Salvador C.A.
Paseo Escalon 4649-4° Piso
Tel: 23-44-60, 23-32-37
Cable: ELECAS

GUATEMALA
IPESA
5a via 2-01, Zona 4
Guatemala City
Tel: 63-6-27 & 64-7-86
Telex: 4192 TELTRO GU

MEXICO
Hewlett-Packard Mexicana, S.A. de C.V.
Adolfo Prieto 622
Col. del Valle
Mexico 12, D.F.
Tel: 543-4232; 523-1874
Telex: 017-74-507

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable: ROTERAN Managua

PANAMA
Electrónico Balboa, S.A.
P.O. Box 4929
Ave. Manuel Espinosa No. 13-50
Bldg. Alina
Panama City
Tel: 230833
Telex: 3481003, Curundu, Canal Zone
Cable: ELECTRON Panama City

PARAGUAY
Z.J. Melamed S.R.L.
Division: Aparatos y Equipos Médicos
Salón de Exposición y Escritorio:
Chile 482
Edificio Victoria—Planta Baja
Asuncion, Paraguay
Tel: 4-5069, 4-6272
Cable: RAMEL

PERU
Compañia Electro Médica S.A.
Ave. Enrique Canaual 312
San Isidro
Casilla 1030
Lima
Tel: 22-3900
Cable: ELMED Lima

PUERTO RICO
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de Leon 154
Pda. 3-PTA de Tierra
San Juan 00906
Tel: (809) 725-3342, 722-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA
Hewlett-Packard De Venezuela C.A.
Apartado 50933
Caracas
Tel: 71.88.05, 71.88.69, 71.99.30
Cable: HEWPACK Caracas
Telex: 21146 HEWPACK

FOR AREAS NOT LISTED,

CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

EUROPE

AUSTRIA
Hewlett-Packard Ges.m.b.H
Handelska 52/3
P.O. Box 7
A-1205 **Vienna**
Tel: (0222) 33 66 06 to 09
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1
B-1170 **Brussels**
Tel: (02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494 paloben bru

DENMARK
Hewlett-Packard A/S
Datavej 38
DK-3460 **Birkerod**
Tel: (01) 81 66 40
Cable: HEWPACK AS
Telex: 166 40 hp as

Hewlett-Packard A/S
Torvet 9
DK-8600 **Silkeborg**
Tel: (06) 82-71-66
Telex: 166 40 hp as
Cable: HEWPACK AS

FINLAND
Hewlett-Packard Oy
Bulevardi 26
P.O. Box 12185
SF-00120 **Helsinki** 12
Tel: (90) 13730
Cable: HEWPACKOY Helsinki
Telex: 12-15363 hel

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boîte Postale No. 6
F-91401 **Orsay**
Tel: (1) 907 78 25
Cable: HEWPACK Orsay
Telex: 60048

Hewlett-Packard France
4 Quai des Etroits
F-69321 **Lyon Cedex** 1
Tel: (78) 42 63 45
Cable: HEWPACK Lyon
Telex: 31617

Hewlett-Packard France
29 rue de la Gare
F-31700 **Blagnac**
Tel: (61) 85 82 29
Telex: 51957

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 **Frankfurt** 56
Tel: (0611) 50 04-1
Cable: HEWPACKSA Frankfurt
Telex: 41 32 49 fra

Hewlett-Packard GmbH
Vertriebsbüro Böblingen
Herrenbergerstrasse 110
D-7030 **Böblingen**, Württemberg
Tel: (07031) 66 72 87
Cable: HEPAK Böblingen
Telex: 72 65 739 bbn

Hewlett-Packard GmbH
Vertriebsbüro Düsseldorf
Vogelsanger Weg 38
D-4000 **Düsseldorf**
Tel: (0211) 63 80 31/35
Telex: 85/86 533 hpdd d

Hewlett-Packard GmbH
Vertriebsbüro Hamburg
Wendenstr. 23
D-2000 **Hamburg** 1
Tel: (0411) 24 05 51/52
Cable: **HEWPACKSA Hamburg**
Telex: 21 63 032 hphh d

Hewlett-Packard GmbH
Vertriebsbüro München
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel: (0811) 601 30 61/7
Telex: 52 49 85
Cable: HEWPACKSA München

(**West Berlin**)
Hewlett-Packard GmbH
Vertriebsbüro Berlin
Wilmersdorfer Strasse 113/114
D-1000 **Berlin W.** 12
Tel: (0311) 3137046
Telex: 18 34 05 hpbln d

GREECE
Kostas Karayannis
18, Ermou Street
GR-**Athens** 126
Tel: 3230-303
Cable: RAKAR Athens
Telex: 21 59 62 rkar gr

IRELAND
Hewlett-Packard Ltd.
224 Bath Road
GB-**Slough**, SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
The Graftons
Stamford New Road
Altrincham, Cheshire, England
Tel: (061) 928-8626
Telex: 668068

ITALY
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
I-20124 **Milan**
Tel: (2) 6251 (10 lines)
Cable: HEWPACKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Piazza Marconi
I-00144 **Rome** - Eur
Tel: (6) 5912544/5, 5915947
Cable: HEWPACKIT Rome
Telex: 61514

Hewlett-Packard Italiana S.p.A.
Vicolo Pastori, 3
I-35100 **Padova**
Tel: (49) 66 40 62
Telex: 32046 via Milan

Hewlett-Packard Italiana S.p.A.
Via Colli, 24
I-10129 **Turin**
Tel: (11) 53 82 64
Telex: 32046 via Milan

LUXEMBURG
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1
B-1170 **Brussels**
Tel: (03/02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

NETHERLANDS
Hewlett-Packard Benelux, N.V.
Weerdestein 117
P.O. Box 7825
NL-**Amsterdam**, Z 11
Tel: (020) 42 77 77
Cable: PALOBEN Amsterdam
Telex: 13 216 hepa nl

NORWAY
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 **Haslum**
Tel: (02) 53 83 60
Telex: 16621 hpnas n

PORTUGAL
Telectra-Empresa Técnica de
Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-**Lisbon** 1
Tel: (19) 68 60 72
Cable: TELECTRA Lisbon
Telex: 1598

SPAIN
Hewlett-Packard Española, S.A.
Jerez No 8
E-**Madrid** 16
Tel: 458 26 00
Telex: 23515 hpe

Hewlett-Packard Española, S.A.
Milanesado 21-23
E-**Barcelona** 17
Tel: (3) 203 62 00
Telex: 52603 hpbe e

SWEDEN
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-161 20 **Bromma** 20
Tel: (08) 98 12 50
Cable: MEASUREMENTS
Stockholm
Telex: 10721

Hewlett-Packard Sverige AB
Hagakersgatan 9C
S-431 41 **Mölndal**
Tel: (031) 27 68 00/01
Telex: 21 312 hpmindl s

SWITZERLAND
Hewlett Packard (Schweiz) AG
Zürcherstrasse 20
P.O. Box 64
CH-8952 Schlieren **Zurich**
Tel: (01) 98 18 21/24
Cable: HPAG CH
Telex: 53933 hpag ch

Hewlett-Packard (Schweiz) AG
9, Chemin Louis-Pictet
CH-1214 Vernier—**Geneva**
Tel: (022) 41 4950
Cable: HEWPACKSA Geneva
Telex: 27 333 hpsa ch

TURKEY
Telekom Engineering Bureau
Saglik Sok No. 15/1
Ayaspasa-Beyoglu
P.O. Box 437 Beyoglu
TR-**Istanbul**
Tel: 49 40 40
Cable: TELEMATION Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
224 Bath Road
GB-**Slough**, SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
GB-**Altrincham**, Cheshire
Tel: (061) 928-8626
Telex: 668068

Hewlett-Packard Ltd's registered address for V.A.T. purposes only:
70, Finsbury Pavement
London, EC2A1SX
Registered No: 69057

SOCIALIST COUNTRIES PLEASE CONTACT:
Hewlett-Packard Ges.m.b.H.
Handelskai 52/3
P.O. Box 7
A-1205 **Vienna**
Ph: (0222) 33 66 06 to 09
Cable: HEWPACK Vienna
Telex: 75923 hewpak a

ALL OTHER EUROPEAN COUNTRIES CONTACT:
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
P.O. Box 85
CH-1217 Meyrin 2 **Geneva**
Switzerland
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2 24 86

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra Empresa Técnia
de Equipamentos Eléctricos
SAR
Rua de Barbosa Rodrigues
42-1°
Box 6487
Luanda
Cable: TELECTRA Luanda

AUSTRALIA
Hewlett-Packard Australia
Pty. Ltd.
22-26 Weir Street
Glen Iris, 3146
Victoria
Tel: 20-1371 (6 lines)
Cable: HEWPARD Melbourne
Telex: 31 024

Hewlett-Packard Australia
Pty. Ltd.
Corner Bridge & West Streets
Pymble, New South Wales, 2073
Tel: 449 6566
Cable: HEWPARD Sydney
Telex: 21561

Hewlett-Packard Australia
Pty. Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 65-2366
Cable: HEWPARD Adelaide

Hewlett Packard Australia
Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
Perth, W.A. 6000
Tel: 25-6800
Cable: HEWPARD Perth

Hewlett-Packard Australia
Pty. Ltd.
10 Woolley Street
P.O. Box 191
Dickson A.C.T. 2602
Tel: 49-8194
Cable: HEWPARD Canberra ACT

Hewlett-Packard Australia
Pty. Ltd.
2nd Floor, 49 Gregory Terrace
Brisbane, Queensland, 4000
Tel: 29 1544

CEYLON
United Electricals Ltd.
P.O. Box 681
60 Park St.
Colombo 2
Tel: 26696
Cable: HOTPOINT Colombo

CYPRUS
Kypronics
19 Gregorios & Xenopoulos Road
P.O. Box 1152
CY-**Nicosia**
Tel: 45628/29
Cable: KYPRONKS PANDEHIS

ETHIOPIA
African Salespower & Agency
Private Ltd., Co.
P. O. Box 718
58/59 Cunningham St.
Addis Ababa
Tel: 12285
Cable: ASACO Addisababa

HONG KONG
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511, Prince's Building 15th Floor
10, Chater Road
Hong Kong
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd.
Kasturi Buildings
Jamshedji Tata Rd.
Bombay 400 020
Tel: 29 50 21
Telex: 3751
Cable: BLUEFROST

Blue Star Ltd.
Band Box House
Prabhadevi
Bombay 400 025
Tel: 45 73 01
Telex: 3751
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
Kampur 208 001
Tel: 6 88 82
Cable: BLUESTAR

Blue Star, Ltd.
7 Hare Street
P.O. Box 506
Calcutta 700 001
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House,
34 Ring Road
Lajpat Nagar
New Delhi 110 024
Tel. 62 32 76
Telex: 463
Cable: BLUESTAR

Blue Star, Ltd.
Blue Star House
11/11A Magarath Road
Bangalore 560 025
Tel: 51473
Telex: 430
Cable: BLUESTAR

Blue Star, Ltd.
1-1-117/1
Sarojini Devi Road
Secunderabad 500 003
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST
Telex: 459

Blue Star, Ltd.
23/24 Second Line Beach
Madras 600 001
Tel: 2 39 55
Telex: 379
Cable: BLUESTAR

Blue Star, Ltd.
1B Kaiser Bungalow
Dindli Road
Jamshedpur 831 001
Tel: 38 04
Cable: BLUESTAR
Telex: 240

INDONESIA
Bah Bolon Trading Coy. N.V.
Djalah Merdeka 29
Bandung
Tel: 4915; 51560
Cable: ILMU
Telex: 08-809

IRAN
Multicorp International Ltd.
Avenue Soraya 130
P.O. Box 1212
IR-Teheran
Tel: 83 10 35-39
Cable: MULTICORP Tehran
Telex: 2893 MCI TN

ISRAEL
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Aminadav Street
Tel-Aviv
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: 33569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku, **Tokyo**
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
Osaka
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
No. 24 Kamisasazima-cho
Nakamura-ku, **Nagoya City**
Tel: (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2-4-2 Shinohara-Kita
Kohoku-ku
Yokohama 222
Tel: 045-432-1504
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.
Rm. 603 3,
2-Chome
IZUMI-CHO,
Mito, 310
Tel: 0292-25-7470

KENYA
Kenya Kinetics
P.O. Box 18311
Nairobi, Kenya
Tel: 57726
Cable: PROTON

KOREA
Amtraco Corporation
Industrial Products Div.
Seoul P.O. Box 1103
8th floor, DaeKyung Bldg.
107 Sejong Ro
Chongro-Ku, Seoul
Tel: 73-8924-7
Cable: AMTRACO Seoul

LEBANON
Constantin E. Macridis
P.O. Box 7213
RL-**Beirut**
Tel: **220846**
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, **Selangor**
Cable: MECOMB Kuala Lumpur

MOZAMBIQUE
A. N. Goncalves, LDA.
4.1 Apt. 14 Av. D. Luis
P.O. Box 107
Lourenco Marques
Telex: 6-203 NEGON MO
Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
94-96 Dixson St.
P.O. Box 9443
Courtenay Place
Wellington, N.Z.
Tel: 56-559
Telex: 6-203 NEGON MU
Cable: HEWPACK Wellington

Hewlett Packard (N.Z.) Ltd.
Box 51092
Pukuranga
Tel: 56-9837
Cable: HEWPACK, Auckland

NIGERIA
Teil (MesaCom Division)
25 Moronli St, Suru-Lere,
P.O. Box 5705
Lagos
Cable: THETEIL LAGOS

PAKISTAN
Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
388, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex Inc.
5th Floor, Architects
Center Bldg.
Ayala Ave., Makati, Rizal
C.C.P.O. Box 1028
Makati, Rizal
Tel: 86-18-87, 87-76-77
Cable: ELEMEX Manila

SINGAPORE
Mechanical and Combustion
Engineering Company Ltd.
9, Jalan Kilang
Red Hill Industrial Estate
Singapore, 3
Tel: 642361-3; 632611
Cable: MECOMB Singapore

Hewlett-Packard Far East
Area Office
P.O. Box 87
Alexandra Post Office
Singapore 3
Tel: 633022
Cable: HEWPACK SINGAPORE

SOUTH AFRICA
Hewlett Packard South Africa
(Pty.), Ltd.
P.O. Box 31716
Braamfontein Transvaal
Milnerton
30 De Beer Street
Johannesburg
Tel: 725-2080, 725-2030
Telex: 0226 JH
Cable: HEWPACK Johannesburg

Hewlett Packard South Africa
(Pty.), Ltd.
Breecastle House
Bree Street
Cape Town
Tel: 3-6019, 3-6545
Cable: HEWPACK Cape Town
Telex: 5-0006

Hewlett Packard South Africa
(Pty.), Ltd.
641 Ridge Road, Durban
P.O. Box 99
Overport, Natal
Tel: 88-6102
Telex: 567954
Cable: HEWPACK

TAIWAN
Hewlett Packard Taiwan
39 Chung Shiao West Road
Sec. 1
Overseas Insurance
Corp. Bldg. 7th Floor
Taipei
Tel: 389160,1,2, 375121,
Ext. 240-249
Telex: TP824 HEWPACK
Cable: HEWPACK Taipei

THAILAND
UNIMESA Co., Ltd.
Chongkoinee Building
56 Suriwongse Road
Bangkok
Tel: 37956, 31300, 31307,
37540
Cable: UNIMESA Bangkok

UGANDA
Uganda Tele-Electric Co., Ltd.
P.O. Box 4449
Kampala
Tel: 57279
Cable: COMCO Kampala

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
Saigon
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 73793
Cable: ARJAYTEE, Lusaka

MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:
Hewlett-Packard
Co-ordination Office for
Mediterranean and Middle
East Operations
Via Marocco, 7
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPACKIT Rome
Telex: 61514

OTHER AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

HEWLETT hp PACKARD

03320-90001

Printed in U.S.A.