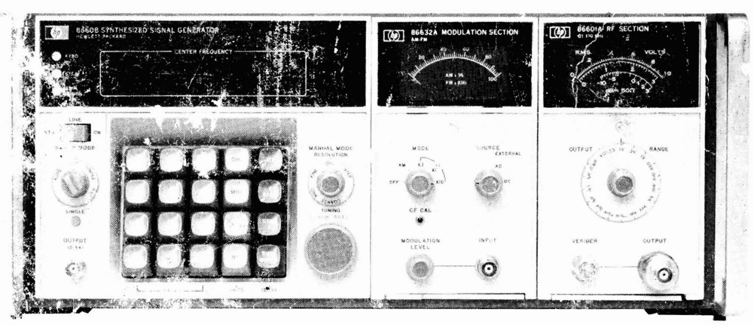
HP 8660B

OPERATING AND SERVICE MANUAL

SYNTHESIZED SIGNAL GENERATOR

8660B



HEWLETT hp PACKARD

HP 8660B

SYNTHESIZED SIGNAL GENERATOR

8660B

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1208A.

For additional important information about serial numbers see INSTRUMENTS COVERED BY MANUAL in Section I.

HEWLETT—PACKARD COMPANY
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

Manual Part No. 08660-90022
Microfiche Part No. 08660-90024

Printed: AUGUST 1972

HEWLETT hp PACKARD

CONTENTS

ILLUSTRATIONS

TABLES

Figure 1-1. Model 8660B Equipment Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 8660B Synthesized Signal Generator. This section covers instrument identification, description, specifications and other basic information.

1-3. Figure 1-1 shows a front view of the instrument and the service kit required for maintenance purposes.

1-4. The various sections in this manual provide information as follows;

a. SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, mounting, packing and shipping, etc.

b. SECTION III, OPERATION, provides information necessary to efficiently operate the instrument.

c. SECTION IV, PERFORMANCE TESTS, provides information required to ascertain that the instrument is performing in accordance with published specifications.

d. SECTION V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs are made.

e. SECTION VI, REPLACEABLE PARTS, provides ordering information for all parts and assemblies.

f. SECTION VII, MANUAL CHANGES, normally will contain no relevant information in the orginal issue of a manual. This section is reserved to provide backdated and up-dated information in manual revisions or reprints.

g. SECTION VIII, SERVICE, provides all information required to return the instrument to operation when a malfunction has occurred.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information supplement may be ordered through your nearest Hewlett-Packard office. The part number is listed on the inside title page of the manual and on the supplement itself.

1-6. On the inside title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4X6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. Instrument specifications are listed in Table 1-1. These specificatiosn are the performance standards or limits against which the instrument may be tested.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number plate (see Figure 1-2) on the back panel. The first four digits and the letter comprise the serial number prefix which denotes the instrument configuration and the country in which it was manufactured. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix as listed under SERIAL NUMBERS on the inside title page.

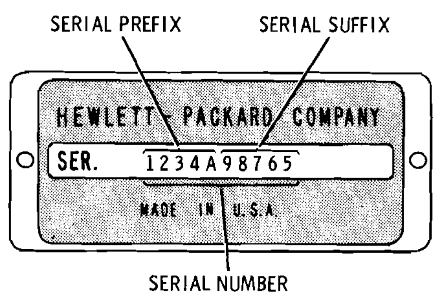


Figure 1-2. Instrument Identification

1-10. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" to document the differences.

1-11. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-12. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-13. TECHNICAL ASSISTANCE

1-14. Hewlett-Packard is prepared to provide technical assistance should problems arise which are not adequately covered in the manual or the manual changes supplement. All correspondence regarding such assistance should contain the complete serial number (prefix and suffix) of the instrument for which assistance is requested.

1-15. DESCRIPTION

1-16. The Hewlett-Packard 8660B Synthesized Signal Generator provides precise, digitally controlled rf signals which are used in plug-in sections to provide the desired output signal. Space for two front-panel plug-in units (a modulator and an rf unit) are provided in the instrument. All operating controls of the Model 8660B and the plug-in units are readily accessible on the front panels. In addition to the two front panel plug-in units, space is provided internally for the Model 11661A Frequency Extension Module, which must be used when the output RF Section is capable of producing output frequencies higher than 160 MHz.

1-17. All of the signals generated in the Model 8660B are phase locked, directly or indirectly, to a 100 MHz master oscillator in the reference section. The 100 MHz master oscillator is phase locked to an internal 10 MHz temperature controlled crystal oscillator or to an external standard. Provisions are made for the internal reference to be used as a reference signal for other equipment.

1-18. The Model 8660B uses synthesizer techniques to provide exact frequency control. When the Model 86601A RF Section is in use any frequency within the range of .01 to 110 MHz may be selected in increments as small as one cycle. When the Model 86602A RF Section, and the Model 11661A Frequency Extension Module are in use, any frequency within the range of 1 to 1300 MHz may be selected in increments as small as one cycle.

NOTE

In Option 004 instruments the output rf frequency is selectable in 100 Hz increments.

1-19. Six rf loops, all phase locked to the 100 MHz master oscillator, are used to generate the precise rf signals used in the RF Section plug-in and the Microwave Extension Module plug-in to produce the desired final output signal.

1-20. The Model 8660B has a front panel keyboard control for frequency selection. The keyboard control may also be used to set the rf output signal to sweep any sweep width desired, or to cause the rf output to step up or down in any frequency increment desired.

1-21. Manual tuning is also provided in the Model 8660B. A rotary pulse generator is used for this purpose. A selector switch directly above the TUNING knob determines rate of frequency change in 1 Hz, 1 kHz and 1 MHz increments, or in keyboard selected step size increments.

1-22. A sweep mode switch is provided to select sweep OFF, AUTO sweep, SINGLE sweep, or MANual sweep. Slow, medium or fast sweep rates are also selected by means of a selector switch.

1-23. Provisions are made to check keyboard entries before they are entered into the rf producing portions of the instrument. Before making the final entry into the keyboard, activating a pushbutton switch labeled KYBD to the left of the numerical readout will cause the readout to display the information stored in the keyboard circuits. Step increments and sweep width can also be displayed by activating push button switches.

1-24. SPECIFICATIONS

1-25. Specifications for the Model 8660B appear in Table 1-1.

1-26. SUPPLEMENTAL PERFORMANCE CHARACTERISTICS

1-27. Supplemental performance characteristics for the Model 8660B appear in Table 1-2.

Table 1-1. Model 8660B Specifications

SPECIFICATIONS

Frequency Selection: 10 digits selected by keyboard. Output frequency range is dependent on RF Section used.

Reference Oscillator:

Internal: 10 MHz quartz oscillator. Aging rate less than ± 3 parts in 10^8 per 24 hours after 72 hour warmup. (± 3 parts in 10^9 per 24 hours optional, Option 001.)

External: Rear panel switch allows operation from any 1 MHz, 2 MHz, 2.5 MHz, 5 MHz, or 10 MHz signal at a level between 0.2 volt and 2 volts RMS into 170 ohms. Stability and spectral purity will be partially determined by the characteristics of the external reference oscillator. When using an external reference frequency below 5 MHz, spurious signals may be slightly higher than specified for the RF Section installed.

Reference Output: Rear panel BNC connector provides output of reference signal selected (INT) or (EXT) at the following levels:
- Internal Reference: 0.5 v to 1 v rms into 170 ohms.
- External Reference: 0.2 to 1 v rms into 170 ohms depending on amplitude of EXT reference signal.

Display:

Solid-state ten-digit numerical display of CW frequency is active in either local or remote mode. Momentary contact pushbuttons provide display of sweep width, selected step size, or characters being entered on the keyboard.

Remote Programming:

All front panel frequency, output level, and modulation functions are programmable.

Programming Input:

Connector type: 36-pin Cinch type 57 (mating connector supplied).

Logic: TTL compatible (negative true). "0" logic state corresponds to $>$ 2 v, "1" logic state corresponds to $<$ 0.8 v.

Internal Fan-in from Programming Connector: 10; (required current approximately 15 mA per line in the "1" state).

General:

Operating Temperature Range: 0° to +55° C.
Leakage: Meets radiated and conducted limits of MIL-I-6181D.
Power: 115 or 230 volts ± 10% 50 to 60 Hz Approximately 200 watts.
Size: 16 3/4 in.wide x 7 in. high x 21 1/2 in. deep (426 x 178 x 547 mm); 19 in. deep behind rack mounting surface.
Weight: Net, 48 lb (21,6 kg).

Options:

001: ± 3 x 10^{-9} / 24 hours. Internal Reference Oscillator
002: No internal reference oscillator
003: Operation from 400 Hz line
004: 100 Hz frequency resolution
100: Internal Frequency Extension Module. Required for operation with 86602 RF Section.

Table 1-2. Model 8660B Supplemental Performance Characteristics

SUPPLEMENTAL PERFORMANCE CHARACTERISTICS

Synthesized Search:
Synthesized search dial changes the synthesized output frequency 180 steps per revolution corresponding to 180 Hz, 180 kHz, or 180 MHz or frequency change depending on frequency tuning switch position. Provides dial tuning of output frequency over entire range of RF section installed.

Digital Sweep:

Type: Symmetrical about CW/center frequency. Sweep width is divided into 100 synthesized steps for fastest sweep speed or 1000 steps for slower sweeps.

Sweep Width: Continuously adjustable over range of RF section installed in 1 Hz or 10 Hz steps (depending on frequency resolution of RF section).

Sweep End Point Accuracy: Same as reference oscillator accuracy (e.g., ±3 X 10^{-8}/24 hours with standard reference oscillator).

Sweep Speed: Selectable 0.1 sec, 1 sec, or 10 sec per sweep.

Sweep Output: 0 to 5 V stepped ramp; 100 or 1000 equal steps depending on sweep speed.

Manual Sweep: Synthesized search dial allows manual sweep over width selected in 1000 steps (display follows output frequency during manual sweep).

Single Sweep: Momentary contact pushbutton initiates single sweep.

Frequency Stepping:
After a step size has been entered on keyboard, depressing STEP ↑ or STEP ↓ button will increment frequency up or down by the desired step size.

Step Accuracy: Same as reference oscillator accuracy.

REMOTE PROGRAMMING

Functions:
All front panel frequency, output level, and modulation functions are programmable.

CW frequency, frequency STEPPING (STEP ↑, STEP ↓), output level, and modulation are programmable.

Frequency: CW freuqency is programmable over entire range with either 1 Hz or 10 Hz resolution depending on RF section installed.

Frequency step function may also be programmed to change output frequency by a previously selected step size.

Output Level: Programmable in 1 dB steps over the otuput range of the RF section installed. (For output level accuracy see RF section specifications.)

Modulation: See specifications for modulation section and RF section installed.

1-28. OPTIONS

1-29. The following options are available for the Model 8660B:

Option 001: Reference oscillator is ±3 parts in 10^{-9} per day.
Option 002: No internal reference oscillator.
Option 003: 400 Hz ac operation
Option 004: 100 Hz resolution (N3 and SL2 phase lock loops are removed).
Option 100: Frequency Extension Module Model 11661A installed. Required when the RF Section is capable of providing frequencies above 160 MHz.

1-30. PLUG-IN SECTIONS

1-31. The following plug-in modules are available for use with the 8660B:

a. Model 86601A, RF Section: Frequency range .01 to 109.999999 MHz in 1 Hz steps (8660B option 004 100 Hz steps). Output level continuously adjustable from +13 to −146 dBm into 50 ohms.

b. Model 86602A, RF Section: Frequency range 1 to 1299.999999 MHz selectable in 1 Hz steps (8660B option 004 100 Hz steps). Output level adjustable from +13 to −146 dBm into 50 ohms.

c. Model 86631A, Auxiliary Section: Fits in Modulation drawer to complete required interconnections. Also provides a means of amplitude modulating the RF Section output with an external signal.

d. Model 86631B, Auxiliary Section: Same capabilities as the Model 86631A plus a pulse modulation capability from an external source.

e. Model 86632A AM/FM Modulation Section: Internal and external AM and FM modulation selected by front panel switches. Meter indicates per cent AM or FM peak deviation.

f. Accessory number 11661A, Frequency Extension Module: This plug-in is an internal plug-in for the Model 8660B mainframe. It is required when the Model 86602A RF Section is used.

1-32. ACCESSORIES SUPPLIED

1-33. The following accessories are provided with the Model 8660B:

a. Detachable three-wire power cable,

b. Rack Mounting Kit,

c. Five circuit board extenders,

d. Type N to BNC adapter.

1-34. ACCESSORIES NOT SUPPLIED

1-35. A service kit, Hewlett-Packard part number 11672A, is recommended for maintenance purposes. Contents of the service kit are listed in Table 1-3. Individual items in the kit may be ordered separately if desired.

1-36. WARRANTY

1-37. Certification and warranty information for the Model 8660B appears on the inside front cover of this manual.

1-38. TEST EQUIPMENT AND ACCESSORIES

1-39. Table 1-3 lists the test equipment and accessories recommended to test, adjust and service the Model 8660B.

Table 1-3. Test Equipment and Accessories List

ITEM	DESCRIPTION	SUGGESTED MODEL	USE*
Digital Voltmeter	Voltage accuracy ± 0.2% Range: .0 V to 60 V	HP 3440A with HP 3443A plug-in	A,S
AC Microvoltmeter	3 μV to 3 V Tuneable to 120 Hz	HP 3410A	A,S
Variable Voltage Transformer	Range 103 to 127 vac Meter Range 103-127 vac ± 1 V	General Radio W4MT3A	A
VLF Comparator	Sensitivity 1 μV into 50 ohms; Compares 100 kHz input to NBS station WWVB	HP 117A	P,A
Oscilloscope	Frequency dc to 50 MHz Time base 10 Ns to 1 s Time base accuracy 3%	HP 180A with HP 1801A and HP 1821 plug-ins	P,A,S
20:1 divider probes	10:1 Divider 10 Megohm 10 pF	HP 10004A (2)	
Spectrum Analyzer	Frequency Range 10 to 600 MHz, Response ± 1 dB, Measurement Accuracy ± 2.0 dB	HP 140/HP 8554L/ HP 8552B	A,S
Electronic Counter	Range 0 - 50 MHz, 0 - 500 MHz with plug-in. Accuracy ± 1 count ± time base accuracy. External time base 10 MHz	HP 5245M with HP 5253B plug-in	P,A,S
Pulse Generator	Pulse rate 100 kHz Pulse width .035 μSec Amplitude .5 v Polarity - Selectable	HP 222A	A
Signal Generator/ Sweeper	Frequency —1 - 110 MHz Output Range +20 to —20 dBm Output CW or swept	HP 8601A	P,A,S
RF Voltmenter	Range 0.1 to 2 volts Freq. Range 1 to 10 MHz	HP 411A	P
Test Oscillator	Freq. Range 10 Hz to 1 kHz Output level +10 to —20 dBm	HP 651B	A,S
Frequency Synthesizer	Freq. Accuracy .001% Freq. Stability ±10 parts in 10^6 per year	HP 3320B	P

* P= Performance Tests A= Adjustments S= Service

Table 1-3. Test Equipment and Accessories List (cont'd)

Item	Description	Suggested Model	Use*
Service Kit	Consisting of:	HP 11672A	S
	Extender Cable for output plug in	11672-60001	
	Extender Cable for Modulator and accessory 11661A	11672-60002	
	Adapter, Sealectro to 5 prong connector	1250-0835	
	Coax adaptor, Sealectro to BNC (female)	1250-1236	
	Coax adapter, Sealectro to BNC (male)	1250-1237	
	Alignment tool	8830-0024	
	Adapter, N plug to BNC Jack	1250-0780	
	Sealectro Tee Connector	1250-0838	
	Selectro cable, female to female 24" long	11672-60004	
	Sealectro cable, Sealectro female to BNC male 36" long	11672-60003	
	Sealectro cable, Sealectro male to female 24" long.	11672-60005	
	Sealectro cable, male to female 24" long	11672-60006	
	Adaptor, OSM/OSM right angle	1250-1249	
	Adaptor, OSM/BNC	1250-1200	

*P = Performance Tests A = Adjustments S = Service

SECTION II
INSTALLATION

2-1 INITIAL INSPECTION

2-2. Mechanical Check

2-3. If the shipping carton shows visible signs of damage when received, the carrier's agent should be present when the instrument is unpacked. If the agent is not present, retain the packaging material to aid in evaluating the cause of damage if the instrument is physically damaged or is not functioning properly.

2-4. Inspect the instrument for physical damage such as bent or broken parts and dents or scratches. If damage is found refer to paragraph 2-7 for recommended claim procedures. If the instrument appears to be free of damage perform the electrical check (see paragraph 2-5). The packaging material should be retained for possible future use.

2-5. Electrical Check

2-6. The electrical check consists of performing the performance test procedures in Section IV of this manual. These procedures enable the operator to determine that the instrument is, or is not, operating within the specifications listed in Table 1-1. The initial performance and accuracy of the instrument are certified as stated on the inside front cover of this manual. If the instrument does not operate as specified, refer to paragraph 2-7 for the recommended claim procedure.

2-7. CLAIMS FOR DAMAGE

2-8. If physical damage is found when the instrument is unpacked notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement without waiting for a claim to be settled with the carrier.

2-9. The warranty statement for the instrument is on the inside front cover of this manual. Contact the nearest Sales/Service Office for information relative to warranty claims.

2-10. PREPARATION FOR USE

CAUTION

Before applying power determine that the rear panel slide switch is in the correct position (115 or 230 volts).

2-11. Power Requirements

2-12. The instrument may be operated on 115 or 230 volts ac ± 10% at 60 cycles, single phase. Power required is approximately 200 watts. The 115/230 volt slide switch on the rear panel of the instrument must be in the correct position to avoid damage. When shipped, the switch is set for 115 volt ac operation.

2-13. Power Cable

2-14. To protect operating personnel, the National Electrical Manufacturers Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a detachable three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground connection. When using a three-prong to two-prong adapter the ground lead on the adapter should be grounded to preserve the safety feature.

2-15. The power cord and power input connector meet the specifications established by the International Electrotechnical Commission (IEC).

2-16. Operating Environment

2-17. The instrument is equipped with a fan which is capable of keeping the instrument ambient temperature within reasonable limits when the instrument is operated at room temperatures between 0 to 55°C (32 to 131°F.).

2-18. Bench Operation

2-19. The instrument cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand permits inclining the instrument for ease in using front panel controls and indicators. The plastic feet are shaped to provide clearance for air circulation and to make modular cabinet width instruments self-aligning when stacked.

2-20. Rack Operation

2-21. The instrument may be rack mounted for stationary use. A rack mounting kit, complete with instructions, is shipped with the instrument.

2-22. STORAGE AND SHIPMENT

2-23. If the instrument is to be stored for an extended period of time it should be enclosed in a clean sealed enclosure.

2-24. Original Packaging

2-25. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales/Service Offices listed at the rear of this manual.

2-26. If the instrument is being returned to Hewlett-Packard for service attach a tag indicating the type of service required, return address, model number and full serial number. Also mark the container FRAGILE to assure careful handling.

2-27. In any correspondence refer to the instrument by model number and full serial number.

2-28. Other Packaging Material

2-29. The following general instructions should be followed when repackaging with commercially available materials.

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard Service Office or Center, attach a tag indicating the type of service required, return address, model number and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (three to four inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides operating instructions for the Hewlett-Packard Model 8660B Synthesized Signal Generator mainframe.

3-3. The Model 8660B is designed to provide precise digitally controlled signals for use in plug-in sections which provide the selected output frequency. It will be necessary to have the operating manuals for the plug-in sections being used in order to efficiently operate the instrument.

NOTE

If a modulation plug-in section is not used it will be necessary to have an Auxiliary Section in place in the modulation plug-in drawer. The Auxiliary Section completes a signal path from the mainframe to the RF Section plug-in and also provides a means of modulating the RF Section from an external source.

3-4. PANEL FEATURES

3-5. Front and rear panel controls, indicators and connectors of the 8660B are shown, and their functions described, in Figure 3-1.

3-6. OPERATING PRINCIPLES

3-7. The 8660B may be operated by front panel controls in the local mode or externally programmed in the remote mode.

NOTE

The remote mode is selected by the external programming device which places a ground on pin 5 of J3 on the rear panel of the 8660B. In the remote mode, all front panel controls of the 8660B are inhibited.

3-8. Local Operation

3-9. In the local mode of operation, all functions of the mainframe are controlled by front panel controls, except when an external standard is used. When an external standard is used the rear panel SELECTOR switch must be in the EXT position.

3-10. The 20-key keyboard may be used to:

a. Select any center frequency within the range of the RF Section plug-in in 1 Hz increments (Opt 004 instruments provides 100 Hz increments).

NOTE

Frequencies which are above the output frequency range of the RF Section, if selected, will be stored in the keyboard register, but the information will not be transferred to the center frequency register since it is above the output range of the RF Section. The center frequency register and the readout will retain the last valid input. Frequencies below the output frequency range of the RF Section will be transferred to the center frequency register and the readout register; the output frequency is still accurate, but the output amplitude is degraded. As an example, the Model 86601A RF Section has a specified lower frequency limit of 10 kHz, but typically will produce a useable rf output down to 3 kHz or less. When frequencies above the RF Section frequency range are selected the OUT OF RNG lamp flashes on one time. When frequencies below the RF Section frequency range are selected the OUT OF RNG lamp remains lit.

b. Select any desired sweep width within the frequency range of the RF Section in use. See paragraph 3-12 for further details of sweep mode operation.

c. Select any incremental step within the frequency range of the RF Section in use. See paragraph 3-15 for further details of incremental step operation.

3-11. Sweep Mode. In the sweep mode the sweep width is selected by the keyboard keys. The sweep width may be displayed on the CENTER FREQUENCY readout by pressing the SWP WIDTH pushbutton to the left of the readout. Only the center frequency is shown in the AUTO or SINGLE sweep modes. In the MAN sweep mode the actual rf output frequency of the RF Section will be displayed.

3-12. When the SWEEP MODE switch is placed in the AUTO position the output signal of the RF Section is swept about the selected center frequency by the sweep width stored in the sweep width storage register. (Example: center frequency 50 MHz, sweep width 20 MHz, the rf output is swept from 40 to 60 MHz.) The sweep rate, selected by the RATE switch, is as follows: FAST

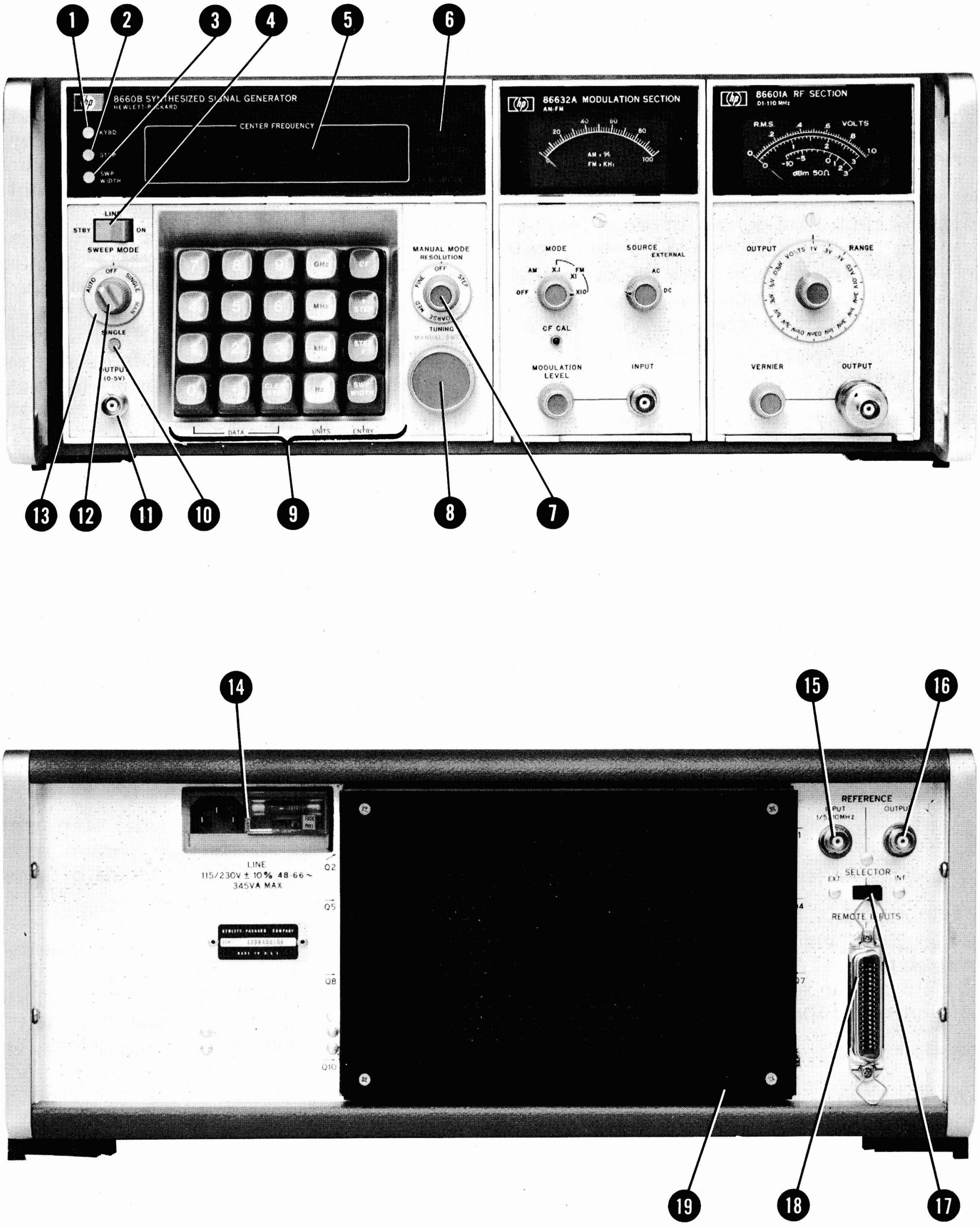


Figure 3-1. Front and Rear Panel Controls, Indicators and Connectors (1 of 2)

(1) **KYBD pushbutton.** When pressed, causes the information stored in the keyboard storage register to be displayed on the CENTER FREQUENCY readout.

(2) **STEP pushbutton.** When pressed, causes the information stored in the step storage register to be displayed on the CENTER FREQUENCY readout.

(3) **SWP WIDTH pushbutton.** When pressed, causes the information stored in the sweep width storage register to be displayed on the CENTER FREQUENCY readout.

(4) **LINE STBY – ON switch.** In the STBY position, with the instrument connected to the ac line source, the reference oscillator oven temperature is maintained at the operating temperature to avoid the necessity of allowing for a warm up period each time the instrument is used.

(5) **CENTER FREQUENCY readout.** Normally displays the output center frequency of the RF Section.

(6) **ANNUNCIATOR.** Provides visual display of mode of operation, crystal oven temperature and out of range frequency selection.

(7) **MANUAL MODE RESOLUTION.** Works in conjunction with the TUNING control to step the rf output in steps of 1 Hz (FINE), 1 kHz (MED) and 1 MHz (COARSE). In the STEP position the TUNING control steps the rf output frequency by the step stored in the step register.

(8) **TUNING – MANUAL SWEEP.** Works as specified in the MANUAL MODE RESOLUTION description. May also be used to set the rf output to any point within the limits stored in the sweep register when the SWEEP MODE switch is set to MAN.

(9) **Keyboard.** Contains 20 keys which are used to enter data or instructions as follows:

Numerals 0 through 9

Decimal Point (.)

CLEAR KYBD. Clears keyboard register (does NOT clear other registers).

GHz, MHz, kHz and Hz select frequency in conjunction with numeric keys.

CF. Transfers keyboard storage register data to the center frequency register.

STEP. ↗ Transfers keyboard storage register data to the step register and steps the center frequency up. May also be used to step the frequency up by the step stored in the step register without a new keyboard entry.

STEP. ↘ Same as STEP ↗ except that frequency is stepped down.

SWP WIDTH. Transfers the data in the keyboard storage register to the sweep register.

(10) **SINGLE pushbutton.** When pressed, causes the rf output to be swept, one time only, across the range stored in the sweep register.

(11) **OUTPUT (0-5V).** Provides a sweep ramp for use in external equipment (oscilloscopes, X-Y recorders, etc.) when operating in the swept mode.

(12) **RATE switch.** The rage switch selects sweep rates as follows: FAST — 100 steps at 1 millisecond per step, MED — 1000 steps at 1 millisecond per step, and SLO — 1000 steps at 10 milliseconds per step.

(13) **SWEEP MODE switch.** With the sweep mode switch in the AUTO position sweep operation is automatic; the output rf is swept about the center frequency by the data stored in the sweep register at the rate selected by the RATE switch. In the SINGLE mode the rf output is swept once each time the SINGLE pushbutton is pressed. In the MAN mode the sweep is controlled by the MANUAL TUNE control and the data stored in the sweep register.

(14) **Line Module.** Contains 115-230V switch, fuse, line cable connector and filtering.

(15) **REFERENCE INPUT.** Used when an external standard of 1, 2, 2.5, 5 or 10 MHz is used.

(16) **REFERENCE OUTPUT.** Provides the capability of using the internal reference as a time base in external equipment.

(17) **SELECTOR.** Selects INT or EXT reference.

(18) **REMOTE INPUTS.** When the instrument is operated in the remote mode (pin 5 of this connector is grounded by the programming device), all functions of the instrument are controlled by the remote programming device. Front panel controls (except for LINE STBY-ON) have no effect on operation of the instrument.

(19) **Air Filter.** Should be cleaned periodically to ensure adequate airflow for instrument cooling.

Figure 3-1. Front and Rear Panel Controls, Indicators and Connectors (2 of 2)

— 100 steps at 1 millisecond per step, MED — 1000 steps at 1 millisecond per step, and SLO — 1000 steps at 10 milliseconds per step.

3-13. When the SWEEP MODE switch is placed in the SINGLE position, pressing the SINGLE pushbutton causes the output of the RF Section to be swept one time. When the single sweep is completed, the output of the RF Section returns to the selected center frequency. The sweep width and sweep rate are selected in the same manner as they are in the AUTO mode.

3-14. When the SWEEP MODE switch is placed in the MAN position the step rate of the output frequency of the RF Section may be manually controlled by the MANUAL SWEEP control. In this mode the sweep width is still controlled by the information in the sweep register. The selected sweep width, in this mode, is divided by 1000 and the output of the RF Section may be controlled in frequency steps that are 1/1000 of the sweep width. (Example: center frequency 40 MHz, sweep width 20 MHz, output may be stepped manually from 40 to 60 MHz in 20 kHz steps.)

3-15. Step Mode. The center frequency may be stepped up, or down, in any increment within the frequency range of the RF Section in use. The increment selected, including units, must be entered in the keyboard before the STEP ↑ or STEP ↓ key is pressed. The step entered into the step register remains in the register until changed (or the instrument is placed in the standby mode) and may be displayed on the readout by pressing the STEP pushbutton.

3-16. Manual Mode. Manual mode operation is essentially the same as the step mode except that increments selected by the MANUAL MODE switch are 1 Hz (FINE), 1 kHz (MED) and 1 MHz (COARSE). These increments are controlled only by the TUNING control. The incremental steps stored in the increment register may also be controlled by the TUNING control when the MANUAL MODE switch is placed in the STEP position.

3-17. Combined Mode. The sweep mode, step mode and manual mode may all be used simultaneously. This feature allows the user to quickly determine the frequency parameters of any device being tested.

3-18. Remote Operation

3-19. In the remote mode of operation the mainframe STEP register and the Center Frequency register are controlled by the programming device. All front panel controls are inhibited.

3-20. In remote operation two four-line parallel codes are applied to the instrument circuits through a rear panel connector. These inputs, if numeric data, are converted to 2 BCD digit serial information and clocked into a temporary storage register. If the inputs are address information they are used to direct a clock to strobe the data from the temporary storage register into the desired final storage register.

3-21. The input programming requirements of the 8660B dictate that BCD inputs are as follows: approximately 0 volts (TTL LOW) = 1 and approximately +5 volts (TTL HIGH) = 0 (sometimes referred to as negative logic or ground true logic). Another requirement is that the least significant data digit must be entered first, then the next least significant data digit, etc.

3-22. When all of the significant data entries have been stored in the temporary storage registers, input digit 1 is set to binary 15 to indicate that the digit 2 information is the address to which the information stored in the temporary storage register is to be transferred.

3-23. There are six final storage registers which may be programmed via the rear panel connector on the 8660B. These storage registers, their addresses, locations and functions are identified in Table 3-1.

3-24. Operation of the storage registers not located in the 8660B mainframe is detailed in the manuals for the plug-in sections in which they are physically located. Table 3-2 provides examples of programming the registers which may be programmed when the 8660B mainframe is used.

3-25. In the remote mode, the temporary storage register is reset to zero each time information is transferred to a final storage register.

Table 3-1. Storage Register Addresses

Name of Register	Address 0=High, 1=Low	Location	Function
Center Frequency	0000 (0)	Mainframe	To set Center Frequency
Step ↑	0001 (1)	Mainframe DCU	To step center frequency up in any increment
Step ↓	0010 (2)		To step center frequency down in any increment
Attenuator	0011 (3)	RF Section plug-in	Controls level of RF OUTPUT
AM-FM Function	0100 (4)	Modulation Section plug-in	Selects Modulation Function
AM-FM %	0101 (5)	Modulation Section plug-in	Selects AM % of Modulation or FM Deviation
FM CAL	0110 (6)	Modulation Section plug-in	Phase locks 20 MHz FM oscillator to the reference loop 20 MHz

Table 3-2. Model 8660B Programming Examples

EXAMPLE 1. Set 100.000000 MHz Center Frequency (CF)		
Input 0=High 1=Low	Temporary Register	CF Register
Data D_1 0001 (1) D_2 0000 (0)	00 00 00 00 00	Last Input
Temporary Command	01 00 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0000 (0)	01 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	01 00 00 00 00

Table 3-2. Model 8660B Programming Examples (cont'd)

EXAMPLE 2. Set 107.654321 MHz Center Frequency (CF)		
Input **0=High 1=Low**	**Temporary Register**	**CF Register**
Data: D_1 0001 (1) D_2 0010 (2)	00 00 00 00 00	Last Input
Temporary Command	21 00 00 00 00	Last Input
Data: D_1 0011 (3) D_2 0100 (4)	21 00 00 00 00	Last Input
Temporary Command	43 21 00 00 00	Last Input
Data: D_1 0101 (5) D_2 0110 (6)	43 21 00 00 00	Last Input
Temporary Command	65 43 21 00 00	Last Input
Data: D_1 0111 (7) D_2 0000 (0)	65 43 21 00 00	Last Input
Temporary Command	07 65 43 21 00	Last Input
Data: D_1 0001 (1) D_2 0000 (0)	07 65 43 21 00	Last Input
Temporary Command	01 07 65 43 21	Last Input
Address: D_1 1111 (15) D_2 0000 (0)	01 07 65 43 21	Last Input
Transfer Command	00 00 00 00 00	01 07 65 43 21

EXAMPLE 3. Set 120 dB Attenuation (RF SECTION) Below +13 dBm (1 volt)		
Input **0=High 1=Low**	**Temporary Register**	**Atten Register**
Data: D_1 0010 (2) D_2 0001 (1)	00 00 00 00 00	Last Input
Temporary Command	12 00 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0011 (3)	12 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	120

Note

The attenuator is a three-digit register; only the three most significant digits are retained.

Table 3-2. Model 8660B Programming Examples (cont'd)

EXAMPLE 4. Set 7 dB Attenuation (RF SECTION) Below +13 dBm (1 volt)

Input 0=High 1=Low	Temporary Register	Atten Register
Data: D_1 0000 (0) D_2 0111 (7)	00 00 00 00 00	Last Input
Temporary Command	70 00 00 00 00	Last Input
Data: D_1 0000 (0) D_2 0000 (0)	70 00 00 00 00	Last Input
Temporary Command	00 70 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0011 (3)	00 70 00 00 00	Last Input
Transfer Command	00 00 00 00 00	007

See note for Example 3

EXAMPLE 5. Shut off Modulation (MODULATION SECTION)

Input 0=High 1=Low	Temporary Register	Function Register
Address: D_1 1111 (15) D_2 0100 (4)	00 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	00

NOTE: All digits are zero - no modulation

EXAMPLE 6. Set 3% AM Modulation, internal 1 kHz (MODULATION SECTION)

Input 0=High 1=Low	Temporary Register	AM-FM % Register
Data: D_1 0011 (3) D_2 0000 (0)	00 00 00 00 00	Last Input
Temporary Command	03 00 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0101 (5)	03 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	03 into % Storage
Data D_1 0001 (1) D_2 1000 (8)	00 00 00 00 00	
Temporary Command	81 00 00 00 00	
Address: D_1 1111 (15) D_2 0100 (4)	81 00 00 00 00	
Transfer Command	00 00 00 00 00	81 into AM-FM Function Register Sets AM and 1 kHz

NOTE: See Table 3-3. for AM-FM Function Register Codes

Table 3-2. Model 8660B Programming Examples (cont'd)

EXAMPLE 7. Set 10 MHz STEP ↑		
Input 0=High 1 = Low	**Temporary Register**	**INCR Register**
Data: D_1 0000 (0) D_2 0001 (1)	00 00 00 00 00	Last Input
Temporary Command	10 00 00 00 00	Last Input
Data: D_1 0000 (0) D_2 0000 (0)	10 00 00 00 00	Last Input
Temporary Command	00 10 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0001 (1)	00 10 00 00 00	Last Input
Transfer Command	00 00 00 00 00	00 10 00 00 00

Table 3-3. AM - FM Function Register Coding

DIGIT 2 (D_2)		DIGIT 1 (D_1)	
0=High	1=Low	0=High	1=Low
AM	1000 (8)	EXT. AC	1000 (8)
FM X .1	0100 (4)	EXT. DC	0100 (4)
FM X 1	0010 (2)	INT. 400 Hz	0010 (2)
FM X 10	0001 (1)	INT. 1 kHz	0001 (1)
OFF	0000 (0)		

Table 3-4. Programming Connections to J3

J3 Pin No.	To A3XA5 Pin No.	Signal	Other
1			To J3 pin 18
3	2	Error	
5	5	LCL-RMT	
9	11	Command	
13	15	Digit 1 - 8	
14	16	Digit 1 - 4	
15	17	Digit 1 - 2	
16	18	Digit 1 - 1	
17	A	Flag (Busy)	
24	J	Reset	
28	S	Digit 2 - 8	
29	T	Digit 2 - 4	
30	U	Digit 2 - 2	
31	V	Digit 2 - 1	
36			Ground

J3 pins not listed are also wired to A3XA5. See the rear interface board schematic diagram for wiring information.

3-26. OPERATOR'S CHECKS

3-27. During final checkout at the factory the Model 8660B Synthesized Signal Generator mainframe is adjusted for proper operation. No adjustment should be required when the instrument is received. The operator's checks listed in Table 3-5 are based on the assumption that properly operating Model 86601A RF Section and Model 86632A AM-FM Modulation Section plug-ins sections are in place. If other plug-in sections are used, refer to the manuals for the specific plug-ins for operating parameters.

3-28. The steps listed in Table 3-5 need not be followed in the sequence listed. Their purpose is to aid the operator in familiarizing himself with the instrument, and to provide assurance that all functions of the instrument are operating properly.

NOTE

Numbers shown in the "Result" column of Table 3-5 are those which should be displayed on the CENTER FREQUENCY readout.

Table 3-5. Operator's Checks

Step	Operation	Result
1	Initial Turn-on	
1-a	Set the rear panel line select switch in the power line module to be compatible with the available line power	
1-b	Connect the instrument to the power outlet; use ground pin adapter for electrical systems having no ground line	
	NOTE The instrument should remain connected to the power source in the STBY (standby) mode when not in use. This will maintain constant temperature in the crystal oven and eliminate the need for a warm-up period.	
1-c	Place the LINE STBY/ON switch in the on position	Cooling fan starts CF 1.000000 MHz
2	Keyboard Register and Readout Checks	
2-a	Hold in KYBD pushbutton and enter 1.23456789 Note that readout input steps from right to left	Units lights (GHz, MHz, kHz, Hz) are off. 1.23456789
2-b	With KYBD pushbutton held in: Press MHz key Press kHz key Press Hz key	1.234567 MHz 1.234 kHz 1 Hz
2-c	Release KYBD pushbutton	1.000000 MHz
2-d	Press KYBD pushbutton	1 Hz
2-e	With KYBD pushbutton held in: Press kHz key Press MHz key Press GHz key Press CLEAR KYBD key	1.000 kHz 1.000000 MHz 1.000000000 GHz Readout blank
3	↑ ↓ Step register and OUT OF RNG annunciator check	
3-a	Enter 109.000000 MHz CF on the keyboard Enter 111111 Hz STEP ↑ on the keyboard	109.000000 MHz 109.111111 MHz

Table 3-5. Operator's Checks (cont'd)

Step	Operation	Result
3-b	Press the KYBD pushbutton Release the KYBD pushbutton	111111 Hz 109.111111 MHz
3-c	Press the STEP ↑ key until the readout shows Note that readout has increased in steps of 111111 Hz	109.999999 MHz
3-c	Press the STEP ↑ key one more time.	109.999999 MHz OUT OF RNG light flashes once
3-e	Place the MANUAL MODE switch in the STEP position and turn the TUNING control counter-clockwise	readout decreases in 111111 Hz steps
3-f	Enter 10 kHz CF on the keyboard Enter 1 Hz STEP ↑ on keyboard Press STEP pushbutton Press STEP ↓ key twice NOTE: With the Model 86601A RF Section the specified lower frequency limit is 10 kHz	10.000 kHz 10.001 Hz 1 Hz 9.999 kHz OUT OF RNG light stays on

NOTE

The Model 86601A RF Section lower frequency limit is specified at 10 kHz. However, the output frequency is accurate down to 1 Hz. The output power level is typically accurate down to 3 kHz or less.

Step	Operation	Result
3-g	Enter 3 kHz CF on the keyboard Enter 100 Hz STEP ↓ Repeatedly press the STEP ↓ key. Note that the center frequency readout decreases in 100 Hz steps. The rf output level will typically start to drop below 2 kHz.	3.000 kHz 2.900 kHz OUT OF RNG light on
4	MANUAL MODE — MANUAL TUNING Check	
4-a	Set the SWEEP MODE switch to OFF and enter 0 MHz CF	.000000 MHz
4-b	Set the MANUAL MODE switch to COARSE and rotate the TUNING control clockwise until the readout indicates Note that the readout steps in 1 MHz increments	109.000000 MHz
4-c	Set the MANUAL MODE switch to MED and rotate the TUNING control clockwise until the readout indicates Note that the readout steps in 1 kHz increments	109.999000 MHz
4-d	Set the MANUAL MODE switch to FINE and rotate the TUNING control clockwise until the readout indicates Note that the readout steps in 1 Hz increments	109.999999 MHz

NOTE

In the COARSE, MED and FINE manual modes the OUT OF RNG light flashes on when the upper frequency limit is passed. The system rejects overrange frequencies and the center frequency register retains the last valid entry.

Table 3-5. Operator's Checks (cont'd)

Step	Operation	Result
5	Sweep Mode Checks	
	NOTE Proper operation of the instrument in the sweep mode is best verified with a spectrum analyzer as described in step 5-c. However, operation of the sweep function can be verified by front panel indications as described in steps 5-a and 5-b.	
5-a	Set CF to 5 kHz and SWP WIDTH to 10 kHz. Place the SWEEP MODE switch in the AUTO position and the RATE switch in the SLO position.	SWEEP and OUT OF RNG lights on. RF output meter level drops every 10 seconds
5-b	Set CF to 10 kHz. Other functions as in step 5-a	SWEEP light remains lit. OUT OF RNG light alternates, 5 seconds on, 5 off
5-c	Connect the rf output to the RF INPUT of the spectrum analyzer. Enter 10 MHz CF and 10 MHz SWP WIDTH and SWEEP MODE to AUTO. Position the RATE switch to MED and adjust the spectrum analyzer for a clear display. Enter 5 MHz STEP and step the frequency across the rf range.	Readout increases 5 MHz steps. Sweep continues to be 5 MHz on each side of the center frequency
6	Manual Sweep Check	
6-a	Enter 50 MHz CF and 10 MHz SWP WIDTH. Place the SWEEP MODE switch in the MAN position. Rotate the MANUAL SWEEP control through its range	Center frequency is tuneable from 45 to 55 MHz
7	Single Sweep Check	
7-a	Enter 50 MHz CF and 20 MHz SWP WIDTH and place the SWEEP MODE switch in the SINGLE position. Press SWP WIDTH pushbutton. Connect the rf output to the RF INPUT of the spectrum analyzer and tune the analyzer to display the 50 MHz signal. Press the SINGLE pushbutton.	50.000000 MHz 20.000000 MHz Spectrum analyzer display is swept once from 40 to 60 MHz

NOTE

The Operator's Checks specified in the manuals for the plug-in sections in use should also be performed.

3-29. If remote programming is to be used the examples shown in Table 3-2 as well as checks specified in manuals for the plug-in sections should be performed.

3-30. Table 3-4 provides information relative to connections to the rear panel remote control connector.

3-31. OPERATOR'S MAINTENANCE

3-32. Operator's maintenance of the Model 8660B Synthesized Signal Generator mainframe is limited to fuse replacement and periodic cleaning of the air filter.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. This section provides instructions for performance testing the Model 8660B Synthesized Signal Generator.

4-3. PURPOSE

4-4. The performance test procedures are used to check instrument performance for incoming inspection and periodic evaluation. The tests are designed to verify published specifications for the instrument. Each test applies directly to a listed specification (see Table 1-1).

4-5. Each performance test procedure begins by quoting the specification which it verifies. Next, a description of the test and any special instructions are listed.

4-6. Test Equipment Required. The test equipment required for performance testing are listed in Table 1-3 and in the individual tests. Test instruments other than those listed may be used providing their performance equals or exceeds the specifications listed in Table 1-3.

4-7. Front Panel Checks and Adjustments. Refer to paragraph 3-26. Operator's Checks.

4-8. PERFORMANCE TESTS

4-9. INTERNAL CRYSTAL OSCILLATOR AGING RATE

SPECIFICATION: 10 MHz quartz oscillaotr. Aging rate less than ± 3 parts in 10^8 per day (±3 parts in 10^9 per day with option 001) after 72 hour warmup.

DESCRIPTION: This test verifies the reference oscillator againg rate by comparing it to the National Bureau of Standards signal from WWVB.

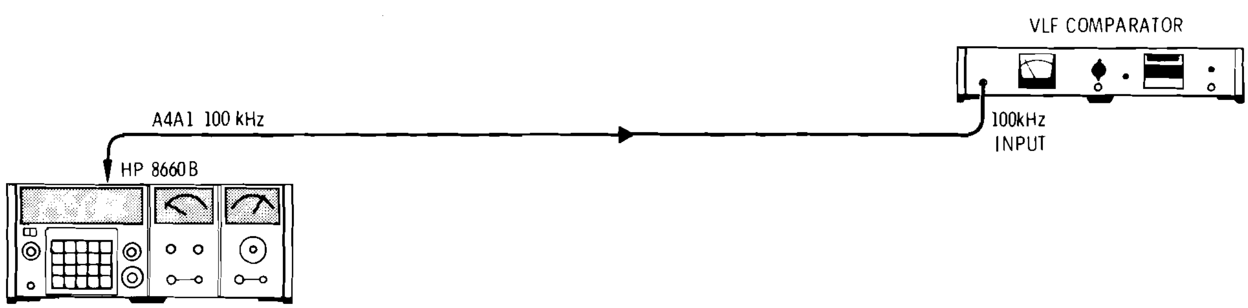


Figure 4-1. Crystal Oscillator Aging Rate Test Setup

RECOMMENDED TEST EQUIPMENT:

VLF Comparator . . . . HP 117A

PROCEDURE:

1. Remove the Model 8660B top cover after the instrument has been connected to the ac line for 72 hours.

PERFORMANCE TESTS

4-9. INTERNAL CRYSTAL OSCILLATOR AGING RATE (cont'd)

2. Connect a cable from the 100 kHz output of the A4A1 reference divider assembly to the VLF Comparator 100 kHz input.
3. Refer to Section III of the VLF Comparator Operating and Service Manual for Comparator operating instructions.
4. Aging rate is checked by noting the average offset between the two signals at two times several hours apart and dividing the offset difference by the hours between observations. The hourly offset is then converted to aging rate per day.

   Example:
   First reading + 3 parts in 10^{10} at 10:00 AM
   Second Reading + 6 parts in 10^{11} at 4:00 PM
   The difference is 2.4 parts in 10^{10} in 6 hours
   $\frac{2.4}{6}$ X 10^{10} = 0.4 parts in 10^{10} per hour

   Frequency change is 0.96 X 10^{9} per day.

4-10. INPUT SENSITIVITY FOR EXTERNAL REFERENCE

SPECIFICATION: 0.2 to 2 volts RMS at 1, 2, 2.5, 5 and 10 MHz.

DESCRIPTION: This test verifies that the Model 8660B will operate with specified reference inputs.

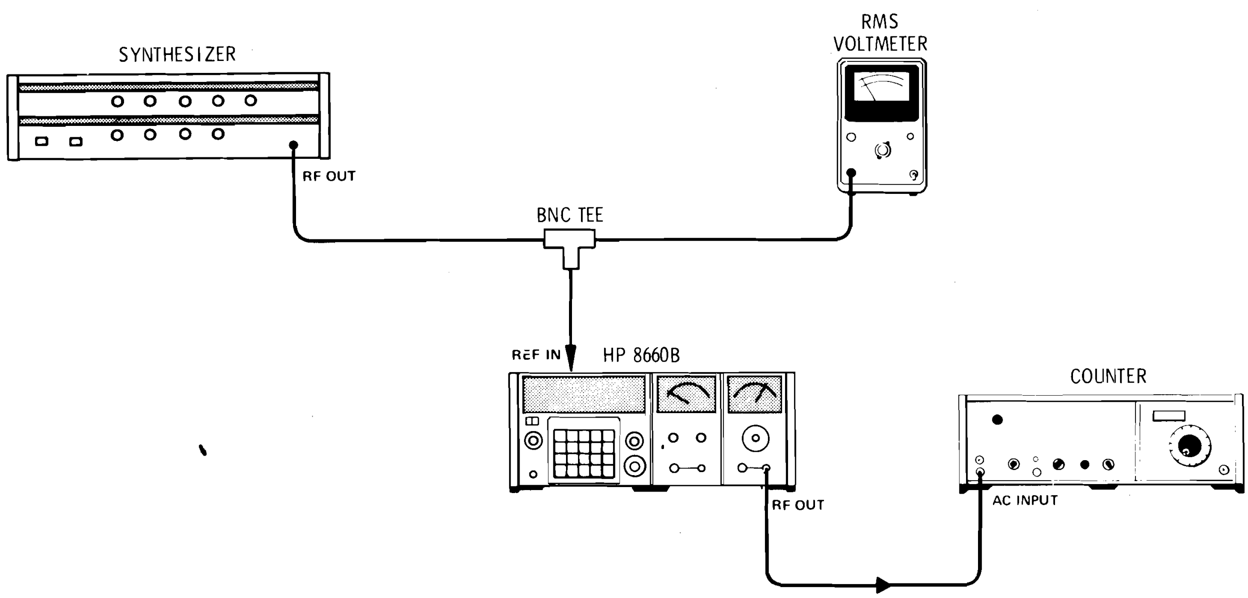


Figure 4-2. Input Reference Sensitivity Test

RECOMMENDED TEST EQUIPMENT:

Electronic Counter	HP 5245M
RMS Voltmeter	HP 411A
Synthesizer	HP 3320B

PERFORMANCE TESTS

4-10. INPUT SENSITIVITY FOR EXTERNAL REFERENCE (cont'd)

PROCEDURE:

1. Connect the Synthesizer to the Model 8660B REFERENCE INPUT (J1) and set the SELECTOR switch S1 to EXT.
2. Set the Synthesizer controls to provide an output of 1 MHz at .2 Vrms as indicated on the rms voltmeter.
3. Connect the Counter to the output of the RF Section in use and enter a 5 MHz center frequency. The Counter readout should be about 5 MHz. (Actual frequency will be determined by stability and settability of the Synthesizer used.)
4. Readjust the Synthesizer output to 2 Vrms. The counter readout should remain at about 5 MHz.
5. Repeat steps 2 through 4 with the Synthesizer set to 2, 2.5, 5 and 10 MHz.

4-11. REFERENCE OUTPUT CHECKS

SPECIFICATION: About 1 Vrms in internal. When an external reference is used the output reference level will be approximately the same as the input from the external reference.

DESCRIPTION: This test verifies proper operation of the reference amplifier and relay switching circuits.

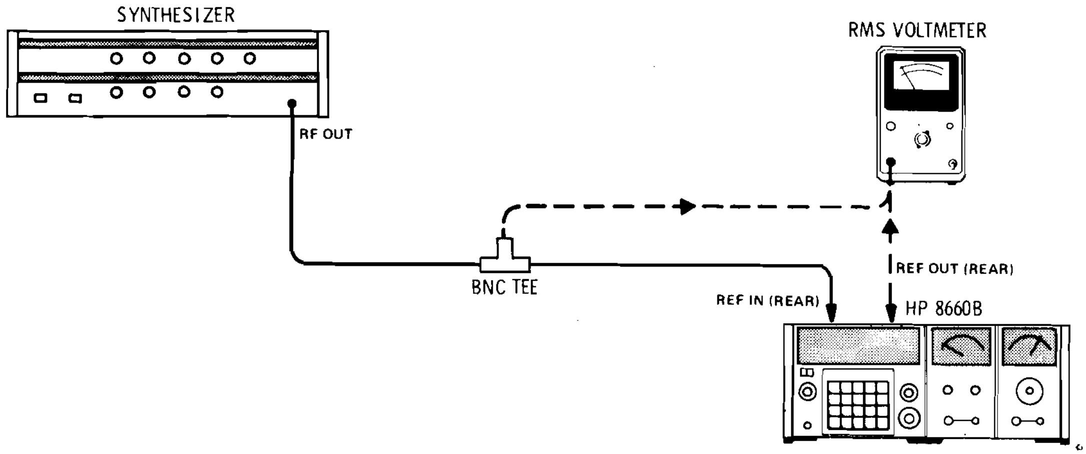


Figure 4-3. Reference Output Test Setup

RECOMMENDED TEST EQUIPMENT:

RMS Voltmeter	HP 411A
Synthesizer	HP 3320B

PROCEDURE:

1. Connect the RMS Voltmeter to the REFERENCE OUTPUT (J2) and the Synthesizer to the REFERENCE INPUT (J1).
2. With the SELECTOR switch (S1) set in the INT position the RMS Voltmeter should display a signal about 1 volt in amplitude.

PERFORMANCE TESTS

4-11. REFERENCE OUTPUT CHECK (cont'd)

3. Set the SELECTOR switch to EXT and the Synthesizer for a 1 MHz. 0.2 v rms output as indicated on the RMS Voltmeter (Voltmeter connected to the Synthesizer output with a BNC Tee).
4. Connect the RMS Voltmeter to the REFERENCE OUTPUT (J2) Voltmeter should indicate about 0.2 v rms.
5. Reset the Synthesizer for a 1 v output as indicated on the RMS Voltmeter (Voltmeter connected to the Synthesizer output with a BNC Tee).
6. Connect the RMS Voltmeter to the REFERENCE OUTPUT (J2) Voltmeter should indicate about 1 v rms.
7. Repeat steps 3 through 6 at 2, 2.5, 5 and 10 MHz.

4-12. SWEEP OUTPUT

SPECIFICATION: 0 to +5V stepped ramp output.

DESCRIPTION: This test verifies that the ramp at the OUTPUT (0-5V) sweep ramp output is from 0 to +5V.

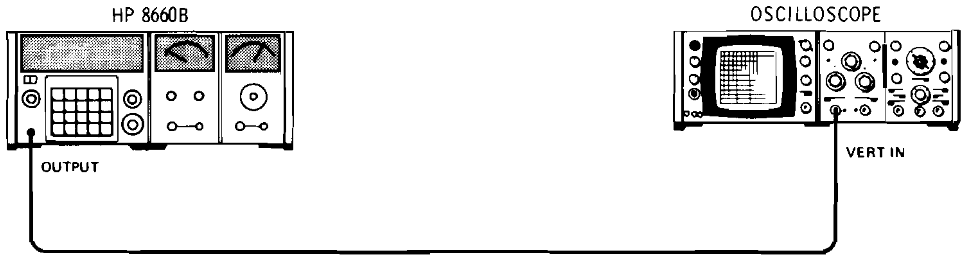


Figure 4-4. Sweep Output Test Setup

RECOMMENDED TEST EQUIPMENT:
Oscilloscope (with 10:1 divider probe) . . . . HP 180A/1801A/1820A

PROCEDURE:
1. Connect the oscilloscope vertical input to the OUTPUT (0-5V) jack on the front panel of the Model 8660B.
2. Set the oscilloscope vertical sensitivity to 2V/Div and the sweep speed to 20 mSec/Div.
3. Enter a center frequency of 5 MHz in the Model 8660B keyboard, set SWEEP MODE to AUTO and SWEEP MODE RATE switch to FAST.
4. The oscilloscope should display a sweep ramp from 0 to +5V in 100 milliseconds.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments and checks required to return the Model 8660B to peak operating capabilities when repairs have been made. Included in this section are test setups and procedures and a test table (Table 5-10) for recording initial data for future reference. Adjustment locations are identified pictorially on Section VIII foldout Service Sheets referred to in the individual tests.

5-3. Except for the power supply test procedures, which should be performed before repairs are made to any part of the instrument, the test procedures are arranged in the same sequence as the Service Sheets to which they refer.

5-4. Data taken while following the adjustment procedures should be recorded in Table 5-10 for comparison purposes when repairs are again required.

5-5. Generally, it will not be necessary to adjust any of the phase lock loops except the one in which the component failure occurred. An exception to this will be when adjustment to any phase lock loop has been attempted while the reference section is not functioning properly.

5-6. RECOMMENDED TEST EQUIPMENT

5-7. Each adjustment procedure in this section contains a list of test equipment and accessories required to perform the procedure. Each test setup identifies test equipment and accessories by callouts.

5-8. Minimum specifications for test equipment used in the adjustment procedures are detailed in Table 1-3. Because the Model 8660B is an extremely accurate instrument, minimum specifications in Table 1-3 are particularly important in performing these adjustment procedures.

5-9. HP 11672A SERVICE KIT

5-10. The HP 11672A Service Kit is an accessory item available from Hewlett-Packard for use in maintaining the Model 8660B Synthesized Signal Generator.

5-11. Table 1-3 contains a detailed description of the Service Kit. Any item in the kit may be ordered separately.

NOTES

a. An RF Section output plug-in must be in place during the tests.

b. If a Modulator Section plug-in is not available, the Model 86631A/B Auxiliary unit must be in place.

c. All tests in which a counter is used should be made with the Model 8660B and the counter referenced to the same source. If the Hewlett-Packard Model 5245M Electronic counter is used, the Model 8660B internal reference may be used as the source.

5-12. CHECKS AND ADJUSTMENTS

ADJUSTMENTS

5-13. POWER SUPPLY CHECKS AND ADJUSTMENTS

REFERENCE: Service Sheet 24.

DESCRIPTION: The power supplies in the Model 8660B provide regulated outputs of +20 volts, +5.25 volts, −10 volts and −40 volts. Unregulated supplies provide +30 volts, +21 volts, +4 volts and −21 volts. These checks verify proper operation of the power supplies.

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter . . . . HP 3440A/3443A
AC Microvoltmeter . . . . HP 3410A
Variable Voltage Transformer . . . . General Radio W5MT3A

PROCEDURE:

1. Remove the top and bottom covers of the Model 8660B and connect the instrument to the ac line through the variable voltage transformer.

2. Use the digital voltmeter and the ac microvoltmeter to check voltages, tolerances and ripple at A20 test points specified in Table 5-1. Adjust the variable voltage transformer to check tolerance of the power supplies at ±10% line voltage variations.

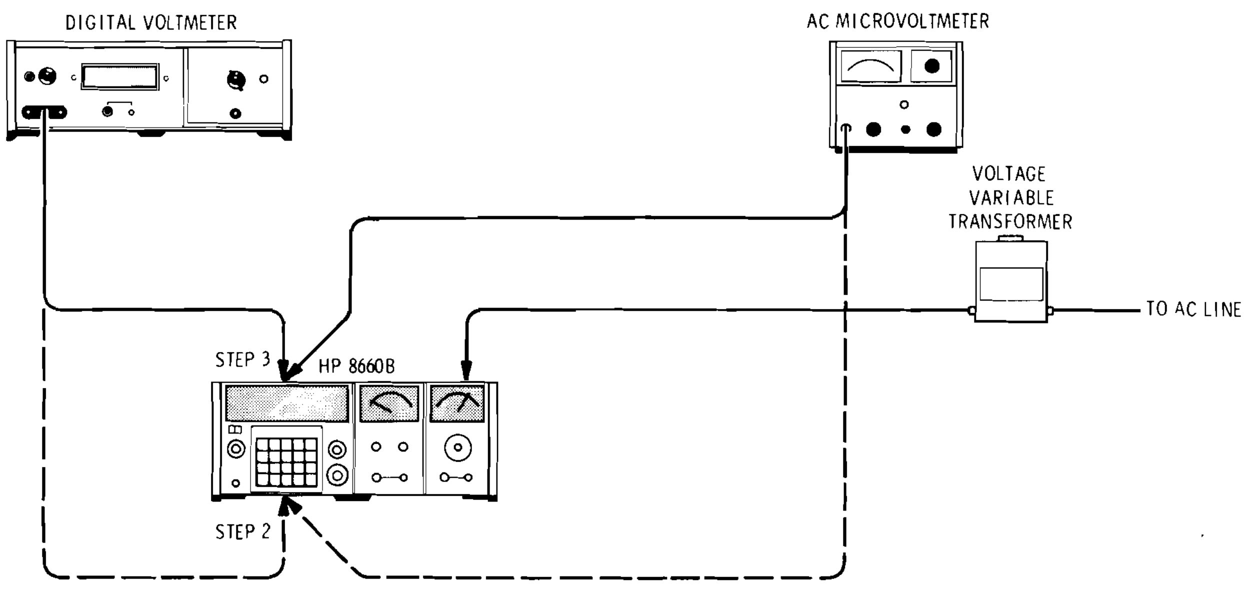


Figure 5-1. Power Supply Test Setup

ADJUSTMENTS

5-13. POWER SUPPLY CHECK AND ADJUSTMENTS (cont'd)

Table 5-1. Unregulated Power Supplies

Test Location	Voltage at normal line	Tolerance high to low line (from normal line)	rms Ripple 120 Hz (at normal line)
+ side of A20 C7	Typical +4.4 V	Specified ± .6 V	Specified 3 mV rms
	Actual	Actual	Actual
+ side of A20C4	Typical +20.5 V	Specified ± 2.4 V	Specified 300 mV rms
	Actual	Actual	Actual
—side of A20C5	Typical —20.5V	Specified ± 2.4 V	Specified 300 mV rms
	Actual	Actual	Actual
+side of A20C1	Typical + 33 V	Specified ± 4 V	Specified 600 mV rms
	Actual	Actual	Actual

3. Use the digital voltmeter and the ac microvoltmeter to check for voltages, tolerances and 120 Hz ripple at A5 test points specified in Table 5-2. Adjust the dc levels shown in Table 5-2 with controls specified in Table 5-2, then adjust the variable voltage transformer to check tolerance of the power supplies at ± 10% of the normal line voltage.

NOTE

If voltages are out of tolerance and cannot be brought into tolerance by adjustment, or if ripple is excessive, refer to Service Sheet 24 and repair as required. The power supply circuit boards are also available on an exchange basis. Troubleshooting to the board or assembly level may be accomplished with the aid of the troubleshooting tree for the power supplies.

Table 5-2. Regulated Power Supplies

Test Point	Adjust Control	Voltage at Normal Line Specified	Tolerance High to Low Line Specified	rms Ripple 120 Hz (Normal Line)
A5TP4	A5R24	+5.25 V	± 20 mV	125 μV
	+5 ADJ	Actual	Actual	Actual
A5TP2	A5R26	—10.0 V	± 5 mV	50 μ V
	—10 ADJ	Actual	Actual	Actual
A5TP3	A5R21	+20.0 V	± mV	50 μV
	+20 ADJ	Actual	Actual	Actual
A5TP1	A5R28	—40.0 V	± 20 mV	50 μV
	—40 ADJ	Actual	Actual	Actual

ADJUSTMENTS

5-14. REFERENCE SECTION, CHECKS AND ADJUSTMENTS

REFERENCE: Service Sheets 2 and 3.

DESCRIPTION: The reference section contains a voltage controlled master oscillator from which all rf signals generated in the Model 8660B mainframe are derived. The master oscillator is phase locked to an internal temperature controlled crystal oscillator or to an external standard. The reference section provides outputs of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz and 100 kHz. These checks verify proper operation of the circuits within the reference section.

RECOMMENDED TEST EQUIPMENT:

VLF Comparator	HP 117A
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1820A
Spectrum Analyzer	HP 140/8554L/8552
Electronic Counter	HP 5245M/5253B

PROCEDURE:

1. **Internal Reference Accuracy Adjustment (See Figure 5-2) (Allow adequate warm up time).**

   a. Remove the Model 8660B top cover and connect the 100 kHz output from the A4A1 assembly to the 100 kHz input of the VLF Comparator.

   b. Remove the left side panel from the Model 8660B.

   c. Remove the cap screw to provide access to the adjustment point of the A21 Crystal oscillator assembly.

   d. Refer to Section III of the VLF Comparator Operating and Service manual for operating instructions and align the Model 8660B A21 assembly.

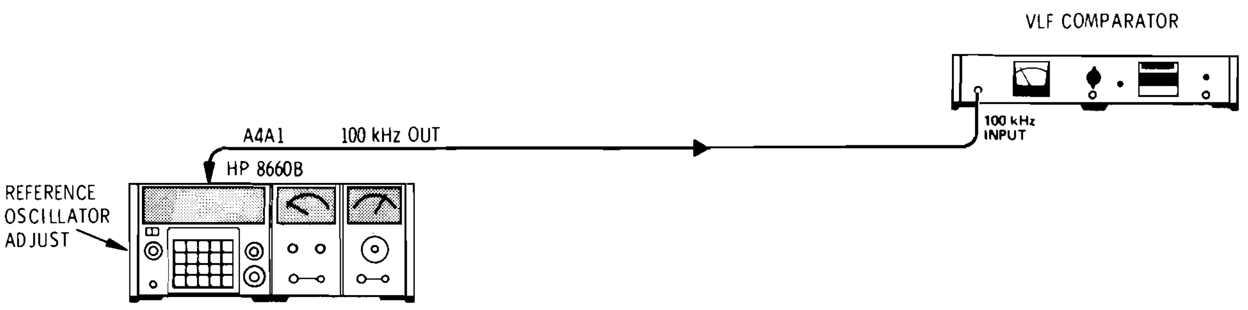


Figure 5-2. Reference Accuracy Adjustment

NOTE

If the VLF Comparator is not available, and an accurate house standard is, the reference oscillator may be adjusted by using an oscilloscope for comparison of the two signals.

2. **Alternate Reference Accuracy Adjustment (See Figure 5-3).**

   a. Use the house standard to trigger the oscilloscope and connect the reference output from the Model 8660B rear panel reference output to the oscilloscope vertical input.

ADJUSTMENTS

5-14. REFERENCE SECTION CHECKS AND ADJUSTMENTS (cont'd)

b. Observe the 10 MHz sine wave on the oscilloscope and adjust the A21 oscillator until the oscilloscope display stops drifting.

c. Set the oscilloscope to sweep at .1 μSec/Division and the sweep magnifier to X10. If drift is observed readjust the A21 oscillator.

NOTE

When the oscilloscope display drift is less than 1 division in 10 seconds the Model 8660B reference is set within 1 part in 10^9 of the house standard.

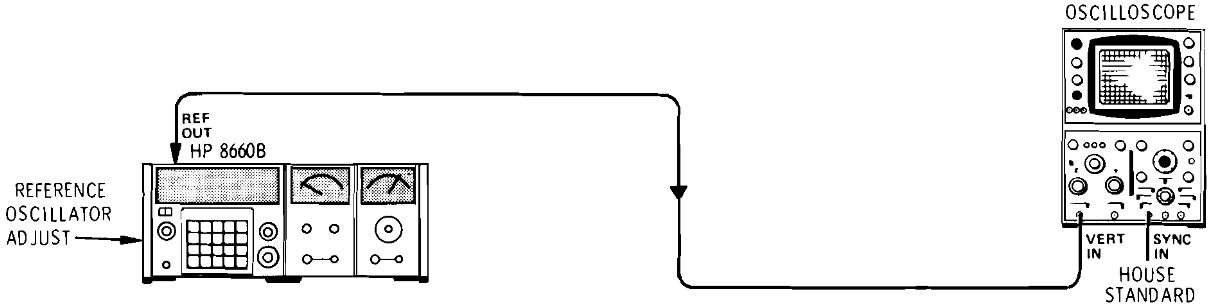


Figure 5-3. Alternate Reference Accuracy Adjustment

3. 100 MHz Output Adjustment

a. Connect the electronic counter to the 100 MHz output on the A4A4 assembly. (See Figure 5-4).

b. If the internal reference is being used, place the rear panel INT/EXT switch in the EXT position to open the 100 MHz phase lock loop. (If an external reference is being used, disconnect the source).

c. Allow 15 minutes warmup time for the oscillator to stabilize and adjust A4A4C2 for a counter readout of 100.000 MHz ± 20 kHz. Disconnect the electronic counter.

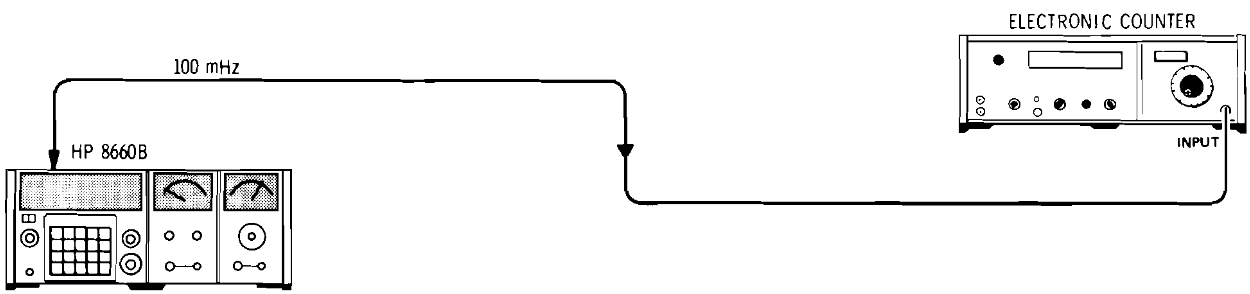


Figure 5-4. 100 MHz Adjustment

d. Connect the Spectrum Analyzer RF INPUT to the 100 MHz output of the A4A4 assembly and tune the Spectrum Analyzer CENTER FREQUENCY to 100 MHz. The 100 MHz signal should be > +10 dBm. (See Figure 5-5).

ADJUSTMENTS

5-14. REFERENCE SECTION CHECKS AND ADJUSTMENTS (cont'd)

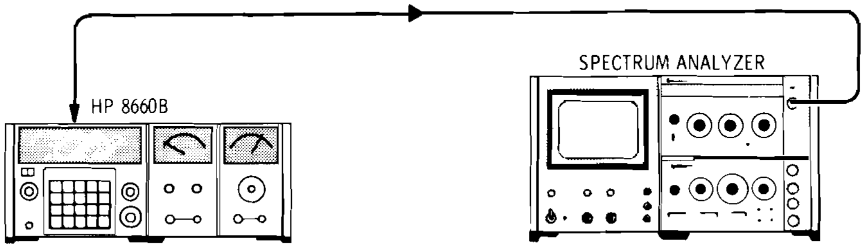


Figure 5-5. RF Level Checks

e. Disconnect the Spectrum Analyzer and enable the 100 MHz phase lock loop by returning the INT/EXT switch to INT or by reconnecting the external standard.

4. 500 MHz Output Adjustment

a. Connect the Spectrum Analyzer RF INPUT to the 500 MHz output connector on the A4A4 assembly and tune the analyzer to 500 MHz. Set the analyzer scan width to 50 MHz per division and other analyzer controls for a clear display. (See Figure 5-5).

b. Adjust A4A4C17, A4A4C23 and A4A4C31 for a peak amplitude of the 500 MHz signal. The 500 MHz signal amplitude should be > +3 dBm. The 400 MHz signal is typically < —10 dBm. The 600 MHz signal is typically < —20 dBm. Disconnect the analyzer.

500 MHz dBm
400 MHz dBm
600 MHz dBm

5. 20 MHz Output Check

a. Connect the Spectrum Analyzer RF INPUT to the 20 MHz output on the A4A4 assembly and tune the analyzer to 20 MHz. The 20 MHz signal should be > —6 dBm and < —2 dBm. Disconnect the analyzer.

20 MHz dBm

6. Reference Section Outputs Not Previously Checked.

a. Check the outputs listed in Table 5-3 for the levels shown (See Figure 5-6).

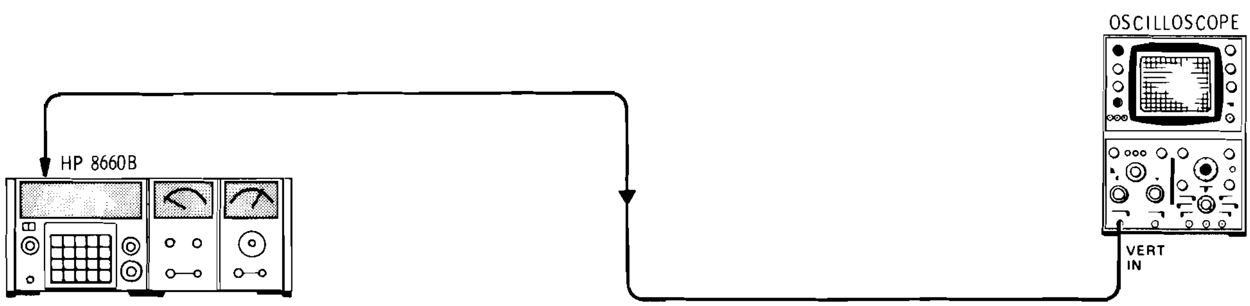


Figure 5-6. Oscilloscope Level Checks

ADJUSTMENTS

5-14. REFERENCE SECTION CHECKS AND ADJUSTMENTS (cont'd)

Table 5-3. Reference Section Output Levels

Test Point	Frequency	Specified Level	Actual Level
A4A4J1	10 MHz	> 1 v p/p	—
A4A1J1	2 MHz	> 2.2 v p/p	—
A4A1J3	400 kHz	> 2.2 v p/p < 5.0 v	—
A4A1J2	100 kHz	> 2.2 v p/p < 5.0 v	—
A4A1J4	100 kHz	> 2.2 v p/p < 5.0 v	—

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS

REFERENCE: Service Sheets 4, 5 and 6.

DESCRIPTION: The High Frequency Section contains a voltage controlled oscillator which provides eleven discrete output frequencies from 350 to 450 MHz in 10 MHz steps. The output of the voltage controlled oscillator is phase locked to a 10 MHz reference derived from the master oscillator in the reference section. The output from the HF section is used in the RF section plug-in or in the internal extension plug-in module. These checks verify proper operation of the High Frequency Section circuits.

RECOMMENDED TEST EQUIPMENT:

Electronic Counter . . . . HP 5245M/5253B
Digital Voltmeter . . . . HP 3440A/3443A
Pulse Generator . . . . HP 222A
Spectrum Analyzer . . . . HP 140/8554L/8552/8553
Oscilloscope (with 10:1 divider probes) . . . . HP 180A/1801A/1820A
Signal Generator/Sweeper . . . . HP 8601A

PROCEDURE:

Preliminary: Remove the covers from the A4A7 phase detector assembly and the A4A6 pretune assembly. Tighten the screws holding the A4A5 voltage controlled oscillator assembly cover.

1. **Phase Detector Response Adjustments.**

a. Disconnect the coaxial cable from VCO INPUT A4A7J1. Connect the PULSE OUTPUT of the pulse generator to A4A7J1. Set the pulse generator for 100 kHz pulse rate, .035 μsec pulse width, .5 volt amplitude and + polarity.

b. Connect the Spectrum Analyzer RF INPUT to the phase error output of the A4A7 assembly (white wire going from the A4A7 assembly to the A4A6 assembly). Set the analyzer controls as follows:

CENTER FREQUENCY . . . . 5 MHz
SCAN WIDTH . . . . 1 MHz/Div
SCAN TIME . . . . 1 Msec/Div
Gain and attenuation . . . . as required

ADJUSTMENTS

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS (cont'd)

c. Adjust EFFiciency control A4A7R18 for a flat response to approximately 5 MHz with very slight peaking (1 dB ± 1 dB). See the waveform in Figure 5-7 for typical response.

d. Disconnect the pulse generator and the Spectrum Analyzer.

2. Balance Adjustment.

a. Connect the digital voltmeter to the phase error output of the A4A7 assembly (white wire going from the A4A7 assembly to the A4A6 assembly).

b. Adjust the BALance control (A4A7R22) for a reading of 0 volts ± .05 volt. Disconnect the digital voltmeter.

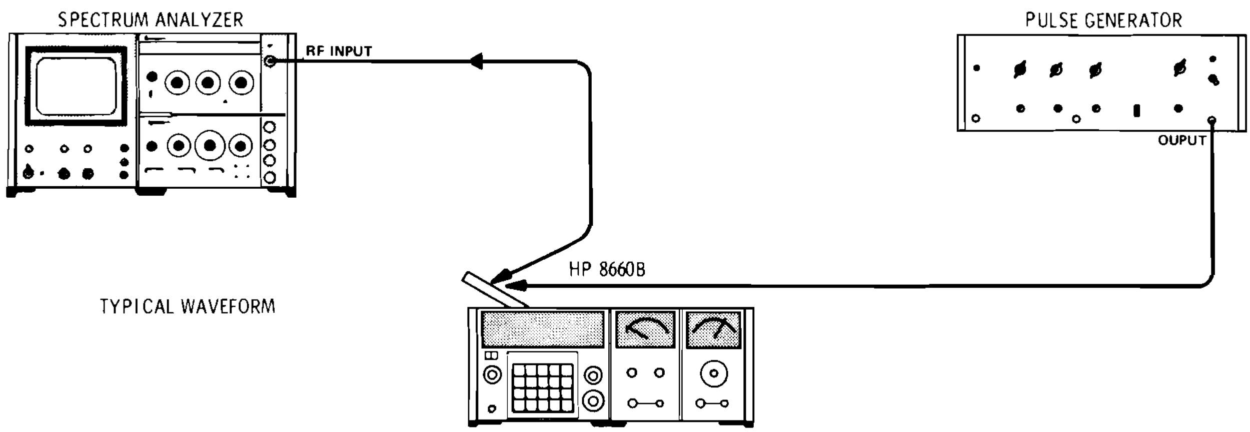


Figure 5-7. Phase Detector Response Adjustment

3. Voltage controlled oscillator adjustment. (See Figure 5-8).

a. With the output cable of the A4A5 assembly disconnected from the VCO OUTPUT, connect the digital voltmeter to the A4A6 FREQuency control output (white lead).

b. Adjust the A4A6 "0" control (A4A6R13) for a digital voltmeter reading of —34 volts (voltage should be adjustable from about —33 to —35 volts).

c. Connect the electronic counter to the A4A5 voltage controlled oscillator output, A4A5J1. Remove the cover from the A4A5 assembly.

ADJUSTMENTS

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS (cont'd)

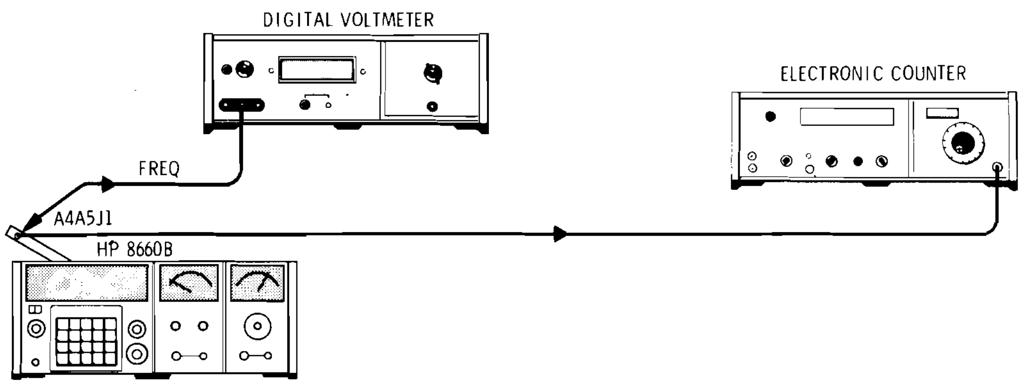


Figure 5-8. Voltage Controlled Oscillator Adjustments

d. Replace the A4A5 cover and hold firmly against the casting. The counter should display 450 MHz ± 1 MHz. If the correct reading is obtained proceed to step f. If the frequency reading is not correct proceed to step e.

e. Adjust capacitor C3 (on A4A5) for a 450 MHz ± 1 MHz counter reading. Replace the A4A5 cover and hold firmly in place to take this reading.

f. Disconnect the electronic counter and reconnect the voltage controlled oscillator output to the phase detector. Fasten the A4A5 cover in place.

g. Connect the digital voltmeter to the lead labeled ∅ from the A4A7 assembly to the A4A6 assembly. Connect the electronic counter to A4A5J2 (350-450 MHz OUTPUT).

h. Set the center frequencies as shown in Table 5-4 and set the digital to analog controls on the A4A6 assembly for 0 ± 0.1 volt for each frequency listed. Note that the counter displays the output frequency listed for each center frequency setting.

ADJUSTMENTS

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS (cont'd)

Table 5-4. Pretune Adjustments

Center Frequency	Adjust Control	Counter Readout
0 MHz	A4A6R13 "0"	450.000000 MHz
10 MHz	A4A6R60 "1"	440.000000 MHz
20 MHz	A4A6R56 "2"	430.000000 MHz
30 MHz	A4A6R52 "3"	420.000000 MHz
40 MHz	A4A6R48 "4"	410.000000 MHz
50 MHz	A4A6R40 "5"	400.000000 MHz
60 MHz	A4A6R40 "6"	390.000000 MHz
70 MHz	A4A6R35 "7"	380.000000 MHz
80 MHz	A4A6R28 "8"	370.000000 MHz
90 MHz	A4A6R22 "9"	360.000000 MHz
100 MHz	A4A6R15 "10"	350.000000 MHz

i. If any of the controls listed in Table 5-4 cannot be adjusted to 0 volts, adjust A4A6R20 "profile" to obtain additional range. Repeat all pretune adjustments until satisfactory results are obtained. Disconnect the digital voltmeter and the electronic counter.

4. Loop Gain Adjustment. (See Figure 5-9).

a. With the center frequency set to 0 MHz connect the Spectrum Analyzer RF INPUT to A4A5J2 (350-450 MHz OUTPUT) and set the analyzer controls as follows:

CENTER FREQUENCY . . . . 450 MHz
BANDWIDTH . . . . 30 kHz
SCAN WIDTH . . . . 5 MHz/Div
SCAN TIME . . . . 5 Msec/Div

b. Disconnect the reference input to A4A7J2 and reconnect it together with the rf output of the Signal Generator/Sweeper.

c. Set the Signal Generator/Sweeper to 11.5 MHz CW at —35 dBm and symmetrical sweep width to 3 MHz. The analyzer display should be approximately as shown in the typical waveform shown in Figure 5-9. Adjust the A4A6 GAIN control (A4A6R2) for the response shown.

d. Disconnect the Analyzer and the Generator/Sweeper. Reconnect the reference signal to A4A7J2.

ADJUSTMENTS

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS (cont'd)

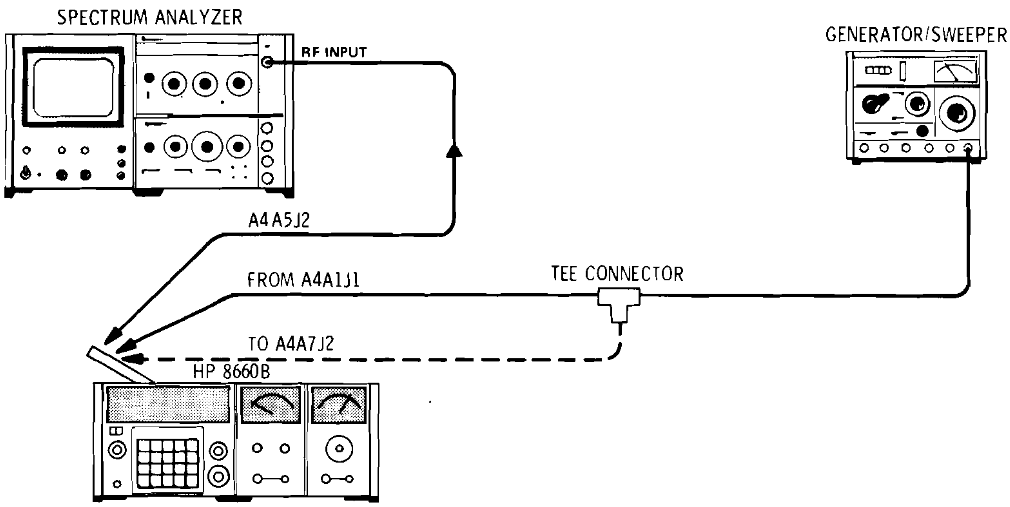


Figure 5-9. Loop Gain Adjustment

5. 10 MHz Trap Adjustment. (See Figure 5-10).

a. Disconnect the coaxial cable from A4A5J1.

b. Disconnect the 10 MHz reference signal from A4A7J2 and reconnect it using a TEE connector. Connect the 10 MHz reference signal from the other TEE port to the Ø input of the A4A6 pretuning assembly (white wire from the A4A7 assembly).

c. Connect the Spectrum Analyzer RF INPUT to the A4A6 FREQuency control output (white-black-violet wire). Set the analyzer controls as follows:

CENTER FREQUENCY	10 MHz
BANDWIDTH	30 kHz
SCAN WIDTH	200 kHz/Div
VIDEO FILTER	OFF
INPUT ATTENUATION	0 dB
SCAN TIME	1 Msec/Div
REF LEVEL	–30 dBm

d. Adjust A4A6C5 for minimum amplitude of the 10 MHz signal.

e. Remove the input to the Ø input from A4A6 and the TEE connector. Reconnect the reference signal to A4A5J1 and disconnect the Spectrum Analyzer.

f. Replace all High Frequency Section covers.

ADJUSTMENTS

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS (cont'd)

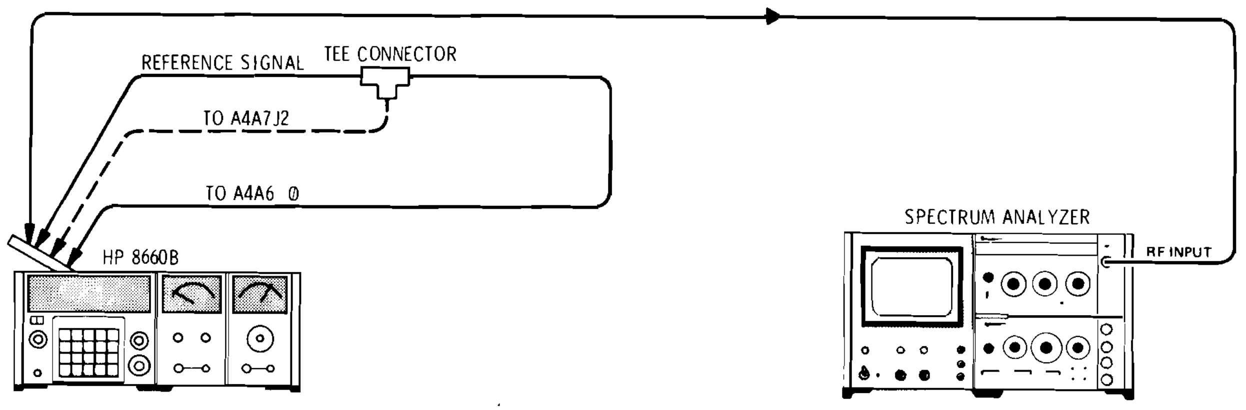


Figure 5-10. 10 MHz Trap Adjustment

6. Output Frequency and Amplitude Check. (See Figure 5-11).

a. Connect the Spectrum Analyzer RF INPUT to A4A5J2. Set the analyzer controls as required to view the 450 MHz signal. (Center frequency 0 MHz). The output should be +13 dBm to +15 dBm.

dBm ____________________

b. Change center frequency in 10 MHz steps from 0 MHz to 100 MHz. The frequency should decrease in 10 MHz steps (amplitude remains at +13 dBm minimum).

440 MHz	dBm	430 MHz	dBm	420 MHz	dBm
410 MHz	dBm	400 MHz	dBm	390 MHz	dBm
380 MHz	dBm	370 MHz	dBm	360 MHz	dBm
350 MHz	dBm				

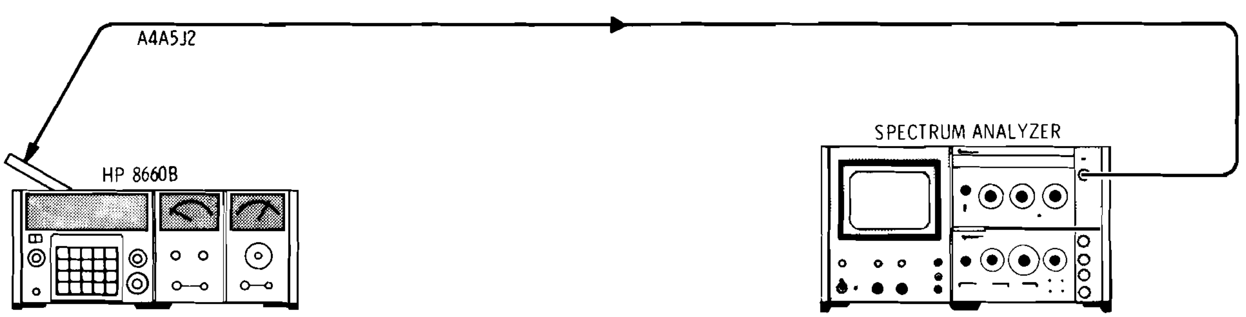


Figure 5-11. Output Amplitude Check

ADJUSTMENTS

5-16. N1 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS

REFERENCE: Service Sheets 7 and 8.

DESCRIPTION: The N1 phase lock loop produces digitally controlled rf signals from 19.8 to 29.7 MHz in 100 kHz steps. The output frequency is selected by 100 kHz and 1 MHz steps. These checks verify proper operation of the loop circuits.

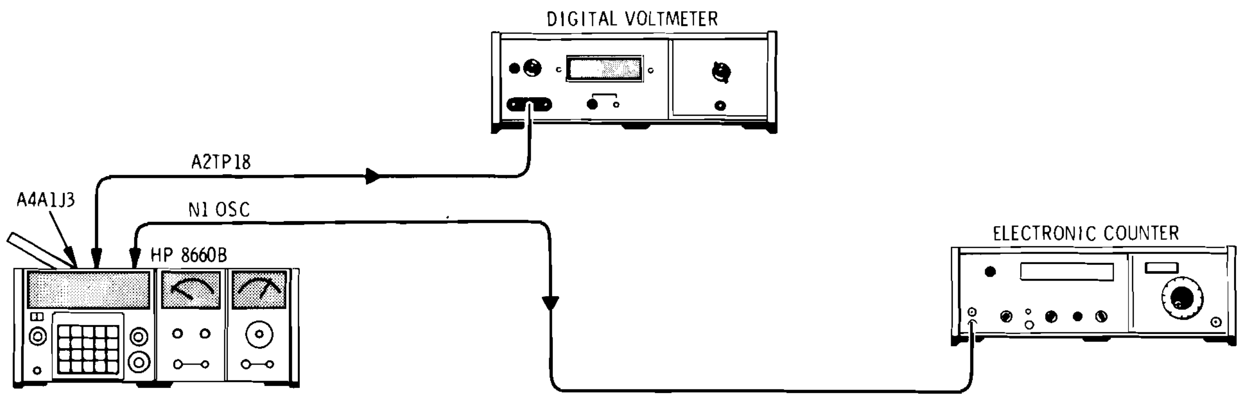


Figure 5-12. N1 Loop Test Setup

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter	HP 3440A/3443A
Electronic Counter	HP 5245M/5253B

PROCEDURE: (See Figure 5-12).

1. Enter 0 MHz center frequency and ground motherboard test point A2TP16 with one of the jumper plugs provided. Connect the digital voltmeter to A2TP18.

2. Adjust A17R31 or A17R28 for a voltmeter reading of −30 volts and disconnect the digital voltmeter.

3. Connect the electronic counter to the N1 oscillator output on the A2 mother board and adjust A17C17 for a counter reading as close as possible to 29.7 MHz (must be within ± 200 kHz).

4. Enter 500 kHz center frequency and adjust A17R28 or A17R31 for a counter reading of 29.2 MHz.

5. Enter 9.5 MHz center frequency and record the counter readout.

   MHz ________________

6. Determine the frequency difference between the readout for step 5 and 20.2 MHz and record.

   MHz ________________

7. Enter 500 kHz center frequency.

   a. If the reading in step 5 was higher than 20.2 MHz adjust A17R28 for a counter readout of 29.2 MHz plus the difference frequency recorded in step 6.

5-16. N1 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS (cont'd)

b. If the reading in step 5 was lower than 20.2 MHz adjust A17R28 for a counter readout of 29.2 MHz minus the difference frequency recorded in step 6.

c. Adjust A17R31 for an output frequency readout of 29.2 MHz.

8. Repeat steps 5 through 7 until the counter readout is 29.2 MHz ±20 kHz for a 500 kHz center frequency and 20.2 MHz ± 20 kHz for a 9.5 MHz center frequency.

9. Remove the ground jumper from A2TP16.

10. Disconnect the 400 kHz reference signal by disconnecting the cable from A4A1J3 and connect the digital voltmeter to A2TP17. Adjust A16R38 for a digital voltmeter readout of 0 v ± 10 mV. Reconnect the 400 kHz reference signal.

11. Enter center frequencies shown in Table 5-5. The counter readings should be as shown in the table.

Table 5-5. N1 Loop Output Frequency Checks

Center Frequency	Counter Readout
0	29.700000 MHz
1.1 MHz	28.600000 MHz
2.2 MHz	27.500000 MHz
3.3 MHz	26.400000 MHz
4.4 MHz	25.300000 MHz
5.5 MHz	24.200000 MHz
6.6 MHz	23.100000 MHz
7.7 MHz	22.000000 MHz
8.8 MHz	20.900000 MHz
9.9 MHz	19.800000 MHz

ADJUSTMENTS

5-17. N2 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS

NOTE

Option 004 instruments use a different N2 programmable divider designated as N2a. In the the following procedure the frequencies shown in parenthesis apply to N2a.

REFERENCE: Service Sheets 9 and 10.

DESCRIPTION: The N2 phase lock loop produces controlled rf signals from 19.80 to 29.79 MHz in 10 kHz increments. The output frequency selected by the 100Hz, 1 kHz and 10 kHz steps. These checks verify proper operation of the loop circuits.

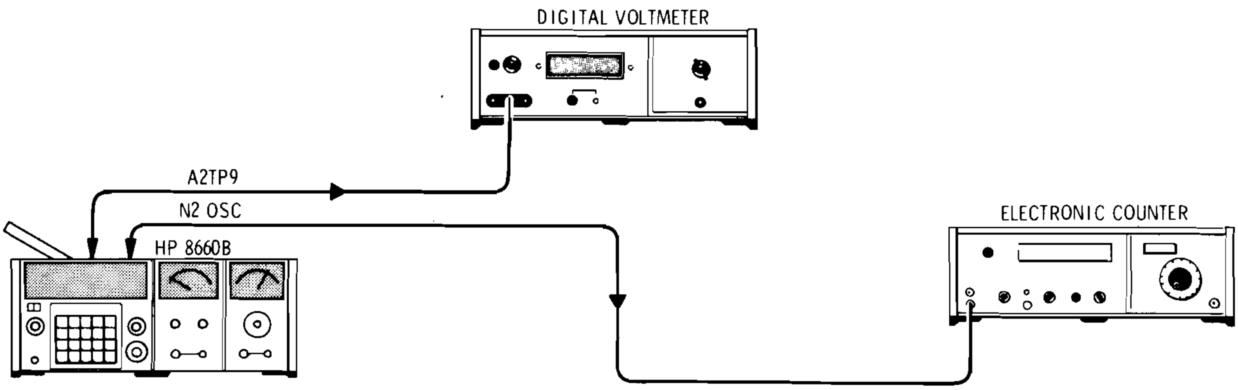


Figure 5-13. N2 Loop Test Setup

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter	HP 3440A/3443A
Electronic Counter	HP 5245M/5253B

PROCEDURE: (See Figure 5-13).

1. Set the center frequency to 0 MHz and ground A2TP12 on the mother board with one of the jumper plugs provided.

2. Connect the digital voltmeter to A2TP9 and adjust A13R37 or A13R39 to —30 volts. Disconnect the digital voltmeter.

3. Connect the electronic counter to the N2 oscillator output at XA13-1-4. Adjust A13C19 for a counter reading as close as possible to 29.79 MHz (N2a 30.00 MHz) (must be within ± 200 kHz).

4. Set the center frequency to 5.5 kHz. Adjust A13R37 or A13R39 for an output frequency reading of 29.250 MHz. (N2a 29.450 MHz).

5. Set the center frequency to 95.5 kHz and record the counter readout.

   MHz

6. Determine the frequency difference between step 5 and 20.25 MHz (N2a 20.450 MHz) and record:

   MHz

ADJUSTMENTS

5-17. N2 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS (cont'd)

7. Set the center frequency to 5.5 kHz.

   a. If the reading in step 5 was more than 20.25 MHz (N2a 20.45 MHz) adjust A13R39 to 29.25 MHz (N2a 29.45 MHz) plus the difference frequency recorded in step 6.

   b. If the reading in step 5 was less than 20.25 MHz (N2a 20.45 MHz) adjust A13R39 to 29.25 MHz (N2a 20.45 MHz) minus the difference frequency recorded in step 6.

   c. Adjust A13R37 for an output frequency of 29.25 MHz (N2a 29.45 MHz).

8. Repeat steps 4 through 7 until the counter readout is 29.25 MHz (N2a 29.45 MHz) ±20 kHz for a center frequency of 20.25 MHz (N2a 20.45 MHz) ±20 kHz for a center frequency of 95.5 kHz.

9. Remove the ground from A2TP12.

10. Set center frequency as shown in Table 5-6. The counter readings should be as shown in the table.

Table 5-6. N2 Oscillator Output Frequency Checks

Center Frequency	Counter Readout N2	Counter Readout N2a
0	29.790000 MHz	30.000000 MHz
11.1 kHz	28.680000 MHz	28.890000 MHz
22.2 kHz	27.570000 MHz	27.780000 MHz
33.3 kHz	26.460000 MHz	26.670000 MHz
44.4 kHz	25.350000 MHz	25.560000 MHz
55.5 kHz	24.240000 MHz	24.450000 MHz
66.6 kHz	23.130000 MHz	23.340000 MHz
77.7 kHz	22.020000 MHz	22.230000 MHz
88.8 kHz	20.910000 MHz	21.120000 MHz
99.9 kHz	19.800000 MHz	20.010000 MHz

ADJUSTMENTS

5-18. N3 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS

NOTE

Option 004 instruments do not include the N3 loop.

REFERENCE: Service Sheets 11 and 12.

DESCRIPTION: The N3 phase lock loop produces digitally controlled rf signals from 2.001 to 2.100 MHz in 1 kHz increments. The output frequency is selected by 1 Hz and 10 Hz steps. These checks verify proper operation of the loop circuits.

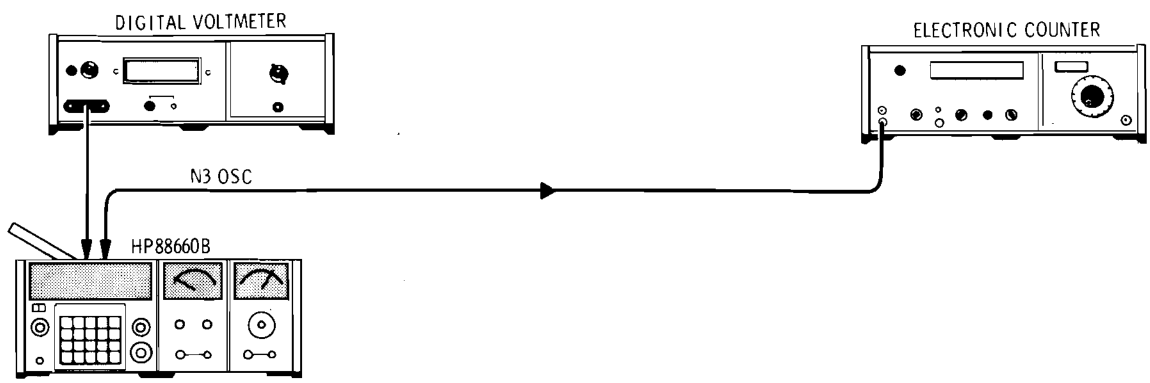


Figure 5-14. N3 Loop Test Setup

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter	HP 3440A/3443A
Electronic Counter	HP 5245M/5253B

PROCEDURE: (See Figure 5-14).

1. Set center frequency to 0 and ground A2TP4 on the mother board with one of the jumper plugs provided.

2. Connect the counter to the N3 oscillator output at XA8-1-4 on the mother board. Adjust A8R26 or A8R24 for a counter readout of 2.100 MHz.

3. Set the center frequency to 5 Hz. Adjust A8R24 for a counter reading of 2.095 MHz. (Must be within ± 20 kHz).

4. Set the center frequency to 95 Hz, and record the frequency displayed on the counter.

   MHz

5. Determine the frequency difference between that recorded in step 4 and 2.005 MHz and record.

   MHz

6. Set the center frequency to 5 Hz.

   a. If the reading in step 4 was less than 2.005 MHz adjust A8R24 to 2.095 MHz minus the frequency difference recorded in step 5.

ADJUSTMENTS

5-18. N3 PHASE LOCK LOOP CHECKS AND ADJUSTMENTS (cont'd)

b. If the reading in step 4 was more than 2.005 MHz adjust A8R24 to 2.095 MHz plus the frequency difference recorded in step 5.

c. Adjust A8R26 for an output frequency of 2.095 MHz.

7. Repeat steps 3 through 6 until the counter readout is 2.095 MHz ± 20 kHz for a 5 Hz center frequency, and 2.005 MHz ± 20 kHz for a 95 Hz center frequency.

8. Remove the ground from A2TP4.

9. Set center frequencies as shown in Table 5-7. The counter readings should be as shown in the table.

Table 5-7. N3 Oscillator Output Frequency Checks

Center Frequency	Counter Readout
0 Hz	2.1000000 MHz
11 Hz	2.0890000 MHz
22 Hz	2.0780000 MHz
33 Hz	2.0670000 MHz
44 Hz	2.0560000 MHz
55 Hz	2.0450000 MHz
66 Hz	2.0340000 MHz
77 Hz	2.0230000 MHz
88 Hz	2.0120000 MHz
99 Hz	2.0010000 MHz

5-19. SUMMING LOOP 2 CHECKS AND ADJUSTMENTS

NOTE

Option 004 instruments do not include SL2

REFERENCE: Service Sheets 13 and 14.

DESCRIPTION: SL2 is a phase lock loop that provides a digitally controlled rf output to Summing Loop 1. This output, which is from 20.0001 to 30.000 MHz in 100 Hz steps, is controlled by 100 Hz, 1 kHz and 10 kHz steps; it is also indirectly controlled by 1 Hz and 10 Hz steps. These checks verify proper operation of the loop circuits.

ADJUSTMENTS

5-19. SUMMING LOOP 2 CHECKS AND ADJUSTMENTS (cont'd)

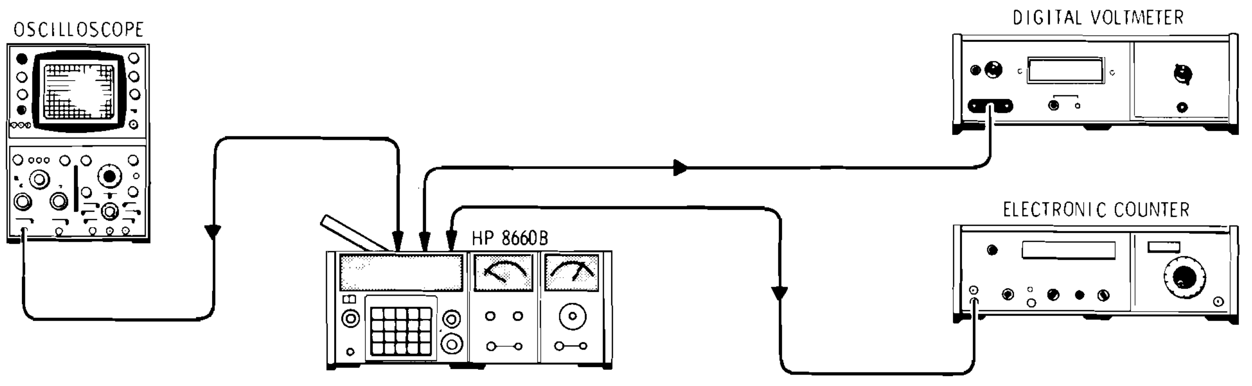


Figure 5-15. SL1 and SL2 Test Setup

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter . . . . HP 3440A/3443A
Electronic Counter . . . . HP 5245M/5253B
Oscilloscope (with 10:1 divider probes) . . . . HP 180A/1801A/1820A

PROCEDURE: (See Figure 5-15).

1. Set center frequency to 55.5 kHz.

   a. With the digital voltmeter connected to A2TP8, adjust A11R15 or A11R19 to 0.00 ± 10 millivolts.

   b. With the oscilloscope connected to A2TP7 adjust A12R37 for 50/50 symmetry.

   c. Disconnect the digital voltmeter and the oscilloscope.

2. Connect the digital voltmeter to varactor test point A2TP5, ground mother board test point A2TP8 with a clip lead, and set center frequency to 0.

   a. Adjust A11R15 or A11R19 to read —30 volts on the digital voltmeter and then disconnect the digital voltmeter.

   b. Connect the counter to test point A2TP6 and adjust A11C17 for a counter readout as close to 30 MHz as possible (must be within ± 300 kHz).

3. Set center frequency to 4.5 kHz. Adjust A11R15 or A11R19 for a counter reading of 29.550 MHz.

4. Set center frequency to 94.5 kHz. Record the output at A2TP6 as read on the counter.

   MHz ____________

5. Determine the difference frequency between that recorded in step 4 and 20.5500 MHz and record.

   MHz ____________

ADJUSTMENTS

5-19. SUMMING LOOP 2 CHECKS AND ADJUSTMENTS (cont'd)

a. Set center frequency to 4.5 kHz.

b. If the frequency readout in step 4 was higher than 20.5500 MHz adjust A11R15 to 29.550 MHz plus the difference frequency determined in step 5.

c. If the frequency readout in step 4 was lower than 20.5500 MHz adjust A11R15 to 29.550 MHz minus the difference frequency determined in step 5.

d. Reset the frequency to 29.550 MHz with A11R19.

e. Repeat steps 3, 4 and 5 until the counter indicates 20.550 MHz ± 20 kHz for a center frequency of 94.5 kHz and 29.5500 MHz ± 20 kHz for a center frequency of 4.5 kHz.

6. Set center frequency as shown in Table 5-8. Adjust the controls listed for counter readouts shown.

Table 5-8. SL2 Oscillator Output Frequency Adjustments

Center Frequency	Adjust	Counter Readout
84.5 kHz	A11R39 "8"	21.55 MHz ± 20 kHz
74.5 kHz	A11R54 "7"	22.55 MHz ± 20 kHz
64.5 kHz	A11R60 "6"	23.55 MHz ± 20 kHz
54.5 kHz	A11R67 "5"	24.55 MHz ± 20 kHz
44.5 kHz	A11R73 "4"	25.55 MHz ± 20 kHz
34.5 kHz	A11R77 "3"	26.55 MHz ± 20 kHz
24.5 kHz	A11R83 "2"	27.55 MHz ± 20 kHz
14.5 kHz	A11R90 "1"	28.55 MHz ± 20 kHz

7. Disconnect the counter, remove the ground from A2TP8 and connect the oscilloscope to A2TP7.

8. Set center frequencies as shown in Table 5-8 and adjust the associated potentiometers for 50/50 symmetry as seen on the oscilloscope (all must be within 40/60).

ADJUSTMENTS

5-20. SUMMING LOOP 1 CHECKS AND ADJUSTMENTS

REFERENCE: Service Sheets 15, 16 and 17.

DESCRIPTION: SL1 is a phase lock loop that provides a digitally controlled rf output to the RF Section plug-in. This output, which is from 20.000001 to 30.000000 MHz in 1 Hz steps is pretuned by 1 MHz, 100 kHz and 10 kHz steps and is also indirectly controlled by 1 kHz to 1 Hz steps. These checks verify proper operation of the loop circuits.

NOTE

In Option 004 instruments the SL1 output is 100 Hz steps.

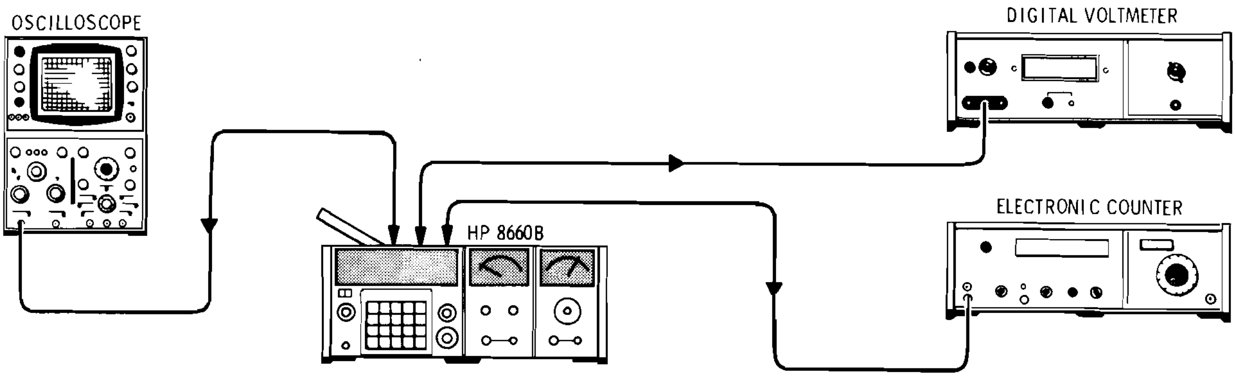


Figure 5-16. SL1 Test Setup

RECOMMENDED TEST EQUIPMENT:

Digital Voltmeter	HP 3440A/3443A
Electronic Counter	HP 5245M/5253B
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1820A

PROCEDURE: (See Figure 5-16).

1. Set center frequency to 5.55 MHz.

   a. With the digital voltmeter connected to A2TP14, adjust A19R3 or A19R9 to 0.00 volt ± 10 millivolts.

   b. With the oscilloscope connected to A2TP13, adjust A15R14 for 50/50 symmetry.

   c. Disconnect the digital voltmeter and the oscilloscope.

2. Connect the digital voltmeter to varactor test point A2TP21, ground mother board test point A2TP14 with the jumper provided, and set center frequency to 0.

   a. Adjust A19R3 or A19R9 to —30 volts and disconnect the digital voltmeter.

   b. Connect the counter to SL1 OSC at XA19-1-2 and adjust A19C18 for a counter readout as close as possible to 30 MHz (must be within ± 300 kHz).

3. Set center frequency to 450 kHz. Adjust A19R3 or A19R9 for a counter reading of 29.550 MHz.

ADJUSTMENTS

5-20. SUMMING LOOP 1 CHECKS AND ADJUSTMENTS (cont'd)

4. Set center frequency to 9.45 MHz. Record frequency of output at SL1 OSC at XA19-1-2.

MHz ________________

5. Determine the difference frequency between that recorded in step 4 and 20.550 MHz and record:

MHz ________________

a. Set center frequency to 450 kHz.

b. If the frequency readout in step 4 was higher than 20.550 MHz adjust A19R3 to 29.550 plus the difference frequency recorded in step 5.

c. If the frequency readout in step 4 was lower than 20.550 MHz adjust A19R3 to 29.55 MHz minus the difference recorded in step 5.

d. Reset the frequency to 29.550 MHz with A19R9.

e. Repeat steps 3 through 5 until the counter indicates 20.550 MHz ± 20 kHz for a center frequency of 9.45 MHz and 29.550 MHz ± 20 kHz for a center frequency setting of 450 kHz.

6. Set center frequency as shown in Table 5-9. Adjust controls listed for counter readouts shown.

Table 5-9. SL1 Oscillator Output Frequency Adjustments

Center Frequency	Adjust	Counter Readout
8.45 MHz	A18R35 “8”	21.550 MHz ± 20 kHz
7.45 MHz	A18R40 “7”	22.550 MHz ± 20 kHz
6.45 MHz	A18R44 “6”	23.550 MHz ± 20 kHz
5.45 MHz	A18R51 “5”	24.550 MHz ± 20 kHz
4.45 MHz	A18R55 “4”	25.550 MHz ± 20 kHz
3.45 MHz	A18R62 “3”	26.550 MHz ± 20 kHz
2.45 MHz	A18R67 “2”	27.550 MHz ± 20 kHz
1.45 MHz	A18R74 “1”	28.550 MHz ± 20 kHz

7. Disconnect the counter, remove the ground from A2TP14 and connect the oscilloscope to A2TP13.

8. Set center frequencies as shown in Table 5-9 and adjust the controls listed for 50/50 symmetry as seen on the oscilloscope. Disconnect the oscilloscope. (All settings must be within 40/60 symmetry.)

ADJUSTMENTS

5-21. DIGITAL CONTROL UNIT (Sweep Output) ADJUSTMENT

REFERENCE: Service Sheet

DESCRIPTION: The Model 8660B sweep output may be used to drive the horizontal sweep of an oscilloscope while the rf output is used to determine the characteristics of a device being tested. This procedure provides information required to properly adjust the sweep ramp.

Figure 5-17. Sweep Ramp Test Setup

RECOMMENDED TEST EQUIPMENT:
Oscilloscope (with 10:1 divider probes) . . . . HP 180A/1801A/1820A

PROCEDURE: (See Figure 5-17).

1. Connect the oscilloscope to the 8660B mainframe OUTPUT (0-5V). Set the oscilloscope vertical sensitivity to 2 V/Div and the sweep speed to 20 Ms/Div.
2. Set the Model 8660B center frequency to 5 MHz, SWEEP MODE switch to AUTO and the SWEEP MODE RATE to FAST.
3. Sweep ramp should go from 0 to +5 volts in 100 milliseconds. Adjust A1A8R4 for a ramp peak of +5 V.
4. Set the SWEEP RATE switch to MED. Set the oscilloscope to 0.2 Sec/Div. Sweep ramp should go from 0 to +5 volts in 1 second.
5. Set the SWEEP RATE switch to SLO. Set the oscilloscope to 1 Sec/Div. The sweep ramp should go from 0 to +5 volts in 10 seconds.

Table 5-10. Adjustments Test Record

Hewlett-Packard
Model 8660B
Synthesized Signal Generator
Serial No. ______________

Tests performed by ______________

Date ______________

5-13. POWER SUPPLIES CHECKS AND ADJUSTMENTS

Power supply	Normal line	Tolerance	Ripple
+4V	______	______	______
+21V	______	______	______
−21V	______	______	______
+30V	______	______	______
+5.25V	______	______	______
−10V	______	______	______
+20V	______	______	______
−40V			

5-14. REFERENCE SECTION CHECKS AND ADJUSTMENTS

Test 3-d. Test 4-b. 500 MHz dBm

Test 5-a. 400 MHz dBm

Test 6-a.	A4A4J1	10 MHz
	A4A1J1	2 MHz
	A4A1J3	400 kHz
	A4A1J2	100 kHz
	A4A1J4	100 kHz

5-15. HIGH FREQUENCY SECTION CHECKS AND ADJUSTMENTS

Test 6-a.	dBm						
Test 6-b.		400 MHz	dBm	430 MHz	dBm	420 MHz	dBm
410 MHz	dBm	400 MHz	dBm	390 MHz	dBm	380 MHz	dBm
370 MHz	dBm	360 MHz	dBm	350 MHz	dBm		

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 is a list of exchange assemblies and Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains names and addresses that correspond to the manufacturer's code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording considerable cost savings. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis, therefore the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number.

6-5. ABBREVIATIONS

6-6. Table 6-2 gives a list of abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are given, one all capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-3 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdown, if appropriate.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) in the instrument.

c. The description of the part.

d. The typical manufacturer of the part in a five-digit code.

e. Manufacturer code number for the part.

The total quantity for each part is given only once — at the first appearance of the part number in the list.

6-9. ORDERING INSTRUCTIONS

6-10. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate quantity required, and address the order to the nearest Hewlett-Packard office.

6-11. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 6-1. Part Numbers for Assembly Exchange Orders

	Assembly	New Part No.	Exchange No.
A1A1	Sw. Cont. Assy.	08660-60107	08660-60246
A1A2	Key Cont. Assy.	08660-60106	08660-60245
A1A3	Readout Cont. Assy.	08660-60105	08660-60244
A1A4	Rom Input Assy.	08660-60102	08660-60241
A1A5	Rom Output Assy.	08660-60103	08660-60242
A1A6	Register Assy.	08660-60104	08660-60243
A1A7	ALU Assy.	08660-60108	08660-60247
A1A8	Sweep Count Assy.	08660-60109	08660-60248
A1A9	"A" Register Assy.	08660-60110	08660-60249
A1A10	Output Register Assy.	08660-60128	08660-60252
A1A12	Numeric Readout Assy.	08660-60111	08660-60250
A1A17	Manual Tuner Assy.	08660-60123	08660-60251
A3A1	Front Interface Board	08660-60028	08660-60222
A3A2	Rear Interface Board	08660-60029	08660-60223
A4A1	Reference Divider	08660-60003	08660-60203
A4A2	Reference Phase Detector	08660-60002	08660-60202
A4A3	Reference ÷ 2	08660-60004	08660-60204
A4A4	Reference VCO	08660-60001	08660-60201
A4A5	H.F. Loop VCO	08660-60005	08660-60205
A4A6	H.F. Loop Pretune Assembly	08660-60007	08660-60207
A4A7	H.F. Loop Phase Detector	08660-60006	08660-60206
A5	Voltage Control Assembly	08660-60023	08660-60220
A6A1	Preregulator Assembly	08660-60024	08660-60221
A8	N3 Oscillator	08660-60014	08660-60214
A10	N3 Phase Detector	08660-60013	08660-60213
A11	SL2 Oscillator	08660-60019	08660-60219
A12	SL2 Phase Detector	08660-60018	08660-60218
A13	N2 Oscillator	08660-60012	08660-60212
A14	N2 Phase Detector	08660-60011	08660-60211
A15	SL1 Phase Detector	08660-60016	08660-60216
A16	N1 Phase Detector	08660-60009	08660-60209
A17	N1 Oscillator	08660-60010	08660-60210
A18	SL1 Mixer	08660-60015	08660-60215
A19	SL1 Oscillator	08660-60017	08660-60217
A20	Rectifier Board Assembly	08660-60021	08660-60232
A22	Reference Switch Assembly	08660-60043	08660-60228
OPTION 004 INSTRUMENTS			
A1A1	Switch Cont. Assy.	08660-60162	08660-60254
A1A2	Key Cont. Assy.	08660-60161	08660-60253
A1A7	ALU Assy.	08660-60163	08660-60255
A14	N2 Phase Detector	08660-60039	08660-60236

Table 6-2. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A	assembly
AT	attenuator; isolator; termination
B	fan; motor
BT	battery
C	capacitor
CP	coupler
CR	diode; diode thyristor; varactor
DC	directional coupler
DL	delay line
DS	annunciator; signaling device (audible or visual); lamp; LED
E	miscellaneous electrical part
F	fuse
FL	filter
H	hardware
HY	circulator
J	electrical connector (stationary portion); jack
K	relay
L	coil; inductor
M	meter
MP	miscellaneous mechanical part
P	electrical connector (movable portion); plug
Q	transistor: SCR; triode thyristor
R	resistor
RT	thermistor
S	switch
T	transformer
TB	terminal board
TC	thermocouple
TP	test point
U	integrated circuit; microcircuit
V	electron tube
VR	voltage regulator; breakdown diode
W	cable; transmission path; wire
X	socket
Y	crystal unit (piezo-electric or quartz)
Z	tuned cavity; tuned circuit

ABBREVIATIONS

A	ampere
ac	alternating current
ACCESS	accessory
ADJ	adjustment
A/D	analog-to-digital
AF	audio frequency
AFC	automatic frequency control
AGC	automatic gain control
AL	aluminum
ALC	automatic level control
AM	amplitude modulation
AMPL	amplifier
APC	automatic phase control
ASSY	assembly
AUX	auxiliary
avg	average
AWG	American wire gauge
BAL	balance
BCD	binary coded decimal
BD	board
BE CU	beryllium copper
BFO	beat frequency oscillator
BH	binder head
BKDN	breakdown
BP	bandpass
BPF	bandpass filter
BRS	brass
BWO	backward-wave oscillator
CAL	calibrate
ccw	counter-clockwise
CER	ceramic
CHAN	channel
cm	centimeter
CMO	cabinet mount only
COAX	coaxial
COEF	coefficient
COM	common
COMP	composition
COMPL	complete
CONN	connector
CP	cadmium plate
CRT	cathode-ray tube
CTL	complementary transistor logic
CW	continuous wave
cw	clockwise
cm	centimeter
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1 mW
dc	direct current
deg	degree (temperature interval or difference)
°	degree (plane angle)
°C	degree Celsius (centigrade)
°F	degree Fahrenheit
°K	degree Kelvin
DEPC	deposited carbon
DET	detector
diam	diameter
DIA	diameter (used in parts list)
DIFF AMPL	differential amplifier
div	division
DPDT	double-pole, double-throw
DR	drive
DSB	double sideband
DTL	diode transistor logic
DVM	digital voltmeter
ECL	emitter coupled logic
EMF	electromotive force
EDP	electronic data processing
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farad
FET	field-effect transistor
F/F	flip-flop
FH	flat head
FIL H	fillister head
FM	frequency modulation
FP	front panel
FREQ	frequency
FXD	fixed
g	gram
GE	germanium
GHz	gigahertz
GL	glass
GRD	ground(ed)
H	henry
h	hour
HET	heterodyne
HEX	hexagonal
HD	head
HDW	hardware
HF	high frequency
HG	mercury
HI	high
HP	Hewlett-Packard
HPF	high pass filter
HR	hour (used in parts list)
HV	high voltage
Hz	Hertz
IC	integrated circuit
ID	inside diameter
IF	intermediate frequency
IMPG	impregnated
in	inch
INCD	incandescent
INCL	include(s)
INP	input
INS	insulation
INT	internal
kg	kilogram
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
lb	pound
LC	inductance-capacitance
LED	light-emitting diode
LF	low frequency
LG	long
LH	left hand
LIM	limit
LIN	linear taper (used in parts list)
lin	linear
LK WASH	lock washer
LO	low; local oscillator
LOG	logrithmic taper (used in parts list)
log	logrithm(ic)
LPF	low pass filter
LV	low voltage
m	meter (distance)
mA	milliampere
MAX	maximum
MΩ	megohm
MEG	meg (10^6) (used in parts list)
MET FLM	metal film
MET OX	metallic oxide
MF	medium frequency; microfarad (used in parts list)
MFR	manufacturer
mg	milligram
MHz	megahertz
mH	millihenry
mho	mho
MIN	minimum
min	minute (time)
'	minute (plane angle)
MINAT	minature
mm	millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (2 of 2)

MOD . . . modulator
MOM . . . momentary
MOS . . . metal-oxide semiconductor
ms . . . millisecond
MTG . . . mounting
MTR . . . meter (indicating device)
mV . . . millivolt
mVac . . . millivolt, ac
mVdc . . . millivolt, dc
mVpk . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . millivolt, rms
mW . . . milliwatt
MUX . . . multiplex
MY . . . mylar
μA . . . microampere
μF . . . microfarad
μH . . . microhenry
μmho . . . micromho
μs . . . microsecond
μV . . . microvolt
μVac . . . microvolt, ac
μVdc . . . microvolt, dc
μVpk . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . microvolt, rms
μW . . . microwatt
nA . . . nanoampere
NC . . . no connection
N/C . . . normally closed
NE . . . neon
NEG . . . negative
nF . . . nanofarad
NI PL . . . nickel plate
N/O . . . normally open
NOM . . . nominal
NORM . . . normal
NPN . . . negative-positive-negative
NPO . . . negative-positive zero (zero temperature coefficient)
NRFR . . . not recommended for field replacement
NSR . . . not separately replaceable
ns . . . nanosecond
nW . . . nanowatt
OBD . . . order by description

OD . . . outside diameter
OH . . . oval head
OP AMPL . . . operational amplifier
OPT . . . option
OSC . . . oscillator
OX . . . oxide
oz . . . ounce
Ω . . . ohm
P . . . peak (used in parts list)
PAM . . . pulse-amplitude modulation
PC . . . printed circuit
PCM . . . pulse-code modulation; pulse-count modulation
PDM . . . pulse-duration modulation
pF . . . picofarad
PH BRZ . . . phosphor bronze
PHL . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . peak inverse voltage
pk . . . peak
PL . . . phase lock
PLO . . . phase lock oscillator
PM . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . part of
POLY . . . polystyrene
PORC . . . porcelain
POS . . . positive; position(s) (used in parts list)
POSN . . . position
POT . . . potentiometer
p-p . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . pulse-repetition frequency
PRR . . . pulse repetition rate
ps . . . picosecond
PT . . . point
PTM . . . pulse-time modulation
PWM . . . pulse-width modulation

PWV . . . peak working voltage
RC . . . resistance-capacitance
RECT . . . rectifier
REF . . . reference
REG . . . regulated
REPL . . . replaceable
RF . . . radio frequency
RFI . . . radio frequency interference
RH . . . round head; right hand
RLC . . . resistance-inductance-capacitance
RMO . . . rack mount only
rms . . . root-mean-square
RND . . . round
ROM . . . read-only memory
R&P . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . second (time)
. . ." . second (plane angle)
S-B . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . selenium
SECT . . . sections
SEMICON . . . semiconductor
SHF . . . superhigh frequency
SI . . . silicon
SIL . . . silver
SL . . . slide
SNR . . . signal-to-noise ratio
SPDT . . . single-pole, double-throw
SPG . . . spring
SR . . . split ring
SPST . . . single-pole, single-throw
SSB . . . single sideband
SST . . . stainless steel
STL . . . steel
SQ . . . square
SWR . . . standing-wave ratio
SYNC . . . synchronize
T . . . timed (slow-blow fuse)
TA . . . tantalum
TC . . . temperature compensating

TD . . . time delay
TERM . . . terminal
TFT . . . thin-film transistor
TGL . . . toggle
THD . . . thread
THRU . . . through
TI . . . titanium
TOL . . . tolerance
TRIM . . . trimmer
TSTR . . . transistor
TTL . . . transistor-transistor logic
TV . . . television
TVI . . . television interference
TWT . . . traveling wave tube
U . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . . ultrahigh frequency
UNREG . . . unregulated
V . . . volt
VA . . . voltampere
Vac . . . volts, ac
VAR . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . volts, dc
VDCW . . . volts, dc, working (used in parts list)
V(F) . . . volts, filtered
VFO . . . variable-frequency oscillator
VHF . . . very-high frequency
Vpk . . . volts, peak
Vp-p . . . volts, peak-to-peak
Vrms . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . voltage-tuned oscillator
VTVM . . . vacuum-tube voltmeter
V(X) . . . volts, switched
W . . . watt
W/ . . . with
WIV . . . working inverse voltage
WW . . . wirewound
W/O . . . without
YIG . . . yttrium-iron-garnet
Z_o . . . characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08660-60120	1	DIGITAL CONTROL ASSY	28480	08660-60120
A1C1	0160-3448	1	C:FXD CER 1000 PF 10% 1000VDCW	56289	C067B251F102KS25-CDH
A1J1	1250-0118	1	CONNECTOR:BNC	24931	28JR 128-1
A1L1	9100-3354	1	COIL:FXD 4 UH	28480	9100-3354
A1S1	3101-1655	1	SWITCH ROCKER:SPDT, SUBMINIATURE	09353	7101-J1CX
A1W1	08660-60116	1	CABLE ASSY:SWITCH	28480	08660-60116
A1W2	08660-60117	1	CABLE ASSY:KEYBOARD	28480	08660-60117
A1W3	08660-60118	2	CABLE ASSY:READOUT	28480	08660-60118
A1W4	08660-60118		CABLE ASSY:READOUT	28480	08660-60118
A1W5	08660-60124	1	D/A OUTPUT CABLE	28480	08660-60124
A1W6	08660-60126	1	WIRING HARNESS	28480	08660-60126
A1W7	08660-60129	1	CABLE ASSY:4V FILTER	28480	08660-60129
A1X			MISCELLANEOUS		
A1X	0370-1131	1	KNOB:CONCENTRIC BAR, JADE GRAY	28480	0370-1131
A1X	0370-1303	1	KNOB:ROUND, JADE GRAY	28480	0370-1303
A1X	0370-2193	1	KNOB:MANUAL MODE SWITCH	28480	0370-2193
A1X	0370-2194	1	KNOB:SWEEP SWITCH	28480	0370-2194
A1X	7120-3044	1	LABEL:IDENTIFICATION	28480	7120-3044
A1X	08660-00056	1	SCREEN R.F.I.	28480	08660-00056
A1X	08660-00101	1	SUPPORT:DIGITAL TOP	28480	08660-00101
A1X	08660-00102	1	FRONT PANEL:RIGHT SIDE	28480	08660-00102
A1X	08660-00103	1	SUPPORT:DIGITAL BOTTOM	28480	08660-00103
A1X	08660-00106	1	FRONT PANEL:LEFT SIDE	28480	08660-00106
A1X	08660-00109	1	PLATE:FRONT WINDOW	28480	08660-00109
A1X	08660-00110	1	INSULATOR:INTERCONNECT	28480	08660-00110
A1X	08660-20121	1	SUB-PANEL:FRONT	28480	08660-20121
A1X	08660-20122	1	WINDOW:FRONT	28480	08660-20122
A1X	08660-20152	1	FRONT PANEL:KEYBOARD	28480	08660-20152
A1X	08660-20153	1	CLAMP:TOP KEYBOARD SWITCH	28480	08660-20153
A1X	08660-20154	1	CLAMP:BOTTOM KEYBOARD SWITCH	28480	08660-20154
A1X	08660-20160	2	RETAINER:PC BOARD	28480	08660-20160
A1X	08660-40004	1	BLOCK:ANNUNCIATOR	28480	08660-40004
A1X	08660-40105	1	FREQUENCY RANGE INDICATOR	28480	08660-40105
A1X	08660-40107	1	PUSHBUTTON:SWEEP	28480	08660-40107
A1X	08660-40108	3	PUSHBUTTON:READOUT	28480	08660-40108
A1A1	08660-60107	1	BOARD ASSY:SWITCH CONTROL	28480	08660-60107
A1A1C1	0180-1714	2	C:FXD ELECT 330 UF 10% 6VDCW	28480	0180-1714
A1A1C2	0180-0197	61	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C7	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A1C8	0180-2206	3	C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X9006B2
A1A1C9	0160-3536	1	C:FXD MICA 620 PF 5% 100VDCW	00853	RDM15F621J1C
A1A1CR1	1901-0040	84	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A1R1	0698-7253	15	R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R2	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R3	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R4	0698-7272	1	R:FXD FLM 31.6K OHM 2% 1/8W	28480	0698-7272
A1A1R5	0698-7228	4	R:FXD FLM 464 OHM 2% 1/8W	28480	0698-7228
A1A1R6	0698-7212	3	R:FXD FLM 100 OHM 2% 1/8W	28480	0698-7212
A1A1R7	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R8	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R9	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R10	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R11	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R12	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R13	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R14	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R15	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R16	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R17	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R18	0698-7212		R:FXD FLM 100 OHM 2% 1/8W	28480	0698-7212
A1A1R19	0698-7253		R:FXD MET FLM 5.11K OHM 2% 1/8W	28480	0698-7253
A1A1R20	0698-7228		R:FXD FLM 464 OHM 2% 1/8W	28480	0698-7228
A1A1R21	0698-7228		R:FXD FLM 464 OHM 2% 1/8W	28480	0698-7228
A1A1R22	0698-7222	3	R:FXD FLM 261 OHM 2% 1/8W	28480	0698-7222
A1A1R23	0698-7228		R:FXD FLM 464 OHM 2% 1/8W	28480	0698-7228
A1A1TP1	0360-0124	4	TERMINAL:SOLDER LUG	28480	0360-0124
A1A1TP2	0360-0124		TERMINAL:SOLDER LUG	28480	0360-0124
A1A1U1	1820-0913	3	IC:TTL LP MONOSTABLE MULTIVIBRATOR	01295	SN74L122N
A1A1U2	1820-0174	16	IC:TTL HEX INVERTER	01295	SN7404N
A1A1U3	1820-0256	3	IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P
A1A1U4	1820-0600	5	IC:TTL LP DECADE COUNTER	12040	DM85L90N

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1U5	1820-0600		IC:TTL LP DECADE COUNTER	12040	DM85L90N
A1A1U6	1820-0600		IC:TTL LP DECADE COUNTER	12040	DM85L90N
A1A1U7	1820-0600		IC:TTL LP DECADE COUNTER	12040	DM85L90N
A1A1U8	1820-0600		IC:TTL LP DECADE COUNTER	12040	DM85L90N
A1A1U9	1820-0054	61	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A1U10	1820-0595	7	IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A1U11	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A1U12	1820-0372	8	IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A1U13	1820-0587	5	IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A1A1U14	1820-0596	6	IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1A1U15	1820-0595		IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A1U16	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A1U17	1820-0374	2	IC:TTL HS DUAL 4-INPT AND GATE	01295	SN74H21N
A1A1U18	1820-0511	13	IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A1U19	1820-0596		IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1A1U20	1820-0587		IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A1A1U21	1820-0595		IC:TTL LP. DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A1U22	1820-0328	10	IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A1U23	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A1U24	1820-0495	4	IC:TTL 1 OF 16 DECODER	01295	SN74154N
A1A1U25	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A1U26	1820-0596		IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1A1U27	1820-0661	12	IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A1U28	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A1U29	1820-0596		IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1A1U30	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A1XA1	1200-0438	8	SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A2	08660-60106	1	BOARD ASSY:KEY CONTROL	28480	08660-60106
A1A2C1	0160-3533	1	C:FXD MICA 470 PF 5% 100VDCW	00853	RDM15F471J1C
A1A2C2	0160-2204	13	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A1A2C3	0160-0161	4	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1A2C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C7	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C8	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C9	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C10	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A2C12	0140-0199	1	C:FXD MICA 240 PF 5%	28480	0140-0199
A1A2Q1	1853-0020	4	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1A2R1	0757-0419	2	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A1A2R2	0757-0428	23	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A1A2R3	0698-0082	34	R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A1A2R4	0757-0280	50	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A2R5	0698-3430	10	R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R6	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R7	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A2R8	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R9	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R10	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A2R11	0757-0438	12	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A2R12	0757-0395	2	R:FXD MET FLM 56.2 OHM 1% 1/8W	28480	0757-0395
A1A2R13	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R14	0698-3160	2	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1A2R15	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1A2R16	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1A2R17	0698-3159	3	R:FXD MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159
A1A2R18	0698-3159		R:FXD MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159
A1A2R19	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A2R20	0698-3132	17	R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A1A2R21	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A2R22	0757-0442	109	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1A2R23	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A2R24	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A1A2R25	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A1A2TP1	0360-1514	2	TERMINAL PIN:SQUARE	28480	0360-1514
A1A2TP2	0360-1514		TERMINAL PIN:SQUARE	28480	0360-1514
A1A2U1	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A2U2	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A2U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A2U4	1820-0709	10	IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A2U5	1820-0659	17	IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A2U6	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A2U7	1820-0595		IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A2U8	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A2U9	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A2U10	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A2U11	1820-0710	7	IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A2U12	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A2U13	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A2U14	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A2U15	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A2U16	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A2U17	1820-0596		IC:TTL LP DUAL EDGE TRIG, C F/F	12040	DM74L74N
A1A2U18	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A2U19	1820-0913		IC:TTL LP MONOSTABLE MULTIVIBRATOR	01295	SN74L122N
A1A2U20	1826-0055	1	IC:LINEAR DUAL COMPARATOR	07263	U6A7711393
A1A2U21	1820-0069	6	IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A1A2U22	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A2U23	1820-0214	7	IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A1A2U24	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A2U25	1820-0055	4	IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A1A2U26	1820-0491	1	IC:TTL BCD/DEC. DECODER/DRIVER	01295	SN74145N
A1A3	08660-60105	1	BOARD ASSY:READOUT CONTROL	28480	08660-60105
A1A3C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C7	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C8	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A3C9	0160-3534	2	C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
A1A3C10	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1A3C11	0140-0196	2	C:FXD MICA 150 PF 5%	72136	RDM15F151J3C
A1A3R1	0698-3447	22	R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R2	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R3	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R4	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R5	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R6	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R7	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R8	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R9	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R10	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A1A3R11	0698-3159		R:FXD MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159
A1A3R12	0757-0401	30	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1A3TP1	0360-0124		TERMINAL:SOLDER LUG	28480	0360-0124
A1A3TP2	0360-0124		TERMINAL:SOLDER LUG	28480	0360-0124
A1A3U1	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A3U2	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A3U3	1820-0725	1	IC:TTL 16-BIT RAM,4 WORDS X 4-BITS	01295	SN74170N
A1A3U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U5	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U6	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A3U7	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A1A3U8	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A3U9	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U10	1820-0913		IC:TTL LP MONOSTABLE MULTIVIBRATOR	01295	SN74L122N
A1A3U11	1820-0904	1	IC:TTL LP 5-BIT COMPARATOR	07263	U7B93L2459X
A1A3U12	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A3U13	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A3U14	1820-0596		IC:TTL LP DUAL EDGE TRIG, C F/F	12040	DM74L74N
A1A3U15	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U16	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U17	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A3U18	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A3U19	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A3U20	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A1A3U21	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A3U22	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A3U23	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A3U24	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A3U25	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A3U26	1820-0256		IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P
A1A3U27	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A3U28	1820-0903	8	IC:TTL LP 8-BIT SFR. IN PARALLEL	01295	SN74L164N
A1A3U29	1820-0065	1	IC:TTL SINGLE PHASE J-K F/F	01295	SN7470N
A1A3U30	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A3U31	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A3U32	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A3U33	1820-0069		IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A1A3U34	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A3U35	1820-0068	12	IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A3U36	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A3U37	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A3U38	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A3U39	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A4	08660-60102	1	BOARD ASSY:ROM INPUT	28480	08660-60102
A1A4C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A4C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A4C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A4C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A4C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A4CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1A4DS1	1990-0326	7	DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS2	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS3	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS4	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS5	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS6	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4DS7	1990-0326		DIODE:VISIBLE LIGHT EMITTER	28480	1990-0326
A1A4R1	0698-3153	17	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R2	0698-3445	35	R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R3	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R4	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R5	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R6	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R7	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R8	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R9	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R10	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R11	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R12	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R13	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R14	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R15	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R16	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4R17	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A1A4R18	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A1A4S1	3101-0137	4	SWITCH:SENSITIVE SPDT SUB-MINIATURE	91929	1SX1-T
A1A4U1	1820-0070	5	IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A4U2	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A4U3	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A4U4	1820-0076	4	IC:TTL DUAL J-K F/F W/PRESET CLOCK	01295	SN7476N
A1A4U5	1820-0076		IC:TTL DUAL J-K F/F W/PRESET CLOCK	01295	SN7476N
A1A4U6	1820-0076		IC:TTL DUAL J-K F/F W/PRESET CLOCK	01295	SN7476N
A1A4U7	1820-0076		IC:TTL DUAL J-K F/F W/PRESET CLOCK	01295	SN7476N
A1A4U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A4U9	1820-0640	7	IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U10	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A1A4U11	1816-0042	1	IC:ROM #1	28480	1816-0042
A1A4U12	1816-0043	1	IC:ROM #2	28480	1816-0043
A1A4U13	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A4U14	1820-0595		IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A4U15	1820-0595		IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A4U16	1820-0595		IC:TTL LP DUAL J-K MASTER SLAVE F/F	12040	DM74L73N
A1A4U17	1816-0044	1	IC:ROM #3	28480	1816-0044
A1A4U18	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U19	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U20	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U21	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U22	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A4U23	1820-0640		IC:TTL DATA SELECTOR/MULTIPLEXER	01295	SN74150N
A1A5	08660-60103	1	BOARD ASSY:ROM OUTPUT	28480	08660-60103
A1A5C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A5U1	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A5U2	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A5U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A5U4	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A5U5	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A5U6	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A5U7	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A5U8	1820-0495		IC:TTL 1 OF 16 DECODER	01295	SN74154N
A1A5U9	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A5U10	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A5U11	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A5U12	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A5U13	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A5U14	1820-0069		IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A1A5U15	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A5U16	1820-0495		IC:TTL 1 OF 16 DECODER	01295	SN74154N
A1A5U17	1820-0778	2	IC:TTL,LOW POWER 4-BIT SYN BIN COUNTER	07263	SL18325
A1A5U18	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A5U19	1820-0587		IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A1A5U20	1820-0587		IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A1A5U21	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A5U22	1820-0069		IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A1A5U23	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A5U24	1820-0495		IC:TTL 1 OF 16 DECODER	01295	SN74154N
A1A6	08660-60104	1	BOARD ASSY:REGISTER	28480	08660-60104
A1A6C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C6	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C7	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C8	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A6C9	0180-1735	2	C:FXD ELECT 0.22 UF 10% 35VDCW	28480	0180-1735
A1A6C10	0180-1735		C:FXD ELECT 0.22 UF 10% 35VDCW	28480	0180-1735
A1A6R1	0698-7236	5	R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A1A6R2	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A1A6U1	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A6U2	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A6U3	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A6U4	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A6U5	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U6	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U7	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U8	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A6U9	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A6U10	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A6U11	1820-0903		IC:TTL LP 8-BIT SER. IN PARALLEL	01295	SN74L164N
A1A6U12	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A6U13	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U14	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U15	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U16	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A6U17	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A6U18	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U19	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A6U20	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A6U21	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A6U22	1820-0583	4	IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1A6U23	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A6U24	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U25	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U26	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U27	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U28	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U29	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A6U30	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1A6U31	1820-0587		IC:TTL LP TRIPLE 3-INPT NAND GATE	12040	DM74L10N
A1A6U32	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U33	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A6U34	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U35	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U36	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A6U37	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A6U38	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A7	08660-60108	1	BOARD ASSY:ALU	28480	08660-60108
A1A7C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A7C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A7C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A7R1	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A7R2	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A7R3	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A7R4	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A1A7U1	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A1A7U2	1820-0778		IC:TTL,LOW POWER 4-BIT SYN BIN COUNTER	07263	SL18325
A1A7U3	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A7U4	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A7U5	1820-0305	2	INTEGRATED CIRCUIT:BINARY FULL ADDER	01295	SN7483N
A1A7U6	1820-0305		INTEGRATED CIRCUIT:BINARY FULL ADDER	01295	SN7483N
A1A7U7	1820-0511		IC:TTL QUAD 2-INPT AND GATE	01295	SN7408N
A1A7U8	1820-0710		IC:DIGITAL TTL+LOGIC 5V 5%	07263	SL17315
A1A7U9	1816-0045	1	IC:ROM #4	28480	1816-0045
A1A7U10	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A7U11	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A7U12	1820-0740	2	IC:TTL H/S 4-BIT TRUE COMPLIMENT	01295	SN74H87N
A1A7U13	1820-0661		IC:TTL QUAD 2-INPT OR GATE	01295	SN7432N
A1A7U14	1820-0740		IC:TTL H/S 4-BIT TRUE COMPLIMENT	01295	SN74H87N
A1A7U15	1820-0069		IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A1A7U16	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A7U17	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A7U18	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A7U19	1820-0077	4	IC:TTL DUAL D F/F	01295	SN7474N
A1A7U20	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A7XA1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A8	08660-60109	1	BOARD ASSY:SWEEP COUNT	28480	08660-60109
A1A8C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A8C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A8C3	0180-0218	1	C:FXD ELECT 0.15 UF 10% 35VDCW	28480	0180-0218
A1A8Q1	1854-0071	13	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1A8R1	0698-3154	21	R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8R2	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8R3	0757-1100	2	R:FXD FLM 600 OHM 1% 1/8W	28480	0757-1100
A1A8R4	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8R5	0757-0465	6	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1A8R6	0757-0472	6	R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A1A8R7	0698-6248	3	R:FXD FLM 3K OHM 0.1% 1/8W	28480	0698-6248
A1A8R8	0698-6248		R:FXD FLM 3K OHM 0.1% 1/8W	28480	0698-6248
A1A8R9	0757-0439	13	R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A1A8R10	0698-3151	9	R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A1A8R11	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A8R11	2100-1773	1	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A1A8R12	0698-6248		R:FXD FLM 3K OHM 0.1% 1/8W	28480	0698-6248
A1A8R13	0757-1100		R:FXD FLM 600 OHM 1% 1/8W	28480	0757-1100
A1A8R14	0757-0274	10	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A1A8R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1A8R16	0757-0449	3	R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A1A8R17	0698-4008	1	R:FXD MET FLM 40K OHM 1% 1/8W	28480	0698-4008
A1A8R18	0698-3201	1	R:FXD FLM 80.0K OHM 1% 1/8W	28480	0698-3201
A1A8R20	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8R21	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1A8R22	0757-0283	1	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1A8R23	0698-5808	1	R:FXD MET FLM 4K OHM 1% 1/8W	28480	0698-5808
A1A8R24	0698-3200	1	R:FXD FLM 8K OHM 1% 1/8W	28480	0698-3200
A1A8R25	0698-6104	1	R:FXD FLM 800 OHM 0.1% 1/8W	28480	0698-6104
A1A8R26	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8R27	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A1A8U1	1826-0013	1	IC:LINEAR	28480	1826-0013
A1A8U2	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1A8U3	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1A8U4	1820-0070		IC:TTL 8-INPT POS NAND GATE	01295	SN7430N
A1A8U5	1820-0546	3	IC:DIGITAL TTL SYNC 4-BIT BCD	28480	1820-0546
A1A8U6	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A1A8U7	1820-0577	3	IC:TTL HEX INVERTER/DRIVER W/OPEN COLL.	01295	SN7416N
A1A8U8	1820-0546		IC:DIGITAL TTL SYNC 4-BIT BCD	28480	1820-0546
A1A8U9	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A8U10	1820-0546		IC:DIGITAL TTL SYNC 4-BIT BCD	28480	1820-0546
A1A8U11	1820-0577		IC:TTL HEX INVERTER/DRIVER W/OPEN COLL.	01295	SN7416N
A1A8U12	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A1A8U13	1820-0577		IC:TTL HEX INVERTER/DRIVER W/OPEN COLL.	01295	SN7416N
A1A9	08660-60110	1	BOARD ASSY:REGISTER "A"	28480	08660-60110
A1A9C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A9C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A9C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A9U1	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A9U2	1820-0709		IC:TTL DUAL 8-BIT SHIFT REG.	07263	U7B93L2859X
A1A9U3	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A9U4	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A9U5	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A9U6	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A9U7	1820-0659		IC:TTL,LOW POWER 4-BIT SHIFT REGISTER	07263	SL17145
A1A9U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A9U9	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A9U10	1820-0372		IC:TTL TRIPLE 3-INPT AND GATE	28480	1820-0372
A1A9U11	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A9U12	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A9U13	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A10	08660-60128	1	BOARD ASSY:OUTPUT REGISTER	28480	08660-60128
A1A10C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A10C2	0140-0196		C:FXD MICA 150 PF 5%	72136	RDM15F151J3C
A1A10C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1A10R1	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A1A10R2	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A1A10U1	1820-0627	1	IC:TTL LP BCD TO DEC. DECODER	07263	U7B93L0159X
A1A10U2	1820-0535	1	IC:TTL DUAL PERI.2-INPT AND DRIVER	01295	SN75451P
A1A10U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A1A10U4	1820-0614	5	IC:TTL DUAL 4-BIT LATCH(LOW POWER)	07263	U6N93L0859
A1A10U5	1820-0614		IC:TTL DUAL 4-BIT LATCH(LOW POWER)	07263	U6N93L0859
A1A10U6	1820-0614		IC:TTL DUAL 4-BIT LATCH(LOW POWER)	07263	U6N93L0859
A1A10U7	1820-0614		IC:TTL DUAL 4-BIT LATCH(LOW POWER)	07263	U6N93L0859
A1A10U8	1820-0614		IC:TTL DUAL 4-BIT LATCH(LOW POWER)	07263	U6N93L0859
A1A11	08660-60112	1	BOARD ASSY:INTERCONNECT	28480	08660-60112
A1A11C1	0160-3452	1	C:FXD DISC CER 0.02 UF 20% 100VDCW	56289	C023B101H203MS25-CDH
A1A11J1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A11J2	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A11J3	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A11J4	1250-1255	7	CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A1A11J5	1251-2361	69	CONNECTOR:PC WRAP-POST TYPE FOR MTG.	00779	86091-2
A1A11J5			(40 CONTACTS)		
A1A11J6	1251-2361		CONNECTOR:PC WRAP-POST TYPE FOR MTG.	00779	86091-2
A1A11J6			(26 CONTACTS)		
A1A11XA1-1	1251-2035	54	CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA1-2	1251-2026	8	CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA101	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA102	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA2-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA2-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA3-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA3-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA4-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA4-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA5-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA5-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA6-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA6-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA7-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA7-2	1251-2026		CONNECTOR:PC 36 CONTACT	71785	252-18-30-300
A1A11XA8-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A11XA9-1	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A1A12	08660-60111	1	BOARD ASSY:NUMERIC READOUT	28480	08660-60111
A1A12C1	0180-0228	17	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1A12C2	0180-1714		C:FXD ELECT 330 UF 10% 6VDCW	28480	0180-1714
A1A12DS1	2140-0356	9	LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A12DS2	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A12DS3	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A12DS4	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A12J1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A12J2	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A12Q1	1854-0492	18	TSTR:SI NPN	28480	1854-0492
A1A12Q2	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q3	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q4	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q5	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q6	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q7	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q8	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q9	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q10	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q12	1854-0492		TSTR:SI NPN	28480	1854-0492

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A12Q13	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q14	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q15	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q16	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q17	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q18	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12Q19	1854-0492		TSTR:SI NPN	28480	1854-0492
A1A12R1	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A1A12R2	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A1A12R3	0698-7217	3	R:FXD FLM 162 OHM 2% 1/8W	28480	0698-7217
A1A12R4	0698-7217		R:FXD FLM 162 OHM 2% 1/8W	28480	0698-7217
A1A12R5	0698-7217		R:FXD FLM 162 OHM 2% 1/8W	28480	0698-7217
A1A12R6	0698-7225	1	R:FXD FLM 348 OHM 2% 1/8W	28480	0698-7225
A1A12S1	3101-0137		SWITCH:SENSITIVE SPDT SUB-MINIATURE	91929	1SX1-T
A1A12S2	3101-0137		SWITCH:SENSITIVE SPDT SUB-MINIATURE	91929	1SX1-T
A1A12S3	3101-0137		SWITCH:SENSITIVE SPDT SUB-MINIATURE	91929	1SX1-T
A1A12U1	1820-0571	2	IC:TTL NUMERIC DISPLAY CHARACTER GEN.	28480	1820-0571
A1A12U2	1820-0571		IC:TTL NUMERIC DISPLAY CHARACTER GEN.	28480	1820-0571
A1A12U3	1990-0315	1	NUMERIC DISPLAY, SOLID STATE	28480	1990-0315
A1A12U4	1990-0311	1	ARRAY:LIGHT EMITTING DIODE,6 DIGITS	28480	1990-0311
A1A12U5	1820-0635	1	IC:DIGITAL	28480	1820-0635
A1A12XA3	1200-0481	2	SOCKET:INTEGRATED CIRCUIT	28480	1200-0481
A1A12XA4	1200-0481		SOCKET:INTEGRATED CIRCUIT	28480	1200-0481
A1A13	08660-60159	1	BOARD ASSY:ANNUNCIATOR BLOCK	28480	08660-60159
A1A13DS1	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A13DS2	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A13DS3	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A13DS4	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A13DS5	2140-0356		LAMP:INCANDESCENT T-1 BULB 5V	71744	CM7-7683
A1A13TP1	0362-0063	6	TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13TP2	0362-0063		TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13TP3	0362-0063		TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13TP4	0362-0063		TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13TP5	0362-0063		TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13TP6	0362-0063		TERMINATION:CRIMP LUG FOR 0.046SQ PIN	00000	OBD
A1A13XA1	1251-1556	5	CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A1A13XA2	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A1A13XA3	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A1A13XA4	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A1A13XA5	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A1A14	08660-60114	1	SWITCH ASSY:SWEEP	28480	08660-60114
A1A15	08660-60113	1	SWITCH ASSY:KEYBOARD	28480	08660-60113
A1A15	0570-0031	12	SCREW:RND HD SLOT DR 4-40 X 0.500" LG	00000	OBD
A1A15	5001-0109	4	SPRING	28480	5001-0109
A1A15	5040-0364	4	UPPER DECK	28480	5040-0364
A1A15	5040-0365	4	LOWER DECK	28480	5040-0365
A1A15	5040-0366	20	FLIPPER	28480	5040-0366
A1A15	5040-0367	20	ACTUATOR	28480	5040-0367
A1A15	5040-6901	1	KEY:DEC POINT	28480	5040-6901
A1A15	5040-6902	1	KEY:NUMBER 1	28480	5040-6902
A1A15	5040-6903	1	KEY NUMBER 2	28480	5040-6903
A1A15	5040-6904	1	KEY NUMBER 3	28480	5040-6904
A1A15	5040-6905	1	KEY NUMBER 4	28480	5040-6905
A1A15	5040-6906	1	KEY NUMBER 5	28480	5040-6906
A1A15	5040-6907	1	KEY NUMBER 6	28480	5040-6907
A1A15	5040-6908	1	KEY NUMBER 7	28480	5040-6908
A1A15	5040-6909	1	KEY NUMBER 8	28480	5040-6909
A1A15	5040-6910	1	KEY NUMBER 9	28480	5040-6910
A1A15	5040-6911	1	KEY NUMBER 0	28480	5040-6911
A1A15	5040-6912	1	KEY:CLEAR KEYBOARD	28480	5040-6912
A1A15	5040-6913	1	KEY:STEP UP	28480	5040-6913
A1A15	5040-6914	1	KEY:STEP DOWN	28480	5040-6914
A1A15	5040-6915	1	KEY:SWEEP WIDTH	28480	5040-6915
A1A15	5040-6916	1	KEY:CONTROL FREQUENCY	28480	5040-6916
A1A15	5040-6917	1	KEY:HZ	28480	5040-6917
A1A15	5040-6918	1	KEY:MHZ	28480	5040-6918
A1A15	5040-6919	1	KEY:KHZ	28480	5040-6919
A1A15	5040-6920	1	KEY:GHZ	28480	5040-6920
A1A15J1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A1A16	08660-60115	1	SWITCH ASSY:MANUAL MODE	28480	08660-60115
A1A17	08660-60123	1	TUNER ASSY:MANUAL MODE	28480	08660-60123
A2	08660-60020	1	BOARD ASSY:INTERCONNECTION	28480	08660-60020
A2C1	0160-3456	30	C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C2	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C3	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2C4	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C5	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C6	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C7	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C8	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C9	0160-2055	159	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C11	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C12	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C13	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C14	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C15	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C16	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C17	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C18	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C19	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C20	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C22	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C23	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C25	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C26	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C27	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C28	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C29	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C30	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C31	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C32	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C33	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C34	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C35	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C36	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C37	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C38	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C39	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C40	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A2C41	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C42	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C43	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2C44	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A2J1	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A2J2	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A2J3	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A2J4	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A2W2	08660-60080	2	CABLE ASSY:GRAY	28480	08660-60080
A2XA8	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA8	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA9	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA10	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA10	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA11	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA11	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA12	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA12	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA13	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA13	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA14	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA14	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA15	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA15	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA16	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA16	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA17	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA17	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA18	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA18	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA19	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A2XA19	1251-2035		CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A3A1		1			
A3A1C1	0160-0154	3	C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22292-PTS
A3A1C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A1C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A1C4	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A1C5	0180-1746	3	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A1C6	0180-0373	1	C:FXD ELECT 0.68 UF 10% 35VDCW	56289	150D684X9035A2-DYS
A3A1CR1	1902-3059	1	DIODE BREAKDOWN:SILICON 3.83V 5%	28480	1902-3059
A3A1CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A3A1Q1	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A3A1Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3A1Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3A1Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3A1R1	0698-3157	7	R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A3A1R2	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A3A1R3	0698-3435	2	R:FXD MET FLM 38.3 OHM 1% 1/8W	28480	0698-3435
A3A1R4	0698-3435		R:FXD MET FLM 38.3 OHM 1% 1/8W	28480	0698-3435
A3A1R5	0757-0279	34	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A1R6	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3A1R7	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3A1R8	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3A1R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3A1R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A3A1R11	0757-0399	13	R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R12	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R13	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R14	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R15	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R16	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R17	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R18	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R19	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A3A1R20	0757-0278	6	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A3A1U1	1820-0174		IC:TTL HEX INVERTER	01295	SN7404N
A3A1U2	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A3A1U3	1820-0069		IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
A3A1U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A3A1U5	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A3A1U6	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A3A1U7	1820-0328		IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A3A1U8	1820-0207	1	IC:TTL MONOSTABLE MULTIVIBRATOR	28480	1820-0207
A3A1U9	1820-0072	2	IC:TTL DUAL 2W 2-INPT AND/OR GATE	01295	SN7450N
A3A1U10	1820-0072		IC:TTL DUAL 2W 2-INPT AND/OR GATE	01295	SN7450N
A3A1XA1	1251-1626	3	CONNECTOR:PC (2 X 12) 24 CONTACT	71785	252-12-30-300
A3A1XA2	1251-2361		CONNECTOR:PC WRAP-POST TYPE FOR MTG.	00779	86091-2
A3A1XA2			(40 CONTACTS)		
A3A1XA3	1251-2663	4	CONNECTOR PC EDGE(2 X 18)36 CONTACT	05574	3VH18/1JNS
A3A1XA4	1251-1626		CONNECTOR:PC (2 X 12) 24 CONTACT	71785	252-12-30-300
A3A1XA5	1251-2663		CONNECTOR PC EDGE(2 X 18)36 CONTACT	05574	3VH18/1JNS
A3A2	08660-60029	1	BOARD ASSY:DIGITAL INT RR	28480	08660-60029
A3A2C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A2C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A2C3	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A3A2C4	0160-2219	1	C:FXD MICA 1100 PF 5%	28480	0160-2219
A3A2Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3A2Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A3A2R1	0757-0421	29	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R2	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R3	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R4	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R5	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R6	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R7	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R8	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R9	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R10	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R11	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R12	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R13	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R14	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R15	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R16	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R17	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R18	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R19	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R20	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R21	0757-0416	33	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A3A2R22	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R23	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R24	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R25	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A2R26	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A3A2R27	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R28	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3A2R29	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2R30	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A3A2U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A3A2U2	1820-0301	2	IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A3A2U3	1820-0256		IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P
A3A2U4	1820-0301		IC:TTL QUAD BI-STABLE D-LATCH	01295	SN7475N
A3A3	08660-60025	1	BOARD ASSY:DIGITAL INTERCONNECT	28480	08660-60025
A3A3J1	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A3A3J2	1250-1255		CONNECTOR:RF JACK, SERIES SMB	98291	51-051-0000
A4	08660-60042	1	LOOP ASSY:H.F.	28480	08660-60042
A4C1	0160-2437	22	C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C2	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C3	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C4	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C5	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C6	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C7	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C8	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C9	0160-3744	6	C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C10	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C11	0160-3744		C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C12	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C13	0160-3744		C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C14	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C15	0160-3744		C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C16	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C17	0160-3744		C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C18	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C19	0160-3744		C:CER FEED-THRU 1000 PF 200VDCW	72982	2425-000-X5U0-102Z
A4C20	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C21	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4C22	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A4J1	1250-0901	18	CONNECTOR:RF BULKHEAD	15558	1104/D
A4J2	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J3	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J4	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J5	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J6	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J7	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J8	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J9	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J10	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J11	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J12	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J13	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4J14	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A4W2	08660-60050	1	CABLE ASSY:GRAY	28480	08660-60050
A4W3	08660-60063	1	CABLE ASSY:GRAY	28480	08660-60063
A4W4	08660-60055	1	CABLE ASSY:GRAY	28480	08660-60055
A4Z	08660-00014	1	COVER:REF. OSC.	28480	08660-00014
A4Z	08660-00015	1	COVER:REF. DIVIDER	28480	08660-00015
A4Z	08660-00016	1	COVER:REF. PHASE DETECTOR	28480	08660-00016
A4Z	08660-00017	1	COVER:DIVIDE BY TWO	28480	08660-00017
A4Z	08660-00018	1	COVER:PRETUNE	28480	08660-00018
A4Z	08660-00019	1	COVER:VCO	28480	08660-00019
A4Z	08660-00020	1	COVER:PHASE DETECTOR	28480	08660-00020
A4Z	08660-00063	1	HOUSING:H.F. LP	28480	08660-00063
A4A1	08660-60003	1	BOARD ASSY:REF. DIVIDER	28480	08660-60003
A4A1C1	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A1C2	0180-0116	7	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A4A1C3	0180-0229	13	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A4A1C4	0160-2199	1	C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A4A1C5	0160-0154		C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22292-PTS
A4A1C6	0160-0154		C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22292-PTS
A4A1C7	0160-0297	2	C:FXD MY 0.0012 UF 10% 200VDCW	56289	192P12292-PTS
A4A1CR1	1902-0048	1	DIODE:BREAKDOWN 6.81V 5%	04713	SZ10939-134
A4A1L1	9100-1642	2	COIL/CHOKE 270.0 UF 5%	28480	9100-1642
A4A1L2	9100-1642		COIL/CHOKE 270.0 UF 5%	28480	9100-1642
A4A1L3	9140-0144	3	COIL:FXD RF 4.7 UH	28480	9140-0144
A4A1Q1	1854-0019	15	TSTR:SI NPN	28480	1854-0019
A4A1Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A1Q3	1854-0045	4	TSTR:SI NPN	04713	2N956

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A1R1	0757-0444	15	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A4A1R2	0698-3622	1	R:FXD MET OX 120 OHM 5% 2W	28480	0698-3622
A4A1R3	0698-0083	40	R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A1R4	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A1R5	0757-0394	28	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A1R6	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A1R7	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A1R8	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A1R9	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A1R10	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A1R11	0698-3441	16	R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4A1R12	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4A1R13	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4A1R14	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A1U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A4A1U2	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A4A1U3	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A4A2	08660-60002	1	BOARD ASSY:REF. PHASE DETECTOR	28480	08660-60002
A4A2C1	0180-0100	1	C:FXD ELECT 4.7 UF 10% 35VDCW	56289	150D475X9035B2-DYS
A4A2C2	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A4A2C3	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A4A2C4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C5	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A4A2C6	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C8	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C9	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A4A2C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C11	0140-0192	1	C:FXD MICA 68 PF 5%	28480	0140-0192
A4A2C12	0160-2308	1	C:FXD MICA 36 PF 5%	28480	0160-2308
A4A2C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C16	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C17	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C18	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C20	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A2C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2C22	0180-2205	1	C:FXD ELECT 0.33 UF 10% 35VDCW	56289	150D334X9035A2-DYS
A4A2C23	0160-3537	2	C:FXD MICA 680 PF 5% 100VDCW	72136	RDM15F681J1C
A4A2C24	0160-2205	3	C:FXD MICA 120 PF 5%	28480	0160-2205
A4A2C25	0160-2218	3	C:FXD MICA 1000 PF 5%	28480	0160-2218
A4A2C26	0180-1745	2	C:FXD ELECT 1.5 UF 10% 20VDCW	28480	0180-1745
A4A2C27	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A2CR1	1902-0049	1	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A4A2CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A4A2CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A4A2CR4	1901-0179	6	DIODE:SILICON 15WV	28480	1901-0179
A4A2CR5	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A4A2L1	9100-1629	30	COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A4A2L2	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A4A2L3	9100-2260	2	COIL:FXD 1.80 UH 10%	82142	09-4436-3K
A4A2L4	9140-0129	2	COIL:FXD RF 220 UH	28480	9140-0129
A4A2L5	9140-0237	1	COIL:FXD 200 UH 5%	28480	9140-0237
A4A2Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2Q3	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2Q4	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2Q5	1853-0015	7	TSTR:SI PNP	80131	2N3640
A4A2Q6	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2Q7	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A4A2Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4A2Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4A2Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4A2Q11	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A2R1	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R2	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R3	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A2R4	0757-0441	17	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A2R5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A2R6	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2R7	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R8	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A2R9	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A2R10	0698-3156	7	R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A4A2R11	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A4A2R12	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R13	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A2R14	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2R15	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R16	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A4A2R17	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4A2R18	0698-0084	13	R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A2R19	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2R20	0698-3446	8	R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A4A2R21	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A2R22	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A2R23	0698-3438	10	R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A2R24	0757-0346	14	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A2R25	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A2R26	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A2R27	0757-0418	5	R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A4A2R28	0698-3158	3	R:FXD MET FLM 23.7K OHM 1% 1/8W	28480	0698-3158
A4A2R29	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A4A2R30	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A4A2R31	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A2R32	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A2R33	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A2R34	0698-3453	1	R:FXD MET FLM 196K OHM 1% 1/8W	28480	0698-3453
A4A2R35	0698-3260	1	R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A4A2R36	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A4A2R37	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A2R38	0698-3444	21	R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A2R39	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A4A2R40	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A2R41	0757-0288	6	R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A4A2R42	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R43	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2R44	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A2R45	0757-0419		R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
A4A2R46	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2R47	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A4A2R48	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A2T1	08552-6044	1	TRANSFORMER:RF 5 PIN	50436	08552-6044
A4A2U1	1820-0370	1	IC:TTL HS QUAD 2-INPT NAND GATE	01295	SN74H00N
A4A3	08660-60004	1	BOARD ASSY:REF. DIVIDE BY 2	28480	08660-60004
A4A3C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C2	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A3C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C4	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A3C5	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C6	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C8	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C11	0160-0978	1	C:FXD MICA 1500 PF 1% 500VDCW	28480	0160-0978
A4A3C12	0160-2534	1	C:FXD MICA 300 PF 1% 300VDCW	00853	RDM15F301F3S
A4A3C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C15	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A3C16	0140-0197	1	C:FXD MICA 180 PF 5% 300VDCW	14655	RDM15F181J3C
A4A3C17	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A4A3C18	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A3C19	0140-0194	1	C:FXD MICA 110 PF 5%	72136	RDM15F111J3C
A4A3CR1	1902-0041	6	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A3L1	9100-0348	2	COIL:FXD 1.0 UH 1%	28480	9100-0348
A4A3L2	9100-0348		COIL:FXD 1.0 UH 1%	28480	9100-0348
A4A3Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A3Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A3Q3	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A3Q4	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A3Q5	1854-0345	9	TSTR:SI NPN	80131	2N5179
A4A3R1	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A3R2	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A4A3R3	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A3R4	0757-0814	1	R:FXD MET FLM 511 OHM 1% 1/2W	28480	0757-0814
A4A3R5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A3R6	0757-0420	6	R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A3R7	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A3R8	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A3R9	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A3R10	0698-3434	2	R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
A4A3R11	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A3R12	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A4A3R13	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A3R14	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A3R15	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A4A3R16	0698-3429	1	R:FXD MET FLM 19.6 OHM 1% 1/8W	28480	0698-3429
A4A3R17	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A3R18	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A4A3R19	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A3R20	0698-3440	23	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A3R21	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A4A3R22	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A3R23	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A4A3R24	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A3R25	0757-0397	5	R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397
A4A3R26	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A4A3U1	1820-0469	3	IC:DIGITAL TTL HI-SPEED F/F	01295	SN74H102N
A4A4	08660-60001	1	BOARD ASSY:REF. VCO	28480	08660-60001
A4A4C1	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A4A4C2	0121-0451	3	C:VAR TRIMMER 1.7-11.0 PF 250VDC	74970	187-0160-005
A4A4C3	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A4A4C4	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A4A4C5	0160-0214	1	C:FXD CER 10PF 5% 500V	71590	TYPE CA
A4A4C6	0160-2266	10	C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COGO-240J
A4A4C7	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A4A4C8	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C10	0160-2306	1	C:FXD MICA 27 PF 5%	28480	0160-2306
A4A4C11	0140-0190	4	C:FXD MICA 39 PF 5%	72136	RDM15E390J3C
A4A4C12	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A4A4C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C16	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C17	0121-0046	1	C:VARI CER 9-35 PF	28480	0121-0046
A4A4C18	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C19	0160-2327	9	C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A4C20	0140-0190		C:FXD MICA 39 PF 5%	72136	RDM15E390J3C
A4A4C21	0140-0190		C:FXD MICA 39 PF 5%	72136	RDM15E390J3C
A4A4C22	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C23	0121-0451		C:VAR TRIMMER 1.7-11.0 PF 250VDC	74970	187-0160-005
A4A4C24	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A4C25	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C26	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C27	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C28	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C29	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C30	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C31	0121-0451		C:VAR TRIMMER 1.7-11.0 PF 250VDC	74970	187-0160-005
A4A4C32	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A4C33	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C34	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C35	0140-0190		C:FXD MICA 39 PF 5%	72136	RDM15E390J3C
A4A4C36	0160-2307	2	C:FXD MICA 47 PF 5%	28480	0160-2307
A4A4C37	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4C38	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A4A4C39	0160-2205		C:FXD MICA 120 PF 5%	28480	0160-2205
A4A4C40	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A4CR1	0122-0247	1	C:VOLTAGE VAR. 10 PF 10% 60WV	04713	1N5140
A4A4CR2	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A4L1	9100-1623	1	COIL/CHOKE 27.0 UH 5%	99800	1537-48
A4A4L2	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A4A4L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A4A4L4	08660-80002	1	INDUCTOR	28480	08660-80002
A4A4L5	08660-80009	3	INDUCTOR	28480	08660-80009
A4A4L6	9100-2247	3	COIL:FXD RF 0.10 UH 10%	28480	9100-2247
A4A4L7	9100-2247		COIL:FXD RF 0.10 UH 10%	28480	9100-2247
A4A4L8			PART OF PRINTED CIRCUIT BOARD		
A4A4L9			PART OF PRINTED CIRCUIT BOARD		
A4A4L10	9100-2247		COIL:FXD RF 0.10 UH 10%	28480	9100-2247
A4A4L11	9140-0158	1	COIL:FXD RF 1 UH 10%	99800	1025-20

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A4Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A4Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A4A4Q3	1854-0345		TSTR:SI NPN	80131	2N5179
A4A4Q4	1854-0345		TSTR:SI NPN	80131	2N5179
A4A4Q5	1854-0540	3	TSTR:SI NPN	04713	MM 8006
A4A4Q6	1854-0431	3	TSTR:SI NPN (REPLACEABLE BY RCA 2N5179)	28480	1854-0431
A4A4Q7	1854-0431		TSTR:SI NPN (REPLACEABLE BY RCA 2N5179)	28480	1854-0431
A4A4Q8	1854-0431		TSTR:SI NPN (REPLACEABLE BY RCA 2N5179)	28480	1854-0431
A4A4Q9	1854-0404	1	TSTR:SI NPN	28480	1854-0404
A4A4R1	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A4R2	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A4R3	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A4A4R4	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A4R5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A4R6	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A4R7	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A4A4R8	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A4A4R9	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A4R10	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A4A4R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A4R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A4R13	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A4R14	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A4R15	0757-0422	1	R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422
A4A4R16	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A4R17	0757-1094	9	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A4A4R18	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
A4A4R19	0757-0398	3	R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398
A4A4R20	0764-0033	1	R:FXD MET OX 33 OHM 5% 2W	28480	0764-0033
A4A4R21	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A4R22	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A4A4R23	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A4R24	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A4R25	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A4A4R26	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A4R27	0698-3155	17	R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A4A4R28	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A4A4R29	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A4R30	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A4R31	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A4A4U1	1820-0714	1	IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A4A5	08660-60005	1	BOARD ASSY:VCO & AMPLIFIERS	28480	08660-60005
A4A5C1	0160-3878	16	C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C2	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C3	0121-0452	2	C:VAR AIR 1.3 TO 5.4 PF 250VDCW	28480	0121-0452
A4A5C4	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C5	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C6	0160-2250	2	C:FXD CER 5.1 PF 500VDCW	72982	301-000-COH0-519E
A4A5C7	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C8	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C9	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C10	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C11	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C12	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C13	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C14	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C15	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C16	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C17	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C18	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C19	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C20	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-COG0-240J
A4A5C21	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C22	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C23	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5C24	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A4A5CR1	0122-0148	1	C:VAR AIR 1.2-4.2 PF	28480	0122-0148
A4A5CR2	1901-1034	1	DIODE:STABISTOR 90V MIN.	28480	1901-1034
A4A5FL1	08660-60038	1	FILTER:LP 600 MHZ	28480	08660-60038
A4A5L2	9100-2250	7	COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L3	08660-80006	4	INDUCTOR	28480	08660-80006
A4A5L4	08660-80006		INDUCTOR	28480	08660-80006
A4A5L5	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L6	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L7	08660-80006		INDUCTOR	28480	08660-80006

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A5L8	08660-80006		INDUCTOR	28480	08660-80006
A4A5L9	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L10	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L11	08660-80009		INDUCTOR	28480	08660-80009
A4A5L12	08660-80009		INDUCTOR	28480	08660-80009
A4A5L13	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5L14	9100-2250		COIL/CHOKE 0.18 UH 10%	28480	9100-2250
A4A5Q1	1854-0540		TSTR:SI NPN	04713	MM 8006
A4A5Q2	08660-80013	4	TSTR:SI NPN SELECTED FROM 2N5179	28480	08660-80013
A4A5Q3	08660-80013		TSTR:SI NPN SELECTED FROM 2N5179	28480	08660-80013
A4A5Q4	08660-80012	1	TSTR:SELECTED FROM 2N5179	28480	08660-80012
A4A5Q5	08660-80013		TSTR:SI NPN SELECTED FROM 2N5179	28480	08660-80013
A4A5Q6	08660-80013		TSTR:SI NPN SELECTED FROM 2N5179	28480	08660-80013
A4A5Q7	1854-0540		TSTR:SI NPN	04713	MM 8006
A4A5R1	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A5R2	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A5R3	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A5R4	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A4A5R5	0698-7205	2	R:FXD FLM 51.1 OHM 2% 1/8W	28480	0698-7205
A4A5R6	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A5R7	0698-7205		R:FXD FLM 51.1 OHM 2% 1/8W	28480	0698-7205
A4A5R8	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A5R9	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A5R10	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A5R11	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R12	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R13	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R14	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R15	0698-3442	12	R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A4A5R16	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A4A5R17	0698-3428	4	R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428
A4A5R18	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A5R19	0698-3428		R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428
A4A5R20	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A5R21	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R22	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R23	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R24	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R25	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A5R26	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A5R27	0698-3428		R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428
A4A5R28	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A5R29	0698-3428		R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428
A4A5R30	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A5R31	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R32	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R33	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A4A5R34	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A5R35	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A5R36	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A5R37	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A5R38	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28490	0757-0416
A4A5R39	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A5R40	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A5R41	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A5R42	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A5T1	08660-80003	1	TRANSFORMER:ISOLATOR	28480	08660-80003
A4A6	08660-60007	1	BOARD ASSY:PRETUNE	28480	08660-60007
A4A6C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A4A6C2	0180-0183	6	C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A4A6C3	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A4A6C4	0180-0141	5	C:FXD ELECT 50 UF +75-10% 50VDCW	56289	30D506G050DD2-DSM
A4A6C5	0121-0452		C:VAR AIR 1.3 TO 5.4 PF 250VDCW	28480	0121-0452
A4A6C6	0160-2263	1	C:FXD CER 18 PF 5% 500VDCW	72982	301-000-C0G0-180J
A4A6C7	0160-0174	15	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A4A6C8	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A4A6C9	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A6C10	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A4A6C11	0160-3537		C:FXD MICA 680 PF 5% 100VDCW	72136	RDM15F681J1C
A4A6CR1	1901-0033	2	DIODE:SILICON 100MA 180WV	07263	FD3369
A4A6L1	9140-0178	1	COIL:FXD 12 UH 10%	28480	9140-0178
A4A6L2	9100-1643	1	COIL/CHOKE 300 UH 5%	28480	9100-1643
A4A6Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4A6Q2	1853-0007	13	TSTR:SI PNP	80131	2N3251
A4A6Q3	1853-0007		TSTR:SI PNP	80131	2N3251

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A6Q4	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q5	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q6	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q7	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q8	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q9	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q10	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q11	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q12	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q13	1853-0007		TSTR:SI PNP	80131	2N3251
A4A6Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A4A6R1	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A6R2	2100-2497	3	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2497
A4A6R3	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A4A6R4	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A6R5	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A6R6	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A6R7	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A4A6R8	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A4A6R9	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A4A6R10	0757-0405	5	R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A4A6R11	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A6R12	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A4A6R13	2100-2497		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2497
A4A6R14	0757-0200	25	R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A4A6R15	2100-1984	5	R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A4A6R16	0698-3439	6	R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A4A6R17	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A4A6R18	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A6R19	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A6R20	2100-1984		R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A4A6R21	0698-3409	1	R:FXD MET FLM 2.37K OHM 1% 1/2W	28480	0698-3409
A4A6R22	2100-1984		R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A4A6R23	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A6R24	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A6R25	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A4A6R26	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A6R27	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A6R28	2100-1984		R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A4A6R29	0757-0836	1	R:FXD MET FLM 7.50K OHM 1% 1/2W	28480	0757-0836
A4A6R30	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A6R31	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A4A6R32	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A4A6R33	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A4A6R34	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A6R35	2100-1984		R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A4A6R36	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A4A6R37	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A6R38	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A6R39	0757-0440	8	R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A4A6R40	2100-2061	2	R:VAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2061
A4A6R41	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A4A6R42	0698-3150	8	R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A4A6R43	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A6R44	2100-2061		R:VAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2061
A4A6R45	0698-3443	9	R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A4A6R46	0698-0085	14	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A4A6R47	0757-0317	6	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A4A6R48	2100-1788	2	R:VAR FLM 500 OHM 10% LIN 1/2W	28480	2100-1788
A4A6R49	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A4A6R50	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A4A6R51	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A4A6R52	2100-1788		R:VAR FLM 500 OHM 10% LIN 1/2W	28480	2100-1788
A4A6R53	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A6R54	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A4A6R55	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A4A6R56	2100-1986	3	R:VAR CERMET 1000 OHM 10% LIN 1/2W	28480	2100-1986
A4A6R57	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A4A6R58	0698-3152	2	R:FXD MET FLM 3.48K OHM 1% 1/8W	28480	0698-3152
A4A6R59	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A4A6R60	2100-2497		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2497
A4A6R61	0757-0447	5	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A4A6R62	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A4A6R63	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A6R64	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A6U1	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A4A7	08660-60006	1	BOARD ASSY:PHASE DETECTOR	28480	08660-60006
A4A7C1	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A7C2	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A7C3	0180-2214	5	C:FXD ELECT 90 UF +75-10% 15VDCW	56289	30D906G015CC2-DSM
A4A7C4	0160-3879	1	C:FXD CER 0.01 UF 20% 100VDCW	72982	8121-8112-X7R-103M
A4A7C5	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A7C6	0180-2214		C:FXD ELECT 90 UF +75-10% 15VDCW	56289	30D906G015CC2-DSM
A4A7C7	0180-0049	8	C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A4A7C8	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A4A7C9	0160-0839	1	C:FXD MICA 110PF 1%	28480	0160-0839
A4A7C10	0160-3064	1	C:FXD MICA 1000 PF 5% 300VDCW	00853	RDM19F102J3S
A4A7C11	0160-0182	2	C:FXD MICA 47PF 5% 300VDCW	14655	RDM15E470J3S
A4A7C12	0160-0182		C:FXD MICA 47PF 5% 300VDCW	14655	RDM15E470J3S
A4A7C13	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
A4A7C14	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-C0G0-240J
A4A7C15	0180-1745		C:FXD ELECT 1.5 UF 10% 20VDCW	28480	0180-1745
A4A7C16	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-C0G0-240J
A4A7C17	0160-2264	1	C:FXD CER 20 PF 5% 500VDCW	72982	301-000-C0G0-200J
A4A7C18	0180-0291	16	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A4A7C19	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A4A7C20	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A4A7C21	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A4A7C22	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A4A7C23	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A4A7C24	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A4A7C25	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A4A7C26	0160-2266		C:FXD CER 24 PF 5% 500VDCW	72982	301-000-C0G0-240J
A4A7CR1	1901-0189	1	DIODE:SILICON MATCHED QUAD	28480	1901-0189
A4A7CR2	10514-8454	4	DIODE:SILICON MATCHED QUAD	28480	10514-8454
A4A7CR3	10514-8454		DIODE:SILICON MATCHED QUAD	28480	10514-8454
A4A7CR4	10514-8454		DIODE:SILICON MATCHED QUAD	28480	10514-8454
A4A7CR5	10514-8454		DIODE:SILICON MATCHED QUAD	28480	10514-8454
A4A7CR6	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A7CR7	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A7CR8	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A7CR9	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A4A7CR10	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A4A7J1	1250-0836	1	CONNECTOR:RF SUB-MINIATURE	98291	50-053-0000
A4A7L1	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A4A7L2	9140-0210	2	COIL/CHOKE 100 UH 5%	82142	15-1315-12J
A4A7L3	9140-0210		COIL/CHOKE 100 UH 5%	82142	15-1315-12J
A4A7L4	9100-2260		COIL:FXD 1.80 UH 10%	82142	09-4436-3K
A4A7L5	9100-2254	1	COIL/CHOKE .39 UH 10%	28480	9100-2254
A4A7L6	08660-80005	2	INDUCTOR	28480	08660-80005
A4A7L7	08660-80005		INDUCTOR	28480	08660-80005
A4A7Q1	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A7Q2	1854-0019		TSTR:SI NPN	28480	1854-0019
A4A7Q3	1853-0034	12	TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A4A7Q4	1855-0049	4	TSTR:SI FET N-CHANNEL DUAL	28480	1855-0049
A4A7Q5	1853-0007		TSTR:SI PNP	80131	2N3251
A4A7Q6	1854-0023	1	TSTR:SI NPN(SELECTED FROM 2N2484)	28480	1854-0023
A4A7R1	0757-0398		R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398
A4A7R2	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A7R3	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A7R4	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A4A7R5	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A7R6	0698-3437	5	R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437
A4A7R7	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A4A7R8	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A4A7R9	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A4A7R10	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A7R11	0757-0276	1	R:FXD MET FLM 61.9 OHM 1% 1/8W	28480	0757-0276
A4A7R12	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A4A7R13	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R14	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R15	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R16	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A7R17	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A4A7R18	2100-1986		R:VAR CERMET 1000 OHM 10% LIN 1/2W	28480	2100-1986
A4A7R19	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R20	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R21	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A7R22	2100-1986		R:VAR CERMET 1000 OHM 10% LIN 1/2W	28480	2100-1986
A4A7R23	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4A7R24	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A7R25	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A4A7R26	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A4A7R27	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R28	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A4A7R29	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A7R30	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7R31	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A4A7R32	0698-3101	1	R:FXD MET FLM 2.87K OHM 1% 1/2W	28480	0698-3101
A4A7R33	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A4A7R34	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A4A7T1	08660-80011	1	TRANSFORMER:TRIFILAR	28480	08660-80011
A4A7T2	08660-80010	1	TRANSFORMER:BIFILAR	28480	08660-80010
A5	08660-60023	1	BOARD ASSY:REGULATOR	28480	08660-60023
A5C1	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C2	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C3	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C4	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C5	0160-2207	1	C:FXD MICA 300 PF 5%	28480	0160-2207
A5C6	0180-1704	7	C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A5C7	0180-0374	6	C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A5C8	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C9	0160-2208	2	C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
A5C10	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A5C11			NOT ASSIGNED		
A5C12	0160-2218		C:FXD MICA 1000 PF 5%	28480	0160-2218
A5C13	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C14	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A5C15	0180-0269	2	C:FXD ELECT 1.0 UF +50-10% 150VDCW	56289	30D105F150BA2-DSM
A5C16			NOT ASSIGNED		
A5C17	0160-2218		C:FXD MICA 1000 PF 5%	28480	0160-2218
A5C18	0180-0269		C:FXD ELECT 1.0 UF +50-10% 150VDCW	56289	30D105F150BA2-DSM
A5C19	0180-0058	15	C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A5CR1	1902-3104	2	DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A5Q1	1853-0037	5	TSTR:SI PNP	04713	SS 2109
A5Q2	1853-0050	17	TSTR:SI PNP	28480	1853-0050
A5Q3	1853-0037		TSTR:SI PNP	04713	SS 2109
A5Q4	1853-0050		TSTR:SI PNP	28480	1853-0050
A5Q5	1853-0037		TSTR:SI PNP	04713	SS 2109
A5Q6	1853-0326	1	TSTR:SI PNP	28480	1853-0326
A5R1	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397
A5R2	0757-0346		R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346
A5R3	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A5R4	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397
A5R5	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397
A5R6	0757-0398		R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398
A5R7	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A5R8	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A5R9	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397
A5R10	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A5R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A5R12	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A5R13	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A5R14	0698-3161	1	R:FXD MET FLM 38.3K OHM 1% 1/8W	28480	0698-3161
A5R15	0757-0424	19	R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A5R16	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A5R17	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A5R18	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A5R19	0698-3136	3	R:FXD MET FLM 17.8K OHM 1% 1/8W	28480	0698-3136
A5R20	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A5R21	2100-1973	1	R:VAR WW 200 OHM 10% 1W	28480	2100-1973
A5R22	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A5R23	0698-3152		R:FXD MET FLM 3.48K OHM 1% 1/8W	28480	0698-3152
A5R24	2100-1799	2	R:VAR WW 500 OHM 10% 1W	28480	2100-1799
A5R25	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A5R26	2100-1799		R:VAR WW 500 OHM 10% 1W	28480	2100-1799
A5R27	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A5R28	2100-2852	1	R:VAR WW 1000 OHM 10% 1W	28480	2100-2852
A5R29	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A5U1	1826-0016	1	IC:LINEAR NEG. VOLTAGE REGULATOR	12040	LM204H
A5U2	1826-0004	1	IC:NEGATIVE VOLTAGE REGULATOR	12040	LM304H
A5U3	1820-0247	2	IC:VOLTAGE REGULATOR 40V MAX.	12040	LM305
A5U4	1820-0247		IC:VOLTAGE REGULATOR 40V MAX.	12040	LM305
A6A1	08660-60024	1	BOARD ASSY:PRE-REGULATOR	28480	08660-60024
A6A1C1	0180-0141		C:FXD ELECT 50 UF +75-10% 50VDCW	56289	30D506G050DD2-DSM

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6A1C2	0180-0141		C:FXD ELECT 50 UF +75-10% 50VDCW	56289	30D506G050DD2-DSM
A6A1C3	0180-0089	1	C:FXD AL ELECT 10 UF +50-10% 150VDCW	56289	30D106F150DD2-DSM
A6A1C4	0150-0121	55	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C9	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A6A1C10	0160-0013	1	C:FXD MY 0.1 UF 10% 400VDCW	56289	160P10494-PMD
A6A1CR1	1902-3262	1	DIODE BREAKDOWN:24.9V 5% 400 MW	28480	1902-3262
A6A1CR2	1902-3203	1	DIODE BREAKDOWN:SILICON 14.7V 5%	28480	1902-3203
A6A1CR3	1902-3333	1	DIODE BREAKDOWN:46.4V 5%	07910	CD35898
A6A1Q1	1854-0072	1	TSTR:SI NPN	80131	2N3054
A6A1Q2	1853-0052	1	TSTR:SI PNP	80131	2N3740
A6A1Q3	1853-0037		TSTR:SI PNP	04713	SS 2109
A6A1Q4	1854-0063	3	TSTR:SI NPN	80131	2N3055
A6A1Q5	1853-0059	1	TSTR:SI PNP	80131	2N3791
A6A1Q6	1853-0037		TSTR:SI PNP	04713	SS 2109
A6A1Q7	1854-0063		TSTR:SI NPN	80131	2N3055
A6A1Q8	1854-0063		TSTR:SI NPN	80131	2N3055
A6A1Q9	1854-0003	1	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
A6A1Q10	1854-0313	1	TSTR:SI NPN	80131	2N3771
A6A1R1	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A6A1R2	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A6A1R3	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A6A1R4	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A6A1R5	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A6A1R6	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A6A1R7	0811-1849	1	R:FXD WW 0.75 OHM 10% 5W	28480	0811-1849
A6A1R8	0812-0019	2	R:FXD WW 0.33 OHM 5% 3W	28480	0812-0019
A6A1R9	0812-0019		R:FXD WW 0.33 OHM 5% 3W	28480	0812-0019
A6A1R10	0812-0021	1	R:FXD WW 0.47 OHM 5% 3W	28480	0812-0021
A6A1R11	0811-1670	1	R:FXD WW 2.2 OHM 5% 2W	28480	0811-1670
A6A1XA20	1251-1388	1	CONNECTOR:PC (2 X 15) 30 CONTACT	71785	252-15-30-008
A6A1Z	0340-0162	2	INSULATOR:TSTR FOR TO-66	13103	A0340-0162-1
A6A1Z	1200-0043	5	INSULATOR:TSTR MOUNTING(TO-3)	71785	293011
A6A1Z	08660-20050	1	HEAT SINK	28480	08660-20050
A6A2	3160-0232	1	FAN ASSY:SKELETON 115V 50/60HZ	28480	3160-0232
A6A2			(FOR STANDARD INSTRUMENT ONLY)		
A6A2	3160-0253	1	FAN	28480	3160-0253
A6A2			(FOR OPTION 03 ONLY)		
A7	5060-1188	1	POWER LINE MODULE	28480	5060-1188
A7R1	0839-0006	1	THERMISTOR:DISC TYPE 10 OHM 10% AT 25C	03508	2D-754
A8	08660-60014	1	BOARD ASSY:N3 OSCILLATOR	28480	08660-60014
A8			FOR OPTION 004, OMIT A8 ASSEMBLY		
A8C1	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A8C2	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A8C3	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A8C4	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A8C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A8C6	0160-3459	6	C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A8C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A8C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A8C9	0160-3459		C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A8C10	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C11	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8C12	0160-0386	15	C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A8C13	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A8C14	0170-0082	7	C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A8C15			NOT USED		
A8C16	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A8C17	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A8C18	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8C22	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A8CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR3	0122-0299	1	C:VOLTAGE VAR 82 PF 5% 20WV	04713	SMV 389-299
A8L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A8L2	9140-0114	13	COIL:FXD RF 10 UH	28480	9140-0114
A8L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A8L4	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A8L5	9100-2815	5	INDUCTOR:FXD 0.70 UH 5%	73899	LF4W070

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8L6	9140-0179	25	COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A8L7	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A8Q1	1854-0092	32	TSTR:SI NPN	80131	2N3563
A8Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A8Q3	1853-0050		TSTR:SI PNP	28480	1853-0050
A8Q4	1853-0050		TSTR:SI PNP	28480	1853-0050
A8Q5	1853-0050		TSTR:SI PNP	28480	1853-0050
A8Q6	1854-0087	8	TSTR:SI NPN	80131	2N3417
A8Q7	1855-0081	5	TSTR:SI FET	80131	2N5245
A8Q8	1853-0066	52	TSTR:SI PNP	80131	2N4250
A8Q9	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q10	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q11	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q12	1854-0087		TSTR:SI NPN	80131	2N3417
A8R1			NOT USED		
A8R2	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A8R3	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A8R4	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A8R5	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A8R6	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R7	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R8	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R10	0757-0479	5	R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A8R11	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A8R12	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A8R13	0698-3228	5	R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A8R14			NOT USED		
A8R15	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A8R16	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R17	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A8R18	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A8R19	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A8R20	0757-0199	6	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A8R21	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A8R22	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A8R23	0698-4037	3	R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A8R24	2100-1760	6	R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A8R25	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A8R26	2100-1759	5	R:VAR WW 2K OHM 5% TYPE V 1W	28480	2100-1759
A8R27	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A8R28	0698-3158		R:FXD MET FLM 23.7K OHM 1% 1/8W	28480	0698-3158
A8R29			NOT USED		
A8R30	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A8R31	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A8R32	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A8R33	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A8R34	0757-0443	2	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A8R35	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A8R36	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R37			NOT USED		
A8R38	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A8R39	0683-8245	5	R:FXD COMP 820K OHM 5% 1/4W	01121	CB 8245
A8R40	0698-3243	13	R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A8R41	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R42	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A8R43	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A8R44	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A8R45	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A8R46	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A8R47	0757-0403	4	R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403
A8R48	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A8R49	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A8R50	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A8U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A8U2	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A8U3	1820-0450	15	IC:DIGITAL TTL	18324	N8290A
A9	08660-60045	1	CABLE ASSY:LOOP BOX	28480	08660-60045
A9W1	8120-1614	1	CABLE:RIBBON, SPEC. PURPOSE	66346	3401
A9A1	08660-60037	1	BOARD ASSY:DIGITAL PROGRAM	28480	08660-60037
A9A1E1	0360-1636	1	TERMINAL:RIBBON CABLE 34 CONTACTS	66346	3402
A9A1R1	0698-7210	28	R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R2	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R3	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R4	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9A1R5	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R6	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R7	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R8	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R9	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R10	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R11	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R12	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R13	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R14	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R15	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R16	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R17	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R18	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R19	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R20	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R21	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R22	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R23	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R24	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R25	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R26	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R27	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A9A1R28	0698-7210		R:FXD FLM 82.5 OHM 2% 1/8W	28480	0698-7210
A10	08660-60013	1	BOARD ASSY:N3 PHASE DETECTOR	28480	08660-60013
A10			FOR OPTION 004, OMIT A10 ASSEMBLY		
A10C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C3	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A10C4	0180-2206		C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X9006B2
A10C5	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A10C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C8	0160-0157	4	C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A10C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C10	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C11	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C12	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C13	0140-0172	3	C:FXD MICA 3000 PF 1% 100VDCW	28480	0140-0172
A10C14	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A10C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C16	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C17	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A10C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A10C22	0160-3539	4	C:FXD MICA 820 PF 5% 100VDCW	28480	0160-3539
A10C23	0160-2453	3	C:FXD MY 0.22 UF 10% 80VDCW	56289	192P2249R8-PTS
A10C24	0170-0040	3	C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A10CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A10CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A10CR3	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A10CR4	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A10L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A10L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A10L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A10L4	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A10L5	9100-1650	3	COIL/CHOKE 680.0 UH 5%	99800	2500-20
A10L6	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A10L7	9100-1652	4	COIL/CHOKE 820 UH 5%	82142	19-1331-33J
A10Q1	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A10Q2	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A10Q3	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A10Q4	1855-0049		TSTR:SI FET N-CHANNEL DUAL	28480	1855-0049
A10Q5	1854-0045		TSTR:SI NPN	04713	2N956
A10Q6	1853-0015		TSTR:SI PNP	80131	2N3640
A10Q7	1854-0092		TSTR:SI NPN	80131	2N3563
A10R1	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A10R2	0757-0289	6	R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A10R3	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A10R4	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A10R5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A10R6	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A10R7	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10R8	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A10R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R11	0698-3450	5	R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A10R12	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A10R13	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A10R14	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A10R15	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A10R16	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A10R17	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A10R18	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A10R19	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A10R20	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A10R21	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R22	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A10R23	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A10R24	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A10R25	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A10R26	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A10R27	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A10R28	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A10R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A10R30	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A10R31	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A10R32	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A10R33	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A10R34	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A10R35	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A10R36	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A10T1	08660-80001	4	TRANSFORMER:SAMPLER	28480	08660-80001
A10U1	1820-0451	8	IC:TTL DUAL J-K F/F	04713	MC3062P
A10U2	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A10U3	1820-0204	4	IC:TTL TRIPLE 3-INPT AND GATE	04713	MC3006P
A10U4	1820-0450		IC:DIGITAL TTL	18324	N8290A
A10U5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A10U6	1820-0450		IC:DIGITAL TTL	18324	N8290A
A10U7	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A11	08660-60019	1	BOARD ASSY:SL2 OSCILLATOR	28480	08660-60019
A11	08660-60040	2	BOARD ASSY:SL2 DETECTOR/OSCILLATOR	28480	08660-60040
A11			FOR OPTION 004, OMIT A11 ASSEMBLY		
A11C1	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A11C2	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A11C3	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A11C4	0180-2214		C:FXD ELECT 90 UF +75-10% 15VDCW	56289	30D906G015CC2-DSM
A11C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A11C6	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A11C7	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A11C8	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A11C9	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A11C10	0180-2210	2	C:FXD ELECT 2 UF +50-10% 150VDCW	28480	0180-2210
A11C11	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A11C12	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A11C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A11C14	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A11C15	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A11C16	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A11C17	0121-0059	4	C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A11C18	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A11C19	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A11C20	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A11C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A11C22	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A11C23	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A11C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A11C25	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A11C26	0180-2207	4	C:FXD ELECT 100 UF 10% 10VDCW	56289	150D101X9010R2-DYS
A11C27	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A11C28	0160-2228	1	C:FXD MICA 2700 PF 5%	28480	0160-2228
A11CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR13	0122-0263	4	C:VOLTAGE VAR 47 PF 10% 60WV	04713	1N5148
A11CR14	0122-0261	4	C:VOLTAGE VAR. 39 PF 10% 60VDCW	04713	1N5147
A11CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A11CR16	1901-0518	3	DIODE:HOT CARRIER	28480	1901-0518
A11CR16	1901-0518		DIODE:HOT CARRIER	28480	1901-0518
A11L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A11L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A11L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A11L4	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A11L5	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A11L6	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A11L7	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A11L8	9100-2815		INDUCTOR:FXD 0.70 UH 5%	73899	LF4W070
A11L9	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A11L10	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A11L11	9140-0129		COIL:FXD RF 220 UH	28480	9140-0129
A11L12	9100-0368	1	COIL:FXD 0.33 UH 10%	36196	1A-3303M
A11Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A11Q2	1855-0081		TSTR:SI FET	80131	2N5245
A11Q3	1854-0345		TSTR:SI NPN	80131	2N5179
A11Q4	1853-0050		TSTR:SI PNP	28480	1853-0050
A11Q5	1853-0050		TSTR:SI PNP	28480	1853-0050
A11Q6	1854-0087		TSTR:SI NPN	80131	2N3417
A11Q7	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q9	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q10	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q11	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q12	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q13	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q14	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q15	1853-0050		TSTR:SI PNP	28480	1853-0050
A11Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q17	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q18	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q19	1853-0066		TSTR:SI PNP	80131	2N4250
A11Q20	1853-0066		TSTR:SI PNP	80131	2N4250
A11R1	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R2	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R3	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R4	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R5	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R6	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R7	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R8	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R9	0757-0479		R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A11R10	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A11R11	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A11R12	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A11R13	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A11R14	0757-0460	2	R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A11R15	2100-1760		R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A11R16	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A11R17	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R18	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R19	2100-1759		R:VAR WW 2K OHM 5% TYPE V 1W	28480	2100-1759
A11R20	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11R21	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A11R22	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R23	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A11R24	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A11R25	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R26	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R27	0757-0458	4	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A11R28	0757-0461	4	R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A11R29	0757-0464	4	R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464
A11R30	0757-0467	4	R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A11R31	0757-0466	4	R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A11R32	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A11R33	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A11R34	0698-3266	8	R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A11R35	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A11R36	0698-3459	4	R:FXD MET FLM 383K OHM 1% 1/8W	28480	0698-3459
A11R37	0698-3162	5	R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A11R38	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A11R39	2100-2574	4	R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A11R40	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A11R41	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R42	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R43	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A11R44	0698-3437		R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437
A11R45	0757-0405		R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A11R46	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A11R47	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A11R48	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A11R49	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A11R50	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A11R51	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A11R52	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A11R53	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A11R54	2100-2574		R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A11R55	0698-3258	2	R:FXD MET FLM 5.36K OHM 1% 1/8W	28480	0698-3258
A11R56	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A11R57	0757-0834	4	R:FXD MET FLM 5.62K OHM 2% 1/2W	28480	0757-0834
A11R58	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R59	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R60	2100-2633	6	R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A11R61	0757-0290	6	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A11R62	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A11R63	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R64	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R65	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A11R66	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R67	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A11R68	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A11R69	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A11R70	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R71	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R72	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A11R73	2100-2521	4	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A11R74	0757-0288		R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A11R75	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R76	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R77	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A11R78	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A11R79	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R80	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R81	0683-8245		R:FXD COMP 820K OHM 5% 1/4W	01121	CB 8245
A11R82	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A11R83	2100-2489	2	R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A11R84	0698-3136		R:FXD MET FLM 17.8K OHM 1% 1/8W	28480	0698-3136
A11R85	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A11R86	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A11R87	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A11R88	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R89	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A11R90	2100-2522	2	R:VAR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A11R91	0757-0123	2	R:FXD MET FLM 34.8K OHM 1% 1/8W	28480	0757-0123
A11R92	0757-0403		R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403
A11R93	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A11R94	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A11R95	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11R96	0757-0402	1	R:FXD MET FLM 110 OHM 1% 1/8W	28480	0757-0402
A11R97	0757-0288		R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A11R98	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A11R99	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A11R100	0757-0395		R:FXD MET FLM 56.2 OHM 1% 1/8W	28480	0757-0395
A11R101	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A11R102	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A11R103	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A11R104	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A11R105	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A11R106	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A11R107	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A11U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A11U2	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A11U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12	08660-60018	1	BOARD ASSY:SL2 DETECTOR	28480	08660-60018
A12	08660-60040		BOARD ASSY:SL2 DETECTOR/OSCILLATOR	28480	08660-60040
A12			. FOR OPTION 004, OMIT A12 ASSEMBLY		
A12C1	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C2	0180-2207		C:FXD ELECT 100 UF 10% 10VDCW	56289	150D101X9010R2-DYS
A12C3	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C4	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C5	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C6	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A12C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A12C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML
A12C9	0160-0301	5	C:FXD MY 0.012 UF 10% 200VDCW	56289	192P12392-PTS
A12C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A12C11	0160-0301		C:FXD MY 0.012 UF 10% 200VDCW	56289	192P12392-PTS
A12C12	0160-2261	4	C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF
A12C13	0160-2261		C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF
A12C14	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C15	0180-2141	1	C:FXD ELECT 3.3 UF 10% 50VDCW	56289	150D335X9050B2-DYS
A12C16	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A12C17	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A12C18	0160-0299	2	C:FXD MY 1800 PF 10% 200VDCW	56289	192P18292-PTS
A12C19	0160-0939	1	C: FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A12C20	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A12C21	0160-0299		C:FXD MY 1800 PF 10% 200VDCW	56289	192P18292-PTS
A12C22	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A12C23	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A12C24	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
A12C25	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A12E1	10534C	2	MIXER:DOUBLE BALANCE	50436	10534C
A12L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A12L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A12L3	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A12L4	9100-1621	2	COIL/CHOKE 18.0 UH 10%	99800	1537-42
A12L5	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A12L6	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A12L7	9100-1658	1	COIL/CHOKE 1600 UH 5%	99800	2500-38
A12Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A12Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q4	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q5	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q6	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q7	1854-0092		TSTR:SI NPN	80131	2N3563
A12Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A12Q9	1853-0066		TSTR:SI PNP	80131	2N4250
A12Q10	1853-0066		TSTR:SI PNP	80131	2N4250
A12Q11	1853-0066		TSTR:SI PNP	80131	2N4250
A12Q12	1854-0092		TSTR:SI NPN	80131	2N3563
A12R1	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A12R2	0757-0400	3	R:FXD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A12R3	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A12R4	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A12R5	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A12R6	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A12R7	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A12R8	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A12R9	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A12R10	0757-0420		R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A12R11	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A12R12	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12R13	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A12R14			NOT USED		
A12R15	0757-0294	2	R:FXD MET FLM 17.8 OHM 1% 1/8W	28480	0757-0294
A12R16	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R17	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R18	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A12R19	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R20	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A12R21	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A12R22	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A12R23	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A12R24	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A12R25	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A12R27	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R28	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R29	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A12R30	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A12R31	0683-3955	2	R:FXD COMP 3.9 MEGOHM 5% 1/4W	01121	CB 3955
A12R32	0683-2055	2	R:FXD COMP 2 MEGOHM 5% 1/4W	01121	CB 2055
A12R33	0683-1055	2	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A12R34	0698-3263	2	R:FXD MET FLM 500K OHM 1% 1/8W	28480	0698-3263
A12R35	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A12R36	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A12R37	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A12R38	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A12R39	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A12R40	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A12R41	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A12R42	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R43	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A12R44	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A12R45	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A12R46	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A12R47	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R48	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12R49	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A12R50	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A12R51	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A12U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U2	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A12U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U5	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A12U6	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U7	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12U9	1820-0450		IC:DIGITAL TTL	18324	N8290A
A13	08660-60012	1	BOARD ASSY:N2 OSCILLATOR	28480	08660-60012
A13C1	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A13C2	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A13C3	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A13C4	0180-2207		C:FXD ELECT 100 UF 10% 10VDCW	56289	150D101X9010R2-DYS
A13C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A13C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A13C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A13C8	0160-3459		C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A13C9			NOT USED		
A13C10	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A13C11	0180-0116		C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X9035B2-DYS
A13C12	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A13C13	0180-2210		C:FXD ELECT 2 UF +50-10% 150VDCW	28480	0180-2210
A13C14	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A13C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A13C16	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A13C17	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A13C18	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A13C19	0121-0059		C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A13C20			NOT USED		
A13C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A13C22	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A13C23	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A13C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A13C25	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A13C26	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A13C27	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A13C28	0160-3459		C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A13C29	0160-0163	1	C:FXD MY 0.033 UF 10% 200VDCW	56289	192P33392-PTS
A13CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR2			NOT USED		
A13CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR8	0122-0263		C:VOLTAGE VAR 47 PF 10% 60WV	04713	1N5148
A13CR9	0122-0261		C:VOLTAGE VAR. 39 PF 10% 60VDCW	04713	1N5147
A13CR10			NOT USED		
A13CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A13L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A13L2	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A13L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A13L4	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A13L5	9100-2815		INDUCTOR:FXD 0.70 UH 5%	73899	LF4W070
A13L6	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A13L7	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A13L8	9100-1674	1	COIL/CHOKE 7500 UH 5%	28480	9100-1674
A13Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A13Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A13Q3	1853-0050		TSTR:SI PNP	28480	1853-0050
A13Q4	1854-0087		TSTR:SI NPN	80131	2N3417
A13Q5	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q6	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q7	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q9	1855-0081		TSTR:SI FET	80131	2N5245
A13Q10	1854-0087		TSTR:SI NPN	80131	2N3417
A13Q11	1853-0050		TSTR:SI PNP	28480	1853-0050
A13Q12	1853-0050		TSTR:SI PNP	28480	1853-0050
A13Q13	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q14	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q15	1853-0066		TSTR:SI PNP	80131	2N4250
A13Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A13R1	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R2	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R3	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R4	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R5	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R6	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R7	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R8	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A13R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R13	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R16	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R17	0757-0479		R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A13R18	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A13R19	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A13R20	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A13R21	0757-0124	2	R:FXD MET FLM 39.2K OHM 1% 1/8W	28480	0757-0124
A13R22	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A13R23	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R24	0698-4002	2	R:FXD MET FLM 5K OHM 1% 1/8W	28480	0698-4002
A13R25	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R26	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A13R27	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A13R28	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A13R29	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A13R30	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A13R31	0698-3162		R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A13R32	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A13R33	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A13R34	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A13R35	0698-4037		R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A13R36	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A13R37	2100-1759		R:VAR WW 2K OHM 5% TYPE V 1W	28480	2100-1759
A13R38			NOT USED		
A13R39	2100-1760		R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A13R40	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A13R41	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A13R42	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A13R43	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A13R44	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R45	0757-0834		R:FXD MET FLM 5.62K OHM 2% 1/2W	28480	0757-0834
A13R46	0698-3459		R:FXD MET FLM 383K OHM 1% 1/8W	28480	0698-3459
A13R47	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A13R48	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A13R49	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A13R50	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A13R51			NOT USED		
A13R52	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
A13R53	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A13R54	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A13R55	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A13R56	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A13R57	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A13R58	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A13R59	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A13R60	0757-0466		R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A13R61	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A13R62	0683-8245		R:FXD COMP 820K OHM 5% 1/4W	01121	CB 8245
A13R63	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A13R64	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A13R65	0757-0467		R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A13R66	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A13R67	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A13R68	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A13R69	0757-0464		R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464
A13R70	0757-0405		R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A13R71	0757-0461		R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A13R72	0698-3437		R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437
A13R73	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A13R74	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A13R75	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A13R76	0757-0403		R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403
A13R77	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A13R78	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A13R79	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A13R80	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A13R81	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A13R82	0757-0400		R:FXD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A13R83	0698-3438		R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
A13R84	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A13R85	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A13U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A13U2	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A13U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A14	08660-60011	1	BOARD ASSY:NZ PHASE DETECTOR	28480	08660-60011
A14			FOR OPTION 004, OMIT 08660-60011-		
A14			ADD 08660-60039.		
A14C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C2			NOT USED		
A14C3	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A14C4	0180-2206		C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X9006B2
A14C5	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A14C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C7	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A14C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C9	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A14C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C11	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C12	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C14	0140-0172		C:FXD MICA 3000 PF 1% 100VDCW	28480	0140-0172
A14C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C16	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14C17	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14C22	0160-3539		C:FXD MICA 820 PF 5% 100VDCW	28480	0160-3539
A14C23	0160-2453		C:FXD MY 0.22 UF 10% 80VDCW	56289	192P2249R8-PTS
A14C24	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A14C25	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A14C26	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A14CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14CR3	1901-1066	4	DIODE:0.75 NS	28480	1901-1066
A14CR4	1901-1066		DIODE:0.75 NS	28480	1901-1066
A14L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A14L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A14L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A14L4	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A14L5	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A14L6	9100-1614	2	COIL/CHOKE:0.82 UH 10%	28480	9100-1614
A14L7	9100-1650		COIL/CHOKE 680.0 UH 5%	99800	2500-20
A14L8	9100-1652		COIL/CHOKE 820 UH 5%	82142	19-1331-33J
A14Q1	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14Q2	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14Q3	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14Q4	1855-0049		TSTR:SI FET N-CHANNEL DUAL	28480	1855-0049
A14Q5	1854-0045		TSTR:SI NPN	04713	2N956
A14Q6	1853-0015		TSTR:SI PNP	80131	2N3640
A14Q7	1854-0092		TSTR:SI NPN	80131	2N3563
A14R1	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A14R2	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A14R3	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A14R4	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A14R5	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14R6	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14R7	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R8	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A14R9	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R11	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14R12	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14R13	0698-3450		R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A14R14	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A14R15	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A14R16	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14R17	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A14R18	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A14R19	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14R20	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14R21	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14R22	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A14R23	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A14R24	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A14R25	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14R26	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14R27	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14R28	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14R29	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A14R30	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14R31	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A14R32	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A14R33	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A14R34	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14R35	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A14R36	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14T1	08660-80001		TRANSFORMER:SAMPLER	28480	08660-80001
A14U1	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A14U2	1820-0204		IC:TTL TRIPLE 3-INPT AND GATE	04713	MC3006P
A14U3	1820-0469		IC:DIGITAL TTL HI-SPEED F/F	01295	SN74H102N
A14U4	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A14U5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14U6	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14U7	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A14	08660-60039	1	BOARD ASSY:N2 PHASE DETECTOR	28480	08660-60039

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14			FOR OPTION 004 ONLY		
A14 C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C2	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A14 C3	0180-2206		C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X9006B2
A14 C4	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A14 C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C6	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C9	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A14 C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C11	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C12	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C13	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C15	0140-0172		C:FXD MICA 3000 PF 1% 100VDCW	28480	0140-0172
A14 C16	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A14 C17	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A14 C19	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A14 C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 C22	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A14 C23	0160-3539		C:FXD MICA 820 PF 5% 100VDCW	28480	0160-3539
A14 C24	0160-2453		C:FXD MY 0.22 UF 10% 80VDCW	56289	192P2249R8-PTS
A14 C25	0170-0040		C:FXD MY 0.047 UF 10% 200VDCW	56289	192P47392-PTS
A14 C26	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A14 CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A14 CR2	1901-1066		DIODE:0.75 NS	28480	1901-1066
A14 CR3	1901-1066		DIODE:0.75 NS	28480	1901-1066
A14 L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A14 L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A14 L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A14 L4	9100-1650		COIL/CHOKE 680.0 UH 5%	99800	2500-20
A14 L5	9100-1652		COIL/CHOKE 820 UH 5%	82142	19-1331-33J
A14 L6	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A14 Q1	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14 Q2	1854-0210	2	TSTR:SI NPN	80131	2N2222
A14 Q3	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14 Q4	1853-0015		TSTR:SI PNP	80131	2N3640
A14 Q5	1854-0210		TSTR:SI NPN	80131	2N2222
A14 Q6	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A14 Q7	1855-0049		TSTR:SI FET N-CHANNEL DUAL	28480	1855-0049
A14 R1	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A14 R2	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A14 R3	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A14 R4	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A14 R5	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14 R6	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A14 R7	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A14 R8	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A14 R9	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A14 R10	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A14 R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14 R12	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14 R13	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14 R14	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14 R15	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A14 R16	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14 R17	0698-3450		R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A14 R18	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A14 R19	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A14 R20	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A14 R21	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14 R22	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A14 R23	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A14 R24	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14 R25	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A14 R26	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A14 R27	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A14 R28	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14 R29	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A14 R30	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14 R31	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14 R32	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A14 R33	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A14 R34	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
A14 R35	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A14 R36	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A14 R37	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A14 R38	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A14 R39	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A14 R40	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A14 R41	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A14 T1	08660-80001		TRANSFORMER:SAMPLER	28480	08660-80001
A14 U1	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A14 U2	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A14 U3	1820-0204		IC:TTL TRIPLE 3-INPT AND GATE	04713	MC3006P
A14 U4	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14 U5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14 U6	1820-0450		IC:DIGITAL TTL	18324	N8290A
A14 U7	1820-0374		IC:TTL HS DUAL 4-INPT AND GATE	01295	SN74H21N
A15	08660-60016	1	BOARD ASSY:SL1 DETECTOR	28480	08660-60016
A15C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A15C2	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A15C3	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C1187S-CML
A15C4	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C508IS-CML
A15C5	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A15C6	0160-3456		C:FXD CER 1000 PF 10% 250VDCW	56289	C067F251F102KS22-CDH
A15C7	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A15C8	0180-2207		C:FXD ELECT 100 UF 10% 10VDCW	56289	150D101X9010R2-DYS
A15C9	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A15C10	0160-2261		C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF
A15C11	0160-2261		C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF
A15C12	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A15C13			NOT USED		
A15C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A15C15	0160-0298	2	C:FXD MY 0.0015 UF 10% 200VDCW	56289	192P15292-PTS
A15C16	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A15C17	0160-0298		C:FXD MY 0.0015 UF 10% 200VDCW	56289	192P15292-PTS
A15C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C508IS-CML
A15C19	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A15C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A15C21	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
A15C22	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C1187S-CML
A15L1	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A15L2	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A15L3	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A15L4	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A15L5	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A15L6	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A15L7	9100-1659	1	COIL/CHOKE 1.8 UH 5%	82142	22-1312-25J
A15L8	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A15Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A15Q2	1853-0015		TSTR:SI PNP	80131	2N3640
A15Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A15Q4	1854-0092		TSTR:SI NPN	80131	2N3563
A15Q5	1854-0092		TSTR:SI NPN	80131	2N3563
A15Q6	1854-0092		TSTR:SI NPN	80131	2N3563
A15R1	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A15R2	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A15R3	0757-0379	1	R:FXD MET FLM 12.1 OHM 1% 1/8W	28480	0757-0379
A15R4	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R5	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R6	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R7	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A15R8	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A15R9	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A15R10	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A15R11	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R12	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A15R13	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A15R14	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A15R15	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A15R16	0698-3150		R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150
A15R17	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R18	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A15R19	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R20	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A15R21	0757-0417	1	R:FXD MET FLM 562 OHM 1% 1/8W	28480	0757-0417

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15R22	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A15R23	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A15R24	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A15R25	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A15R26	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A15U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A15U2	1820-0077		IC:TTL DUAL D F/F	01295	SN7474N
A15U3	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A15U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A15U5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A15U6	1820-0450		IC:DIGITAL TTL	18324	N8290A
A15U7	1820-0068		IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A15U8	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A15U9	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A15U10	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A16	08660-60009	1	BOARD ASSY:N1 PHASE DETECTOR	28480	08660-60009
A16C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C2	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A16C3	0180-2206		C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X9006B2
A16C4	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A16C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C6	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C8	0160-0297		C:FXD MY 0.0012 UF 10% 200VDCW	56289	192P12292-PTS
A16C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C10	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C11	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C12	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C13	0160-0937	1	C:FXD MICA 1000 PF 2%	14655	RDM19F102G3S
A16C14	0160-3459		C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A16C15	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C16	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A16C17	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C18	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A16C19	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A16C20	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C21	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A16C22	0160-3539		C:FXD MICA 820 PF 5% 100VDCW	28480	0160-3539
A16C23	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A16C24	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A16C25	0160-3459		C:FXD CER 0.02 UF 20% 100VDCW	56289	C023F101H203MS22CDH
A16C26	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A16C27	0160-0134	1	C:FXD MICA 220PF 5% 300VDCW	14655	RDM15F221J3C
A16C28	0160-2307		C:FXD MICA 47 PF 5%	28480	0160-2307
A16C29	0160-0302	1	C:FXD MY 0.018 UF 10% 200VDCW	56289	192P18392-PTS
A16C30	0160-0945	2	C:FXD MICA 910 PF 5%	28480	0160-0945
A16C31	0140-0200	1	C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
A16CR1	1902-3104		DIODE:BREAKDOWN 5.62V 5%	04713	SZ10939-110
A16CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A16CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A16CR4	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A16CR5	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A16CR6	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A16L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A16L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A16L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A16L4	9100-1614		COIL/CHOKE:0.82 UH 10%	28480	9100-1614
A16L5	9100-2564	2	INDUCTOR:SHIELDED 150 UH 10%	82142	15S-151K
A16L6	9100-2564		INDUCTOR:SHIELDED 150 UH 10%	82142	15S-151K
A16Q1	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A16Q2	1853-0034		TSTR:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034
A16Q3	1855-0082	1	TSTR:SI FET P-CHANNEL	28480	1855-0082
A16Q4	1854-0092		TSTR:SI NPN	80131	2N3563
A16Q5	1853-0015		TSTR:SI PNP	80131	2N3640
A16Q6	1854-0045		TSTR:SI NPN	04713	2N956
A16R1	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A16R2	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A16R3	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A16R4	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A16R5	0757-1092	1	R:FXD MET FLM 287 OHM 1% 1/2W	28480	0757-1092
A16R6	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A16R7	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A16R8	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A16R9	0757-0420		R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A16R10	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16R11	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A16R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A16R13	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A16R14	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A16R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A16R16	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A16R17	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A16R18	0698-3450		R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A16R19	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A16R20	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A16R21	0757-0424		R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
A16R22	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A16R23	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A16R24	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A16R25	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A16R26	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A16R27	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A16R28	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A16R29	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A16R30	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A16R31	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A16R32	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A16R33	0698-3162		R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A16R34	0698-3450		R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450
A16R35	0757-0420		R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A16R36	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A16R37	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A16R38	2100-1760		R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A16R39	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A16R40	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A16R41	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A16R42	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A16R43	0698-3158		R:FXD MET FLM 23.7K OHM 1% 1/8W	28480	0698-3158
A16R44	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A16R45	0757-0420		R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A16R46	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A16R47	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A16T1	08660-80001		TRANSFORMER:SAMPLER	28480	08660-80001
A16U1	1820-0058	1	IC:LIN. OP. AMP. 15K MIN.(TO-99)	07263	U5B770939X
A16U2	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A16U3	1820-0451		IC:TTL DUAL J-K F/F	04713	MC3062P
A16U4	1820-0469		IC:DIGITAL TTL HI-SPEED F/F	01295	SN74H102N
A16U5	1820-0450		IC:DIGITAL TTL	18324	N8290A
A16U6	1820-0450		IC:DIGITAL TTL	18324	N8290A
A16U7	1820-0204		IC:TTL TRIPLE 3-INPT AND GATE	04713	MC3006P
A17	08660-60010	1	BOARD ASSY:N1 OSCILLATOR	28480	08660-60010
A17C1	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A17C2	0180-2215	1	C:FXD AL ELECT 170 UF +75-10% 170VDCW	56289	30D177G015DD2-DSM
A17C3	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A17C4	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A17C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A17C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A17C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C8	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A17C9	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A17C10	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A17C11	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A17C12	0180-0374		C:FXD TANT. 10 UF 10% 20VDCW	56289	150D106X9020B2-DYS
A17C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C14	0160-3047	1	C:FXD MICA 3280 PF 1% 100VDCW	28480	0160-3047
A17C15	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A17C16	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A17C17	0121-0059		C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A17C18	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A17C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C20	0160-0301		C:FXD MY 0.012 UF 10% 200VDCW	56289	192P12392-PTS
A17C21	0160-3092	1	C:FXD MICA 1600 PF 1% 100VDCW	14655	RDM19F162F1S
A17C23	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A17C24	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A17C25	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C26	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C27	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C28	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C29	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C30	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17C31	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C32	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A17C33	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C34	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C35	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C36	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17C37	0160-0162	1	C:FXD MY 0.022 UF 10% 200VDCW	56289	192P22392-PTS
A17C38	0140-0210	1	C:FXD MICA 270 PF 5%	28480	0140-0210
A17C39	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A17CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR6	0122-0263		C:VOLTAGE VAR 47 PF 10% 60WV	04713	1N5148
A17CR7	0122-0261		C:VOLTAGE VAR. 39 PF 10% 60VDCW	04713	1N5147
A17CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A17L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A17L2	9100-2562	2	INDUCTOR:SHIELDED 100 UH 10%	82142	15S-101K
A17L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A17L4	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A17L5	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A17L6	9100-2815		INDUCTOR:FXD 0.70 UH 5%	73899	LF4W070
A17L7	9100-1652		COIL/CHOKE 820 UH 5%	82142	19-1331-33J
A17L8	9100-2566	1	INDUCTOR:SHIELDED 270 UH 10%	82142	15S-271K
A17L9	9100-2568	1	INDUCTOR:SHIELDED 390 UH 10%	82142	155-391K
A17Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A17Q2	1853-0050		TSTR:SI PNP	28480	1853-0050
A17Q3	1854-0345		TSTR:SI NPN	80131	2N5179
A17Q4	1853-0050		TSTR:SI PNP	28480	1853-0050
A17Q5	1855-0081		TSTR:SI FET	80131	2N5245
A17Q6	1854-0087		TSTR:SI NPN	80131	2N3417
A17Q7	1853-0050		TSTR:SI PNP	28480	1853-0050
A17Q8	1854-0092		TSTR:SI NPN	80131	2N3563
A17Q9	1854-0087		TSTR:SI NPN	80131	2N3417
A17Q10	1854-0092		TSTR:SI NPN	80131	2N3563
A17Q11	1853-0066		TSTR:SI PNP	80131	2N4250
A17Q12	1853-0066		TSTR:SI PNP	80131	2N4250
A17Q13	1853-0066		TSTR:SI PNP	80131	2N4250
A17Q14	1853-0066		TSTR:SI PNP	80131	2N4250
A17Q15	1854-0092		TSTR:SI NPN	80131	2N3563
A17Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A17Q19	1853-0066		TSTR:SI PNP	80131	2N4250
A17R1	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R2	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R3	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R4	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R5	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R6	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R7	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R8	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A17R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R13	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R16	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R17	0757-0479		R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A17R18	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A17R19	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A17R20	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A17R21	0757-0124		R:FXD MET FLM 39.2K OHM 1% 1/8W	28480	0757-0124
A17R22	0757-0449		R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
A17R23	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17R24	0698-4002		R:FXD MET FLM 5K OHM 1% 1/8W	28480	0698-4002
A17R25	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R26	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A17R27	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A17R28	2100-1760		R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A17R29	0698-3156		R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A17R31	2100-1759		R:VAR WW 2K OHM 5% TYPE V 1W	28480	2100-1759
A17R32	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A17R33	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A17R34	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A17R35	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A17R36	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A17R36	0757-0421		R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A17R37	0698-4037		R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A17R38	0698-3162		R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A17R39	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A17R40	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A17R41	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A17R42	0757-0834		R:FXD MET FLM 5.62K OHM 2% 1/2W	28480	0757-0834
A17R43	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A17R44	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A17R45	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A17R46	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A17R47	0698-3459		R:FXD MET FLM 383K OHM 1% 1/8W	28480	0698-3459
A17R48	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A17R49	0757-0835	1	R:FXD MET FLM 6.81K OHM 1% 1/2W	28480	0757-0835
A17R50	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A17R51	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A17R52	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A17R53	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A17R54	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A17R55	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A17R56	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A17R57	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A17R58	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A17R59	0757-0466		R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A17R60	0683-8245		R:FXD COMP 820K OHM 5% 1/4W	01121	CB 8245
A17R61	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A17R62	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A17R63	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A17R64	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A17R65	0757-0467		R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A17R66	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A17R67	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A17R68	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A17R69	0757-0464		R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464
A17R70	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A17R71	0757-0405		R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A17R72	0757-0461		R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A17R73	0757-0403		R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403
A17R74	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R75	0698-3437		R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437
A17R76	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A17R77	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A17R78	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A17R79	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A17R80	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A17R81	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A17R82	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A17R83	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A17R84	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R85	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R86	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A17R87	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A17R88	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R89	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R90	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A17R91	0698-3433	2	R:FXD MET FLM 28.7 OHM 1% 1/8W	28480	0698-3433
A17R92	0698-3432	1	R:FXD MET FLM 26.1 OHM 1% 1/8W	28480	0698-3432
A17R93	0698-3433		R:FXD MET FLM 28.7 OHM 1% 1/8W	28480	0698-3433
A17R94	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A17R95	0698-0084		R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084
A17R96	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A17R97	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A17R98	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17R99	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A17U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A17U2	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A18	08660-60015	1	BOARD ASSY:SL1 MIXER	28480	08660-60015
A18C1	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
A18C2			NOT USED		
A18C3	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A18C4			NOT USED		
A18C5	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A18C6			NOT USED		
A18C7	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A18C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A18C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A18C10	0160-0301		C:FXD MY 0.012 UF 10% 200VDCW	56289	192P12392-PTS
A18C11	0160-0301		C:FXD MY 0.012 UF 10% 200VDCW	56289	192P12392-PTS
A18C12	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A18C13	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A18C14	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A18C15	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A18C16	0180-2214		C:FXD ELECT 90 UF +75-10% 15VDCW	56289	30D906G015CC2-DSM
A18C17	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	8104BX102M
A18C18			NOT USED		
A18C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A18C20	0180-0141		C:FXD ELECT 50 UF +75-10% 50VDCW	56289	30D506G050DD2-DSM
A18C21	0180-1819	1	C:FXD ELECT 100 UF +75-10% 50VDCW	28480	0180-1819
A18C22	0180-0141		C:FXD ELECT 50 UF +75-10% 50VDCW	56289	30D506G050DD2-DSM
A18CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A18CR2	1901-0518		DIODE:HOT CARRIER	28480	1901-0518
A18E1	10534C		MIXER:DOUBLE BALANCE	50436	10534C
A18L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A18L2	9140-0114		COIL:FXD RF 10 UH	28480	9140-0114
A18L3	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A18L4	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A18L5	9100-1621		COIL/CHOKE 18.0 UH 10%	99800	1537-42
A18L6	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A18Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q3	1853-0050		TSTR:SI PNP	28480	1853-0050
A18Q4	1854-0087		TSTR:SI NPN	80131	2N3417
A18Q5	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q6	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q7	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q9	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q10	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q11	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q12	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q13	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q14	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q15	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q17	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q18	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q19	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q20	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q21	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q22	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q23	1853-0066		TSTR:SI PNP	80131	2N4250
A18Q24	1853-0066		TSTR:SI PNP	80131	2N4250
A18R1	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R2	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R3	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R4	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R5	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R6	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R7	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R8	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R9	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R10	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R12	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R13	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R15	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R16	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18R17	0757-0479		R:FXD MET FLM 392K OHM 1% 1/8W	28480	0757-0479
A18R18	0757-0472		R:FXD MET FLM 200K OHM 1% 1/8W	28480	0757-0472
A18R19	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A18R20	0698-3228		R:FXD MET FLM 49.9K OHM 1% 1/8W	28480	0698-3228
A18R21	0683-3955		R:FXD COMP 3.9 MEGOHM 5% 1/4W	01121	CB 3955
A18R22	0683-2055		R:FXD COMP 2 MEGOHM 5% 1/4W	01121	CB 2055
A18R23	0683-1055		R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A18R24	0698-3263		R:FXD MET FLM 500K OHM 1% 1/8W	28480	0698-3263
A18R25	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R26	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R27	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A18R28	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A18R29	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A18R30	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A18R31	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A18R32	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A18R33	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R34	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R35	2100-2574		R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A18R36	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A18R37	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A18R38	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R39	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R40	2100-2574		R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A18R41	0698-3258		R:FXD MET FLM 5.36K OHM 1% 1/8W	28480	0698-3258
A18R42	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R43	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R45	0757-0290		R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
A18R46	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A18R47	0757-0400		R:FXD MET FLM 90.9 OHM 1% 1/8W	28480	0757-0400
A18R48	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399
A18R49	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R49	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R50	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R51	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R52	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
A18R53	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R54	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R55	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R56	0757-0288		R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A18R57	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
A18R58	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A18R59	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
A18R60	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R61	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R62	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R63	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A18R64	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A18R65	0757-0416		R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
A18R66	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R67	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R68	2100-2489		R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2489
A18R69	0698-3136		R:FXD MET FLM 17.8K OHM 1% 1/8W	28480	0698-3136
A18R70	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A18R71	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A18R72	0698-0083		R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
A18R73	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A18R74	2100-2522		R:VAR CERMET 10K OHM 10% LIN 1/2W	28480	2100-2522
A18R75	0757-0123		R:FXD MET FLM 34.8K OHM 1% 1/8W	28480	0757-0123
A18R76	0757-0420		R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A18R77	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A18R78	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A18R79	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A18R80	0757-0288		R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A18R81	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A18R82	0698-0085		R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A18R83	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A18R84	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A18R85	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A18R86	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A18R87	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A18U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A18U2	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A18U3	1820-0214		IC:TTL BCD TO DEC. DECODER	01295	SN7442N
A19	08660-60017	1	BOARD ASSY:SLI OSCILLATOR	28480	08660-60017

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A19C1	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A19C2	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A19C3	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A19C4	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X901582-DYS
A19C5	0160-0945		C:FXD MICA 910 PF 5%	28480	0160-0945
A19C6	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
A19C7	0180-2214		C:FXD ELECT 90 UF +75-10% 15VDCW	56289	30D906G015CC2-DSM
A19C8	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A19C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C10	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A19C11	0160-2220	1	C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
A19C12	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A19C13	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A19C14	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A19C15	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A19C16	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	30D106G050CB2-DSM
A19C17	0170-0082		C:FXD MY 0.01UF 20% 50VDCW	84411	601PE STYLE 1
A19C18	0121-0059		C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A19C19	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A19C20	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A19C21	0160-0386		C:FXD CER 3.3 TO 0.25 PF 500VDCW	72982	301-000-S2H0-339C
A19C22	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C23	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C25	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C26	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C27	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C28	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C29	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C30	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C31	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C32	0140-0195	1	C:FXD MICA 130 PF 5% 300VDCW	14655	DM15F131J-300V
A19C33	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A19C34	0160-2202	1	C:FXD MICA 75 PF 5%	28480	0160-2202
A19C35	0160-2200	1	C:FXD MICA 43 PF 5%	72136	RDM15E430J3C
A19C36	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A19C37	0160-0157		C:FXD MY 0.0047 UF 10% 200VDCW	56289	192P47292-PTS
A19C38	0160-0164	1	C:FXD MY 0.039 UF 10% 200VDCW	56289	192P39392-PTS
A19C39	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A19CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR6	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR9	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR12	0122-0263		C:VOLTAGE VAR 47 PF 10% 60WV	04713	1N5148
A19CR13	0122-0261		C:VOLTAGE VAR. 39 PF 10% 60VDCW	04713	1N5147
A19CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A19L1	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A19L2	9100-2562		INDUCTOR:SHIELDED 100 UH 10%	82142	15S-101K
A19L3	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A19L4	9100-1629		COIL/CHOKE 47.0 UH 5%	28480	9100-1629
A19L5	9100-2572	1	INDUCTOR:SHIELDED 820 UH 10%	82142	15S-821K
A19L6	9100-2815		INDUCTOR:FXD 0.70 UH 5%	73899	LF4W070
A19L7	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A19L8	9140-0179		COIL/CHOKE 22.0 UH 10%	28480	9140-0179
A19L9	9100-1611	2	COIL:FXD 0.22 UH 20%	28480	9100-1611
A19L10	9100-1611		COIL:FXD 0.22 UH 20%	28480	9100-1611
A19Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A19Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A19Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A19Q4	1855-0081		TSTR:SI FET	80131	2N5245
A19Q5	1854-0345		TSTR:SI NPN	80131	2N5179
A19Q6	1853-0050		TSTR:SI PNP	28480	1853-0050
A19Q7	1853-0050		TSTR:SI PNP	28480	1853-0050
A19Q8	1854-0092		TSTR:SI NPN	80131	2N3563
A19Q9	1854-0092		TSTR:SI NPN	80131	2N3563
A19Q10	1854-0022	1	TSTR:SI NPN	07263	S17843

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A19R1	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A19R2	0698-3442		R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442
A19R3	2100-1760		R:VAR WW 5K OHM 5% TYPE V 1W	28480	2100-1760
A19R4	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
A19R5	0698-3437		R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437
A19R6	0757-0460		R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460
A19R7			NOT USED		
A19R8	0757-0461		R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461
A19R9	2100-1759		R:VAR WW 2K OHM 5% TYPE V 1W	28480	2100-1759
A19R10	0757-0439		R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A19R11	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A19R12	0757-0405		R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A19R13	0757-0464		R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464
A19R14	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A19R15	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	28480	0698-3439
A19R16	0757-0467		R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A19R17	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A19R18	0757-0466		R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
A19R19	0757-0834		R:FXD MET FLM 5.62K OHM 2% 1/2W	28480	0757-0834
A19R20	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
A19R21	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A19R22	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A19R23	0757-0441		R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
A19R24	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A19R25	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A19R26	0698-3445		R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445
A19R27	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A19R28	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A19R29	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A19R30	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A19R31	0698-3266		R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A19R32	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R33	0757-0444		R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A19R34	0698-3459		R:FXD MET FLM 383K OHM 1% 1/8W	28480	0698-3459
A19R35	0698-3162		R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162
A19R36	0698-3157		R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A19R37	0757-0288		R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288
A19R38	0698-3155		R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155
A19R39	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A19R40	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A19R41	0683-8245		R:FXD COMP 820K OHM 5% 1/4W	01121	CB 8245
A19R42	0698-3243		R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243
A19R43	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
A19R44	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R45	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A19R46	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A19R47	0698-3441		R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441
A19R48	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A19R49	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A19R50	0698-3440		R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440
A19R51	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A19R52	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A19R53	0757-0200		R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200
A19R54	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154
A19R55	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A19R56	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A19R57	0698-3447		R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447
A19R58	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R59	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A19R60	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R61	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R62	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
A19R63	0757-0180		R:FXD MET FLM 31.6 OHM 1% 1/8W	28480	0757-0180
A19R64	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A19R65	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A19R66	0757-0294		R:FXD MET FLM 17.8 OHM 1% 1/8W	28480	0757-0294
A19R67	0698-3443		R:FXD MET FLM 287 OHM 1% 1/8W	28480	0698-3443
A19R68	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
A19R69	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274
A19R70	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A19R71	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A19R72	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A20	08660-60021	1	BOARD ASSY:RECTIFIER	28480	08660-60021
A20C1	0180-2363	2	C:FXD AL ELECT 3600 UF +75-10% 40VDCW	56289	36D362G040AB2B-DQB
A20C2	0180-1968	1	C:FXD ELECT 18000 UF +75-10% 15VDCW	56289	32D183G015BB2B-DQB

See introduction to this section for ordering information

Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A20C3	0180-2369		C:FXD AL ELECT 3600 UF +75-10% 40VDCW	56289	36D362G040AB2B-DQB
A20C4	0180-0084	2	C:FXD ELECT 300 UF +20-15% 6VDCW	28480	0180-0084
A20C5	0180-0084		C:FXD ELECT 300 UF +20-15% 6VDCW	28480	0180-0084
A20C6	0180-2334	1	C:FXD AL ELECT 3900 UF +50-10% 75VDCW	56289	36D392F075BB2B-DQB
A20C7	0180-2100	1	C:FXD ELECT 1200UF +75-10% 15VDCW	56289	39D128G015FL4-DSB
A20C8	0180-0058		C:FXD AL ELECT 50 UF +75-10% 25VDCW	56289	30D506G025CC2-DSM
A20C9	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A20C10	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A20C11	0180-0049		C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
A20CR1	1901-0638	4	DIODE ASSY:SI FULL WAVE BRIDGE	28480	1901-0638
A20CR2			NOT USED		
A20CR3	1901-0638		DIODE ASSY:SI FULL WAVE BRIDGE	28480	1901-0638
A20CR4	1901-0638		DIODE ASSY:SI FULL WAVE BRIDGE	28480	1901-0638
A20CR5	1901-0364	1	DIODE ASSY:SI 200PIV/CELL	28480	1901-0364
A20CR6	1901-0638		DIODE ASSY:SI FULL WAVE BRIDGE	28480	1901-0638
A20CR7	1884-0024	1	THYRISTOR:7.4A 200 PIV	04713	SCR 246
A20F1	2110-0036	1	FUSE:CARTRIDGE 8A 125V	75915	312008
A20K1	0490-0908	2	RELAY:4 FORM C 5 AMP	24796	R40-E1-X4-V800
A20K2	0490-0908		RELAY:4 FORM C 5 AMP	24796	R40-E1-X4-V800
A20R1	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R2	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R3	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R4	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R5	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R6	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R7	0757-0193	1	R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
A20XA5	1251-1626		CONNECTOR:PC (2 X 12) 24 CONTACT	71785	252-12-30-300
A20Z	0490-0861	1	RELAY RETAINER:4/2 FORM C RELAYS	24796	R40-P33
A20Z	0490-0907	1	SOCKET:RELAY W/4FORM C"SLIMLINE"	77342	R40-S420/W RET.
A21	0960-0151	1	CRYSTAL OSCILLATOR:10 MHZ	28480	0960-0151
A21			(FOR STANDARD INSTRUMENT ONLY)		
A21	0960-0150	1	CRYSTAL OSCILLATOR:10 MHZ	28480	0960-0150
A21			(FOR OPTION 001 ONLY)		
A21			(OMIT A21 ASSY FOR OPTION 002)		
A22	08660-60043	1	SWITCH ASSY:REFERENCE	28480	08660-60043
A22	08660-00009	1	COVER:SWITCH HOUSING	28480	08660-00009
A22	08660-20051	1	HOUSING:REF. SWITCH	28480	08660-20051
A22C1	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22C2	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22C3	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22C4	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22C5	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22C6	0160-2437		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P
A22J1	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A22J2	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A22J3	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A22J4	1250-0901		CONNECTOR:RF BULKHEAD	15558	1104/D
A22A1	08660-60027	1	BOARD ASSY:REF. SWITCH	28480	08660-60027
A22A1C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A1C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A1C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A1C4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A1K1	0490-0916	6	RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A1K2	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A1K3	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A2	08660-60026	1	BOARD ASSY:REF. AMP. SWITCH	28480	08660-60026
A22A2C1	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C5	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C6	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A22A2C7	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A22A2C8	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2C9	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A22A2CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22A2CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A22A2K1	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A2K2	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A2K3	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A22A2L1	9140-0118	1	COIL:FXD 500 UH 5%	28480	9140-0118
A22A2L2	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A22A2Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A22A2Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A22A2Q3	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A22A2R1	0698-7227	1	R:FXD FLM 422 OHM 2% 1/8W	28480	0698-7227
A22A2R2	0698-7222		R:FXD FLM 261 OHM 2% 1/8W	28480	0698-7222
A22A2R3	0698-7240	1	R:FXD MET FLM 1.47K OHM 2% 1/8W	28480	0698-7240
A22A2R4	0698-7248	1	R:FXD FLM 3.16K OHM 2% 1/8W	28480	0698-7248
A22A2R5	0698-7222		R:FXD FLM 261 OHM 2% 1/8W	28480	0698-7222
A22A2R6	0698-7212		R:FXD FLM 100 OHM 2% 1/8W	28480	0698-7212
A22A2R7	0698-7229	1	R:FXD FLM 511 OHM 2% 1/8W	28480	0698-7229
A22A2R8	0698-7188	2	R:FXD MET FLM 10 OHM 2% 1/8W	28480	0698-7188
A22A2R9	0698-7188		R:FXD MET FLM 10 OHM 2% 1/8W	28480	0698-7188
A23	08660-60044	1	WIRING HARNESS:MAIN	28480	08660-60044
A23J	1251-1908	73	CONTACT:R & P CONNECTOR,MALE	81312	100-1022P
A23J	1251-2041	21	CONTACT:COAX	28480	1251-2041
A23J	1251-2663		CONNECTOR PC EDGE(2 X 18)36 CONTACT	05574	3VH18/1JNS
A23J3	1251-0085	1	CONNECTOR:FEMALE 36-PIN MINAT	28480	1251-0085
A23J4	1251-2531	1	BODY:R & P CONNECTOR PLUG 66 CONTACT	81312	MRAC-66P-G7
A23J5	1251-2563	2	BODY:R & P CONNECTOR 42 MALE CONTACT	81312	MRAC42P-G7
A23J6	1251-2563		BODY:R & P CONNECTOR 42 MALE CONTACT	81312	MRAC42P-G7
A23J7	1251-1017	2	CONNECTOR:2 PIN, MATES W/1251-1016	81312	JF2P-2S-AB
A23W3	08660-60054	1	CABLE ASSY:WHITE	28480	08660-60054
A23W6	08660-60056	1	CABLE ASSY:ORANGE	28480	08660-60056
A23W7	08660-60058	1	CABLE ASSY:W/RED	28480	08660-60058
A23W8	08660-60057	1	CABLE ASSY:W/GREEN	28480	08660-60057
A23W9	08660-60071	1	CABLE ASSY:WHITE/BROWN	28480	08660-60071
A23W10	08660-60052	1	CABLE ASSY:RED	28480	08660-60052
A23W11	08660-60053	1	CABLE ASSY:BROWN	28480	08660-60053
A23W12	08660-60075	1	CABLE ASSY:GREEN	28480	08660-60075
A23W13	08660-60067	1	CABLE ASSY:W/RED	28480	08660-60067
A23W14	08660-60066	1	CABLE ASSY:W/BLUE	28480	08660-60066
A23W15	08660-60059	1	CABLE ASSY:W/YELLOW	28480	08660-60059
A23W16	08660-60081	1	CABLE ASSY:WHITE/RED	28480	08660-60081
A23W17	08660-60074	1	CABLE ASSY:WHITE/BROWN	28480	08660-60074
A23W18	08660-60072	1	CABLE ASSY:WHITE/ORANGE	28480	08660-60072
A23W19	08660-60073	1	CABLE ASSY:WHITE/YELLOW	28480	08660-60073
A23W20	08660-60076	1	CABLE ASSY:WHITE/BLACK	28480	08660-60076
A23W21	08660-60077	1	CABLE ASSY:WHITE/GREY	28480	08660-60077
A23W23	08660-60060	1	CABLE ASSY:W/ORANGE	28480	08660-60060
A23Z	08660-20053	6	PIN:GUIDE	28480	08660-20053
A24	08660-60064	1	WIRING HARNESS	28480	08660-60064
A24P7	1251-1017		CONNECTOR:2 PIN, MATES W/1251-1016	81312	JF2P-2S-AB
A24S1	3101-1536	1	SWITCH:TOGGLE DPDT 3A 125VAC	95146	MSH-203N
A25	08660-60069	1	CABLE HARNESS LIGHTS	28480	08660-60069
F1	2110-0304	1	FUSE:CARTRIDGE 1.5 AMP 250V SLOW-BLOW	71400	MDX-1-1/2A
F2	2110-0332	1	FUSE:3A	71400	GMW 3
F3	2110-0047	3	FUSE:CARTRIDGE 1A	71400	TYPE GMW-1
F4	2110-0047		FUSE:CARTRIDGE 1A	71400	TYPE GMW-1
F5	2110-0047		FUSE:CARTRIDGE 1A	71400	TYPE GMW-1
W1	08660-60061	2	CABLE ASSY:GREY	28480	08660-60061
W2	08660-60061		CABLE ASSY:GREY	28480	08660-60061
W4	08660-60046	1	CABLE ASSY:INTERFACE	28480	08660-60046
W5	08660-60065	1	CABLE ASSY:ORANGE	28480	08660-60065
W22	08660-60062	1	CABLE ASSY:WHITE	28480	08660-60062
W22			FOR OPTION 002, OMIT W22 CABLE ASSY		
	8120-1348	1	CABLE ASSY:POWER, DETACHABLE	70903	KHS-7041
	9100-3131	1	TRANSFORMER:POWER	28480	9100-3131
	5000-0052	2	PLATE:FLUTED ALUMINUM	28480	5000-0052
	5040-1485	3	CONDUCTOR ASSEMBLY:PLUG-IN JUMPER	28480	5040-1485
	5060-0222	2	HANDLE ASSY:5H SIDE	28480	5060-0222
	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
	5060-8735	2	RETAINER HANDLE ASSY:OLIVE GRAY(STD)	28480	5060-8735
	08660-00001	1	PANEL:REAR	28480	08660-00001
	08660-00003	1	SUPPORT:66 PIN CONNECTOR	28480	08660-00003
	08660-00004	1	SUPPORT:42 PIN CONNECTOR	28480	08660-00004
	08660-00005	1	BRACKET:INTERFACE, LEFT	28480	08660-00005
	08660-00006	1	BRACKET:INTERFACE, RIGHT	28480	08660-00006
	08660-00007	1	SUPPORT:REF. OSCILLATOR	28480	08660-00007
	08660-00008	1	COVER:HEAT SINK	28480	08660-00008
	08660-00021	2	FILTER:SIDE	28480	08660-00021
	08660-00024	2	COVER:SIDE	28480	08660-00024
	08660-00025	1	COVER:BOTTOM	28480	08660-00025
	08660-00026	1	COVER:TOP	28480	08660-00026
	08660-00027	1	SUPPORT:LOOP BOX, REAR	28480	08660-00027
	08660-00028	1	CLAMP:REF. OSC.(OPT 002)	28480	08660-00028
	08660-00029	1	BRACKET:LP BOX LT SC	28480	08660-00029
	08660-00030	1	COVER:SL1 OSC.	28480	08660-00030
	08660-00031	1	COVER:SL1 PHASE DETECTOR	28480	08660-00031

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	08660-00032	1	COVER:N1	28480	08660-00032
	08660-00033	1	COVER:N2(OPT. 004)	28480	08660-00033
	08660-00034	1	COVER:N3(OPT 004)	28480	08660-00034
	08660-00035	1	COVER:SL2(OPT 004)	28480	08660-00035
	08660-00036	1	SUPPORT:H.F. LP BOX	28480	08660-00036
	08660-00037	1	COVER:BOTTOM 1.3 GHZ MOD	28480	08660-00037
	08660-00038	1	LATCH:H.F. LP BOX	28480	08660-00038
	08660-00041	1	COVER:WIRING HARNESS	28480	08660-00041
	08660-00042	1	COVER:N2A(OPT 004)	28480	08660-00042
	08660-00043	1	COVER:COUPLING BOARD(OPT 004)	28480	08660-00043
	08660-00044	1	COVER:BLANK (OPT 004)	28480	08660-00044
	08660-20040	1	BOARD:PC(OPT 004)	28480	08660-20040
	08660-20052	2	PIN LATCH	28480	08660-20052
	08660-20054	2	PIN:PIVOT	28480	08660-20054
	08660-20055	1	SCREW:SHOULDER	28480	08660-20055
	08660-20056	2	END PLATE:LP BOX	28480	08660-20056
	08660-20057	2	GUIDE:MOD. PLUG-IN	28480	08660-20057
	08660-20058	2	GUIDE:RF PLUG-IN	28480	08660-20058
	08660-20061	1	FRAME:FRONT	28480	08660-20061
	08660-20062	11	EXTRACTOR:SHIELD	28480	08660-20062
	08660-20076	2	FRAME:SIDE	28480	08660-20076
	08660-60080		CABLE ASSY:GRAY	28480	08660-60080
	08660-60083	1	CABLE ASSY:GREY	28480	08660-60083
	1251-0084	1	PLUG:36-CONTACT MALE W/HOOD & CLAMP	28480	1251-0084
	1250-0780	1	CONNECTOR:RF STRAIGHT ADAPTER	24931	29 JP 104-2
	5020-7623	1	BRACKET:7H L.H. RACK MOUNT	28480	5020-7623
	5020-7624	1	BRACKET:7H R.H. RACK MOUNT	28480	5020-7624
	5060-0256	1	EXT. BOARD ASSY:24 CONTACT	28480	5060-0256
	5060-0277	1	EXT. BOARD ASSY:18 PIN	28480	5060-0277
	5060-0276	2	EXT. BOARD ASSY:15 PIN	28480	5060-0276
	5060-0258	1	EXT. BOARD ASSY:24 CONTACT	28480	5060-0258
	08660-60070	1	KIT:RACK MOUNT	28480	08660-60070
	05580-2042	1	STRIP:FILLER	28480	05580-2042

Table 6-4. Code List of Manufacturers

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00779	AMP INC.(AIRCRAFT MARINE PROD.)	HARRISBURG, PA.	17101
00853	SANGAMO ELECTRIC CO.PICKENS DIV.	PICKENS, S.C.	29671
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
03508	G.E. CO. SEMICONDUCTOR PROD. DEPT.	SYRACUSE, N.Y.	13201
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
05574	VIKING IND. INC.	CHATSWORTH, CALIF.	91311
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
07910	CONTINENTAL DEVICE CORP.	HAWTHORNE, CALIF.	90250
09353	C & K COMPONENTS INC.	NEWTON, MASS.	02158
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
13103	THERMALLOY CO.	DALLAS, TEX.	75247
14655	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07105
15558	MICON ELECTRONICS INC.	GARDEN CITY LONG IS., N.Y.	11530
15636	ELEC-TROL INC.	NORTHRIDGE, CALIF.	91325
18324	SIGNETICS CORP.	SUNNYVALE, CALIF.	94086
24796	PARELCO INC.	SAN JUAN CAPISTRANO, CALIF.	92675
24931	SPECIALTY CONNECTOR CO. INC.	INDIANAPOLIS, IND.	46227
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
36196	STANWYCK COIL PROD. LTD.	HAWKSBURY ONTARIO, CANADA	
50436	HEWLETT-PACKARD CO. MICROWAVE DIV	PALO ALTO, CALIF	94304
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
66346	MINNESOTA MINING & MFG. CO. MINCOM DIV.	ST. PAUL, MINN.	55101
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71590	GLOBE UNION INC. CENTRALAB DIV.	MILWAUKEE, WISC.	53201
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGO, ILL.	60640
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73899	JFD ELECTRONICS CORP.	BROOKLYN, N.Y.	11219
74970	JOHNSON E.F. CO.	WASECA, MINN.	56093
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
77342	AMERICAN MACHINE & FOUNDRY CO. POTTER & BRUMFIELD DIV.	PRINCETON, IND.	47570
80031	MEPCO DIV. SESSIONS CLOCK CO.	MORRISTOWN, N.J.	07960
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
81312	WINCHESTER ELECTRONICS DIV. LITTON IND. INC.	OAKVILLE, CONN.	06779
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
84411	TRW CAPACITOR DIV.	OGALLALA, NEBR.	69153
91929	HONEYWELL INC. MICRO SWITCH DIV.	FREEPORT, ILL.	61032
95146	ALCO ELECT. PROD. INC.	LAWRENCE, MASS.	01843
96733	SAN FERNANDO ELECT. MFG. CO.	SAN FERNANDO, CALIF.	91341
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544
99800	DELEVAN ELECTRONICS CORP.	E. AURORA, N.Y.	14052

See introduction to this section for ordering information

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section will be used in future issues or revisions of this manual to provide back-dating information.

7-3. In the interim, any necessary changes to the information contained in this manual will be documented in Manual Change sheets shipped with the manual.

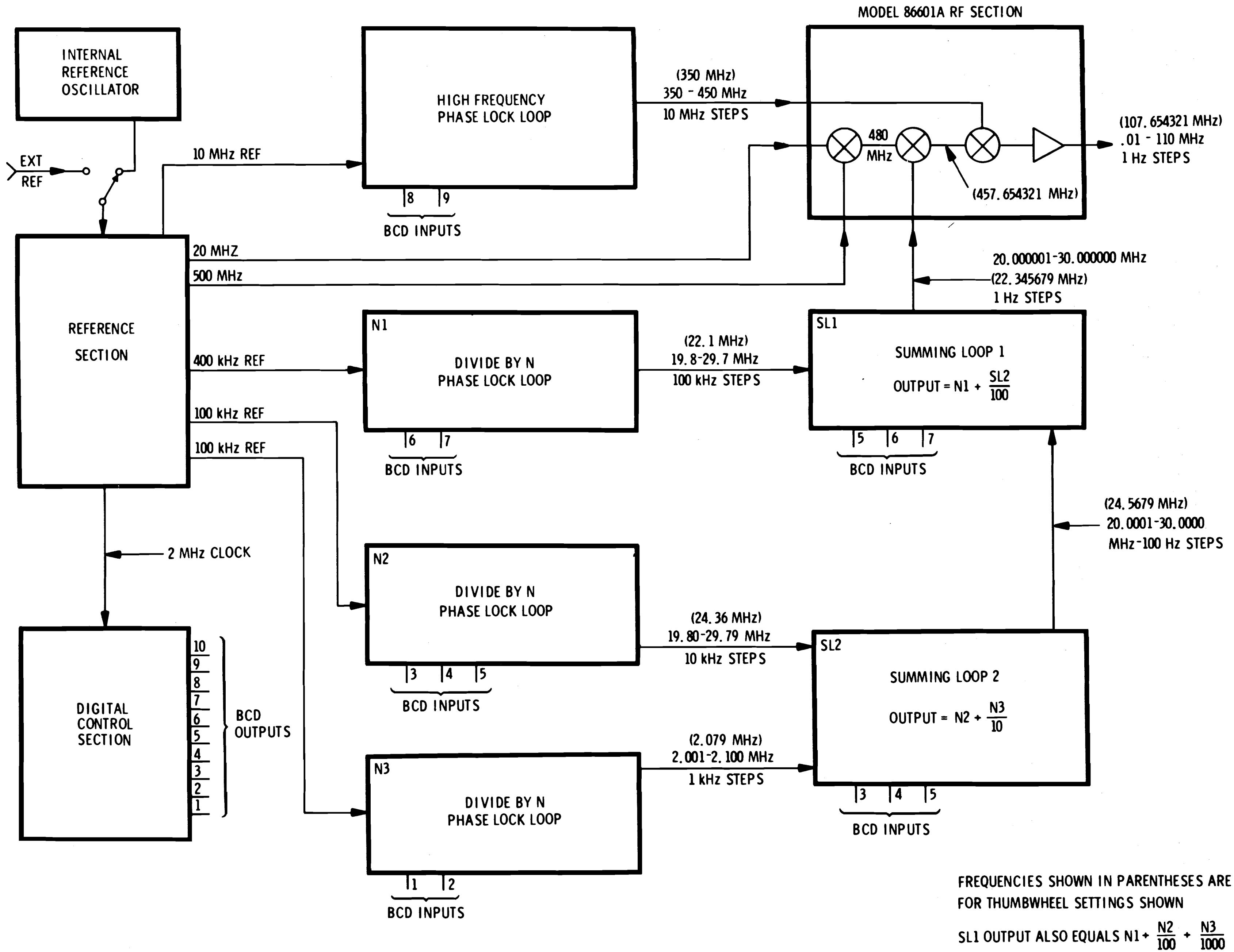


Figure 8-1. Model 8660B Simplified Block Diagram

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for testing, troubleshooting and repairing the Hewlett-Packard Model 8660B Synthesized Signal Generator.

8-3. PRINCIPLES OF OPERATION

8-4. Figure 8-1, Simplified Block Diagram, and the following discussion illustrates the basic principles of operation of the Model 8660B. More detailed information about principles of operation for the phase locked loops and the Digital Control Unit appears on Service Sheets 1 and 18 respectively. In addition, detailed information to the circuit level is provided on individual service sheets.

8-5. Reference Section. A 100 MHz voltage controlled oscillator which is phase locked to an internal reference, or an external standard, serves as a master oscillator. The internal reference is a 10 MHz temperature controlled crystal oscillator. The external standard may be 1, 2, 2.5, 5 or 10 MHz at 0.2 to 2 volts rms. All of the outputs from the reference section are derived from the 100 MHz master oscillator.

8-6. The reference section provides the following outputs:

a. 500 MHz to the RF Output Section.

b. 100 MHz to the RF Output Section. This 100 MHz is coupled out of the RF Output Section for use in other circuits.

c. 20 MHz to the Modulator Section. This 20 MHz is coupled out of the Modulator Section for use in the RF Output Section and the Frequency Extension Module.

d. 10 MHz to the High Frequency Loop phase detector.

e. 2 MHz to the Digital Control Unit to be used as a clock.

f. 400 kHz to the N1 loop for a reference signal.

g. Separate 100 kHz signals to the N2 and N3 loops for a reference signal.

NOTE

In the following discussion the terms digit 1, digit 2, through digit 10 are used to refer to the ten digits of frequency selection. Digit 1 refers to the least significant digit (1 Hz increments). Digit numbers progress from right to left until digit 10 refers to the most significant digit (1 GHz Increment).

8-7. High Frequency Loop. The HF loop contains a voltage controlled oscillator which provides eleven discrete outputs between 350 and 450 MHz in 10 MHz steps when the Model 86601A RF Section is used. When other RF Sections are used the output of the HF loop will be ten discrete outputs between 360 and 450 MHz in 10 MHz steps.

8-8. The HF loop voltage controlled oscillator is pretuned to a frequency selected by digits 8 and 9 when the Model 86601A RF Section is used (digit 9 is set to 1 or 0 only). Only digit 8 is used to control the HF loop voltage controlled oscillator when a higher frequency RF Section is used.

8-9. Pretuning tunes the voltage controlled oscillator to a point within the capture range of the phase lock loop and the phase detector then causes the loop to be phase locked to the 10 MHz reference signal at the exact frequency selected.

8-10. When the Model 86601A RF Section is used the output of the HF loop is applied to the RF Output Section. When a higher frequency RF Section is used, the output of the HF loop is applied to the Frequency Extension Module.

8-11. N1 Phase Lock Loop. The N1 loop provides an output to Summing Loop 1 that is between 19.8 and 29.7 MHz in 100 kHz steps. The N1 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by digits 6 and 7.

8-12. The N1 sampling phase detector is driven by pulses derived from the N1 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by digits 6 and 7. When the loop is phase locked the 400 kHz reference input is sampled at a

100 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to precisely control the voltage controlled oscillator frequency.

NOTE

In option 004 instruments the N2A programmable divider is used. The N2 loop output is then between 20.01 and 30.00 MHz.

8-13. N2 Phase Lock Loop. The N2 loop provides an output to Summing Loop 2 that is between 19.80 and 29.79 MHz in 10 kHz steps. The N2 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by digits 4 and 5.

8-14. The N2 sampling phase detector is driven by pulses derived from the N2 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by digits 3, 4 and 5. When the loop is phase locked the 100 kHz reference signal input is sampled at a 10 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to predisely control the voltage controlled oscillator.

8-15. N3 Phase Lock Loop. The N3 loop provides an output to Summing Loop 2 that is between 2.001 and 2.100 MHz in 1 kHz steps. The N3 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by digit 2.

8-16. The N3 sampling phase detector is driven by pulses derived from the N3 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by digits 1 and 2. When the loop is phase locked the 100 kHz reference signal is sampled at a 10 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to precisely control the voltage controlled oscillator frequency.

NOTE

In option 004 instruments SL2 is not used.

8-17. Summing Loop 2. SL2 provides an output to SL1 that is between 20.0001 and 30.0000 MHz in 100 Hz steps. The SL2 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by digits 3, 4 and 5.

8-18. The output from the SL2 voltage controlled oscillator is also applied to a mixer where it is mixed with the output of the N2 loop. The output of this mixer is applied to one input of a digital phase detector through a pulse shaper. The other input to the digital phase detector is the divided by ten output of the N3 loop assembly in pulse form. When SL2 is phase locked the frequency ratio of the two inputs to the phase detector is always 1:1; the mixer output frequency must exactly match the divided by ten output of the N3 loop assembly (the pulses are received alternately).

NOTE

In option 004 instruments the SL1 output is from 20.0001 to 30 MHz.

8-19. Summing Loop 1. SL1 provides an output to the RF Output Section that is between 20.000001 and 30 MHz in 1 Hz steps. The SL1 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by digits 5, 6 and 7.

8-20. The output from the SL1 voltage controlled oscillator is also applied to a mixer where it is mixed with the output of the N1 loop. The output of this mixer is applied to one input of a digital phase detector through a pulse shaper. The other input to the digital phase detector is the divided by one hundred output of the SL2 voltage controlled oscillator in pulse form. When SL1 is phase locked the frequency ratio of the two inputs to the phase detector is 1:1; the mixer output frequency must exactly match the divided by one hundred output of the SL2 voltage controlled oscillator (the pulses are received alternately).

8-21. Digital Control Unit. In the local mode all functions of the Model 8660B are controlled by the DCU. These functions are itemized and described in Section III of this manual.

8-22. Interface Circuits. The interface circuits provide the capability of operating the Model 8660B with the DCU (local mode), or by a remote programming device (remote mode).

8-23. RF Section. An RF Section plug-in is required to produce a useable rf output. Figure 8-1 shows a simplified block diagram of the Model 8660B with a Model 86601A RF Section used in the system. All plug-in sections are covered by separate manuals.

8-24. Modulation Section. If a modulation section is not available, it will be necessary to have an Auxiliary Section in the modulator drawer to complete necessary connections.

8-25. RECOMMENDED TEST EQUIPMENT

8-26. Test equipment and accessories required to maintain the Model 8660B are listed in Table 1-3. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

8-27. TROUBLESHOOTING

8-27. Troubleshooting procedures are divided into three maintenance levels in this manual.

8-29. The first maintenace level is a repair-by-substitution method for the digital control unit only. If trouble developes in the digital control unit and a set of spare assemblies is on hand, refer to Table 8-1 for troubleshooting procedures.

8-30. The second maintenance level is designed to utilize the HP Module Exchange Program. A set of troubleshooting trees enable a relatively inexperienced technician to isolate the cause of a malfunction to a circuit board or assembly. A factory repaired replacement for the defective circuit board or assembly may be ordered through the nearest HP Sales/Service office using the special part numbers listed in Table 6-1. Refer to paragraph 8-34 and Figure 8-2 for additional information relative to the Module Exchange Program.

8-31. The third maintenance level involves repairing the instrument to the component level. The troubleshooting trees, in addition to aiding in the detection of faulty circuit boards or assemblies, also refers the technician to Service Sheets to be used if repairs are to be accomplished to the component level. Circuit descriptions and test procedures for this maintenance level are located on the page facing the schematic diagram of the circuit to be repaired.

8-32. If the cause of a malfunction is found and remedied in any circuit containing adjustable components, the applicable adjustment procedure in Section V of the manual should be performed.

8-33. REPAIR

8-34. Module Exchange. This instrument, because of its modular design, may be repaired by simply replacing a defective module. Modular design is a method of construction that groups individual circuits on a replaceable assembly. Modular design, coupled with a factory-repaired module exchange program, eliminates the need to repair to the component level. Factory-repaired modules are available on an exchange-for-credit basis that reduces module cost substantially below the cost of a new module.

8-35. This manual provides a procedure which enables the technician to quickly isolate the cause of a malfunction to the defective module.

8-36. Exchange modules should be ordered by the exchange numbers shown in Table 6-1 from the nearest Hewlett-Packard Sales/Service Office.

8-37. Figure 8-2 illustrates the module exchange procedure.

NOTE

Do not send a defective module to the HP office until the replacement module is received.

8-38. Line Voltage Requirements. During adjustment, testing and use, the Model 8660B must be connected to a source of power capable of delivering about 200 watts of power at 115 or 230 volts ac ± 10%, single phase. If adjustment of the dc voltage regulators is required, the Model 8660B should be connected to the ac source through an adjustable auto-transformer. The line voltage may then be adjusted to check the Model 8660B regulators when the line voltage is changed ± 10%.

8-39. Servicing Aids on Printed Circuit Boards. Servicing aids on printed circuit boards include test points, transistor and integrated circuit reference designators, adjustment callouts and assembly stock numbers. Figure 8-3 illustrates the proper method to identify pin numbers on the circuit boards.

8-40. Circuit Board Extenders. Circuit board extenders are provided with the instrument. These extenders enable the technician to extend plug-in boards clear of the assembly to provide easy access to components and test points. See Figure 8-4 for a typical example of extender board use.

NOTE

Extending some circuit boards, particularly those containing oscillators, may cause a change in operating frequency. Adjustment of variable components should not be attempted, except as required for troubleshooting purposes, while the circuit boards are extended.

8-41. Diagram Notes. Table 8-2, Schematic Diagram Notes, provides information relative to symbols and values shown on schematic diagrams.

8-42. Part Location Aids. The locations of chassis mounted parts and major assemblies are shown in Figure 805. The location of individual components

Table 8-1. Troubleshooting by Replacement (1 of 2)

Test	Result	Procedure
1. Perform operator's checks 1 through 1-c	Readout does not display 1.000000 MHz	Check the 2 MHz and power supply inputs to the DCU. If present, proceed to step 1-a.
1-a. Ground the connector pin labeled PWR DET on the mother board	Readout displays 1.000000 MHz Readout display is not correct	Trouble is in the A3 interface assembly A2, A1, A7, A4, A5, A6, A12
2. Enter a center frequency (within the limits of the RF section in use) in Hz.	Readout correct. (It has been determined that the data out of the DCU is incorrect or Readout incorrect, but rf output is correct	A9, A10, A1, A5, A4, A7 A, A2, A1, A12
3. Enter center frequencies in GHz, MHz, kHz (stay within limits of the RF section in use).	Readout does not justify properly	A3, A2, check wiring from the keyboard to the A1A11 mother board
4. Perform operator's checks 2-a and 2-b	Readout does not justify properly	A3, A2, check wiring from the keyboard to the A1A11 mother board
5. Perform operator's check 2-c	Readout incorrect	A1, A4, A5
6. Perform operator's checks 2-d and 2-e	Readout does not blank when CLEAR KYBD is pressed	A2, check wiring between keyboard and A1A11 mother board
7. Perform operator's check 3-a	STEP ↑ operation does not function properly	A2, A4, A5, A6, A7, check wiring between keyboard and A1A11 mother board
7-a. Check STEP down operation	STEP ↓ operation does not function properly	Same as step 7
8. Perform operator's check 3-b	STEP readout incorrect	A1, A4, A5, A7, check STEP push-button switch and wiring
9. Perform Operator's checks 3-c and 3-d	OUT OF RNG light does not clash	A6, A1, light bulb, a4. a5. a7. Check OPID lines as follows: Extend the A1A7 assembly and check the following lines on connector -1 RF Section — 86601 — 86602 Pin 3 — 0 — 1 Pin C — 0 — 0 Pin B — 0 — 0 Pin 2 — 0 — 0

Table 8-1. Troubleshooting by Replacement (2 of 2)

Test	Result	Procedure
		If proper levels are present, trouble is in the A1A7 assembly or associated wiring. If proper levels are not present, trouble is in the cabling to the plug-in unit.
10. Perform Operator's check 3-e	Readout does not decrease in 111111 Hz steps	A1, A4, A5, A6, A7. Check MANUAL switch and wiring. Check the TUNING control and wiring/Extend the A1A1 assembly on two extender boards and use an oscilloscope to check for pulses at A1A1U12 pins 4 and 5. If pulses are present, the A1A1 assembly is probably defective. If the pulses are not present, the TUNING control, A1A17 is probably defective.
11. Perform operator's check 3-f	OUT OF RNG light does stay on below lower frequency limit.	A6, A1, lightbulb, A4, A5, A7. Check OPID lines on the A1A7 assembly as shown in step 9. Results are the same.
12. Perform operator's checks 4-a through 4-d	Manual time mode not operating properly.	A1, A4, A5, A6, A7. Check MANUAL switch, A1A17 TUNING control. Extend the A1A1 assembly on two extender boards and check as in step 10. Results are the same.
13. Perform operator's checks 5-a through 5-c.	Does not perform as Specified in Table 3-5	A4, A5, A6, A7, A8, A1, A9, A10, A12. Check lightbulbs, sweep switches and wiring.
14. Perform Operator's check 6-a.	Readout and/or output is incorrect	A1, A4, A5, A6, A7, A8, A9, A10, A12. Check sweep switches and TUNING control. Extend the A1A1 assembly on two extender boards and check as in step 10. Results are the same.
15. Perform Operator's check 7-a	Incorrect output	A4, A5, A6, A7, A8, A1, A9, A10, A12. Check SINGLE switch and wiring.

Table 8-2. Schematic Diagram Notes

SCHEMATIC DIAGRAM NOTES

Inductance is in microhenries, Resistance is in ohms and Capacitance is in microfarads unless otherwise noted.

P/O	part of
	Screwdriver Adjustment
○	Panel Control
	Encloses Front Panel designations
	Encloses Rear Panel designations
—— – – ——	Circuit assembly borderline
– – – – – – –	Other assembly borderline
CW	Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
1	Numbers in stars on circuit assemblies show locations of test points.
	Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example: (947) denotes white base, yellow wide stripe, violet narrow stripe.
A 2	Indicates an output from a schematic that goes to an input identified as A on Service Sheet 2.
6 K	Indicates an input to a schematic that comes from an output identified as K on Service Sheet 6.
⏚	Indicates Circuit ground

mounted on printed circuit boards or other assemblies are shown on the appropriate schematic page or the page opposite it. The part reference designator is the assembly designation plus the part designation. (Example: A10R1 is R1 on the A10 assembly). For specific component descriptions and ordering information refer to the parts list in Section VI of this manual.

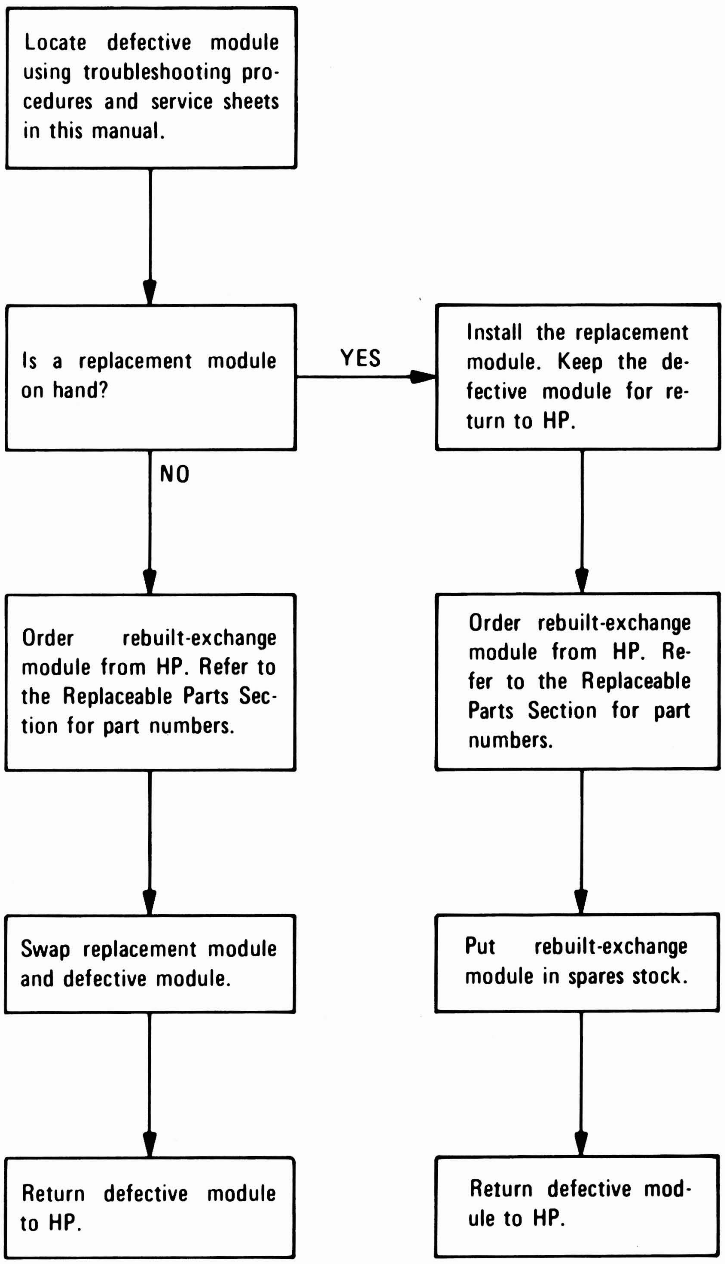
8-43. Table 8-3 lists all assemblies and provides location information for photos, schematics, etc.

Table 8-3. Assembly Locations

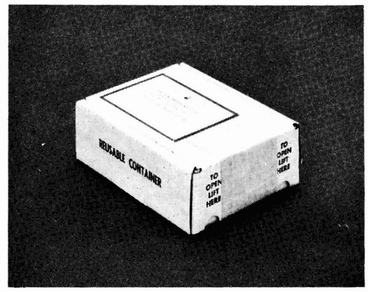
Assembly Numbers and Description	Service Sheet Number	Photo: Figure 8-
A1 Digital Control Unit	18-38	
A2 Loop Mother Board		5
A3 Interface Assembly	22, 23	5, 60, 62
A4 HF Loop Assembly	2, 3, 4, 5, 6	5, 13, 14, 16, 17, 19, 21, 23
A5 Voltage Control Assembly	24	5, 65
A6 Regulator Assembly	24	5, 65
A7 AC Line Module	24	5
A8 N3 Oscillator	12	5, 37
A9 Cable Loop Board	25	5
A10 N3 Phase Detector	11	5, 35
A11 SL2 Oscillator	14	5, 41
A12 SL2 Phase Detector	13	5, 39
A13 N2 Oscillator	10	5, 33
A14 N2 Phase Detector	9, 9a	5, 29, 31
A15 SL1 Phase Detector	15	5, 43
A16 N1 Phase Detector	7	5, 25
A17 N1 Oscillator	8	5, 27
A18 SL1 Mixer	16	5, 45
A19 SL1 Oscillator	17	5, 47
A20 Rectifier Assembly	24	5, 64
A21 Reference Oscillator	2	5, 11
A22 Reference Switch Assembly	2	5, 12

Module Exchange Repair Program

The module exchange program described here is a method of keeping your Hewlett-Packard instrument in service without repairing the instrument to the component level.



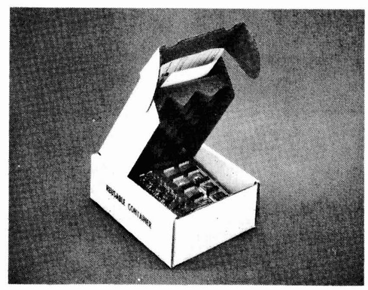
A.



Rebuilt-exchange modules are shipped individually in boxes like this. In addition to the circuit module, the box contains:

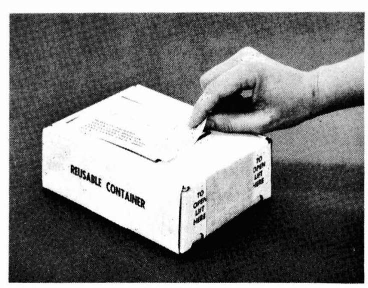
- Module repair report
- Return address label
- Tape for resealing box

B.



Open box carefully - it will be used to return defective module to HP. Complete repair report. Place it and defective module in box. Be sure to remove enclosed return address label.

C.

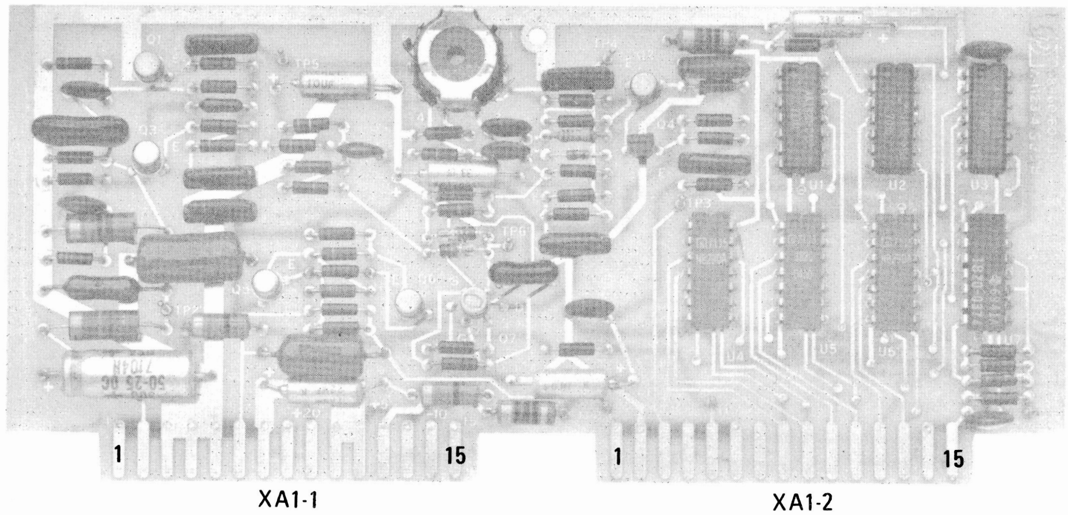


Seal box with tape provided. Inside U.S.A.*, stick preprinted return address label over label already on box, and return box to HP. Outside U.S.A., do not use address label: instead, address box to the nearest HP office.

*HP pays postage on boxes mailed in U.S.A.

Figure 8-2. Modular Exchange Procedure

COMPONENT SIDE



WIRING SIDE

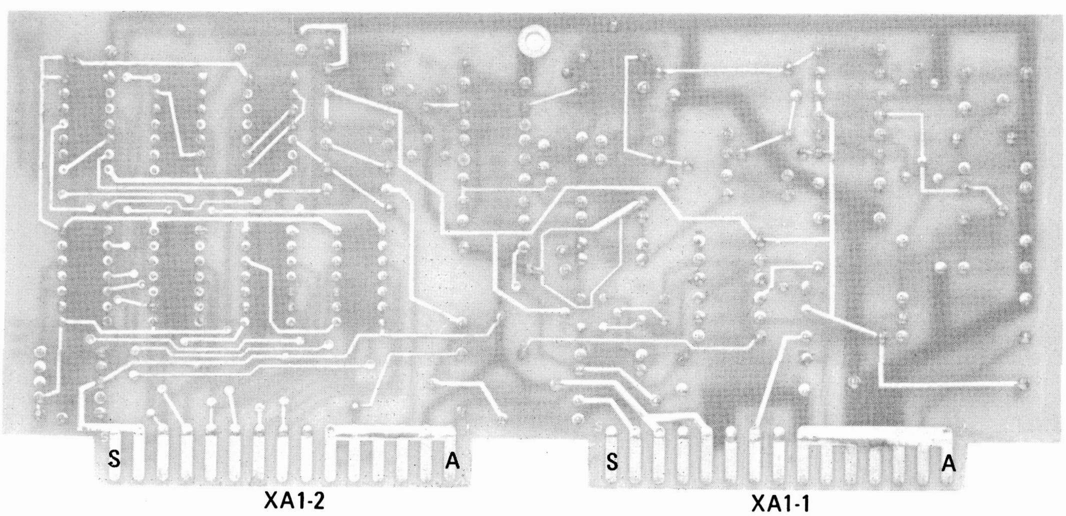
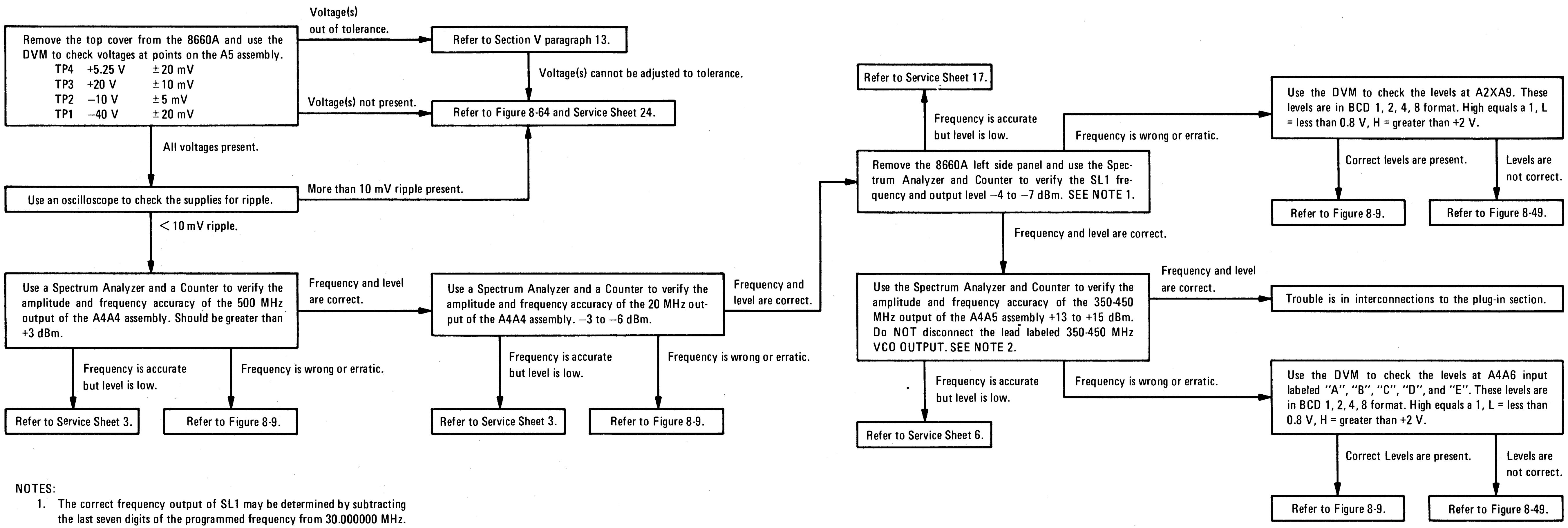


Figure 8-3. Printed Circuit Board Connector Identification

Figure 8-4. Model 8660B With Circuit Board Extended for Maintenance

NOTE

This procedure is based on the assumption that the cause of trouble has been isolated to the Model 8660A by performing the tests specified in the Modulation or RF Section Manual.

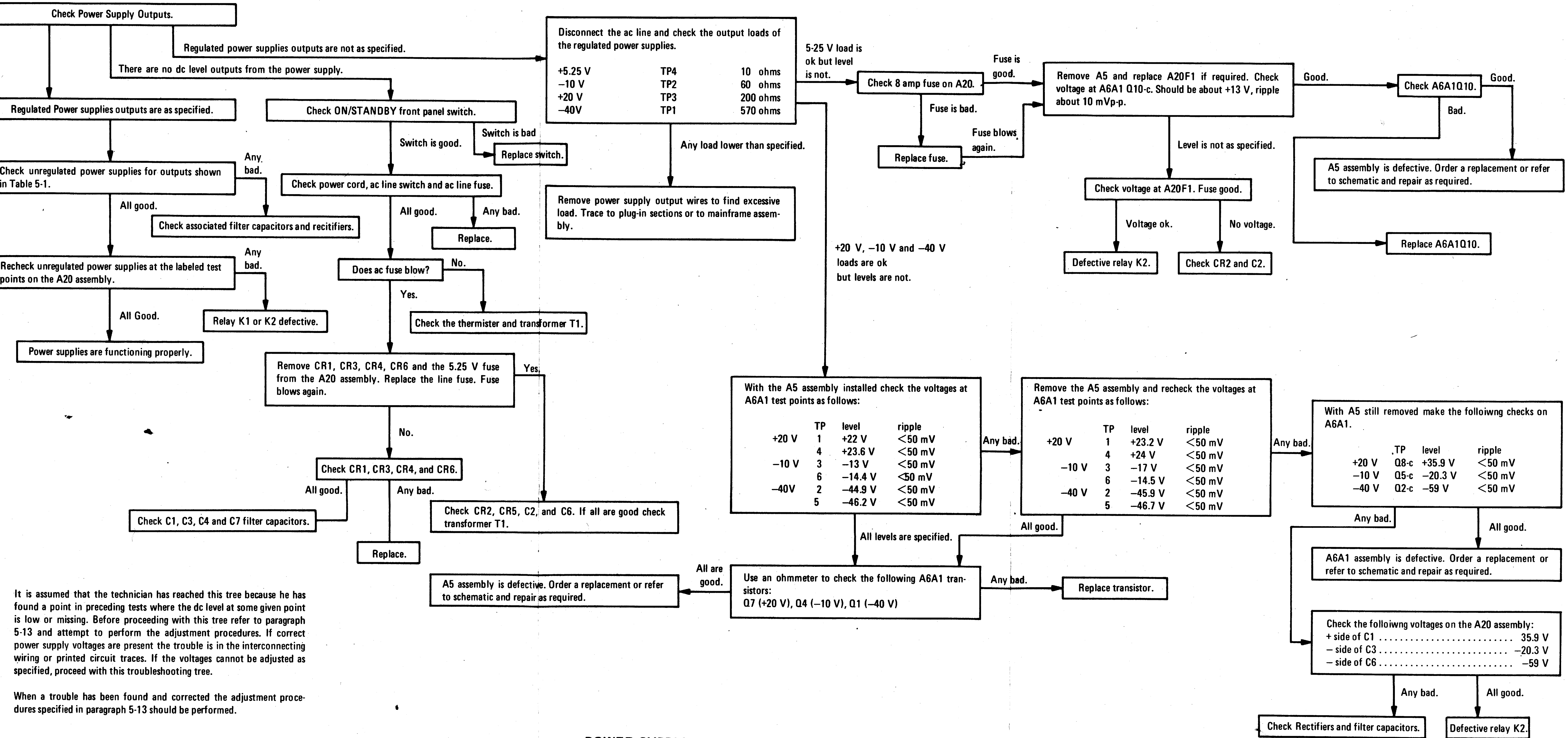


NOTES:

1. The correct frequency output of SL1 may be determined by subtracting the last seven digits of the programmed frequency from 30.000000 MHz. EXAMPLE: Programmed frequency is 107.654321 MHz. Subtract 7.654321 from 30.000000. SL1 frequency is 22.345679 MHz.

2. Determine output frequency by subtracting digit 8 or 9 (10 MHz and 100 MHz steps) from 450 MHz. EXAMPLE: Programmed frequency is 107 MHz. Subtract 100 from 450. HF Loop output is 350 MHz.

BASIC TROUBLESHOOTING TREE



It is assumed that the technician has reached this tree because he has found a point in preceding tests where the dc level at some given point is low or missing. Before proceeding with this tree refer to paragraph 5-13 and attempt to perform the adjustment procedures. If correct power supply voltages are present the trouble is in the interconnecting wiring or printed circuit traces. If the voltages cannot be adjusted as specified, proceed with this troubleshooting tree.

When a trouble has been found and corrected the adjustment procedures specified in paragraph 5-13 should be performed.

POWER SUPPLY TROUBLESHOOTING TREE

Figure 8-5. Basic Troubleshooting Tree and Power Supply Troubleshooting Tree

NOTE

Use the DVM to verify the presence of dc operating voltages at all assemblies before beginning tests.

Disconnect the REF INPUT cable from A4A2. Use the Spectrum Analyzer and the Counter to verify the presence of the reference signal at the cable output (10 MHz, at least + 5 dBm).

- Frequency or amplitude is not as specified. →
- Signal is as specified. Reconnect REF INPUT cable. ↓

Use the Spectrum Analyzer and the Counter to verify the presence of the 100 MHz signal at the A4A4 100 MHz OUTPUT. Should be exactly 100 MHz, at least + 10 dBm.

- Frequency not as specified. → Remove the covers from A4A3 and A4A2...
- Amplitude not as specified. → A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Amplitude and frequency are as specified. → Use the Spectrum Analyzer and the Counter to check the 500 MHz output...

Remove the covers from A4A3 and A4A2. Use an Oscilloscope and a Counter to verify the presence of the 20 MHz input to A4A3. Should be 20 MHz ± 1 MHz and at least 300 mV p-p.

- Frequency or level is not as specified. → A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Frequency and level are as specified. ↓

Use an Oscilloscope and a Counter to verify the presence of the 20 MHz output from the A4A3 assembly. Should be 20 MHz ± 1 MHz and at least 2 V p-p.

- Frequency or level is not as specified. → A4A3 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Frequency and level are as specified. ↓

Connect the Oscilloscope to A4A2 TP1. The Oscilloscope should display a 20 nanosecond pulse at least 2 V p-p.

- Pulse is not as specified. → A4A2 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.
- Pulse is present as specified. ↓

Use the DVM to check the dc level at the A4A2 "VCO" lead. Voltage should be about +12 to +14 Volts.

- Voltage is not as specified. → A4A2 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.
- Voltage is as specified. ↓

Connect the Counter to the 20 MHz OUTPUT from the A4A4 assembly. Verify that A4A4C2 can be adjusted to 20 MHz ± 5 kHz.

- Adjustment works as specified. → A4A2 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.
- Adjustment does not work as specified. → A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.

Use the Spectrum Analyzer and the Counter to check the 500 MHz output from the A4A4 assembly. Should be exactly 500 MHz and at least + 3 dBm.

- Frequency or level is not as specified. → A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Signal is as specified. ↓

Use the Spectrum Analyzer and the Counter to check the 20 MHz output from the A4A4 assembly. Should be exactly 20 MHz and at a level between −3 and −6 dBm.

- Frequency or level is not as specified. → A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Signal is as specified. ↓

Use the Oscilloscope to check the 10 MHz output from the A4A4 assembly. Level should be greater than 1.5 V p-p. Use the Counter to check the frequency. Frequency should be exactly 10 MHz.

- Frequency or level is not as specified. → A4A3 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
- Signal is as specified. ↓

Use the Oscilloscope and a Counter to check the reference outputs from the A4A1 assembly. The 2 MHz, 400 kHz, and both 100 kHz signals should be greater than 2 V p-p.

- Frequency or level is not as specified. → Use an Oscilloscope to check to 10 MHz input to the A4A1 assembly from the A4A3 assembly. Level should be greater than 1.5 V p-p.
  - Signal is not as specified. → A4A3 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.
  - Signal is as specified. → A4A1 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.
- All signals are as specified. ↓

Reference Loop is functioning properly. →

Set the rear panel REFERENCE switch to EXT and apply a 1 Vrms 10 MHz signal to the reference INPUT. Recheck the signal at the end of the cable to the A4A2 assembly.

Signal is not present.

Check cable.

A22 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.

Signal is now present.

Set the rear panel REFERENCE switch to INT and check the output of the A21 reference oscillator.

Signal is present.

Check cable.

Signal is not present.

A21 is defective. Order a replacement unit.

A4A4 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.

A4A3 assembly is defective. Order replacement assembly or refer to Service Sheet 3 and repair as required.

Signal is not as specified.

Use an Oscilloscope to check to 10 MHz input to the A4A1 assembly from the A4A3 assembly. Level should be greater than 1.5 V p-p.

Signal is as specified.

A4A1 assembly is defective. Order replacement assembly or refer to Service Sheet 2 and repair as required.

Use the Spectrum Analyzer and a Counter to verify that the output at the rear connector of the A4A5 assembly is about +13 to +15 dBm at the frequencies shown for the Thumbwheel settings below.

Thumbwheel settings 9	Thumbwheel settings 8	Frequency output MHz	Input logic level EDCBA
0	0	450.000000	00000
0	1	440.000000	00001
0	2	430.000000	00010
0	3	420.000000	00011
0	4	410.000000	00100
0	5	400.000000	00101
0	6	390.000000	00110
0	7	380.000000	00111
0	8	370.000000	01000
0	9	360.000000	01001
1	0	350.000000	10000

If the frequencies are not correct use the DVM to check the logic levels at the A4A6 "A", "B", "C", "D" and "E" inputs. For thumbwheel settings shown above they should be as shown in the level column. 1 = high, about + 3 V.

All frequencies and levels are as specified. HF Loop is functioning properly.

No output or low output.

A4A5 assembly is defective. Order replacement assembly or refer to Service Sheet 6 and reapair as required.

Check interconnections to the interface circuit if interconnections are good, trouble is in the interface circuits or the DCU. Refer to Figure 8-49.

Input logic levels are not as specified.

Levels are as specified but frequencies are not.

Use the oscilloscope and the Counter to check the 10 MHz input to the A4A7 assembly. Should be greater than 1.5 V p-p.

Frequency and level is as specified.

Frequency or level not as specified.

Trouble is in the reference section. Start at beginning of this tree.

Open the HF phase lock loop by removing hte cable from the A4A5 350-450 MHz VCO OUTPUT. Use the Oscilloscope or the DVM to check the dc level on the lead marked Ø between the A4A6 and A4A7 assemblies. The level should be 0 V ± 0.1 V.

DC level is not as specified.

The A4A7 assembly is defective. Order a replacement assembly or refer to Service Sheet 5 and repair as required.

DC level is as specified.

Refer to the first step in the HF loop procedure and repeat the frequency portion of the test. Frequencies shown should be within ± 500 kHz.

Frequencies are not as specified.

Use the DVM to check the dc level on the lead marked "freq" between the A4A5 and A4A6 assemblies. Thumbwheels 9 and 8 set to 00 level should be −34 Vdc. Thumbwheels set to 10 level should be −7 Vdc. If levels are not as specified refer to paragraph 5-15 and perform the adjustment procedure.

Adjustment procedure does not correct the problem.

Use the DVM to measure the lead labeled "comp" in the A4A6 assembly. Should be about −37 to −38 V.

Voltage is as specified.

The A4A6 assembly is defective. Order a replacement assembly or refer to Service Sheet 4 and repair as required.

Frequencies are as specified.

Close the HF loop by reconnecting the cable between the A4A6 and A4A7 assemblies. Use the Oscilloscope to check for a 2 - 3 V p-p beat note at the lead labeled Ø on the A4A7 assembly.

Beat note is present.

The A4A6 Assembly is defective. Order a replacement assembly or refer to Service Sheet 4 and repair as required.

Beat note is not present.

The A4A7 assembly is defective. Order a replacement assembly or refer to Service Sheet 5 and repair as required.

◀ IC INFORMATION AND TROUBLESHOOTING TREE

Figure 8-6. RF Loops Troubleshooting Tree (1 of 2)

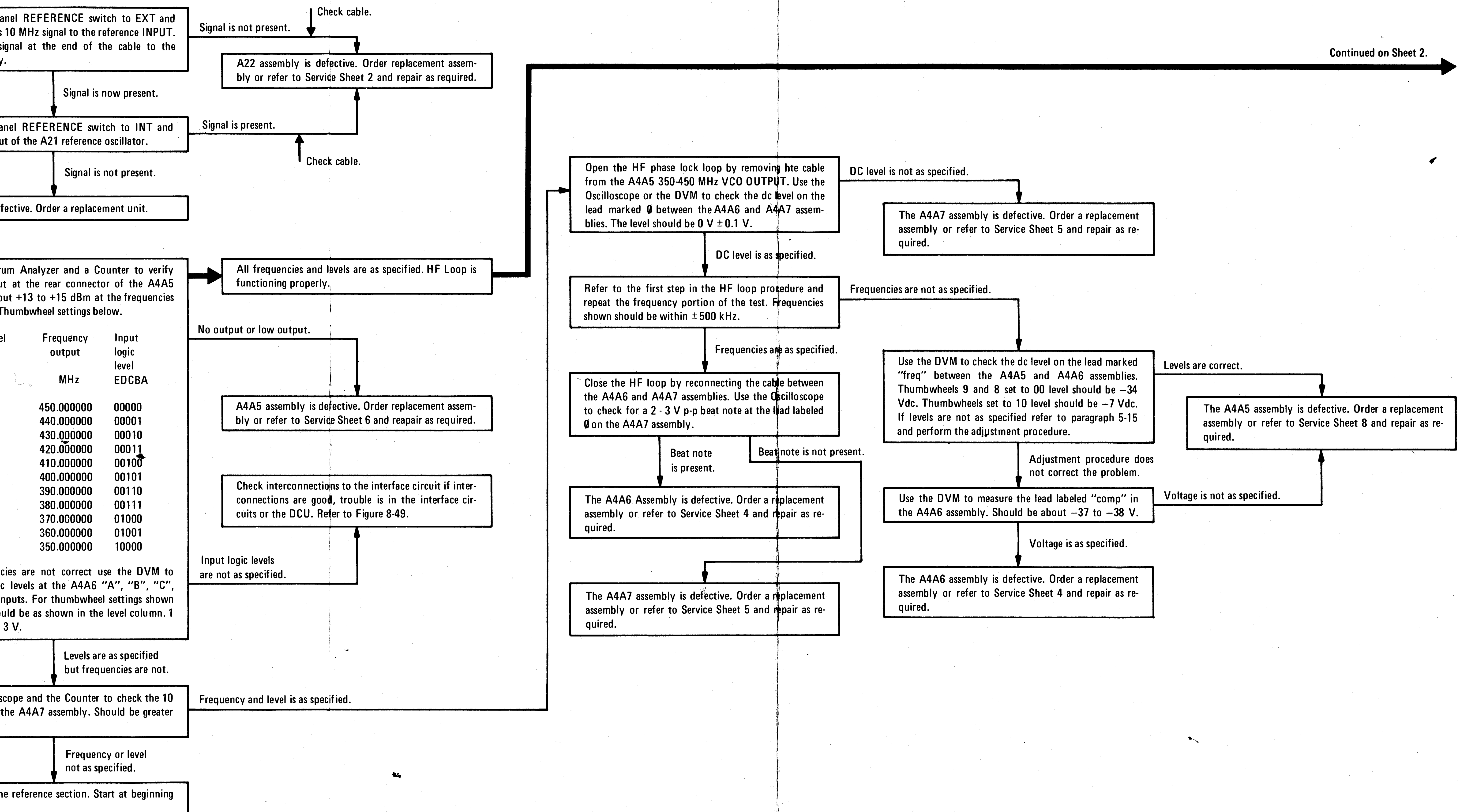
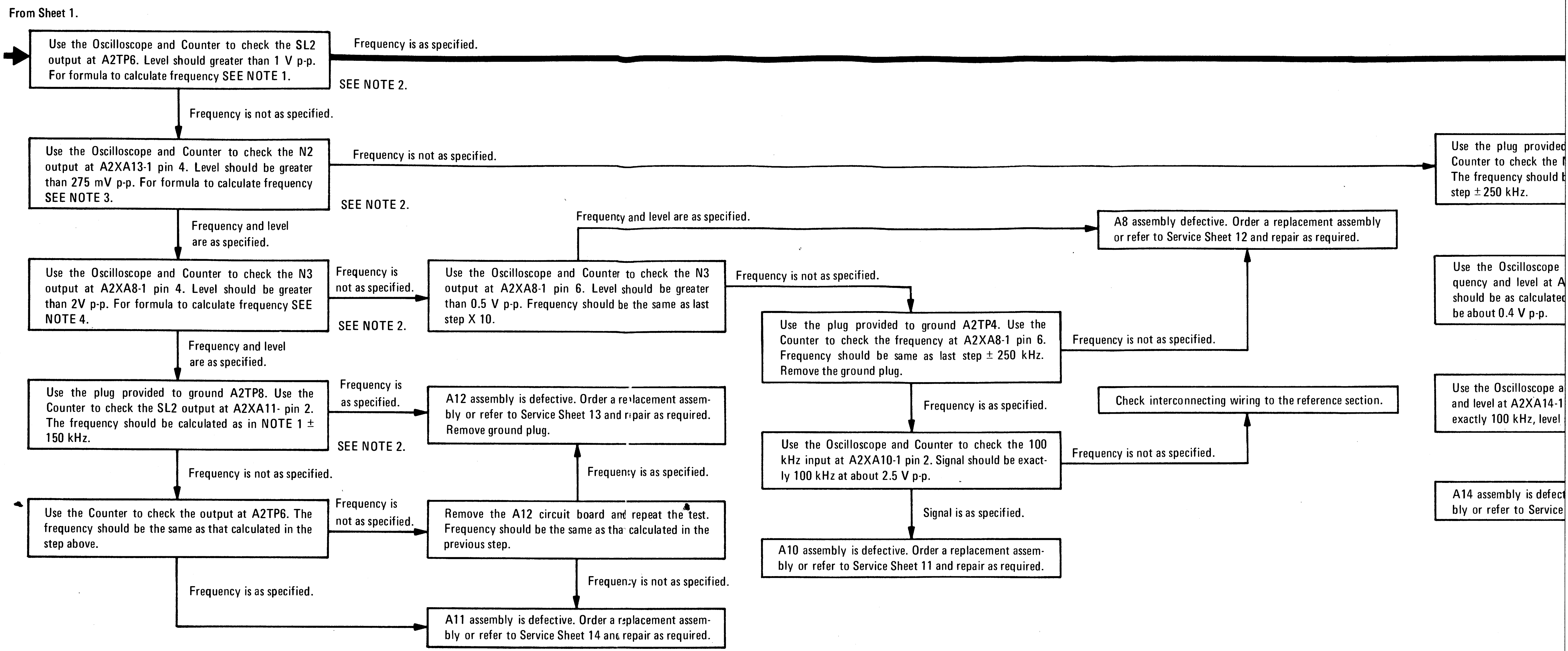


Figure 8-6. RF Loops Troubleshooting Tree (1 of 2)


From Sheet 1.
Use the Oscilloscope and Counter to check the SL2 output at A2TP6. Level should greater than 1 V p-p. For formula to calculate frequency SEE NOTE 1.
Frequency is as specified.
SEE NOTE 2.
Frequency is not as specified.
Use the Oscilloscope and Counter to check the N2 output at A2XA13-1 pin 4. Level should be greater than 275 mV p-p. For formula to calculate frequency SEE NOTE 3.
Frequency is not as specified.
SEE NOTE 2.
Use the plug provided
Counter to check the
The frequency should b
step ± 250 kHz.
Frequency and level are as specified.
Use the Oscilloscope and Counter to check the N3 output at A2XA8-1 pin 4. Level should be greater than 2V p-p. For formula to calculate frequency SEE NOTE 4.
Frequency is not as specified.
SEE NOTE 2.
Use the Oscilloscope and Counter to check the N3 output at A2XA8-1 pin 6. Level should be greater than 0.5 V p-p. Frequency should be the same as last step X 10.
Frequency and level are as specified.
A8 assembly defective. Order a replacement assembly or refer to Service Sheet 12 and repair as required.
Frequency is not as specified.
Use the plug provided to ground A2TP4. Use the Counter to check the frequency at A2XA8-1 pin 6. Frequency should be same as last step ± 250 kHz. Remove the ground plug.
Frequency is not as specified.
Use the Oscilloscope
quency and level at A
should be as calculated
be about 0.4 V p-p.
Frequency and level are as specified.
Use the plug provided to ground A2TP8. Use the Counter to check the SL2 output at A2XA11- pin 2. The frequency should be calculated as in NOTE 1 ± 150 kHz.
Frequency is as specified.
SEE NOTE 2.
A12 assembly is defective. Order a replacement assembly or refer to Service Sheet 13 and repair as required. Remove ground plug.
Frequency is as specified.
Check interconnecting wiring to the reference section.
Use the Oscilloscope a
and level at A2XA14-1
exactly 100 kHz, level
Use the Oscilloscope and Counter to check the 100 kHz input at A2XA10-1 pin 2. Signal should be exactly 100 kHz at about 2.5 V p-p.
Frequency is not as specified.
Frequency is not as specified.
Frequency is as specified.
Use the Counter to check the output at A2TP6. The frequency should be the same as that calculated in the step above.
Frequency is not as specified.
Remove the A12 circuit board and repeat the test. Frequency should be the same as that calculated in the previous step.
Signal is as specified.
A14 assembly is defect
bly or refer to Service
A10 assembly is defective. Order a replacement assembly or refer to Service Sheet 11 and repair as required.
Frequency is as specified.
Frequency is not as specified.
A11 assembly is defective. Order a replacement assembly or refer to Service Sheet 14 and repair as required.

to ground A2TP4. Use the
requency at A2XA8-1 pin 6.
ame as last step ± 250 kHz.

Frequency is not as specified.

A8 assembly defective. Order a replacement assembly or refer to Service Sheet 12 and repair as required.

Frequency is as specified.

nd Counter to check the 100
pin 2. Signal should be exact-
V p-p.

Frequency is not as specified.

Check interconnecting wiring to the reference section.

Signal is as specified.

e. Order a replacement assem-
heet 11 and repair as required.

Use the plug provided to ground A2TP12. Use the Counter to check the N2 output at A2XA13-1 pin 4. The frequency should be as calculated for the previous step ± 250 kHz.

Frequency is not as specified.

A13 assembly defective. Order a replacement assembly or refer to Service Sheet 10 and repair as required.

Frequency is as specified.

Use the Oscilloscope and Counter to check the frequency and level at A2XA13-1 pin 6. The frequency should be as calculated in previous step. Level should be about 0.4 V p-p.

Frequency is not as specified.

Frequency and level are as specified.

Check interconnection wiring to the reference section.

Use the Oscilloscope and Counter to check frequency and level at A2XA14-1 pin 2. The frequency should be exactly 100 kHz, level should be about 2 V p-p.

Frequency is not as specified.

Frequency and level are as specified.

A14 assembly is defective. Order a replacement assembly or refer to Service Sheet 9 and repair as required.

Use the Oscilloscope and Counter to check the N1 output at A2XA17-1 pin 2. Level should be greater than 0.4 V p-p. For formula to calculate frequency SEE NOTE 5.

Frequency is not as specified.

SEE NOTE 2.

Use the plug
Counter to ch
quency should
kHz.

Frequency and level are as specified.

A17 assembly
or refer to Ser

Use the plug provided to ground A2TP14. Use the Counter to check the SL1 output at A2TP22 SEE NOTE 6. Frequency should be as calculated ± 150 kHz.

Frequency is not as specified.

SEE NOTE 2.

Use the DVM
The level is c
Thumbwheels
Thumbwheels
mediate steps

Frequency is as specified.

Use the Counter to check the frequency at A2XA19-1 pin 2. Frequency should be as calculated for step above.

Frequency is not as specified.

A19 is defec
refer to Servic

Frequency is as specified.

Use the Counter to check the frequency at A2TP19. The frequency should be the difference frequency between the N1 and SL1 outputs.

Frequency is not as specified.

A18 assembly
or refer to Ser

Frequency is as specified.

A15 assembly is defective. Order a replacement assembly or refer to Service Sheet 15 and repair as required.

ovided to ground A2TP12. Use the . the N2 output at A2XA13-1 pin 4. ould be as calculated for the previous

Frequency is not as specified.

A13 assembly defective. Order a replacement assembly or refer to Service Sheet 10 and repair as required.

Frequency is as specified.

cope and Counter to check the fre- at A2XA13-1 pin 6. The frequency ulated in previous step. Level should -p.

Frequency is not as specified.

Frequency and level are as specified.

Check interconnection wiring to the reference section.

ope and Counter to check frequency A14-1 pin 2. The frequency should be level should be about 2 V p-p.

Frequency is not as specified.

Frequency and level are as specified.

defective. Order a replacement assem- ervice Sheet 9 and repair as required.

Use the Oscilloscope and Counter to check the N1 output at A2XA17-1 pin 2. Level should be greater than 0.4 V p-p. For formula to calculate frequency SEE NOTE 5.

Frequency is not as specified.

Use the plug provided to ground A2TP16. Use the Counter to check the output at A2XA17-1 pin 2. Frequency should be as calculated for last step ± 250 kHz.

Frequency is as specified.

Use the Counter to check the frequency at A2XA17-1 pin D. Should be as calculated for last step.

SEE NOTE 2.

Frequency is not as specified.

A17 assembly defective. Order a replacement assembly or refer to Service Sheet 8 and repair as required.

Frequency is not as specified.

Frequency is as specified.

Use the Oscilloscope and Counter to check the input at A2XA16-1 pin 2. Input should be exactly 400 kHz at about 2.5 V p-p.

Signal is as specified.

Signal is not as specified.

A16 assembly defective. Order replacement assembly or refer to Service Sheet 7 and repair as required.

Check interconnecting wiring to the reference section.

Frequency and level are as specified.

Use the plug provided to ground A2TP14. Use the Counter to check the SL1 output at A2TP22 SEE NOTE 6. Frequency should be as calculated ± 150 kHz.

Frequency is not as specified.

SEE NOTE 2.

Use the DVM to check dc levels at A2XA18-2 pin R. The level is controlled by thumbwheels 5, 6 and 7. Thumbwheels set to 000, level should be –25.5 V. Thumbwheels set to 9, level should be –5-4 V. Intermediate steps should be about 2.2 V.

Level is as specified.

Level is not as specified.

Frequency is as specified.

Use the Counter to check the frequency at A2XA19-1 pin 2. Frequency should be as calculated for step above.

Frequency is not as specified.

A19 is defective. Order a replacement assembly or refer to Service Sheet 17 and repair as required.

Frequency is as specified.

Use the Counter to check the frequency at A2TP19. The frequency should be the difference frequency between the N1 and SL1 outputs.

Frequency is not as specified.

A18 assembly defective. Order replacement assembly or refer to Service Sheet 16 and repair as required.

Frequency is as specified.

A15 assembly is defective. Order a replacement assembly or refer to Service Sheet 15 and repair as required.

NOTES:

1. The output frequency of the SL2 loop may be determined by adding the N2 output frequency to the divided-by-ten output of the N3 loop assembly. EXAMPLE: Programmed frequency is 107.654321 MHz. 24.36 + 0.2079 = 24.5679. Output frequency is 24.5679 MHz.

2. If there is no RF output, or if the RF level is low, the trouble is in the circuit board containing the voltage controlled oscillator and output circuits.

3. The output frequency of the N2 loop is equal to 29.79 MHz less the setting of thumbwheel digits 5, 4 and 3. EXAMPLE: Thumbwheels set to 107.654321 MHz, 29.79 - 5.43 = 24.36. Output frequency is 24.36 MHz.

4. The output frequency of the N3 loop is equal to 2.100 MHz less the setting of thumbwheel digits 2 and 1. EXAMPLE: Thumbwheels set to 107.654321 MHz, (2.100 - .021 = 2.079). Output frequency is 2.079 MHz.

5. The output frequency of the N1 loop is equal to 29.7 MHz less the setting of thumbwheel digits 7 and 6. EXAMPLE: Thumbwheels set to 107.654321 MHz, 29.7 - 7.6 = 22.1. Output Frequency is 22.1 MHz.

6. The output frequency of the SL1 loop may be determined by subtracting the last seven digits of the programmed frequency from 30.000000 - 7.654321 = 22.345679. Output frequency is 22.345679 MHz.

Figure 8-6. RF Loops Troubleshooting Tree (2 of 2)

SERVICE SHEET 1

BLOCK DIAGRAM

General

The Hewlett-Packard Model 8660B is a signal generator which utilizes synthesizer techniques to produce precise rf output signals. These signals may be selected in increments as small as one Hz.

Each step in the generation of the output frequency is controlled by phase lock loops. This ensures that the output frequency is exactly that selected by front panel (or remote) controls.

All of the seven phase lock loops (five loops in option 004) are referenced to a single source. This source may be the internal temperature controlled crystal oscillator or an external frequency standard of 1, 2, 2.5, 5, or 10 MHz.

The Model 8660B mainframe does not provide a direct rf output, except for the reference signal which may be used as a time base for external equipment. The signals generated within the mainframe are used in plug-in modules which utilize mixing techniques to provide the selected output rf signals.

Reference Loop

The reference loop consists of four circuit boards mounted in the A4 assembly. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 2 and 3.

All of the signals generated within the Model 8660B mainframe are derived from the 100 MHz master oscillator in the reference loop. The master oscillator is a voltage controlled oscillator which is phase locked to a stable reference. The 100 MHz oscillator is located in the A4A4 assembly.

Also included in the A4A4 assembly are divide-by-five and multiply-by-five circuits. The outputs from the A4A4 assembly are 500 MHz, 100 MHz, and 20 MHz. The 20 MHz output from the A4A4 assembly is sampled in the reference loop phase detector to provide a phase correction signal to the master oscillator. The 20 MHz signal is also applied to the A4A3 assembly where it is divided by two to provide a 10 MHz signal for use in the A4A1 reference dividers and in the high frequency phase lock loop.

The reference loop input circuit (A4A2) converts the signal from the reference oscillator into sharp short-duration pulses to open a sampler gate which samples the 20 MHz signal from the A4A4 assembly. The sampled signal is used to generate an error signal which biases the varactor in the 100 MHz voltage controlled oscillator in the A4A4 assembly to maintain the phase locked condition.

SERVICE SHEET 1 (cont'd)

The A4A1 assembly divides the 10 MHz input from the A4A3 assembly by five to provide a 2 MHz clock for the digital control unit. The 2 MHz signal is divided by five to provide a 400 kHz signal to the phase detector in the N1 loop. The 400 kHz is twice divided by two to provide 100 kHz signals to the phase detectors in the N2 and N3 loops.

High Frequency Loop

The HF loop consists of three circuit boards mounted in the A4 assembly. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 4, 5 and 6.

The HF loop provides digitally controlled rf signals between 350 and 450 MHz in precisely selected 10 MHz increments.

The sampling phase detector (A4A7) compares the voltage controlled oscillator (A4A5) output to a 10 MHz signal from the reference loop and provides an output to phase lock the voltage controlled oscillator to the reference signal. The phase detector assembly contains a pulse generator, a sampler and a signal processing circuit.

The frequency of the voltage controlled oscillator (A4A5) is roughly pretuned by a digital to analog converter located in the A4A6 assembly. The error signal from the A4A7 assembly is summed with the output of the digital to analog converter to maintain the phase locked condition. The A4A5 assembly also contains two identical three-stage amplifiers. These amplifiers serve as buffers to isolate any extraneous signals at their outputs from the oscillator. One of the amplifiers provides an output to the rf plug-in; the other output goes to the HF loop sampling phase detector.

The A4A6 pretuning circuit consists of a digital to analog converter which roughly pretunes the voltage controlled oscillator to the 10 MHz increment between 350 and 450 MHz selected by CF digits 8 and 9 of the front panel (or remote) controls. The pretuning cannot, by itself, set the voltage controlled oscillator frequency accurately; it does set the frequency within the capture range of the loop.

The A4A6 assembly also contains a summing circuit which sums the negative dc level from the digital to analog converter with the current from a +20 volt source and the output of the phase detector. The output from the summing circuit precisely controls the frequency of the voltage controlled oscillator.

Divide By N Loop N1

The purpose of the N1 loop is to generate digitally controlled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference signal which is derived from the master oscillator in the reference loop. The output of the N1 loop is applied to summing loop 1.

SERVICE SHEET 1 (cont'd)

The N1 loop circuits are mounted on two circuit boards, A16 and A17. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 7 and 8.

The A16 phase detector assembly contains a programmable divider, a sampling phase detector and a signal processing circuit.

The programmable divider divides by a number determined by CF digits 6 and 7 of the front panel (or remote) controls. The terminal count of the programmable divider is always 297. The actual number of cycles counted is determined by the count programmed into the divider prior to the start of each count cycle. The output of the programmable divider is always 100 kHz when the loop is locked.

The output frequency of the N1 loop may be determined by subtracting the CF digits 7 and 6 information from 29.7 MHz. As an example, if CF digits 7 and 6 are set for 3.4 MHz, the N1 output frequency will be 26.3 MHz (29.7 - 3.4).

The sampling phase detector uses the 100 kHz pulses from the programmable divider to sample the 400 kHz reference signal and provides an error output to the summing circuit in the A17 assembly.

The signal processing circuit consists of an operational amplifier with lead and lag compensation.

The A17 assembly contains a digital to analog converter, a voltage controlled oscillator and a summing circuit.

The digital to analog converter converts the digital inputs from CF digits 6 and 7 to a dc level which roughly pretunes the voltage controlled oscillator to a frequency within the capture range of the loop.

The summing circuit sums the current from the negative digital to analog converter source with current from a +20 volt source and the error signal from the phase detector to precisely control the voltage controlled oscillator frequency.

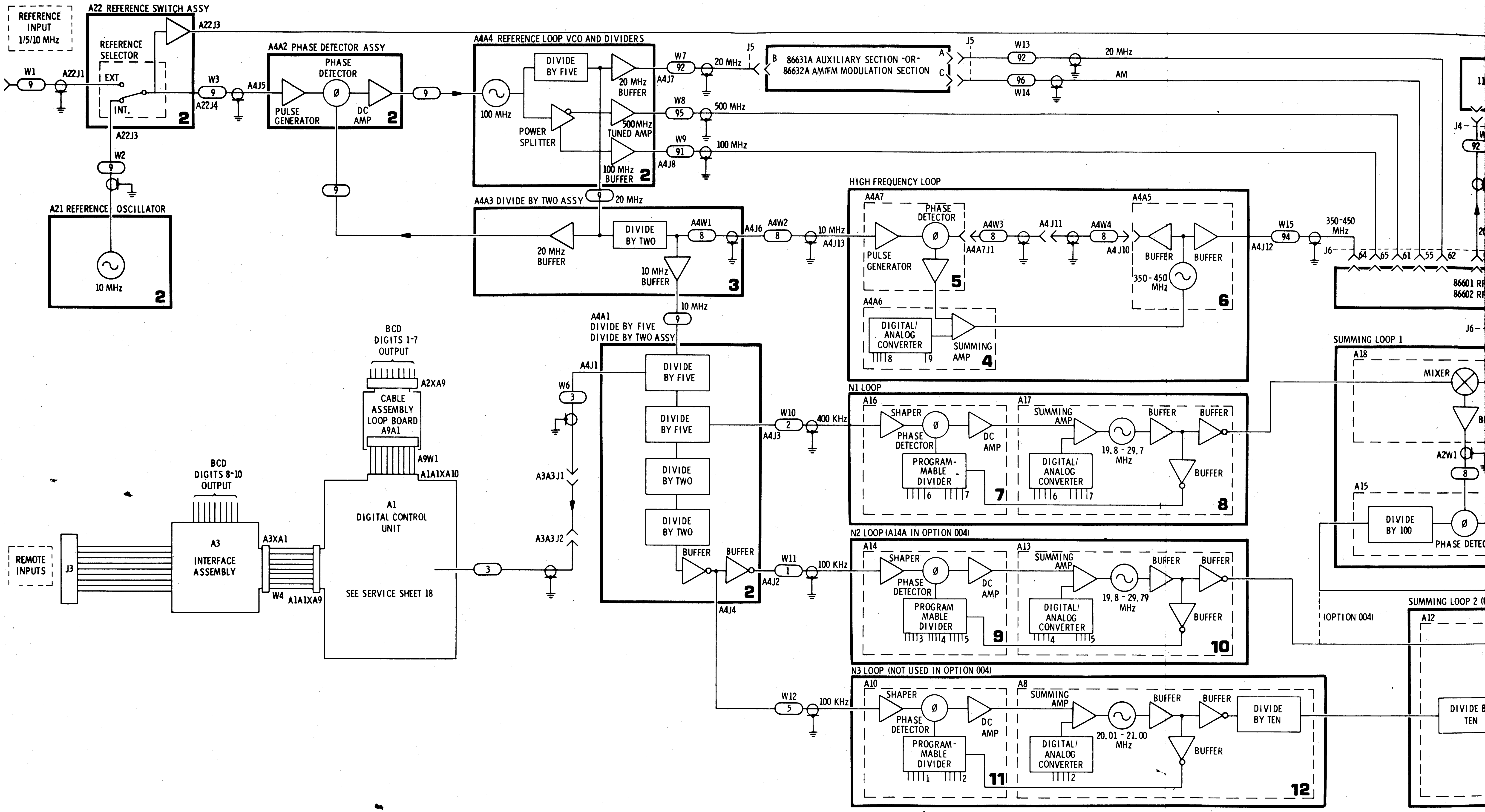
Divide By N Loop N2

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selected 10 kHz increments.

NOTE

In option 004 instruments the N2 loop output is from 20.01 to 30.00 MHz in 10 kHz increments.

The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The output of the N2 loop is applied to summing loop 2 (Summing loop 1 in option 004 instruments).



REFERENCE INPUT 1/5/10 MHz
A22 REFERENCE SWITCH ASSY
REFERENCE SELECTOR
EXT
INT.
A22J1
A22J3
A22J4
W1
W2
W3
A21 REFERENCE OSCILLATOR
10 MHz
A4A2 PHASE DETECTOR ASSY
PHASE DETECTOR
PULSE GENERATOR
DC AMP
A4J5
A4A4 REFERENCE LOOP VCO AND DIVIDERS
100 MHz
DIVIDE BY FIVE
POWER SPLITTER
20 MHz BUFFER
500 MHz TUNED AMP
100 MHz BUFFER
A4J7
A4J8
W7
W8
W9
20 MHz
500 MHz
100 MHz
J5
86631A AUXILIARY SECTION -OR- 86632A AM/FM MODULATION SECTION
W13
W14
AM
A4A3 DIVIDE BY TWO ASSY
20 MHz BUFFER
DIVIDE BY TWO
10 MHz BUFFER
A4W1
A4J6
A4W2
A4J13
10 MHz
HIGH FREQUENCY LOOP
A4A7
PULSE GENERATOR
A4W3
A4A7J1
A4 J11
A4W4
A4 J10
A4A5
BUFFER
350-450 MHz
A4J12
W15
J6
A4A6
DIGITAL/ ANALOG CONVERTER
SUMMING AMP
86601 RF
86602 RF
A4A1 DIVIDE BY FIVE DIVIDE BY TWO ASSY
A4J1
W6
DIVIDE BY FIVE
DIVIDE BY TWO
A4J3
A4J2
A4J4
W10
W11
W12
400 KHz
100 KHz
BCD DIGITS 1-7 OUTPUT
A2XA9
CABLE ASSEMBLY LOOP BOARD A9A1
A9W1
A1A1XA10
A1 DIGITAL CONTROL UNIT
SEE SERVICE SHEET 18
A3A3J1
A3A3J2
BCD DIGITS 8-10 OUTPUT
A3 INTERFACE ASSEMBLY
A3XA1
W4
A1A1XA9
REMOTE INPUTS
J3
N1 LOOP
A16
SHAPER
PROGRAM-MABLE DIVIDER
A17
19.8 - 29.7 MHz
N2 LOOP (A14A IN OPTION 004)
A14
A13
N3 LOOP (NOT USED IN OPTION 004)
A10
A8
20.01 - 21.00 MHz
DIVIDE BY TEN
SUMMING LOOP 1
A18
MIXER
A2W1
A15
DIVIDE BY 100
PHASE DETEC
(OPTION 004)
SUMMING LOOP 2
A12

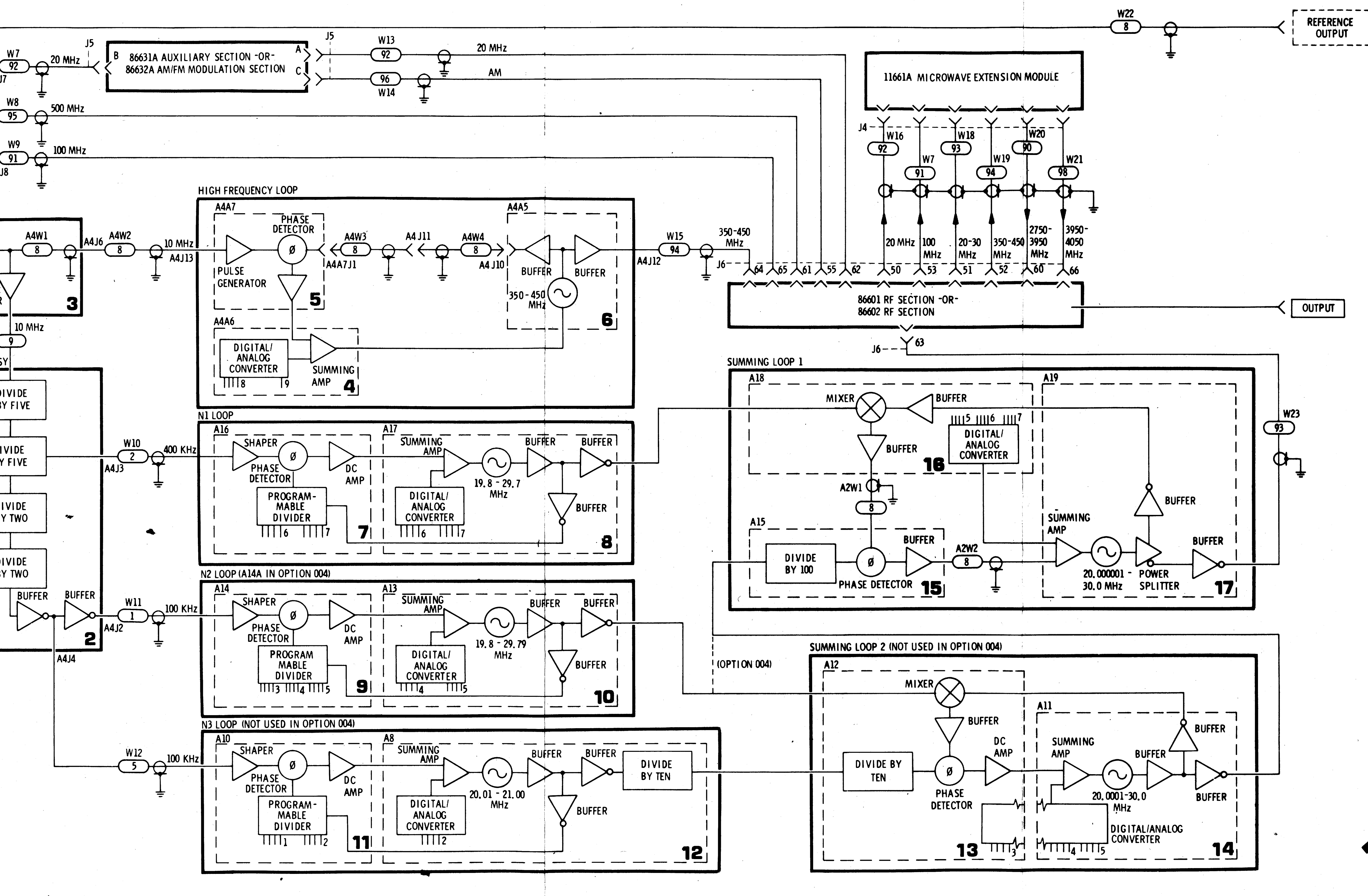


Figure 8-7. Model 8660B Block Diagram

SERVICE SHEET 2

P/O REFERENCE LOOP CIRCUITS

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When repairing the reference loop only one of the four covers should be removed at any given time. Operating the instrument with the voltage controlled oscillator cover removed may cause faulty or erratic performance after required repairs have been completed.

NOTE

After making repairs in any part of the reference loop circuits the adjustment procedures specified in Section V paragraph 5-14 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Test Oscillator
10:1 Oscilloscope probes (2)
Electronic Counter
Oscilloscope

REFERENCE LOOP GENERAL

The reference loop consists of four circuit boards located in the A4 assembly. This service sheet provides information about circuit operation and test procedures for the reference oscillator, reference amplifier and relays, the phase detector and the divide-by-five and divide-by-two circuits. Schematic diagrams, text and troubleshooting information for the voltage controlled oscillator and divide-by-two circuits appear on Service Sheet 3.

The accuracy and stability of all the signals generated in the Model 8660B mainframe are traceable to the reference loop outputs.

The reference loop provides output frequencies of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz, and 100 kHz. These signals are used in other circuits in the mainframe and in the plug-in sections. All of the reference section outputs are derived from a 100 MHz master oscillator which is phase locked to a stable reference source. The reference signal may be supplied by the internal reference oscillator or by an external reference standard. The reference signal may be 1, 2, 2.5, 5 or 10 MHz at a level of 0.2 to 2 volts rms.

1 REFERENCE OSCILLATOR, AMPLIFIER AND RELAYS

The Model 8660B (except for option 002 instruments) contains a 10 MHz temperature controlled crystal oscillator which is used as a

SERVICE SHEET 2 (cont'd)

PHASE DETECTOR ASSEMBLY (A4A2) GENERAL:

The phase detector consists of three basic circuits; a pulse generator, a sampler and a circuit to process the error signal.

The pulse generator converts the reference signal to very sharp, short duration pulses. These pulses are used to forward bias the sampler gate diodes.

The sampler gate provides a means of comparing the pulses generated from the reference signal to the 20 MHz signal from the A4A3 assembly. An error signal is developed to control the voltage controlled oscillator in the A4A4 assembly when a phase error exists.

2 PULSE GENERATOR

The pulse generator consists of Q1 through Q5, U1, T1 and associated components.

The reference input to Q1 may be 1, 2, 2.5, 5 or 10 MHz. Q1 and Q2 act as an amplifier for low level signals and as a limiter for high level signals. Q3 acts as a limiter to ensure that the input to NAND gate U1A is always the same when the input reference signal is 0.2 to 2 volts rms. The output from Q3 is essentially a square wave with a slow rise time and a fast fall time; it is clipped, top and bottom, and is approximately 5 volts peak to peak.

U1, C11 and R20 are used as a pulse shaper. The output of U1A is differentiated by C11 and R20 and inverted by U1B. The sharp pulses (20 to 25 nanoseconds) are inverted by U1D to provide positive-going pulses to drive Q4/Q5.

Q4/Q5 comprise a complementary emitter-follower pair; its purpose is to provide a low impedance drive to T1.

TEST PROCEDURE 2

Test 2-a. Composite waveform SS2-1 and trace 2 of composite waveform SS2-2 illustrate the development of the 10 MHz pulses derived from the internal reference signal. These pulses are used to drive the sampling phase detector diode gates. Observing the individual waveforms on an oscilloscope should enable the technician to quickly isolate a malfunction in the circuit to an individual stage or to the reference oscillator/switching circuits.

There are no loops or feedback circuits in the pulse generator circuit. It is safe to assume when a correct waveform is observed that all preceding portions of the circuit are operating properly.

SERVICE SHEET 2 (cont'd)

reference source. Also included are switching relays and a buffer amplifier. The buffer amplifier serves to isolate the reference oscillator when its output is used as a reference source for external equipment.

TEST PROCEDURE 1

Test 1-a. Connect the oscilloscope to the Model 8660B rear panel REFERENCE OUTPUT connector. If the internal reference is being used the oscilloscope should display a 10 MHz signal at about 4 volts peak to peak. If an external reference is used the oscilloscope should display the reference frequency at about the same level as the reference signal input.

If the signal is present proceed to test 1-b. If the signal is not present proceed to test 1-c.

Test 1-b. Disconnect the coaxial cable from A4J5 (REF INPUT) and connect the oscilloscope to the end of the cable. If the internal reference is being used the oscilloscope should display a 10 MHz signal at about 5 volts peak to peak. If an external reference is used the oscilloscope should display the input reference signal.

If the signal appeared in test 1-a, but does not appear in test 1-b, the cable between the A4A2 assembly and the reference relay/amplifier is probably defective.

If the correct signal is observed in test 1-b, proceed to TEST PROCEDURE 2.

Test 1-c. If the signal was not present in test 1-a, tilt the A4 assembly out of the frame, disconnect the coaxial cable from the reference oscillator assembly and connect the reference oscillator output to the oscilloscope. The oscilloscope should display a 10 MHz signal at about 7 volts peak to peak.

If the signal is not present, check for dc levels as follows: terminal 1, +20 volts, terminal 2, +35 volts (oven voltage) and terminal 6, +5.2 volts (when present indicates thermostat is open, temperature stabilized). If the voltages are correct the reference oscillator assembly (A21) is defective.

NOTE

The reference oscillator assembly is not considered a field repairable unit. Replacement is recommended.

If the signal is present at the reference oscillator output check the SELECTOR switch, the relay assembly (A22A1) and the reference amplifier (A22A2).

SERVICE SHEET 2 (cont'd)

3 SAMPLER

Sampler diodes CR4 and CR5 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C18 and C19 to forward bias CR4 and CR5. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at the junction of R32, R33, R34, and C20.

To be supplied

To be supplied

While CR4 and CR5 are forward biased the sampling gate is open and the 20 MHz signal from the A4A3 assembly is sampled. If the 20 MHz input from the A4A3 assembly is not phase locked to the pulses derived from the reference signal an ac signal will appear on the base of Q7. The polarity of the signal at any given time depends on the polarity of the 20 MHz signal from the A4A3 assembly when the last sample was taken. The amplitude of the ac signal at any given time depends on what portion of the 20 MHz sine wave the last sample was taken from.

Each time CR4 and CR5 are forward biased the charge on C20 will change unless the phase relationship is the same as it was in the previous sample. The time constant of C20 and R34 is long and since the time between samples is never more than one microsecond, C20 cannot discharge appreciably between sampling pulses.

The reverse bias levels for CR4 and CR5 are maintained at the same levels (opposite polarities) by voltage divider networks.

SERVICE SHEET 2 (cont'd)

TEST PROCEDURE 3

Test 3-a. An oscilloscope loads the sampling circuit at TP3 and TP4 to a point where accurate analysis of the signal is not possible. However, observing the waveforms and comparing them to the typical waveforms shown in composite waveform SS2-2 will provide an adequate indication that the circuit is, or is not, functioning properly. The important points to observe are the two-to-one frequency ratio between the 20 MHz signal and the pulses, and the time coincidence of the positive-going and negative-going pulses at TP3 and TP4 with the pulses at TP1.

4 ERROR SIGNAL AMPLIFIER

When a phase difference between the reference signal and the 20 MHz input exists, a signal appears on C20. This signal is amplified and used to correct the frequency of the voltage controlled oscillator in the A4A4 assembly.

Q7 and Q9 provide a high impedance input for the sampler output. Q8 and Q10 comprise a differential amplifier. Emitter-follower Q11 provides the output to the A4A4 assembly.

TEST PROCEDURE 4

Test 4-a. Connect an oscilloscope to the A4A2 output laveled VCO. With the input 10 MHz reference disconnected from A4J5, (REF INPUT) connect a test oscillator (output 0 dBm, 3 kHz) to A4A2TP2. (The exact frequency is unimportant - 3 kHz was chosen arbitrarily.)

Vary the output level of the test oscillator and note that the A4A2 output level displayed on the oscilloscope varies.

NOTE

> If the A4A2 output does not vary when the test oscillator output is varied, use the oscilloscope to check back through the stages for a point in the circuit where the level does change with a change in the output level of the test oscillator. The following stage is probably defective.

5 REFERENCE DIVIDE-BY-FIVE AND DIVIDE-BY-TWO ASSEMBLY A4A1

The A4A1 assembly divides the 10 MHz input from the A4A3 assembly four times; two times by five and two times by two. The assembly provides a 2 MHz clock signal to the digital control unit, 100 kHz signals to the N2 and N3 loops and 400 kHz to the N1 loop.

Reference Loop
SERVICE SHEET 1

SERVICE SHEET 2 (cont'd)

Q3 and CR1 reduce the +20 volt input to +5 volts for operation of all circuits in the assembly. This method of providing power is used to minimize the effect of ac ripple on the power supply.

Q1 isolates the circuit from the 10 MHz source. Q2 amplifies the 10 MHz input and NAND gate U1A shapes it into pulses to drive U2. U2 provides a divided-by-five 2 MHz output at pin 8 which is used as a clock signal in the digital control unit. The 2 MHz output is also available at pin 11 of U2 and is used to drive U3.

U3 divides the 2 MHz input from pin 11 of U2 by five and provides outputs of 400 kHz at pins 8 and 11. The 400 kHz output at U3 pin 8 is used as the phase detector reference in the N1 loop. The 400 kHz at pin 11 of U3 is coupled to U3 pin 14 and divided by two. The 200 kHz output of U3 at pin 12 is coupled back to U2 pin 14 through NAND gate U1C and again divided by two. The 100 kHz output from U2 pin 12 is coupled through NAND gate U1B to the phase detector in the N3 loop. The 100 kHz signal is also coupled through NAND gate U1D to the phase detector in the N2 loop.

TEST PROCEDURE 5

Composite waveform SS2-3 illustrates the development of pulses from the 10 MHz reference input and the 2 MHz clock output to the digital control unit.

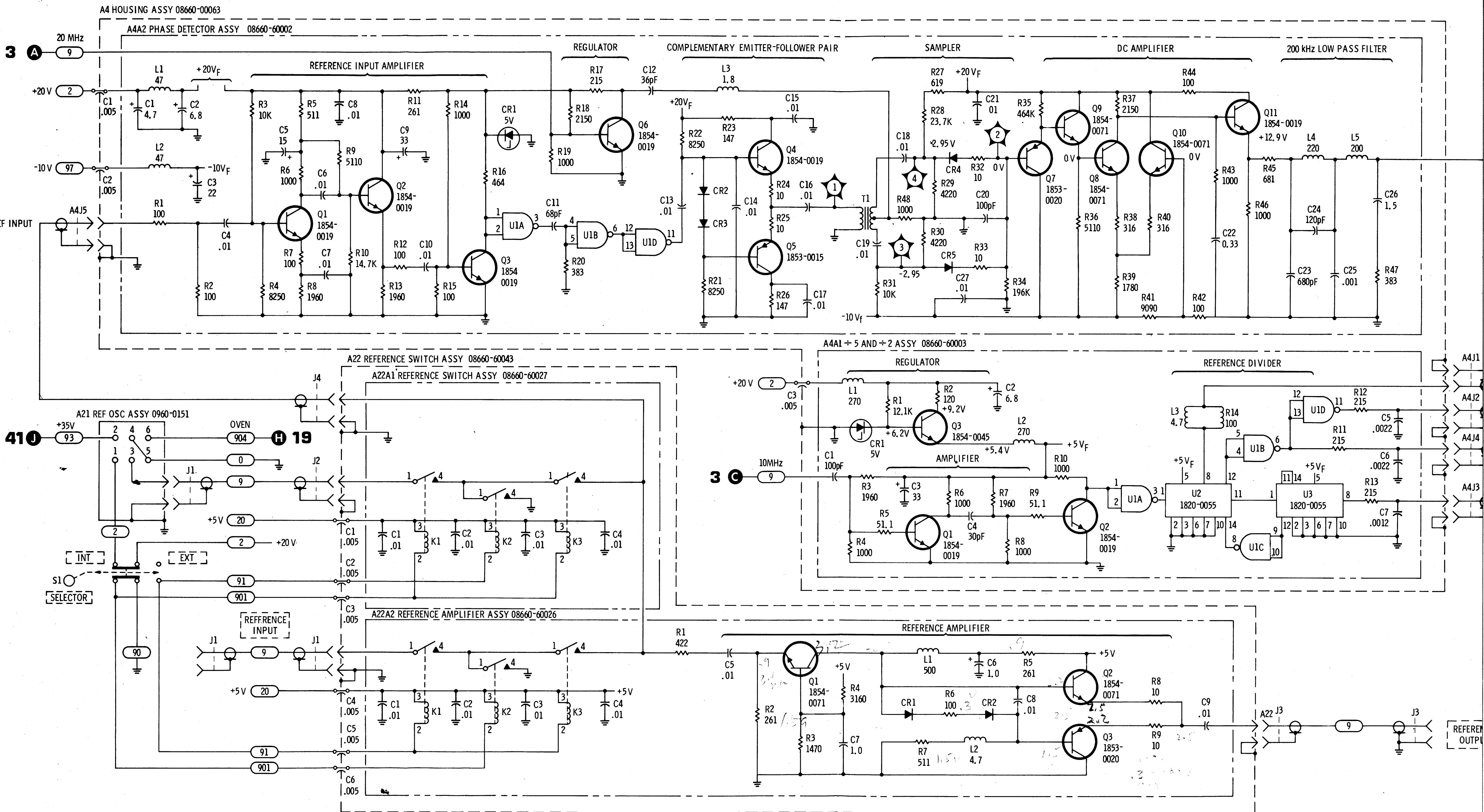
Composite waveform SS2-4 illustrates the development of the 400 kHz and 100 kHz N loop reference signals from the 2 MHz clock signals.

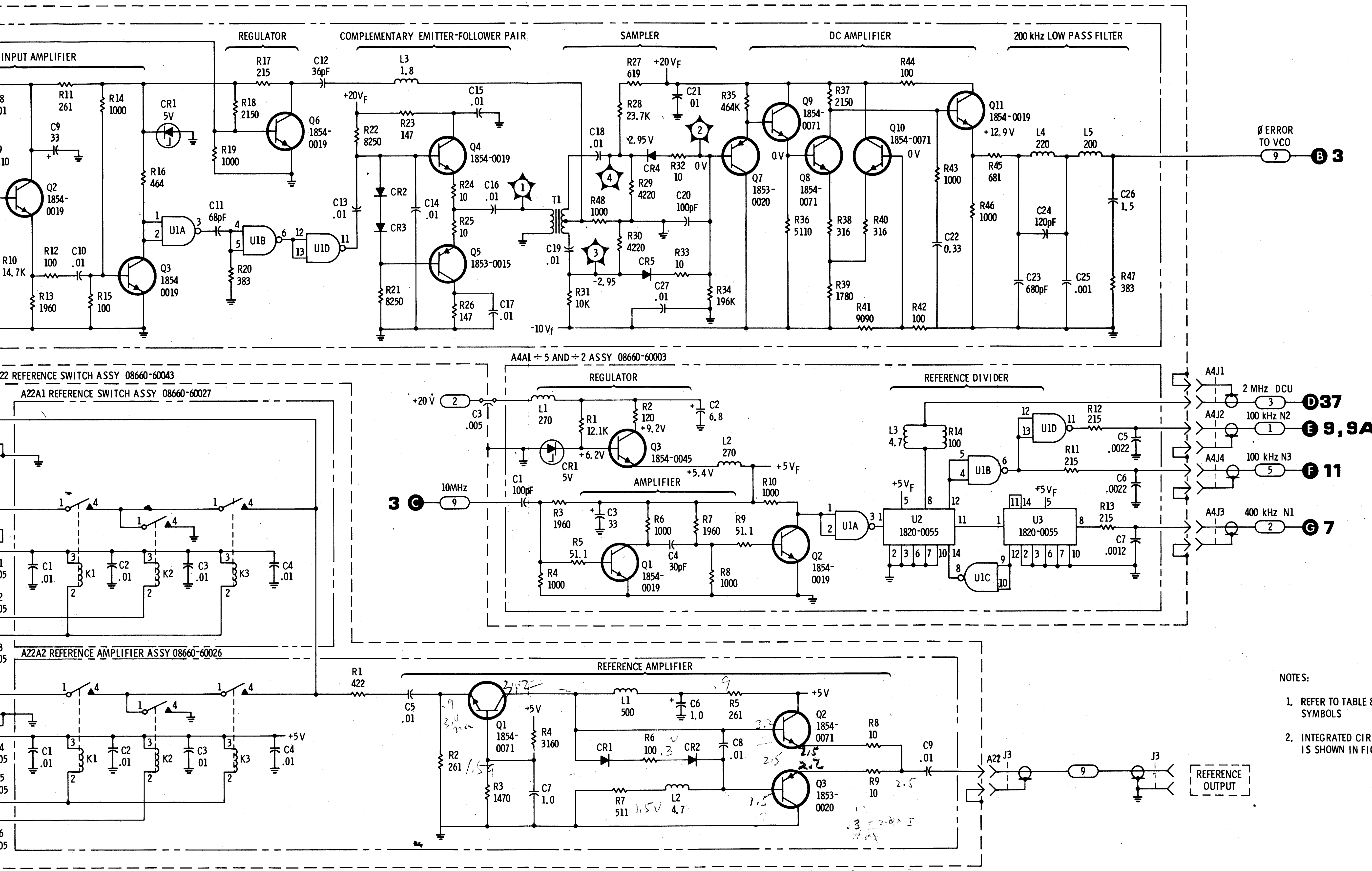
To be supplied

To be supplied

There are no loops or feed back paths in the circuit. It is safe to assume that when the proper waveform is observed at any point that preceding stages are functioning properly.

Observing the waveforms at the test points specified should enable the technician to quickly isolate the cause of a malfunction to a specific stage or component.


A4 HOUSING ASSY 08660-00063
A4A2 PHASE DETECTOR ASSY 08660-60002
20 MHz
REFERENCE INPUT AMPLIFIER
REGULATOR
COMPLEMENTARY EMITTER-FOLLOWER PAIR
SAMPLER
DC AMPLIFIER
200 kHz LOW PASS FILTER
A4A1 ÷ 5 AND ÷ 2 ASSY 08660-60003
REGULATOR
AMPLIFIER
REFERENCE DIVIDER
10MHz
A22 REFERENCE SWITCH ASSY 08660-60043
A22A1 REFERENCE SWITCH ASSY 08660-60027
A21 REF OSC ASSY 0960-0151
OVEN
INT
EXT
S1
SELECTOR
REFFRENCE INPUT
A22A2 REFERENCE AMPLIFIER ASSY 08660-60026
REFERENCE AMPLIFIER
A4J1
A4J2
A4J4
A4J3
A4J5
J1
J2
J3
J4
A22 J3



REFERENCE DESIGNATIONS	
A4	A21
C1-3 J1-5	A22 C1-6 J1-4
A4A1	A22A1
C1-7 CR1 L1, 2 Q1-3 R1-13 U1-3	C1-4 K1-3
A4A2	A22A2
C1-27 CR1-5 L1-5 Q1-11 R1-48 T1 U1	C1-9 CR1, 2 K1-3 L1, 2 Q1-3 R1-9
	CHASSIS
	J1, 3 S1

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUITS INTERNAL LOGIC IS SHOWN IN FIGURE 8-7

2

Figure 8-8. Reference Circuit Schematics

SERVICE SHEET 3

P/O REFERENCE LOOP CIRCUITS

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When repairing the reference loop only one of the four covers should be removed at any given time. Operation of the instrument with the voltage controlled oscillator cover removed may cause faulty or erratic performance after required repairs have been completed.

NOTE

> After making repairs in any part of the reference loop circuits the adjustment procedures specified in Section V paragraph 5-14 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Oscilloscope
Electronic Counter
10:1 probes (2)

REFERENCE LOOP GENERAL

The reference loop consists of four circuit boards located in the A4 assembly. Service Sheet 2 provides information about circuit operation and test procedures for the reference oscillator, reference amplifier and relays, the phase detector and the divide-by-five and divide-by-two circuits. Schematic diagrams, text and troubleshooting information for the voltage controlled oscillator and divide-by-two circuits appear on this service sheet.

The accuracy and stability of all the signals generated in the Model 8660B mainframe are traceable to the reference loop circuits.

The reference loop provides output frequencies of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz, and 100 kHz. These signals are used in other circuits in the mainframe and in the plug-in sections. All of the reference section outputs are derived from a 100 MHz master oscillator which is phase locked to a stable reference source. The reference signal may be supplied by the internal reference oscillator or by an external reference standard. The reference signal may be 1, 2, 2.5, 5 or 10 MHz at a level of 0.2 to 2 volts rms.

1 OSCILLATOR, POWER SPLITTER, 500 MHz AMP and 100 MHz AMP

Q3 and associated components comprise a 100 MHz voltage controlled oscillator. Varactor CR1 is biased by the output of the A4A2 phase detector to assure that the oscillator is phase locked to the reference signal at 100 MHz.

SERVICE SHEET 3 (cont'd)

The oscillator output is capacitively coupled to the base of Q4 which functions as a power splitter.

Q9 and associated components provide isolation from the +20 volt power supply for the oscillator and power splitter to minimize effects of ac power supply ripple or line variations.

The collector output of Q4 is capacitively coupled to A8, a 100 MHz tuned amplifier which functions as a buffer stage. The times five function is accomplished by Q7 which is tuned to 500 MHz. The 500 MHz output from the Q7 tank circuit is capacitively coupled to Q6, another 500 MHz tuned amplifier which also provides isolation.

The emitter output of Q4 is capacitively coupled to the base of Q5 which functions as a 100 MHz tuned amplifier buffer stage. This output is used in the Frequency Extension Module (accessory number 11661A).

TEST PROCEDURE 1

NOTE

> If the signal frequency is close to that specified in the following tests but is erratic, or not exact, the trouble is probably in the Phase Detector circuit. Refer to Service Sheet 2.

Test 1-a. With the A4A4 assembly cover removed use the counter and oscilloscope (separately) to check the 500 MHz output. The counter should indicate exactly 500 MHz and the oscilloscope should display a sine wave at about 0.2 volt peak to peak.

If the signal is present proceed to test 1-d. If the signal is not present proceed to test 1-b.

Test 1-b. Connect the oscilloscope and the counter (separately) to Q4-c. The counter should indicate exactly 100 MHz and the oscilloscope should display a sine wave at about 0.25 volts.

If the signal is present, but was not present in test 1-a, check Q6, Q7, Q8 and associated components. If the signal is not present, proceed to test 1-c.

Test 1-c. Connect the oscilloscope and the counter (separately) to Q4-b. The counter should indicate exactly 100 MHz and the scope should display a sine wave at about 0.4 volts.

SERVICE SHEET 3 (cont'd)

If the signal is present, but was not present in previous tests, Q4 is probably defective. If the signal is not present check Q3, Q9 and associated components.

Test 1-d. Use the oscilloscope and the counter (separately) to check the 100 MHz output. The counter should indicate exactly 100 MHz and the oscilloscope should display a sine wave at about 0.5 volts.

If the signal is not present, but was present in test 1-a, check Q5 and associated components. If the signal is present, proceed to Test Procedure 2.

2 20 MHz OUTPUTS

A third 100 MHz signal is capacitively coupled from the oscillator tank circuit to the base of 100 MHz tuned amplifier Q2. The output of Q2 is used to drive a divide-by-five circuit (U1) which provides the 20 MHz output. The 20 MHz output is used to drive the divide-by-two circuit in the A4A3 assembly. The 20 MHz signal is also coupled to 20 MHz tuned amplifier Q1 for use in circuits external to the reference loop.

TEST PROCEDURE 2

Test 2-a. Connect the oscilloscope to the 20 MHz output from Q1. The display should be similar to that shown in the center trace of composite waveform SS3-1. Proceed to test 2-b.

Test 2-b. Connect the oscilloscope to the 20 MHz output which goes to the A4A3 assembly. The display should be similar to that shown in the lower trace of composite waveform SS3-1.

If the correct signal is present, but was not present in test 2-a, check Q1 and associated components.

If the signal is not present proceed to test 2-c.

Test 2-c. Connect the oscilloscope to Q2-c. The oscilloscope display should be similar to the top trace in composite waveform SS3-1. If the signal is present, but was not present in test 2-b, U1 is probably defective.

If the signal is not present at Q2-c, Q2 is probably defective.

SERVICE SHEET 3 (cont'd)

To be supplied

3 DIVIDE-BY-TWO CIRCUIT A4A3

The A4A3 assembly provides 10 MHz outputs to the HF Loop (A4A7) phase detector, and to the divide-by-five and divide-by-two circuits (A4A1). It also provides a 20 MHz output for use in the reference loop phase detector A4A2.

Q1 and Q2 amplify the 20 MHz signal from the A4A4 assembly and applies it to U1 which divides by two. The +5 volts required for operation of U1 is derived from the +20 volt supply by R4 and CR1 to minimize effects of power supply ac ripple and line variations.

The output from U1 is capacitively coupled out to the HF loops as a reference signal. It is also coupled through Q3 to 10 MHz tuned amplifier Q4. The 10 MHz output from Q4 is used in the divide-by-five and divide-by-two circuits (A4A1).

The 20 MHz output of Q2 is also coupled through tuned amplifier Q5 to the A4A2 phase detector assembly.

TEST PROCEDURE 3

Test 3-a. Connect the oscilloscope to the 10 MHz output to the A4A1 assembly. The oscilloscope display should be about as shown in the bottom trace of composite waveform SS3-2. Verify that the frequency is exactly 10 MHz with the counter.

If the signal is not present proceed to test 3-b. If the signal is present, proceed to test 3-d.

Test 3-b. Connect the oscilloscope to the 10 MHz output which goes to the A4A4 assembly. The oscilloscope display should be about as shown in the next-to-the-bottom trace of composite waveform SS3-2. Verify that the frequency is exactly 10 MHz with the counter.

If the signal is present, but was not present in test 3-a, check Q3, Q5 and associated components. If the signal is not present proceed to test 3-c.

Reference Loop
SERVICE SHEET 2

SERVICE SHEET 3 (cont'd)

To be supplied

Test 3-c. Connect the oscilloscope to U1 pin 12. The oscilloscope display should be similar to the second from the top trace in composite waveform SS3-2.

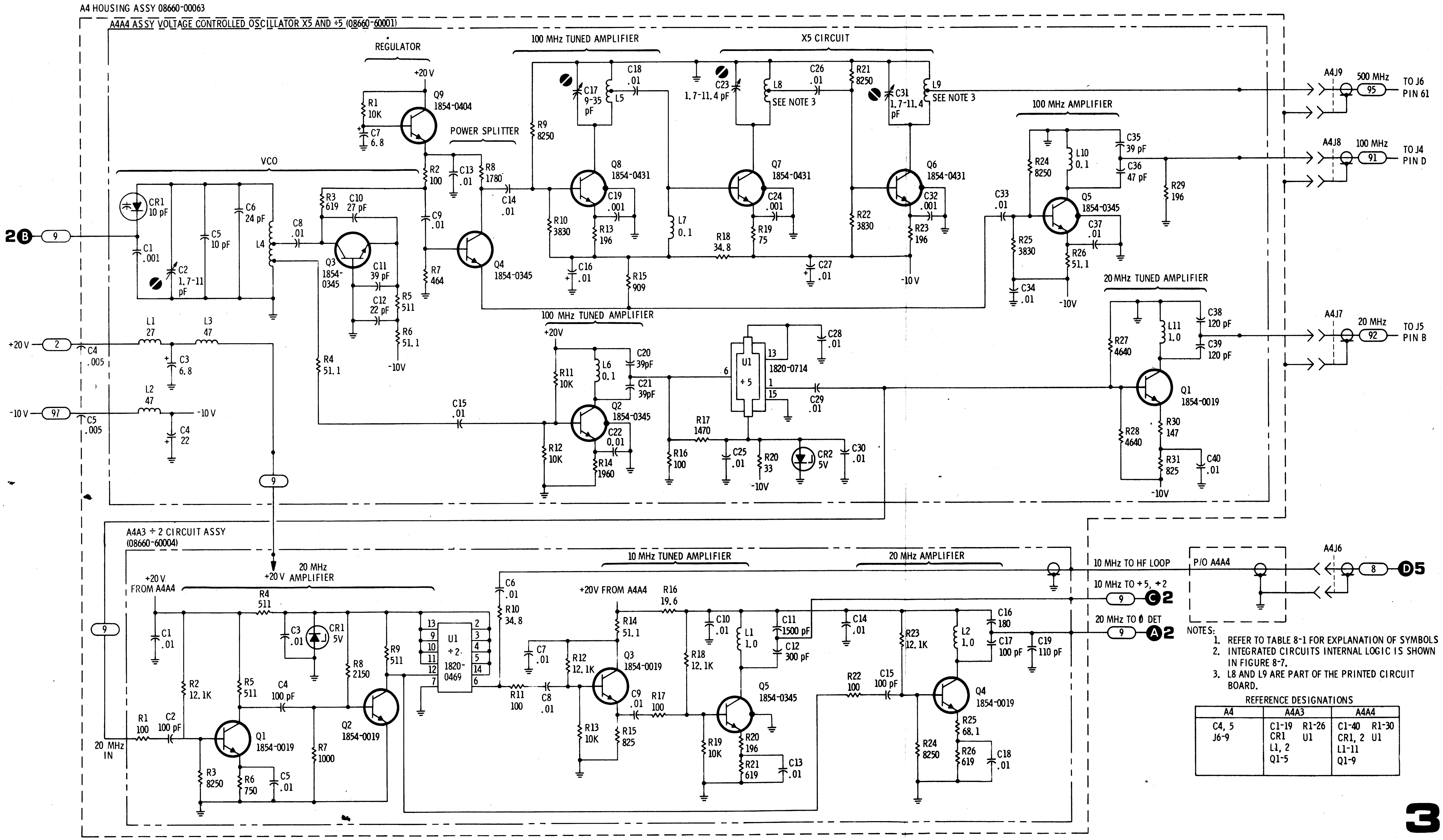
NOTE

> The counter may be used to verify that the frequency is approximately 20 MHz. However, this point in the circuit is critical; the additional load on the circuit will probably disturb the phase lock loop balance.

If the display is correct, but was not correct in previous tests, U1 is probably defective. If the display is not correct, check Q1, Q2 and associated components.

Test 3-d. Connect the oscilloscope and the counter (separately) to the 20 MHz output to the A4A2 assembly. The oscilloscope display should be similar to that shown in the top trace of composite waveform SS3-2. The counter readout should be exactly 20 MHz.

If the correct signal is not present check Q4 and associated components.



NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUITS INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.
3. L8 AND L9 ARE PART OF THE PRINTED CIRCUIT BOARD.

REFERENCE DESIGNATIONS

A4	A4A3	A4A4
C4, 5 J6-9	C1-19 R1-26 CR1 U1 L1, 2 Q1-5	C1-40 R1-30 CR1, 2 U1 L1-11 Q1-9

3

Figure 8-9. Reference VCO and Divider Schematics

SERVICE SHEET 4

PRETUNING ASSEMBLY (A4A6)

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A6 assembly, a part of the three-assembly High Frequency Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A5 and A4A7, are shown schematically and described on Service Sheets 5 and 6.

NOTE

> After making repairs in any parts of the HF Loop circuits the adjustment procedure specified in Section V paragraph 5-15 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Digital Voltmeter

HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the internal extension module and in the plug-in RF Sections to provide the desired output signal.

1 PRETUNING CIRCUIT

Q1 through Q11, U1 and associated components comprise a digital to analog converter which pretunes the A4A5 voltage controlled oscillator. The pretuning circuit cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the loop.

Integrated circuit U1 is a decoder which converts the BCD input from CF digit 8 to individual select lines which turn on one of nine transistors connected in a resistive network. The transistor which is turned on effectively grounds one point in the resistive network. The voltage level output to the voltage controlled oscillator depends on which transistor is turned on. The voltage varies from about —7 volts (350 MHz) to about —34 volts (450 MHz).

A single input line, representative of BCD '1' from CF digit 9 drives Q1 to turn on Q11. Q11, the tenth transistor switch in the pretuning network, grounds the lowest resistance point in the network; it pretunes the voltage controlled oscillator to 350 MHz.

TEST PROCEDURE 1

Test 1-a. With the digital voltmeter connected to the junction of R15, R18 and R19 set the CF as shown in table 8-3. The voltages shown in the table are typical; the actual voltage levels will depend on the characteristics of the varactor used in the voltage controlled oscillator.

If changing the setting of CF digit 8 through its range does not result in a change in the dc level at the junction of R15, R18 and R19, U1 may be defective.

Test 1-b. Use the digital voltmeter to check the A, B, C and D inputs to U1 from CF digit 8. These inputs are binary 1 2 4 8 positive true logic. (Example: with CF digit 8 set to a 3, U1 pins 15 and 14 should be high, about +4 volts, and pins 12

Reference Loop VCO
SERVICE SHEET 3

SERVICE SHEET 4 (cont'd)

and 13 should be low, about 0.3 volt). If the A, B, C and D inputs to U1 are correct, use the digital voltmeter to check the U1 output. (Example: if thumbwheel digit 8 is set to a 3, Inputs A and B will be high and U1 pin 4 will go low.)

Operation of transistors Q2 through Q11 may be checked by checking the dc level at their collectors which are connected to the transistor shell. The numbers plated on the circuit board next to the potentiometers correspond to CF digits 8 and 9. CF digit 8 controls Q2 through Q10 and CF digit 9 drives Q1 to control Q11. The metallic shell (collector) of the transistor selected goes low (0.1 volt or less).

2 SUMMING CIRCUIT

Common base current source Q13 sums the output of the digital to analog converter, current from a +20 volt source (R13) and the error signal from the A4A7 sampling phase detector. The output of the digital to analog converter is partially controlled by common base current source Q14. Conduction of Q14 is controlled by a temperature sensitive stabistor diode on the voltage controlled oscillator circuit board. The current from Q14 is injected into the pretuning network to provide correct compensation for the voltage controlled oscillator drift characteristics. Q12 provides a means of coupling the error signal from the phase detector through C7 to the voltage controlled oscillator in the A4A5 assembly.

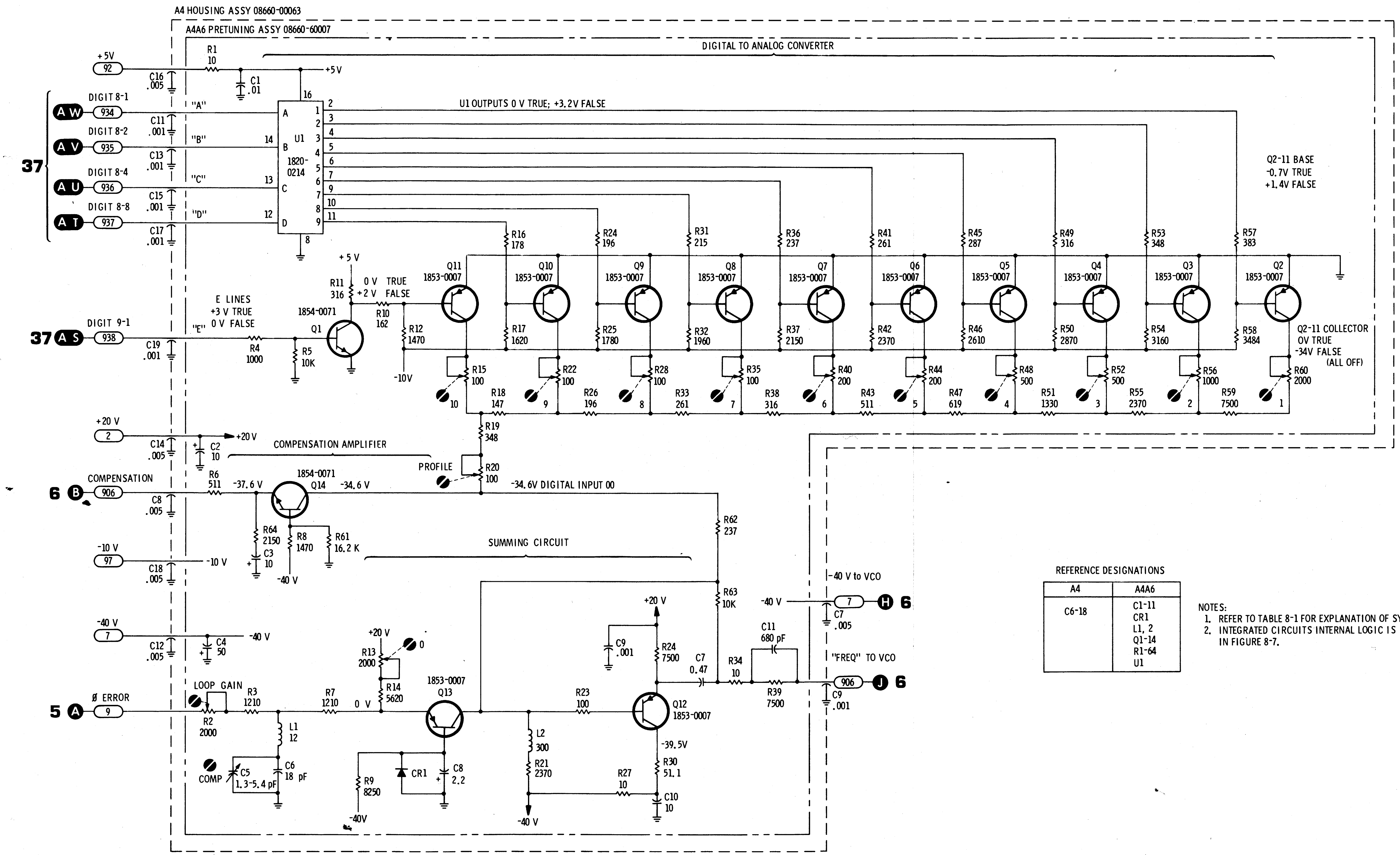
TEST PROCEDURE 2

Test 2-a. Connect the digital voltmeter to the A4A6 output labeled FREQ on the circuit board. Set the CF digits as shown in Table 8-3. The voltages shown are typical; actual voltage levels depend on the characteristics of the varactor in the voltage controlled oscillator.

If the voltages were correct in test 1-a, but are not in test 2-a, check Q12, Q13 and associated components.

Table 8-4. Pretuning DC Levels

Center Frequency	Test 1-a DC Level	Test 2-a DC Level
0000.010000 MHz	—34.7 volts	—34.5 volts
0010.010000 MHz	—28.3 volts	—29.3 volts
0020.010000 MHz	—23.1 volts	—25.0 volts
0030.010000 MHz	—18.7 volts	—21.4 volts
0040.010000 MHz	—14.9 volts	—18.4 volts
0050.010000 MHz	—11.6 volts	—15.7 volts
0060.010000 MHz	—8.9 volts	—13.5 volts
0070.010000 MHz	—6.5 volts	—11.6 volts
0080.010000 MHz	—4.5 volts	—9.9 volts
0090.010000 MHz	—2.6 volts	—8.4 volts
0100.010000 MHz	—1.1 volts	—7.2 volts



REFERENCE DESIGNATIONS

A4	A4A6
C6-18	C1-11 CR1 L1, 2 Q1-14 R1-64 U1

NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUITS INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.

4

Figure 8-10. HF Loop Pretuning Circuit Schematic

SERVICE SHEET 5

SAMPLING PHASE DETECTOR (A4A7)

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A7 assembly, a part of the three-assembly High Frequency Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A5 and A4A6, are shown schematically and described on Service Sheets 4 and 6.

NOTE

After making repairs in any part of the HF Loop circuits the adjustment procedure specified in Section V paragraph 5-15 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Test Oscillator
Digital Voltmeter

HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the internal extension module and in the plug-in RF Sections to provide the desired output signal.

The sampling phase detector compares the voltage controlled oscillator output to a 10 MHz signal from the reference section. The output of the phase detector circuit is a beat note or a varying dc level. The phase detector assembly contains a pulse generator, a sampler, and a signal processing circuit.

1 PULSE GENERATOR

Q1 and Q2 comprise a non-saturating, limiting amplifier. It provides a constant amplitude square wave (about 6 volts) derived from the 10 MHz reference signal. The circuit is designed to minimize the sensitivity of the output ac swing to power supply ripple.

The output of Q2 is applied to Q3 which converts the signal to a stable current waveform. A two-to-one stepdown transformer (T1) is used in conjunction with Q3 to provide the additional current required to drive the step-recovery diode CR1.

When Q3 conducts heavily CR1 is reverse biased by the signal which appears across the secondary winding of T1. When Q3 is turned off the collapsing

inductive field of the T1 primary winding and the resonant circuit of L5 and C8 cause a flyback action which drives CR1 into conduction.

NOTE

One of the characteristics of a step-recovery diode, also called a charge-storage diode, is that the junction transition capacitance accumulates a charge while the diode is forward biased.

When the pulse which forward biased CR1 has ended, CR1 is again reverse biased; however, current will flow in the reverse direction until the charge stored in CR1 is depleted. When the charge stored in CR1 is depleted current flow stops abruptly; the sharp current transition causes L6 and L7 to develop large narrow voltages spikes of about 6 volts amplitude and one nanosecond in duration. The pulse is positive-going at L7 and negative-going at L6. These pulses are coupled through C10, C11 and balun T2 to forward bias the diodes in the sampler bridge. Balun T2 improves amplitude balance of the pulses.

TEST PROCEDURE 1

Test 1-a. Composite waveform SS5-1 illustrates the correct waveforms for the three stages of the pulse generator.

To be supplied

NOTE

Since an oscilloscope would load the remainder of the pulse generator circuit, and due to the short duration of the gate pulse, waveform analysis is not practicable. If the waveforms are as shown in SS5-1 and the loop does not phase lock, proceed to test procedure 2

2 SAMPLER AND SIGNAL PROCESSOR

The sampler is a matched quad diode gate which is normally reverse biased. When the step-recovery diode generates the gate pulse all four of the sampler gate diodes are simultaneously forward biased. When the sampler gate diodes are forward

SERVICE SHEET 5 (cont'd)

inductive field of the T1 primary winding and the resonant circuit of L5 and C8 cause a flyback action which drives CR1 into conduction.

NOTE

One of the characteristics of a step-recovery diode, also called a charge-storage diode, is that the junction transition capacitance accumulates a charge while the diode is forward biased.

When the pulse which forward biased CR1 has ended, CR1 is again reverse biased; however, current will flow in the reverse direction until the charge stored in CR1 is depleted. When the charge stored in CR1 is depleted current flow stops abruptly; the sharp current transition causes L6 and L7 to develop large narrow voltages spikes of about 6 volts amplitude and one nanosecond in duration. The pulse is positive-going at L7 and negative-going at L6. These pulses are coupled through C10, C11 and balun T2 to forward bias the diodes in the sampler bridge. Balun T2 improves amplitude balance of the pulses.

TEST PROCEDURE 1

Test 1-a. Composite waveform SS5-1 illustrates the correct waveforms for the three stages of the pulse generator.

To be supplied

NOTE

Since an oscilloscope would load the remainder of the pulse generator circuit, and due to the short duration of the gate pulse, waveform analysis is not practicable. If the waveforms are as shown in SS5-1 and the loop does not phase lock, proceed to test procedure 2

2 SAMPLER AND SIGNAL PROCESSOR

The sampler is a matched quad diode gate which is normally reverse biased. When the step-recovery diode generates the gate pulse all four of the sampler gate diodes are simultaneously forward biased. When the sampler gate diodes are forward

HF Loop Pretuning
SERVICE SHEET 4

SERVICE SHEET 5 (cont'd)

biased a sample of the signal from the A4A5 voltage controlled oscillator is taken and stored in C12.

Q4 and Q5 comprise a differential amplifier. The non-inverting input (G2) is derived from the sampling circuit. The output is applied to emitter-follower Q6 which provides a low impedance phase error output. The output of Q6 is also fed back to the differential amplifier inverting input (G1) to close the loop at unity gain. The holding capacitor, C12 is connected directly between the two inputs to Q4; this bootstraps C12 to extend the sampler's frequency response.

CR8 and CR9 provide reverse bias voltages for the sampling gate diodes. These bias voltages are balanced and centered on the output signal to improve sampler efficiency.

R18 controls the response of the sampler by varying the amount of back-bias for the bridge; it is adjusted for maximum frequency response with minimum peaking.

R22 controls the quiescent output level to the summing circuit in A4A6; it should be adjusted for zero output with the input from the voltage controlled oscillator disconnected.

If the voltage controlled oscillator output is harmonically related to the reference signal the output of the phase detector is proportional to the sine of the difference in phase of the two signals. If the voltage controlled oscillator frequency is not harmonically related to the reference signal, the output of the phase detector is a beat note at the difference frequency.

TEST PROCEDURE 2

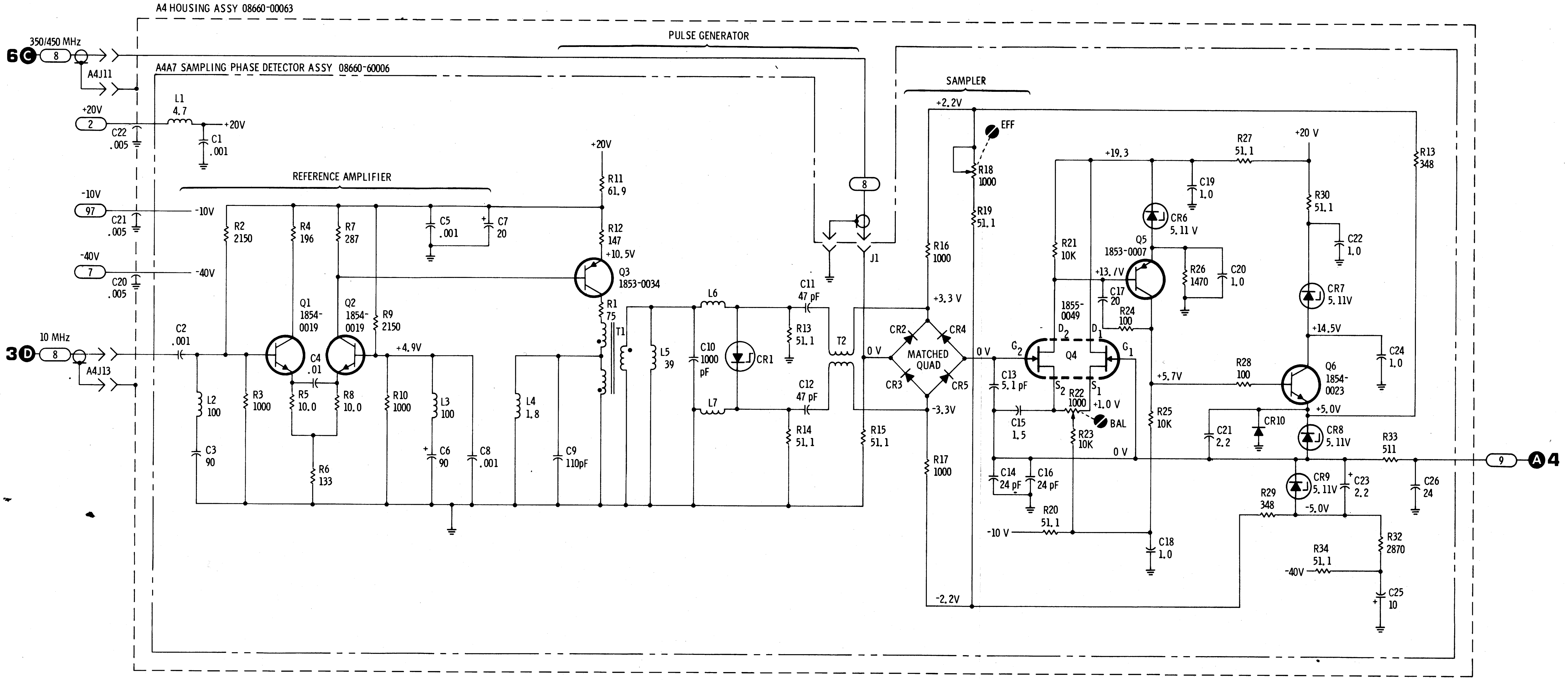
Test 2-a. Disconnect the input to the sampler gate from the A4A5 voltage controlled oscillator and substitute a 1 MHz, 10 dBm signal from the test oscillator. Connect the oscilloscope to the phase error output (labeled ϕ on the circuit board). Varying the output level of the test oscillator should cause the oscilloscope display to follow the amplitude change.

If the oscilloscope display is not as specified proceed to test 2-b.

If the display is correct and the display for test 1-b was correct, check the step-recovery diode and associated components.

Test 2-b. With the oscilloscope connected as it was in test 2-a, inject the 1 MHz signal at Q4-G2. If the signal is now displayed on the oscilloscope and varies as the output of the test oscillator is varied, check the step-recovery diode, the sampler gate diodes and associated components.

If the signal is not displayed check Q4, Q5, Q6 and associated components.



REFERENCE DESIGNATIONS

A4	A4A7
C19 - 21 J11, 13	C1-26 CR1-10 L1-7 Q1-6 R1-34 T1, 2

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS

5

Figure 8-11. Sampling Phase Detector Schematic

HF Loop Phase Detector
SERVICE SHEET 5

SERVICE SHEET 6

VCO AND AMPLIFIERS (A4A5)

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A5 assembly, a part of the three-assembly HF Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A6 and A4A7, are shown schematically and described on Service Sheets 4 and 5.

NOTE

After making repairs to any part of the HF Loop circuits the adjustment procedures specified in Section V paragraph 5-15 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Spectrum Analyzer
Electronic Counter

1 HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF Loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the Frequency Extension Module and in the plug-in RF Section to provide the desired output signal.

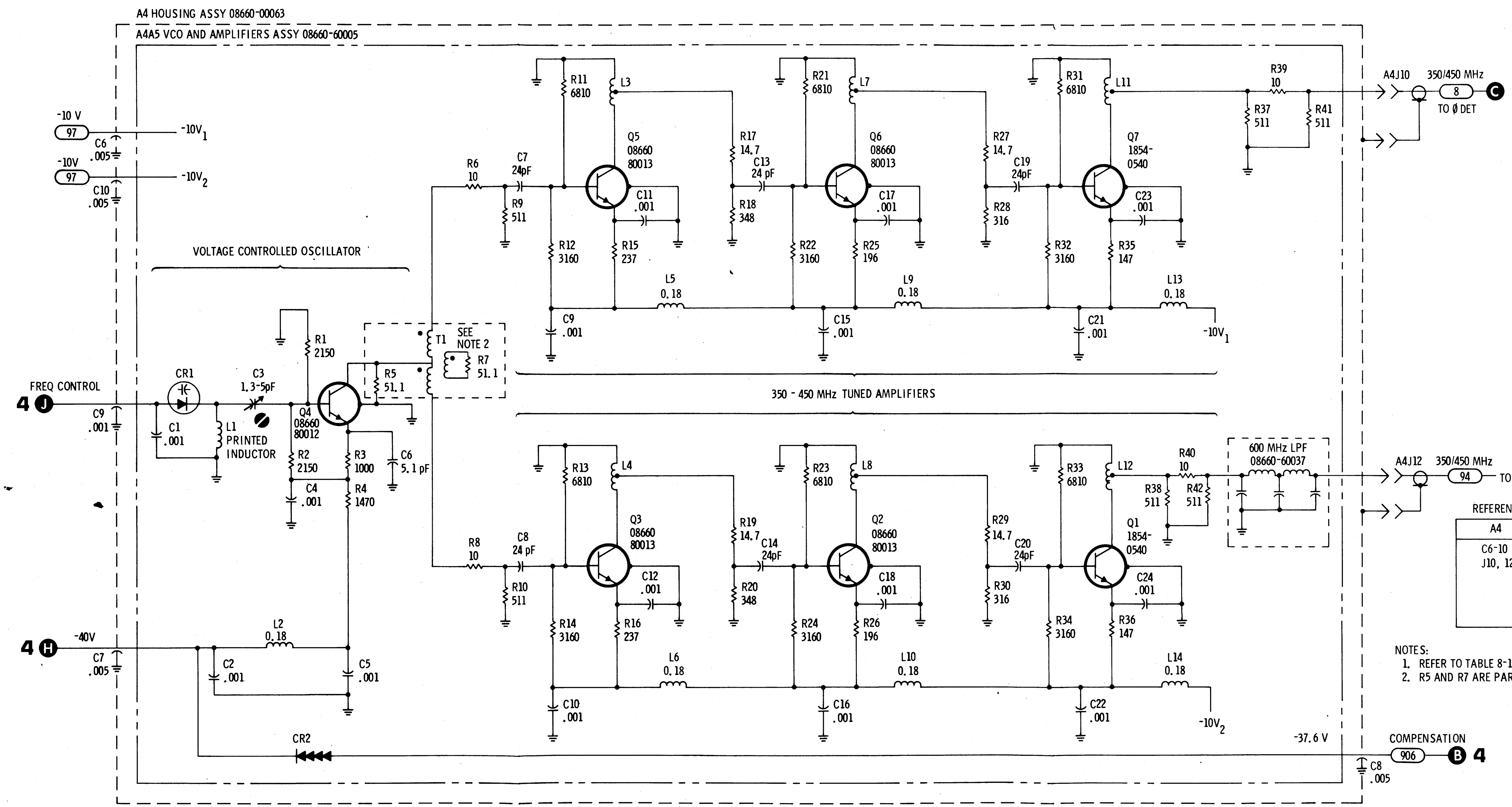
VCO AND AMPLIFIERS

Transistor A4 and associated components comprise a voltage controlled oscillator. The output frequency, when the loop is phase locked, is always a 10 MHz harmonic between 350 and 450 MHz. C3 is adjusted to set the high frequency end of the band. C1 is part of the loop filter in the control path and also provides an ac ground for the varactor at the bias point.

The oscillator output (about .5 volts rms) is coupled through an isolation transformer to two identical three-stage buffer amplifiers. The isolation transformer splits the power equally to the two amplifiers and also eliminates feedthrough of extraneous signals from one amplifier to the other. The amplifiers provide outputs that are about 1 volt rms into 50 ohms.

Additional isolation from extraneous signals is provided by separate power supply inputs to the two amplifiers, extensive decoupling between stages, multiple grounding points for individual stages and separation of ground planes for individual stages.

CR2 is a stabistor used for temperature compensation for the voltage controlled oscillator. The forward voltage drop of the stabistor changes with the voltage controlled oscillator temperature and controls a current source (A4A6Q14) in the pretuning assembly.



REFERENCE DESIGNATIONS

A4	A4A5
C6-10 J10, 12	C1-24 CR1 L1-14 Q1-7 R1-42 T1

NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. R5 AND R7 ARE PART OF THE T1 ASSEMBLY.

6

Figure 8-12. VCO and Amplifiers Schematic

SERVICE SHEET 7

N1 PHASE DETECTOR ASSEMBLY A16

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A16 assembly, a part of the two-assembly N1 phase lock loop is shown schematically and described on this service sheet. The N1 Oscillator assembly, A17, is shown schematically and described on Service Sheet 8.

When trouble has been isolated to the A16 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs in any part of the N1 loop circuits the adjustment procedures specified in Section V paragraph 5-16 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N1 LOOP GENERAL INFORMATION

The purpose of the N1 loop is to generate digitally contolled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N1 loop is applied to Summing Loop 1.

1 PROGRAMMABLE DIVIDER CIRCUIT

The integrated circuits in the A16 assembly, except for U1, are all used to count down the input from the N1 voltage controlled oscillator. When there is no BCD input (all inputs low) and the loop is locked, the input from the voltage controlled oscillator will be 29.7 MHz; the programmable divider will divide by 297 and provide a 100 kHz output at TP3. U5 and U6 are preset by CF digits 6 and 7 and programmed to vary between start counts of 00 to 99. Operation of the circuit is as follows:

Assume that initially there are no BCD input to decade dividers U5 and U6 and they have been preset to zero. Assume also that U2A pin 6 ($\overline{Q}$) and U2B pin 8 ($\overline{Q}$) are both low. U4 pin 6 ($\overline{Q}$), U3A pin 6 ($\overline{Q}$) and U3B pin 8 ($\overline{Q}$) are all high.

AND gate U7A functions as a Schmitt trigger to change the incoming positive half cycles of the sine wave from the voltage controlled oscillator to positive-going pulses. These pulses clock U5 when AND gate U7B is enabled. U5 pin 12 provides a divided-by-ten output to clock U6 and also provides A and B (BCD 1 and 2) outputs. The A and B outputs of U5 have no effect on U4 until AND gate U7C pin 8 goes high (AND gate U7C will be discussed later in this text).

U6 pin 12 provides a divided-by-one hundred output to clock U2A and also provides A and D (BCD 1 and 8) outputs to AND gate U7C. The A and D outputs have no effect on AND gate U7C until after U2B pin 8 ($\overline{Q}$) goes high at the count of 200.

The D output of U6 (pin 12) goes high on the count of 8 (80 input pulses to U5). This output has no effect on U2A because U2A is clocked on negative-going pulses only.

The D output of U6 (pin 12) goes low at the count of 10 (100 input pulses to U5) and clocks U2A. This causes U2A pin 6 ($\overline{Q}$) to go high. When the D output of U6 (pin 12) again goes low at the count of 10 (200 input pulses to U5), U2A is again clocked and the Q output goes low to clock U2B. When U2B pin 8 ($\overline{Q}$) goes high, it provides a high input to AND gate U7C pin 11.

Ninety input cycles after U2B pin 8 ($\overline{Q}$) goes high (290 input cycles), U6 A and D outputs (BCD 1 and 8) go high and enable AND gate U7C and provide a high to J input 3 of U4, U4 still cannot be clocked because U4 J pins 4 and 5 are still low.

Three input cycles after U4 pin 3 goes high (293 input cycles), the A and B outputs of U5 (BCD 1 and 2) go high and enable the J input to J-K flip-flop U4.

The 294th input cycle will clock U4 at pin 12 because all J and K inputs are high. When clocked, U4 $\overline{Q}$ goes low and AND gate U7B is no longer enabled; the count, as far as U5, U6 and U2 are concerned, is ended. When U4 $\overline{Q}$ goes low it also sets U3A and U3B; the $\overline{Q}$ outputs go low and the Q outputs go high. When U3A pin 6 ($\overline{Q}$) goes low it is used to preset U5 and U6 to the start count programmed by CF digits 6 and 7 or by remote control; U2A and U2B $\overline{Q}$ outputs are set low. When U5, U6, U2A and U2B are preset the J input to U4 is no longer enabled since the count is no longer at the 'sense' count of 293.

When U3B pin 9 (Q) goes high the leading edge is used to generate the sampling pulse. The first pulse to the sampling phase detector is initiated by the 294th input cycle. Since three more cycles are required to restart the count cycle, following sampler pulses are 297 cycles apart.

The 295th input cycle will clock U4 and since U4 K is high, U4 $\overline{Q}$ will go high. This $\overline{Q}$ high is applied to the K input of U3A (pin 2) and to pin 4 of AND gate U7B. AND gate U7B will not be enabled because U3B pin 8 ($\overline{Q}$) is holding AND gate U7B pin 5 low.

The 296th input cycle will clock U3A because the K input is now high. U3A pin 6 ($\overline{Q}$) will go high. This high $\overline{Q}$ output is applied to AND gate U7B pin 5 and the next count cycle is enabled through AND gate U7B.

When there is a preset input programmed into U5 and U6 pins 3, 4, 10 and 11 the terminal count is still 297. However, the count starts at the number programmed into the BCD inputs. As an example, if the BCD input into U5 and U6 is 99, the first cycle would cause the same digital circuit changes that the 100th cycle caused in the discussion above (U2A would be clocked). The frequency division would be 297 - 99, equal to division by 198. The phase lock loop operation would result in an input frequency to the programmable divider of 19.8 MHz. When divided by 198, the divider output at TP3 would again be 100 kHz.

The output from U3B at TP3 is always 100 kHz when the voltage controlled oscillator is phase locked to the reference signal.

Q6 and CR1 provide Vcc to U3 to minimize the effect of power supply ac ripple and line variations.

TEST PROCEDURE 1

Composite waveform SS7-1 illustrates the proper timing relationship between the 400 kHz reference input, the pulse output from the

pulse generator and the sampling point on the 400 kHz reference signal when the loop is phase locked.

To be supplied

NOTE

In the following tests the CF is set to 0 unless otherwise noted.

Test 1-a. Use the electronic counter to check for 400.000 kHz at TP5.

If the 400.000 kHz signal is displayed on the counter, verify that the sine wave at TP5 is as shown in trace 2 of composite waveform SS7-1. If the signal is as shown proceed to test 1-b.

If the 400 kHz signal cannot be counted or does not appear as shown on the composite waveform for TP5, check the reference input at XA16-1-2. The reference input signal should be about 4 volts peak-to-peak and 400 kHz as shown in trace 1 of composite waveform SS7-1. If the correct waveform is observed, but was not observed at TP5, check Q1, Q2 and associated components. If the correct waveform is not present, check the cabling to the reference loop and, if necessary, the reference loop (See Service Sheet 3).

If trouble is found and corrected, perform the adjustment procedures specified in paragraph 5-16 to verify proper operation of the loop.

Test 1-b. Connect one oscilloscope channel and the counter to TP4 and the other oscilloscope channel to the junction of C20, R24 and T1. If the loop is locked the waveforms will be as shown in traces 3 and 4 of composite waveform SS7-1 and the counter will display 100.000 kHz.

Note that the waveform shown by trace 3 of the composite waveform may appear as shown even if the counter does not indicate 100.000 kHz. This is because the frequency sensitivity of the oscilloscope is not as exact as the frequency sensitivity of the counter.

If the programmable divider and the pulse shaper are working properly but the loop is not locked, trace 4 as shown in composite pulse generator and the sampling point on the 400 kHz reference signal when the loop is phase locked.

To be supplied

NOTE

In the following tests the CF is set to 0 unless otherwise noted.

Test 1-a. Use the electronic counter to check for 400.000 kHz at TP5.

If the 400.000 kHz signal is displayed on the counter, verify that the sine wave at TP5 is as shown in trace 2 of composite waveform SS7-1. If the signal is as shown proceed to test 1-b.

If the 400 kHz signal cannot be counted or does not appear as shown on the composite waveform for TP5, check the reference input at XA16-1-2. The reference input signal should be about 4 volts peak-to-peak and 400 kHz as shown in trace 1 of composite waveform SS7-1. If the correct waveform is observed, but was not observed at TP5, check Q1, Q2 and associated components. If the correct waveform is not present, check the cabling to the reference loop and, if necessary, the reference loop (See Service Sheet 3).

If trouble is found and corrected, perform the adjustment procedures specified in paragraph 5-16 to verify proper operation of the loop.

Test 1-b. Connect one oscilloscope channel and the counter to TP4 and the other oscilloscope channel to the junction of C20, R24 and T1. If the loop is locked the waveforms will be as shown in traces 3 and 4 of composite waveform SS7-1 and the counter will display 100.000 kHz.

Note that the waveform shown by trace 3 of the composite waveform may appear as shown even if the counter does not indicate 100.000 kHz. This is because the frequency sensitivity of the oscilloscope is not as exact as the frequency sensitivity of the counter.

If the programmable divider and the pulse shaper are working properly but the loop is not locked, trace 4 as shown in composite

waveform SS7-1 may still show the pulses, but the signal between the pulses will be erratic.

Test 1-c. If the pulses are not present at TP4 or the junction of C20, R24 and T1 and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope should display a waveform similar to that shown in trace 3 of the composite waveform SS7-1 at about half the amplitude.

If the pulses are not present at TP3 proceed to test 1-d.

If the pulses are present at TP3 but were not present at TP4, check Q4, Q5 and associated components. After repairs are made recheck test procedure 1-b.

If the pulses are now present at TP4 and the junction of C20, R24 and T1, but the four-cycle sine wave is not present as shown in trace 4 of composite waveform SS7-1, rotate R38 through its range to see if the proper waveform can be obtained. If the frequency displayed on the counter does change as R38 is rotated but phase lock cannot be achieved, check Q3, the sampling diodes and associated components.

Test 1-d. If the pulse is not present at TP3 in test 1-c connect the oscilloscope to AND gate U7B pin 6. The waveform should be as shown in the top trace of composite waveform SS7-2. If the correct signal is observed proceed to test 1-e.

If the correct signal is not observed connect the oscilloscope to TP1. The waveform should be as shown in the center trace of composite waveform SS7-2. If the signal is present, but was not present at AND gate U7B pin 6, use the digital voltmeter to check the voltage at pins 4 and 5 of AND gate U7B. The digital voltmeter should indicate about 4 volts. If the voltages are present AND gate U7B is defective.

To be supplied

If the voltages are not present at AND gate U7B pins 4 and 5, ground pin 2 of U4. If the signal now appears at AND gate U7B pin 6, U3 and U7B are functioning properly. The trouble is probably in the gating circuit to U4. Proceed to test 1-e.

If the signal is not present at TP1, use the oscilloscope to check the input from the voltage controlled oscillator at XA16-2-15. The signal should be as shown in the lower trace in composite waveform SS7-2.

If the signal is present AND gate U7A is probably defective. If the signal is not present, the A17 assembly or interconnections are defective.

Test 1-e. It is assumed in this test that the signal from the N1 voltage controlled oscillator is present at U5 pin 8. Composite waveform SS7-3 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts.

To be supplied

If none of the waveforms are present, U5 is probably defective.

Note that the reset pulse in trace 5 is in time coincidence with the 'missing' pulse in trace 1 and that the reset pulse resets traces 2 and 4.

Test 1-f. Composite waveform SS7-4 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts in amplitude. Sync the oscilloscope to TP3 for this test.

To be supplied

Note that U4 pin 8 goes high only when all of the J inputs (U4 pins 3, 4 and 5) are high.

If the waveforms for traces 2 and/or 3 are not present, U5 is probably defective.

If the waveforms for traces 1, 4 and 5 are not present, proceed to test 1-g.

Test 1-g. Composite waveform SS7-5 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts in amplitude. Sync the oscilloscope to TP3 for this test.

HF Loop VCO
◀ SERVICE SHEET 6

SERVICE SHEET 7 (cont'd)

To be supplied

If the inputs to AND gate U7C are not as shown, U6 or U2 may be defective.

If the inputs are as shown but there is no output at AND gate U7C pin 8, U7 is defective.

2 SAMPLING PULSE GENERATOR

The positive-going output from U3B pin 9 is used to generate the pulse required to open the sampler gate. Common base amplifier Q5 and emitter follower Q4 amplifies and couples the pulse to T1. CR2 and CR3 are used to minimize flyback action. CR3 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 400 kHz signal from the reference loop is applied to the secondary center tap of T1. L5 and C8 (along with C7 in the reference loop A4A1 assembly) comprise a low pass filter with a cut off frequency of about 500 MHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. L6 and C13 comprise a tuned circuit which bypasses unwanted signals and further filters the sine wave.

Sampler diodes CR4 and CR5 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR4 and CR5. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR4 and CR5 are forward biased the sampling gate is open and the 400 kHz reference signal is sampled.

This type of sampling phase detector may be phase locked at virtually any point on the sine wave curve. Ideally, the zero crossover point of the sine wave should be used to improve the lock and hold-in capability of the loop.

If the divided down output of the voltage controlled oscillator in the A17 assembly (100 kHz pulses) is not phase locked to the 400 kHz reference signal an ac signal is developed at TP6. The polarity of the signal at any given time depends on the polarity of the 400 kHz reference signal at the time the last sample was taken. The amplitude of the signal at any given time depends on what portion of the sine wave the last sample was taken from. Each time CR4 and CR5 are forward biased the signal derived from the 400 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends, CR4 and CR5 are again reverse biased and the sampling gate is closed. Since Q3 is a high impedance device, the charge will remain on C22 until the next sampling pulse. The error signal from Q3 is applied to the summing amplifier in the A17 assembly through operational amplifier U1.

Test point 8 may be grounded to open the phase lock loop. Since the emitter of A17Q4 in the A17 assembly is also almost exactly at dc ground level, grounding this test point will not affect the pretuning circuit. With the loop open both the pretuning and the error signal may be checked.

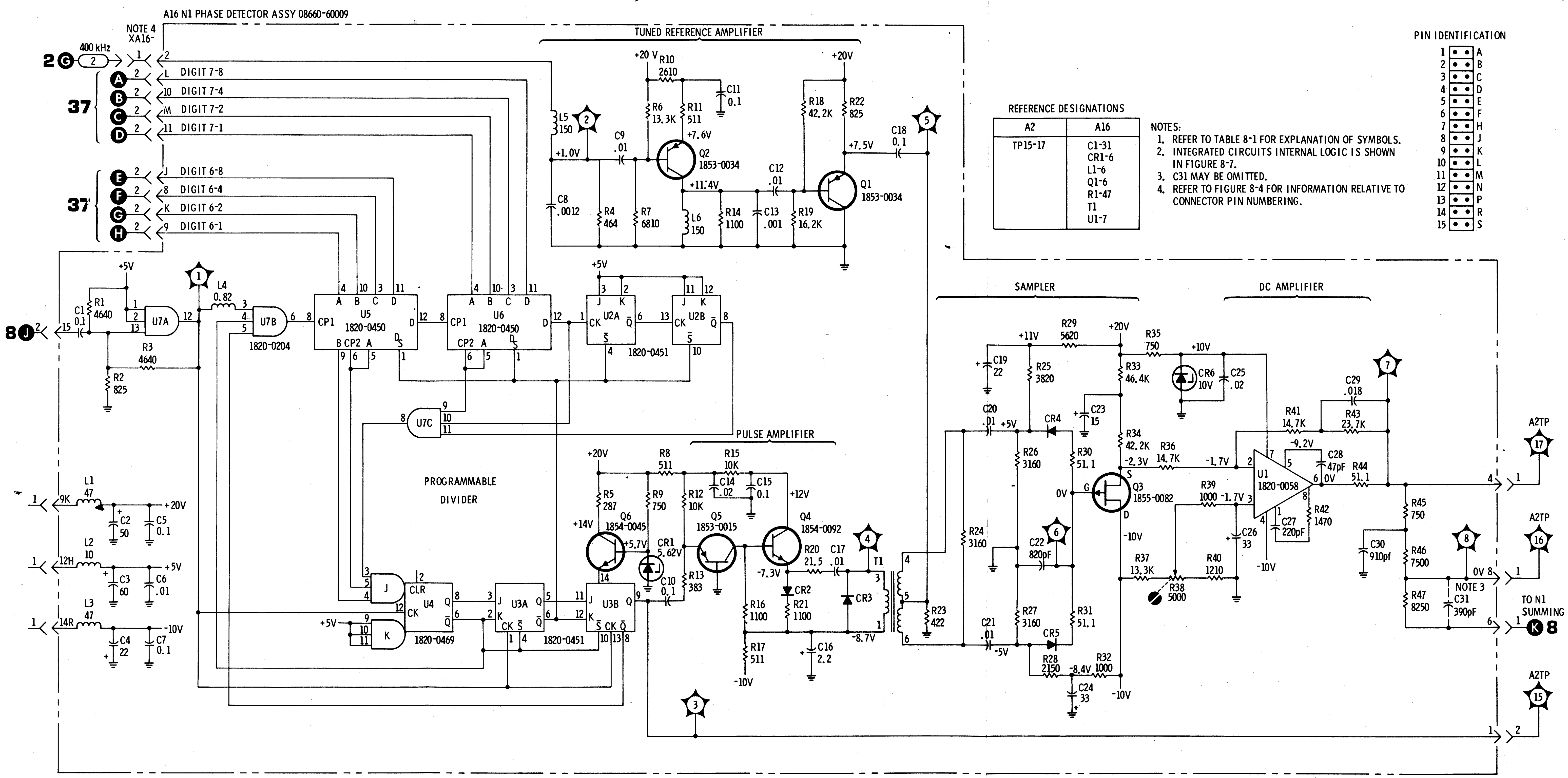


Figure 8-13. N1 Phase Detector Schematic

SERVICE SHEET 8

N1 PRETUNING AND OSCILLATOR ASSEMBLY A17

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A17 assembly, a part of the two-assembly N1 phase lock loop is shown schematically and described on this service sheet. The N1 Phase Detector Assembly, A16, is shown schematically and described on service sheet 7.

When trouble has been isolated to the A17 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs in any part of the N1 loop circuits the adjustment procedures specified in Section V paragraph 5-16 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Digital Voltmeter
Electronic Counter
Oscilloscope (with 10:1 divider probes)

N1 LOOP GENERAL INFORMATION

The purpose of the N1 loop is to generate digitally controlled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N1 loop is applied to Summing Loop 1.

1 VOLTAGE CONTROLLED OSCILLATOR

Q3, Q5 and associated components comprise a voltage controlled oscillator. Two varactors (CR6 and CR7) are used in parallel to provide a high Q as well as the wide capacitance range required.

FET Q5 acts as a source follower in the feedback circuit; it provides high impedance at the gate and a low impedance at the source. The gain of the FET is held at less than unity to minimize the miller effect which might reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the signal from the FET and applies it to two separate amplifiers. Q10 and Q15 provide the output to drive the SL1 mixer and Q8 drives the programmable divider in the A16 assembly.

TEST PROCEDURE 1

Test 1-a. Connect the electronic counter to XA17-1-2 and set CF as shown in table 8-4. The counter readout should be as shown in the table. (Make allowances for counter accuracy).

If the counter does not display a frequency at, or close to, that specified, connect the oscilloscope to TP3. The oscilloscope should display a sine wave at about .3 volts peak-to-peak. If the sine wave is present at TP3 but there is no signal at XA17-1-2, check Q10, Q15 and associated components.

If there is no signal at TP3 check the bias level at TP2. The bias level should be about as shown in Table 8-4 for the front panel frequency setting. If the bias level is within the range of approximately —3.4 to —30 volts, and there is no signal at TP3 check Q1, Q3, Q5 and associated components. If the bias voltage is not within the range shown, proceed to 2-b.

If the counter displays the correct readout for some, but not all, of the front panel settings, proceed to 2-a.

2 PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U1, U2, Q11 through Q14 and Q16 through Q19). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the phase lock loop, The inputs to U1 and U2 are BCD bits coded 8, 4, 2 and 1. When any of the BCD inputs are high they cause the output of the NAND gate to which they are connected to go low; the transistor connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q9 is biased to provide approximately —25 volts at TP1 (Q7-e). With this dc level at TP1 the oscillator is roughly preset to 29.7 MHz.

When any one or more of the BCD inputs go high the transistor associated with it saturates and the current through Q9 is reduced. The reduction in current flow through Q9 changes the bias on Q7 and causes the voltage at TP1 to go less negative (closer to dc ground level). Finally, when the BCD input is 99, the voltage at TP1 is approximately —5.2 volts and the oscillator frequency is roughly preset to 19.8 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the N1 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volts supply through R31, R32 and R33, a negative source from the digital to analog converter (TP1) and the error signal from the N1 phase detector. The voltage at the summing point is always zero volts.

When TP1 is at approximately —25 volts (all inputs low), most of the current from the +20 volts source flows through Q7; very little current flows through Q4. Under these conditions the voltage at Q4-c is about —30 volts. As the voltage at TP1 decreases (gets closer to dc ground level), less current flows through Q7, more current flows through Q4, and the Q4 collector voltage goes less negative.

CR3 through CR5, CR8 through CR15 and associated resistors are use the voltage applied to the voltage controlled oscillator so that the freq be linear with the applied voltage. When all BCD inputs are low, Q4-c i —30 volts, the junction of R43 R48 is about —27.5 volts and all of the the resistive network are reverse biased. As the voltage at TP1 decre closer to —5.2 volts), current through Q4 increases and the Q4 collect goes less negative. As the Q4 collector voltage decreases first CR3, the are forward biased. As the diodes are forward biased resistors are added with R38 and R39 to shape the rate at which the voltage decreases at Q

Q2 and Q5 are emitter followers which couple the output of Q4 to the Q2 provides a high impedance for the output of the summing amplifier R46, L7 and C14 comprise a 400 kHz trap to attenuate (15 to 20 dB kHz ripple which may be present from the reference signal used in detector. R51, L8, C20 and C21 comprise a low pass filter with frequency of about 200 kHz.

TEST PROCEDURE 2

Table 8-4 represents typical voltage levels for test points 1 and 2 frequencies at XA17-1-2 for given settings of CF digits six and seven loop is locked.

NOTE

> While the voltages shown for TP2 are typical (they will var from instrument to instrument due to differences in varacto characteristics), they are representative of normal ratio of TP to TP1 voltages.

Test 2-a. With the digital voltmeter connected to TP1 select CF's show 8-4. The voltage level should approximately follow those shown in Tabl

If the voltage at TP1 does not vary at all, first verify the presence of in information to the NAND gates, then check Q7, Q9 and associated co

If the voltage at TP1 does not vary as shown, or some CF (or CF produce a change, first verify the presence of the input to th gate/transistor combination affected, then check the NAND gate transistor.

If the voltages at TP1 are approximately as shown in Table 8-4 proce 2-b.

Test 2-b. Connect the digital voltmeter to TP2 and the counter to XA the voltage at TP2 does not change about as shown in Table 8-4 fo CF's, or does not change at all, check Q2, Q4, Q6 and associated compo

If the voltage at TP2 varies approximately as shown in Table 8-4 frequency at XA17-1-2 does not step (or there is no rf output), ref Procedure 1 and check the oscillator circuits.

N1 Phase D
SERVICE

CE SHEET 8

ETUNING AND OSCILLATOR ASSEMBLY A17

ly, causes of malfunctions in the Model 8660B will be isolated to a circuit or assembly as a result of performing the tests specified in the shooting trees.

17 assembly, a part of the two-assembly N1 phase lock loop is shown tically and described on this service sheet. The N1 Phase Detector ly, A16, is shown schematically and described on service sheet 7.

rouble has been isolated to the A17 assembly it should be removed and led using two extender boards. This will provide easy access to test points nponents.

NOTE

After making repairs in any part of the N1 loop circuits the adjustment procedures specified in Section V paragraph 5-16 should be performed to ensure proper operation of the instrument.

EQUIPMENT REQUIRED (see Table 1-3)

Voltmeter
nic Counter
cope (with 10:1 divider probes)

OP GENERAL INFORMATION

rpose of the N1 loop is to generate digitally controlled rf signals in the of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage led oscillator is phase locked to a 400 kHz reference which is derived from ster oscillator in the reference section. The rf output from the N1 loop is to Summing Loop 1.

LTAGE CONTROLLED OSCILLATOR

and associated components comprise a voltage controlled oscillator. Two rs (CR6 and CR7) are used in parallel to provide a high Q as well as the pacitance range required.

5 acts as a source follower in the feedback circuit; it provides high nce at the gate and a low impedance at the source. The gain of the FET is less than unity to minimize the miller effect which might reflect ance back into the oscillator tank circuit.

plifies the signal from the FET and applies it to two separate amplifiers. d Q15 provide the output to drive the SL1 mixer and Q8 drives the mable divider in the A16 assembly.

SERVICE SHEET 8 (cont'd)

TEST PROCEDURE 1

Test 1-a. Connect the electronic counter to XA17-1-2 and set CF as shown in table 8-4. The counter readout should be as shown in the table. (Make allowances for counter accuracy).

If the counter does not display a frequency at, or close to, that specified, connect the oscilloscope to TP3. The oscilloscope should display a sine wave at about .3 volts peak-to-peak. If the sine wave is present at TP3 but there is no signal at XA17-1-2, check Q10, Q15 and associated components.

If there is no signal at TP3 check the bias level at TP2. The bias level should be about as shown in Table 8-4 for the front panel frequency setting. If the bias level is within the range of approximately −3.4 to −30 volts, and there is no signal at TP3 check Q1, Q3, Q5 and associated components. If the bias voltage is not within the range shown, proceed to 2-b.

If the counter displays the correct readout for some, but not all, of the front panel settings, proceed to 2-a.

2 PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U1, U2, Q11 through Q14 and Q16 through Q19). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the phase lock loop, The inputs to U1 and U2 are BCD bits coded 8, 4, 2 and 1. When any of the BCD inputs are high they cause the output of the NAND gate to which they are connected to go low; the transistor connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q9 is biased to provide approximately −25 volts at TP1 (Q7-e). With this dc level at TP1 the oscillator is roughly preset to 29.7 MHz.

When any one or more of the BCD inputs go high the transistor associated with it saturates and the current through Q9 is reduced. The reduction in current flow through Q9 changes the bias on Q7 and causes the voltage at TP1 to go less negative (closer to dc ground level). Finally, when the BCD input is 99, the voltage at TP1 is approximately −5.2 volts and the oscillator frequency is roughly preset to 19.8 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the N1 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volts supply through R31, R32 and R33, a negative source from the digital to analog converter (TP1) and the error signal from the N1 phase detector. The voltage at the summing point is always zero volts.

When TP1 is at approximately −25 volts (all inputs low), most of the current from the +20 volts source flows through Q7; very little current flows through Q4. Under these conditions the voltage at Q4-c is about −30 volts. As the voltage at TP1 decreases (gets closer to dc ground level), less current flows through Q7, more current flows through Q4, and the Q4 collector voltage goes less negative.

SERVICE SHEET 8 (cont'd)

CR3 through CR5, CR8 through CR15 and associated resistors are used to shape the voltage applied to the voltage controlled oscillator so that the frequency will be linear with the applied voltage. When all BCD inputs are low, Q4-c is at about −30 volts, the junction of R43 R48 is about −27.5 volts and all of the diodes in the resistive network are reverse biased. As the voltage at TP1 decreases (gets closer to −5.2 volts), current through Q4 increases and the Q4 collector voltage goes less negative. As the Q4 collector voltage decreases first CR3, then CR4 etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R38 and R39 to shape the rate at which the voltage decreases at Q4-c.

Q2 and Q5 are emitter followers which couple the output of Q4 to the varactors. Q2 provides a high impedance for the output of the summing amplifier collector. R46, L7 and C14 comprise a 400 kHz trap to attenuate (15 to 20 dB) any 400 kHz ripple which may be present from the reference signal used in the phase detector. R51, L8, C20 and C21 comprise a low pass filter with a cutoff frequency of about 200 kHz.

TEST PROCEDURE 2

Table 8-4 represents typical voltage levels for test points 1 and 2 and exact frequencies at XA17-1-2 for given settings of CF digits six and seven when the loop is locked.

NOTE

While the voltages shown for TP2 are typical (they will vary from instrument to instrument due to differences in varactor characteristics), they are representative of normal ratio of TP2 to TP1 voltages.

Test 2-a. With the digital voltmeter connected to TP1 select CF's shown in Table 8-4. The voltage level should approximately follow those shown in Table 8-4.

If the voltage at TP1 does not vary at all, first verify the presence of input digital information to the NAND gates, then check Q7, Q9 and associated components.

If the voltage at TP1 does not vary as shown, or some CF (or CF's) do not produce a change, first verify the presence of the input to the NAND gate/transistor combination affected, then check the NAND gate and the transistor.

If the voltages at TP1 are approximately as shown in Table 8-4 proceed to Test 2-b.

Test 2-b. Connect the digital voltmeter to TP2 and the counter to XA17-1-2. If the voltage at TP2 does not change about as shown in Table 8-4 for specified CF's, or does not change at all, check Q2, Q4, Q6 and associated components.

If the voltage at TP2 varies approximately as shown in Table 8-4, but the frequency at XA17-1-2 does not step (or there is no rf output), refer to Test Procedure 1 and check the oscillator circuits.

N1 Phase Detector
◀ SERVICE SHEET 7

SERVICE SHEET 8 (cont'd)

If the voltage at TP2 varies approximately as shown in Table 8-4 and the frequency readout of the counter approximately follows the table (± 20-30 kHz) check Q8 and associated components.

Table 8-5. N1 Oscillator Test Point Measurements

Center Frequency MHz	Frequency At TP3 kHz	Voltage at TP1	Voltage at TP2
0000.100000	29600.000	—25.2v	—29.2v
0000.100000	29600.000	—25.0v	—28.7v
0000.200000	29500.000	—24.8v	—28.2v
0000.300000	29400.000	—24.6v	—27.7v
0000.400000	29300.000	—24.4v	—27.1v
0000.500000	29200.000	—24.2v	—26.6v
0000.600000	29100.000	—24.0v	—26.2v
0000.700000	29000.000	—23.8v	—25.7v
0000.800000	28900.000	—23.6v	—25.2v
0000.900000	28800.000	—23.4v	—24.7v
0001.000000	28700.000	—23.2v	—24.3v
0002.000000	27700.000	—21.2v	—20.2v
0003,000000	26700.000	—19.2v	—16.6v
0004,000000	25700.000	—17.2v	—13.6v
0005.000000	24700.000	—15.2v	—11.9v
0006.000000	23700.000	—13.2v	—8.9v
0007.000000	22700.000	—11.2v	—7.1v
0008.000000	21700.000	—9.2v	—5.6v
0009.000000	20700.000	—7.1v	—4.3v
0009.900000	19800.000	—5.3v	—3.4v

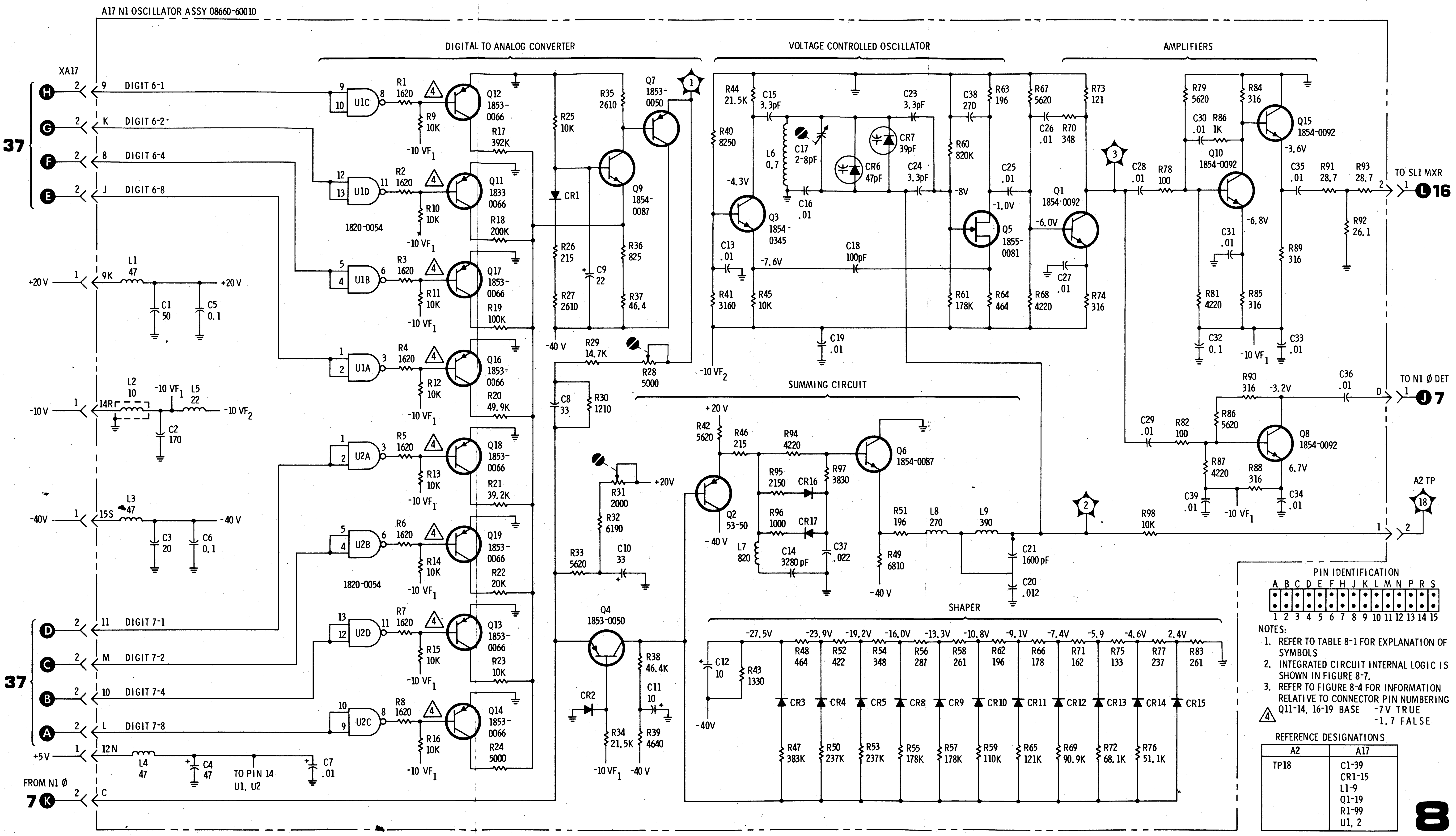


Figure 8-14. N1 VCO Schematic

SERVICE SHEET 9

N2 PHASE DETECTOR ASSEMBLY A14

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A14 assembly, a part of the two-assembly N2 phase lock loop is shown schematically and described on this service sheet. The N2 Oscillator assembly, A13, is shown schematically and described on service sheet 10.

When trouble has been isolated to the A14 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs in any part of the N2 loop circuits the adjustment procedures specified in Section V paragraph 5-17 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N2 LOOP GENERAL INFORMATION

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N2 loop is applied to Summing Loop 2.

1 PROGRAMMABLE DIVIDER CIRCUIT

All of the integrated circuits in the A14 assembly are used to count down the input from the N2 voltage controlled oscillator.

When there is no BCD input to U5, U6 and U7 (all inputs low) the input from the oscillator will be 29.79 MHz; the programmable divider will divide by 2979 to provide a 10 kHz output. U5, U6 and U7 may be preset by CF digits 3, 4 and 5 and programmed to vary between counts of 1980 and 2979. Operation of the circuit is as follows:

Assume that initially there are no BCD inputs to U5, U6 and U7 (divide-by-ten decades) and they have all been preset to zero.

At the start of every count cycle, regardless of the BCD input, U1A pin 6 ($\overline{Q}$) and U1B pin 8 ($\overline{Q}$) are both low; U3 pin 6 ($\overline{Q}$), U4A pin 6 ($\overline{Q}$) and U4B pin 8 ($\overline{Q}$) are all high.

NAND gate U8C functions as a Schmitt trigger and provides pulses derived from the N2 voltage controlled oscillator output to clock U7 when AND gate U2B is enabled. U7 provides a divide-by-ten output to clock U6 and also provides A and C (binary 1 and 4) outputs to J inputs of JK flip-flop U3. The A and C outputs have no effect on U3 until the count down reaches 2975.

U6 provides a divide-by-ten output to clock U5 and also provides A, B and C (binary 1, 2 and 4) outputs to AND gates U2A and U2C. The A, B and C outputs have no effect on the circuit until the count down of 2970 is reached.

U5 provides a divide-by-ten output to clock U1A and also provides A and D outputs to NAND gate U8A. The A and D (binary 1 and 8) outputs have no effect on the circuit until the count down has reached 2900.

The D output of U5 (pin 12) goes low on the 1000th pulse input to U7 pin 8 and clocks U1A. One thousand input cycles later U1A is again clocked and the negative-going $\overline{Q}$ output of U1A (pin 6) clocks U1B. When U1B $\overline{Q}$ goes high it provides a high to AND gate U2A. The count down has reached 2000.

When the count down reaches 2900,U5 A and D outputs are high. NAND gate U8A pin 3 goes low and NAND gate U8B pin 6 goes high.

When the count down reaches 2970, U6 A, B and C outputs are high. The B and C outputs are applied to AND gate U2C pins 10 and 11, and since U2C pin 9 has been high since the count of 2900, U2C pin 8 goes high. The U6A output is applied to AND gate U2A, and since the other two inputs to U2A are high, U2A pin 12 goes high and is applied to U3 J input pin 3.

When the count down reaches 2975, U7 A and C high outputs are applied to U3 J input pins 4 and 5. Since U3 J pin 3 is now held high, the next input pulse from U8C will clock U3. Count coincidence at 2975 cycles has been achieved.

When the count down reaches 2976, U3 is clocked and the U3 $\overline{Q}$ output goes low. When U3 $\overline{Q}$ goes low, AND gate U2B is no longer enabled; the count, as far as U7, U6, U5 and U1 are concerned is ended. When U3 $\overline{Q}$ goes low it also sets U4A and U4B; the $\overline{Q}$ outputs go low and the Q outputs go high. When the $\overline{Q}$ output of U4B goes low it presets U7, U6, U5 and U1. When U7, U6, U5 and U1 are preset the J inputs to U3 are inhibited since the count is no longer at the coincident count of 2975.

When the U4B Q output goes high the leading edge of the pulse is used to generate the sampler pulse. The first pulse to the sampling phase detector is initiated by the 2976th input cycle. Since three more cycles are required to restart the count cycle, following sampler pulses will be 2979 cycles apart.

When the count down reaches 2977, U3 is again clocked and since the K input is high and the J input is low, $\overline{Q}$ will go high. This $\overline{Q}$ high is applied to the K input of U4A and to pin 4 of AND gate U2B. U2B will not be enabled because U4B $\overline{Q}$ is holding AND gate U2B pin 5 low.

When the count down reaches 2978 U4A is clocked because the K input is high. U4A $\overline{Q}$ goes high and is applied to the K input of U4B.

On the 2979th input cycle, U4B is clocked and the $\overline{Q}$ output goes high. When U4B $\overline{Q}$ goes high the preset pulse is ended and AND gate U2B is enabled. The next input cycle will initiate the count cycle.

When there is a preset input programmed into U7, U6 and U5, the terminal count is still 2979. However, the count down starts at the number programmed into the BCD inputs. As an example, if the binary input to U7, U6 and U5 is 999, the first input cycle would cause the same digital circuit changes that the 1000th input cycle caused in the discussion above (U1A would be clocked for the first time). The frequency division would be 2979 minus 999, equal to division by 1980. The phase lock loop operation would result in an input frequency to the programmable divider of 19.80 MHz. When the 19.80 MHz is divided by 1980 the divider output would again be 10 kHz.

The output from U4B is always 10 kHz when the oscillator is phase locked.

SERVICE SHEET 9 (cont'd)

TEST PROCEDURE 1

Composite Waveform SS9-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is phase locked.

NOTE

Center frequency is initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 5 volts p/p at TP5. The display should be similar to that shown in the second trace from the top in composite waveform SS9-1.

If the correct signal is present, proceed to test 1-b.

If the counter readout is 100.000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA14-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS9-1.

If the correct signal is observed but was not observed at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA14-1-2 check interconnections to the reference loop and, if necessary, the reference loop.

To be supplied

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 10.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS9-1 at about 7 volts amplitude.

goes high it provides a high
ached 2000.

A and D outputs are high.
AND gate U8B pin 6 goes

, B and C outputs are high.
gate U2C pins 10 and 11,
he count of 2900, U2C pin
AND gate U2A, and since
2A pin 12 goes high and is

A and C high outputs are
ce U3 J pin 3 is now held
C will clock U3. Count
ed.

is clocked and the U3 $\overline{Q}$
ND gate U2B is no longer
5 and U1 are concerned is
A and U4B; the $\overline{Q}$ outputs
the $\overline{Q}$ output of U4B goes
n U7, U6, U5 and U1 are
e the count is no longer at

eading edge of the pulse is
first pulse to the sampling
n input cycle. Since three
nt cycle, following sampler

is again clocked and since
$\overline{Q}$ will go high. This $\overline{Q}$ high
pin 4 of AND gate U2B.
is holding AND gate U2B

is clocked because the K
ied to the K input of U4B.

ed and the $\overline{Q}$ output goes
lse is ended and AND gate
nitiate the count cycle.

into U7, U6 and U5, the
count down starts at the
ts. As an example, if the
he first input cycle would
t the 1000th input cycle
d be clocked for the first
2979 minus 999, equal to
eration would result in an
ider of 19.80 MHz. When
der output would again be

hen the oscillator is phase

TEST PROCEDURE 1

Composite Waveform SS9-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is phase locked.

NOTE

Center frequency is initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 5 volts p/p at TP5. The display should be similar to that shown in the second trace from the top in composite waveform SS9-1.

If the correct signal is present, proceed to test 1-b.

If the counter readout is 100.000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA14-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS9-1.

If the correct signal is observed but was not observed at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA14-1-2 check interconnections to the reference loop and, if necessary, the reference loop.

To be supplied

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 10.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS9-1 at about 7 volts amplitude.

If the signal is not present proceed to test 1-c. If the signal is present, connect the oscilloscope to the junction of R19 and C20. The oscilloscope display should be similar to that shown in the lower trace of composite waveform SS9-1.

If the programmable divider and the pulse generator are working properly but the loop is not phase locked, the oscilloscope may still show the signals, but the relationship between the pulses and the sine wave will not be the same as shown in composite waveform SS9-1. If the voltage controlled oscillator and the summing circuits in the A13 assembly are known to be functioning properly proceed to test procedure 2.

Test 1-c. If the pulses are not present at TP5, and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope should display pulses at approximately 10 kHz and about 3.5 v p/p.

If the pulses are present at TP3, but were not present at TP4, check Q6, Q7 and associated components.

If the pulses are not present at TP3 proceed to test 1-d.

Test 1-d. If the pulse is not present at TP3 connect the oscilloscope to U2B pin 6. The waveform should be similar to that shown in the top trace of composite waveform SS9-2. If the signal is as shown proceed to test 1-e.

If there is no signal present at AND gate U2B pin 6 connect the oscilloscope to TP1. The waveform should be similar to that shown in the center trace of composite waveform SS9-2. If the signal is now present, use the digital voltmeter to check the voltage at AND gate U2B pins 4 and 5. The digital voltmeter should indicate about +3.7 volts; if it does, U2B is defective.

If the voltages are not present at AND gate U2B pins 4 and 5, ground U3B pin 2. If the voltages now appear at AND gate U2B pins 4 and 5 and the signal appears at U2B pin 6, U2B is functioning properly; the trouble is probably in the gating circuits to U3.

If the voltage is present at AND gate U2B pin 4 with U3 pin 2 grounded, but is not present at U2B pin 5, U4 is probably defective.

If the voltages are not present at AND gate U2B pins 4 or 5 with U3 pin 2 grounded, U3 is probably defective.

If the signal is not present at TP1, use the oscilloscope to check the voltage controlled oscillator input at XA14-2-15. The display should be similar to the lower trace in composite waveform SS9-2. If the signal is present NAND gate U8C is probably defective. If the signal is not present check interconnections to the A13 assembly and, if necessary, the A13 assembly.

To be supplied

Test 1-e. It is assumed in this test that the signal input is present at U7 pin 8 only because U3 pin 2 is grounded. Composite waveforms SS9-3 through SS9-7 illustrate the correct waveforms for the integrated circuits in the programmable divider loop. All waveforms are about 4.5 volts in amplitude. Follow the numerical sequence of the waveforms; when an IC output is missing the trouble is found. Replace the defective component, remove the ground from U3 pin 2, and repeat test 1-b.

Composite waveform SS9-8 illustrates the proper waveforms for U3 under normal operating conditions.

NOTE

Composite waveforms SS9-7 and SS9-8 waveform pictures were taken with the oscilloscope being triggered from TP3 and the oscilloscope sweep magnified X10

To be supplied

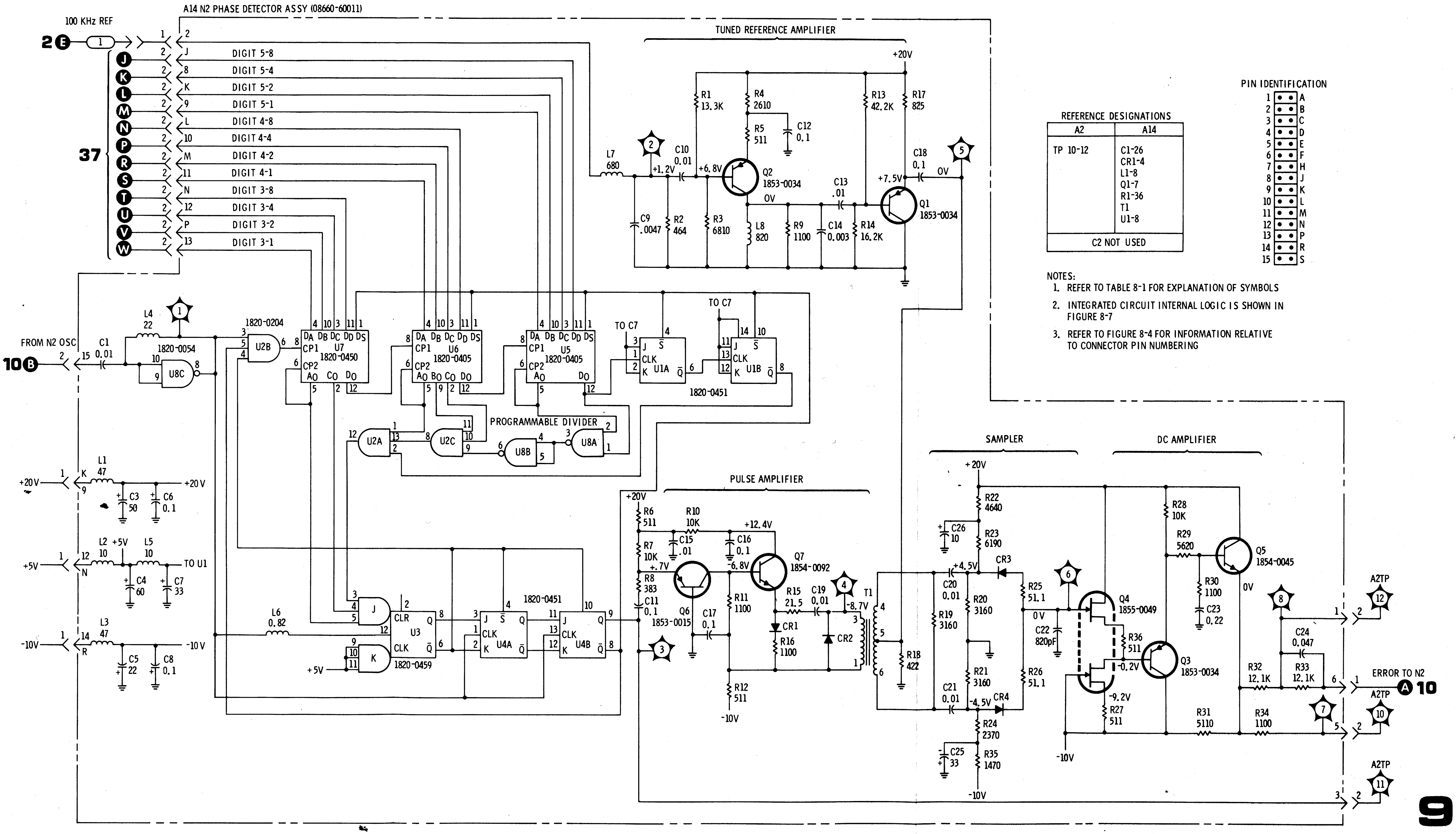


Figure 8-15. N2 Phase Detector Schematic

SERVICE SHEET 9 (cont'd)

To be supplied

2 SAMPLING PHASE DETECTOR

The positive-going output from U4B pin 9 is used to generate the pulse required to open the sampler gate. Common base amplifier Q6 and emitter follower Q7 amplifies and couples the pulse to T1. CR1 and CR2 are used to minimize transformer flyback action. CR2 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 100 kHz signal from the reference loop is applied to the secondary center tap of T1. L7 and C9 (along with C3 in the reference loop A4A1 assembly) comprise a low pass filter; it has an impedance of about 450 ohms and a cutoff frequency of about 150 kHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. L8 and C14 comprise a tuned circuit which bypasses unwanted high frequency signals and further filters the sine wave.

Sampler diodes CR3 and CR4 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR3 and CR4. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR3 and CR4 are forward biased the sampling gate is open and the 100 kHz reference signal is sampled.

SERVICE SHEET 9 (cont'd)

This type of sampling phase detector may be phase locked at virtually any point on the sine wave curve. Ideally, the zero volt crossover point of the sine wave should be used to improve the lock and hold in capability of the loop.

If the divided down output of the voltage controlled oscillator in the A13 assembly (10 kHz pulses) is not phase locked to the 100 kHz reference signal an ac signal is developed at TP6. The polarity of the signal at any given time depends on the polarity of the 100 kHz sine wave at the time the last sample was taken. The amplitude of the signal at any given time depends on what portion of the sine wave the last sample was taken from. Each time CR3 and CR4 are forward biased the signal derived from the 100 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends, CR3 and CR4 are again reverse biased and the sampling gate is closed. Since Q4 is a high input impedance device, the charge will remain in C22 until the next sampling pulse. The error signal from Q4 is applied to the summing amplifier in the A13 assembly through emitter followers Q3 and Q5.

Test Point 8 may be grounded to open the phase lock loop. Since the emitter of A13Q12 in the A13 assembly is also exactly at dc ground level, grounding this test point will not affect the pretuning circuit. With the loop open both the pretuning and the error signal may be checked.

TEST PROCEDURE 2

Test 2-a. Connect the oscilloscope to TP6. If the 100 kHz reference signal is present one of the sampling gate diodes (CR3 or CR4) is probably shorted. If the gate pulses are present one of the sampling gate diodes is probably open (Negative-going pulses CR4 - positive going pulses CR3). Proceed to test 2-b.

Test 2-b. With the oscilloscope connected to TP6, ground TP8. The signal displayed should be similar to that shown in Composite Waveform SS9-9, at about 4 volts. The frequency of the signal will be determined by the frequency difference detected by the sampling gate (typically 200 to 400 Hz).

If the signal is present at TP6, connect the oscilloscope to Q5-e. The sine wave should be about the same as that shown for TP6 except that the sampling points will not be as obvious.

If the signal is present at Q5-e the error amplifier and the sampling circuits are functioning properly.

If the signal is not present at Q5-e and was present at TP6, check Q3, Q4, Q5 and associated components. After repairs are made repeat the test and remove the ground from TP8.

NOTE

Operation of the circuit shown on Service Sheet 9-a is essentially the same as that shown on Service Sheet 9. Reference designations differ. The count down is always 3000.

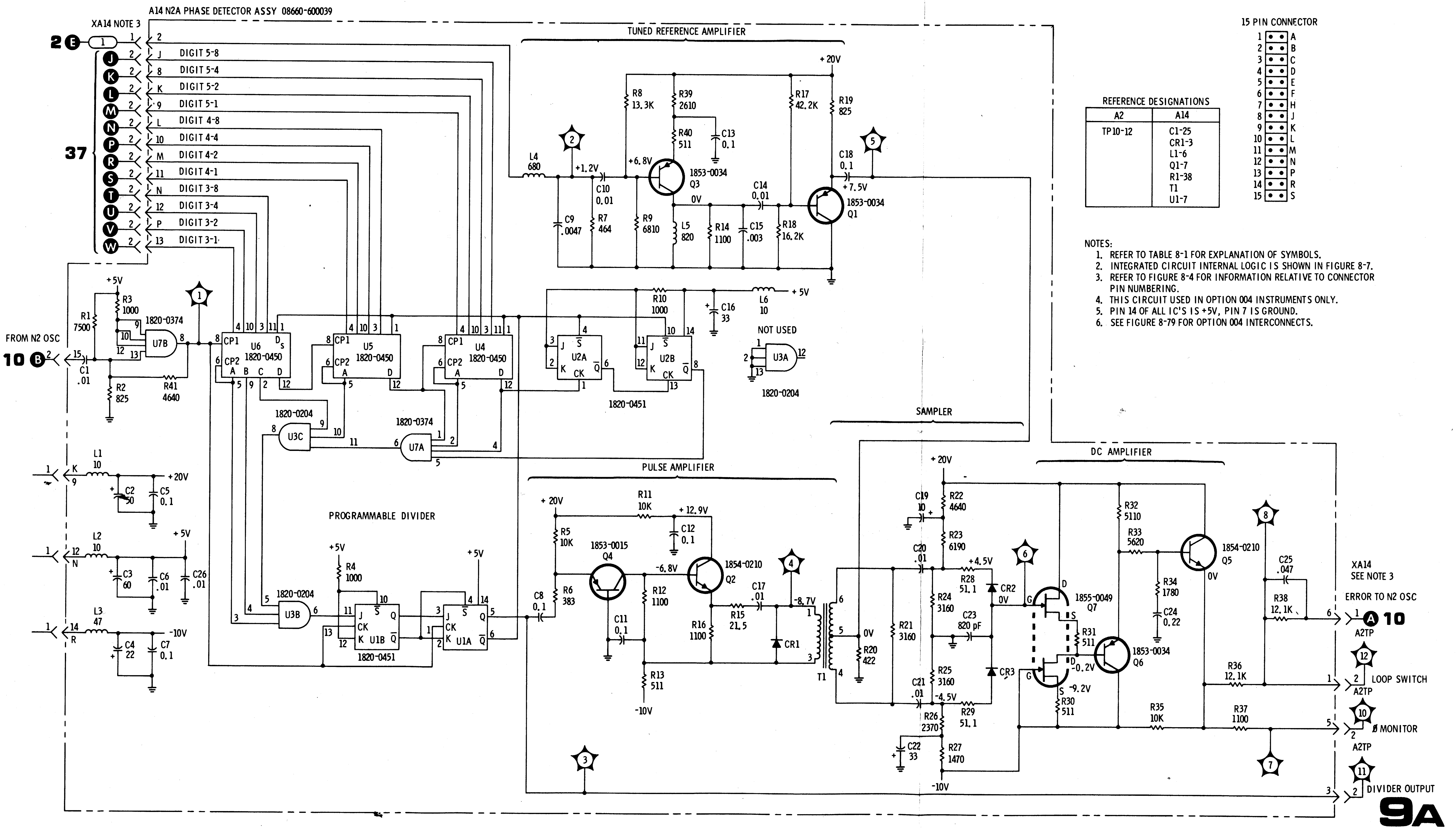


Figure 8-16. N2a Phase Detector Schematic

SERVICE SHEET 10

N2 OSCILLATOR ASSEMBLY A13

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A13 assembly, a part of the two-assembly N2 phase lock loop is shown schematically and described on this service sheet. The N2 Phase Detector assembly, A14, is shown schematically and described on Service Sheet 9.

When trouble has been isolated to the A13 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the N2 loop circuits the adjustment procedures specified in Section V paragraph 5-17 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Electronic Counter

N2 LOOP GENERAL INFORMATION

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output of the N2 loop is applied to Summing Loop 2.

1 VOLTAGE CONTROLLED OSCILLATOR

Varactors CR8 and CR9, transistors Q2 and Q9 and associated components comprise a voltage controlled oscillator. Two varactors are used in parallel to provide high Q as well as the wide capacitance range required. C18 provides isolation for the dc levels required to bias the varactors. C17 provides the feedback required to sustain oscillation. The resonant tank circuit is coupled to Q9 by means of capacitive divider C22 and C23. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source. The gain of the FET amplifier for the output signal is less than one; this minimizes the miller effect which might otherwise reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the signal and applies it to U1A which functions as a Schmitt trigger. U1D inverts the output from U1A and applies it to the programmable divider in the A14 assembly. U1C inverts the output from U1A and applies it to the divide-by-one hundred circuit in Summing Loop 2.

TEST PROCEDURE 1

NOTE

> Do not use long coax leads from the counter to TP3. The capacitive loading may attenuate the signal below a useable level.

SERVICE SHEET 10 (cont'd)

Test 1-a. Connect the counter to TP3 and set Center Frequencies as shown in Table 8-5. The counter readout should be as shown in the table. (Make allowances for counter accuracy.)

NOTE

> If the frequency readouts listed in Table 8-5 are not approximately as shown check the voltage levels shown for TP2 in Table 8-5. If the voltage levels are incorrect proceed to test procedure 2.

If the signal is present use the oscilloscope to check the outputs at XA13-1 pins 4 and 6 with center frequency set to zero. The signal at XA13-1-4 should be about 0.8 volt p/p and the signal at XA13-1-6 should be about 0.3 volt.

If the signal is present at TP3 but is not present at XA13-1 pins 4 and 6 check U1.

Test 1-b. If the signal is not present at TP3 use the oscilloscope to check the signal at the collector of Q1. The signal should be about 1 volt in amplitude.

If the signal is not present at Q1-c use the oscilloscope to check the signal at the Q1 base. If the signal is now present (about 0.3 volt), Q1 is probably defective.

If the signal is not present at Q1 base, check Q2, Q9 and associated components.

2 PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U2, U3, transistors connected to the outputs of the NAND gates and associated components). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the loop. The inputs to U2 and U3 are BCD bits coded 8, 4, 2 and 1. When any of the BCD inputs are high they cause the output of the NAND gate with which they are associated to go low; the transistor associated with the NAND gate is switched on.

When all of the BCD inputs are low Q4 is biased to provide approximately —25 volts at TP1 (Q3-e). With this dc level at TP1 the oscillator is roughly preset to 29.79 MHz.

When any one or more of the BCD inputs go high the transistor associated with it saturates and draws current through R34 and R35. The change in bias for Q4 causes the voltage at TP1 to go less negative (closer to ground level). Finally when the binary input is 99, the voltage at TP1 is approximately —5.2 volts and the oscillator frequency is roughly preset to 19.80 MHz.

Q12 is a summing amplifier which combines the output of the digital to analog converter and the signal from the N2 phase detector. The summing point (Q12-e) sums the current from three sources; a current source from the +20 volt supply through R28, R30 and R37, a negative source from the digital to analog converter (TP1) and the signal from the N2 phase detector. The voltage at the summing point is always zero volts.

When TP1 is at approximately —25 volts (no BCD input), most of the current from the +20 volt supply flows through Q4 and Q3; very little flows through Q12. Under these conditions the voltage at Q12-c is about —30 volts. As the voltage at TP1 decreases (gets closer to ground level) less current flows through Q4 and Q3, more current flows through Q12, and the Q12 collector voltage decreases.

N2a Phase Detector
SERVICE SHEET 9
(2 of 2)

SERVICE SHEET 10 (cont'd)

CR4 through CR7, CR11 through CR16 and associated resistors are used to shape the voltage applied to the varactors in the voltage controlled oscillator circuit so that the frequency will be linear with the voltage change. The voltage at the junction of R42 and R47 is about —27.5 volts. When there is no BCD input (Q12-c is about —30 volts) all of the diodes in the shaper are reverse biased. As the voltage at TP1 decreases (gets closer to —5.2 volts) current through Q12 increases and the Q12 collector voltage also decreases. As the Q12-c voltage decreases first CR4, then CR5, etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R31 and R32 to shape the voltage curve to the varactors.

Q11 and Q10 are emitter followers which couple the output of Q12 to the varactors. Q11 provides a high impedance for the output of the summing amplifier, Q12.

TEST PROCEDURE 2

Test 2-a. Use the digital voltmeter to check the voltages at TP1 and TP2. These dc levels should be about as shown in Table 8-5 for the center frequencies shown.

If the voltages at TP1 are about right, but those at TP2 are not, check Q12, Q11, Q10 and associated components.

If the voltages at TP1 are not approximately as shown in Table 8-5, check the components in the digital to analog converter.

NOTE

Also check the BCD input lines for the correct levels. With CF digits 4 and 5 set to a zero all eight input lines should be low. With CF digits 4 and 5 set to a 1 inputs at XA13-2 pins 11 and 9 should be high, etc..

Table 8-6. N2 Frequency versus Voltage Chart

Center Frequency	Counter Readout	TP1 Volts	TP2 Volts
00000 Hz	29.790000 MHz	—25	—31
11100 Hz	28.680000 MHz	—23	—26
22200 Hz	27.570000 MHz	—21	—21
33300 Hz	26.460000 MHz	—18.5	—16.8
44400 Hz	25.350000 MHz	—16.4	—13.4
55500 Hz	24.240000 MHz	—14.2	—10.6
66600 Hz	23.130000 MHz	—12	—8.3
77700 Hz	22.020000 MHz	—9.8	—6.4
88800 Hz	20.910000 MHz	—7.7	—4.8
99900 Hz	19.800000 MHz	—5.4	—3.6

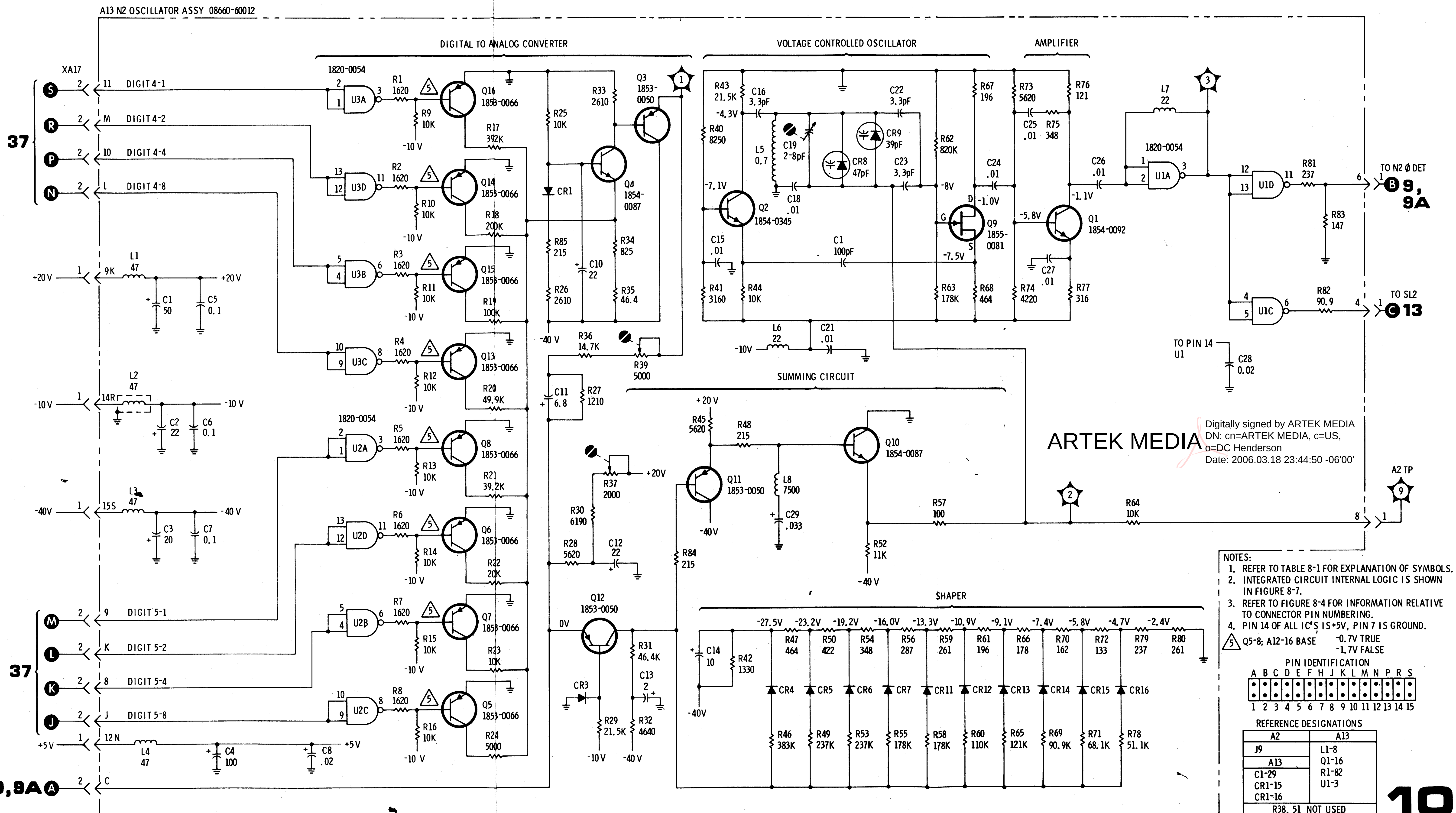


Figure 8-17. N2 VCO Schematic

SERVICE SHEET 11

N3 PHASE DETECTOR ASSEMBLY A10

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A10 assembly, a part of the two-assembly N3 phase lock loop is shown schematically and described on this service sheet. The N3 oscillator assembly, A8, is shown schematically and described on Service Sheet 12.

When trouble has been isolated to the A10 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the N3 loop circuits the adjustment procedures specified in Section V paragraph 5-18 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N3 LOOP GENERAL INFORMATION

The purpose of the N3 loop is to generate digitally controlled rf signals in the range of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section.

The rf output of the N3 voltage controlled oscillator is divided by ten before being applied to the SL2 assembly. The output to SL2 is 2.001 to 2.100 MHz in 1 kHz increments.

1 N3 PROGRAMMABLE DIVIDER CIRCUIT

All of the integrated circuits in the A10 assembly are used to count down the input from the N3 voltage controlled oscillator.

When there are no BCD inputs to U5 and U6 (all inputs low), the input from the oscillator will be 21.00 MHz when the oscillator is phase locked; the programmable divider will divide by 2100 to provide a 10 kHz output at TP3. U5 and U6 are preset by CF digits 1 and 2 and programmed to vary between start counts of 00 and 99. Operation of the circuit is as follows:

Assume that initially all BCD inputs are low and U4, U5 and U6 have been preset to zero. Assume also that U2A pin 6 ($\overline{Q}$) and U2B pin 8 ($\overline{Q}$) are both low. U1B pin 8 ($\overline{Q}$) and U1A pin 6 ($\overline{Q}$) are both high.

NAND gate U7C couples the input from the N3 oscillator to the clock input of U5. U5 provides a divided-by-ten output to clock U6 and also provides A, B and C (BCD 1, 2 and 4) outputs. The A, B and C outputs are not used until the count of 2097 has been reached.

U6 provides a divided-by-ten output to clock U4 and also provides A and D (BCD 1 and 8) outputs to AND gates U3A and U3C. The A and D outputs are not used until the count has reached 2090.

U4 provides a divided-by-ten output to clock U2A. At the count of 1000 U4 clocks U2A and the U2A $\overline{Q}$ output at pin 6 goes high. At the count of 2000 U4 again clocks U2A and the negative-going $\overline{Q}$ output at pin 6 clocks U2B. When U2B is clocked $\overline{Q}$ at pin 8 goes high and is applied to pins 2 and 13 of AND gate U3A.

At the count of 2090 the high A and D outputs of U6 are applied to AND gates U3A and U3C. Since U3A pins 2 and 13 are both high, U3A is enabled and it places a high on pin 11 of AND gate U3C.

SERVICE SHEET 11 (cont'd)

At the count of 2097 the high A, B and C outputs of U5 are applied to AND gates U3B and U3C to provide a high at the J input of U1B at pin 11.

At the count of 2098 U1B is clocked, U1B $\overline{Q}$ (pin 8) goes low and sets U1A. U1A $\overline{Q}$ (pin 6) goes low and presets U2, U4, U5 and U6; they are held in preset until the count is completed.

When U1A is set Q (pin 5) goes high and initiates the sampling pulse. The first pulse to the sampling phase detector is initiated by the 2098th input cycle. Since two more cycles are required to restart the count cycle, following sampler pulses are 2100 cycles apart when there is no BCD input.

At the count of 2099 U1B is again clocked and $\overline{Q}$ (pin 8) goes high. The high at pin 8 is applied to the K input of U1A (pin 2).

At the count of 2100 U1A is clocked and pin 6 $\overline{Q}$ goes high to end the preset pulse. The next input to U5 initiates the next count cycle.

When there is a BCD input programmed into U5 and U6 pins 3, 4, 10 and 11 the terminal count is still 2100. However, the count starts at the number programmed into the BCD inputs. As an example, if the BCD input to U5 and U6 is 99, the first input cycle would cause the same digital circuit changes that the 100th input cycle caused in the discussion above (U4 would be clocked). The frequency division would be 2100-99, equal to division by 2001. The phase lock loop operation would result in an input frequency to the programmable divider of 20.01 MHz. When divided by 2001, the divider output at TP3 would again be 10 kHz.

The output from U1A pin 5 is always 10 kHz when the oscillator is phase locked regardless of the oscillator frequency.

TEST PROCEDURE 1

Composite Waveform SS11-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is locked.

NOTE

Center Frequency is initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 5 volts p/p at TP5. The display should be similar to that shown in the second trace from the top of composite waveform SS11-1.

To be supplied

SERVICE SHEET 11 (cont'd)

If the counter readout is 100,000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA10-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS11-1.

If the correct signal is present at XA10-1-2, but was not present at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA10-1-2 check interconnections to the reference loop and, if necessary, the reference loop.

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 100.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS11-1 at about 7 volts amplitude. If the signal is not present, proceed to test 1-c.

If the signal is present, connect the oscilloscope to the junction of R19 and C20. The oscilloscope display should be similar to that shown in the lowest trace of composite waveform SS11-1.

If the programmable divider and the pulse generator are working properly but the loop is not phase locked, the oscilloscope may still display the signals at the junction of R19 and C20, but the relationship between the pulses and the sine wave will not be the same as shown in composite waveform SS11-1. If the voltage controlled oscillator and the summing circuit in the A8 assembly are known to be functioning properly, proceed to test procedure 2.

Test 1-c. If the pulses are not present at TP4, and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope display should be a series of pulses at approximately 10 kHz and about 3.5 volts in amplitude.

If the pulses are present at TP3, but were not present at TP4, check Q6, Q7 and associated components.

If the pulses are not present at TP3, proceed to test 1-d.

Test 1-d. If the pulse is not present at TP3 connect the oscilloscope to NAND gate U7C pin 8. The oscilloscope should display a slightly distorted sine wave at about 21 MHz and about 3 volts in amplitude.

If the signal is not present at U7C pin 8, connect the oscilloscope to XA10-2-15. The 21 MHz signal should be about 0.1 volt in amplitude. If the signal is present, U7 is probably defective. If the signal is not present check interconnections to the A8 assembly and, if necessary the A8 assembly.

Test 1-e. It is assumed in this test that the signal input is present at U5 pin 8. Composite waveforms SS11-2 through SS11-6 illustrate the correct waveforms for the integrated circuit points shown.

NOTE

These waveforms were taken with the oscilloscope triggered from TP3.

SERVICE SHEET 11 (cont'd)

At the count of 2097 the high A, B and C outputs of U5 are applied to AND gates U3B and U3C to provide a high at the J input of U1B at pin 11.

At the count of 2098 U1B is clocked, U1B $\overline{Q}$ (pin 8) goes low and sets U1A. U1A $\overline{Q}$ (pin 6) goes low and presets U2, U4, U5 and U6; they are held in preset until the count is completed.

When U1A is set Q (pin 5) goes high and initiates the sampling pulse. The first pulse to the sampling phase detector is initiated by the 2098th input cycle. Since two more cycles are required to restart the count cycle, following sampler pulses are 2100 cycles apart when there is no BCD input.

At the count of 2099 U1B is again clocked and $\overline{Q}$ (pin 8) goes high. The high at pin 8 is applied to the K input of U1A (pin 2).

At the count of 2100 U1A is clocked and pin 6 $\overline{Q}$ goes high to end the preset pulse. The next input to U5 initiates the next count cycle.

When there is a BCD input programmed into U5 and U6 pins 3, 4, 10 and 11 the terminal count is still 2100. However, the count starts at the number programmed into the BCD inputs. As an example, if the BCD input to U5 and U6 is 99, the first input cycle would cause the same digital circuit changes that the 100th input cycle caused in the discussion above (U4 would be clocked). The frequency division would be 2100-99, equal to division by 2001. The phase lock loop operation would result in an input frequency to the programmable divider of 20.01 MHz. When divided by 2001, the divider output at TP3 would again be 10 kHz.

The output from U1A pin 5 is always 10 kHz when the oscillator is phase locked regardless of the oscillator frequency.

TEST PROCEDURE 1

Composite Waveform SS11-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is locked.

NOTE

Center Frequency is initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 5 volts p/p at TP5. The display should be similar to that shown in the second trace from the top of composite waveform SS11-1.

To be supplied

SERVICE SHEET 11 (cont'd)

If the counter readout is 100,000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA10-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS11-1.

If the correct signal is present at XA10-1-2, but was not present at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA10-1-2 check interconnections to the reference loop and, if necessary, the reference loop.

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 100.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS11-1 at about 7 volts amplitude. If the signal is not present, proceed to test 1-c.

If the signal is present, connect the oscilloscope to the junction of R19 and C20. The oscilloscope display should be similar to that shown in the lowest trace of composite waveform SS11-1.

If the programmable divider and the pulse generator are working properly but the loop is not phase locked, the oscilloscope may still display the signals at the junction of R19 and C20, but the relationship between the pulses and the sine wave will not be the same as shown in composite waveform SS11-1. If the voltage controlled oscillator and the summing circuit in the A8 assembly are known to be functioning properly, proceed to test procedure 2.

Test 1-c. If the pulses are not present at TP4, and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope display should be a series of pulses at approximately 10 kHz and about 3.5 volts in amplitude.

If the pulses are present at TP3, but were not present at TP4, check Q6, Q7 and associated components.

If the pulses are not present at TP3, proceed to test 1-d.

Test 1-d. If the pulse is not present at TP3 connect the oscilloscope to NAND gate U7C pin 8. The oscilloscope should display a slightly distorted sine wave at about 21 MHz and about 3 volts in amplitude.

If the signal is not present at U7C pin 8, connect the oscilloscope to XA10-2-15. The 21 MHz signal should be about 0.1 volt in amplitude. If the signal is present, U7 is probably defective. If the signal is not present check interconnections to the A8 assembly and, if necessary the A8 assembly.

Test 1-e. It is assumed in this test that the signal input is present at U5 pin 8. Composite waveforms SS11-2 through SS11-6 illustrate the correct waveforms for the integrated circuit points shown.

NOTE

These waveforms were taken with the oscilloscope triggered from TP3.

SERVICE SHEET 11 (cont'd)

Follow the numerical sequence of the waveforms shown; when an IC output is missing the trouble is found. Replace the defective component and repeat test 1-b.

NOTE

If the output from U5 is not present proceed to test 1-f before replacing U5.

Test 1-f. Composite waveform SS11-7 illustrates correct waveforms for a properly operating U1. In this test the oscilloscope was again triggered by TP3 and the sweep delay of the oscilloscope was used to center the pulses shown.

If the waveforms in composite waveform SS11-7 cannot be observed (because an adequate oscilloscope is not available or other reasons) measure the voltage at U1 pin 6, it should be about +3.7 volts; U1 pin 5 should be at about +100 millivolts. If the voltages are not as specified, ground U1 pin 10. The voltages should then be; U1 pin 6 about +130 millivolts and U1 pin 5 about +3.8 volts. If the voltages are as specified in either case and there is no output from U5, U5 is probably defective.

If there is no change in the dc levels at U1 pins 5 and 6 with U1 pin 10 grounded U1 is probably defective.

To be supplied

To be supplied

SERVICE SHEET 11 (cont'd)

To be supplied

2 SAMPLING PHASE DETECTOR

The positive-going output from U1A Q (pin 5) is used to generate the pulse required to open the sampler gate. Common base amplifier Q6 and emitter follower Q7 amplifies and couples the pulse to T1. CR1 and CR2 are used to minimize transformer flyback action. CR2 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 100 kHz signal from the reference loop is applied through Q2 and Q1 to the secondary center tap of T1. L5 and C8 (along with C4 in the reference loop A4A1 assembly) comprise a low pass filter; it has an impedance of about 450 ohms and a cutoff frequency of about 150 kHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. Q2 and Q1 amplify the signal to the level required in the sampling phase detector. L7 and C13 comprise a tuned circuit which bypasses unwanted high frequency signals and further filters the sine wave.

Sampler diodes CR3 and CR4 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR3 and CR4. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR3 and CR4 are forward biased the sampling gate is open and the 100 kHz reference input signal is sampled.

This type of sampling phase detector may be phase locked to virtually any point on the sine wave slope. Ideally, the zero crossover point of the sine wave should be used to improve the lock and lock hold capabilities of the loop.

If the divided down output of the voltage controlled oscillator (10 kHz pulses) is not phase locked to the 100 kHz reference signal an ac error signal will be developed at TP6. The polarity of the error signal at any given point in time depends on the polarity of the 100 kHz reference signal at the time the last sample was taken. The amplitude of the error signal at any given time depends on what part of the sine wave the last sample was taken from. Each time CR3 and CR4 are forward biased the 100 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends CR3 and CR4 are again reverse biased and the sampling gate is closed. Since Q4 is a high impedance input device, the charge will remain on C22 until the next sampling pulse. The current through Q4 is controlled by the difference in Gate-source voltage of the lower FET. Operation of the dual FET sets the output level at the lower FET drain to exactly the level at the upper FET gate. The output is coupled through two emitter followers to the summing amplifier in the A8 assembly.

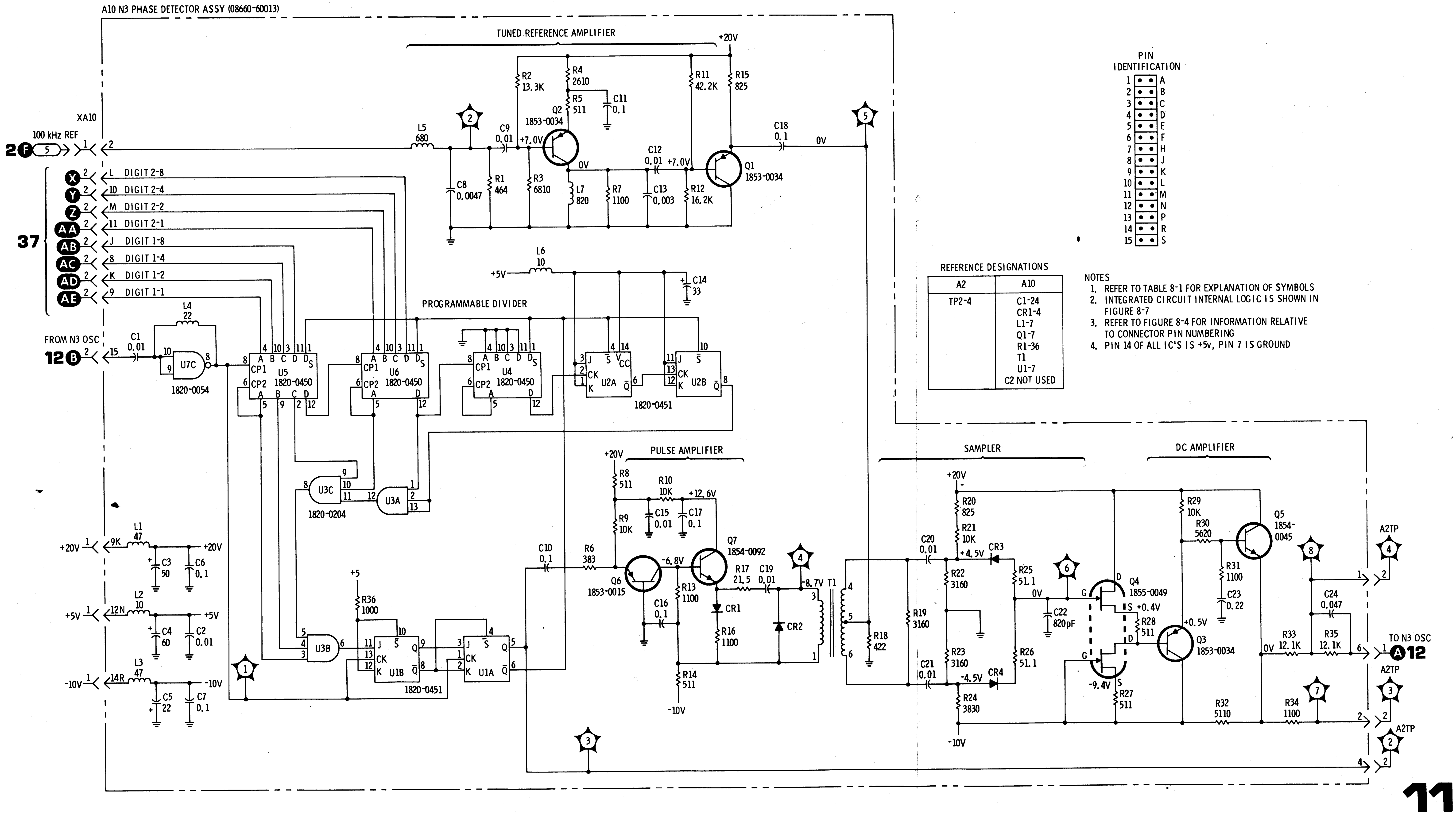


Figure 8-18. N3 Phase Detector Schematic

SERVICE SHEET 12

N3 OSCILLATOR ASSEMBLY A8

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A8 assembly, a part of the two-assembly N3 phase lock loop is shown schematically and described on this service sheet. The N3 Phase Detector assembly, A10, is shown schematically and described on Service Sheet 11.

When trouble has been isolated to the A8 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the N3 loop circuits the adjustment procedures specified in Section V paragraph 5-18 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Electronic Counter

N3 LOOP GENERAL INFORMATION

The purpose of the N3 loop is to generate digitally controlled rf signals in the range of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output of the N3 voltage controlled oscillator is divided by ten before it is applied to summing Loop 2. The output from the N3 assembly to SL2 is 2.001 to 2.100 MHz in selectable 1 kHz increments.

1 VOLTAGE CONTROLLED OSCILLATOR

Q2, Q7 and associated components comprise a voltage controlled oscillator. C14 and C17 provide isolation for the dc levels required to bias the varactor. C13 provides the feedback required to sustain oscillation. The resonant tank is coupled to Q7 by capacitive divider C16 and C17. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source. The gain of the FET for the output signal at the drain is held at less than unity to minimize the miller effect which might otherwise reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the voltage controlled oscillator output and applies it to U1A which functions as a Schmitt trigger. U1D provides the output to the N3 programmable divider in the A10 assembly. U1B and U3 provide a divided by ten output to Summing Loop 2.

SERVICE SHEET 12 (cont'd)

TEST PROCEDURE

NOTE

> Do not use long coax leads from the counter to N3 test points. The capacitive loading may attenuate the signal below a useable level.

Test 1-a. Connect the counter to TP2. With the center freuqency set to zero the counter readout should be 21.00 MHz. Set CF digits 1 and 2 to the settings specified in Table 8-6. Frequency readouts on the counter should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

> If the frequency readouts listed in Table 8-6 are not approximately as shown, check the voltage levels shown for TP3 in the table. If the voltage levels are incorrect proceed to test procedure 2.

If the signal is present use the oscilloscope to check the signal at points shown in composite waveform SS12-1. Signals shown are about 4 volts in amplitude.

To be supplied

If the signal is present at TP2 but is not present at U1 pin 11, U1 is probably defective; if the signal is not present at U3 pin 12, U1 or U3 may be defective.

If the signal is not present at TP2 use the oscilloscope to check for the signal at Q1-b. If the signal is present at Q1-b check Q1 and NAND gate U1A. If the signal is not present check Q2, Q7 and associated components.

2 PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U2 and Q8 through Q11). The digital to analog converter

SERVICE SHEET 12 (cont'd)

cannot, by itself, set the oscillator frequency precisely; it does set the fr within the capture range of the phase lock loop. The inputs to U2 are B coded 1, 2, 4 and 8. When any one of the BCD inputs are high they ca output of the NAND gate to which they are connected to go low; the tr connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q6 is biased to provide approximate volts at TP1 (Q5-e). With this dc level at TP1 the oscillator is roughly pres MHz (how close depends on adjustment of R24 and R26).

When any one or more BCD inputs go high the transistor associated saturates and the current through Q6 is reduced. The reduction of through Q6 changes the bias on Q5 and causes the voltage at TP1 to negative (closer to dc ground level). Finally, when the BCD input is 9, the at TP1 is approximately −6.7 volts and the oscillator is roughly preset t MHz (again depending on adjustment of R24 and R26).

Q3 is a summing amplifier which combines the output of the digital to converter and the error signal from the N3 Phase Detector. The summi (Q3-e) sums the current from three sources; a current source from the power supply through R19, R25 and R26, a negative source from the d analog converter (TP1), and the error signal from the phase detector. The at the summing point is always zero volts.

The output from Q3 is coupled through Q4 and Q12 to control the varactor CR5 and the frequency of the voltage controlled oscillator.

TEST PROCEDURE 2

Test 2-a. Use the digital voltmeter to check the voltages at TP1 and TP3 dc levels should be about as shown in Table 8-6 for the center frequencies

NOTE

> These voltages are typical. They will vary from instrument to instrument because of differences in individual varactor characteristics.

If the voltages at TP1 are about right, but those at TP3 are not, check Q12 and associated components.

If the voltages at TP1 are not approximately as shown in Table 8-6, ch components in the digital to analog converter.

NOTE

> Also check the dc levels at the BCD input lines.

ICE SHEET 12

CILLATOR ASSEMBLY A8

lly, causes of malfunctions in the Model 8660B will be isolated to a circuit or assembly as a result of performing the tests specified in the eshooting trees.

.8 assembly, a part of the two-assembly N3 phase lock loop is shown atically and described on this service sheet. The N3 Phase Detector ly, A10, is shown schematically and described on Service Sheet 11.

trouble has been isolated to the A8 assembly it should be removed and lled using two extender boards. This will provide easy access to test points mponents.

NOTE

> After making repairs to any part of the N3 loop circuits the adjustment procedures specified in Section V paragraph 5-18 should be performed to ensure proper operation of the instrument.

EQUIPMENT REQUIRED (See Table 1-3)

Voltmeter
nic Counter

OP GENERAL INFORMATION

urpose of the N3 loop is to generate digitally controlled rf signals in the of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage lled oscillator is phase locked to a 100 kHz reference which is derived from aster oscillator in the reference section. The rf output of the N3 voltage lled oscillator is divided by ten before it is applied to summing Loop 2. The from the N3 assembly to SL2 is 2.001 to 2.100 MHz in selectable 1 kHz ents.

LTAGE CONTROLLED OSCILLATOR

7 and associated components comprise a voltage controlled oscillator. C14 17 provide isolation for the dc levels required to bias the varactor. C13 es the feedback required to sustain oscillation. The resonant tank is coupled by capacitive divider C16 and C17. The FET acts as a source follower in the ck circuit; it provides a high impedance at the gate and a low impedance at rce. The gain of the FET for the output signal at the drain is held at less unity to minimize the miller effect which might otherwise reflect ance back into the oscillator tank circuit.

plifies the voltage controlled oscillator output and applies it to U1A which ons as a Schmitt trigger. U1D provides the output to the N3 programmable in the A10 assembly. U1B and U3 provide a divided by ten output to ing Loop 2.

TEST PROCEDURE

NOTE

> Do not use long coax leads from the counter to N3 test points. The capacitive loading may attenuate the signal below a useable level.

Test 1-a. Connect the counter to TP2. With the center freuqency set to zero the counter readout should be 21.00 MHz. Set CF digits 1 and 2 to the settings specified in Table 8-6. Frequency readouts on the counter should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

> If the frequency readouts listed in Table 8-6 are not approximately as shown, check the voltage levels shown for TP3 in the table. If the voltage levels are incorrect proceed to test procedure 2.

If the signal is present use the oscilloscope to check the signal at points shown in composite waveform SS12-1. Signals shown are about 4 volts in amplitude.

To be supplied

If the signal is present at TP2 but is not present at U1 pin 11, U1 is probably defective; if the signal is not present at U3 pin 12, U1 or U3 may be defective.

If the signal is not present at TP2 use the oscilloscope to check for the signal at Q1-b. If the signal is present at Q1-b check Q1 and NAND gate U1A. If the signal is not present check Q2, Q7 and associated components.

2 PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U2 and Q8 through Q11). The digital to analog converter

cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the phase lock loop. The inputs to U2 are BCD bits coded 1, 2, 4 and 8. When any one of the BCD inputs are high they cause the output of the NAND gate to which they are connected to go low; the transistor connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q6 is biased to provide approximately −8.5 volts at TP1 (Q5-e). With this dc level at TP1 the oscillator is roughly preset to 21 MHz (how close depends on adjustment of R24 and R26).

When any one or more BCD inputs go high the transistor associated with it saturates and the current through Q6 is reduced. The reduction of current through Q6 changes the bias on Q5 and causes the voltage at TP1 to go less negative (closer to dc ground level). Finally, when the BCD input is 9, the voltage at TP1 is approximately −6.7 volts and the oscillator is roughly preset to 20.01 MHz (again depending on adjustment of R24 and R26).

Q3 is a summing amplifier which combines the output of the digital to analog converter and the error signal from the N3 Phase Detector. The summing point (Q3-e) sums the current from three sources; a current source from the +20 volt power supply through R19, R25 and R26, a negative source from the digital to analog converter (TP1), and the error signal from the phase detector. The voltage at the summing point is always zero volts.

The output from Q3 is coupled through Q4 and Q12 to control the bias on varactor CR5 and the frequency of the voltage controlled oscillator.

TEST PROCEDURE 2

Test 2-a. Use the digital voltmeter to check the voltages at TP1 and TP3. These dc levels should be about as shown in Table 8-6 for the center frequencies shown.

NOTE

> These voltages are typical. They will vary from instrument to instrument because of differences in individual varactor characteristics.

If the voltages at TP1 are about right, but those at TP3 are not, check Q3, Q4, Q12 and associated components.

If the voltages at TP1 are not approximately as shown in Table 8-6, check the components in the digital to analog converter.

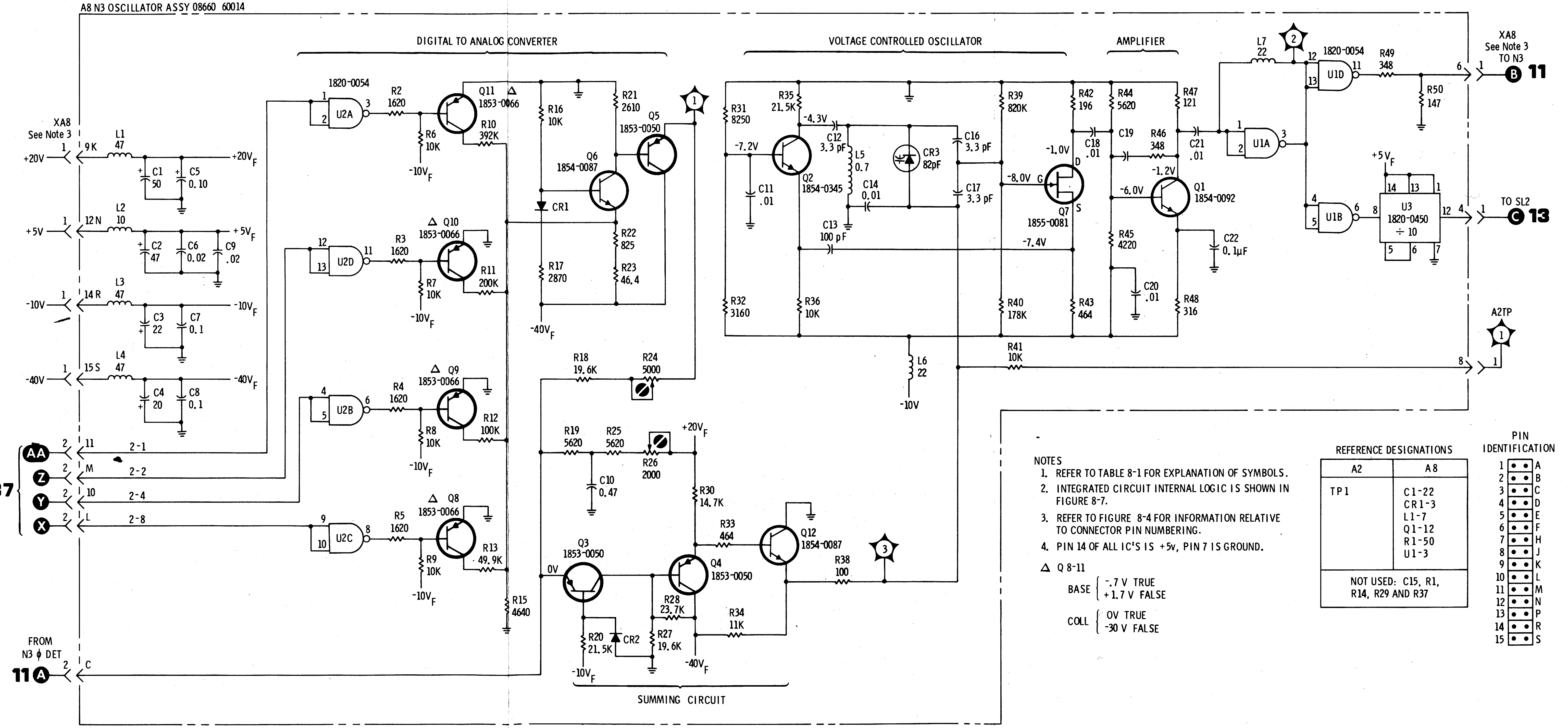
NOTE

> Also check the dc levels at the BCD input lines.

SERVICE SHEET 12 (cont'd)

Table 8-7. N3 Frequency Versus Voltage Chart

Center Frequency	Counter Readout	TP1 Voltage	TP3 Voltage
00 Hz	21.000000 MHz	−8.5 V	−3.7 V
11 Hz	20.890000 MHz	−8.3 V	−3.6 V
22 Hz	20.780000 MHz	−8.1 V	−3.5 V
33 Hz	20.670000 MHz	−7.9 V	−3.4 V
44 Hz	20.560000 MHz	−7.7 V	−3.3 V
55 Hz	20.450000 MHz	−7.5 V	−3.2 V
66 Hz	20.340000 MHz	−7.3 V	−3.1 V
77 Hz	20.230000 MHz	−7.1 V	−3.0 V
88 Hz.	20.120000 MHz	−6.9 V	−2.9 V
99 Hz	20.010000 MHz	−6.7 V	−2.8 V



NOTES

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING.
4. PIN 14 OF ALL IC'S IS +5v, PIN 7 IS GROUND.

△ Q 8-11

BASE { -.7 V TRUE / +1.7 V FALSE

COLL { 0V TRUE / -30 V FALSE

REFERENCE DESIGNATIONS

A2	A8
TP1	C1-22 CR1-3 L1-7 Q1-12 R1-50 U1-3
NOT USED: C15, R1, R14, R29 AND R37	

PIN IDENTIFICATION

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

12

Figure 8-19. N3 VCO Schematic

SERVICE SHEET 13

SUMMING LOOP 2 PHASE DETECTOR A12

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A12 assembly, a part of the two-assembly SL2, is shown schematically and described on this Service Sheet. The SL2 Oscillator Assembly (A11) is shown schematically and described on Service Sheet 14.

When trouble has been isolated to the A12 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the SL2 circuits the adjustment procedures in Section V paragraph 5-19 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 2 GENERAL

The purpose of Summing Loop 2 (SL2) is to generate digitally controlled rf signals in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. The difference frequency between the SL2 voltage controlled oscillator and the input from the N2 loop is phase locked to the divided-by-ten output of the N3 assembly. The output of SL2 is applied to SL1.

The portion of the pretuning circuit that appears on service sheet 13 (U8 and Q8 through Q11) is explained in the text for service sheet 14.

1 PHASE DETECTOR

There are three signal inputs to the phase detector assembly. They are the output of the N2 voltage controlled oscillator, the divided by ten output of the N3 voltage controlled oscillator and the output of the SL2 voltage controlled oscillator.

The N2 and SL2 signals are mixed and the difference frequency is used as one input to the digital phase detector. The second input to the digital phase detector is the divided by ten input from the N3 assembly.

The output of the N3 voltage controlled oscillator is divided by ten in the N3 assembly and again divided by ten by U9. Q12 and NAND gate U7A shape the resulting pulses which vary in frequency (depending on programming to the N3 loop) from 0.2001 to 0.2100 MHz. The pulses at TP2 are negative-going.

The inputs from the N2 loop and the SL2 voltage controlled oscillator are applied to double balanced mixer E1 R and L ports. The difference signal from the X port is amplified by Q5 and Q4 and shaped by Q3, Q7 and NAND gates U4B and U4C. When the loop is phase locked the negative-going pulses at TP3 are at the same frequency as those at TP2. The pulses do not appear in time coincidence; they are received alternately.

U7B, U7D, U4A and U4D comprise a coincidence gate which inhibits signals that appear simultaneously at TP2 and TP3. Normally, when signals are not present, TP2 and TP3 are both high. When a signal appears at TP2, U7B pin 6 and U4D pin 13 go high. If there is no signal at TP3 U5D pin 12 is also high; U4D pin 11 goes low, and U1B pin 6 goes high. The positive pulse at TP5 drives the clock generator and the sense circuit or phase detector. When a signal appears at TP3, U4A pin 3 and U7D pin 12 go high. If there is no signal at TP2, U7D pin 13 is also high; U7D pin 11 goes low, and U7C pin 8 goes high. The positive pulse at TP9 drives the clock generator and the sense circuit or the phase detector. When signals appear at TP2 and TP3 at the same time U7D pin 13 and U4D pin 12 go low, U7D pin 11 and U4D pin 11 remain high, and the signals cannot reach TP5 or TP9.

U1A, U1C, U1D and U5C comprise a clock generator which clocks U2A and U2B each time a signal appears at TP5 or TP9. With no signals present TP5 and TP9 are low. When a positive pulse appears at TP9 U1A pin 3 goes low, U1D pin 11 goes high and a negative-going pulse appears at TP6. When a positive pulse appears at TP5 operation of the circuit is the same except that U1C pin 8 goes low (rather than U1A pin 3). Since a clock pulse is generated for each input, the pulse frequency at TP6 is the sum of the frequencies at TP5 and TP9.

Since the sense circuit does not function when the loop is locked, operation of the phase detector will be discussed first.

When the loop is phase locked U2A $\overline{Q}$ is held high to enable U3A and U3D. Assume that initially U2B $\overline{Q}$ is high, U3B pin 6 is low and U3C pin 8 is high. When a positive-going signal from TP9 appears at U3A pin 1, U3A pin 3 goes low and causes a change in state of flip-flop U3B/U3C; U3B pin 6 goes high and U3C pin 8 goes low. The high at U2B pin 12 sets the flip/flop and the positive-going trailing edge of the clock pulse causes U2B Q to go high. The following positive pulse from TP5 is applied to U3D pin 12, U3D pin 11 goes low and changes the state of flip/flop U3B/U3C. U3B pin 6 goes low and the clock pulse causes U2B $\overline{Q}$ to again go high. This sequence continues as long as the signals at TP5 and TP9 are received alternately.

The signals at TP5 and TP9 are applied to the sense circuit even when the loop is phase locked. They have no effect on the circuit because of the relationship of the Q and $\overline{Q}$ outputs of U2B to the incoming signals.

When U2B Q is high NAND gates U6A and U6C are enabled. When the signal from TP5 appears at U6C pin 9, U6C pin 8 goes low; flip/flop U5A/U5B does not change state because U5B pin 3 is low. The signal at U6B has no effect because U2B $\overline{Q}$ and U6B pin 4 are low.

When U2B $\overline{Q}$ is high NAND gates U6B and U6D are enabled. When the signal at TP9 appears at U6D pin 13, U6D pin 11 goes low; flip/flop U5A/U5B does not change state becuase U5B pin 3 is low. The signal at pin 1 of U6A has no effect on the circuit because U2B Q and pin 2 of U6A are low.

When two or more consecutive pulses from either input (TP5 or TP9) occur between pulses from the other input the sense circuit functions to disable the phase detector until the frequency error is corrected.

As an example of circuit operation assume that two pulses from TP9 (SL2 signal) are received between two pulses from TP5 (N3 signal) indicating that the SL2 frequency is high. When the first pulse from TP9 is received U3A pin 3 goes low, U3B pin 6 goes high to set U2B and the clock pulse causes U2B Q to go high. When the second consecutive pulse is received from TP9 U6A has been enabled by the high Q output of U2B. U6A pin 3 goes low and causes flip/flop U5A/U5B to change state. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. If a third SL2 signal is received prior to receipt of an N3 signal U6A pin 3 will again go low but will have no effect on flip/flop U5A/U5B because U5A pin 13 is low.

When an N3 pulse is received U2B Q is still high and U6C pin 8 will go low to change the state of flip/flop U5A/U5B. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go high and enable U3A and U3D. The propagation time of the signal through the sense circuit is long enough for the pulse from N3 (TP5) to have ended before U3D is enabled so the state of flip/flop U3B/U3C does not change.

The next pulse from SL2 will again cause U6A pin 3 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A high again, the clock pulse again causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. The signal applied to U3A has no effect on flip/flop U3B/U3C because U3B pin 5 is low.

The sense circuit continues operation in the manner described above until two consectutive N3 pulses are received between two SL2 signals. When this occurs the first pulse causes U6C pin 8 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A low the clock pulse will cause U2A $\overline{Q}$ to go high and enable U3A and U3D. Again, because of propagation time through the sense circuit

When U2B Q is high NAND gates U6A and U6C are enabled. When the signal from TP5 appears at U6C pin 9, U6C pin 8 goes low; flip/flop U5A/U5B does not change state because U5B pin 3 is low. The signal at U6B has no effect because U2B $\overline{Q}$ and U6B pin 4 are low.

When U2B $\overline{Q}$ is high NAND gates U6B and U6D are enabled. When the signal at TP9 appears at U6D pin 13, U6D pin 11 goes low; flip/flop U5A/U5B does not change state becuase U5B pin 3 is low. The signal at pin 1 of U6A has no effect on the circuit because U2B Q and pin 2 of U6A are low.

When two or more consecutive pulses from either input (TP5 or TP9) occur between pulses from the other input the sense circuit functions to disable the phase detector until the frequency error is corrected.

As an example of circuit operation assume that two pulses from TP9 (SL2 signal) are received between two pulses from TP5 (N3 signal) indicating that the SL2 frequency is high. When the first pulse from TP9 is received U3A pin 3 goes low, U3B pin 6 goes high to set U2B and the clock pulse causes U2B Q to go high. When the second consecutive pulse is received from TP9 U6A has been enabled by the high Q output of U2B. U6A pin 3 goes low and causes flip/flop U5A/U5B to change state. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. If a third SL2 signal is received prior to receipt of an N3 signal U6A pin 3 will again go low but will have no effect on flip/flop U5A/U5B because U5A pin 13 is low.

When an N3 pulse is received U2B Q is still high and U6C pin 8 will go low to change the state of flip/flop U5A/U5B. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go high and enable U3A and U3D. The propagation time of the signal through the sense circuit is long enough for the pulse from N3 (TP5) to have ended before U3D is enabled so the state of flip/flop U3B/U3C does not change.

The next pulse from SL2 will again cause U6A pin 3 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A high again, the clock pulse again causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. The signal applied to U3A has no effect on flip/flop U3B/U3C because U3B pin 5 is low.

The sense circuit continues operation in the manner described above until two consectutive N3 pulses are received between two SL2 signals. When this occurs the first pulse causes U6C pin 8 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A low the clock pulse will cause U2A $\overline{Q}$ to go high and enable U3A and U3D. Again, because of propagation time through the sense circuit

the pulse will have ended before U3D in enabled. The second consecutive N3 pulse again causes U6C pin 8 to go low but, because U5B pin 3 is low, no change in state occurs in flip/flop U5A/U5B. Since U3D is now enabled, U3D pin 11 goes low and causes flip/flop U3B/U3C to change state. With the D input to U2B low, the clock pulse causes U2B Q output to go high. Phase lock has been achieved and the loop will remain locked as long as pulses at the same frequency appear alternately at TP5 and TP9.

When the SL2 frequency is low U2B Q is low. When the SL2 frequency is high U2B Q is high.

DC amplifier Q2, Q1, Q6 and associated components filter the Q output of U2B and applies it to a summing circuit in the A11 assembly to precisely control the voltage controlled oscillator.

TEST PROCEDURE 1

Test 1-a. Connect the oscilloscope input to test points shown by composite waveform SS13-1. This composite waveform illustrates correct waveforms and timing relationships for the points tested. All signals are about 4 volts in amplitude.

NOTE

The oscilloscope was triggered from TP1 for these tests.

To be supplied

If the pulses are not present at TP2 proceed to test 1-b.

If the pulses are not present at TP3 proceed to test 1-c.

If the pulses are present at TP2 and TP3, but opposite polarity pulses are not present at TP5 and/or TP9, check the NAND gates between TP2 and TP5 or TP3 and TP9 as appropriate.

If the positive-going pulses are present at TP5 and TP9, but negative-going pulses are not present at TP6 for each of the pulses, check NAND gates U1A, U1C, U1D and U5C as appropriate.

If the pulses are approximately as shown in the top five traces of composite waveform SS13-1 but there is no square wave at TP7, use the oscilloscope to check the signal at NAND gate U3B pin 6. The display should be the same as that shown for TP7. If the signal is present, U2B is probably defective.

If the signal is not present at U3B pin 6 use the oscilloscope to check the signals at NAND gates U3D pin 11 and U3A pin 3. The signals should appear as they did at TP5 and TP9 except that they are inverted. If the signals are present U3B or U3C may be defective. If the signal is present at one of the NAND gate outputs but not at the other, replace U3.

If the signal is not present at U3D pin 11 or U3A pin 3, use the digital voltmeter to check the dc level at U2A pin 6. The dc level should be about +4 volts. If U2A pin 6 is at about +4 volts, U3 is defective.

If the +4 volts is not present at U2A pin 6, ground U2A pin 1. If the voltage at U2A pin 6 does not go to about +4 volts, U2 is defective.

If trouble still has not been found, connect the counter to TP3 and the digital voltmeter and the oscilloscope to NAND gate U5A pin 12. The counter readout should be about 210 kHz and U5A pin 12 should be low (about +60 millivolts). If the counter readout is lower or higher than 210 kHz and U5A pin 12 is high, slowly rotate A11R19 through its range while observing the counter and the oscilloscope. As the counter readout passes through the 210 kHz point the oscilloscope display should show a change in dc level; if it does not, U5 or U6 is probably defective.

Test 1-b. If there is no signal at TP2, or the signal is not approximately as shown in the top trace of composite waveform SS13-2, connect the oscilloscope first to TP1, then to U9 pin 8. TP1 and U9 pin 8 signals should be as shown in composite waveform SS13-2. All signal levels are about 4 volts.

To be supplied

◀ N3 VCO
SERVICE SHEET 12

SERVICE SHEET 13 (cont'd)

If the signal is as shown at TP1, U7A or Q12 may be defective.

If the signal is as shown at U9 pin 8 but does not appear at TP1, U9 is probably defective.

If the signal does not appear at U9 pin 8 check the interconnections to the N3 loop and, if necessary, the N3 loop.

Test 1-c. If there is no signal at TP3, or the signal is not approximately as shown in the top trace of composite waveform SS13-3, connect the oscilloscope, in turn, to the points shown in composite waveform SS13-3.

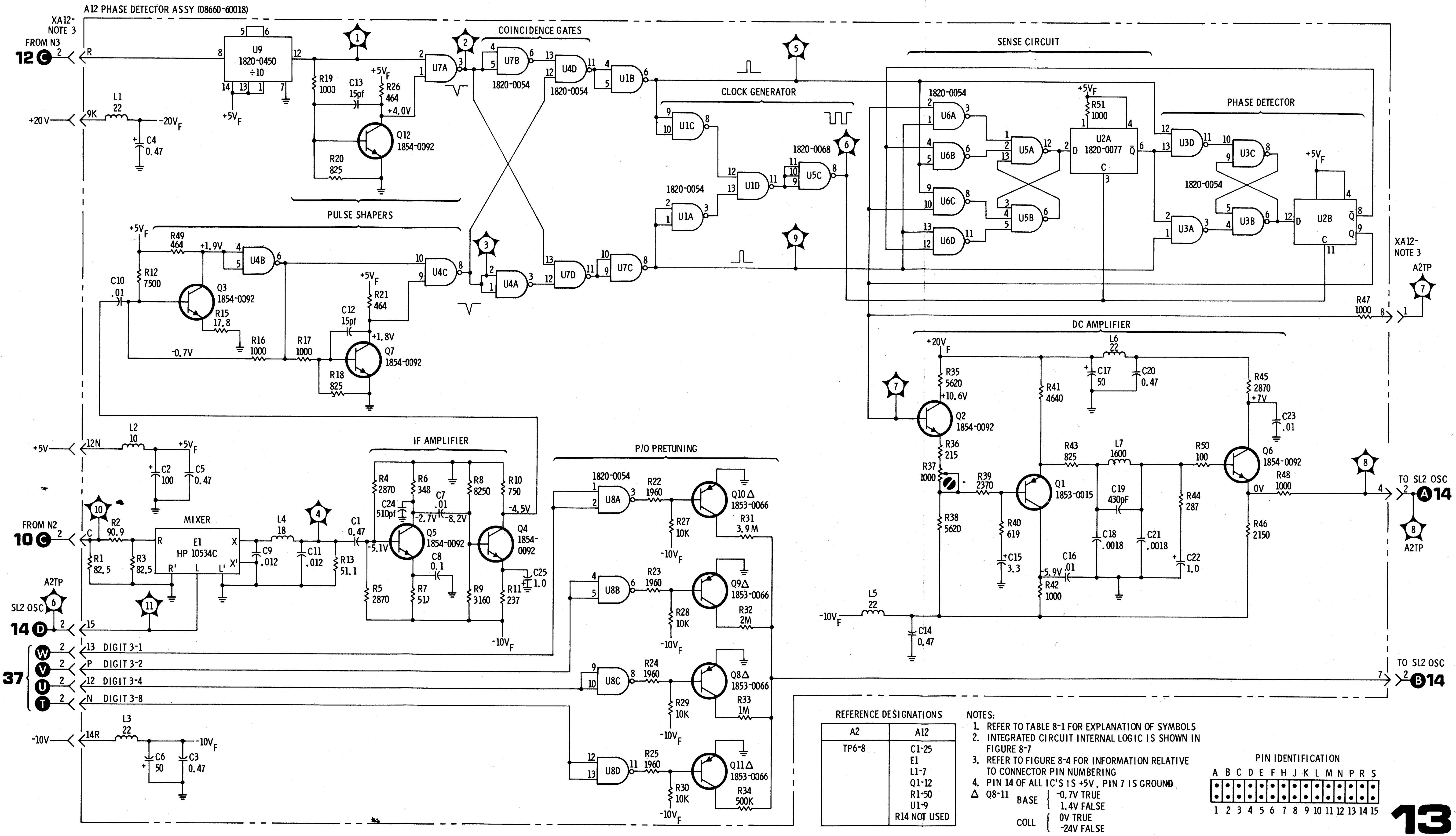
To be supplied

If the signal shown in the second trace from the top of composite waveform SS13-3 is not as shown check Q3, Q7, U4B, U4C and associated components.

If the signal does not appear at Q4-c but the signal at TP4 is present check Q5, Q4 and associated components.

If the signal is not present at TP4 check for signals shown at TP10 and TP11. If both signals are present mixer E1 is probably defective. If either TP10 or TP11 signals are not present, trouble is in the N2 Loop or the SL2 voltage controlled oscillator.

Test 1-d. To check operation of the dc amplifier connect the digital voltmeter to TP8 and rotate A11R19 through its range. The digital voltmeter readout should vary from about −1.5 volt to about +1.5 volt. If the voltage does not vary as A11R19 is adjusted, check Q2, Q1, Q6 and associated components.



REFERENCE DESIGNATIONS	
A2	A12
TP6-8	C1-25 E1 L1-7 Q1-12 R1-50 U1-9 R14 NOT USED

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING
4. PIN 14 OF ALL IC'S IS +5V, PIN 7 IS GROUND.

△ Q8-11 BASE { -0.7V TRUE / 1.4V FALSE; COLL { 0V TRUE / -24V FALSE

Figure 8-20. SL2 Phase Detector Schematic

SERVICE SHEET 14

SUMMING LOOP 2 OSCILLATOR A11

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A11 assembly, a part of the two-assembly SL2, is shown schematically and described on this service sheet. The SL2 Phase Detector assembly (A12) is shown schematically and described on service sheet 13.

When trouble has been isolated to the A11 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL2 circuits the adjustment procedures in Section V paragraph 5-19 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 2 GENERAL

The purpose of Summing Loop 2 (SL2) is to generate digitally controlled rf signals in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. The difference frequency between the SL2 voltage controlled oscillator and the input from the N2 loop is phase locked to the divided-by-ten output of the N3 assembly. The output of SL2 is applied to SL1.

1 PRETUNING AND OSCILLATOR

The A11 assembly contains a voltage controlled oscillator, a digital to analog converter and a circuit to combine the pretuning dc level with the output from the phase detector. The frequency of the voltage controlled oscillator is roughly preset by the pretuning signal from the digital to analog converter circuit. The pretuning signal cannot, by itself, set the oscillator precisely; it does set the frequency within the capture range of the phase lock loop.

U2 is a decoder which converts the BCD information from digit 5 to turn on one of nine transistors in a resistive network. Quad NAND gate U3 turns on one or more transistors (Q17 through Q20) when there is a BCD input from digit 4. Quad NAND gate U8 in the A12 assembly turns on one or more transistors (A12Q8 through A12Q11 also in the A12 assembly) when there is a BCD input from digit 3.

When there is no BCD input (all inputs low), the voltage at TP3 is approximately −25 volts and the oscillator is roughly preset to 30.0000 MHz. As the digital to

analog transistors are switched on the voltage at TP3 decreases (becomes less negative). When the BCD inputs are at 999 the voltage at TP3 is about −5 volts and the oscillator is roughly preset to 20.0001 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the SL2 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volt supply through R19, R20 and R21, a negative source from the digital to analog converter (TP3) and the signal from the SL2 phase detector. The voltage at the summing point is always zero volts.

When TP3 is at approximately −25 volts (all BCD inputs low), most of the current from the +20 volt source flows through Q5, very little flows through Q4. Under these conditions the voltage at Q4-c is about −30 volts. As the voltage at TP3 decreases (gets closer to dc ground level) less current flows through Q5, more flows through Q4 and the voltage at Q4-c decreases.

CR2 through CR11 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that the frequency change is linear with the applied voltage. The voltage at the junction of R52 and R53 is about −27.5 volts. When all BCD inputs are low (Q4-c is at about −30 volts) all of the diodes in the shaper are reverse biased. As the voltage at TP3 decreases (gets closer to −5 volts), current through Q4 increases and the Q4 collector voltage decreases. As the Q4-c voltage decreases first CR11, then CR10, etc are forward biased. As the diodes are forward biased resistors are added in parallel with R37 and R38 to shape the voltage curve to the varactors. Q15 provides a low impedance output to drive the varactors.

Q1 drives U1A which functions as a Schmitt trigger. U1B inverts the signal and applies it to the SL1 phase detector. U1D also inverts the signal and applies it to the SL2 phase detector.

TEST PROCEDURE 1

Test 1-a. Connect the counter to TP4. With the center freuqency set to zero the counter readout should be 30.000000 MHz. Set CF to the settings specified in Table 8-7. Frequency readouts should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

If the frequency readout listed in Table 8-7 are not as shown, check the voltage levels shown for TP5 in the table. If the voltages are incorrect proceed to test procedure 2

If the signal is present use the oscilloscope to check the signals at points shown by composite waveform SS14-1.

ICE SHEET 14

IING LOOP 2 OSCILLATOR A11

lly, causes of malfunctions in the Model 8660B will be isolated to a circuit or assembly as a result of performing the tests specified in the eshooting trees.

11 assembly, a part of the two-assembly SL2, is shown schematically and bed on this service sheet. The SL2 Phase Detector assembly (A12) is shown atically and described on service sheet 13.

trouble has been isolated to the A11 assembly it should be removed and lled using two extender boards. This will provide easy access to test points mponents.

NOTE

> After making repairs to any part of the SL2 circuits the adjustment procedures in Section V paragraph 5-19 should be performed to ensure proper operation of the instrument.

EQUIPMENT REQUIRED (See Table 1-3)

scope (with 10:1 divider probes)
l Voltmeter
onic Counter

IING LOOP 2 GENERAL

urpose of Summing Loop 2 (SL2) is to generate digitally controlled rf in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. ifference frequency between the SL2 voltage controlled oscillator and the from the N2 loop is phase locked to the divided-by-ten output of the N3 bly. The output of SL2 is applied to SL1.

RETUNING AND OSCILLATOR

11 assembly contains a voltage controlled oscillator, a digital to analog rter and a circuit to combine the pretuning dc level with the output from ase detector. The frequency of the voltage controlled oscillator is roughly by the pretuning signal from the digital to analog converter circuit. The ning signal cannot, by itself, set the oscillator precisely; it does set the ency within the capture range of the phase lock loop.

a decoder which converts the BCD information from digit 5 to turn on one e transistors in a resistive network. Quad NAND gate U3 turns on one or transistors (Q17 through Q20) when there is a BCD input from digit 4. NAND gate U8 in the A12 assembly turns on one or more transistors Q8 through A12Q11 also in the A12 assembly) when there is a BCD input digit 3.

there is no BCD input (all inputs low), the voltage at TP3 is approximately olts and the oscillator is roughly preset to 30.0000 MHz. As the digital to

SERVICE SHEET 14 (cont'd)

analog transistors are switched on the voltage at TP3 decreases (becomes less negative). When the BCD inputs are at 999 the voltage at TP3 is about −5 volts and the oscillator is roughly preset to 20.0001 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the SL2 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volt supply through R19, R20 and R21, a negative source from the digital to analog converter (TP3) and the signal from the SL2 phase detector. The voltage at the summing point is always zero volts.

When TP3 is at approximately −25 volts (all BCD inputs low), most of the current from the +20 volt source flows through Q5, very little flows through Q4. Under these conditions the voltage at Q4-c is about −30 volts. As the voltage at TP3 decreases (gets closer to dc ground level) less current flows through Q5, more flows through Q4 and the voltage at Q4-c decreases.

CR2 through CR11 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that the frequency change is linear with the applied voltage. The voltage at the junction of R52 and R53 is about −27.5 volts. When all BCD inputs are low (Q4-c is at about −30 volts) all of the diodes in the shaper are reverse biased. As the voltage at TP3 decreases (gets closer to −5 volts), current through Q4 increases and the Q4 collector voltage decreases. As the Q4-c voltage decreases first CR11, then CR10, etc are forward biased. As the diodes are forward biased resistors are added in parallel with R37 and R38 to shape the voltage curve to the varactors. Q15 provides a low impedance output to drive the varactors.

Q1 drives U1A which functions as a Schmitt trigger. U1B inverts the signal and applies it to the SL1 phase detector. U1D also inverts the signal and applies it to the SL2 phase detector.

TEST PROCEDURE 1

Test 1-a. Connect the counter to TP4. With the center freuqency set to zero the counter readout should be 30.000000 MHz. Set CF to the settings specified in Table 8-7. Frequency readouts should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

> If the frequency readout listed in Table 8-7 are not as shown, check the voltage levels shown for TP5 in the table. If the voltages are incorrect proceed to test procedure 2

If the signal is present use the oscilloscope to check the signals at points shown by composite waveform SS14-1.

SERVICE SHEET 14 (cont'd)

To be supplied

If the signal is present at TP4 but is not present at XA11-1-2 or XA11-1-6, U1 is probably defective.

If the signal is not present at TP4, use the oscilloscope to check for the signal at Q1-b. If the signal in present at Q1-b, check Q1 and NAND gate U1B. If the signal is not present at Q1-b check Q2, Q3 and associated components.

TEST PROCEDURE 2

Test 2-a. Use the digital voltmeter to check the voltages at TP3, TP2 and TP5. These dc levels should be about as shown in Table 8-7 for the center frequencies shown.

NOTE

> These voltages are typical. They will vary from instrument to instrument because of differences in individual varactor characteristics.

If the voltage at TP3 does not change when CF digit 5 is changed to any position, U2 is probably defective. (Verify presence of BCD inputs). If the voltage at TP3 reaches about −25 volts when any CF digit 5 position is set (other than 0) the transistor associated with that number is probably open.

When the voltage at TP3 does not change with a change of the setting of CF digit 4, U3 or the associated transistors may be defective.

When the voltage at TP3 does not change with a change in the setting of CF digit 3, A12U8 or associated transistors may be defective. (This portion of the digital to analog converter is located in the A12 assembly).

SL2 Phase Detector
SERVICE SHEET 13

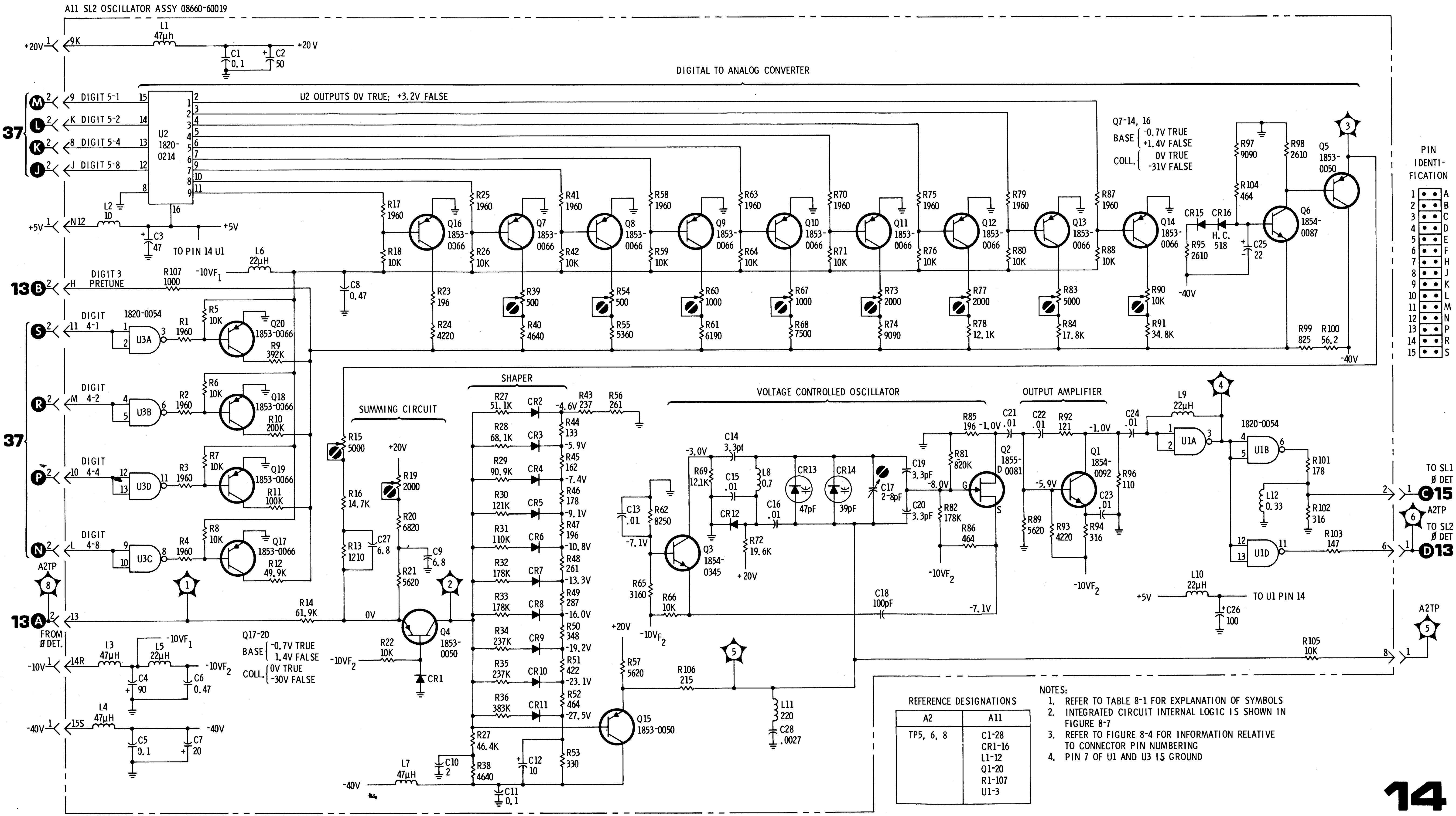
SERVICE SHEET 14 (cont'd)

If the voltages are approximately correct at TP3 but are not correct at either TP2 or TP5, check Q4, Q15 and associated components.

The counter is connected to TP4 for readouts specified in Table 8-7.

Table 8-8. SL2 Frequency Versus Voltage Chart

Center Frequency	Counter Readout	TP3	TP2	TP5
00000 Hz	30.000000 MHz	−25.1 V	−31.6 V	−30.9 V
11100 Hz	28.890000 MHz	−22.8 V	−25.5 V	−24.8 V
22200 Hz	27.780000 MHz	−20.5 V	−20.5 V	−19.9 V
33300 Hz	26.670000 MHz	−18.3 V	−16.4 V	−15.7 V
44400 Hz	25.560000 MHz	−16. V	−13. V	−12.4 V
55500 Hz	24.450000 MHz	−13.8 V	−10.3 V	−9.6 V
66600 Hz	23.340000 MHz	−11.7 V	−8. V	−7.3 V
77700 Hz	22.230000 MHz	−9.5 V	−6.2 V	−5.5 V
88800 Hz	21.120000 MHz	−7.3 V	−4.6 V	−4. V
99900 Hz	20.010000 MHz	−5.3 V	−3.4 V	−2.8 V



REFERENCE DESIGNATIONS	
A2	A11
TP5, 6, 8	C1-28 CR1-16 L1-12 Q1-20 R1-107 U1-3

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING
4. PIN 7 OF U1 AND U3 IS GROUND

14

Figure 8-21. SL2 VCO Schematic

SERVICE SHEET 15

SUMMING LOOP 1 PHASE DETECTOR A15

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A15 assembly, a part of the three-assembly SL1, is shown schematically and described on this Service Sheet. The SL1 Oscillator Assembly (A19) is shown schematically and described on service sheet 17. The SL1 Mixer and D/A Converter Assembly (A18) is shown schematically and described on Service Sheet 16.

When trouble has been isolated to the A15 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-20 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section plug-in.

1 PHASE DETECTOR ASSEMBLY A15

There are two signal inputs to the phase detector assembly. One is the input from the SL2 loop which is shaped by U10D and divided by 100 by U6 and U5. The output of U5 is again shaped by Q5 and U4A to provide negative-going pulses at TP2. The other input to the phase detector is from the SL1 mixer and is the difference frequency between the N1 oscillator and the SL1 voltage controlled oscillator. Q6, U4B, Q4 and U4C shape the signal and provides negative-going pulses at TP3.

The pulse frequency at TP2 and TP3 varies (depending on programming) from 0.200001 to 0.300000 MHz. When the phase lock loop is locked the pulse frequency is the same at TP2 and TP3. The sampling ratio is 1:1.

U9A, U3B, U4D and U9B comprise coincidence gates which inhibit signals which appear simultaneously at TP2 and TP3. Normally, when signals are not present, TP2 and TP3 are both high.

When a signal appears at TP2, U9A pin 3 and U3B pin 4 go high. If there is no signal at TP3, U3B pin 5 is also high; U3B pin 6 goes low and U3C pin 8 goes high. The positive pulse at TP4 drives the clock generator and the sense circuit or the phase detector.

When a signal appears at TP3, U4D pin 11 and U9B pin 5 go high. If there is no signal at TP2, U9B pin 4 is also high; U9B pin 6 goes low and U9D pin 11 goes high. The positive pulse at TP8 drives the clock generator and the sense circuit or the phase detector.

When signals appear simultaneously at TP2 and TP3, U9B pin 4 and U3B pin 5 go low: U9B pin 6 and U3B pin 6 remain high and the signals cannot reach TP4 or TP8.

U7C, U9C, U3D and U3A comprise a clock generator which clocks U2A and U2B each time a signal appears at TP4 or TP8. With no signals present TP4 and TP8 are low. When a positive pulse appears at TP8, U9C pin 8 goes low, U3D pin 11 goes high and a negative-going pulse appears at TP5. When a positive pulse appears at TP4 operation of the circuit is the same except that U7C pin 8 (rather than U9C pin 8 goes low). Since a clock

pulse is generated for each input, the clock pulse frequency at TP5 is the sum of the pulse frequencies at TP4 and TP8. U2A and U2B are clocked by the positive-going trailing edge of the negative clock pulses.

Since the sense circuit does not function when the loop is locked, operation of the phase detector will be described first.

When the loop is phase locked U2A $\overline{Q}$ is held high to enable U1A and U1B. Assume that initially U2B $\overline{Q}$ is high U1D pin 11 is low and U1C pin 8 is high. When a positive pulse from TP8 appears at U1A pin 1, U1A pin 3 goes low and causes a change in state of flip/flop U1D/U1C: U1D pin 11 goes high and U1C pin 8 goes low. The high at U1D pin 11 sets the D input to U2B and the clock pulse causes U2B Q to go high. The following positive pulse at TP4 is applied to U1B pin 5, U1B pin 6 goes low and changes the state of flip/flop U1D/U1C. U1D pin 11 goes low and the clock pulse causes U2B $\overline{Q}$ to again go high. This sequence continues as long as the pulses at TP4 and TP8 alternate.

The signals at TP4 and TP8 are applied to the sense circuit even when the loop is phase locked. They have no effect on the circuit because of the relationship between the Q and $\overline{Q}$ outputs of U2B to the incoming signals.

When U2B is high, NAND gates U8A and U8C are enabled. When the signal from TP4 appears at U8C pin 9, U8C pin 8 goes low; flip/flop U7A/U7B does not change state because U7B pin 3 is low. The signal at U8B pin 4 has no effect because U2B $\overline{Q}$ and U8B pin 5 are low.

When two or more consecutive pulses from either input (TP4 or TP8) occur between pulses from the other input, the sense circuits function to disable the phase detector until the frequency error has been corrected.

As an example of circuit operation, assume that two pulses from TP8 are received between two pulses from TP4, indicating that the SL1 frequency is too high. When the first pulse from TP8 is received U1A pin 3 goes low, U1D pin 11 goes high to set the D input to U2B and the clock pulse causes U2B Q to go high. When the second consecutive pulse is received from TP8, U8A has been enabled by the high Q output of U2B. U8A pin 3 goes low and causes flip/flop U7A/U7B to change state. When the D input to U2A goes high, the clock pulse causes U2A $\overline{Q}$ to go low and inhibit NAND gates U1A and U1B. If a third pulse from TP8 is received prior to receipt of a signal from TP4, U8A pin 3 will again go low but will not affect flip/flop U7A/U7B because U7A pin 13 is low.

When a pulse is received from TP4, U2B Q is still high and U8C pin 8 will go low and change the state of flip/flop U7A/U7B. When the D input to U2A goes low the clock pulse will cause U2A $\overline{Q}$ to go high and enable U1A and U1B. The propagation time of the signal through the sense circuit is long enough for the pulse from TP4 to have ended before U1B is enabled so the state of flip/flop U1D/U1C does not change.

The next pulse from TP8 will again cause U8A pin 3 to go low and change the state of flip/flop U7A/U7B. With the D input of U2A high again, the clock pulse causes U2A $\overline{Q}$ to go low and inhibit U1A and U1B. The signal applied to U1A has no effect on flip/flop U1D/U1C because U1D pin 12 is low.

The sense circuit continues operation in the manner described above until two consecutive pulses are received at TP4 between two pulses at TP8. When this occurs the first pulse causes U8C pin 8 to go low and change the state of flip/flop U7A/U7B. With the D input to U2A low the clock pulse will cause U2A $\overline{Q}$ to go high and enable NAND gates U1A and U1B. Because of the propagation time through the sense circuit, the pulse will have ended before U1B is enabled. The second consecutive pulse from TP4 again causes U8C pin 8 to go low, but because U7B pin 3 is now low, no change in state occurs in flip/flop U7A/U7B. Since U1B is enabled, U1B pin 6 goes low and causes flip/flop U1D/U1C to change state. With the D input of U2B low, the clock pulse will cause U2B $\overline{Q}$ output to go high.

Phase lock has been achieved and the loop will remain locked as long a
the same frequency are received alternately at TP4 and TP8.

When the SL1 frequency is too low, U2B Q is low. When the SL1 freque
high, U2B Q is high.

DC amplifier Q1, Q2, Q3 and associated components filter the Q outp
and applies it to a summing circuit in the A19 assembly to precisely c
voltage controlled oscillator.

TEST PROCEDURE 1

Test 1-a. Connect the oscilloscope input to test points shown by
waveform SS15-1. This composite waveform illustrates correct wave
timing relationships for the points tested. All signals are about 4
amplitude.

NOTE

> The oscilloscope was triggered from TP1 for all waveforms.

If the pulses are not present at TP2 proceed to test 1-b.

If the pulses are not present at TP3 proceed to test 1-c.

If the pulses are present at TP2 and TP3, but opposite polarity puls
present at TP4 and/or TP8, check the NAND gates between TP2 and T
and TP8 as appropriate.

If the positive-going pulses are present at TP4 and TP8, but negative-go
are not present at TP5 for each of the pulses, check NAND gates U3A, U
and U9C as appropriate.

To be supplied

If the pulses are approximately as shown in the top five traces of
waveform SS15-1 but there is no square wave at TP6, use the oscil
check the signal at NAND gate U1D pin 11. The display should be th
that shown for TP6. If the signal is present, U2B is probably defective.

If the signal is not present at U1D pin 11 use the oscilloscope to check
at NAND gates U1A pin 3 and U1B pin 6. The signals should appear as t
TP4 and TP8 except that they are inverted. If the signals are present, U1
may be defective. If the signal is present at one of the NAND gates but
other, replace U1.

If the signal is not present at U1A pin 3 or U1B pin 6, use the digital vo
check the dc level at U2A pin 6. If U2A pin 6 is about +4 volts, U1 is de

If the +4 volts is not present at U2A pin 6, ground U2A pin 1. If the
U2A pin 6 does not go to about +4 volts, U2 is defective.

SL2 VCO
SERVICE S

lock pulse frequency at TP5 is the sum of P8. U2A and U2B are clocked by the ve clock pulses.

ion when the loop is locked, operation of t.

$\overline{Q}$ is held high to enable U1A and U1B. J1D pin 11 is low and U1C pin 8 is high. rs at U1A pin 1, U1A pin 3 goes low and)/U1C: U1D pin 11 goes high and U1C pin ets the D input to U2B and the clock pulse g positive pulse at TP4 is applied to U1B s the state of flip/flop U1D/U1C. U1D pin es U2B $\overline{Q}$ to again go high. This sequence nd TP8 alternate.

l to the sense circuit even when the loop is n the circuit because of the relationship the incoming signals.

nd U8C are enabled. When the signal from 8 goes low; flip/flop U7A/U7B does not v. The signal at U8B pin 4 has no effect

s from either input (TP4 or TP8) occur the sense circuits function to disable the has been corrected.

ime that two pulses from TP8 are received ting that the SL1 frequency is too high. ved U1A pin 3 goes low, U1D pin 11 goes the clock pulse causes U2B Q to go high. eceived from TP8, U8A has been enabled 3 goes low and causes flip/flop U7A/U7B J2A goes high, the clock pulse causes U2A J1A and U1B. If a third pulse from TP8 is om TP4, U8A pin 3 will again go low but se U7A pin 13 is low.

B Q is still high and U8C pin 8 will go low J7B. When the D input to U2A goes low go high and enable U1A and U1B. The the sense circuit is long enough for the U1B is enabled so the state of flip/flop

use U8A pin 3 to go low and change the) input of U2A high again, the clock pulse A and U1B. The signal applied to U1A has U1D pin 12 is low.

in the manner described above until two between two pulses at TP8. When this to go low and change the state of flip/flop w the clock pulse will cause U2A $\overline{Q}$ to go l U1B. Because of the propagation time l have ended before U1B is enabled. The n causes U8C pin 8 to go low, but because e occurs in flip/flop U7A/U7B. Since U1B auses flip/flop U1D/$\overline{U1C}$ to change state. pulse will cause U2B $\overline{Q}$ output to go high.

SERVICE SHEET 15 (cont'd)

Phase lock has been achieved and the loop will remain locked as long as pulses at the same frequency are received alternately at TP4 and TP8.

When the SL1 frequency is too low, U2B Q is low. When the SL1 frequency is too high, U2B Q is high.

DC amplifier Q1, Q2, Q3 and associated components filter the Q output of U2B and applies it to a summing circuit in the A19 assembly to precisely control the voltage controlled oscillator.

TEST PROCEDURE 1

Test 1-a. Connect the oscilloscope input to test points shown by composite waveform SS15-1. This composite waveform illustrates correct waveforms and timing relationships for the points tested. All signals are about 4 volts in amplitude.

NOTE

The oscilloscope was triggered from TP1 for all waveforms.

If the pulses are not present at TP2 proceed to test 1-b.

If the pulses are not present at TP3 proceed to test 1-c.

If the pulses are present at TP2 and TP3, but opposite polarity pulses are not present at TP4 and/or TP8, check the NAND gates between TP2 and TP4 or TP3 and TP8 as appropriate.

If the positive-going pulses are present at TP4 and TP8, but negative-going pulses are not present at TP5 for each of the pulses, check NAND gates U3A, U3D, U7C, and U9C as appropriate.

To be supplied

If the pulses are approximately as shown in the top five traces of composite waveform SS15-1 but there is no square wave at TP6, use the oscilloscope to check the signal at NAND gate U1D pin 11. The display should be the same as that shown for TP6. If the signal is present, U2B is probably defective.

If the signal is not present at U1D pin 11 use the oscilloscope to check the signals at NAND gates U1A pin 3 and U1B pin 6. The signals should appear as they did at TP4 and TP8 except that they are inverted. If the signals are present, U1C or U1D may be defective. If the signal is present at one of the NAND gates but not at the other, replace U1.

If the signal is not present at U1A pin 3 or U1B pin 6, use the digital voltmeter to check the dc level at U2A pin 6. If U2A pin 6 is about +4 volts, U1 is defective.

If the +4 volts is not present at U2A pin 6, ground U2A pin 1. If the voltage at U2A pin 6 does not go to about +4 volts, U2 is defective.

SL2 VCO
◀ SERVICE SHEET 14

SERVICE SHEET 15 (cont'd)

If the cause of trouble still has not been found, connect the counter to TP3 and the digital voltmeter and oscilloscope to NAND gate U7A pin 12. The counter readout should be about 300.000 kHz (center frequency set to zero) and U7A pin 12 should be low (about +70 millivolts). If the counter readout is lower or higher than 300 kHz and U5A pin 12 is high, slowly rotate A15R14 through its range while observing the counter and the oscilloscope. As the counter readout passes through the 300 kHz point the oscilloscope display should show a change in level; if it does not, U7 or U8 is probably defective.

Test 1-b. If there is no signal at TP2 or the signal is not approximately as shown in the top trace of composite waveform SS15-2, connect the oscilloscope first to TP2, then U6 pin 12, U6 pin 8 and finally to XA15-2-14. In making the checks in the order shown, the point at which the correct signal is first observed is followed by the defective circuit. If the signal is not present at XA15-2-14, check the interconnections to the SL2 loop and, if necessary, the SL2 loop.

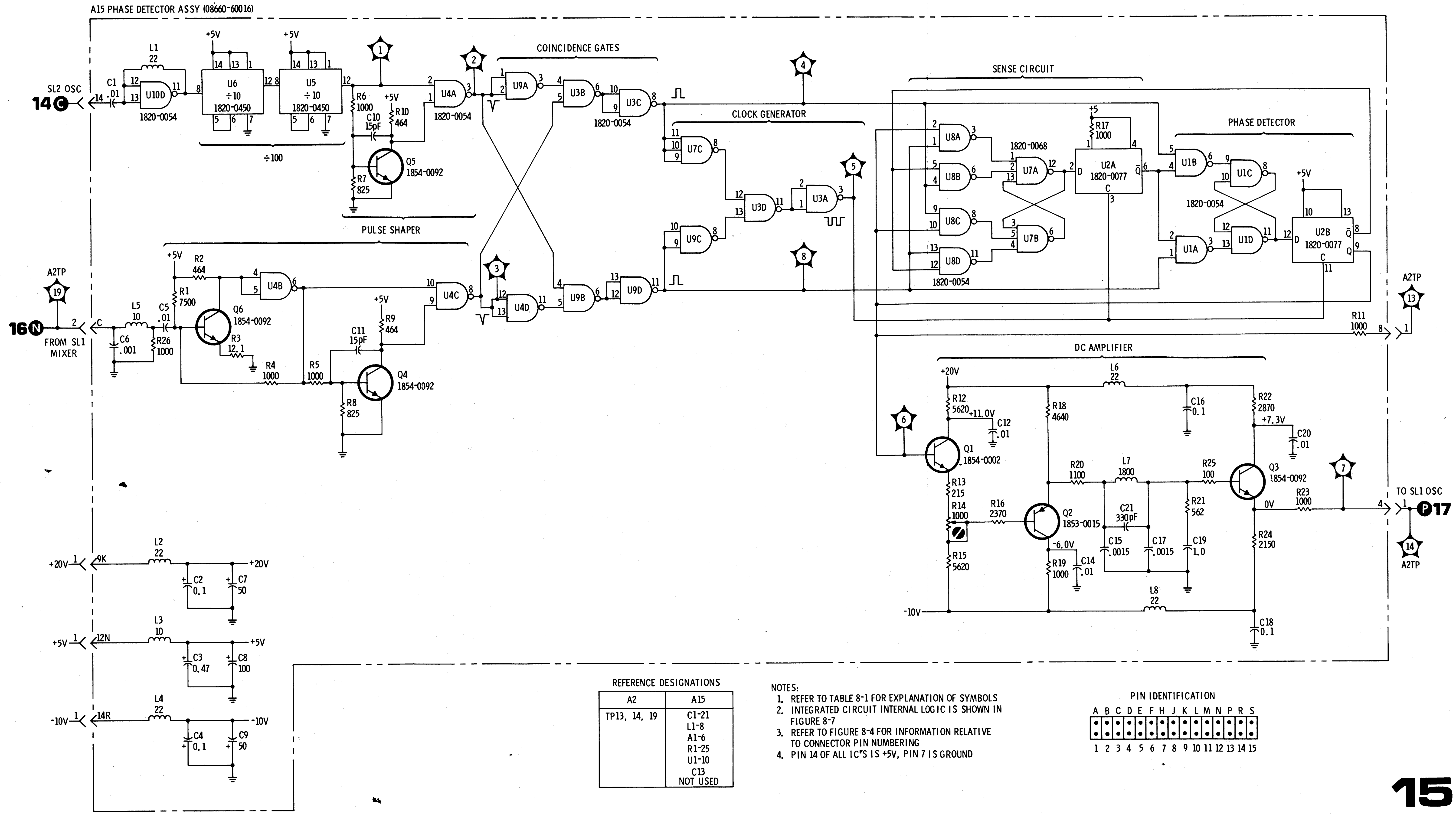
To be supplied

Test 1-c. If there is no signal at TP3 or the signal is not approximately as shown in the top trace fo composite waveform SS15-3 connect the oscilloscope first to U4 pin 6, then to U4 pin 4 or 5 and finally to XA15-2-C.

To be supplied

In making the checks in the order shown, the point at which the signal is first observed is followed by the defective circuit. If the signal is not present at XA15-2-C check the interconnections to the A18 assembly and, if necessary, the A18 assembly.

Test 1-d. To check operation of the dc amplifier connect the digital voltmeter to Q3-e, ground TP7, and rotate A15R14 through its range. The digital voltmeter readout should vary from about −1.5 volts to about +1.5 volts. If the voltage does not vary as A15R14 is adjusted, check Q1, Q2, Q3 and associated components.



REFERENCE DESIGNATIONS

A2	A15
TP13, 14, 19	C1-21 L1-8 A1-6 R1-25 U1-10 C13 NOT USED

NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING
4. PIN 14 OF ALL IC'S IS +5V, PIN 7 IS GROUND

15

Figure 8-22. SL1 Phase Detector Schematic

SERVICE SHEET 16

SUMMING LOOP 1 MIXER AND D TO A A18

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A18 assembly, a part of the three-assembly SL1, is shown schematically and described on this service sheet. The SL1 Phase Detector Assembly (A15) is shown schematically and described on Service Sheet 15. The SL1 Oscillator Assembly (A19) is shown schematically and described on Service Sheet 17.

When trouble has been isolated to the A18 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-20 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section output plug-in.

1 MIXER AND AMPLIFIERS

E1 is a double balanced mixer which mixes the output of the SL1 voltage controlled oscillator with the output of the N1 loop and provides an output which is the difference frequency of the two inputs.

Q14 and Q1 amplify the input from the SL1 voltage controlled oscillator.

Q2, Q15, Q18 and associated components amplify the output from the mixer before applying it to the phase detector circuit in the A15 assembly.

TEST PROCEDURE 1

Test 1-a. With the center frequency set to zero use the counter and the oscilloscope to check for the following (approximately sine wave) signals:

TP5 300.000 kHz at about 4 volts p/p
TP4 (oscilloscope only) 300 kHz at about 0.1 volt p/p
TP3 29.700000 MHz at about 0.5 volt p/p
Q1-e 30.000000 MHz at about 1.1 volt p/p
TP2 30.000000 MHz at about 0.5 volts p/p

◀ *SL1 Phase Detector* SERVICE SHEET 15

SERVICE SHEET 16 (cont'd)

2 DIGITAL TO ANALOG CONVERTER

U3 is a decoder which converts the BCD inputs from digit 7 to an output that will turn on one of nine transistors in a resistive network. Quad NAND gates U2 and U1 turn on one or more transistors connected to their outputs in a resistive network. U2 and U1 are controlled by digits 6 and 5 respectively.

The current flow through Q4 and the bias for Q3 is determined by which of the transistors in the resistive network are saturated. The dc level at TP1 is determined by which transistors are on. This dc level is applied to a summing circuit in the A19 assembly and used to roughly pretune the voltage controlled oscillator. When the BCD input is 000 the dc level at TP1 is about −25 volts. When the BCD input is 999 the dc level is about −5 volts.

TEST PROCEDURE 2

Test 2-a. Connect the digital voltmeter to TP1 and the counter to TP5. Refer to Table 8-8 for CF settings, counter readouts, and approximate voltage levels.

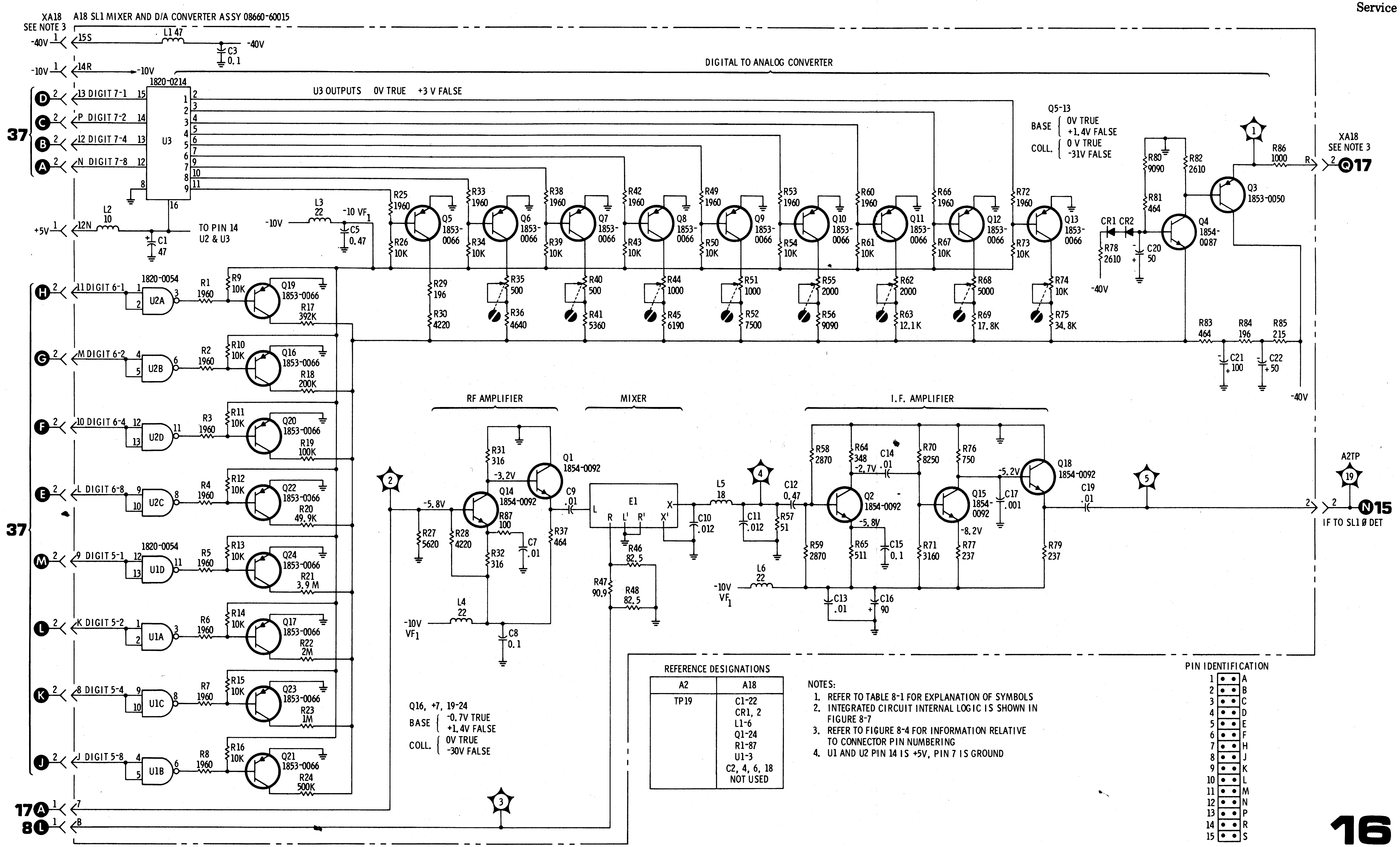
NOTE

> The voltage readings are typical and may vary greatly from that shown due to differences in varactor characteristics. The important point to note is the ratio of change as the center frequency is changed.

If the voltage ratio changes about as shown but the frequency requirements are not met, trouble is probably in the oscillator assembly or the phase detector assembly.

Table 8-9. SL1 Frequency Versus Voltage Chart

Center Frequency	Frequency TP5	Voltage TP1
0000000 Hz	300.000 kHz	−25.5 V
1110000 Hz	290.000 kHz	−23.4 V
2220000 Hz	280.000 kHz	−21.0 V
3330000 Hz	270.000 kHz	−18.8 V
4440000 Hz	260.000 kHz	−16.6 V
5550000 Hz	250.000 kHz	−14.3 V
6660000 Hz	240.000 kHz	−12.1 V
7770000 Hz	230.000 kHz	−9.9 V
8880000 Hz	220.000 kHz	−7.7 V
9990000 Hz	210.000 kHz	−5.4 V
9999999 Hz	200.000 kHz	−5.4 V



A2	A18
TP19	C1-22 CR1, 2 L1-6 Q1-24 R1-87 U1-3 C2, 4, 6, 18 NOT USED

REFERENCE DESIGNATIONS

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING
4. U1 AND U2 PIN 14 IS +5V, PIN 7 IS GROUND

Figure 8-23. SL1 Mixer and D/A Converter Schematic

SERVICE SHEET 17

SUMMING LOOP 1 OSCILLATOR A19

Normally, causes of malfunctions in the Model 8660B will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A19 assembly, a part of the three-assembly SL2, is shown schematically and described on this service sheet. The SL1 Mixer and D/A converter Assembly (A18) is shown schematically and described on Service Sheet 16. The SL1 Phase Detector Assembly (A15) is shown schematically and described on Service Sheet 15.

When trouble has been isolated to the A19 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

> After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-20 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section plug-in.

1 SUMMING AMPLIFIER

Q6 is a summing amplifier which combines the output of the digital to analog converter and the signal from the SL1 phase detector. The summing point (Q6-e) sums the current from three sources; a current source from the +20 volt supply through R9, R10 and R11, a negative source from the digital to analog converter through R3, R7 and R68, and the signal from the SL1 phase detector through R6. The dc level at the summing point is held at zero volts.

When the input at XA19-2-J is about —25 volts (all BCD inputs to A18 low) most of the current from the +20 volt source flows through A18Q3; very little flows through Q6. Under these conditions the voltage at Q6-c is about —30 volts. As the voltage at XA19-2-J decreases (becomes less negative), less current flows through A18Q3, more flows through Q6, and the voltage at Q6-c decreases (becomes less negative).

SERVICE SHEET 17 (cont'd)

CR1 through CR10 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that frequency change is linear with voltage change. The voltage at the junction of R32 and R39 is about —27.5 volts. When all BCD input to the A18 assembly are low, Q6-c is about —30 volts and all of the diodes in the shaper are reverse biased. As the voltage from the digital to analog converter decreases (gets closer to —5 volts) current through Q6 increases and the Q6 collector voltage decreases. As the Q6-c voltage decreases first CR10, then CR9, etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R35 and R38 to shape the voltage curve to the varactors. Q7 provides a low impedance output to drive the varactors.

TEST PROCEDURE 1

Test 1-a. Connect the digital voltmeter to TP1 and set the center frequency as shown in Table 8-9.

NOTE

> The voltage readings are typical and may vary greatly from that shown due to differences in varactor characteristics. The important point to note is the ratio of change as the center frequency is changed.

If the voltage at TP1 does not change as the CF are changed check the input from the digital to analog converter (A18) at XA19-2-J. If the voltage levels at this point do not change as the CF is changed, trouble is probably in the A18 assembly.

If the voltage level from the digital to analog converter does change, but the level at TP1 does not, check Q6, Q7 and associated components.

2 VOLTAGE CONTROLLED OSCILLATOR AND AMPLIFIERS

Q5, Q4 and associated components comprise a voltage controlled oscillator. C17, C20 and C21 provide isolation for the dc levels required to bias the varactors. C19 provides the feedback necessary to sustain oscillation. The resonant tank circuit is coupled to Q4 by capacitive divider C20 and C21. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source.

Q3 is a power splitter which drives two two-stage amplifiers. One amplifier output is applied to the RF Section plug-in and the other is applied to the mixer in the A18 assembly.

TEST PROCEDURE 2

Test 2-a. Connect the oscilloscope to TP3 then to TP4. The sine wave at both test points should be about 0.3 volts p/p.

SL1 Mixer and D/A
◀ SERVICE SHEET 16

Model 8660B will be isolated to a circuit
erforming the tests specified in the

sembly SL2, is shown schematically and
.1 Mixer and D/A converter Assembly
ed on Service Sheet 16. The SL1 Phase
atically and described on Service Sheet

.19 assembly it should be removed and
is will provide easy access to test points

TE

part of the SL1 circuits the
n V paragraph 5-20 should be
ation of the instrument.

ble 1-3)

.1) is to generate digitally controlled rf
00000 MHz in selectable increments as
oscillator is phase locked to the divided
and the difference frequency of the N1
t of SL1 is applied to the RF Section

ines the output of the digital to analog
ase detector. The summing point (Q6-e)
urrent source from the +20 volt supply
urce from the digital to analog converter
om the SL1 phase detector through R6.
at zero volts.

volts (all BCD inputs to A18 low) most
flows through A18Q3; very little flows
oltage at Q6-c is about —30 volts. As the
less negative), less current flows through
voltage at Q6-c decreases (becomes less

SERVICE SHEET 17 (cont'd)

CR1 through CR10 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that frequency change is linear with voltage change. The voltage at the junction of R32 and R39 is about —27.5 volts. When all BCD input to the A18 assembly are low, Q6-c is about —30 volts and all of the diodes in the shaper are reverse biased. As the voltage from the digital to analog converter decreases (gets closer to —5 volts) current through Q6 increases and the Q6 collector voltage decreases. As the Q6-c voltage decreases first CR10, then CR9, etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R35 and R38 to shape the voltage curve to the varactors. Q7 provides a low impedance output to drive the varactors.

TEST PROCEDURE 1

Test 1-a. Connect the digital voltmeter to TP1 and set the center frequency as shown in Table 8-9.

NOTE

The voltage readings are typical and may vary greatly from that shown due to differences in varactor characteristics. The important point to note is the ratio of change as the center frequency is changed.

If the voltage at TP1 does not change as the CF are changed check the input from the digital to analog converter (A18) at XA19-2-J. If the voltage levels at this point do not change as the CF is changed, trouble is probably in the A18 assembly.

If the voltage level from the digital to analog converter does change, but the level at TP1 does not, check Q6, Q7 and associated components.

2 VOLTAGE CONTROLLED OSCILLATOR AND AMPLIFIERS

Q5, Q4 and associated components comprise a voltage controlled oscillator. C17, C20 and C21 provide isolation for the dc levels required to bias the varactors. C19 provides the feedback necessary to sustain oscillation. The resonant tank circuit is coupled to Q4 by capacitive divider C20 and C21. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source.

Q3 is a power splitter which drives two two-stage amplifiers. One amplifier output is applied to the RF Section plug-in and the other is applied to the mixer in the A18 assembly.

TEST PROCEDURE 2

Test 2-a. Connect the oscilloscope to TP3 then to TP4. The sine wave at both test points should be about 0.3 volts p/p.

SL1 Mixer and D/A
SERVICE SHEET 16

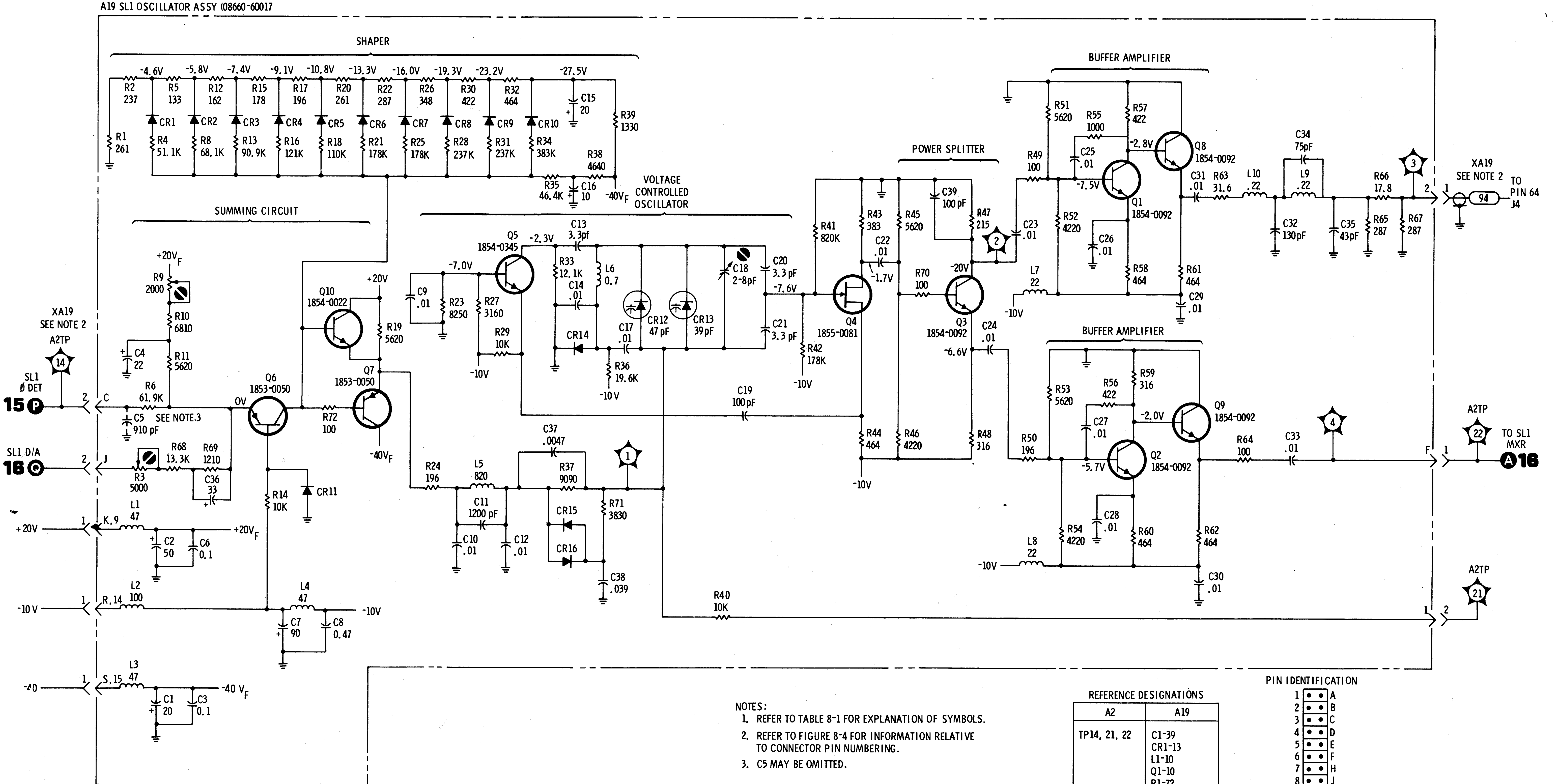
SERVICE SHEET 17 (cont'd)

If the signal is not present at either TP3 or TP4 connect the oscilloscope to Q3-b. The signal level should be about 0.2 volts p/p. If the signal is present at Q3-b but was not present at TP3 or TP4, Q3 is probably defective. If the signal is not present at Q3-b, check Q5, Q4 and associated components.

Test 2-b. Connect the counter to TP3 or TP4 and check for correct frequencies at the CF shown in Table 8-9.

Table 8-10. Varactor Bias Versus Frequency SL1

Center Frequency	Frequency TP3 or TP4	Voltage TP1
0000000 Hz	30.000000 MHz	—30.7 V
1110000 Hz	28.890000 MHz	—25.3 V
2220000 Hz	27.780000 MHz	—21.2 V
3330000 Hz	26.670000 MHz	—17.2 V
4440000 Hz	25.560000 MHz	—13.4 V
5550000 Hz	24.450000 MHz	—10.6 V
6660000 Hz	23.340000 MHz	—8.2 V
7770000 Hz	22.230000 MHz	—6.3 V
8880000 Hz	21.120000 MHz	—4.7 V
9990000 Hz	20.010000 MHz	—3.3 V
9999999 Hz	20.000001 MHz	—3.2 V



NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING.
3. C5 MAY BE OMITTED.

REFERENCE DESIGNATIONS

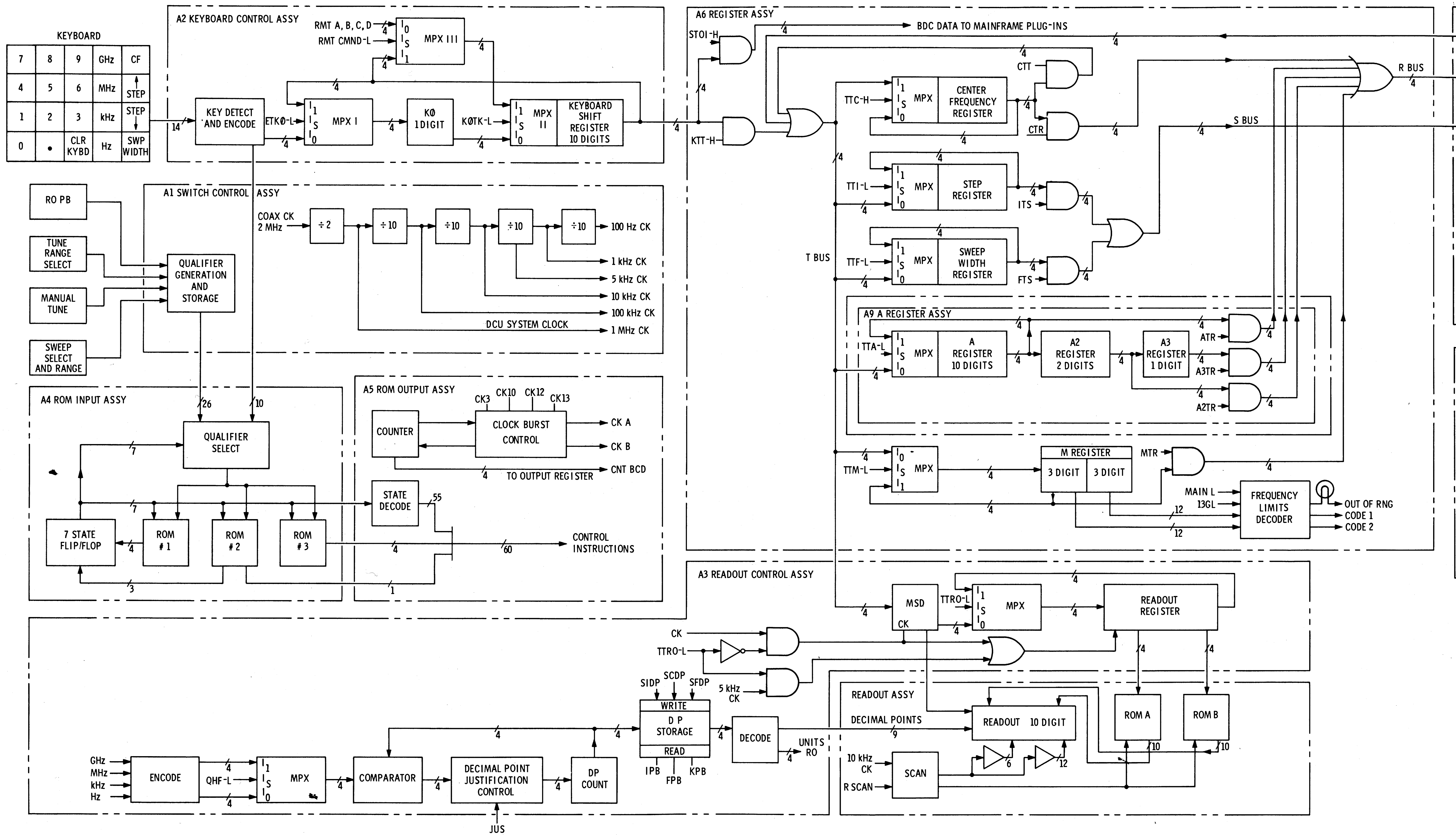
A2	A19
TP14, 21, 22	C1-39 CR1-13 L1-10 Q1-10 R1-72
R7 NOT USED	

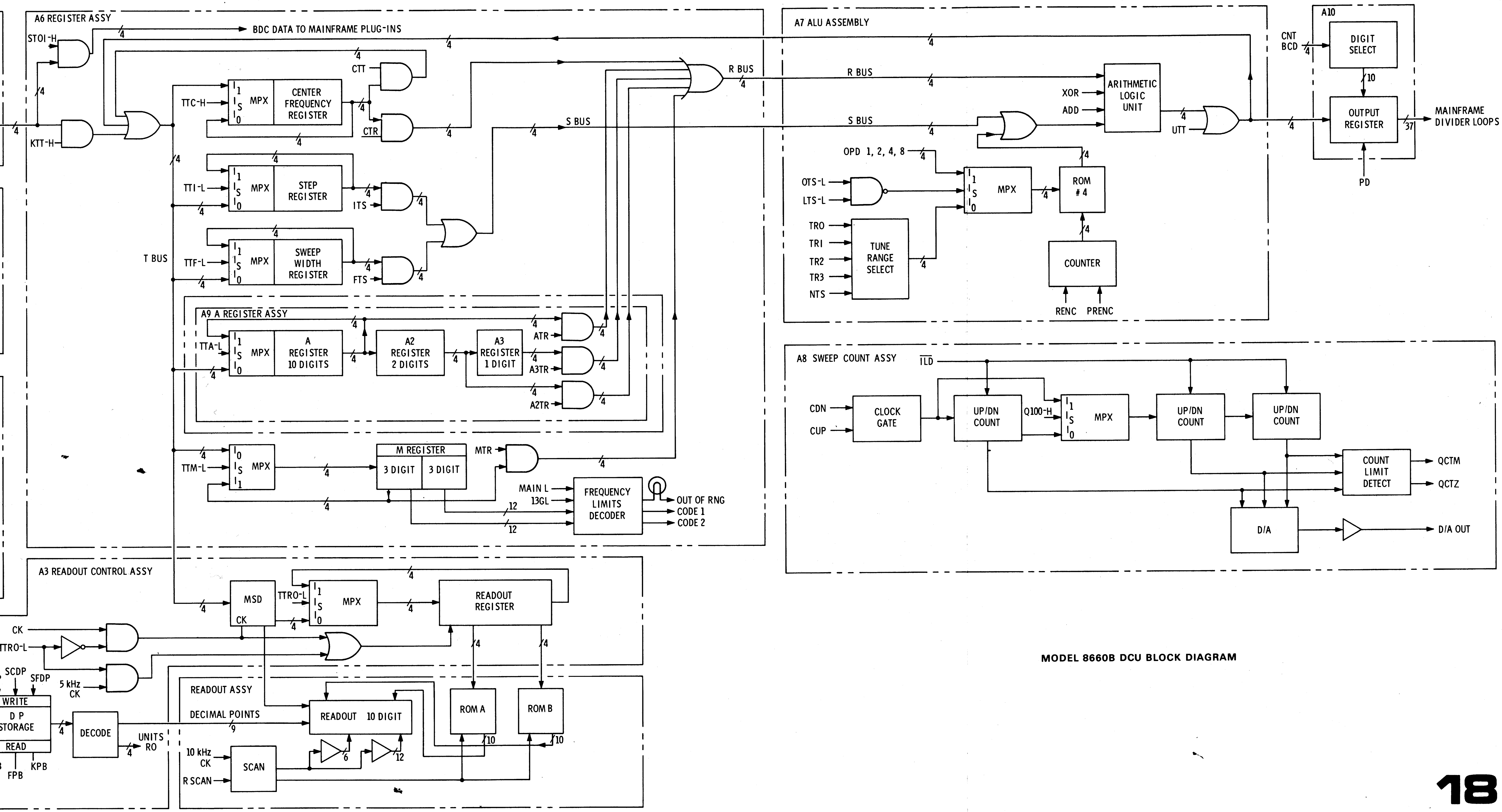
PIN IDENTIFICATION

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

17

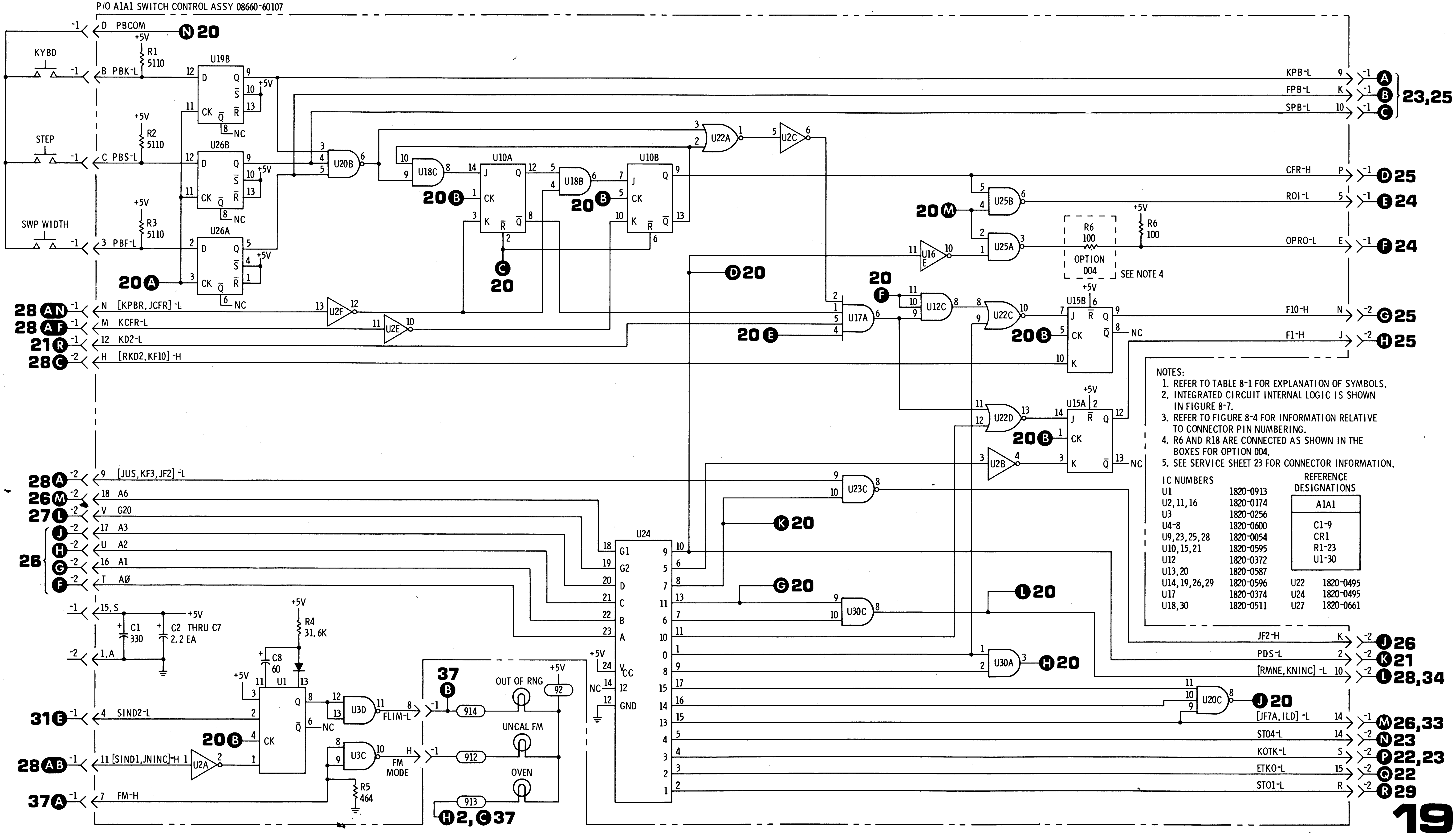
Figure 8-24. SL1 VCO Schematic


KEYBOARD
7 8 9 GHz CF
4 5 6 MHz STEP
1 2 3 kHz STEP
0 • CLR KYBD Hz SWP WIDTH
A2 KEYBOARD CONTROL ASSY
RMT A, B, C, D
RMT CMND-L
MPX III
KEY DETECT AND ENCODE
ETKØ-L
MPX I
KØ 1 DIGIT
KØTK-L
MPX II
KEYBOARD SHIFT REGISTER 10 DIGITS
RO PB
TUNE RANGE SELECT
MANUAL TUNE
SWEEP SELECT AND RANGE
QUALIFIER GENERATION AND STORAGE
A1 SWITCH CONTROL ASSY
COAX CK 2 MHz
÷2
÷10
100 Hz CK
1 kHz CK
5 kHz CK
10 kHz CK
100 kHz CK
DCU SYSTEM CLOCK
1 MHz CK
A4 ROM INPUT ASSY
QUALIFIER SELECT
7 STATE FLIP/FLOP
ROM #1
ROM #2
ROM #3
A5 ROM OUTPUT ASSY
COUNTER
CLOCK BURST CONTROL
CK3 CK10 CK12 CK13
CK A
CK B
CNT BCD
TO OUTPUT REGISTER
STATE DECODE
CONTROL INSTRUCTIONS
A6 REGISTER ASSY
STOI-H
KTT-H
BDC DATA TO MAINFRAME PLUG-INS
T BUS
TTC-H
MPX
CENTER FREQUENCY REGISTER
CTT
CTR
R BUS
S BUS
TTI-L
STEP REGISTER
ITS
TTF-L
SWEEP WIDTH REGISTER
FTS
A9 A REGISTER ASSY
TTA-L
A REGISTER 10 DIGITS
A2 REGISTER 2 DIGITS
A3 REGISTER 1 DIGIT
ATR
A3TR
A2TR
TTM-L
M REGISTER
3 DIGIT
MTR
MAIN L
13GL
FREQUENCY LIMITS DECODER
OUT OF RNG
CODE 1
CODE 2
A3 READOUT CONTROL ASSY
MSD
TTRO-L
READOUT REGISTER
CK
5 kHz CK
SIDP SCDP SFDP
WRITE
D P STORAGE
READ
IPB FPB KPB
DECODE
UNITS RO
READOUT ASSY
DECIMAL POINTS
READOUT 10 DIGIT
ROM A
ROM B
10 kHz CK
R SCAN
SCAN
GHz
MHz
kHz
Hz
ENCODE
QHF-L
COMPARATOR
DECIMAL POINT JUSTIFICATION CONTROL
DP COUNT
JUS



MODEL 8660B DCU BLOCK DIAGRAM

Figure 8-25. DCU Block Diagram A1



NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING.
4. R6 AND R18 ARE CONNECTED AS SHOWN IN THE BOXES FOR OPTION 004.
5. SEE SERVICE SHEET 23 FOR CONNECTOR INFORMATION.

IC NUMBERS	
U1	1820-0913
U2, 11, 16	1820-0174
U3	1820-0256
U4-8	1820-0600
U9, 23, 25, 28	1820-0054
U10, 15, 21	1820-0595
U12	1820-0372
U13, 20	1820-0587
U14, 19, 26, 29	1820-0596
U17	1820-0374
U18, 30	1820-0511
U22	1820-0495
U24	1820-0495
U27	1820-0661

REFERENCE DESIGNATIONS
A1A1
C1-9
CR1
R1-23
U1-30

Figure 8-26. A1A1 Switch Control Assy (1 of 2)

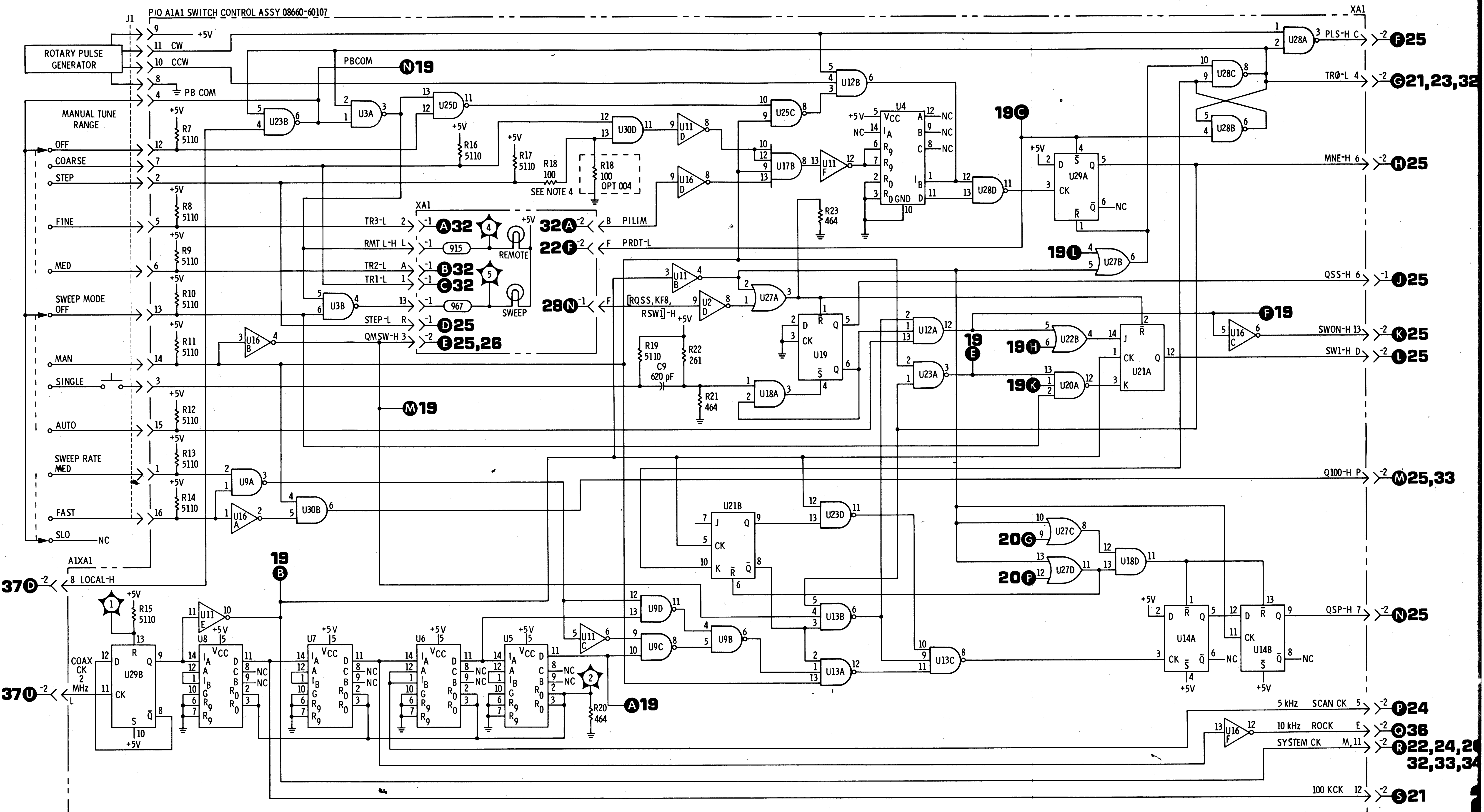


Figure 8-26. A1A1 Switch Control A

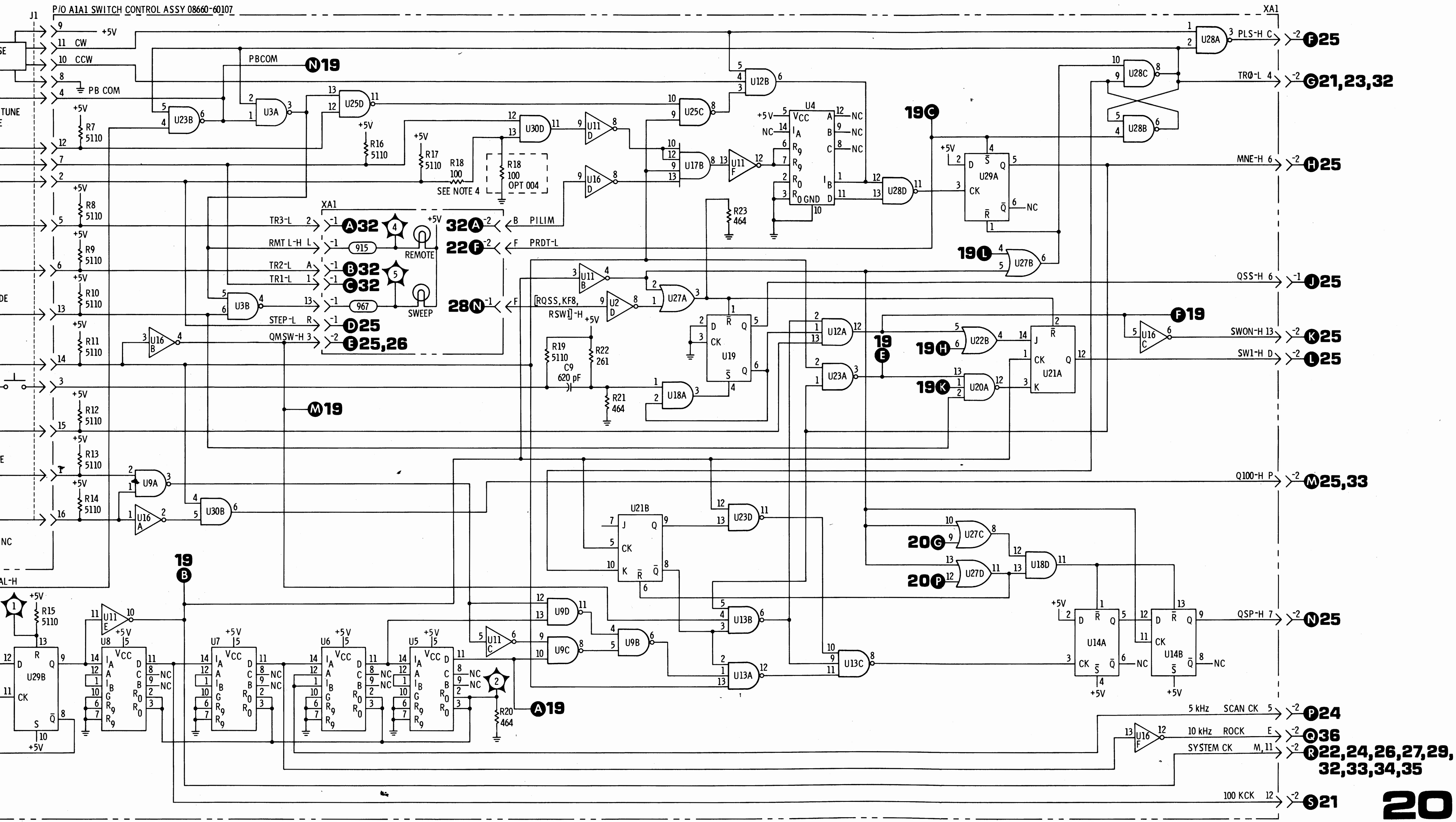


Figure 8-26. A1A1 Switch Control Assy (2 of 2)

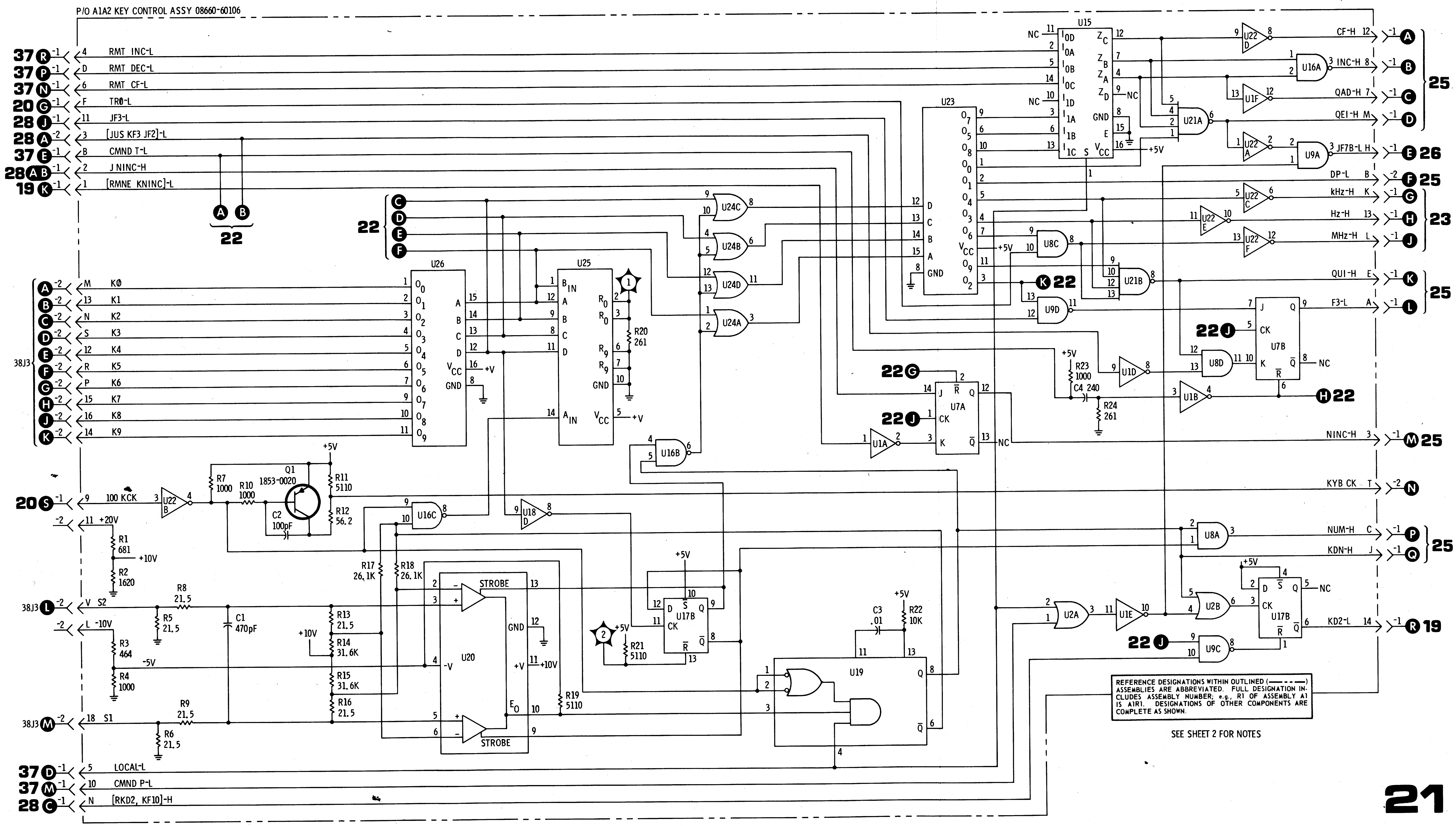
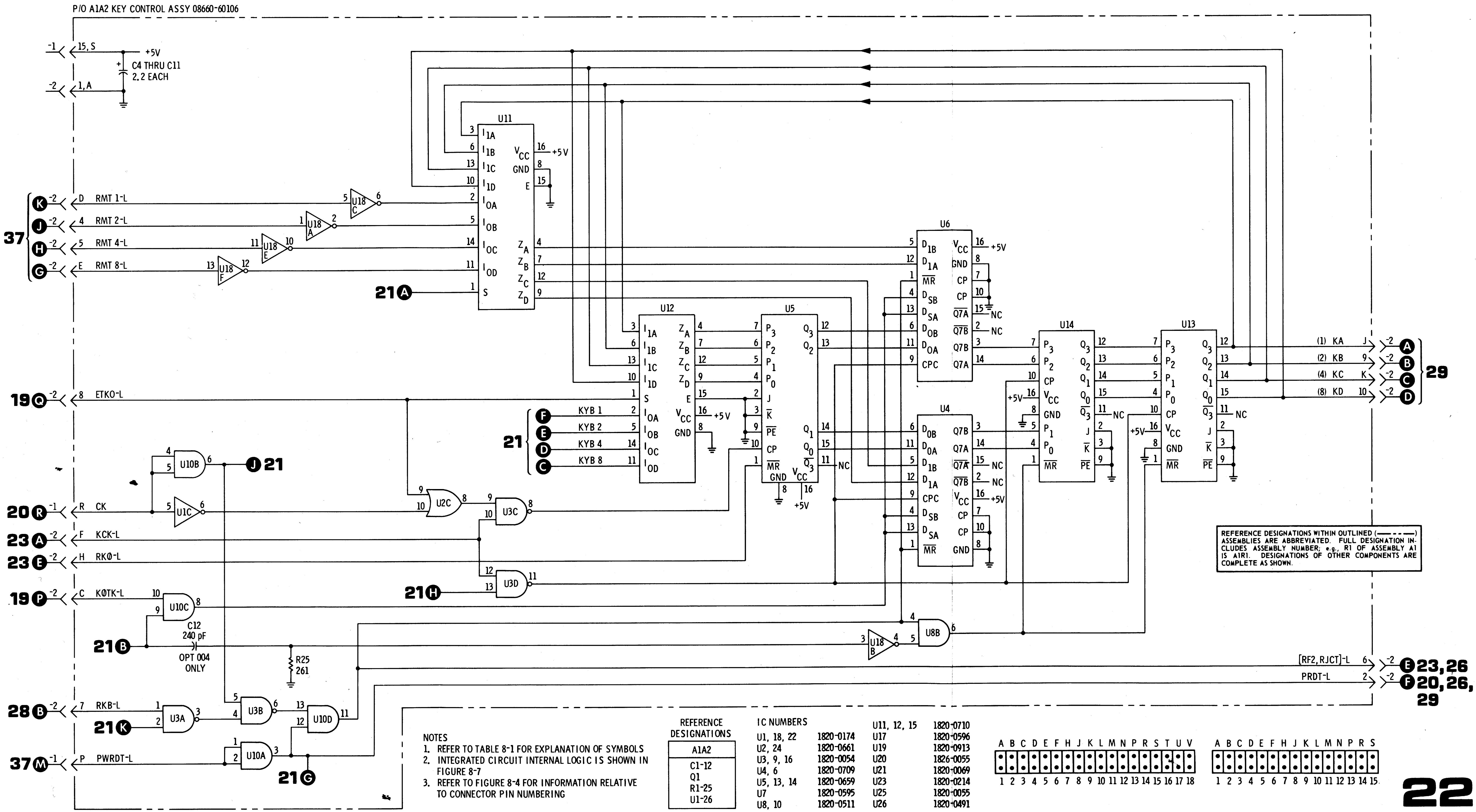


Figure 8-27. P/O A1A2 Key Control Assy (1 of 2)

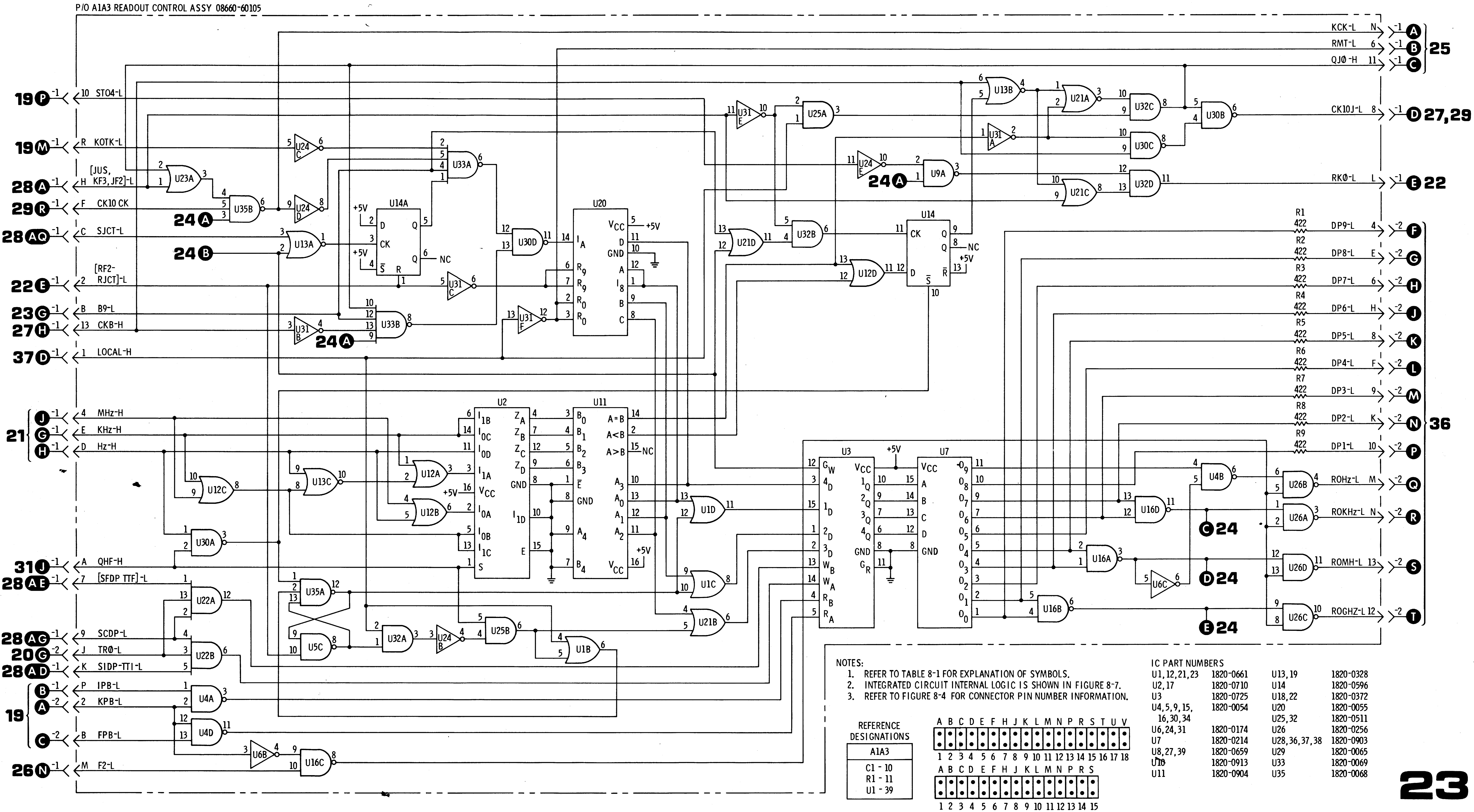


NOTES
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING

REFERENCE DESIGNATIONS
A1A2
C1-12 Q1 R1-25 U1-26

IC NUMBERS			
U1, 18, 22	1820-0174	U11, 12, 15	1820-0710
U2, 24	1820-0661	U17	1820-0596
U3, 9, 16	1820-0054	U19	1820-0913
U4, 6	1820-0709	U20	1826-0055
U5, 13, 14	1820-0659	U21	1820-0069
U7	1820-0595	U23	1820-0214
U8, 10	1820-0511	U25	1820-0055
		U26	1820-0491

Figure 8-27. P/O A1A2 Key Control Assy (2 of 2)



NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.
3. REFER TO FIGURE 8-4 FOR CONNECTOR PIN NUMBER INFORMATION.

REFERENCE DESIGNATIONS
A1A3
C1 - 10
R1 - 11
U1 - 39

IC PART NUMBERS

U1,12,21,23	1820-0661	U13,19	1820-0328
U2,17	1820-0710	U14	1820-0596
U3	1820-0725	U18,22	1820-0372
U4,5,9,15, 16,30,34	1820-0054	U20	1820-0055
		U25,32	1820-0511
U6,24,31	1820-0174	U26	1820-0256
U7	1820-0214	U28,36,37,38	1820-0903
U8,27,39	1820-0659	U29	1820-0065
U10	1820-0913	U33	1820-0069
U11	1820-0904	U35	1820-0068

Figure 8-28. P/O A1A3 Readout Control Assy (1 of 2)

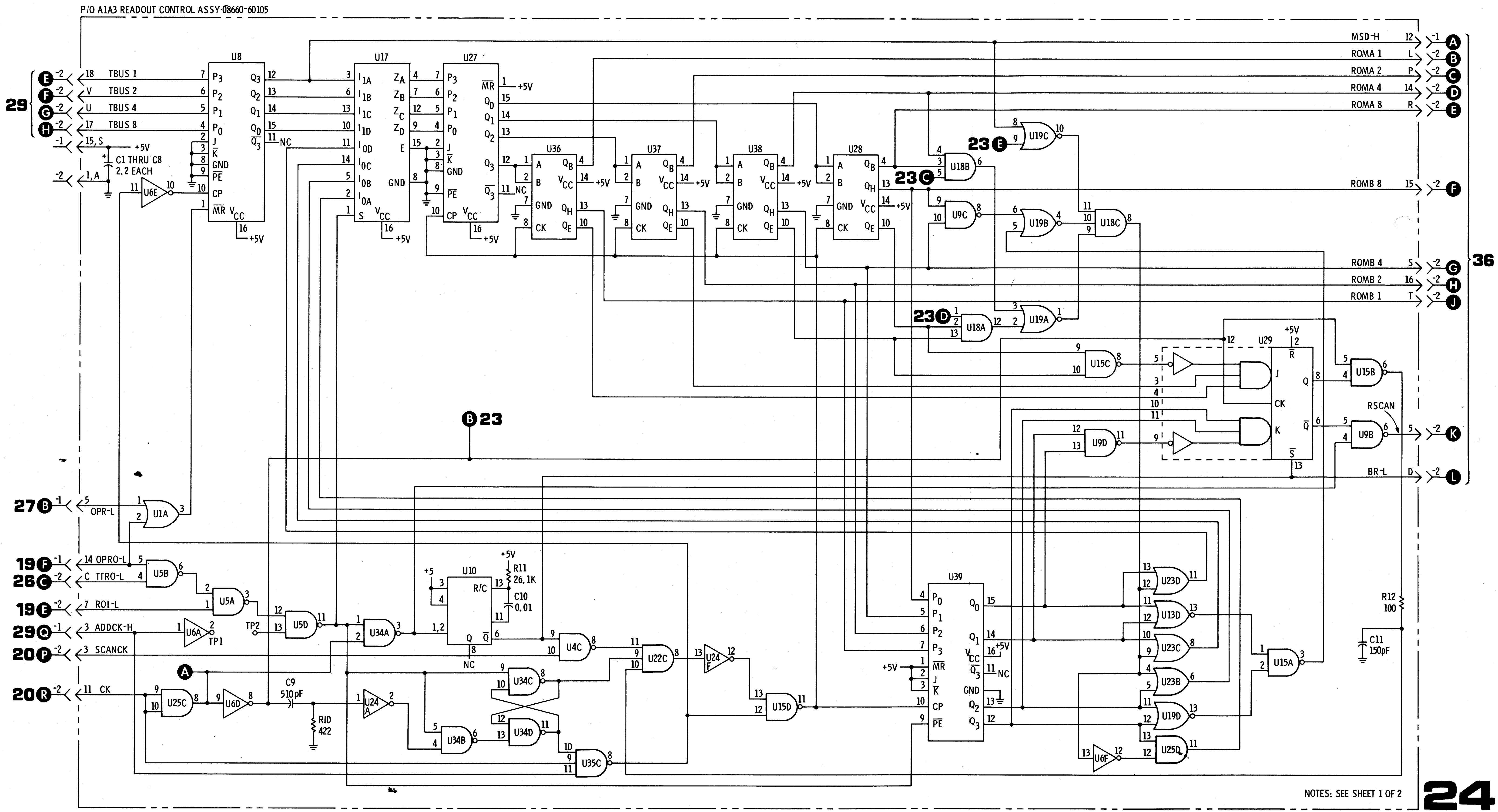
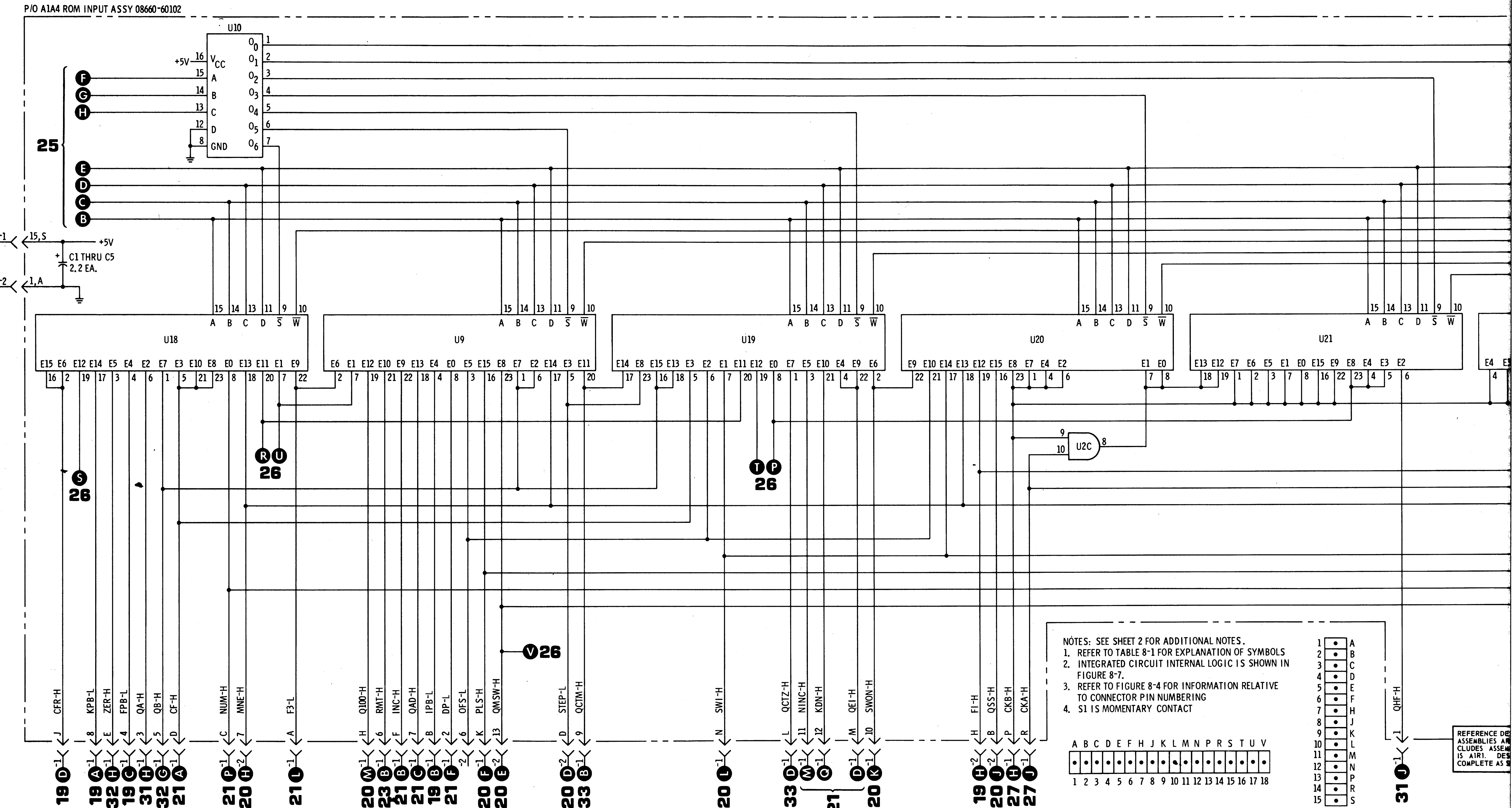


Figure 8-28. P/O A1A3 Readout Control Assy (2 of 2)



NOTES: SEE SHEET 2 FOR ADDITIONAL NOTES.

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING
4. S1 IS MOMENTARY CONTACT

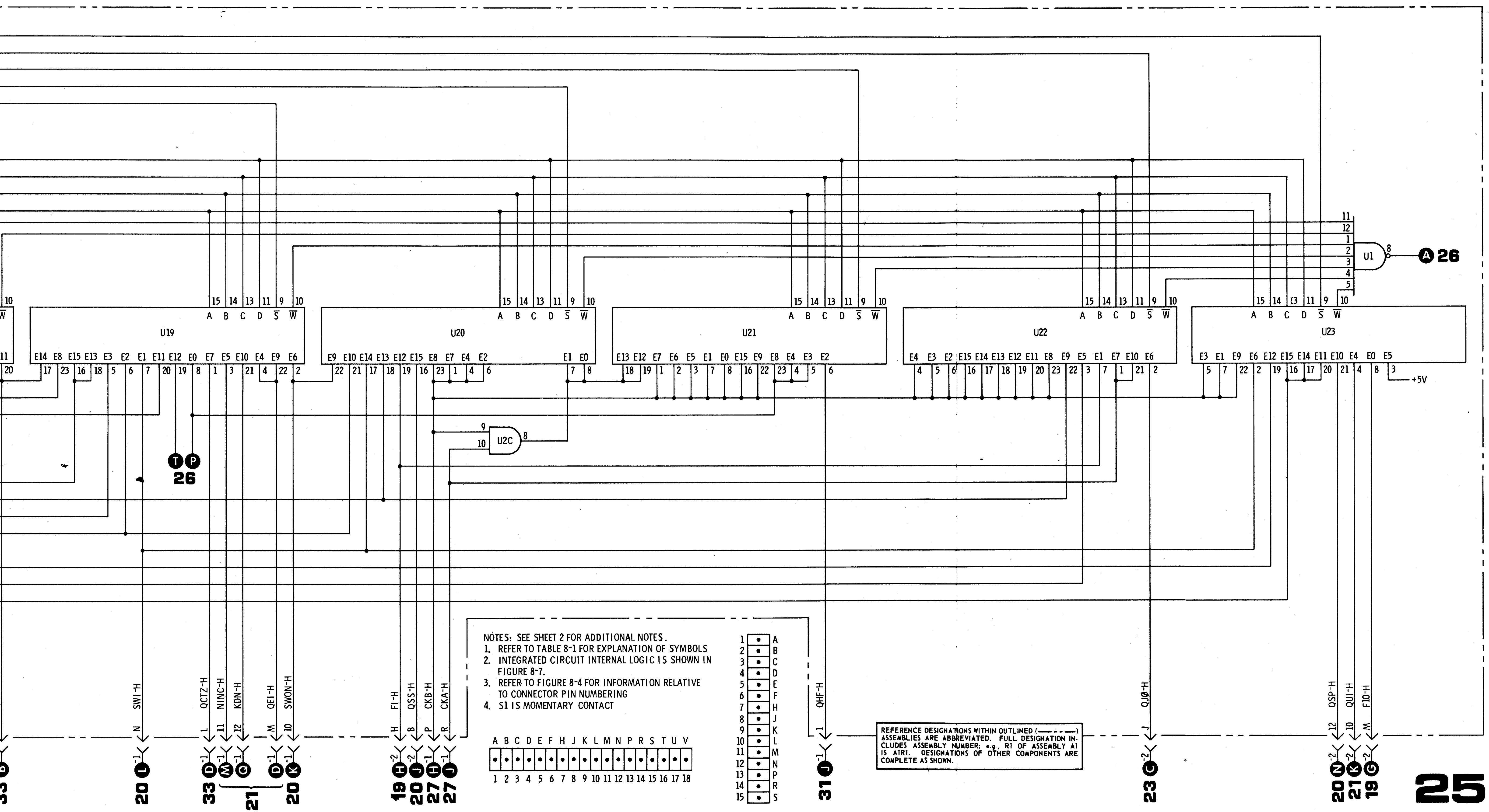
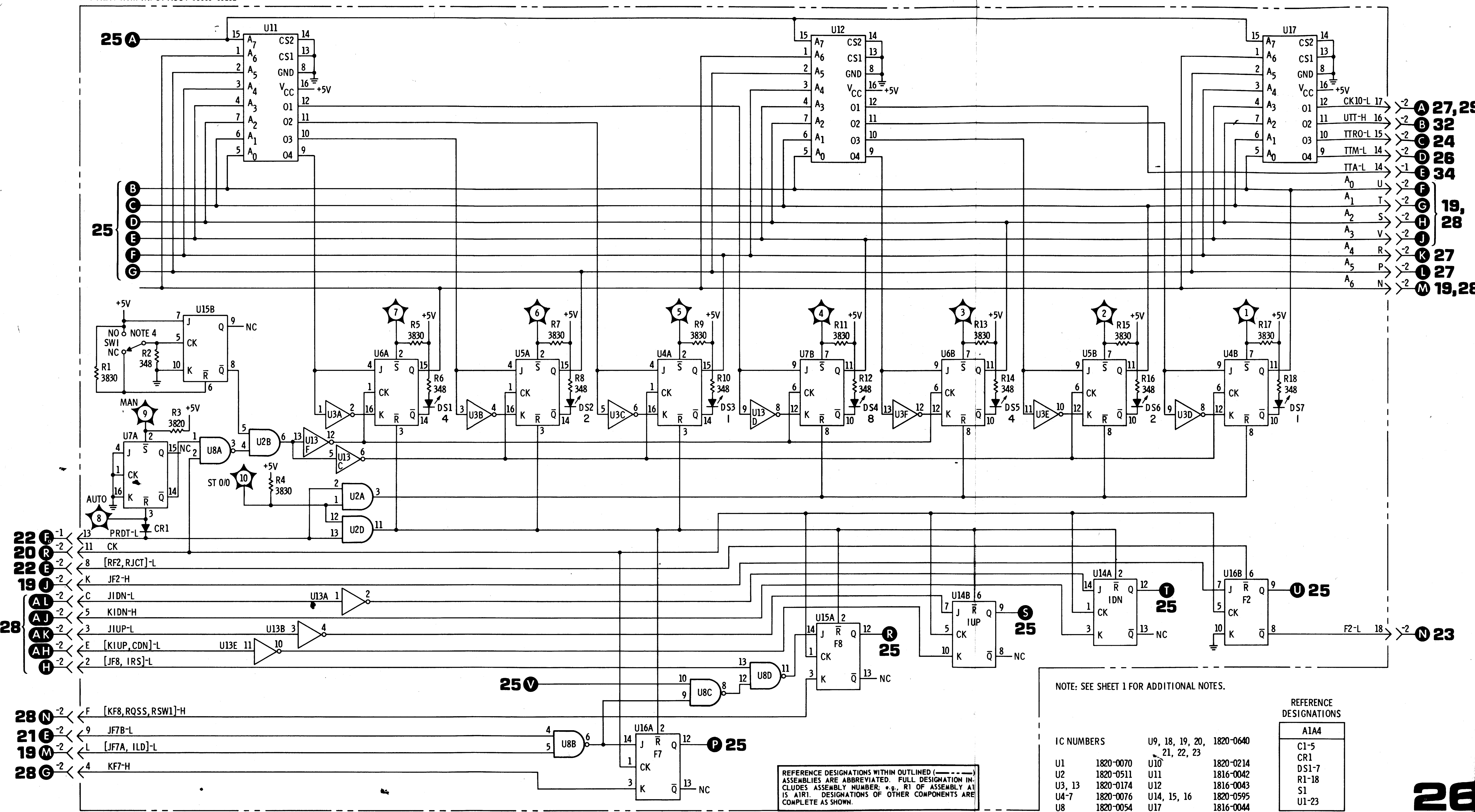


Figure 8-29. P/O A1A4 ROM Input Assy (1 of 2)

P/O A1A4 ROM INPUT ASSY 08660-60102



NOTE: SEE SHEET 1 FOR ADDITIONAL NOTES.

REFERENCE DESIGNATIONS WITHIN OUTLINED (— - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

IC NUMBERS

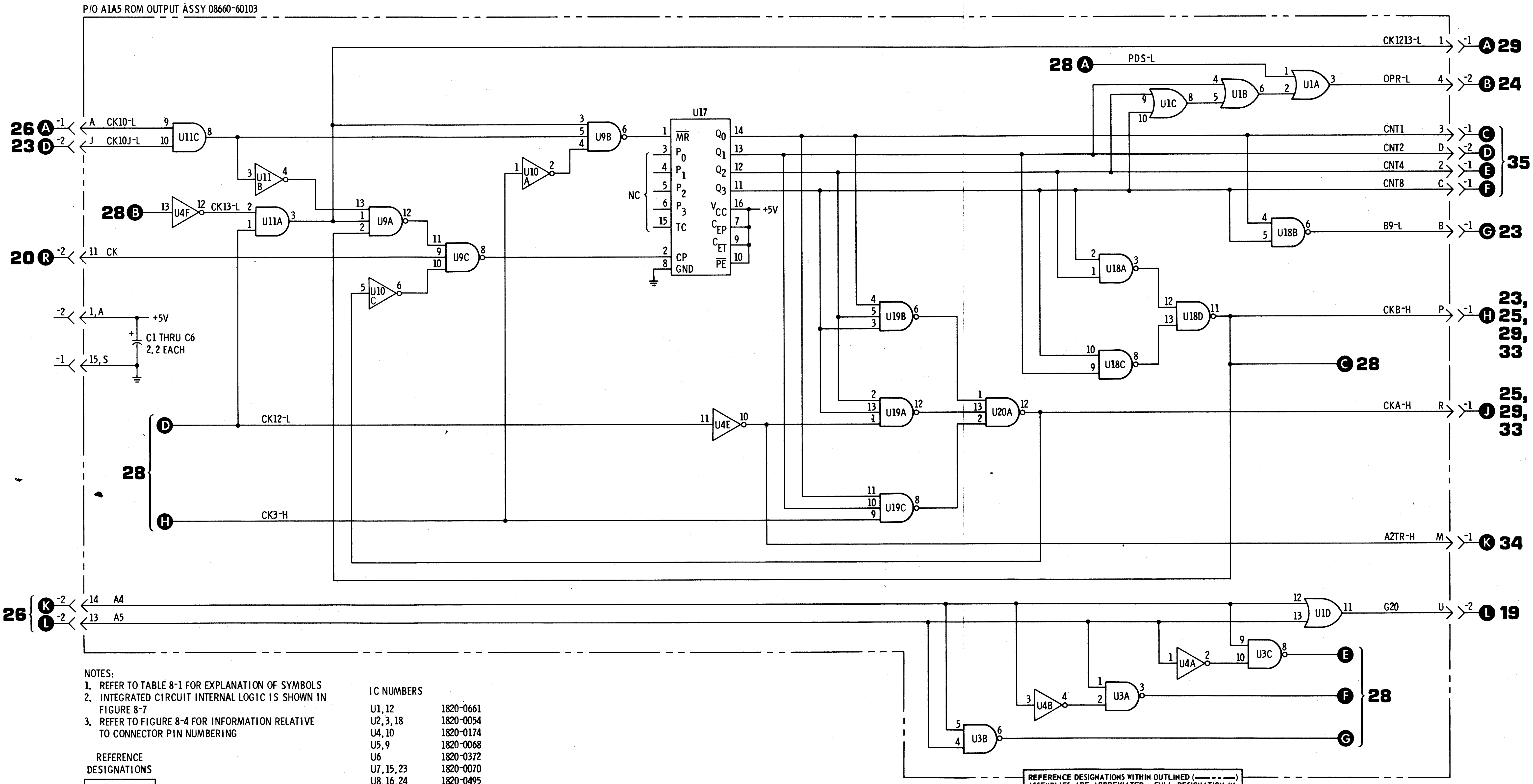
U1	1820-0070
U2	1820-0511
U3, 13	1820-0174
U4-7	1820-0076
U8	1820-0054
U9, 18, 19, 20, 21, 22, 23	1820-0640
U10	1820-0214
U11	1816-0042
U12	1816-0043
U14, 15, 16	1820-0595
U17	1816-0044

REFERENCE DESIGNATIONS

A1A4
C1-5
CR1
DS1-7
R1-18
S1
U1-23

26

Figure 8-29. P/O A1A4 ROM Input Assy (2 of



NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING

REFERENCE DESIGNATIONS

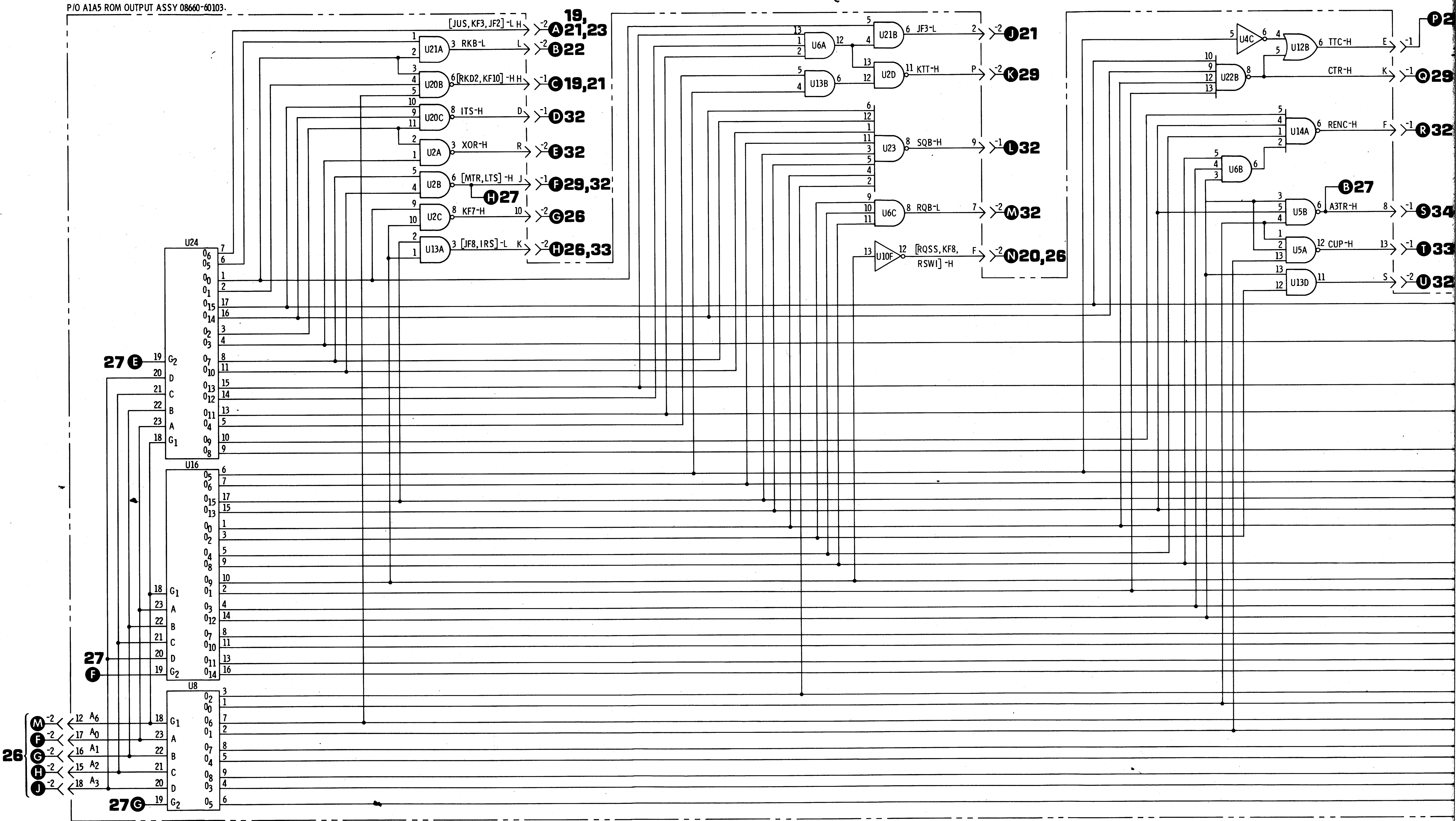
A1A5
C1-6 U1-24

IC NUMBERS

U1,12	1820-0661
U2,3,18	1820-0054
U4,10	1820-0174
U5,9	1820-0068
U6	1820-0372
U7,15,23	1820-0070
U8,16,24	1820-0495
U11,13,21	1820-0511
U14,22	1820-0069
U17	1820-0778
U19,20	1820-0587

27

Figure 8-30. P/O A1A5 ROM Output Assy (1 of 2)



P/O A1A5 ROM OUTPUT ASSY 08660-60103
U24
U16
U8
U21A
U20B
U20C
U2A
U2B
U2C
U13A
U6A
U13B
U21B
U2D
U23
U6C
U10F
U4C
U12B
U22B
U14A
U6B
U5B
U5A
U13D
[JUS, KF3, JF2] -L
RKB-L
[RKD2, KF10] -H
ITS-H
XOR-H
[MTR, LTS] -H
KF7-H
[JF8, IRS] -L
JF3-L
KTT-H
SQB-H
RQB-L
[RQSS, KF8, RSWI] -H
TTC-H
CTR-H
RENC-H
A3TR-H
CUP-H

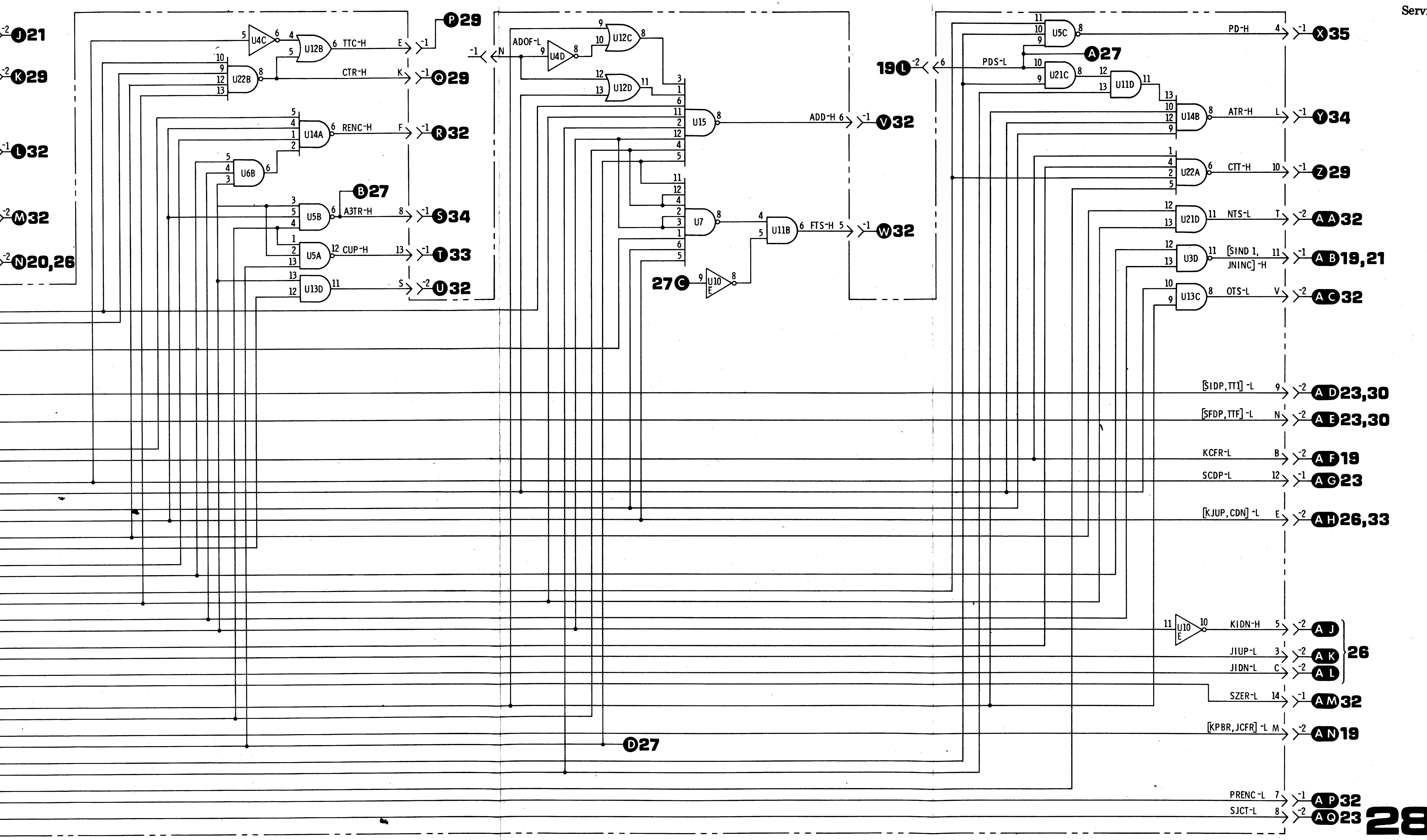
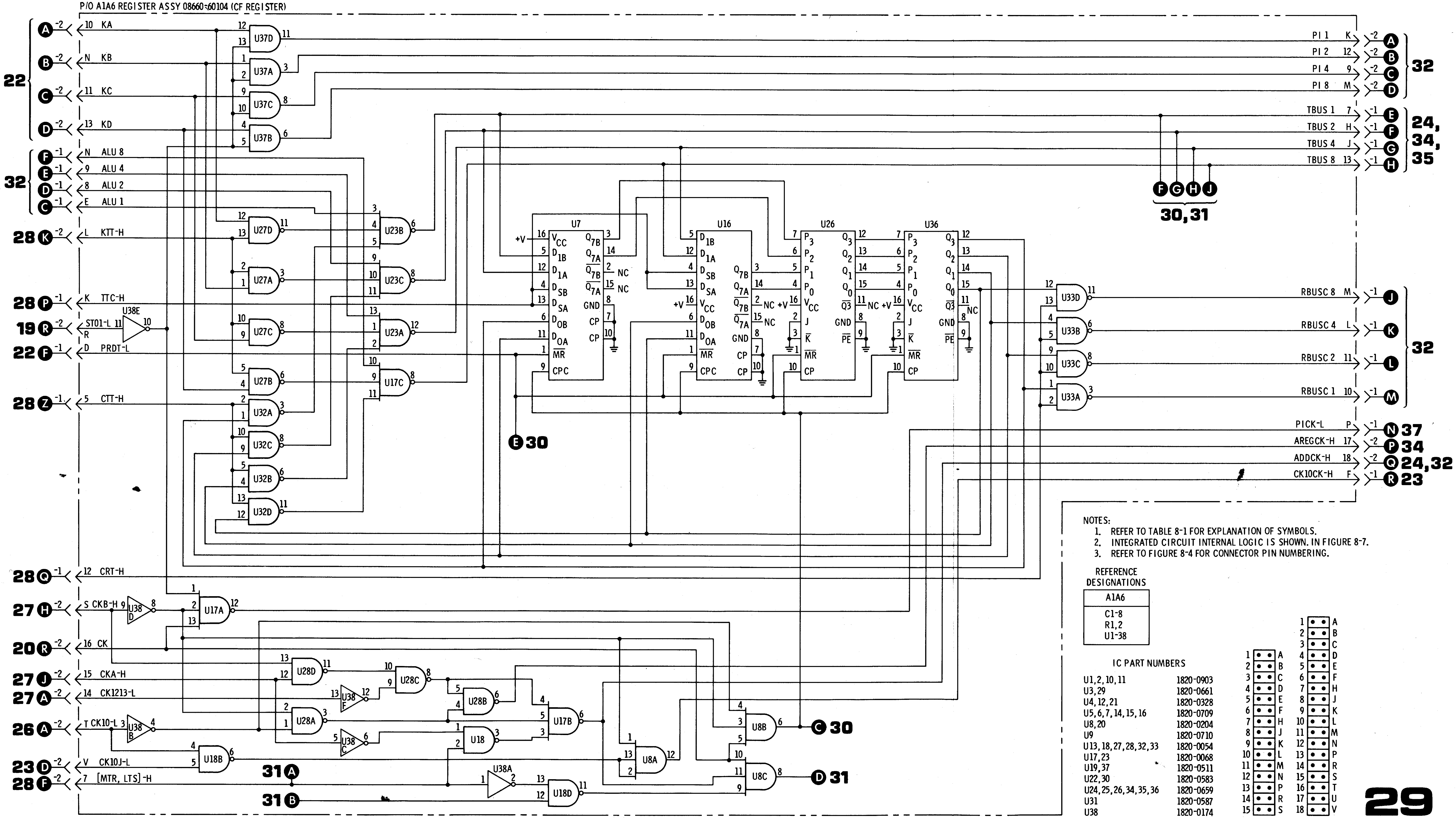


Figure 8-30. P/O A1A5 ROM Output Assy (2 of 2)



NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN. IN FIGURE 8-7.
3. REFER TO FIGURE 8-4 FOR CONNECTOR PIN NUMBERING.

REFERENCE DESIGNATIONS
A1A6
C1-8 R1,2 U1-38

IC PART NUMBERS

U1,2,10,11	1820-0903
U3,29	1820-0661
U4,12,21	1820-0328
U5,6,7,14,15,16	1820-0709
U8,20	1820-0204
U9	1820-0710
U13,18,27,28,32,33	1820-0054
U17,23	1820-0068
U19,37	1820-0511
U22,30	1820-0583
U24,25,26,34,35,36	1820-0659
U31	1820-0587
U38	1820-0174

29

Figure 8-31. P/O A1A6 Register Assy (1 of 3)

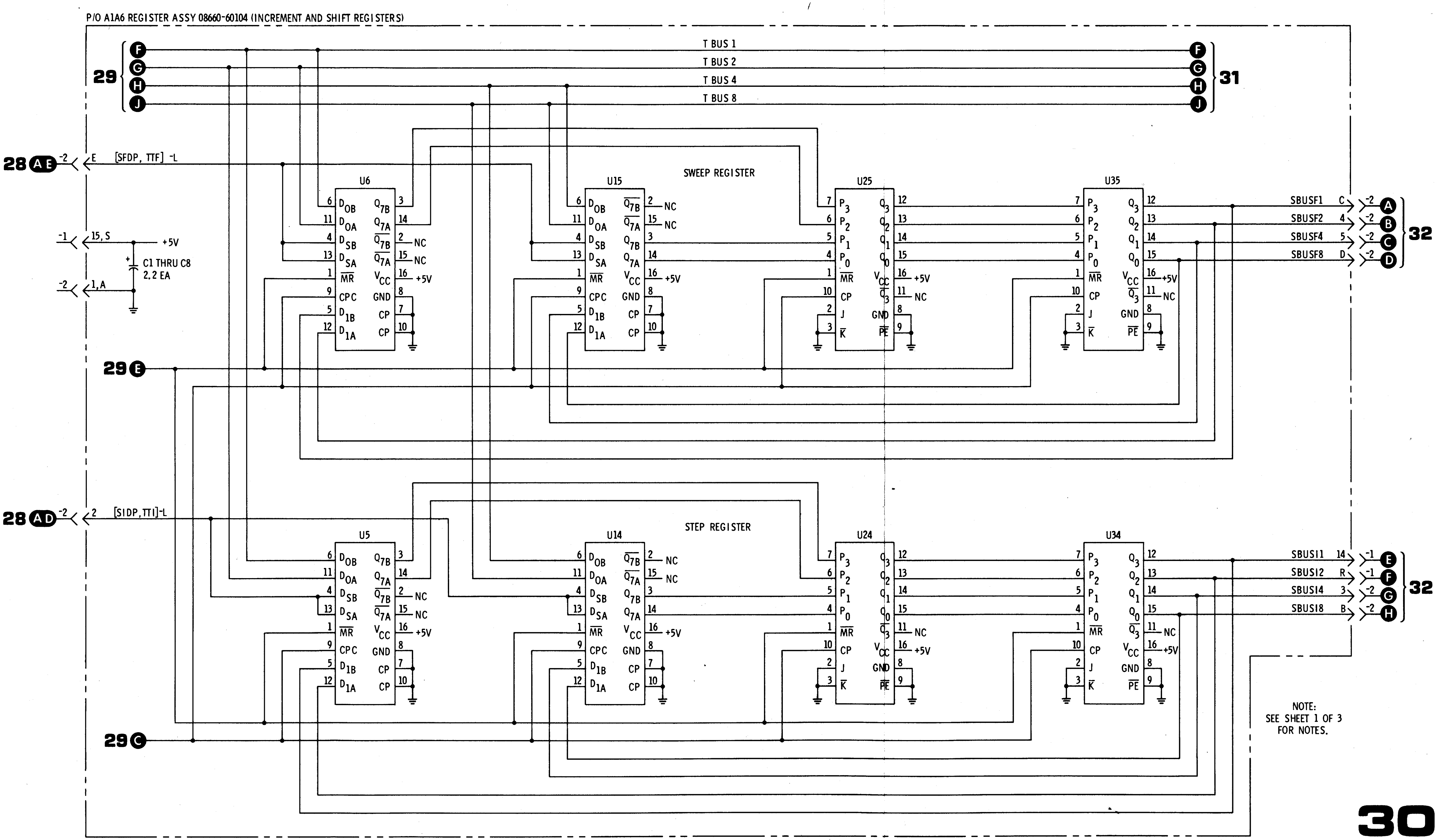


Figure 8-31. P/O A1A6 Register Assy (2 of 3)

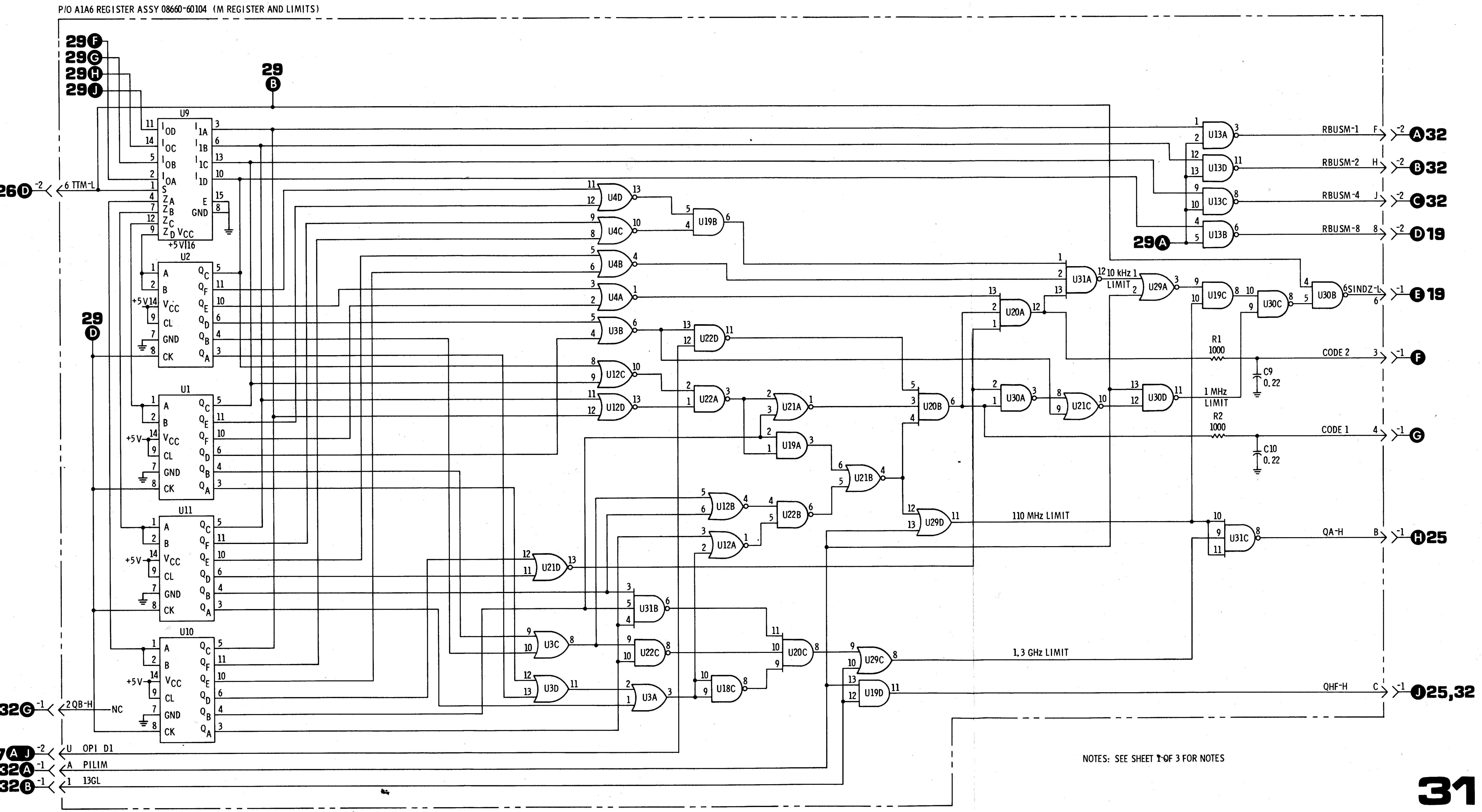


Figure 8-31. P/O A1A6 Register Assy (3 of 3)

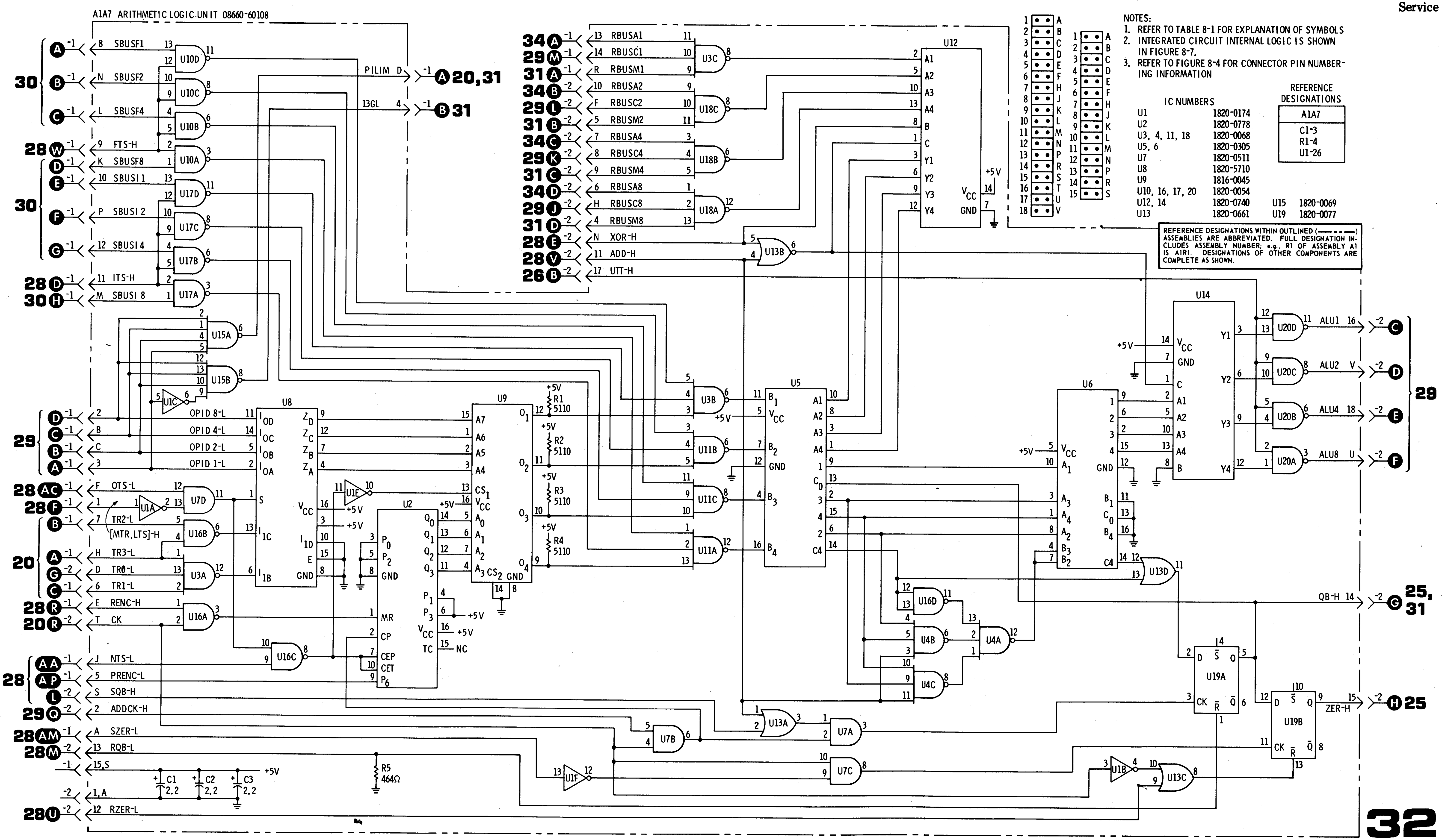
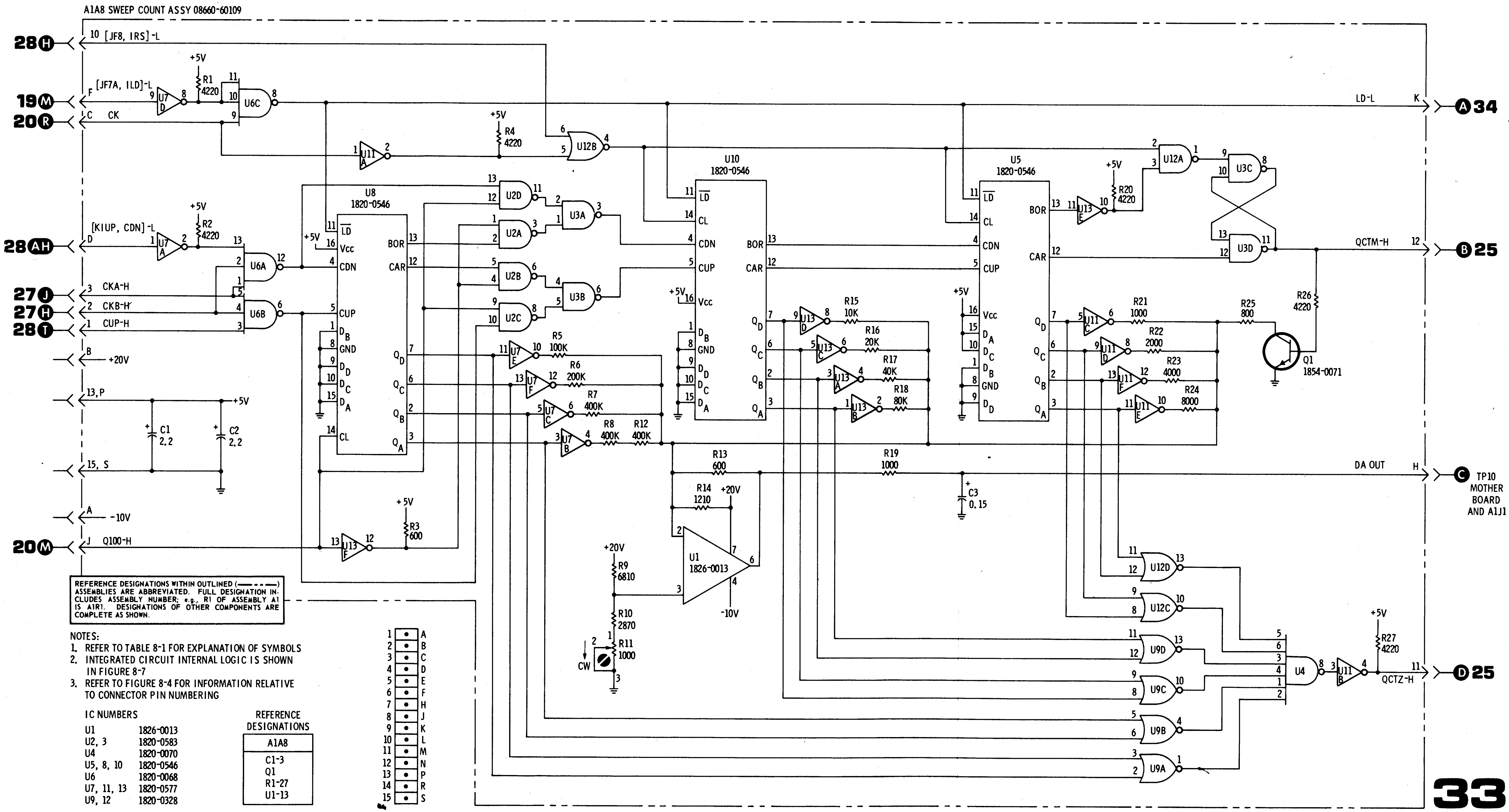


Figure 8-32. A1A7 Arithmetic Logic Unit



NOTES:
1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-7
3. REFER TO FIGURE 8-4 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING

IC NUMBERS

U1	1826-0013
U2, 3	1820-0583
U4	1820-0070
U5, 8, 10	1820-0546
U6	1820-0068
U7, 11, 13	1820-0577
U9, 12	1820-0328

REFERENCE DESIGNATIONS

A1A8
C1-3
Q1
R1-27
U1-13

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

33

Figure 8-33. A1A8 Sweep Count Assy

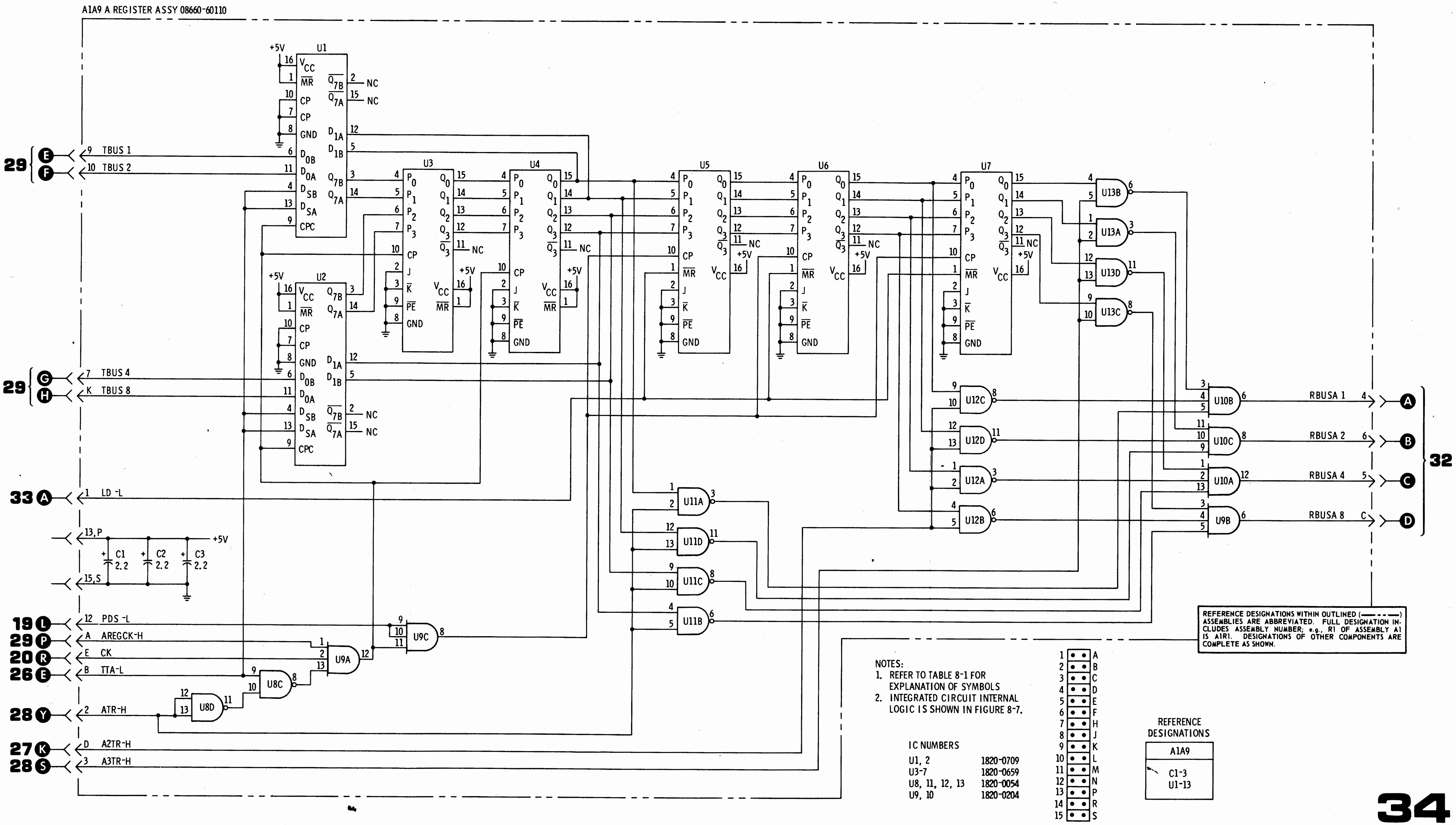
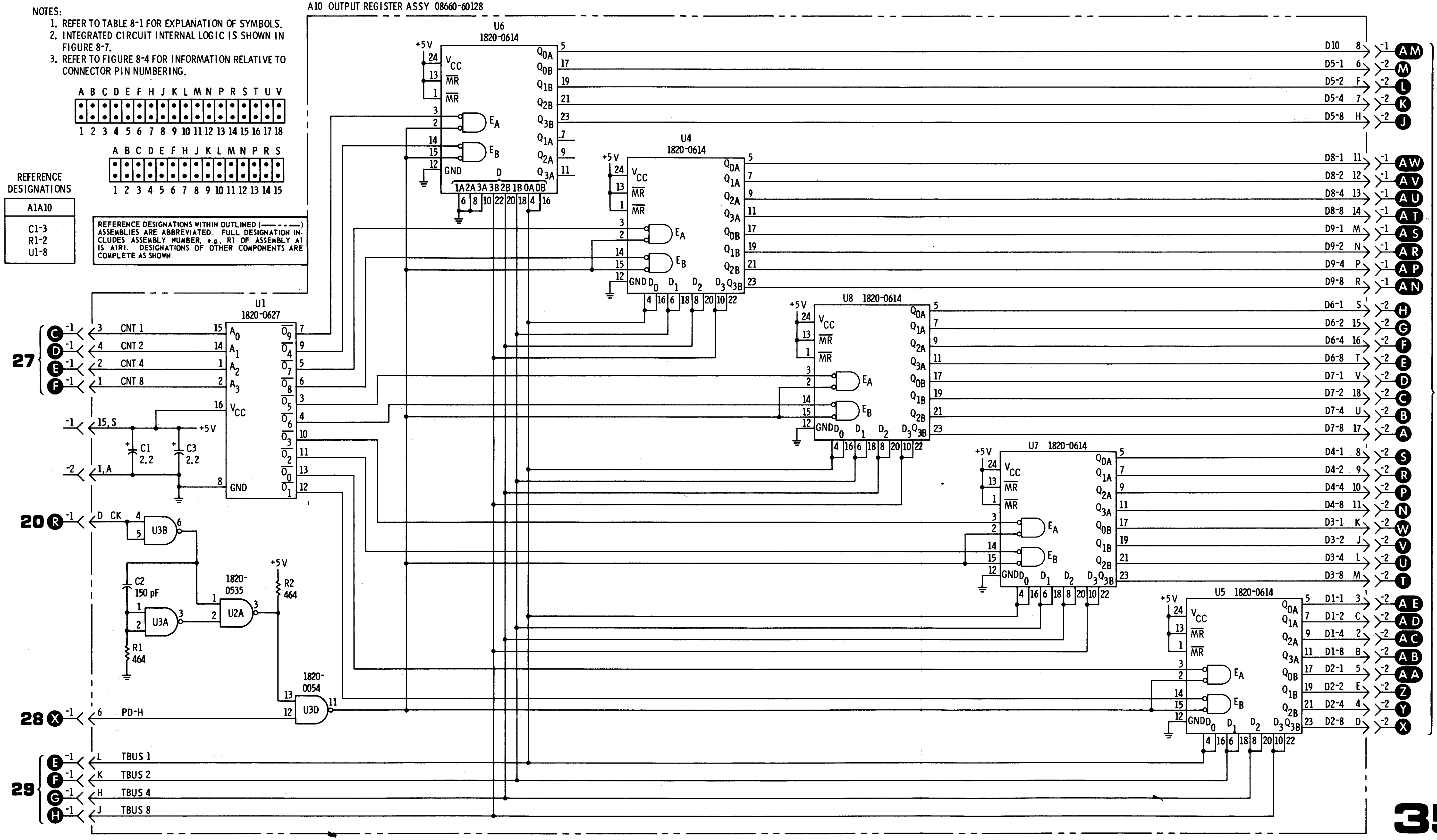


Figure 8-34. A1A9 A Register Assy



35

Figure 8-35. A1A10 Output Register Assy

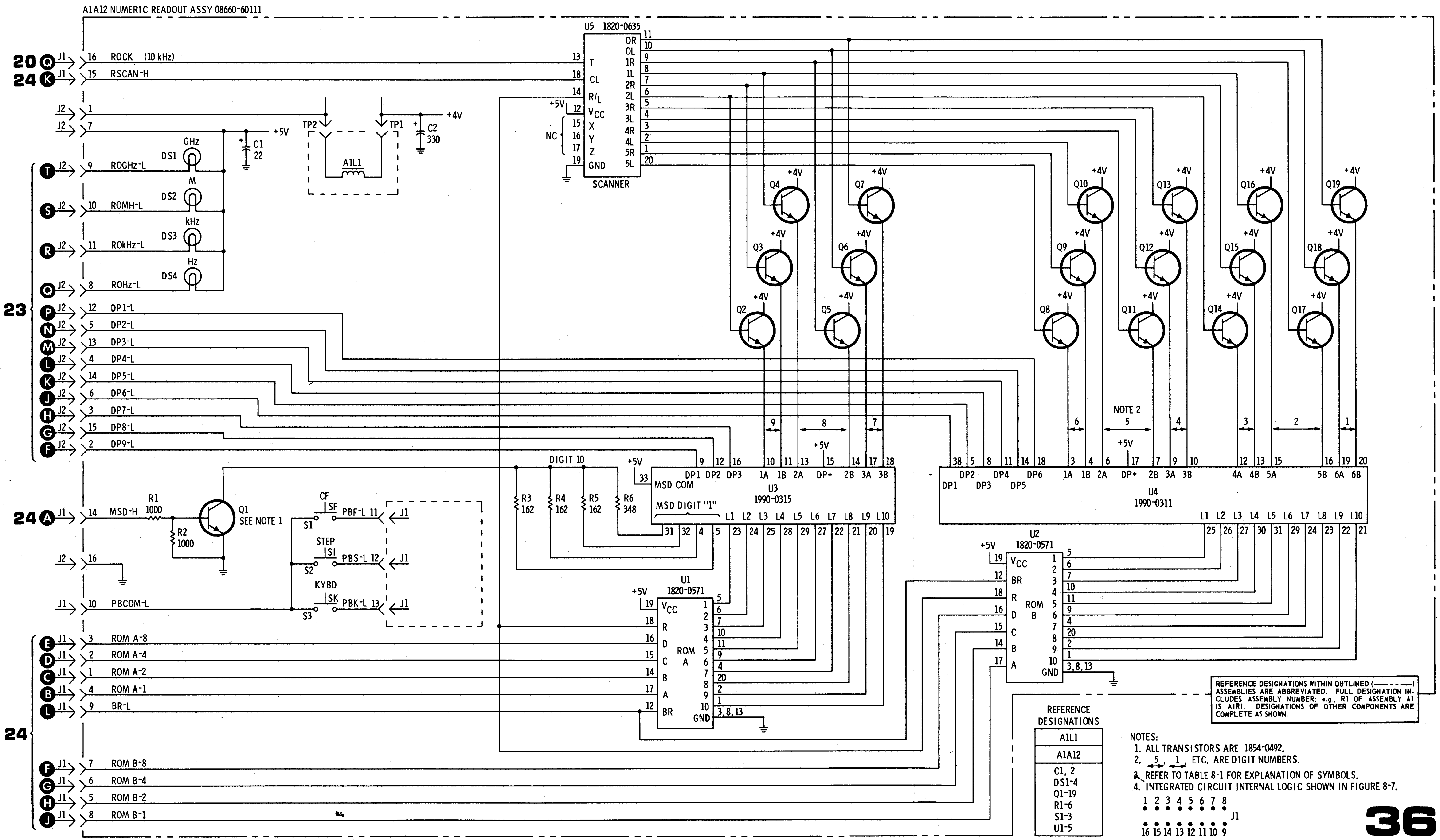


Figure 8-36. A1A12 Numeric Readout Assy

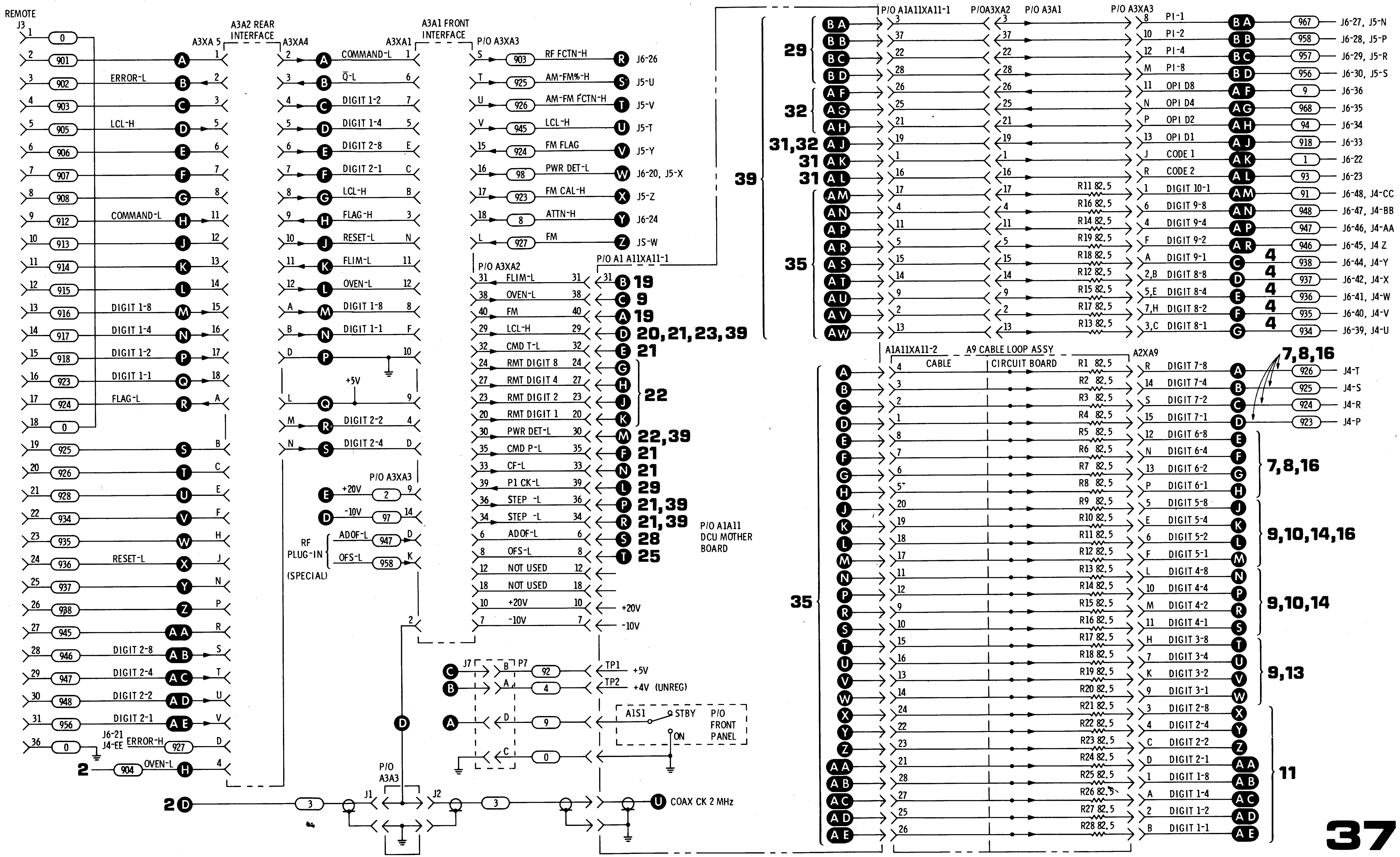
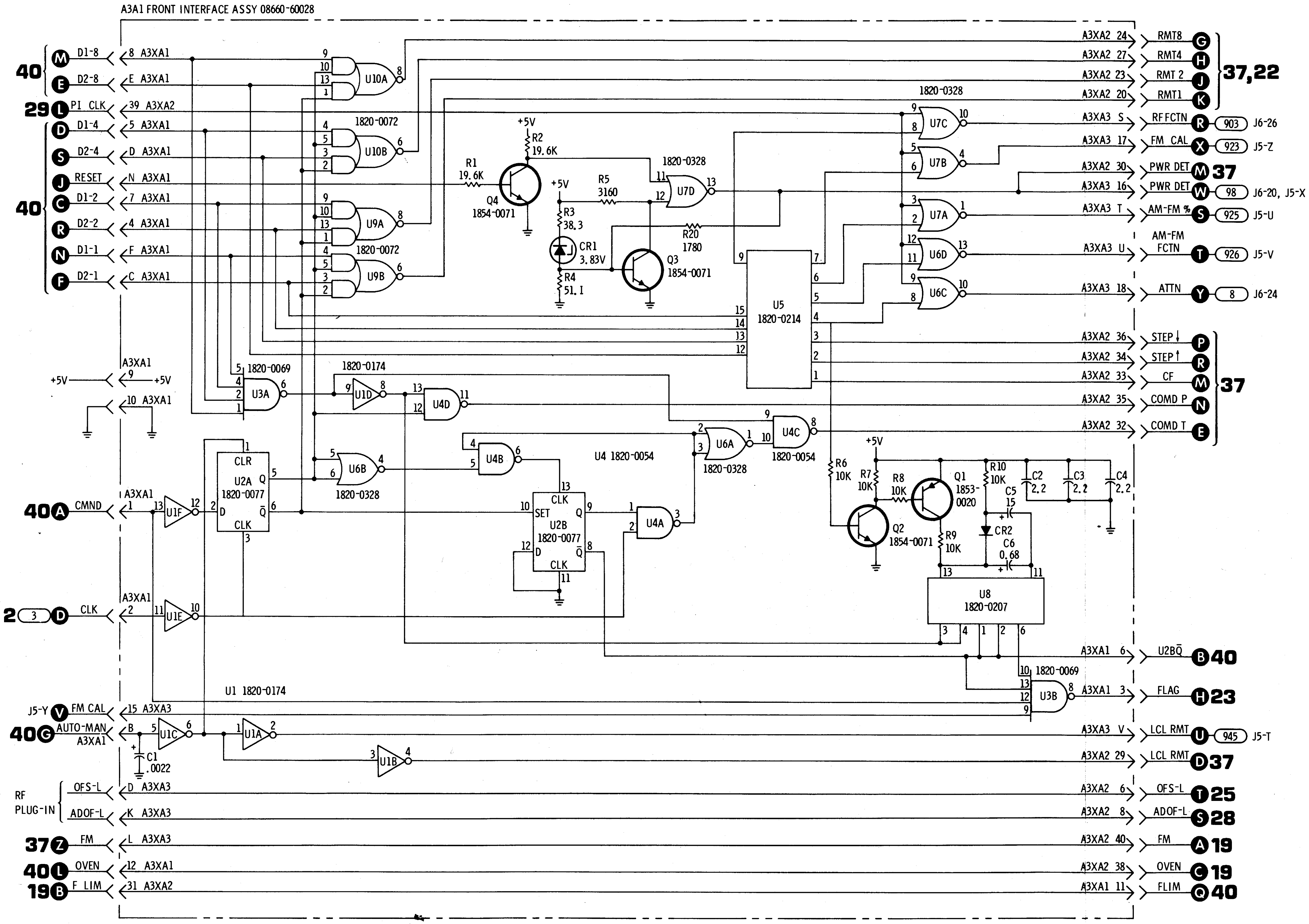


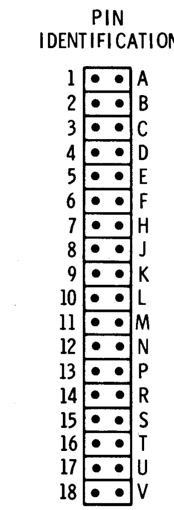
Figure 8-37. DCU and Interface Wiring Diagram

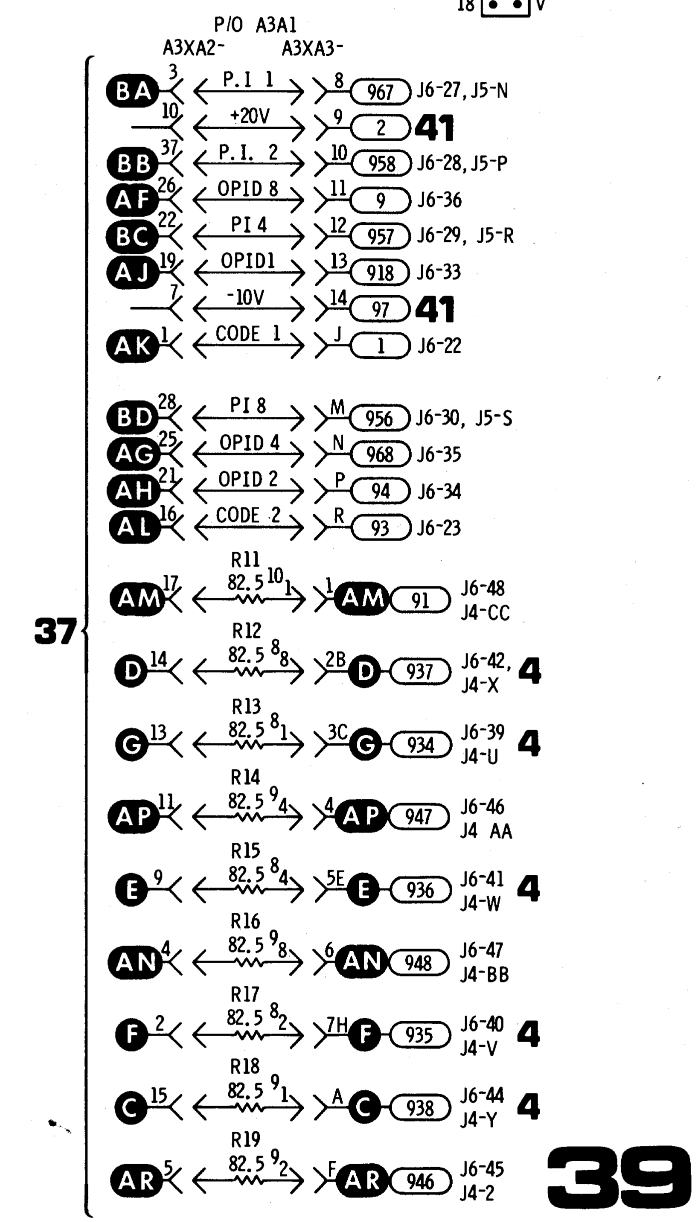


REFERENCE DESIGNATIONS	
A3A1	
C1-6 CR1, 2 Q1-4 R1-10 U1-10	

NOTES:

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUITS INTERNAL LOGIC IS SHOWN IN FIGURE 8-7.





39

Figure 8-38. Front Interface Board Schematic