Errata

Title & Document Type: 3314A Function Generator Service Manual

Manual Part Number: 03314-90021

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HP References in this Manual

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

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Agilent Technologies

SERVICE MANUAL

FUNCTION GENERATOR

3314A

HEWLETT PACKARD

HEWLETT PACKARD

MODEL 3314A
FUNCTION GENERATOR

Serial Numbers: 2141A00101 and Greater

Manual Part No. 03314-90021
Microfiche Part No. 03314-90071

P.O. Box 69, Marysville, Washington, U.S.A., 98270

Printed: April 1983

HEWLETT PACKARD

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

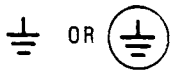
A

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

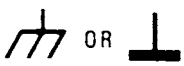
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE: The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

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SECTION 1
GENERAL INFORMATION

1-1. INTRODUCTION

This Service Manual contains information for Service-Trained personnel to install, test, adjust and service the Hewlett-Packard Model 3314A Function Generator. A front panel overview and the HP-IB Summary are also included, however, the Operating and Programming Manual should be used for detailed operating information.

1-2. MANUAL AND INSTRUMENT IDENTIFICATION

The -hp- part number for this manual and for a microfiche of this manual are located on the title page. Each 4 x 6 inch microfiche contains up to 96 photo-duplicates of the Service Manual pages. The latest Manual Changes Supplement as well as Service Notes are also included in the microfiche.

Attached to the 3314A's rear panel is a serial number plate.

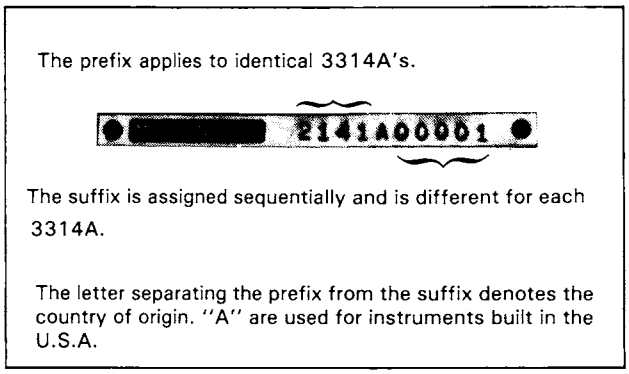


Figure 1-1. Serial Number Plate

This manual applies to 3314As within the serial number range on the title page. Instruments outside this range are covered by a Manual Change Supplement or by the Backdating Section of this manual. In addition to change information, the Manual Change Supplement also contains information correcting errors in the manual.

1-3. DESCRIPTION

The 3314A Function Generator is a multi-mode, programmable function generator. The 3314A features Sine, Triangle and Squarewave functions from 1mHz to 19.99MHz. In addition, the 3314A can be redefined as an ARBitrary Waveform Generator. ARB waveforms are made up of a series of voltage ramps called vectors. The operator has control over the number of vectors, the height and length of each vector. The operating modes include:

Free Run	Gate	N Cycle
CW	CW	1/2 Cycle
linear sweeps	linear sweeps	Fin X N
log sweeps	ARB	Fin ÷ N
ARB		

In addition, the 3314A has a programmable time interval for internal triggering. A trigger (either internal or external) is an important part of every operating mode except Free Run when not sweeping.

1-4. OPTIONS

The 3314A may be equipped with one or more of the following options:

Option 001, Simultaneous X3 Output
Option 907, Front Handle Kit
Option 908, Rack Mount Adapters
Option 910, Extra Manual Set

Option 001 to the 3314A Function Generator is a low impedance, rear panel output. The X3 Output voltage is 3 times the voltage from the 3314A's Main 50Ω Output. Note that the X3 Output is always active and that the voltage depends upon the selected amplitude and the Main Output's load. This output is DC coupled and is useable to 1 MHz.

1-5. SUPPLIED ACCESSORIES

Every 3314A is supplied with the following accessories:

An Operating and Programming Manual
A Service Manual
A Power Cord
A 50Ω Feedthrough Termination

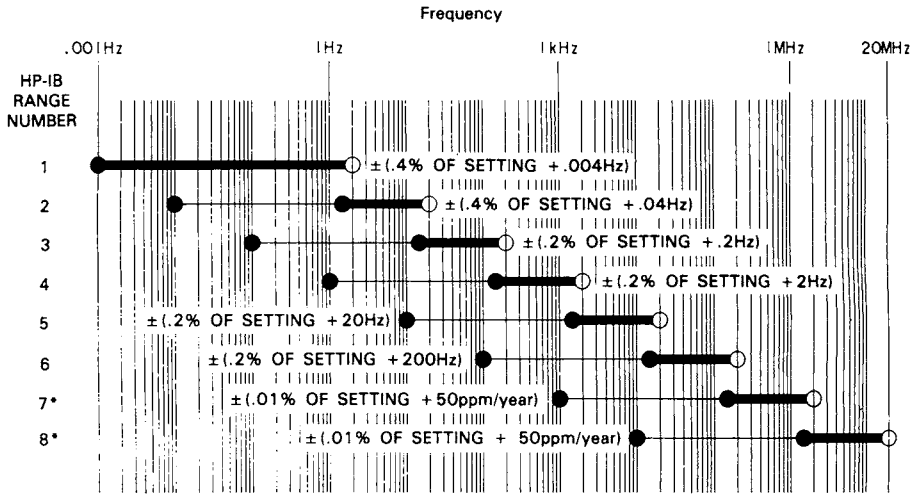
The power cord included with your 3314A was selected at the factory based upon the country of destination. If your power cord is incompatible with your AC mains outlet, contact your local -hp- Sales Office.

1-6. SPECIFICATIONS

The 3314A's specifications are listed in Table 1-1, Specifications. These specifications are the performance standards or limits against which every 3314A is tested.

Some of the 3314A's operating characteristics are listed in Table 1-2, Supplemental Characteristics. The Operating and Programming Manual contains detailed discussions of the remaining operating characteristics.

Table 1-1. Specifications



DENOTES FREQUENCY RANGE USING AUTO-RANGING.

DENOTES EXTENDED FREQUENCY RANGE USING RANGE HOLD.

○ FREQUENCIES UP TO BUT NOT INCLUDING THIS POINT ARE ALLOWED.

* FREQUENCY IS SYNTHESIZED IN RANGES 7 AND 8 IN THE FREE RUN MODE WITH VCO = OFF.

ACCURACY APPLIES IN THE FREE RUN MODE WITH SYMMETRY = 50% (FIXED), AND VCO = OFF AND WITH RANGE HOLD ON OR OFF.

Amplitude

Absolute Amplitude Accuracy:

±(1% of display + .035Vp-p), sine wave and square wave
±(1% of display + .06Vp-p), triangle

Amplitudes: 1.00Vp-p to 10.00Vp-p (Range 4)
Frequency: 10kHz
Auto-Range: ON

Flatness--*sine wave*:

Combines sine power flatness and vernier attenuator flatness
Relative to 10kHz, 1.00 V to 10.00Vp-p (Range 4)

20Hz	50kHz	1MHz	19.99MHz
.07dB	.33dB	1.5dB	

Step Attenuator Accuracy:

	.001Hz	50kHz	19.99MHz
20dB	.05dB	.3dB	
40dB			
60dB		.5dB	

DC Offset

Offset Accuracy:

±(3% of display + 10 mVDC +0.5% of AC Amplitude Range)

Frequency: <100kHz
Auto-Range: ON

Residual DC Offset:

< 0.5% of AC Amplitude Range

Setting: OVDC
Frequency: ≤100kHz

Symmetry

Symmetry Accuracy (Fixed):

50% ±0.2%

Fixed Symmetry: 50% (SYM light OFF)
Frequency: 1Hz to 100kHz
Function: square wave

Table 1-1. Specifications (Cont'd)

Symmetry Accuracy (Variable)

±0.5% of period:

Frequency: 1Hz to 100kHz
Function: square wave

Phase

Phase Offset--Phase lock Modes

Accuracy: ±2° (50Hz to 25kHz)

Phase Offset is referenced to the signal output for Fin ÷ N or the trigger input for Fin X N.

Start/Stop Phase--Burst Modes:

Accuracy: ±3° (applies from .001Hz to 1kHz)

Function Characteristics

Sine Harmonic Distortion:

Individual harmonics will be below these levels, relative to carrier level.
Offset = OV. Function Invert = OFF.
*Add 4dB for ambient temperature 0 to 5°C or 45 to 55°C.

20Hz	50kHz	1999kHz	19.99MHz
-55dB*	-40dB	-25dB	

Square Wave Rise/Fall Time:

≤9ns, 10% to 90% of a 10 Vp-p output

Square Wave Aberrations:

<5% at 10 Vp-p output

Triangle Linearity:

±0.2% of the p-p voltage

Frequency: .01Hz to 1kHz, Amplitude = 10 Vp-p
Deviation is from a best fit straight line, from 10% to 90% of each ramp.

Internal Trigger Interval

Period Accuracy: ±(0.01% + 50 ppm/year) of displayed interval (excluding sweep intervals)

Frequency Sweep

Sweep Frequency Accuracy--Manual Sweep:

±(0.2% of Stop Freq +0.1% of Stop Freq Range), Stop Freq Range ≤200kHz
±1% of Stop Freq, Stop Freq in 2MHz Range
±3% of Stop Freq, Stop Freq in 20MHz Range

Modulation

Amplitude Modulation Envelope Distortion:

≤ -40dB

Carrier: = 1MHz, 10Vp-p, sine wave
Modulating Input: 1kHz, sine wave
Index of Modulation: 95%

VCO Linearity:

±0.15% of p-p frequency, .1Hz through 200kHz Range
±1% of p-p frequency, 2MHz Range
±3% of p-p frequency, 20MHz Range

-8Vdc to +1 Vdc input (-80% to +10%)
Deviation is from a best fit straight line.

Option 001 - Simultaneous X3 Output.

Specifications apply when the X3 Output is terminated with >500Ω and <500pf and when the Main output is terminated with 50Ω.

The X3 Output is useable into all loads until the output current limits at ≈ 30 mA peak or the output voltage clips at ≈ 15V peak.

X3 Gain Accuracy:

±1% at 10kHz
X3 Output amplitude ≈ (3 ± 1%) x Main Output Amplitude

Sine Power Flatness:

Relative to full output power at 10kHz

20Hz	50kHz	500kHz	1MHz
±.1dB	±.5dB	±1.5dB	

Harmonic Distortion:

All harmonically related signals will be below these levels, relative to the fundamental.

20Hz	50kHz	1MHz
-53dB	-38dB	

Square Wave Rise/Fall Time:
<200ns, 10% to 90% at full output.

Residual DC Offset:

<40mVDC

Table 1-2. Supplemental Characteristics

General

Specifications apply when:

Main signal output is terminated into 50 ±0.1 ohms
Warm-up is ≥30 minutes
Within ±5°C, and 24 hours of last internal calibration
Temperature 0° to 55°C
Relative Humidity ≤95% at 40°C
Altitude ≤ 15,000 ft.

Storage Limits:

Temperature −40° to +75°C
Altitude ≤ 15,000 ft.

Power:

100/120/220/240 V, +5% −10%, 48 to 66 Hz
95 VA maximum

Weight:

7.3 kg (16 lbs) net
10.5 kg (23 lbs) shipping

Dimensions:

132.6 mm (5.22 in) high
212.3 mm (8.36 in) wide
419.0 mm (16.50 in) deep

Accessories Included:

11048C 50 ohm feed through

Accessories:

Transit case for one 3314A; -hp- #9211-2677

OPTION 001:

Amplitude Range:

AC only to 30Vp-p or 60mAp-p before clipping.
DC only to ±15VDC or ±30mADC before clipping.
AC + DC to ± 15V peak or ±30mA peak before clipping.

Frequency Range:

DC to 1MHz

Output Resistance:

<2Ω at 10kHz

Relationship of the X3 Amplitude to the 3314A's displayed amplitude:

$$\text{X3 AMPTD} = 3 \left[2 \times \text{Display} \frac{\text{Main Output Load}}{\text{Main Output Load} + 50} \right]$$

1-7. SAFETY CONSIDERATIONS

The 3314A is a Safety Class 1 instrument (provided with a protective earth terminal). The instrument and manuals should be reviewed for safety markings and instructions before operation.

1-8. GROUNDING

The outer conductor of all BNC type connectors, the shield and pins 12 and 18 through 24 of the HP-IB connector, the frame, chassis, covers, and all exposed metal surfaces are connected to the protective earth terminal.

WARNING

Do NOT interrupt the protective earth ground or "float" the 3314A. This action could expose operators to potentially hazardous voltages!

1-9. RECOMMENDED TEST EQUIPMENT

Equipment required to maintain the 3314A is listed in Table 1-3 Recommended Test Equipment. Other equipment may be substituted if it meets or exceeds the performance of the listed equipment. When substitutions are made, the user may have to change the test procedures to accomodate different operating characteristics.

1-10. OPERATOR MAINTENANCE

Operator Maintenance is limited to replacing the line fuse. There are no operator controls inside the 3314A. The Z-Axis polarity switch is located inside the 3314A, however, only Service Trained personnel using the instructions located in Section 2 of this manual are to set this switch.

WARNING

Under no circumstances should an operator remove any covers, screws, shields or in any other way enter the 3314A. There are no operator controls inside the 3314A.

Table 1-3. Recommended Test Equipment

Instrument	Critical Specs	Recommended Model	
Electronic Counter	Freq Measurement to 20MHz. Accuracy ±2 counts, Resolution 8 Digits	-hp-5328A (-hp- 5345A)	PA
High Speed Digital Voltmeter	DC Voltage Ov-10v Sample/Hold Measurement, External Trigger: Low True TTL Edge Trigger, Trigger Delay: Selectable, 10us to 140us.	-hp- 3437A	P
Synthesizer/Function Generator	Sine Output: 1kHz Amplitude: 1Vrms into 10kOhm	-hp-3325A (-hp- 3335A)	PA
VHF Attenuator (see Note 1)	Atten: 100dB in 10dB steps, Freq Range 50Hz to 20MHz, Impedance 50 Ohms	-hp- 355D	P
Spectrum Analyzer	Freq Range 40MHz to 120MHz, Amplitude Accuracy: ±.5dB	-hp- 8557A (-hp- 8558B) (-hp-141T,8552B)	P
Spectrum Analyzer (see Note 2)	Freq Range 20 Hz to 40MHz, Amplitude Accuracy: ±.2dB	-hp- 3585A	PA
Thermal Converter	Input Impedance 50 Ohms, Input Voltage 3Vrms, Freq: 2kHz to 20MHz, Frequency Response: ±.05dB	-hp- 11049A	P
AC/DC Digital Voltmeter	DC Function, Acc. ±.05%, AC Function: True RMS, Acc. ±.2% Resolution 6 Digits	-hp- 3455A (-hp- 3456A)	PA
Resistor	1MΩ ±5%		P
Capacitor	1uf ±20%		P
Oscilloscope	Vertical BW DC to 275MHz, Deflection .01v to 10v/Div Horizontal Sweep: .05us to 1s/Div X10 Mag, Delayed Sweep	-hp- 1725A (-hp- 1745A)	PA
Power Supply	Volts: −8v to +2V DC Amps: 10mA	-hp- 6235A	P
BNC Tee/ Adaptor	Male Female Female/ BNC to Dual Banana Plug	-hp- 1250-0781 -hp- 1250-2277	PA
BNC to Triax Adaptor	Female BNC to Male	-hp- 1250-0595	P
50 Ohm Load	Accuracy ±.2% Power Rating: 1W	-hp- 11048C	PA

Note 1: Variable attenuator must be characterized.
Note 2: The 3585A is required because of its ±.2dB Amplitude Accuracy.

P = Performance Test
A = Adjustments
( ) = Alternative Instruments

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides installation instructions for the 3314A Function Generator. This section also provides information about initial inspection and damage claims, preparation for using the 3314A and what to do in-case of difficulty. In addition, installation instruction sheets for several -hp- accessories (rack, handle and foot kits) are located at the end of this section.

2-2. INITIAL INSPECTION

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be:

An Operating and Programming Manual
A Service Manual
A Power Cord
A 50Ω Feedthrough Termination

If the contents are incomplete, if there is mechanical damage or defect or if the 3314A does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container or the cushioning material is damaged, notify the carrier as well. Keep the shipping material for the carrier's inspection. The -hp- office will arrange for repair or replacement at -hp- option without waiting for a claim settlement.

WARNING

The integrity of the protective earth ground may be interrupted if the 3314A has been mechanically damaged. Under no circumstances should a 3314A be connected to power if it is damaged.

2-3. MATING CONNECTORS

The 3314A uses 50Ω BNC(f) type connectors for all signal I/O. The outer shield is connected to protective earth ground.

The HP-IB connector is an Amphenol or Cinch type 57 connector. See Figure 2-1 for pin assignments.

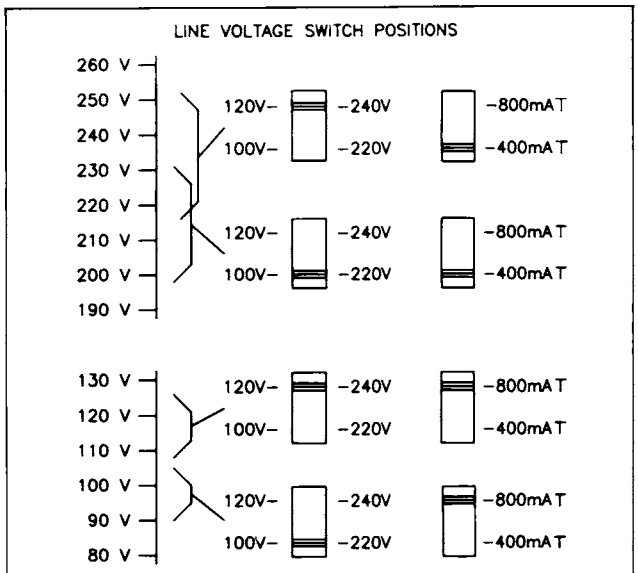
2-4. LINE VOLTAGE SELECTION

Figure 2-2 provides instructions for line voltage and fuse selection. The line voltage switch positions and line fuse are selected at the factory based upon the country of destination. Always check the line voltage switch and line fuse before connecting the 3314A to power.

CAUTION

Connecting the 3314A to a power source when the line voltage switches are improperly set will destroy the line fuse.

Using the wrong line fuse value or type will not protect the circuitry inside the 3314A and may result in damage to your 3314A.



△2

Voltage Selected	Fuse Value	-hp- Part Number
110/120V	1A SLO BLOW	2110-0312
220/240V	0.5A SLO BLOW	2110-0202

CAUTION

Using the wrong fuse value or fuse type will not protect the circuitry inside the 3314A and may result in damage to your 3314A.

Figure 2-2. Line Voltage/Line Fuse Selection

"See section VII for "△" explanations."

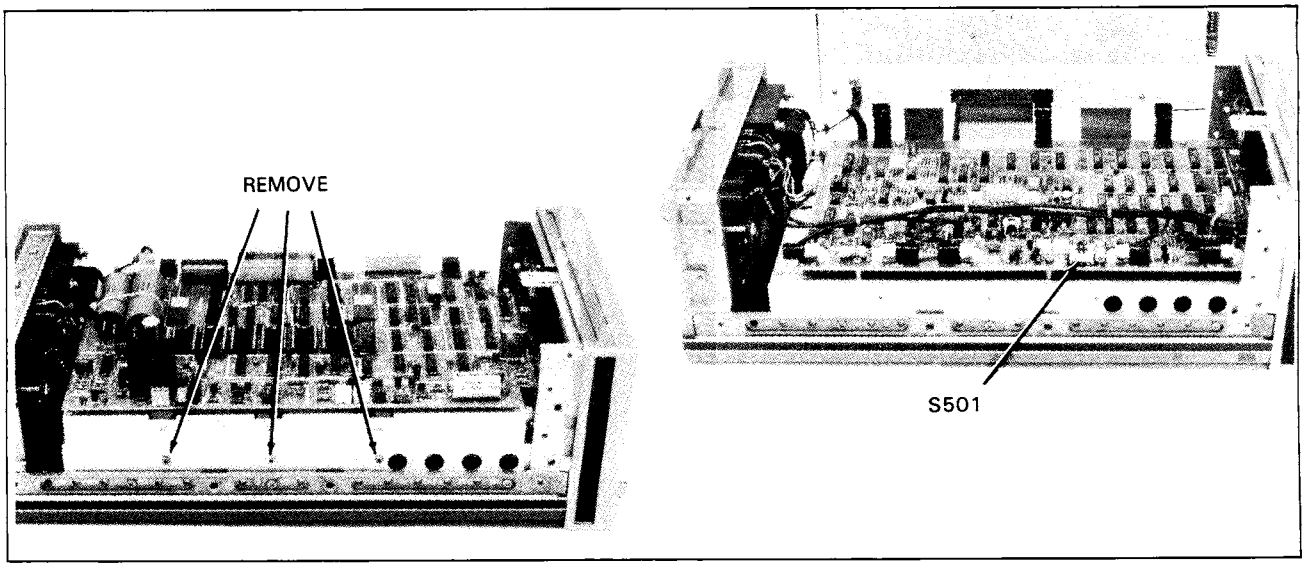


Figure 2-3. Z-AXIS Polarity Selection

2-5. Z-AXIS POLARITY SELECTION

The polarity of the Z-Axis output can be inverted by setting S501 on the A2 PC board. This switch is set at the factory to output positive (> +5V) blanking pulses, negative (< −5V) intensifying pulses and 0V baseline.

To gain access to this switch:

1. Disconnect the 3314A from its power source.

2. Remove the top handle and then the top cover.

3. Remove the three screws that secure the A3 PC Assembly shield to the main deck. See Figure 2-3.

4. Raise the A3 PC Assembly on its hinges to expose the A2 PC Assembly.

5. S501 is located at the left edge of the A2 PC Assembly.

6. Set S501 as required. "BLK-" is for negative blanking pulses. "BLK+" is for positive blanking pulses.

7. Re-assemble the 3314A.

2-6. HP-IB ADDRESS SELECTION

The HP-IB address is set from the front panel and stored in non-volatile memory.

To view the address:

1. Press the blue shift key and then the LCL key. The current address will be displayed for about 1/2 second.

To change the address:

1. Press the RECALL key and then the LCL key. The current address will be displayed indefinitely.

2. Set the 3314A's address from 0 to 30 inclusive with the Modify knob. Address 31 is not allowed. Incrementing the past 30 sets the address to Listen Only. When the 3314A is set to Listen Only, the displayed address will be "L-O".

3. Press the STORE key and then the LCL key to execute the entry.

The HP-IB address is set at the factory to 7. 7 is also the default address if the non-volatile memory is lost.

If you are using a controller in the "command" mode or are using an older type that requires the Talk and Listen addresses, use Table 2-1 to determine the proper addresses.

2-7. POWER ON AND OPERATOR'S CHECKS

Connect the 3314A to its power source using the power cord provided. If the power cord included with your 3314A is not compatible with the outlet, contact your nearest -hp- office for a replacement.

Table 2-1. HP-IB Address

Device	Talk	Listen	
0	@	SP	
1	A	!	
2	B	"	
3	C	#	
4	D	$	
5	E	%	
6	F	&	
7	G	'	3314A factory setting
8	H	(	
9	I	)	
10	J	*	
11	K	+	
12	L	,	
13	M	-	
14	N	.	
15	O	/	
16	P	0	
17	Q	1	
18	R	2	
19	S	3	
20	T	4	
21	U	5	usually the controller
22	V	6	
23	W	7	
24	X	8	
25	Y	9	
26	Z	:	
27	[	;	
28	\	<	
29	]	=	
30	^	>	
Listen Only			

Set the LINE switch, located at the upper left corner of the front panel, to the ON position. At this time the 3314A will

initiate a 2 second count down to allow electrical stabilization.

do a CALibrate ALL to generate a full complement of calibration constants. Every frequency range and all three functions are checked by a CAL ALL.

display the appropriate calibration errors if the CAL ALL failed. The 3314A will attempt to calibrate itself for another 20 seconds or until a calibration is successful.

This checks ~80% of the all the 3314A's circuitry. A special memory test has been built into the 3314A to test every ROM and RAM IC. To perform this test, hold the "ARB" key in while power is turned ON. While the 3314A is checking the memory, the front panel will be completely blank (about 30 seconds). After the test is finished, all the front panel LEDs will be lit if the test was successful. If the test was not successful, one or more of these LEDs will be off.

ROM IC#	LED	RAM IC#	LED
1	FREQ	1	SW/TR INTVL
2	AMPTD	2	START FREQ
3	OFFSET	3	STOP FREQ
4	SYM	4	MKR FREQ
5	PHASE		
6	N		

In addition, you can now check every front panel key. When a key is pressed, a corresponding LED should go OFF. The Modify knob and arrow keys cause elements of the 7 segment display to go OFF.

2-8. WHAT TO DO IN CASE OF DIFFICULTY

There are several operator actions that should be performed before an 3314A is diagnosed as defective.

1. Clear the 3314A's memory completely by holding the PRESET key in while setting power ON. The 3314A will display "E09" after the normal start up to indicate the the non-volatile memory has been cleared.

2. Check the Line Voltage and the Line Voltage Select Switches. These must be compatible.

3. Check the Line Fuse for the proper value and type. Normal blow type fuses are not allowed.

4. Clean the air filter.

5. Perform the Operators Checks. See Paragraph 2-7.

6. Check the system cabling and the loading of each output.

7. Check the performance of the 3314A against the specifications with the instructions in Section 4 of this manual.

Hewlett-Packard has a world-wide service organization in case your 3314A requires service. Page ii of this manual contains explicit warranty information and should be thoroughly understood before an instrument is shipped to a repair facility. When a 3314A is shipped to a repair facility, use one of the Service Repair Tags to insure timely action. If you need more Service Repair Tags, order part number 9320-3896 from your nearest sales and service office.

2-9. OPTION 001: PRE-INSTALLATION AND ORDERING INFORMATION

This information applies when you want to install Option 001 into a 3314A in the field. Option 001 has been completely installed and tested at the factory in 3314A's which were ordered with Option 001.

Field installation requires that you order the following components. Contact your nearest -hp-Sales and Service Office for current ordering information and prices.

Qty.	Description	-hp- Part Number
1	X3 PC Assembly	03314-66505
1	X3 Output Cable	03314-61611
1	X3 Power Supply Cable	03314-61616
1	BNC Jack	1250-1717
4	SCREW PH M3	0515-0055
4	WASHER-LOCK-SCR 4	2190-0004
1*	DIODE, Zener, 35.8V	1902-3301
2*	Tie Point	1251-0213
.2ft.*	Flexible Tubing	0890-0060
1**	CABLE, COAX, A5 to Main Output	03314-61613
2**	WASHER, SHLDR	5040-0345

* These items are required if you are installing Option 001 into 3314A's with serial numbers 2141A00101 through 2141A00150.
** These items are required if you are installing Option 001 into 3314A's with serial numbers 2141A00151 through 2141A00261. Cable W13 in this serial number range is 20mm shorter than a standard cable (too short to be used with Option 001). The short cable can be identified because it has an RCA PHONO type connector. The longer cable has a BNC panel connector.

WARNING

Failure to install A1CR123 (35.8V zener diode) into 3314A's with serial numbers 2141A00101 through 2141A00150 when installing Option 001, will affect the warranty of the 3314A and Option 001. This diode protects the X3 PC Assembly from "high line" operation. High line conditions exist whenever the line voltage exceeds the line voltage switch settings by more than 5%.

2-10. INSTALLATION (OPTION 001)

WARNING

Maintenance described herein is performed with power supplied to the instrument and protective covers removed. Such maintenance should be performed by service-trained personnel who are aware of the hazards involved (for example fire and electrical shock). Where maintenance can be performed without power applied, the power cord should be removed.

WARNING

Before any repair is completed, ensure that all safety features are intact and functioning and that all necessary parts are connected to their protective grounding means.

WARNING

All 3314A's with serial numbers from 2141A00101 through 2141A00150 must have a 35.8V zener diode added to the power supply before installing Option 001. This diode is required to protect Option 001 from "high line" operation. High line conditions exist when the line voltage exceeds the line voltage switch settings by more than 5%.

NOTE

The installation of A3CR123 must be done very carefully to meet HP's stringent quality assurance requirements. Failure to install A3CR123 as directed will affect the warranty. See "LIMITATION OF WARRANTY" paragraph on page i of this manual for exact details.

2-11. HOW TO INSTALL A3CR123 (Serial numbers 2141A00101 through 2141A00150 only)

Read the entire set of instructions and review Figure 2-4, "A3CR123 Installation" before beginning. Review the general safety consideration and the static sensitivity topics in Section VIII of the Service Manual.

CAUTION

There are several components on the A3 PC Assembly that are static sensitive. The work station, the soldering iron and the service personnel should be static protected.

A. Remove the power cord.

B. Remove the screws securing the top handle and then remove the handle. Remove the top cover by pulling the cover carefully up and to the rear of the 3314A.

C. Disconnect all five cables from the A3 PC Assembly.

D. Remove all eight screws that secure the A3 PC Assembly to the deck.

E. Carefully lift the A3 PC Assembly straight up. There are three transistors mounted on the deck that connect to the A3 PC Assembly via three connectors on the left side of the PC board.

F. Unsolder the collector of A3Q115 and the end of A3R146 that is nearest Q112.

G. Solder a Tie Point (1251-0213) into the empty holes created in step F.

H. Wrap the lead from A3Q115 around its tie point. This lead should make one full turn around the tie point to insure good mechanical contact and the lead should have a slight bend to relieve any stress.

I. Wrap the lead from A3R146 around its tie point. This lead should make one full turn around the tie point to insure good mechanical contact and the lead should have a slight bend to relieve any stress.

J. Install about .6 inch of flexible tubing on each lead of A3CR123.

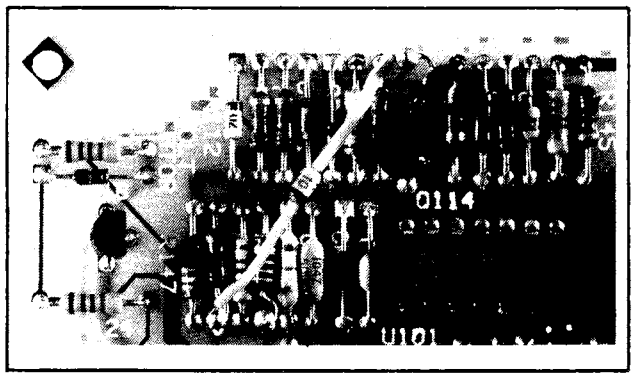


Figure 2-4. A3CR123 Installation

K. Wrap the lead from the cathode (the end with the stripe of A3CR123 to the A3R146 tie point. This lead should make one full turn around the tie point to insure good mechanical contact, the lead should have a slight bend to relieve stress and the end of the flexible tubing should end <.1 inch from the tie point. See Figure 2-4, "A3CR123 installation".

L. Install the other lead from A3CR123 onto the A3Q115 tie point. This lead should make one full turn around the tie point to insure good mechanical contact, the lead should have a slight bend to relieve any stress and the end of the flexible tubing should end <.1 inch from the tie point. See Figure 2-4, "A3CR123 Installation."

M. Solder the leads to each tie point.

N. Remove the solder flux from both sides of the A3 PC Assembly with flux remover.

O. Carefully install the A3PC Assembly back into the 3314A. Make sure the leads from Q100, Q101 and Q108 are correctly seated in their respective connectors and are not bent. When the A3 PC Assembly is correctly installed, each transistor lead will show about .05 inch above the connectors.

P. Complete the assembly of the 3314A by reversing the actions taken in steps D, C, B and then A.

2-12. HOW TO INSTALL OPTION 001

A. Remove the power cord.

B. Remove the top and bottom covers.

C. Install the A3 PC assembly onto the A1 VCO shield using the four screws and washers supplied. Make sure that the two adjustment holes in the A5 PC Board align with the holes in the shield.

D. Install the X3 Power Supply Cable, 03314-61616, from A5J1 to A3J102.

E. Remove the temporary plug from the X3 Output hole in the rear panel.

F. Install the X3 BNC jack, 1250-1717, in the X3 Output hole. If you do not have a socket type wrench to tighten the nut properly, you will have to remove the rear panel. The rear panel is secured to the rear frame with two screws from the top and two screws from the bottom.

G. Install the X3 Output Cable, 03314-61611, from A5J4 to the X3 Output jack just installed. Install the rear panel if removed in step F.

H. Using a razor or sharp knife, carefully cut the tubing that secures the two SMB connectors located in the middle of the Main Output Cable. It is not necessary to remove the tubing, just to disconnect the SMB connectors.

I. Connect each SMB connector from the Main Output Cable to a corresponding SMB connector on the X3 PC Assembly.

J. Dress the cables so that they are not stressed and so that they will not interfere with the fan blades.

K. Replace all covers and then connect the power cord. All X3 PC Assemblies were fully tested at the factory, however, the Performance Tests should be performed to verify that the X3 Output is fully operational.

2-13. RE-PACKAGING A 3314A

The best material to re-pack a 3314A is the original material used by the factory. If this material has not been retained, the following steps should be performed:

1. Wrap the 3314A in heavy paper or plastic. If you are shipping the 3314A to a -hp- office, attach one of the Service Repair Tags. The front panel should also be protected with an additional piece of cardboard.

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

3. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning. Do not use loose filler such as styrofoam chips.

4. Seal the shipping container.

5. Mark the shipping container FRAGILE to ensure careful handling.

6. In any correspondence, refer to the 3314A by its full serial number.

2-14. INSTALLING ACCESSORIES

-hp- manufactures several kits to adapt your 3314A with handles, feet and rack mounts. These kits are available from -hp-.

5 1/4 H Front Handle Kit	5061-0089	Option 907
5 1/4 H Rack Adapter Kit (Half Module)	5061-0057	Option 908
5 1/4 H Support Shelf Kit	5061-0097	
Slide Kit (For Support Shelf)	1494-0041	
Lock Link Kit (Vertical and Horizontal)	5061-0094	
5 1/4 H Bail Handle Kit (Half Module)	5061-2002	
Feet-Rear Panel Stand-Off	5061-2009	
Feet-Rear and Cord Wrap	5061-0095	

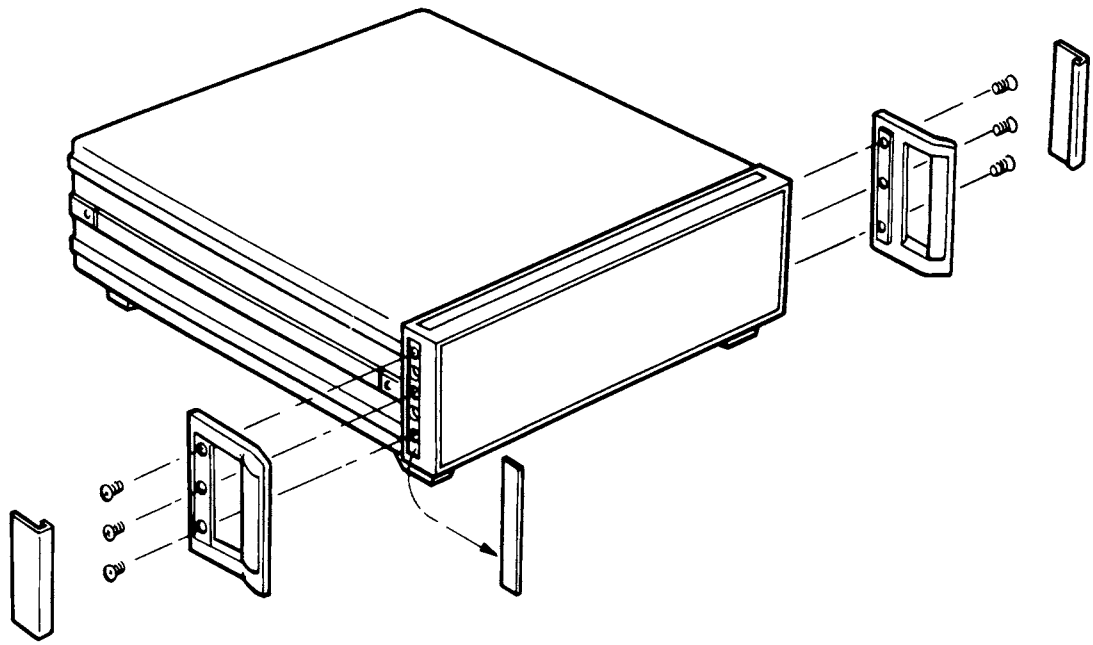
5¼H FRONT HANDLE KIT

[PRODUCT HT. 132.6mm/5.219 in.]

HP PART NUMBER 5061-0089 (OPTION 907)

CONTENTS

QTY.		PART NO.
2	FRONT HANDLE ASS'Y	5060-9899
2	FRONT HANDLE TRIM	5020-8896
6	#8-32 x 3/8 SCREW	2510-0195



INSTRUCTIONS

1. REMOVE SIDE TRIM STRIPS.
2. ATTACH FRONT HANDLE ASS'Y WITH 3 SCREWS PER SIDE.
3. PRESS FRONT HANDLE TRIM IN PLACE.

LABEL NO. 5955-0414

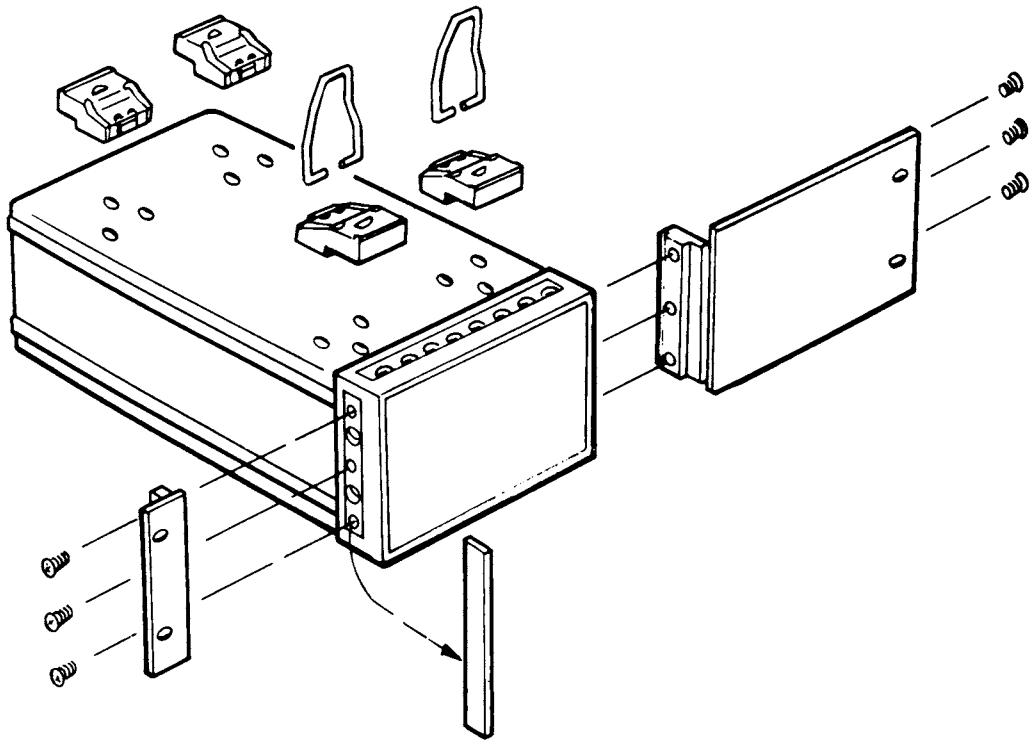
5¼H RACK ADAPTER KIT HALF MODULE

[PRODUCT HT. 132.6mm/5.219 in.]

HP PART NUMBER 5061-0057

CONTENTS

QTY.		PART NO.
1	ADAPTER ASS'Y	5061-0006
1	RACK FLANGE	5020-8862
6	8-32 x 3/8 SCREW	2510-0193



INSTRUCTIONS

1. REMOVE SIDE TRIM STRIPS.
2. ATTACH ADAPTER ASS'Y TO LEFT OR RIGHT SIDE WITH 3 SCREWS.
3. ATTACH RACK FLANGE TO OPPOSITE SIDE WITH 3 SCREWS.

LABEL NO. 5955-0423

5¼H SUPPORT SHELF KIT SUB MODULES

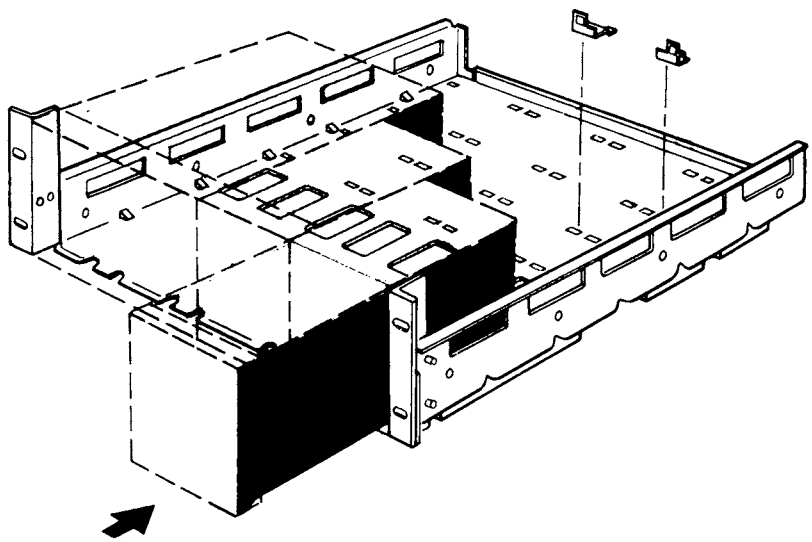
[PRODUCT WTS. to 22.7kg/50 lbs.]

HP PART NUMBER 5061-0097

CONTENTS

QTY.		PART NO.
1	SUPPORT SHELF ASS'Y	5061-0097
8	TIE DOWN CLIPS	1600-0517
8	#6-32 x 3/16 SCREW*	2360-0330
8	#6-32 x 7/16 SCREW**	2360-0199
8	#6 WASHER	3050-0227

* STANDARD CABINETS ** PLASTIC CABINETS



INSTRUCTIONS

1. REMOVE FEET FROM SUB MODULE INSTRUMENT.
2. SET MODULE ON FLOOR OF TRAY AND SLIDE BACK UNTIL TRAY TAB IS INSERTED IN FRONT FRAME.
3. INSERT 2 TIE DOWN CLIPS IN APPROPRIATE TRAY SLOTS, PRESS CLIPS OVER REAR CASTING BOSSES AND LOCK DOWN WITH APPROPRIATE #6-32 SCREWS & WASHERS.
4. MOUNT SUPPORT SHELF IN ANY STD. 19" RACK ENCLOSURE.

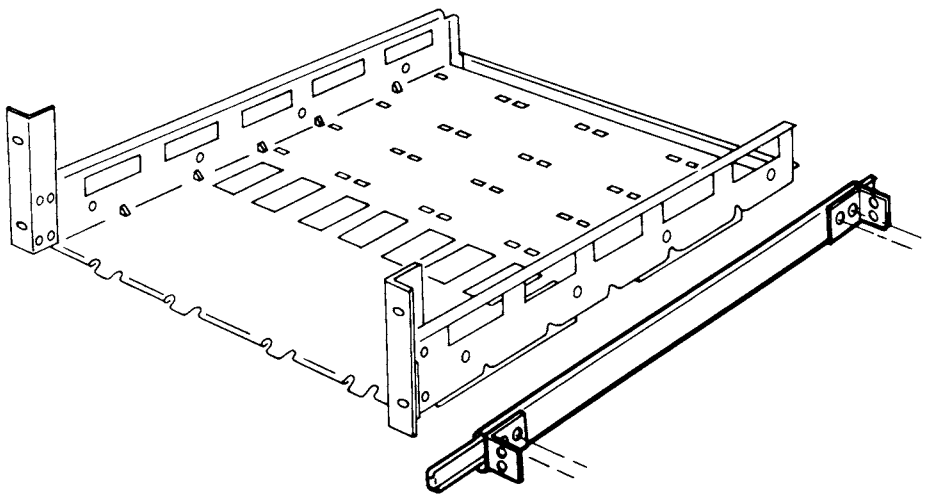
LABEL NO. 5955-0484

SLIDE KIT
SUB-MODULE SUPPORT SHELF
SYSTEM II

HP PART NUMBER 1494-0041

CONTENTS

QTY.		PART NO.
1 PR.	SLIDE ASSEMBLY	1494-0041
8	#8-32 x ¼ PAN HEAD SCREW	
8	#8-32 NUT W/LOCKWASHER	2580-0006
8	#10-32 x 7/16 PAN HEAD SCREW	
8	#10-32 UNISTRUT NUT	0590-0678



INSTRUCTIONS

1. ATTACH SLIDE (INNER MEMBER) TO EACH SIDE OF SUPPORT SHELF USING 4 # 8-32 x ¼ P.H. SCREWS AND NUTS PER SIDE.
2. INSERT 2 UNISTRUT NUTS IN THE REAR OF EACH OF THE 4 VERTICAL COLUMNS OF THE H.P. SYSTEMS ENCLOSURE.
3. ATTACH SLIDE (OUTER MEMBER) TO EACH SIDE OF SYSTEMS ENCLOSURE USING 4 #10-32 x 7/16 P.H. SCREWS PER SIDE.

LABEL NO.5955-3358

HEWLETT PACKARD

LOCK LINK KIT VERTICAL AND HORIZONTAL

HP PART NUMBER 5061-0094

THE VERTICAL AND HORIZONTAL LOCK LINK HARDWARE IS USED FOR LOCKING TOGETHER VARIOUS BENCH AND RACK MOUNTABLE COMBINATIONS OF FULL AND SUB MODULE CABINETS OF EQUAL DEPTHS. SUFFICIENT HORIZONTAL LINKS (12 FRONT, 6 REAR), TO FORM THREE SIDE BY SIDE JOINTS (UP TO 4 SUB MODULE INSTRUMENTS), AND SUFFICIENT VERTICAL LINKS (4 FRONT, 4 REAR) TO FORM TWO SETS OF OVER-UNDER JOININGS.*

CONTENTS

QTY		PART NO.
4	VERTICAL LOCK LINK, FRONT	1600-0367
8	#6-32 × 3/16 PAN HEAD	2360-0330
4	VERTICAL LOCK LINK, REAR	0050-0517
8	#6-32 × 7/16 FLAT HEAD (100) PLASTIC MOD.	2360-0360
8	#6-32 × 5/16 FLAT HEAD (100) METAL MOD.	2360-0334
12	HORIZONTAL LOCK LINK, FRONT	0050-0515
12	#8-32 × 1/4 FLAT HEAD (100)	2510-0192
6	HORIZONTAL LOCK LINK, REAR	0050-0516
12	#6-32 × 7/16 FLAT HEAD (100) PLASTIC MOD.	2360-0360
12	#6-32 × 5/16 FLAT HEAD (100) METAL MOD.	2360-0334

INSTRUCTIONS

Vertical Locking

1. REMOVE TOP TRIM STRIP FROM BOTTOM FRONT FRAME.
2. ATTACH FRONT VERTICAL LOCK LINKS TO BOTTOM FRONT FRAME USING 2 #6-32 PAN HD. SCREWS PER LINK.
3. SLIDE TOP CABINET BACK TO LOCK FRONT FRAMES TOGETHER.
4. ATTACH REAR VERTICAL LOCK LINKS OVER APPROPRIATE REAR BOSSES USING 2 #6-32 F.H.M. SCREWS PER LINK.

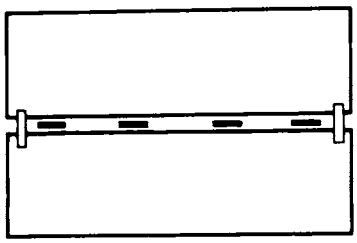
Horizontal Locking

1. REMOVE APPROPRIATE SIDE TRIM STRIPS.
2. ATTACH FRONT HORIZONTAL LOCK LINKS TO FRONT FRAMES USING 1 #8-32 F.H.M. SCREW PER LINK. OPPOSING LINKS MUST BE INSTALLED TO INTERLOCK.
3. PRESS CABINETS TOGETHER, SLIDE LEFT CABINET BACK TO LOCK FRONT FRAMES.
4. ATTACH REAR HORIZONTAL LOCK LINKS OVER APPROPRIATE REAR BOSSES, USING 2 #6-32 F.H.M. SCREWS PER LINK.

*LOCKING CABINET TOGETHER HORIZONTALLY IN A CONFIGURATION WIDER THAN 1 FULL MODULE WIDTH OR LOCKING MORE THAN TWO SUB MODULES VERTICALLY IS NOT RECOMMENDED.

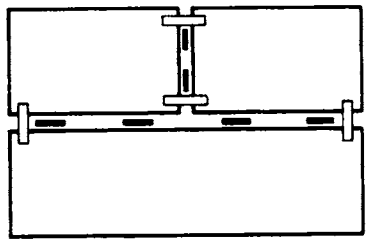
LABEL NO. 5955-0438

FRONT LOCK LINKS ▬▬

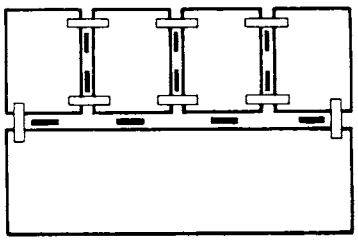


– VERTICAL LOCK LINKS FRONT
– VERTICAL LOCK LINKS REAR

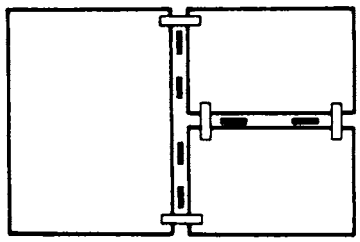
REAR LOCK LINKS ▭



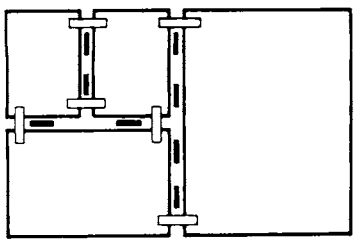
4 – VERTICAL LOCK LINKS FRONT
2 – VERTICAL LOCK LINKS REAR
4 – HORIZONTAL LOCK LINKS FRONT
– HORIZONTAL LOCK LINKS REAR



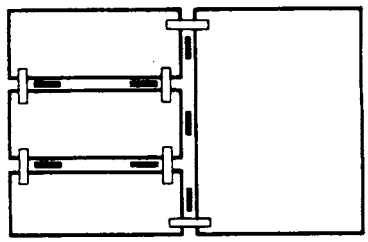
4 – VERTICAL LOCK LINKS FRONT
2 – VERTICAL LOCK LINKS REAR
12 – HORIZONTAL LOCK LINKS FRONT
6 – HORIZONTAL LOCK LINKS REAR



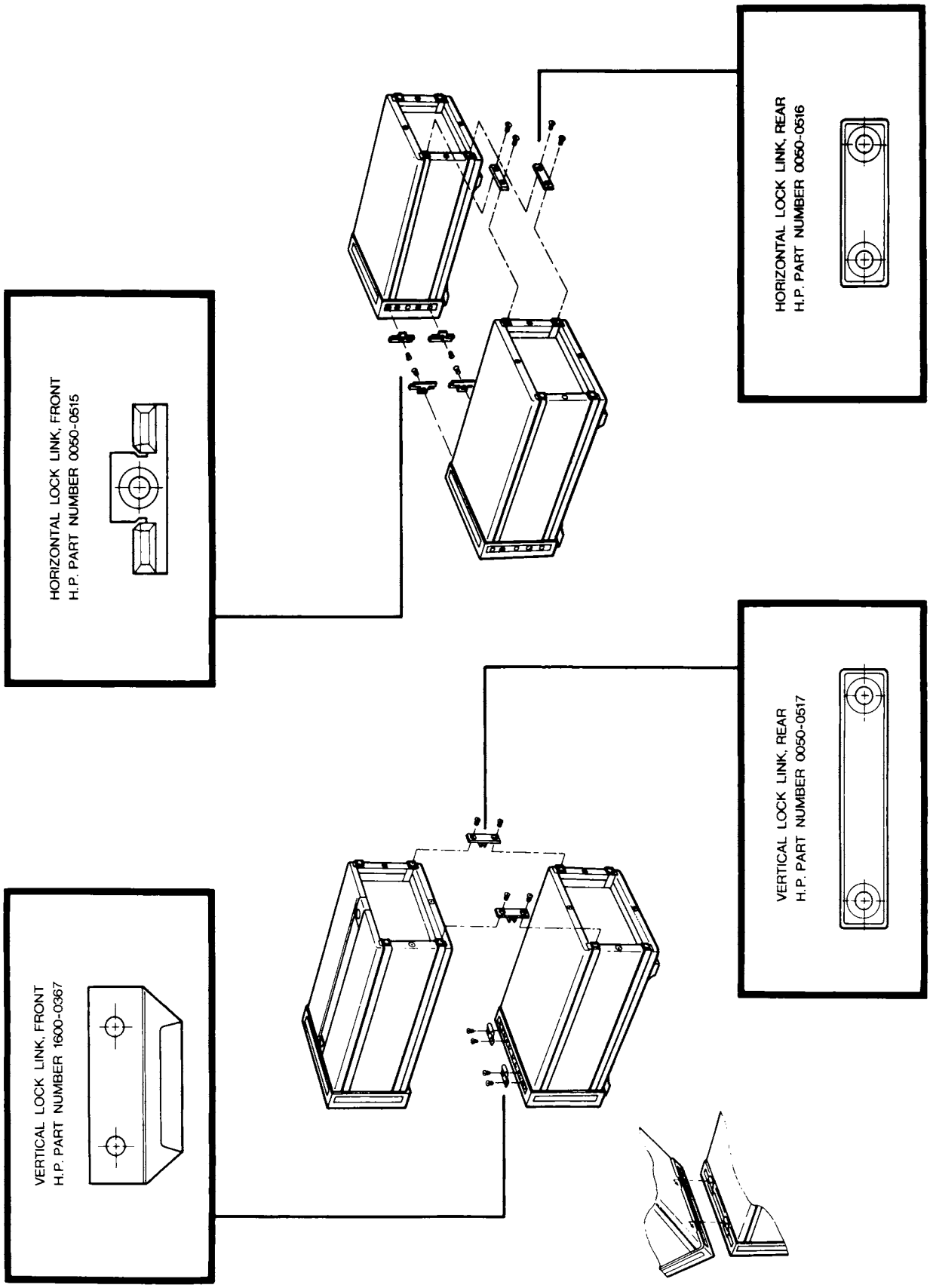
2 – VERTICAL LOCK LINKS FRONT
2 – VERTICAL LOCK LINKS REAR
8 – HORIZONTAL LOCK LINKS FRONT
2 – HORIZONTAL LOCK LINKS REAR



2 – VERTICAL LOCK LINKS FRONT
2 – VERTICAL LOCK LINKS REAR
12 – HORIZONTAL LOCK LINKS FRONT
4 – HORIZONTAL LOCK LINKS REAR



4 – VERTICAL LOCK LINKS FRONT
4 – VERTICAL LOCK LINKS REAR
6 – HORIZONTAL LOCK LINKS FRONT
2 – HORIZONTAL LOCK LINKS REAR


HORIZONTAL LOCK LINK, FRONT
H.P. PART NUMBER 0050-0515
HORIZONTAL LOCK LINK, REAR
H.P. PART NUMBER 0050-0516
VERTICAL LOCK LINK, FRONT
H.P. PART NUMBER 1600-0367
VERTICAL LOCK LINK, REAR
H.P. PART NUMBER 0050-0517

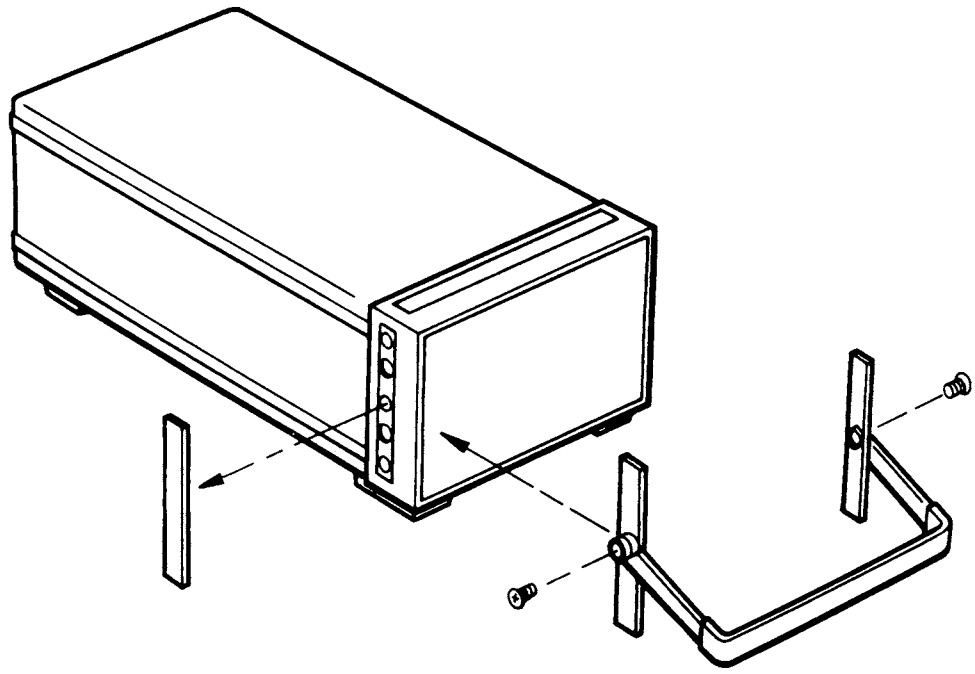
5¼H BAIL HANDLE KIT HALF MODULE

[PRODUCT HT. 132.6mm/5.219 in.]

HP PART NUMBER 5061-2002

CONTENTS

QTY.		PART NO.
1	BAIL HANDLE ASS'Y	5061-0036
2	BAIL HANDLE ADAPTER	5040-7217
2	BAIL HANDLE RETAINER	5040-7216
2	#8-32 x 5/8 SCREW	2510-0194
2	SPACER	0380-0004



INSTRUCTIONS

1. REMOVE SIDE TRIM STRIPS.
2. ATTACH HANDLE ASSEMBLY WITH 1 SCREW PER SIDE.

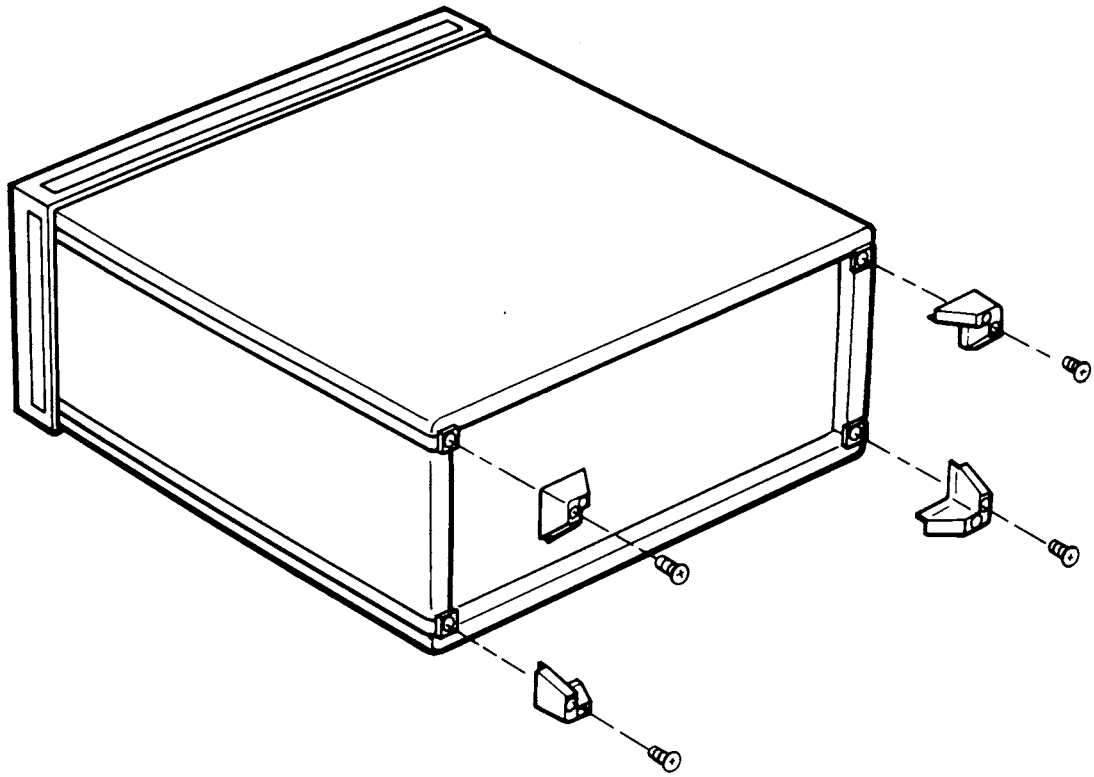
LABEL NO. 5955-0442

FEET-REAR PANEL STAND-OFF FULL & SUB MODULES

HP PART NUMBER 5061-2009

CONTENTS

QTY.		PART NO.
4	FOOT—REAR PANEL STAND-OFF	5040-7221
4	#6-32 x 5/16 PAN HD. SCREW	2360-0195



INSTRUCTIONS

1. PLACE ONE FOOT OVER EACH CORNER BOSS ON REAR CASTING AND SECURE WITH 1 SCREW.

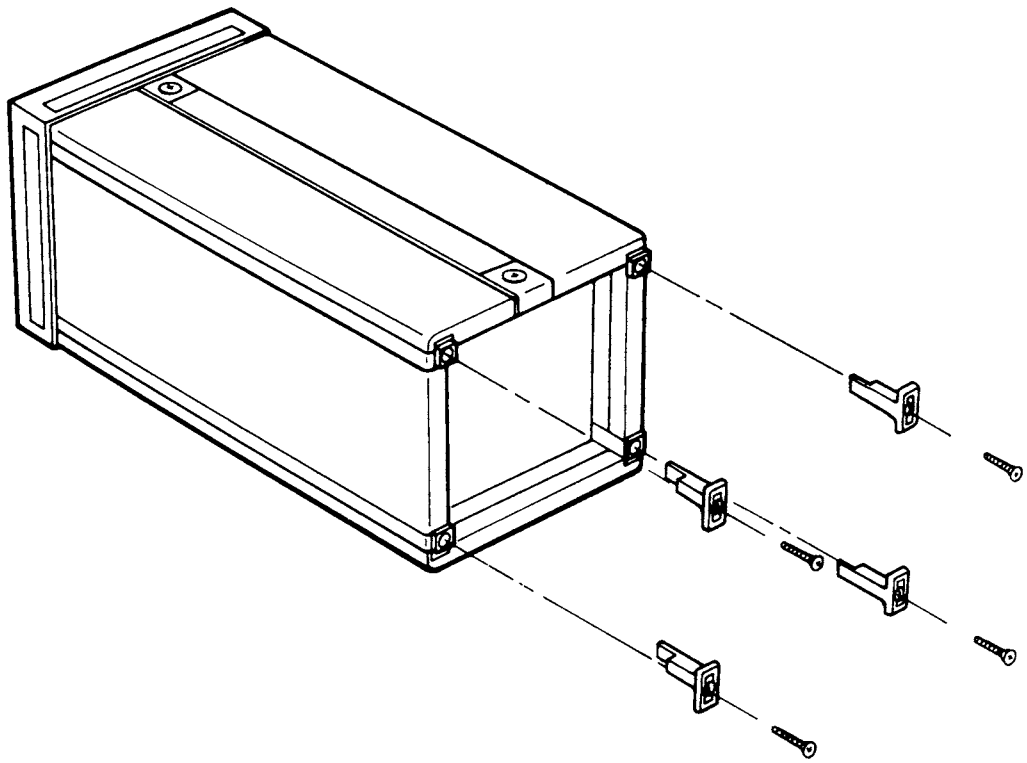
LABEL NO. 5955-0440

FEET-REAR & CORD WRAP SUB MODULES

HP PART NUMBER 5061-0095

CONTENTS

QTY.		PART NO.
4	FOOT—REAR & CORD WRAP	5040-7213
4	#6-32 x 1 PAN HD. SCREW	2360-0209



INSTRUCTIONS

1. PLACE ONE FOOT OVER EACH CORNER BOSS ON REAR CASTING AND SECURE WITH 1 SCREW.

LABEL NO. 5955-0446

SECTION III
OPERATION

3-1. INTRODUCTION

This section contains a front and rear panel overview, error code listing and an HP-IB Summary. The Operating and Programming Manual should be used for detailed operating information.

Table 3-1. Error Codes With Status Byte Bit #

Error #	Definition	Status Byte bit #
00	No Error (used via HP-IB, only)	
	--- OPERATOR ERRORS (non-ARB) ---	
01	Frequency/Symmetry conflict	0
02	Bus address entry error	0
03	Front panel failure/Invalid keycode	0
04	Calibration measurement not performed	1
05	Allowed in sweep, only	0
06	Not allowed in sweep	0
07	Not allowed in log sweep	0
08	Store 0 not allowed	0
09	Non-volatile memory lost;battery down	0
	--- OPERATOR ERRORS (ARB) ---	
10	Vector insert not allowed	0
11	Vector delete not allowed	0
18	Allowed in ARB, only	0
19	Not allowed in ARB	0
	--- PLL ERRORS ---	
20	Unstable input frequency	1
21	Input frequency outside of acquisition range	1
22	3314A output frequency would be out of range	1
23	SW/TR INTVL >20ms	1
24	Internal phase locked loop, unlocked	0
	--- FREQUENCY CALIBRATION ERRORS ---	
30	No frequency detected	0
31	Frequency error exceeds correction capability	0
32	Frequency unstable during calibration	0
	--- AMPLITUDE CALIBRATION ERRORS ---	
34	Signal amplitude outside measurement range	0
35	Signal amplitude gain too high	0
36	Signal amplitude gain too low	0
37	Signal amplitude gain exceeds correction capability	0
38	Signal amplitude gain offset exceeds correction capability	0
	--- HP-IB ERRORS ---	
41	Mnemonic invalid	0
42	Definition number invalid	0
43	Data invalid	0
44	Units invalid	0
45	Range Hold not allowed	0
46	ARB/SWEEP parameter conflict	0
47	Not allowed in MAN Sweep	0
	--- OVERLOAD ---	
50	AM or FM/VCO input voltage exceeds normal operating limits	1
51	Output voltage exceeds safe operating limits;	3

HP-IB PROGRAMMING SUMMARY

HP-IB Address

The 3314A's HP-IB address is set at the factory to 7. To view the current HP-IB address, press the BLUE shift key and then the LOCAL key. To change the HP-IB address, press the RECALL and then the LOCAL keys, rotate the TUNING KNOB until the desired address is displayed and then press the STORE and LOCAL keys. Listen Only is set by incrementing the address past 30.

3314A Programming Codes

3314A Function	HP-IB Codes		Format Of Returned Data
	Program	Query	
Amplitude	AP	QAP	AP 000000dd.ddVO or
milli-Volt p-p	MV		AP 000000d.dddVO or
Volt p-p	VO		AP 000000.dddVO or
			AP 00000.0ddddVO
Ampl Modulation	AM	QAM	AMd
OFF	0		
ON	1		
ARB	AR	QAR	ARd
OFF	0		
ON	1		
ON/Clear Wave	2		
Calibrate All	CA		
Calibrate Disable	CD		
Calibrate Enable	CE		
Calibrate Freq	CF		
Data Transfer Mode	DM		
Unbuffered	1		
96 Byte Buffer	2		
Delete Vector	DV		
Δ t	DT	QDT	DT 00000.0ddddSN or
milli-Seconds	MS		DT 0000.00ddddSN
Seconds	SN		
Display Errors	DE		
OFF	0		
ON	1		
Error Codes		QER	ERdd
Frequency	FR	QFR	FR 00ddddddddHZ or
Hertz	HZ		FR 000000ddd.dHZ or
kilo-Hertz	KZ		FR 000000dd.ddHZ or
Mega-Hertz	MZ		FR 000000d.dddHZ
Freq Modulation	FM	QFM	FMd
OFF	0		
ON	1		
Function Invert	FI	QFI	FId
OFF	0		
ON	1		
Function	FU	QFU	FUd
OFF	0		
Sine	1		
Square	2		
Triangle	3		
Insert Vector	IV		
Manual Sweep	MA	QMA	MAd
OFF	0		
ON	1		
Manual Trigger	MN		
Marker Frequency	MK	QMK	MK 00ddddddddHZ or
Hertz	HZ		MK 000000ddd.dHZ or
kilo-Hertz	KZ		MK 000000dd.ddHZ or
Mega-Hertz	MZ		MK 000000d.dddHZ
Mode	MO	QMO	MOd
Free Run	1		
Gate	2		
N Cycle	3		
1/2 Cycle	4		
Fin X N	5		
Fin ÷ N	6		
N	NM	QNM	NM 000000dddd.EN
Enter	EN		
Offset	OF	QOF	OFs0000000d.ddVO or
Volts DC	VO		OFs000000d.dddVO
Phase	PH	QPH	PHs000000ddd.dDG PHASE
degree	DG		
PLL Status Mask	PM		
(bit 5 of Status Byte)			
Masked	0		
= 1 at Lock	1		
= 1 at Unlock	2		
= 1 either	3		

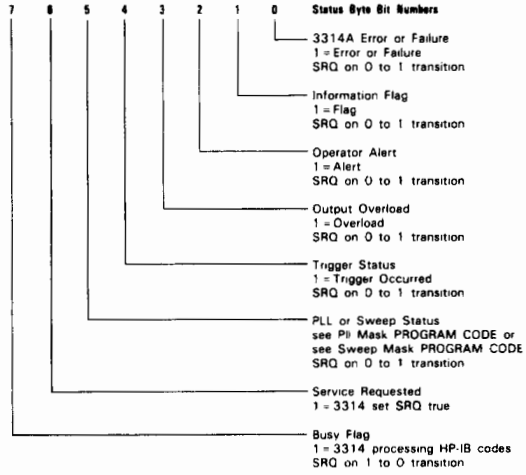
3314A Function	HP-IB Codes		Format of Returned Data
	Program	Query	
Preset	PR		
Range Down	RD		
Range Hold	RH		
OFF	0		
DC Offset	1 to 2		
Amplitude	1 to 4		
Frequency	1 to 8		
Range Up	RU		
Recall (non-ARB)	RC		
Register	0 to 5		
Recall Wave (ARB)	RW	QRW	RWd
ARB ON and recall Wave	0 to 5		
SRQ Mask, bits 0-3	ML		
Mask	@ to O		
SRQ Mask, bits 4-7	MH		
Mask	@ to O		
Start Frequency	ST	QST	ST 00ddddddddHZ or
Hertz	HZ		ST 000000ddd.dHZ or
kilo-Hertz	KZ		ST 000000dd.ddHZ or
Mega-Hertz	MZ		ST 000000d.dddHZ
Stop Frequency	SP	QSP	SP 00ddddddddHZ or
Hertz	HZ		SP 000000ddd.dHZ or
kilo-Hertz	KZ		SP 000000dd.ddHZ or
Mega-Hertz	MZ		SP 000000d.dddHZ
Store (non-ARB)	SO		
Register	1 to 5		
Sweep	SW	QSW	SWd
OFF	0		
Linear	1		
Log	2		
Sweep Status Mask	SM		
(bit 5 of Status Byte)			
Masked	0		
= 1 at Start	1		
= 1 at Stop	2		
= 1 either	3		
Symmetry	SY	QSY	SY 00000000dd.PC
Percent	PC		
Sweep/Trig Interval	TI	QTI	TI 000000dddd.SN or
milli-Seconds	MS		TI 000000ddd.dSN or
Seconds	SN		TI 000000dd.ddSN or
			TI 000000d.dddSN or
			TI 000000.ddddSN or
			TI 00000.0ddddSN or
			TI 0000.00ddddSN
Trigger Level	LV	QLV	LVd
1V Threshold	1		
0V Threshold	2		
Trigger Slope	SL	QSL	SLd
Positive	1		
Negative	2		
Trigger Source	SR	QSR	SRd
Internal	1		
External	2		
VCO	VC	QVC	VCd
OFF	0		
ON	1		
Vector Height	VH	QVH	VHs000000dddd.EN
Enter	EN		
Vector Length	VL	QVL	VL 000000dddd.EN
Enter	EN		
Vector Marker	VM	QVM	VM 000000dddd.EN
Enter	EN		

d = ASCII digits 0 to 9.
s = sign bit, ASCII space or -
All other characters are exactly as shown.
All returned data is followed by an ASCII carriage return and line feed with HP-IB EOI true, concurrent with the line feed.

HP-IB PROGRAMMING SUMMARY (cont)

Status Byte

Bits of the Status Byte are set (1) only after unmasking that bit and the condition is met. All bits are reset immediately after the Status Byte is sent.



Unmasking The Status Byte

The 3314A will Request Service (SRQ line true) when a bit of the Status Byte is unmasked and the operating condition to set that bit exists. Masking is not affected by PRESET or CLEAR 7. All bits except bit 7 will set SRQ at the 0 to 1 logic transition. Bit 7 will set SRQ at the 1 to 0 logic transition and is useful when using Data Transfer Mode 2, indicating when the 3314A is ready to be programmed again.

ML	3	2	1	0	Bit Number
@	MASKED	MASKED	MASKED	MASKED	
A	MASKED	MASKED	MASKED	UNMASKED	
B	MASKED	MASKED	UNMASKED	MASKED	
C	MASKED	MASKED	UNMASKED	UNMASKED	
D	MASKED	UNMASKED	MASKED	MASKED	
E	MASKED	UNMASKED	MASKED	UNMASKED	
F	MASKED	UNMASKED	UNMASKED	MASKED	
G	MASKED	UNMASKED	UNMASKED	UNMASKED	
H	UNMASKED	MASKED	MASKED	MASKED	
I	UNMASKED	MASKED	MASKED	UNMASKED	
J	UNMASKED	MASKED	UNMASKED	MASKED	
K	UNMASKED	MASKED	UNMASKED	UNMASKED	
L	UNMASKED	UNMASKED	MASKED	MASKED	
M	UNMASKED	UNMASKED	MASKED	UNMASKED	
N	UNMASKED	UNMASKED	UNMASKED	MASKED	
O	UNMASKED	UNMASKED	UNMASKED	UNMASKED	

MH	7	6	5	4	Bit Number
@	MASKED		MASKED	MASKED	
A	MASKED		MASKED	UNMASKED	
B	MASKED		UNMASKED	MASKED	
C	MASKED		UNMASKED	UNMASKED	
D	MASKED		MASKED	MASKED	
E	MASKED		MASKED	UNMASKED	
F	MASKED		UNMASKED	MASKED	
G	MASKED		UNMASKED	UNMASKED	
H	UNMASKED		MASKED	MASKED	
I	UNMASKED		MASKED	UNMASKED	
J	UNMASKED		UNMASKED	MASKED	
K	UNMASKED		UNMASKED	UNMASKED	
L	UNMASKED		MASKED	MASKED	
M	UNMASKED		MASKED	UNMASKED	
N	UNMASKED		UNMASKED	MASKED	
O	UNMASKED		UNMASKED	UNMASKED	

Error Codes

ER #	Definition	Status Byte Bit #
00	No errors since errors were last queried (HP-IB function, only)	
	--- OPERATOR ERRORS (non-ARB) ---	
01	Frequency/Symmetry conflict	0
02	Bus address entry error	0
03	Front panel key failure	0
04	Calibration measurements not performed	1
05	Allowed in sweep, only	0
06	Not allowed in sweep	0
07	Not allowed in log sweep	0
08	Store 0 not allowed	0
09	Non-volatile memory lost;battery down	0
	--- OPERATOR ERRORS (ARB)	
10	Vector insert not allowed	0
11	Vector delete not allowed	0
18	Allowed in ARB, only	0
19	Not allowed in ARB	0
	--- PLL ERRORS ---	
20	Unstable input frequency	1
21	Input frequency outside of capture range	1
22	3314A output frequency would be out of range	1
23	Internal interval > 20ms	1
24	Internal synthesis unlocked	0

ER #	Definition	Status Byte Bit #
	--- FREQUENCY CALIBRATION ERRORS ---	
30	No frequency detected	0
31	Frequency error exceeds correction capability	0
32	Frequency unstable during calibration	0
	--- AMPLITUDE CALIBRATION ERRORS ---	
34	Signal amplitude outside measurement range	0
35	Signal amplitude gain too high	0
36	Signal amplitude gain too low	0
37	Signal amplitude gain out of limit	0
38	Signal amplitude gain offset out of limit	0
	--- HP-IB ERRORS ---	
41	Mnemonic invalid	0
42	Definition number invalid	0
43	Data invalid	0
44	Units invalid	0
45	Range Hold not allowed	0
46	ARB/SWEEP parameter conflict	0
47	Not allowed in Manual Sweep	0
	--- OVERLOAD ---	
50	AM or FM/VCO input voltage exceeds normal operating limits (HP-IB) function only)	1
51	Output voltage exceeds safe operating limits; 3314A has disconnected itself	3

Mode

The 3314A has 7 basic operating modes. The trigger signal, either the 3314A's internal trigger source or an external signal you supply, is essential to every operating mode except FREE RUN with sweep off.

FREE RUN Mode. The 3314A outputs continuous Sine, Square, Triangle or ARB functions. Continuous functions, sweeps and ARB operations are allowed.

GATE Mode. The output is "gated" ON and OFF by the Trigger level. Gated functions, sweeps and ARB operations are allowed.

N CYCLE Mode. The 3314A outputs a burst of N complete cycles of the selected function, starting when a Trigger edge is received. The N parameter sets the number of cycles from 1 to 1999. The start/stop phase is set with the Phase parameter from -90° to +90°.

1/2 CYCLE Mode. The 3314A outputs alternate 1/2 cycles of the selected funtion when a Trigger edge is received. The start phase of the first 1/2 cycle (and the stop phase of the second 1/2 cycle) is set with the Phase parameter from -90° to +90°.

Fin X N Mode. The 3314A will phase lock to the Trigger (reference) signal and output a frequency "N" times the reference frequency. The N parameter sets "N" from 1 to 1999. The frequency limits for both the 3314A and the reference are from 50Hz to 20MHz.

Fin + N Mode. The 3314A will phase lock to the Trigger (reference) signal and output a frequency equal to the reference frequency divided by "N". The N parameter sets "N" from 1 to 1999. The frequency limits for both the 3314A and the reference are from 50Hz to 20MHz.

ARB Mode. The ARB mode redefines the 3314A as an Arbitrary Waveform Generator. The output waveform consists of a series of voltage ramps called vectors. The operator has control over the number of vectors, the length of each vector in time and the height of each vector. Both continuous ARB functions (FREE RUN Mode) and gated ARB (GATE Mode) are allowed.

STATUS

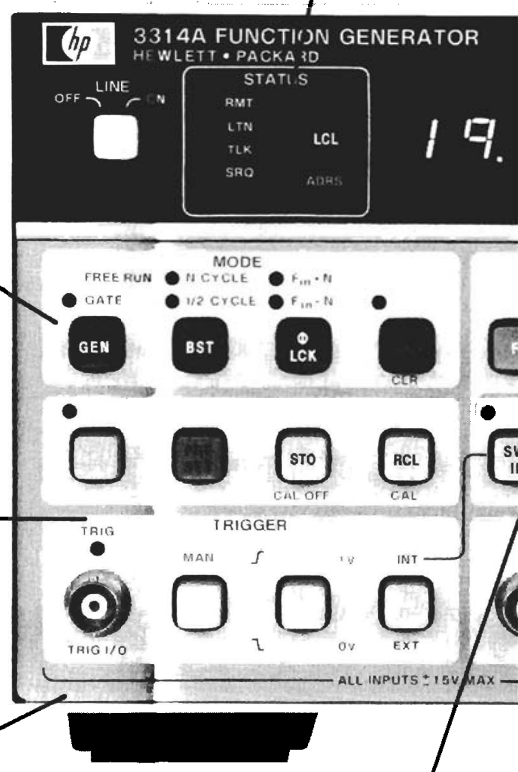
This group contains the HP-IB status indicators and the LCL key to switch control of the 3314A from remote to front panel operation. When the LCL key is preceded by the BLUE shift key, the 3314A displays its HP-IB address for 1/2 second. The HP-IB address is set from the front panel and stored in non-volatile memory. The factory setting is 7.

Preset

The Preset key initializes the 3314A to its basic operating state. This feature is especially useful to quickly recover from complex operating states.

Store/Recall

Up to 5, non-ARB front panel control settings can be stored in registers 1 through 5 to be recalled in the future. Register 0 is reserved for the front panel setting at power off. In addition, 6 ARB waveforms can be recalled from ARB registers 0 through 5. ARB waveforms are automatically stored as they are created.



External Trigger

One EXT Trigger is a signal you apply to the Trigger I/O port that satisifies the selectable slope and threshold conditions (note that the Trigger I/O port is an input when EXT Trigger is selected). EXT Triggers are level sensitive for Gate; edge sensitive for Burst, Phase Lock and Sweep operations. The minimum signal that will consistently trigger the 3314A is ≥ 300mVp-p, centered on the 3314A's threshold voltage.

Another EXT Trigger is the MAN key. You will have to press this key twice when in Gate mode, to simulate a complete trigger cycle (both levels). Once is sufficient for all other operations.

There are two EXT Triggers available from the HP-IB, the Group Execute Trigger (GET) and the "MN" programming command.

Internal Trigger

The **SW/TR INTVL** parameter sets the period of the internal trigger (note that the Trigger I/O port is an output when INT trigger is selected). This output signal is useful as a sync signal during sweeps, gate and burst operations.

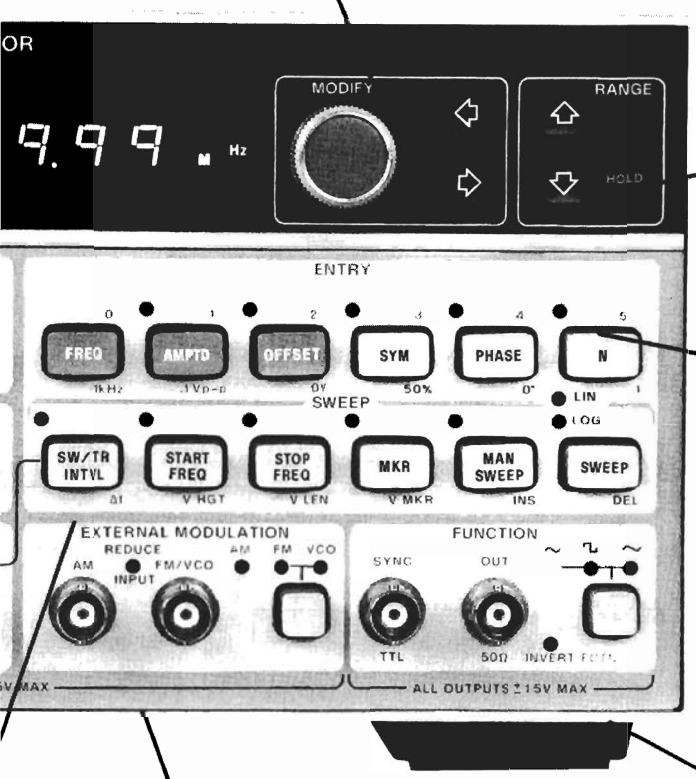
MEET THE 3314A FUNCTION GENERATOR

Modify

All variable parameters (selected by keys in the Entry Group) are entered into the 3314A using the Modify knob or the ↑ or ↓ keys. These controls change the value of the displayed operating parameter. The Modify knob has 2 basic operating modes called "Cursor" and "Multi Speed".

CURSOR (a digit is flashing). This mode is useful when making small changes or changes of constant increments. The flashing cursor digit is incremented or decremented by 1 whenever rotation of the Modify knob is sensed. The ← and → keys move the cursor through the display.

MULTI SPEED (no digit is flashing). This mode is useful when making large changes. The least significant digit in the display is incremented or decremented 1, 2, 4, 8, 16 or 32 times faster depending upon how fast you turn the Modify knob.



External Modulation

Type	Sensitivity	Range
AM	±1V ~ 100%	0% to > 100%
FM	±1V ~ ±1% of range	0% to ±1% deviation
VCO	10%/Volt	+10% to -80%, useable to -100%

Range

RANGE UP or DOWN (↑ or ↓) keys multiply or divide the displayed value by 10 until the 3314A's operating limits are reached. This provides an extremely fast method to modify the displayed parameter.

RANGE HOLD inhibits auto-ranging of Frequency (8 ranges), Amplitude (4 ranges), and/or DC Offset (2 ranges) when these parameters are changed with the Modify knob. When in Fin X N and Fin ÷ N, Frequency Range Hold also inhibits auto-acquisition.

Entry

Most of the keys in this group are select keys for variable entries. The top row contains select keys for the more universal parameters. Note that the blue shifted definition of these keys presets the parameter. The second row contains the select keys for the 3314A's sweep capabilities. The SW/TR INTVL key is the select key for the sweep interval (SW INTVL) and for the internal trigger interval (TR INTVL). When ARB is active, the functions of the keys in the second row are redefined.

Function

The **MAIN OUTPUT.** This output has a characteristic output impedance of 50Ω. Although operation into other than 50Ω is allowed, the actual AC amplitude and DC offset will be different from the displayed values and the quality of the functions will be degraded at higher frequencies due to transmission line impedance mismatches.

The **SYNC OUTPUT.** This output has a characteristic output impedance of 50Ω when terminated into ≤50Ω. When terminated into >50Ω, it will deliver TTL compatible levels of 0 to >2.5V. The maximum unloaded voltage is limited to ~3V. The edges of the sync signal are coincident with the peaks of the sine and triangle functions and coincident with the edges of the square function. This relationship is inverted by Function Invert.

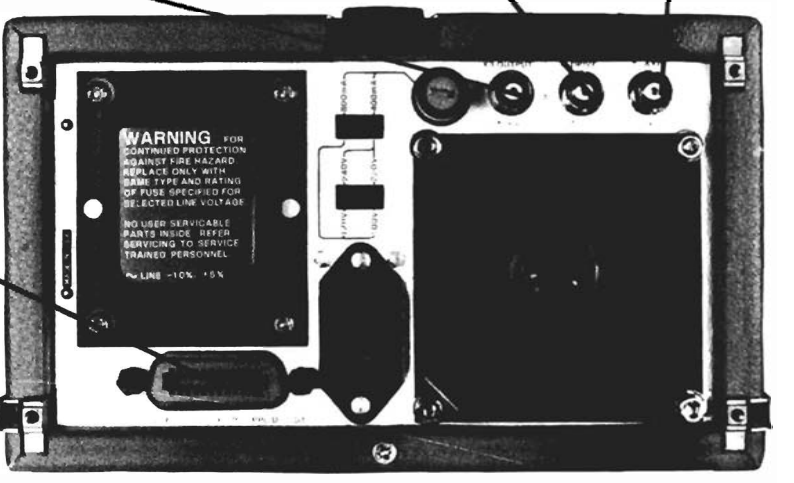
Figure 3-1. Meet the 3314A Function Generator

The **Z Axis** output produces voltage levels to blank ($> +5V$) or enhance ($< -5V$) the intensity of an oscilloscope display during sweep (intensifies the marker frequency and blanks the retrace) or ARB (intensifies the current vector).

The **X Axis** output produces a voltage ramp from -5V to +5V whose voltage is proportional to the sweep frequency. This output is useful to drive the X Axis of plotters and oscilloscopes.

The **X3** output (only instruments with Option 001 have this output) is a high voltage, low impedance output whose output voltage is 3 times the displayed amplitude and offset when the Main Output is terminated into 50Ω. This output is capable of sourcing ±30mA peak current without clipping. The upper frequency limit is 1MHz.

The **HP-IB** is used to control the operation of the 3314A from a remote controller. This connector uses metric fasteners and is not compatible with older cables using english threaded fasteners. Metric fasteners are available from -hp- to upgrade older cables.



SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The following tests are designed to compare various 3314A parameters to their given specifications, in order to determine the functional accuracy of the instrument. Test data can be entered on the Performance Test Record located at the end of this section. The test record which contains the tested specifications and acceptable limits, may be copied without written permission from the Hewlett-Packard Co.

The following Performance tests include:

When "PRESET" is pressed on the 3314A, the instrument defaults to the following conditions:

MODE -- Free Run
FREQ -- 1kHz
AMPTD -- 100mVp-p
OFFSET -- 0VDC
SYM -- 50%
TRIGGER SLOPE -- Positive
TRIGGER LEVEL -- 1Vp-p
TRIGGER SOURCE -- Internal
PHASE -- 0°
N -- 1
SW/TR INTVL -- 10ms
START FREQ -- 1kHz
STOP FREQ -- 10kHz
MKR -- 5kHz

NOTE

The following tests were developed using the listed equipment. Similar equipment with equal or better performance may be used, however, the operator will be responsible for determining whether or not his or her results are accurate.

4-2. FREQUENCY ACCURACY TEST

This is a test to verify the accuracy of the 3314A output signal frequency.

Specification:

Range 1,2: ±(0.4% of setting +0.2% of range)
Range 3,4,5,6,: ±(0.2% of setting +0.1% of range)
Range 7,8: ±(0.01% of setting +50ppm/year)

Equipment Required:

-hp- 5328A Universal Counter
-hp- 11048C 50 Ohm Feedthrough Termination

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Amplitude 1Vp-p
Frequency 19.99MHz
Frequency Range Hold ..... On

C. Set the Counter as follows:

Function ..... Freq A
Resolution 1Hz
Input Attenuation x1
Coupling ..... DC
Channel Input ..... Com

D. Connect the output of the 3314A to the Counter input (see Figure 4-1).

E. Record the Counter frequency to 4 significant digits in the test record. Compare this value to the limits given in part A of Table 4-2 for the frequency setting of 19.99MHz.

F. Using the Range Down function, decrement the frequency of the 3314A to the settings listed in part A of Table 4-2, recording the measured value in the test record.

NOTE

In order to measure the 199.9Hz frequency setting, set the resolution of the counter to 0.1Hz.

G. Using the Modify Knob only, set the frequency of the 3314A to 00.1Hz.

H. Set the Counter to "Per A" and the resolution to 1kHz.

I. Measure the period of the 00.1Hz signal. Take the reciprocal of that value and compare the result to the limits shown in part B of Table 4-2 for the 00.1Hz setting.

J. Set the Counter function to "Freq A" and the resolution to 0.1Hz.

Table 4-1. Recommended Equipment List

Instrument	Critical Specs	Recommended Model
Electronic Counter	Freq Measurement to 20MHz. Accuracy ± 2 counts. Resolution 8 Digits.	-hp- 5328A
High Speed Digital Voltmeter	DC Voltage 0V-10V Sample/Hold Measurement. External Trigger: Low True TTL Edge Trigger, Trigger Delay: Selectable, 10us to 140us.	-hp- 3437A
Synthesizer/ Function Generator	Sine Output: 1kHz. Amplitude: 1VRMS into 10kΩ.	-hp- 3325A
VHF Attenuator (see note 1)	Atten: 100dB in 10dB steps, Freq Range 50Hz to 20MHz, Impedance 50Ω.	-hp- 355D
Spectrum Analyzer	Freq Range 40MHz to 120MHz. Amplitude Accuracy: ±0.5dB.	-hp- 8557A
Spectrum Analyzer	Freq Range 20Hz to 40MHz. Amplitude Accuracy: ±0.5dB.	-hp- 3585A
Thermal Converter	Input Impedance 50 Ohms, Input Voltage 3 VRMS. Freq: 2kHz to 20MHz. Freq Response: ±0.05dB.	-hp- 11049A
AC/DC Digital Voltmeter	DC Function: Acc.±0.05%, AC Function: True RMS, Acc. ±0.2%. Resolution 6 Digits.	-hp- 3455A
Resistor	1 MΩ ± 5%.	
Capacitor	1uf	
Oscilloscope	Vertical BW DC to 100MHz, Deflection 0.01V to 10V/Div. Horizontal Sweep: 0.05us to 1s/Div. x10 Mag Delayed Sweep.	-hp- 1725A
Power Supply	Volts: -8VDC to +2VDC. Amps: 10mA.	-hp- 6235A
BNC Tee Adaptor	Male Female Female/ BNC to Dual Banana Plug.	-hp- 1250-0781 -hp- 1250-2277
BNC to Triax Adaptor	Female BNC to Male	-hp- 1250-0595
50 Ohm Load	Accuracy ±0.2%. Power Rating: 1w.	-hp- 11048C
	Note 1: Variable Attenuator must be characterized.	

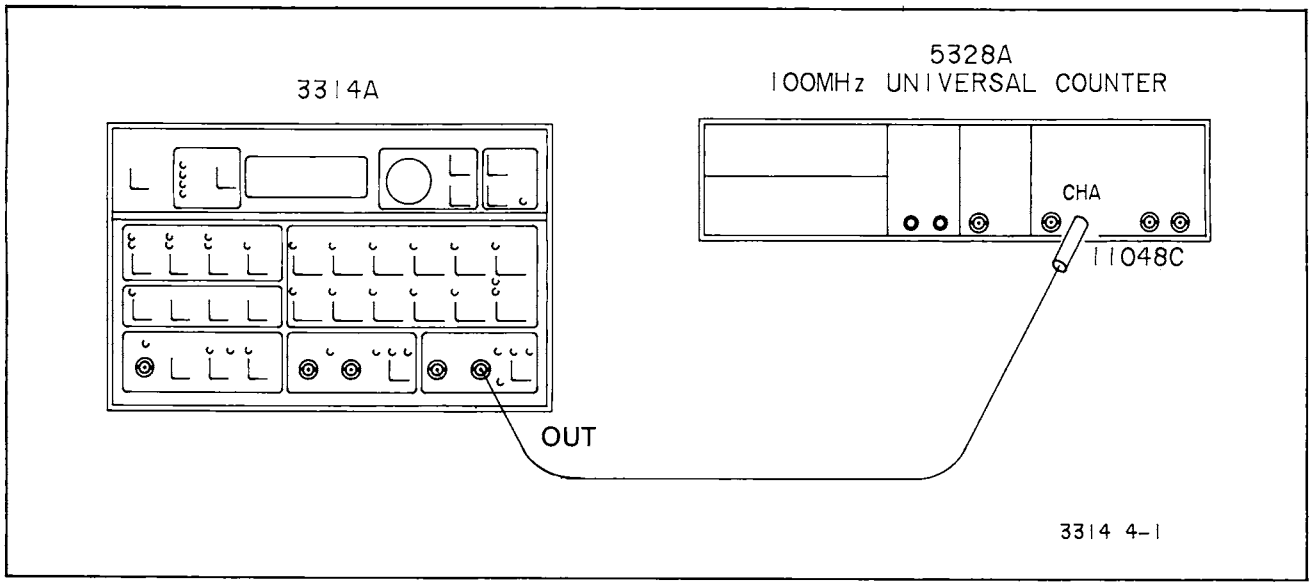


Figure 4-1. Frequency Accuracy Test

K. Using the Range Up function, increment the value of frequency displayed on the 3314A to the values listed in part B of Table 4-2, recording the measured value in the test record.

NOTE

Allow the Counter at least 15 seconds to stabilize and display the correct frequency measurement.

Table 4-2. Frequency Accuracy Measurement Parameters With Specified Limits

3314A Frequency Setting (A)	Upper Limit	Lower Limit
19.99MHz	19.992MHz	19.988MHz
1999kHz	1999.2kHz	1998.8kHz
199.9kHz	200.5kHz	199.3kHz
19.99kHz	20.05kHz	19.93kHz
1999.Hz	2005Hz	1993Hz
199.9Hz	200.5Hz	199.3Hz
3314A Frequency Setting (B)	**Upper Limit**	**Lower Limit**
00.1Hz	0.3Hz	0.0Hz
001H	3Hz	0.0Hz
0.01kHz	30Hz	00Hz
00.1kHz	300Hz	0Hz
001kHz	1000.1Hz	999.9Hz
0.01MHz	10.001kHz	9.999kHz

4-3. TIME AXIS AND VARIABLE SYMMETRY

This is a test to check the Symmetry function of the 3314A.

Specification:

%Symmetry	Specification
50%	50% ± 0.2% of period
5%	5% ± 0.5% of period
95%	95% ± 0.5% of period

Equipment Required:

-hp- 5328A Universal Counter
-hp- 11048C 50 Ohm Feedthrough Termination

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... Square
Frequency 100kHz
Amplitude 10Vp-p
Symmetry 50%

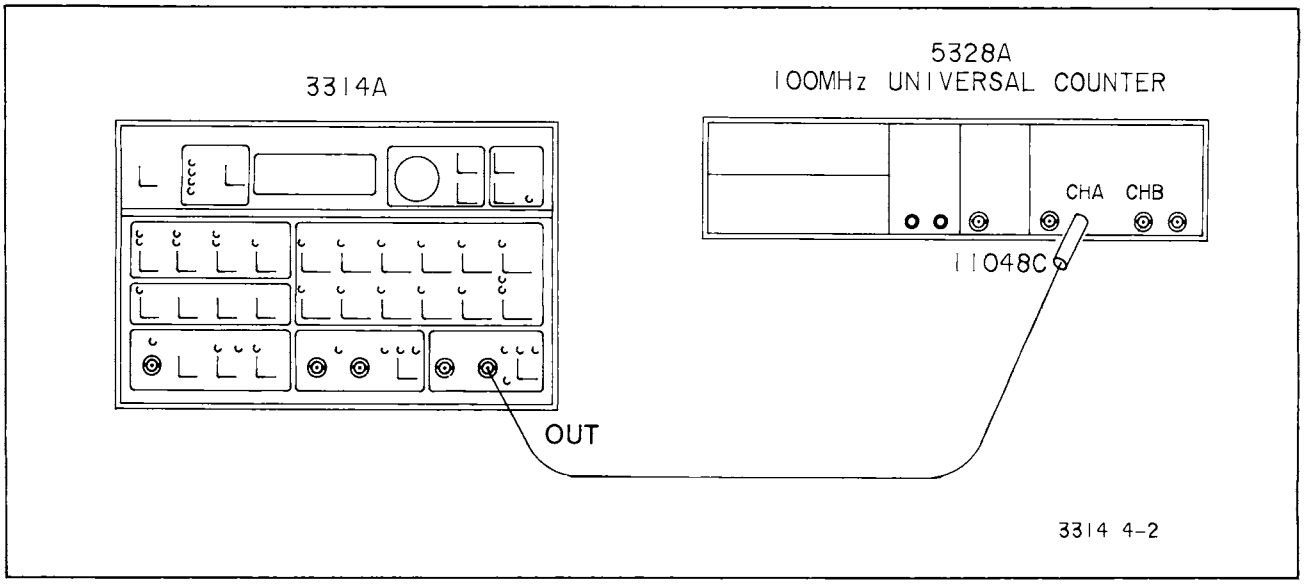


Figure 4-2. Time Axis and Variable Symmetry

C. Set the Counter as follows:

Function ..... Per Avg A
Resolution 0.1kHz
Attenuation x10
Channel A Slope ..... +
Channel B Slope ..... –
Coupling ..... DC
(Both Channels)
Channel Input ..... Sep

D. Connect the 3314A to the Counter as shown in Figure 4-2.

E. Record the period of the 3314A Square Wave signal (t) displayed on the Counter.

F. Change the Counter function to "TI Avg A→B".

G. Record reading (t_1).

H. Calculate the percent of symmetry using the following equation and record in the test record:

%Symmetry = $(t_1/t)100\%$

I. Adjust the symmetry on the 3314A to 5%, set the Counter function back to Period Avg A, and repeat steps E through H.

J. Adjust the symmetry on the 3314A to 95%, set the Counter function back to Period Avg A, and repeat steps E through H.

4-4. INTERNAL TRIGGER ACCURACY

This test measures the accuracy of the 3314A Internal Trigger Period.

Specification:

±0.01% of setting +50ppm/year

Equipment Required:

-hp- 5328A Universal Counter

Procedures:

A. Preset the 3314A.

B. Set the Counter as follows:

Function ..... Per Avg A
Resolution 1MHz
Attenuation x1
Coupling ..... AC
Channel Input ..... Com

C. Connect the 3314A to the Counter as shown in Figure 4-3.

D. Record the measured value of the 3314A trigger period in the test record. The reading should be 10ms ±0.001ms.

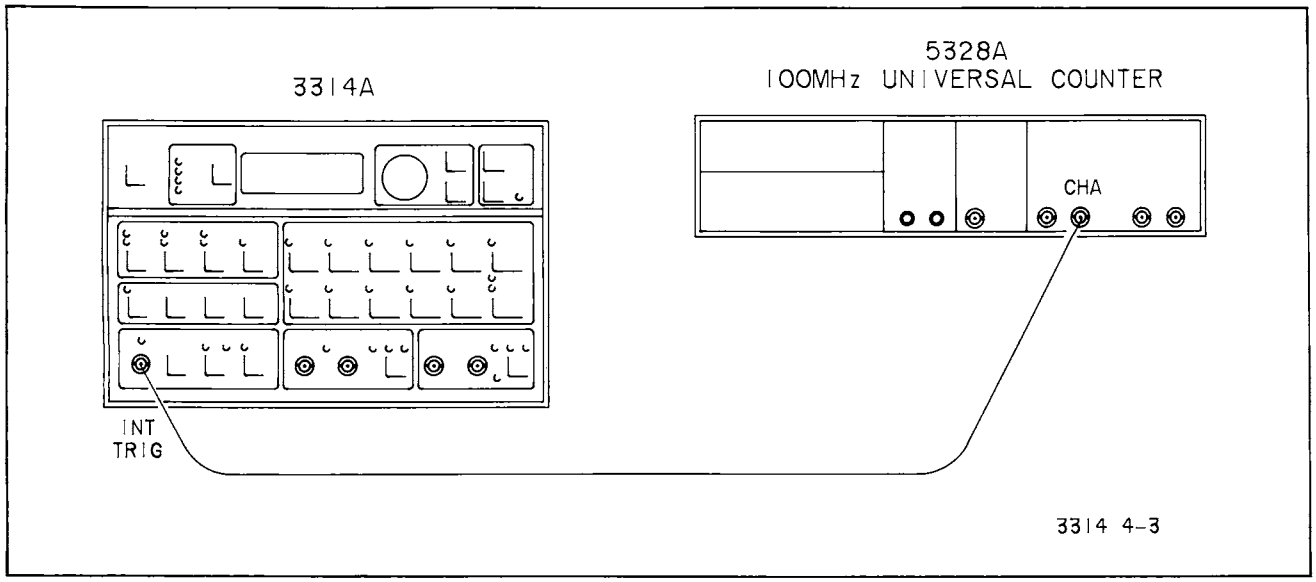


Figure 4-3. Internal Trigger Accuracy

4-5. TRIANGLE LINEARITY

This procedure determines the linearity of the 3314A Triangle wave at frequencies between 1Hz and 1kHz.

Specification:

±0.2%

Equipment Required:

-hp- 3437A High Speed Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination
-hp- 1250-0595 Triax to BNC Connector

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... Triangle
Amplitude 10Vp-p

C. Set the Digital Voltmeter as follows:

Range 10V
Trigger ..... Ext
Readings 1
Delay 0.00055s

D. Connect the 3314A to the Voltmeter as shown in Figure 4-4.

E. Note the Digital Voltmeter reading. Record this value on the Performance Test Record under "Positive Slope Measurement". This is the 10% point on the positive slope of the Triangle (see Figure 4-5).

F. Increment the delay on the Digital Voltmeter to the values listed below. At each increment note and record the corresponding voltage under "Positive Slope Measurement" in the Performance Test Record. (Each increment represents a 10% segment of the positive slope.)

Delay	Percent of Slope
0.00060	20
0.00065	30
0.00070	40
0.00075	50
0.00080	60
0.00085	70
0.00090	80
0.00095	90

G. Measurements for the negative slope of the Triangle wave are made by incrementing the delay on the voltmeter to the values listed below. Note and record the corresponding voltages under "Negative Slope Measurement" in the Performance Test Record.

Delay	Percent of Slope
0.00105	90
0.0011	80
0.00115	70
0.0012	60
0.00125	50
0.0013	40
0.00135	30
0.0014	20
0.00145	10

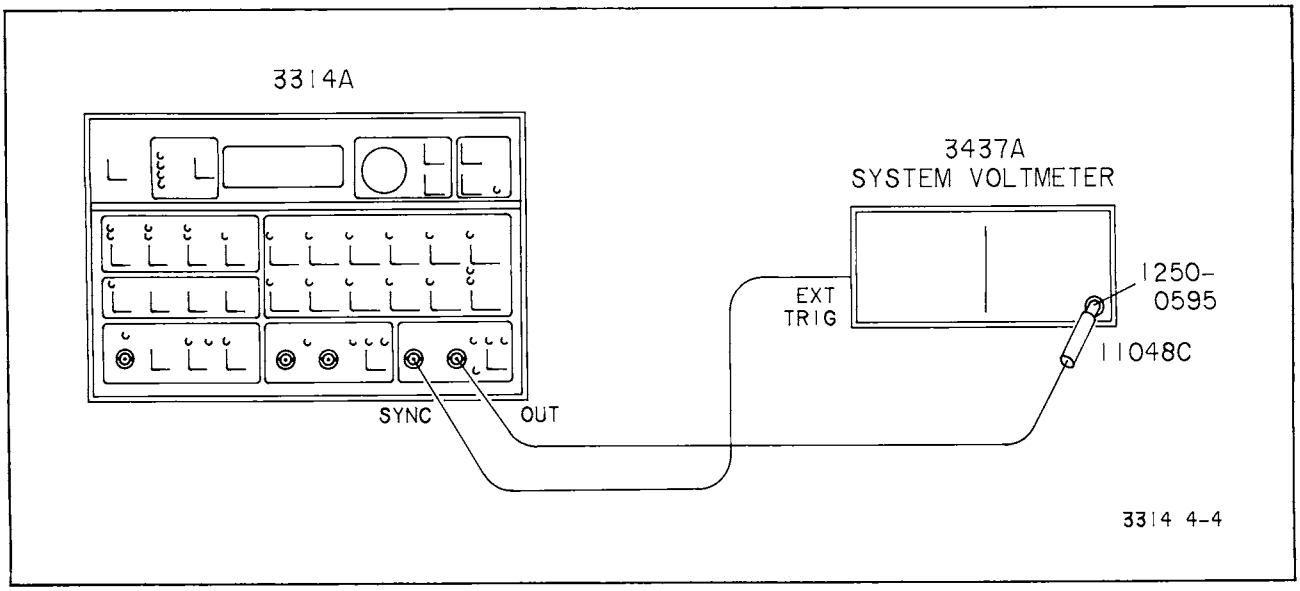


Figure 4-4. Triangle Linearity

H. Algebraically add the voltages recorded in the "Positive Slope Measurement" column and enter the total in the "Σy" space.

I. Multiply Σy by 45 (which is Σx) and enter the result in the ΣxΣy space.

J. Multiply each y value by the corresponding x value and enter the result in the "x Times y" column. Total these values and enter the result in the "Σxy" space.

K. The equation for determining the "best fit straight line" specification for each y value is:

$$y = mx + b$$

where m and b are constants to be calculated from data previously taken.

NOTE

Calculate the values of m and b to at least 5 decimal places.

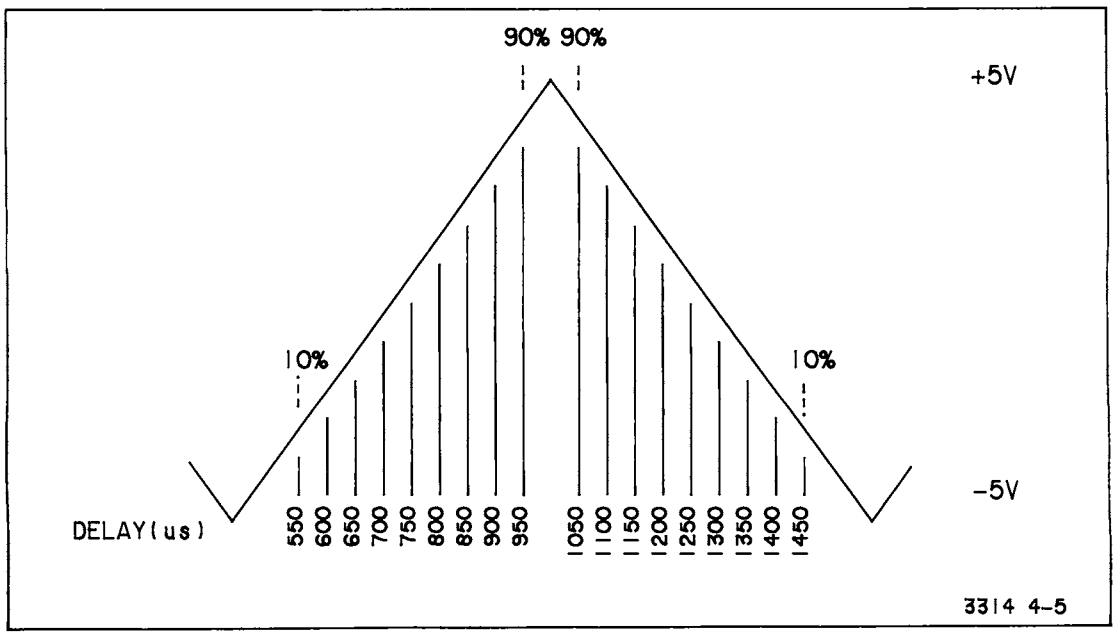


Figure 4-5. Triangle Linearity

L. Determine the value of m using the following equation:

$$m = \frac{\Sigma xy - \Sigma x \Sigma y/n}{\Sigma x^2 - (\Sigma x)^2/n}$$

where Σx, Σy, Σxy, $\Sigma x \Sigma y$, Σz^2, and $(\Sigma x)^2$ are the previously calculated values entered on the performance test record, and n = 9 (the number of points to be calculated).

M. Determine the value of b using the equation:

$$b = \Sigma y/n - m\Sigma x/n$$

N. Calculate the "best fit straight line" value for y_0 through y_9 using the equation:

$$y = mx + b$$

Enter each result on the Performance Test Record in the "Best Fit Straight Line" column.

O. Algebraically add the voltages recorded in the "Negative Slope Measurement" column and enter the total in the "Σy" space.

P. Repeat steps I through N to determine the "best fit straight line" values for the negative slope.

4-6. Start/Stop PHASE ACCURACY

This test determines the Start/Stop phase accuracy of the N Cycle mode on the 3314A.

Specification:

±3°

Equipment Required:

-hp- 3437A High Speed Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination
-hp- 1250-0595 Triax to BNC Connector

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... Triangle
Amplitude 10Vp-p
Mode ..... N Cycle
Trigger ..... Negative Edge

C. Set the Digital Voltmeter as follows:

Range 10V
Trigger ..... Ext
Readings 1
Delay 0.00025s

D. Connect the 3314A to the Digital Voltmeter as shown in Figure 4-6.

E. Record the voltage reading displayed on the Digital Voltmeter.

F. Set the delay on the Voltmeter to 0.00075s, and record the voltage reading.

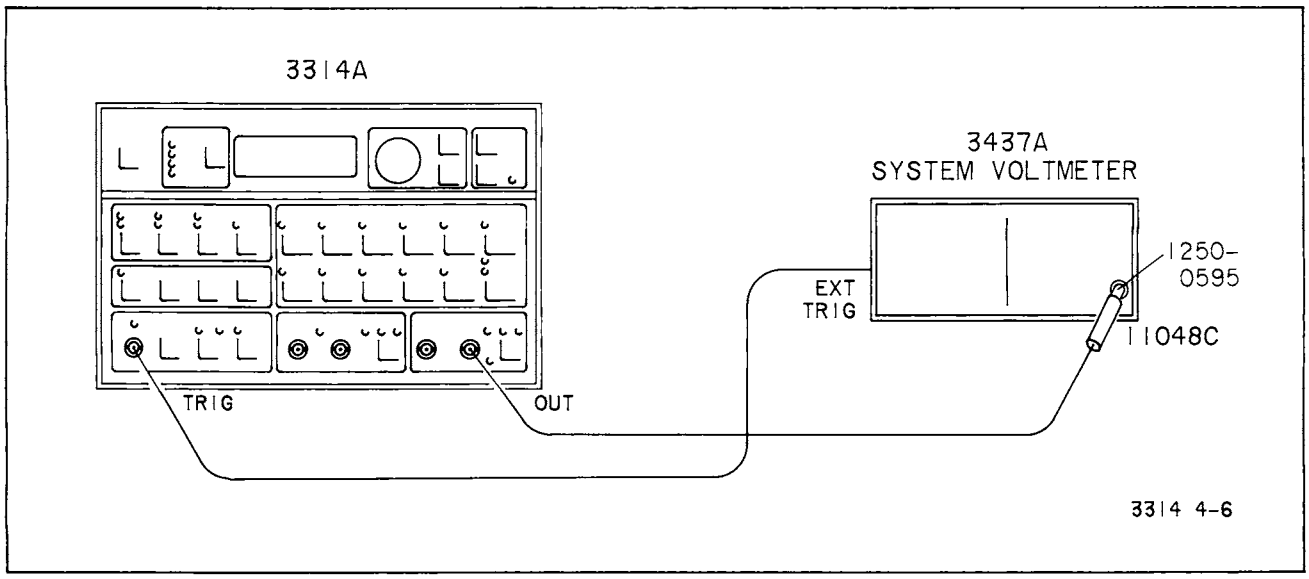


Figure 4-6.Start/Stop Phase Accuracy

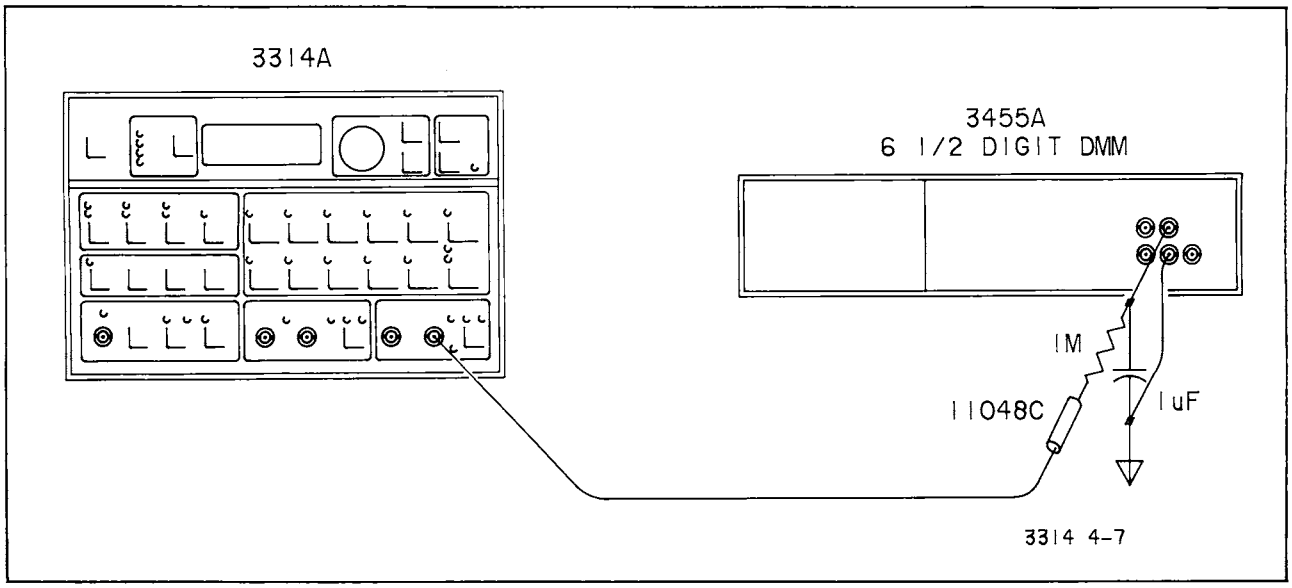


Figure 4-7. Residual and Variable DC Offset Accuracy

G. Average the readings taken in steps E and F and record in the Performance Test Record under "AVG"

H. Set the delay on the Voltmeter to 0.010s, and record the corresponding voltage.

I. This test passes if the average of the readings taken in steps E & F is within ±0.167V of the reading taken in step H. (0.167V corresponds to 3° of phase difference.)

4-7. RESIDUAL DC AND DC OFFSET ACCURACY

This is a test to determine the accuracy of the Residual DC Offset (0V DC offset) and the Variable DC Offset function of the 3314A.

Specification:

Residual: ±0.5% of AC Amplitude Range
Variable: ±(3% of setting, +10mV, +0.5% of AC Amplitude Range)

Equipment Required:

-hp- 3455A Digital Voltmeter
1 MΩ/1 μF Low Pass Filter
-hp- 11048C 50 Ohm Feedthrough Termination

Procedures: (Residual)

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 100kHz
Amplitude 10Vp-p

C. Set the Digital Voltmeter as follows:

Function ..... DC
Trigger ..... Internal
Range ..... Auto

D. Connect the 3314A to the Digital Voltmeter as shown in Figure 4-7.

E. Record and compare the Residual DC Offset measured on the Digital Voltmeter to the limits corresponding to the 10.00V 3314A setting given in Table 4-3.

NOTE

Tables 4-3 and 4-4 are provided for convenience in spot checking the measured parameters. The values obtained in this test may be permanently recorded in the corresponding section of the Performance Test Record.

F. Using the Range Down function, decrement the amplitude displayed on the 3314A to the values listed in Table 4-3. Record and compare the measured Residual Offset at each decrement to its corresponding limits.

(Variable Offset)

G. Set the amplitude of the 3314A to 10V and adjust the DC Offset to 5V.

H. Record and compare the DC Offset measured on the Digital Voltmeter to the limits shown in Table 4-4 for the 10V setting with 5V DC offset.

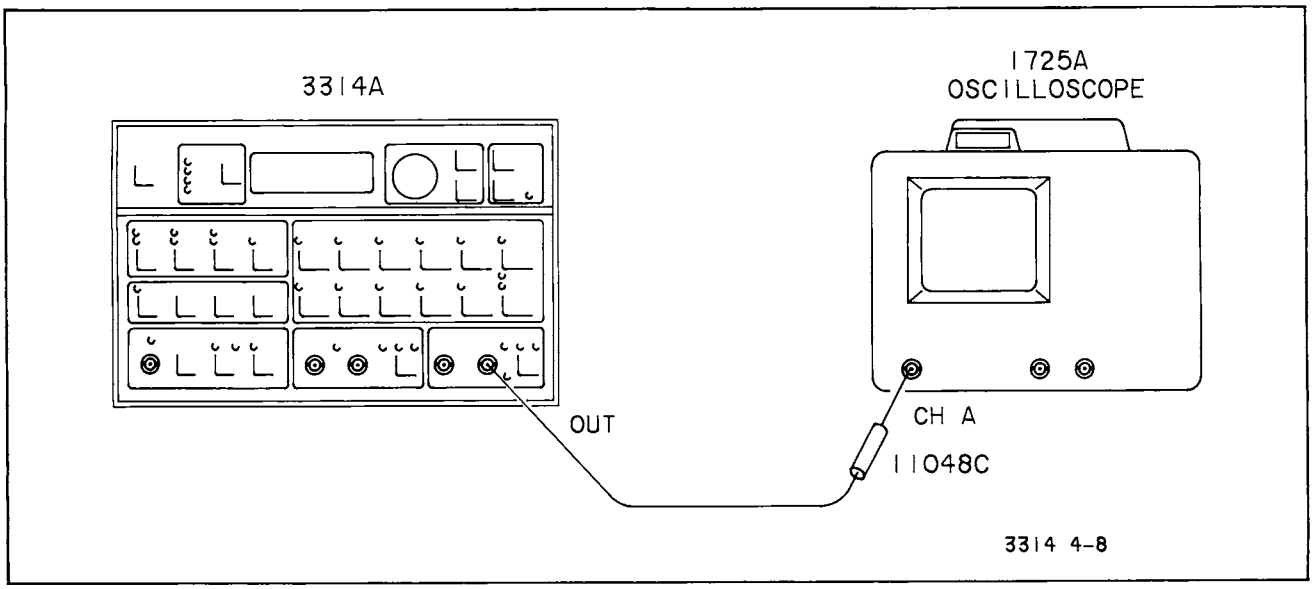


Figure 4-8. Square Wave Rise Time and Overshoot

I. Using the Range Down function, decrement the amplitude of the 3314A to the values shown in Table 4-4, each time recording and comparing the measured Offset to its corresponding limits.

J. Set the amplitude on the 3314A to 10V and adjust the DC offset to 0.887V.

Table 4-3. Residual DC Offset Limits

3314A Voltage Setting	Residual Offset	
	Upper Limit	Lower Limit
10.00V	50mV	−50mV
1.000V	5mV	−5mV
100.0mV	0.5mV	−0.5mV
10.00mV	0.1mV	−0.1mV

Table 4-4. Variable DC Offset Limits

Voltage Setting	DC Offset	Upper Limit	Lower Limit
10.00V	5V	5.21V	4.79V
1.000V	5V	5.16V	4.84V
100.0mV	5V	5.16V	4.84V
10.00mV	5V	5.16V	4.84V
10.00V	0.887V	0.974V	0.8V
1.000V	0.887V	0.924V	0.85V
100.0mV	0.887V	0.924V	0.85V
10.00mV	0.887V	0.924V	0.85V
10.00V	−0.887V	−0.8V	−0.974V
1.000V	−0.887V	−0.85V	−0.924V
100.0mV	−0.887V	−0.85V	−0.924V
10.00mV	−0.887V	−0.85V	−0.924V
10.00V	−5V	−4.79V	−5.21V
1.000V	−5V	−4.84V	−5.16V
100.0mV	−5V	−4.84V	−5.16V
10.00mV	−5V	−4.84V	−5.16V

K. Record and compare the DC Offset measured on the Digital Voltmeter to the limits given in the appropriate section of Table 4-4.

L. Repeat step I for the offset of 0.887V.

M. Set the amplitude of the 3314A to 10V and adjust the DC offset to −0.887V.

N. Record and compare the DC Offset measured on the Digital Voltmeter to the corresponding limits shown in Table 4-4.

O. Repeat step I for the offset of −0.887V.

P. Set the amplitude of the 3314A to 10V and adjust the DC offset to −5V.

Q. Record and compare the DC Offset measured on the Digital Voltmeter to the corresponding limits shown in Table 4-4.

R. Repeat step I for the Offset of −5V.

4-8. SQUARE WAVE RISE TIME AND OVERSHOOT

This test examines the Rise/Fall time and Peak Overshoot of the 3314A Square Wave signal.

Specification:

Square Wave Rise/Fall Time (10% to 90%) 9ns
Square Wave Overshoot ..... <5% at 10Vp-p

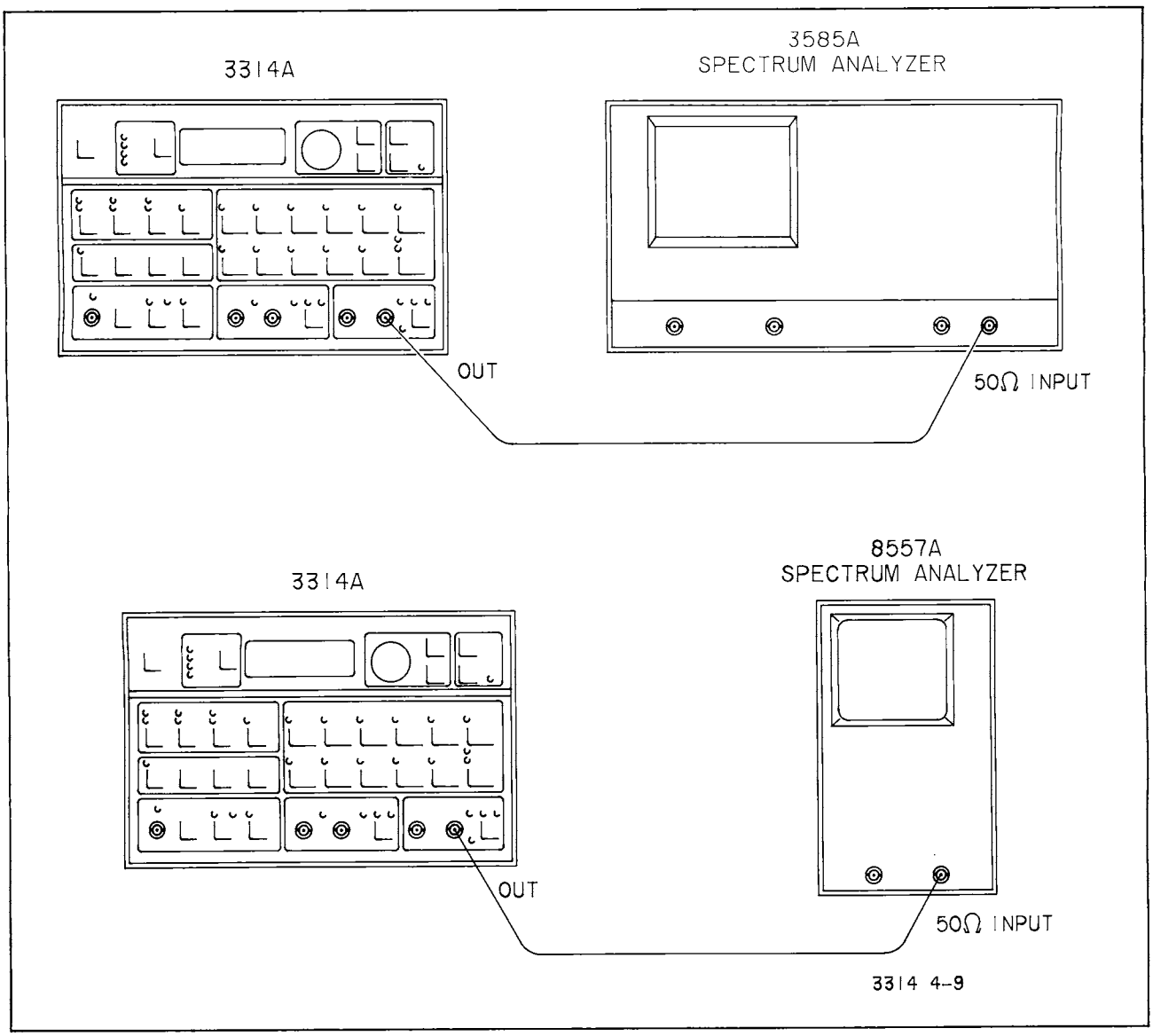


Figure 4-9. Sine Wave Harmonics

Equipment Required:

-hp- 1725A Oscilloscope*
-hp- 11048C 50 Ohm Feedthrough Termination

*An Oscilloscope other than the 1725A may be used provided it has at least a 275MHz bandwidth. This is necessary because the 3314A's fast rise time in some instances, can cause an Oscilloscope with a bandwidth <275MHz to ring, and in turn, mask the 3314A's actual response.

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... Square
Frequency 19.99MHz
Amplitude 10Vp-p

C. Set the Oscilloscope as follows:

Volts/Div 2V
Time/div 0.01us/cm
Coupling ..... DC
Horizontal Display ..... Main
Main Triggering ..... Positive

D. Connect the 3314A to the Oscilloscope as shown in Figure 4-8.

E. While observing the waveform on the Oscilloscope, use the Horizontal Position knob to ad-

just the waveform until the bottom of the Square wave's rising edge is on top of the Y-axis graticule. Note the distance between the 10% and 90% points on the rising edge. If the distance between the points is less than or equal to −9cm (note scope setting), the specification is met.

F. Set the Main Triggering function of the Oscilloscope to negative.

G. Observe the trailing edge of the waveform. Note the distance between the 90% and 10% points. If the distance is less than or equal to 1cm, the test passes.

H. Set the Time/div setting on the Oscilloscope to 1us/cm.

I. Rotate the Oscilloscope's "Cal" knob (located on the VOLTS/DIV knob) counterclockwise until the waveform is four divisions tall. The "intensified" portion on the top of the wave should be <0.5V (1 minor division).

4-9. SINE WAVE HARMONICS

This is a test to check the amplitude levels of the Sine Wave Harmonics.

Specification:

20Hz to 50kHz	−55dB
50kHz to 1.999MHz	−40dB
1.999MHz to 19.99MHz	−25dB

Equipment Required:

-hp- 3585A Spectrum Analyzer
-hp- 8557A Spectrum Analyzer

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency	20.0Hz (Range 3)
Amplitude	10Vp-p
Function	Sine
Range Hold	On

C. Connect the 3314A to the 3585A as shown in Figure 4-9.

NOTE

To get to the frequencies listed in the following ranges (see Tables 4-5, 4-6, 4-7), set the 3314A to the middle value in the range (i.e. range 3, 100.0Hz), activate Range Hold, then use the Modify knob to select the frequencies. Be sure that the frequency on the 3314A is set exactly as shown in the table.

D. To verify that the Sine wave harmonics are within specification, set the Spectrum Analyzer as follows:

1. Press "INSTR PRESET".
2. Press "DSPL LINE" and adjust the Control knob for a −55 dB level.
3. Press "STOP FREQ" and set it to 8 times the 3314A frequency setting.
4. Press "MARKER" and using the Control knob, place it over the fundamental.
5. Press "MKR→REF LVL" and wait for the sweep to update the screen display.

E. Observe the harmonics displayed on the Spectrum Analyzer and verify that they are below the −55dB level.

F. Repeat steps D (parts 3-5) and E for the 3314A frequency settings listed in Tables 4-5 and 4-6 whose harmonic level specification is −55dB.

G. Press "INSTR PRESET" on the Spectrum Analyzer.

H. Press "DSPL LINE" and adjust the Control knob for a −40dB level.

I. Repeat step D, parts 3-5 for the 3314A frequency settings listed in Table 4-6 whose harmonic level specification is −40dB. Verify that these levels are within the specification.

J. Disconnect the 3314A from the 3585A Spectrum Analyzer.

K. To measure the harmonics of the frequencies listed in Table 4-7, connect the 3314A to the 8557A Spectrum Analyzer as shown in Figure 4-9.

L. Set the frequency of the 3314A to 1.00MHz.

M. Set the 8557A as follows:

Input Range	+ 30dBm
Time/div	Auto
Start Frequency	1MHz

N. Measure 2nd through 7th harmonics.

O. Set the frequency on the 3314A to 10.00MHz, and adjust the start frequency on the 8557A to 10MHz.

P. Measure 2nd through 7th harmonics.

Q. Set the frequency on the 3314A to 19.99MHz, and adjust the start frequency on the 8557A to 19.99MHz.

R. Measure the 2nd through 7th harmonics.

SINE WAVE HARMONICS

Table 4-5. Sine Wave Harmonic Test Frequencies 3Hz Resolution Bandwidth

3314A Frequency	Range	Harmonics dB 2nd	3rd	4th	5th	6th	7th
20.0Hz	3						
100.0Hz	3						
199.9Hz	3						
100.Hz	4				−55dB		
1000.Hz	4						
1999.Hz	4						

Table 4-6. Sine Wave Harmonic Test Frequencies 300Hz Resolution Bandwidth

3314A Frequency	Range	Harmonics dB 2nd	3rd	4th	5th	6th	7th
1.00kHz	5						
10.0kHz	5						
19.99kHz	5				−55dB		
10.0kHz	6						
100.0kHz	6						
199.9kHz	6						
100.kHz	7				−40dB		
1000.kHz	7						
1999.kHz	7						

Table 4-7. Sine Wave Harmonic Test Frequencies (8557A Spectrum Analyzer)

3314A Frequency	Range	Harmonics dB 2nd	3rd	4th	5th	6th	7th
1.00MHz	8						
10.00MHz	8				−25dB		
19.99MHz	8						

4-10. AM HARMONICS

This test measures the AM envelope distortion.

Specification:

Sideband harmonics 40dB below sideband level

Equipment Required:

-hp- 3325A Synthesizer/Function Generator
-hp- 3585A Spectrum Analyzer
-hp- 11048C 50 Ohm Feedthrough Termination

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 1MHz
Amplitude 10Vp-p
External Modulation ..... AM

C. Set the 3325A as follows:

Function ..... Sine
Frequency 1kHz
Amplitude 1Vp-p

D. Press "INSTR PRESET" on the Spectrum Analyzer and set it as follows:

Center Frequency 1MHz
Frequency Span 10kHz

E. Connect the 3314A to the Synthesizer and Spectrum Analyzer as shown in Figure 4-10.

F. Press "DSPL LINE" on the Spectrum Analyzer and adjust the Control knob for a −46dB level.

G. Press "MARKER" and place it over the carrier peak.

H. Press "MKR→REFLVL".

I. Note the levels of the AM sideband harmonics (located at 1kHz intervals from sideband) relative to "DSPL LINE". The levels should not exceed this reference.

4-11. VCO LINEARITY

This is a test to determine the linearity of the Voltage Controlled Oscillator.

Specification:

±3% of setting

Equipment Required:

-hp- 6235A Triple Output Power Supply
-hp- 5328A Universal Counter
-hp- 3455A Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination

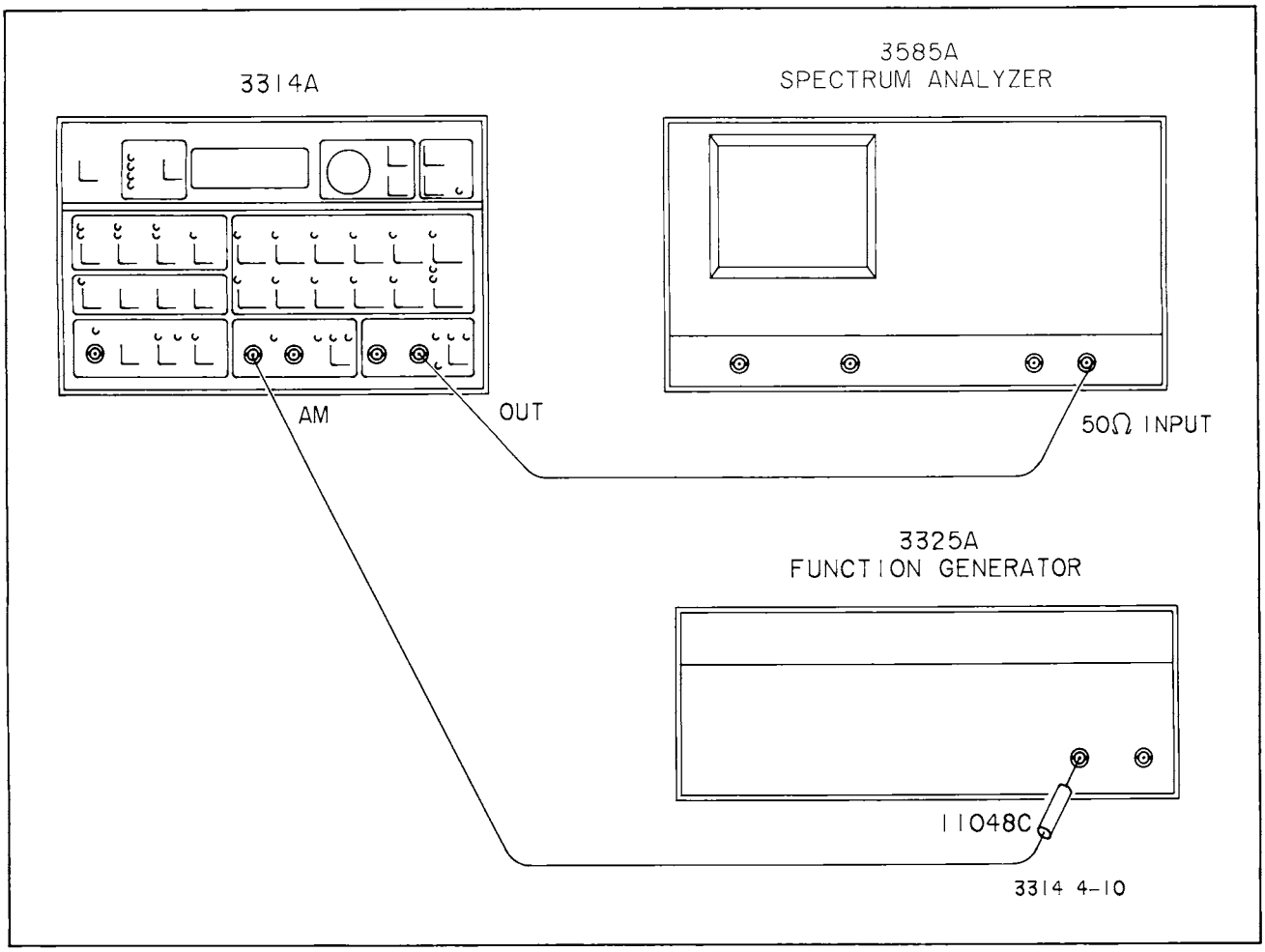


Figure 4-10. AM Harmonics

Procedures:

A. Preset the the 3314A.

B. Set the 3314A as follows:

Frequency 10MHz
Amplitude 10Vp-p
VCO ..... On

C. Set the Counter as follows:

Function ..... Frequency A
Resolution 0.1kHz
Channel Input ..... Com

D. Set the Voltmeter as follows:

Range ..... Auto
Function ..... DC
Trigger ..... Internal

E. Connect the Counter, Voltmeter, and Power Supply to the 3314A as shown in Figure 4-11.

F. Set the power supply voltage to $-8V \pm 10mV$ and record the frequency reading on the Counter. Frequency should be 2MHz ± 300kHz.

G. Set the power supply voltage to $-4.5V \pm 10mV$ and record the frequency reading on the Counter. Frequency should be 5.5MHz ± 300kHz.

H. Set the power supply voltage to $+1V \pm 10mV$ and record the frequency reading on the Counter. Frequency should be 11MHz ± 300kHz.

4-12. PHASE LOCKED LOOP PHASE ACCURACY

This is a test to determine the Phase Accuracy of the 3314A Phase Locked Loop.

Specification:

±2 degrees of setting

Equipment Required:

-hp- 3325A Synthesizer/Function Generator
-hp- 5328A Universal Counter
-hp- 11048C 50 Ohm Feedthrough Termination

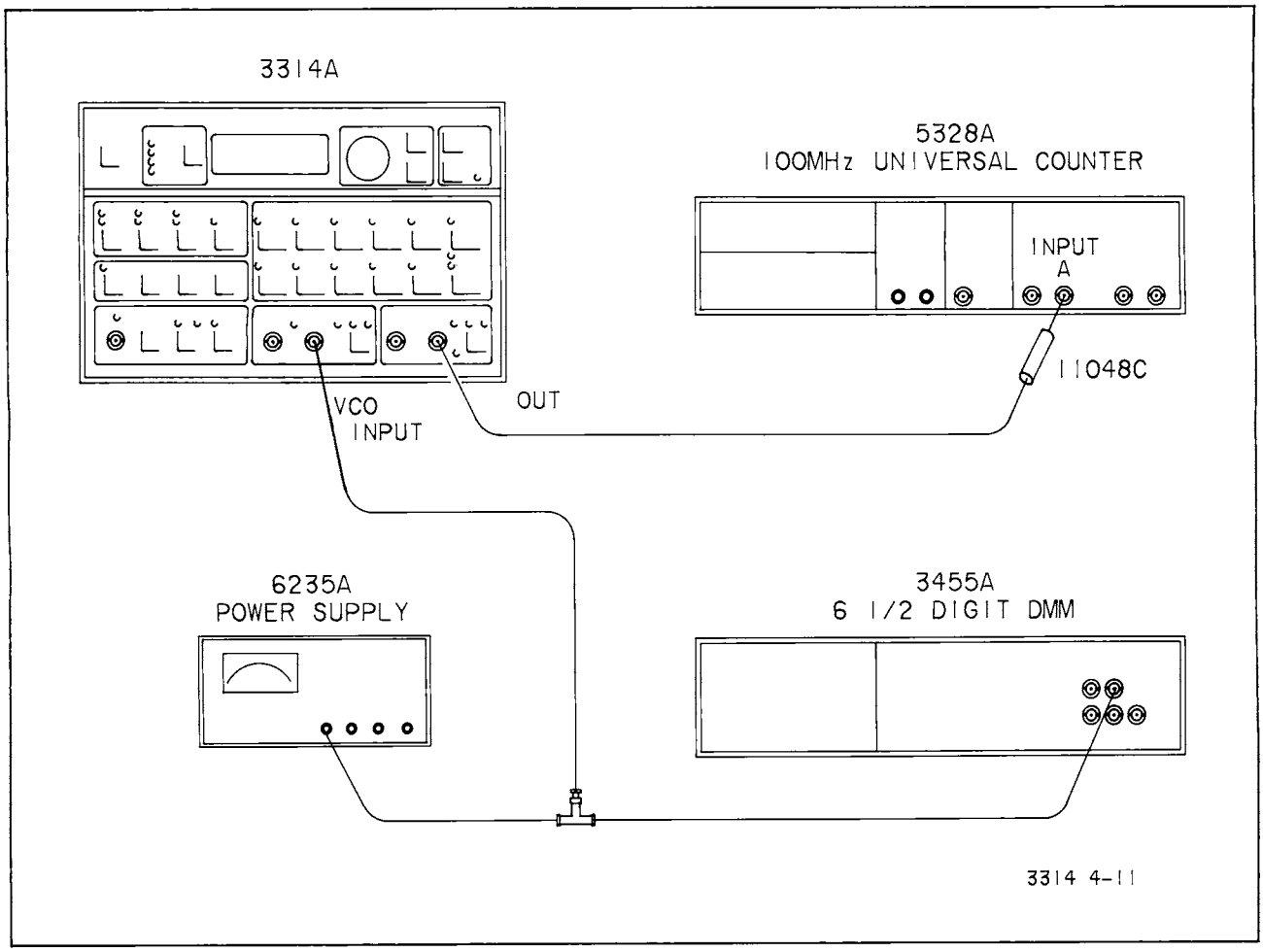


Figure 4-11. VCO Linearity

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function	Square
Amplitude	1Vp-p
Trigger Source	Ext
Mode	Fin x N
Trigger Threshold	0V
Phase	−199.9 degrees

C. Set the Synthesizer/Function Generator as follows:

Function	Square
Amplitude	1Vp-p
Frequency	50Hz

D. Set the Universal Counter as follows:

Coupling	DC
Attenuation	x1
Slope Setting	Cha. +, Chb. +
Function	Period Avg A
Periods Averaged	10^2
Channel Input	Sep

E. Connect the Synthesizer/Function Generator and the Universal Counter to the 3314A as shown in Figure 4-12.

F. Note and record the period (t) of the 50Hz signal now being measured on the Universal Counter.

G. Change the function of the Universal Counter to "TI Avg A-B" and record the corresponding period (t_1).

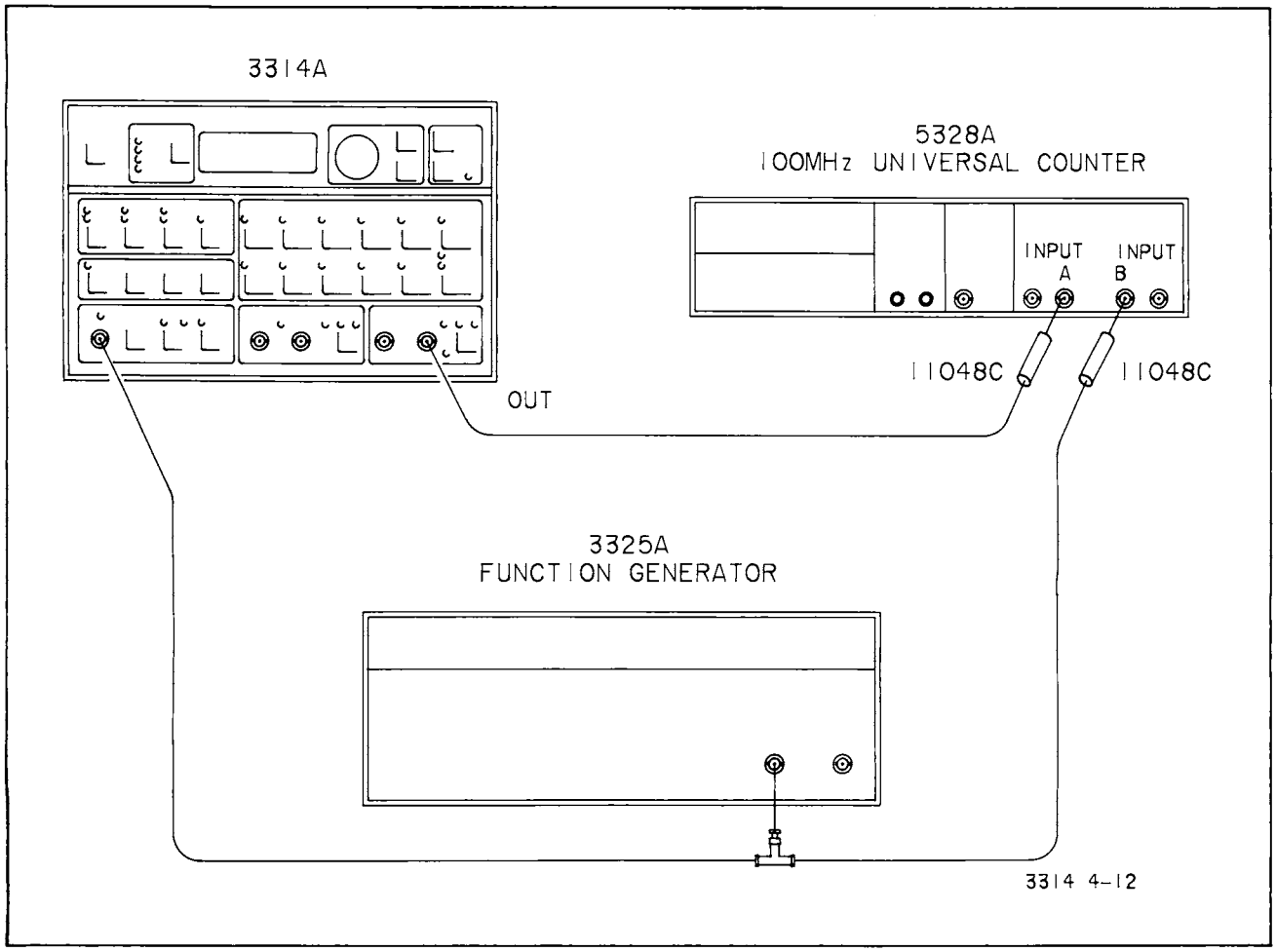


Figure 4-12. Phase Locked Loop Phase Accuracy

H. The accuracy of the phase setting displayed on the 3314A can be determined by the following equation:

$$\phi = (t_1/t)360°$$

where t is the period of the 50Hz Synthesizer/Function Generator signal (constant throughout the test), and t_1 is the change in time between the trailing edges of the phase locked signals (varies with phase setting).

I. Repeat step H for phase settings on the 3314A of −90°, 0°, +90°, and +199.9° noting that each phase setting will have a corresponding value of t_1 to be entered into the above equation.

NOTE

The data taken above can be entered into the Performance Test Record for permanent reference and comparison.

NOTE

This test always results in positive phases. Subtract 360° from the measured results to obtain negative phase shifts.

4-13. AMPLITUDE ACCURACY

This test determines the amplitude accuracy of the 3314A's Sine, Square, and Triangle wave signals.

Specifications:

Sine/Square	±1% of setting ±35mV
Triangle	±1% of setting ±60mV

Equipment Required:

-hp- 3455A Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination

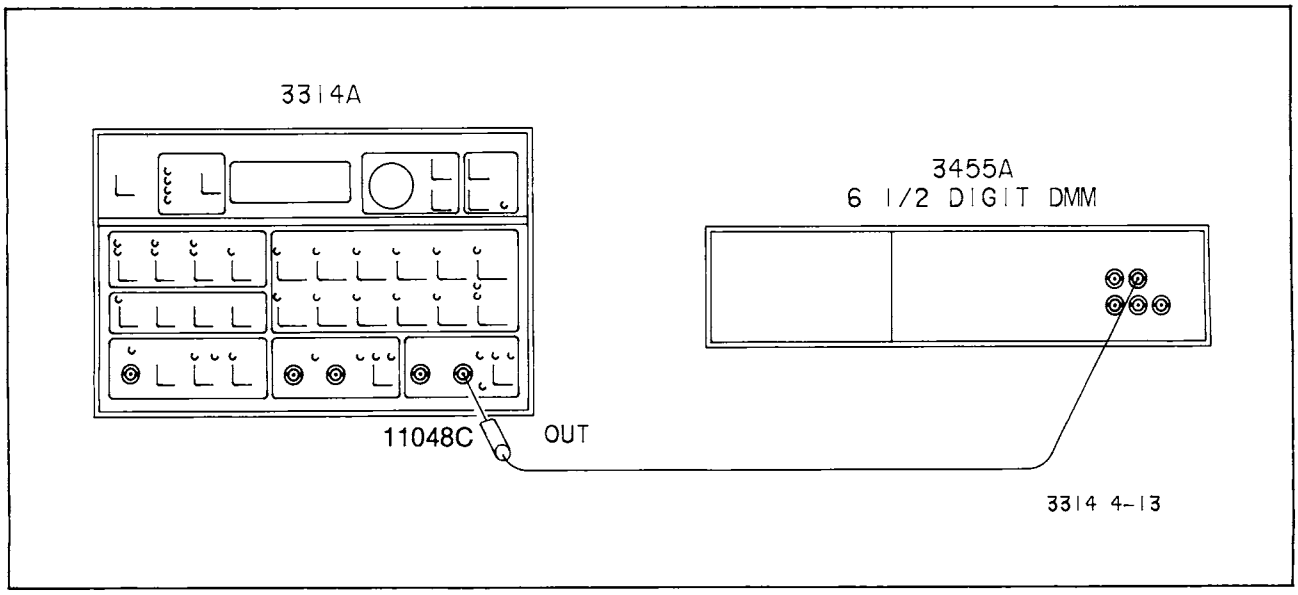


Figure 4-13. Amplitude Accuracy

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 10kHz
Amplitude 10Vp-p

C. Set the Digital Voltmeter as follows:

Range ..... Auto
Function ..... AC
Trigger ..... Internal

D. Connect the 3314A to the Digital Voltmeter as shown in Figure 4-13.

NOTE

Cable length between the 3314A and the Digital Voltmeter should be as short as possible.

E. Calibrate the 3314A by pressing the Blue Shift Key followed by the "RCL" Key.

F. Note and record the voltage measured on the Digital Voltmeter. Reading should be 3.535V ±0.0477V.

G. Repeat step E.

H. Change the function on the 3314A to a Square wave.

I. Note and record the voltage measured on the Digital Voltmeter. Reading should be 5.0V ±0.0477V.

J. Repeat step E.

K. Change the function on the 3314A to a Triangle wave.

L. Note and record the voltage measured on the Digital Voltmeter. Reading should be 2.8867V ±0.0477V.

4-14. SINE WAVE POWER FLATNESS

This is a test to check the amplitude flatness of the 3314A Sine wave signal.

Specification:

20Hz to 50kHz	± 0.04dB
50kHz to 1MHz	± 0.17dB
1MHz to 19.99MHz	± 0.8dB

Equipment Required:

-hp- 3455A Digital Voltmeter
-hp- 11049A Thermal Converter

NOTE

For accurate test results, allow the 3314A and the Thermal Converter time to settle and adjust to surrounding temperatures. Avoid sudden temperature changes around the Thermal Converter.

Procedures:

A. Preset the 3314A.

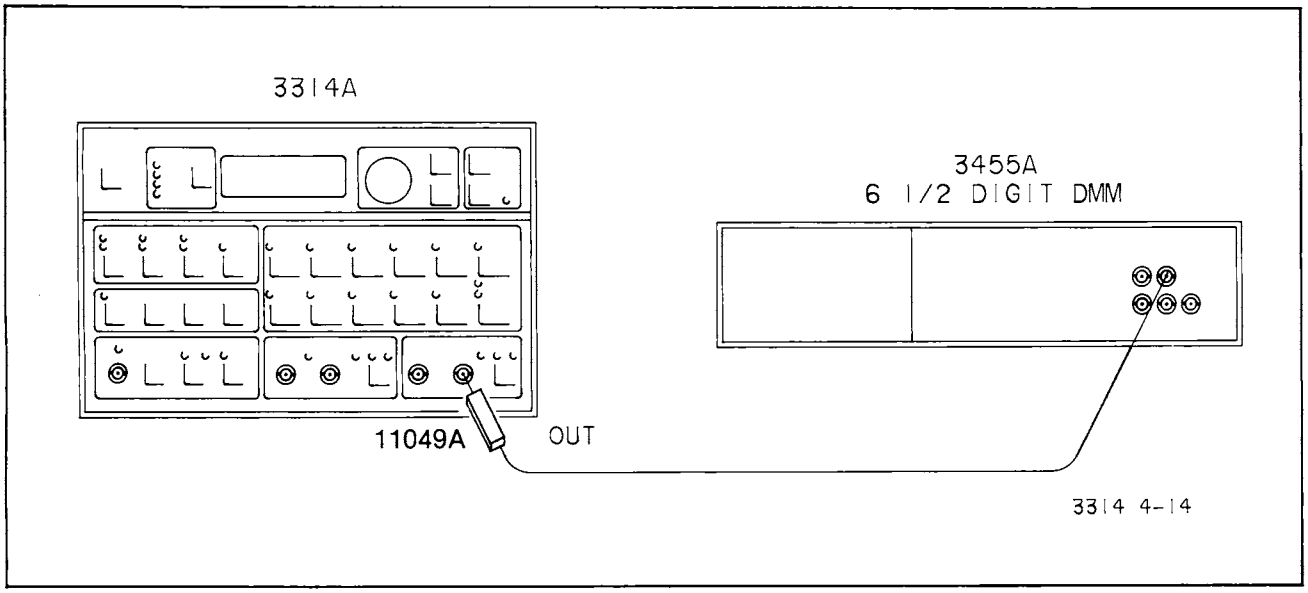


Figure 4-14. Sine Wave Power Flatness

B. Set the 3314A as follows:

Amplitude 7.5Vp-p
Frequency 10kHz

C. Set the 3455A as follows:

Range 1
Function ..... DC
Trigger ..... Internal

CAUTION

Double check the 3314A Signal Amplitude. The input signal to the Thermal Converter must not exceed 3V RMS (8Vp-p).

D. Connect the 3314A to the Thermal Converter and the Digital Voltmeter as shown in Figure 4-14.

E. Record the voltage measured on the Digital Voltmeter. This is the reference voltage for the 7.5Vp-p 3314A setting.

F. Set the frequency on the 3314A to 100Hz.

G. Carefully adjust the amplitude on the 3314A until the voltage measured on the Digital Voltmeter is equal to the reference voltage recorded in step E.

H. Record the 3314A's displayed amplitude (in Vp-p) in the appropriate section of Table 4-8 in the Performance Test Record.

I. Repeat steps G & H for the 3314A frequency settings given below:

50kHz
800kHz
1MHz
5MHz
19.99MHz

J. Set the amplitude of the 3314A to 7.5Vp-p and the frequency to 10kHz.

K. Note and record the voltage reading on the Digital Voltmeter.

L. Using the data taken in steps E & K, calculate the reference drift of the 3314A using the equation given below:

Drift(dB) = 20 Log (Step E Reference/Step K Reference)

M. If Drift(dB) is < 0.025dB, the data taken in steps F,G,H, and I is acceptable. Proceed to step O.

N. If Drift(dB) is > 0.025dB, the data taken in steps F,G,H, and I is unacceptable. Repeat steps A through L. If the test fails again, perform the Amplitude Accuracy Test for amplitude verification and repeat Flatness test.

O. Disconnect the Thermal Converter from the 3314A.

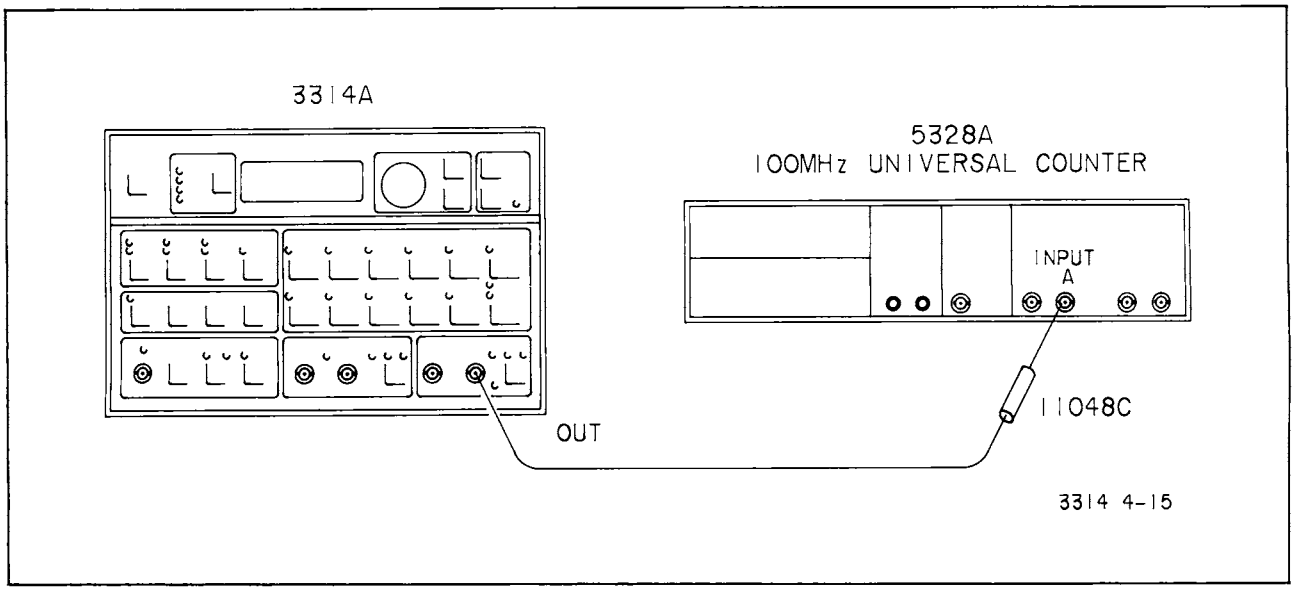


Figure 4-15. Manual Sweep Accuracy

P. Using the equation: Flatness Error (dB) = 20 Log (7.50V/Displayed Amplitude), calculate the Flatness Error in dB for each amplitude entered in the Performance Test Record. Compare the result of each calculation to the specification given in the table.

4-15. MANUAL SWEEP ACCURACY

This test checks the accuracy of the 3314A Manual Linear Sweep.

Specification:

Manual Linear Sweep Accuracy:
Stop Range = 20MHz ±3% of Stop Frequency
Stop Range = 2MHz ±1% of Stop Frequency
Stop Range ≤ 200kHz ±0.2% of Stop Frequency
0.1% of Range

Equipment Required:

-hp- 5328A Universal Counter
-hp- 11048C 50 Ohm Feedthrough Termination

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Amplitude 10Vp-p
Start Frequency 1MHz
Stop Frequency 10MHz
Sweep ..... Linear

C. Set the Counter as follows:

Function ..... Frequency A
Resolution 10Hz
Channel Input ..... Com

D. Connect the 3314A to the Counter as shown in Figure 4-15.

E. Press the "MAN SWEEP" key on the 3314A.

F. Press "START FREQ".

G. Record the frequency reading on the Universal Counter. Reading should be 1MHz ±100kHz.

H. Set "STOP FREQ" on the 3314A to 1MHz and "START FREQ" to 100kHz.

I. Record the frequency reading on the Universal Counter. The reading should be 100kHz ±1kHz.

J. Set "STOP FREQ" on the 3314A to 100kHz and "START FREQ" to 10kHz.

K. Record the frequency reading on the Universal Counter. The reading should be 10kHz ±400Hz.

4-16. STEP ATTENUATOR ACCURACY

This test compares the accuracy of the 3314A Step Attenuator against an attenuator of known precision.

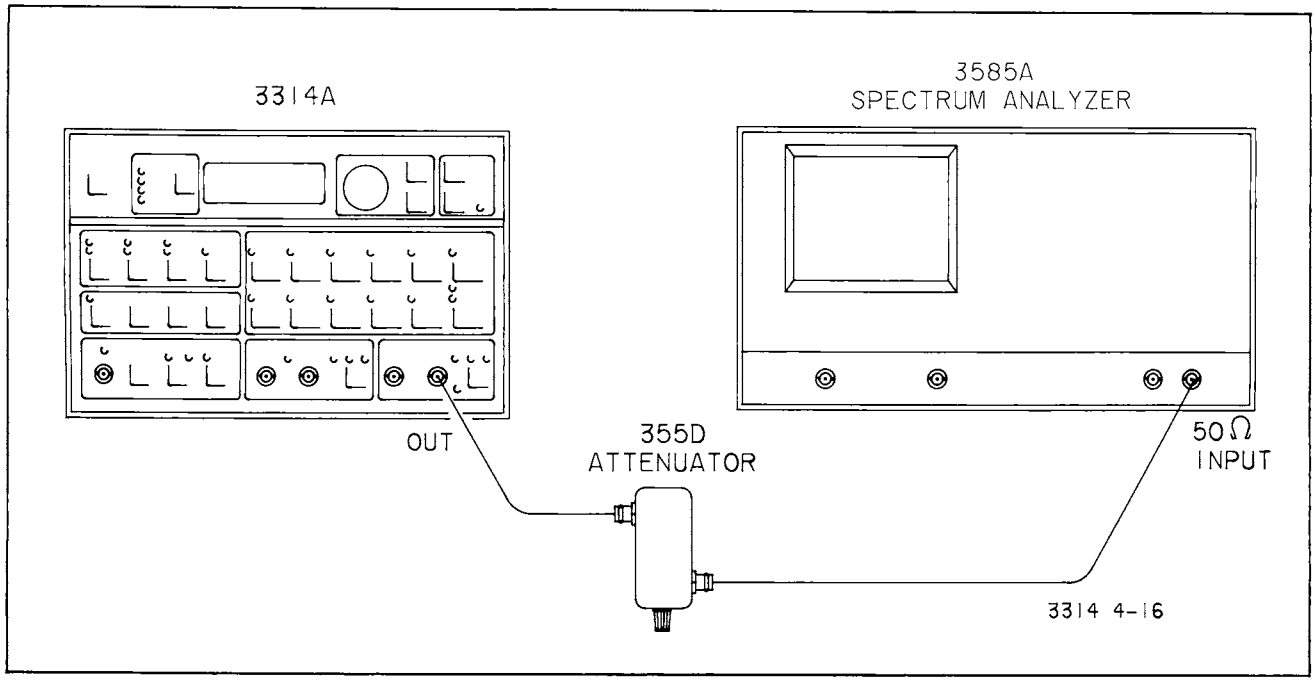


Figure 4-16. Step Attenuator Accuracy

Specification:

0.001Hz to 50kHz ±0.05dB
50kHz to 19.99MHz (20dB,40dB Attenuation) ±0.3dB
50kHz to 19.99MHz (60dB attenuation only) ±0.5dB

Equipment Required:

-hp- 3585A Spectrum Analyzer
-hp- 355D VHF Attenuator*

***NOTE**

This attenuator must have current certification data at frequencies of 50kHz, 1MHz, 20MHz, and attenuations of 20dB, 40dB, and 60dB.

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 50kHz
Amplitude 10Vp-p

C. Set the 355D to 20dB attenuation.

D. Connect the 3314A to the Attenuator and Spectrum Analyzer as shown in Figure 4-16.

E. Set the 3585A as follows:

1. Press "INSTR PRESET".

2. Enter Center Frequency (3314A Frequency Setting).

3. Set Frequency Span to 2x Center Frequency.

4. Enable "COUNTER".

5. Press "MKR→CF".

6. Disable COUNTER

7. Press "MANUAL".

8. Press "CLEAR A".

9. Press "MKR→REF LVL".

10. Set "dB/DIV" to 1dB.

11. Press "REF LVL" and adjust to approximately 1dB below full scale.

12. Set Video Bandwidth to 10Hz.

13. Press "OFFSET".

14. Press "ENTER OFFSET".

15. Press "SAVE (off)", "4 (cal)".

F. Using the Range Down function, set the amplitude of the 3314A to 1.000Vp-p.

G. Set the attenuation on the 355D to 0dB.

H. Record the Marker Amplitude displayed on the CRT in the appropriate section of Table 4-9 located in the Performance Test Record.

I. From the reading taken in step H, subtract the Insertion Loss Error of the 355D. Add that quantity to the 355D attenuation setting and enter the result under "Actual Attenuation" in Table 4-9. (See Performance Test Record for an example.)

J. Set the attenuation of the 355D to 40dB.

K. Set the amplitude of the 3314A to 10.00Vp-p.

L. Repeat step E.

M. Using the Range Down function, set the amplitude of the 3314A to 100mVp-p.

N. Set the attenuation of the 355D to 0dB.

O. Repeat steps H&I.

P. Set the attenuation of the 355D to 60dB.

Q. Set the amplitude of the 3314A to 10.00Vp-p.

R. Repeat step E.

S. Using the Range Down function, set the amplitude of the 3314A to 10.0mVp-p.

T. Set the attenuation of the 355D to 0dB.

U. Repeat steps H & I.

V. Set the 3314A to the remaining frequencies shown in Table 4-9. Repeat steps E through U for each setting.

4-17. VERNIER ATTENUATOR FLATNESS

This test checks the flatness of the 3314A Vernier Attenuator.

Specification:

20Hz to 50kHz	±0.03dB
50kHz to 1MHz	±0.16dB
1MHz to 20MHz	±0.7dB

Equipment Required:

-hp- 3585A Spectrum Analyzer
-hp- 355D VHF Attenuator*

***NOTE**

This attenuator must have current certification data at frequencies of 10kHz, 50kHz, 1MHz, 20MHz, and attenuations of 10dB and 20dB.

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency	10kHz
Amplitude	10Vp-p
Range Hold	On

C. Set the 355D to 10dB attenuation.

D. Connect the 3314A to the Attenuator and Spectrum Analyzer as shown in Figure 4-17.

E. Set the 3585A as follows:

1. Press "INSTR PRESET".

2. Enter Center Frequency (3314A Frequency Setting).

3. Set the Frequency Span to 2x Center Frequency.

4. Enable "COUNTER".

5. Press "MKR→CF".

6. Disable COUNTER.

7. Press "MANUAL".

8. Press "CLEAR A".

9. Press "MKR→REF LVL".

10 Set "dB/DIV" to 1dB.

11. Press "REF LVL" and adjust to approximately 1dB below full scale.

12 Set Video Bandwidth to 10Hz.

13. Press "OFFSET".

14. Press "ENTER OFFSET".

15. Press "SAVE (off)", "4 (cal)".

F. Using the Modify knob, set the amplitude of the 3314A to 3.16Vp-p.

G. Set the attenuation of the 355D to 0dB.

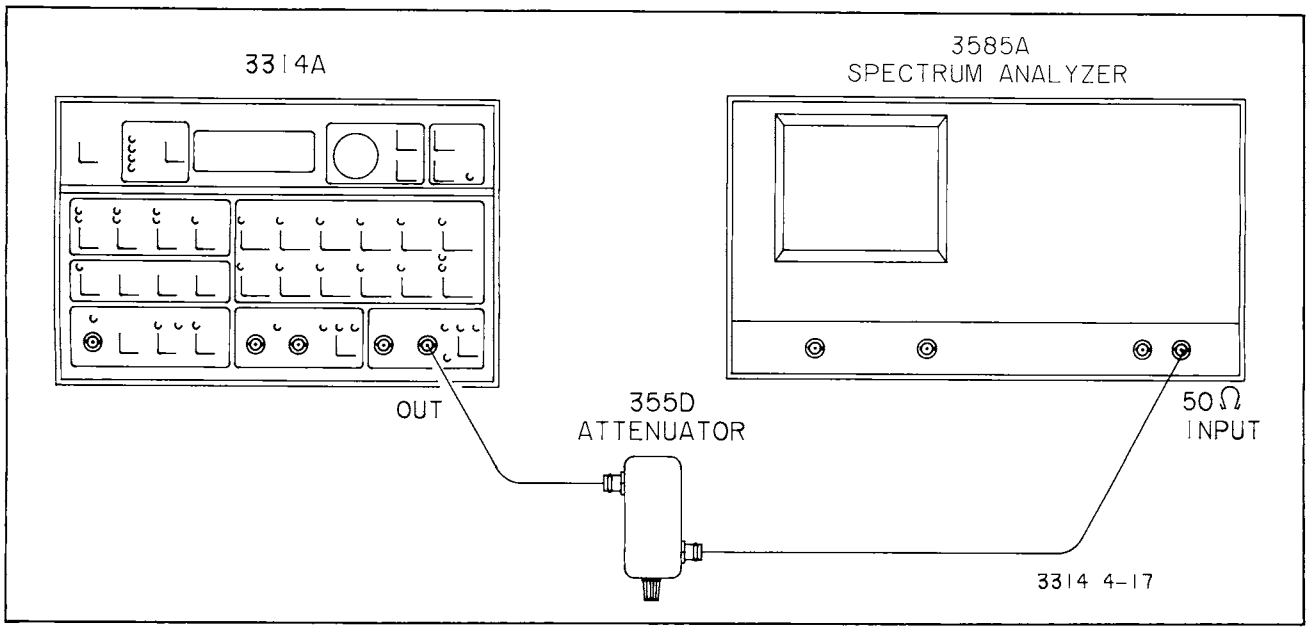


Figure 4-17. Vernier Attenuator Flatness

H. Record the Marker Amplitude displayed on the CRT in the appropriate section of Table 4-10 located in the Performance Test Record.

I. From the reading taken in step H, subtract the Insertion Loss Error of the 355D. Add that quantity to the 355D attenuator setting and enter the result under "Actual Attenuation" in Table 4-10. (See Performance Test Record for example.)

NOTE

The "Actual Attenuation" calculated for settings of 10dB & 20dB at 10kHz is the reference attenuation to which "Actual Attenuation" at 50kHz, 1MHz, and 20MHz will be compared. (See Table 4-10.)

J. Set the attenuation of the 355D to 10dB.

K. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 50kHz.

L. Repeat steps E through I.

M. Set the attenuation of the 355D to 10dB.

N. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 1MHz.

O. Repeat steps E through I.

P. Set the attenuation of the 355D to 10dB.

Q. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 19.99MHz.

R. Repeat steps E through I.

S. Set the attenuation of the 355D to 20dB.

T. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 10kHz.

U. Repeat step E.

V. Set the amplitude of the 3314A to 1.00Vp-p.

W. Set the attenuation of the 355D to 0dB.

X. Repeat steps H & I.

Y. Set the attenuation of the 355D to 20dB.

Z. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 50kHz.

A.A. Repeat steps E, V-X.

B.B. Set the attenuation of the 355D to 20dB.

C.C. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 1MHz.

D.D. Repeat steps E, V-X.

E.E. Set the attenuation of the 355D to 20dB.

F.F. Set the amplitude of the 3314A to 10.0Vp-p and the frequency to 19.99MHz.

G.G. Repeat steps E, V-X.

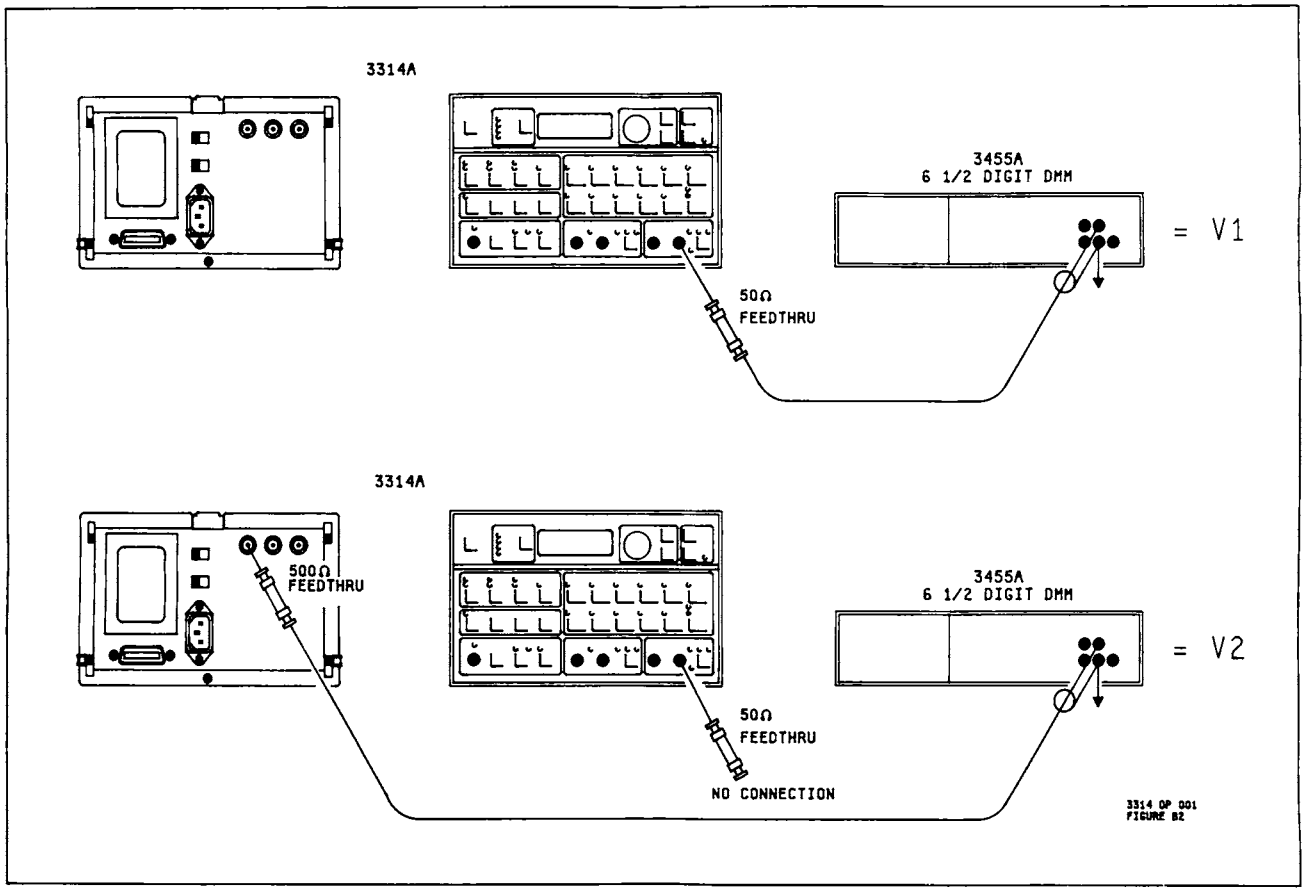


Figure 4-18. X3 Gain Accuracy Connections

4-18. OPTION 001 PERFORMANCE TESTS

These tests measure the performance of Option 001 to determine its functional quality.

4-19. X3 GAIN ACCURACY

This test measures the output voltage at the Main Output and at the X3 output to determine the gain. The gain at 10kHz is specified to be 3 ± 1%.

Equipment Required:

-hp- 3455A Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination
A 500Ω Feedthrough Termination consisting of:
1 499Ω resistor, -hp- part number 0698-4123

Procedure:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 10kHz
Amplitude 10Vp-p

C. Connect the 50 Ohm Feedthrough to the 3314A's Main Output. Connect the 500Ω Feedthrough Termination to the 3314A's X3 Output.

D. Set the digital voltmeter to measure ≈ 3.5VRMS and then measure and record the voltage from the Main Output (V1).

E. Set the digital voltmeter to measure ≈ 10.6VRMS and then measure and record the voltage from the X3 Output (V2).

F. Compute the gain error using the following formula:

$$\text{Gain Error (\%)} = \left[\frac{V2}{V1} - 3 \right] \times 100\%$$

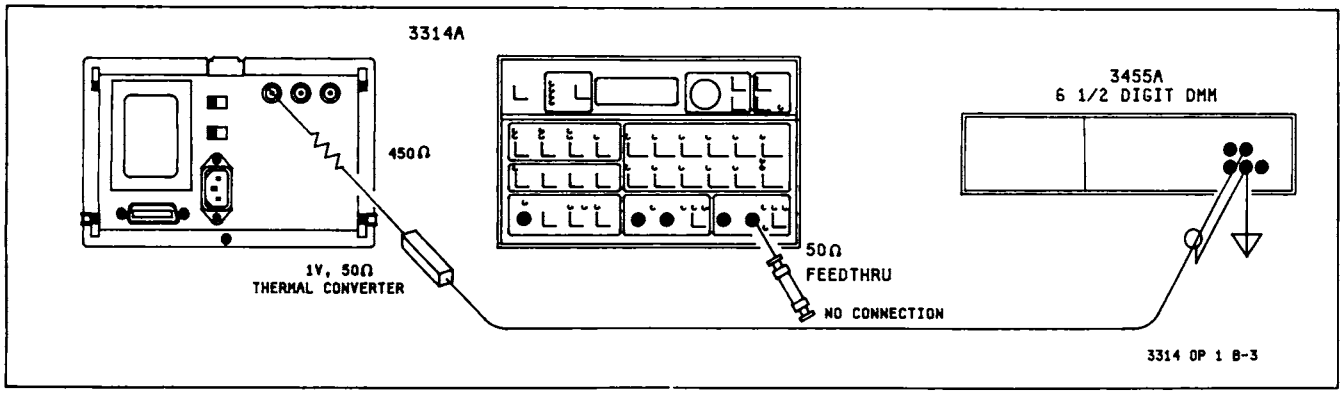


Figure 4-19. Sine Power Flatness Connections

4-20. SINE POWER FLATNESS

This test measures the X3 Output's power level at 30Vp-p and 10kHz. Using this as a power reference, various power levels are measured at different frequencies to determine power flatness.

Required Equipment:

-hp- 3455 Digital Voltmeter
-hp- 11048C 50 Ohm Thermal Converter
A 450 Ohm Series Voltage Reducer consisting of:
1 450Ω resistor, -hp- part number 0698-3510

Procedure:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 10kHz
Amplitude 10Vp-p

C. Connect a 50 Ohm Feedthrough Termination to the 3314A's Main Output. Connect the 450Ω Series Voltage Reducer to the 3314A's X3 Output.

D. Set the digital voltmeter to measure ≈ 0.007mVdc and measure and record the thermal converter's output voltage (Vref).

E. Reduce the 3314A's amplitude to 9.89Vp-p and record the thermal converter's output voltage (V1 limit). This corresponds to a 0.1dB change and is the low frequency flatness limit.

F. Reduce the 3314A's amplitude to 9.44Vp-p and record the thermal converter's output voltage (V2 limit). This corresponds to a 0.5dB change and is the mid frequency flatness limit.

G. Reduce the 3314A's amplitude to 8.41Vp-p and record the thermal converter's output voltage (V3 limit). This corresponds to a 1.5dB change and is the high frequency flatness limit.

H. Set the 3314A's amplitude back to 10Vp-p and set the frequency to each of these values:

20Hz 50kHz 500kHz 1MHz

I. Measure and record the thermal converter's output voltage (V20Hz, V50kHz, V500kHz, V1MHz).

J. Voltages V20Hz and V50kHz should be within this range:

0.1dB RANGE = Vref ± (Vref − V1 limit)

K. Voltage V500kHz should be within this range:

0.5dB RANGE = Vref ± (Vref − V2 limit)

L. Voltage V1MHz should be within this range:

1.5dB RANGE = Vref ± (Vref − V3 limit)

4-21. HARMONIC DISTORTION

This test measures the relative harmonic levels with a spectrum analyzer.

Required equipment:

-hp- 3585A Spectrum Analyzer
-hp- 11048C 50 Ohm Feedthrough Termination
A 500Ω Feedthrough Termination consisting of:
1 499Ω resistor, -hp- part number 0698-4123

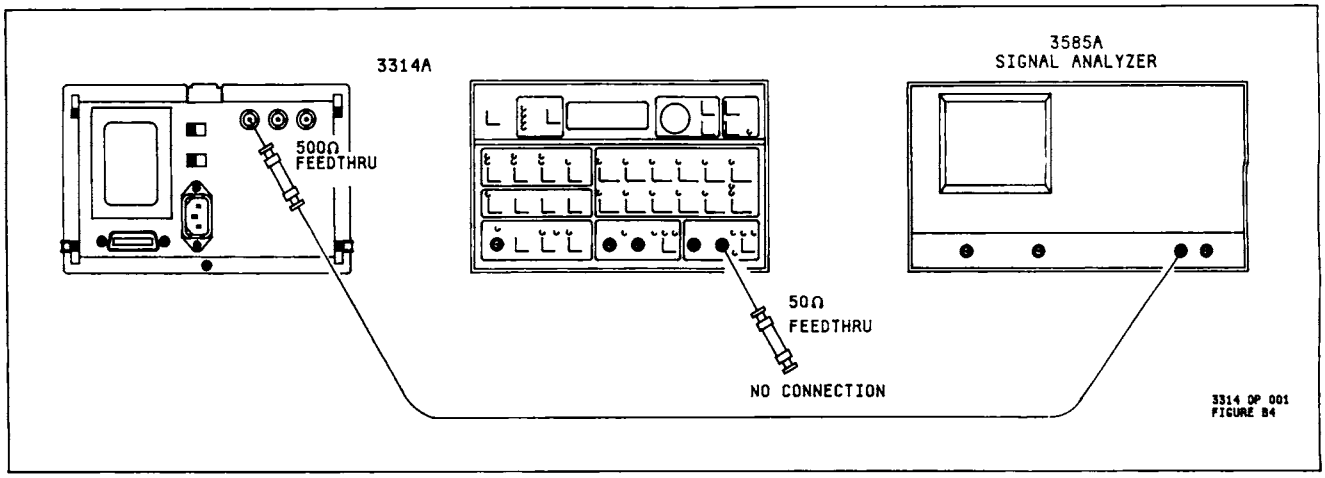


Figure 4-20. Harmonic Distortion Connections

Procedure:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 20Hz
Amplitude 10Vp-p

C. Connect the 50 Ohm Feedthrough Termination to the 3314A's Main Output. Connect the 500Ω Feedthrough Termination to the 3314A's X3 Output.

D. Connect the spectrum analyzer's 1MΩ input to the 3314A's X3 Output. Set the spectrum analyzer to measure the fundamental and at least 7 harmonics. Use the Marker function to measure the level difference between the fundamental and the largest harmonic.

E. Change the 3314A's frequency to each of these values and then repeat step D.

50kHz 1MHz

4-22. SQUARE WAVE RISE/FALL TIME

This test uses a wide bandwidth oscilloscope to measure the rise and fall time of a 10kHz, 30Vp-p square wave.

Required Equipment:

-hp- 1725 275MHz Oscilloscope
-hp- 11048C 50 Ohm Feedthrough Termination
A 500Ω Feedthrough Termination consisting of:
1 499Ω resistor, -hp- part number 0698-4123

Procedure:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency 10kHz
Amplitude 10Vp-p
Function ..... Square Wave

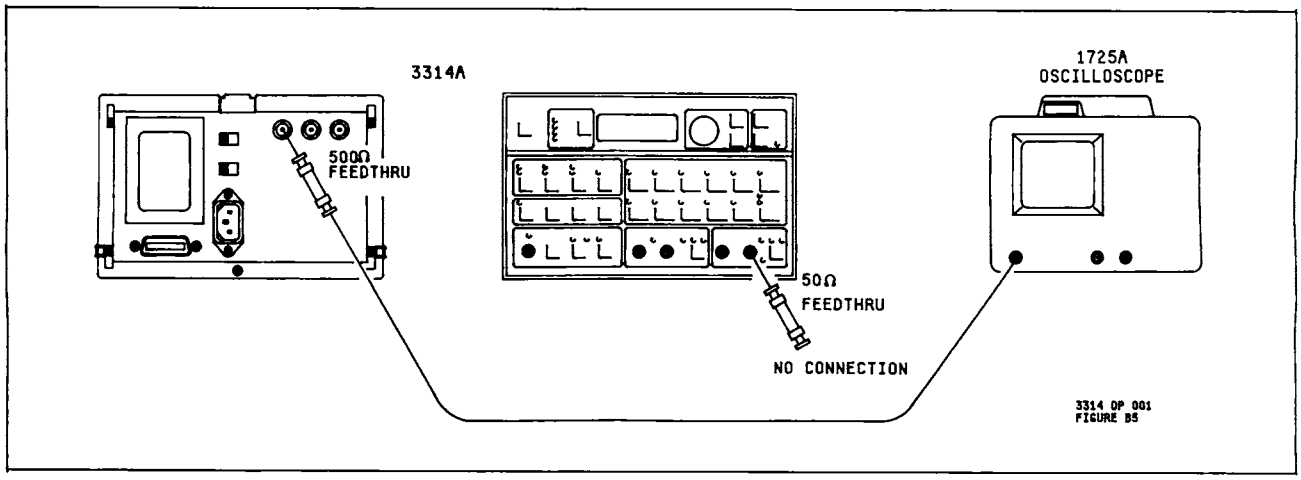


Figure 4-21. Square Wave Rise/Fall Time Connections

C. Connect the 50 Ohm Feedthrough Termination to the 3314A's Main Output. Connect the 500Ω Feedthrough Termination to the 3314A's X3 Output.

D. Connect the oscilloscope's 1MΩ input to the 3314A's X3 Output.

E. Set the oscilloscope to display 2 complete cycles with the peaks of the square wave at the 0% and 100% graticule lines.

F. Using the oscilloscope's delay function (set the delayed time per division to .1μS/DIV), measure the rise and fall time from the 10% to 90% graticule lines. In both cases, this should be less than 2 divisions (<200ns).

4-23. RESIDUAL DC OFFSET

This test measures the DC voltage output from the X3 Output with no signal present.

Required Equipment:

-hp- 3455A Digital Voltmeter
-hp- 11048C 50 Ohm Feedthrough Termination
A 500Ω Feedthrough Termination consisting of:
1 499Ω resistor, -hp- part number 0698-4123

Procedure:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... OFF
Offset 0VDC

C. Connect the 50 Ohm Feedthrough Termination to the 3314A's Main Output. Connect the 500Ω Feedthrough Termination to the 3314A's X3 Output.

D. Measure the DC voltage at the X3 Output. This voltage should be within 40mV of 0VDC.

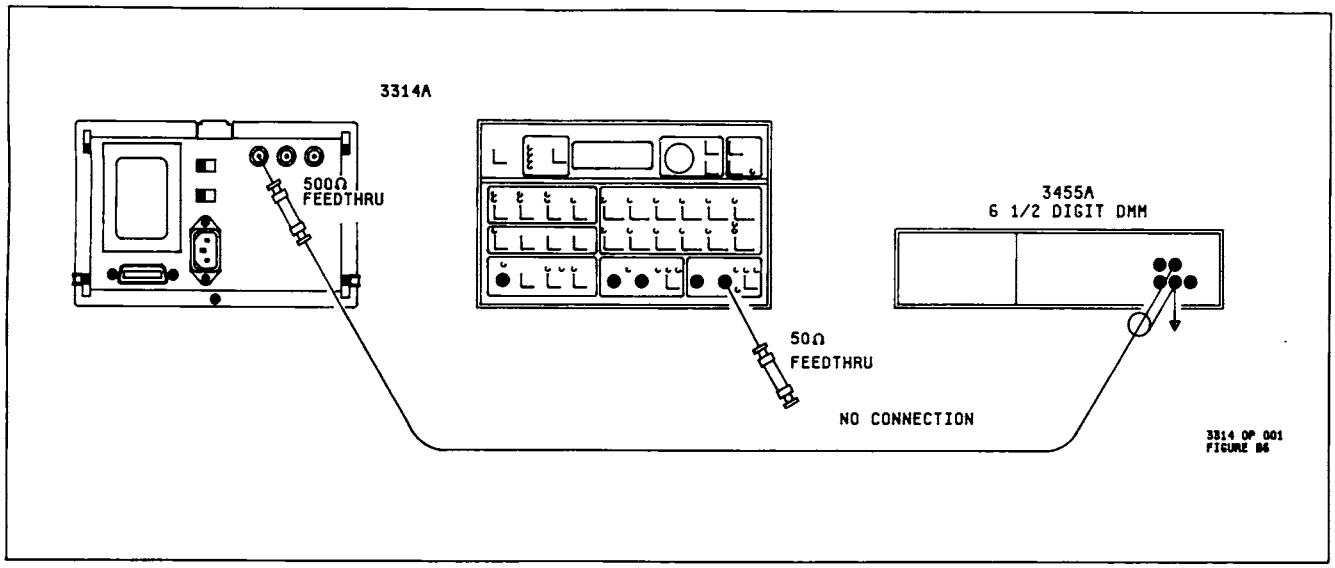


Figure 4-22. Residual DC Offset Connections

PERFORMANCE TEST RECORD

HEWLETT-PACKARD MODEL 3314A

FUNCTION GENERATOR

SERIAL NO. _____

Tests Performed By _____

Date _____

FREQUENCY ACCURACY TEST:

3314A Frequency (A)	Specification	Counter Reading
19.99 MHz	± 2000 Hz	_____
1999 kHz	± 200 Hz	_____
199.9 kHz	± 600 Hz	_____
19.99 kHz	± 60 Hz	_____
1999. Hz	± 6 Hz	_____
199.9 Hz	± 6 Hz	_____
3314A Frequency (B)		
00.1 Hz	± 0.2 Hz	_____
001 Hz	± 2 Hz	_____
0.01 kHz	± 20 Hz	_____
00.1 kHz	± 200 Hz	_____
001 kHz	± 0.1 Hz	_____
0.01MHz	± 1Hz	_____

TIME AXIS AND VARIABLE SYMMETRY:

%Symmetry	Specification	Calculated%
50%	± 0.2%	_____
5%	± 0.5%	_____
95%	± 0.5%	_____

INTERNAL TRIGGER ACCURACY:

Period	Specification	Counter Reading
10.0ms	± 0.001 ms	_____

TRIANGLE LINEARITY

x Values	Positive Slope Measurement	x Times y	Calculated Best Fit Straight Line	Tolerance*
$x_1 = 1$	10% _____	_____	(y_1)_____	± 0.02V
$x_2 = 2$	20% _____	_____	(y_2)_____	± 0.02V
$x_3 = 3$	30% _____	_____	(y_3)_____	± 0.02V
$x_4 = 4$	40% _____	_____	(y_4)_____	± 0.02V
$x_5 = 5$	50% _____	_____	(y_5)_____	± 0.02V
$x_6 = 6$	60% _____	_____	(y_6)_____	± 0.02V
$x_7 = 7$	70% _____	_____	(y_7)_____	± 0.02V
$x_8 = 8$	80% _____	_____	(y_8)_____	± 0.02V
$x_9 = 9$	90% _____	_____	(y_9)_____	± 0.02V

$\Sigma x = 45$ Σy _____ Σxy_____

$(\Sigma x)^2 = 2025$ $\Sigma x\ \Sigma y$_____ $m =$_____

$\Sigma x^2 = 285$ $b =$_____

*Tolerance is the maximum allowable difference between the "Positive Slope Measurement" (or "Negative Slope Measurement") and the "Calculated Best Fit Straight Line" value. Tolerance is calculated by:

Tolerance = (Triangle Amplitude)(Specification)

= (10Vp-p)(0.2%)

= 0.02V

x Values	Negative Slope Measurement	x Times y	Calculated Best Fit Straight Line	Tolerance*
$x_9 = 9$	90% _____	_____	(y_9)_____	± 0.02V
$x_8 = 8$	80% _____	_____	(y_8)_____	± 0.02V
$x_7 = 7$	70% _____	_____	(y_7)_____	± 0.02V
$x_6 = 6$	60% _____	_____	(y_6)_____	± 0.02V
$x_5 = 5$	50% _____	_____	(y_5)_____	± 0.02V
$x_4 = 4$	40% _____	_____	(y_4)_____	± 0.02V
$x_3 = 3$	30% _____	_____	(y_3)_____	± 0.02V
$x_2 = 2$	20% _____	_____	(y_2)_____	± 0.02V
$x_1 = 1$	10% _____	_____	(y_1)_____	± 0.02V

$\Sigma x = 45$ Σy _____ Σxy_____

$(\Sigma x)^2 = 2025$ $\Sigma x\ \Sigma y$_____ $m =$_____

$\Sigma x^2 = 285$ $b =$_____

N CYCLE PHASE ACCURACY:

Step E Reading	Step F Reading	AVG	Specification	Step H Reading
_____	_____	_____	± 0.167V	_____

RESIDUAL DC AND DC OFFSET ACCURACY:

(Residual)

3314A Voltage	Offset	Specification	Voltmeter Reading
10.00V	0V	± 0.05V	_____
1.000V	0V	± 0.005V	_____
100.0mV	0V	± 0.0005V	_____
10.00mV	0V	± 0.00005V	_____

(Variable)

3314A Voltage	Offset	Specification	Voltmeter Reading
10.00V	5V	± 0.21V	_____
1.000V	5V	± 0.16V	_____
100.0mV	5V	± 0.16V	_____
10.00mV	5V	± 0.16V	_____
10.00V	0.887V	± 0.087V	_____
1.000V	0.887V	± 0.037V	_____
100.0mV	0.887V	± 0.037V	_____
10.00mV	0.887V	± 0.037V	_____

DC OFFSET ACCURACY (cont):

3314A Voltage	Offset	Specification	Voltmeter Reading
10.00V	– 0.887V	± 0.087V	_____
1.000V	– 0.887V	± 0.037V	_____
100.0mV	– 0.887V	± 0.037V	_____
10.00mV	– 0.887V	± 0.037V	_____
10.00V	– 5V	± 0.21V	_____
1.000V	– 5V	± 0.16V	_____
100.0mV	– 5V	± 0.16V	_____
10.00mV	– 5V	± 0.16V	_____

SQUARE WAVE RISE TIME AND OVERSHOOT:

Rise Time		Fall Time	
Specification	Oscilloscope Reading	Specification	Oscilloscope Reading
≤ 1cm	_____	≤ 1cm	_____

Overshoot

Specification	Oscilloscope Reading
± 0.5V	_____

SINE WAVE HARMONICS:

3314A Frequency	Range	Specification	Pass	Fail
20.0Hz	3	HARMONICS < −55dB	_____	_____
100.0Hz	3	HARMONICS < −55dB	_____	_____
199.9Hz	3	HARMONICS < −55dB	_____	_____
100.Hz	4	HARMONICS < −55dB	_____	_____
1000.Hz	4	HARMONICS < −55dB	_____	_____
1999.Hz	4	HARMONICS < −55dB	_____	_____
1.00kHz	5	HARMONICS < −55dB	_____	_____
10.00kHz	5	HARMONICS < −55dB	_____	_____
19.99kHz	5	HARMONICS < −55dB	_____	_____
10.0kHz	6	HARMONICS < −55dB	_____	_____
100.0kHz	6	HARMONICS < −40dB	_____	_____
199.9kHz	6	HARMONICS < −40dB	_____	_____
100.kHz	7	HARMONICS < −40dB	_____	_____
1000.kHz	7	HARMONICS < −40dB	_____	_____
1999.kHz	7	HARMONICS < −40dB	_____	_____

			Measured Levels					
			2nd	3rd	4th	5th	6th	7th
1.00MHz	8	−25dB	_____	_____	_____	_____	_____	_____
10.00MHz	8	−25dB	_____	_____	_____	_____	_____	_____
19.99MHz	8	−25dB	_____	_____	_____	_____	_____	_____

PERFORMANCE TEST RECORD (Cont'd)

AM HARMONICS:

Specification	Pass	Fail
Harmonic Levels Below "DSPL Line" Reference	_____	_____

VCO LINEARITY:

Power Supply Voltage	Specification	Counter Reading
−8V ± 10mV	2MHz ± 300kHz	_____
−4.5V ± 10mV	5.5MHz ± 300kHz	_____
1V ± 10mV	11MHz ± 300kHz	_____

PHASE LOCKED LOOP PHASE ACCURACY:

3314A Phase Setting	Specification	(t)	(t_1)	Calculated Phase
−199.9°	SETTING ± 2°	_____	_____	_____
−90°	SETTING ± 2°	_____	_____	_____
0°	SETTING ± 2°	_____	_____	_____
90°	SETTING ± 2°	_____	_____	_____
199.9°	SETTING ± 2°	_____	_____	_____

AMPLITUDE ACCURACY:

Function	Specification	Voltmeter Reading
Sine	3.535V ± 0.0477V	_____
Square	5.0V ± 0.0477V	_____
Triangle	2.8867V ± 0.0477V	_____

SINE WAVE POWER FLATNESS:

$$\text{Drift(dB)} = 20 \text{ Log } \frac{\text{Step E Reference}}{\text{Step K Reference}} < 0.025\text{dB}$$

$$\text{Flatness Error(dB)} = 20 \text{ Log } \left(\frac{7.5\text{V}}{\text{Displayed Amplitude}}\right)$$

Step E Reference_____ Drift(dB) _____

Step K Reference_____

Table 4-8. Sine Wave Power Flatness

3314A Frequency	3314A Displayed Amplitude	VREF	Specification	Calculated Flatness Error
100 Hz	_____	_____	± 0.04dB	_____
50 kHz	_____		± 0.04dB	_____
800kHz	_____		± 0.17dB	_____
1MHz	_____		± 0.17dB	_____
5MHz	_____		± 0.8dB	_____
19.99MHz	_____		± 0.8dB	_____

MANUAL SWEEP ACCURACY:

"Start Freq"	"Stop Freq"	Specification	Counter Reading
1 MHz	10 MHz	1 MHz ± 100 kHz	_____
100 kHz	1 MHz	100 kHz ± 1 kHz	_____
10 kHz	100 kHz	10 kHz ± 400 Hz	_____

Table 4-9. Step Attenuator Accuracy

3314A Frequency	355D Attenuation	3585A Marker Amplitude	355D Insertion Loss	Actual Attenuation	Upper Limit	Lower Limit
	20 dB	_____	_____	_____	20.05 dB	19.95 dB
50 kHz	40 dB	_____	_____	_____	40.05 dB	39.95 dB
	60 dB	_____	_____	_____	60.05 dB	59.95 dB
	20 dB	_____	_____	_____	20.3 dB	19.7 dB
1 MHz	40 dB	_____	_____	_____	40.3 dB	39.7 dB
	60 dB	_____	_____	_____	60.5 dB	59.5 dB
	20 dB	_____	_____	_____	20.3 dB	19.7 dB
19.99 MHz	40 dB	_____	_____	_____	40.3 dB	39.7 dB
	60 dB	_____	_____	_____	60.5 dB	59.5 dB

Example: Actual Attenuation = 355D Attenuation Setting + (Marker Reading - Insertion Loss)

= 20 dB + (0.01 dB – (– 0.013 dB))

= 20.023 dB

Table 4-10. Vernier Attenuator Flatness

3314A Frequency	355D Attenuation	3585A Marker Amplitude	355D Insertion Loss	Actual Attenuation	Upper Limit	Lower Limit
10 kHz	10 dB	_____	_____	_____ *Ref	_____	_____
	20 dB	_____	_____	_____ *Ref	_____	_____
50 kHz	10 dB	_____	_____	_____	Ref +0.03 dB	Ref −0.03 dB
	20 dB	_____	_____	_____	Ref +0.03 dB	Ref −0.03 dB
1 MHz	10 dB	_____	_____	_____	Ref +0.16 dB	Ref −0.16 dB
	20 dB	_____	_____	_____	Ref +0.16 dB	Ref −0.16 dB
19.99 MHz	10 dB	_____	_____	_____	Ref +0.7 dB	Ref −0.7 dB
	20 dB	_____	_____	_____	Ref +0.7 dB	Ref −0.7 dB

Example: Actual Attenuation = 355D Attenuation Setting + (Marker Reading - Insertion Loss)

= 20 dB + (0.01 dB − (−0.013 dB))

= 20.023 dB

*Reference for attenuation flatness.

OPTION 001:

X3 Gain Accuracy:

$$\frac{\text{Voltmeter Reading}}{\sim 3.5\text{VRMS}} \qquad \frac{V1}{\_\_\_\_\_}$$

$$\frac{\text{Voltmeter Reading}}{\sim 10.6\text{VRMS}} \qquad \frac{V2}{\_\_\_\_\_}$$

$$\text{Gain Error (\%)} = \left[\frac{V2}{V1} - 3\right] \times 100\%$$

$$= \_\_\_\_\_$$

PERFORMANCE TEST RECORD (Cont'd)

SINE POWER FLATNESS:

Vref	V1 Limit	V2 Limit	V3 Limit
_____	_____	_____	_____

3314A Frequency	Thermal Converter Output Voltage
20Hz	_____
50kHz	_____
500kHz	_____
1MHz	_____

The recorded voltages for 3314A frequency settings of 20Hz and 50kHz should fall within the range which is calculated as follows:

0.1dB Range = Vref ± (Vref – V1 Limit)
= _____

For the 500kHz frequency setting, the recorded voltage should fall within the range:

0.5dB Range = Vref ± (Vref - V2 Limit)
= _____

For the 1MHz frequency setting, the recorded voltage should fall within the range:

1.5dB Range = Vref ± (Vref - V3 Limit)
= _____

HARMONIC DISTORTION:

3314A Frequency	Fundamental Level (dB)	Harmonic Levels (dB)	
20Hz	_____	2nd	_____
		3rd	_____
		4th	_____
		5th	_____
		6th	_____
		7th	_____

Harmonic Levels are acceptable if:

(Fundamental Level - Highest Level in Harmonics Column) < –53dB

PERFORMANCE TEST RECORD (Cont'd)

3314A Frequency	Fundamental Level (dB)	Harmonic Levels (dB)	
50kHz	_____	2nd	_____
		3rd	_____
		4th	_____
		5th	_____
		6th	_____
		7th	_____

Harmonic Levels are acceptable if:

(Fundamental Level - Highest Level in Harmonics Column) < −53dB

3314A Frequency	Fundamental Level (dB)	Harmonic Levels (dB)	
1MHz	_____	2nd	_____
		3rd	_____
		4th	_____
		5th	_____
		6th	_____
		7th	_____

Harmonic Levels are acceptable if:

(Fundamental Level - Highest Level in Harmonics Column) < −38dB

SQUARE WAVE RISE/FALL TIME:

Rise Time		Fall Time	
Specification	Oscilloscope Reading	Specification	Oscilloscope Reading
≤200ns	_____	≤200ns	_____

RESIDUAL DC OFFSET:

Specification	Measured Offset
≤40 mVdc	_____

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

The adjustment and measurement procedures contained in this section are intended to restore the 3314A to its optimum operating condition. Adjustment of the instrument will be necessary following repair, replacement of components, or if desired, after the instrument has failed a Performance Test. These procedures should also be followed for periodic maintenance of the instrument*. The individual adjustments and measurements should be completed in the order in which they are presented. They include:

* It is recommended that a routine adjustment of the 3314A be performed at least once a year.

The adjustment and measurement locations for the procedures described in this section are found on page 5-21/22.

WARNING

Maintenance described herein is performed with power supplied to the instrument and protective covers removed. Such maintenance should be performed by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power cord should be removed.

NOTE

Allow the 3314A a "warm-up" period of 30 minutes prior to making adjustments.

5-2. BATTERY VOLTAGE AND CURRENT DRAIN CHECK

This procedure checks for excessive current drawn by RAM and measures the voltage across Battery A3B1 and at pin 18 of A3U211 (CMOS RAM Memory).

Equipment Required:

-hp- 3455A Digital Voltmeter

Procedures:

A. Turn the 3314A off.

B. Set the digital voltmeter as follows:

Function ..... DC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

C. Using the voltmeter, measure the voltage across A3R13. This voltage has a typical value of 1.35mV and a maximum value of 18.5mV. A voltage > 18.5mV across A3R13 indicates excessive current drain which may result in the discharge of A3B1.

Table 5-1. Recommended Equipment List

Equipment	Critical Specifications	Recommended Model
Digital Voltmeter	DC Function, Acc. ±0.05%. Resolution 6 Digits.	-hp- 3455A
Universal Counter	Freq. Measurement to 20MHz. Acc: ±2 counts. Resolution 8 Digits.	-hp- 5328A
Oscilloscope	Vertical BW DC to 275MHz. Deflection 0.01V to 10V/Div. Horizontal Sweep 0.05μs.	-hp- 1725A
Spectrum Analyzer	Freq. Range 20MHz to 40MHz. Amplitude Accuracy: ±0.2dB.	-hp- 3585A
Synthesizer/ Function Generator	Sine Output: 1kHz. Amplitude: 1VRMS into 10kΩ.	-hp- 3325A
50Ω Load	Accuracy: ±0.2%. Power Rating: 1w.	-hp- 11048C
Spectrum Analyzer	Freq. Range 40MHz to 120MHz. Amplitude Acc: ±0.5dB.	-hp- 8558B
BNC/TEE Adaptor	Male Female Female BNC.	-hp- 1250-0781
10:1 Probe	1MΩ, 20-26pf input capacitance.	-hp- 10041A

NOTE

If the voltage measured across A3R13 indicates a large current drain, suspect bad RAMs.

CAUTION

Servicing personnel should wear a static control wristband to avoid Electrostatic Discharge ("Static Zap") of the components within the 3314A. Potentials as low as 500V though not noticed by touching the instrument, can damage sensitive components within the instrument.

D. Simultaneously short the (+) terminal of A3B1 to ground while measuring the DC voltage across the battery. Maintain the short and measurement for approximately five seconds. Monitor the voltmeter display and verify that the voltage remains >2.20V. *(REMOVE SHORT IMMEDIATELY AFTER MAKING THIS MEASUREMENT.)*

NOTE

If the battery voltage failed to remain > 2.20V, suspect not only bad RAMs, but also the possibility that A3CR2 may have been destroyed while probing. This would result in current loading by the power supplies.

E. Measure the voltage at pin 18 of A3U211 with respect to ground. The voltage should be ≥ 2.5VDC but < 3.5VDC.

NOTE

This step is a check to insure that the short applied in step D did not drain A3B1 below its required operating potential.

5-3. POWER SUPPLY ADJUSTMENT

This adjustment enables the 3314A to generate accurate voltage levels (through Amplitude Calibration) and calibrate its frequency over the proper range by setting the −15VDC and +15VDC supply levels and measuring the +5VDC supply.

Equipment Required:

-hp- 3455A Digital Voltmeter

Procedures:

A. Preset the 3314A.

B. Set the digital voltmeter as follows:

Function ..... DC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

C. Using the voltmeter, measure the −15VDC supply with respect to ground on A1J5 pin 17.

D. If necessary, adjust A3R113 until −15VDC ± 5mV is measured on the voltmeter.

E. Measure the +15VDC supply with respect to ground on A1J5 pin 20.

F. If necessary, adjust A3R114 until +15VDC ±5mV is measured on the voltmeter.

G. Measure the +5VDC supply with respect to ground at A3TP3. The level should be 5.1VDC ±100mV.

NOTE

If the voltage measured in step G is below the specified level, disconnect cables A3J1 through A3J3 while continuing to monitor the +5V supply at A3TP3. This will determine which PC assembly is causing the failure. If after J1 through J3 have been disconnected the voltage remains below the required level, suspect problems with either the controller hardware or power supplies.

5-4. 5V SWITCHING SUPPLY FREQUENCY CHECK

This procedure measures the Switching Frequency of the +5VDC supply.

Equipment Required:

-hp- 5328A Universal Counter
-hp- 10041A 10:1 Probe

Procedures:

A. Preset the 3314A.

B. Set the counter as follows:

Function	Freq A
Resolution	1Hz
Level A	Preset
Slope	+
Coupling	AC
Attenuation	x10
Input Termination	1 MΩ
Sample Rate	Adjust CCW as necessary

C. Using the probe, measure the Switching frequency at the collector of A3Q108. The frequency should be 33kHz ±3.3kHz.

NOTE

Note that this is the "average" value and that instantaneous deviations greater than the 10% spread may occur. If the measured frequency remains outside the 33kHz ±3.3kHz range, suspect hardware problems or a possible short of the +5V supply.

5-5. CRYSTAL OSCILLATOR FREQUENCY CHECK

This procedure measures the Crystal Oscillator frequency.

Equipment Required:

-hp- 5328A Universal Counter

Procedures:

A. Preset the 3314A.

B. Set the counter as follows:

Function	Freq A
Resolution	1Hz
Level A	Preset
Slope	+
Coupling	AC
Attenuation	x10
Input Termination	1 MΩ
Sample Rate	Adjust CCW as necessary

C. Using the counter, measure the Crystal Oscillator frequency at A3TP5 (MPU CLK 1) and A3TP4 (MPU CLK 2). The frequency should be 1.0MHz ±50Hz.

NOTE

If the frequency measured in step C is outside the given range by 10% or more, the crystal may have to be replaced.

5-6. RAM/ROM TEST

This procedure checks for RAM or ROM failures within the 3314A and tests the functioning of the front panel keys.

Equipment Required:

NONE

Procedures:

A. Turn the 3314A OFF, then ON, while simultaneously pressing the "ARB" key.

Table 5-2. RAM/ROM Location and Reference LED's

	ROM Test					
LED	FREQ	AMPTD	OFFSET	SYM	PHASE	N
Reference Designator	U238	U236	U210	U209	U208	U207
ROM Address Block	4000-5FFF	6000-7FFF	8000-9FFF	A000-B000	C000-D000	E000-FFFF

	RAM Test			
LED	SW/TR INTVL	START FREQ	STOP FREQ	MKR
Reference Designator	U234	U233	U211	U212
RAM Location	UPPER4 NMOS	LOWER4 NMOS	UPPER4 CMOS	LOWER4 CMOS

B. After power has been restored to the 3314A, release the "ARB" key.

C. The 3314A front panel will be blank for approximately 30 seconds while the RAM/ROM Test is in Progress. At the end of this period, all front panel LED'S and display segments should illuminate.

D. RAM or ROM failures are indicated by the non-illumination of the LED corresponding to the selected front panel parameter listed in Table 5-2. For example, if the ROM with reference designator U236 failed, the "AMPTD" LED on the 3314A front panel would not illuminate.

NOTE

Should a LED assigned to the RAM/ROM locations fail to illuminate, press its corresponding key. If the LED illuminates when the key is pressed, then the RAM or ROM is probably bad. If the LED does not illuminate when the key is pressed, then the LED is most likely defective.

E. After replacing any failed RAM or ROMs, repeat test beginning with step A. This is necessary because of the serial manner in which the RAMs are checked. (The RAM test stops after the first bad RAM is found.) Repeat this test until all RAM (and ROM) LEDs illuminate then proceed to step F.

F. After determining RAM/ROM quality, press each front panel key and verify that its corresponding LED toggles. This assures that each key functions properly.

G. Observe the rightmost seven segment display while pressing the "Range Up" key. Segment "B" of the display (see Figure 5-1), should toggle.

H. Press the "Range Down" key to verify that it toggles segment "C" (see Figure 5-1), of the seven segment display.

I. Press Modify keys "←" and "→" to verify that they toggle segments "F" and "E" respectively.

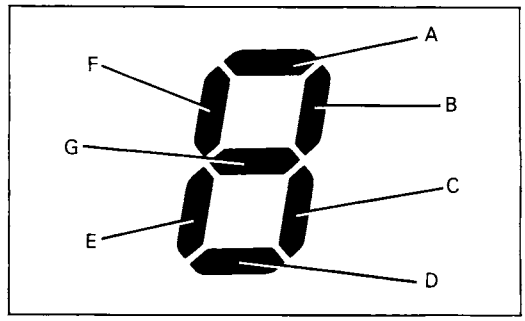


Figure 5-1. Seven Segment Display

J. Observe the "1" on the left side of the 3314A display. Rotate the Modify Knob clockwise to confirm that the upper segment toggles. Rotate the Modify Knob counterclockwise to confirm that the bottom segment toggles.

K. Recycle the power on the 3314A to exit the RAM/ROM test. "E09" will appear in the display due to the memory in RAM that was lost while the test was being performed. This is the normal instrument response.

5-7. AMPLITUDE CALIBRATION REFERENCE VOLTAGE CHECK

This procedure verifies the Reference Voltage levels for Amplitude Calibration.

Equipment Required:

-hp- 3455A Digital Voltmeter

Procedures:

A. Preset the 3314A.

B. Set the digital voltmeter as follows:

Function ..... DC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

C. Using the voltmeter, measure the voltage between A1U805 pin 3 and ground. The level should be +5.515VDC ±0.005V.

D. Measure the voltage between A1U805 pin 6 and ground. The level should be −5.515VDC ±0.005V.

NOTE

If the voltages measured in steps C and D are outside their given tolerances, check the levels of the +15VDC and −15VDC supplies. Adjust the supplies if necessary and repeat steps C and D of this test. If the voltages still do not meet the specification, check the values of A1R804 through A1R807 against those given on the schematic. A1U805 may also need to be replaced.

5-8. MULTIPLEX DAC OFFSET ADJUSTMENT

This adjustment cancels the offset voltage of A2U207, thus assuring the proper functioning of the Multiplex DAC.

Equipment Required:

-hp- 3455A Digital Voltmeter

Procedures:

A. Preset the 3314A.

B. Set the digital voltmeter as follows:

Function ..... DC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

NOTE

Due to the precision required for this adjustment, connect the 3455A ground to A2J8 pin 4 of the 3314A.

C. Using the voltmeter, measure the DC voltage between A2U213 pin 1 and ground. The level should be 0.0VDC ±0.1mV.

D. If necessary, adjust A2R212 (DAC Offset) until 0.0VDC ±0.1mV is measured.

NOTE

Sweep and Amplitude accuracy are affected by this adjustment.

5-9. FREQUENCY ACCURACY CALIBRATION ADJUSTMENT

This adjustment sets the Frequency Calibration potentiometer to the center of the calibration range, thus insuring the 3314A's ability to calibrate frequency over its entire operating temperature range.

Equipment Required:

NONE

Procedures:

A. Preset the 3314A.

B. Set A3S1(4) and A3S1(5) to the "closed" position.

C. Turn the 3314A OFF, then ON.

D. Return A3S1(4) and A3S1(5) to the "open" position. (The 3314A is now in Test Mode 01.)

E. Adjust A2R429 (Freq Cal) until 000 ±002 is shown in the 3314A display.

F. Press the "Range Down" key to return the 3314A to normal operation. Verify that the instrument passes the calibration without "E31" appearing in the display*.

NOTE

If "E31" continues to be displayed, press the "Range Up" key four times to set the frequency to 10MHz. If "E31" was displayed as the frequency changed to 10MHz, adjust A1C218 (10MHz Adjust) in either direction and perform a calibration ("Blue","RCL"). Repeat adjustment and calibration until "E31" no longer appears when the calibration is performed. (If E31 continued to appear after adjusting A1C218, check the power supplies for proper amplitude, adjust if necessary, and repeat Frequency Accuracy Calibration adjustment.)

5-10. Z-AXIS POLARITY OBSERVATION

This procedure measures the amplitude of the Z-Axis Marker pulse and verifies its change in polarity when the Z-Axis switch is toggled.

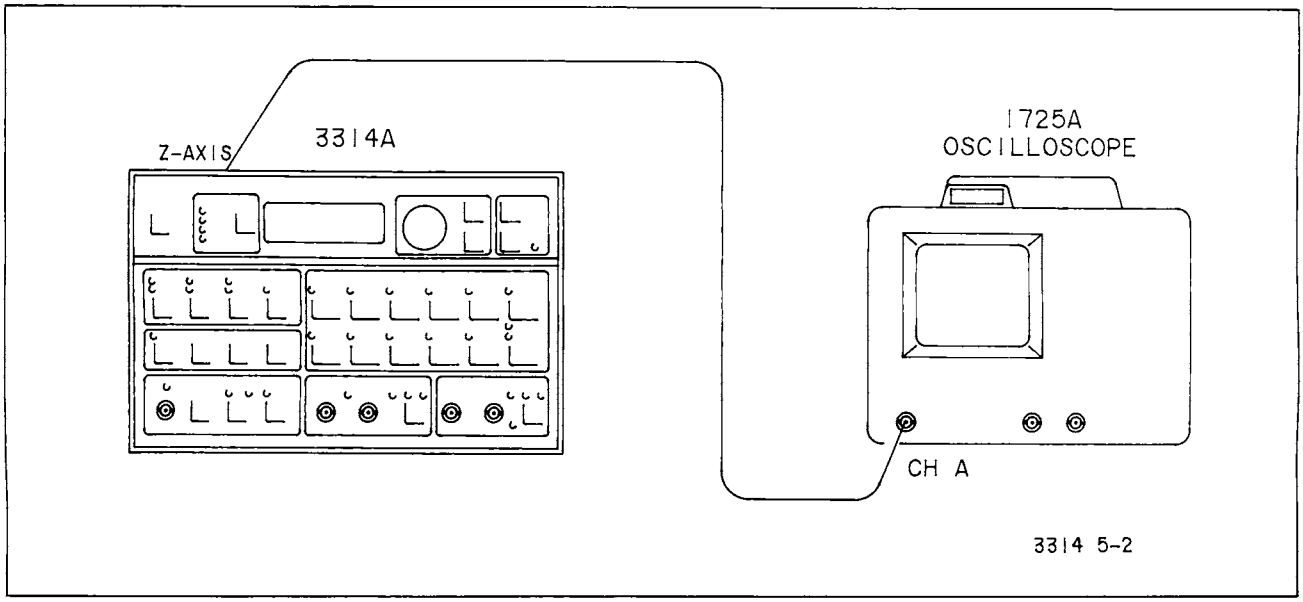


Figure 5-2. Z-Axis Polarity Observation

Equipment Required:

-hp- 1725A Oscilloscope

Procedures:

A. Preset the 3314A.

B. Set the oscilloscope as follows:

Volts/Div 5V
Coupling ..... DC
Vert Display ..... A
Internal Trig ..... A
Time/Div 2ms
Horiz Display ..... Main

C. Connect the 3314A's "Z-Axis" output to the oscilloscope's channel A input.

D. Enable the 3314A Linear Sweep.

E. Observe the waveform on the oscilloscope. The waveform should have the amplitude and polarity as shown in Figure 5-3 if A2S501 is in the "BLK +" position. If A2S501 is in the "BLK −" position, the waveform should appear as shown in Figure 5-4.

NOTE

Note the position that the Z-Axis switch is currently in. It should be returned to that position as soon as this test is completed.

F. Switch A2S501 from its previous state and observe the waveform's change in polarity. This assures that the Z-Axis switch is functioning properly.

G. Return A2S501 to the position it was in when the instrument was received.

5-11. LOG SWEEP START FREQUENCY ADJUSTMENT

This adjustment provides accurate Log Sweep Start frequencies by setting the Frequency Control Voltage (FCV) to the correct level.

Equipment Required:

-hp- 5328A Universal Counter

Procedures:

A. Preset the 3314A.

B. Set the counter as follows:

Function ..... Per Avg A
Periods Averaged 10
Level A ..... Preset
Slope ..... +
Coupling ..... AC
Attenuation x1
Sample Rate ..... Adjust CCW as necessary

C. Connect the 3314A to the counter.

D. Enable the 3314A "Log Sweep".

E. Perform a calibration of the Sweep Stop frequency by pressing "Blue", "RCL".

F. Press "Man Sweep".

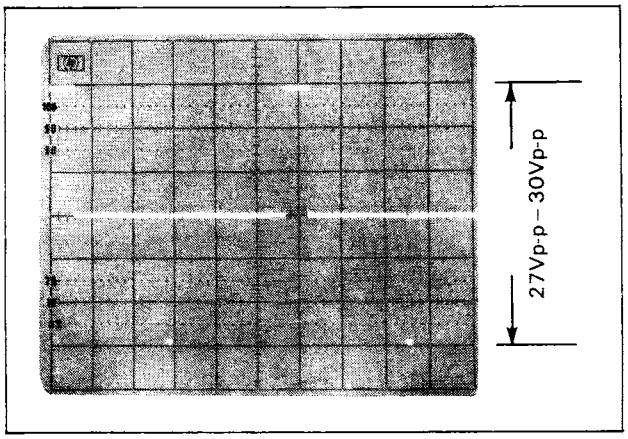


Figure 5-3. Z-Axis Polarity Observation "BLK+"

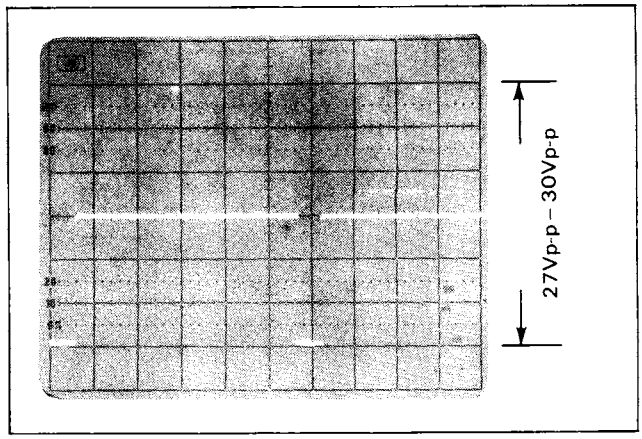


Figure 5-4. Z-Axis Polarity Observation "BLK–"

G. Press "Stop Freq" and record the period measured on the counter. (This period should be between 97.8μs and 102.2μs.)

H. Press "Start Freq". 1000Hz should now be displayed on the 3314A.

I. While monitoring the counter's display, adjust A2R427 (Log Sweep) until a reading 10x the period recorded in step G ($\pm$1μs) is measured on the counter.

NOTE

If this adjustment fails to provide accurate Log Sweep Start frequencies, suspect problems with either the frequency generator on the A1 board, the Freq/Sym DAC, or the FCV line.

5-12. LINEAR SWEEP START FREQUENCY ADJUSTMENT

This adjustment insures accurate Linear Sweep Start frequencies by providing the proper reference to the Multiplex DAC.

Equipment Required:

-hp- 5328A Universal Counter

Procedures:

A. Preset the 3314A.

B. Set the counter as follows:

Function ..... Freq A
Resolution 1Hz
Level A ..... Preset
Slope ..... +
Coupling ..... AC
Attenuation x1

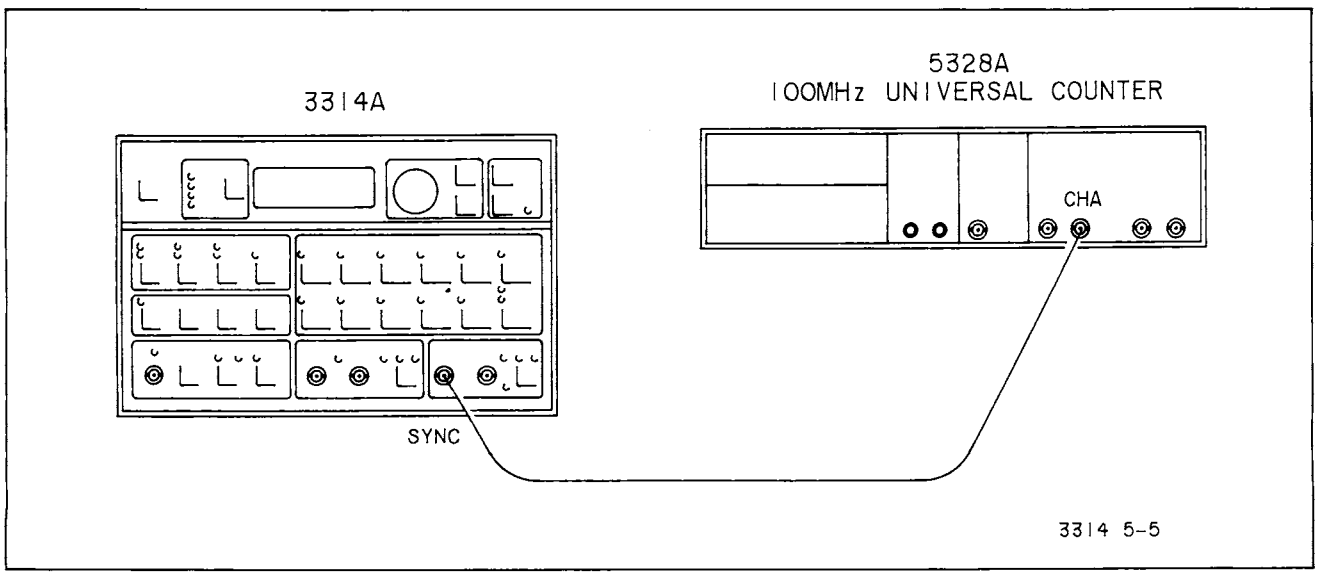


Figure 5-5. Log Sweep Start Frequency Adjustment

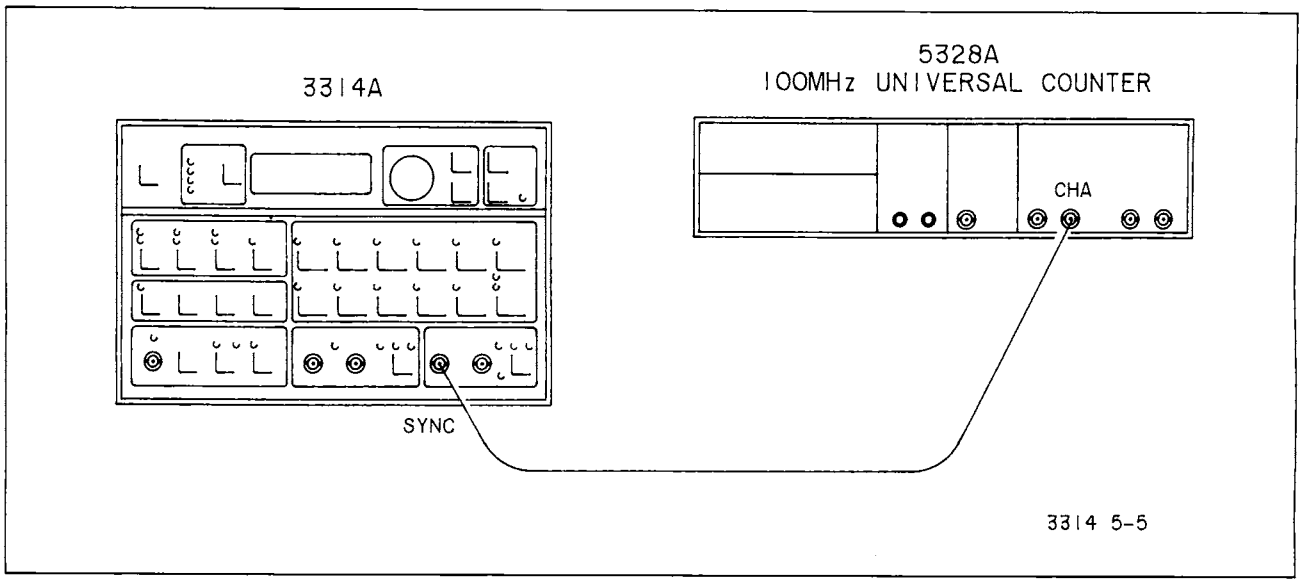


Figure 5-6. Linear Sweep Start Frequency Adjustment

C. Connect the 3314A to the counter.

D. Enable the 3314A "Linear Sweep".

E. Perform a calibration of the Sweep Stop frequency by pressing "Blue", "RCL".

F. Press "Man Sweep".

G. Press "Stop Freq" and record the period measured on the counter. (This period should be between 99.7μs and 100.3μs.)

H. Press "Start Freq". 1000Hz should now be displayed on the 3314A.

I. While monitoring the counter's display, adjust A2R205 (Lin Sweep) until a reading 10x the period recorded in step G ($\pm$ 1μs) is measured on the counter.

NOTE

If this adjustment fails to produce the desired results, consider possible problems with A2U201 or the A2U212 analog switch.

5-13. DC OFFSET ADJUSTMENT

This adjustment assures accurate DC Offset levels.

Equipment Required:

-hp- 3455A Digital Voltmeter

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Function ..... Off
DC Offset 0.002V

C. Set the voltmeter as follows:

Function ..... DC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

D. Connect the 3314A to the digital voltmeter.

E. Note the DC Offset measured on the voltmeter. If necessary, adjust A2R267 (DC Zero) until an Offset of 0.002VDC $\pm$ 5mV is indicated by the voltmeter.

NOTE

If small errors between the actual and displayed offset continue to exist after adjusting A2R267, check the values of A2R233, A2R234, A2R264, A2R265, and A2R266 against those given on the schematic. If large errors result, look for problems on the output amplifier board.

5-14. PHASE LOCK PHASE ADJUSTMENT

This adjustment insures the Phase accuracy between the 3314A and the reference to which it is locked, by regulating bias currents which control the phase difference and stabilize the phase locked loop.

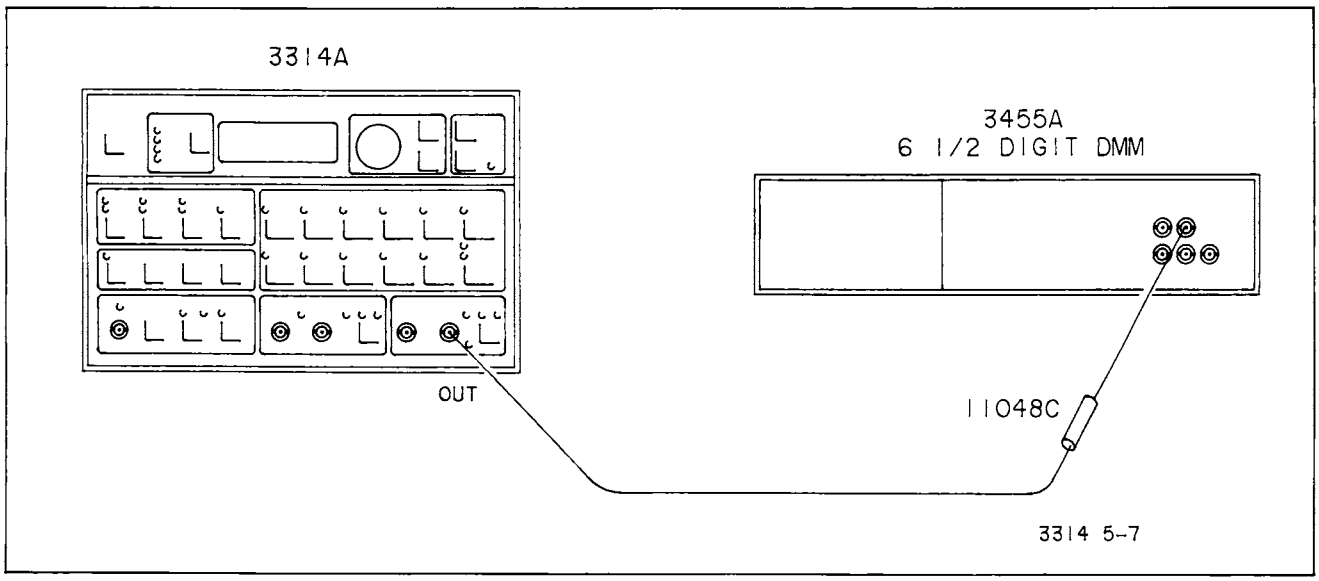


Figure 5-7. DC Offset Adjustment

Equipment Required:

-hp- 1725A Oscilloscope

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Mode	Fin x N
Trig Intvl	0.1ms

C. Set the oscilloscope as follows:

	Chan. A	Chan. B
Coupling	DC	DC
Volts/Div	0.5V	0.5V
Vert Display		Alt
Int Trig		B
Time/Div		0.02ms
DLY Time Int		Delta T Off
Horiz Display		Main

D. Connect the "Sync" and "Trigger" outputs of the 3314A to oscilloscope channels A and B respectively.

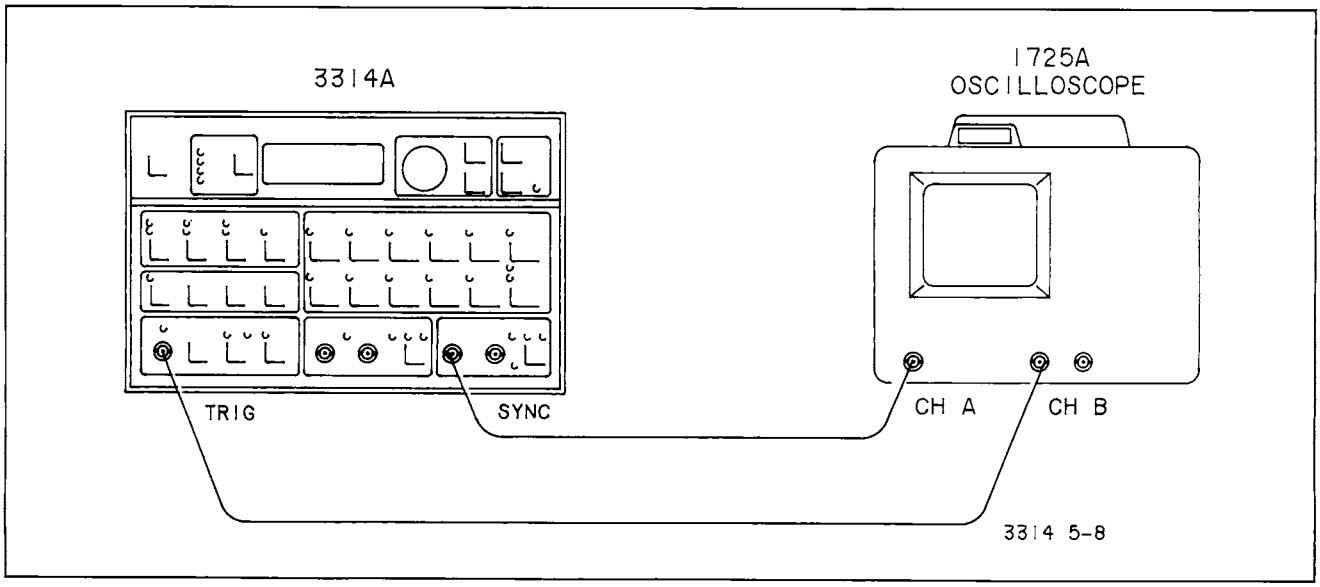


Figure 5-8. Phase Lock Phase Adjustment

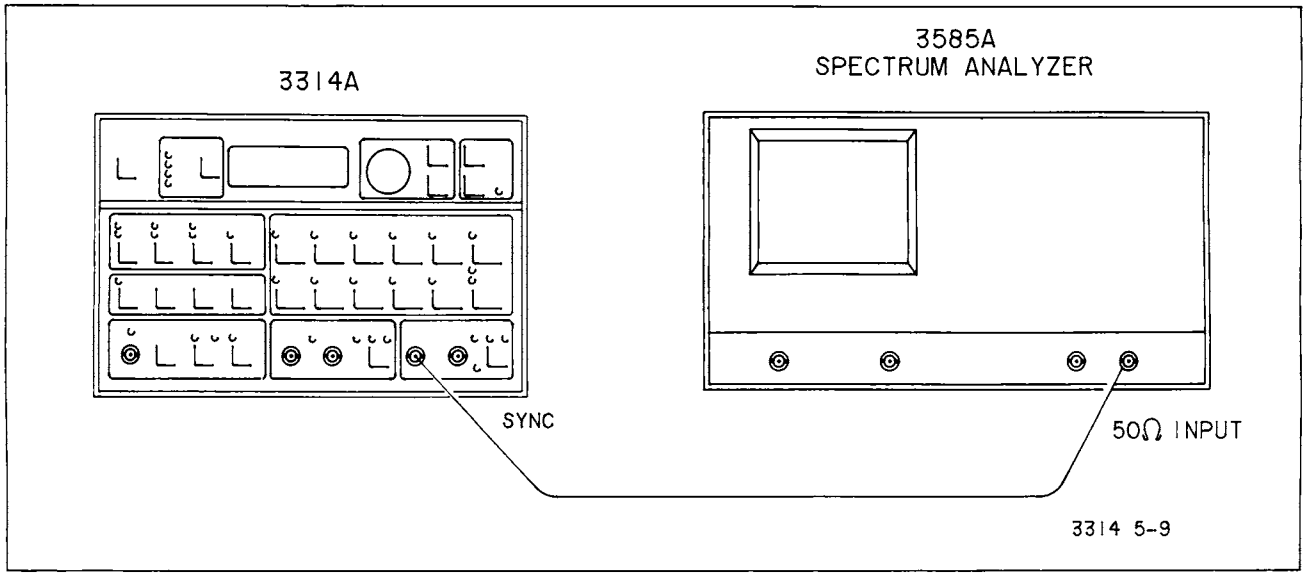


Figure 5-9. Symmetry Adjustment

E. Activate "Range Hold" on the 10kHz range by pressing the "Freq" key followed by the "Blue"/"Range Down" keys.

F. Observe the waveforms displayed on the oscilloscope. Both square waves should be in phase. Center both waveforms around the oscilloscope's x-axis graticule.

G. Set the phase on the 3314A to +180°.

H. Set the "Delayed Time/Division" knob on the oscilloscope to 0.5μs.

I. Adjust the Time Interval Stop Control until the Marker overlaps the rising edge of the 3314A Trigger square wave (chan. B).

J. Change the oscilloscope's "Horiz Display" to "DLY'D" and increase the beam intensity.

K. Using the "Time Interval Stop Control", set the rising edge of the Trigger signal so that it is centered on the oscilloscope's y-axis graticule.

L. Adjust A2R113 (Phase +180) so that the falling edge of the 3314A "Sync" square wave coincides with the "Trigger" rising edge on the y-axis graticule*. The edges should not be more than 166ns apart.

Note

Expect at least 1μs of phase jitter on the "Sync" falling edge. Adjust the edge so that the y-axis graticule appears in the "center" of the jitter.

M. Set the phase on the 3314A to −180°. The "Sync" waveform will shift a full period in relation to the "Trigger" waveform.

N. Adjust A2R108 (Phase −180) so that the falling edge of the 3314A "Sync" square wave coincides with the "Trigger" rising edge on the y-axis graticule*. The edges should not be more than 166ns apart.

Note

Expect at least 1μs of phase jitter on the "Sync" falling edge. Adjust the edge so that the y-axis graticule appears in the "center" of the jitter.

O. Set the 3314A phase back to +180° and verify that "Phase +180" is within its specification. If necessary, adjust A2R113 until the specification is met (<166ns).

P. Set the 3314A phase to −180° and verify that "Phase −180" is within its specification (<166ns). Adjust A2R108 if necessary.

Q. Repeat steps O and P until both phase adjustments remain within specification.

R. Set the 3314A phase to 0°. Verify that both the "Sync" and "Trigger" waveforms are in phase.

5-15. SYMMETRY ADJUSTMENT

This adjustment minimizes the second harmonic of the differential triangle wave thus producing a symmetrical waveform. This assures that the functions derived from the triangle wave (sine, square), will also be symmetrical.

Equipment Required:

-hp- 3585A Spectrum Analyzer

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Amplitude 3Vp-p
Function ..... triangle

C. Press "Instr Preset" on the spectrum analyzer.

D. Set the spectrum analyzer as follows:

Stop Freq 10kHz
Counter ..... On

E. Connect the 3314A to the spectrum analyzer by first removing phono cable A1J8 from the instrument. Second, move the "Sync" cable from A1J1 to A1J2 and connect the 3314A to the analyzer's 50Ω input via the 3314A's "Sync" output. (See Figure 5-9.)

F. Press "Manual" on the spectrum analyzer and enter 1kHz. This places the spectrum analyzer marker over the 3314A fundamental.

G. After the counter reading on the spectrum analyzer screen has stabilized, press the following key sequence:

"MKR – OFS – STEP"
"Counter" (Off)
"Offset"
"Enter Offset"
"Manual" (Enter 0Hz)
"Manual"
"Up Arrow"
"Up Arrow"

The marker on the spectrum analyzer screen is now over the second harmonic of the 1kHz triangle wave signal.

H. Note the amplitude of the second harmonic (see screen upper right). This level should be ≤ −75dB. If necessary, adjust A1R110 (Symmetry) on the 3314A until this level is brought into specification.

I. Press "Cont" on the spectrum analyzer. Observe that the 1kHz spectrum up to the 9th harmonic is displayed on the screen.

J. Check the level of the EVEN harmonics (4th-8th) to verify that they are ≤ −75dB.

K. Place phono cable A1J8 back in the instrument and move the "Sync" cable back to A1J1.

NOTE

If this adjustment fails to yield satisfactory results, check for possible problems with either the Freq/Sym DAC or the A1U103 biasing circuit.

5-16. HOLD PHASE ZERO ADJUSTMENT

This procedure sets the zero point of the servo loop by adjusting the offset of the input to the Hold Phase Servo Amplifier.

Equipment Required:
-hp- 1725A Oscilloscope

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Mode ..... Gate
Frequency 10kHz
Amplitude 10Vp-p
Function ..... triangle
Trig Intvl 1ms

C. Set the oscilloscope as follows:

Volts/Div 2V
Time/Div 0.2ms
Coupling 50Ω
Vert Display ..... A
Int Trig ..... A
Horiz Display ..... Main

D. Connect the 3314A to the oscilloscope.

E. Using the Vertical Position knob on the oscilloscope, adjust the display until the triangle wave is centered around the x-axis graticule.

F. Observe the horizontal segment of the waveform between the triangle bursts. If necessary, adjust A1R269 (Hold Phase Zero) until the segment is centered on the x-axis graticule.

NOTE

Gate, N Cycle, 1/2 Cycle, and ARB modes are affected by this adjustment.

5-17. DC/AC BALANCE ADJUSTMENT

These adjustments minimize residual signals at 0V amplitudes and insure amplitude accuracy while "Amplitude Range Hold" is activated.

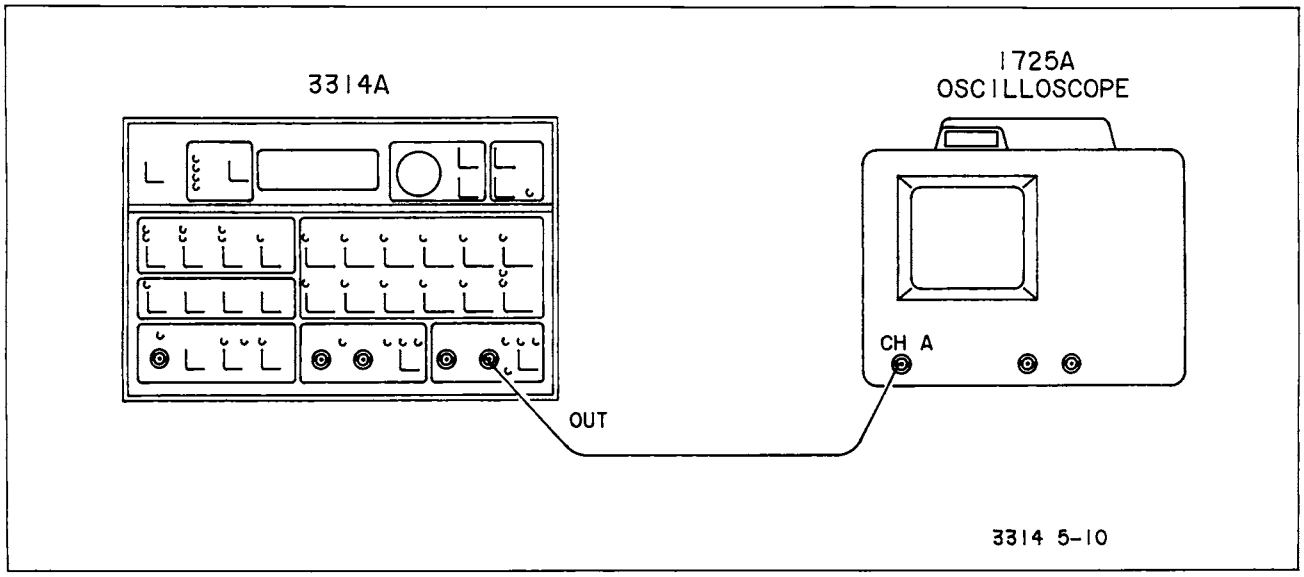


Figure 5-10. Hold Phase Zero Adjustment

Equipment Required:

-hp- 1725A Oscilloscope

Procedures:

A. Set A3S1(4) and A3S1(5) to the "closed" position.

B. Turn the 3314A OFF, then ON.

C. Return A3S1(4) and A3S1(5) to the "open" position.

D. Press "Range Up". (The 3314A is now in Test Mode 02.)

E. Set the oscilloscope as follows:

Volts/Div	0.01V
Time/Div	0.1ms
Vert Display	A
Int Trig	A
Horiz Display	Main
Coupling	50Ω
BW Limit	20MHz
Main Triggering	Ext

F. Set the Coupling Select lever on the oscilloscope to ground and center the trace on the x-axis graticule.

G. Set the coupling on the oscilloscope back to DC and connect the 3314A's "Sync" and "Function" out-

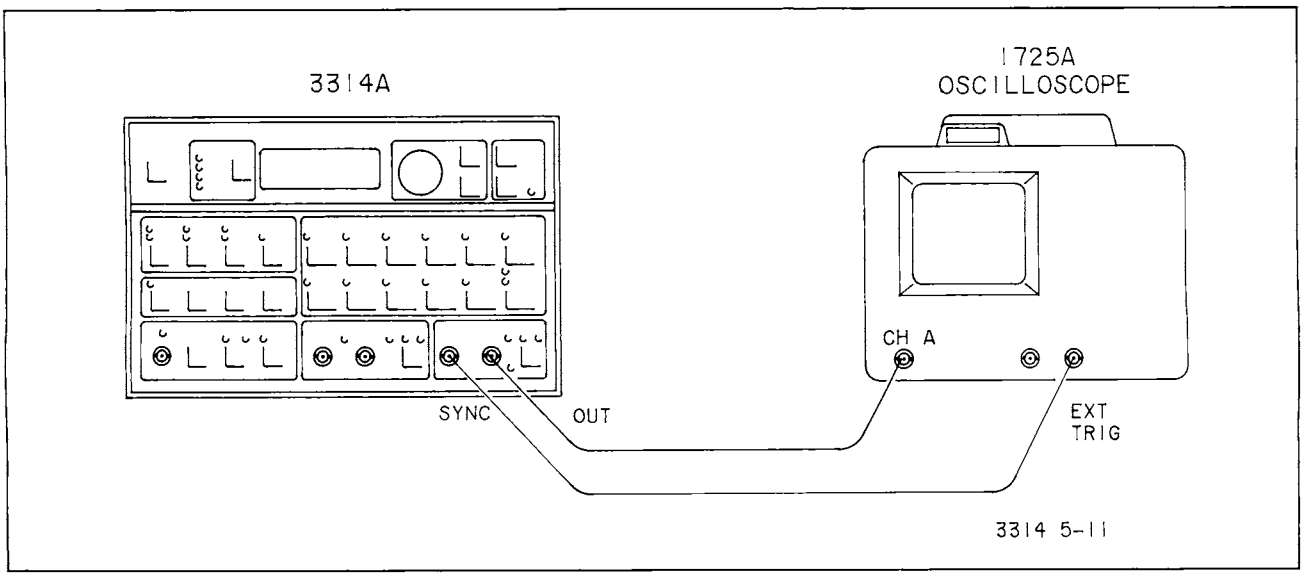


Figure 5-11. DC/AC Balance Adjustment

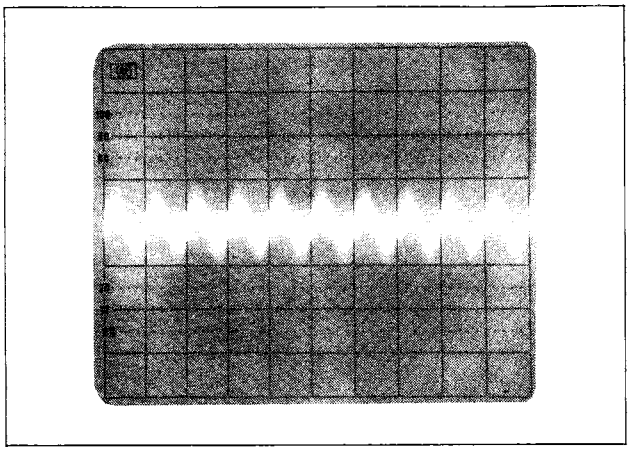


Figure 5-12A. DC/AC Balance Sine Adjustment

puts to the oscilloscope's "Ext Trig" and channel A inputs respectively.

H. Observe the "pulsating" beam on the oscilloscope. Adjust A1R559 (Sine AC Bal) to make the beam as narrow as possible.

I. While continuing to observe the beam on the oscilloscope, adjust A1R542 (DC Bal) until the beam (which will continue to pulsate) remains centered around the x-axis graticule. (See Figure 5-12A.)*

NOTE

The beam may shift 1 or 2 divisions with respect to the x-axis graticule which is acceptable.

J. Press "Range Up" on the 3314A to invoke Test Mode 03.

K. Adjust A1R511 (Triangle AC Bal) to make the beam as narrow as possible. (See Figure 5-12B.)

L. Press "Range Up" two times to exit the test modes and return the 3314A to normal operation.

NOTE

This adjustment may affect the symmetry of the instrument. It is therefore recommended that the symmetry (paragraph 5-15), be checked and adjusted (if necessary) before proceeding.

5-18. LOW FREQUENCY HARMONIC DISTORTION ADJUSTMENT

These adjustments minimize the harmonic distortion on the lower frequencies generated by the 3314A.

Equipment Required:

-hp- 3585A Spectrum Analyzer

Procedures:

A. Preset the 3314A.

B. Set the amplitude of the 3314A to 3.0Vp-p.

C. Press "Instr Preset" on the spectrum analyzer and set the Stop frequency at 10kHz.

D. Connect the 3314A to the spectrum analyzer.

E. Determine the exact frequency of the signal by pressing the following spectrum analyzer keys:

"Manual" (enter 1kHz)
"Counter" (on)

F. After the counter reading on the spectrum analyzer has stabilized, press the following key sequence (this accurately locates each harmonic):

"MKR – OFS→STEP"
"Counter" (Off)
"Manual" (enter 0Hz)
"Manual"
"Up Arrow"
"MKR→REFLVL"
"Offset" (on)
"Enter Offset"
"Manual"
"Up Arrow"

The spectrum analyzer marker is now over the second harmonic.

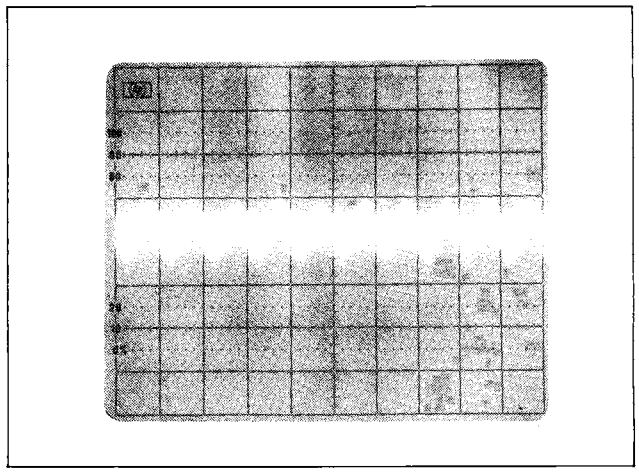


Figure 5-12B. DC/AC Balance Triangle Adjustment

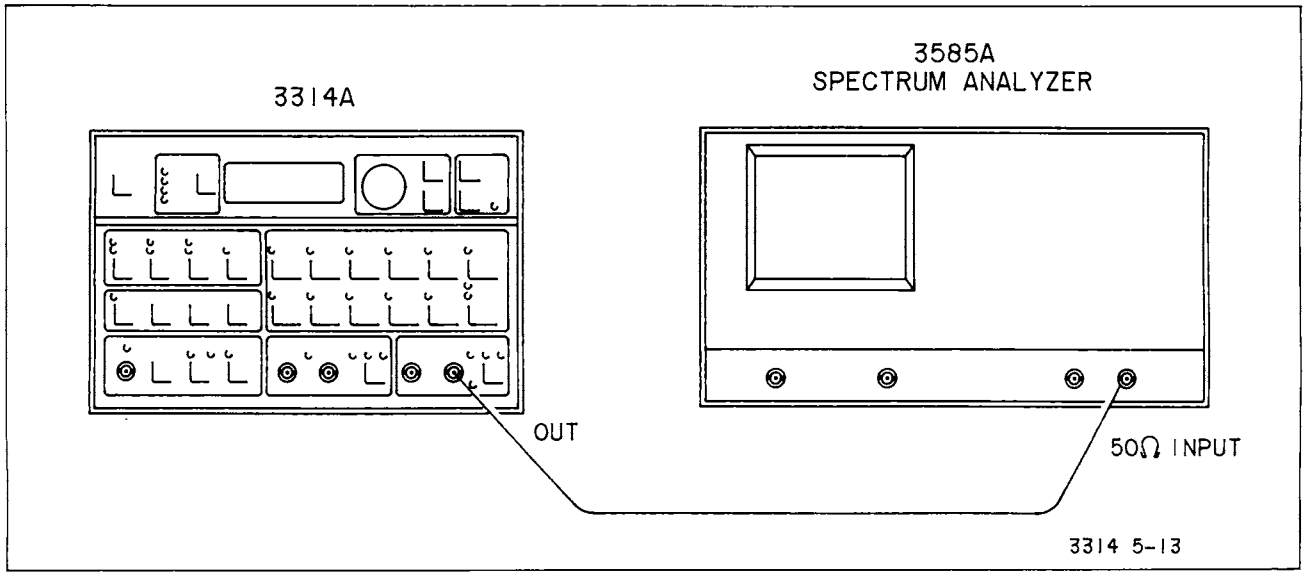


Figure 5-13. Low Frequency Harmonic Distortion Adjustment

Δ3 G. Set the amplitude of the 3314A to 10.00 Vpp.

H. Adjust A1R344 until the second harmonic is at its minimum level.

I. Set the amplitude of the 3314A to 1.00 Vpp. Adjust A1R563 until the second harmonic is at its minimum level.

J. Repeat steps H and I until the second harmonic remains at a minimum level across the amplitude range.

K. Press "Up Arrow" three times on the spectrum analyzer to place the marker over the 5th harmonic.

L. Adjust A1R550 until the 5th harmonic level is at a minimum.

M. Press "Down Arrow" two times to place the marker over the 3rd harmonic.

N. Adjust A1R551 until the 3rd harmonic is at a minimum level.

O. A1R550 and A1R551 interact. Therefore, repeated adjustments of the 3rd and 5th harmonic levels will have to be made to insure that they remain at a minimum. (Third harmonic ≤ -60dB. Fifth harmonic ≤ -60dB.)

P. Press "Instr Preset" on the spectrum analyzer and set the Stop frequency to 110kHz. Verify that harmonic levels out to the tenth harmonic are less than or equal to -60dB.

Δ3 See Section VII for "Δ" explanations.

5-19. AMPLITUDE CALIBRATION PAD SELECTION

This procedure is a method for selecting three resistors which in turn minimize the amplitude difference between the sine, square, and triangle functions. This enables Amplitude Calibration to correct for accurate voltage levels.

NOTE

DC/AC Balance and Low Frequency Harmonic distortion must be completed before proceeding.

NOTE

Due to the length and involvement of this procedure, it is recommended that the "Sine Shaper Replacement Kit" (P/N 03314-82501) which contains a Sine Shaper IC and three factory selected resistors, be ordered from the nearest -hp- Sales and Service Office. This procedure should be followed if the Kit is unavailable or if the situation requires immediate action.

Equipment Required:

-hp- 3455A Digital Voltmeter
-hp- 11048C 50Ω load

Procedures:

A. Preset the 3314A and set the amplitude to 10Vp-p.

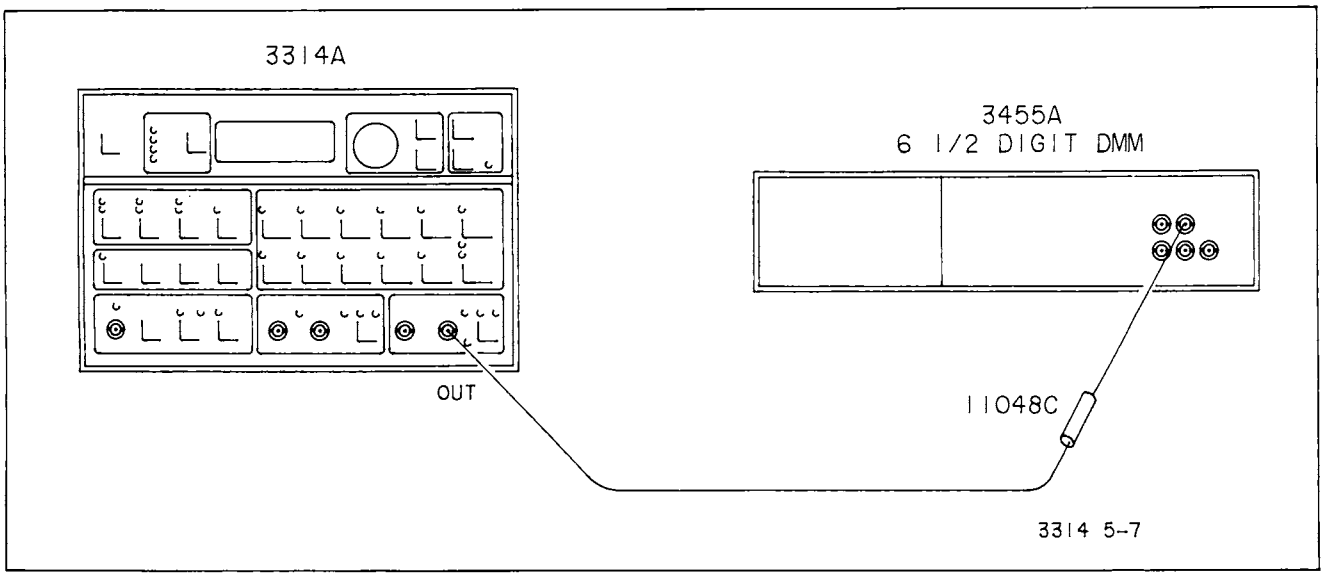


Figure 5-14. Amplitude Calibration Pad Selection.

B. Set the digital voltmeter as follows:

Function ..... AC
Range ..... Auto
Trigger ..... Internal
Math ..... Off
Sample Rate ..... Maximum

C. Remove the phono cable from A8J1 and perform a calibration on the 3314A by pressing "Blue" "RCL". (E34 will appear in the display.)

D. Set the 3314A CAL OFF by pressing "Blue"/"STO" and replace the phono cable.

E. Measure the voltage across pins 24 and 27 of A1U502. If this voltage is > 0.404V, the following selection procedure is invalid. Increase the value of A1R522 until the voltage is ≤ 0.404V and repeat adjustment procedure beginning with step C. If the voltage across pins 24 and 27 was ≤ 0.404V, proceed to step F.

F. Connect the 3314A to the voltmeter via the 3314A's "Function" output. (See Figure 5-14.)

G. Record the reading on the voltmeter. This is the RMS value of the 3314A sine wave signal. Convert this value to Vp-p using the equation:

Vp-p = 2.828 * RMS Reading

H. Change the function on the 3314A to square wave.

I. Record the reading on the voltmeter. This is the RMS value of the 3314A square wave signal. Convert this value to Vp-p using the equation:

Vp-p = 2 * RMS Reading

J. Change the function on the 3314A to triangle.

K. Record the reading on the voltmeter. This is the RMS value of the triangle signal. Convert this value to Vp-p using the equation:

Vp-p = 3.464 * RMS Reading

L. Calculate the percent error between the sine wave and square wave Vp-p amplitudes determined in steps G and I using the equation:

%Error = [(square Vp-p − sine Vp-p)/sine Vp-p] * 100%

If %Error is inside the −12% to +12% range, the sine and square wave amplitude difference is acceptable, proceed to step Q.

If %Error is outside the −12% to +12% range, A1R522 may be the wrong value. However, gain errors in the amplifier stages, or a decrease in amplitude of the triangle signals at the inputs of A1U502 are possible reasons for %Error failing to meet the specification. If after investigation the above parameters prove acceptable, proceed to step M.

M. From %Error calculated in step L and the value of R522 currently in the board, determine the "padded" value of R522 using Table 5-3*.

NOTE

If |%Error| is >30% (see Table 5-3), R522 can be determined using the equation:

*R522 = 2/(%Error/122 * (1/259.6 + 2/R522 in Bd) + 2/R522 in Board)*

Table 5-3. R522 Selection Chart

% Error = (Square Vp-p − Sine Vp-p)/Sine Vp-p X100									
HP P/N	R522 In Board	-30% To -24%	-24% To -20%	-20% To -16%	-16% To -12%	12% To 16%	16% To 20%	20% To 24%	24% To 30%
0699-0051	320	505	466	421.7	383				
0699-0274	350	540.9	505	466	421.7	320			
0698-7649	383	588.1	540.9	505	466	320	320		
0698-7388	421.7	660	588.1	588.1	540.9	350	320	320	
0699-0163	466	738.5	738.5	660	588.1	383	383	350	320
0698-6965	505	845	845	738.5	660	421.7	383	383	350
0698-6804	540.9	979.3	845	738.5	738.5	421.7	421.7	383	350
0698-7387	588.1	1153	979.3	845	738.5	466	466	421.7	383
0698-6797	660	1364	1153	979.3	845	540.9	505	466	421.7
0699-0164	738.5	1.65K	1364	1153	979.3	588.1	540.9	505	466
0698-6329	845	2.1K	1.65K	1364	1153	660	588.1	588.1	540.9
0698-6811	979.3	2.8K	2.1K	1.65K	1364	738.5	660	660	588.1
0698-6862	1153	4.12K	2.8K	2.1K	1.65K	845	738.5	738.5	660
0699-0190	1364	6.65K	4.12K	2.8K	2.1K	979.3	845	845	738.5
0698-4427	1.65K	14K	6.65K	4.12K	2.8K	1153	979.3	979.3	845
0698-4432	2.1K		14K	6.65K	4.12K	1364	1153	1153	979.3
0698-4436	2.8K		14K	14K	14K	1.65K	1364	1364	1153
0698-3493	4.12K				14K	2.1K	1.65K	1.65K	1364
0698-3484	6.65K					2.8K	2.1K	1.65K	1.65K
0698-4479	14K					2.8K	2.8K	2.1K	1.65K

N. Insert the "padded" value of R522 and repeat the Low Frequency Harmonic distortion adjustment followed by the DC/AC Balance adjustment.

O. Repeat steps C through L. If %Error still does not meet the specification, then the adjustment fails. If %Error does meet the specification, proceed to step P.

P. Measure the voltage across pins 24 and 27 of A1U502. If the new %Error meets the specification but the voltage is > 0.361V, the adjustment fails. If the voltage is < 0.361V, proceed to step Q.

Q. Calculate and record the average of the sine and square wave Vp-p amplitudes determined in steps G and I.

R. Using the average calculated in step Q, calculate the "padded" value of A1R506 (Sine/Square Amplitude Adjust) given the equation:

R506(New) = (Avg/10Vp-p) * R506 (Currently in Board)

Choose the closest 1% resistor.

S. Calculate the "padded" value of A1R528 (Triangle Amplitude Adjust) using the equation:

R528New = [(R506new/R506old)(10Vp-p)/triangle Vp-p] * R528 in Board

where: "R506new" is the value chosen in step R, and "triangle Vp-p" is the value determined in step K.

Choose the closest 1% resistor.

5-20. HIGH FREQUENCY HARMONIC DISTORTION ADJUSTMENT

This adjustment insures accurate high frequencies and minimizes high frequency harmonic distortion.

Equipment Required:

-hp- 1725A Oscilloscope
-hp- 8558B Spectrum Analyzer
-hp- 10041A 10:1 Probe

Procedures:

A. Set A3S1(4) and A3S1(5) on the 3314A to the "closed" position.

B. Turn the 3314A OFF, then ON.

C. Set A3S1(4) and A3S1(5) back to the "open" position.

D. Press "Range Up" three times to invoke test mode 04.

E. Set the oscilloscope as follows:

	Chan. A	Chan.B
Volts/Div	0.02V	1V
Coupling	DC	DC
Vert Display	A	
Int Trigger	B	
Horiz Display	X-Y	

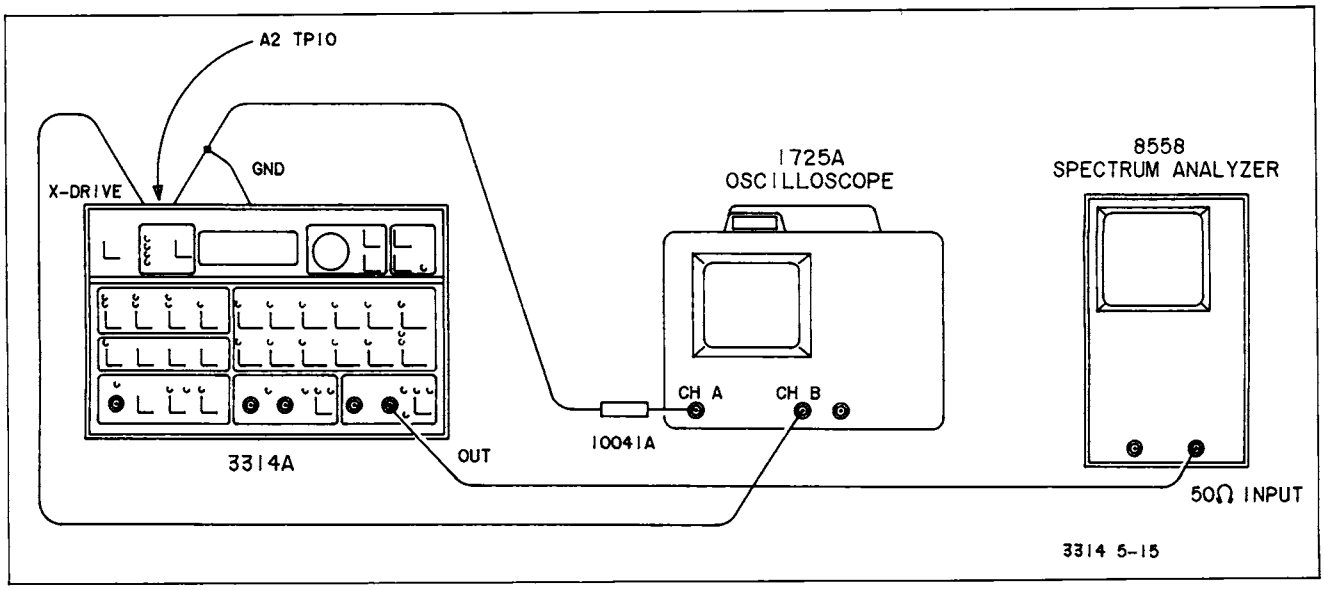


Figure 5.15. High Frequency Harmonic Distortion Adjustment

F. Set the spectrum analyzer as follows:

Input Attenuation	70dB
Freq Span/Div	10MHz
Resolution BW	Coupled at optimum
Freq Start	0Hz
Sweep Time/Div	Auto
Trigger	Line
dB/Div	10dB
Reference Level	60dBm
Ref Level Fine	0dBm

G. Connect the 3314A to the oscilloscope and spectrum analyzer. (See Figure 5-15.)

NOTE

Center oscilloscope trace with both inputs grounded.

H. Adjust "Input Atten" on the spectrum analyzer until the fundamental is within 10dB of full scale. Adjust "Ref Level Fine" until the fundamental is referenced to the top graticule on the analyzer screen.

I. Using a non-ferrous screwdriver, adjust A1C218 until the X-Y plot is centered (average of positive and negative deviations is 0V) around the oscilloscope's x-axis graticule (see Figure 5-16).

J. Adjust A1C307 and A1C308 until the X-Y plot is as flat as possible. (Note: Adjusting A1C307 flattens the response while A1C308 minimizes harmonic distortion levels. (See Figure 5-16.)

K. Repeat steps I and J until the trace on the oscilloscope remains within 0.6Vp-p with a second harmonic level < -35dB. (All other harmonics should remain below -30dB.)

L. Press "Range Up" on the 3314A to exit test mode 04 and return the 3314A to normal operation.

5-21. ATTENUATOR HIGH FREQUENCY COMPENSATION ADJUSTMENT

This adjustment compensates for stray capacitances on the Output Amplifier board which result in a limited amplifier bandwidth.

Equipment Required:

-hp- 1725A Oscilloscope*

* An oscilloscope other than the 1725A may be used provided it has at least a 275MHz bandwidth. This is necessary because the 3314A's fast rise time can cause

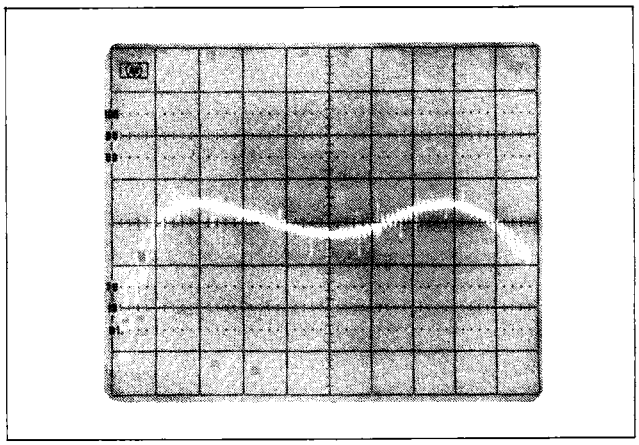


Figure 5-16. High Frequency Harmonic Distortion Adjustment

an oscilloscope with a bandwidth less than 275MHz to "ring", and in turn, mask the 3314A's actual response.

Procedures:

A. Preset the 3314A.

B. Set the 3314A as follows:

Frequency	1MHz
Amplitude	10mVp-p
Function	square

C. Set the oscilloscope as follows:

Volts/Div	0.01V
Coupling	DC
Vert Display	A
Int Trigger	A
Time/Div	0.1μs
Horiz Display	Main

D. Connect the 3314A to the oscilloscope.

E. While monitoring the square wave on the oscilloscope, adjust A8C29 until the overshoot of the waveform is at a minimum. (Avoid rounding the waveform.)

5-22. X3 (OPTION 001) FUNCTIONAL CHECK

This procedure provides a functional check of Option 001 by verifying the amplitude level at the x3 output and testing the 3314A Overload Protection feature.

NOTE

This procedure applies only to those instruments which have had Option 001 installed.

Equipment Required:

-hp- 1725A Oscilloscope
-hp- 11048C 50Ω load
-hp- 1250-0781 BNC/TEE Adaptor

Procedures:

A. Preset the 3314A.

B. Set the amplitude of the 3314A to 10Vp-p.

C. Set the oscilloscope as follows:

Volts/Div	5V
Coupling	DC
Vert Display	A
Int Trigger	A
Time/Div	0.2ms
Horiz Display	Main

D. Set up and connect the instruments as shown in Figure 5-18A.

E. Observe the x3 output on the oscilloscope. Verify that its amplitude is 30Vp-p.

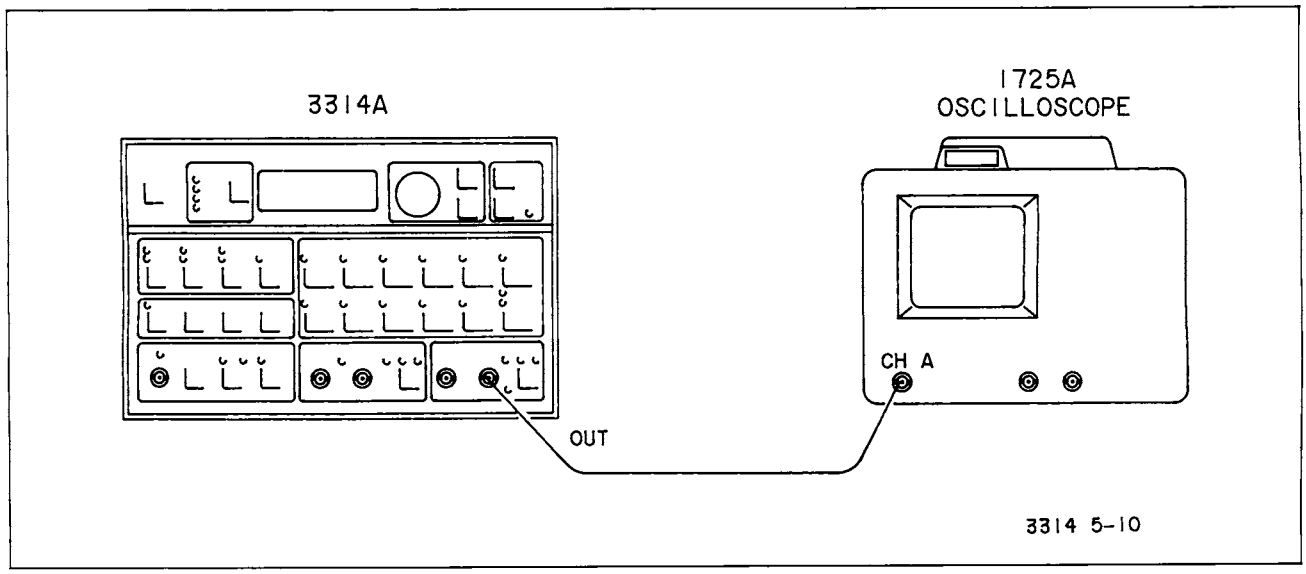


Figure 5-17. Attenuator High Frequency Compensation Adjustment

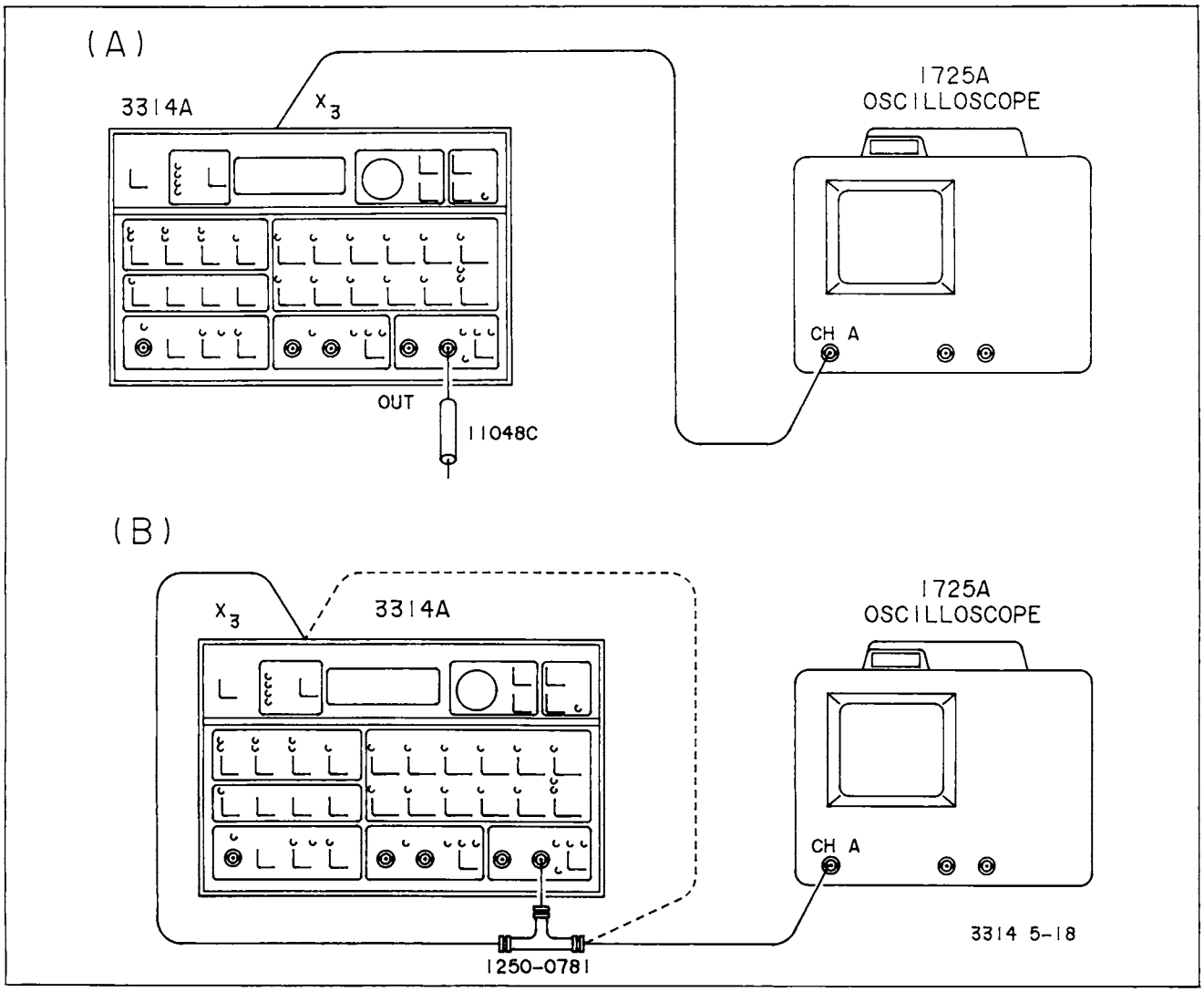


Figure 5-18. X3 (Option 001) Functional Check

F. Replace the 50Ω load on the front of the 3314A with the BNC/TEE connector.

G. Move the cable from the x3 output to one end of the TEE.

H. Observe the oscilloscope and verify that a signal is present at the output of the 3314A.

I. Using another cable, connect the x3 output to the other end of the TEE. (See part B of Figure 5-18.)

J. Satisfactory operation of the Overload Protection feature is indicated by a flashing "E51" in the 3314A display. The flashing "E51" signifies that all attenuator relays on the A8 board have opened in order to protect the 3314A from the excessive voltage present at the Function output. The open relays can also be detected by observing the oscilloscope and noting the shift of the signal to either a +20V or −20VDC level.

5-23. X3 (OPTION 001) SQUARE WAVE RISE/FALL TIME AND OVERSHOOT ADJUSTMENT

Adjusting A5C12 affects both the squarewave rise/fall time and the squarewave overshoot. To insure specified performance over the entire range of specified loads, A5C12 should be adjusted when the X3 Output is driving 500Ω and 250pF.

Required Equipment:

-hp- 1725A 275MHz Oscilloscope
-hp- 11048C 50Ω Feedthrough Termination
A 500Ω 250pF feedthrough termination, consisting of:
1 499Ω resistor, -hp- part number 0698-4123
1 240pF* capacitor, -hp- part number 0140-0199

* The oscilloscope adds ≈10pF of capacitance.

Procedure:

A. Preset the 3314A.

B. Set the 3314A controls as follows:

Frequency 100kHz
Amplitude 10Vp-p
Function ..... Squarewave

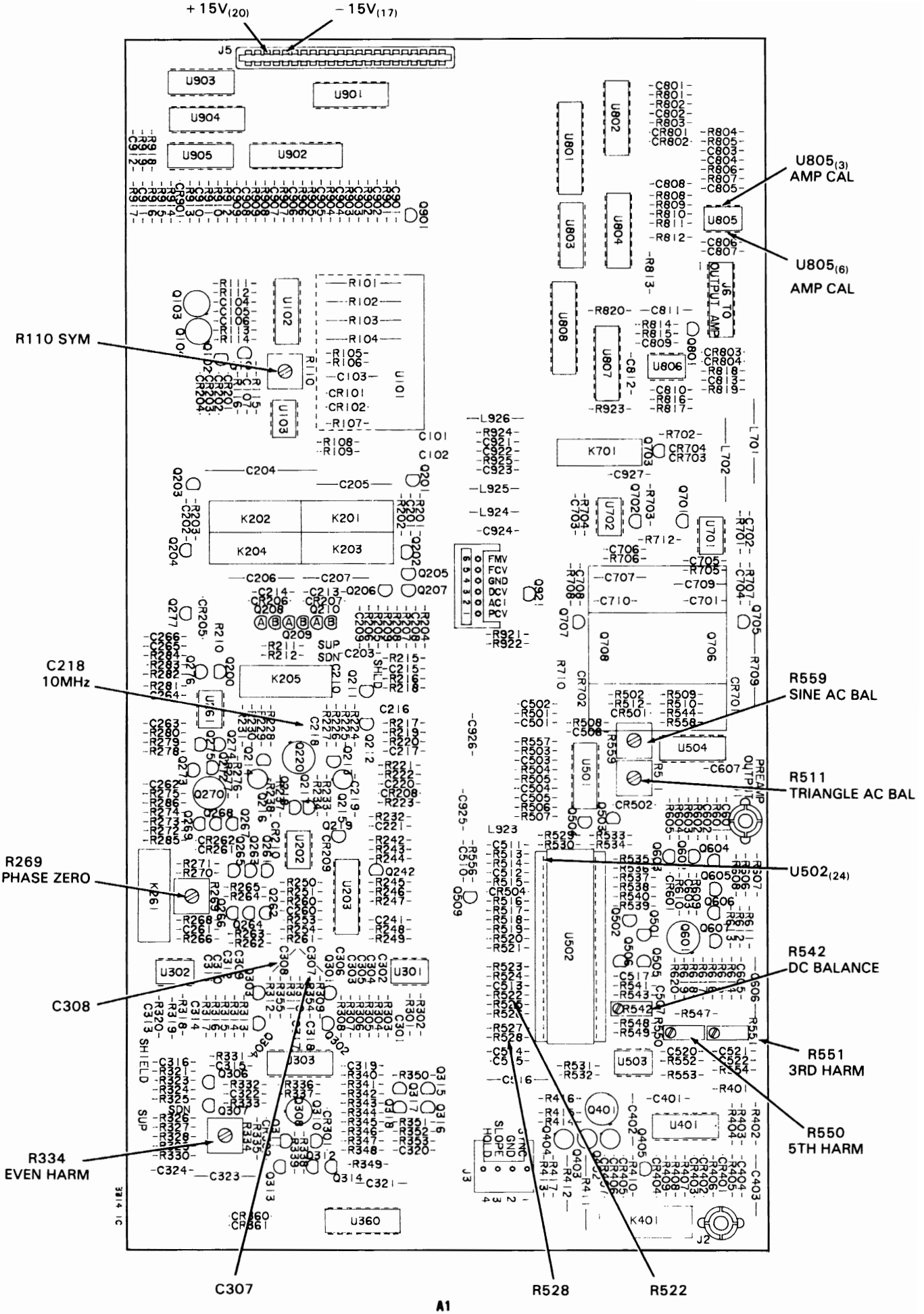
C. Connect the 50Ω Feedthrough Termination to the 3314A's Main Output. Connect the 500Ω, 250pF Feedthrough Termination to the 3314A's X3 Output.

D. Connect the oscilloscope's 1MΩ input to the 3314A's X3 Output.

E. Set the oscilloscope to display 2 complete cycles with the peaks of the square wave at the 0% and 100% graticule lines.

F. Remove the 3314A's bottom cover to gain access to A5C12.

G. Adjust A5C12, using a non-ferrous alignment tool, for minimum rise/fall time and overshoot. Overshoot should be $<5\%$ of the peak to peak amplitude while the rise/fall time should be less than 200ns.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−15V(17)
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AMP CAL
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J6 TO OUTPUT AMP
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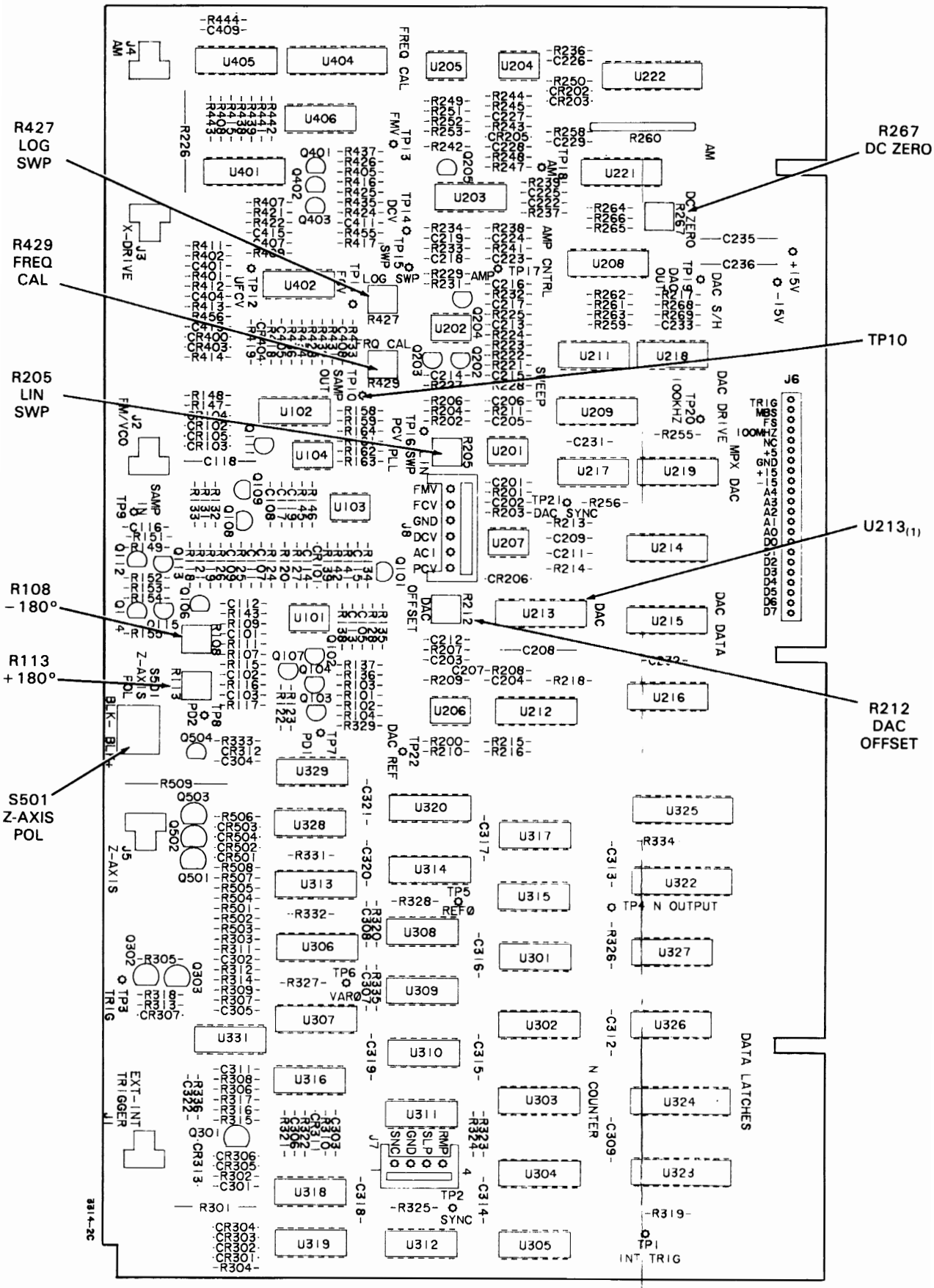
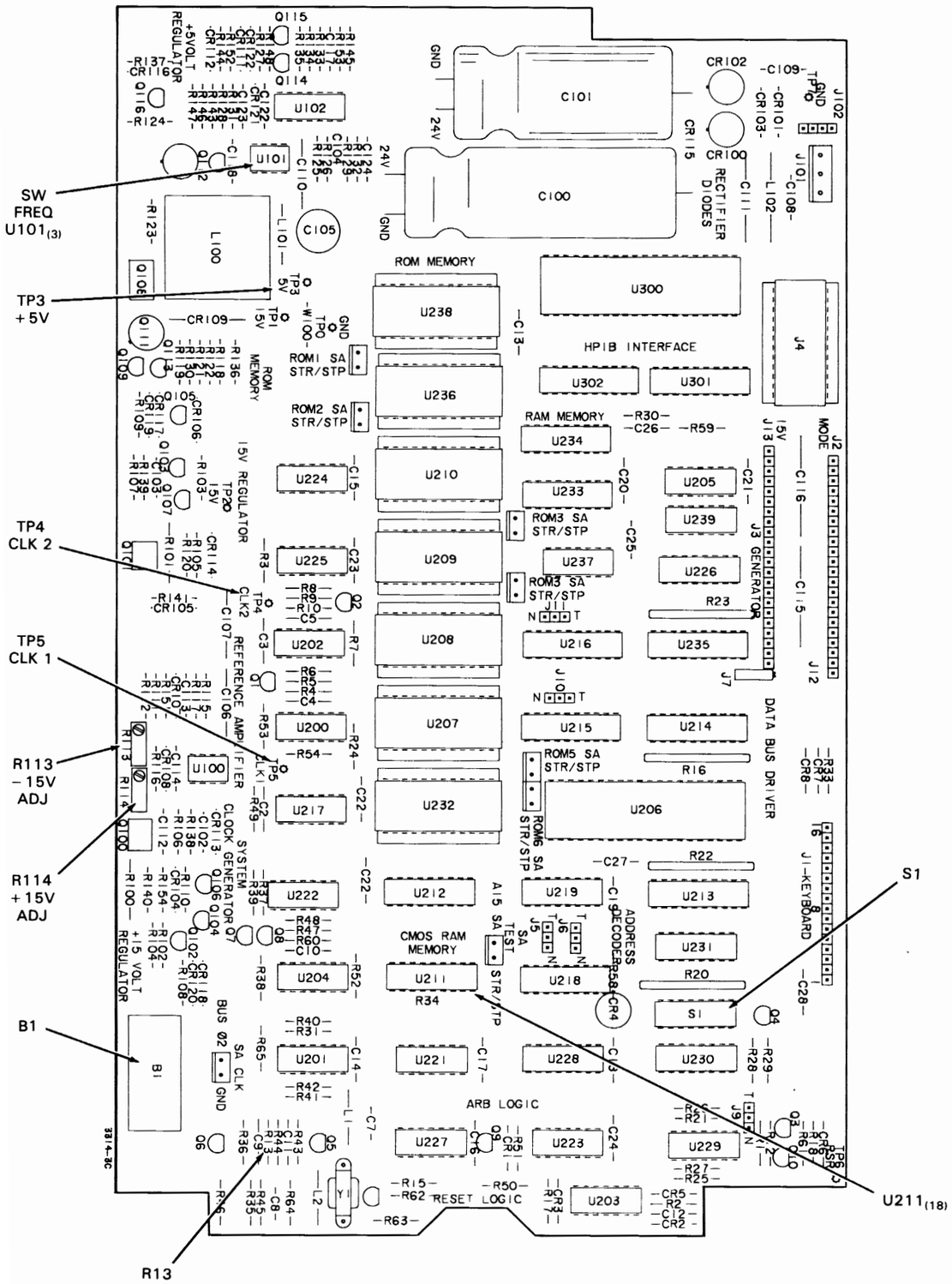
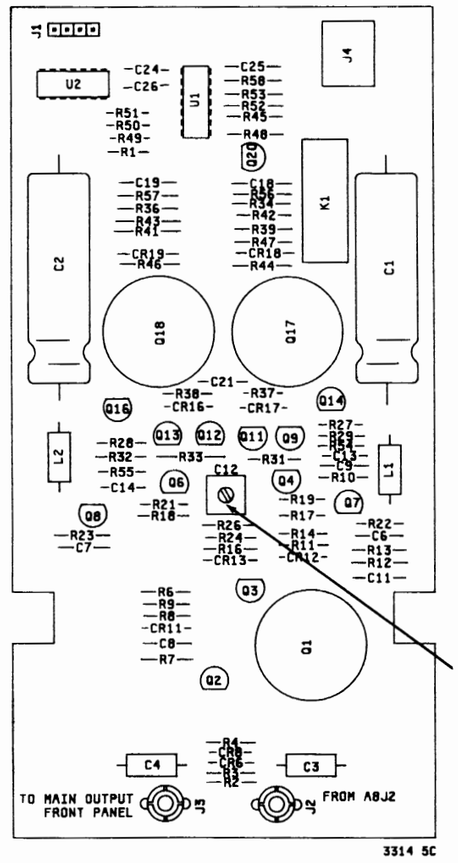
U994
U995
U996
U997
U998
U999
U1000
C218
10MHz
R559
SINE AC BAL
R511
TRIANGLE AC BAL
U502(24)
R269
HOLD PHASE ZERO
C308
R542
DC BALANCE
R551
3RD HARM
R550
5TH HARM
R334
EVEN HARM
C307
R528
R522
PREAMP OUTPUT
A1
03314-66501



A2
03314-66502





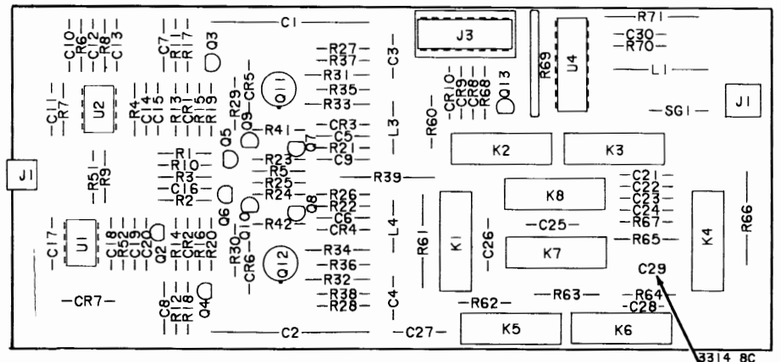


Figure 5-19. Adjustment Locations

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-1 lists abbreviations used in Table 6-3, Replaceable Parts and throughout this manual. Table 6-2 lists the manufacturer's name and address by manufacturer's code numbers.

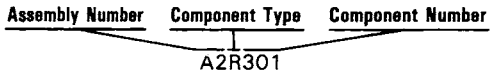
6-2. REPLACEABLE PARTS LIST

Table 6-3. Replaceable Parts List is organized as follows:

1. PC Board Assemblies
   A1, A2, A3, A4, A5, A6, A8
2. Chassis Mounted Components
3. Chassis Components
4. Hardware

Table 6-3 headings include:

1. REFERENCE DESIGNATOR



2. HP PART NUMBER

3. CD The Check Digit is used by -hp- to verify the order has been transmitted correctly.

4. QTY The total quantity in the instrument.

5. DESCRIPTION The -hp- description of the part.

6. MFR CODE The manufacturer's code. see Table 6-2.

7. MFR PART NUMBER The manufacturer's part number.

6-3. ORDERING INFORMATION

To order a part listed in Table 6-3, quote the -hp- part number, check digit, quantity required and address the order to the nearest -hp- office.

To order a part that is not listed in Table 6-3, describe the part, its function, the instrument model and serial number, the quantity required and address the order to the nearest -hp- office.

6-4. DIRECT MAIL SYSTEM

Within the USA, -hp- can supply parts through a direct mail order system. Advantages of using this system are:

1. Direct ordering and shipment from the -hp- Parts Center in Mountain View, California.

2. No maximum or minimum on any mail order. There is a minimum order amount for parts ordered through a local -hp- office when the orders require billing and invoicing.

3. Transportation charges are prepaid. A small handling charge is added to each order.

4. No invoicing. A check or money order must accompany each order.

Mail order forms and specific ordering information is available through you local -hp- office. Addresses and phone numbers are located at the back of this manual.

6-5. SPECIAL HANDLING

The 3314A contains many static sensitive components. Use the appropriate precautions when removing, handling and installing all parts to avoid unnecessary waste.

6-6. PARTS KITS

The Sine Shaper/Amplitude Control IC, A1U502, has three bias resistors that must be factory selected. Whenever replacing A1U502, order 03314-82501.

Table 6-1. List of Abbreviations.

ABBREVIATIONS

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

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

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

elect . . . electrolytic
encap . . . encapsulated

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

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

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

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

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

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

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

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

nA . . . nanoampere(s) = 10_{-9} amperes
NC . . . normally closed
Ne . . . neon
NO . . . normally open

NPO . . . negative positive zero (zero temperature coefficient)
ns . . . nanosecond(s) = 10^{-9} seconds
nsr . . . not separately replaceable

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

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

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

Se . . . selenium
sect . . . section(s)
Si . . . silicon

sl . . . slide
SPDT . . . single-pole double-throw
SPST . . . single-pole single-throw

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

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

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

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

® Dupont de Nemours

DESIGNATORS

A . . . assembly
B . . . motor
BT . . . battery
C . . . capacitor
CR . . . diode or thyristor
DL . . . delay line
DS . . . lamp
E . . . misc electronic part
F . . . fuse

FL . . . filter
HR . . . heater
IC . . . integrated circuit
J . . . jack
K . . . relay
L . . . inductor
M . . . meter
MP . . . mechanical part
P . . . plug

Q . . . transistor
QCR . . . transistor-diode
R(p) . . . resistor(pack)
RT . . . thermistor
S . . . switch
T . . . transformer
TB . . . terminal board
TC . . . thermocouple
TP . . . test point

TS . . . terminal strip
U . . . microcircuit
V . . . vacuum tube, neon bulb, photocell, etc.
W . . . cable
X . . . socket
XDS . . . lampholder
XF . . . fuseholder
Y . . . crystal
Z . . . network

Table 6-2. Code List of Manufacturers

Mfr. No.	Manufacturer's Name	Address
H9027	Schurter A G H	Luzern, Switzerland
S0545	Nippon Electric Co.	Tokyo, Japan
S0562	Toshiba Corporation	Tokyo, Japan
00000	Any Satisfactory Supplier	
01121	Allen-Bradley Co.	Milwaukee, WI 53204
01295	Texas Instr. Inc. Semicond Cmpnt Div.	Dallas, TX 75222
03888	K D I Pyrofilm Corp.	Whippany, NJ 07981
04713	Motorola Semiconductor Products	Phoenix, AZ 85008
07263	Fairchild Semiconductor Div.	Mountain View, CA 94042
09023	Cornell-Dubilier Elek Div Fed Pac	Sanford, NC 27330
11502	TRW Inc. Boone Div.	Boone, NC 28607
13606	Sprague Elect Co Semiconductor Div.	Concord, NH 03301
17856	Siliconix Inc.	Santa Clara, CA 95054
18324	Signetics Corp.	Sunnyvale, CA 94086
19701	Mepco/Electra Corp.	Mineral Wells, TX 76067
24546	Corning Glass Works (Bradford)	Bradford, PA 16701
27014	National Semiconductor Corp.	Santa Clara, CA 95051
28480	Hewlett-Packard Co. Corporate Hq.	Palo Alto, CA 94304
3L585	RCA Corp Solid State Div.	Somerville, NJ 08876
3L680	Beman Mfg Inc.	Etters, PA 17319
32997	Bourns Inc. Trimpot Prod Div.	Riverside, CA 92507
50522	General Instr Corp Opto Div.	Palo Alto, CA 94304
52763	Stettner-Trush Inc.	Cazenovia, NY 13035
54670	Arizona Coil Inc.	Nogales, AZ 85621
56289	Sprague Electric Co.	North Adams, MA 01247
75042	TRW Inc. Philadelphia Div.	Philadelphia, PA 19108
80031	Mepco/Electra Corp.	Morristown, NJ 07960
91637	Dale Electronics Inc.	Columbus, NE 68601

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	03314-66501	5	2	PC ASSEMBLY-ANALOG	28480	03314-66501
A1C101	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A1C102	0180-0376	5	2	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A1C103	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1C104	0160-4813	1	3	CAPACITOR-FXD 180PF +-5% 100VDC CER	28480	0160-4813
A1C105	0160-4571	8	2	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C106	0160-4813	1	74	CAPACITOR-FXD 180PF +-5% 100VDC CER	28480	0160-4813
A1C107	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C108-109	0160-4385	2		CAPACITOR-FXD 15PF ±5% 200VDC CER	28480	0160-4385
A1C201	0160-3847	9	73	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C202	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C203	0160-2235	7	1	CAPACITOR-FXD .75PF +-.25PF 500VDC CER	28480	0160-2235
A1C204	0160-5529	3	1	CAPACITOR-FXD 2.5UF 50VDC	28480	0160-5529
A1C205	0160-5530	4	1	CAPACITOR-FXD .25UF 100VDC	28480	0160-5530
A1C206	0160-5531	5	1	CAPACITOR-FXD .025UF 100VDC	28480	0160-5531
A1C207	0160-5532	6	1	CAPACITOR-FXD 2500PF 100VDC	28480	0160-5532
A1C208	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C209	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C210	0160-3046	0	1	CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
A1C211	0160-3847	9		CAPACITOR-FXD .01UF +100 -0% 50VDC CER	28480	0160-3847
A1C213	0160-4791	4	6	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C214	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C215	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C216	0160-4298	6	1	CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A1C217	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C218	0121-0523	0	1	CAPACITOR-V TRMR-PSTN 1-8.5PF 750V	28480	0121-0523
A1C219	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C220	0160-4532	1	19	CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C221	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C241	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C260	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C261	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C262	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C263	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C264	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C265	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C266	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C301	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C302	0160-3914	1	5	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A1C303	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A1C304	0160-3334	9	2	CAPACITOR-FXD .01UF +-10% 50VDC CER	28480	0160-3334
A1C305	0160-4800	6		CAPACITOR-FXD 120PF 100V	28480	0160-4800
A1C306	0160-4814	2		CAPACITOR-FXD 150PF 100V	28480	0160-4814
A1C307	0121-0046	2	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
A1C308	0121-0046	2		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
A1C309	0160-4814	2		CAPACITOR-FXD 150PF 100V	28480	0160-4814
A1C310	0160-4800	6		CAPACITOR-FXD 120PF 100V	28480	0160-4800
A1C311	0160-3334	9		CAPACITOR-FXD .01UF +-10% 50VDC CER	28480	0160-3334
A1C312	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A1C313	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C314	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A1C315	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C316	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C317	0160-0572	1		CAPACITOR-FXD 2200PF .20	28480	0160-0572
A1C318	0160-0572	1		CAPACITOR-FXD 2200PF .20	28480	0160-0572
A1C319	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C320	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C321	0180-0309	4	2	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A1C322	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C323	0180-1746	5	9	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C324	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C401	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C402	0180-2623	9		CAPACITOR-FXD 12UF 6V	28480	0160-2623
A1C403	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1C404	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C501	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C502	0160-4808	4	3	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A1C503	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C504	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C505	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C506	0160-4803	9	1	CAPACITOR-FXD 68PF +-5% 100VDC CER 0+-30	28480	0160-4803
A1C510	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C511	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C512	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C513	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C514	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C515	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C516	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1C517	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C520	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C521	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C522	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C531	0160-2237	9		CAPACITOR-FXD 1.2PF ±.25PF 500VDC CER	28480	0160-2237
A1C541 543	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100DC CER	28480	0160-3879
A1C601	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C602	0160-4798	1	1	CAPACITOR-FXD 2.7PF +-.25PF 100VDC CER	28480	0160-4798
A1C603	0160-4795	8	1	CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A1C605	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C606	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C607	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C701	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1C702	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C703	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C704	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C705	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C706	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C707	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1C708	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C709	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C710	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C801	0160-4801	7	9	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A1C802	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C803	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C804	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C805	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C806	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C807	0160-4803	9		CAPACITOR-FXD 68PF +-5% 100VDC CER 0+-30	28480	0160-4803
A1C808	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C809	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C810	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C811	0180-0291	3	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1C812	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C813	0160-4810	8	5	CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A1C901	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C902	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C903	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C904	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C905	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C906	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C907	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C908	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C909	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C910	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A1C911	0160-4805	1	3	CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A1C912	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C921	0160-5350	3	1	CAPACITOR-FXD 300PF +-5% 100VDC CER	28480	0160-5350
A1C922	0160-4822	2	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A1C923	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C924	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C925	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1C926	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C927	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A1CR101	1901-0040	1	67	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR102	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR201	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR202	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR203	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR204	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR205	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR208	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR209	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR210	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR261	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR262	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR301	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR302	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR360	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR361	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR401	1901-0519	9	5	DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519
A1CR402	1901-0519	9		DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519
A1CR403	1901-0519	9		DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519
A1CR404	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR405	1902-0944	6	1	DIODE-ZNR 2.7V 5% DO-35 PD=.4W TC=-.044%	28480	1902-0944
A1CR406	1901-0519	9		DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519
A1CR407	1901-0519	9		DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR501	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR502	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR503	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR504	1902-0943	5	1	DIODE-ZNR 2.4V 5% DO-35 PD=.4W TC=-.037%	28480	1902-0943
A1CR601	1902-0031	2		DIODE-BKDN 12.7V	28480	1902-0031
A1CR701	1901-0026	3	2	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A1CR702	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
A1CR703	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR704	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR801	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR802	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR803	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR804	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR901	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1J1	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A1J2	1251-2969	8	2	CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A1J3	1251-6854	8	2	CONNECTOR 4-PIN F POST TYPE	28480	1251-6854
A1J4	1251-3961	2	2	CONNECTOR 6-PIN F POST TYPE	28480	1251-3961
A1J5	1251-4979	4	4	CONNECTOR 22-PIN M POST TYPE	28480	1251-4979
A1J6	1200-0507	9	2	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A1K201	0490-1346	8	2	RELAY-REED	28480	0490-1346
A1K202	0490-1346	8		RELAY-REED	28480	0490-1346
A1K203	0490-1270	7	15	RELAY-REED	28480	0490-1270
A1K204	0490-1270	7		RELAY-REED	28480	0490-1270
A1K205	0490-1270	7		RELAY-REED	28480	0490-1270
A1K261	0490-1270	7		RELAY-REED	28480	0490-1270
A1K401	0490-1270	7		RELAY-REED	28480	0490-1270
A1K701	0490-1270	7		RELAY-REED	28480	0490-1270
A1L310	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1L505,506	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1L701	9100-3334	2	4	COIL-FXD 250UH .01	28480	9100-3334
A1L702	9100-3334	2		COIL-FXD 250UH .01	28480	9100-3334
A1L923	9100-3458	1	5	CHOKE-WIDE BAND	28480	9100-3458
A1L924	9100-3458	1		CHOKE-WIDE BAND	28480	9100-3458
A1L925	9100-3458	1		CHOKE-WIDE BAND	28480	9100-3458
A1L926	9100-1645	4	1	INDUCTOR-390UH .05	28480	9100-1645
A1MP101a	5041-3020	3		HYBRID SPACER	28480	5041-3020
A1MP101b	5041-3020	3		HYBRID SPACER	28480	5041-3020
A1MP101c	5041-3020	3		HYBRID SPACER	28480	5041-3020
A1MP101d	5041-3020	3	4	HYBRID SPACER	28480	5041-3020
A1MP706b	0340-0564	3		INSULATOR-XSTR THRM-CNDCT	28480	0340-0564
A1MP706c	0535-0004	9	2	NUT-HEX DBL-CHAM M3 X 0.5 2.4MM-THK	00000	ORDER BY DESCRIPTION
A1MP706a	1205-0474	9	1	HEAT SINK	28480	1205-0474
A1MP706f	2190-0913	9		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0913
A1MP706d	3050-0716	5	2	WASHER-FL MTLC NO. 5 .128-IN-ID	28480	3050-0716
A1MP706g	2190-0913	9		WASHER-LK ML CL NO. 4 .115-IN-ID	28480	2190-0913
A1MP708b	0340-0564	3		INSULATOR-XSTR THRM-CNDCT	28480	0340-0564
A1MP708c	0535-0004	9		NUT-HEX DBL-CHAM M3 X 0.5 2.4MM-THK	00000	ORDER BY DESCRIPTION
A1MP706e	3050-0716	5		WASHER-FL MTLC NO.5 .128-IN-ID	28480	3050-0716
A1Q101	1853-0086	2	21	TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q102	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q103	1855-0414	4	4	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1Q104	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1Q200	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q201	1853-0518	5	4	TRANSISTOR-SELECTED	28480	1853-0518
A1Q202	1853-0518	5		TRANSISTOR-SELECTED	28480	1853-0518
A1Q203	1853-0518	5		TRANSISTOR-SELECTED	28480	1853-0518
A1Q204	1853-0518	5		TRANSISTOR-SELECTED	28480	1853-0518
A1Q205	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q206	1853-0448	0	11	TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q207	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q208	1854-0938	5	3	TRANSISTOR-PAIR, SELECTED	28480	1854-0938
A1Q209	1854-0938	5		TRANSISTOR-PAIR, SELECTED	28480	1854-0938
A1Q210	1854-0938	5		TRANSISTOR-PAIR, SELECTED	28480	1854-0938
A1Q211	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q212	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q213	1854-0636	0	4	TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0636
A1Q214	1854-0636	0		TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0636
A1Q215	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1Q216	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1Q217	1854-0795	2	20	TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q218	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q219	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q220	1855-0441	7	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE TO-78	28480	1855-0441
A1Q242	1854-0071	7	10	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q261	1853-0089	5	6	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A1Q262	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A1Q263	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A1Q264	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1Q265	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A1Q266	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A1Q267	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q268	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q269	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q270	1853-0083	9	1	TRANSISTOR-DUAL PNP PD=600MW	28480	1853-0083
A1Q272	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q273	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q274	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q275	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q276	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q277	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q301	1854-0636	0		TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0636
A1Q302	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q303	1854-0636	0		TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0636
A1Q304	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q305	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300 MHZ	04713	ZN3904
A1Q306	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q307	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q308	1853-0075	9	1	TRANSISTOR-DUAL PNP PD=400MW	28480	1853-0075
A1Q310	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q310	9170-0894	0	5	CORE-SHIELDING BEAD	28480	9170-0894
A1Q311	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q311	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1Q312	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q312	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1Q313	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q313	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1Q314	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q315	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q316	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q317	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q318	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q401	1853-0320	7	1	TRANSISTOR PNP 2N4032 SI TO-5 PD=800MW	07263	2N4032
A1Q402	1853-0203	5		TRANSISTOR PNP SS5651	28480	1853-0203
A1Q403	1853-0203	5		TRANSISTOR PNP SS5651	28480	1853-0203
A1Q404	1853-0203	5		TRANSISTOR PNP SS5651	28480	1853-0203
A1Q405	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q501	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q502	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q503	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q504	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q505	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q506	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q509	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q601	1853-0517	4	1	TRANSISTOR-DUAL PNP	28480	1853-0517
A1Q602	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q603	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q603	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A1Q604	1853-0036	2	28	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q605	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A1Q606	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A1Q607	1854-0215	1	23	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A1Q701	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q702	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q703	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q705	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q706	1853-0367	2	1	TRANSISTOR PNP SI PD=15W FT=50MHZ	04713	MJE233
A1Q707	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q708	1854-0692	8	1	TRANSISTOR NPN SI PD=15W FT=50MHZ	04713	MJE223
A1Q801	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q901	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
A1Q921	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1R101	0698-8142	6	2	RESISTOR 4M .25% .5W F TC=0+-50	28480	0698-8142
A1R102	0699-0498	1	2	RESISTOR 8M 1% .5W F TC=0+-100	28480	0699-0498
A1R103	0698-8142	6		RESISTOR 4M .25% .5W F TC=0+-50	28480	0698-8142
A1R104	0699-0498	1		RESISTOR 8M 1% .5W F TC=0+-100	28480	0699-0498
A1R105	0757-0442	9	77	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R106	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R107	0698-3161	9	2	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A1R108	0698-4496	5	2	RESISTOR 45.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4532-F
A1R109	0698-4496	5		RESISTOR 45.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4532-F
A1R110	2100-3214	0	1	RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	28480	2100-3214
A1R111	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R112	0757-0280	3	57	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R113	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R114	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R115	0683-2265	1	2	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R116	0757-0401	0	39	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R201	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R202	0757-0277	8	37	RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R203	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R204	0757-0427	0	1	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1R205	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R206	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R207	0757-0420	3	4	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R208	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R209	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R211	0698-7212	9		RESISTOR 100 1% .05W F TC=0 + -100	24546	C3-1/8-TO-1COR-F
A1R212	06898-7212	9		RESISTOR 100 1% 05W F TC=0+ -100	24546	C3-1/8-TO-1COR-F
A1R213-214	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+ -100	24546	C3-1/8-TO-51R1-F
A1R215	0757-0407	6	5	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R216	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R217	0698-4386	2	1	RESISTOR 59 1% .125W F TC=0+-100	24546	C4-1/8-T0-59R0-F
A1R218	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R219	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R220	0757-0283	6	12	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R221	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A1R222	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R223	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R224	0698-8827	4	4	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1R225	0757-0273	4	3	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A1R226	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R227	0757-0410	1	4	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A1R228	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A1R229	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R230	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A1R231	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1R232	0698-4123	5	16	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R233	0698-6343	5	2	RESISTOR 9K .1% .125W F TC=0+-25	28480	0698-6343
A1R234	0698-6362	8	2	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A1R235	0698-4503	5		RESISTOR 66.5K 1% .125W F TC=0+ -100	24546	C4-1/8-TO-6652-F
A1R237	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A1R238	0698-6343	5		RESISTOR 9K .1% .125W F TC=0+-25	28480	0698-6343
A1R242	0698-4442	1	1	RESISTOR 4.42K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4421-F
A1R243	0698-4438	5	3	RESISTOR 3.09K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3091-F
A1R244	0757-0421	4	3	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A1R245	0698-4438	5		RESISTOR 3.09K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3091-F
A1R246	0698-6448	1	2	RESISTOR 216.2 .1% .125W F TC=0+-25	28480	0698-6448
A1R247	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-TO-316R-F
A1R248	0698-6448	1		RESISTOR 216.2 .1% .125W F TC=0+-25	28480	0698-6448
A1R249	0698-3279	0	18	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R250	0698-4457	8	2	RESISTOR 576 1% .125W F TC=0+-100	28480	0698-4457
A1R251	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R253	0698-4457	8		RESISTOR 576 1% .125W F TC=0+-100	28480	0698-4457
A1R254	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R260	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R261	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R262	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R263	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R264	0698-4420	5	1	RESISTOR 226 1% .125W F TC=0+-100	24546	C4-1/8-T0-226R-F
A1R265	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R266	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R268	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R269	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A1R270	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R271	0698-3262	1	1	RESISTOR 40.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-40R2-F
A1R272	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R273	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R274	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R275	0698-3155	1	5	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1R276	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R277	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A1R278	0698-5453	6	2	RESISTOR 900 .1% .125W F TC=0+-50	03888	PME55 T-2-900R-B
A1R279	0698-5453	6		RESISTOR 900 .1% .125W F TC=0+-50	03888	PME55 T-2-900R-B
A1R280	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R281	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R282	0757-0281	4	1	RESISTOR 2.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A1R283	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R284	0698-3443	0	4	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A1R285	0757-0449	6	7	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A1R286	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R301	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R302	0698-6317	3	2	RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R303	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R304	0757-0200	7		RESISTOR 5620 OHM .01 F	28480	0757-0200
A1R305	0757-0427	0		RESISTOR - F 1500 OHM .01	28480	0757-0427
A1R306	0698-4369	1		RESISTOR - F 23.2 OHM .01	28480	0698-4369
A1R307	0698-7205	0		RESISTOR 51.1 1% .05 W F TC = 0 + - 100	24546	C3-1/8-TO-51R1-F
A1R308	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R309	0698-6323	1	2	RESISTOR 100 .1% .125W F TC=0+-25	28480	0698-6323
A1R310	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R311	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R312	0698-6323	1		RESISTOR 100 .1% .125W F TC=0+-25	28480	0698-6323
A1R313	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R314	0698-7205	0		RESISTOR 51.1 1% .05W F TC = 0 ± 100	24546	C3-1/8-TO-51R1-F
A1R315	0698-4369	1		RESISTOR - F 23.2 OHM .01	28480	0698-4369
A1R316	0757-0427	0		RESISTOR - F 1500 OHM .01	28480	0757-0427
A1R317	0757-0200	7		RESISTOR - F 5620 OHM .01	28480	0757-0200
A1R318	0698-3279			RESISTOR 4.99K 1% .125 F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R319	0698-6317	3		RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B
A1R320	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R321	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R322	0698-3279	0		RESISTOR 4.99K 1% .125W F TC = 0 + - 100	24546	C4-1/8-TO-4991-F
A1R323	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R324	0698-3444	1		RESISTOR 31.6 1% .125W F TC = 0 + - 100	24546	C4-1/8-TO-316R-F
A1R327	0698-3444	1		RESISTOR 31.6 1% .125W F TC = 0 + - 100	24546	C4-1/8-TO-316R-F
A1R328	0698-6320	8	7	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A1R329	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A1R330	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A1R331	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R332	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R333	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R334	2100-0568			RESISTOR - TRMR 100 10%	28480	2100-0568
A1R335	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R336	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R337	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R338	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R339	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R340	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R341	0757-0403	2	2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A1R342	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R343	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R344	0757-0284	7		RESISTOR 150 1% .125W F TC = 0 + - 100	24546	C4-1/8-TO-151-F
A1R345	0757-0412	3	1	RESISTOR 365 1% .125W F TC=0+-100	24546	C4-1/8-T0-365R-F
A1R346	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R347	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R348	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A1R349	0757-0421	4		RESISTOR 825 1% .125W TC=0+-100	24546	C4-1/8-T0-825R-F
A1R350	0757-0399	5		RESISTOR-F 82.5 OHM .01	28480	0757-0399
A1R351	0757-0399	5		RESISTOR-F 82.5 OHM .01	28480	0757-0399
A1R352	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R353	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R354	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R355	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R360	0698-4417	0	1	RESISTOR 174 1% .125W F TC=0+-100	24546	C4-1/8-T0-174R-F
A1R361	0698-3445	2	3	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A1R401	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R402	0698-7985	3	1	RESISTOR 2 5% .25W F TC=0+-100	11502	TF07-1/4-T0-2R0-J
A1R403	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R404	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1R405	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R406	0757-0465	6	20	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R407	0698-7332	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A1R408	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A1R409	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R410	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R411	0689-5105	6	1	RESISTOR 51 5% 1W CC TC=0+412	01121	GB5105
A1R412	0686-3305	8	1	RESISTOR 33 5% .5W CC TC=0+412	01121	EB3305
A1R413	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A1R416	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A1R417	0683-1505	0	1	RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
A1R501	0698-6103	5	1	RESISTOR 1.6K .1% .125W F TC=0+-50	28480	0698-6103
A1R502	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A1R503	0698-8613	6	1	RESISTOR 8.97K .1% .125W F TC=0+-25	28480	0698-8613
A1R504	0698-6360	6	9	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R505	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R506*	0698-3581	7	1	RESISTOR 13.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1372-F

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R506*	0698-3264	3		R-F 11.8k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1182-F
A1R506*	0757-0444	1		R-F 12.1k .01 .125w F TC = 0 + – 100	28480	0757-0444
A1R506*	0698-3519	1		R-F 12.4k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1242-F
A1R506*	0698-3359	7		R-F 12.7k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1272-F
A1R506*	0757-0445	2		R-F 13k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1302-F
A1R506*	0757-0289	2		R-F 13.3k .01 .125w F TC = 0 + – 100	28480	0757-0289
A1R506*	0698-3581	7		R-F 13.7k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1372-F
A1R506*	0698-4479	4		R-F 14k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1402-F
A1R506*	0698-4307	7		R-F 14.3k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1432-F
A1R506*	0698-3156	2		R-F 14.7k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2372-F
A1R506*	0757-0446	3		R-F 15k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1822-F
A1R506*	0698-3540	8		R-F 15.4k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-4222-F
A1R506*	0698-4480	7		R-F 15.8k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1582-F
A1R506*	0757-0447	4		R-F 16.2k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1622-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R528*	0698-4308	8		R-F 16.9k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1692-F
A1R528*	0698-4482	9		R-F 17.4k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1742-F
A1R528*	0698-3136	8		R-F 17.8k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1782-F
A1R528*	0757-0448	5		R-F 18.2k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1822-F
A1R528*	0698-4483	0		R-F 18.7k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1872-F
A1R528*	0698-4484	1		R-F 19.1k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1912-F
A1R528*	0698-3157	3		R-F 19.6k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-1962-F
A1R528*	0757-0449	6		R-F 20k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2002-F
A1R528*	0698-3245	0		R-F 20.5k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2052-F
A1R528*	0698-4205	4		R-F 21k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2102-F
A1R528*	0757-0199	3		R-F 21.5k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2152-F
A1R528*	0757-0450	9		R-F 22.1k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2212-F
A15R28*	0757-0349	5		R-F 22.6k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2262-F
A1R528*	0698-4485	2		R-F 23.2k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2322-F
A1R528*	0698-3158	4		R-F 23.7k .01 .124w F TC = 0 + – 100	24546	C4-1/8-TO-2372-F
A1R528*	0757-0451	0		R-F 24.3k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2432-F
A1R528*	0698-4486	3		R-F 24.9k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2492-F
A1R528*	0698-4487	4		R-F 25.5k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2552-F
A1R528*	0698-3159	5		R-F 26.1k .01 .125w F TC = 0 + – 100	24546	C4-1/8-TO-2612-F

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R507	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A1R508	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1R509	0698-6355	9	2	RESISTOR 400 .1% .125W F TC=0+-25	28480	0698-6355
A1R510	0698-6355	9		RESISTOR 400 .1% .125W F TC=0+-25	28480	0698-6355
A1R511	2100-3210	6	4	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A1R512	0698-4196	2	1	RESISTOR 1.07K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1071-F
A1R513	0698-8180	2	2	RESISTOR 4.22K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-4221-B
A1R514	0699-0692	7	2	RESISTOR 1.4K .1% .125W F TC=0+-25	28480	0699-0692
A1R515	0699-0690	5	2	RESISTOR 302 .1% .125W F TC=0+-25	28480	0699-0690
A1R516	0698-6446	9	2	RESISTOR 2.162K .1% .125W F TC=0+-25	28480	0698-6446
A1R517	0698-6446	9		RESISTOR 2.162K .1% .125W F TC=0+-25	28480	0698-6446
A1R518	0699-0690	5		RESISTOR 302 .1% .125W F TC=0+-25	28480	0699-0690
A1R519	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A1R520	0757-0291	6	10	RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A1R521	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A1R522*	0698-6811	2	1	RESISTOR 979.3 .25% .125W F TC=0+-25	28480	0698-6811
A1R523	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1R524	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1R525	0699-0189	7	2	RESISTOR 259.6 .1% .125W F TC=0+-25	28480	0699-0189
A1R526	0699-0189	7		RESISTOR 259.6 .1% .125W F TC=0+-25	28480	0699-0189
A1R527	0698-6347	9	1	RESISTOR 1.5K .1% .125W F TC=0+-25	28480	0698-6347
A1R528*	0698-4205	4	1	RESISTOR 21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2102-F
A1R529	0699-0689	2	2	RESISTOR 88.5 .1% .125W F TC=0+-25	28480	0699-0689
A1R530	0699-0689	2		RESISTOR 88.5 .1% .125W F TC=0+-25	28480	0699-0689
A1R531	0683-5615	1	1	RESISTOR 560 5% .25W FC TC=-400/+600	01121	CB5615
A1R532	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A1R533	0699-0688	1	2	RESISTOR 78.4 .1% .125W F TC=0+-25	28480	0699-0688
A1R534	0699-0688	1		RESISTOR 78.4 .1% .125W F TC=0+-25	28480	0699-0688
A1R535	0698-8180	2		RESISTOR 4.22K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-4221-B
A1R536	0699-0692	7		RESISTOR 1.4K .1% .125W F TC=0+-25	28480	0699-0692
A1R537	0699-0691	6	2	RESISTOR 306 .1% .125W F TC=0+-25	28480	0699-0691
A1R538	0698-8191	5	2	RESISTOR 12.5K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1252-B
A1R539	0699-0691	6		RESISTOR 306 .1% .125W F TC=0+-25	28480	0699-0691
A1R540	0698-8191	5		RESISTOR 12.5K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1252-B
A1R541	0698-0063	4	5	RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF 1/8-T1-5231-F
A1R542	2100-3821	5	1	RESISTOR-TRMR 200 10% C TOP-ADJ 10-TRN	32997	3262W-1-201
A1R543	0698-0063	4		RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-5231-F
A1R544	0698-3515	7	1	RESISTOR 5.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5901-F
A1R547	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R548	0698-8235	8	1	RESISTOR 9.31K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-9311-F
A1R549	0698-3274	5	1	RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-3274
A1R550	2100-3089	7	2	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A1R551	2100-3089	7		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A1R552	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R553	0698-6943	1	1	RESISTOR 20K .1% .125W F TC=0+-50	28480	0698-6943
A1R554	0698-3193	7	1	RESISTOR 10K .25% .125W F TC=0+-50	28480	0698-3193
A1R556	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R557	0698-3154	0	3	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R558	0698-4476	1	1	RESISTOR 10.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1022-F
A1R559	2100-3210	6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A1R561	0698-4493	2		RESISTOR 34K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3402-F
A1R601	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R602	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R603	0698-3442	9	3	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1R604	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1R605	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R606	0698-4424	9		RESISTOR 1.4K 1% 1/8W F TC=+-100	24546	C4-1/8-TO-1401-F
A1R607	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R608	0757-0346	2	7	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R609	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R610	0698-6447	0		RESISTOR- F 683.8 .001	28480	0698-6447
A1R611	0698-6447	0		RESISTOR- F 683.8 .001	28480	0698-6447
A1R562	0698-3572	6		RESISTOR 60.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6042-F
A1R612	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R613	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A1R614	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1R615	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R616	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C1-1/8-T0-2610-F
A1R563	2100-2655	1		RESISTOR - TRMR 100K 10%	28480	2100-2655
A1R617	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R618	0698-7363	1	2	RESISTOR 75 .1% .125W F TC=0+-50	19701	MF4C1/8-T2-75R0-B
A1R619	0698-7363	1		RESISTOR 75 .1% .125W F TC=0+-50	19701	MF4C1/8-T2-75R0-B
A1R620	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R701	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R702	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R703	0698-4439	6	1	RESISTOR 3.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3241-F
A1R704	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R705	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R706	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R707	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R708	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R709	0757-0984	4	4	RESISTOR 10 1% .5W F TC=0+-100	28480	0757-0984
A1R710	0757-0984	4		RESISTOR 10 1% .5W F TC=0+-100	28480	0757-0984
A1R712	0683-1565	2	1	RESISTOR 15M 5% .25W FC TC=-900/+1200	01121	CB1565
A1R801	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R802	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R803	0757-0446	3	4	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A1R804	0699-0845	2	2	RESISTOR 17.2K .1% .125W F TC=0+-25	28480	0699-0845
A1R805	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R806	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1R807	0699-0845	2		RESISTOR 17.2K .1% .125W F TC=0+-25	28480	0699-0845
A1R808	0757-0278	9	3	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A1R809	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R810	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R811	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A1R812	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A1R813	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R814	0757-0271	2	2	RESISTOR 124K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1243-F
A1R815	0698-3215	4	3	RESISTOR 499K 1% .125W F TC=0+-100	28480	0698-3215
A1R816	0698-3215	4		RESISTOR 499K 1% .125W F TC=0+-100	28480	0698-3215
A1R817	0757-0271	2		RESISTOR 124K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1243-F
A1R818	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R819	0757-0451	0	1	RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
A1R820	0683-5655	9	1	RESISTOR 5.6M 5% .25W FC TC=-900/+1100	01121	CB5655
A1R901	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R902	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R903	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R904	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R905	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R906	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R907	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R908	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R909	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R910	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R911	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A1R912	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A1R913	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R914	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R915	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R916	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A1R917	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R918	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R919	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R921	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R922	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R923	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R924	0757-0415	6	1	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A1R925	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1U101	IQG3-0073	7	1	FREQUENCY DAC HYBRID	28480	IQG3-0073
A1U102	1826-0522	4	4	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074CN
A1U103	1826-0547	3	4	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072ACP
A1U202	1826-0346	0	3	IC OP AMP GP DUAL 8-DIP-P PKG	27014	LM358N
A1U203	1858-0040	8	1	TRANSISTOR ARRAY 16-PIN PLSTC DIP	3L680	CA3127E
A1U261	1826-0346	0		IC OP AMP GP DUAL 8-DIP-P PKG	27014	LM358N
A1U301	1820-0493	6	3	IC OP AMP GP 8-DIP-P PKG	27014	LM307N
A1U302	1820-0493	6		IC OP AMP GP 8-DIP-P PKG	27014	LM307N
A1U303	1858-0063	5	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L680	CA3102E
A1U360	1820-0803	2	1	IC GATE ECL OR-NOR TPL	04713	MC10105P
A1U401	1826-0138	8	3	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A1U501	1826-0522	4		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074CN
A1U502	03314-82501	9	1	SIN-SHPR REPL KIT	28480	03314-82501
A1U503	1820-0493	6		IC OP AMP GP 8-DIP-P PKG	27014	LM307N
A1U504	1826-0777	1	1	IC SWITCH ANLG DUAL 14-DIP-P PKG	17856	DG303CJ
A1U701	1826-0519	9	3	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	01295	TL071CP
A1U702	1826-0346	0		IC OP AMP GP DUAL 8-DIP-P PKG	27014	LM358N
A1U801	1820-1730	6	9	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U802	1826-0188	8	2	IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A1U803	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A1U804	1820-1440	5	2	IC LCH TTL LS QUAD	01295	SN74LS279N
A1U805	1826-0412	1	4	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A1U806	1826-0412	1		IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A1U807	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A1U808	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U901	1820-1216	3	3	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U902	1820-1997	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U903	1820-1197	9	6	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1U904	1820-1445	0	1	IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1U905	1820-1211	8	2	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74L886N
A1W15	03314-61615			CBL ASSY- VCO	28480	03314-61615
A1XU101	1600-0882	1	2	CONNECTOR STRIP	28480	1600-0882
A1XU101	1600-0882	1		CONNECTOR STRIP	28480	1600-0882
A1XU303	1200-0638	7	1	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A2	03314-66502	6	1	PC ASSEMBLY-MODC	28480	03314-66502
A2C101	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C102	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C103	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C105	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C106	0160-3558	9	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A2C107	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A2C108	0160-2225	5	1	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A2C109	0160-4810	8		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A2C111	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A2C112	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C115	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C116	0160-4808	4		CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A2C117	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C118	0160-0161	4	1	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2C119	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C201	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C202	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C203	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C204	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C205	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C206	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C207	0160-2250	6	1	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A2C208	0180-1746	5		CAPACITOR-FXD 150F+-10% 20VDC TA	56289	150D156X9020B2
A2C209	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C211	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C212	0160-4789	0	2	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A2C213	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C214	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C215	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C216	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C217	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C218	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C219	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C222	0160-0127	2	10	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C223	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C224	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A2C225	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C226	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C227	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C228	0160-4787	8	4	CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-4787
A2C229	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C231	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C232	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C233	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A2C235	0180-1746	5		CAPACITOR-FXD 150F+-10% 20VDC TA	56289	150D156X9020B2
A2C236	0180-1746	5		CAPACITOR-FXD 150F+-10% 20VDC TA	56289	150D156X9020B2
A2C301	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A2C302	0160-4787	8		CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-4787
A2C303	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A2C304	0160-4812	0	3	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A2C305	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C306	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C307	0160-4811	9		CAPACITOR-FXD 270PF +-5% 100VDC CER	28480	0160-4811
A2C308	0160-5348	9	1	CAPACITOR-FXD 51PF +-5% 100VDC CER 0+-30	28480	0160-5348
A2C309	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847

See introduction to this section for ordering information
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Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2C311	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C312	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C313	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C314	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C315	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C316	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C317	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C318	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C319	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C320	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C321	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A2C322	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C401	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C404	0160-4787	8		CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-4787
A2C405	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C407	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C408	0160-4790	3	1	CAPACITOR-FXD 12PF +-5% 100VDC CER 0+-30	28480	0160-4790
A2C409	0160-4814	2		CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4814
A2C411	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C413	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C415	0160-4787	8		CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-4787
A2CR101	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR102	1901-0376	6	4	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR103	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR104	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR105	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR106	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR107	1902-0951	5	1	DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A2CR202	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR203	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR205	1901-0518	8	3	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2CR206	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2CR301	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR302	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR303	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2CR304	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2CR305	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR306	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2CR307	1902-0958	2		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A2CR311	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR312	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR313	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR400	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR403	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR404	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR501	1902-3345	7	2	DIODE-ZNR 51.1V 5% DO-35 PD=.4W	28480	1902-3345
A2CR502	1901-0050	3	2	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR503	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2CR504	1902-3345	7		DIODE-ZNR 51.1V 5% DO-35 PD=.4W	28480	1902-3345
A2J1	1251-6254	2	6	CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A2J2	1251-6254	2		CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A2J3	1251-6254	2		CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A2J4	1251-6254	2		CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A2J5	1251-6254	2		CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A2J6	1251-4979	4		CONNECTOR 22-PIN M POST TYPE	28480	1251-4979
A2J7	1251-6854	8		CONNECTOR 4-PIN F POST TYPE	28480	1251-6854
A2J8	1251-3961	2		CONNECTOR 6-PIN F POST TYPE	28480	1251-3961
A2MP1	5040-7721	7	3	P.C. HINGE	28480	5040-7721
A2MP2	5040-7721	7		P.C. HINGE	28480	5040-7721
A2MP3	5040-7721	7		P.C. HINGE	28480	5040-7721
A2Q101	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q102	1853-0412	8	1	TRANSISTOR PNP SI DARL TO-92 PD=625MW	04713	MPSA65
A2Q103	1854-0009	1	1	TRANSISTOR NPN SI PD=300MW FT=600MHZ	04713	2N709
A2Q106	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q107	1855-0081	1	2	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A2Q108	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A2Q109	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q111	1855-0410	0	2	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0410
A2Q112	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q113	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q114	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q115	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q202	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q203	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q204	1855-0082	2	1	TRANSISTOR J-FET P-CHAN D MODE SI	28480	1855-0082

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2Q205	1855-0410	0		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0410
A2Q301	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q302	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q303	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q401	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q402	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q403	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q501	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q502	1853-0066	8		TRANSISTOR PNP SI PD = 625MW	28480	1853-0066
A2Q503	1853-0264	8	3	TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A2Q504	1854-0474	4	3	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A2R101	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A2R107	0699-0034	1	1	RESISTOR 2.312K .25% .125W F TC=0+-50	28480	0699-0034
A2R108	2100-3212	8	2	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A2R109	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A2R111	0699-0122	8	1	RESISTOR 4.8K .1% .125W F TC=0+-25	28480	0699-0122
A2R113	2100-3210	6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A2R115	0757-0476	9	1	RESISTOR 301K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3013-F
A2R116	0698-4453	4	2	RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A2R117	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R118	0683-4725	2	6	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R119	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R120	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R121	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R122	0683-6845	1	1	RESISTOR 680K 5% .25W FC TC=-600/+900	01121	CB6845
A2R123	0683-2055	7	1	RESISTOR 2M 5% .25W FC TC=-900/+1100	01121	CB2055
A2R124	0683-4755	8	1	RESISTOR 4.7M 5% .25W FC TC=-900/+1100	01121	CB4755
A2R125	0683-1655	1	1	RESISTOR 1.6M 5% .25W FC TC=-900/+1100	01121	CB1655
A2R126	0698-4543	3	1	RESISTOR 487K 1% .125W F TC=0+-100	28480	0698-4543
A2R127	0683-1055	5	2	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A2R128	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R131	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A2R132	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R133	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R134	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R135	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R136	0698-7394	8	1	RESISTOR 698 .1% .125W F TC=0+-25	19701	MF4C1/8-T9-698R-B
A2R137	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R139	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A2R141	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A2R142	0698-7447	2	1	RESISTOR 10K .1% .25W F TC=0+-25	19701	MF52C1/4-T9-1002-B
A2R143	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R145	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R146	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R147	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R148	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2R149	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R151	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A2R152	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R153	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A2R154	0698-4440	9	1	RESISTOR 3.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3401-F
A2R155	0683-2225	3	1	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A2R158	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R159	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R161	0698-4502	4	2	RESISTOR 64.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6492-F
A2R162	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R163	0698-4502	4		RESISTOR 64.9K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6492-F
A2R164	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R180	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2002-F
A2R200	0757-0433	8	2	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A2R201	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A2R202	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R203	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A2R204	0698-6358	2	4	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A2R205	2100-3211	7	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3211
A2R206	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A2R207	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A2R208	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A2R209	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A2R210	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R211	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R212	2100-3253	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A2R213	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R214	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R215	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A2R216	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R217	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R218	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R221	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R222	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R223	0757-0446	3		RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A2R224	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A2R225	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A2R226	0764-0016	8	2	RESISTOR 1K 5% 2W MO TC=0+-200	28480	0764-0016
A2R227	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R228	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A2R229	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R231	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R232	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R233	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R234	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R236	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R237	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A2R238	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R239	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A2R241	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R242	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R243	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R244	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R245	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R247	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R248	0698-4453	4		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A2R249	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R250	0757-0469	0		RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
A2R251**	8150-3375	5		JUMPER WIRE-ELEC	28480	8150-3375
A2R252	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R253	0698-4479	4	1	RESISTOR 14K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
A2R255	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R256	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R258	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R259	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R260	1810-0269	3	8	NETWORK-RES 9-SIP 10.0K OHM X 8	28480	1810-0269
A2R261	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R262	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R263	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R264	0698-6630	3	1	RESISTOR 20K .1% .125W F TC=0+-25	28480	0698-6630
A2R265	0698-6629	0	1	RESISTOR 60K .1% .125W F TC=0+-25	28480	0698-6629
A2R266	0698-5540	2	1	RESISTOR 1.1M 5% .25W FC TC=-900/+1100	01121	CB1155
A2R267	2100-3210	6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A2R268	0683-1015	7	2	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R301	0690-1021	0	1	RESISTOR 1K 10% 1W CC TC=0+647	01121	GB1021
A2R302	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R303	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R304	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R305	0698-4435	2	2	RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
A2R306	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R307	0757-0413	4	1	RESISTOR 392 1% .125W F TC=0+-100	24546	C4-1/8-T0-392R-F
A2R308	0698-4121	3		RESISTOR 11.3K .01	28480	0698-4121
A2R309	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A2R310	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R311	0698-4435	2		RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
A2R312	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R313	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A2R314	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A2R315	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R316	0698-3202	9	1	RESISTOR 1.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1741-F
A2R317	0698-4437	4	9	RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A2R318	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R319	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R320	0683-5105	4	1	RESISTOR 51 5% .25W FC TC=-400/+500	01121	CB5105
A2R321	0683-1625	5	1	RESISTOR 1.6K 5% .25W FC TC=-400/+700	01121	CB1625
A2R322	0757-0422	5	1	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2R323	0698-5546	8	1	RESISTOR 174 1% .125W F TC=0+-25	28480	0698-5546
A2R324	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A2R325	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R326	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R327	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R328	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R329	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R331	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R332	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R333	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R334	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

See introduction to this section for ordering information
*Indicates factory selected value
**Rev A Boards Only

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R335	0683-5115	6	11	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A2R336	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R401	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R402	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R405	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R407	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R408	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R409	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R411	0683-1065	7	2	RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A2R412	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R413	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R414	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R415	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R416	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R417	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A2R418	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R419	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R421	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R422	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A2R424	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R425	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R426	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R427	2100-3212	8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A2R428	0698-6321	9	1	RESISTOR 9.9K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-9901-B
A2R429	2100-0554	5	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A2R431	0698-4444	3	1	RESISTOR 4.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4871-F
A2R432	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A2R433	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R434	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R435	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R436	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A2R437	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R438	0757-0435	0	1	RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A2R439	0698-3179	9	1	RESISTOR 2.55K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2551
A2R441	0698-4432	9	1	RESISTOR 2.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2101-F
A2R443	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R444	0698-3493	0	1	RESISTOR 4.12K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4121-F
A2R455	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R456	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R501	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R502	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R503	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R504	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R505	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R506	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R507	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A2R508	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R509	0764-0016	8		RESISTOR 1K 5% 2W MO TC=0+-200	28480	0764-0016
A2S501	3101-0642	5	1	SWITCH-SL DPDT MTNTR .5A 125VAC/DC PC	28480	3101-0642
A2TP1	1251-0600	0	33	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP12	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP13	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP14	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP15	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP16	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP17	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP18	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP19	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP20	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP21	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP22	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2U101	1826-0547	3		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072ACP
A2U102	1821-0001	4	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	31680	CA3046
A2U103	1826-0476	7	1	IC SWITCH ANLG 8-DIP-P PKG	01295	TL601CP
A2U104	1826-0412	1		IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A2U201	1826-0547	3		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072ACP

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2U202	1826-0547	3		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072ACP
A2U203	1826-0522	4		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074CN
A2U204	1826-0519	9		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	01295	TL071CP
A2U205	1826-0412	1		IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A2U206	1826-0081	0	1	IC OP AMP WB TO-99 PKG	27014	LM318H
A2U207	1826-0357	3	1	IC OP AMP WB TO-99 PKG	27014	LF357H
A2U208	1826-0907	9	1	IC-QUAD ANALOG SWITCH	28480	1826-0907
A2U209	1820-1245	8	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS155N
A2U211	1820-0471	0	1	IC INV TTL HEX 1-INP	01295	SN7406N
A2U212	1820-1545	1	2	IC MULTIPLXR 2-CHAN-ANLG TRIPLE 16-DIP-C	3L585	CD4053BY
A2U213	1826-0684	9	1	IC CONV 12-B D/A 18-DIP-C PKG	28480	1826-0684
A2U214	1820-1447	2	3	IC TTL LS 16-BIT STAT RAM 45-NS 3-S	01295	SN74LS670N
A2U215	1820-1447	2		IC TTL LS 16-BIT STAT RAM 45-NS 3-S	01295	SN74LS670N
A2U216	1820-1447	2		IC TTL LS 16-BIT STAT RAM 45-NS 3-S	01295	SN74LS670N
A2U217	1820-1112	8	6	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2U218	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U219	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U221	1826-0944	4	1	IC-AD7523AD	28480	1826-0944
A2U222	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U301	1820-1275	4	1	IC GATE TTL S NOR DUAL 5-INP	01295	SN74S260N
A2U302	1820-1278	7	4	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A2U303	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A2U304	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A2U305	1820-1206	1	2	IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
A2U306	1820-0629	0	2	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2U307	1820-1279	8	1	IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
A2U308	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U309	1820-1322	2	1	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A2U310	1820-0693	8	3	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A2U311	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A2U312	1820-1158	2	3	IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A2U313	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2U314	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A2U315	1820-1158	2		IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A2U316	1820-1158	2		IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A2U317	1820-1442	7	2	IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS290N
A2U318	1820-1211	8		IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A2U319	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U320	1820-1428	9	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
A2U322	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U323	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U324	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U325	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U326	1820-1491	6	2	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A2U327	1820-1440	5		IC LCH TTL LS QUAD	01295	SN74LS279N
A2U328	1820-1414	3	1	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS12N
A2U329	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2U331	1826-0755	5	1	IC COMPARATOR HS 14-DIP-P PKG	18324	NE527N
A2U401	1820-1545	1		IC MULTIPLXR 2-CHAN-ANLG TRIPLE 16-DIP-C	3L585	CD4053BY
A2U402	1826-0522	4		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074CN
A2U404	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U405	1826-0188	8		IC CONV 8-B D/A 16-DIP-C PKG	04713	MC1408L-8
A2U406	1826-0138	8		IC COMPARATOR OP QUAD 14-DIP-P PKG	01295	LM339N
A3	03314-66503	7	1	PC ASSEMBLY-CONT-POWER	28480	03314-66503
A3B1	1420-0278	7	1	BATTERY 3V .72A-HR LI/S-DIOX W-FLEX	28480	1420-0278
A3C2	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C3	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C4	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C5	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C7	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A3C8	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A3C9	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C10	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C11	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A3C13	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A3C14	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C15	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C16	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C17	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C18	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C19	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C20	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C21	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C22	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C23	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C24	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C25	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C26	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C27	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C28	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C100	0180-3081	5	1	CAPACITOR-FXD 3000UF+50-10% 35VDC AL	28480	0180-3081
A3C101	0180-3082	6	1	CAPACITOR-FXD 1500UF+50-10% 35VDC AL	28480	0180-3082
A3C102	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C103	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C104	0160-0362	7	1	CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-0362
A3C105	0180-0650	8	1	CAPACITOR-FXD 390UF+100-10% 20VDC AL	09023	UPC390-20-E2E
A3C106	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C107	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C108	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C109	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C110	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C111	0180-2207	5	1	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010B2
A3C112	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C113	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C114	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C115	0180-0058	0	2	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C116	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C117	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A3C118	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A3C122	0160-4814	2		CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4814
A3C123	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A3C124	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A3CR1	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1990-0517	4	1	LED-LAMP LUM-INT=3mCD IF=20MA-MAX BVR=5V	28480	5082-4655
A3CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR100	1901-0200	5	2	DIODE PWR RECT 100V 1.5A	28480	1901-0200
A3CR101	1901-0704	4	4	DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A3CR102	1901-0200	5		DIODE PWR RECT 100V 1.5A	28480	1901-0200
A3CR103	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A3CR104	1902-0960	6	2	DIODE-ZNR 12V 5% DO-35 PD=.4W TC=+.077%	28480	1902-0960
A3CR105	1902-0960	6		DIODE-ZNR 12V 5% DO-35 PD=.4W TC=+.077%	28480	1902-0960
A3CR106	1902-0958	2		DIODE ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A3CR107	1902-0777	3	1	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
A3CR108	1901-0040	1		DIODE SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR109	1901-0782	8	1	DIODE-SCHOTTKY 1N5821 30V 3A	04713	1N5821
A3CR111	1902-0953	7	1	DIODE-ZNR 6.7V 5% DO-35 PD=.4W TC=+.053%	28480	1902-0953
A3CR112	1902-0766	0	1	DIODE-ZNR 18.2V 5% DO-35 PD=.4W	28480	1902-0766
A3CR113	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A3CR114	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A3CR115	1884-0266	5	1	THYRISTOR-SCR 2N6400 TO-220AB VRRM=50	28480	2N6400
A3CR116	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR117	1901-0040	1		DIODE SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR118	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR119	1901-0040	1		DIODE SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR120	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR121	1901-0040	1		DIODE SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR122	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR123	1902-3301	5		DIODE-ZNR 34.8V 5% DO-35 PO = .4W	28480	1902-3301
A3J1	1251-6569	2	2	CONNECTOR 16-PIN M POST TYPE	28480	1251-6569
A3J2	1251-4979	4		CONNECTOR 22-PIN M POST TYPE	28480	1251-4979
A3J3	1251-4979	4		CONNECTOR 22-PIN M POST TYPE	28480	1251-4979
A3J4	1200-0888	9	1	SOCKET-IC 24-CONT DIP DIP SLDR	28480	1200-0888
A3J5	1251-4822	6	6	CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J5A	1258-0141	8	7	JUMPER-REM	28480	1258-0141
A3J6	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J6A	1258-0141	8		JUMPER-REM	28480	1258-0141
A3J7	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J7A	1258-0141	8		JUMPER-REM	28480	1258-0141
A3J8A4	1251-4335	6	1	CONN-POST TYPE	28480	1251-4335
A3CR124	1901-0040	1		DIODE-SWITCHING 30V 50MA ZNS DO-35	28480	A01-0040
A3CR125	1901-0040	1		DIODE-SWITCHING 30V 50MA ZNS DO-35	28480	1901-0040

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3J9	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J9a	1258-0141	8		JUMPER-REM	28480	1258-0141
A3J10	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J10a	1258-0141	8		JUMPER-REM	28480	1258-0141
A3J11	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J11a	1258-0141	8		JUMPER-REM	28480	1258-0141
A3J101	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A3J102	1251-4484	6	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-4484
A3L1	9140-0393	1	1	INDUCTOR RF-CH-MLD 20UH 5% .166DX.385LG	28480	9140-0393
A3L2	9100-3912	2	1	INDUCTOR RF-CH-MLD 15UH 5% .166DX.385LG	28480	9100-3912
A3L100	9100-3017	8	1	300 MH AT 5 AMP DC	28480	9100-3017
A3L101	9140-0261	2	1	INDUCTOR RF-CH-MLD 100NH 5% .166DX.385LG	28480	9140-0261
A3L102	9100-3334	2		INDUCTOR 250H 10% .3D	28480	9100-3334
A3MP1	5040-7787	5	3	PC HINGE-HALF	28480	5040-7787
A3MP2	5040-7787	5		PC HINGE-HALF	28480	5040-7787
A3MP3	5040-7787	5		PC HINGE-HALF	28480	5040-7787
A3Q1	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q5	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q6	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q7	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q9	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q10	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q11	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q100	1853-0450	4	1	TRANSISTOR PNP SI TO-220AB PD=60W	04713	MJE371K
A3Q101	1854-0880	0	1	TRANSISTOR NPN SI TO-220AB PD=60W	28480	1854-0880
A3Q102	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q103	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q104	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q105	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q106	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q107	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q108	1853-0251	3	1	TRANSISTOR PNP SI PD=90W FT=2MHZ	28480	1853-0251
A3Q109	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q111	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3Q112	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q113	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q114	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q115	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q116	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3R1	0698-3558	8	1	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A3R2	0683-1065	7		RESISTOR 10M 5% .25W CC TC= 900/+1100	01121	CB1065
A3R3	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R4	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A3R5	0757-0384	8	8	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R6	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R8	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A3R9	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R10	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R12	0698-4480	7	1	RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A3R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R15	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R16	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A3R18	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R20	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A3R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R22	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A3R23	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A3R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R34	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R35	0683-3325	6	2	RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
A3R36	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R37	0683-2025	1	7	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R38	0683-2415	3	1	RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
A3R39	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R43	0757-0391	7	1	RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A3R44	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R45	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R46	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R47	0683-3325	6		RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
A3R48	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R50	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A3R51	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R53	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R54	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R58	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R59	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A3R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R61	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R62	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R63	0757-0437	2	1	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A3R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R65	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3R100	0811-3079	0	2	RESISTOR .51 5% .5W PW TC=0+-300	75042	BW20-1/2-33/64-J
A3R101	0811-3079	0		RESISTOR .51 5% .5W PW TC=0+-300	75042	BW20-1/2-33/64-J
A3R102	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R103	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R104	0757-0452	1	2	RESISTOR 27.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2742-F
A3R105	0757-0452	1		RESISTOR 27.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2742-F
A3R106	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R107	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R108	0683-4715	0	2	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R109	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R110	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R111	0698-8249	4	1	RESISTOR 23.7K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-2372-F
A3R112	0698-5542	4	2	RESISTOR 29K 1% .125W F TC=0+-25	28480	0698-5542
A3R113	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE ADJ 1-TRN	28480	2100-3273
A3R114	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE ADJ 1-TRN	28480	2100-3351
A3R115	0698-8963	9	1	RESISTOR 16.9K 1% .1W F TC=0+-10	28480	0698-8963
A3R116	0698-5542	4		RESISTOR 29K 1% .125W F TC=0+-25	28480	0698-5542
A3R117	0698-3512	4	1	RESISTOR 1.18K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1181-F
A3R118	0683-1045	3	3	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R119	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R120	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R121	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R122	0683-5125	8	2	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A3R123	0683-1035	1	5	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R124	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R125	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R126	0683-3335	8	2	RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
A3R127	0683-3335	8		RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
A3R128	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R129	0698-4438	5		RESISTOR 3.09K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3091-F
A3R130	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R131	0698-3215	4		RESISTOR 499K 1% .125W F TC=0+-100	28480	0698-3215
A3R132	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A3R133	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R134	0698-0063	4		RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-5231-F
A3R135	0683-2265	1		RESISTOR 22M 5% .25W FC TC=+900/+1200	01121	CB2265
A3R136	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R137	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R138	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R139	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R140	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R141	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R143	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A3R144	0683-1315	0	1	RESISTOR 130 5% .25W FC TC=-400/+600	01121	CB1315
A3R145	0683-1025	9	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R146	0683-2235	5	1	RESISTOR 22K 5% .25W FC TC=-400/+800	01121	CB2235

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R147	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A3R148	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R151	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R152	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A3R153	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R154	0683-0275	9	1	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB2755
A3S1	3101-2094	5	1	SWITCH-RKR DIP-RKR-ASSY 8-1A .05A 30VDC	28480	3101-2094
A3SA1	1251-6427	1	2	CONNECTOR- 2PIN MALE	28480	1251-6427
A3SA2	1251-6427	1		CONNECTOR- 2 PIN MALE	28480	1251-6427
A3TP0	0360-0077	5	8	TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP1	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP2	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP3	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP4	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP5	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP6	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3TP7	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A3U100	1826-0139	9	2	IC OP AMP GP DUAL 8-DIP-P PKG	34649	CA1458G
A3U101	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	01295	NE555P
A3U102	1826-0138	8		IC COMPARATOR GP QUAD 14-DIP P PKG	01295	LM339N
A3U200	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A3U201	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A3U202	1820-0328	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3U203	1820-2019	6	1	IC SCHMITT-TRIG CMOS HEX	04713	MC14584BCP
A3U204	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U205	1820-1442	7		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS290N
A3U206	1820-1480	3	1	IC MICPROC NMOS 8-BIT	04713	MC6800L
A3U207	1818-3045	0	6	ROM-MK36000	28480	FGR-ROM
A3U208	1818-3046	0		ROM-MK36000	28480	FGR-ROM
A3U209	1818-3047	0		ROM-MK36000	28480	FGR-ROM
A3U210	1818-3048	0		ROM-MK36000	28480	FGR-ROM
A3U211	1818-1346	5	2	IC-UPD444/6514	50562	UPD444/6514
A3U212	1818-1346	5		IC-UPD444/6514	50562	UPD444/6514
A3U213	1820-2075	4	3	IC MISC TTL LS	01295	SN74LS245N
A3U214	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A3U215	1820-2102	8	2	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A3U216	1820-2102	8		IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A3U217	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U218	1820-1240	3	1	IC DCDR TTL S 3-TO-8-LINE 3-INP	01295	SN74S138N
A3U219	1820-1216	3		IC DCDR TTL LS 3-TO 8-LINE 3-INP	01295	SN74LS138N
A3U221Δ4	1820-1322	2	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74S02N
A3U222	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A3U223	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A3U224	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A3U225	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U226	1820-1196	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A3U227	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U228	1820-1991	1	1	IC CNTR TTL LS DECD DUAL 4 BIT	01295	SN74LS390N
A3U229	1820-1198	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A3U230	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A3U231	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A3U232	1820-2005	0	1	IC TIMER NMOS	50545	UPD0253D
A3U233	1818-0438	4	2	IC NMOS 4096 (4K) STAT RAM 450-NS 3 S	01295	TMS2114-45NL
A3U234	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450 NS 3 S	01295	TMS2114-45NL
A3U235	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A3U236	1818-3049	0		ROM-MK36000	28480	FGR-ROM
A3U237	1820-1202	7	1	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A3U238	1818-3050	0		ROM-MK36000	28480	FGR-ROM
A3U239	1820-1206	1		IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
A3U300	1820-2113	1	1	IC MICPROC-ACCESS NMOS	04713	MC6848P
A3U301	1820-2483	8	1	IC RCVR TTL LS BUS OCTL	01295	SN75161N
A3U302	1820-2485	0	1	IC RCVR TTL LS BUS OCTL	01295	SN75160N
A3W100	8150-3375	5		JUMPER WIRE-ELEC	28480	8150-3375
A3XQ8	1251-6133	6	1	CONNECTOR POST TP-SKT	28480	1251-6133
A3XQ100	1251-4645	1	2	CONNECTOR 3-PIN F POST TYPE	28480	1251-4645
A3XQ101	1251-4645	1		CONNECTOR 3 PIN F POST TYPE	28480	1251-4645
A3XQ138	1251-6133	6		CONNECTOR-POST - TP - SKT	28480	1251-6133

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3Y1	0410-0465	2	1	CRYSTAL-QUARTZ 4.00000 MHZ HC-6/U-HLDR	28480	0410-0465
A4	03314-66504	8	1	PC ASSEMBLY-FRONT PANEL	28480	03314-66504
A4C1	0180-2298	6	1	CAPACITOR-FXD 220UF+-10% 10VDC TA	56289	150D227X9010B2
A4C2	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A4C3	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A4C4	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A4CR1-A4CR46	1990-0757	4	46	LED CIMV57124	50522	MV57124
A4DS0	1990-0619	7	4	DISPLAY-NUM-SEG 1-CHAR .3 H	28480	5082-7613
A4DS1	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3 H	28480	5082-7613
A4DS2	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H	28480	5082-7613
A4DS3	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H	28480	5082-7613
A4E1	5060-9444	7	1	ROTARY PULSE GENERATOR	28480	5060-9444
A4J1	1251-6569	2		CONNECTOR-16 PIN MALE	28480	1251-6569
A4L1	9100-3334	2		COIL-FXD 25UH .01	28480	9100-3334
A4MP1-A4MP38	4040-2109	4		L.E.D. SPACER	28480	4040-2109
				L.E.D. SPACER	28480	
A4Q1	1853-0066	8	8	TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q2	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q3	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q4	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q5	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q6	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q7	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q8	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4R1	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R2	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R3	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R4	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R5	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R6	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R7	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R8	0698-4437	4		RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A4R9	1810-0269	3		NETWORK-RES 9 SIP10.0K OHM X 8	28480	1810-0269
A4R10	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A4R11	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R12	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R13	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R14	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R15	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R16	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R17	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R18	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A4R19	1810-0269	3		NETWORK-RES 9 SIP10.0K OHM X 8	28480	1810-0269
A4R20	1810-0368	3	2	NETWORK-RES 6 SIP10.0K OHM X 5	01121	206A103
A4R21	1810-0368	3		NETWORK-RES 6 SIP10.0K OHM X 5	01121	206A103
A4R22	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A4S1	5060-9436	7	31	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4S16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4S30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A4U1	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U2	1820-1438	1	2	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257AN
A4U3	1820-1438	1		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257AN
A4U4	1820-1045	6	1	IC SHF-RGTR TTL D-TYPE SERIAL-IN PRL-OUT	18324	N8273N
A4U5	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A4U6	1858-0047	5	2	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A4U7	1858-0047	5		TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A4U8	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4XDS0-A4XDS3	1200-0424	9	4	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0424
MPE001A	2190-0016	3	1	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
MPE001B	2950-0043	8	1	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A5	03314-66505	9	1	PC ASSEMBLY- X3 OUTPUT	28480	03314-66505
A5C1	0180-2779	6	2	CAPACITOR-FXD 470UF+75-10% 50VDC AL	56289	30D477G050FK2
A5C2	0180-2779	6		CAPACITOR-FXD 470UF+75-10% 50VDC AL	56289	30D477G050FK2
A5C3	0180-0116	1	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035R2
A5C4	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035R2
A5C6	0160-4571	8	4	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A5C7	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A5C8	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A5C9	0160-4789	0	1	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A5C11	0160-4787	8	1	CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-4787
A5C12	0121-0060	0	1	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304322 2/8PF NPO
A5C13	0160-3847	9	2	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A5C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A5C18	0160-3508	9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A5C19	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A5C21	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A5C24	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A5C25	0160-4532	1	1	CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A5C26	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A5CR6	1901-0050	3	4	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR11	1901-0040	1	4	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR13	1902-0965	1	1	DIODE-ZNR 20V 5% DO-35 PD=.4W TC=+.092%	28480	1902-0965
A5CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5J1	1251-4484	6	1	CONNECTOR-4P M PST	28480	1251-4484
A5J2	1250-1189	0	1	CONNECTOR-RF SMB FEM PC 50-OHM	28480	1250-1189
A5J3	1250-1810	7	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1810
A5J4	1251-6254	2	1	PC PHONO JACK	28480	1251-6254
A5K1	0490-1270	7	1	RELAY-REED	28480	0490-1270
A5L1	9100-0541	7	2	INDUCTOR RF-CH-MLD 250UH 10% .25DX.5LG	28480	9100-0541
A5L2	9100-0541	7		INDUCTOR RF-CH-MLD 250UH 10% .25DX.5LG	28480	9100-0541
A5MP1	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A5MP17A	1205-0033	6	2	HEAT SINK TO-5/TO-39-CS	28480	1205-0033
A5MP17B	1200-0185	9	2	INSULATOR-XSTR NYLON	28480	1200-0185
A5MP18A	1205-0033	6	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0033
A5MP18B	1200-0185	9		INSULATOR-XSTR NYLON	28480	1200-0185

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5Q1	1854-0830	6	1	TRANSISTOR-DUAL NPN PD=500MW	27014	LM394
A5Q2	1854-0474	4	4	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q3	1853-0036	2	3	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q4	1853-0042	0	1	TRANSISTOR PNP SI PD=310MW FT=200MHZ	28480	1853-0042
A5Q6	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q7	1854-0215	1	3	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q9	1853-0264	8	2	TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A5Q11	1853-0264	8		TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A5Q12	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q13	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q14	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q16	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q17	1854-0090	0	1	TRANSISTOR NPN SI TO-39 PD=1W FT=100MHZ	28480	1854-0090
A5Q18	1853-0037	3	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0037
A5Q20	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5R1	0683-1005	5	1	RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
A5R2	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R3	0698-3558	8	1	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A5R4	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R6	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R7	0698-4037	0	10	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R8	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A5R9	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A5R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R11	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R12	0757-0161	9	2	RESISTOR 604 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
A5R13	0757-0161	9		RESISTOR 604 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
A5R14	0698-6619	8	1	RESISTOR 15K .1% .125W F TC=0+-25	28480	0698-6619
A5R16	0698-6614	3	1	RESISTOR 7.5K .1% .125W F TC=0+-25	28480	0698-6614
A5R17	0698-3443	0	2	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A5R18	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A5R19	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R21	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R22	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R23	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R24	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A5R26	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A5R27	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751 -F
A5R28	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R29	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R31	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R32	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R33	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R34	0698-3453	2	2	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A5R36	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A5R37	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R38	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A5R39	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R41	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R42	0683-0825	5	2	RESISTOR 8.2 5% .25W FC TC=-400/+500	01121	CB82G5
A5R43	0683-0825	5		RESISTOR 8.2 5% .25W FC TC=-400/+500	01121	CB82G5
A5R44	0683-0565	0	2	RESISTOR 5.6 5% .25W FC TC=-400/+500	01121	CB56G5
A5R45	0683-1025	9	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A5R46	0683-0565	0		RESISTOR 5.6 5% .25W FC TC=-400/+500	01121	CB56G5
A5R47	0698-3430	5	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A5R48	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R49	0698-7332	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A5R50	0698-8353	1	1	RESISTOR 806K 1% .125W F TC=0+-100	28480	0698-8353
A5R51	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A5R52	0698-4539	7	1	RESISTOR 402K 1% .125W F TC=0+-100	28480	0698-4539
A5R53	0698-4531	9	1	RESISTOR 267K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2673-F
A5R54	0698-3262	1	2	RESISTOR 40.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
A5R55	0698-3262	1		RESISTOR 40.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
A5R56	0757-0277	8	2	RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A5R57	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A5R58	0757-0470	3	1	RESISTOR 162K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1623-F
A5U1	1826-0412	1	1	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A5U2	1906-0096	7	1	DIODE-MDA202 200V	04713	MDA202

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	00314-66506	4	1	PC ASSEMBLY-LINE SWITCH	28480	00314-66506
A6J1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6J11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6S1	3101-2300	6	2	SWITCH-SLIDE DPDT	28480	3101-2300
A6S2	3101-2300	6		SWITCH-SLIDE DPDT	28480	3101-2300
A8	03314-66508	2	1	OUTPUT BOARD	28480	03314-66508
A8C1	0180-2506	7	2	CAPACITOR-FXD 470UF+50-10% 25VDC AL	28480	0180-2506
A8C2	0180-2506	7		CAPACITOR-FXD 470UF+50-10% 25VDC AL	28480	0180-2506
A8C3	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A8C4	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A8C5	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C6	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C7	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C8	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C9	0160-2236	8	1	CAPACITOR-FXD 1PF +-.25PF 500VDC CER	28480	0160-2236
A8C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C11	0160-4810	8		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A8C12	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C13	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C14	0160-4810	8		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A8C15	0160-4810	8		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A8C16	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A8C17	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C18	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A8C19	0160-4807	3	2	CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A8C20	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A8C21	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C22	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C23	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C24	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C25	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C26	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C27	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A8C28	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A8C29	0121-0487	5	1	CAPACITOR-V TRMR-PSTN 1-3.5PF 300V	80031	2222-809-05001
A8C30	0160-4808	4		CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A8CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR5	1902-0025	4	2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A8CR6	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A8CR7	1902-0960	6		DIODE-ZNR RV 5% DO-35 PD=.4W	28480	1902-0960
A8CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8J1	1251-6254	2		CONNECTOR-SGL CONT RTANG-F	28480	1251-6254
A8J2	1250-1810	7		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1810
A8J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A8K1	0490-1270	7		RELAY-REED	28480	0490-1270
A8K2	0490-1270	7		RELAY-REED	28480	0490-1270
A8K3	0490-1270	7		RELAY-REED	28480	0490-1270
A8K4	0490-1270	7		RELAY-REED	28480	0490-1270
A8K5	0490-1270	7		RELAY-REED	28480	0490-1270
A8K6	0490-1270	7		RELAY-REED	28480	0490-1270
A8K7	0490-1270	7		RELAY-REED	28480	0490-1270
A8K8	0490-1270	7		RELAY-REED	28480	0490-1270
A8L1	9140-0746	8	1	INDUCTOR 400UH		
A8L3	9100-1791	1	2	IDCTR 290 NH 20%	28480	9100-1791
A8L4	9100-1791	1	2	IDCTR 290 NH 20%	28480	9100-1791
A8L5-A8L12	9170-0894	0		CORE-MAGNETIC	28480	9170-0894

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8MP1	03314-01101	5	1	OUTPUT HEAT SINK	28480	03314-01101
A8MP1a	1390-0457	9	2	FASTENER-SNAP-IN PLGR 0.076 IN - .165 IN	28480	1390-0457
A8MP1c	1390-0457	9		FASTENER-SNAP-IN PLGR 0.076 IN - .165 IN	28480	1390-0457
A8MP1b	1390-0458	0		FASTENER-SNAP-IN GROM 0.076 IN - .165 IN	28480	1390-0458
A8MP1d	1390-0458	0	2	FASTENER-SNAP-IN GROM 0.076 IN - .165 IN	28480	1390-0458
A8Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q3	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q5	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A8Q6	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A8Q7	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A8Q8	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A8Q9	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A8Q10	1854-0795	2		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A8Q11	1853-0495	7	1	TRANSISTOR PNP PD=1W FT=1GHZ	28480	1853-0495
A8Q12	1854-0876	0	1	TRANSISTOR NPN PD=1W FT=1GHZ	28480	1854-0876
A8Q13	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8R1	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A8R2	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A8R3	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
A8R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R7	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A8R8	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R13	8150-3375	5		JUMPER WIRE-ELEC	28480	8150-3375
A8R14	0757-0440	7		RESISTOR 7.5K .01 1/8	28480	0757-0440
A8R15	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A8R16	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A8R17	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A8R18	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A8R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R21	0698-3178	8	2	RESISTOR 487 1% .125W F TC=0+-100	24546	C4-1/8-T0-487R-F
A8R22	0698-3178	8		RESISTOR 487 1% .125W F TC=0+-100	24546	C4-1/8-T0-487R-F
A8R23	0757-0397	3	2	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A8R24	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A8R25	0698-7171	9	1	RESISTOR 1.73 1% .25W F TC=0+-100	11502	TF07-1/4-T0-1R73-F
A8R26	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R27	0698-4421	6		RESISTOR 249 1% .125W F TC=0+-100	24546	C4-1/8-T0-249R-F
A8R28	0698-4421	6		RESISTOR 249 1% .125W F TC=0+-100	24546	C4-1/8-T0-249R-F
A8R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R30	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R31	0698-8011	8	4	RESISTOR 25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-25R0-B
A8R32	0698-8011	8		RESISTOR 25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-25R0-B
A8R33	0698-8011	8		RESISTOR 25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-25R0-B
A8R34	0698-8011	8		RESISTOR 25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-25R0-B
A8R35	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A8R36	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A8R37	0698-6979	3	2	RESISTOR 111.1K .1% .125W F TC=0+-25	28480	0698-6979
A8R38	0698-6979	3		RESISTOR 111.1K .1% .125W F TC=0+-25	28480	0698-6979
A8R39	0757-0803	8	1	RESISTOR 26.1 1% .5W F TC=0+-100	28480	0757-0803
A8R41	0698-0063	4		RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-5231-F
A8R42	0698-0063	4		RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-5231-F
A8R51	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R52	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R60	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A8R61	0699-0999	7	1	RESISTOR-FXD 57.2 OHM .001%	28480	0699-0999
A8R62	0699-0633	6	1	RESISTOR 2.475K .1% .125W F TC=0+-25	28480	0699-0633
A8R63	0698-8258	5	1	RESISTOR 247.5 .1% .25W F TC=0+-25	19701	MF52C1/4-T9-247R5-B
A8R64	0699-0641	6	1	RESISTOR 24.75K .1% .125W F TC=0+-25	28480	0699-0641
A8R65	0699-0627	8	1	RESISTOR 305.6 .1% .25W F TC=0+-25	28480	0699-0627
A8R66	0699-0803	2	1	RESISTOR 65.7 .1% 2W F TC=0+-25	28480	0699-0803
A8R67	0699-0626	7	1	RESISTOR 3.056K .1% .125W F TC=0+-25	28480	0699-0626
A8R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R69	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A8R70	0698-4464	7	1	RESISTOR 887 1% .125W F TC=0+-100	24546	C4-1/8-T0-887R-F
A8R71	0698-4880	1	1	RESISTOR 807 1% .5W F TC=0+-100	28480	0698-4880
A8SG1	1970-0052	0	1	TUBE-ELECTRON SURGE V PTCTR	28480	1970-0052

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8U1	1826-0043	4	1	IC OP AMP GP TO-99 PKG	27680	CA3O7T
A8U2	1826-0139	9		IC OP AMP GP DUAL 8-DIP-P PKG	27680	CA1458G
A8U4	1858-0048	6	1	TRANSISTOR ARRAY 16-PIN PLSTC DIP	27680	CA3082E

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS PARTS FOR 3314A		
F1	2110-0312	4	1	FUSE 1A 250V TO 1.25X.25 UL	28480	2110-0312
F1**	2110-0202	1		FUSE .5A 250V TO 1.25X.25 UL	28480	2110-0202
MP1A	5061-1979	9	1	COVER- U TOP	28480	5061-1979
MP1B	5060-9803	2	1	HANDLE-SIDE STRAP	28480	5060-9803
MP1C	5040-7219	8	1	STRAP HANDLE CAP- FRONT	28480	5040-7219
MP1D	5040-7220	1	1	STRAP HANDLE CAP- REAR	28480	5040-7220
MP2A	5060-9964	6	1	BOTTOM COVER	28480	5060-9964
MP2B	5040-7201	8	2	FOOT	28480	5040-7201
MP2C	5040-7222	3	2	FOOT-NON SKID	28480	5040-7222
MP2D	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP2E	5001-2221	0	1	INFORMATION TRAY	28480	5001-2221
MP2F	9320-4963	1	1	INFORMATION CARD	28480	9320-4963
MP2G	9320-4964	2	1	INFORMATION CARD	28480	9320-4964
MP2H	9320-4965	3	1	INFORMATION CARD	28480	9320-4965
MP2I	1460-1345	5		TILT STAND SST	28480	1460-1345
MP2J	5040-7201	8		FOOT	28480	5040-7201
MP2K	5040-7222	3		FOOT-NON SKID	28480	5040-7222
MP3A	5001-0439	8	2	SIDE TRIM	28480	5001-0439
MP3B	5040-7203	0	1	TRIM-TOP	28480	5040-7203
MP3C	5001-0439	8		SIDE TRIM	28480	5001-0439
MP4A	5020-8815	0	1	FRAME-FRONT	28480	5020-8815
MP4B	5020-8816	1	1	FRAME-REAR	28480	5020-8816
MP4C	5020-8836	5	2	STRUT-CORNER	28480	5020-8836
MP4D	5020-8836	5		STRUT-CORNER	28480	5020-8836
MP5A	03314-00201	4	1	SUB-PANEL	28480	03314-00201
MP5B	5040-6927	3	1	DIVIDER STRIP	28480	5040-6927
MP5C	03314-04301	3	1	DRESS PANEL	28480	03314-04301
MP5D	1250-1717	0	6	BNC JACK	28480	1250-1717
MP5E	1250-1717	0		BNC JACK	28480	1250-1717
MP5F	1250-1717	0		BNC JACK	28480	1250-1717
MP5G	1250-1717	0		BNC JACK	28480	1250-1717
MP5H	5040-0345	7	2	INSULATOR-CONNECTOR	28480	5040-0345
MP5I	5040-0345	7		INSULATOR-CONNECTOR	28480	5040-0345
MP5J	8160-0376	0	1	RFI RING	28480	8160-0376
MP5M	03314-69301	9	1	FRONT PANEL LENS ASSEMBLY	28480	03314-69301
MP5N	0370-3045	4	1	KNOB-3/4 RND	28480	0370-3045
MP5O	03314-69302	0	1	ANN FRAME ASSEMBLY	28480	03314-69302
MP6A	03314-00202	5	1	REAR PANEL	28480	03314-00202
MP6B	1250-1717	0		BNC JACK	28480	1250-1717
MP6C	1250-1717	0		BNC JACK	28480	1250-1717
MP6D	03314-68501	9	1	FAN ASSEMBLY	28480	03314-68501
MP6F	2110-0564	8	1	FUSEHOLDER BODY 12A MAX FOR UL	H2027	031.1657
MP6G	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
MP6H	2110-0569	3	1	FUSEHOLDER COMPONENT NUT; THREAD M12.7	28480	2110-0569
MP6I	1400-0090	9	1	FUSEHOLDER COMPONENT FOR USE ON	28480	1400-0090
MP6K	35601-04103	8	1	COVER ASSEMBLY-TRANSFORMER	28480	35601-04103
MP6L	6960-0086	4	1	NYLON HOLE PLUG	28480	6960-0086
MP6M	7121-1980	2	1	LABEL-WARNING	28480	7121-1980
MP7A	03314-00101	3	1	MAIN DECK	28480	03314-00101
MP7C	03314-00602	9	1	SHIELD-VCO BOTTOM	28480	03314-00602
MP7DΔ3	03314-00608	5	1	SHIELD-VCO TOP	28480	03314-00608
MP7E	1251-6972	1	1	CONNECTOR	28480	1251-6972
MP7F	1251-7153	2	1	CONNECTOR-4 PIN MALE	28480	1251-7153
MP7G	03314-00606	3	1	CABLE SHIELD 1	28480	03314-00606
MP7H	03314-00607	4	1	CABLE SHIELD 2	28480	03314-00607
MP7I	1400-0054	5	1	CLAMP-CABLE	28480	1400-0054
MP7L	03314-00604	1	1	SHIELD CONT/HEAT SINK	28480	03314-00604
MP7M	03314-24101	3	2	INSULATOR-CONNECTOR	28480	03314-24101
MP7N	03314-00603	0	1	SHIELD-TRANSFORMER	28480	03314-00603
MP7O	03314-00605	2	1	SHIELD-LINE SWITCH	28480	03314-00605
MP7P	03314-24191	3		INSULATOR-CONNECTOR	28480	03314-24191
MP8	11048-60001	2	1	TERMINAL-FEED THRU	28480	11048-60001
MP9A	5041-0276	5	5	KEY CAP- UL PEARL	28480	5041-0276
MP9B	5041-0276	5		KEY CAP- UL PEARL	28480	5041-0276
MP9C	5041-0276	5		KEY CAP- UL PEARL	28480	5041-0276
MP9D	5041-0276	5		KEY CAP- UL PEARL	28480	5041-0276
MP9E	5041-0276	5		KEY CAP- UL PEARL	28480	5041-0276
MP9F	5041-0441	6	1	KEY CAP- S.BLUE	28480	5041-0441
MP9G	5041-2019	8	1	KEY CAP- GEN	28480	5041-2019
MP9H	5041-2020	1	1	KEY CAP- BST	28480	5041-2020
MP9I	5041-2021	2	1	KEY CAP- PHASE LOCK	28480	5041-2021
MP9J	5041-2023	4	1	KEY CAP- LCL	28480	5041-2023
MP9K	5041-2024	5	1	KEY CAP- ARB	28480	5041-2024
MP9L	5041-2025	6	1	KEY CAP- PRE SET	28480	5041-2025
MP9M	5041-2034	7	1	KEY CAP- STO	28480	5041-2034
MP9N	5041-2035	8	1	KEY CAP- RCL	28480	5041-2035
MP9O	5041-2036	9	4	KEY CAP- 1/4(ARROW)	28480	5041-2036
MP9P	5041-2036	9		KEY CAP- 1/4(ARROW)	28480	5041-2036
MP9Q	5041-2036	9		KEY CAP- 1/4(ARROW)	28480	5041-2036
MP9R	5041-2036	9		KEY CAP- 1/4(ARROW)	28480	5041-2036
MP9S	5041-2037	0	1	KEY CAP- SYM	28480	5041-2037
MP9T	5041-2038	1	1	KEY CAP- N	28480	5041-2038
MP9U	5041-2039	2	1	KEY CAP- PHASE	28480	5041-2039

See introduction to this section for ordering information
*Indicates factory selected value
**Fuse required for 220/240V line voltages

Table 6-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP9V	5041-2040	5	1	KEY CAP- SW/TR-INTVL	28480	5041-2040
MP9W	5041-2041	6	1	KEY CAP- MAN SWEEP	28480	5041-2041
MP9X	5041-2042	7	1	KEY CAP- MKR	28480	5041-2042
MP9Y	5041-2043	8	1	KEY CAP- FREQ	28480	5041-2043
MP9Z	5041-2044	9	1	KEY CAP- AMPTD	28480	5041-2044
MP10A	5041-2045	0	1	KEY CAP- OFFSET	28480	5041-2045
MP10B	5041-2046	1	1	KEY CAP- START FREQ	28480	5041-2046
MP10C	5041-2047	2	1	KEY CAP- STOP FREQ	28480	5041-2047
MP10D	5041-2048	3	1	KEY CAP- SWEEP	28480	5041-2048
MP100A	0340-0564	3	5	INSULATOR	28480	0340-0564
MP100B	3050-0440	2	2	WASHER-SHLDR NO. 4 .115-IN-ID .2-IN-OD	28480	3050-0440
MP101A	0340-0564	3		INSULATOR	28480	0340-0564
MP101B	3050-0440	2		WASHER-SHLDR NO. 4 .115-IN-ID .2-IN-OD	28480	3050-0440
MP108A	0340-0564	3		INSULATOR	28480	0340-0564
T1	9100-4253	6	1	TRANSFORMER-POWER	28480	9100-4253
W1	03314-61601	6	1	CABLE ASSEMBLY-FRONT POWER	28480	03314-61601
W2	03314-61602	7	1	CABLE ASSEMBLY-REAR POWER	28480	03314-61602
W3	03314-61603	8	1	CABLE HP-IB	28480	03314-61603
W7	03314-61607	2	1	CABLE ASSEMBLY-SYNC	28480	03314-61607
W8	03314-61608	3	1	CABLE, COAX (A4 TO A8)	28480	03314-61608
W12	03314-61612	9	1	CABLE, RIBBON (A4 TO A8)	28480	03314-61612
W13	03314-61613	0	1	CABLE, COAX (W17 OR A5 TO MAIN OUT)	28480	03314-61613
W17	03314-61617	4	1	CABLE, COAX (A8 TO W13 OR A5)	28480	03314-61617
W20**	03314-61620	9	1	COAX CABLE HARNESS	28480	03314-61620
W21	8120-3150	1		16 PIN RIBBON (A4 TO A2)		
W22	8120-3593	6		22 PIN RIBBON (A3 TO A2)		
W23	8120-3606	0		22 PIN RIBBON (A1 TO A2)		

NOTE

Individually marked cables, making up cable harness W20, are not available. Unmarked cables may be ordered using the following part numbers.

MARKED CABLES	UNMARKED CABLE PART NUMBER
AM, FM-VCO, Z AXIS CABLES	8120-2585
EXT TRIG CABLE	8120-2587

See introduction to this section for ordering information
*Indicates factory selected value

SECTION VII

MANUAL BACKDATING AND CHANGES

7.1. INTRODUCTION

This revision of the manual applies directly to instruments in the serial number range indicated on the title page. Earlier versions of this instrument (serial numbers lower than shown on title page), differ slightly in design and in some cases appearance. The information presented in this section adapts the manual to any earlier instrument.

7.2. MANUAL CHANGE SHEETS

As -hp- continues to improve the performance of the 3314A, corrections and modifications to the manual may be required. These changes are documented by a yellow "MANUAL CHANGES" supplement. In order to keep the manual up to date, one should periodically request the most recent supplement which is available from the nearest HP Sales and Service Office. Any changes shown on the supplement sheet which apply to your instrument (identified by serial number), should be implemented into the manual.

7.3. FORMAT

Design and component changes within the instrument are noted by the "Δ" symbol. The numbered delta refers to the numbered delta in the backdating section and its corresponding change. As a convenience, it is recommended that all changes which pertain to your instrument be copied on the page where the discrepancies occur.

Δ1 Applies to instruments with Serial Number 2141A00150 and lower.

Page 8-69/8-70, Figure 8-31.

Instruments in this Serial Number range do not have A3CR123.

*** NOTE ***

This range of instruments must be modified with A3CR123 (P/N 1902-3301), if they are to be retrofitted with Option 001 (X3 Amplifier).

Δ2 Applies to instruments with Serial Number 2141A00200 and lower.

Page 2-1, Figure 2-2, Page 8-69/8-70, Figure 8-31.

Instruments in the above Serial Number range contain one of the following fuses:

Line Voltage	Fuse Value	-hp- P/N
110/120V	0.8A SLO BLOW	2110-0336
220/240V	0.4A SLO BLOW	2110-0340

Instruments in this range should continue to use these fuses since the instrument's back panel correctly identifies them. If, however, an older rear panel is to be replaced with a newer one (03314-00202), order one of the fuses listed on page 2-1 as well.

Δ3 Applies to instruments with Serial Number 2141A01515 and lower.

Page 5-14, Paragraph 5-18. (LOW FREQ HARMONIC DISTORTION ADJ)

When performing this adjustment on instruments in this Serial Number range, skip Steps G-J. Continue with Steps K-P until the adjustment is completed.

Page 6-27.

The old part number for the "VCO Top Shield" for instruments in this Serial number range is 03314-00601. When replacing this shield, order part number 03314-00608.

Page 8-37, Figure 8-13.

Instruments in this range do not have A1C108 and A1C109.

Page 8-39/8-40, Figure 8-15.

For instruments in this range, A1R211 and A1R212 are 0.125w resistors (P/N 0757-0401).

For instruments in this range, A1R213 and A1R214 are 49.9 ohm resistors (P/N 0757-0277).

Instruments in this range do not have A1R235.

Page 8-47/8-48, Figure 8-20.

For instruments in this range, A1R307 and A1R314 are 49.9 ohm resistors (P/N 0757-0277).

For instruments in this range, A1R306 and A1R315 are 23.7 ohm resistors (P/N 0698-3431).

Instruments in this range do not have A1R322 or A1Q305.

Page 8-51/8-52, Figure 8-22.

Instruments in this range do not have A1CR503, A1C531, A1R561, A1R562, A1R563, A1L506, A1L505, A1C543, or A1C541.

Δ4 Applies to instruments with Serial Number 2141A01156 and lower.

Page 8-69/8-70, Figure 8-31.

Instruments in this serial number range do not have A3CR124 or A3CR125.

Page 6-17, Table 6-3.

Instruments in this serial number range do not have A3J8. These instruments contain eight Rom SA start/stop connectors instead (A3SA1 — A3SA8, P/N 1251-6427).

Page 6-20, Table 6-3.

For instruments in this Serial Number range, A3U221 is a SN74LS02N (P/N 1820-1144).

Page 8-13 through 8-17, Signature Analyzer Tests #1-#5.

For instruments in this Serial Number range, the Signature Analyzer Tests found on the above pages will not give the correct signatures. Use the following Analyzer tests to troubleshoot a digital problem.

Page 8-71/8-72, Figure 8-32.

For instruments in this Serial Number range, U204a and U221c are not used. The 2 MHz clock that drives U232 pins 9 and 15 originates from U201 pin 5. The SA clock originates from U201b pin 9.

SA TEST #1

Signature Analyzer set up:

CLOCK/GROUND SA BUS PHASE 2 CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP SA A15 STR/STP CONNECTOR
BOTH POSITIVE TRIGGER

Procedure:

Set A3 S1 for positions 1 and 2 closed.
Cycle power.
Take signatures.
+5 VOLT = 0003

SIGNATURES

U206

Pin #	Signatures
26	0000
27	0003
28	0000
29	0003
30	0003
31	0003
32	0003
33	0003
9	UUUU
10	FFFF
11	8484
12	P763
13	1U5P
14	0356
15	U759
16	6F9A
17	7791
18	6321
19	37C5
20	6U28
22	4FCA
23	4868
24	9UP1
25	0002

U200

Pin #	Signatures
1	29A4
2	29A7
12	0000
13	0003

U224

Pin #	Signatures
1	U759
2	29A7
3	C755
4	6F9A
5	29A7
6	1214
11	PPH8
12	29A7
13	0356

U215

Pin #	Signatures
2	7791
5	6321
6	37C5
9	6U28
12	4FCA
15	4868
16	9UP1
19	0002

U218

Pin #	Signatures
1	4868
2	9UP1
3	0002
4	0000
5	0000
6	0003
7	2302
9	F9CF
10	534H
11	C9U1
12	1183
13	64HF
14	29A4
15	5FUA

U221

Pin #	Signatures
4	29A7
5	29A4
6	0000
11	0000
12	29A4
13	29A7

U237

Pin #	Signatures
1	7791
2	29A7
12	U15A
13	0003

U239

Pin #	Signatures
1	7791
2	6F9A
12	4493
13	29A4

U216

Pin #	Signatures
2	UUUU
5	FFFF
6	8484
9	P763
12	1U5P
15	0356
16	U759
19	6F9A

U219

Pin #	Signatures
1	37C5
2	6U28
3	4FCA
4	0000
5	5FUA
6	0003
7	A689
9	A275
10	9842
11	8P4F
12	5P1A
13	282A
14	02H5
15	3APP

U223

Pin #	Signatures
1	282A
2	5P1A
3	A275
4	A689
5	0003
6	04UU
8	UF80
9	04UU
10	0003
11	U87F
12	U87F
13	8P4F

SA TEST #2

Signature Analyzer set up:

CLOCK/GROUND SA BUS PHASE 2 CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP SEE TABLE 7-1
BOTH NEGATIVE TRIGGERS

Procedure:

Set A3 S1 for positions 1 and 2 closed.
Cycle power.
Move START/STOP to SA ROM connector of ROM under test. (See Table 7-1)
Take signatures of ROM under test.
+5 Volt = 1180

NOTE

IF BAD SIGNATURES ARE FOUND ON MORE THAN ONE ROM OR MULTIPLE FAILURES ON A SINGLE ROM MAKE SURE THAT THE A' BUS SIGNATURES ARE CORRECT (SA TEST #1: U215 and U216)

U238 (ROM #1)		U236 (ROM #2)		U210 (ROM #3)	
Pin #	**Signature**	**Pin #**	**Signature**	**Pin #**	**Signature**
9	P097	9	4A7C	9	7374
10	7561	10	2U36	10	50A3
11	620P	11	5020	11	UC66
13	HU7P	13	0CA0	13	32FH
14	PA21	14	P930	14	225A
15	10FH	15	9CAP	15	A60C
16	77F8	16	6F22	16	P902
17	31FH	17	160P	17	029F

U209 (ROM #4)		U208 (ROM #5)		U207 (ROM #6)	
Pin #	**Signature**	**Pin #**	**Signature**	**Pin #**	**Signature**
9	1843	9	0U3H	9	954U
10	0F9C	10	F7A9	10	CF1C
11	2H9A	11	92F2	11	A60C
13	9321	13	4CP4	13	2A24
14	295F	14	UPPA	14	2313
15	2A27	15	9558	15	P9F9
16	7H72	16	F849	16	6362
17	245C	17	293F	17	A1A7

Table 7-1. SA Start/Stop Connections

START/STOP POSITIONS:	
U238 ROM #1	START (NEGATIVE TRIGGER) SA ROM #1 TEST POINT STOP (NEGATIVE TRIGGER) SA ROM #2 TEST POINT
U236 ROM #2	START (NEGATIVE TRIGGER) SA ROM #2 TEST POINT STOP (NEGATIVE TRIGGER) SA ROM #3 TEST POINT
U210 ROM #3	START (NEGATIVE TRIGGER) SA ROM #3 TEST POINT STOP (NEGATIVE TRIGGER) SA ROM #4 TEST POINT
U209 ROM #4	START (NEGATIVE TRIGGER) SA ROM #4 TEST POINT STOP (NEGATIVE TRIGGER) SA ROM #5 TEST POINT
U208 ROM #5	START (NEGATIVE TRIGGER) SA ROM #5 TEST POINT STOP (NEGATIVE TRIGGER) SA ROM #6 TEST POINT
U207 ROM #6	START (NEGATIVE TRIGGER) SA ROM #6 TEST POINT STOP (NEGATIVE TRIGGER) U218 PIN 15

SA TEST #4

Signature Analyzer set up:
CLOCK/GROUND SA BUS PHASE 2 CONNECTOR
CLOCK NEGATIVE TRIGGER
START/STOP ROM#3 SA CONNECTOR
BOTH POSITIVE TRIGGER

Procedure:

Set A3 S1 for positions 3 closed.
Cycle power.
Take signatures.
+5 VOLT = 8094

NOTE

DISCONNECT ANY HP-IB CONNECTORS FROM THE REAR PANEL

Signatures

U300		U301		U302	
Pin #	**Signature**	**Pin #**	**Signature**	**Pin #**	**Signature**
3	CC74	1	370A	1	370A
5	2C8F	2	8094	2	1172
6	8094	3	8094	3	4595
7	84F4	4	370A	4	49H2
8	H56A	5	1761	5	U341
9	6850	6	8094	6	8556
10	A939	7	8094	7	57U2
11	6F82	8	8094	8	5800
12	U47C	9	8094	9	87P2
13	UP52	12	8094	12	87P2
14	5509	13	8094	13	5800
15	HH39	14	8094	14	57U2
16	8094	15	8094	15	8556
17	370A	16	1761	16	U341
18	1761	17	370A	17	49H2
19	8094	18	8094	18	4595
21	8094	19	8094	19	1172
22	8094				
23	8094				
25	8094				
26	8094				
27	370A				
28	370A				
29	87P2				
30	5800				
31	57U2				
32	8556				
33	U341				
34	49H2				
35	4595				
36	1172				
37	5626				
38	8475				
39	PH3H				
40	0000				

SA TEST #5

Signature Analyzer set up:

CLOCK/GROUND SA BUS PHASE 2 CONNECTOR
CLOCK NEGATIVE TRIGGER
START/STOP SA ROM 3 CONNECTOR
BOTH POSITIVE TRIGGER

Procedure :

Set A3S1 for position 4 closed.
Cycle Power.
Take Signatures.
+5 Volt = 0803

SIGNATURES

NOTE

( ) INDICATES SIGNATURES WITH THE CONNECTOR UNDER TEST REMOVED.

J3		J2	
Pin #	**Signature**	**Pin #**	**Signature**
1	C449	1	C449
2	PPAA	2	PPAA
3	HA95	3	HA95
4	2CU3	4	2CU3
5	0045 (4264)	5	4264
6	201F (3330)	6	3330
7	CCCA (755P)	7	755P
8	9978	8	9978
9	PAP7	9	PAP7
10	4CO8	10	4CO8
11	13PC	11	13PC
12	F965	12	7HP3
13	KEYED PIN	13	C377
14	0000	14	0000
15	0000	15	0003
16	0803	16	0000
17	0000	17	0803
18	0000	18	0000 (0803)
19	0000	19	UNSTABLE
20	0803	20	UNSTABLE (0000)
21	0803	21	3155
22	0803	22	0803

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section contains information to repair the 3314A Function Generator. If you are not familiar with the 3314A, review the Safety Considerations before proceeding to the Troubleshooting Section.

8-2. SAFETY CONSIDERATIONS

This section contains WARNINGS and CAUTIONS which must be followed for your protection and to avoid damage to the equipment.

WARNING

Maintenance described herein is performed with power supplied to the instrument and protective covers removed. Such maintenance should be performed by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power cord should be removed.

WARNING

Before any repair is completed, ensure that all safety features are intact and functioning and that all necessary parts are connected to their protective grounding means.

WARNING

Line voltage (110Vrms to 240Vrms) is present on the following components whenever the power is applied:

Rear Panel Components
The Power Line Filter E1
The Power Line Fuse Holder
The Line Switch PC Assembly (A6)
The Fan (B1)

Cables
The Power Cable W1 from the Line Switch Assembly to
The Line Switch (located on the front panel).

PC Assemblies
A4, Front Panel & Keyboard
A6, Line Switch PC Assembly

Front Panel Components
The Line Switch S1

CAUTION

Before troubleshooting the Power Supply, disconnect the cables to the other PC boards (J1, J2, J3, J102) and remove jumper A3W100. This insures that the Controller part of the A3 PC board and all of the other boards are not damaged while working on the Power Supply.

CAUTION

Review the STATIC SENSITIVITY and CLEAN HANDLING topics that follow. Failure to follow these procedures may cause unnecessary component waste.

8-3. STATIC SENSITIVITY

Several components on the A1, A2, A3, and A8 PC Assemblies will be destroyed if you do not use special handling techniques. It is important to:

1. Use an electrically conductive work surface such as the Model 8005, Field Service Work Station made by 3M. The Model 8005 contains a conductive work surface, a wrist strap and a grounding cord.

2. Make sure the 3314A's power cord is removed before soldering or unsoldering any components.

3. Store all components in conductive containers.

8-4. CLEAN HANDLING

The A1 PC Assembly must be clean handled. Solder flux and body oils must be removed (especially from the area under the shield). or the 3314A's frequency and symmetry accuracy in the lowest portions of each range may be degraded. This occurs when the integrating currents are very low (bottom of range) and the contaminants create leakage paths, shunting current away

from the integrating capacitor. Care should be taken to keep flux remover or any cleaning solutions away from the relay coils.

8-5. PARTS KITS

The Sine Shaper/Amplitude Control IC (A1U502) has three bias resistors that are factory selected. There is a selection procedure in Section V, however, this procedure is long, involved and is not recommended. Whenever replacing A1U502, order part number 03314-82501.

8-6. EPROM REPLACEMENT

The first 3314A's that were produced have six EPROMs (Electrically Programmable Read Only Memory). These ICs (A3U207, A3U208, A3U209, A3U210, A3U236 and A3U238) contain the 3314A's operating system. When an EPROM fails, all six should be replaced with ROMs (Read Only Memory ICs). The EPROMs can be replaced with ROMs on a 1 to 1 basis. Failed EPROMs (and ROMs) are quickly detected using the ROM/RAM Checksum front panel test. EPROMs can be identified by the erasing window on the top of the IC. Note that this window is probably covered with tape to keep stray UV light out of the IC. This tape should be left in place. Reliability may be marginally improved by also removing the ROM IC sockets and soldering the ROMs directly to the PC assembly.

IC#	ROM Part Number
A3U207	1818-3045
A3U208	1818-3046
A3U209	1818-3047
A3U210	1818-3048
A3U236	1818-3049
A3U238	1818-3050

8-7. THEORY OF OPERATION

This section contains the theory of operation for the Model 3314A Function Generator. The theory is divided into four sections:

1. The Analog Board and Output Amplifier Board (A1 and A8).
2. The Mode Board (A2).
3. The Controller Board and Front Panel Board (A3 and A4).
4. The $\times 3$ Output (A5).

Circuit descriptions are given for unique complex circuits. These descriptions may be helpful when troubleshooting the instrument.

8-8. ANALOG AND OUTPUT BOARDS (A1 and A8)

This section discusses a simplified function generator,a differential integrator, the method used to control the 3314A triangle generator, the Sine Shaper and the Output Amp/Attenuator.

8-9. Basic Function Generator

The block diagram of a basic Function Generator is shown in Figure 8-1. A triangle waveform is generated by charging and discharging capacitor C by alternately switching the current sources Iup and Idn. The time required to charge and discharge the capacitor determines the period of one cycle and, therefore, the frequency.

The triangle waveform from the capacitor is buffered and applied to the Hysteresis Comparator which acts as a two state latch to control the direction of integration. As the triangle waveform alternately crosses the upper and lower switching levels of the input, a square wave is generated at the output of the Hysteresis Comparator. This square wave is fed back to the switch which controls the path of Iup and Idn.

To obtain a sine wave, the triangle wave is shaped by a nonlinear network which varies the attenuation of the input triangle according to its level.

The Current Clamp holds the triangle ramp at a certain level when it is turned on. It accomplishes this by "stealing" current from the capacitor node and is used to turn the output on and off in gated and 1/2 cycle functions.

The output stage consists of a gain control and an output amplifier which allows for different amplitude settings and the proper output impedance. The sync output is a buffered square wave, from the output of the Hysteresis Comparator.

8-10. Basic Triangle Differential Integrator

The 3314A's triangle generation is different from that of a basic function generator because the 3314A uses a differential integrator. A simplified schematic of the differential integrator used in the 3314A is shown in Figure 8-2. Notice that the integrating capacitor is no longer referenced to ground but floats across a differential pair and the integrator currents are both flowing in the same direction. If Sup is high and Sdn is low (during T_1) Q1 is on and Q2 is off. This means that the current Idn is flowing through the integrator capacitor C and both Idn and Iup are flowing through Q1. The net affect of constant current flowing through C is a voltage ramp which is sensed across the collectors of the differential pair and buffered by multi-gain (*1 or *10) stages. The Common Mode Loop assures that the current through the transistor that is turned on is exactly Iup + Idn. This assures that the collectors of the differential pair will not drift towards the supply voltages as a function of the offsets in the currents Iup and Idn. The voltage sensed at the positive input of the Common Mode Loop amplifier should always be -5 VDC for proper operation.

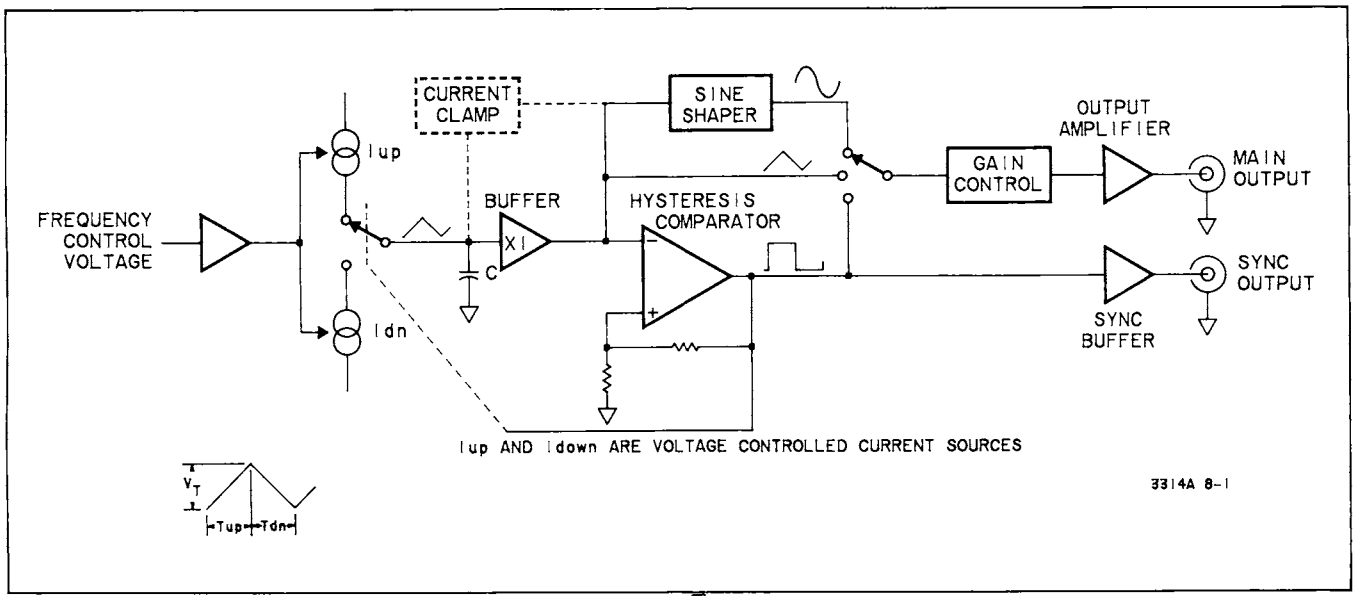


Figure 8-1. Basic Function Generator Block Diagram

The integrating capacitor C varies from 27 pF to 2.77 μF corresponding to frequency ranges of 20 MHz to 200 Hz. The two lowest ranges (20 and 2 Hz) are implemented by changing the multigain buffers from a gain of 1 to a gain of 10. This has the affect of making the integrator ramp over a voltage range 10 times larger, there by simulating capacitances 10 times larger. The integrating currents Iup and Idn are 1/10 their normal value in Range 2 and in all ranges when variable symmetry is active.
The relationship of the integrating capacitors and the frequency ranges is shown in Table 8-1.

The differential outputs from the differential integrator are Tup and Tdn (Triangle up and Triangle dn). These signals are always 1 Volt p-p if measured with respect to ground and 2 Volts p-p if they are measured differentially. The signals always have a −5VDC (X10) or −6VDC (X1) offset.

8-11. Triangle Generator Control in the 3314A

Refer to the block diagram of the 3314A Triangle Generator, Figure 8-3 , for the following discussion.

The Freq/Sym Dac (U502) controls the amount of current (Iup and Idn) flowing into the integrator. The micro-processor writes to the DAC the Frequency and Symmetry required, and the DAC outputs the corresponding currents. Also note that the FM , VCO and Sweeping voltages/currents also change the integration current at this Integrated Circuit. Since the control of the integrating currents, Iup and Idn, has been discussed, the remaining discussion will deal with the control of the direction of integration.

The control of the direction of integration in the integrator depends on the particular mode the 3314A is operating in. Table 8-2 shows the relationship between the different modes and the control signals.

The signals S up and dn are the outputs of the triangle comparator and are used in the normal modes.

The Servo up and dn are signals derived from the Phase Servo Amplifier. The signal contains the information necessary to "servo" the integrator to the proper DC level (set by phase) when the output is required to turn off, as in the Gate Mode. The correct phase that the in-

Table 8-1. Frequency Range Capacitance

Range	C total	C range	X10	Iup/Idn÷10
8	27.7 pF	27.7 pF (C218)	NO	NO
7	277.7 pF	250 pF (C211&C210)	NO	NO
6	2777.7 pF	2500 pF (C207)	NO	NO
5	27777.7 pF	.025 μF (C206)	NO	NO
4	277777.7 pF	.25 μF (C205)	NO	NO
3	2777777.7 pF	2.5 μF (C204)	NO	NO
2	2777777.7 pF	2.5 μF (C204)	YES	NO
1	2777777.7 pF	2.5 μF (C204)	YES	YES

Table 8-2. Integration Controls Signals

	S up & dn	Servo up & dn	Hold	Ramp Mode
Free Run	complete control	don't care	high	high
Burst Mode	Semi-control	controls on HOLD ramp	high-normal low-on the hold ramp	high
ARBitrary	don't care	same control as S up & dn except on last integation ramp	low	low/high during the last vector

tegrator servos to is a function of the Phase Control Voltage (PCV) which comes from the A2 board.

HOLD switches control of the integrator currents from Sup and Sdn to Servo up and Servo dn. This occurs on hold ramp for non-continuous operation.

RAMP MODE switches Servo up and Servo dn from 2 state (identical to Sup and Sdn) to an analog servo signal which drives the integrator to equilibrium, at hold phase.

8-12. Normal Mode (Free Run, Hold Bar=high)

In free run the integrator receives Iup and Idn from the Freq/Sym DAC corresponding to the desired frequency and symmetry. The integrator outputs differential voltage ramps whose directions are controlled by the state of Sup and Sdn. The differential voltage ramps (Tup and Tdn) are then directed to the comparator where the level is sensed and Sup and Sdn determine the correct direction of integration. This process continues until a different mode is selected.

8-13. Servo Mode (Gate/N Cycle/ 1/2 Cycle)

In the modes that require the output of the 3314A to "switch" on and off additional control signals are required. This signal is called Servo and is comprised of the differential signals Servo up and Servo dn. These signals are generated in the Phase Servo Amplifier and are used in the following manner: Servo up and dn stop the integrator at the desired start/stop phase by making Q210a sink Iup and Q210b sink Idn. This results in zero current flowing through the integrating capacitor and keeping the phase constant. Returning control from Servo up and dn to S up and dn starts the integrator ramping again. Servo up and Servo dn are used on the last ramp of the triangle being generated. The relationship between S up and S dn, Servo up and Servo dn, Tup and Tdn, and Hold Bar are shown for different modes in Figure 8-4.

8-14. Servo Mode (ARBitrary Waveform)

When the 3314A is in the ARB mode several changes take place in the Triangle Generation circuitry. Sup and

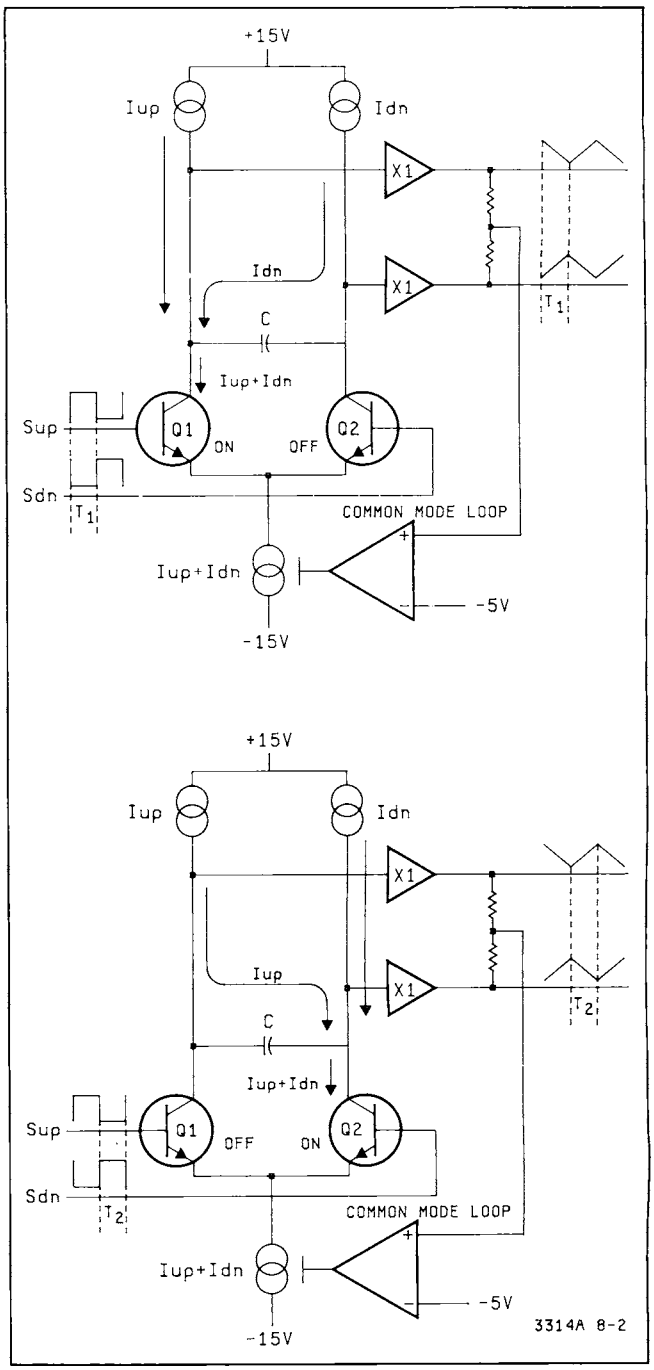


Figure 8-2. Basic Differential Integrator

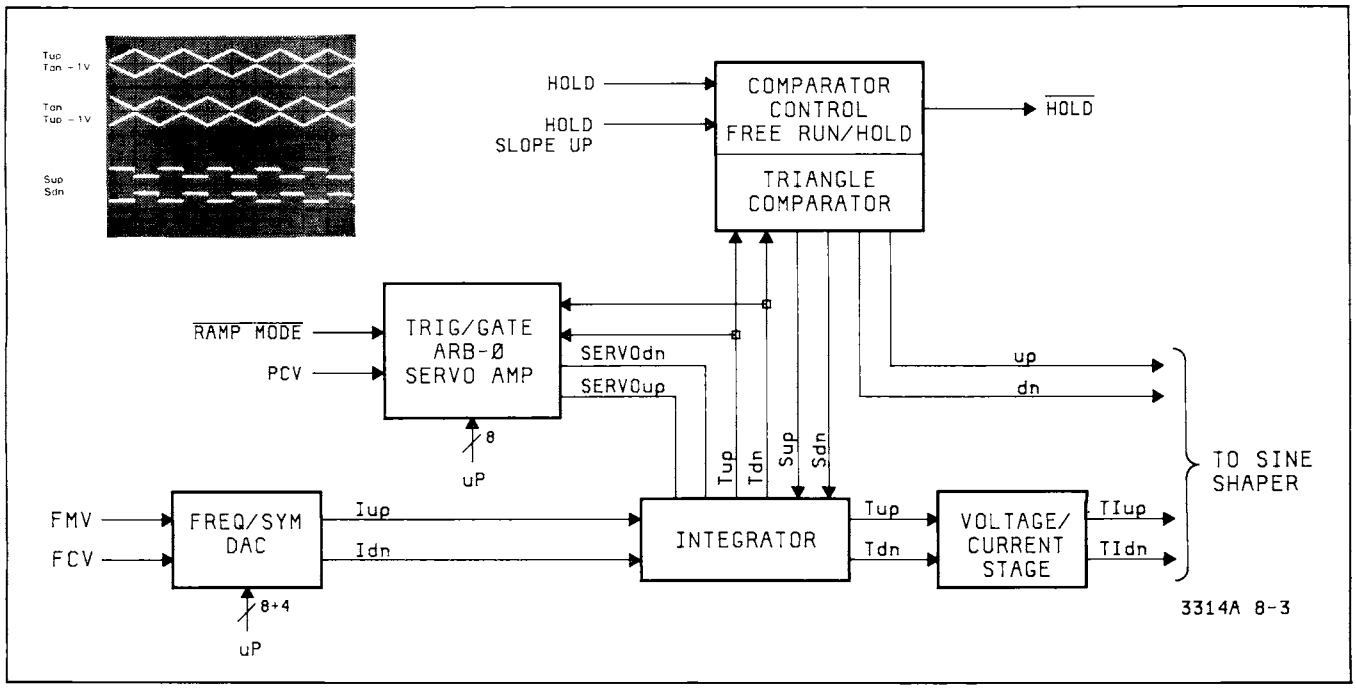


Figure 8-3. 3314A Triangle Generation

Sdn are disabled and Servo up and Servo dn have control of the direction of the integration. The controller writes a new word to the Freq/Sym DAC for each vector. The currents Iup and Idn vary as a function of the height of the vector. Servo up and dn are the direction control lines (similar to S up and dn in Free Run) for every vector except for the last vector when Servo up and dn become Servo signals (similar to Servo up and dn in Gating Modes). The ARB control and timing are controlled by the ARB control/timing block which is written to by the controller board (A3) for each sequence of vectors.

8-15. Transconductance Stage

The transconductance stage transforms the differential voltage signals Tup and Tdn into differential current signals TIup and TI dn. TIup and TIdn are then used as inputs the Sine Shaper/Amplitude Control Hybrid Integrated Circuit.

8-16. The Sine Shaper/Amplitude Control Hybrid IC

Refer to Figure 8-9. The Basic Operation Troubleshooting Diagram for the following discussion.

Sine waves are generated from the triangle waveforms by the Sine Shaper Hybrid integrated circuit. The sine waves are generated by driving a non-linear shaping circuit with a triangle waveform. This is done internal to the integrated circuit and no further discussion is necessary.

The vernier amplitude control of the 3314A is also accomplished with the Sine Shaper Hybrid. The inputs to the integrated circuit are the differential signals: Up and Dn, TIup and TIdn and the Amplitude Control Current (ACI) generated on the A2 board. The amplitude of each function is determined by the value of the ACI.

8-17. Preamplifier

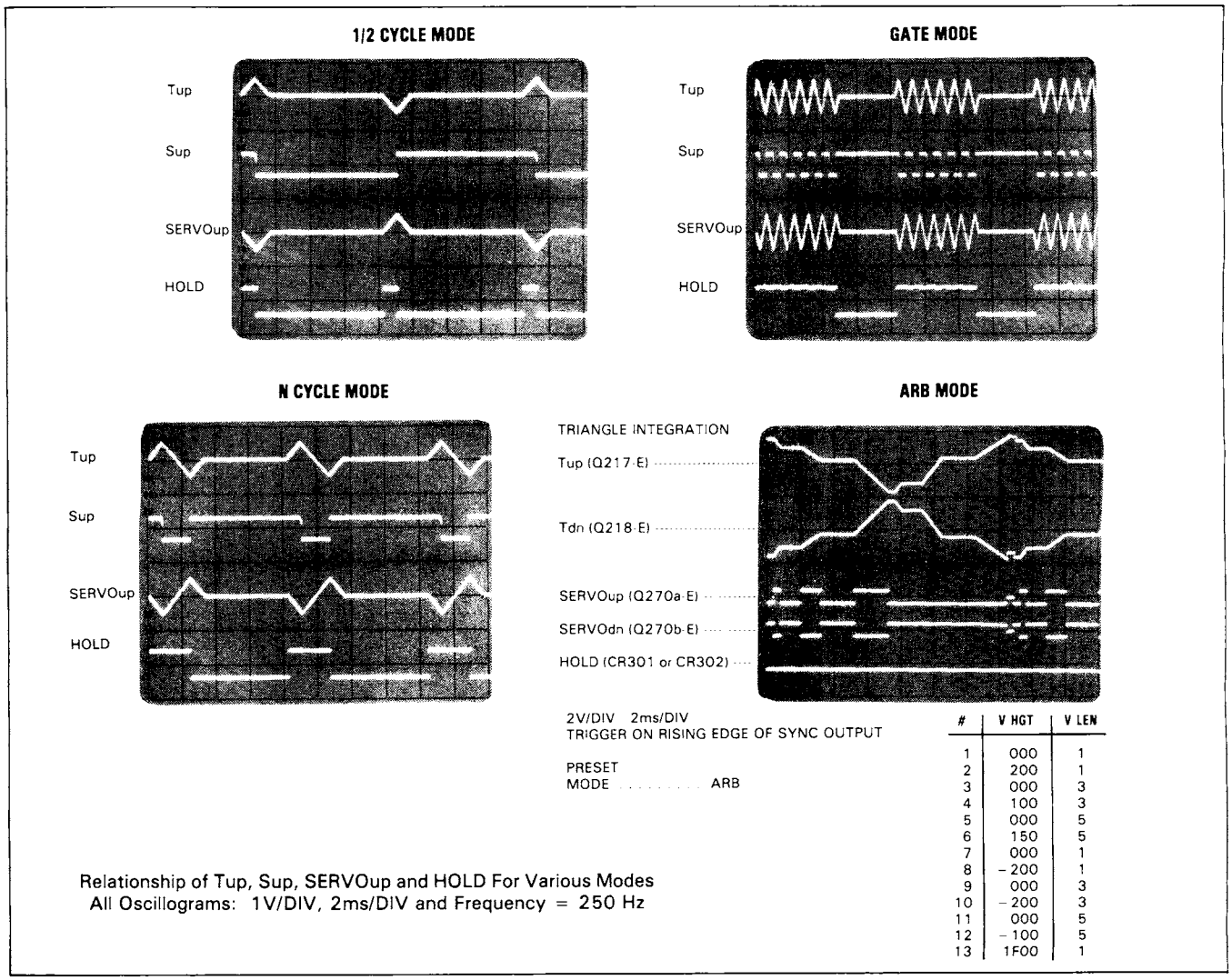
The output of the Sine Shaper/Amplitude Control Hybrid Integrated Circuit is a pair of differential current signals Sig up and Sig dn. These signals are fed into the Preamplifier and transformed into a single output, voltage waveform which represents the final output of the 3314A. This signal is then fed to the output amplifier and step attenuator on the A8 board.

8-18. Output Amplifier and Attenuator (A8)

The output board amplifies the output of the preamp from the A1 board and attenuates the signal according to the amplitude range the 3314A is in. The DC offset current is summed into the output of the A8 board after the attenuator.

8-19. MODE BOARD (A2)

The Mode board function is to control the Triangle Generator in the varied modes found in the 3314A. The control signals for 1/2 Cycle, N Cycle, Gate , Sweeping and Phase Lock Modes are all generated on the Mode Board.



Relationship of Tup, Sup, SERVOup and HOLD For Various Modes
All Oscillograms: 1V/DIV, 2ms/DIV and Frequency = 250 Hz

Figure 8-4. Integrator Control Signals

8-20. DACs On the A2 Board

Refer to the Troubleshooting Block Diagrams, Figures 8-8 through 8-10b, for the following discussion. There are three DACs on the A2 board. They are:

Multiplexed DAC U213 – Controls offset phase (UPCV), start/stop phase (PCV), sweeps (SWP), DC offset voltage (DCV), and the amplitude current (ACI).

AM SCALE DAC U221 – Scales the AM input voltage as a function of the amplitude setting to provide a constant % of modulation as amplitude is varied.

Freq Cal DAC U405 – Offsets the Frequency Control Voltage (FCV) for frequency calibration.

The Multi-plexed DAC controls four different functions. The functions are:

1. UPCV (Unconditioned Phase Control Voltage) – This output is either the Phase Control Voltage or the X-Drive voltage depending on which mode the 3314A is in. The signal is summed with +5 Volts and becomes the X Drive out. It also is buffered and sent to the A1 board where it determines the start/stop phase when the 3314A is in non-continuous modes that require the output to be offset to a specific phase. Note that in linear sweep this line is fed back to the DAC and used for the reference (instead of the normal +10 Volts). This enables the DAC to become a multiplying DAC, letting the X-Drive output always vary from −5 to +5 Volts.

2. Sweep – This output is used in the sweeping modes of the 3314A. In linear sweep the output ranges from –10V to 0V varying the triangle generator frequency over the correct frequency range. In linear sweep a maximum of 2 decades is allowed.

In Log Sweep this output varies logarithmically over the range desired (the micro-processor writes for every step) and the range is automatically changed.

3. DCV (DC offset Voltage) – This output determines the DC offset current summed into the output amplifier. The line is fed into the DC Offset Amplifier located on the A1 board.

4. AMP (Amplitude) – This output controls the amplitude of the 3314A. The AMP line is summed with the AM signal from the front panel and changed into a current. This current (ACI) is then fed into the Sine Shaper/Amplitude Chip where the vernier control (20dB) is located. The function invert is also located on this signal.

The AM Scale DAC scales the AM input voltage as a function of the amplitude range to provide a constant % of modulation as amplitude is varied.

The FREQ CAL DAC is used in the frequency calibration cycle. It offsets the frequency control voltage (FCV) by a calculated cal constant when the microprocessor determines that the output frequency is incorrect (see calibration cycle).

8-21. Phase Locked Loop

Refer to the simplified block diagram of the phase lock loop for the following discussion, Figure 8-5. The Phase Lock circuitry of the 3314A has the following components:

1. Phase Detector
2. Loop Shaping
3. Sample and Hold
4. ÷ N counter
5. Internal or External Trigger
6. Main Generator

The trigger signal (internal or external) is buffered through the trigger comparator and applied to the input of the ÷ N counter. The ÷ N counter divides ,depending on which mode, the trigger signal or the Main Generator output by the programmable number N. The Main generator and the trigger signal are then phase compared by the Phase Detector. The output of the phase detector is then filtered with the Loop Filter and sampled by the Sample and Hold circuit. This sampled voltage is fed back to the 3314A's Main Generator where the frequency is adjusted such that the 3314A's (A1) frequency is exactly in phase with the internal or external signal.

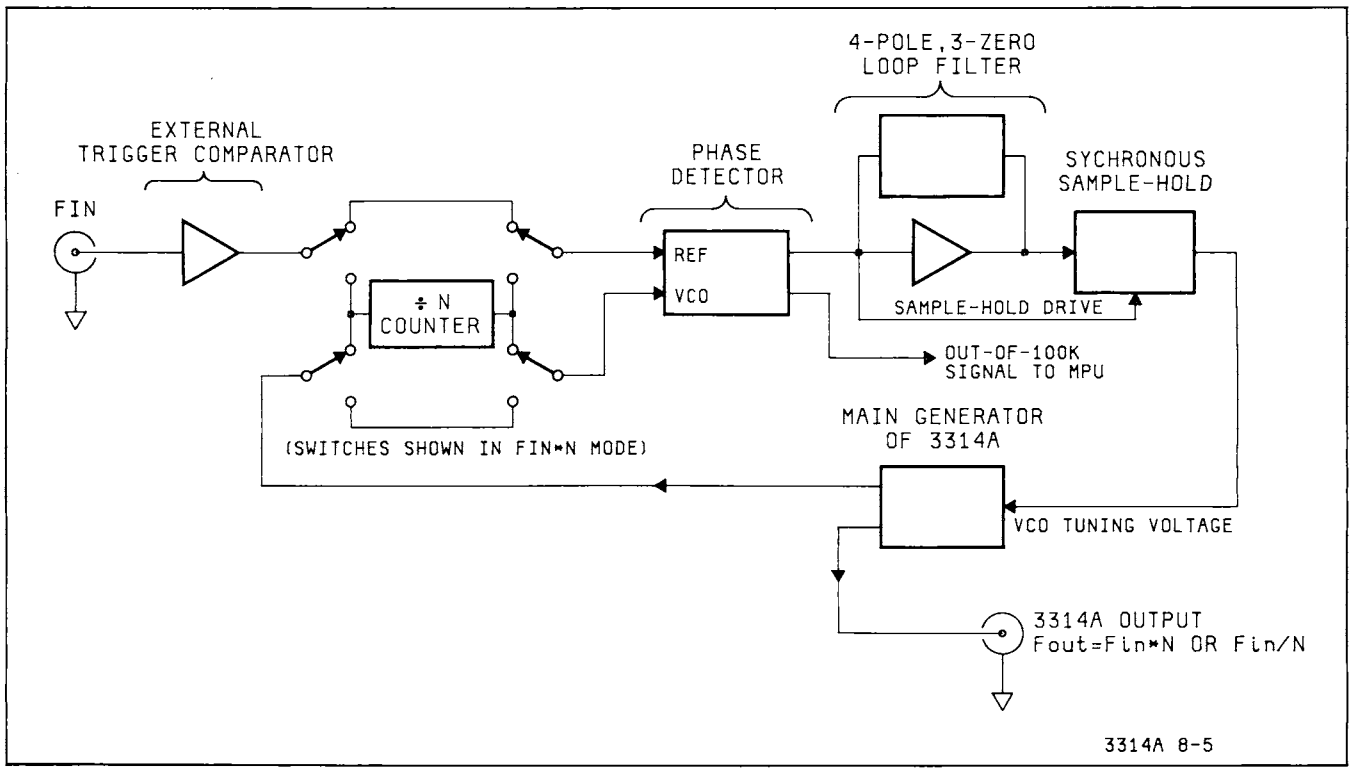


Figure 8-5. Phase Locked Loop Block Diagram

The Phase Detector is a four state machine. When the phase lock loop is in its locked condition, the Phase Detector clocks between the two middle states and clocks into the outer two states if the 3314A's signal drifts in or out of phase by a predetermined margin. If the phase locked loop stays in either of the two outside states for a long period of time, the micro-processor interprets this as an out-of-lock condition and flashes the corresponding LED on the front panel.

The Phase Locked Loop is also used in the top two frequency ranges of the 3314A. The instrument automatically uses the phase locked loop in these ranges to assure accurate frequencies. The trigger signal is the internally generated time base created on the A3 controller board. The time base is 10 kHz and is multiplied by N (1 to 1999) to accomplish generating a synthesized signal from 10 kHz to 19.99 MHz. All of the loop shaping networks and preset conditions are adjusted internally by the 3314A when the instrument is in these top two ranges.

8-22. VCO, FM, AM and Sweeping

As can be seen on the Troubleshooting Block Diagrams, Figures 8-10a and 8-10b, the FM modulation signal is summed into Iup and Idn currents before they reach the integrator on the A1 board. The VCO signal, on the other hand, is summed directly into the Freq/Sym DAC and the output currents reflect the change representing a change in frequency.

The AM signal is summed with the output of the 12 bit variable DAC with the aid of an additional 8 bit DAC. This DAC assures that the modulating signal will be 100% modulation when it is ±1 Volt. The output of the DACs are summed and called ACI and fed into the Sine Shaper/Amplitude Hybrid Integrated Circuit. The output of the summed currents is sensed for overrange and a warning light is lit if the current is too large.

The 3314A accomplishes linear and log sweeps by varying the FCV line to the Freq/Sym DAC. This DAC initially has the stop frequency programmed into it and the FCV varies Iup and Idn over the required range. The sweep voltages are generated from the 12 bit Multi-plexed DAC. In linear sweep the reference to this DAC becomes the buffered output of itself such that it is a multiplying DAC. In Log sweep the Multi-plexed DAC is written to for each successive frequency and the voltage (FCV) varies logarithmically.

8-23. DC Offset

The DC Offset Voltage that is summed at the output of the A8 output amplifier board is generated from the 12 bit variable DAC. This voltage (DCV) is fed into the DC offset amplifier on the A1 board where it is transformed into a proportionate current and eventually summed with the main generator output. The current varies from −200mA to +200mA resulting in a DC offset of ± 5 Volts DC, independent of the main generator output.

8-24. Calibration Cycle

Refer to the Troubleshooting Block Diagrams, Figures 8-8 and 8-10b, for the following discussion.

There are two calibration cycles (Frequency and Amplitude) in the 3314A Function Generator. The cycles determine the correct calibration constants for accurate operation and are initiated in the following ways:

Frequency Calibration	Amplitude Calibration
Power Up	Power Up
Forced Cal (Front Panel)	Forced Cal (Front Panel)
Frequency Range Change	Function Change
Forced Freq Cal (Front Panel)	ARB Mode Entry or Exit

8-25. Frequency Calibration

A power up or turn on calibration takes place in the following manner. The Freq/Sym DAC outputs the amount of current corresponding to the frequency requested on the front panel. The frequency is sensed at the output of the 3314A and measured by the internal time base found on the Controller Board (A3). The correct offset to enable the frequency to be exact is calculated and this offset is entered into the Freq/Cal DAC located on the A2 board. The output of the Freq/Cal DAC is then summed into the currents controlling the Freq/Sym DAC. The output frequency is then sensed again and the cycle is repeated five times if the frequency calibration fails.

If the micro-processor tries the calibration five times and the frequency still cannot be pulled into the correct limits then a CAL ERROR 32 is displayed on the front panel.

If the micro-processor senses the frequency and finds that it is more than 6.4% out of limit, a CAL ERROR 31 is displayed on the front panel.

If the micro-processor cannot sense a frequency at the output of the 3314A (no signal present) then a CAL ERROR 30 is displayed on the front panel.

The Cal Constants for the lowest two ranges are calculated from the higher ranges because of the time involved to calibrate the lower ranges with the normal cycle.

8-26. Amplitude Calibration

When a function is changed or the 3314A is forced to calibrate amplitude, the micro-processor sets the fre-

quency of the 3314A to 10kHz and the amplitude to the lowest possible value for that range. It then offsets the signal's DC level with the DC OFFSET DAC until the upper comparator in the Amplitude Calibration Comparator is tripped. The micro-processor stores this number and then decreases the DC level of the signal until the lower comparator is triggered. The average of these two numbers is then calculated and used to correct any unwanted DC offset at the output. Once this is done the micro-processor adjusts the peak to peak value of the output signal by varying the ACI line through the variable DAC to determine the amount of correction needed to correct the peak to peak level of the output signal. Once those Calibration Constants are determined, the whole process (DC Offset and Peak to Peak) is performed in the Function Invert Mode. These four calibration constants are stored in memory and used according to which function or DC offset is selected from the front panel.

8-27. POWER SUPPLY, CONTROLLER AND FRONT PANEL (A3 & A4)

8-28. The Power Supplies

The 3314A has three power supplies: +15V, −15V normal regulation supplies and a +5 Volt switching supply. When the power supplies are being troubleshot, J1 and J2 should be disconnected to ensure that any power supply transients or overvoltages will not reach the other boards.

8-29. The Controller

The controller section of the 3314A is composed of a 6800 Motorola processor, 48k bytes of ROM, 1k byte of dynamic NMOS RAM, 1k byte of CMOS RAM and the additional circuitry required to control the 3314A. The interface to the other boards in the 3314A is accomplished with eight data and four address lines.

The controller section contains several other areas that are critical to the proper operation of the 3314A. These areas include the Frequency Calibration Sense (U225, U229, U224 and U232) , the ARBitrary Control (U227, U221, U228, U229 and U232) and the Timer for Sweep Control (U232).

The controller section has Signature Analysis built into both its hardware and software. This is recommended for troubleshooting problems on this board. See the troubleshooting section for more information.

8-30. The Front Panel

The Front Panel interfaces the 3314A controller section with the outside world. It accomplishes this by sampling the front panel switches, rotary pulse generator (RPG), and driving the front panel LEDs. The front panel has an 8 row by 10 column annunciator array and an 8 row by 5 column key array that are scanned simultaneously. It takes about 10ms to scan all 10 columns.

8-31. X3 OUTPUT

Option 001 to the 3314A is a high input impedance, low output impedance, non-inverting amplifier. The amplifier is comprised of six basic circuits (see Schematic T). The first circuit is a high gain differential pair (Q1a & b), with bias provided by Q2 and input protection given by CR6 and CR8 (the amplifier's gain of 3 is set by R14 and R16). A complimentary common base stage (Q4 & Q6) follows, which is biased by Q7 and Q8. Q11, Q12, Q17, Q18 form a complimentary two stage voltage follower. Q14 and Q16 combined with R42 and R43, limit the current at the output to 30mA peak. The +24V and −24V power supply shown in the upper left hand corner of the schematic is rectified by U2. Finally, an output protection relay comprised of U1 and K1 disconnects the output when the power is off or when the voltage on the output BNC's exceeds ±20V.

8-32. TROUBLESHOOTING

There are three basic 3314A troubleshooting areas containing the following items:

DIGITAL TROUBLESHOOTING

1. ROM/RAM CHECKSUM (front panel test)
2. A3S1 TESTS
   FREE RUN (SA Test 1 and 2)
   HP-IB (SA Test 4)
   COUNTER TEST (SA Test 3)
   LATCH TEST
   DAC EXERCISE
   TWEAK (assists making four adjustments)
   NO CAL (disables Calibration and centers all cal constants)

ANALOG TROUBLESHOOTING

1. CAL CONSTANT EVALUATION PROGRAM

2. TROUBLESHOOTING BLOCK DIAGRAMS
   MULTIPLEXED DAC
   Required by all operating modes
   BASIC OPERATION
   Free Run; Frequency (not synthesized); Amplitude; Offset; Sweep; Modulation
   GENERAL OPERATION
   All modes of operation

3. CONTROL LATCH TRUTH TABLES
   A1 FOUTR LATCH (A1U902)
   A1 FUNAT LATCH (A1U808)
   A1 ANSTAT LATCH (A1U801)
   A1 INHIB LATCH (A1U807)
   A2 INPHA LATCH (A2U322)

A2 LOCMOD LATCH (A2U325)
A2 MBSTAT LATCH (A2U327)
A2 NDIVH LATCH (1/2 of A2U323)

SCHEMATICS

A1 GENERATOR (03314-66501)
SCHEMATICS A through I
A2 MODE (03314-66502)
SCHEMATICS J through M
A3 CONTROLLER/POWER SUPPLY (03314-66503)
SCHEMATICS N through Q
A4 FRONT PANEL (03314-66504)
SCHEMATIC R
A8 OUTPUT AMP (03314-66508)
SCHEMATIC S
A5 ×3 OUTPUT (03314-66505)
SCHEMATIC T

8-33. DIGITAL TROUBLESHOOTING

8-34. 3314A Controller Self Test and Signature Analysis

The 3314A controller has self tests and signature analysis designed into the controller hardware and software. These tests include a confidence ROM/RAM checksum and detailed SA routines to simplify troubleshooting of the controller board. Other tests available for the 3314A that are initiated on the A3 controller board are also discussed.

8-35. Available Tests

The following are the available tests for the 3314A:

1. ROM/RAM CHECKSUM (initiated through front panel)
2. Tests initiated through A3 S1

S7	S6	S5	S4	S3	S2	S1	FUNCTION/TEST
0	0	0	0	0	0	0	NORMAL OPERATION
X	X	X	X	X	1	1	FREE RUN SA
X	X	0	0	1	0	0	HP-IB SA
X	X	0	1	0	0	0	A3 LATCH SA
X	X	0	1	1	0	0	COUNTER SA
X	X	1	0	0	0	0	LATCH TEST
X	X	1	0	1	0	0	DAC EXERCISE
X	X	1	1	0	0	0	TWEAK (ADJUST) and DATE CODE
X	X	1	1	1	0	0	NO CALIBRATION

X = DON'T CARE
1 = CLOSED POSITION
0 = OPEN POSITION

8-36. Description of Tests and Functions

THE ROM/RAM CHECKSUM is initiated through the front panel by cycling power with the ARB key pushed. The checksum takes approximately 30 seconds to complete and during this time the display is blanked. The test is complete when the display and LEDs on the front panel are lighted. If a ROM or RAM fails a specific LED will not light, indicating which ROM or RAM is defective. The LEDs that correspond to the defective parts are:

ROM	Corresponding Blanked LED
U238	FREQ LED
U236	AMPLITUDE LED
U210	OFFSET LED
U209	SYMMETRY LED
U208	PHASE LED
U207	"N" NUMBER LED
RAM	
U234	SW/TR INTVL LED
U233	START FREQ LED
U211	STOP FREQ LED
U212	MKR LED

8-37. Tests Initiated From A3 S1

THE FREE RUN TEST (SA Tests #1 and 2) disables the instruction bus and sets the micro-processor in a count sequence. Because the instruction bus is disabled the processor and associated memory can be checked for faults using Signature Analysis. For those people that are not familiar with SA techniques, this is the "kernel" and must pass for the remaining tests to run.

THE HP-IB TEST (SA Test #4) writes data to the HP-IB chip in a recirculating pattern so that the HP-IB chip and latches can be checked with signature analysis. The handshake lines are not tested nor is the ability of the 3314A to receive data from the HP-IB.

THE COUNTER TEST (SA Test #3) checks the hardware on the controller board that was not checked in the Free Run test. This routine requires that both the processor and memory be functional. The test does not exercise the output buffers to the other boards. The output latches should be checked with SA Test #5.

THE LATCH TEST (SA Test #5) checks the output of the A3 board data lines D1 through D8. The processor accomplishes this by continually clocking the output buffers. This test should be run if the controller section seems to be running properly but a digital problem is still evident (such as no frequency or amplitude change).

THE LATCH TEST programs the controller to write to the latches on the other boards. The controller walks a "1" through each latch sequentially. Use the individual latch enable or clock signal as triggers.

THE DAC EXERCISE writes to the various DACs in the instrument. The output of the DACs, if they are functional, should be a ramp. The various DACs that are checked are:

A2 U213 MULTIPLEX DAC

A2 U405 FREQUENCY CORRECTION DAC

A2 U221 AM SCALER DAC

A1 U101 FREQ/SYM DAC

A1 U802 DC OFFSET CORRECTION DAC

TWEAK sets the 3314 up for three calibration procedures and four tests. See adjustment procedure for details. This test also causes the 3314A to display the Date Code of the firmware for about ½ second.

NO CAL mode disables the calibration sequence of the 3314A. This test is useful when adjusting a 3314A or troubleshooting a 3314A that has a re-occurring error. The "cal constants" are set to mid-range values when this mode is engaged.

8-38. TROUBLESHOOTING SEQUENCE OF THE CONTROLLER (A3)

There are five Signature Analysis Tests. They are:

SA Test #	Title
1	Free Run SA
2	ROM/RAM Output Verification
3	Counter SA
4	HP-IB SA
5	A3 Latch Test

Refer to the previous section for descriptions of the above tests.

The test sequence for troubleshooting the A3 board should be:

1. Run the Front Panel ROM/RAM CHECKSUM.

2. If the CHECKSUM passes (all LEDs on) there is a 90% probability that the controller is functioning; this DOES NOT imply that the output buffers of the controller board are functioning and they should be tested using SA TEST #5.

3. If the CHECKSUM does not pass (front panel goes away and never reappears), SA Test #1,#2 and #3 should be used sequentially until the problem is found. See "How to Use SA Test #1, #2 and #3 " in this section.

4. If the CHECKSUM does not pass (front panel comes back but there is an indication of a failed ROM or RAM) then the LED that hasn't been turned on should be checked by pushing the corresponding button and determining if the LED turns on.If the LED turns on the ROM or RAM under question is probably defective.To be absolutely sure, run SA Test #2 on the suspect ROM. There is no such test for the suspect RAM.

5. If the CHECKSUM passes and the instrument is experiencing a HP-IB failure SA Test #4 should be run.

6. If the instrument passes the CHECKSUM, SA TESTS #1,2,3, and the instrument is malfunctioning with respect to digital signals, run SA TEST #5 which checks the output latches of the A3 board.

8-39. How to Use SA Tests #1, #2, and #3

The normal troubleshooting procedure for using SA on the 3314 controlling section is as follows:

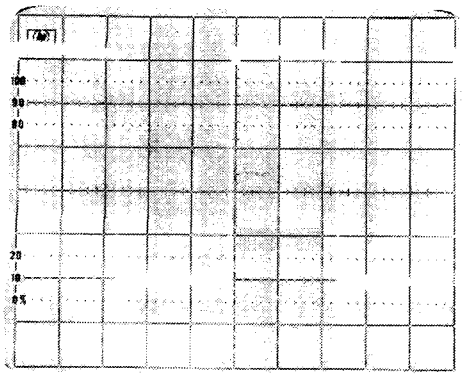
1. Follow the instructions for running SA Test #1. This test checks approximately 60% of the controller hardware by allowing the micro-processor to count through its addresses. The SA tests #2 and #3 should not be run until SA test #1 has determined that switch S1, pins 12, 13, 14 are working properly (correct signatures from U231 pins 10,12,14).

2. If SA Test #1 passes (all signatures are correct), run SA Test #2 by following the instructions given at the begining of the test. This test determines if the ROMs contain the correct bit pattern.

3. If SA test #2 passes, run SA Test #3 by following the instructions given at the begining of the test. This test requires that the Switches S1 pins 12,13 and 14 are functioning properly. The test uses internal ROM space for instructions to the micro-processor to toggle individual circuits that are not checked in the free run mode.

4. It is possible that certain failures may force the microprocessor into a non-fuctioning state (i.e., the processor will not count in the free run SA Test #1). If this is the case, the following steps are suggested:

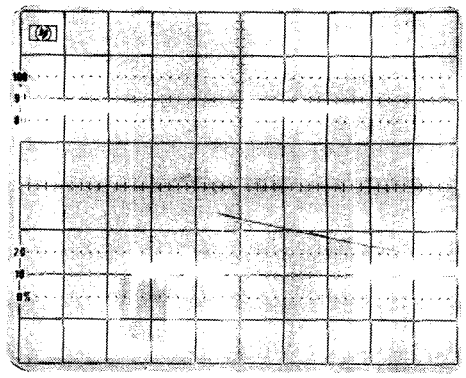
   A. Make sure all power supplies are the correct levels.



PIN 3 and 7

1V/DIV .2μS/DIV

U206



PIN 36

1V/DIV 2μS/DIV

Figure 8-6. SA Clocks

B. Make sure that the Data Bus is correct. In SA #1 data lines D7 and D5 are low and the rest of the data lines are pulled high.

C. Check the following pins on the microprocessor and see if they correspond to the following table:

U206 pin#	Signal	Should Be
2	HALT	+ 5 V
4	IRQ	GND
5	VMA	+ 4 V
6	NMI	+ 4 V
34	RNI	+ 4 V
39	TSC	GND
40	RES	+ 5 V
3,37 & 36	PHASE 1 & 2	SEE OSCILLOGRAMS

8-40. SA TEST #1

Signature Analyzer set up:

CLOCK/GROUND SA CLOCK CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP SA A15 STR/STP CONNECTOR
BOTH POSITIVE TRIGGER

Procedure:

Set A3S1 for positions 1, 2, 7, and 8 closed.
Cycle Power.
Take signatures.
+5 Volt = 0003

SIGNATURES Δ4

U206

Pin #	Signatures
26	0000
27	0003
28	0000
29	0003
30	0003
31	0003
32	0003
33	0003
9	UUUU
10	FFFF

U215

Pin #	Signatures
2	7791
5	6321
6	37C5
9	6U28
12	4FCA
15	4868
16	9UP1
19	0002

U216

Pin #	Signatures
2	UUUU
5	FFFF
6	8484
9	P763
12	1U5P
15	0356
16	U759
19	6F9A

U218

Pin #	Signatures
11	8484
12	P763
13	1U5P
14	0356
15	U759
16	6F9A
17	7791
18	6321
19	37C5
20	6U28
22	4FCA
23	4868
24	9UP1
25	0002

U219

Pin #	Signatures
1	4868
2	9UP1
3	0002
4	0000
5	0000
6	0003
7	2302
9	F9CF
10	534H
11	C9U1
12	1183
13	64HF
14	29A4
15	5FUA

U200

Pin #	Signatures
1	29A4
2	2947
12	0000
13	0003

U221

Pin #	Signatures
4	29A7
5	29A4
6	0000
11	0000
12	29A4
13	29A7

U223

Pin #	Signatures
1	282A
2	5P1A
3	A275
4	A689
5	0003
6	04UU
8	UF80
9	04UU
10	0003
11	U87F
12	U87F
13	8P4F

U224

Pin #	Signatures
1	U759
2	29A7
3	C755
4	6F9A
5	29A7
6	1214
11	PPH8
12	29A7
13	0356

U237

Pin #	Signatures
1	7791
2	29A7
12	U15A
13	0003

U239

Pin #	Signatures
1	7791
2	6F9A
12	4493
13	29A4

See Section VII for Δ explanations.

8-41. SA TEST #2

Signature Analyzer set up:

CLOCK/GROUND SA BUS PHASE 2 CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP SEE TABLE 8-3
BOTH NEGATIVE TRIGGERS

Procedure:

Set A3 S1 for positions 1 and 2 closed.
Cycle power.
Move START/STOP to SA ROM connector of ROM under test. (See Table 8-3.)
Take signatures of ROM under test.
+5 Volt = 1180

SIGNATURES Δ4

U238 (ROM #1)		U236 (ROM #2)		U210 (ROM #3)	
Pin #	**Signature**	**Pin #**	**Signature**	**Pin #**	**Signature**
9	PO97	9	4A7C	9	7374
10	7561	10	2U36	10	50A3
11	620P	11	5020	11	UC66
13	HU7P	13	OCAO	13	32FH
14	PA21	14	P930	14	225A
15	10FH	15	9CAP	15	A60C
16	77F8	16	6F22	16	P902
17	31FH	17	160P	17	029F

U209 (ROM #4)		U208 (ROM #5)		U207 (ROM #6)	
Pin #	**Signature**	**Pin #**	**Signature**	**Pin #**	**Signature**
9	1843	9	0U3H	9	954U
10	OF9C	10	F7A9	10	CF1C
11	2H9A	11	92F2	11	A60C
13	9321	13	4CP4	13	2A24
14	295F	14	UPPA	14	2313
15	2A27	15	9558	15	P9F9
16	7H72	16	F849	16	6362
17	245C	17	293F	17	A1A7

Table 8-3. SA Start/Stop Connections

START/STOP POSITIONS:	
U238 ROM #1	START J8 PIN 1 STOP J8 PIN 2
U236 ROM #2	START J8 PIN 2 STOP J8 PIN 3**
U210 ROM #3	START J8 PIN 3** STOP J8 PIN 4
U209 ROM #4	START J8 PIN 4 STOP J8 PIN 5
U208 ROM #5	START J8 PIN 5 STOP J8 PIN 6
U207 ROM #6	START J8 PIN 6 STOP J8 PIN 7

**NOTE: There are two positions on J8 labeled #3.

8-42. SA TEST #3

Signature Analyzer set up:

CLOCK/GROUND SA CLOCK CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP J8 PIN 3 (there are two positions labeled #3)
BOTH POSITIVE TRIGGER

Procedure:

Set A3S1 for positions 3, 4, 7, and 8 closed.
Cycle Power.
Take signatures.
+5 Volt = UA2P
( ) indicates optional signature.

SIGNATURES

Pin #	Signature
	U200
1	817U
2	7C51
5	0000
12	HU58
13	2576
	U222
4	9690 (3AF5)
5	0FA3
6	CCA4 (57F2)
8	2576
9	UA2P (0000)
10	HU58
11	HU58
12	UA2P (0000)
13	2576
	U226
2	0000
3	P1F2
4	UA2U
5	0000
6	CCC1
7	0000
9	0000
10	UA2P
11	UA66
12	0000
13	224C
	U228
1	0000 (UA2P)
2	7899 (6959)
3	HF54 (5PP3)
4	HF54 (5PP3)
7	CCF8 (CA12)
10	0000
12	7FA2 (FC37)
13	7FA2 (FC37)
14	7899 (6959)
15	CCF8 (6A12)
	U231
1	AC30
2	U344
3	UAAU
4	UA2P
7	A93F
9	CP18
10	0000
11	F352
12	0000
13	U44F

Pin #	Signature
	U206
4	H87H
5	UA2P
6	UA2P
9	P1F2
10	UA2U
11	CCC1
12	UA66
13	224C
14	182A
15	9644
16	859P
17	114F
18	9751
19	7A2A
20	8C5C
22	162U
23	464A
24	3H1C
25	3H1A
26	UP8F
27	81F9
28	2APU
29	19H9
30	P644
31	079H
32	7C95 (8745)
33	U737
34	2576
	U229
1	U344
2	2253
3	H87U
4	UA2P
5	4742
6	CH6F
8	293C
9	H315
10	H315
11	UA2P
12	0000
13	0000
	U232
1	UP8F
2	81F9
3	2APU
4	19H9
6	079H
7	7C95 (8745)
8	U737
9	UA2P (0000)
10	U344
13	H905 (996H)
15	UA2P (0000)
16	CH6F
17	9690
18	H905 (996H)
19	P1F2
20	UA2U
21	817U
22	HU58
23	2576

Pin #	Signature
	U221
8	293C
9	7899 (6959)
10	40C4 (84HF)
	U224
8	UA2P
9	UA2P
10	0000
	U225
1	FU6H
2	UA2P
3	0000
6	UA2P
8	UA2P
9	0000
11	0000
13	FU6H
	U227
3	675A
4	40C4 (84H4)
6	0000
9	7899 (6959)
10	UA2P
11	9690
	U230
2	2253
3	UAAU
4	PA49
5	FU6H
6	A93F
7	4742
9	1H70
10	H315
11	CP18
12	H700
13	F352
14	U44F
15	OFA3
	U237
3	H315
4	9690
5	0000
6	UA2P

8-43 SA TEST #4

Signature Analyzer set up:

CLOCK/GROUND SA CLOCK CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP J8 PIN 3 (there are two positions labeled #3)
BOTH POSITIVE TRIGGER

Procedure:

Set A3S1 for positions 3, 7, and 8 closed.
Cycle power.
Take signatures.
+5 Volt = CFUC

Note: DISCONNECT ANY HP-IB CONNECTORS FROM THE REAR PANEL.

Signatures Δ4

U300		U301		U302	
Pin #	Signature	Pin #	Signature	Pin #	Signature
3	7F45	1	F010	1	F010
5	377U	2	CFUC	2	F011
6	CFUC	3	CFUC	3	2AA4
7	FFA3	4	F010	4	AU9C
8	P5C8	5	F0U3	5	C73U
9	7460	6	CFUC	6	6HF8
10	6C69	7	CFUC	7	P65A
11	9AA7	8	CFUC	8	1892
12	HU7F	9	CFUC	9	UC1P
13	6A4U	12	CFUC	12	UC1P
14	4761	13	CFUC	13	1892
15	3632	14	CFUC	14	P65A
16	CFUC	15	CFUC	15	6HF8
17	F010	16	F0U3	16	C73U
18	F0U3	17	F010	17	AU9C
19	CFUC	18	CFU3	18	2AA4
21	CFUC	19	CFUC	19	F011
22	CFUC				
23	CFUC				
25	CFUC				
26	CFUC				
27	F010				
28	F010				
29	UC1P				
30	1892				
31	P65A				
32	6HF8				
33	C73U				
34	AU9C				
35	2AA4				
36	F011				
37	A5P4				
38	56A0				
39	C9HH				
40	0000				

8-44. SA TEST #5

Signature Analyzer set up:

CLOCK/GROUND SA CLOCK CONNECTOR
CLOCK NEGATIVE TRIGGER

START/STOP J8 PIN 3 (there are two positions labeled #3)
BOTH POSITIVE TRIGGER

Procedure:

Set A3S1 for positions 4, 7, and 8 closed.
Cycle Power.
Take signatures.
+5 Volt = HCP8

SIGNATURES Δ4

NOTE

( ) INDICATES SIGNATURES WITH THE CONNECTOR UNDER TEST REMOVED.

J3		J2	
Pin #	**Signature**	**Pin #**	**Signature**
1	9384	1	9384
2	P20P	2	P20P
3	2752	3	2752
4	8911	4	8911
5	8013 (A8P7)	5	A8P7
6	29P9 (53U3)	6	53U3
7	H4U6 (H987)	7	H987
8	P379	8	P379
9	0HH9	9	0HH9
10	1C2U	10	1C2U
11	A5F0	11	A5F0
12	5HH7	12	U7P5
13	KEY	13	U46C
14	GND	14	−15V
15	GND	15	+15V
16	+5V	16	GND
17	−15V	17	±5V
18	−15V	18	0000
19	−15VA	19	UNSTABLE
20	+15V	20	UNSTABLE
21	+15V	21	95A7
22	+15VA	22	HCP8

8-45. ANALOG TROUBLESHOOTING

8-46. Calibration Constant Evaluation Program

If the 3314A is experiencing a calibration error or an analog problem, the following HPL program should be used. This program causes the 3314A to return all of its calibration constants to the computer. The data is operated upon and printed on the computer's printer. In addition, a separate printing to help make the data more meaningful is also available. The following equipment is required:

-hp- 9825 Desktop Computer with
-hp- 98210A String ROM
-hp- 98210A 9862A Plotter-Gen IO/Extended IO ROM
-hp- 98034A HP-IB Interface (set to 7)
-hp- 3314A Function Generator (HP-IB address = 7)

```
0: "3314A CAL CONSTANTS EVALUATION   6/82":
1: dim E$[4],B$[16]
2: dev "dut",707
3: dsp "Do you need REFERENCE KEY? (y,n)";rdb(0)→X
4: dsp "";if X=121 or X=249;cll 'KEY';sto -1
5: dsp "";if X=121 or X=249;cll 'KEY'
6:
7: "ERROR?":fxd 0;fmt ;wrt "dut","OER";red "dut",X
8: if X>0;prt "PRIOR ERROR:",X;spc
9:
10: "CC Counter":0→K
11:
12: "**** FREQUENCY CAL CONSTANTS ****":
13: "Symmetry Loop":for S=49 to 50
14: if S=49;"FREQ CAL-VAR SYM"→B$
15: if S=50;"FREQ CAL-FIX SYM"→B$
16: cll 'Head'
17: fmt "DE0CDFRRH1SY",f2.0,"PC";wrt "dut",S
18:
19: "Range Loop":for R=1 to 8
20: fmt "CEFRRH",f1.0;wrt "dut",R
21: cll 'Freq Cal Constant'(R,S)
22: cll 'Error'
23: cll 'Print'
24:
25: "nxt R":next R
26: next S
27:
28:
29: "**** SPECIAL FREQ CAL CONSTANTS ****":
30: for R=9 to 11
31: if R=9;"FREQ CAL- ARB"→B$
32: if R=10;"FREQ CAL-LOW FRQ"→B$
33: if R=11;sto +4
34: cll 'Head'
35: cll 'Freq Cal Constant'(R)
36: cll 'Error'
37: cll 'Print'
38: next R
39:
40:
41: "**** AMPLITUDE CAL CONSTANTS ****":
42: "Function Loop":for R=2 to 4;R→F;if R=4;1→F
43: "Amp Error Flag":cfg 1
44: if F=1;"AMP CAL-SINE"→B$
45: if F=2;"AMP CAL-SQUARE"→B$
46: if F=3;"AMP CAL-TRIANGLE"→B$
47: cll 'Head'
48: fmt "DE0CDFRRH5CEFU",f1.0;wrt "dut",F
49:
50: "Gain/Offset Loop":for G=1 to 4
51: cll 'Amp Cal Constant'(R,G)
52: cll 'Error'
53: cll 'Print'
54:
55: next G
56: next R
57: spc 3
58: end
59: "**** END OF CAL CONSTANTS PROGRAM ****":
```

Figure 8-7. Program Listing and Example Printouts

```
60:
61:
62:
63: "[MARG]":
64: if K<19;ret abs(C)>.65*'[LIMIT]'
65: ret abs(C)>.9*'[LIMIT]'
66:
67: "[LIMIT]":if K<19;ret 127
68: if G=1;ret 440
69: if G=2;ret 400
70: ret 127
71:
72: "[DAC MID]":if G=1 and R=3;ret int(3600/1.027)
73: if G=1;ret 3600
74: ret 0
75:
76:
77: "Two Comp":
78: "p1=most significant byte":
79: "p2=least significant byte":
80: "p3=2's Compliment results":
81: "p4=# of bits":
82: p1*2↑(p4/2)+p2→p3
83: if p3>=2↑(p4-1);p3-2↑p4→p3
84: ret
85:
86: "Freq Cal Constant":
87: "p1=frequency range":
88: "p2=symmetry":
89: fmt ;wrt "dut","QCC"
90: "Variable SYM":if p2#50;for I=1 to p1;rdb("dut")-128→C;next I
91: "Fixed SYM":if p2=50;for I=1 to p1+8;rdb("dut")-128→C;next I
92: ret
93:
94: "Amp Cal Constant":
95: "p1=R-loop value":
96: "p2=gain/offset loop variable":
97: fmt ;wrt "dut","QCC"
98: for I=1 to 20+6(p1-2)+2(p2=2)+4(p2>2);rdb("dut")→p3;next I
99: rdb("dut")→p4
100: if p2<3;cll 'Two Comp'(p3,p4,p5,16)
101: if p2=3;cll 'Two Comp'(0,p4,p6,8);p3+p6-128→p5
102: if p2=4;cll 'Two Comp'(0,p4,p6,8);p3-p6-128→p5
103: "TRIANGLE CORRECTION FACTOR":if p1=3;int(p5/1.027)→p5
104: "normalize":p5-'[DAC MID]'→C
105: ret
106:
107: "Error":
108: fmt ;wrt "dut","QER"
109: red "dut",E$
110: if E$[1,3]="ER0";"P    "→E$;if '[MARG]';"ADJ"→E$;gto +2
111: E$[3,4]→E$[2]
112: "amp error":if fl91;" ? "→E$
113: if K>18;if C=0 and not fl91 and E$[1,1]#"P";sfs 1
114: ret
115:
116: "Print":K+1→K
117: "  no number":if S#50 and R=8;prt " 8";ret
118: "  no number":if S#50 and R=11;prt "19";ret
119: fmt f2.0,x,f4.0,x,f4.0,x,c3;wrt 16,K,C,'[LIMIT]',E$[1,3]
120: ret
121:
122: "Head":
123: spc ;prt B$
124: prt " #   CC  LIM P/F"
125: ret
126: "KEY":
127: prt "CC =Cal Constant"
128: prt "LIM=+-Limits"
129: prt "P  =Pass"
130: prt "ADJ=Marginal"
131: prt "Exx=Error Number"
132: prt "?  =Ignore Data"
```

Figure 8-7. Program Listing and Example Printout (Cont'd)

```
133: spc 2
134: prt "1 VSYM R1    2Hz"
135: prt "2 VSYM R2   20Hz"
136: prt "3 VSYM R3  200Hz"
137: prt "4 VSYM R4   2kHz"
138: prt "5 VSYM R5  20kHz"
139: prt "6 VSYM R6 200kHz"
140: prt "7 VSYM R7   2MHz"
141: prt "8                "
142: spc 3
143: prt "9  SYM R1    2Hz"
144: prt "10 SYM R2   20Hz"
145: prt "11 SYM R3  200Hz"
146: prt "12 SYM R4   2kHz"
147: prt "13 SYM R5  20kHz"
148: prt "14 SYM R6 200kHz"
149: prt "15 SYM R7   2MHz"
150: prt "16 SYM R8  20MHz"
151: spc 3
152: prt "17 ARB R2  200Hz"
153: spc 3
154: prt "18  LF R2  200Hz"
155: prt "19               "
156: spc 3
157: prt "20 SQ  AMPLITUDE"
158: prt "21 SQ  GAIN OFFS"
159: prt "22 SQ    +OFFSET"
160: prt "23 SQ    -OFFSET"
161: spc 3
162: prt "24 TR  AMPLITUDE"
163: prt "25 TR  GAIN OFFS"
164: prt "26 TR    +OFFSET"
165: prt "27 TR    -OFFSET"
166: spc 3
167: prt "28 SN  AMPLITUDE"
168: prt "29 SN  GAIN OFFS"
169: prt "30 SN    +OFFSET"
170: prt "31 SN    -OFFSET"
171: spc 3
172: ret
*5116
```

```
CC =Cal Constant
LIM=+-Limits
P  =Pass
ADJ=Marginal
Exx=Error Number
?  =Ignore Data


1 VSYM R1    2Hz
2 VSYM R2   20Hz
3 VSYM R3  200Hz
4 VSYM R4   2kHz
5 VSYM R5  20kHz
6 VSYM R6 200kHz
7 VSYM R7   2MHz
8



9  SYM R1    2Hz
10 SYM R2   20Hz
11 SYM R3  200Hz
12 SYM R4   2kHz
13 SYM R5  20kHz
14 SYM R6 200kHz
15 SYM R7   2MHz
16 SYM R8  20MHz



17 ARB R2  200Hz



18  LF R2  200Hz
19



20 SQ  AMPLITUDE
21 SQ  GAIN OFFS
22 SQ    +OFFSET
23 SQ    -OFFSET



24 TR  AMPLITUDE
25 TR  GAIN OFFS
26 TR    +OFFSET
27 TR    -OFFSET



28 SN  AMPLITUDE
29 SN  GAIN OFFS
30 SN    +OFFSET
31 SN    -OFFSET
```

```
FREQ CAL-VAR SYM
 #   CC  LIM P/F
 1   -6  127 P
 2    3  127 P
 3    8  127 P
 4    6  127 P
 5  -17  127 P
 6   11  127 P
 7   25  127 P
 8

FREQ CAL-FIX SYM
 #   CC  LIM P/F
 9   -6  127 P
10   -2  127 P
11    8  127 P
12   14  127 P
13   10  127 P
14  -15  127 P
15   16  127 P
16   35  127 P

FREQ CAL- ARB
 #   CC  LIM P/F
17   -3  127 P

FREQ CAL-LOW FRQ
 #   CC  LIM P/F
18   -2  127 P
19

AMP CAL-SQUARE
 #   CC  LIM P/F
20  159  440 P
21    8  400 P
22  -26  127 P
23  -48  127 P

AMP CAL-TRIANGLE
 #   CC  LIM P/F
24  -42  440 P
25   16  400 P
26  -41  127 P
27  -34  127 P

AMP CAL-SINE
 #   CC  LIM P/F
28   45  440 P
29   12  400 P
30  -36  127 P
31  -40  127 P
```

Figure 8-7. Program Listing and Example Printout (Cont'd)

8-47. Control Latch Truth Tables

The A1 Generator Board and A2 Mode Board have several control latches which determine exactly which functions are active and how the circuits are configured. The data is written to these latches by the Controller.

The MBSTAT Latch and the ANSTAT Latch contain status information about the PC boards and the Controller reads data from them.

THE INPHA LATCH, A2U322, controls the counters, switching, PLL bandwidth and other functions related to the phase locked loop.

Table 8-4. INPHA Latch

33314A MODE	MSB	LSB	NDIV	VDIV	RDIV	PLL
FREE RUN						
1A Continuous .001 ≤ F ≤ 199.9k	1111	0111	1			off
1B Continuous 200k ≤ F ≤ 1.999M	0110	1101	F	1	10	on
1C Continuous,FM off 2M ≤ F ≤ 19.99M	0110	1001	F	1	1	on
1D Continuous,FM on 2M ≤ F ≤ 19.99M	0110	0101	F	10	10	on
1E Cont Sweep;VCO .001 ≤ F ≤ 19.99M	1111	0111	1			off
GATE						
2A Gate	1101	0111	1			off
2B Gated Sweep, on	0111	0111	1			off
2C Gated Sweep, off	0101	0111	1			off
N CYCLE						
3 N Cycle	0011	0111	N			off
1/2 CYCLE						
4 1/2 Cycle	0001	0111	1			off
Fin X N						
5A Fin X N 50 ≤ Fref ≤ 999	1110	1011	2N	1	1	on
5B Fin X N 1k ≤ Fref ≤ 999k or 19.99M / N, whichever is less	0110	1011	2N	1	1	on
5C Fin X N,N>1 1M ≤ Fref ≤ 9.999M or 19.99M / N, whichever is less	0110	0111	N	10	5	on
5D Fin X N,N=1 1M ≤ Fref ≤ 19.99M	0110	0010	5N	10	1	on
Fin / N						
6A Fin / N 50 ≤ Fref ≤ 999	1110	1010	N	2	1	on
6B Fin / N,CAL SYM 1k ≤ Fref ≤ 1.999M	0110	1010	N	2	1	on
6C Fin / N,CAL SYM 2M ≤ Fref ≤ 19.99M	0110	0010	5N	10	1	on
6D Fin / N,VAR SYM 1k ≤ Fref ≤ 199.9k	0110	1010	N	2	1	on
6E Fin / N,VAR SYM 200k ≤ Fref ≤ 19.99M, where Fref / N ≤ 1.999M	0110	0010	5N	10	1	on
ARB						
7 ARB,Cont & Gate	0101	0111	1			off
AUX FUNCTIONS						
8A FREQ CAL,Range=8	0111	0101	*	10	1	off
8B FREQ CAL,Range<8	0111	1101	*	1	1	off
8C EXT FREQ MEAS	0111	0010	*	1		off

Table 8-4. INPHA Latch (Cont'd)

* N divider under program control to output 500Hz to the Period Measurement State Machine (PMSM) on the A3 Controller.

F is the mantissa of the programmed frequency.

The lower frequency limit in all modes can be extended to the LSD of the displayed frequency using the Range Hold function. The frequency resolution remains the LSD of the held range. (Minimum Freq = Freq Resolution)

Fref frequency limits are:
0Hz to 20MHz, External
50Hz to 500kHz (INT INTVL = 2us to 20ms), Internal

INPHA LATCH DECODING

MSB							LSB
H	G	F	E	D	C	B	A

ABCD = ÷N and post divider steering and divider control

A (U322-2) selects the input to the N Divider; 0 = Trig/2, 1 = Sync

B (U322-5) selects the reference input to the phase detector;

0 = 10kHz(Cont), 1 = Trig/2(Fin X N, Fin / N)

C (U322-6) and B (U322-5) controls Reference Divider

C	B	REF DIVIDER (A2U314)
0	0	÷ 1
0	1	÷ 10
1	0	÷ 1
1	1	÷ 5

D (U322-9) and A (U322-2) controls Variable Divider

D	A	VAR DIVIDER (A2U307)
0	0	÷ 10
0	1	÷ 10
1	0	÷ 2
1	1	÷ 1

E (U322-12) controls PLL; 0 = PLL ON, 1 = PLL OFF

G (U322-16) and F (U322-15) selects Mode (Cont, PLL, Gate, 1/2 Cycle, N Cycle)

G	F	MODE SELECTED
0	0	1/2 Cycle
0	1	N Cycle
1	0	Gate,ARB
1	1	Cont, Fin / N, Fin X N

H (U322-19) changes PLL bandwidth; 0 when Fref ≥ 1kHz, 1 when Fref < 1kHz

THE LOCMOD LATCH, A2U325, controls the external trigger parameters, modulation and some of the sweep circuitry.

LIN SWP ON, A2U235-2, D0, 0 = Lin Sweep, controls the Multiplexed DAC during linear sweeps by switching the DAC's reference from +10V to the PCV output of the DAC. This makes the DAC into a "multiplying DAC" multiplying the SWP by PCV.

SWEEP ON, A2U235-5, D1, 1 = Sweeping, enables the SWP voltage from the Multiplexed DAC to A2U402 resulting in control of FCV.

FM ON, A2U235-6, D2, 1 = FM ON, enables the FM switch, A2U401.

VCO ON, A2U235-9, D3, 1 = VCO ON, enables the VCO switch A2U401.

SYM ON, A2U235-12, D4, 1 = Variable Sym, enables the X .1 circuitry in the FM circuitry. During variable symmetry, Iup and Idn are 1/10 their normal value, therefore, FMV must be 1/10 also.

RETRACE, A2U235-15, D5, 0 = Blanking, goes to S501, the Z Axis Polarity switch and is low whenever a blanking signal is sourced from the Z Axis Output.

MARKER, A2U235-16, D6, 0 = Marker, goes to S501, the Z Axis Polarity switch and is low whenever an intensifying signal is sourced from the Z Axis Output.

TRIGGER RESET, A2U235-19, D7, 0 = Reset, goes to the MBSTAT Latch to reset two trigger sense latches.

THE NDIVH LATCH, 1/2 of A2U323, controls the external trigger parameters and resets the remaining latches in the MBSTAT Latch (see TRIGGER RESET in the LOCMOD Latch to reset the remaining MBSTAT Latch elements).

MBSTAT LATCH RESET, A2U323-12, D4, 0 = reset, resets the PLL Out of Lock and Reduce Input elements of the MBSTAT Latch.

EXT TRIG EN, A2U323-15, D5, 1 = Ext Trigger, selects between External and Internal Triggers.

TRIGGER SLOPE, A2U323-16, D6, 1 = Negative Slope, selects between positive and negative trigger edges.

TRIGGER LEVEL, A2U323-19, D7, 1 = OV Threshold, selects between OV and 1V trigger threshold levels.

THE MBSTAT Latch, A2U327, (Mode Board STATus Latch) contains four elements that the Controller reads as required.

PLL OUT OF LOCK, A2U327-4, D3, 1 = Out of Lock, indicates when the Phase Locked Loop is unlocked.

GATED ON, A2U327-7, D2, 1 = Gated On, indicates when the main output is ON.

TRIGGER EDGE, A2U327-9, D1, 1 = Trigger has occurred, indicates when a trigger edge has been detected to start gated sweeps and gated ARB waveforms.

REDUCE INPUT, A2U327-13, D0, 1 = Overload, indicates when the AM, FM, or VCO inputs are being overdriven.

THE FOUTR LATCH, A1U902, selects the integrating range capacitors A1C204 through A1C207 and A1C210.

	D0	D1	D2	D3	D4	D5
Frequency Range	A1U902 PIN #					X1/X10
	9	12	15	6	5	16
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	1
4	1	0	0	0	0	1
5	1	1	0	0	0	1
6	1	1	1	0	0	1
7	1	1	1	1	0	1
8	1	1	1	1	1	1

In Range 1, Iup and Idn are divided by 10.

THE FUNAT LATCH, A1U808, selects the function and the step attenuation.

	D7	D6	D5	D4	D3	
Amplitude Range	A1U808 PIN #					Attenuation
	19	2	5	16	15	
1 & during CAL	1	1	0	1	0	60dB
2	1	0	1	1	0	40dB
3	0	0	1	1	1	20dB
4	0	0	0	0	0	0dB

	D2	D1	D0
Function	A1U808 PIN#		
	6	9	12
SINE	1	1	0
SQUARE	0	0	0
TRIANGLE	1	0	1

THE INHIB LATCH, A1U807, inhibits PCV (the Phase Control Voltage) and the DCV (the DC OFFSET Voltage) from affecting the operation of the A1 board.

INHIBIT PCV, A1U807-6, D0, 1 = Inhibit, inhibits PCV during continuous modes.

ENABLE DCV, A1U807-10, D1, 1 = Offset Enabled, disables DCV when the OFFSET is other than 0VDC.

THE ANSTAT LATCH, A1U804, is used to detect output overloads and during amplitude calibrations to detect when the amplitude reaches two preset threshold levels.

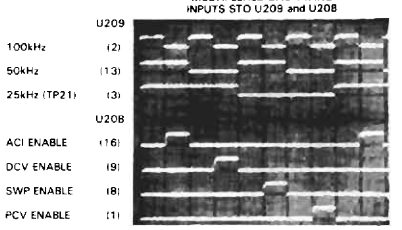
Output Overload (A1U804-9), D0, 1 = Overload, is detected by the voltage comparators A1U806a&b.

Amplitude Calibration (A1U804-4,7) D2, 1 = −Threshold Detected, D1, 1 = +Threshold Detected, senses when the voltage at the output of the output amplifier reaches +5.515V and −5.515V thresholds.

8-48. Multiplexed DAC Troubleshooting Diagram

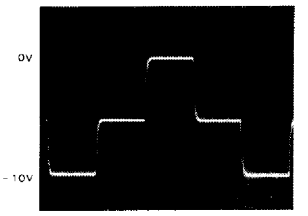
This Multiplexed DAC is used in every operating mode to control the more universal 3314A features. Along with power supplies, the Multiplexed DAC outputs should be verified before proceeding to more complex circuits.

MULTIPLEXED DAC TIMING
INPUTS STO U209 and U208



10V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

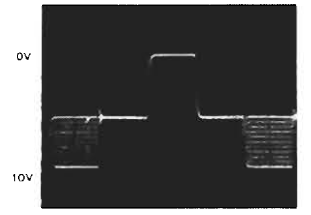
TP 19, MULTIPLEXED DAC OUTPUT AT POWER ON



ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

TP 19, MULTIPLEXED DAC OUTPUT (10.00Vp-p to 0.00Vp-p)

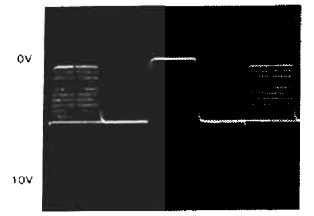


ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

Multiple exposure of TP 19 as the output amplitude ranges from 10.00Vp-p to 0.00Vp-p in 1V steps. Amplitude Range Hold is asserted.

TP 19, MULTIPLEXED DAC OUTPUT
(10.00Vp-p to 0.00Vp-p with invert function asserted)

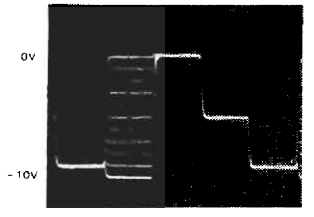


ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

Multiple exposure of ACI as the output amplitude ranges from 10.00Vp-p to 0.00Vp-p in 1.00V steps with Invert Function and Amplitude Range Hold asserted.

TP 19, MULTIPLEXED DAC OUTPUT (- 5VDC to + 5VDC)

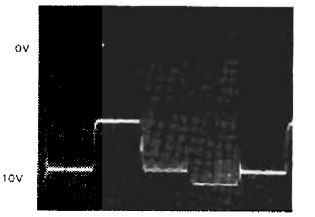


ACI DCV SWP PCV

± V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

Multiple exposure of DCV as the DC Offset ranges from - 5VDC to + 5VDC in 1V steps. Offset Range Hold asserted.

TP 19, MULTIPLEXED DAC OUTPUT DURING SWEEPS

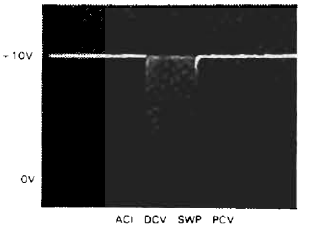


ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

SWP and PCV during an LOG Sweep. During LIN sweeps, the negative value of the SWP voltage varies as the Start Frequency varies.

TP 22, DAC REFERENCE DURING LIN SWEEP

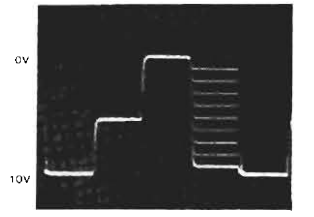


ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

During Linear Sweeps, PCV becomes the DAC Reference. At this time, the DAC becomes a multiplying DAC.

TP 19, MULTIPLEXED DAC OUTPUT (Phase)

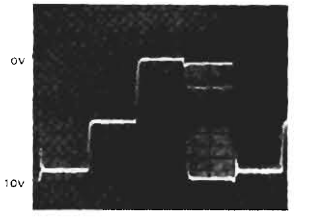


ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

Multiple exposure of PCV while in Gate or one of the Burst Modes at Phase ranges from - 90° to + 90° in 10° steps.

TP 19, MULTIPLEXED DAC OUTPUT (Phase)



ACI DCV SWP PCV

2V/DIV 10μS/DIV
TRIGGER ON RISING EDGE AT TP21, DAC SYNC

Multiple exposure of PCV while in one of the p Lock Modes as Phase ranges from - 180° to + 190° in 10° steps.

A2 MODE BOARD

A3 CONTROLLER

4MHz CRYSTAL OSC

4MHz

÷ 4

1MHz

÷ 10

100KHz

MULTI PHASE CLOCK TO uP

19

J6

U217 ÷ 2

U217 ÷ 2

U212

+10V

NORM

LIN SWEEP

TP22 DAC REF

8/ DATA

2/ WRITE ADDRESS

2/ WRITE STROBES

4x12 BIT STORAGE U214, U215, U216

READ ADDRESS 2^1 2^0

R_{VAR}

R_{REF} 10K

U213 12 BIT R_{VAR} CONTROL

U207

TP 21 DAC SYNC

R212 DAC OFFSET ADJUST

+15

25KHz

50KHz

100KHz

SWITCH SELECT

U209 U211

EN

To

To

5uS

40uS

LTN SWP ON

FROM U325(2)

MULTIPLEXED DAC

A1 GENERATOR

TP19 DAC OUT

4 CYCLES -10V TO 0V

AC OFFSET DJUST

U208

0 1 2 3

1 8 9 16

U201

-10V = START FREQ OR -200°

0V = STOP FREQ OR +200°

UPCV TO R108

LINEAR SWEEP START FREQ ADJUST

R205

0V

U201

J8(1)

PCV TO U261

TRIG/GATE/ARB SERVO AMP

TP16 PCV

U202

X-AXIS OUTPUT

-5V = START FREQ OR -200°

+5V = STOP FREQ OR +200°

+5

Q204

FROM U325(5)

MODE ON SWEEP

U202

TP15 SWP

0V = STOP FREQ

SWP TO R427

TP14 DCV

0V = +5V OFFSET

-5V = 0V OFFSET

-10V = -5V OFFSET

+15

U203

DC OFFSET ZERO ADJUST

R267

+.66V = +5V OFFSET

0V = 0 OFFSET

-.66V = -5V OFFSET

J8(3)

DCV TO R703

OFFSET AMP

TP17 AMP

0V = FULL INVERTED AMPL

-5V = 0 AMPL

-10V = FULL AMPL

U203

1K

U205 REDUCE INPUT

TO MBSTAT LATCH U327(15)

AM INPUT

RVAR

0V

U221

AMSCL DAC

8 DATA

1 WRITE STROBES

8 BIT DAC

U203

402

TP18 AM

0V

0mA = FULL INVERTED AMPL

5mA = 0 AMPL

10mA = FULL AMPL

Q205

U203

J8(2)

AC1 TO U502

FUNCTION/AMPL CONTROL (SINE SHAPER)

3314-1Ba

Figure 8-8. Multiplexed DAC Troubleshooting Diagram

8-49. Basic Operation Troubleshooting Diagram

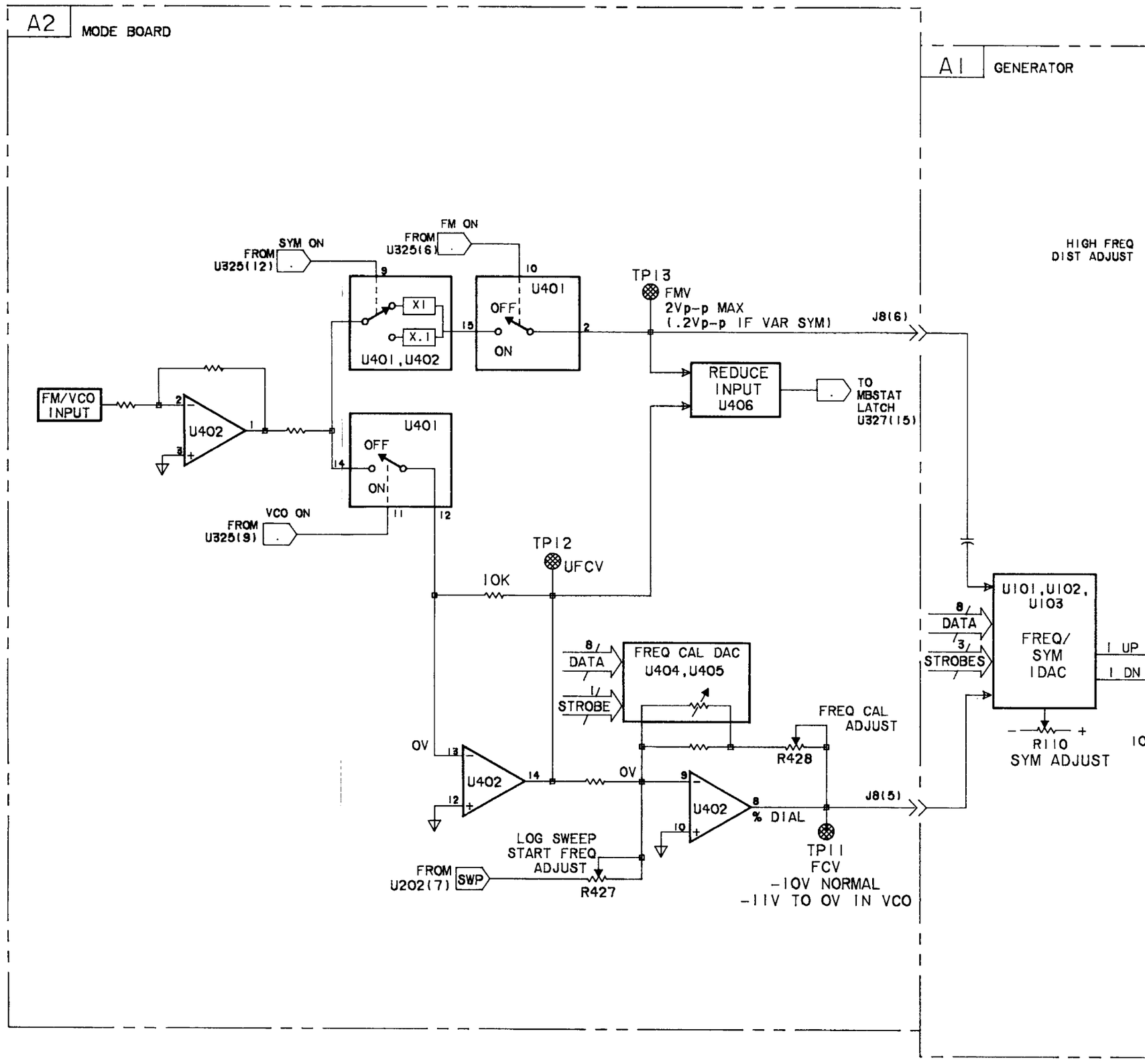
This diagram applies to the 3314A when:

MODE is Free Run
FREQUENCY is <2MHz
FREQUENCY is <20MHz with VCO or
SWEEP

When the 3314A is configured this way, you should be able to completely exercise:

FREQUENCY within the above limits
AMPLITUDE
OFFSET
SYMMETRY
AM, FM and VCO MODULATION
LINEAR and LOG SWEEPS

It may help to center the calibration constants to keep from over-driving some of these circuits. To center the calibration constants, set switches 3, 4 and 5 of A3S1 to the closed position.


A2
MODE BOARD
A1
GENERATOR
HIGH FREQ
DIST ADJUST
SYM ON
FROM
U325(12)
FM ON
FROM
U325(6)
U401
X1
X.1
U401,U402
OFF
ON
TP13
FMV
2Vp-p MAX
(.2Vp-p IF VAR SYM)
J8(6)
FM/VCO
INPUT
U402
REDUCE
INPUT
U406
TO
MBSTAT
LATCH
U327(15)
U401
OFF
ON
VCO ON
FROM
U325(9)
TP12
UFCV
10K
U101,U102,
U103
FREQ/
SYM
IDAC
8/
DATA
3/
STROBES
1 UP
1 DN
8/
DATA
1/
STROBE
FREQ CAL DAC
U404,U405
FREQ CAL
ADJUST
R428
R110
SYM ADJUST
OV
U402
OV
U402
% DIAL
J8(5)
TP11
FCV
-10V NORMAL
-11V TO OV IN VCO
LOG SWEEP
START FREQ
ADJUST
FROM
U202(7)
SWP
R427

A1 GENERATOR

A8 OUTPUT AMP

HIGH FREQ DIST ADJUST
C306
C308
TRIANGLE COMPARATOR
R334 EVEN HARMONIC ADJ
S UP
S DN
UP
DN
T UP
T DN
8/ DATA
1/ STROBE
DATA LATCH U808
J6(1)
J6(2)
J6(11)
J6(14)
J6(15)
J6(16)
J3(1)
J3(2)
J3(11)
J3(14)
J3(15)
J3(16)
SINE
SQUARE
TRIANGLE
8/ DATA
1/ STROBE
DC OFFSET CAL DAC U801 U802
J6(5)
J3(5)
1K
6
RELAY DRIVERS U4
8
FROM Q205 AC1
J8(2)
UP
DN
AMPLITUDE CONTROL
FUNCTION SELECT
SINE SHAPER
U501 U502 U503 U504
OUT UP
OUT DN
PREAMP
J1
J1
50
OUTPUT AMP
60dB STEP ATTENUATOR 20dB/STEP K1-K8
J2
MAIN OUTPUT
L1
U101, U102, U103 FREQ/ SYM IDAC
8/ DATA
3/ STROBES
I UP
I DN
INTEGRATOR
R110 SYM ADJUST
C218 10MHz ADJUST
T UP ~ 1Vp-p
T DN ~ 1Vp-p
VOLTAGE-CURRENT
TI UP
TI DN
3RD,5TH HARMONIC ADJUST
R550
R551 3RD HARMONIC ADJUST
SYNC DRIVE
SYNC OUTPUT
4/ DATA
1/ STROBE
AMP CAL U803 U804 U805 U806
J6(10)
J3(10)
11K
CALIBRATION LEVEL SENSE
OUTPUT OVERLOAD SENSE
FROM U203(1) DCV
J8(3)
OFFSET AMP
-100mA TO +100mA
J6(4)
J3(4)

3314-1Bb

Figure 8-9. Basic Operation Troubleshooting Diagram

8-50. General Operation Troubleshooting Diagram

This diagram (2 sheets) includes all of the 3314A's functional blocks and applies to all operating modes. In conjunction with the Control Latch Truth Tables (to indicate the proper configuration) all of the 3314A's features can be exercised.

A2 MODE BOARD

A1 GENERATOR

FROM U311(5) HOLD → J3(4) ECL 1 = HOLD → COMPARATOR CONTROL FREE RUN/HOLD

FROM U310(6) HOLD SLOPE → J3(3) TTL 1 = HOLD ON UP SLOPE → TRIANGLE COMPARATOR

HIGH FREQ DIST ADJUST: C306, C308

R334 EVEN HARMONIC ADJ

FROM U401(2) FMV → J4(6)
2Vp-p MAX
.2Vp-p IF VAR SYM

FROM U201(1) PCV → J4(1)
-8.2V IF PHASE = 0
0V IF PHASE = ±90°

FROM U402(8) FCV → J4(5)
-10V NOMINAL
-11V TO 0V IF VCO

ARB CONTROL/ TIMING
U903 U904 U905
2/ DATA / 2/ STROBES /
PHASE SIGN
SERVO/RAMP MODE
RAMP UP
RAMP DN
ARB SYNC

TRIG/ GATE/ ARB PHASE SERVO AMP
SERVO UP
SERVO DN
S UP
S DN
UP
DN
(0)HOLD (1)CONT
T UP
T DN

R269 HOLD PHASE ADJUST

U101, U102, U103
FREQ/ SYM IDAC
8/ DATA / 3/ STROBES /
SYM COMP 1 UP
SYM COMP 1 DN
0 TO 9mA
0 TO 9mA
1 UP
1 DN
0 TO 2.22mA
0 TO 2.22mA

R110 SYM ADJUST

INTEGRATOR
FROM U902 8/ RANGE CONTROL
C218 10MHz ADJUST

VOLTAGE-CURRENT
T UP 1Vp-p
T DN 1Vp-p
TI UP
TI DN

SINE SHAPER
U501 U502 U503 U504
OUT UP
OUT DN

SINE
SQUARE
TRIANGLE

8/ DATA / 1/ STROBE
DATA LATCH
U808

8/ DATA / 1/ STROBE
DC OFF CAL D
U801 U802

FROM Q205 AC1 → J8(2)
UP
DN

3RD,5TH HARMONIC ADJUST R550
R551 3RD HARMONIC ADJUST

ARB SYNC
UP
DN
SYNC DRIVE

4/ DATA / 1/ STROBE
AMP C
U803 U804 U805 U806

TO U309(12) SYNC → J3(1)
SYNC OUTPUT

FROM U203(1) DCV → J8(3)
OFFSET AMP
-100mA TO +100mA

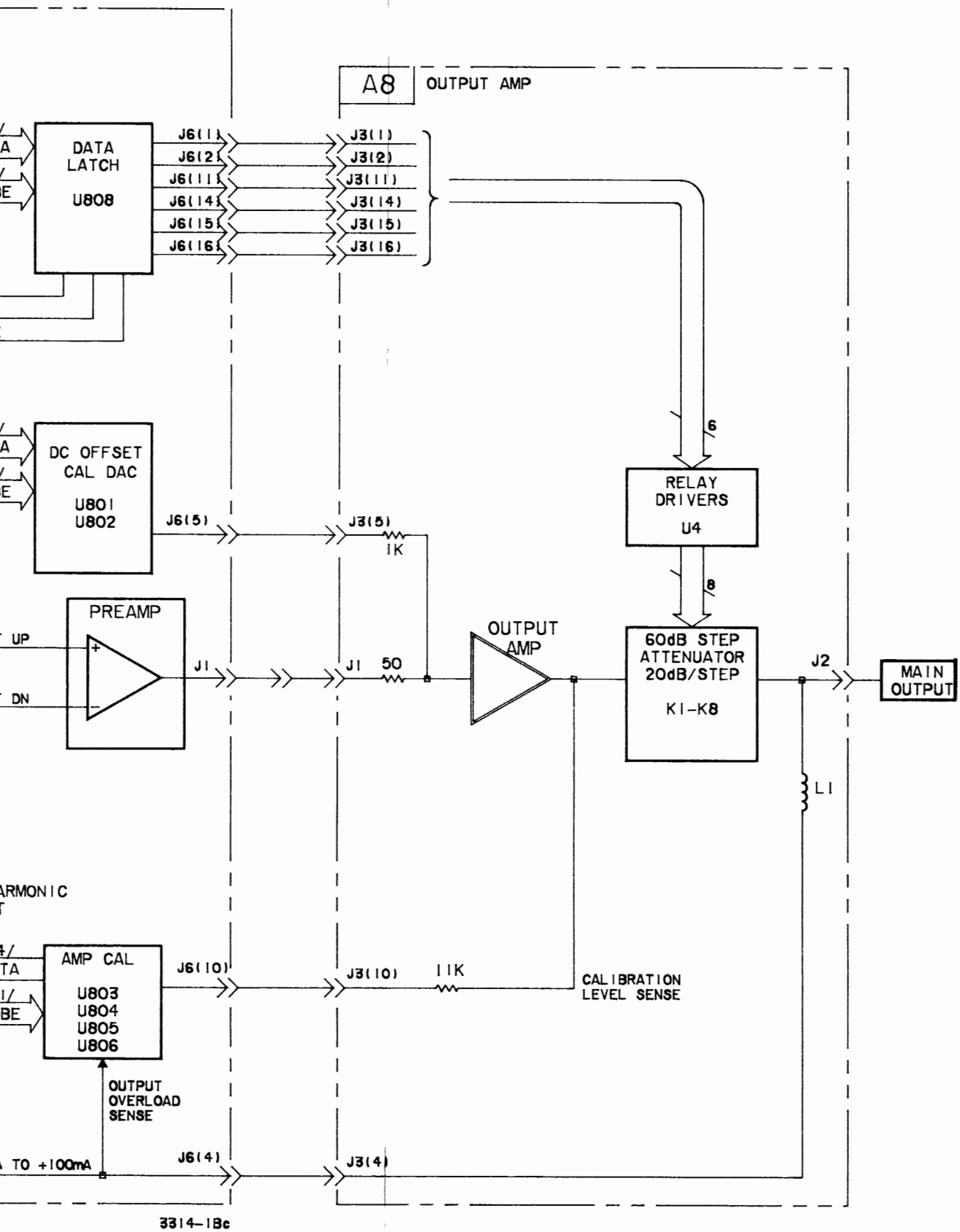


Figure 8-10A. General Operation Troubleshooting Diagram (A1 and A8)

A2 MODE BOARD

A3 CONTROLLER

4MHz CRYSTAL OSC

4MHz

U201 ÷ 4

1MHz

1MHz CLOCK TO u PROCESSOR (MULTI PHASE)

U205 ÷ 10

100KHz

J2 (19)

TIMER CHIP U232

8/ DATA

2/ ADDRESS

J2 (22)

U317 ÷ 10

10KHz

TP1 INT TRIG

INT

EXT

1K

TRIGGER I/O

TP3 EXT TRIG

FROM U323 (15) EXT/INT

FROM U323 (16) +/- SLOPE

FROM U323 (19) 1V/0V THRESHOLD

FROM U325 (15) RETRACE

FROM U325 (16) MARKER

POLARITY SELECT S501

Z-AXIS

U311 ÷ 2

TP2 SYNC

CONT

FxN

F÷N

CONT FxN

U315 U316

8/ DATA

2/ STROBE

÷ N U302 U303 U304

TP4 ÷ N

FROM U322 (2)

FROM U322 (5)

CONT FxN

F÷N

CONT FxN

F÷N

U315 U316

FROM U322 (6)

FROM U308 (3)

U314 ÷ 1,5,10

U307 ÷ 1,2,10

FROM U322 (9)

FROM U320 (4)

TP5 REF Ø

TP6 VAR Ø

EXT FREQ SENSE U320 INT

UNLOCK

PHASE DETECTOR U313 U306 S/H

TO J6 (20)

TP7

PD1 PHASE DETECTOR O

≈10uA

FROM U201 (7)

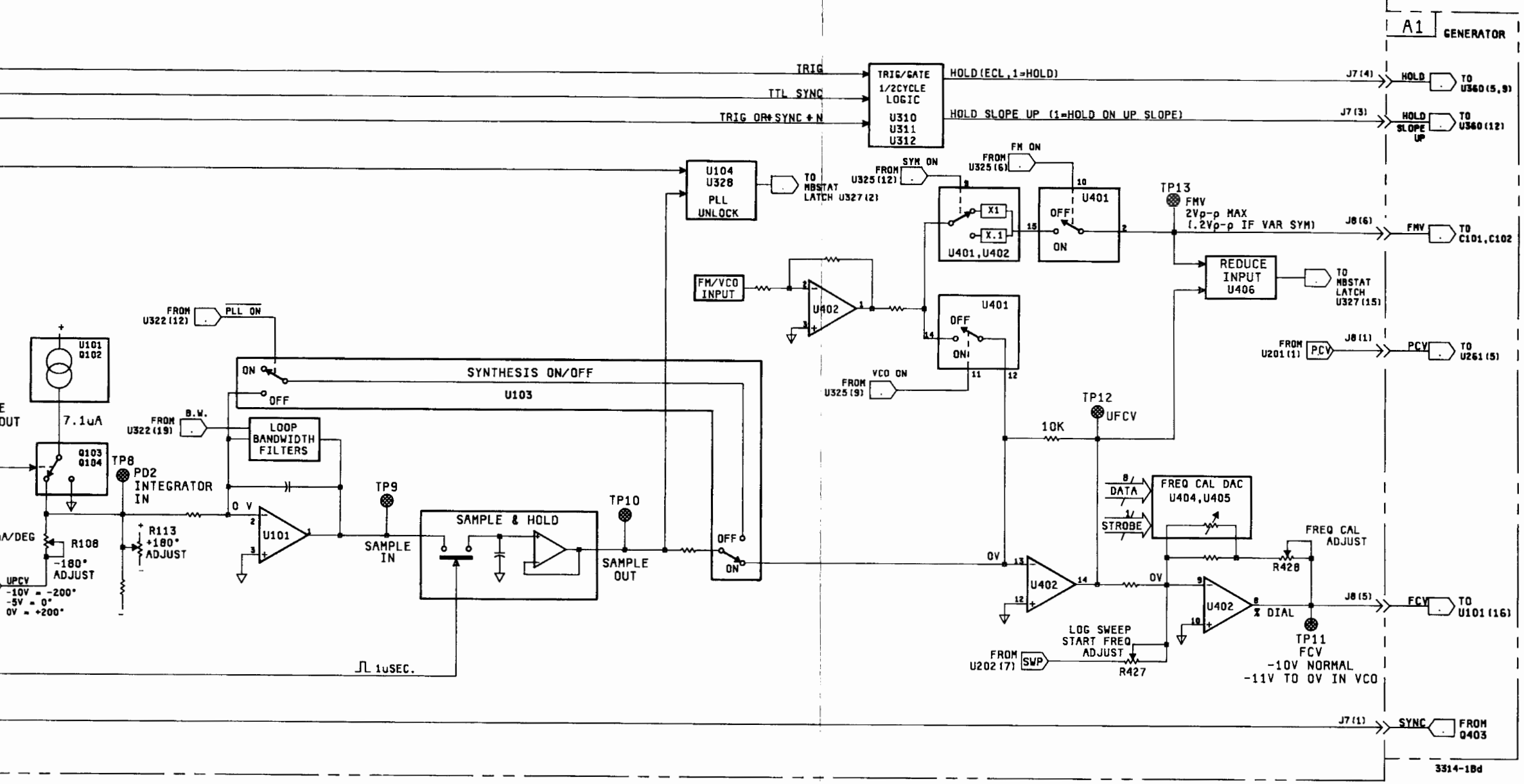


Figure 8-10B. General Operation Troubleshooting Diagram (A2 and A3)

8-51. Calibration Error Troubleshooting

The following flowcharts have been provided to aid in troubleshooting the 3314A when frequency calibration or amplitude calibration errors are detected. The charts themselves may or may not lead to a direct solution, however, their intent is only to offer direction and suggest troubleshooting alternatives.

Troubleshooting tree number one (Figure 8-11A), deals with frequency calibration problems (error codes 30, 31, 32). Troubleshooting tree number two (Fig. 8-11B), deals with amplitude calibration problems (error codes 34, 35, 36, 37, 38). Summarized, the above error codes describe the following symptoms.

Frequency Calibration Errors

Error Code	
30	No frequency detected
31	Frequency error exceeds correction capability
32	Frequency unstable during calibration

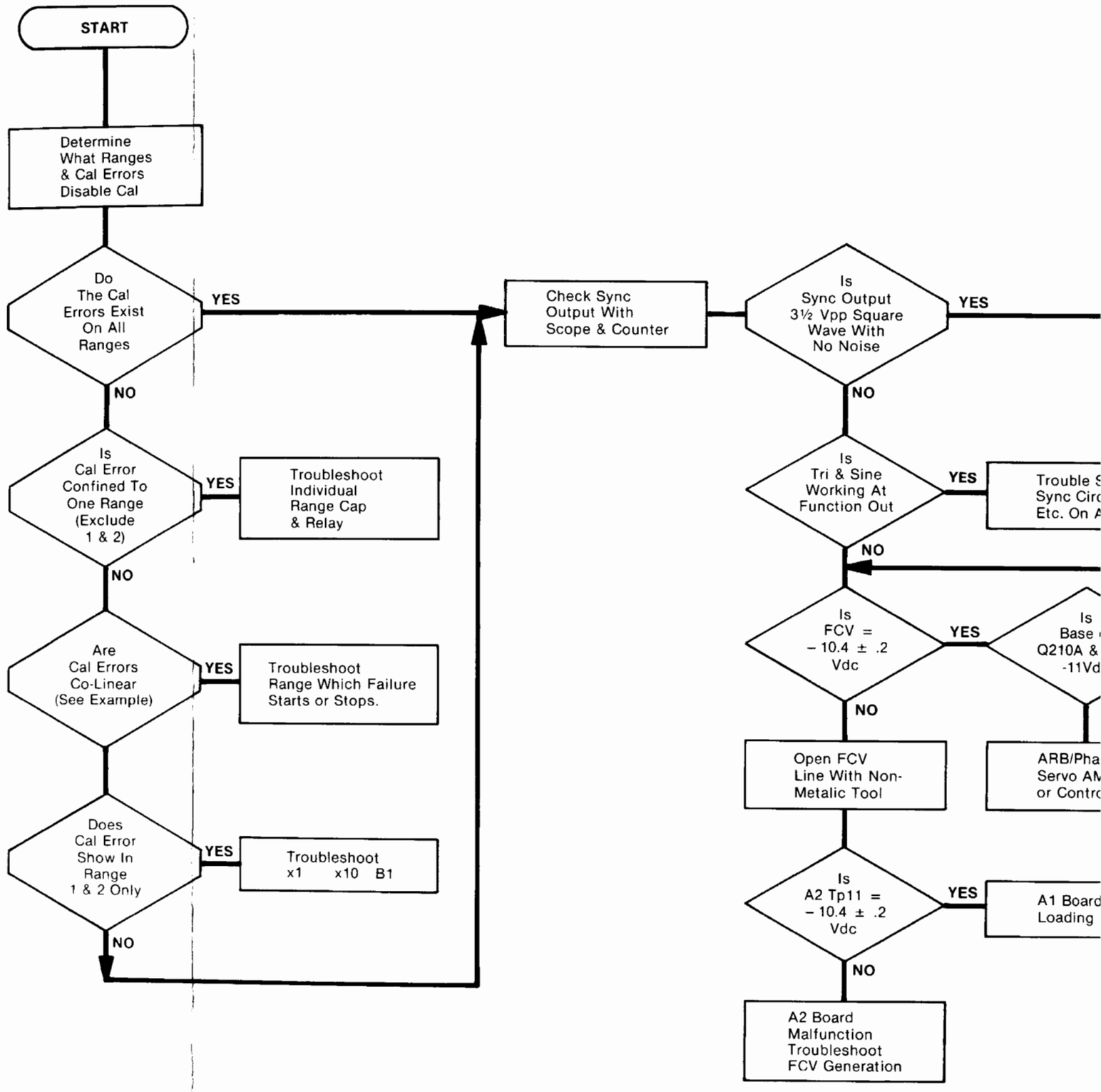
Amplitude Calibration Errors

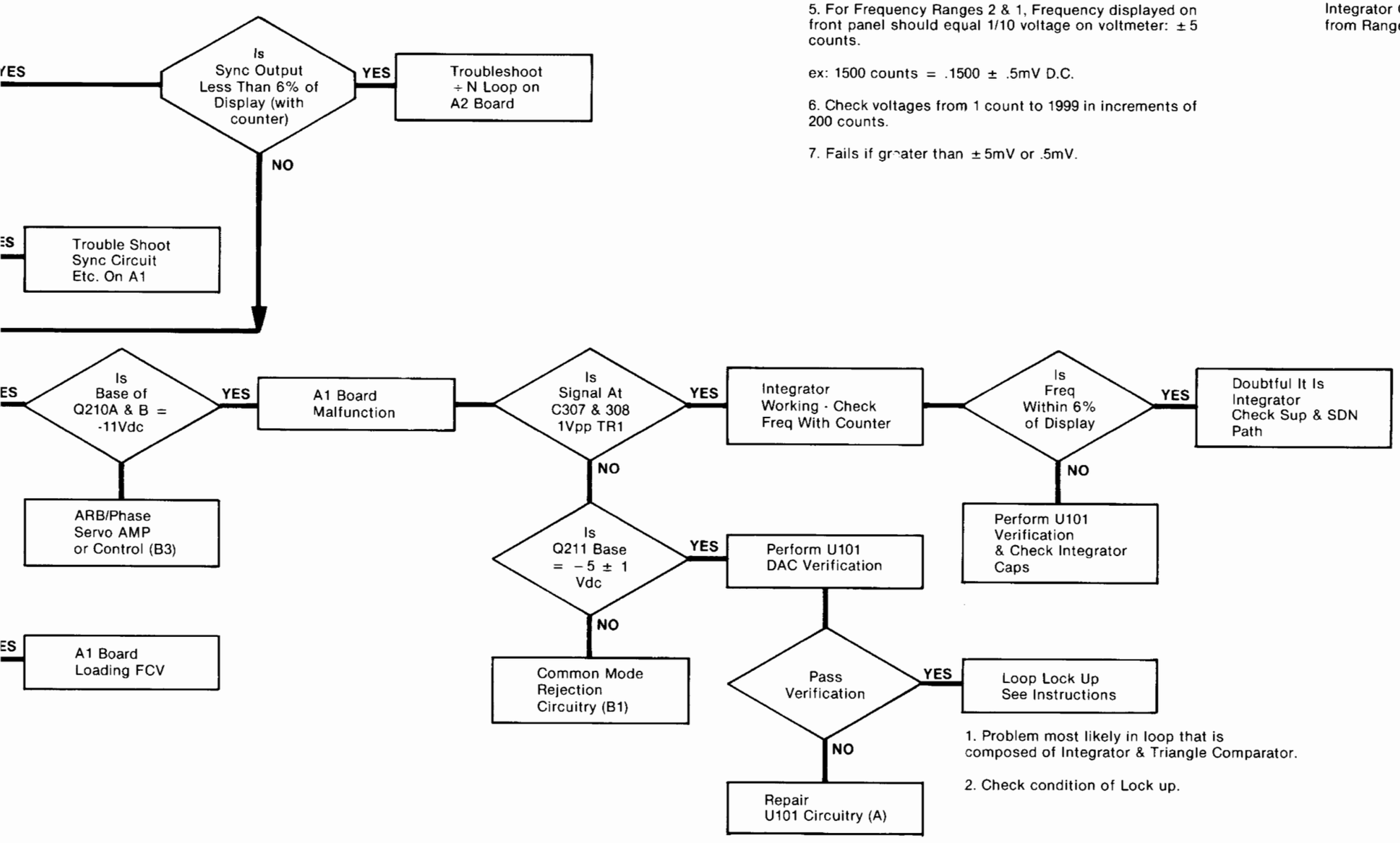
Error Code	
34	Signal amplitude outside measurement range
35	Signal amplitude gain too high
36	Signal amplitude gain too low
37	Signal amplitude gain out of limit
38	Signal amplitude gain offset out of limit

Troubleshooting the 3314A via the flowcharts begins by doing a cold start on the instrument (cycling power while simultaneously pressing the "preset" key). One should also review the static sensitivity and clean handling precautions found on page 8-1 of this manual before proceeding.

Set Up Conditions:

Turn On/Cold Start





1. Problem most likely in loop that is composed of Integrator & Triangle Comparator.

2. Check condition of Lock up.

Figure 8-11A. Frequency Calibration Troubleshooting Flowchart.

U101 DAC VERIFICATION

1. Remove A1 Q203 & Q201 Emitters

2. From Emitter Pads to Ground Install 900 Ω Resistors.

3. Measure voltage across resistors with 3453A or 3456A.

4. For Frequency Ranges 6-3, Frequency displayed on front panel should equal voltage on voltmeter ±5 counts.

ex: 1500 counts = 1.500 ± .5mV D.C.

5. For Frequency Ranges 2 & 1, Frequency displayed on front panel should equal 1/10 voltage on voltmeter: ±5 counts.

ex: 1500 counts = .1500 ± .5mV D.C.

6. Check voltages from 1 count to 1999 in increments of 200 counts.

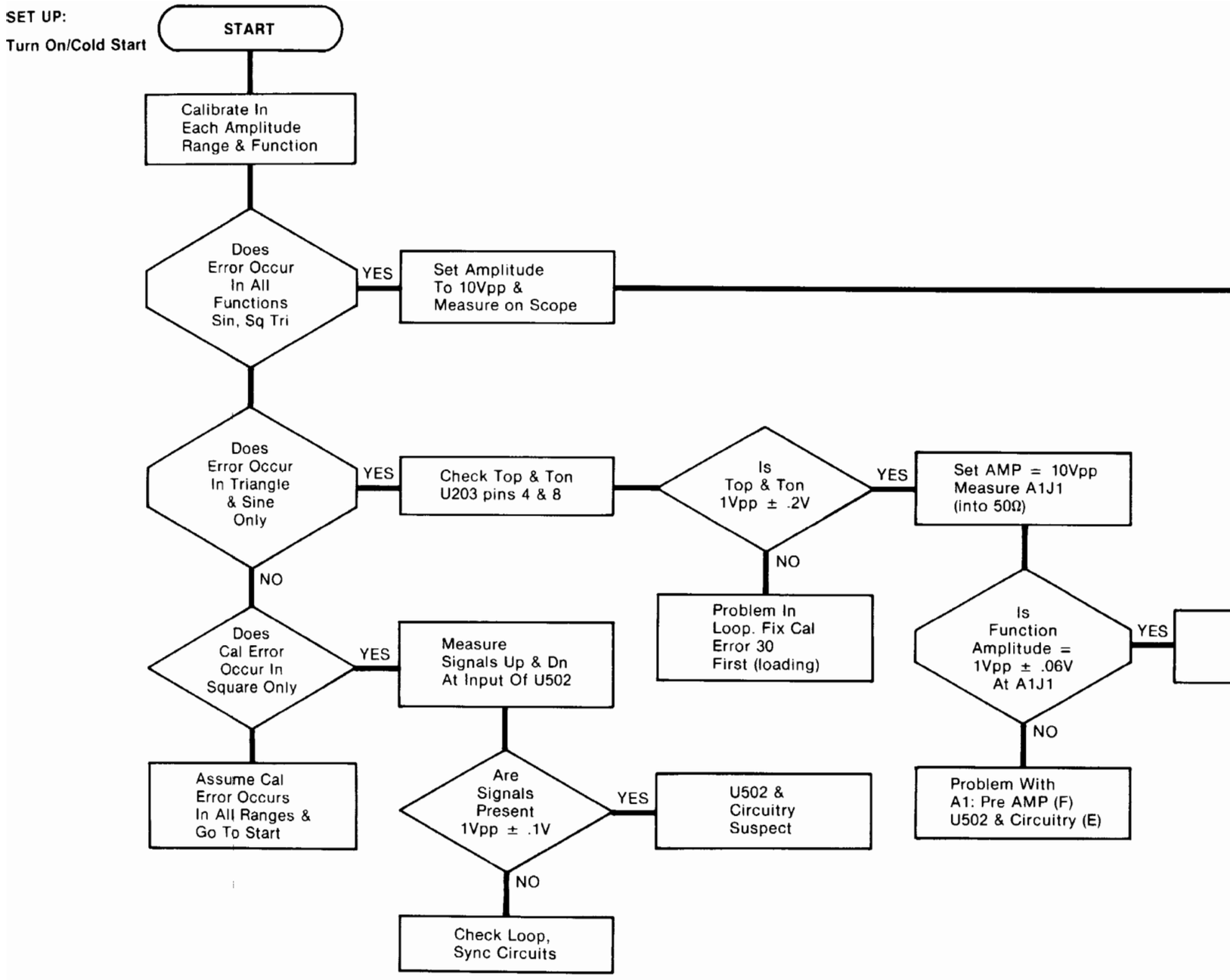
7. Fails if greater than ±5mV or .5mV.

CO-LINEAR

Example:
If Cal error is seen in Range 5 & lower but not in Range 6 & Higher, chances are problem is in Range 5 if relay is open or cap is bad.

Example:
If cal error is seen in Range 4 & greater but not in Range 3 & lower. Problem may be in Range 4 (relay stuck) or Range 5 (relay open, cap bad).

Remember:
Integrator Capacitors are additive
from Range 8 to Range 3.


SET UP:
Turn On/Cold Start
START
Calibrate In Each Amplitude Range & Function
Does Error Occur In All Functions Sin, Sq Tri
YES
Set Amplitude To 10Vpp & Measure on Scope
Does Error Occur In Triangle & Sine Only
YES
Check Top & Ton U203 pins 4 & 8
Is Top & Ton 1Vpp ± .2V
YES
Set AMP = 10Vpp Measure A1J1 (into 50Ω)
NO
Problem In Loop. Fix Cal Error 30 First (loading)
NO
Does Cal Error Occur In Square Only
YES
Measure Signals Up & Dn At Input Of U502
Is Function Amplitude = 1Vpp ± .06V At A1J1
YES
NO
Assume Cal Error Occurs In All Ranges & Go To Start
Are Signals Present 1Vpp ± .1V
YES
U502 & Circuitry Suspect
Problem With A1: Pre AMP (F) U502 & Circuitry (E)
NO
Check Loop, Sync Circuits

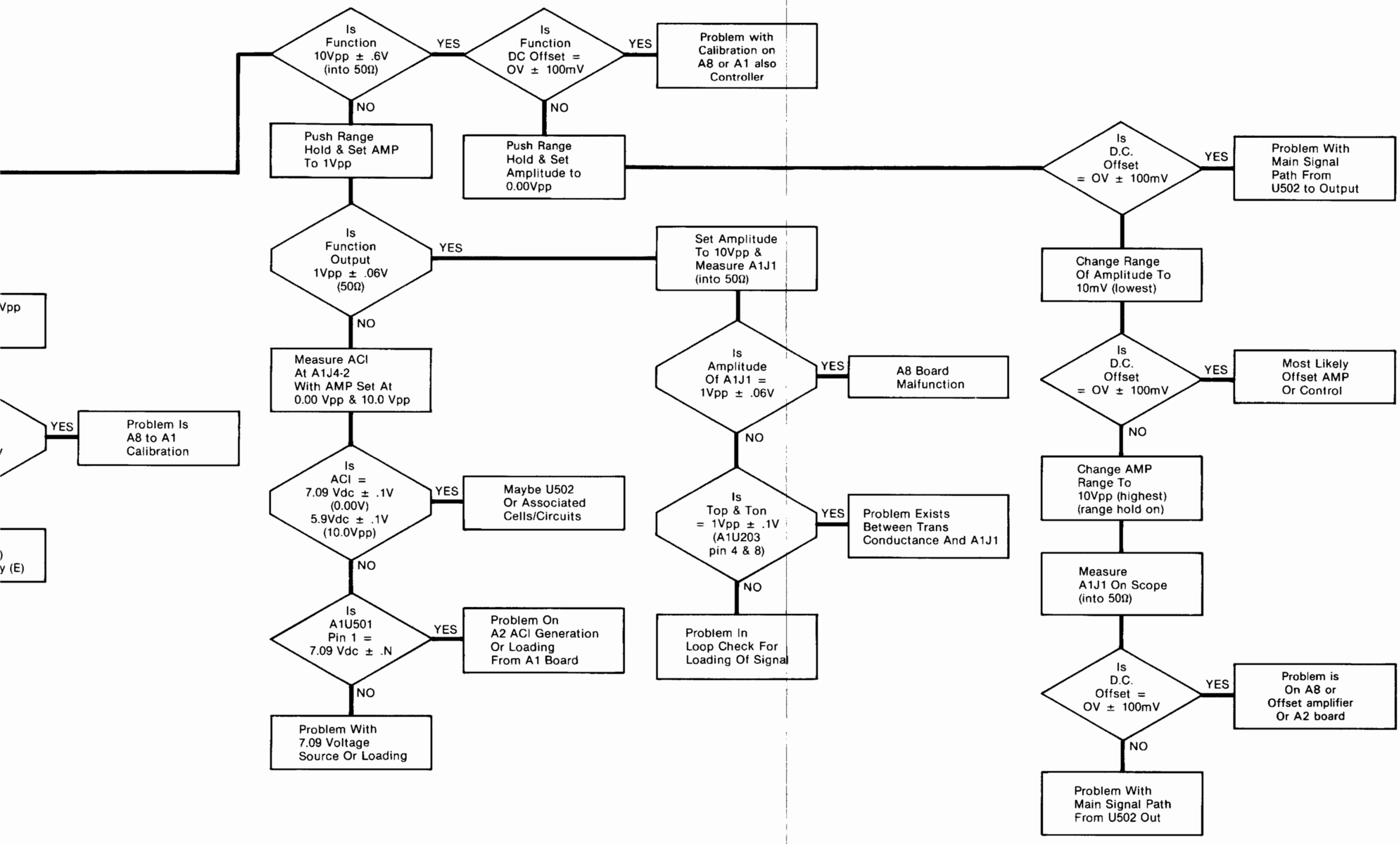


Figure 8-11B. Amplitude Calibration Troubleshooting Flowchart.

8-52. SCHEMATICS

This section contains 22 schematics organized by PC Assembly.

A1, 03314-66501, Generator PC Board
- A Integrator Current Control (includes the Freq/Sym DAC)
- B1 Triangle Integrator
- B2 Transconductance Amplifier
- B3 Trig/Gate/Arb Phase Servo Amplifier
- C Hysteresis Comparator
- D Sync Circuits and Sync Output
- E Function and Vernier Amplitude Control (includes the Sine Shaper IC)
- F Preamplifier
- G Offset Amplifier
- H Output Interface
- I Misc Interface

A2, 03314-66502, Mode PC Board
- J Phase Locked Loop (analog)
- K Multiplexed DAC and X Drive Output
- L Phase Locked Loop (digital) and Dividers
- M Frequency Control and Z Axis Output

A3, 03314-66503, Controller/Power Supply PC Board
- N Power Supplies
- O Clock Circuits
- P Processor, Memory and HP-IB
- Q Timer and IO

A4, 03314-66504, Front Panel and Keyboard
- R Front Panel and Keyboard

A8, 03314-66504, Output Amplifier and Step Attenuator
- S Output Amplifier and Step Attenuator

A5, 03314-66505, x3 Output
- T x3 Output

8-53. Special Schematic Symbols

The 3314A schematics use an arrow with a letter inside to denote circuit connections from schematic to schematic. The arrow indicates the signal direction, the signal name and the source or destination schematic letter where a corresponding arrow with the same signal name will be found.

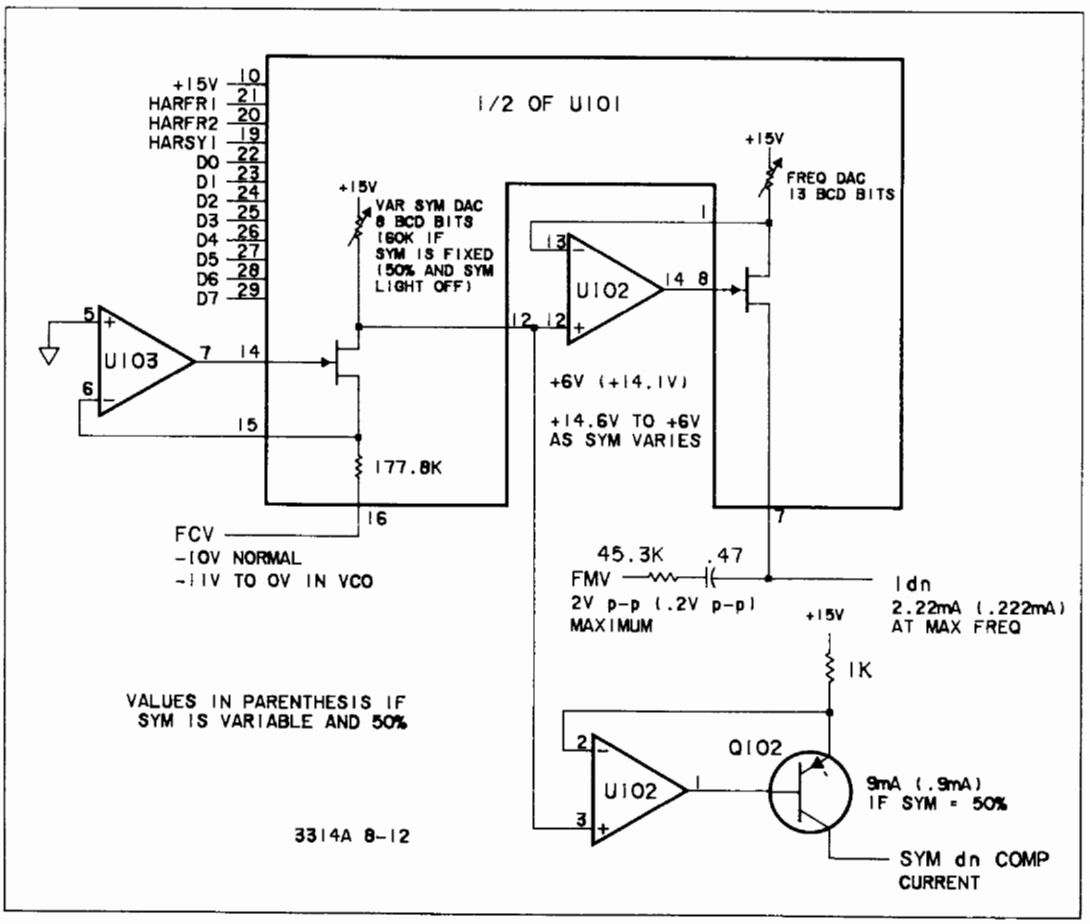
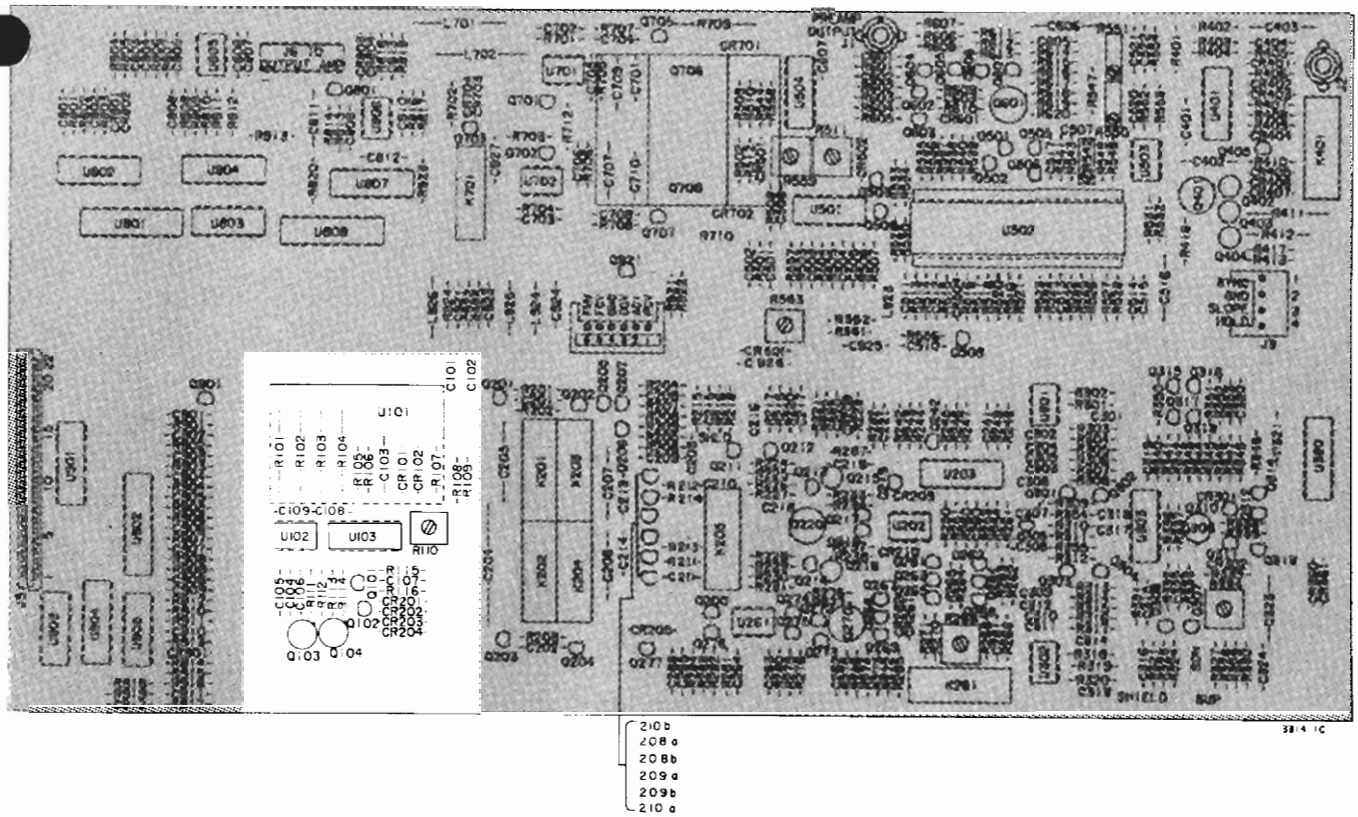


Figure 8-12. Integrator Current Block Diagram



A1
03314-66501

P/O A1

03314-66501
INTEGRATOR CURRENT CONTROL
(INSIDE SHIELD)

HARFR2 U901-14
HARSY1 U901-13
HARFR1 U901-15
D0 D1 D2 D3 D4 D5 D6 D7
+15s
C109 Δ3 12pF
R102 8M
R101 4M
R105 10K
U102
<3mV
U101
FREQ/SYM DAC
SVS
FNN
SNN
ING
FNN *
RSO2
SNG
INO
GND
IPO
FCV
FPN
FPN
SPN
IPG
RSO1
SPG
R104 8M
R103 4M
C108 Δ3 12pF
R106 10K
U102
<3mV
R113 1K
R114 10K
U1C3
Q101
SYM DN COMP Q273-E B3
R110 100K
SYM ADJ
R115 22M
U103
CR102
-15s
+15S L925 1
C103 2.2
C105 .1
+15s
-15s L924 1
-15s
C106 180pF
Q104
R108 45.3K
C101 .47
R109 45.3K
C102 .47
I DN Q203-E B1
I UP Q201-E B1
FMVS R925 1
FCV
R107 38.3K
-15
CR101
U103
C104 180pF
R111 10K
R112 1K
U103
Q102
SYM UP COMP Q272-E B3
R116 100
C107 .1
-15s
SHIELD
Q103
VAR SYM OFF Q901-C 1
FCVS R929 1
-10V NORMALLY
-11V TO 0V IN VCO

* CONNECTION NEED ONLY BE MADE TO PIN 1 OR PIN 9

NOTE: SEE SECTION VII FOR 'Δ' EXPLANATION.

3314 1A/1

A

Figure 8-13. Integrator Current Control (includes the Freq/Sym DAC)

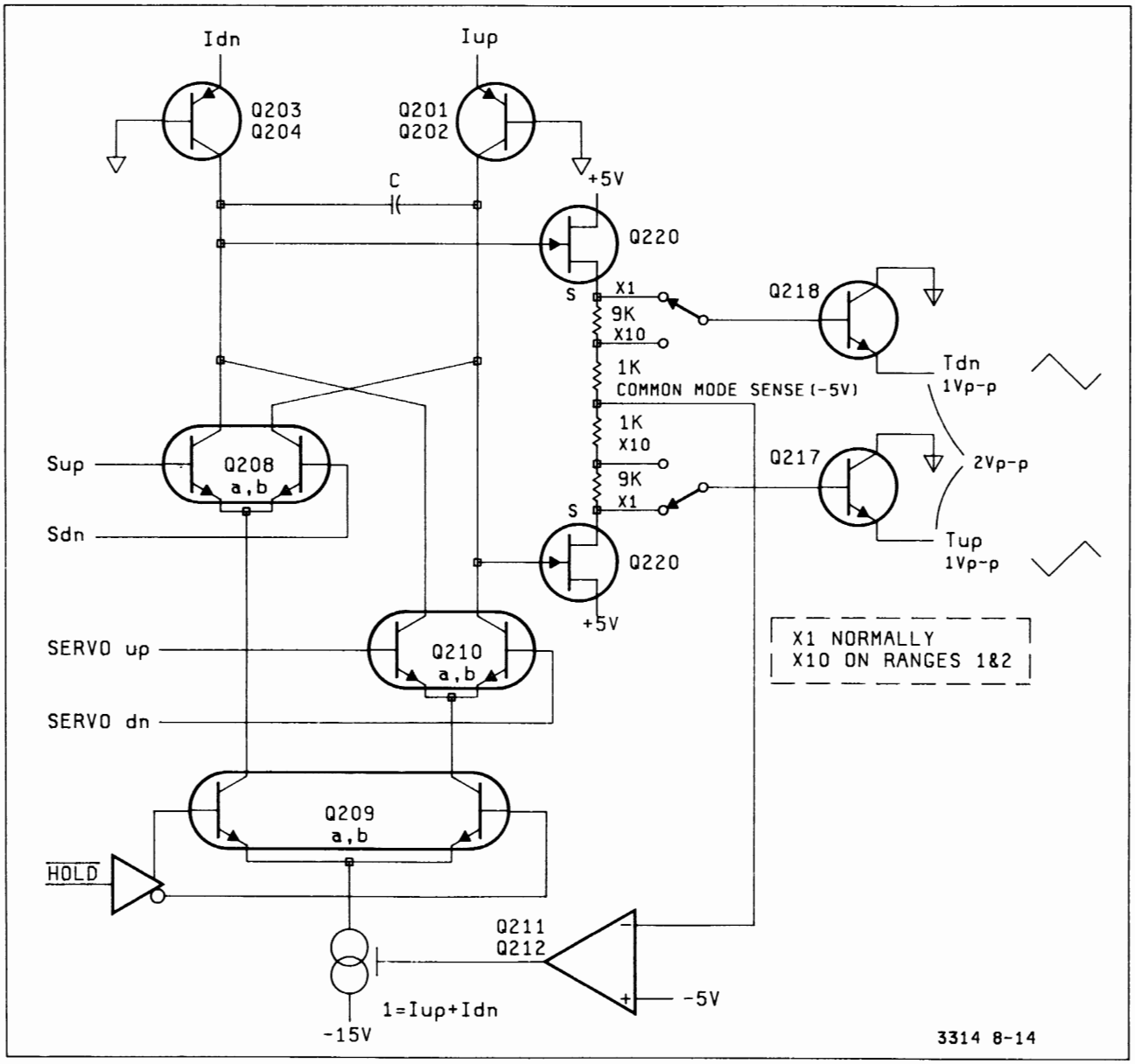
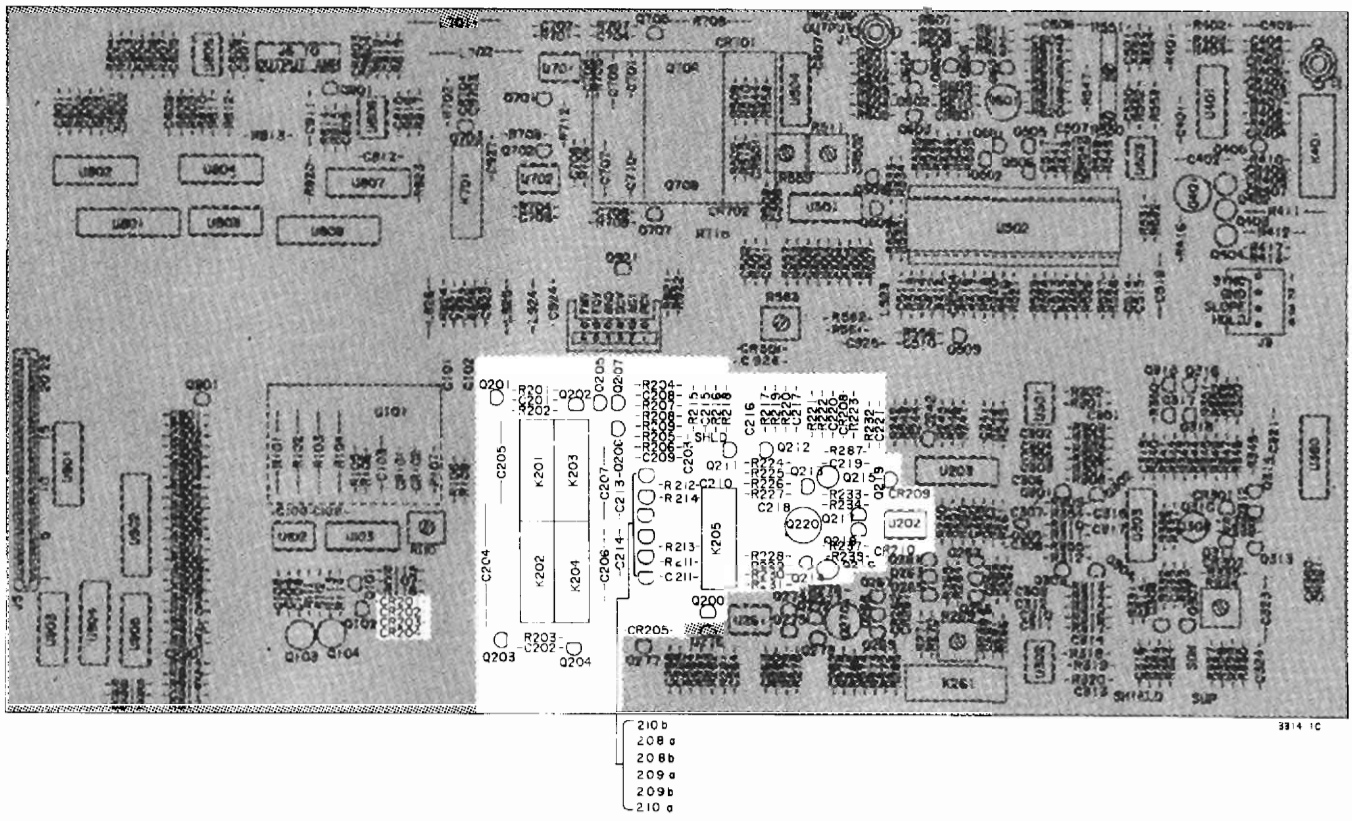


Figure 8-14. Integrator Block Diagram

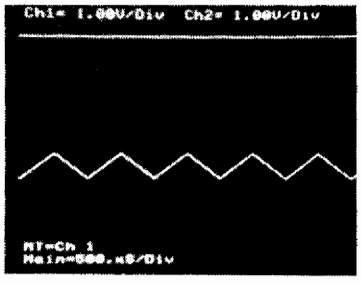


A1
03314-66501

Note: All front panel settings are from instrument turn on unless otherwise noted.

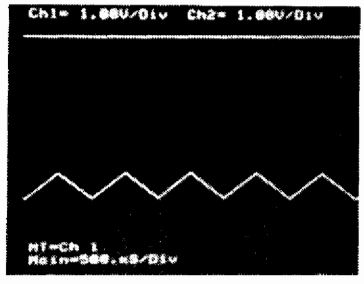
1

Ground



2

Ground



P/O A1 03314-66501
INTEGRATOR 200
(INSIDE SHIELD)

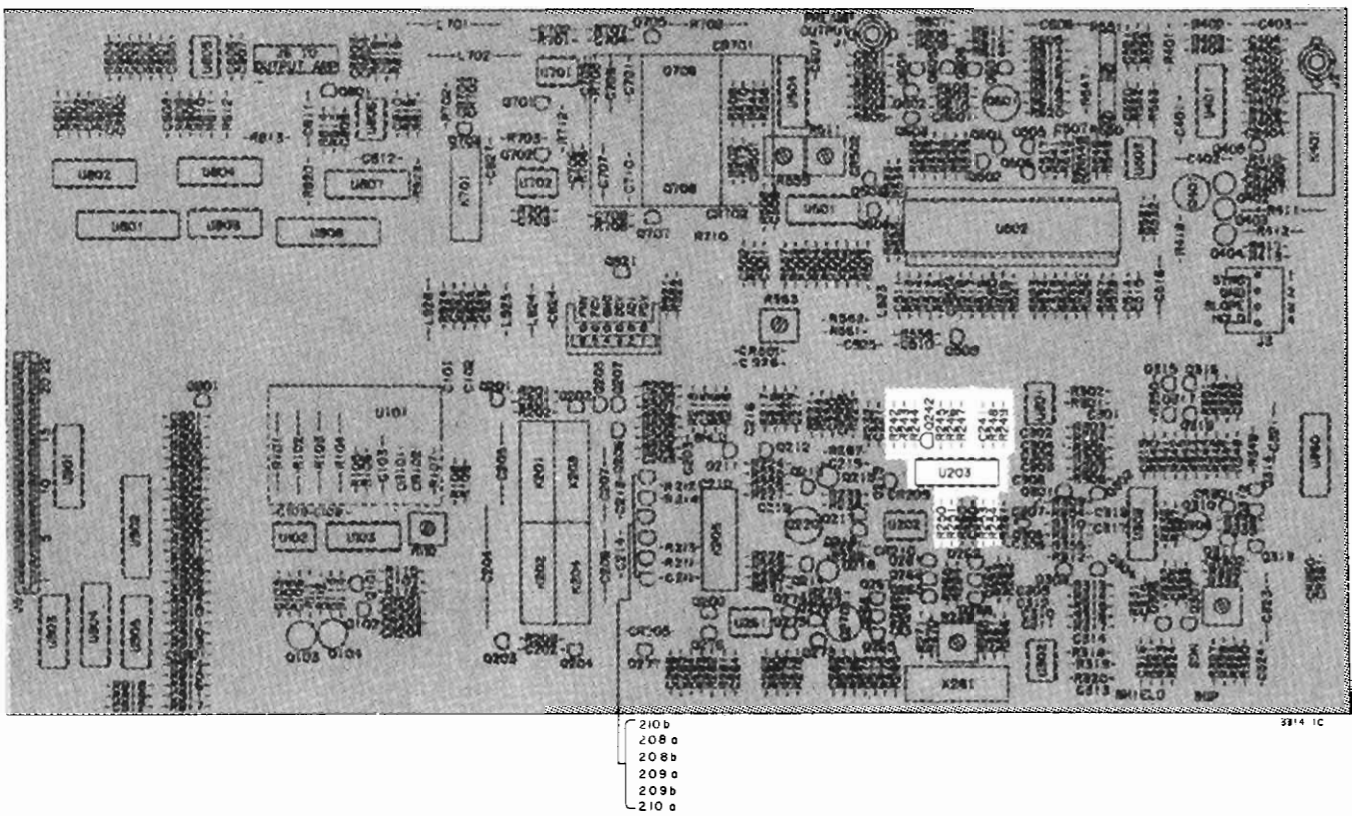
Idn U101(7)
Iup U101(6)
Q203
Q204
Q201
Q202
R203 49.9
R202 49.9
C202 .01
C201 .01
10MHz ADJUST
C218
C214 10pF
C213 10pF
C204 2.5
C203 .75pF
C205 .25
C206 .025
C207 2500pF
C210 250pF
C211 .01
K201
K202
K203
K204
K205
CR202
CR201
CR203
CR204
CR205
200Hz RANGE
2KHz RANGE
20KHz RANGE
200KHz RANGE
2MHz RANGE
2.5 R904
.25 R903
.025 R905
.0025 R906
.00025 R908
1Vp-p (10Vp-p IN RANGE 1&2)
Q208b
Q208a
Q210a
Q210b
Sup R324
Sdn R327
R211 100
R212 100
R213 51.1
R214 51.1
SERVO dn R277
SERVO up R276
-12V
I=Iup+Idn IN
CONTINUOUS MODES
-12V
I=Iup+Idn IN
NON-CONTINUOUS MODES
WHEN GENERATOR IS OFF
+5s
R222 49.9
Q220
+4V
C219 .01
R225 3.01K
R226 1K
R227 301
Q213
I=10mA
-11.3V
-12V
-15S
R230 3.01K
R229 1K
R228 301
Q214
X1/X10 R907
Q200
CR208
Q219
R223 10K
-15s
U202
CR209
X10 PATH
X1 PATH
C220 1000pF
Q217
Q215
Q216
Q218
R233 9K
R234 1K
R237 1K
R238 9K
R221 200K
R224 1M
R231 1M
COMMON MODE SENSE -5V
CR210
R232 499
C221 .1
R235 66.5K
R561
Tup R254
R263
C307
Idn R251
R265
C308
HOLD CR301 CR302
R205 49.9
Q205
Q206
Q207
R201 1K
R204 1.5K
R207 750
R208 750
C208 .01
+8.2V
+7.5V
+4.2V/3.4V
+3.8V
Q209a
Q209b
-13.7V
R206 100
R209 100
C209 .01
R215 200
R216 100
R218 200
C216 4700pF
Q211
Q212
R217 59
R219 1K
R220 2K
-5V
+15s
+5s
-15s
C215 .01
C217 .01
+5

SEE SECTION VII FOR "△" EXPLANATION.

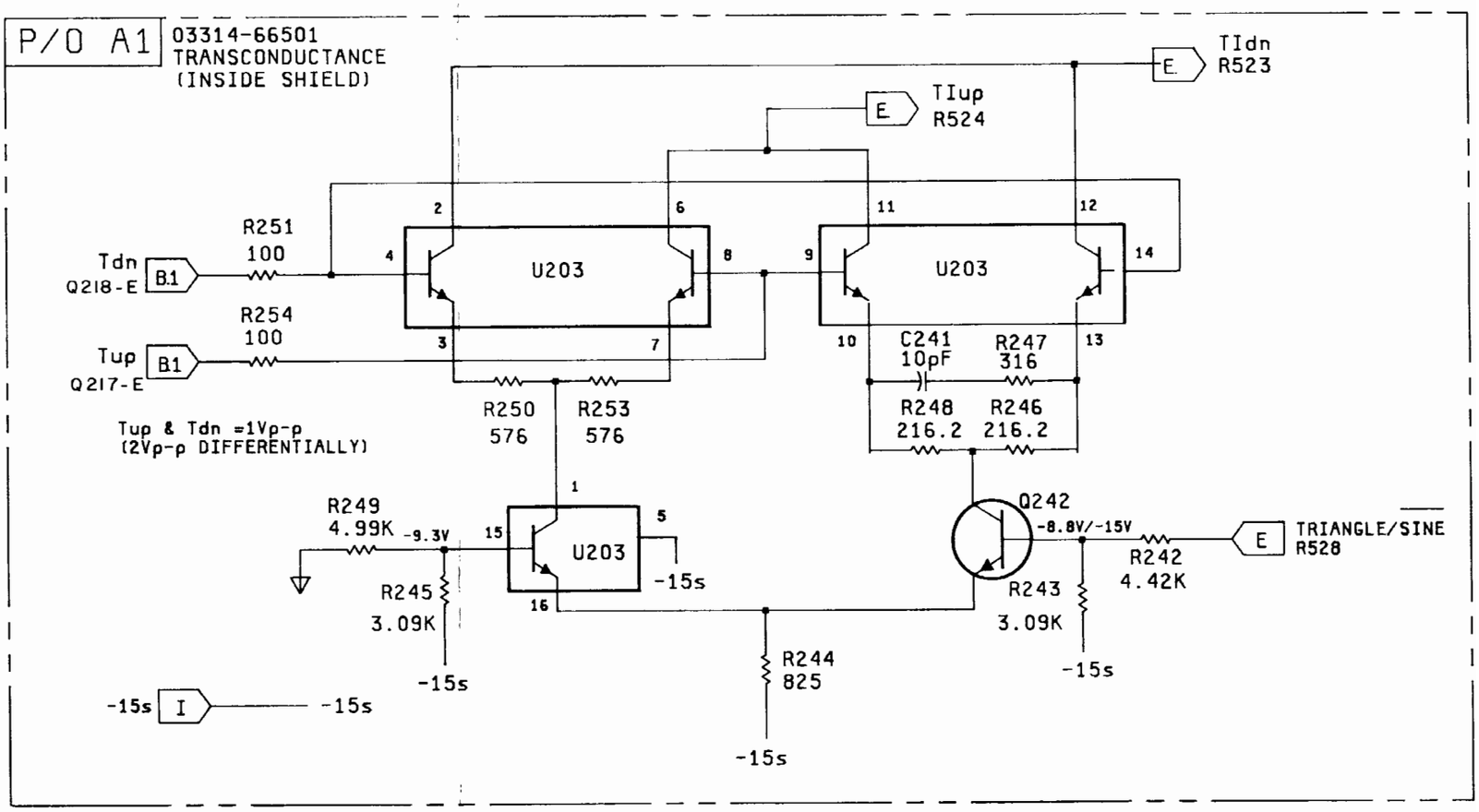
3314 1A/2a

B1

Figure 8-15. Triangle Integrator

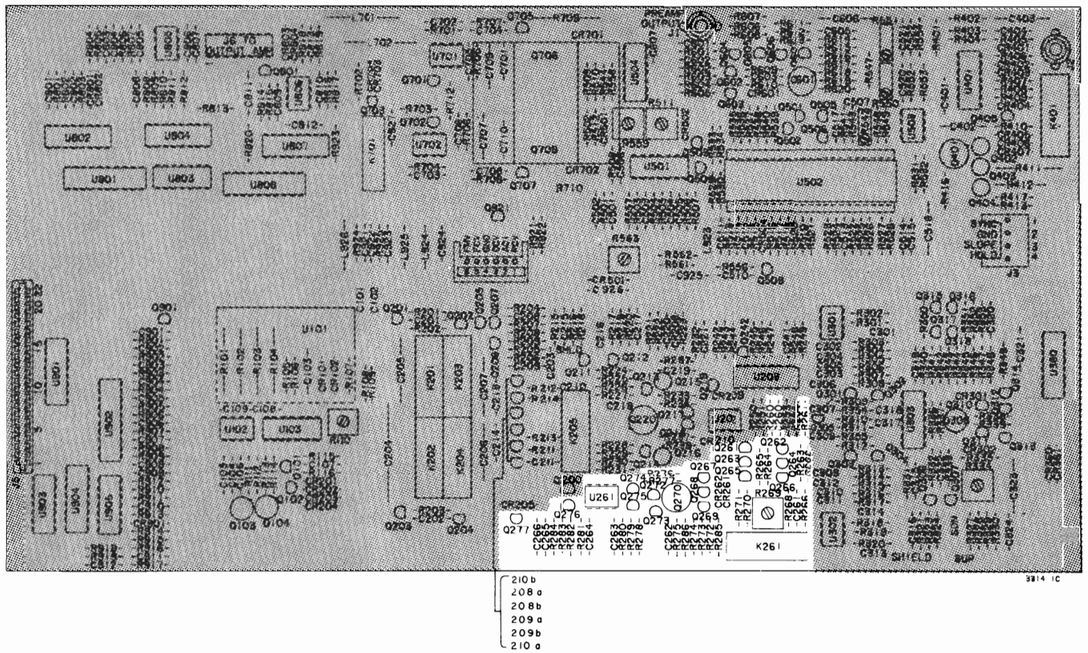


A1
03314-66501



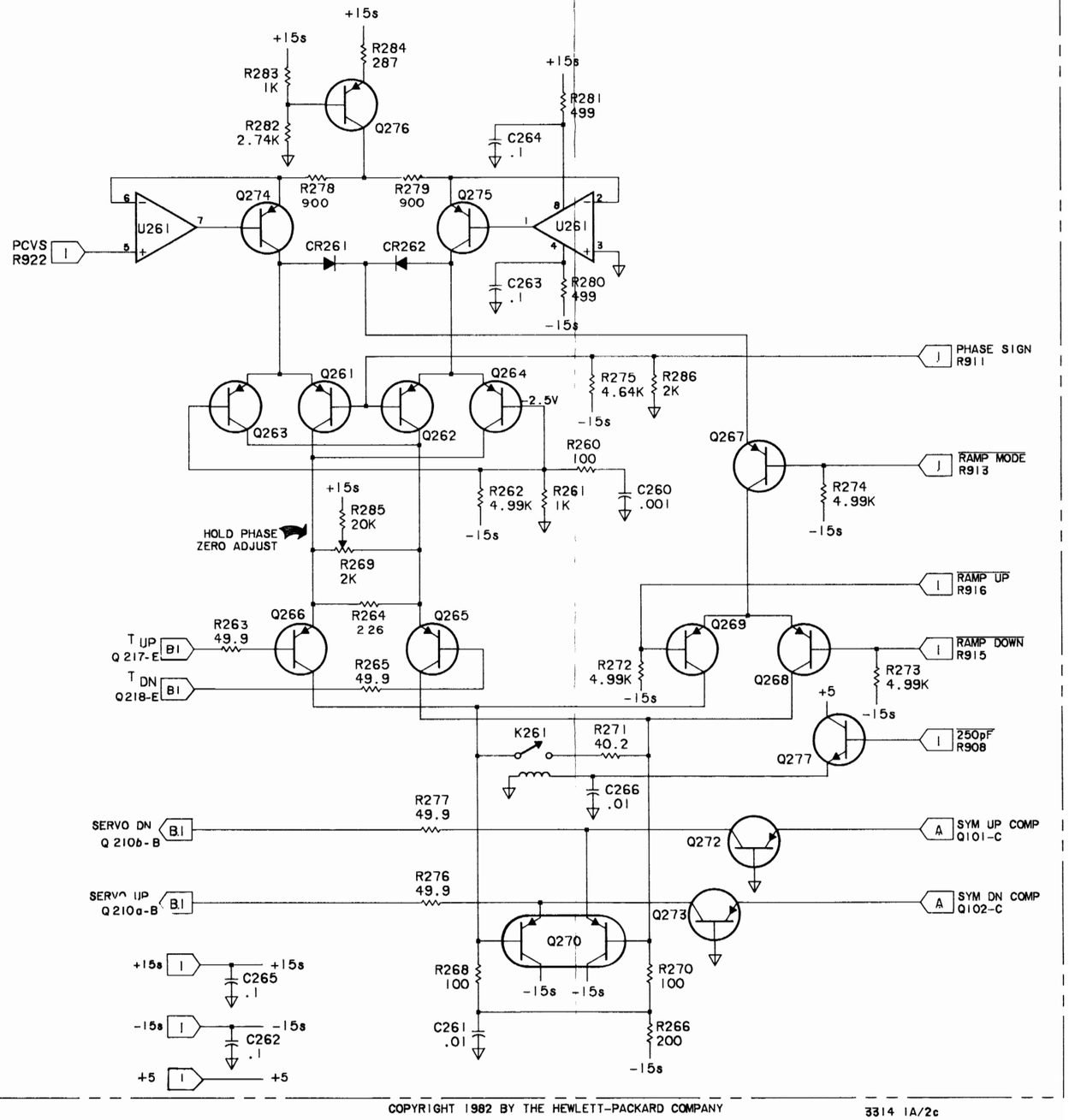
B2

Figure 8-16. Transconductance Amplifier



A1
03314-66501

P/O A1 03314-66501
TRIG/GATE/ARB SERVO



3314 1A/2c

B3

Figure 8-17. Trig/Gate/Arb Phase Servo Amplifier

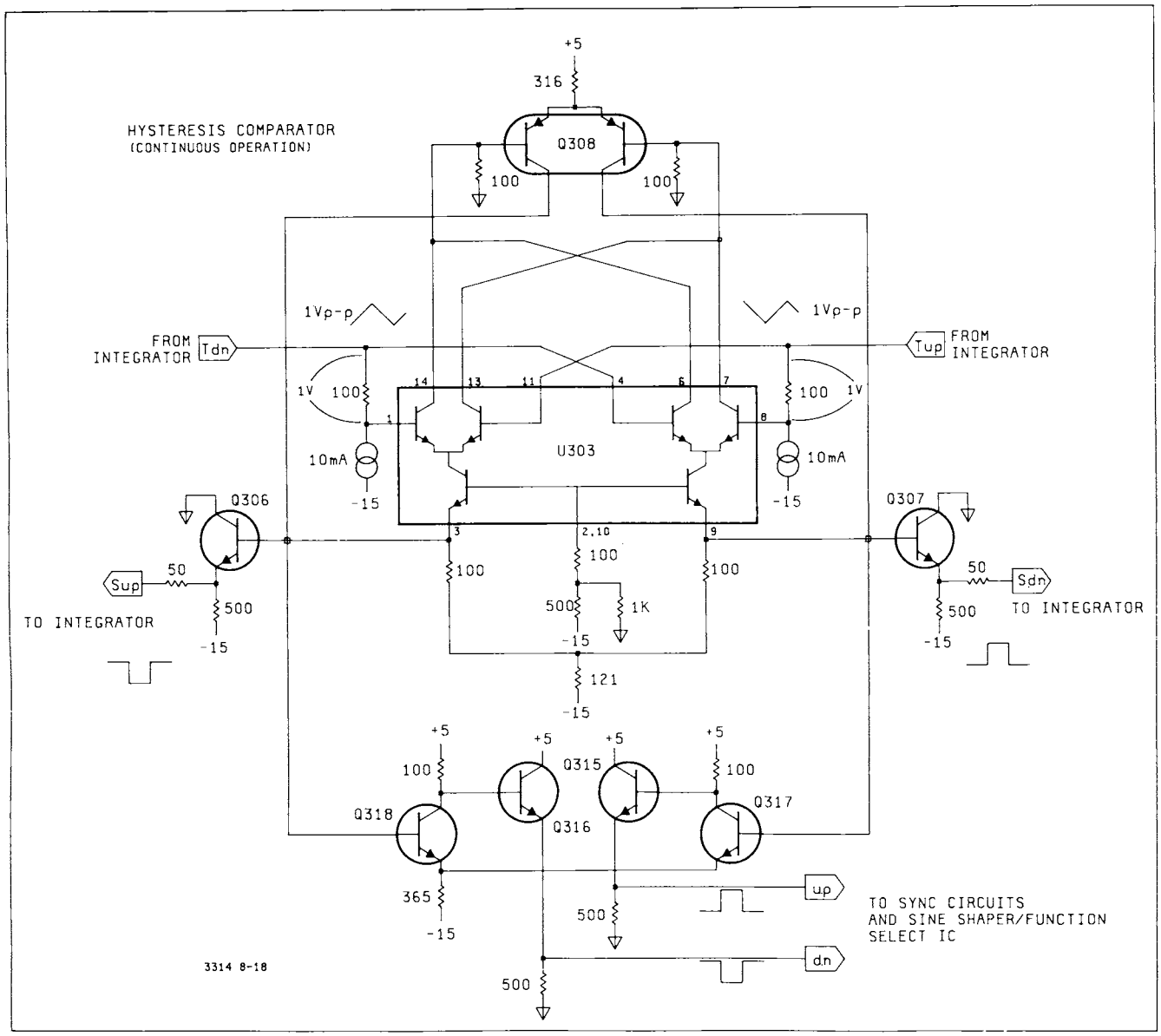


Figure 8-18. Comparator Block Diagram (Continuous Operation)

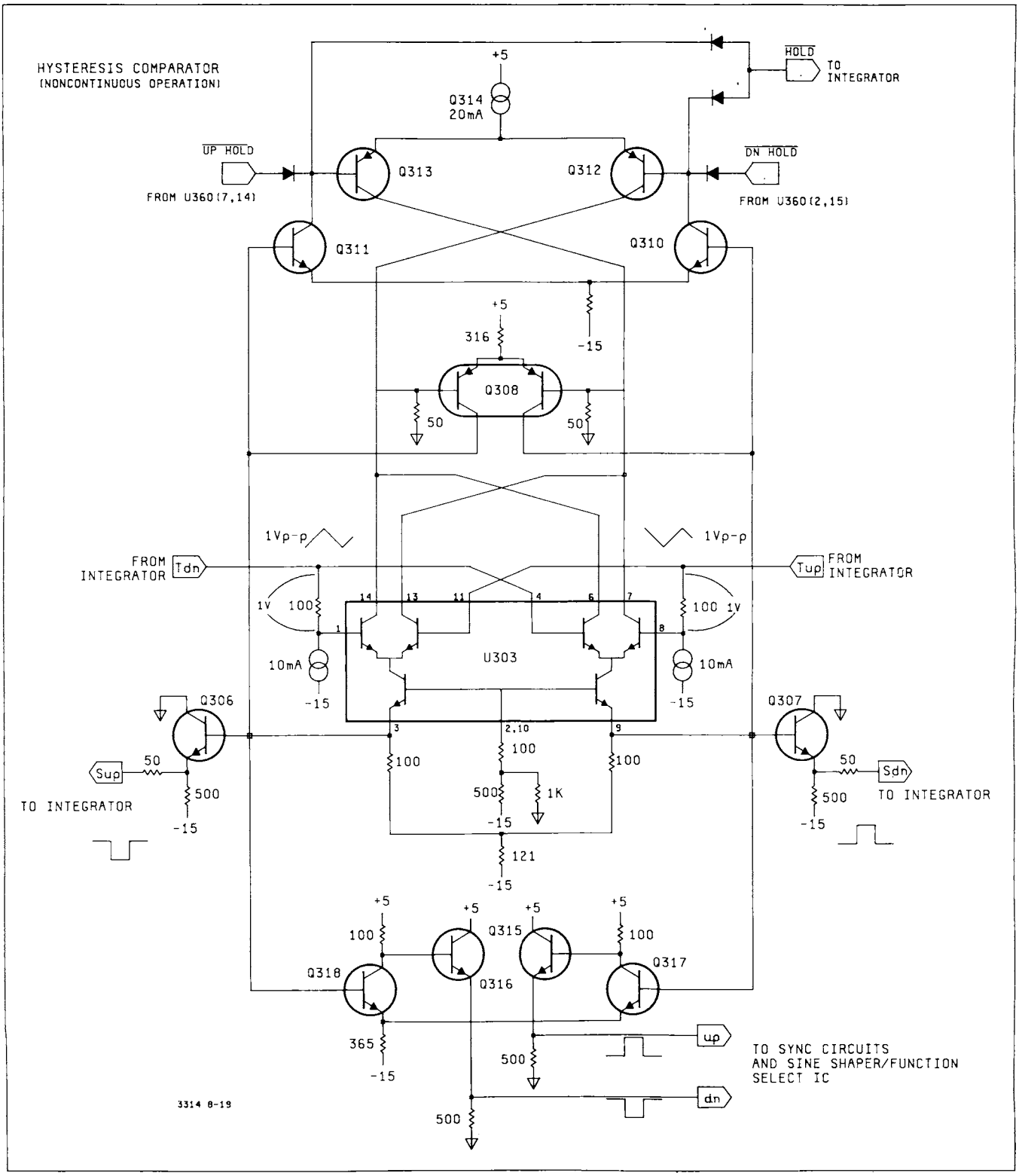
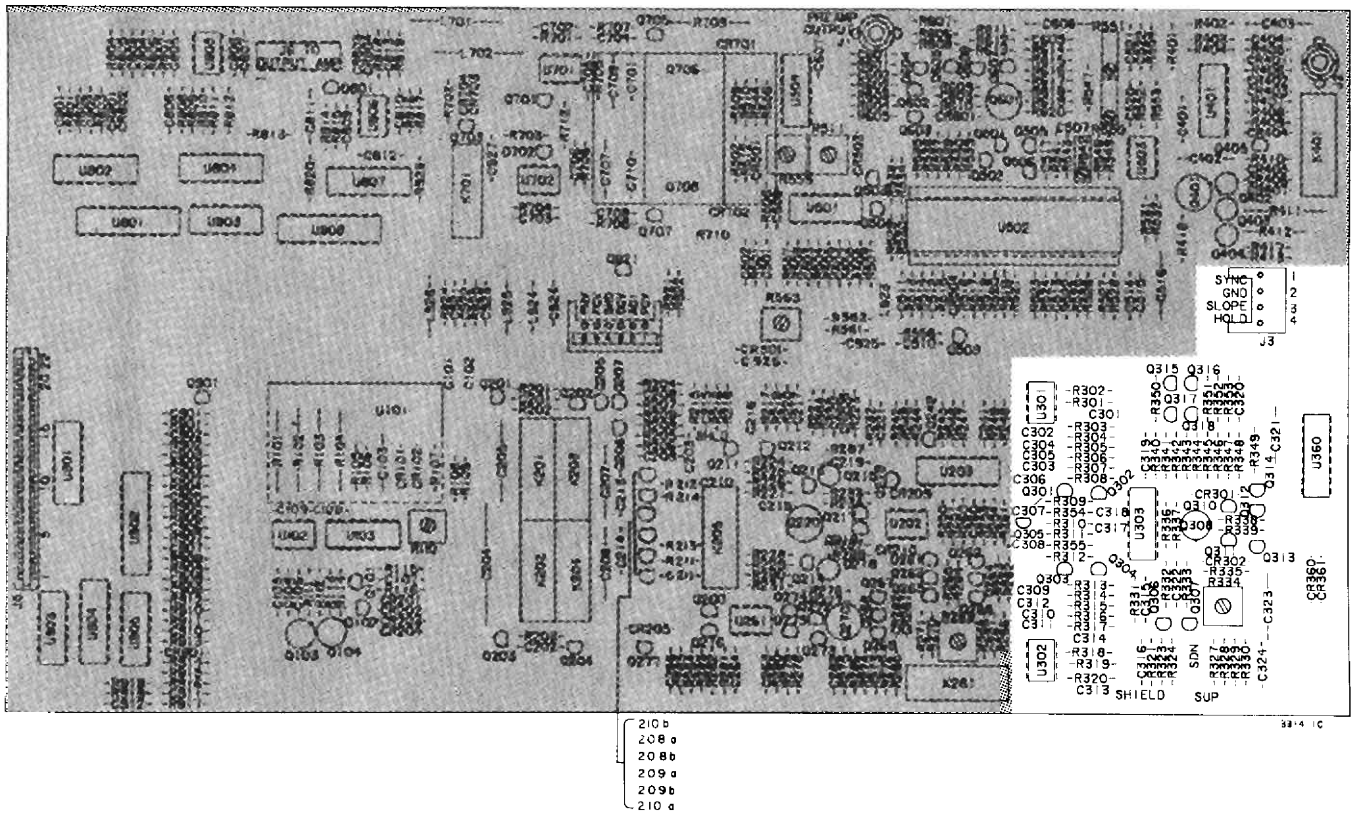


Figure 8-19. Comparator Block Diagram (Non-Continuous Operation)

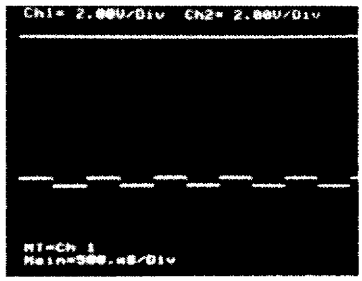


A1
03314-66501

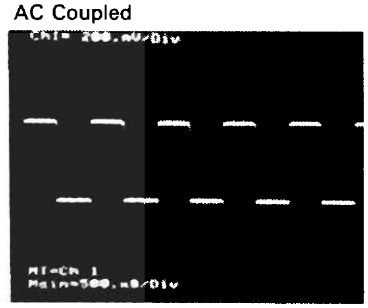
Note: All front panel settings are from instrument turn on unless otherwise noted.

1 DC Coupled

Ground



1 AC Coupled



2

Ground

3

Ground

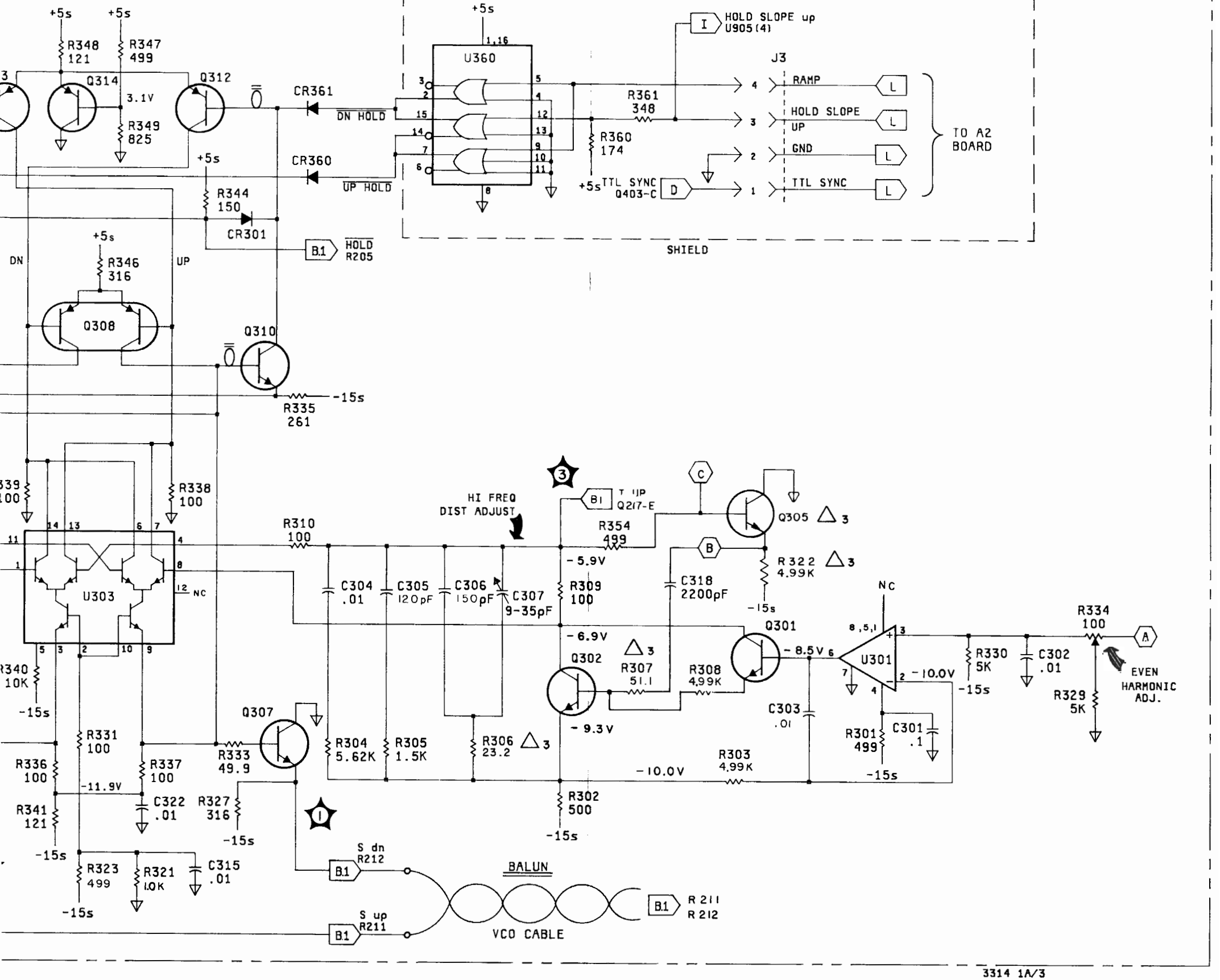
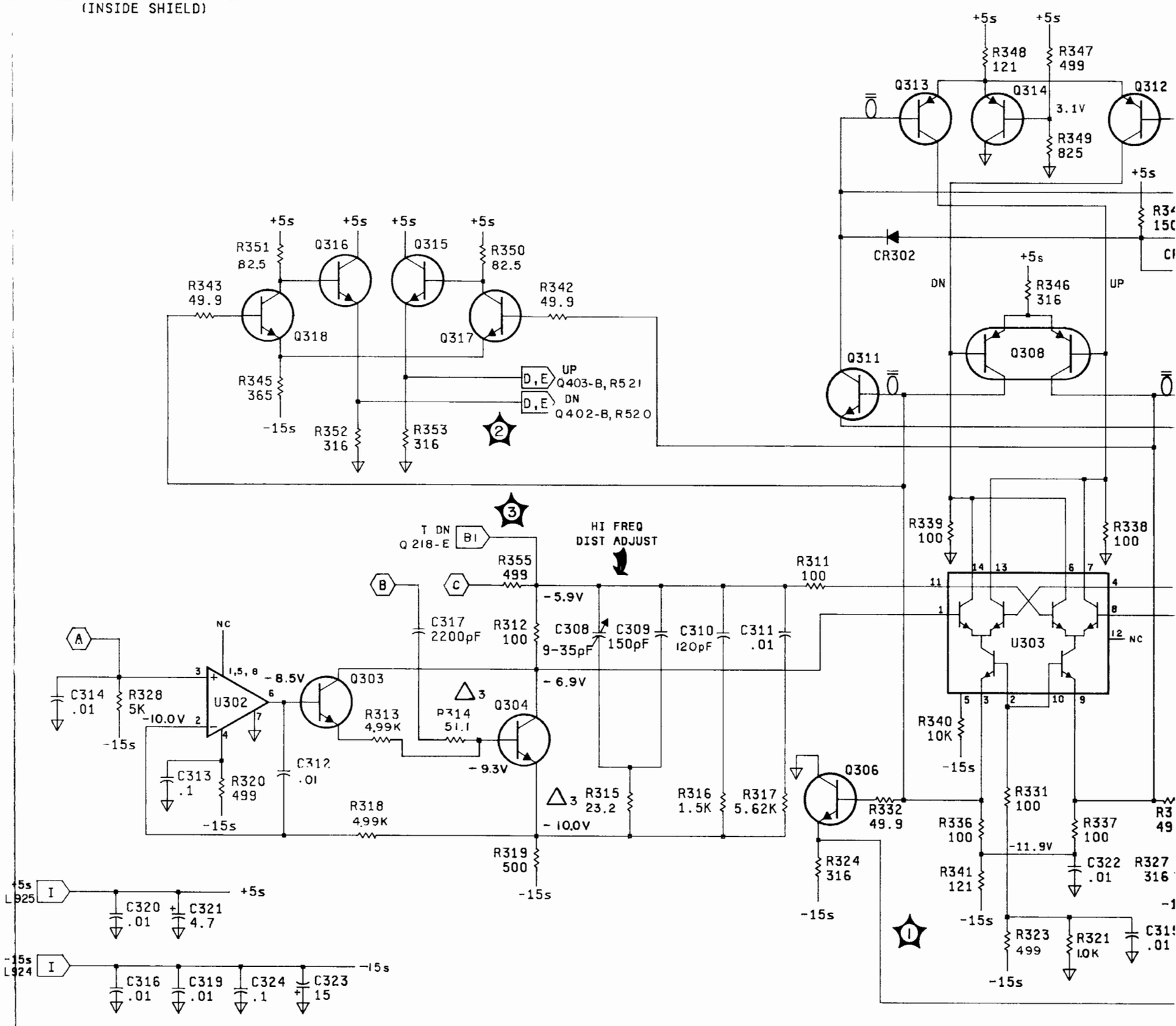
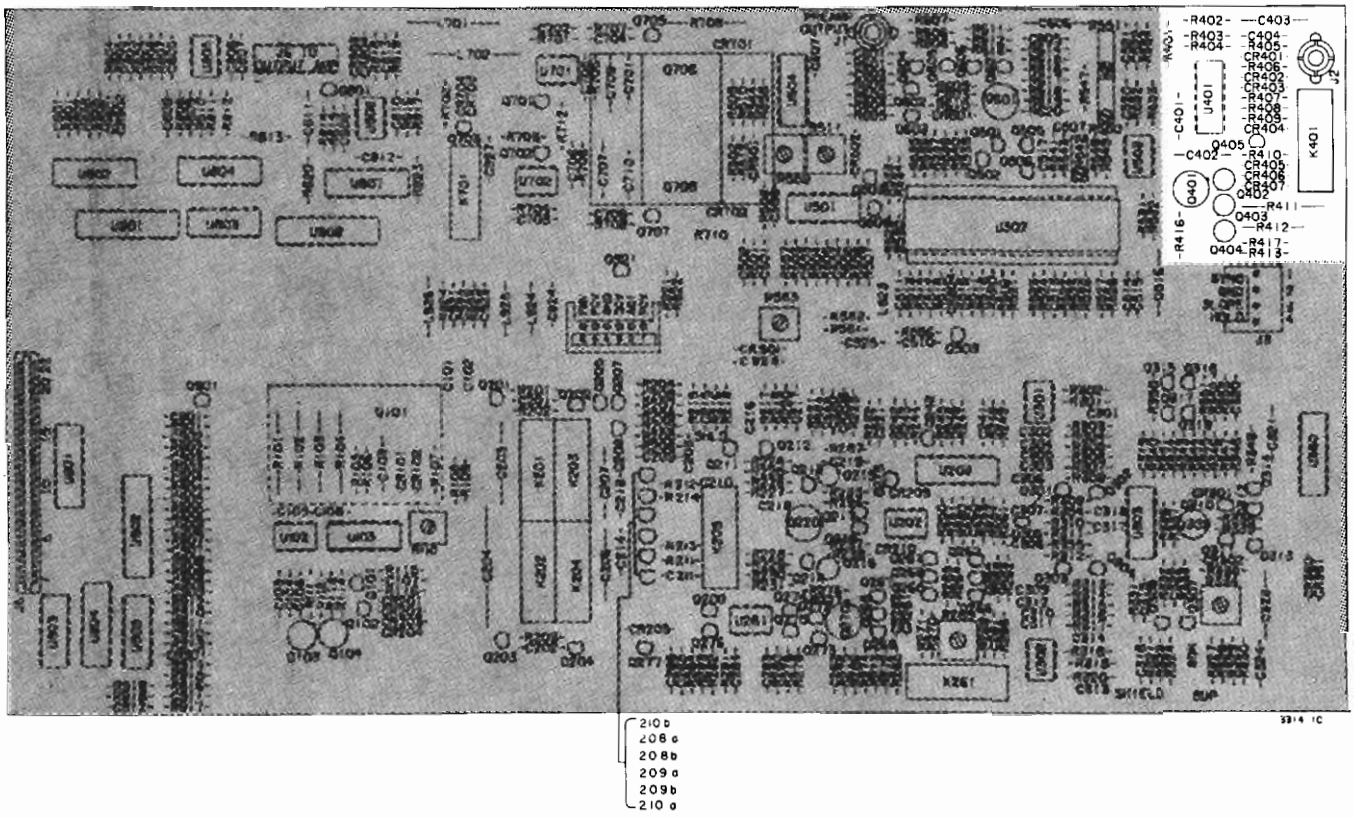


Figure 8-20. Hysteresis Comparator

P/O A1 03314-66501
TRIANGLE COMPARATOR
(INSIDE SHIELD)



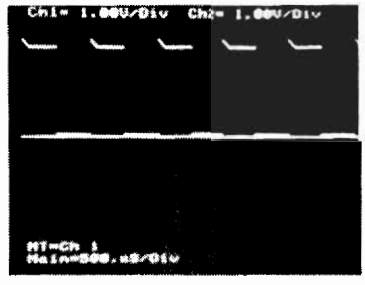
NOTE: SEE SECTION VII FOR 'Δ' EXPLANATION.



A1
03314-66501

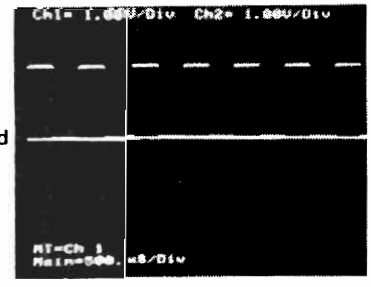
Note: All front panel settings are from instrument turn on unless otherwise noted.

1



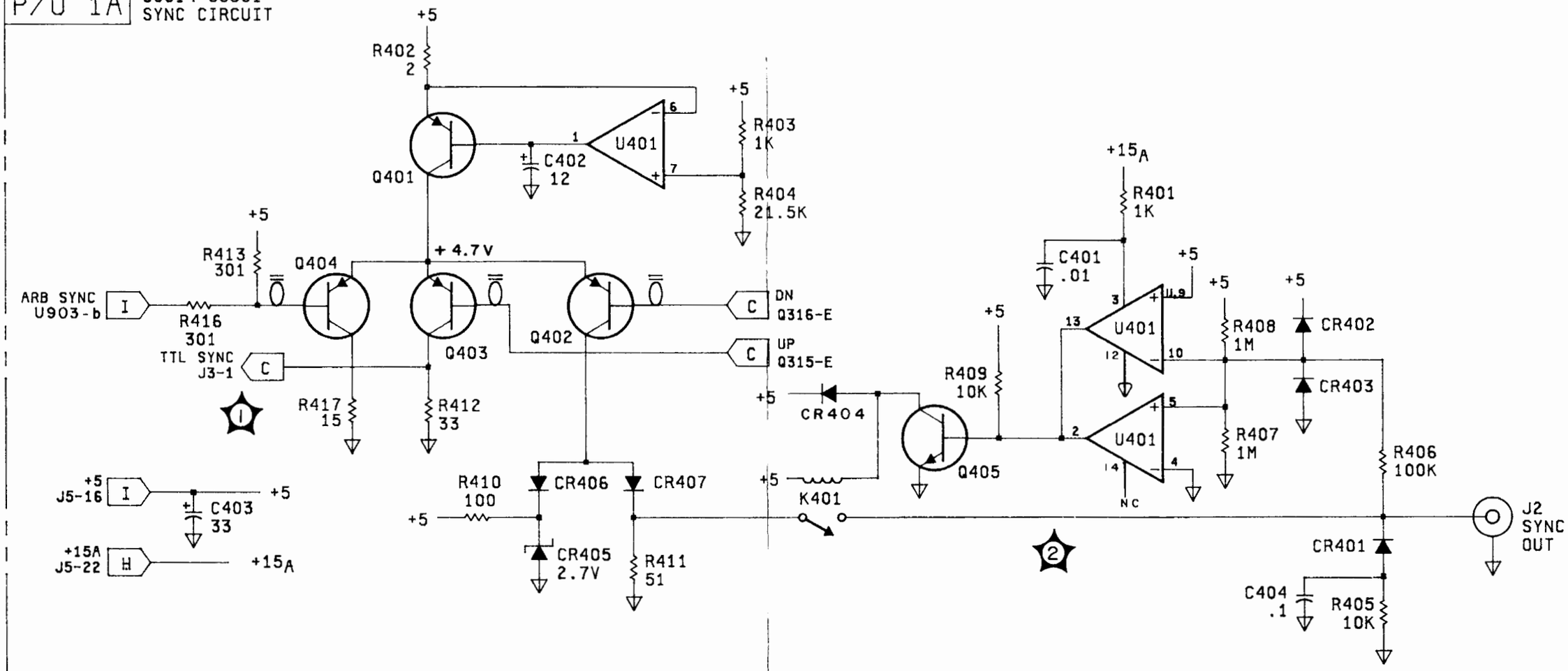
Ground

2



Ground

P/O 1A 03314-66501
SYNC CIRCUIT

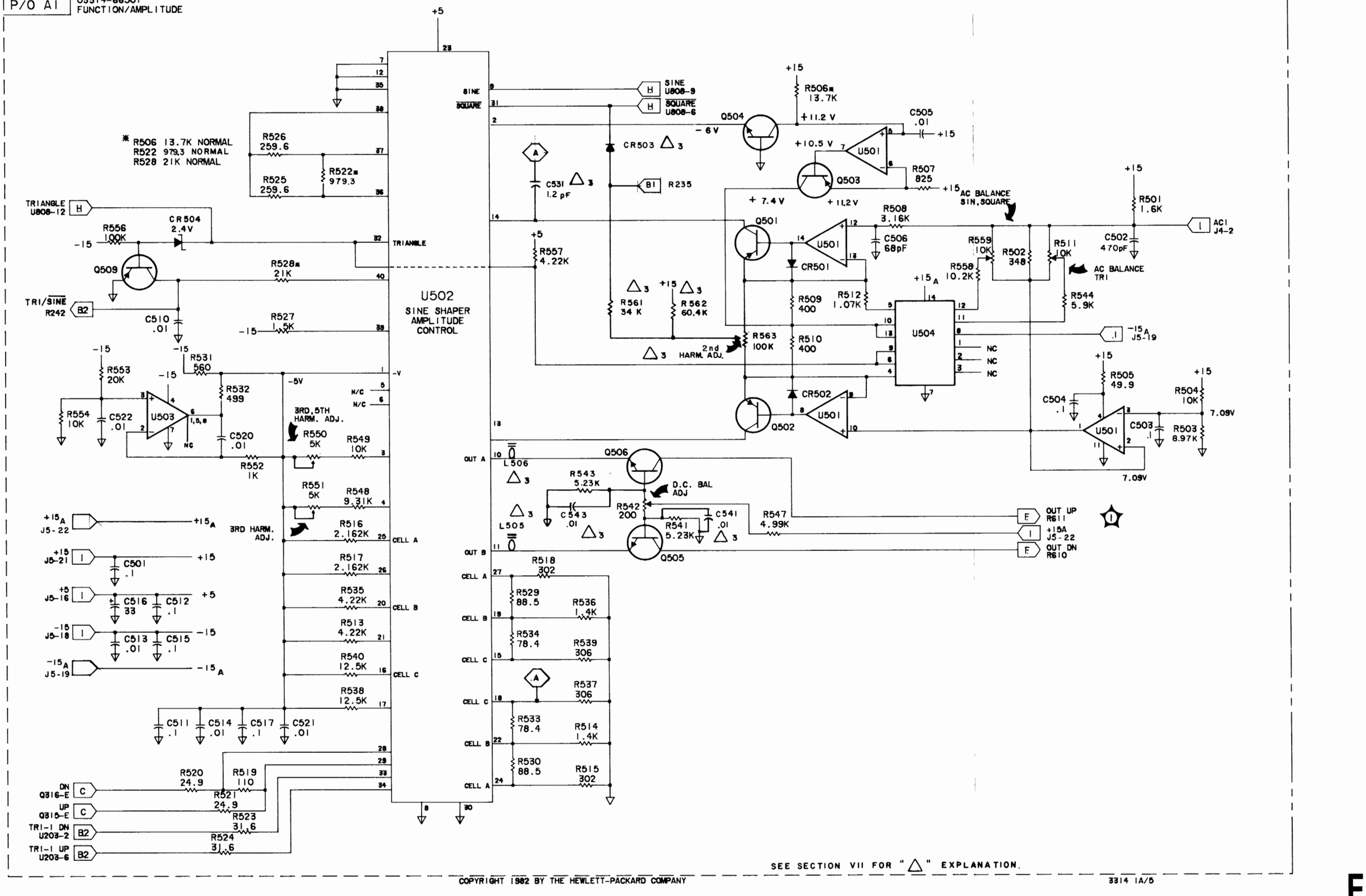


3314 1A/4

D

Figure 8-21. Sync Circuits and Sync Output

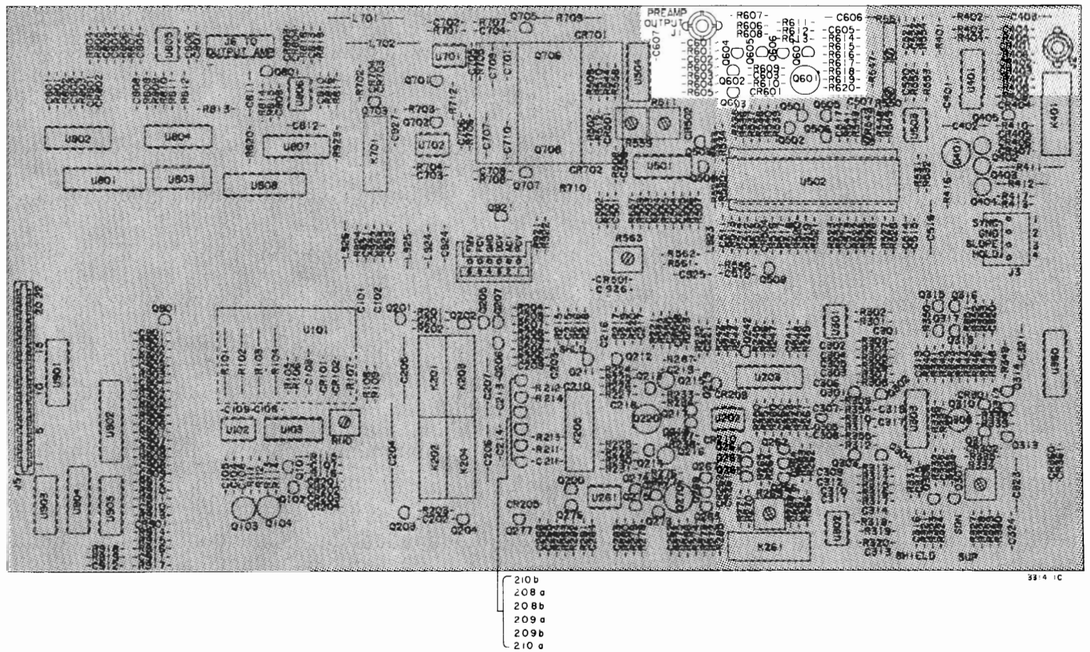
P/O A1 | 03314-66501 FUNCTION/AMPLITUDE



SEE SECTION VII FOR "△" EXPLANATION.

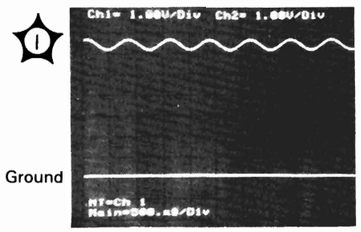
3314 1A/5

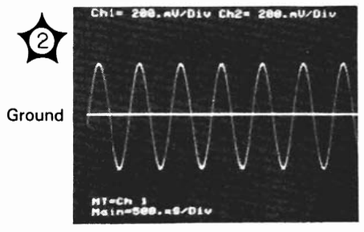
Figure 8-22. Function and Vernier Amplitude Control (includes the Sine Shaper IC)

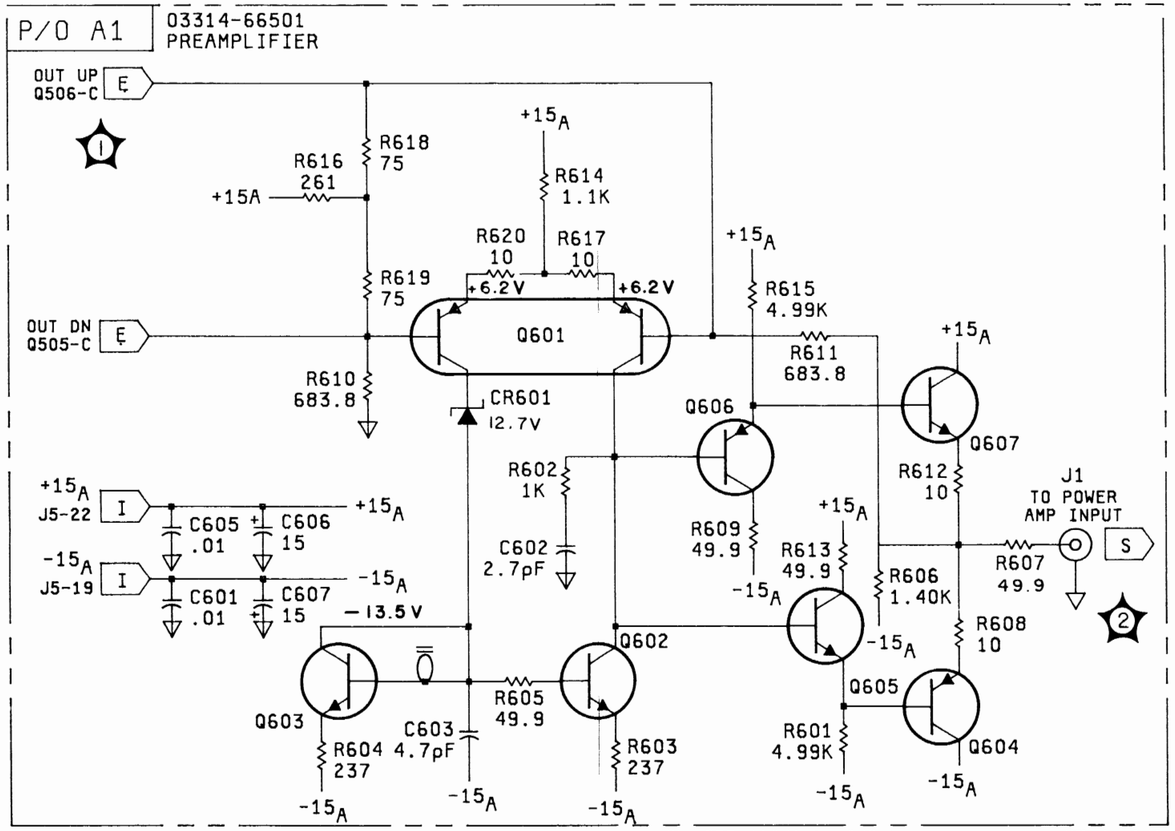


A1
03314-66501

Note: All front panel settings are from instrument turn on unless otherwise noted.

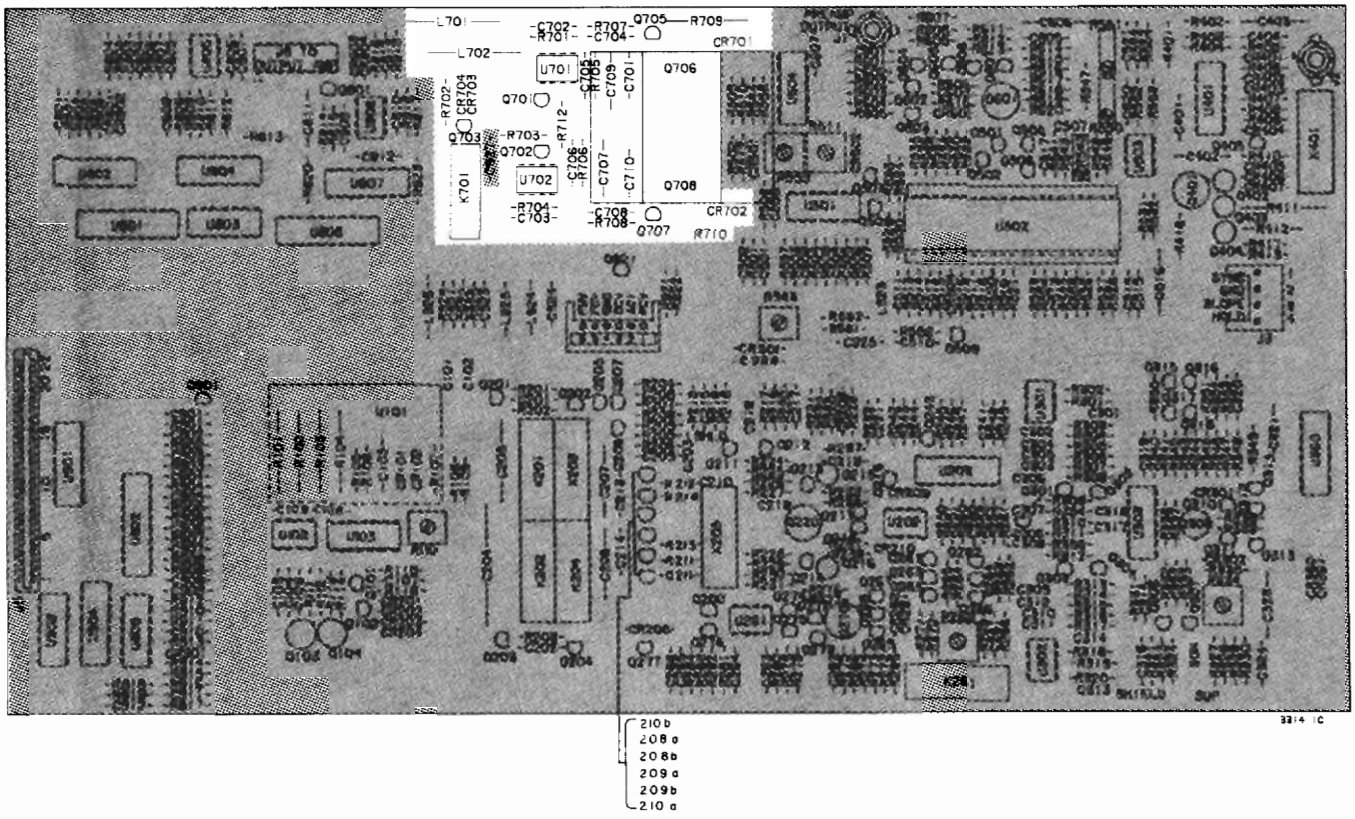






F

Figure 8-23. Preamplifier



A1
03314-66501

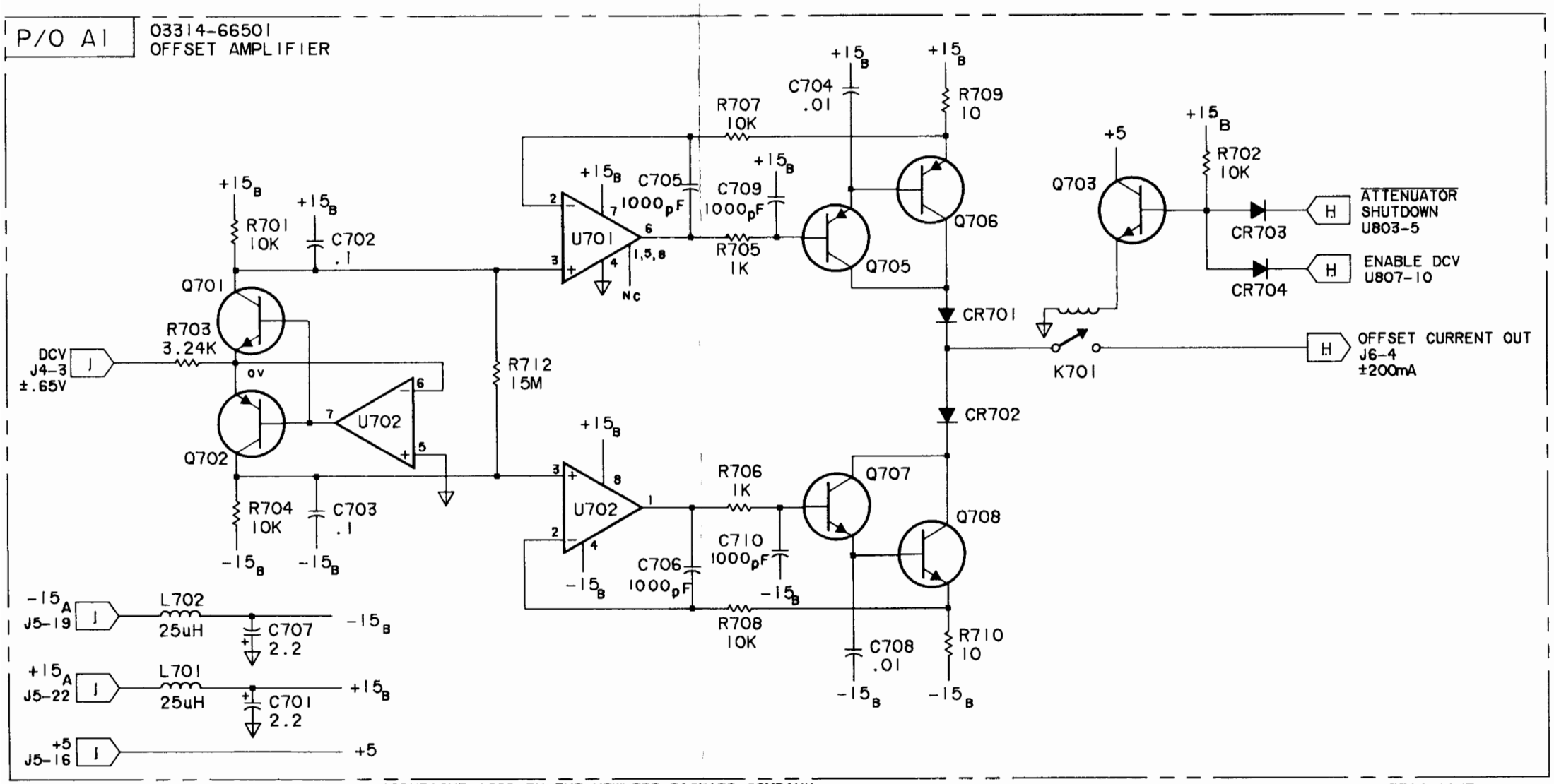
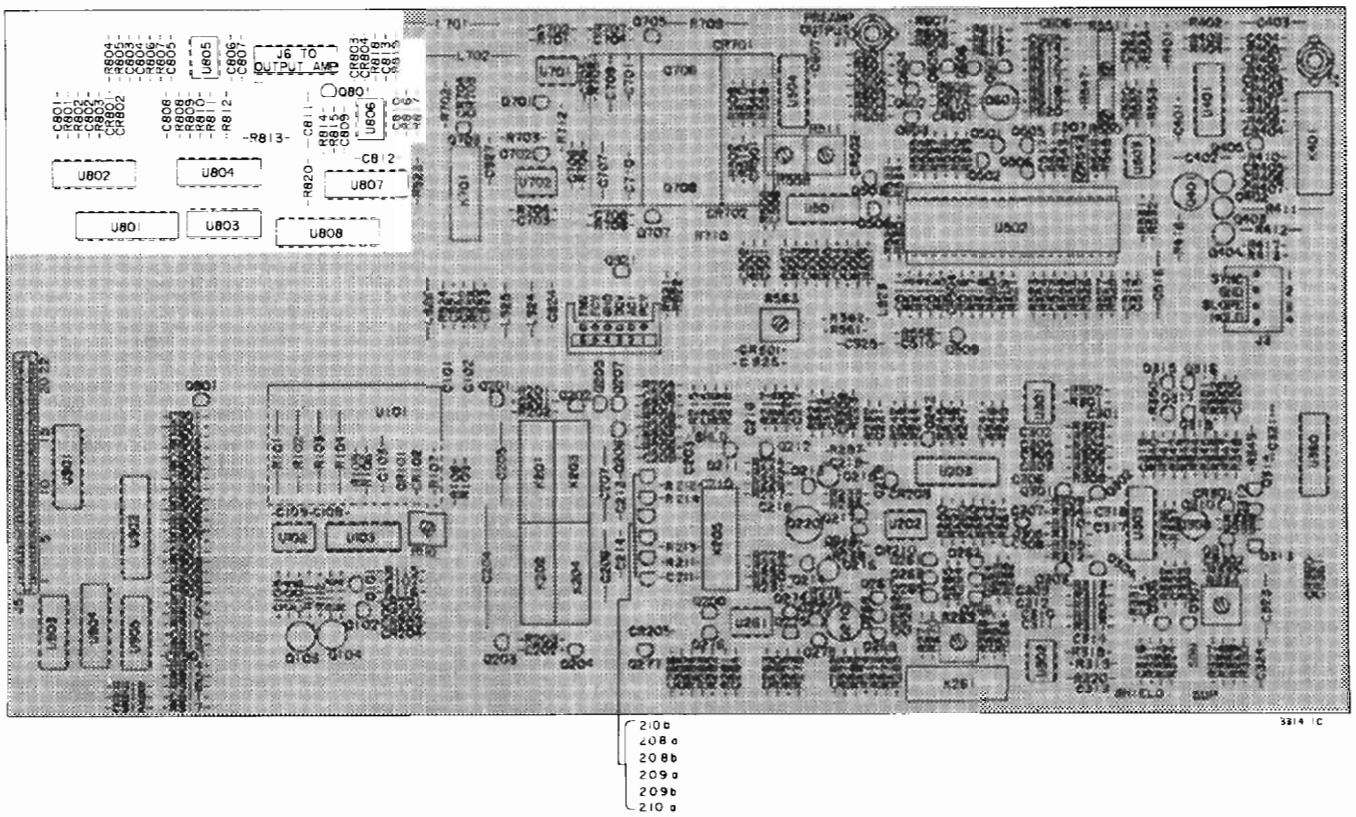
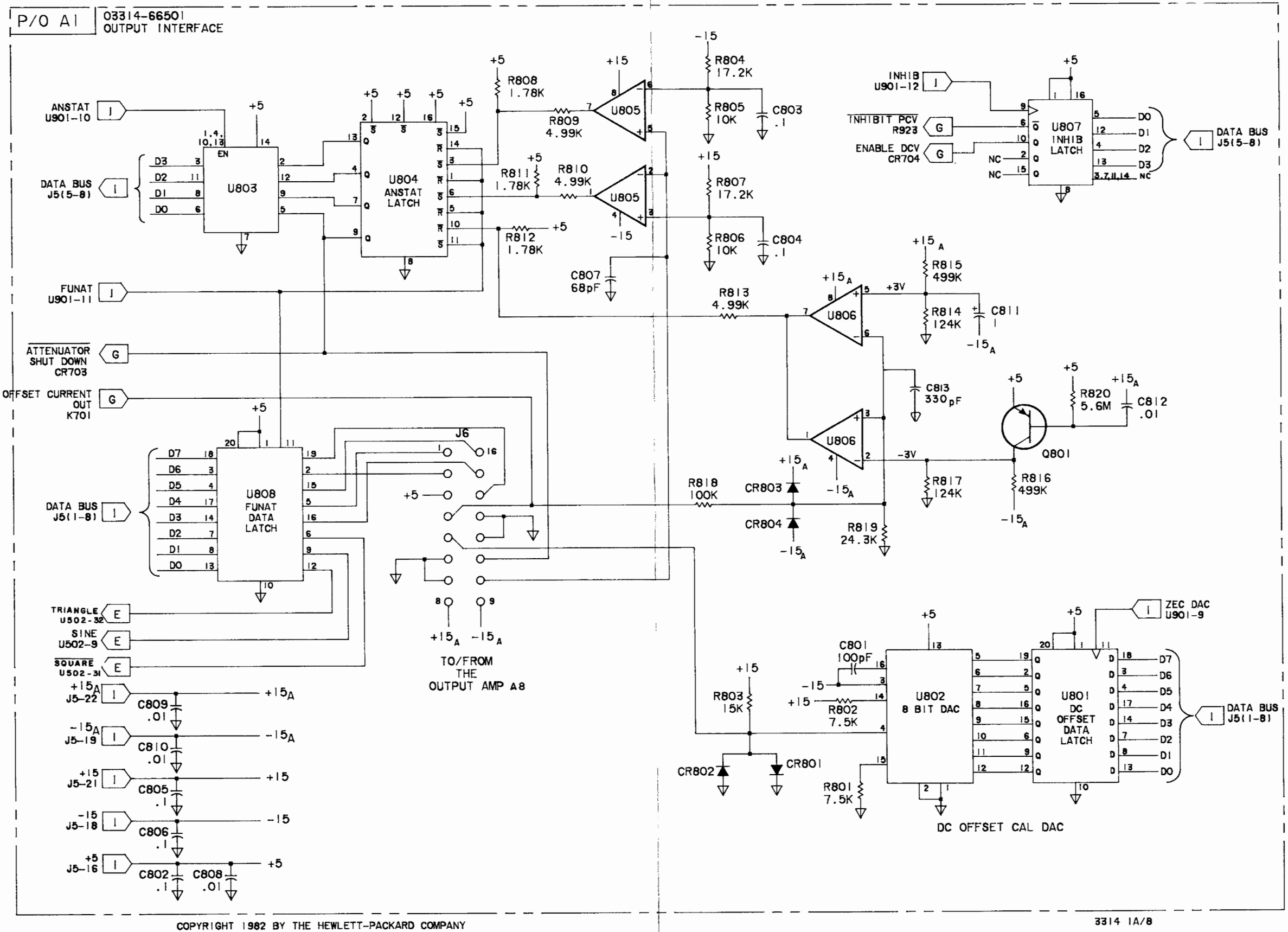


Figure 8-24. Offset Amplifier



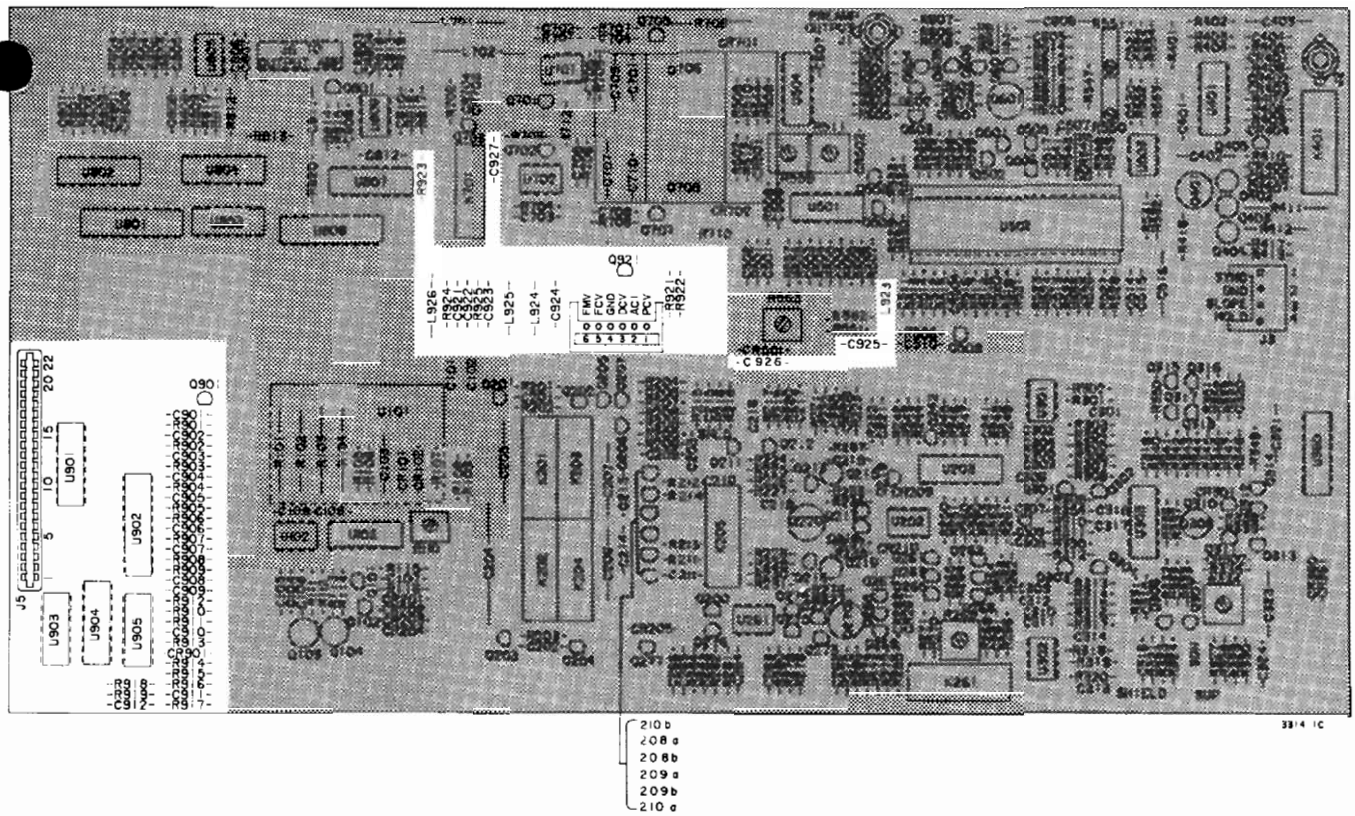
A1
03314-66501

P/O A1 | 03314-66501
OUTPUT INTERFACE



H

Figure 8-25. Output Interface



A1
03314-66501

P/O A1 03314-66501 MISC INTERFACE

J5

TO/FROM CONTROLLER BOARD

22 +15A → D,F,G,H +15A

21 +15 → L923 C923 .1 → A,B1,B3 +15s

20 +15 → E,H +15

19 -15A → E,F,G,H -15A

E,H -15

18 -15 → L924 C924 .1 → A,B1,B2,B3,C -15s

17 -15 → C901 .1 → B1,C -15

16 +5 → C909 .1, C912 .01, L925, C925 .1 → B3,D,E,G,H +5s

15 GND

14 GND

13 NC

12 GBS

11 A2

10 A1

9 A0

P

O

U901 MUX ANALOG BOARD STROBE

EN, EN

FOUTR

H ZECDAC U801-11

H ANSTAT U801-1

H FUNAT U808-11

H INHIB U807-9

A HARSY1 U101-1-19

A HARFR2 U101-20

A HARFR1 U101-21

U902 FOUTR DATA LATCH

DATA BUS D0 D1 D2 D3 D4 D5 D6 D7

U903 C U903 D U903 B

U904 U904

U905 D U905 A U905 B

R919 1K R918 1K R914 1K R913 2K

CR901

R912 61.9K R915 4.99K C910 .001

R916 4.99K

B3 RAMP MODE Q267-B

B3 RAMP DOWN Q268-B

B3 RAMP UP Q269-B

D ARB SYNC R416

HOLD SLOPE UP J3-3 C

R910 1K R911 3.01K R917 100 C911 47pF

B3 PHASE SIGN Q261-B

R902 10K C902 .01 Q901 R901 100K -15

A VAR SYM OFF Q104-B

B1 XTO Q200-E

R907 1K C907 .01

R908 10 C908 .1 R909 1K +5

B1,3 250pF K205 2MHz RANGE

R906 10 C906 .1

B1 .0025uF K204 200KHz RANGE

R905 10 C905 .1

B1 .025uF K203 20KHz RANGE

R903 10 C903 .1

B1 .25uF K202 2KHz RANGE

R904 10 C904 .1

B1 2.5uF K201 200Hz RANGE

J4

TO/FROM MODE BOARD

FMV 6

FCV 5

GND 4

DCV 3

ACI 2

PCV 1

FMVS C101 A R925 100 C922 1000pF

FCVS U101-16 A R924 475 C921 300pF L926 390

DCV R703 G C927 .1

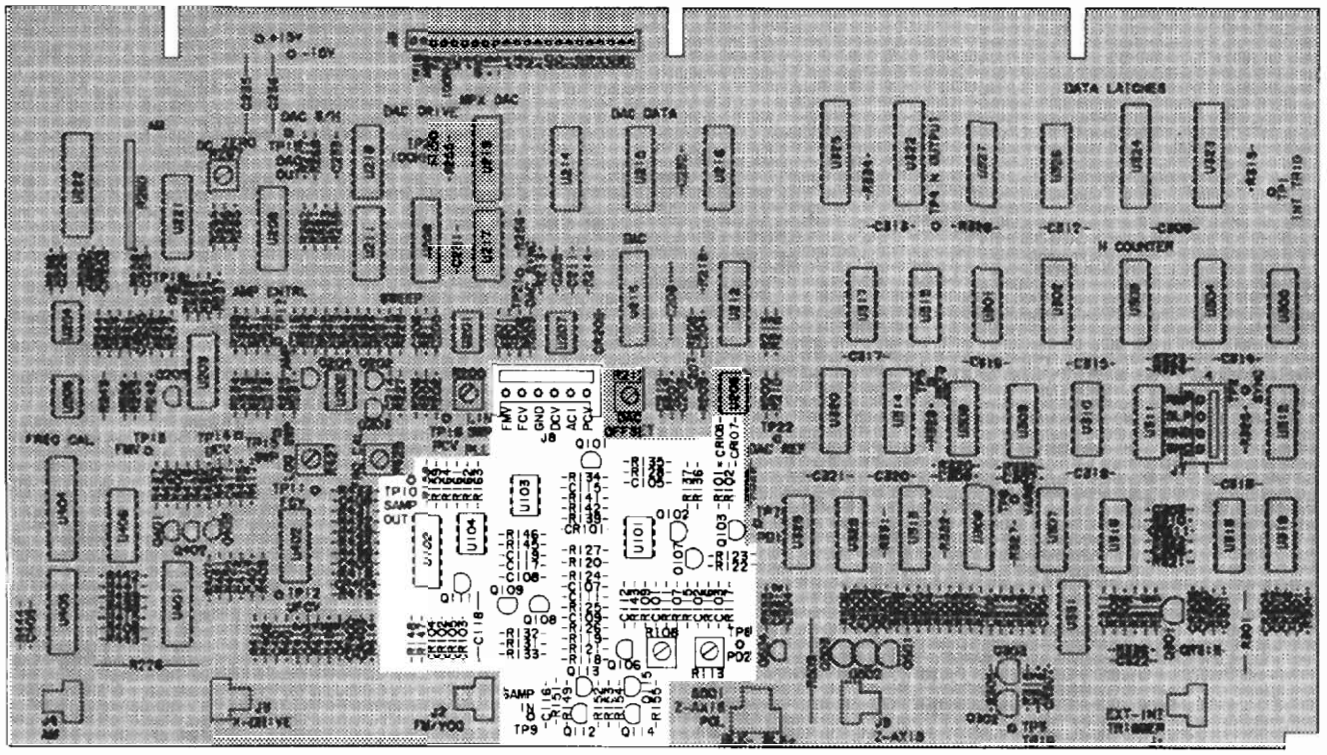
ACI R508 E

PCVS U261-5 B3 R922 100K R921 10K C926 .01

Q921 R923 10K H INHIBIT PCV U807-6

3314 1A/9

Figure 8-26. Misc Interface



A2
03314-66502

P/O A2 03314-66502 REV B
MODE BOARD

R135 100K
+15
R134 10K
PLL ON (U322-12) L
Q101
+15V WHEN PLL ON
+1V WHEN PLL OFF

CURRENT SWITCH

R139 499
+10V WHEN PLL ON
+5V WHEN PLL OFF
R136 698
+15
R137 1K
CR101
Q102
I=7.1MA WHEN PLL ON
I=0 WHEN PLL OFF
U101B
R141 4.99K
C115 .001
+15
+10V
R142 10K
R143 100
-15
C112 .1

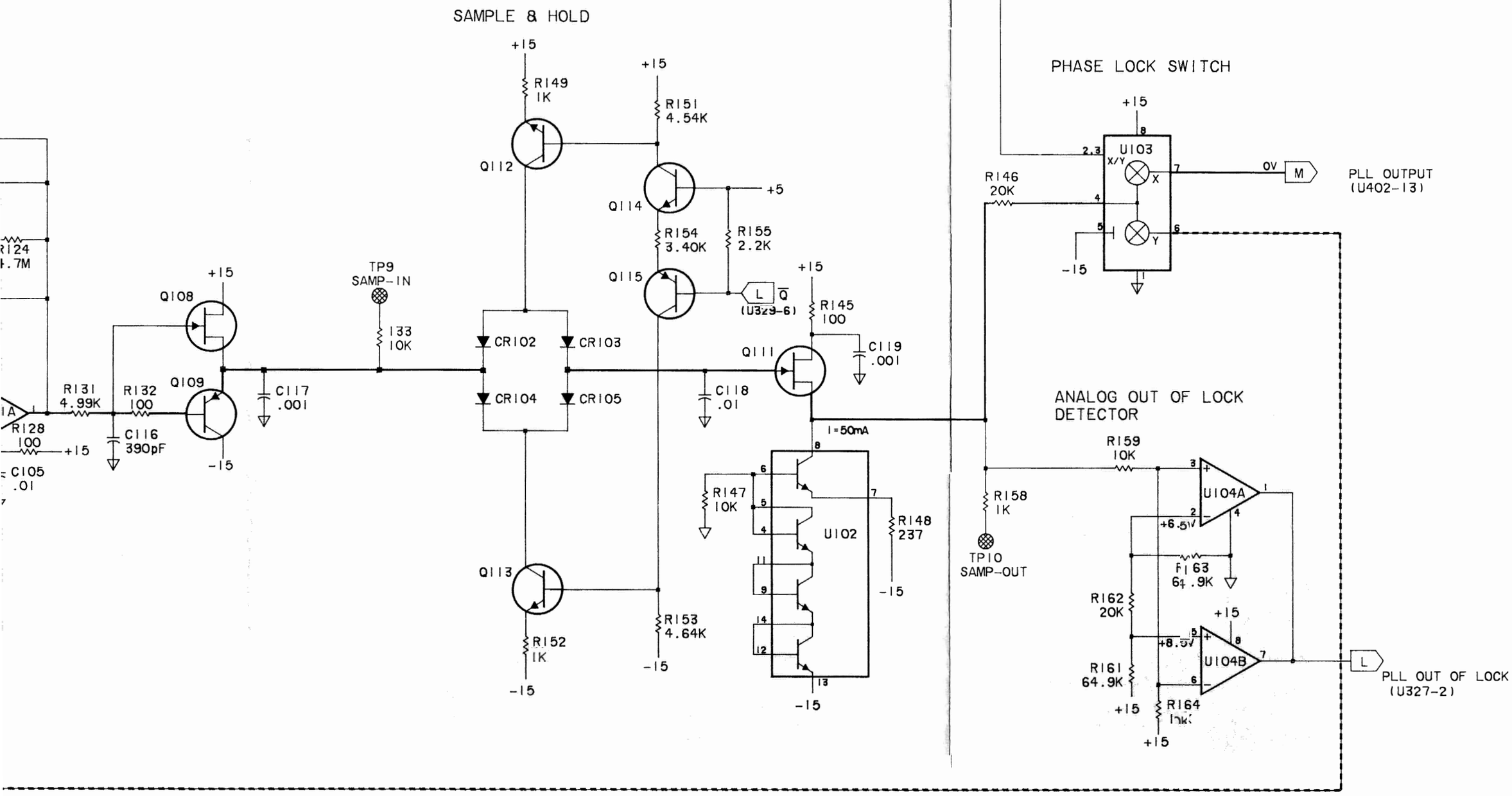
PHASE DETECTOR OUTPUT (U313-5) L
R101 1K
Q103
CR106
CR107 5.1V

INTEGRATOR

PLL B.W. (U322-19) L
R118 4.7K
Q106
R119 4.7K
R121 100K
-15
Q107
TP8
PD2
R117 10K
C109 330pF
R126 487K
R125 1.6M
C106 1
C108 2000pF
R124 4.7M
C107 .01
C111 47pF
R123 2M
0V
U101A
R131 4.99K
R128 100
+15
C105 .01
R132 1M
R122 1M
R120 10K
R107 2.21K
R108 200
-180° ADJ
UPCV (U201-7)
R109 5K
C101 .1
R111 4.8K
-15
R116 402
C103 .001
R115 301K
+15
R113 10K
C102 .1
+180° ±20° ADJ.
-15

A2 A1
J8 J4

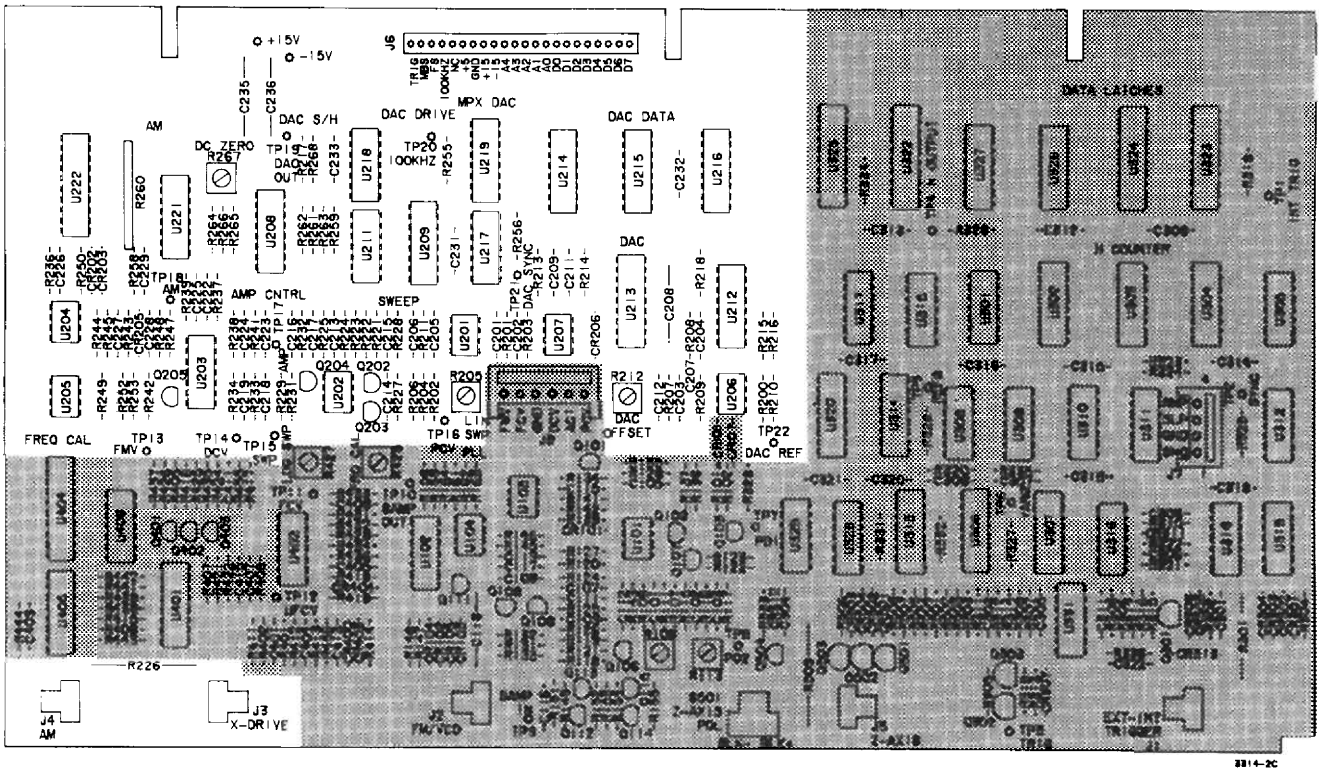
PCV U201(1)	K	1	1	PCVS
ACI Q205	K	2	1	ACI
DCV R264	K	3	1	DCV
		4	1	
FCV U402(8)	M	5	1	FCV
FMV U401(2)	M	6	1	FMV



3314 2A/1

J

Figure 8-27. Phase Locked Loop (analog)



A2
03314-66502

P/O A2 03314-66502 REV B
MODE BOARD

SWEEP SWITCH AND BUFFER

PHASE CONTROL TO PLL

12 BIT DAC AND LATCHES

MULTIPLEX SWITCH

X DRIVE

SWEEP VOLTAGE

DCV

AM OVERLOAD DETECTION

ACI

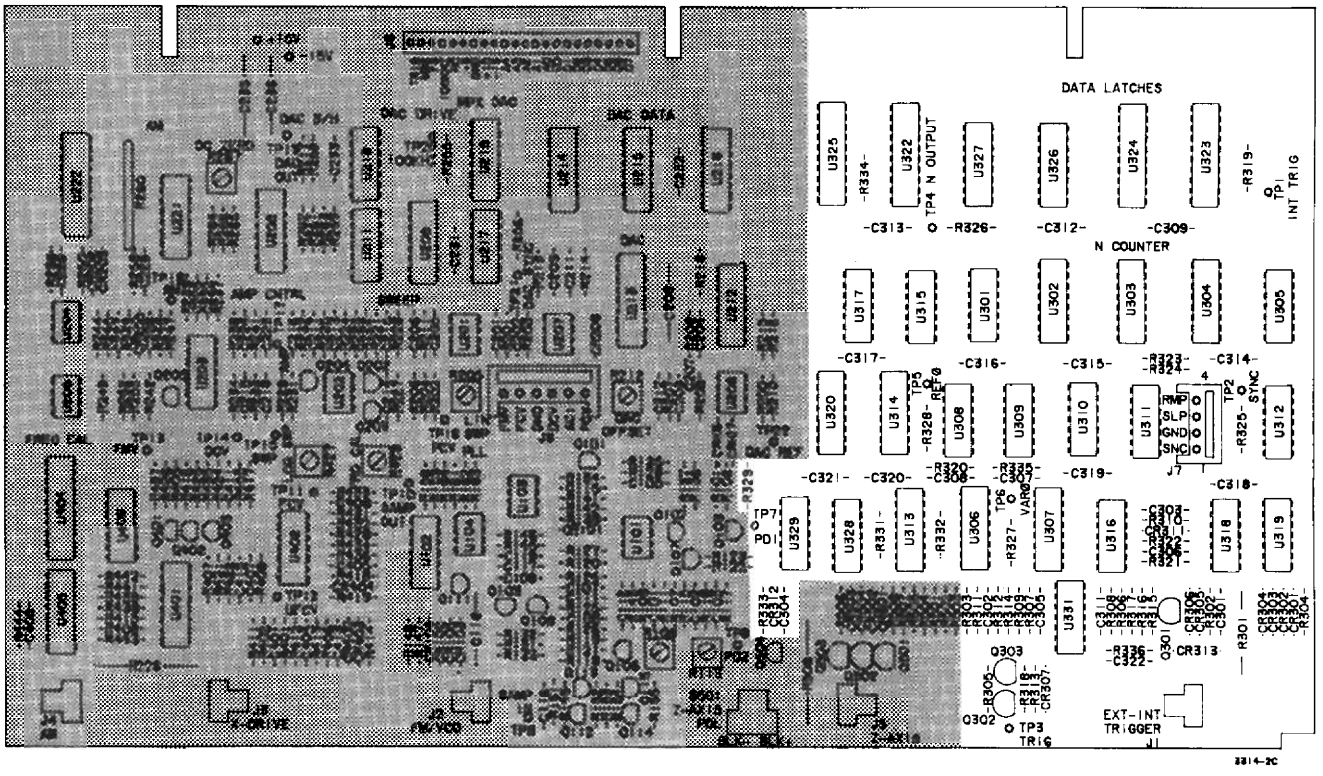
AM INPUT AND MULTIPLYING DAC

-NOTE-
R268 IF U208 = DG308
R268 IF U208 = LF13202

8314 2A/2

K

Figure 8-28. Multiplexed DAC and X Drive Output



A2
03314-66502

P/O A2 03314-66502 REV B
MODE BOARD

DIVIDE BY 10

STEERING(1) NETWORK

STEERING(2) NETWORK

TP2 SYNC

DIVIDE BY N

TP4 ÷N OUTPUT

TRIG/2

INPHA LATCH

LOCMOD LATCH

FROM A3

TRIGGER COMPARATOR

EXT-INT TRIGGER J1

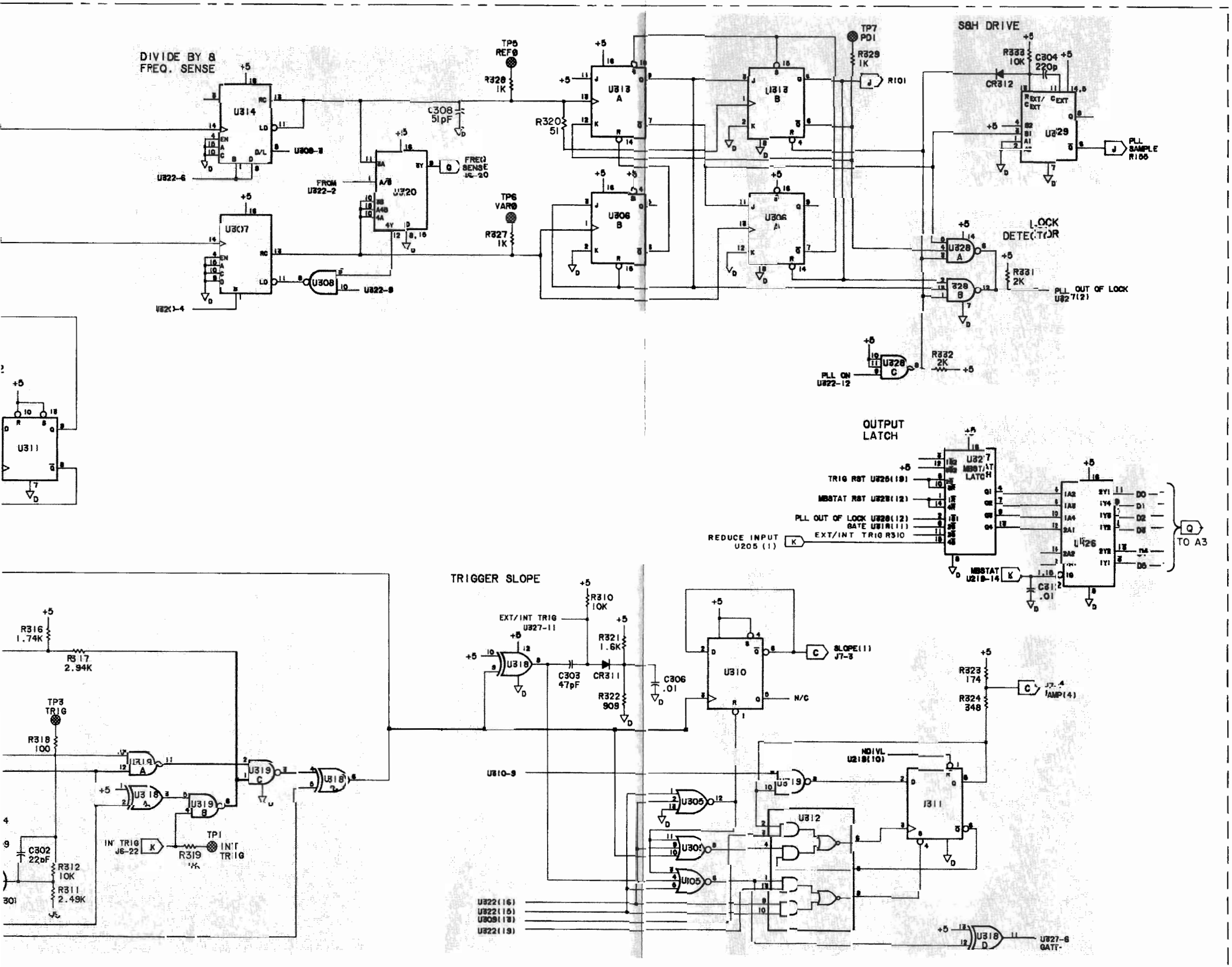
NDIVL LATCH U219(10)

NDJVL LATCH U219(10)

MSTAT RESET

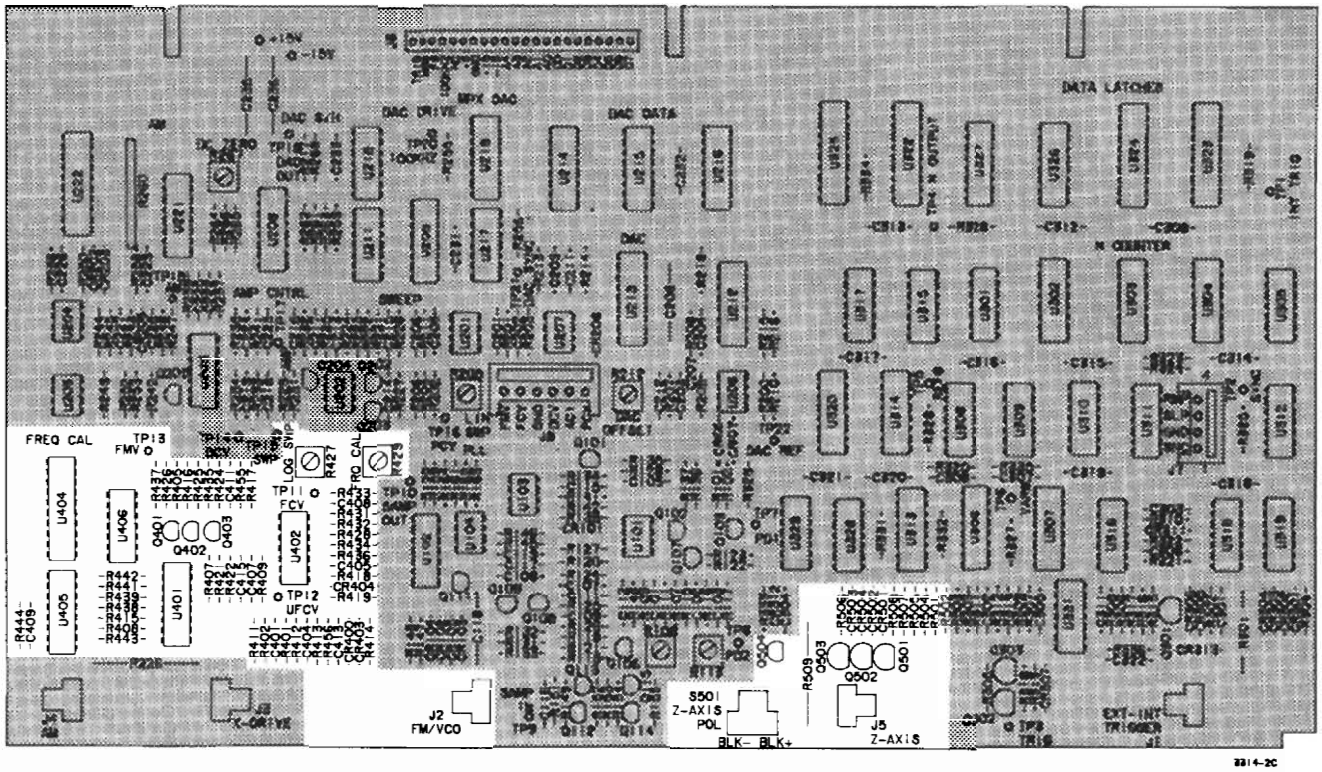
J7-2

J6-17



8814 2A/3

Figure 8-29. Phase Locked Loop (digital) and Dividers



A2
03314-66502

P/O A2 03314-66502 REV B
MODE BOARD

V.C.O. SWITCH

FCV OUTPUT

FM/V.C.O. BUFFER

J2 FM/VCO INPUT

R414 10K

CR403

CR400

R413 10K

C404 22pF

+15

R456 100

C413 1

U402

C411 .1

R455 100

-15

R412 10K

R409 10K

C407 1

+15

R415 100K

Q402

R416 10K

L

U325(9)

+5

U401

6,7,8

U103(7) PLL OUTPUT

J

R417 5K

R418 10K

CR404

-15

C405 1

R419 10K

U202(7) SWEEP VOLTAGE

K

TP12 UFCV

FM/SYMMETRY SWITCH

+15

R401 100K

R402 20K

U402

C415 22pF

R421 1K

R422 9.09K

X1

X.1

U401

R411 10

TP13 FMV

R426 10K

J

FMV J8-6

R407 100K

SYMMETRY ON U325(6)

R405 10K

Q401

R424 100K

FM ON U325-6

R425 10K

Q403

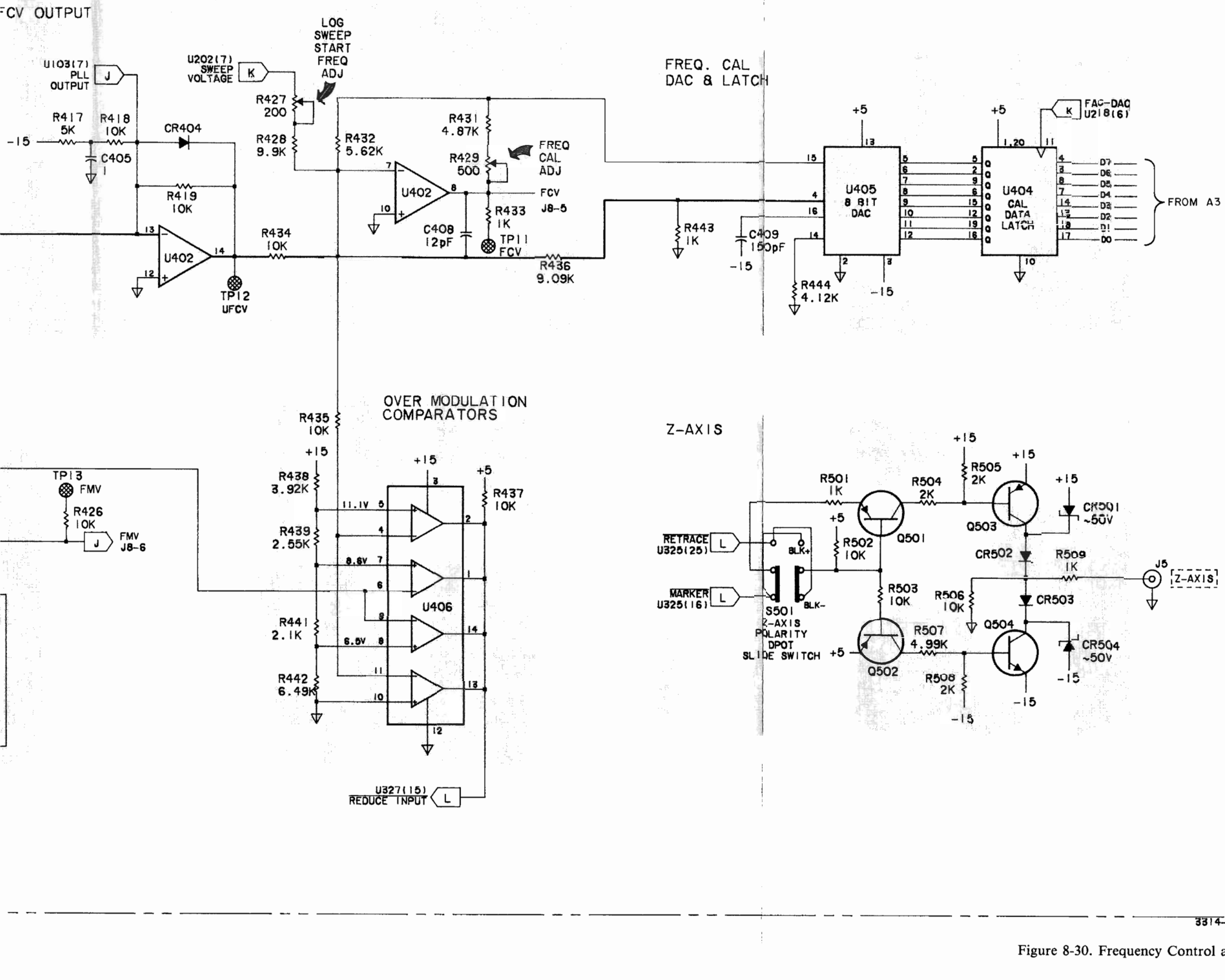
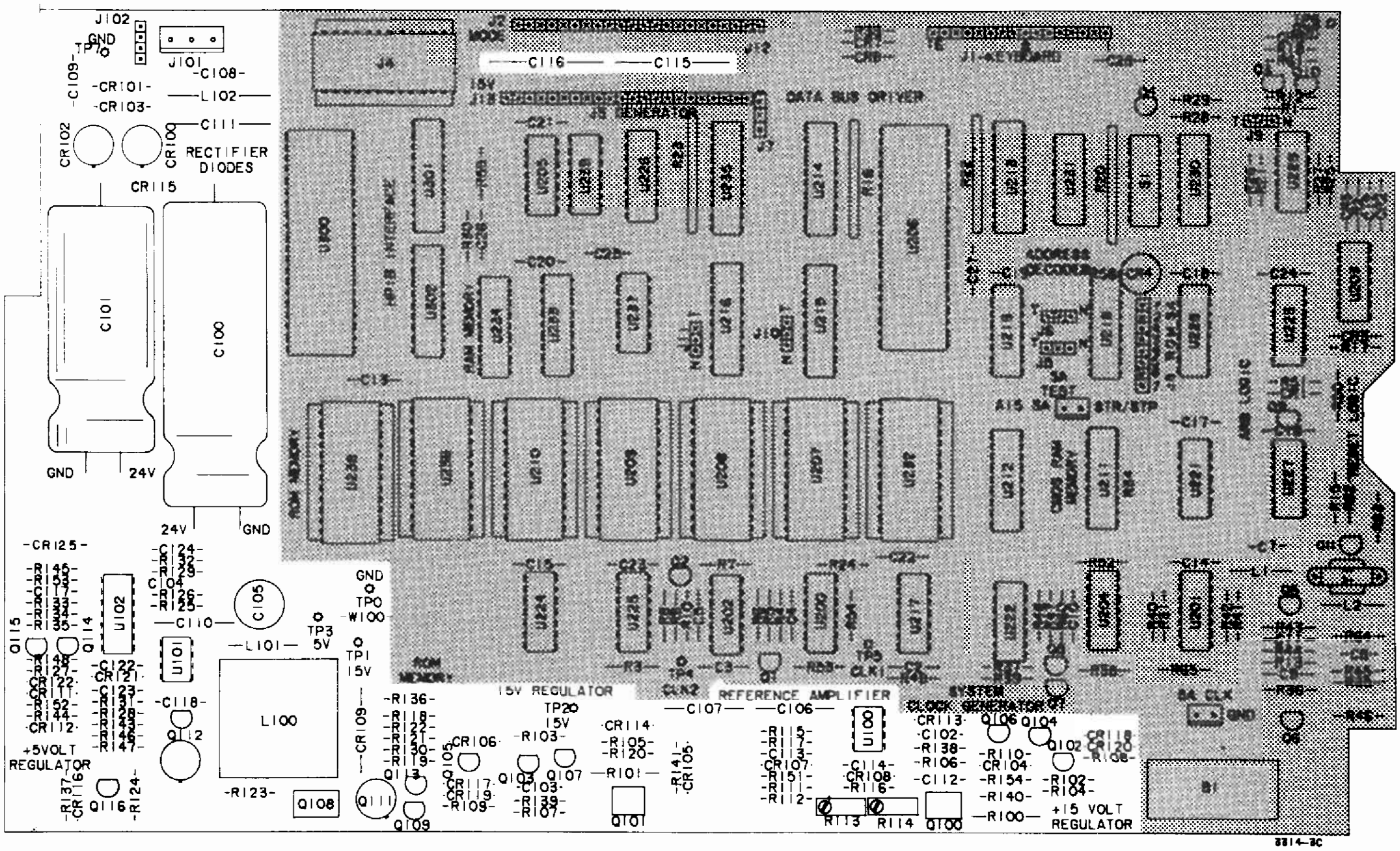


Figure 8-30. Frequency Control and Z-Axis Output



A3
03314-66503

P/O A3 03314-66503 POWER SUPPLY

F PROCESSOR RESET

U209-9 ○ 0 → µP RESET → U102D → R146 20K, R147 4.99K

E OVERVOLTAGE PROTECTION

R143 5.1K

△1 CR123 34.8V

SCR CR115

R153 510

R145 1K

Q115 R152 2K +15V R144 130 CR112 18.2V

FIRES SCR WHEN +15V SUPPLY EXCEEDS +19V.

Q114 R148 2K +5V CR111 6.2V

FIRES SCR WHEN +5V SUPPLY EXCEEDS +7V.

○ R50

F1 SLO-BLO

1A	100-120V
.5A	220-240V

AC POWER TO HIGH VOLTAGE OUTPUT OPTION

J102

A6

INPUT FILTER

F1 1A SLO-BLO △2

S1

M BI FAN

T1

A RECTIFIER/FILTER

CR100 CR101 CR102 CR103

C108 .1 C109 .1

+24V 1.2A C100 3000

-24V 1.0A C101 1500

B +15 VOLT REGULATOR

R100 .51 Q100 R102 510 R104 27.4K Q102 R154 9.7 R138 2K Q106 R110 10K CR104 12V R140 10K R106 510 Q104 CR118 CR120 R108 470 C102

CR113 C106 15

R112 20K

C112 100pF CR125

+15 V ADJUSTMENT +15V±.375V

R114 500

C114 .1 U100B CR108 CR124 R151 10K R116 20K

C -15 VOLT REGULATOR

R101 .51 Q101 R103 510 R105 27.4K Q103 R139 2K Q107 R120 10K CR105 12V R141 10K R107 510 Q105 CR117 CR119 R109 470 C103

CR114 C110 100pF R111 23.7K

-15 VOLT ADJUSTMENT -15V±.85V

R113 2K R115 16.9K U100A -6.2V

C107 15 R117 1.18K CR107 6.2V

P/O J1

PIN	SIGNAL	TO/FROM	FUNCTIONAL BLOCK
15	GND	A4,P1-15	
16	+5V	A4,P1-16	D

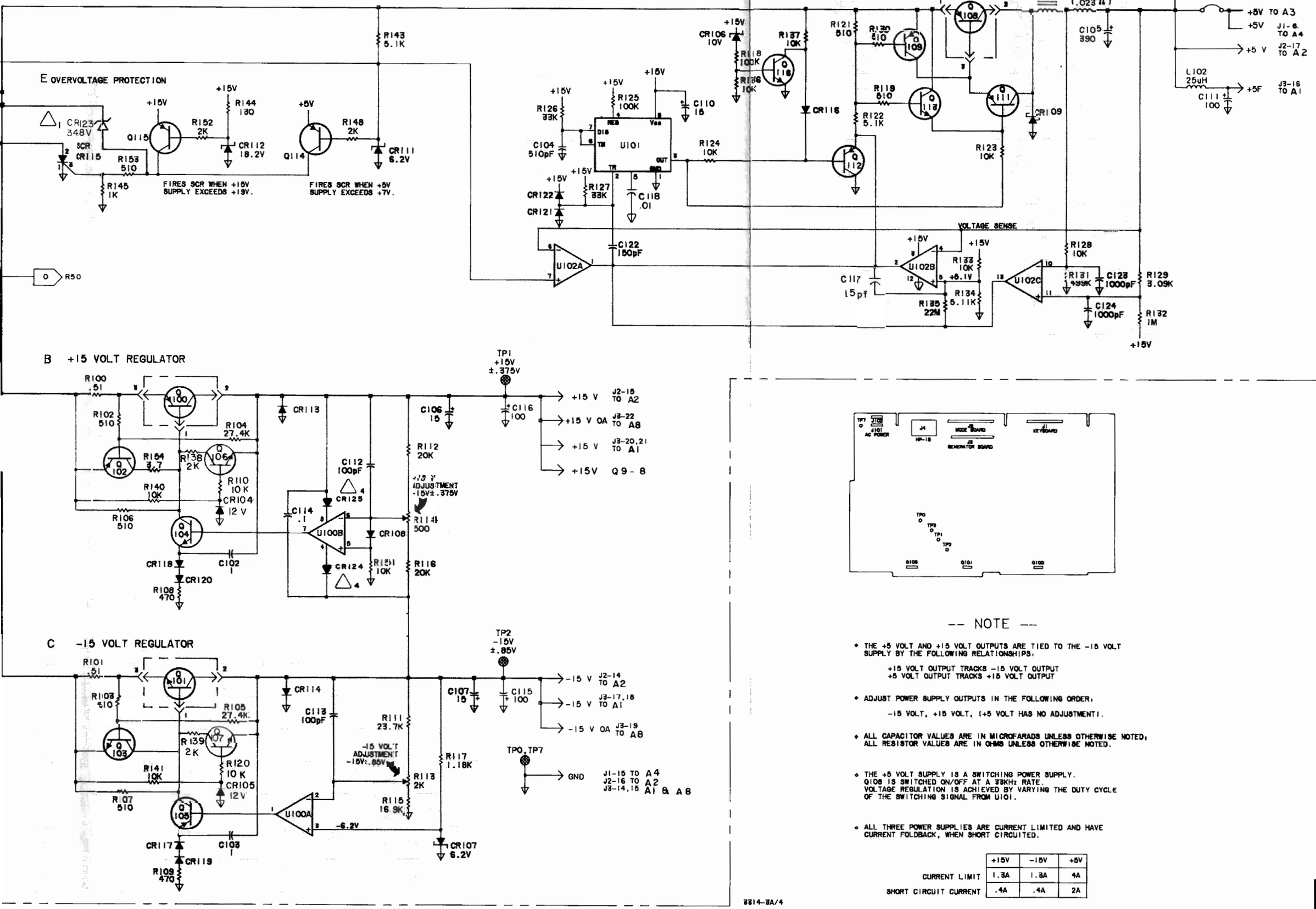
P/O J2

PIN	SIGNAL	TO/FROM	FUNCTIONAL BLOCK
14	-15V	A2,P1-14	C
15	+15V	A2,P1-15	B
16	GND	A2,P1-16	
17	+5V	A2,P1-17	D

P/O J3

PIN	SIGNAL	TO/FROM	FUNCTIONAL BLOCK
17 18	-15V	A1,P1-17 A1,P1-18	C
19	-15V QA	A8,J3-8	C
20 21	+15V	A1,P1-20 A1,P1-21	B
22	+15V QA	A8,J3-8	C
14 15	GND	A1,P1-14 A1,P1-15	
16	+5F	A1,P1-16	D

NOTE: SEE SECTION 7 FOR △ EXPLANATION



-- NOTE --

- THE +5 VOLT AND +15 VOLT OUTPUTS ARE TIED TO THE -15 VOLT SUPPLY BY THE FOLLOWING RELATIONSHIPS:

  +15 VOLT OUTPUT TRACKS -15 VOLT OUTPUT
  +5 VOLT OUTPUT TRACKS +15 VOLT OUTPUT

- ADJUST POWER SUPPLY OUTPUTS IN THE FOLLOWING ORDER:

  -15 VOLT, +15 VOLT, (+5 VOLT HAS NO ADJUSTMENT).

- ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED; ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.

- THE +5 VOLT SUPPLY IS A SWITCHING POWER SUPPLY. Q108 IS SWITCHED ON/OFF AT A 33KHz RATE. VOLTAGE REGULATION IS ACHIEVED BY VARYING THE DUTY CYCLE OF THE SWITCHING SIGNAL FROM U101.

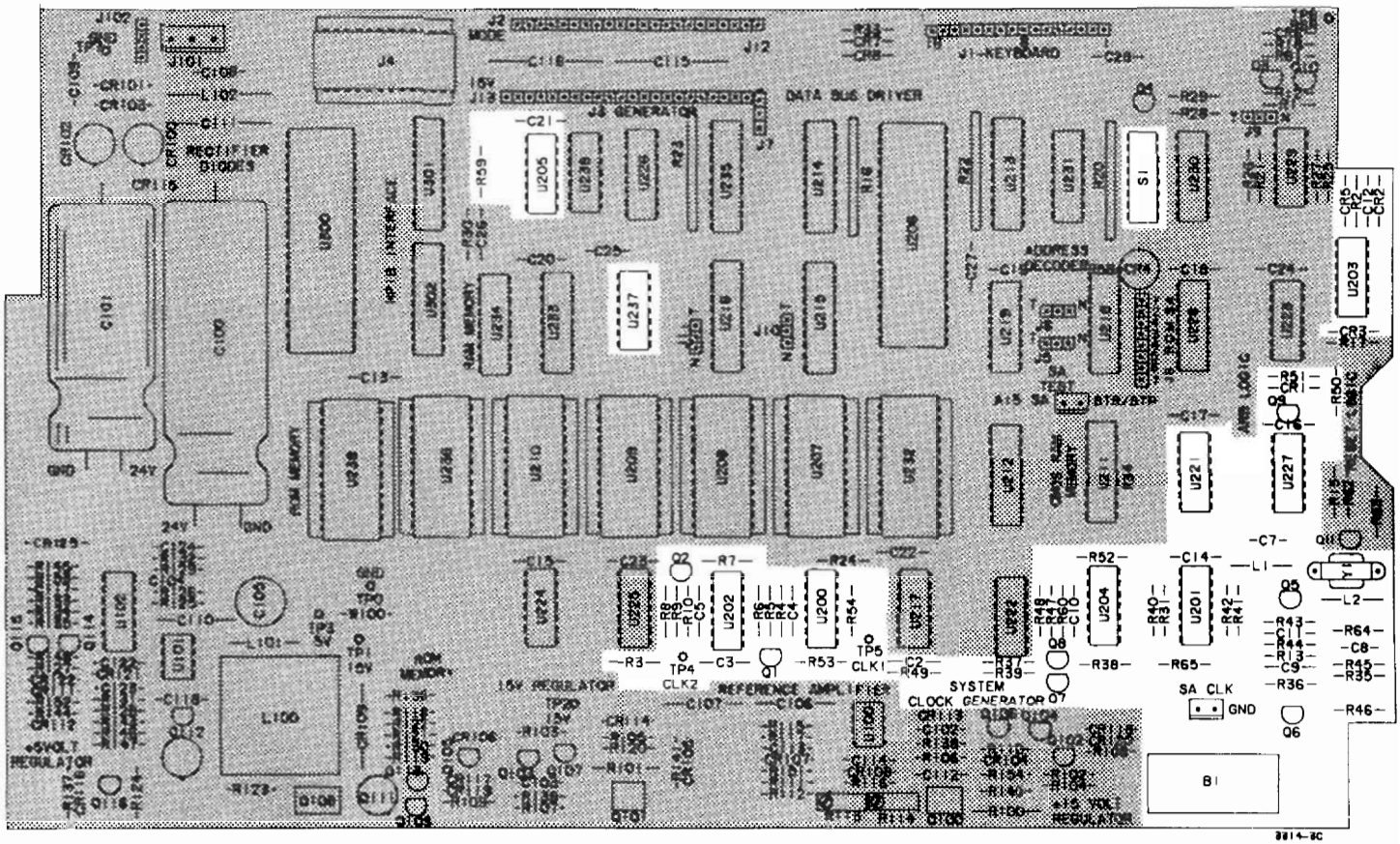
- ALL THREE POWER SUPPLIES ARE CURRENT LIMITED AND HAVE CURRENT FOLDBACK, WHEN SHORT CIRCUITED.

	+15V	-15V	+5V
CURRENT LIMIT	1.3A	1.3A	4A
SHORT CIRCUIT CURRENT	.4A	.4A	2A

3314-8A/4

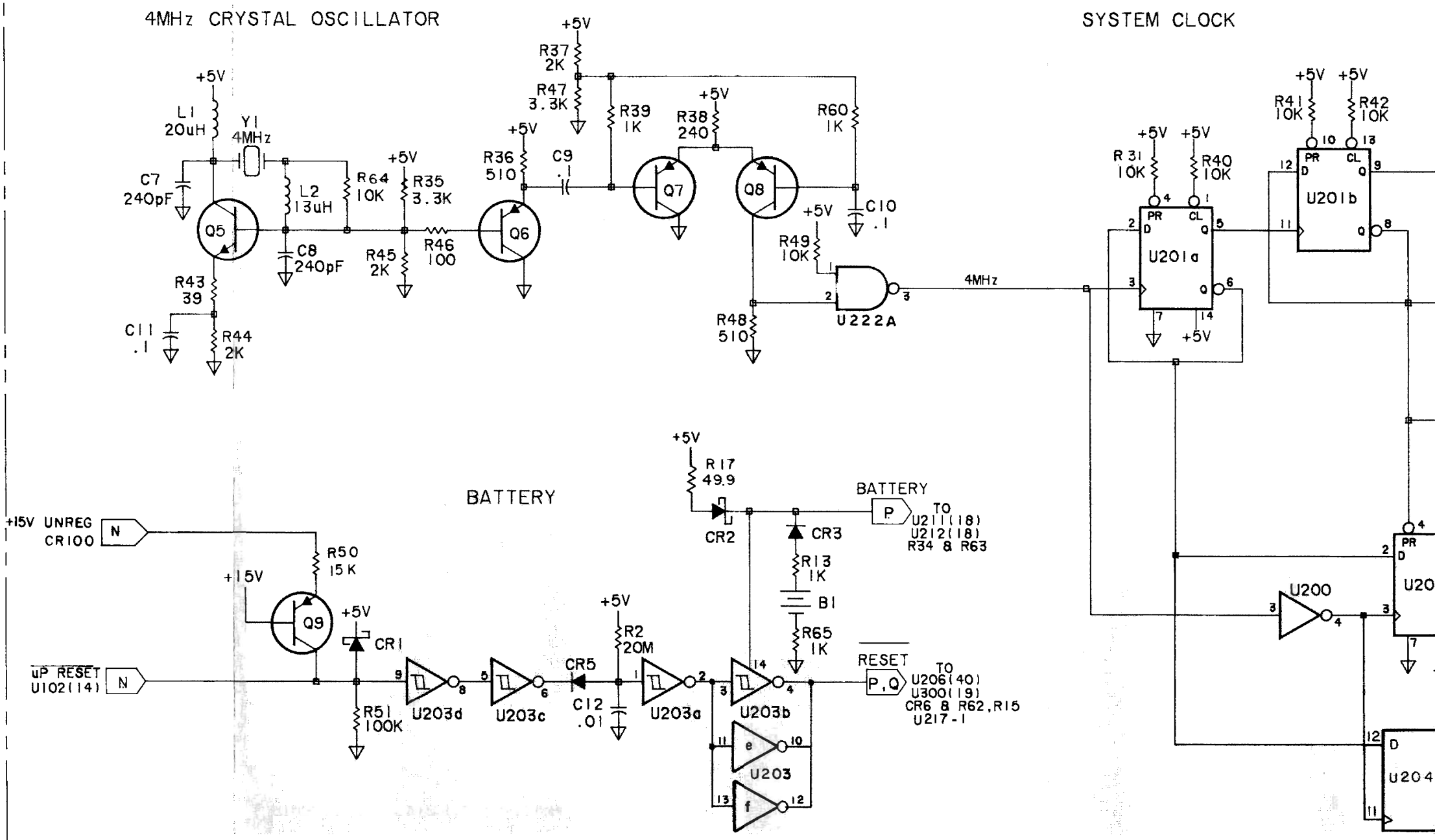
N

Figure 8-31. Power Supplies



A3
03314-66503

P/O A3 03314-66503
CONTROLLER



NOTE: SEE SECTION VII FOR 'Δ' EXPLANATION.

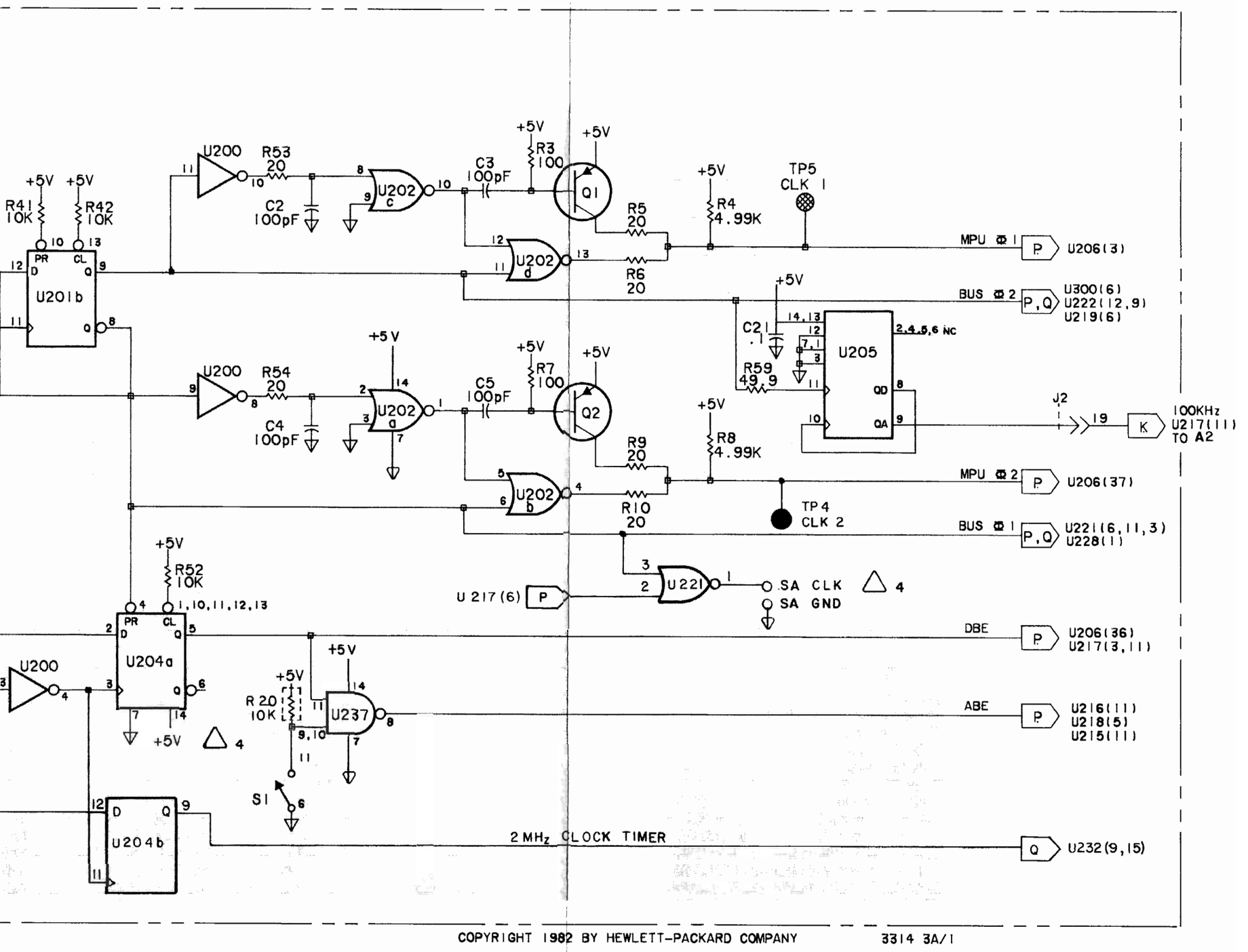
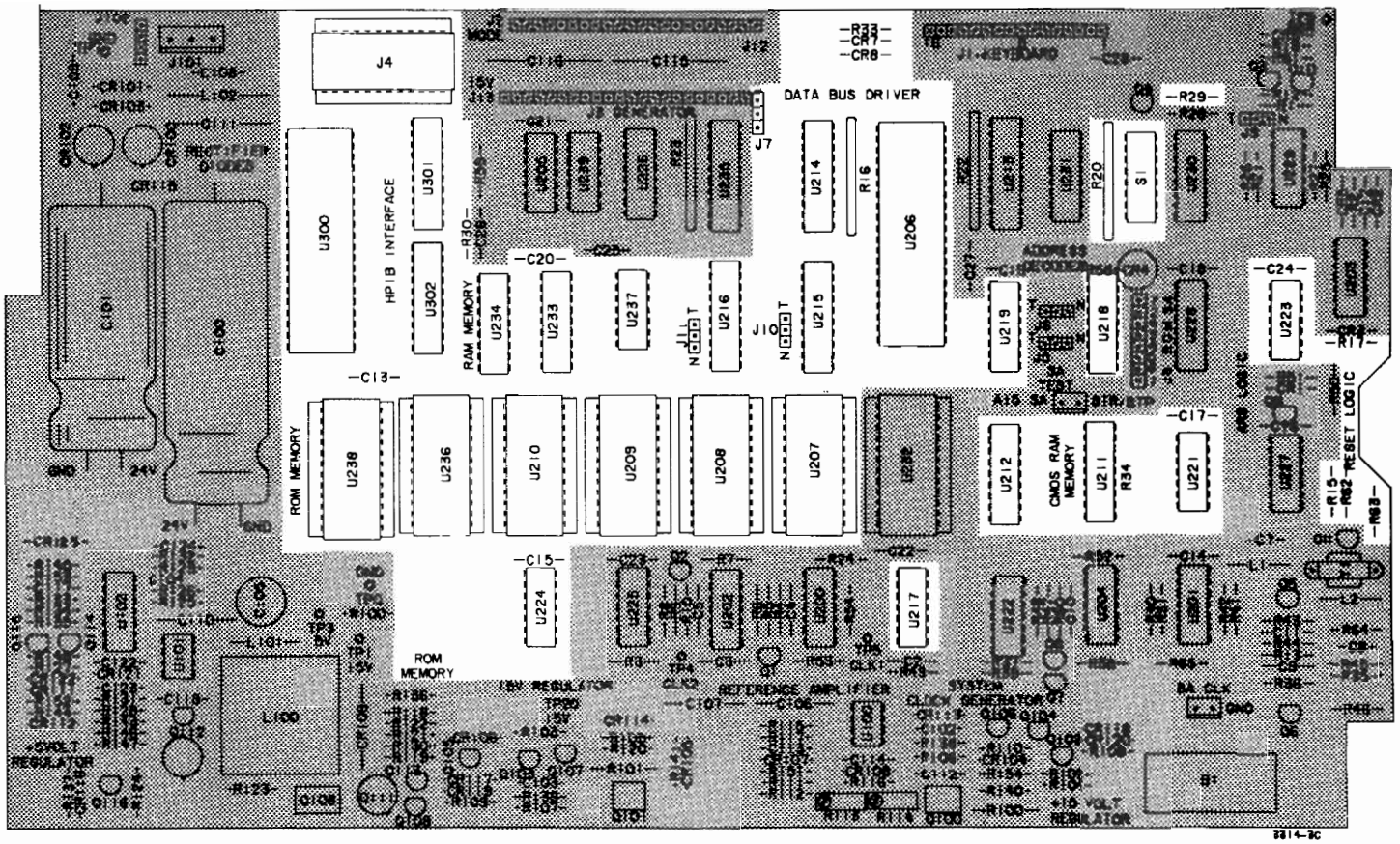


Figure 8-32. Clock Circuits



A3
03314-66503

P/O A3 03314-66503 CONTROLLER

CPU AND BUFFERS

ROM, RAM, ADDRESS DECODING

TO A4

U201(9) P

U227(3) Q

U223 Q

U223 C

U223 b

U219

J8-7 STP

U213(19) Q

U231(1,15) Q

U230(9) U201(8) Q

U217 b

U217 a

U200(13) U222(13) Q

U204(6) Q

U203(4) Q

U237(8) Q

U221(2) Q

ABE

U218

J8-6 STR/STP

J8-5 STR/STP

J8-4 STR/STP

J8-3 STR/STP

A' BUS

U214

U215

U216

U206 CPU

U236 D'BUS (8-17)

P,Q

S1

C22 .01

CR8

CR7

R33 1K

R16 10K

ROM U207

ROM U208

ROM U209

ROM U210

D' BUS

R20 10K

U230(10) Q

U232(17) Q

U237

7,35,38 NC

R28 10K

R29 10K

U227(6) Q

Q4

J9

Q U229(3)

TP6 $\overline{RSR}$

Q U203(4)

R

J1 13 RSR

R61 10K

RES'

Q3

Q10

R18 100K

CR6

R15 20K

R12 15.8K

R1 4.02K

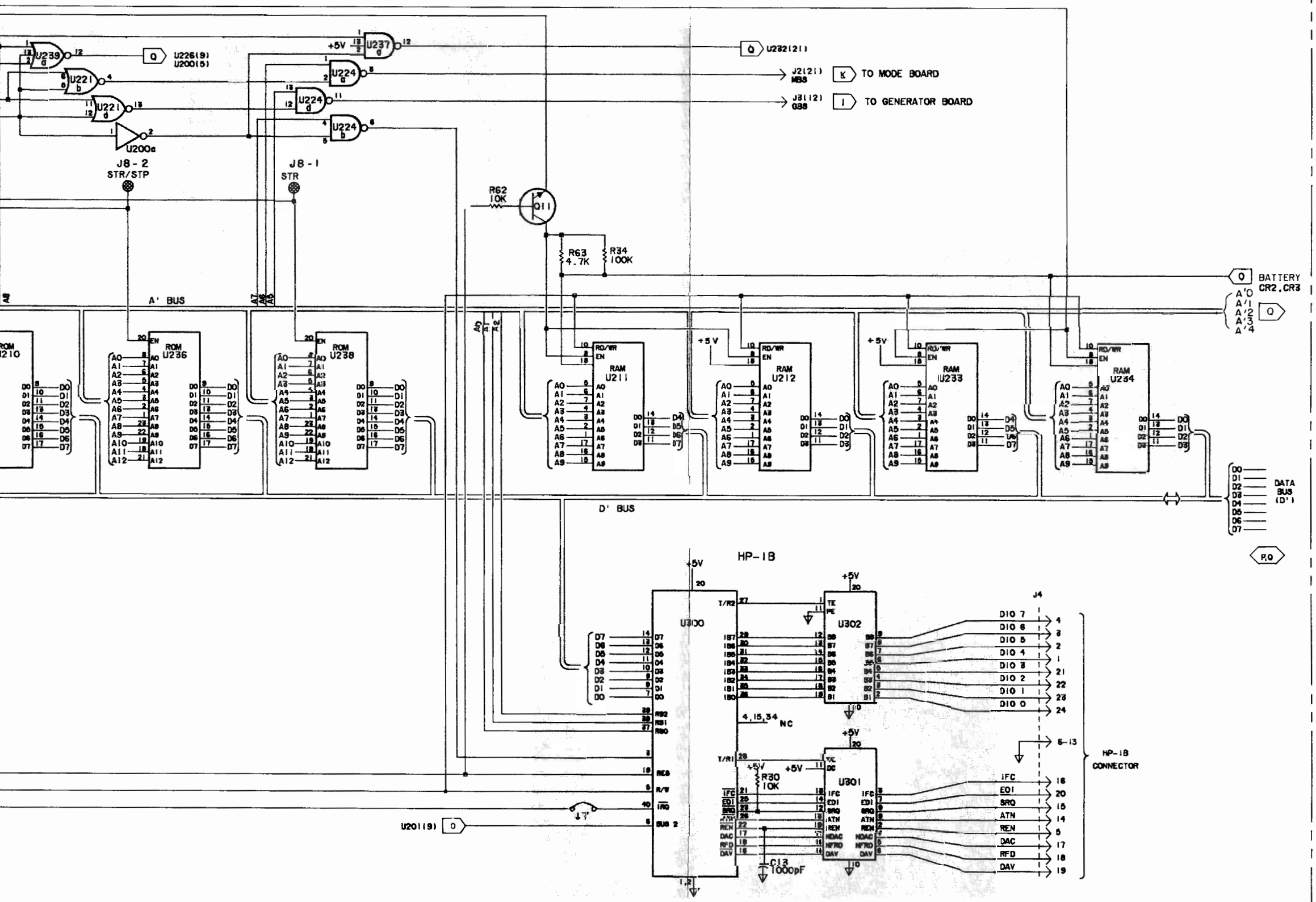
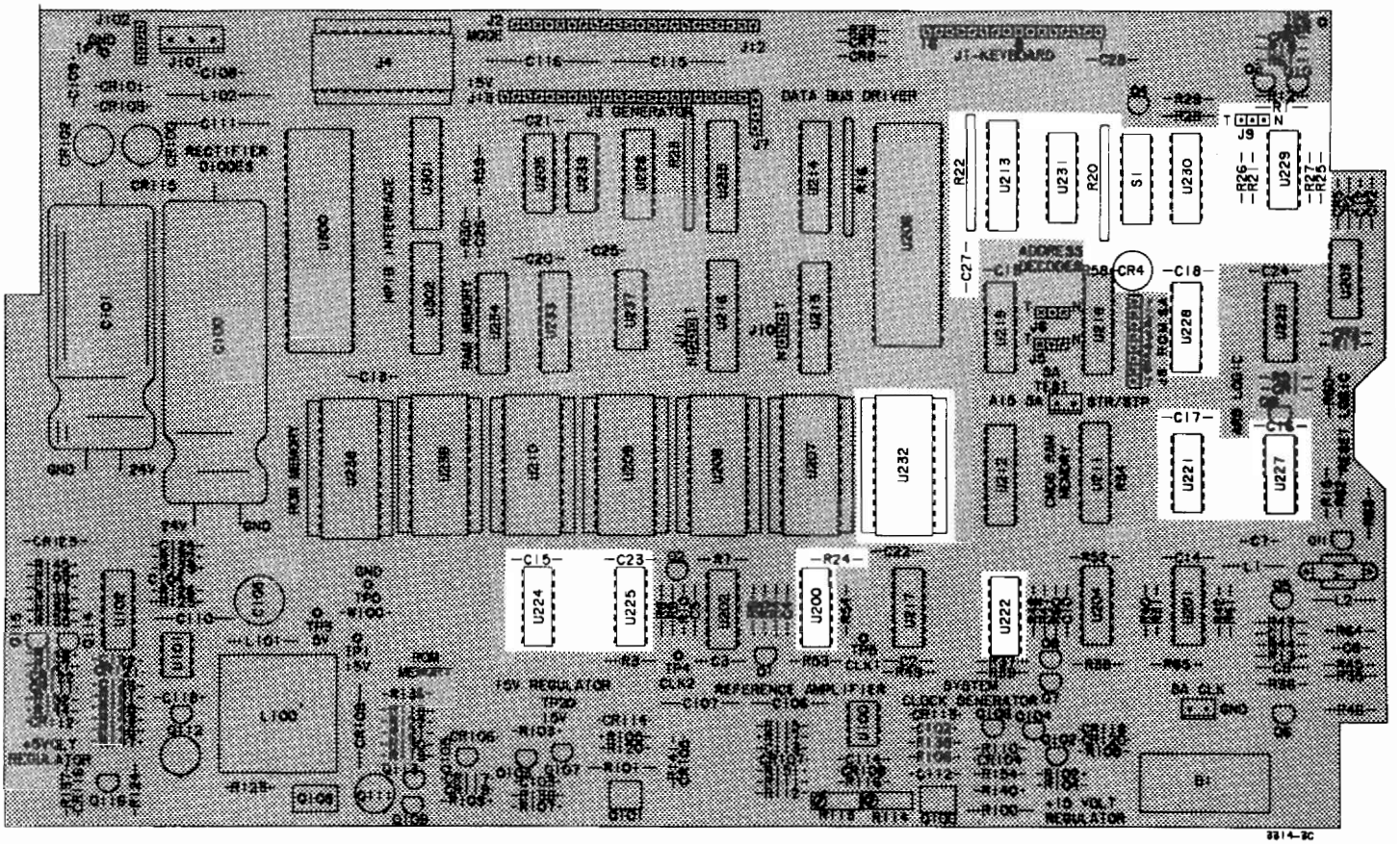


Figure 8-33. Processor, Memory and HP-IB



A3
03314-66503

P/O A3 03314-66503
CONTROLLER BOARD

I/O

U239(12) P
A' BUS P
A' BUS
U226
A" BUS
+5V

U239-12 P
U217-9 P
U200
U235
D" BUS
D' BUS
R23 10K
+5V

U223(8) P
U219(9) P
U213
R22 10K

J2
J3
K
L
TO A2
I
TO A1

+5
R26 10k
J9
IRQ
U206(4),U300(4) P
U229
+5V
R58 1K
CR4
U219(7) P
U230
J4
TO/FROM KEYBOARD

R20 10K
U231
S1

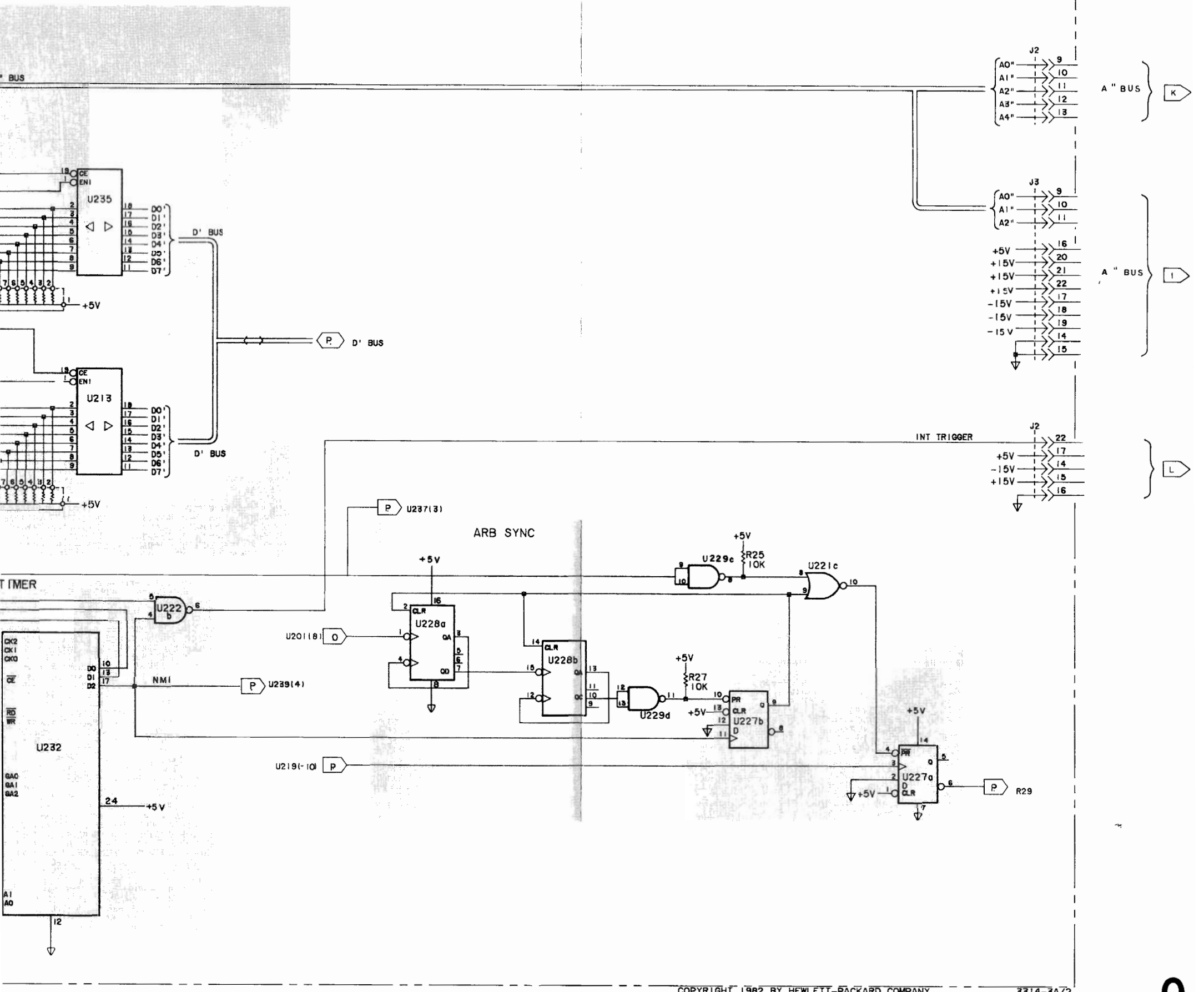
TIMER

FREQUENCY SENSE
U224c
U225b
U225a
U229b
R21 10K

△3
U204(9) 0
U237(12) P
U201(9) 0
U217(9) P
U200
U222 d
U222 c
U222 b
R24 10K
U232
NMI
24
+5V

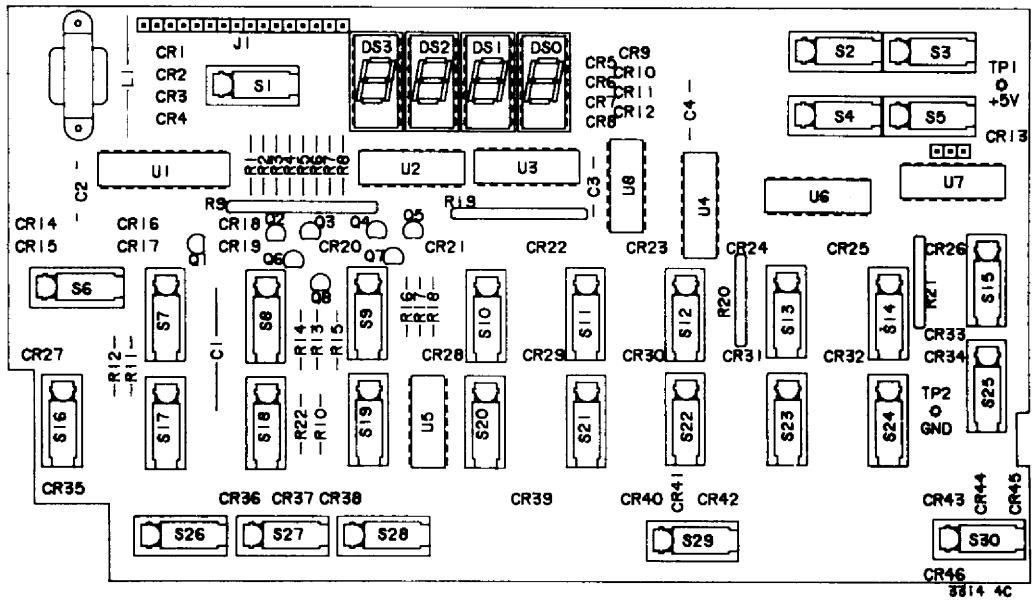
TIMER BUS P
A' BUS P

NOTE SEE SECTION VII FOR '△' EXPLANATION.



3314-3A/2

Figure 8-34. Timer and IO



A4
03314-66504

A4 | 03314-66504
DISPLAY & KEYBOARD

INPUT LATC
(ROW ENABLE)

TO/FROM CONTROLLER Q

J1

D0 D1 D2 D3 D4 D5 D6 D7 CSQ RBS KBS

+5 L1 25uH +5

KEYBOARD/
RPG BUFFER

U2 U3

DISPLAY/
KEYBOARD
DRIVE
(COLUMN ENABLE)

SHIFT
REG.
U4

R10 30K
R22 30K

U5

R21 4.7K
R20 4.7K

DIGIT DRIVE

KS0 KS1 KS2 KS3 KS4 KS5 KS6 KS7 KS8 KS9

U6 U7

ED0 ED1 ED2 ED3 ED4 ED5 ED6 ED7 ED8 ED9

RPG SENSE
(ROTATION & DIRECTION)

RPG R/S/W
RPG R/W
RPG W/S/B
RPG B

U8

KEY MATRIX
(4X8)

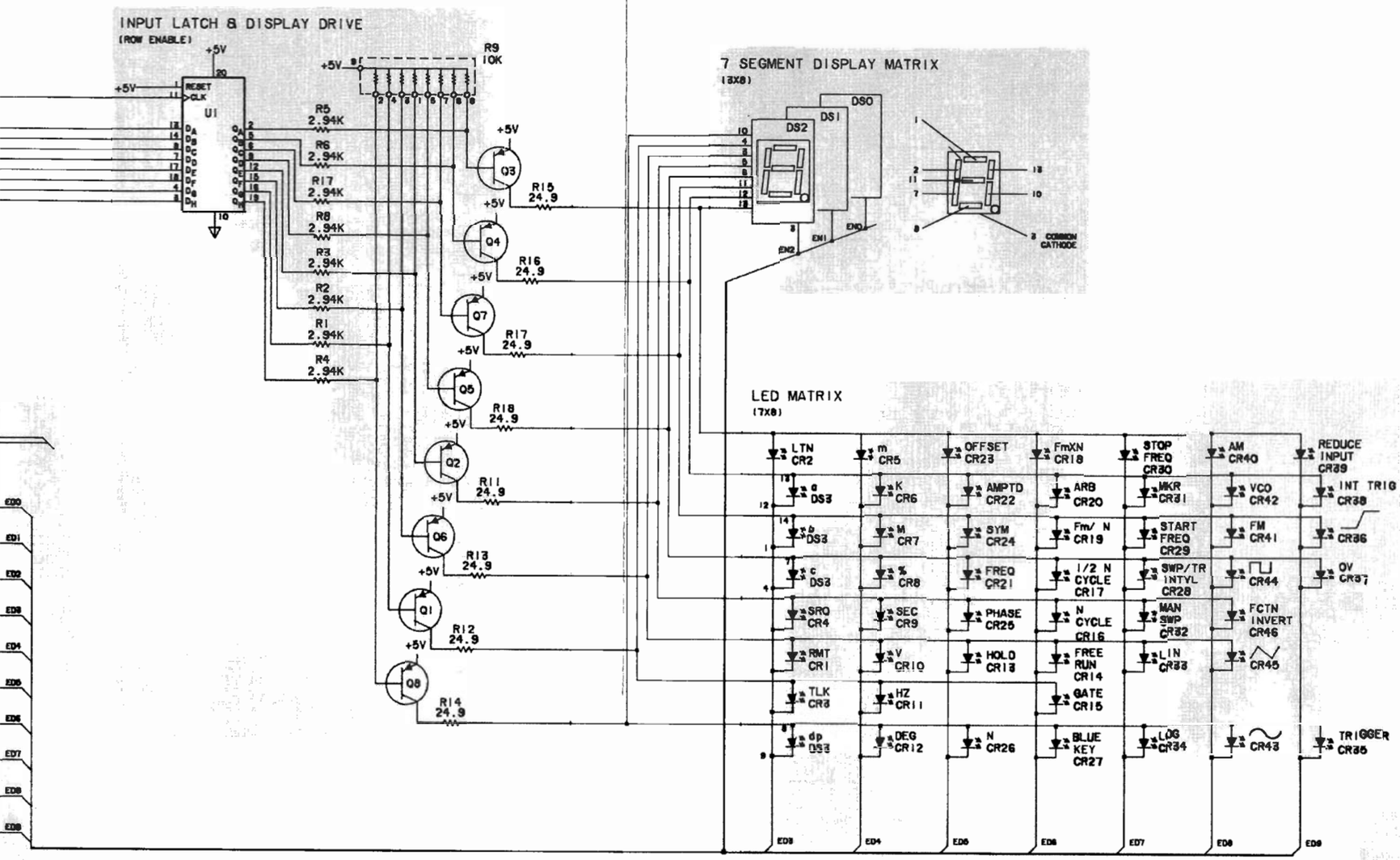
R19 10K

D0 D1 D2 D3 D4 D5 D6 D7

LCL(S1)	STO(S18)	PST(S17)
SEP(S27)	REL(S19)	SWP(S25)
SCE(S28)	FREQ(S10)	SWP/TR INT VL(S20)
BLUE KEY (S16)	STR(S12)	STOP FREQ (S22)
MAN(S26)	NE(S15)	ST FREQ (S21)
GEN(S6)	PHASE (S14)	MKR(S23)
SST(S7)	ADRTO (S11)	MAN SWP (S24)
Ø LOCK (S8)	OFFSET (S12)	ARB(S9)

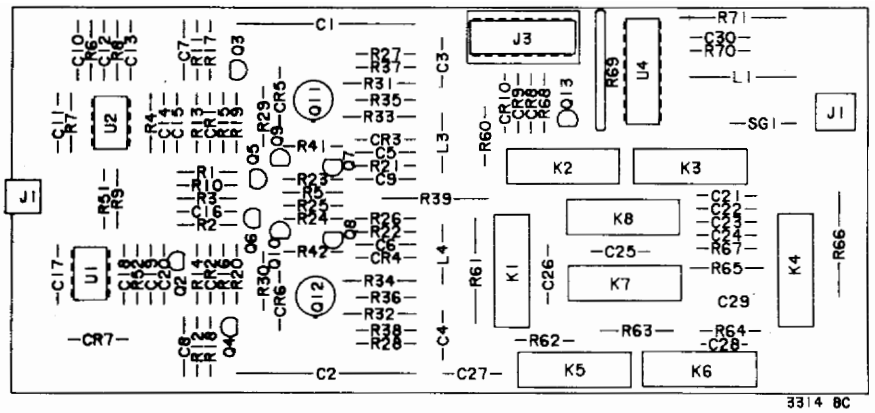
AM,FM,VCO(S29)
(S24)
(S2)
(S4)
(S3)
(S5)

KEY MATRIX



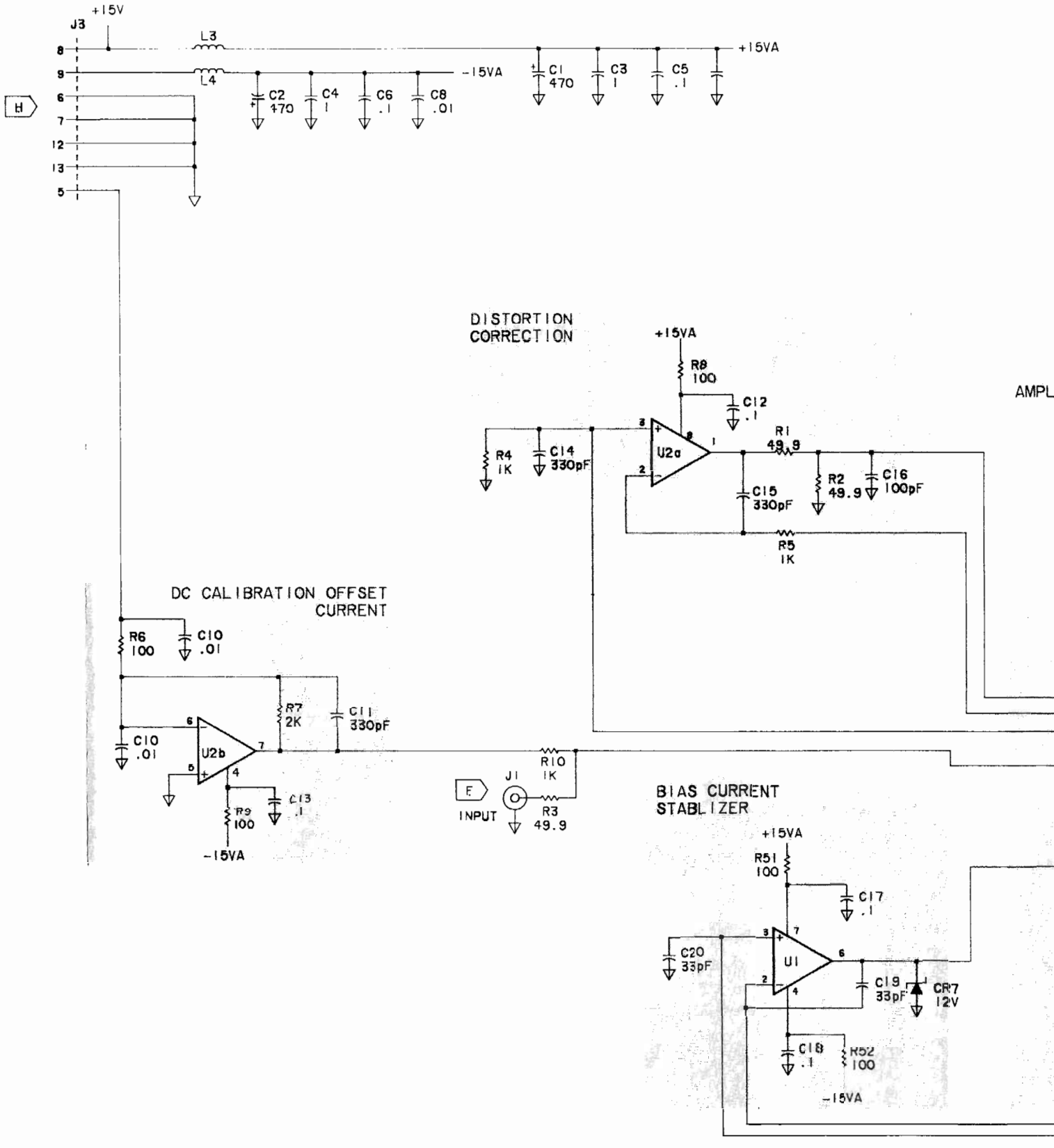
3314 4A

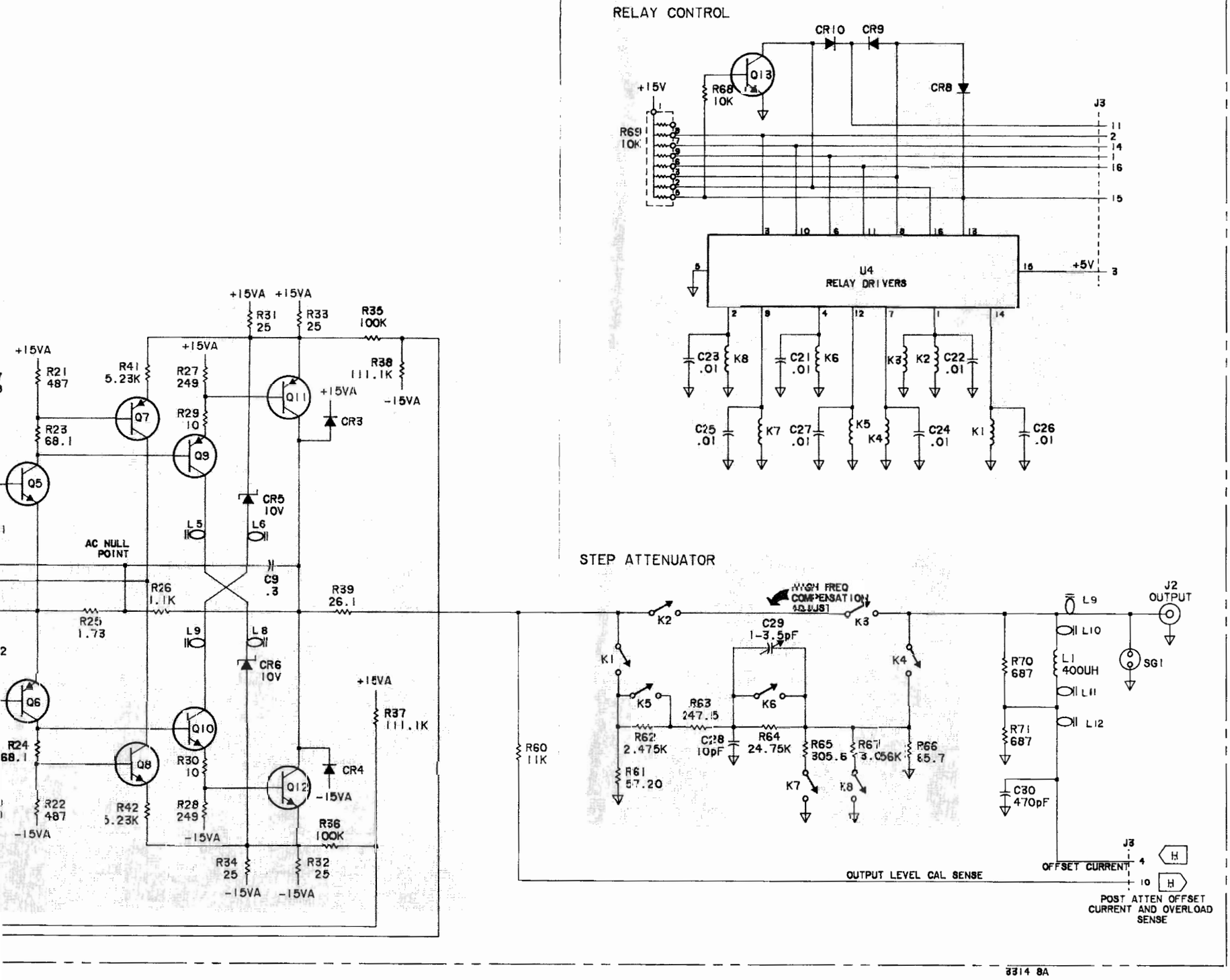
Figure 8-35. Front Panel and Keyboard



A8
03314-66508

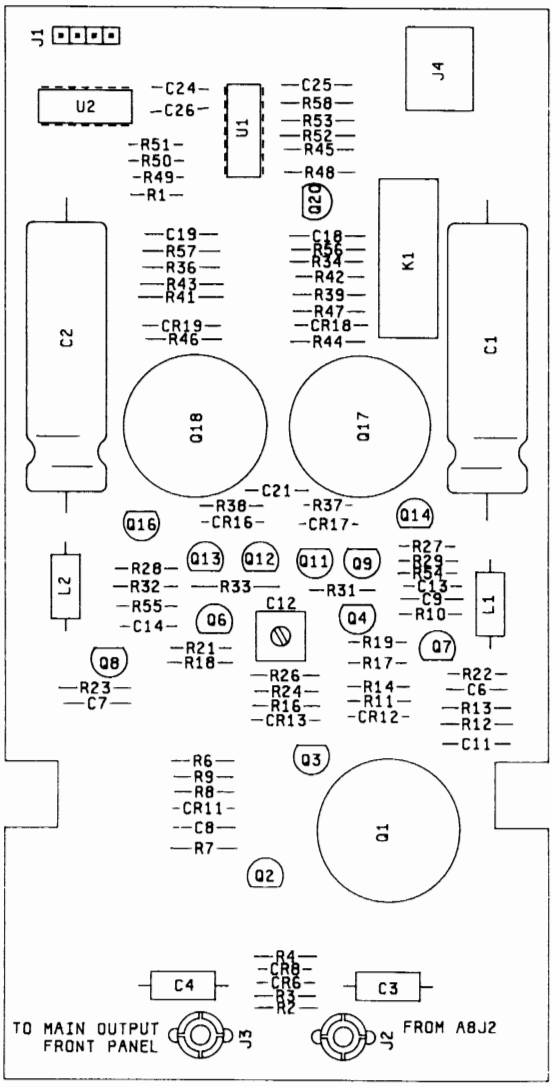
A8 | 03314-66508
OUTPUT AMPLIFIER



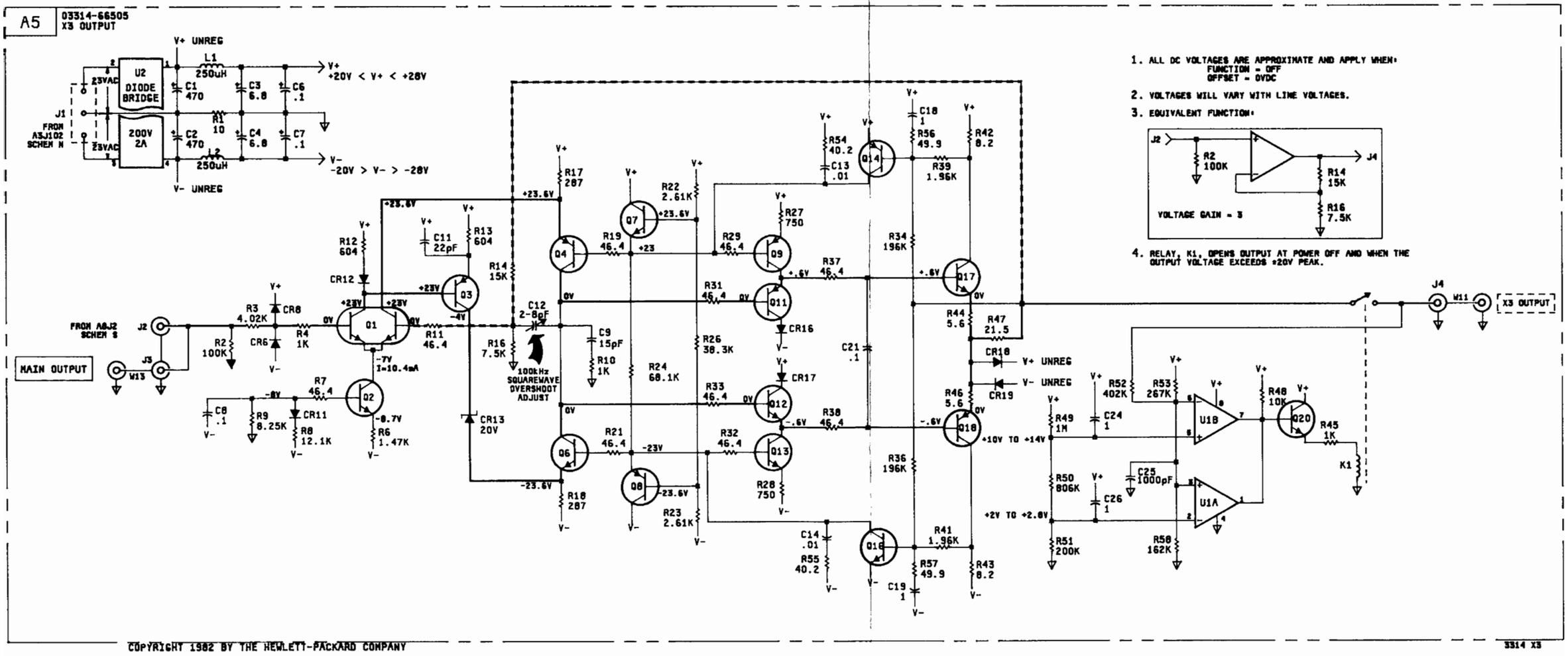


S

Figure 8-36. Output Amplifier and Step Attenuator



A5
03314-66505



3314 X3

Figure 8-37. X3 Output Amplifier