Errata

Title & Document Type: 3336A/B/C Synthesizer/Level Generator Operating & Service Manual

Manual Part Number: 03336-90000

Revision Date: October 1979

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.

About this Manual

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

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Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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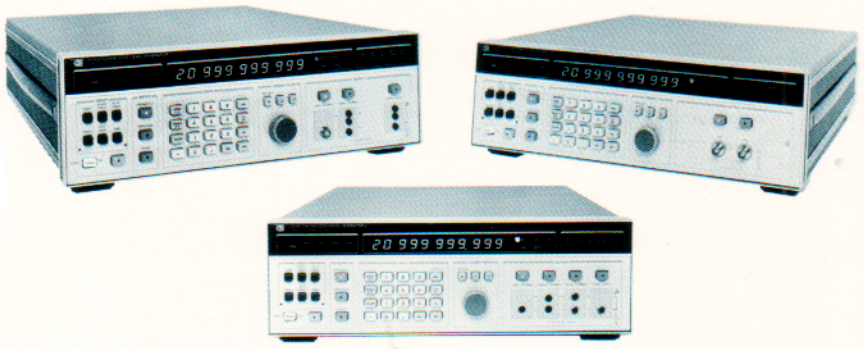
Agilent Technologies

OPERATING AND SERVICE MANUAL

SYNTHESIZER/LEVEL GENERATOR

3336A/B/C



HEWLETT PACKARD

hp 3336A/B/C

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

MODEL 3336A/B/C SYNTHESIZER/LEVEL GENERATOR

Serial Number 1930A00101 (3336A)
1931A00101 (3336B)
1932A00101 (3336C)

IMPORTANT NOTICE

This manual applies to instruments with the above serial numbers and greater. As changes are made in the instrument to improve performance and reliability, the appropriate pages will be revised to include this information.

WARNING

To prevent potential fire or shock hazard, do not expose equipment to rain or moisture.

Manual Part No. 03336-90000

Microfiche Part No. 03336-90050

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

Printed: October 1979

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment [,except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period] . During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

HP software and firmware products which are designated by HP for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If HP receives notice of such defects during the warranty period, HP shall repair or replace software media and firmware which do not execute their programming instructions due to such defects. HP does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

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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

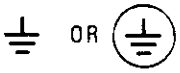
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

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

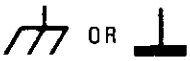
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

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).

DANGER

The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.

WARNING

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.

CAUTION

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.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 3336A/B/C Synthesizer/Level Generator.

1-3. Supplied with the instrument is an Operating Manual. This supplement is a copy of the first four sections of the Operating and Service Manual, and should be kept with the instrument for use by the operator. The -hp- part number of the Operating Manual is listed on the title page.

1-4. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4 x 6 inch microfilm transparencies of the Operating and Service Manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

1-5. SPECIFICATIONS.

1-6. Instrument specifications and supplemental characteristics are listed in Table 1-1. The specifications are the performance standards or limits against which the instrument is tested. Supplemental characteristics are included in Table 1-1 as additional information for the user.

1-7. SAFETY CONSIDERATIONS.

1-8. This product is a Safety Class 1 instrument (provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings, instructions, cautions and warnings to ensure safe operation.

1-9. INSTRUMENTS COVERED BY THIS MANUAL.

1-10. Attached to the instrument rear panel is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the same serial number prefix and higher serial number suffixes listed under SERIAL NUMBERS on the title page.

1-11. If your instrument's serial number suffix is lower than that listed on the title page, refer to Section VII, Manual Changes. There, you will find information to backdate your manual, making it apply to your instrument.

Table 1-1. Specifications and General Information.

FREQUENCY

Range:

Model 3336A:	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	150 ohm balanced	10 kHz to 2.099 999 999 MHz
	600 ohm balanced	200 Hz to 109.999 999 kHz
Model 3336B:	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	124 ohm balanced	10 kHz to 10.999 999 999 MHz
	135 ohm balanced	10 kHz to 2.099 999 999 MHz
	600 ohm balanced	200 Hz to 109.999 999 kHz
Model 3336C:	50 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz

Resolution:

1 μHz for frequencies < 100 kHz
1 MHz for frequencies ≥ 100 kHz

Accuracy: (instruments without Option 004)

$\pm 5 \times 10^{-6}$ of programmed frequency

Aging Rate: (instruments without Option 004)

$\pm 5 \times 10^{-6}$ per year (20° to 30°C)

Warm-Up Time:

30 minutes

AMPLITUDE

Range:

Model 3336A:	75 ohm output	−72.99 to +7.00 dBm
	150 ohm output	−78.23 to +1.76 dBm
	600 ohm output	−72.99 to +7.00 dBm
Model 3336B:	75 ohm output	−72.99 to +7.00 dBm
	124 ohm output	−78.23 to +1.76 dBm
	135 ohm output	−78.23 to +1.76 dBm
	600 ohm output	−72.99 to +7.00 dBm
Model 3336C:	50 ohm output	−71.23 to +8.76 dBm
	75 ohm output	−72.99 to +7.00 dBm

Absolute Accuracy: specified at 10 kHz for the 50, 75 and 600 ohm outputs; specified at 50 kHz for the 124, 135 and 150 ohm outputs.

± .05 dB, for the top 9.99 dB of amplitude range (20° to 30°C)

± .08 dB, for the top 9.99 dB of amplitude range (0° to 55°C)

Flatness: referenced to amplitudes at 10 kHz for the 50, 75 and 600 ohm outputs; referenced to amplitudes at 50 kHz for the 124, 135 and 150 ohm outputs.

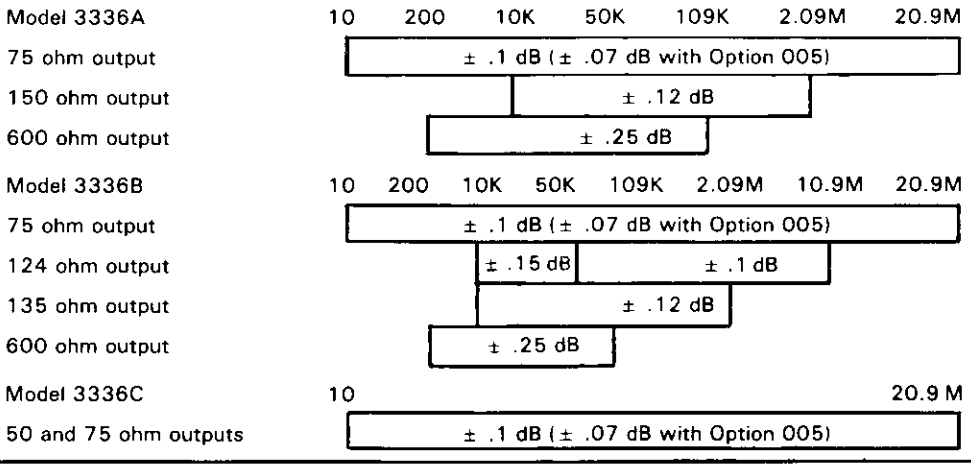


Table 1-1. Specifications and General Information (Cont'd).

Attenuator Accuracy: (instruments without Option 005)

Attenuation	10Hz	1 MHz	10M	20.9M
10 to 19.99 dB	± .1 dB	± .15 dB	± .2 dB	
20 to 39.99 dB	± .15 dB	± .2 dB	± .25 dB	
40 to 79.99 dB	± .2 dB	± .25 dB	± .3 dB	

NOTE

Amplitude Accuracy is the sum of Absolute Accuracy and, as needed, Flatness and Attenuator Accuracy.

Warm-Up Time:

30 minutes

MAIN SIGNAL OUTPUTS

On Carrier Return Loss:

	10	10K	30K	2.09M	10.9M	20.9M
Model 3336A						
75 ohm output	> 30 dB					
150 ohm output	> 20 dB	> 30 dB				
Model 3336B						
75 ohm output	> 30 dB					
124 ohm output	> 20 dB	> 30 dB				
135 ohm output	> 20 dB	> 30 dB				

	10	10K	30K	2.09M	10.0M	20.9M
Model 3336C						
50 ohm output	> 30 dB				> 25 dB*	
75 ohm output	> 30 dB					

*Return Loss of 50 ohm output is > 30 dB to 20.9 MHz with Option 005.

Balance:

	300	10K	50 K	2.09M	10.8M
Model 3336A					
150 ohm output		> 36 dB			
600 ohm output	> 38 dB				

	300	10K	50K	2.09M	10.9M
Model 3336B					
124 ohm output		> 30 dB			
135 ohm output		> 36 dB			
600 ohm output	> 38 dB				

SPECTRAL PURITY

Integrated Phase Noise:

Model 3336A and 3336B
> −64 dB, for a 3 kHz band, 2 kHz either side of a 20 MHz carrier.

Model 3336C
> −54 dB, for a 30 kHz band, centered on a 20 MHz carrier, excluding 1 Hz about the carrier.

Phase Jitter

.3° peak to peak maximum, measured per Bell System Technical Reference PUB 41009, "Transmission Parameters Affecting Voiceband Data Transmission—Measuring Techniques May 1975" and per CCITT Orange Book, Volume IV.2 "Specifications of Measuring Equipment".

Table 1-1. Specifications and General Information (Cont'd).

Harmonic Distortion

No harmonically related signal will exceed these values with respect to the carrier:

10	30	50	10K	100K	1M	5M	20.9M	
– 35dB	– 50dB	– 60dB			– 55dB	– 50dB		Normal Leveling
			– 50dB	– 60dB	– 55dB	– 50dB		Fast Leveling

Spurious: (dc to 200 MHz except where noted)

All non-harmonically related signals from dc to 200 MHz will be more than 70 dB below the carrier or less than one of the following levels, whichever is greater.

Model 3336A	without Option 005	with Option 005
75 ohm output	– 100 dBm	– 115 dBm
150 ohm output	– 100 dBm (to 10 MHz)	– 100 dBm (to 10 MHz)
600 ohm output*	– 100 dBm (to 10 MHz)	– 100 dBm (to 10 MHz)
Model 3336B	**without Option 005**	**with Option 005**
75 ohm output	– 100 dBm	– 115 dBm
124 ohm output	– 100 dBm	– 115 dBm
135 ohm output	– 100 dBm	– 115 dBm
600 ohm output*	– 100 dBm	– 115 dBm
Model 3336C	**without Option 005**	**with Option 005**
50 ohm output	– 100 dBm	– 115 dBm
75 ohm output	– 100 dBm	– 115 dBm

*Line related signals from the 600 ohm outputs will be more than 70 dB below the carrier or – 83 dBm whichever is greater.

Amplitude Blanking:

Maximum signal output during amplitude blanking: < – 85 dBm

Impulse Level in adjacent channels caused by amplitude blanking: > 22 dBm 0

PHASE OFFSET

Range:

± 719.9° with respect to arbitrary starting phase or assigned zero phase.

Resolution: 0.1°

Increment Accuracy: ± 0.2°

Ambient Stability: ± 1 degree of phase per degree C.

FREQUENCY SWEEP

Sweep Flatness:

± .15 dB, Normal Leveling, 50 Hz to 1 MHz, .5s Sweep Time.

± .15 dB, Fast Leveling, 10 kHz to 20 MHz, .03s Sweep Time.

Sweep Time

Linear Sweep: .01 sec to 99.99 sec

Single Log Sweep: 2 sec to 99.99 sec

Continuous Log Sweep: .1 sec to 99.99 sec

Minimum Sweep Width

Log Sweep: 1 decade

Linear Sweep: Minimum Bandwidth (Hz) = .1(Hz/sec) x Sweep Time (sec)

Table 1-1. Specifications and General Information (Cont'd).

Phase Continuity:

Sweep is phase continuous over the full frequency range

AMPLITUDE MODULATION

Modulation Depth: 0 to 100 %

Modulation Frequency Range: 50 Hz to 50 kHz

Envelope Distortion: < −30 dBc to 80% modulation

Input Impedance: 20 K ohm

PHASE MODULATION

Range: 0 to ± 850°

Linearity: ± .5% of peak to peak deviaion from best fit straight line.

Modulation Frequency Range: dc to 5 kHz

Input Sensitivity: ± 5 V peak for ≈ 850° phase shift (≈ 170°/volt)

Input Impedance: 20 K ohm

HP-IB CONTROL

Frequency Switching Time: (Time to settle to within 1 Hz to final value, exclusive of programming and processing time)

< 10 ms for 100 kHz step

< 25 ms for 1 MHz step

< 70 ms for 20 MHz step

Phase Switching Time: (to within 90° of phase lock, exclusive of programming and processing time)

< 15 ms

Amplitude Switching Time: (to within .1 dB of final value, exclusive of programming and processing time)

< 500 ms

AUXILIARY OUTPUTS

AUX 0 dBm:
Frequency range is from 21 MHz to 60.999 999 999 MHz (underrange to 20.000 000 001 MHz). Amplitude is 0 dBm (50 ohm).

SYNC OUT:
Square wave with $V_{high} \geq 1.2$ V, $V_{low} \leq 0.2$ V into 50 ohms, to synchronize other instruments to the Main Signal Outputs. Level transition occurs at Main Signal Output zero crossing.

REF OUT:
0 dBm (50 ohm), 1 MHz signal for phase-locking additional instruments to the Model 3336.

10 MHz OVEN OUT:
Instruments with Option 004, only. 0 dBm (50 ohm), 10 MHz signal from a temperature stabilized, crystal oscillator for phase-locking the Model 3336 or other instruments.

X DRIVE:
0 to > + 10 Vdc linear ramp proportional to the sweep frequency. Linearity, ± 1% of final value, 10% to 90%, best fit straight line.

Z BLANK:
Sweep related TTL compatible voltage levels. Low level is capable of sinking current from a positive voltage source.

Maximum Current = 200 mA
Maximum Voltage = + 45 Vdc
Maximum Power Dissipation = 1 W

MARKER:
TTL compatible high to low level transition at the programmed Marker Frequency.

Table 1-1. Specifications and General Information (Cont'd).

AUXILIARY INPUTS

EXT REF IN:
For phase-locking the 3336A/B/C to an external frequency reference. Signal from 0 dBm to + 20 dBm (50 ohm). Signal frequency must be within 1×10^{-6} of a sub-harmonic of 10 MHz from 1 MHz to 10 MHz.

AMPTD MOD:
Amplitude modulation input (see AMPLITUDE MODULATION specifications)

PHASE MOD:
Phase modulation input (see PHASE MODULATION specifications)

EXTERNAL LEVELING:
Input from an External Leveling voltage source to regulate the signal amplitude at a remote point. Input Sensitivity: .25 dB/volt

OPTION 004, HIGH STABILITY FREQUENCY REFERENCE

Aging Rate:
$\pm 5 \times 10^{-8}$ per week after 72 hours continuous operation.
$\pm 1 \times 10^{-7}$ per month after 15 days continuous operation.

Ambient Stability:
$\pm 5 \times 10^{-8}$ maximum, 0° to 55°C

Warm-Up Time:
Reference frequency will be within 1×10^{-7} of the turn-off frequency, 20 minutes after turn-on, for an off time less than 24 hours.

OPTION 005, HIGH ACCURACY ATTENUATOR

Attenuation	10Hz 20 MHz
10 to 19.99 dB	± .035 dB
20 to 39.99 dB	± .06 dB
40 to 79.99 dB	± .1 dB

GENERAL

Operating Environment:

Temperature: 0° to 55°C

Relative Humidity: 85%, 0° to 40°C

Altitude: < 15,000 ft. (< 4600 meters)

Storage Environment:

Temperature: −50° to +65°C

Altitude: < 50,000 ft. (< 15,000 meters)

Power Requirements:

100/120, 220/240 V, +5%, −10%, 48 to 66 Hz, 60 VA (100 VA with all options), 10 VA standby.

Size: 132.6 mm (5 1/4 in) high x 425.5 mm (16-3/4) wide x 497.8 (19-5/8) deep

Weight: 10 kg (22 lbs.) net, 15.5 kg (34 lbs.) shipping

1-12. This manual may have a yellow Manual Change Supplement with it. This supplement contains information for correcting errors in the manual and new information to keep your manual current. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change Supplement. The supplement for this manual is identified with the manual print date and part number. Both appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13. DESCRIPTION.

1-14. The Hewlett-Packard Model 3336 Synthesizer/Level Generator is an accurate, stable and spectrally pure sine wave source, producing synthesized frequencies with 11 digits of resolution from 10 Hz to 20.999 999 999 MHz and precise output levels from −72.99 to +7.00 dBm (75 ohm output) in .01 dBm steps. A general purpose model and two communications models are available, each having a different combination of balanced and unbalanced outputs, output impedances and output connectors.

1-15. AVAILABLE MODELS.

1-16. The Model 3336 is manufactured as one of three models identified by the letters A, B or C following the model number. The difference between models is the configuration of the front panel outputs. The outputs on each model are:

MODEL	OUTPUTS	ACCEPTS CONNECTOR TYPE
3336A	75 ohm unbal	75 ohm BNC
	150 ohm bal	Siemens type 3 prong 9REL STP-6 AC
	600 ohm bal	Siemens type 3 prong 9REL STP-6 AC
3336A with Option 001	75 ohm unbal	Siemens type 1.6/5mm coaxial
	150 ohm bal	Siemens type 3 prong 9REL STP-6 AC
	600 ohm bal	Siemens type 3 prong 9REL STP-6 AC
3336B	75 ohm unbal	WECO type 439A or 440A
	124 ohm bal	WECO type 443A
	135 ohm bal	WECO type 241A
	600 ohm bal	WECO type 310
3336B with Option 001	75 ohm unbal	WECO type 358A
	124 ohm bal	WECO type 372A
	135 ohm bal	WECO type 241A
	600 ohm bal	WECO type 310
3336C	50 ohm unbal	50 ohm BNC
	75 ohm unbal	75 ohm BNC

1-17. ACCESSORIES SUPPLIED.

1-18. A special BNC to BNC connector is supplied with the High Stability Frequency Reference (Option 004) to connect the High Stability Frequency Reference to the instrument. This connector is -hp- Part No. 1250-1499.

1-19. ACCESSORIES AVAILABLE.

1-20. The following accessories are available for use with the Model 3336A/B/C:

-hp- Part No.	Description
11048C	50 ohm Feedthrough Termination
11094B	75 ohm Feedthrough Termination
11356A	Ground Isolator
85428B	50 to 75 Ω Minimum Loss Impedance Matching Pad
11477A	High Stability Frequency Reference Kit (converts standard instrument to Option 004)
5061-0077	Rack Mount Flange Kit (Option 908)
5061-0083	Rack Mount Flange/Front Handle Kit (Option 909)
5061-0089	Front Handle Kit (Option 907)
11473A	(2)-600 Ω Balanced (WECO 310) to 75 Ω Unbalanced (BNC) Balancing Transformers
11473B	(2)-600 Ω Balanced (Siemens 9REL-STP-6AC) 75 Ω Unbalanced (BNC) Balancing Transformers
11474A	(2)-135 Ω Balanced (WECO 241) to 75 Ω Unbalanced (BNC) Balancing Transformers
11475A	(2)-150 Ω Balanced (Siemens 9REL-STP-6AC) to 75 Ω Unbalanced (BNC) Balancing Transformers
11476A	(2)-124 Ω Balanced (WECO 408A) to 75 Ω Unbalanced (BNC) Balancing Transformers
5061-0743	Telephone connector adapter kit [adapters convert all 3336B output to BNC (f)]

1-21. RECOMMENDED TEST EQUIPMENT.

1-22. Equipment required to maintain the Model 3336A/B/C is listed in Table 1-2. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-2. Recommended Equipment List.

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR V = Oper. Ver. P = Performance Test T = Troubleshooting A = Adjustments	RECOMMENDED MODEL
Electronic Counter	Frequency Measurements Range: to 20.9 MHz Resolution: 8 digits Accuracy: ±1 part/10^9 Time Interval Average Resolution: .1 ns	V, P, A	-hp- Model 5328A with Options 010 and 040 or 041
Digital Voltmeter	dc Function Ranges: .1V, 1V, 10V, 100V Accuracy: ± .2% Resolution: 4½ digits ac Function Ranges: 1V, 10V, 100V Accuracy: ± .5% Resolution: 4 digits	T	-hp- Model 3466A
	dc function Ranges: .1V, 1V, 10V, 100V Accuracy: ± .05% Resolution: 6 digits ac Function Ranges: 1V, 10V, 100V Accuracy: ± .15% at 10 and 50 kHz Resolution: 5 digits	V, P, A	-hp- Model 3455A with Option 001 (Average Responding Converter) or -hp- Model 3490A
Wave Analyzer	Frequency Range: 10 Hz to 50 kHz Amplitude Accuracy: ± .5 dB Spurious Response: ≤ −80dBc Y-Axis output	V, P, A	-hp- Model 3581A or 3581C
Synthesizer	Frequency Range: 200 Hz to 20.9 MHz Amplitude Range: −60 to +13 dBm Phase Noise: ≤ 70 dBc Spurious: ≤ −75 dBc	P	-hp- Model 3335A (-hp- Model 3325A is acceptable except for Phase Noise and Spurious Performance Tests)
Unbalanced Directional Couplers	50 ohm Frequency Range: .1 to 20.9 MHz Directivity: ≥ 40 dB	P (3336C only)	-hp- Model 8721A*
	75 ohm Frequency Range: .1 to 20.9 MHz Directivity: ≥ 40 dB	P (all models)	-hp- Model 8721A* with Option 008

*Unbalanced Directional Couplers are also part of Transmission/Reflection kits:

50 Ω Reflection/Transmission Kit -hp- Model 11652A
75 Ω Reflection/Transmission Kit -hp- Model 11652A with Option 008

Table 1-2. Recommended Equipment List (Cont'd).

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
System Voltmeter	dc Voltage Range: ± 10 V Trigger: External Trigger Delay: Programmable	P	-hp- Model 3437A
1 MHz Low Pass Filter	Cut-Off Frequency: 1 MHz Stop-Band Frequency: 4 to 80 MHz	P	J903 TT Electronics Inc 2214 S. Barry Avenue Los Angeles, CA 90064
15 kHz Low Pass Filter	Cut-Off Frequency: 15 kHz Consisting of Resistor: 10K ohm, ±1% Capacitor: 1600 pF, ±5%	P (3336C only)	 -hp- Part No. 0757-0340 -hp- Part No. 0160-2223
500 Hz - 3500 Hz Bandpass Filter	Pass Band: 500 to 3500 Hz	P (3336A/B only)	3100 Kronhite Avon Industrial Park Bodwell St. Avon, MA 02327
High Frequency Probe	Frequency Range: .1 to 20 MHz Accuracy: ± .5 dB (Diode Detector)	P	-hp- Model 11096B
Signature Analyzer	Signature: 4 digit Hexadecimal Characters: 0 thru 9, A, C, F, H, P, U Logic Threshold: + 2.2 V, high + .5 V, low	T	-hp- Model 5004A
Minimum Loss Impedance Matching Pads	50 - 75 ohm	V, P	-hp- Model 85428B
	124 - 75 ohm R1 = 15.9 ohm, ± 1% R2 = 119.3 ohm, ± 1% R3 = 62.0 ohm, ± 1%	A, P (3336B only)	 -hp- Part No. 0698-4361 -hp- Part No. 0698-6806 -hp- Part No. 0698-6800
	135 - 75 ohm R1 = 22.5 ohm, ± 1% R2 = 112.5 ohm, ± 1% R3 = 67.5 ohm, ± 1%	A, P (3336B only)	 -hp- Part No. 0698-4086 -hp- Part No. 0698-7469 -hp- Part No. 0698-8558
	150 - 75 ohm R1 = 31.1 ohm, ± 1% R2 = 106.1 ohm, ± 1% R3 = 75 ohm, ± 1%	A, P (3336A only)	 -hp- Part No. 0698-4375 -hp- Part No. 0698-4405 -hp- Part No. 0757-0710
	600 - 75 ohm R1 = 261.2 ohm, ± 1% R2 = 80.2 ohm, ± 1% R3 = 300 ohm, ± 1%	A, P (3336A/B only)	 -hp- Part No. 0698-3132 -hp- Part No. 0698-4096 -hp- Part No.0698-6982
Terminations	50 ohm, ± 2%	V, P, A, T	-hp- Model 11048C
	75 ohm, ± 2%	V, P, A, T	-hp- Model 11094B
	124 ohm, ± 1%	V, P, A (3336B only)	-hp- Part No. 0698-6284
	135 ohm, ± 1%	V, P, A (3336B only)	-hp- Part No. 0698-5197
	150 ohm, ± 1%	V, P, A (3336B only)	-hp- Part No. 0757-0715
	600 ohm, ± 1%	V, P, A (3336A/B only)	-hp- Part No. 0698-5405

Table 1-2. Recommended Equipment List (Cont'd).

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
Balanced Directional Couplers	124 ohm Frequency Range: .01 to 10.9 MHz Directivity: ≥ 40 dB	P (3336B only) P (3336B/Opt 001)	-hp- Part No. 5061-1135 -hp- Part No. 5061-1136 (Opt 001)
	150 ohm Frequency Range: .01 to 20.9 MHz Directivity: ≥ 40 dB	P (3336A only)	-hp- Part No. 5061-1137
DC Power Supply	Output Voltage: Output Current: ≥ 20 mA	P	-hp- Model 6214A
Double Balanced Mixer	Input/Output Z: 50 ohm Frequency Range: 1 to 20.9 MHz	P	-hp- Model 10534A or 10514A
Attenuators	Attenuation: 10 dB (fixed) VSWR: ≤ 1.02, dc to 20.9 MHz Input/Output Z: 50 ohms	P	-hp- Model 8491A Option 010 (2 required)
	Attenuation: 0 to 70 dB Attenuation Step Size: 10 dB Input/Output Z: 50 ohm Certification required at 1 MHz, 10 MHz, 20.9 MHz	P	-hp- Model 355D
Spectrum Analyzer	Frequency Range: .1 to 100 MHz Amplitude Accuracy: ± 1 dB Harmonic Distortion: ≤ −65 dBc Spurious: ≤ −70 dBc	V, P, A	-hp- Model 141T/8553B/8552B
	Frequency Range: 10 Hz to 50 kHz Amplitude Accuracy: ± 1 dB Harmonic Distortion: ≤ −65 dBc Spurious: ≤ −70 dBc	V, P	-hp- Model 3580A
Thermal Converter	Input Z: 75 ohms Maximum Input: .5 V rms Flatness: Certification required at 10 kHz, 100 kHz, 1 MHz, 10 MHz and 20 MHz	V, P, A	-hp- Model 11051A/H01
Oscilloscope	Vertical Bandwidth: dc to 100 MHz Deflection: .01V to 10V/DIV Horizontal Sweep: .05 μs to 1s/DIV Delayed Sweep	A, T	-hp- Model 1740A
Function Generator	Frequency: 1 and 10 kHz Functions: Sine, Squarewave Symmetry: Variable	P, A	-hp- Model 3312A
ac Voltmeter	Ranges: 1 mV to 1 V Frequency Range: 25 Hz to 1 MHz Scale: Logarithmic Accuracy: ± 2%, 100 Hz to 10 kHz	P	-hp- Model 400 FL

Table 1-2. Recommended Equipment List (Cont'd).

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
Resistors for Balance Test (3 of each required)	62 ohm, ± 1%	P (3336B only)	-hp- Part No. 0698-6800
	67.5 ohm, ± 1%	P (3336B only)	-hp- Part No. 0698-8558
	75 ohm, ± 1%	P (3336A only)	-hp- Part No. 0757-0710
	300 ohm, ± 1%	P (3336A/B only)	-hp- Part No. 0698-6982
Resistor	1K ohm, ± 1%	T	-hp- Part No.
Amplifier	Gain: 20 dB Frequency Range: .1 to 20.9 MHz Input/Output Z: 50 ohm	P	QB 300 Q-Bit Corp. P.O. Box 2208 Melbourne, Florida 32901
Adapters	BNC (f) to WECO 440A (3336B only)	V, P, A, T	-hp- Part No. 1250-0556 (2 required)
	BNC (f) to WECO 358 (3336B only)	V, P, A, T	-hp- Part No. 1250-0591 (2 required)
	BNC (f) to WECO 347 (3336B only)	V, P, A, T	-hp- Part No. 1251-3759 (2 required)
	BNC (f) to 1.6/5.6 (m) (3336A with Option 001 only)	V, P, A, T	S 230 W & G Instruments Inc. 119 Naylon Avenue Livington, NJ 07039
	BNC (f) to WECO 310 (3336B only)	V, P, A, T	-hp- Part No. 1251-3757
	BNC (f) to TRIAX (m)	P	-hp- Part No. 1250-0595
	BNC (f) to Dual Banana Plug	V, P, A, T	-hp- Part No. 1250-2277
	BNC (m) to Dual Banana Post	V, P, A, T	-hp- Part No. 1250-1264
	Dual Banana Plug (used with termination resistors)	V, P, A	-hp- Part No. 1251-2816 (4 required)
	BNC (f) to Type N (m)	P	-hp- Part No. 1250-0780 (2 required)
	BNC (m) to Type N (f)	P	-hp- Part No. 1250-0077 (2 required)
Cables	50 ohm BNC (m) to BNC (m)		
	12"	V, P, A, T	-hp- Model 11170A (2 required)
	24"	V, P, A, T	-hp- Model 11170B (2 required)
	36"	V, P, A, T	-hp- Model 11170C (2 required)
	75 ohm BNC (m) to BNC (m)		
	6"	V, P, A, T	-hp- Part No. 15582-60010 (2 required)
	36"	V, P, A, T	-hp- Part No. 15582-60020 (2 required)
	75 ohm BNC (m) to Siemens type 9 REL STP-6AC Consisting of	V, P, A, T	
	Siemens type connector (m)		-hp- Part No. 5060-4444
	BNC (m) connector		-hp- Part No. 1250-1283
	6", RG 59 coaxial cable (75 ohm)		

1-23. OPTIONS.

1-24. The following options are available for the Model 3336 Synthesizer/Level Generator;

Option 001, Special Output connectors (Model 3336A and B only)
See Paragraph 1-15

Option 004, High Stability Frequency Reference

Option 005, High Accuracy Attenuator

Option 907, Front Handle Assembly

Option 908, Rack Mount Flange Kit

Option 909, Rack Mount Flange Kit/Front Handle Assembly

Option 910, Additional Operating and Service Manual

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for installing and interfacing the Model 3336A/B/C Synthesizer/Level Generator. Included are initial inspection procedures, power and grounding requirements, line voltage selection, environmental requirements, installation instructions, HP-IB connection procedure, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. 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. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars and scratches and in perfect electrical order upon receipt. Procedures for checking electrical performance are given in Section IV. If there is mechanical damage or defect or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard Sales and Service Office listed at the end of this manual. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for the carrier's inspection. The warranty statement is located in the front of this manual.

2-5. PREPARATION FOR USE.

2-6. Power Requirements.

2-7. The Model 3336 requires a power source of 100, 120, 220, or 240 V ac, +5%, −10%, 48 to 66 Hz single phase. Power consumption is 100 VA maximum.

2-8. Line Voltage Selection.

CAUTION

Before connecting ac power to this instrument, make sure the Model 3336 is set to the line voltage of the power source. Also ensure that the common connection of the power outlet is connected to a protective earth contact.

2-9. The line voltage selection switches are set at the factory to correspond to the most commonly used line voltage of the country of destination. The serial number plate (located on the rear panel) is marked at the factory to indicate the selected line voltage. To reduce confusion, update this plate every time the line voltage switches are changed. Information necessary to change the line voltage selection is in the Power Supply Service Group of the Operating and Service Manual.

CAUTION

Make sure the correct fuse is installed for the selected line voltage!

Line Voltage	*Fuse*	*-hp- Part Number*
100/120 Vac	*1 Amp*	*2110-0001*
220/240 Vac	*½ Amp*	*2110-0012*

USE FAST BLOW TYPE FUSES ONLY! Using slow blow type fuses or fuse values other than those recommended defeats an important protection circuit and will damage the Model 3336.

2-10. Power Cable.

2-11. In accordance with international safety standards, this instrument is equipped with a three-wire cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2-1 for the connector configuration and -hp- part number of the available power cables.

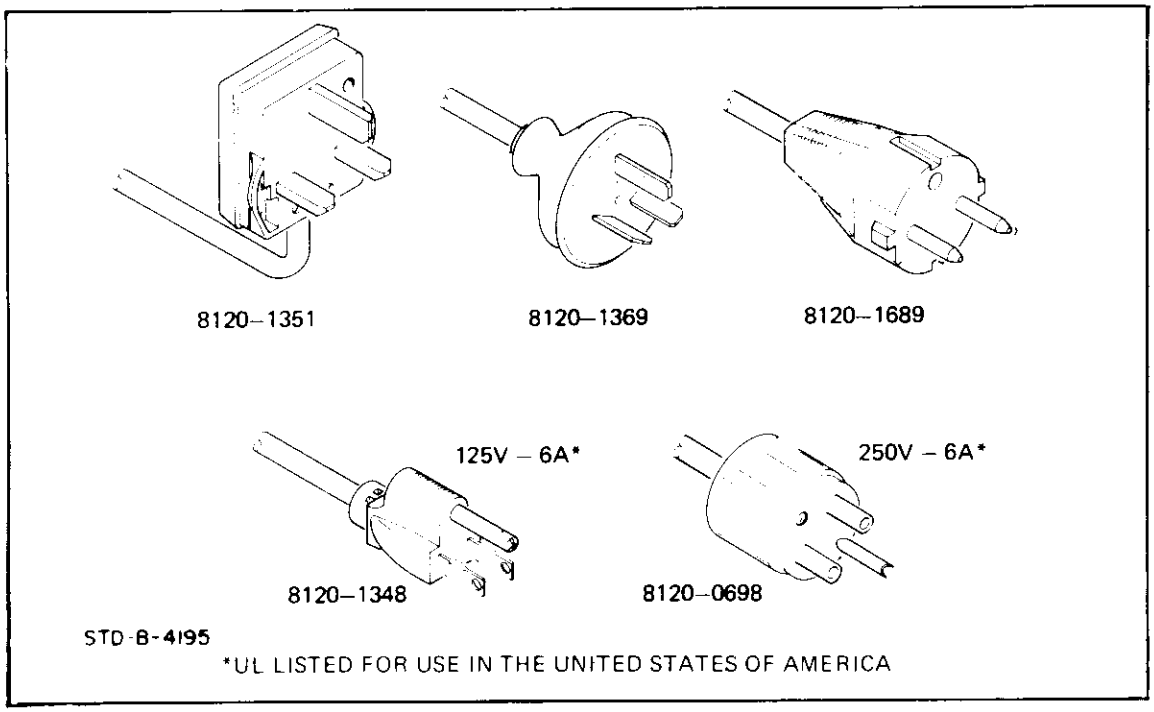


Figure 2-1. Power Cables.

2-12. HP-IB Connections.

2-13. Interconnection data concerning the rear panel HP-IB connector is provided in Figure 2-2. This connector is compatible with the -hp- 10631 (A, B, or C) HP-IB cables. The lengths of these cables are as follows:

10631A	1 meter
10631B	2 meters
10631C	4 meters

Up to 15 instruments (including the controller) may be connected in an HP-IB system. The HP-IB cables have identical stacking connectors on both ends so that several cables can be connected to a single source. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack can produce enough leverage to damage the connector mounting. Be sure that the connector screws are tightened firmly in place to keep it from working loose during use, and be sure to observe the CAUTION of Figure 2-2.

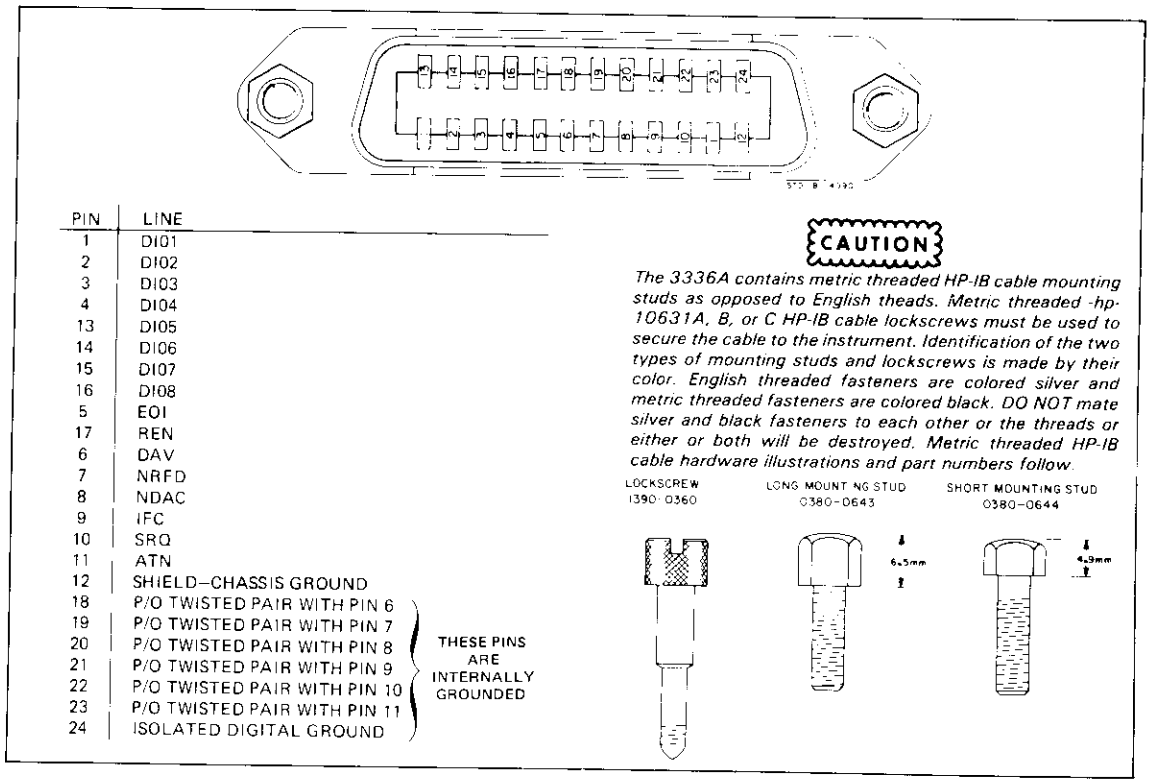


Figure 2-2. HP-IB Connector.

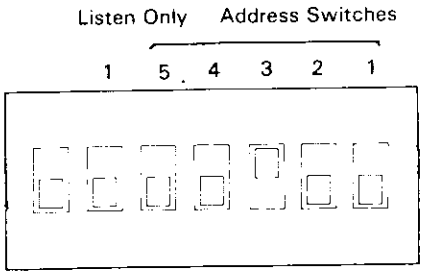
2-14. Cable Length Restrictions. System components can be interconnected in virtually any configuration. However, to achieve reliable system performance, proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly and the system will fail to perform. The maximum length of cable that can be used to connect a group of instruments must not exceed 2 meters (6.5 ft.) times the number of instruments to be connected, or 20 meters (65.6 ft.), whichever is less.

2-15. 3336 Listen/Talk Address.

2-16. The Model 3336 is normally shipped from the factory with the Device address of 4, (talk address D, listen address $). The address switches are located on the rear panel. The binary weighted HP-IB address switches 1 thru 5 set the Device address and consequenctly the Talk and Listen address. All the possible Device, Listen and Talk addresses and the HP-IB address switch positions are shown in Table 2-1. Switch 6, marked "Listen Only", disables the instruments talk capability. This is normally left in the Ø position (talk enabled). Switch 7 is not used. The instrument will display it's Device address for 1 second after pressing the Blue Shift key and then the LOCAL key.

Table 2-1. HP-IB Addresses.

ASCII Code Character		Address Switches					5-bit Decimal Code
Listen	Talk	A5	A4	A3	A2	A1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$ ← Factory Selected Address	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30



NOTE

The Equivalent Codes shown correspond only to the 5-bit binary switch code. These bits are the same for both listen and talk addresses. The sixth and seventh bits determine whether the address is listen (01) or talk (10). Some controllers distinguish between talk and listen automatically, requiring only the Device address (decimal equivalent).

2-17. HP-IB Description.

2-18. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if you are not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1975 "IEEE Standard Digital Interface for Programmable Instrumentation".

2-19. Connecting Oven Option 004.

2-20. In order to use the Oven Option 004, an external connection must be made between the rear panel 10 MHz OVEN OUTPUT and the REF IN connectors. A special connector for this purpose, -hp- Part No. 1250-1499, is supplied with instruments having Option 004.

2-21. OPERATING ENVIRONMENT.

WARNING

To prevent potential electrical or fire hazard, do not expose equipment to rain or moisture.

2-22. In order for the Model 3336 to meet the specifications listed in Table 1-1, the operating environment must be within the following limits:

Temperature	0 to +55°C
Relative Humidity	95% at 40°C
Altitude	4600 meters (15,000 feet)

2-23. Cooling System.

2-24. The cooling fan intake and the exhaust vent are located in the rear panel. When operating the instrument, provide at least 75 mm (3 inches) of clearance at the rear, and at least 7 mm (¼ inch) on all sides of the instrument. Failure to allow adequate air circulation will result in excessive internal temperature, reducing instrument reliability.

2-25. It is imperative that the fan filter be inspected frequently and cleaned or replaced as necessary to permit the free flow of air through the instrument. To clean the filter, remove the four nuts that secure the filter retainer. Remove the filter and flush with soapy water, rinse clean, and air dry.

2-26. Bench Operation.

2-27. The instrument has plastic feet attached to the bottom panel. The front feet contain foldaway tilt stands for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel. The plastic feet are shaped to make fullwidth modular instruments self-align when they are stacked. A front handle kit, -hp-Part No. 5061-0089 (Option 907), can be installed for ease of handling the instrument on the bench (see Figure 2-3). The kit is shipped with the instrument if Option 907 is ordered. Otherwise, the front handle kit is available separately by its -hp- part number.

2-30. STORAGE AND SHIPMENT.

2-31. Environment.

2-32. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature	−40%C to +75°C
Relative Humidity	95% at 40°C
Altitude	15,300 meters (50,000 feet)

2-33. Instrument Identification.

2-34. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. In any correspondence, refer to the instrument by model number and full serial number.

2-35. Packaging.

2-36. Original Packaging. If the original packaging has been retained, pack the instrument in the same manner as it was received. Be sure to seal the shipping container securely. Also, mark the container FRAGILE to assure careful handling.

2-37. Other Packaging. The following general instructions should be used for repackaging with commercially available materials.

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

b. Use a strong shipping container. A doublewall carton made of 250-pound test material is adequate.

c. Use enough shock-absorbing material (3-to-4 inch layer)around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

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

2-38. Rack Mounting.

2-39. The Model 3336 can be mounted in a rack having an EIA standard width of 482.6 mm (19 inches). The instrument can be rack mounted with or without a handle kit by use of the following items:

a. Rack mounting without handles; use Rack Mount Flange Kit -hp- Part No. 5061-0077 (Option 908).

b. Rack mounting with handles; use the combination Rack Mount Flange/Front Handle Kit -hp- Part No. 5061-0083 (Option 909).

NOTE

The Rack Mount Flange Kit (item a) will not provide the space requirement for rack mounting when used with the bench handle assembly (-hp- Part No. 5060-9899, Option 907). To rack mount with handles, the combination kit of item b (Option 909) must be used (see Figure 2-3). If either Option 908 or 909 is ordered, the corresponding kit is shipped with the instrument. Otherwise, both kits are available separately by their -hp- part numbers.

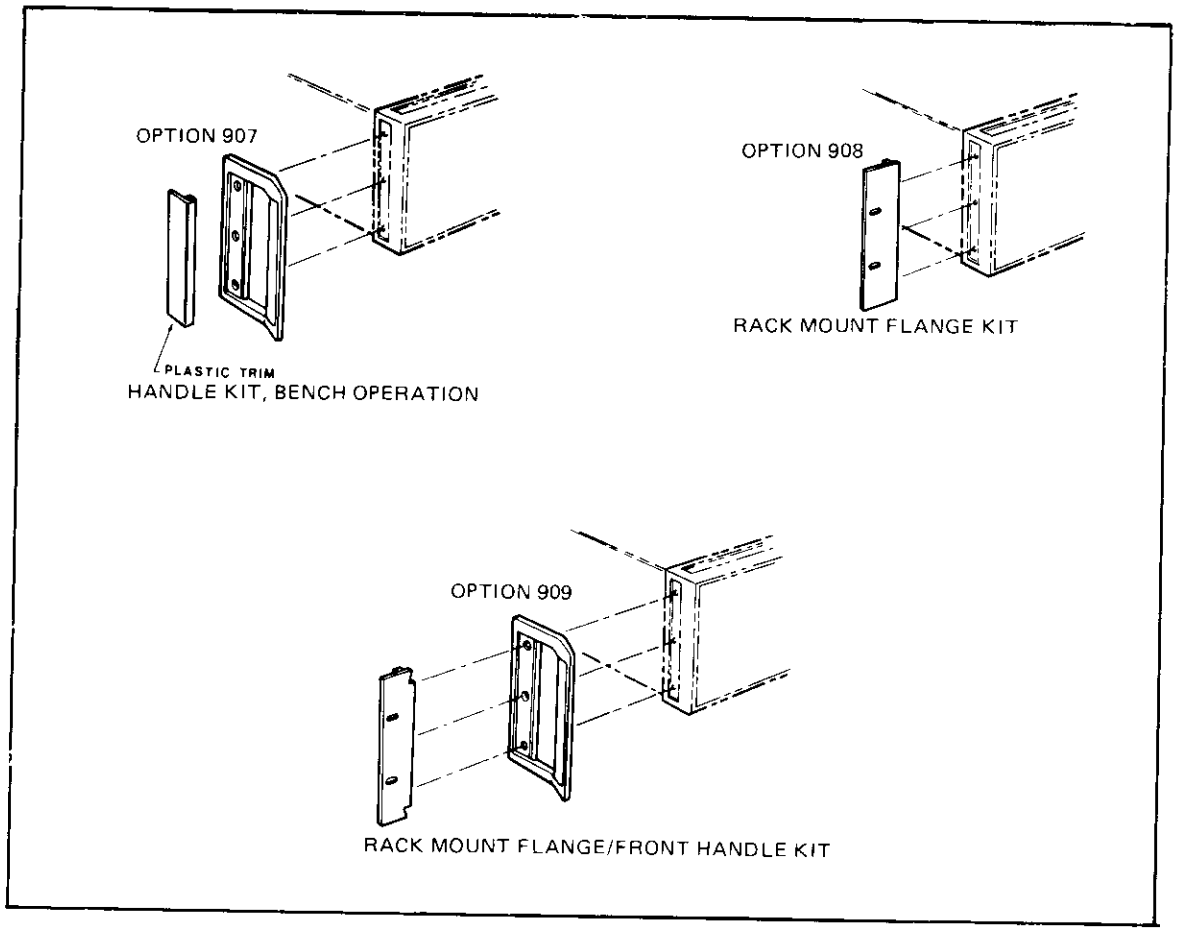


Figure 2-3. Rack Mount and Handle Kits.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section has operating and programming instructions for the -hp- Model 3336 Synthesizer/Level Generator. This section includes:

Descriptions of the controls, annunciators and input/output connectors.

Power and warm-up requirements.

Manual and remote programming instructions.

Operator verification procedures.

Operator maintenance procedures.

3-3. The Table of Contents for this section is organized by subject for quick access to specific operating information.

3-4. PANEL FEATURES.

3-5. Figure 3-1 is a picture of the instrument with a brief description of all the controls, annunciators, and input/output connectors. A paragraph number where more detailed information about each feature is located, is supplied with each caption.

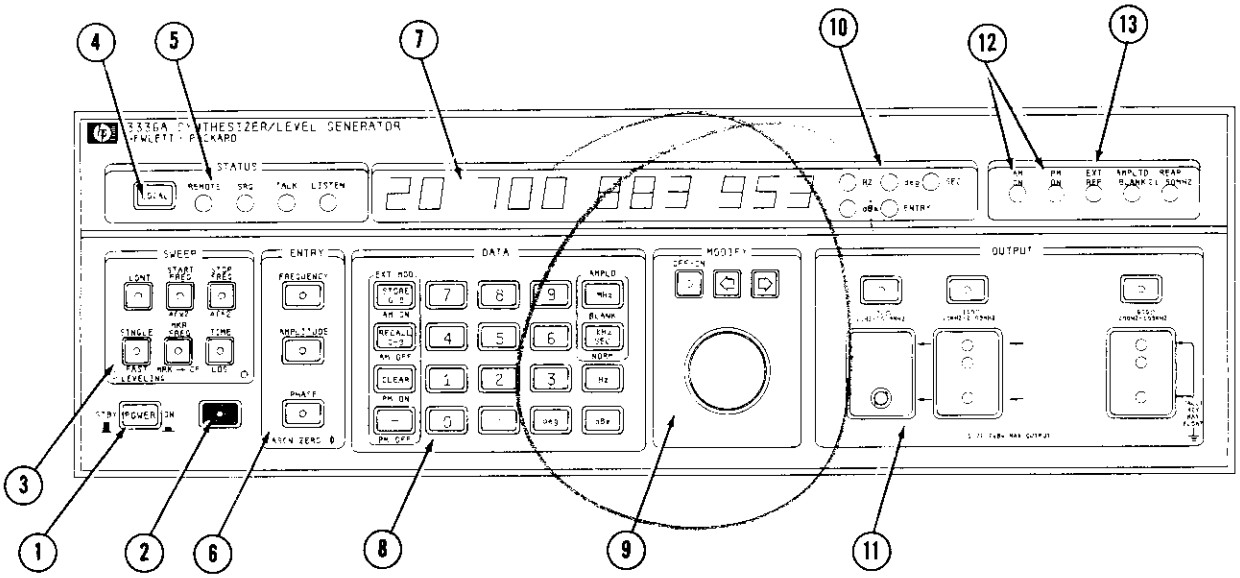
Paragraph		Page
3-4.	Panel Features	3-1
3-6.	Power Requirements	3-4
3-8.	Warm-up	3-4
3-10.	Initial (Turn-On) Conditions	3-4
3-12.	Front Panel Signal Outputs	3-4
3-20.	Sync Output	3-6
3-23.	Ext Ref Input	3-6
3-25.	10 MHz Oven Output (Option 004)	3-7
3-29.	Ref Output	3-7
3-31.	Manual Programming	3-7
3-36.	Programming Errors	3-8
3-45.	21-60 MHz Output	3-9
3-49.	Amplitude Leveling	3-9
3-55.	Amplitude Blanking	3-10
3-60.	Frequency Sweep	3-11
3-85.	Amplitude Modulation	3-15
3-90.	Phase Modulation	3-15
3-94.	Operting State Storage	3-15
3-97.	Operator Maintenance	3-16
3-103.	Remote Operation	3-16

APPENDICES

A. Detailed Implementation of Bus Messages

B. -hp- 3336A/B/C Programming Times

C. -hp- 9825A Bus Message Implementation Table



(1) POWER Switch. Applies power to the instrument in ON position. In STBY (standby), applies power to the High Stability Frequency Option (option 004), maintaining the instrument in a ready state. (Paragraph 3-6)

(2) BLUE Shift Key. Causes some keys to change to secondary functions printed in blue. The front panel "shifts" back to primary functions after the next key is pressed.

(3) SWEEP Group. Contains entry keys for entering sweep parameters, plus sweep start/stop keys. When preceded by the BLUE Shift Key, the entry keys become sweep modification keys, the TIME key selects Linear/Log sweep, and the SINGLE sweep start/stop key selects Fast/Slow internal leveling. (Sweep, Paragraph 3-60/Internal leveling, Paragraph 3-49)

(4) LOCAL Key. Switches the instrument from remote to local (front panel) control unless a Local Lockout statement was executed. When preceded by the BLUE Shift Key, displays the HP-IB address in decimal code. (Paragraph 3-114)

(5) STATUS Annunciator Group. Indicates the instrument's HP-IB status: REMOTE; Service Request (SRQ); Addressed to TALK; Addressed to LISTEN. (Remote Programming, Paragraph 3-103)

(6) ENTRY Group. Prefix keys for the major operating parameters. When one of these keys is pressed, the selected parameter is displayed and can be changed using the Modify Controls or the Number/Units Keyboard. (Paragraph 3-31) When preceded by the BLUE Shift Key, the PHASE key assigns zero degrees phase to the present output. (Paragraph 3-57)

(7) ALPHANUMERIC Display. Displays the values of the operating parameters, programming error codes, HP-IB address, and "OSC FAIL" if the internal oscillator is not operating properly. (Error Codes, Paragraph 3-36)

(8) DATA Group. Contains a Number/Units keyboard to exactly set the value of a selected parameter. (Paragraph 3-33) Also included are keys to STORE and later RECALL the operating state of the instrument. (Paragraph 3-94) When preceded by the BLUE Shift Key, the MHz units key selects the Amplitude Blanking operation mode, and the kHz/SEC key returns the instrument to normal operation mode. (Paragraph 3-54) The STORE, RECALL, CLEAR, and – keys become the Amplitude or Phase modulation ON/OFF controls. (Paragraph 3-85/90)

(9) MODIFY Group. Consists of a Modify ON/OFF Key, two Horizontal Arrow keys to move the digit to be modified left or right, and a Tuning Knob to increase or decrease the selected (flashing) digit. (Paragraph 3-35)

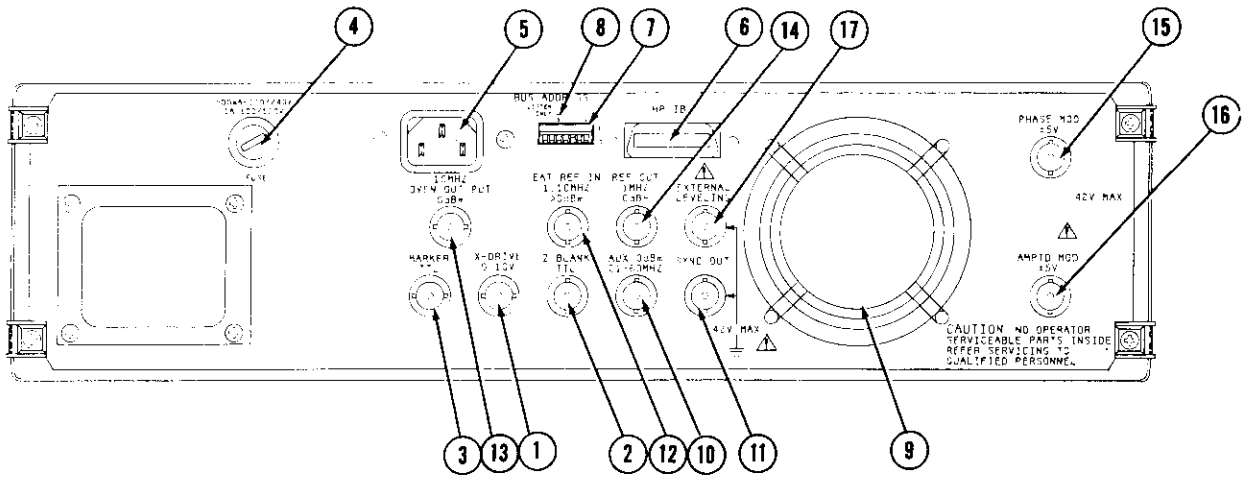
(10) UNITS Annunciators. Indicates the units of measurement of the displayed value. The ENTRY Annunciator lights when an entry is in progress.

(11) OUTPUT Group. Main Signal Outputs and Output Select Keys to activate an output port. Output Select Keys automatically deactivate all other output ports in this group.

(12) MODULATION STATUS Annunciators. Appropriate annunciator lights when Amplitude or Phase Modulation is enabled. (Paragraph 3-85/90)

(13) EXT REF Annunciator. Lit when an external frequency reference is connected to the EXT REF Input. Flashes if the instrument does not lock to the external reference. (Paragraph 3-23)

Figure 3-1. Panel Features.



(1) X DRIVE Output. Supplies a 0 V to > +10 Vdc linear ramp during frequency sweeps. Does not reset after single sweep until SINGLE key is pressed. (Paragraph 3-81)

(2) Z BLANK Output. Supplies a TTL low level during frequency sweeps, capable of sinking current from a positive source. (Paragraph 3-71)

(3) MARKER Output. Supplies a TTL high to low level transition at the programmed Marker Frequency. Only occurs during linear sweep up. (Paragraph 3-83)

(4) AC Line Fuseholder. Contains the line fuse. Use a 1 Amp fuse for 100/120 volt operation. Use a ½ Amp fuse for a 220/240 Volt operation. (Paragraph 3-99)

DO NOT USE SLOW BLOW FUSES!

(5) AC Line Input Connector. Accepts power cord supplied with the instrument.

(6) HP-IB Connector. Used to interface the instrument with the Hewlett-Packard Interface Bus (HP-IB). This connector accepts metric threaded cable lockscrews only. Metric lockscrews are black anodized. (Figure 2-3)

(7) HP-IB Address Selection Switches. Binary weighted switches that set the HP-IB (talk and listen) Address of the instrument. Preset to 14 at the factory. (Paragraph 2-15)

(8) LON Switch. When set to LON, the instrument will Listen ONLY to messages from the HP-IB. The instrument's transmit capabilities are disabled.

(9) Air Filter. Cleans air circulated through the instrument for cooling. Check and clean this filter periodically. (Paragraph 3-101)

(10) REAR 21-60 MHz OUTPUT Annunciator. Lit when the 21-60 MHz OUTPUT is activated. Output is activated by programming frequencies ≥ 21 MHz and deactivated by programming frequencies < 20 MHz. (Paragraph 3-45)

(11) SYNC Output. Supplies a TTL level square wave (into 50 ohms) to synchronize other instruments to the Main Signal Outputs. (Paragraph 3-20)

(12) EXT REF Input. Allows the instrument's internal oscillator to phase-lock to an external frequency standard. (Paragraph 3-23)

Input Level:	0 to +20 dBm (50 ohm)
Input Frequency:	within part per million of 10 MHz or a subharmonic of 10 MHz to 1 MHz

(13) 10 MHz OVEN Output. Option 004 instruments only. Output signal from a temperature stabilized crystal oscillator. Connects to the instrument with a special BNC to BNC adapter (-hp- part number 1250-1499) to the EXT REF Input. (Paragraph 3-23)

(14) 1 MHz REF Output. 1 MHz square wave derived from the instrument's reference oscillator to phase-lock the reference oscillator of another instrument to the Model 3336. (Paragraph 3-29)

(15) PHASE MOD Input. Input for phase modulating signal. (Paragraph 3-90)

(16) AMPTD MOD Input. Input for amplitude modulating signal. (Paragraph 3-85)

(17) EXT LEVEL Input. Input from an external leveling voltage source to regulate the signal amplitude at a remote point. (Paragraph 3-53)

LEAVE DISCONNECTED UNLESS EXTERNAL LEVELING

Figure 3-1. Panel Features (Cont'd).

3-6. POWER REQUIREMENTS.

3-7. The Model 3336 requires a power source of 100, 120, 220 or 240 Vac, +5% −10%, 48 to 66 Hz, single phase. Instructions to change the line voltage selection are located in the Service Section of the Operating and Service Manual. Fuse replacement is described in the Operator Maintenance chapter of this section, Paragraph 3-97.

3-8. WARM-UP.

3-9. A standard instrument (without Option 004) requires 30 minutes to warm-up. Instruments with the High Stability Frequency Reference Option (Option 004) require 30 minutes to warm-up if power has been disconnected for less than 24 hours. If an Option 004 instrument is disconnected from its power source longer than 24 hours, the warm-up period may be as long as 72 hours.

3-10. INITIAL (Turn-On) OPERATING CONDITIONS.

3-11. When the instrument is turned on, its operating state will be:

FREQUENCY ..... 10000 Hz
AMPLITUDE ..... Minimum
PHASE ..... 0.0 deg
OUTPUT PHASE RELATIONSHIP
TO FREQUENCY REFERENCE ..... Arbitrary
OUTPUT ..... 75 ohm (Models A or B) 50 ohm (Model C)
SWEEP ..... Linear
Start Frequency ..... 1 MHz
Stop Frequency ..... 10 MHz
Marker Frequency ..... 5 MHz
Sweep Time ..... 1 sec
AMPLITUDE BLANKING ..... Off
PHASE MODULATION ..... Off
AMPLITUDE MODULATION ..... Off
FAST LEVELING ..... Off

NOTE

If the instrument displays "OSC FAIL", the frequency synthesis circuits are not operating properly. Refer the instrument to qualified service personnel for repair.

3-12. FRONT PANEL SIGNAL OUTPUTS.

CAUTION

The maximum peak voltage that can be safely applied between the chassis and the outer conductor of any input or output is ± 42 volts.

3-13. The Model 3336 is manufactured as one of three models identified by the letters A, B or C following the model number. The difference between models is the configuration of the front panel outputs. The outputs on each model are:

Model	Outputs	Accepts Connector Type
3336A	75 ohm unbal	75 ohm BNC
	150 ohm bal	Siemens type 9REL STP—6AC
	600 ohm bal	Siemens type 9REL STP—6AC
3336A with Option 001	75 ohm unbal	Siemens type 1.6/5mm coaxial
	150 ohm bal	Siemens type 9REL STP—6AC
	600 ohm bal	Siemens type 9REL STP—6AC
3336B	75 ohm unbal	WECO type 439A or 440A
	124 ohm bal	WECO type 443A
	135 ohm bal	WECO type 241A
	600 ohm bal	WECO type 310
3336B with Option 001	75 ohm unbal	WECO type 358A
	124 ohm bal	WECO type 372A
	135 ohm bal	WECO type 241A
	600 ohm bal	WECO type 310
3336C	50 ohm unbal	50 ohm BNC
	75 ohm unbal	75 ohm BNC

3-14. Frequency Limits.

3-15. It is possible to enter frequencies from 10 Hz to 20.999 999 999 MHz for any front panel output. The instrument specifications, however, apply only during operation within the following frequency limits:

Output	Lower Frequency Limit	Upper Frequency Limit
50 ohm unbal	10 Hz	20.9 MHz
75 ohm unbal	10 Hz	20.9 MHz
124 ohm bal	10 kHz	10.9 MHz
135 ohm bal	10 kHz	2.09 MHz
150 ohm bal	10 kHz	2.09 MHz
600 ohm bal	200 Hz	109 kHz

3-16. Frequency Resolution.

3-17. The frequency resolution for all outputs with programmable frequencies is:

1 μHz for frequencies below 100 kHz.
1 mHz for frequencies 100 kHz and above.

3-18. Level Limits.

3-19. Every front panel output has an amplitude range of 79.99 dB with 0.01 dBm resolution. The absolute maximum and minimum amplitudes, however, differ from output to output. The upper and lower output level limits for each output are:

Output	Lower Level Limit	Upper Level Limit
50 ohm unbal	−71.23 dBm	+8.76 dBm
75 ohm unbal	−72.99 dBm	+7.00 dBm
124 ohm bal	−78.23 dBm	+1.76 dBm
135 ohm bal	−78.23 dBm	+1.76 dBm
150 ohm bal	−78.23 dBm	+1.76 dBm
600 ohm bal	−72.99 dBm	+7.00 dBm

NOTE

When changing from one output to another, expect a level change equal to the difference of the output level limits. For example, when changing from the 50 ohm to the 75 ohm output, the output level will decrease 1.76 dB. Conversely, expect the level to increase when changing back to the 50 ohm output.

3-20. SYNC OUTPUT.

3-21. This rear panel output supplies a TTL level square wave for synchronizing other instruments to the signal from any front panel output. The phase relationship between the front panel signal and the Sync signal is always constant with the transition between levels occurring at the zero-crossing of the front panel signal.

3-22. When the SYNC Output is terminated with 50 ohms, the Sync Signal levels are:

Low Level = $\leq$ +0.2 V
High Level = $\geq$ +1.2 V

NOTE

If the SYNC Output is connected to a high impedance load, the voltage levels will be approximately twice the values given. The improper termination of a 50 ohm system, however, may cause ringing at the positive and negative transitions.

3-23. EXT REF INPUT.

3-24. The Model 3336's reference oscillator may be phase locked to an external frequency standard, transferring the standard's frequency accuracy and aging rate to the Model 3336. The input signal level must be: from 0 dBm to +20 dBm (50 ohm) and the frequency must be within 10 parts per million of 10 MHz or a submultiple of 10 MHz down to 1 MHz (10 MHz, 5 MHz, 3.3333 MHz, 2.5 MHz.....1 MHz). The EXT REF annunciator will light continuously when the instrument and an external frequency reference are phase-locked together. If they are not phase-locked but a signal is present, the annunciator will flash on and off.

3-25. 10 MHz OVEN OUTPUT (Option 004).

3-26. This output is available on instruments equipped with Option 004, only. Option 004 is a temperature stabilized crystal oscillator with an aging rate specified at $\pm 5 \times 10^{-8}$ per week after 72 hours operation. Option 004 is connected to the instrument with a BNC to BNC adapter, -hp- part number 1250-1499, connecting the 10 MHz OVEN Output to the EXT REF Input. The EXT REF annunciator will be on continuously when the instrument and Option 004 (or any frequency standard) are phase-locked together. If they are not locked, but a signal is present, the annunciator will flash on and off.

3-27. To reduce the warm-up time and realize the maximum performance from an instrument equipped with Option 004, always leave the instrument connected to a power source. Power is maintained to Option 004 whenever the instrument is plugged in. The warm-up time for an instrument equipped with Option 004 is 20 minutes if power has been interrupted for less than 24 hours. If, however, power is interrupted for longer than 24 hours, it may take as long as 72 hours before Option 004 will meet its aging rate specification.

3-28. The signal at the 10 MHz OVEN Output is a 0 dBm (50 ohms) square wave and is present when the Model 3336 is connected to a power source.

3-29. REF OUT (Frequency Reference Output).

3-30. This output supplies a 1 MHz, 0 dBm (50 ohm) square wave derived from the Model 3336's frequency reference. When this signal is applied to the external reference input of a compatible instrument, the reference oscillator of both instruments will be phase-locked together.

3-31. MANUAL PROGRAMMING.

3-32. Programming the Model 3336 from the front panel can be done in two ways. The value of the operating parameter may be set exactly using the Entry keys and the Number/Units keyboard, or the value can be modified using the Tuning Knob in the Modify group.

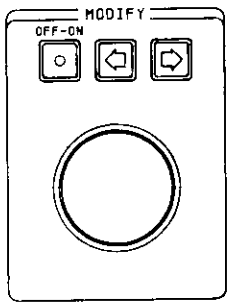
3-33. To exactly set the value of any operating parameter:

1. Press the key associated with the desired operating parameter (the light in the center of any Entry key indicates the active entry parameter).
2. Press the exact number sequence, including decimal point and minus sign, of the value to be assigned.
3. Press the appropriate Units key to execute the entry.

3-34. There are two operating rules to be aware of when modifying frequency.

1. If the last frequency entered with the Number/Units keyboard is within the specified frequency limits of the selected output, the frequency can be modified, using the Tuning control ONLY within those frequency limits.
2. Frequency can be modified from 10 Hz to 20.999 999 999 MHz if the last frequency entered with the Number/Units keyboard is outside the specified frequency limits of the selected output.

3-35. To modify the present value of any operating parameter:



1. Turn the Modify group "ON" by pressing the ON/OFF key. "ON" status is inidicated by the light in the center of this key.

2. Press one of the horizontal arrow keys to move the flashing digit to be modified one position to the left or right. This flashing digit is the least significant digit that will be modified.

3. Rotate the Tuning Knob clockwise to increase the flashing digit and counterclockwise to decrease it. This is a two speed control.

That is, if the Tuning Knob is rotated slowly, the flashing digit increases (decreases) by one. If, however, the Tuning Knob is rotated faster (> .5 rpm) the flashing digit will increase (decrease) by three.

NOTE

Attempts to enter or modify operating parameters beyond the capabilities of the instrument are ignored and result in the word ERROR followed by a number to be displayed for one second. Refer to the Error Code Messages to determined the exact nature of the programming problem.

3-36. Programming Errors.

3-37. The word "ERROR" followed by a number will be displayed for one second after a programming error occurs. Refer to the error code messages to determine the nature of the programming problem.

Error Code	Message
1	Numeric entry too large or small
2	Incorrect units assigned to parameter
4	Sweep time too long or too short
6	Sweep bandwidth too small; Start frequency greater than stop frequency (log sweep)

3-38. F. bound Err. For added flexibility, the actual programmable frequency limit of every front panel output is from 10 Hz to 20.999 999 999 MHz. However, the instrument may not meet it's stringent specifications when operated outside the frequency limits of each output. As a warning, "F. bound Err" will be displayed for 1 second after a frequency is entered that exceeds these frequency limits. These limits are printed on the front panel just below each output select key and are listed in Paragraph 3-14.

3-39. Clear Display.

3-40. The [CLEAR] key causes the display to clear to zero. This key is useful when an error is made entering numerical data. This key has no effect on existing programs.

3-41. Output Selection.

3-42. Pressing the key above any front panel output, activates that output port and deactivates all other output ports in this group. The light in the center of these keys indicates the active port. When the 21-60 MHz AUX Output on the rear panel outputs are deactivated. At this time, the light in the center of the Output Select key indicates the front panel output port to be activated if and when the 21-60 MHz AUX Output is deactivated. Any front panel output may be selected at any time.

NOTE

When changing from one output to another, expect a level change relative to the different absolute amplitude ranges of each output. (Paragraph 3-16)

3-43. Frequency Entry.

3-44. To enter frequency, press the FREQUENCY Entry key (it is not necessary to press this key if the light in its center is lit indicating that it is already the entry function). Next, enter the number sequence, most significant digit first, including decimal point of the desired frequency and finally, press the appropriate Units key (MHz, kHz, Hz). Three units keys allow the frequency to be entered in the most convenient form, however, the instrument always displays the frequency in Hz.

3-45. 21-60 MHz Aux Output.

3-46. This rear panel output is activated by entering frequencies ≥ 21 MHz and deactivated by entering frequencies below 20 MHz.

3-47. Level Entry.

3-48. Output levels are entered by pressing the AMPLITUDE Entry key followed by the – key (if needed), the exact number sequence of the desired level (most significant digit first) including decimal point and the dBm Units key.

3-49. Amplitude Leveling.

3-50. Internal Amplitude Leveling. Internal Amplitude Leveling regulates the output power ensuring accurate output levels throughout the entire frequency range of the instrument. The Model 3336 has two leveling modes, Normal and Fast, with different settling times. The settling times are nominally 250 ms for the Normal mode and 1 ms for the Fast mode. At turn-on, the instrument is in the Normal Leveling Mode and this is the operating mode that should be used unless the advantage of faster settling time is needed. One advantage of the Fast Leveling Mode is improved flatness of frequency sweeps above 10 kHz.

NOTE

Use discretion when using the Fast Leveling Mode below 10 kHz. At frequencies below 10 kHz, the Fast Leveling circuit responds to the instantaneous amplitude changes of the output signal, resulting in distortion and degraded amplitude accuracy. As a warning "F. bound Err." will be displayed when frequencies below 10 kHz are entered while in the Fast Leveling Mode.

3-51. Amplitude Leveling Mode Selection. To change from one leveling mode to the other, press the BLUE shift key followed by SINGLE . The light to the lower left of this key will be on when the instrument is in the Fast Leveling Mode. Fast Leveling Amplitude Modulation and Amplitude Blanking are mutually exclusive operating modes. That is, the instrument cannot have Fast Leveling, Amplitude Modulation or Amplitude Blanking enabled at the same time. For example, if the instrument is in the Fast Leveling Mode when Amplitude Modulation is programmed, the instrument will automatically return to the Normal Leveling Mode. Conversely, Amplitude Modulation will be automatically turned OFF when Fast Leveling is programmed.

3-52. Normal Amplitude Leveling and Amplitude Modulation. The Amplitude Leveling circuit senses an increase in output power as the percentage of modulation increases because of the presence of sideband energy. The Leveling circuit responds by reducing the signal (carrier and sidebands) until the TOTAL output power equals the amplitude setting of the instrument. This constant power regulation of the output causes what appears to be carrier compression. The ratio of the carrier to the sidebands, however, is correct.

3-53. External Amplitude Leveling. An external Amplitude Leveling input (located on the rear panel) allows regulation of the amplitude at a remote point. This input, marked EXT LEVEL, has a nominal input impedance of 1 K ohm and a + 1 V change at this input causes a + .25 dB change at the signal output.

CAUTION

Terminating or connecting the EXT LEVEL input to circuits other than an active amplitude leveling voltage source will degrade the amplitude accuracy. Leave this input disconnected unless externally leveling the instrument.

3-54. Amplitude Blanking.

3-55. When the instrument is making a frequency change, the output signal does not instantaneously change to the new frequency. The potential exists in the Normal (no blanking) operating mode, to produce unwanted energy at intermediate frequencies during a frequency change. In the Amplitude Blanking mode, the output level is automatically reduced during the frequency change, resulting in the unwanted energy becoming insignificant. Amplitude Blanking reduces the output level to less than −85 dBm during the time the instrument is changing frequencies.

3-56. To select Amplitude Blanking, press the BLUE shift key and then press [MHz] (BLANK). The AMPTD BLANK annunciator will be lit when the instrument is in the Amplitude Blanking Mode. Even though the Amplitude Blanking Mode is selected, the output signal will not be affected if the frequency is changed using the Modify Group (tuning knob). Fast Leveling and Amplitude Blanking are mutually exclusive operating modes. That is, the instrument will automatically return to Normal Leveling when Amplitude Blanking is selected and, conversely, when Fast Leveling is selected, Amplitude Blanking is removed. To return to Normal operation, press the BLUE shift key followed by [kHz SEC] (NORM).

3-57. Phase Entry.

3-58. The phase of the output signal may be shifted up to ± 719.9° with 0.1° resolution. To enter a phase shift, press the PHASE entry key, followed by the exact number sequence of the desired phase shift and then the [PHASE] units key. Press the – key before entering the number of degrees for negative phase shifts.

3-59. After entering a phase shift, the new phase may be assigned the zero phase position. Subsequent changes in phase will be referenced to this point, extending the 719.9° offset limit. To assign zero phase, press the BLUE shift key followed by the PHASE entry key.

3-60. Frequency Sweep.

3-61. The Model 3336 produces phase continuous, logarithmic or linear, single or continuous frequency sweeps over its entire frequency range. Three auxiliary outputs provide sweep related X-axis drive, Z-axis blanking and frequency marking for X, Y axis presentations of the frequency sweep. A special "ZOOM" feature can quickly position and expand a point of interest in the sweep display.

NOTE

"F. bound Err." will be displayed for 1 second after a sweep is started if either the Start or Stop frequency is outside the specified frequency limits of the output selected.

3-62. At instrument Turn-on, the sweep parameters are:

Sweep Mode	Linear
Start Frequency	1 000 000.0 Hz
Stop Frequency	10 000 000.0 Hz
Marker Frequency	5 000 000.0 Hz
Time	1.0 Sec

3-63. Single Sweep Execution.

3-64. The Single Sweep has a two step execution cycle. To begin a Single Sweep:

Press SINGLE to set the output and display to the Start Frequency and reset the X-axis drive.

Press SINGLE again, to start the sweep. The light in the center of this key will be on when the instrument is sweeping.

After a Single Sweep stops, the output and display remain at the Stop Frequency until the cycle is initiated again. The X-axis drive remains at its maximum value (+ 10.5 Vdc).

NOTE

The actual stop frequency at the end of a single sweep may be slightly higher than the programmed value.

3-65. Sweep Entry.

3-66. To exactly set any of the sweep parameters, press the appropriate sweep parameter entry key, and then enter the numerical value followed by the appropriate units key. To change from linear to log or log to linear sweep mode, press the BLUE shift key followed by TIME/LOG. The light to the lower right of this key will be on when the instrument is in the logarithmic sweep mode.

3-67. Continuous Sweep Execution.

3-68. Press CONT to start a continuous sweep. The light in the center of this key will be on when the instrument is sweeping. In the Linear Sweep Mode, the instrument will sweep from the Start Frequency to the Stop Frequency in the programmed time and then sweep back to the Start Frequency. In the Log Sweep Mode, the instrument will sweep from the Start Frequency to the Stop Frequency in the programmed time, immediately reset to the Start Frequency and continue the cycle.

NOTE

The Stop Frequency must be greater than Start Frequency when the instrument is in the Log Sweep Mode.

3-69. Log Sweep.

3-70. The Single Log Sweep is a logarithmic approximation made up of 10 linear segments per decade. The minimum log sweep width is one decade of frequency.

NOTE

The actual Stop Frequency at the end of a Single Log Sweep, will be higher than the programmed value because of computation time required by the control circuits. The actual value will always be within 0.25% of the programmed value and the error will decrease as the sweep time increases.

3-71. Sweep Time Limits.

3-72. The maximum sweep time for all sweep types and sweep modes is 99.99 sec. The sweep time resolution is 0.01 sec for sweep times ≥ 1 sec, and 0.001 sec for sweep times < 1 sec. The minimum sweep times are:

Linear Sweep
- Single.....0.01 sec
- Continuous.....0.01 sec

Log Sweep
- Single.....2.00 sec
- Continuous.....0.10 sec

NOTE

In Single Log Sweep, the sweep time is increased between segments. The time increase in seconds, is approximately equal to:

$$.045\ (10 \log \frac{\textit{Stop Frequency}}{\textit{Start Frequency}})\ \textit{seconds}$$

3-73. Sweep Bandwidth Limits.

3-74. The maximum sweep bandwidths are the specified frequency limits of each output. (See Paragraph 3-14) The minimum sweep limits are:

- Log Sweep.....1 decade
- Linear Sweep.....(.1 Hz/sec) x (sweep time)

3-75. Sweep Modification.

3-76. While the instrument is continuously sweeping, the Sweep Time, Start Frequency, Stop Frequency, Marker Frequency, Sweep Bandwidth and Output Amplitude can be modified. When a modification is entered, the sweep stops, resets to the Start Frequency and then, after a brief computation period, the sweep automatically restarts.

3-77. Sweep Bandwidth Modification. In Linear Sweep Mode, the sweep bandwidth can be doubled or halved by pressing the Blue shift key followed by Δf x 2 or Δf ÷ 2. When MKR → cf is used to set the sweep center frequency equal to the marker frequency in conjunction with these bandwidth modification keys, it is possible to "ZOOM" in on a specific point of the sweep. For example, during a continuous linear sweep from 1 MHz to 10 MHz while monitoring the Marker and the response of the swept device on an oscilloscope, an interesting response is noted at about 8 MHz. This point of interest, however, is too compressed to analyze properly. To "ZOOM" in on this point, center it in the display by (1) modifying the Marker frequency until the marker transition occurs at the same time as the point of interest and (2) pressing the Blue shift key followed by the MKR → cf. The point of interest should now be in the center of the display. (3) Expand the display by using the Blue shift key and the Δf ÷ 2 key. Repeat these steps as necessary to modify the sweep until the desired display is produced.

3-78. Sweep Marker.

3-79. Sweep Marker Output. The MRKR Output (located on the rear panel) produces a TTL high to low level transition at the programmed Marker Frequency during the linear sweep up. This signal resets to the high level at the end of sweep. The marker transition will not occur in the sweep down or Log sweep. Set the Marker Frequency by pressing 

followed by the desired frequency and finally the appropriate Units key.

3-80. The Marker Frequency can be set anywhere in the sweep band, but, if it is set within 400 microseconds of the sweep stop, the Stop Frequency will be increased until it occurs approximately 400 microseconds after the Marker. The equation to determine the approximate maximum Marker Frequencies is:

$$\text{Max Marker Freq} = \text{Stop Freq} - \frac{.0004 \times \text{Bandwidth}}{\text{Sweep Time}}$$

3-81. X-axis Drive.

3-82. The X DRIVE Output (located on the rear panel) supplies the following signals:

Single Linear Sweep: 0 V at start frequency, increasing linearly to > + 10 V dc at stop frequency. Remains at final voltage until reset prior to start of the next sweep.

Continuous Linear Sweep: Increases linearly from 0 V to > + 10 V dc during sweep up. Resets and remains at 0 V during sweep down.

Log Sweep: 0 V at start frequency, increasing to > + 10 V dc with the sweep segments.

The X DRIVE Output has a nominal voltage of + 10.5 V dc at the end of a sweep to be compatible with oscilloscopes requiring + 10.0 V for full screen horizontal deflection. At the end of Single Sweeps (no reset), the X DRIVE voltage decays toward 0 V at less than 10 mV per second.

3-83. Z-axis Blank.

3-84. The Z BLANK Output (located on the rear panel) produces TTL compatible voltage levels as follows:

Single Linear Sweep: Low level during sweep from Start to Stop Frequency. High level at all other times.

Continuous Linear Sweep: Low level during sweep up. High level during sweep down.

Single Log Sweep: Low level during sweep up. High level at all other times.

Continuous Log Sweep: Low level during sweep up. High level momentarily at end of sweep.

The Z BLANK Output low level is capable of sinking current from a positive voltage source through a pen-lift relay or other device. The Z BLANK Output ratings are:

Maximum Current	200 mA
Voltage Range	0 V to +45 V dc
Maximum Power (output voltage x current)	1 Watt

3-85. AMPLITUDE MODULATION.

3-86. Amplitude Modulation Selection.

3-87. To program Amplitude Modulation, press the BLUE shift key followed by the AM ON (STORE) key. To disable Amplitude Modulation, press the BLUE shift key followed by the AM OFF (RECALL) key. The AMPTD MOD annunciator will light when Amplitude Modulation is enabled.

3-88. When Amplitude Modulation is enabled and no modulating signal is present, the output level is the programmed level. At 100% modulation, the maximum output amplitude will be twice the programmed level.

3-89. Amptd Mod Input. (Located on the rear panel) is the modulating signal input. This input is rated:

Maximum Input Voltage	±5 V peak
Nominal Input Impedance	20 k ohm, 10 k ohm when Amplitude Modulation is OFF
Input Sensitivity	<10 V p-p for 100% modulation
Frequency Range	50 Hz to 50 kHz
Envelope Distortion	−30 dB to 80% modulation

3-90. PHASE MODULATION.

3-91. Phase Modulation Selection.

3-92. To program Phase Modulation press the BLUE shift key followed by the PM ON (CLEAR) key. The Phase Mod annunciator will light when Phase Modulation is enabled. To disable Phase Modulation, press the BLUE shift key followed by the PM OFF (−) key.

3-93. Phase Mod Input. The PHASE MOD Input (located on the rear panel) is the Phase Modulating Signal input. This input is rated:

Maximum Input Voltage	±5 V peak
Nominal Input Impedance	10 k ohm
Input Frequency Range	dc to 5 kHz
Maximum Ø Shift	± 850°
Input Sensitivity	> ± 170°/volt

3-94. OPERATING STATE STORAGE.

3-95. Up to ten entire instrument operating states (programs) may be saved for use in the future. Each instrument state is stored in a location identified by a number from 0 to 9. To

Store the current operating state, press the STORE 0-9 key followed by the number of the desired storage location. If two programs are stored in the same location, the first program is lost. To Recall an operating state, press the RECALL 0-9 key followed by the number of the location where the program is stored.

3-96. All stored information is lost when power is removed from the instrument or when the POWER switch is set to STBY. Any stored phase information is invalid because the phase of the output signal is arbitrary when recalled. The command to start a frequency sweep is not saved and therefore, either the CONT key or SINGLE key must be pressed after recalling a frequency sweep.

3-97. OPERATOR MAINTENANCE.

3-98. Maintenance performed by the operator is limited to checking and cleaning the air filter and replacing the line fuse.

3-99. Line Fuse Replacement.

3-100. To replace the line fuse (located in a fuseholder on the rear panel) disconnect the power cord and rotate the fuseholder on the rear panel) disconnect the power cord and rotate the fuseholder's slotted cap ½ turn counterclockwise. Install the new line fuse in the fuseholder and secure it by rotating the slotted cap ½ turn clockwise. Generally, if the line fuse needs replacement, a malfunction exists in the instrument and it must be referred to qualified service personnel. The correct replacement fuse is:

Line Voltage	Fuse	-hp- Part No.
100/120 V	1 Amp	2110-0001
220/240 V	½ Amp	2110-0012

WARNING

DO NOT USE SLOW BLOW FUSES

The use of SLOW BLOW fuses prevents the proper operation of an important protection circuit and may result in damage to the instrument.

3-101. Air Filter Replacement.

3-102. The Air Filter (located over the intake fan on the rear panel) should be inspected frequently and cleaned or replaced as necessary to allow a free flow of air through the instrument. To remove the filter, disconnect the instrument from power and remove the four thumbscrews from the filter retainer. Remove the filter and wash thoroughly using a mild soap, rinse clear and air dry. If the filter needs replacement, use -hp- Part No. 3150-0227.

3-103. REMOTE OPERATION.

3-104. Introduction.

3-105. The Model 3336 can be remotely operated via the Hewlett-Packard Interface Bus (HP-IB). This section describes how the Model 3336 responds to specific messages and how

to implement these messages over the HP-IB. Directions to interface the instrument with an HP-IB system are given in Section II. Since remote operation parallels manual (front panel) operation, the operator should be thoroughly familiar with the front panel operation of the instrument before attempting to operate it via the HP-IB.

3-106. The Hewlett-Packard Interface Bus. The Hewlett-Packard Interface Bus referred to as the HP-IB from now on, is a multi-wire parallel bus interconnecting up to 15 devices providing a means of communication between these devices. The ability to communicate between devices, program and coordinate instrument operation, transfer measurement data and manage the system, create new and powerful capabilities such as:

—unattended operation.

—data manipulation and storage.

—automatic generation of permanent records by using peripherals such as plotters and printers.

—the capabilities created by the coordinated operation of two or more devices.

In fact, it is not unusual to see all these capabilities used in a single application of the HP-IB.

NOTE

HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1975, "Standard Digital Interface for Programmable Instrumentation".

3-107. Beginner's Guide. The quickest and easiest way to get started with the HP-IB is to use a Beginner's Guide, if one is available, for the controller in your system. A Beginner's Guide has been prepared using the -hp- 9825A Desktop Computer at this time. The guide contains descriptions and excercises that illustrate most of the -hp- 3336 HP-IB operations and enough of the -hp- 9825A Input/Output characteristics to allow the operator to write working programs. It may take as little as 60 minutes for an inexperienced operator to complete all the exercises in the guide. The Beginner's Guide is published as a Programming Note and additional copies may be ordered from your -hp- Sales and Service Office. Order Programming Note 03336-00002, -hp- 3336/9825 HP-IB Beginner's Guide.

3-108. Quick Reference Guide. A comprehensive yet succinct description the -hp- 3336 HP-IB operation has been developed for those operators who are already experienced with the HP-IB. One important use for this guide is to include it in your system documentation. The Quick Reference Guide is published as a Programming Note and additional copies may be ordered from your -hp- Sales and Service Office. Order Programming Note 03336-00001, -hp- 3336 HP-IB Quick Reference Guide.

3-109. Special Operating Considerations. If possible, lock all instruments to a single frequency reference. This will greatly simplify the tuning subroutine in the controller's program. Use the most accurate frequency reference availalble. The -hp- 3336 aging rate is specified at less than $\pm$ 5 x 10^{-6} per year. The -hp- 3336 with Option 004 aging rate is specified at less than $\pm$ 5 x 10^{-8} per week.

3-110. HP-IB Operating Principles.

3-111. Talker. Any device that can, when addressed, send over the HP-IB is a TALKER.

The -hp- 3336 is a talker since it can send messages indicated its operating state and the values of all its programmable functions.

3-112. Listener. Any device that can, when addressed, receive over the HP-IB is a LISTENER. The -hp- 3336 is a listener since it can receive messages that program its functions. Obviously, it is possible for a device to be both a talker and a listener, though not at the same time.

3-113. Controller. The device that directs which device will talk and which device or devices will listen is the CONTROLLER. The system controller (usually a calculator or computer) is the active controller most of the time. However, it may direct another device to become the active controller. The system controller is the only device which can unconditionally assume control of the bus.

3-114. Addressing. The active controller directs which device will talk and which device or devices will listen by specifically ADDRESSING those devices. Each device has a talk address and a listen address. Therefore, when a controller addresses a device, it also specifies whether the device will talk or listen. Some controllers require a decimal equivalent of the talk and listen addresses, called the DEVICE ADDRESS. The factory presets the device address (automatically assigning talk and listen addresses) to:

Device Address	4
Talk Address	D
Listen Address	$

The device address may be changed if desired (see Section II of this manual). Actually, there is no reason to change it unless another device with the same address is added to the system.

3-115. Abridged Description of the HP-IB.

3-116. The HP-IB consists of 16 active signal lines that are used to interconnect up to 15 devices (e.g., instruments). The 16 signal lines are organized according to function. The catagories are DATA, HANDSHAKE, and GENERAL INTERFACE MANAGEMENT lines. The structure of the HP-IB is illustrated in Figure 3-2.

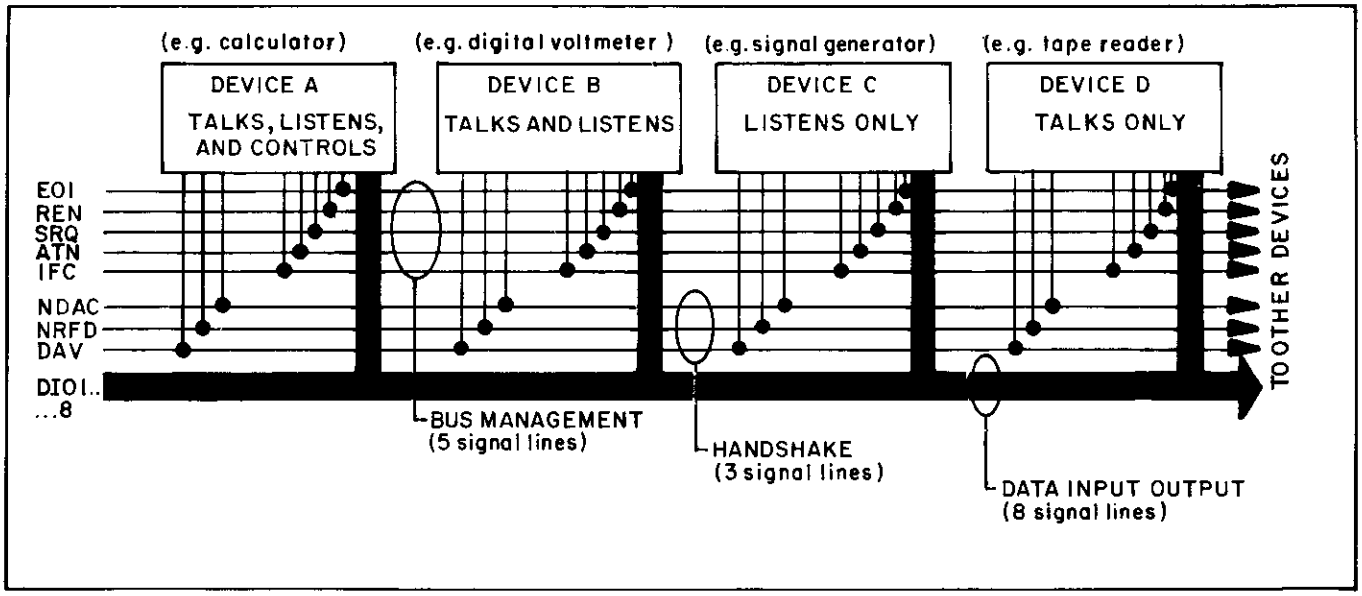


Figure 3-2. General Interface Management Lines.

3-117. Data Lines. Eight DATA lines are used to carry instrument addresses, instrument control instructions, measurement results and instruments status information in bit parallel, byte serial form. Ordinarily, a seven bit ASCII code represents each byte of DATA. The eighth bit is available for parity checking. DATA is sent over the DATA lines in both directions.

3-118. Handshake Lines (DAV, NFRD, NDAC). Data is transferred between devices using an interlocked HANDSHAKE technique. This method causes the data to be moved at a rate determined by the slowest device involved in the transfer. The HANDSHAKE lines coordinate the asynchronous data transfer by communicating the status of the transfer to the device sending the data (talker), the device receiving the data (listener) and the device controlling the transfer (controller).

3-119. General Interface Management Lines. These five lines operate independently and in conjunction to send Bus Management Message to the devices connected to the HP-IB. Each line has a precise definition that is either sent or not sent depending on the truth state of the line. The lines are defined as follows:

Attention (ATN)—When TRUE, identifies ASCII characters on the DATA lines as commands. Identifies ASCII characters on the DATA lines as data when FALSE.

Remote Enable (REN)—Places the interface bus in the REMOTE mode.

Interface Clear (IFC)—Halts all activity on the HP-IB.

Service Request (SRQ)—A device on the bus uses this line to request service from the controller.

End or Identify (EOI)—Indicates the last character of a multi-byte message. Also used with ATN (true) to indicate a parallel poll.

3-120. Producing Controller Statements for Instrument Operation.

3-121. The interface between the operator and the instrument is changed dramatically when an instrument is operated over the HP-IB. During non HP-IB operation, the operator actuates front panel controls that are labeled according to function. Often, only a single control is used to activate a function and getting the results of a measurement simply consists of reading the display! In contrast, during HP-IB operation, the operator typically faces an alpha-numeric keyboard. Neither the key functions nor their labels correspond to the instrument operation. The natural question arises:

> "What instructions must be entered on the controller to cause a particular action in the instrument?"

This sub-section explains how to answer that question.

3-122. An ideal HP-IB operating section in an instrument manual would include specific instructions such as:

> "To set the frequency of the -hp- 3336 to 19.5 MHz enter wrt 704, "FR19.5MH" on the controller.

This instruction is very specific and leaves no room for error. Unfortunately, it is not possible to supply such specific instructions because it is not possible to predict which instruments and controllers will be used together. The instrument's operating instructions, therefore, can only describe how the instrument interfaces with the HP-IB. An analogous situation exists for the controller's operating instructions. Almost all statements sent over the HP-IB to

operate an instrument, contain a portion that depends upon the individual instrument, and a portion that depends upon the controller used in the system. The operator must produce the required statement from information found parially in the controller documentation. The concept of Bus Messages, presented in the next paragraph, is a significant aid to this process.

3-123. Bus Messages. When all the bus operations are organized according to how they are physically implemented on the HP-IB, twelve unique Bus Messages are found:

	DATA
	Data Send (to -hp- 3336)
	Data Receive (from -hp- 3336)
	TRIGGER
System Management	REMOTE
	LOCAL
	LOCAL LOCKOUT
	CLEAR LOCKOUT/SET LOCAL
	CLEAR
	REQUIRE SERVICE
	STATUS BYTE
	PASS CONTROL
	ABORT
	STATUS BIT

The Data Message implements the primary purpose of the HP-IB. It is used to send the codes that activate instrument functions and transfer measurement data from one device to another. This message is subdivided into Data Send and Data Receive for operator convenience. Technically, there is no difference between Data Messages used to send and receive information. The Trigger Message causes simultaneous action in two or more devices on the bus. The action executed depends upon the design of the particular instrument. The -hp-3336 does not respond to the Trigger Message. The remaining ten Bus Messages are used to manage the system. Their only purpose is to facilitate the implementation of the Data Trigger Messages.

3-124. Implementing Bus Messages. Recall that the objective is to answer the question:

> "What instructions must be entered on the controller to cause a particular action in the instrument?"

This question is answered by converting the Bus Messages into controller statements that cause the desired action in the instrument when executed by the controller. Since these twelve messages describe every possible HP-IB operation, converting them to controller statements will enable the operator to implement every possible HP-IB operation. A procedure for converting the Bus Messages to controller statements are in the following paragraphs.

NOTE

If the controller used in your system is a -hp- 9825A, Desktop Computer, substitute the appropriate Bus Message Implementation Table in Appendix C for Table 3-1. The appropriate controller statements that implement each bus message are given in this table. If you do make this substitution, be sure to study the descriptions of the Bus Messages thoroughly. The information supplied is not restricted to that required to convert the Bus Messages.

3-125. Step One. Choose one of the Bus Messages for conversion. Begin with the System Management Messages since they are usually easier to convert to controller statements than the Trigger or Data Messages. Locate the description of the Bus Message in this manual. The description of each message contains the following information as applicable:

—the response of the -hp- 3336 to the message.

—the device dependent information required for the controller statement.

—any prerequisite operations.

—suggestions for optimizing the use of the message.

The device dependent information required for the controller statement is always found under the heading Implementation.

NOTE

1. The Require Service Message originates at the instrument rather than at the controller. Consequently, there is no controller message that implements this message. This does not diminish the importance of this message to the operator. Study it carefully in turn.

2. The Status Bit, Pass Control, Abort, and Trigger Messages can not be implemented because the -hp- 3336 does not have the capacity or the need to respond to them.

3-126. Step Two. Find the description of the selected Bus Message in the controller documentation. This description usually consists of the following information:

—one or more controller statements that implement the message.

—mnemonics for the controller statements.

—syntax of the controller statements.

—suggestions for optimizing the implementation of the message.

3-127. Step Three. Integrate the device dependent information, found in Step One, with the controller dependent information found in Step Two. The syntax of the controller statement explains how this should be done.

3-128. Step Four. Record the statements that implement each Bus Message in Table 3-1 as they are found. The operator needs to translate the Bus Messages only once. Table 3-1 can be used as a quick reference when writing programs in the future and should be included in your system documentation.

3-129. When searching for a message in the controller documentation, it is usually best to start with the Table of Contents. If the message is not referenced there, look in the Index. In order to use the twelve bus messages, the controller documentation must organize the Input/Output Operation programming statements according to the definitions of the twelve messages. It would be unusual for any manufacturer of controllers to do otherwise. The exact nomenclature, however, used to describe the Bus Messages may vary from one manufacturer to another.

NOTE

If your controller documentation does not contain a programmable statement for a particular Bus Message, the controller may not be capable of implementing the message.

Table 3-1. Bus Message Implementation Table.

			Controller	Instrument #1	Instrument #2
				hp- 3336	
	Select Code			7	
		Device		04	
	Address	Listen		$	
		Talk		D	

Bus Message	Description	Sample Implementation		
Data	Output text and variables to single devices.		yes	
	Output single characters.			
	Input data from a device.			
	Input single characters.			
	Specify addressed and send data in ASCII form.			
	Output data to multiple listeners.			
	Transfer data from device to device.			
Trigger	Send a "Group Execute Trigger" to all devices.		no	
	Send a "Group Execute Trigger" to selected devices.			
Clear	Clear all devices.		yes	
	Clear selected devices.			
Remote	Enable remote mode on all devices. Device will remote when addressed.		yes	
	Set remote on selected devices.			
Local	Return selected device to front panel control.		yes	
Local Lockout	Prevent all devices from returning to local mode.		yes	
Clear Lockout/ Set Local	Set local mode and disable local lockout on all devices.		yes	
Pass Control	Transfer bus management to another controller.		no	
Serial Poll (Status Byte)	Input the Status Byte of a selected device.		yes	
Abort I/O	Clear all bus operations and return the bus management to the system controller.		no	
Require Service	Request Service from the controller.	Normally originates from the device.	yes*	

*Controllers can send the Requires Service message, however, normally this message originates from the device. The -hp- 3336 can send this message. It will not respond to a service request from another device or controller.

3-130. System Management Messages.

3-131. The purpose of the ten System Management Messages is to control the system so that Data and Trigger messages can be sent as desired.

3-132. Remote. When it is first turned on, the -hp- 3336 is in the Local mode and under front panel control. In order to be operated over the HP-IB,it must be switched to the Remote mode. The Remote Message switches the instrument to the Remote mode. In this mode, the only operational front panel controls are the Power switch and the Local key (see Local Lockout Message, Paragraph 3-136). All other instrument functions are activated over the HP-IB through the system controller. The instrument configuration does not change when switched to Remote.

3-133. Implementation. The syntax and mnemonics for the program statement(s) that implements the Remote Message are found in the controller documentation. Only the listen address, which is $ for the -hp- 3336, must come from the instrument documentation. A technical description of the implementation of the Remote Message is presented in Figure 3-1 of Appendix B.

3-134. Local. The Local Message switches the -hp- 3336 from Remote to Local operation. The instrument is operated using front panel controls while in the Local mode. Another way to switch the instrument to the Local mode is to actuate the front panel Local control (see Local Lockout Message, Paragraph 3-136).

3-135. Implementation. The syntax and mnemonics for the program statement that implements the Local Message are found in the controller documentation. Only the listen address, which is $ for the -hp- 3336, is taken from the instrument documentation. An instrument must be addressed to listen in order for it to enter the Local mode. A technical description of the Local Message implementation is presented in Figure 3-2 of Appendix B.

3-136. Local Lockout. The Local Lockout Message disables the Local control on the front panel of the -hp- 3336. All devices on the HP-IB with Local Lockout capability will respond when this message is sent. The instrument can be switched to Local mode by executing the Local Message. Local Lockout, however, will still be in effect if the instrument is switched back to the Remote mode. To remove Local Lockout, see Paragraph 3-138, Clear Lockout/Set Local Message.

3-137. Implementation. The entire program statement that implements the Local Lockout Message is found in the controller documentation. No part of the program statement depends on the individual instrument. A technical description of the Local Lockout Message implementation is presented in Figure 3-3 of Appendix B.

3-138. Clear Lockout/Set Local. This message switches all instruments on the HP-IB to the Local mode and clears all Local Lockout conditions. Other methods to accomplish the same thing are to disconnect the HP-IB cable, turn the controller off or turn the individual instruments off.

3-139. Implementation. The entire program statement that implements the Clear Lockout/Set Local Message is found in the controller documentation. No part of the program statement depends on the individual instrument. A technical description of the Clear Lockout/Set Local Message is presented in Figure 3-4 of Appendix B.

3-140. Clear. The Clear Message resets instruments to a predefined state. The predefined state of the -hp- 3336 is its turn on state (see Paragraph 3-10), except that stored instrument states are retained. The Clear Message can be a universal instruction, resetting all devices on the bus capable of responding, or an addressed instruction sent to selected devices only.

3-141. Implementation. When the Clear Message is a universal instruction, the entire program statement is found in the controller documentation. When it is an addressed instruction, the syntax and mnemonics of the program statement are found in the controller documentation. A technical description of the Clear Message implementation is presented in Figure 3-5 of Appendix B.

NOTE

The -hp- 3336 will respond to a universal Clear Message when it is in the Local operation mode.

3-142. Require Service. The Require Service Message is a request for service which is sent from a device on the HP-IB to the active controller. Any of the following conditions in the -hp- 3336 can, when enabled, generate a Require Service Message:

—Received an unrecognizable program string.

—Sweep started.

—Sweep stopped.

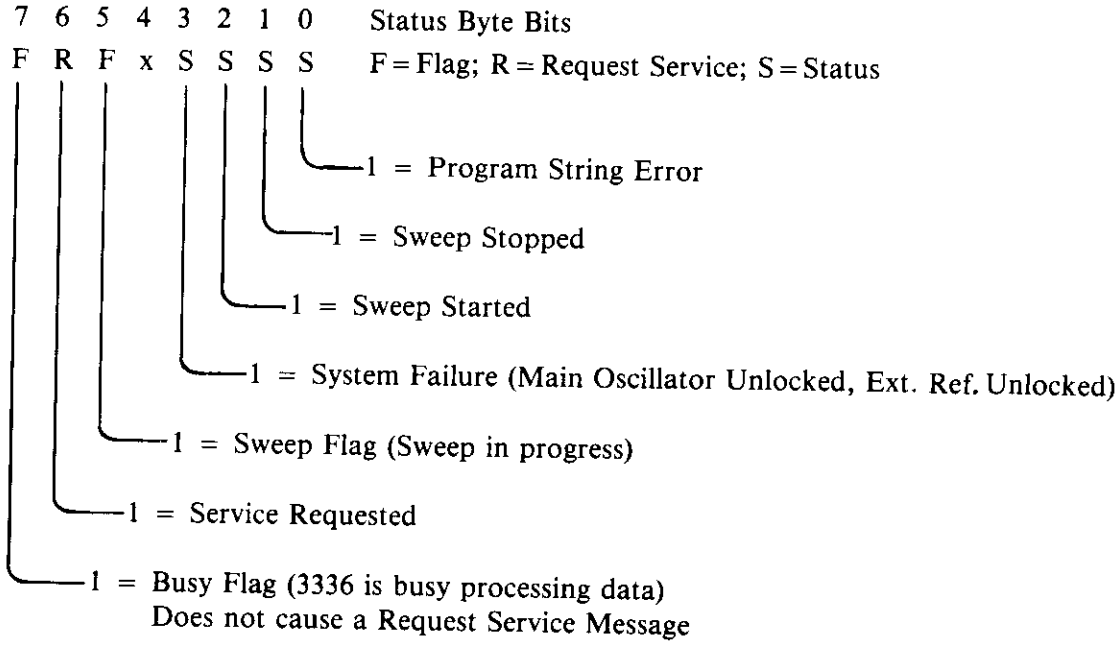
—System failure; External reference unlocked or main oscillator failure, "OSC FAIL"

All conditions that cause a Require Service Message from the -hp- 3336 are disabled (masked) at turn-on. The condition or conditions that will cause a Require Service Message are enabled using the Data Message, Paragraph 3-153. The Require Service Message is completely independent of all other bus activity. It is sent on a single line (wire) called the SRQ Line, whose state is either true or false. This line is shared by all devices on the HP-IB. If the controller is programmed to respond when a Require Service Message is received, the controller must determine which device or devices are requesting service. This is accomplished by conducting a Serial Poll. Each polled device responds by sending a Status Poll. Each polled device responds by sending a Status Byte which indicates, among other things, whether or not the device requested service. Serial Polling and Status Byte Messages are fully explained in the discussion of the Status Byte Message (see Paragraph 3-144, Status Byte). The Require Service Message will be cleared when the device sending it is polled or the condition causing it disappears. In some applications, the controller is programmed to interrupt its main program and respond to a Require Service Message immediately. In other applications, it may periodically check the status of the Service Request Line and respond when a request is discovered.

3-143. Implementation. The Require Service Message originates in the devices on the bus. A technical description of its implementation is presented in Figure 3-6 of Appendix B.

3-144. Status Byte. A Status Byte Message is sent by a device on the bus to the active controller. The individual bits of the Status Byte indicate the status of various instrument functions and whether the instrument request service. Once the Status Byte of an instrument is in the controller, the status of the instrument functions may be determined by examining the truth state of each bit. The controller can be programmed to take the appropriate action based upon the functional status of the bus instruments. For example, if bit 6 of the -hp- 3336

Status Byte is true, the -hp- 3336 request service. If bit $ is also true, the reason it requested service is because the -hp- 3336 received a program string it could not recognize or respond to. In this case, the appropriate action may be to print a message advising the operator that the -hp- 3336 received an invalid instruction. Only the instrument status associated with bits 0 thru 3 can cause service requests. See Masking Service Requests.



3-145. Status Bytes are requested by the controller by conducting a Serial Poll (see Paragraph 3-131, Serial Polling). Usually, a serial poll is conducted in response to a Require Service Message received from an instrument on the HP-IB. Occasionally, a Serial Poll is conducted even though a Require Service Message was not received. The programmer may wish to check the status of an instrument function that is encoded in the status Byte but does not generate a Service Request. There are two and up to six such functions in the -hp- 3336. Bit 0 through bit 3 of the Status Byte are maskable. That is, the corresponding conditions of each bit will not cause a Service Request unless programmed to do so. Bit 7 of the Status Byte is the Busy Flag. This bit will be true (1) when the -hp- 3336 is processing instructions and is not capable of communicating, except for the Status Byte, over the HP-IB.

3-146. Serial Polling. A Serial Poll is a routine in the program that sequentially requests the Status Byte from some or all devices on the HP-IB. The structure of the routine depends on the way the controller implements the Serial Poll and the purpose of the poll. Some controllers have a single program statement that enables a Serial Poll, polls the addressed device and then disables the Serial Poll. In this case, a Serial Poll of a system consists of several Serial Polls (one for each device). Recall that Serial Polls are sometimes conducted on a single device to learn the status of an instrument that is encoded in the Status Byte but does not generate a Service Request.

3-147. Implementation. The syntax and mnemonics for the controller statements that implement a Serial Poll are found in the controller documentation. The structure of the Serial Poll (what instruments to be polled in what order) routine is developed in accord with the total system. Only the listen addresses of the devices to be polled and the definitions of the bis in the Status Byte are taken from the instrument documentation. The listen address of the -hp- 3336 is $. A technical description of the Status Byte Message implementation is presented in Figure 3-7 of Appendix B.

3-148. Status Bit. The Status Bit Message is sent from a device on the bus to the active controller. It communicates the truth state of a predefined condition which may describe a specific instrument function or the entire instrument condition. The advantage of the Parallel Poll is that the status of up to eight devices can be checked at the same time. The -hp- 3336 does not respond to a Parallel Poll. Refer to the controller documentation or the documentation of an instrument with Parallel Poll capabilities for more information about the Status Bit.

3-149. Pass Control. The Pass Control Message transfers the management of the bus from the system controller to another device with controller capability in the system. The -hp-3336 does not have controller capability. See the controller documentation or the documentation of a device with controller capability for more information about the Pass Control Message.

3-150. Abort. The Abort Message is used by the system controller to regain control of the HP-IB from the active controller. See the system controller documentation for more information about the Abort Message.

3-151. Trigger. The Trigger Message causes a predefined response in each device receiving it. When more than one device receives the Trigger Message, the predefined response in all devices occurs simultaneously. The -hp- 3336 does not respond to the Trigger Message. See the controller documentation or the documentation of a device capable of responding for more information about the Trigger Message.

3-152. Remote Operation of the -hp- 3336.

3-153. Data. Almost every function of the -hp- 3336 can be activated remotely by sending Instrument Programming Codes over the HP-IB. The Instrument Programming Codes are sent using the Data Message.

3-154. Implementation. Usually, there are several controller statements that will implement the Data Message. Each statement will have some unique advantage. Thoroughly research this Bus Message in the controller documentation to be certain you are using the optimum statement for your application. The syntax and mnemonics for the controller statement come from the controller documentation. The instrument listen address, which is $ for the -hp- 3336, and the Instrument Programming Codes come from the instrument documentation. The Instrument Programming Codes and their format are presented in the paragraphs that follow.

3-155. Instrument Programming Codes. All of the -hp- 3336 programming codes and their binary, octal, decimal, and hexadecimal values are presented in Table 3-2. Each programming code is an instruction to the instrument. In most cases, sending these instructions corresponds to pressing front panel controls during local operation. For isntance, receiving the ASCII characters AM during remote operation has the same effect as pressing the AMPLITUDE entry key during local operation. There are exceptions to this one to one relationship. They are:

All "ON/OFF" and "FAST/SLOW" type controls have separate ASCII instructions to select each mode.

These front panel controls or operations are NOT available to the

Table 3-2. Instrument Programming Codes—Data Receive.

Instruction	ASCII Code	Binary Code	Octal Code	Decimal Code	Hexadecimal Code
Entry Parameters					
Frequency	F	01000110	106	70	46
	F	01000110	106	70	46
or	F	01000110	106	70	46
	R	01010010	122	82	52
Amplitude	A	01000001	101	65	41
	M	01001101	115	77	4D
Phase	P	01010000	120	80	50
	H	01001000	110	72	48
Sweep Start Frequency	S	01010011	123	83	53
	T	01010100	124	84	54
Sweep Stop Frequency	S	01010011	123	83	53
	P	01010000	120	80	50
Marker Frequency	M	01001101	115	77	4D
	F	01000110	106	70	46
Sweep Time	T	01010100	124	84	54
	I	01001001	111	73	49
Digits					
Ø	Ø	00110000	060	48	30
1	1	00110001	061	49	31
2	2	00110010	062	50	32
3	3	00110011	063	51	33
4	4	00110100	064	52	34
5	5	00110101	065	53	35
6	6	00110110	066	54	36
7	7	00110111	067	55	37
8	8	00111000	070	56	38
9	9	00111001	071	57	39
.	.	00101110	056	46	2E
+	+	00101011	053	43	2B
−	−	00101101	055	45	2D
Units					
Hertz	H	01001000	110	72	48
	H	01001000	110	72	48
or	H	01001000	110	72	48
	Z	01011010	132	90	9A
Kilo-Hertz	K	01001011	113	75	8B
	H	01001000	110	72	48
Mega-Hertz	M	01001101	115	77	4D
	H	01001000	110	72	48
dBm	D	01000100	104	68	44
	B	01000010	102	66	42
Degrees	D	01000100	104	68	44
	E	01000101	105	69	45
Seconds	S	01010011	123	83	53
	E	01000101	105	69	45

Table 3-2. Instrument Programming Codes—Data Receive.

Instruction	ASCII Code	Binary Code	Octal Code	Decimal Code	Hexadecimal Code
Leveling Loop Speed					
Fast	F	01000110	106	70	46
Leveling	L	01001100	114	76	4C
Off	Ø	00110000	060	48	30
Fast	F	01000110	106	70	46
Leveling	L	01001100	114	76	4C
On	1	00110001	061	49	31
Data Transfer Mode					
Mode 1	M	01001101	115	77	4D
	D	01000100	104	68	44
	1	00110001	061	49	31
Mode 2	M	01001101	115	77	4D
	D	01000100	104	68	44
	2	00110010	062	50	32
Sweep Mode					
Linear Sweep	S	01010011	123	83	53
	M	01001101	115	77	4D
	1	00110010	061	49	31
Log Sweep	S	01010011	123	83	53
	M	01001101	115	77	4D
	2	00110010	062	50	32
Assign Zero	A	01000001	101	65	41
Phase	P	01010000	120	80	50
*Start Single	S	01010011	123	83	53
Sweep	S	01010011	123	83	53
Start Continuous Sweep	S	01010011	123	83	53
	C	01000011	103	67	43
Store Program	S	01010011	123	83	53
	R	01010010	122	82	52
plus one digit (0 thru 9)					
Recall Program	R	01010010	122	82	52
	E	01000101	105	69	45
plus one digit (0 thru 9)					
Masking Service Requests	M	01001101	115	77	4D
	S	01010011	123	83	53
and one of the following	@	01000000	100	64	40
	A	01000001	101	65	41
	B	01000010	102	66	42
	C	01000011	103	67	43
	D	01000100	104	68	44
	E	01000101	105	69	45
	F	01000110	106	70	46
	G	01000111	107	71	47
	H	01001000	110	72	48
	I	01001001	111	73	49
	J	01001010	112	74	4A
	K	01001011	113	75	4B
	L	01001100	114	76	4C
	M	01001101	115	77	4D
	N	01001110	116	78	4E
	O	01001111	117	79	4F
EOS (End of String)					
Line Feed	LF	00001010	12	10	A
or Asterisk	*	00101010	52	42	2A

*Start Single code must be sent twice "SSSS". The first "SS" resets the sweep to start conditions and the second "SS" starts the sweep.

Table 3-2. Instrument Programming Codes—Data Receive (Cont'd).

Instruction	ASCII Code	Binary Code	Octal Code	Decimal Code	Hexadecimal Code
Output Selection by Model					
Model 3336A					
75 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	1	00110001	061	49	31
150 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	2	00110010	116	78	4E
600 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	3	00110011	063	51	33
Model 3336B					
75 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	1	00110001	061	49	31
124 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	2	00110010	062	50	32
135 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	3	00110011	063	51	33
600 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	4	00110100	064	52	34
Model 3336C					
50 ohm	0	01001111	117	79	4F
	I	01001001	111	73	49
	1	00110001	061	49	31
75 ohm	0	01001111	117	79	4F
	I	01001001	062	50	32
	2	00110010	062	50	32
Modulation					
Amplitude Modulation Off	M A Ø	01001101 01000001 00110000	115 101 060	77 64 48	4D 41 30
Amplitude Modulation On	M A 1	01001101 01000001 00110001	115 101 102	77 64 49	4D 41 31
Phase Modulation Off	M P Ø	01001101 01010000 00110000	115 120 060	77 80 48	4D 50 30
Phase Modulation On	M P 1	01001101 01010000 00110001	115 120 061	77 80 49	4D 50 31
Amplitude Blanking					
Amplitude Blanking Off	A B Ø	01000001 01000010 00110000	101 102 060	65 66 48	41 42 30
Amplitude Blanking On	A B 1	01000001 01000010 00110001	101 102 061	65 66 49	41 42 31

HP-IB programmer:

—Δfx2	—display BUS ADDRESS
—Δf – 2	—all controls in the Modify Group
—MRKR→CF	—CLEAR display

These HP-IB operations are NOT available from the front panel:

—Data Transfer Mode Selection
—Service Request Masking
—Interrogration of Programming Errors

3-156. Data Transfer Mode Selection. The -hp- 3336 accepts Data Messages in one of two Data Transfer Modes.

a. Data Transfer Mode 1. The -hp- 3336 is in Data Transfer Mode 1 at turn-on and while in this mode, each Instrument Programming Code is processed when received. That is, the instrument immediately performs the instruction. The -hp- 3336 can NOT receive another character until the instrument has completely performed the previous instruction. The time required to transfer data has been extended by the time -hp- 3336 takes to perform the instruction. The advantage of Mode 1 is that it is less complicated to use but as your system sophistication increases, the advantage of faster programming time makes Data Transfer Mode 2 important.

b. Data Transfer Mode 2. The -hp- 3336 accepts and stores a string of Program Instruction Codes in an interrnal buffer when it is in Data Transfer Mode 2. These codes are NOT processed until the buffer is full (48 characters) or the EOS (End of String) character is received. The advantage of Data Transfer Mode 2 is that after a string of Instructions is sent to the -hp- 3336, at the fastest rate the instrument can accept them (150-200 μsec per character), communication can take place between other devices on the bus. A "Busy" flag, encoded into bit 7 of the Status Byte, indicates when the instrument is "Busy" processing a string of Instructions. The instrument can NOT accept Data Messages during the time it is "Busy". If a string longer than 48 characters is sent, the instrument will "hold up" the bus until the first 48 characters are processed and the remaining characters are accepted. Therefore, to realize the maximum effectiveness, a program string longer than 48 characters should be divided and an EOS character sent after (or at a convenient place before) the 48th character. Data Transfer Mode 2 must be remotely programmed. The instrument will remain in Mode 2 until Mode 1 is programmed or the POWER switch is set to STBY.

3-157. Masking Service Requests. At instrument turn-on, all four SRQ conditions are masked (disabled) from generating a Request Service Message. The true states of these four conditions are encoded into the Status Byte (bits 0 thru 3). Any combination of these four

conditions can be enabled by sending one of the following Program Instruction Codes:

Instrument Programming Codes (ASCII)	System Fail Bit 3	Sweep Start Bit 2	Sweep Stop Bit 1	Program Error Bit 0
MS@	Mask	Mask	Mask	Mask
MSA	Mask	Mask	Mask	Enable
MSB	Mask	Mask	Enable	Mask
MSC	Mask	Mask	Enable	Enable
MSD	Mask	Enable	Mask	Mask
MSE	Mask	Enable	Mask	Enable
MSF	Mask	Enable	Enable	Mask
MSG	Mask	Enable	Enable	Enable
MSH	Enable	Mask	Mask	Mask
MSI	Enable	Mask	Mask	Enable
MSJ	Enable	Mask	Enable	Mask
MSK	Enable	Mask	Enable	Enable
MSL	Enable	Enable	Mask	Mask
MSM	Enable	Enable	Mask	Enable
MSN	Enable	Enable	Enable	Mask
MSO	Enable	Enable	Enable	Enable

3-158. Formats for Instrument programming Codes. The format for the programming codes is identical to the front panel (manual) operation. A unique one, two or three ASCII character programming code is sent to the instrument to activate the same functions that are activated by front panel switches in manual operation. For example, the instruction AB1 programs Ampltidue Blanking ON. While the characters comprising each programming code must be received in a certain order, the order in which the programming codes are received is not important. Sending "AB0, FL1, MP1" or "MP1, FL2, AB0" result in the activation of the same functions, Amplitude Blanking OFF, Fast Leveling ON, and Phase Modulation ON, but in reverse order. Note, the -hp- 3336 ignores commas and spaces. They are included for operator clarity.

3-159. When the -hp- 3336 is in the Local mode, certain instrument functions are set using SEVERAL front panel controls. For instance, to enter Frequency, the FREQUENCY key, the appropriate digits including the decimal point, and then the appropriate frequency UNITS key (MHz, kHz, Hz) is pressed. Obviously, the order in which the controls are actuated is important. When operating in the Remote mode, the same method is used to set the Entry Frequency except that ASCII characters are sent over the HP-IB to activate the instrument functions instead of pressing front panel controls. The ASCII character group "FR" activates the function controlled by the FREQUENCY key, ASCII digits correspond to the digit keys and the ASCII character groups "MH", "KH", "HZ" correspond to the MHz, kHz and Hz units keys. For example, to program the -hp- 3336 to output 12.534 763 MHz, the ASCII character group "FR12.534763MH" is sent. As before, the order within the character group is important, however, the character group can be placed anywhere within a larger group of instrument instructions.

3-160. Data (Receive). In addition to the information about the instrument encoded into the Status Byte (see Paragraph 3-144), the following instrument functions may be individually interrogated and the -hp- 3336 will return the value or state of the function using the Data message:

—Frequency
—Amplitude
—Phase
—Sweep Start Frequency
—Sweep Stop Frequency
—Sweep Marker Frequency
—Amplitude Blanking On/Off
—Sweep Time
—Output Impedance
—Programming Errors
—Sweep Mode (Log/Linear)
—Amplitude Modulation (On/Off)
—Phase Modulation (On/Off)
—Leveling Loop Speed (Fast/Slow)

3-161. Implementation. The interrogation of an instrument function is a two step process. That is, the instrument must be sent the Programming Code (IFR for instance) and then the instrument must be addressed to Talk. At this time the -hp- 3336 will return the data asked for. The syntax and mnemonics for the controller statements come from the controller documentation. In the first step, the instrument listen address, which is $ for the -hp- 3336, and the Instrument Programming Codes come from the instrument documentation. In the second step, only the instrument Talk address, which is D for the -hp- 3336, comes from the instrument documentation. The instrument Programming Codes and their binary, octal, decimal, and hexadecimal values are presented in Table 3-3.

NOTE

When using Data Transfer Mode 2 (see Paragraph 3-156), the Interrogate instruction must be placed at the end of the string of Programming Codes or programming errors will occur. Only one interrogating instructing may be sent in each string.

Table 3-3. Instrument Programming Codes—Data Send.

Instruction	ASCII Code	Binary Code	Octal Code	Decimal Code	Hexadecimal Code
Interrogation					
Frequency	I	01001001	111	73	49
	F	01000110	106	70	46
	R	01010010	122	82	52
or	I	01001001	111	73	49
	F	01000110	106	70	46
	F	01000110	106	70	46
Amplitude	I	01001001	111	73	49
	A	01000001	101	65	41
	M	01001101	115	77	4D
Phase	I	01001001	111	73	49
	P	01010000	120	80	50
	H	01001000	110	72	48
Sweep Start Frequency	I	01001001	111	73	49
	S	01010011	123	83	53
	T	01010100	124	84	54
Sweep Stop Frequency	I	01001001	111	73	49
	S	01010011	123	83	53
	P	01010000	120	80	50

Table 3-3. Instrument Programming Codes–Data Send (Cont'd).

Instruction	ASCII Code	Binary Code	Octal Code	Decimal Code	Hexadecimal Code
Sweep Marker Frequency	I	01001001	111	73	49
	M	01001101	115	77	4D
	F	01000110	106	70	46
Sweep Time	I	01001001	111	73	49
	T	01010100	124	84	54
	I	01001001	111	73	49
Output Impedance	I	01001001	111	73	49
	O	01001111	117	79	4F
	I	01001001	111	73	49
Sweep Type	I	01001001	111	73	49
	S	01010011	123	83	53
	M	01001101	115	77	4D
Amplitude Modulation State	I	01001001	111	73	49
	M	01001101	123	83	53
	A	01000001	101	65	41
Phase Modulation State	I	01001001	111	73	49
	M	01001101	123	83	53
	P	01010000	120	80	50
Error Codes	I	01001001	111	73	49
	E	01000101	105	69	45
	R	01010010	122	82	52
Amplitude Blanking State	I	01001001	111	73	49
	A	01000001	101	65	41
	B	01000010	102	66	42
Fast Leveling	I	01001001	111	73	49
	F	01000110	106	70	46
	L	01001100	114	76	4C
Carriage Return	CR	00001101	15	13	D
Line Feed	LF	00001010	12	10	A

3-162. Data Formats. The format of the data that is returned is illustrated in the following paragraphs. The characters that are used in the illustrations and their definitions are:

D	= ASCII digits Ø through 9
Ø	= ASCII digit Ø (zero)
.	= ASCII decimal point
–	= ASCII minus sign
CR	= ASCII carriage return
LF&EOI	= ASCII line feed concurrent with EOI message

All other characters are the actual ASCII characters used.

Spaces have been added to the illustrations for operator clarity but are not used by the instrument.

a. Frequency. After receiving "IFR" or "IFF", the -hp- 3336 will return its frequency, in Hz, formatted as follows:

FR DDDDD.DDDDDD HZ CR LF&EOI — For frequencies with more than 3 significant digits after the decimal point.

or

FR DDDDDDDD.DDD HZ CR LF&EOI — For frequencies with less than 3 significant digits after the decimal point.

b. Amplitude. After receiving "IAM", the -hp- 3336 will send its output amplitude, in dBm, formatted as follows:

AM ØØØØØØ DD.DDØ DB CR LF&EOI — A minus sign will replace the first zero if the value is less than Ø dBm.

c. Phase. After receiving "IPH", the -hp- 3336 will send its phase shift, in degrees, formatted as follows:

PH ØØØØØDDD.DØØ DE CR LF&EOI — A minus sign will replace the first zero if the phase shift is negative.

d. Sweep Start Frequency. After receiving "IST", the -hp- 3336 will send the frequency in Hz, formatted as follows:

ST DDDDD.DDDDDD HZ CR LF&EOI — For frequencies with more than 3 significant digits after the decimal point.

or

ST DDDDDDD.DDD HZ CR LF&EOI — For frequencies with 3 or less significant digits after the decimal point.

e. Sweep Stop Frequency. After receiving "ISP", the -hp- 3336 will send the frequency in Hz, formatted as follows:

SP DDDDD.DDDDDD HZ CR LF&EOI — For frequencies with more than 3 significant digits after the decimal point.

or

SP DDDDDDDD.DDD HZ CR LF&EOI — For frequencies with 3 or less significant digits after the decimal point.

f. Sweep Marker Frequency. After receiving "IMF", the -hp- 3336 will send the frequency in Hz, formatted as follows:

MF DDDDD.DDDDDD HZ CR LF&EOI — For frequencies with more than 3 significant digits after the decimal point.

or

MF DDDDDDDD.DDD HZ CR LF&EOI — For frequencies with 3 or less significant digits after the decimal point.

g. Sweep Time. After receiving "ITI", the -hp- 3336 will send the time in seconds, formatted as follows:

T1 ØØØØØØDD.DDD SE CR LF&EOI

h. Output Impedance. After receiving "IOI", the -hp- 3336 will send a digit indicating which output is active, formatted as follows:

IO D CR LF&EOI

The digit D returned varies with the instrument model.

3336A	75 ohm	D = 1
	150 ohm	D = 2
	600 ohm	D = 3

3336B	75 ohm	D = 1
	124 ohm	D = 2
	135 ohm	D = 3
	600 ohm	D = 4
3336C	50 ohm	D = 1
	75 ohm	D = 2

i. Programming Errors. After receiving "IER", the -hp- 3336 will send a digit indicating the type of programming error, formated as follows:

ER D CR LF&EOI

The digit D has the following definitions:

1 = Entry parameter data is absolutely out of bounds.

2 = Invalid units.

4 = Sweep time too small.

6 = Sweep bandwidth too small.
Start frequency too small (log sweep).
Start frequency is greater than stop frequency (log sweep).

7 = Unrecognizable program code received from HP-IB.

8 = Unrecognizable character received.

9 = Option does not exist.

0 = No error has occured since the last time errors were interrogated.

j. Sweep Mode. After receiving "ISM", the -hp- 3336 will send the digit 1 or 2 indicating the sweep mode is linear (1) or logarithmic (2) formatted as follows:

SM D CR LF&EOI

k. Amplitude Modulation. After receiving "IMA", the -hp- 3336 will send the digit Ø or 1 indicating amplitude modulation is Off (Ø) or On (1) formatted as follows:

MA D CR LF&EOI

l. Phase Modulation. After receiving "IMP", the -hp- 3336 will send the digit Ø or 1 indicating phase modulation is Off (Ø) or On (1) formatted as follows:

MP D CR LF&EOI

m. Amplitude Blanking. After receiving "IAB", the -hp- 3336 will send the digit Ø or 1 indicating amplitude blanking is Off (Ø) or On (1) formatted as follows:

AB D CR LF&EOI

n. Fast Leveling. After receiving "IFL", the -hp- 3336 will send the digit Ø or 1 indicating that fast leveling is Off (Ø) or On (1) formatted as follows:

FL D CR LF&EOI

APPENDIX A

Detailed Implementation of Bus Messages

3-A-1. Introduction.

3-A-2. This appendix contains technical descriptions of the implementation of the HP-IB messages. Included at the end are two timing diagrams describing the handshake technique. The figure that comprise this appendix are:

Message	Figure
Remote	3-A-1
Local	3-A-2
Local Lockout	3-A-3
Clear Lockout/Set Local	3-A-4
Clear	3-A-5
Data (send)	3-A-6
Data (receive)	3-A-7
Serial Poll (status byte)	3-A-8
Trigger	3-A-9
Require ervice	3-A-10
Pass Control	3-A-11
Abort I/O	3-A-12
Handshake	
Functional Diagram	3-A-13
Timing Relationship	3-A-14

3-A-3. Codes used in these figures are:

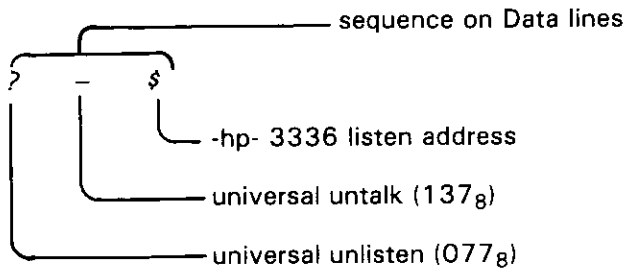
T = True
F = False
X = don't care

The characters sent or received on the Data lines are ASCII. The logic on the HP-IB is low true, floating high for false.

To enter the REMOTE mode:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



To remain in the Remote mode:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
X	X	X	T	X

Figure 3-A-1. Remote Message.

To enter the LOCAL mode:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	X

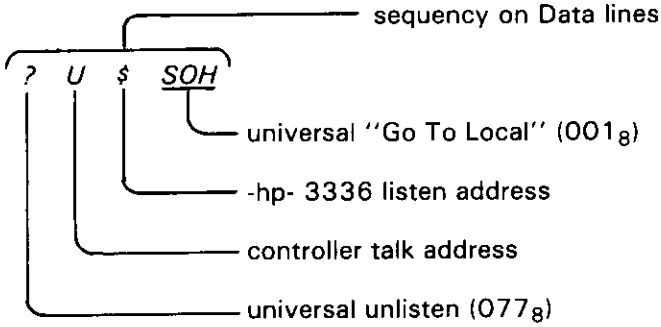
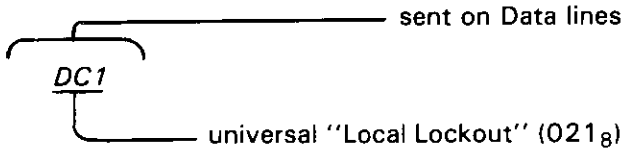


Figure 3-A-2. Local Message.

To enable LOCAL LOCKOUT:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	F



To maintain LOCAL LOCKOUT:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
X	X	X	T	X

Figure 3-A-3. Local Lockout.

To clear LOCAL LOCKOUT and SET LOCAL:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
X	X	X	F	X

Figure 3-A-4. Clear Local Lockout/Set Local.

To CLEAR all devices on the HP-IB, capable of responding:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	X	X

The -hp- 3336 will respond to this message while in LOCAL as well as REMOTE.

To CLEAR selected devices:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	X	X

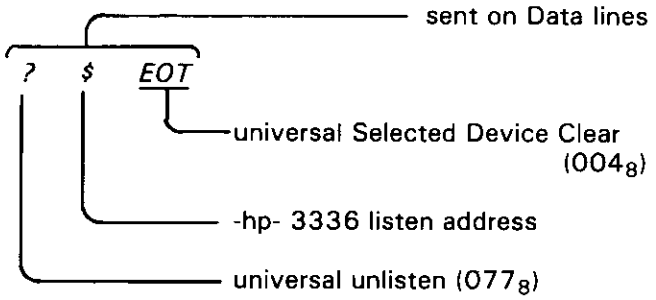
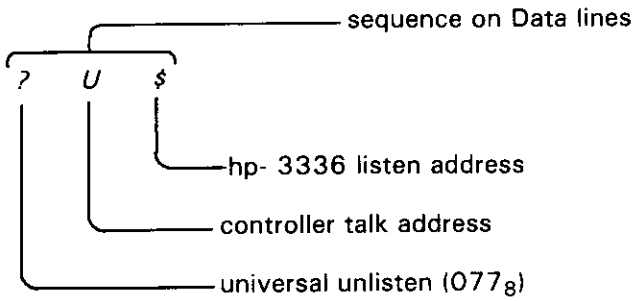


Figure 3-A-5. Clear.

To send specific programming instructions to the -hp- 3336 using the DATA message:

First:

BUS MANAGEMENT LINES				
ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



Second:

BUS MANAGEMENT LINES				
ATN	IFC	SRQ	REN	EOI
F	F	X	T	X

NOTE

The -hp- 3336 must already be in REMOTE.

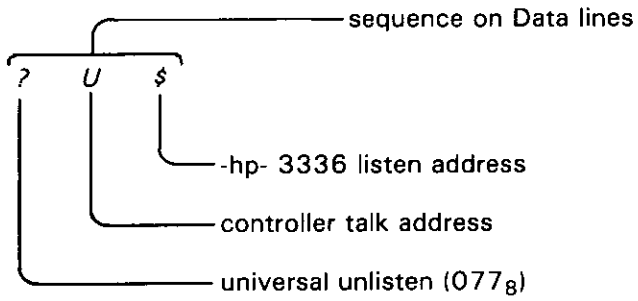
Figure 3-A-6. Data (send).

To make the -hp- 3336 return specific information about its operating state:

First:

BUS MANAGEMENT LINES

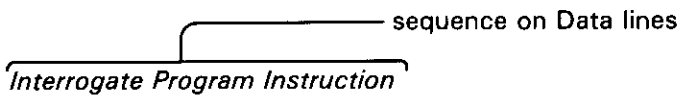
ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



Second:

BUS MANAGEMENT LINES

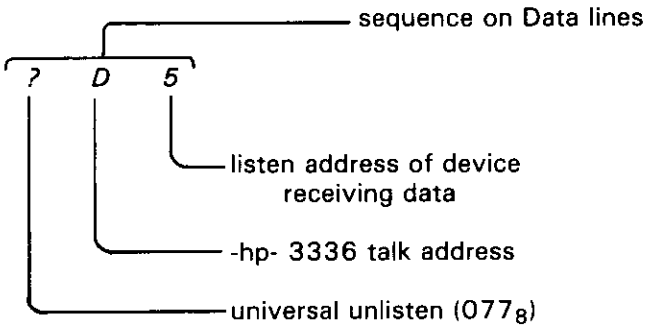
ATN	IFC	SRQ	REN	EOI
F	F	X	T	X



Third:

BUS MANAGEMENT LINES

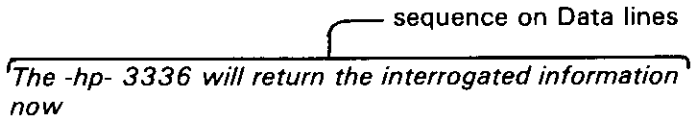
ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



Fourth:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
F	F	X	T	F*



*Bus Management Line "EOI" will be true concurrent with the last character of a multi-byte message. The sending device sets this line.

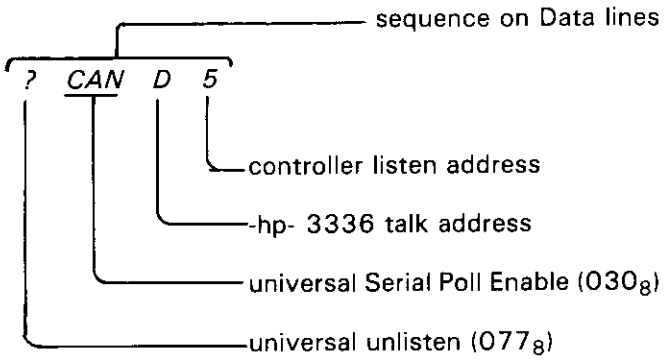
Figure 3-A-7. Data (receive).

To SERIAL POLL the -hp- 3336:

First:

BUS MANAGEMENT LINES

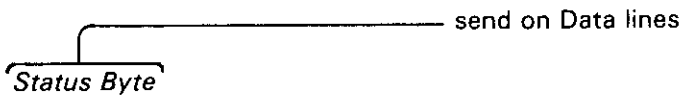
ATN	IFC	SRQ	REN	EOI
T	F	X	X	X



Second:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
F	F	X	X	F*



Third:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	X	X

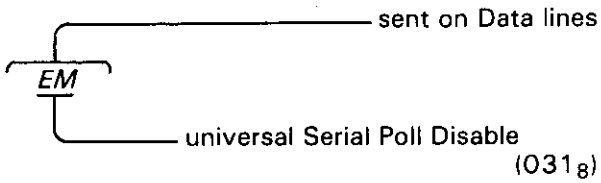
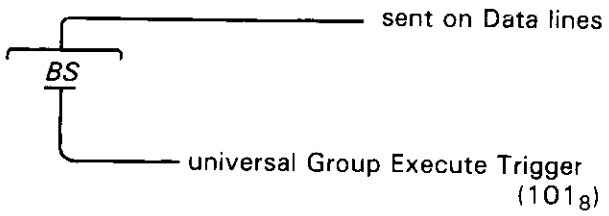


Figure 3-A-8. Serial Poll (obtaining the Status Byte).

To cause simultaneous action in all devices capable of responding:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	X

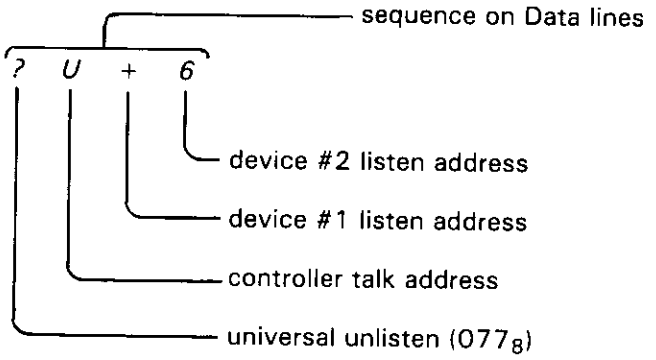


To cause simultaneous action in selected devices:

First:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



Second:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
F	F	X	T	X

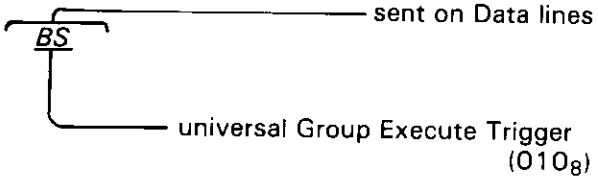


Figure 3-A-9. Trigger.

To send the REQUIRE SERVICE message:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
X	X	T	X	X

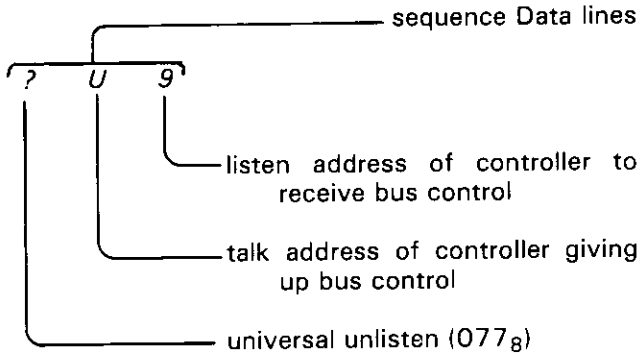
Figure 3-A-10. Require Service.

To PASS CONTROL of the HP-IB from one controller to another:

First:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
T	F	X	T	X



Second:

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
F	F	X	T	X

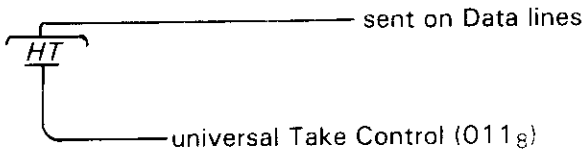


Figure 3-A-11. Pass Control.

To halt all activity and return bus control to the system controller.

BUS MANAGEMENT LINES

ATN	IFC	SRQ	REN	EOI
X	T	X	X	X

Only the system controller has this capability.

Figure 3-A-12. Abort I/O.

3-A-4. Handshake.

3-A-5. Every character on the Data Lines is asynchronously transferred among various devices using a three wire handshake technique. This technique coordinates the transfer by communicating the status of the transfer to the active controller, talker and listener. The speed of the transfer is determined by the slowest device involved in the transfer and, therefore, insures that data is not lost.

3-A-6. Figures 3-A-13 and 3-A-14 are presentations of the Handshake sequence. Handshake Lines NRFD and NDAC are controlled by the listener. The Data Lines and Handshake Line DAV are controlled by the talker.

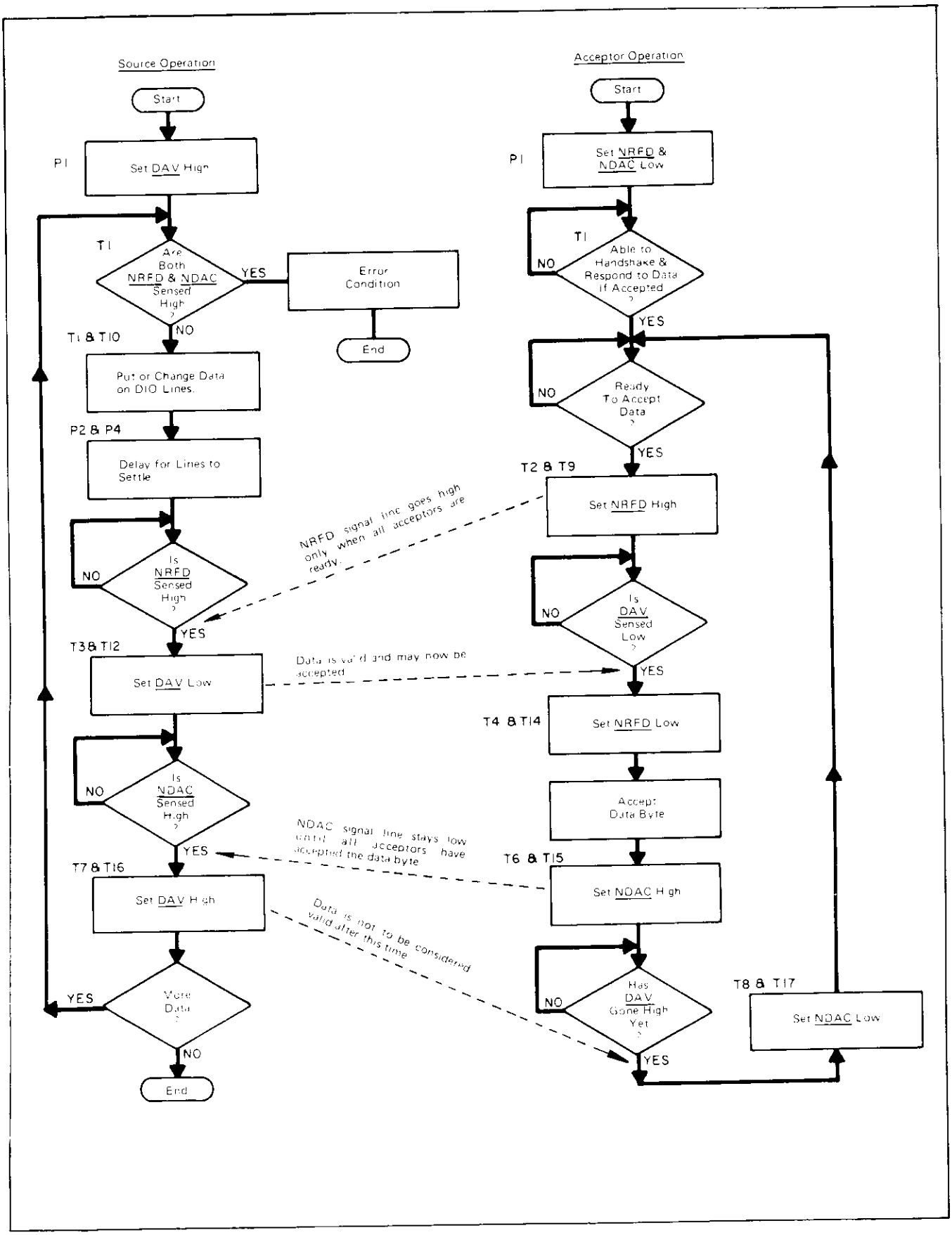


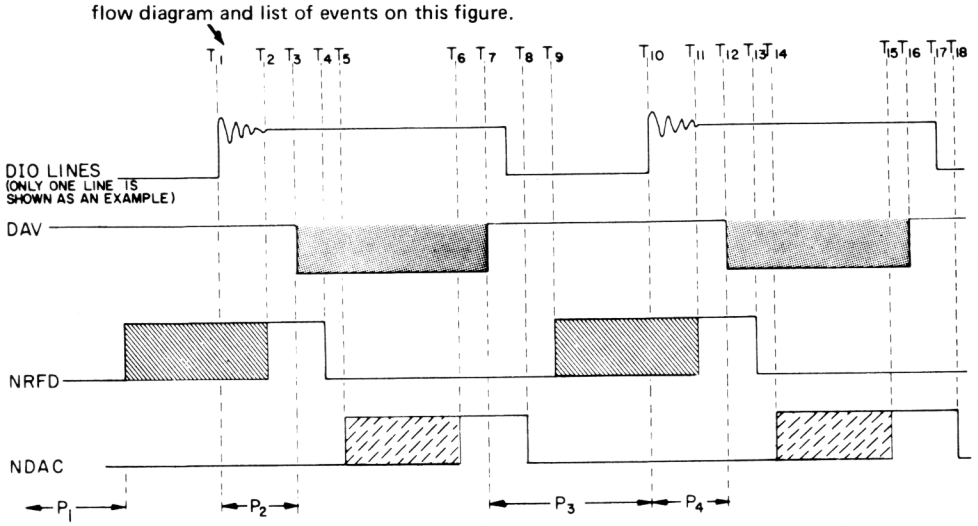
Figure 3-A-13. Handshake Functional Block Diagram.

The timing diagram illustrates the handshake process by indicating the actual waveforms on the DAV, NRFD, and NDAC lines. The NRFD and NDAC signals each represent composite waveforms resulting from two or more Listeners accepting the same data byte at slightly different times. This is usually due to variations in the transmission path length and individual instrument response rates (delays).

The flow chart represents the same sequence of events in a different form.

The subscripted letters on the flow chart and the timing diagram refer to the same event on the list of events.

HANDSHAKE line timing diagram for one talker and multiple listeners using the handshake process. Two cycles of the handshake sequence are shown. Also refer to the flow diagram and list of events on this figure.



List of Events for Handshake Process

P_1	–	Source initializes DAV to high (False - data not valid).
	–	Acceptors initialize NRFD to low (True - none are ready for data), and set NDAC to low (True - none have accepted the data).
T_1		Source checks for error condition (both NRFD and NDAC high), then places data byte on DIO lines.
P_2		Source delays to allow data to settle on DIO lines.

Figure 3-A-14. Handshake Timing Relationship.

T_2	Acceptors have all indicated readiness to accept first data byte; NRFD goes high.
T_3	When the data is settled and valid, and the source has sensed NRFD high, DAV is set low.
T_4	First acceptor sets NRFD low to indicate that it is no longer ready, then accepts the data. Other acceptors follow at their own rates.
T_5	First acceptor sets NDAC high to indicate that it has accepted the data. (NDAC remains low due to other acceptors driving NDAC low).
T_6	Last acceptor sets NDAC high to indicate that it has accepted the data; all have now accepted and NDAC goes high.
T_7	Source, having sensed that NDAC is high, sets DAV high. This indicates to the acceptors that data on the DIO lines must now be considered not valid. Upon completion of this step, one byte of data has been transferred.
P_3 (T_7–T_{10})	Source changes data on the DIO lines.
T_8 *	Acceptors, upon sensing DAV high set NDAC low in preparation for next cycle. NDAC goes low as the first acceptor sets it low.
T_9	First acceptor indicates that it is ready for the next data byte by setting NRFD high. (NRFD remains low due to other acceptors driving NRFD low).
T_{10}	Source checks for error condition (both NRFD and NDAC high), then places data byte on DIO lines (as at T_1).
P_4 (T_{10}–T_{12})	Source delays to allow data to settle on DIO lines.
T_{11}	Last acceptor indicates that it is ready for the next data byte by setting NRFD high: NRFD signal line goes high.
T_{12}	Source, upon sensing NRFD high, sets DAV low to indicate that data on DIO lines is settled and valid.
T_{13}	First acceptor sets NRFD low to indicate that it is no longer ready, then accepts the data.
T_{14}	First acceptor sets NDAC high to indicate that it has accepted the data.
T_{15}	Last acceptor sets NDAC high to indicate that it has accepted the data (as at T_6).
T_{16}	Source, having sensed that NDAC is high, sets DAV high (as at T_7).
T_{17}	Source removes data byte from DIO signal lines after setting DAV high.
T_{18} *	Acceptors, upon sensing DAV high, set NDAC low in preparation for next cycle.
*	Note that all three handshake lines return to their initialized states, as at T_1 and T_2.

Figure 3-A-14. Handshake Timing Relationship (Cont'd).

Table 3-A-1. ASCII Character Codes.

ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec	ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec	ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec	ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec
NULL	00000000	000	0	space	00100000	040	32	@	01000000	100	64		01100000	140	96
SOH	00000001	001	1	!	00100001	041	33	A	01000001	101	65	a	01100001	141	97
STX	00000010	002	2		00100010	042	34	B	01000010	102	66	b	01100010	142	98
ETX	00000011	003	3	#	00100011	043	35	C	01000011	103	67	c	01100011	143	99
EOT	00000100	004	4	$	00100100	044	36	D	01000100	104	68	d	01100100	144	100
ENQ	00000101	005	5	%	00100101	045	37	E	01000101	105	69	e	01100101	145	101
ACK	00000110	006	6	&	00100110	046	38	F	01000110	106	70	f	01100110	146	102
BELL	00000111	007	7	'	00100111	047	39	G	01000111	107	71	g	01100111	147	103
BS	00001000	010	8	(	00101000	050	40	H	01001000	110	72	h	01101000	150	104
HT	00001001	011	9	)	00101001	051	41	I	01001001	111	73	i	01101001	151	105
LF	00001010	012	10	*	00101010	052	42	J	01001010	112	74	j	01101010	152	106
VT	00001011	013	11	+	00101011	053	43	K	01001011	113	75	k	01101011	153	107
FF	00001100	014	12	,	00101100	054	44	L	01001100	114	76		01101100	154	108
CR	00001101	015	13	-	00101101	055	45	M	01001101	115	77	m	01101101	155	109
SO	00001110	016	14	.	00101110	056	46	N	01001110	116	78	n	01101110	156	110
SI	00001111	017	15	/	00101111	057	47	O	01001111	117	79	o	01101111	157	111
DLE	00010000	020	16	0	00110000	060	48	P	01010000	120	80	p	01110000	160	112
DC1	00010001	021	17	1	00110001	061	49	Q	01010001	121	81	q	01110001	161	113
DC2	00010010	022	18	2	00110010	062	50	R	01010010	122	82	r	01110010	162	114
DC3	00010011	023	19	3	00110011	063	51	S	01010011	123	83	s	01110011	163	115
DC4	00010100	024	20	4	00110100	064	52	T	01010100	124	84	t	01110100	164	116
NAK	00010101	025	21	5	00110101	065	53	U	01010101	125	85	u	01110101	165	117
SYNC	00010110	026	22	6	00110110	066	54	V	01010110	126	86	v	01110110	166	118
ETB	00010111	027	23	7	00110111	067	55	W	01010111	127	87	w	01110111	167	119
CAN	00011000	030	24	8	00111000	070	56	X	01011000	130	88	x	01111000	170	120
EM	00011001	031	25	9	00111001	071	57	Y	01011001	131	89	y	01111001	171	121
SUB	00011010	032	26	:	00111010	072	58	Z	01011010	132	90	z	01111010	172	122
ESC	00011011	033	27	;	00111011	073	59	[	01011011	133	91	{	01111011	173	123
FS	00011100	034	28	<	00111100	074	60	\	01011100	134	92	|	01111100	174	124
GS	00011101	035	29	=	00111101	075	61	]	01011101	135	93	}	01111101	175	125
RS	00011110	036	30	>	00111110	076	62	^	01011110	136	94	~	01111110	176	126
US	00011111	037	31	?	00111111	077	63	_	01011111	137	95	DEL	01111111	177	127

APPENDIX B

-hp- 3336A/B/C Programming Times

3-B-1. Approximate Programming Times.

3-B-2. The -hp- 3336 processes each programming code as it is received when in Data Transfer Mode 1. The 3336 can not receive the next program code until the previous code has been processed. Approximate times are supplied so the operator can predict program times more accurately. This ability allows the program to be executed at its fastest rate without any loss of accuracy arising from not allowing for enough settling time. In Data Transfer Mode 2, these times still apply except, the Program Codes are not processed until the EOS character is received (see Paragraph 3-156).

3-B-3. In addition to the program times, each character requires 150 to 200 μseconds to be received from the HP-IB. This is the transfer rate when Data Transfer Mode 2 is used. The processing times, however, still exist and processing starts when the EOS character is received. At this time, the controller is free to perform other function while the -hp- 3336 is processing program codes.

NOTE

These times are in addition to the settling times for frequency, amplitude and phase changes listed in Table 1-1.

Table 3-B-1. Programming Code Execution Time.

Numeric Data in Entry Parameter Strings		1.7 ms per digit
Frequency	FF,FR	6.5 ms
Delimiter	HH,HZ,KH,MH	10.9 ms
Start Frequency	ST	6.5 ms
Stop Frequency	SP	6.5 ms
Marker Frequency	MF	6.5 ms
Delimiter	HH,HZ,KH,MH	7.5 ms
Sweep Time	ST	5 ms
Delimiter	SE	5 ms
Amplitude	AM	6 ms
Delimiter	DB	165 ms
Phase	PH	5 ms
Delimiter	DE	28 ms
Output Impedance	OI	9 ms
Store (#)	SR	20 ms
Recall (#)	RE	975 ms
Assign Zero Phase	AP	10 ms
Start Single Sweep	SS	500 ms
Start Continuous Sweep	SC	500 ms
Interrogation	[I(mnemonic)]	5 ms + (mnemonic time)
Mask Service Request	MS	2 ms
Sweep Mode	SM	3 ms
Programming Mode	MD	2 ms
Amplitude Blanking	AB	2.5 ms
Fast Leveling	FL	4.5 ms

APPENDIX C

-hp- 9825A Bus Message Implementation Table

			Controller	Instrument #1	Instrument #2
			-hp- 9825A	-hp- 3336	
	Select Code		7	7	
		Device	21	04	
	Address	Listen	5	$	
		Talk	U	D	

Bus Message	Description	Sample Implementation		
Data	Output text and variables to single devices.	wrt 704,"FR20.25MH"	yes	
	Output single characters.	wtb 704,A	yes	
	Input data from a device.	red 704,A	yes	
	Input single characters.	rdb (704)→A	yes	
	Specify addressed and send data in ASCII form.	cmd 7,"?U$","FR20.25MH"	yes	
	Output data to multiple listeners.	wrt "SYN1,SYN2","AM-24.37DB"		
		cmd 7, "?U$1","AM-24.37DB"	yes	
	Transfer data from device to device.	cmd 7, "?D1"	yes	
Trigger	Send a "Group Execute Trigger" to all devices.	trg 7	no	
	Send a "Group Execute Trigger" to selected devices.	trg 711	no	
Clear	Clear all devices.	clr 7	yes	
	Clear selected devices.	clr 704	yes	
Remote	Enable remote mode on all devices. Device will remote when addressed.	rem 7	yes	
	Set remote on selected devices.	rem 704	yes	
Local	Return selected device to front panel control.	lcl 704	yes	
Local Lockout	Prevent all devices from returning to local mode.	llo 7	yes	
Clear Lockout/ Set Local	Set local mode and disable local lockout on all devices.	lcl 7	yes	
Pass Control	Transfer bus management to another controller.	pct 723	yes	
Serial Poll (Status Byte)	Input the Status Byte of a selected device.	rds (704)→A	yes	
Abort I/O	Clear all bus operations and return the bus management to the system controller.	cli 7	no	
Require Service	Request Service from the controller.	Originates from the device.	yes	

*Controllers can send the Requires Service message, however, normally this message originates from the device. The -hp- 3336 can send this message. It will not respond to a service request from another device or controller.

SECTION IV
PERFORMANCE TEST

4-1. INTRODUCTION.

4-2. This section contains in cabinet test procedures to verify that the -hp- Model 3336 is operating properly. These performance tests compare the instrument's performance to its specifications, listed in Table 4-1. In most tests, the result is a measure of the actual performance of the instrument; in other tests, the result is a pass/fail indication.

Table 4-1. Specifications.

FREQUENCY

Range:

Model 3336A:	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	150 ohm balanced	10 kHz to 2.099 999 999 MHz
	600 ohm balanced	200 Hz to 109.999 999 kHz
Model 3336B:	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	124 ohm balanced	10 kHz to 10.999 999 999 MHz
	135 ohm balanced	10 kHz to 2.099 999 999 MHz
	600 ohm balanced	200 Hz to 109.999 999 kHz
Model 3336C:	50 ohm unbalanced	10 Hz to 20.999 999 999 MHz
	75 ohm unbalanced	10 Hz to 20.999 999 999 MHz

Resolution:

1 μHz for frequencies < 100 kHz
1 mHz for frequencies ≥ 100 kHz

Aging Rate: (instruments without Option 004)

$\pm 5 \times 10^{-6}$ per year (20° to 30°C)

Warm-Up Time:

30 minutes

AMPLITUDE

Range:

Model 3336A:	75 ohm output	−72.99 to +7.00 dBm
	150 ohm output	−78.23 to +1.76 dBm
	600 ohm output	−72.99 to +7.00 dBm
Model 3336B:	75 ohm output	−72.99 to +7.00 dBm
	124 ohm output	78.23 to +1.76 dBm
	135 ohm output	−78.23 to +1.76 dBm
	600 ohm output	−72.99 to +7.00 dBm
Model 3336C:	50 ohm output	−71.23 to +8.76 dBm
	75 ohm output	−72.99 to +7.00 dBm

Absolute Accuracy: specified at 10 kHz for the 50, 75 and 600 ohm outputs; specified at 50 kHz for the 124, 135 and 150 ohm outputs, after 30 minutes warmup.

± .05 dB, for the top 9.99 dB of amplitude range (20° to 30°C)

± .08 dB, for the top 9.99 dB of amplitude range (0° to 55°C)

Table 4-1. Specifications (Cont'd)

Flatness: referenced to amplitudes at 10 kHz for the 50, 75 and 600 ohm outputs; referenced to amplitudes at 50 kHz for the 124, 135 and 150 ohm outputs.

	10Hz	200	10K	50K	109K	2.09M	10.9M	20.9MHz
Model 3336A								
75 ohm output	± .1 dB (± .07 dB with Option 005)							
150 ohm output			± .12 dB					
600 ohm output			± .25 dB					
Model 3336B								
75 ohm output	± .1 dB (± .07 dB with Option 005)							
124 ohm output		± .15dB		± .1 dB				
135 ohm output			± .12 dB					
600 ohm output			± .25 dB					

	10Hz	20.9 MHz
Model 3336C		
50 and 75 ohm outputs	± .1 dB (± .07 dB with Option 005)	

Attenuator Accuracy: (instruments without Option 005)

Attenuation	10Hz	1 M	10M	20.9MHz
10 to 19.99 dB	± .1 dB	± .15 dB	± .2 dB	
20 to 39.99 dB	± .15 dB	± .2 dB	± .25 dB	
40 to 79.99 dB	± .2 dB	± .25 dB	± .3 dB	

NOTE

Amplitude Accuracy is the sum of Absolute Accuracy and, as needed, Flatness and Attenuator Accuracy.

Warm-Up Time:

30 minutes

MAIN SIGNAL OUTPUTS

On Carrier Return Loss:

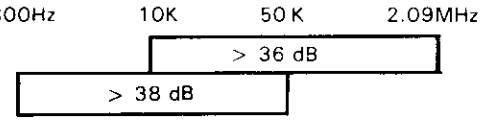
	10Hz	10K	30K	2.09M	10.9M	2.09MHz
Model 3336A						
75 ohm output	> 30 dB					
150 ohm output	> 20 dB		> 30 dB			
Model 3336B						
75 ohm output	> 30 dB					
124 ohm output	> 20 dB		> 30 dB			
135 ohm output	> 20 dB		> 30 dB			
Model 3336C						
50 ohm output	> 30 dB				> 25 dB*	
75 ohm output	> 30 dB					

*Return Loss of 50 ohm output is > 30 dB to 20.9 MHz with Option 005.

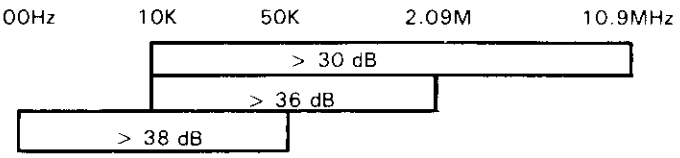
Table 4-1. Specifications (Cont'd)

Balance:

Model 3336A



Model 3336B



SPECTRAL PURITY

Integrated Phase Noise:

Model 3336A and 3336B

< - 72 dB, for a 3 kHz band, centered 2 kHz either side of a 20 MHz carrier.

Model 3336C

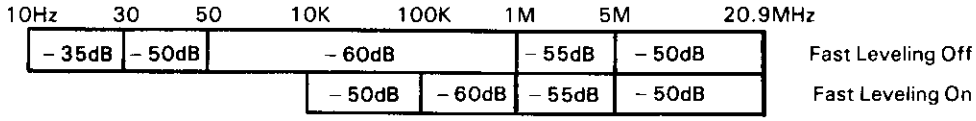
< - 64 dB, for a 30 kHz band, centered on a 20 MHz carrier, excluding 1 Hz about the carrier.

Phase Jitter:

.3° peak to peak maximum, measured per Bell System Technical Reference PUB 41009, "Transmission Parameters Affecting Voiceband Data Transmission-Measuring Techniques May 1975" and per CCITT Orange Book, Volume IV.2 "Specifications of Measuring Equipment".

HARMONIC DISTORTION

No harmonically related signal will exceed these values with respect to the carrier:



Spurious: (dc to 200 MHz except where noted)

All non-harmonically related signals from dc to 200 MHz will be more than 70 dB below the carrier or less than one of the following levels, whichever is greater.

Model 3336A	without Option 005	with Option 005
75 ohm output	– 100 dBm	– 115 dBm
150 ohm output	– 100 dBm (to 10 MHz)	– 100 dBm (to 10 MHz)
600 ohm output*	– 100 dBm (to 10 MHz)	– 100 dBm (to 10 MHz)

Model 3336B	without Option 005	with Option 005
75 ohm output	– 100 dBm	– 115 dBm
124 ohm output	– 100 dBm	– 115 dBm
135 ohm output	– 100 dBm	– 115 dBm
600 ohm output*	– 100 dBm	– 115 dBm

Model 3336C	without Option 005	with Option 005
50 ohm output	– 100 dBm	– 115 dBm
75 ohm output	– 100 dBm	– 115 dBm

*Line related signals from the 600 ohm outputs will be more than 70 dB below the carrier or – 83 dBm whichever is greater.

Amplitude Blanking:

Maximum signal output during amplitude blanking: < – 85 dBm

Impulse Level in adjacent channels caused by amplitude blanking: > 22 dBm 0

Table 4-1. Specifications (Cont'd)

PHASE OFFSET

Range:

± 719.9° with respect to arbitrary starting phase or assigned zero phase.

Resolution: 0.1°

Increment Accuracy: ± 0.2°

Ambient Stability: ± 1 degree of phase per degree C.

FREQUENCY SWEEP

Sweep Flatness:

± .15 dB, Normal Leveling, 50 Hz to 1 MHz, .5s Sweep Time.

± .15 dB, Fast Leveling, 10 kHz to 20 MHz, .03s Sweep Time.

Sweep Time

Linear Sweep: .01 sec to 99.99 sec

Single Log Sweep: 2 sec to 99.99 sec

Continuous Log Sweep: .1 sec to 99.99 sec

Minimum Sweep Width

Log Sweep: 1 decade

Linear Sweep: Minimum Bandwidth (Hz) = .1(Hz/sec) x Sweep Time (sec)

Phase Continuity:

Sweep is phase continuous over the full frequency range

AMPLITUDE MODULATION

Modulation Depth: 0 to 100 %

Modulation Frequency Range: 50 Hz to 50 kHz

Envelope Distortion: < −30 dBc to 80% modulation

Input Impedance: >20 k Ω

PHASE MODULATION

Range: 0 to ± 850°

Linearity: < ± .5% of peak to peak deviation from best fit straight line.

Modulation Frequency Range: dc to 5 kHz

Input Sensitivity: ± 5 V peak for ≈ 850° phase shift (≈ 170°/volt)

Input Impedance: >20 k Ω

HP-IB CONTROL

Frequency Switching Time: (Time to settle to within 1 Hz to final value, exclusive of programming and processing time)

< 10 ms for 100 kHz step

< 25 ms for 1 MHz step

< 70 ms for 20 MHz step

Phase Switching Time: (to within 90° of phase lock, exclusive of programming and processing time)

< 15 ms

Amplitude Switching Time: (to within .1 dB of final value, exclusive of programming and processing time)

< 500 ms

Table 4-1. Specifications (Cont'd)

AUXILIARY OUTPUTS

AUX 0 dBm:
Frequency range is from 21 MHz to 60.999 999 999 MHz (underrange to 20.000 000 001 MHz). Amplitude is 0 dBm (50 ohm).

SYNC OUT:
Square wave with $V_{high} \geq 1.2$ V, $V_{low} \leq 0.2$ V into 50 ohms, to synchronize other instruments to the Main Signal Outputs. Level transition occurs at Main Signal Output zero crossing.

REF OUT:
0 dBm (50 ohm), 1 MHz signal for phase-locking additional instruments to the Model 3336.

10 MHz OVEN OUT:
Instruments with Option 004, only. 0 dBm (50 ohm), 10 MHz signal from a temperature stabilized, crystal oscillator for phase-locking the Model 3336 or other instruments.

X DRIVE:
0 to > + 10 Vdc linear ramp proportional to the sweep frequency. Linearity, ± 1% of final value, 10% to 90%, best fit straight line.

Z BLANK:
Sweep related TTL compatible voltage levels. Low level is capable of sinking current from a positive voltage source.

Maximum Current = 200 mA
Maximum Voltage = + 45 Vdc
Maximum Power Dissipation = 1 W (V x A)

MARKER:
TTL compatible high to low level transition at the programmed Marker Frequency.

AUXILIARY INPUTS

EXT REF IN:
For phase-locking the 3336A/B/C to an external frequency reference. Signal from 0 dBm to + 20 dBm (50 ohm) Signal frequency must be within 1×10^{-6} of a sub-harmonic of 10 MHz from 1 MHz to 10 MHz.

AMPTD MOD:
Amplitude modulation input (see AMPLITUDE MODULATION specifications)

PHASE MOD:
Phase modulation input (see PHASE MODULATION specifications)

EXTERNAL LEVELING:
Input from an External Leveling voltage source to regulate the signal amplitude at a remote point. Input Sensitivity: 1 dB/Volt, ±.25 dB

OPTION 004, HIGH STABILITY FREQUENCY REFERENCE

Aging Rate:
± 5×10^{-8} per week after 72 hours continuous operation.
± 1×10^{-7} per month after 15 days continuous operation.

Ambient Stability:
± 5×10^{-8} maximum, 0° to 55°C

Warm-Up Time:
Reference frequency will be within 1×10^{-7} of the turn-off frequency, 20 minutes after turn-on, for an off time less than 24 hours.

OPTION 005, HIGH ACCURACY ATTENUATOR

Attenuation	10Hz 20 MHz
10 to 19.99 dB	+ .035 dB
20 to 39.99 dB	± .06 dB
40 to 79.99 dB	± .1 dB

Table 4-1. Specifications (Cont'd)

GENERAL

Operating Environment:

Temperature: 0° to 55°C

Relative Humidity: ≤85%, 0° to 40°C

Altitude: < 15,000 ft. (< 4600 meters)

Storage Environment:

Temperature: −50° to +65°C

Altitude: < 50,000 ft. (<15,000 meters)

Power Requirements:

100/120, 220/240 V, +5%, −10%, 48 to 66 Hz, 60 VA (100 VA with all options), 10 VA standby.

Size: 132.6 mm (5 1/4 in) high x 425.5 mm (16-3/4) wide x 497.8 (19-5/8) deep

Weight: 10 kg (22 lbs.) net, 15.5 kg (34 lbs.) shipping

4-3. RECOMMENDED EQUIPMENT.

4-4. Each performance test lists the recommended equipment to complete that test. A complete list of the equipment used to perform all the tests is provided in Table 4-2. Substitute equipment may be used only if it meets or exceeds the critical specifications listed in the table. For this reason, some of the test procedures contain discussions of measurement techniques.

4-5. OPERATOR VERIFICATION.

4-6. A special sub-set of the Performance Tests, called the Operator Verification, is recommended for:

a. Incoming inspection.

b. General after-repair inspection.

c. Instilling high confidence about the instruments operation when time and equipment resources are limited.

After repair, there may be one or more Performance Tests, not in this list, that will verify that the repair is complete. These should also be performed. In some cases, these additional tests are recommended in Section VIII.

4-7. The recommended Performance Tests that comprise the Operator Verification are:

Test	Paragraph No.
Frequency Accuracy	4-12
Absolute Amplitude Accuracy	4-14
Amplitude Flatness (75 ohm output only)	4-16
Harmonic Distortion	4-27
Spurious Response	4-29

Table 4-2. Recommended Test Equipment

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
		V = Oper. Ver. P = Performance Test T = Troubleshooting A = Adjustments	
Electronic Counter	Frequency Measurements Range: to 20.9 MHz Resolution: 8 digits Accuracy: ±1 part/10^9 Time Interval Average Resolution: .1 ns	V, P, A	-hp- Model 5328A with Options 010 and 040 or 041
Digital Voltmeter	dc Function Ranges: .1V, 1V, 10V, 100V Accuracy: ± .2% Resolution: 4½ digits ac Function Ranges: 1V, 10V, 100V Accuracy: ± .5% Resolution: 4 digits	T	-hp- Model 3466A or -hp- Model 3455A w/Option 001
	dc function Ranges: .1V, 1V, 10V, 100V Accuracy: ± .05% Resolution: 6 digits ac Function Ranges: 1V, 10V, 100V Accuracy: ± .15% at 10 and 50 kHz Resolution: 5 digits	V, P, A	-hp- Model 3455A with Option 001 (Average Responding Converter) or -hp- Model 3490A
Wave Analyzer	Frequency Range: 15 Hz to 50 kHz Amplitude Accuracy: ± .5 dB Spurious Response: ≤ −80dBc Y-Axis output	V, P, A	-hp- Model 3581A or 3581C
Synthesizer	Frequency Range: 200 Hz to 20.9 MHz Amplitude Range: −60 to +13 dBm Phase Noise: ≤ 70 dBc @ 20MHz Spurious: ≤ −75 dBc	P	-hp- Model 3335A (-hp- Model 3325A is acceptable except for Phase Noise and Spurious Performance Tests)
Unbalanced Directional Couplers	50 ohm Frequency Range: .1 to 20.9 MHz Directivity: ≥ 40 dB	P (3336C only)	-hp- Model 8721A*
	75 ohm Frequency Range: .1 to 20.9 MHz Directivity: ≥ 40 dB	P (all models)	-hp- Model 8721A* with Option 008

*Unbalanced Directional Couplers are also part of Transmission/Reflection kits:

50 Ω Transmission/Reflection Kit -hp- Model 11652A
75 Ω Transmission/Reflection Kit -hp- Model 11652A with Option 008

Table 4-2. Recommended Test Equipment (Cont'd)

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
Balanced Directional Couplers	124 ohm Frequency Range: .01 to 10.9 MHz Directivity: ≥ 40 dB	P (3336B only)	-hp- Part No. 5061-1137 -hp- Part No. 5061-1136 (Opt 001)
	150 ohm Frequency Range: .01 to 20.9 MHz Directivity: ≥ 40 dB	P (3336A only)	-hp- Part No. 5061-1135
DC Power Supply	Output Voltage: Output Current: ≥ 20 mA	P	-hp- Model 6214A
Double Balanced Mixer	Input/Output Z: 50 ohm Frequency Range: 1 to 20.9 MHz	P	-hp- Model 10534A or 10514A
Attenuators	Attenuation: 10 dB (fixed) VSWR: ≤ 1.02, dc to 20.9 MHz Input/Output Z: 50 ohms	P	-hp- Model 8491A Option 010 (2 required)
	Attenuation: 0 to 70 dB Attenuation Step Size: 10 dB Input/Output Z: 50 ohm Certification required at 1 MHz, 10 MHz, 20.9 MHz	P	-hp- Model 355D
Spectrum Analyzer	Frequency Range: .1 to 100 MHz Amplitude Accuracy: ± 1 dB Harmonic Distortion: ≤ −65 dBc Spurious: ≤ −70 dBc	V, P, A	-hp- Model 141T/8553B/8552B
	Frequency Range: 10 Hz to 50 kHz Amplitude Accuracy: ± 1 dB Harmonic Distortion: ≤ −65 dBc Spurious: ≤ −70 dBc	V, P, A	-hp- Model 3580A
Thermal Converter	Input Z: 75 ohms Maximum Input: .5 V rms Flatness: Certification required at 10 kHz, 100 kHz, 1 MHz, 10 MHz and 20 MHz	V, P, A	-hp- Model 11051A/H07
Oscilloscope	Vertical Bandwidth: dc to 100 MHz Deflection: .01V to 10V/DIV Horizontal Sweep: .05 μs to 1s/DIV Delayed Sweep	A, T	-hp- Model 1740A
Function Generator	Frequency: 1 and 10 kHz Functions: Sine, Squarewave Symmetry: Variable	P, A	-hp- Model 3312A
ac Voltmeter	Ranges: 1 mV to 1 V Frequency Range: 25 Hz to 1 MHz Scale: Logarithmic Accuracy: ± 2%, 100 Hz to 10 kHz	P	-hp- Model 400 E or EL
System Voltmeter	dc Voltage Range: ± 10 V Trigger: External Trigger Delay: Programmable	P	-hp- Model 3437A

Table 4-2. Recommended Test Equipment (Cont'd)

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
1 MHz Low Pass Filter	Cut-Off Frequency: 1 MHz Stop-Band Frequency: 4 to 80 MHz	P	J903 TT Electronics Inc 2214 S. Barry Avenue Los Angeles, CA 90064 (213) 478-8224
15 kHz Low Pass Filter	Cut-Off Frequency: 15 kHz Consisting of Resistor: 10K ohm, ± 1% Capacitor: 1600 pF, ±5%	P (3336C only)	
High Frequency Probe	Frequency Range: .1 to 20 MHz Accuracy: ± .5 dB (Diode Detector)	P	-hp- Model 11096B
Signature Analyzer	Signature: 4 digit Hexadecimal Characters: 0 thru 9, A, C, F, H, P, U Logic Threshold: + 2.2 V, high + .5 V, low	T	-hp- Model 5004A
Minimum Loss Impedance Matching Pads	50 - 75 ohm	V, P	-hp- Model 85428B
Terminations	50 ohm, ± .1% 75 ohm, ± .1%	V, P, A, T V, P, A, T	-hp- Model 11048C -hp- Model 11094B
Resistor	1 x 50Ω .1% .125W 4 x 62Ω .1% .125W 5 x 75Ω .1% .125W 9 x 135Ω 1 x 150Ω .1% .125W 1 x 225Ω 1% .5W 1 x 358Ω 1% .125W 8 x 600Ω .1% .125W 1 x 675Ω 1% .125W 1 x 10kΩ 1% .25W	V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T V, P, A, T	-hp- Part No. 0698-6364 -hp- Part No. 0698-6800 -hp- Part No. 0698-7363 -hp- Part No. 0698-7364 -hp- Part No. 0698-6774 -hp- Part No. 0757-0980 -hp- Part No. 0698-3242 -hp- Part No. 0698-7408 -hp- Part No. 0698-4194 -hp- Part No. 0757-0340
Capacitors	1 x 1600pF 5% 300V	V, P, A, T	-hp- Part No. 0160-2223
Amplifier	Gain: 20 dB Frequency Range: .1 to 20.9 MHz Input/Output Z: 50 ohm	P	QB 300 Q-Bit Corp. P.O. Box 2208 Melbourne, Florida 32901 (305) 727-1838
Frequency Counter	Resolution: .1 Hz @ 20 MHz Aging Rate: <1 x 10-8/wk for standard instruments <5 x 10-9/wk for Option 004		-hp- Model 5328A w/Option 10 -hp- Model 5335A w/Option 10 -hp- Model 5345 w/o Option 001

Table 4-2. Recommended Test Equipment (Cont'd)

INSTRUMENT	CRITICAL SPECIFICATION	REQUIRED FOR	RECOMMENDED MODEL
Adapters	BNC (f) to WECO 440A (3336B only)	V, P, A, T	-hp- Part No. 1250-0556 (2 required)
	BNC (f) to WECO 358 (3336B only)	V, P, A, T	-hp- Part No. 1250-0591 (2 required)
	BNC (f) to WECO 347 (3336B only)	V, P, A, T	-hp- Part No. 1251-3759 (2 required)
	BNC (f) to 1.6/5.6 (m) (3336A with Option 001 only)	V, P, A, T	S 230 W & G Instruments Inc. 119 Naylon Avenue Livington, NJ 07039 (201) 994-0854
	BNC (f) to WECO 310 (3336B only)	V, P, A, T	-hp- Part No. 1251-3757
	BNC (f) to TRIAX (m)	P	-hp- Part No. 1250-0595
	BNC (f) to Dual Banana Plug	V, P, A, T	-hp- Part No. 1250-2277
	BNC (m) to Dual Banana Post	V, P, A, T	-hp- Part No. 1250-1264
	Dual Banana Plug (used with termination resistors)	V, P, A	-hp- Part No. 1251-2816 (4 required)
	BNC (f) to Type N (m)	P	-hp- Part No. 1250-0780 (2 required)
	BNC (m) to Type N (f)	P	-hp- Part No. 1250-0077 (2 required)
Cables	50 ohm BNC (m) to BNC (m)		
	12"	V, P, A, T	-hp- Model 11170A (2 required)
	24"	V, P, A, T	-hp- Model 11170B (2 required)
	36"	V, P, A, T	-hp- Model 11170C (2 required)
	75 ohm BNC (m) to BNC (m)		
	6"	V, P, A, T	-hp- Part No. 15582-60010 (2 required)
	36"	V, P, A, T	-hp- Part No. 15582-60020 (2 required)
	75 ohm BNC (m) to Siemens type 9 REL STP-6AC Consisting of	V, P, A, T	
	Siemens type connector (m)		-hp- Part No. 5060-4444
	BNC (m) connector		-hp- Part No. 1250-1448
	6", RG 59 coaxial cable (75 ohm)		-hp- Part No. 8120-1289

4-8. PERFORMANCE TEST RECORD.

4-9. A Performance Test Record is located at the end of this section to help you consolidate the test results, -hp- recommends that copies of the Performance Test Record be used. Copies of the Performance Test Record can be made at any time without written permission from Hewlett-Packard.

4-10. PERFORMANCE TESTS.

4-11. The following Performance Tests have been specifically developed to test the -hp-3336:

Test	Paragraph No.
Frequency Accuracy	4-12
Absolute Amplitude Accuracy	4-14
Amplitude Flatness	4-16
Attenuator Accuracy	4-18
Phase Increment Accuracy	4-20
On Carrier Return Loss	4-22
Output Balance	4-25
Harmonic Distortion	4-27
Spurious Signals	4-29
Amplitude Modulation Envelope Distortion	4-31
Phase Modulation Linearity	4-33
X Drive Linearity	4-35
Integrated Phase Noise	4-37

4-12. Frequency Accuracy.

4-13. The frequency accuracy of the 3336 is not specified. However, the aging rate is. A standard 3336 should pass this test, one year after the frequency has been calibrated. A 3336 with Option 004 should pass this test, one week after the frequency has been calibrated.

Specification: (Aging Rate)

$\pm 5 \times 10^{-6}$ per year (20 to 30°C)

$\pm 5 \times 10^{-8}$ per week, Option 004

Required Equipment:

Electronic Counter	-hp- Model 5328A with Option 010
75 ohm Feedthru Termination	-hp- Model 11094B

a. Connect the equipment as shown in Figure 4-1.

b. Set the 3336 (DUT) output amplitude to +7.00 dBm (75 ohm output). Set the output frequency to 20 MHz. If the 3336 has Option 004, disconnect the adapter between the 10 MHz OVEN Output and the EXT REF Input.

c. Set the electronic counter to measure frequency with .1 Hz resolution. (On the -hp-5328A, the counter will overflow, however, the accuracy of the measurement is not affected.

To determine the overflow digit, measure the output frequency with 1 Hz resolution.)

d. Enter the counter reading on the Performance Test Record.

e. If the 3336 has Option 004, reconnect the adapter between the 10 MHz OVEN Output and the EXT REF Input.

f. Measure the frequency again, and enter the reading on the Performance Test Record.

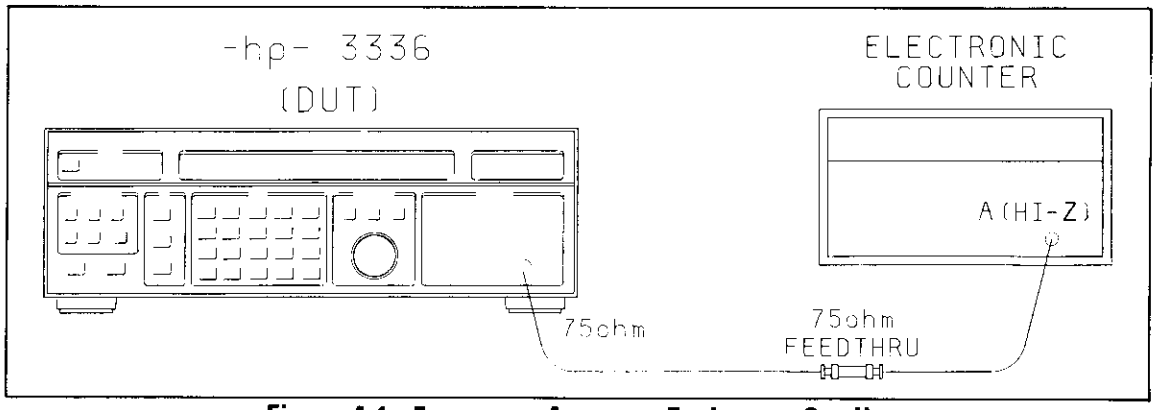


Figure 4-1. Frequency Accuracy Equipment Set Up.

4-14. Absolute Amplitude Accuracy.

4-15. This performance test verifies that the -hp- Model 3336 meets the Absolute Accuracy specification in Table 4-1.

Specification: Accuracy applies to the top 9.99 dB of amplitude range (20° to 30° C).

3336A	75 ohm output	±.05 dB at 10 kHz
	150 ohm output	±.05 dB at 50 kHz
	600 ohm output	±.05 dB at 10 kHz
3336B	75 ohm output	±.05 dB at 10 kHz
	124 ohm output	±.05 dB at 50 kHz
	135 ohm output	±.05 dB at 50 kHz
	600 ohm output	±.05 dB at 10 kHz
3336C	50 ohm output	±.05dB at 10 kHz
	75 ohm output	±.05 dB at 10 kHz

Required Equipment:

AC Voltmeter	-hp- Model 3455A with Option 001 (average responding)

Terminations: all 0.1% or better

3336A	75 ohm	-hp- Model 11094B
	150 ohm	-hp- Part No. 0757-0715
	600 ohm	-hp- Part No. 0698-5405
3336B	75 ohm	-hp- Model 11094B
	124 ohm	-hp- Part No. 0698-6284
	135 ohm	-hp- Part No. 0698-5197
	600 ohm	-hp- Part No. 0698-5405
3336C	50 ohm	-hp- Model 11048C
	75 ohm	-hp- Model 11094B

NOTE

The ac voltmeter used in this test must be accurate to ±.15%

a. Connect the equipment as shown in Figure 4-2. Use the proper termination at the voltmeter's input. For example, if you are testing the 600 ohm output, use a 600 ohm termination.

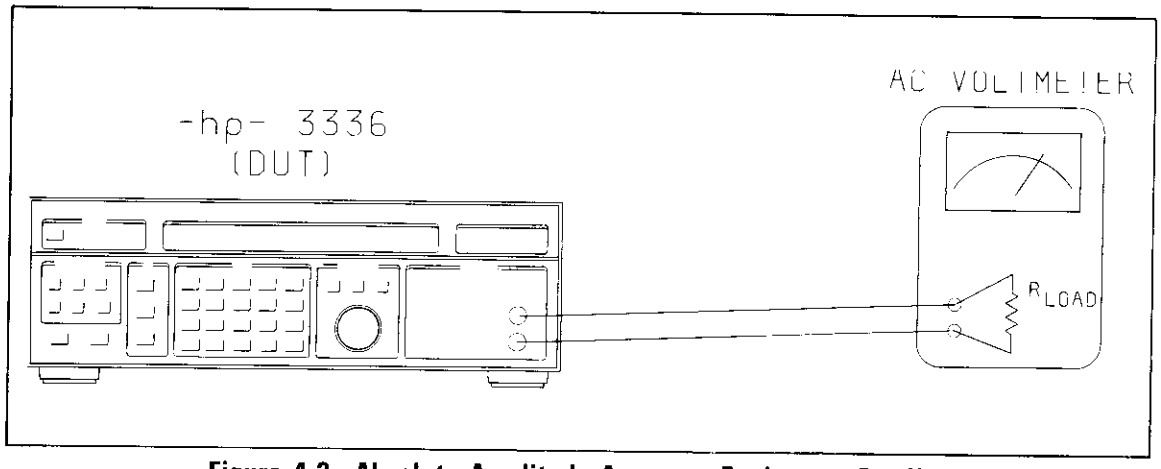


Figure 4-2. Absolute Amplitude Accuracy Equipment Set Up.

b. Refer to the following table for Step c.

	OUTPUT	AMPLITUDE	FREQUENCY	NOMINAL	MINIMUM	MAXIMUM
3336A	75Ω	7.00 dBm	10 kHz	0.6131	0.6096	0.6166
	150Ω	1.76 dBm	50 kHz	0.4743	0.4716	0.4770
	600Ω	7.00 dBm	10 kHz	1.7341	1.7242	1.7441
3336B	75Ω	7.00 dBm	10 kHz	0.6131	0.6096	0.6166
	124Ω	1.76 dBm	50 kHz	0.4312	0.4288	0.4337
	135Ω	1.76 dBm	50 kHz	0.4500	0.4474	0.4526
	600Ω	7.00 dBm	10 kHz	1.7341	1.7242	1.7441
3336C	50Ω	8.76 dBm	10 kHz	0.6130	0.6095	0.6166
	75Ω	7.00 dBm	10 kHz	0.6131	0.6096	0.6166

c. Set up the 3336 for each of test conditions above and enter the ac voltmeter readings on the Performance Test Record. Refer to the minimum and maximum values above to see if the measured values meet the specifications.

d. Refer to the following table for Step e.

	OUTPUT	AMPLITUDE	FREQUENCY	NOMINAL	MINIMUM	MAXIMUM
3336A	75Ω	−2.99 dBm	10 kHz	0.1941	0.1930	0.1952
	150Ω	−8.23 dBm	50 kHz	0.1502	0.1493	0.1510
	600Ω	−2.99 dBm	10 kHz	0.5490	0.5459	0.5522
3336B	75Ω	−2.99 dBm	10 kHz	0.1941	0.1930	0.1952
	124Ω	−8.23 dBm	50 kHz	0.1365	0.1357	0.1373
	135Ω	−8.23 dBm	50 kHz	0.1425	0.1416	0.1433
	600Ω	−2.99 dBm	10 kHz	0.5490	0.5459	0.5522
3336C	50Ω	−1.23 dBm	10 kHz	0.1941	0.1930	0.1952
	75Ω	−2.99 dBm	10 kHz	0.1941	0.1930	0.1952

e. Set up the 3336 for each of test conditions above and enter the ac voltmeter readings on the Performance Test Record. Refer to the minimum and maximum values above to see if the measured values meet the specifications.

4-16. Amplitude Flatness.

4-17. This performance test verifies that the -hp- Model 3336 meets the Amplitude Flatness specification in Table 4-1.

Specification:

Referenced to amplitudes at 10 kHz for the 50, 75 and 600 ohm outputs. Referenced to amplitudes at 50 kHz for the 124, 135 and 150 ohm outputs.

3336A	75 ohm output	±.1 dB (±.07 dB)*	10 Hz to 20.9 MHz
	150 ohm output	±.12 dB	10 kHz to 2.09 MHz
	600 ohm output	±.25 dB	200 Hz to 109 kHz
3336B	75 ohm output	±.1 dB (±.07 dB)*	10 Hz to 20.9 MHz
	124 ohm output	±.15 dB	10 kHz to 50 kHz
		±.1 dB	50 kHz to 10.9 MHz
	135 ohm output	±.12 dB	10 kHz to 2.09 MHz
	600 ohm output	±.25 dB	200 Hz to 109 kHz
3336C	50 ohm output	±.1 dB (±.07 dB)*	10 Hz to 20.9 MHz
	75 ohm output	±.1 dB (±.07 dB)*	10 Hz to 20.9 MHz

***NOTE**

Specifications in parenthesis apply to instruments with Option 005.

Required Equipment:

75 ohm, .5 V Thermal Converter	-hp- Model 11051A/H07
DC Voltmeter	-hp- Model 3455A

Impedance Matching Pads

3336A	150 to 75 ohm	
	R1 = 75 ohm 1%	-hp- Part No. 0698-7363
	600 to 75 ohm	
	R1 = 225 ohm 1%	-hp- Part No. 0757-0980
	R2 = 300 ohm 1%	-hp- Part No. 0698-6319
3336B	124 to 75 ohm	
	R1 = 358 ohm 1%	-hp- Part No. 0698-3242
	R2 = 62 ohm 1%	-hp- Part No. 0698-6800
	135 to 75 ohm	
	R1 = 675 ohm	-hp- Part No. 0698-4194
	R2 = 67.5 ohm (2 x 135)	-hp- Part No. 0698-7364 (need 2)
	600 to 75 ohm	
	R1 = 225 ohm 1%	-hp- Part No. 0757-0980
	R2 = 300 ohm 1%	-hp- Part No. 0698-6319
3336C	50 to 75 ohm	-hp- Model 85428B

a. Connect the equipment as shown in Figure 4-3. Connect the thermal converter directly to the 3336 (DUT), 75 ohm output. If this is not possible, use the shortest cables available. Use the appropriate impedance matching pad between the other 3336 outputs and the 75 ohm thermal converter.

b. Set the frequency and amplitude of the 3336 to the values in the following table. The 10 kHz measurement must be taken first because the thermal converter voltage at this frequency will be used as a reference for the other frequencies.

	OUTPUT	FREQUENCIES	AMPLITUDE	CONVERTER VOLTAGE
3336A	75Ω	10 Hz, 100 kHz, 1 MHz, 10 MHz, 20.9 MHz	5.00 dBm	0.487 V
	150Ω	10 kHz, 100 kHz, 1 MHz, 2.09 MHz	1.50 dBm	0.230 V
	600Ω	200 Hz, 109 kHz	6.50 dBm	0.205 V
3336B	75Ω	10 Hz, 100 kHz, 1 MHz, 10 MHz, 20.9 MHz	5.00 dBm	0.487 V
	124Ω	10 kHz, 100 kHz, 1 MHz, 10.9 MHz	1.50 dBm	0.209 V
	135Ω	10 kHz, 100 kHz, 1 MHz, 2.09 MHz	1.50 dBm	0.218 V
	600Ω	200 Hz, 109 kHz	6.50 dBm	0.205 V
3336C	50Ω	10 Hz, 100 kHz, 1 MHz, 10 MHz, 20.9 MHz	8.50 dBm	0.377 V
	75Ω	10 Hz, 100 kHz 1 MHz, 10 MHz,	5.00 dBm 20.9 MHz	0.487 V

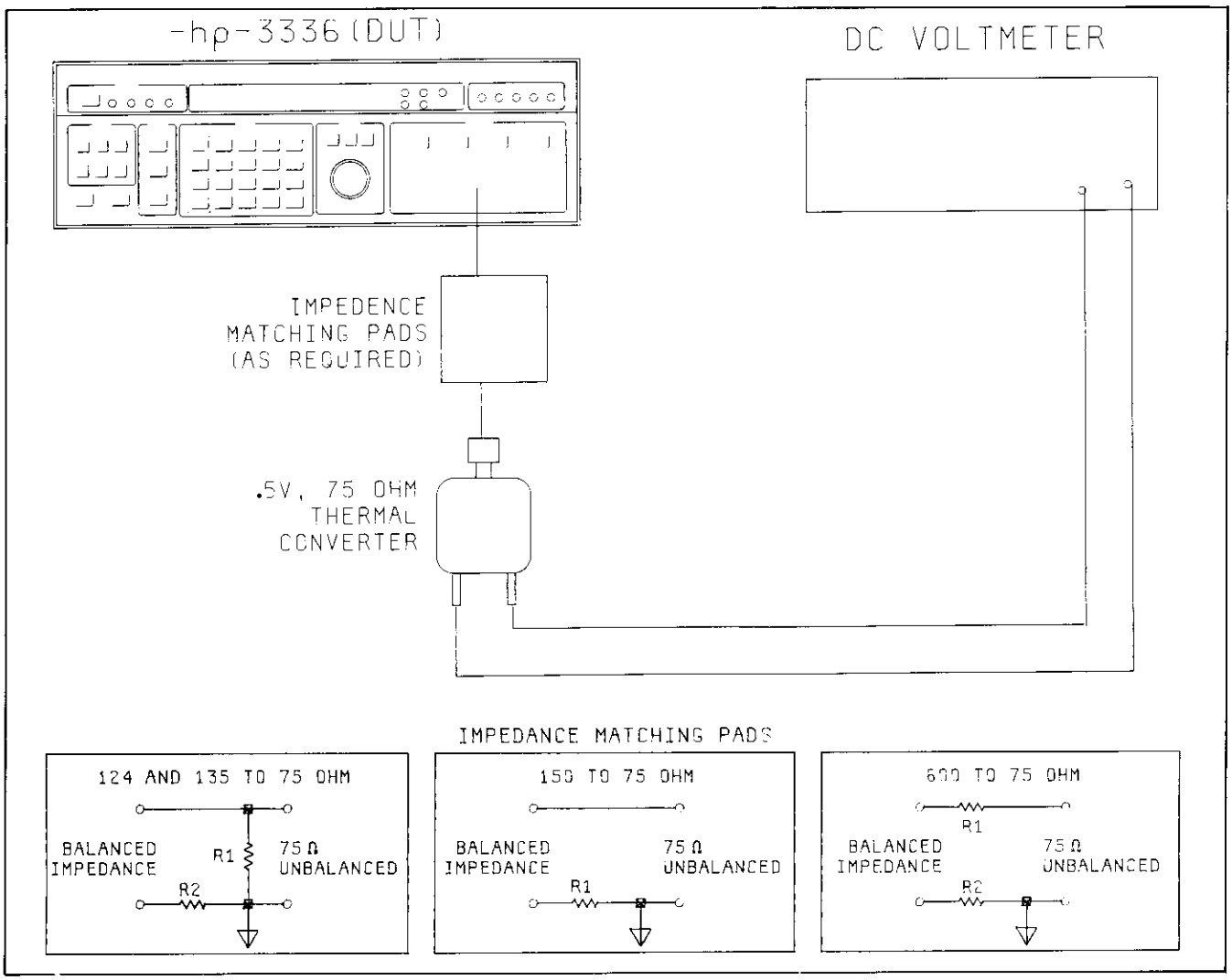


Figure 4-3. Amplitude Flatness Equipment Set Up.

c. Allow time for the thermal converter to settle before taking any measurements. The accuracy of this test is enhanced if the thermal converter is protected from drafts and other sources of temperature change. Measure and record the thermal converter's output with the 3336 programmed at 10 kHz.

CAUTION

Use extreme caution when making the following measurements at the 75 ohm output. The converter voltage will approach maximum, and the converter will be destroyed if care is not exercised.

d. Measure the thermal converter voltage for each output at the frequencies listed above. At each frequency setting, adjust the amplitude of the 3336 in .01 dBm steps until the converter voltage is equal to the reference voltage recorded at 10 kHz. When the converter level matches the reference level, record the amplitude setting of the 3336. Do not adjust the amplitude of the 3336 in increments larger than .01 dBm.

e. If the certified error of the thermal converter being used was given in dBm, enter this value in the Performance Test Record. If it was given as a percentage, convert it to dBm using the following formula:

$$dBm = 20\log(1 - \%error/1000)$$

f. Compute the amplitude flatness of the 3336 at each output and frequency setting using the following formula:

	Reference level (from Step c)
−	336 Amplitude setting (from Step d)
+	Thermal converter error (from step e)
=	3336 amplitude flatness

4-18. Attenuator Accuracy Verification.

4-19. This performance test verifies that the -hp- 3336 meets the attenuator accuracy specification listed in Table 4-1 using a "put and take" measurement system at four attenuator settings and three test frequencies. It is preferred that this test be performed in a screen room. If one is not available, an electrically "clean" environment is a must. It is important that the specified cables be used and that the test equipment be arranged as illustrated. Failure to follow the test procedures explicitly can result in erroneous data.

NOTE

A certification program is available to verify the 3336 attenuator specifications. To recertify, the attenuator must be returned to Hewlett-Packard. The recertified attenuator will be returned with the results of each attenuation setting. Contact your nearest Hewlett-Packard Sales Office for further details. A list of these offices is provided at the back of this manual.

Required Equipment:

Attenuator (10 dB, 20 dB, 40 dB, 70 dB attenuations) with Certification	-hp- Model 355D
(2) 10 dB, 50 ohm Coaxial Attenuators	-hp- Model 8491A Option 010
75 ohm to 50 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B
50 ohm Feedthru Termination	-hp- Model 11048C
Mixer	-hp- Model 10514A
Synthesizer	-hp- Model 3325A
Wave Analyzer	-hp- Model 3581A/C
DC Voltmeter	-hp- Model 3455A
DC Power Supply	-hp- Model 6214A
20 dB Amplifier	Q Bit Corp. Model QB-300

Cables:	
(1) 50 ohm, 1 ft.	-hp- 11170A
(1) 50 ohm, 2 ft.	-hp- 11170B
(1) 50 ohm, 3 ft.	-hp- 11170C
Adapters: 50 ohm	
(1) Type N (m) to BNC (m)	-hp- 1250-0082
(2) Type N (f) to BNC (m)	-hp- 1250-0077
(1) Type N (m) to BNC (f)	-hp- 1250-0780
(1) BNC (f) to Dual Banana	-hp- 1251-2277
(1) BNC (m) to BNC (m)	-hp- 1250-0216
Adapters: 75 ohm	
(1) BNC (m) to BNC (m)	-hp- 1250-1288

NOTE

Q Bit Corporation; P.O. Box 2208; Melbourne, Florida 32901.

a. Connect the equipment electrically as shown in Figure 4-4 and physically as shown in Figure 4-5.

NOTE

The quality of the test results depends upon the equipment arrangement. It is important that the physical location of the instruments be as shown in Figure 4-5. Do not cross cables. Allow the Q-Bit Amplifier 30 minutes to warm-up.

b. Set the 3336 (DUT) controls as follows:

Ampltiude..... +7.00 dBm (75 ohm output)
Frequency.....20 MHz

c. Set the Reference Synthesizer as follows:

Amplitude..... +7.00 dBm (50 ohm output)
Frequency.....20.008 MHz

d. Set the Wave Analyzer controls as follows:

Scale.....Volts
Resolution Bandwidth.....100 Hz
Sweep Mode.....Manual
Amplitude Reference Level.....Normal
Input Sensitivity (initially).....1V
Input (3581C).....Unbalanced
AFC.....OUT; Tune Frequency to 8 kHz
AFC.....Push IN after Tuning to 8 kHz

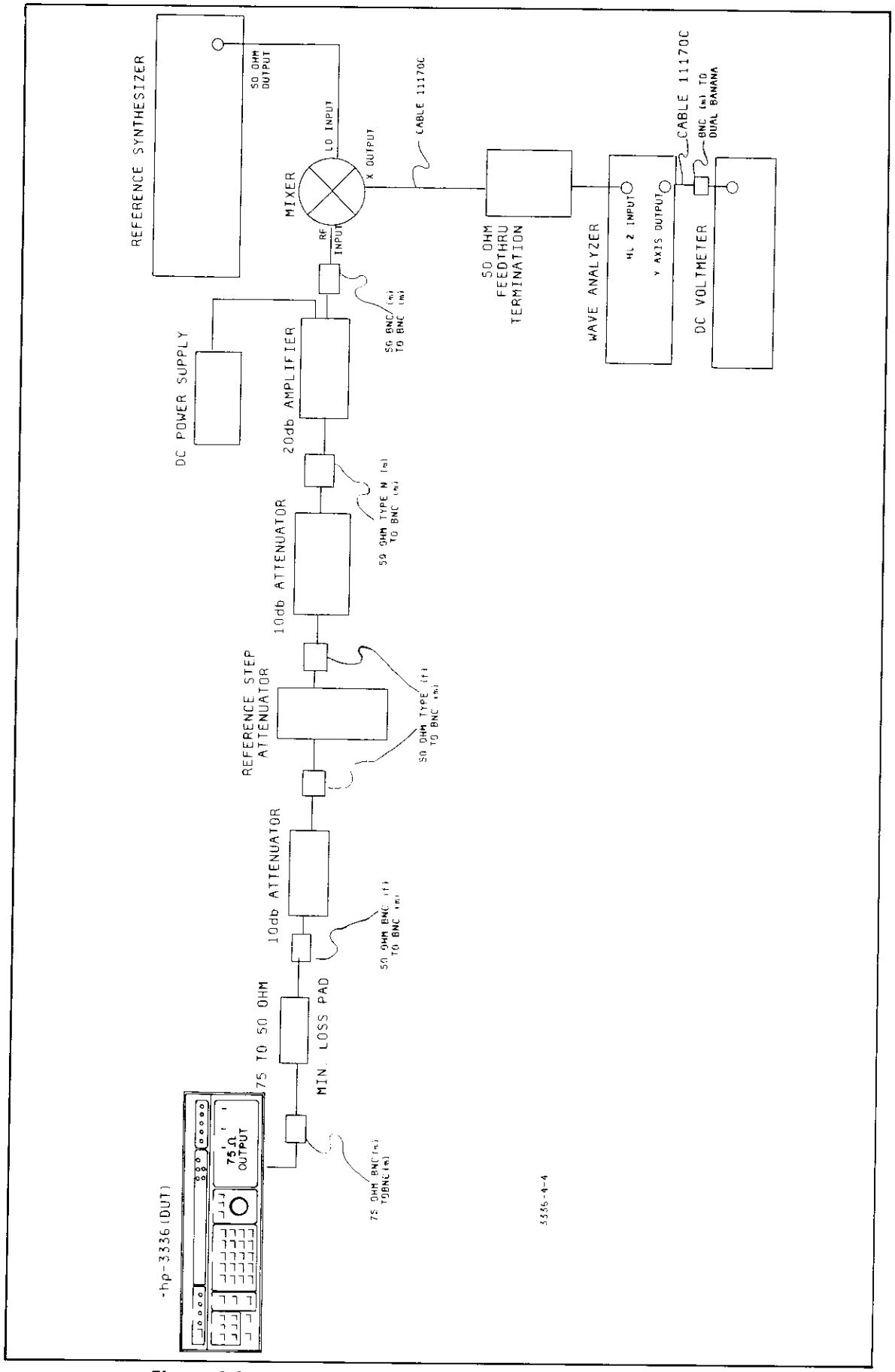


Figure 4-4. Equipment Set Up for Attenuator Accuracy Test

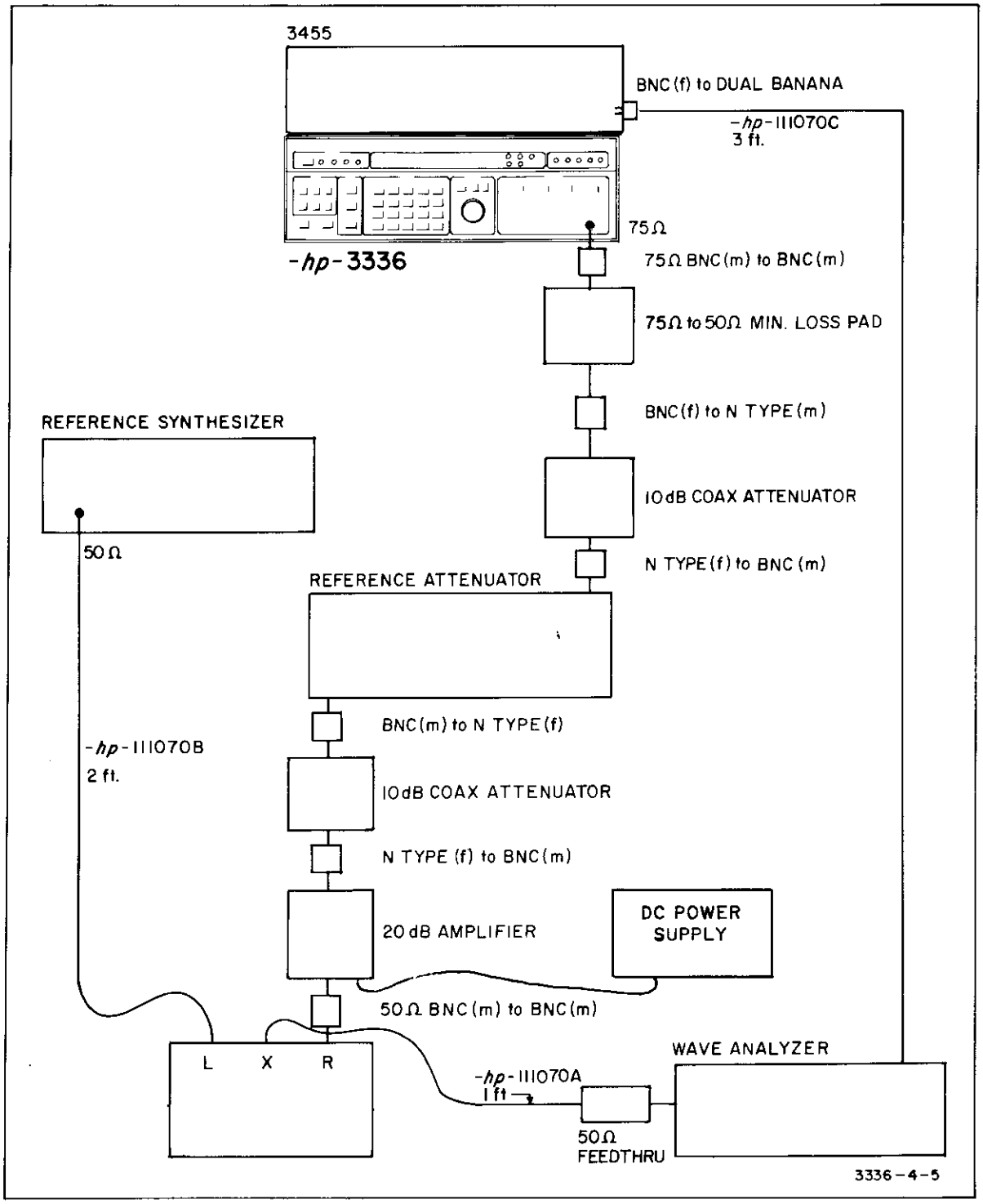


Figure 4-5. Physical Location for Attenuator Accuracy

e. The objective of this procedure is to compare the reference attenuator against the 3336 attenuator. The 3336 is tested at 10, 20, 40, and 70 dB attenuation levels. Begin each test by setting up the reference attenuator and the 3336 to the levels shown in the table below under Step e.

	STEP E		STEP H	
TEST	3336	REFERENCE	3336	REFERENCE
10 dB	7 dBm	10 dB	−3 dBm	0 dB
20 dB	7 dBm	20 dB	−13 dBm	0 dB
40 dB	7 dBm	40 dB	−33 dBm	0 dB
70 dB	7 dBm	70 dB	−63 dBm	0 dB

f. Adjust the wave analyzer sensitivity until the DVM reads approximately 4.6 volts.

g. Observe the DVM for several seconds to determine the average reading and record it in the Performance Test Record as V1.

h. Reduce the 3336 level to the value shown in the table above under Step h.

i. Adjust the reference attenuator to 0 dB.

j. Again observe the DVM and record the average value in the Performance Test Record, this time as V2.

k. Repeat Steps e - h until all four attenuation levels have been tested.

4-20. Phase Increment Accuracy.

4-21. This performance test verifies that the -hp- 3336 meets the Phase Increment Accuracy specification listed in Table 4-1.

Specification:

Any phase increment will be within 0.2° of the selected value.

Required Equipment:

Electronic Counter	-hp- Model 5328A with Option 040 or Option 041
75 ohm Feedthru Termination	-hp- Model 11094B

a. Connect the REF OUT output, located on the 3336 (DUT) rear panel, to the B input of the electronic counter. This will be the reference source against which phase increments will be measured.

b. Connect the 3336 (DUT), 75 ohm output, to the A input of the electronic counter. Terminate this output with a 75 ohm feedthru termination at the counter's input.

c. Set the 3336 (DUT) output frequency to 1 MHz and output amplitude to +7.00 dBm.

d. Set the electronic counter controls to measure the average time interval from input A to input B (T.I.AVG A−B). Set the counter to average 10^7 intervals. Note, the gate time to average 10^7 intervals will be 1 second. Do not use the first reading displayed after changing phase.

e. Adjust the 3336 (DUT) output phase until the counter displays a time interval from 190 ns to 210 ns. Each degree incremented on the 3336 will cause a 2.8 ns change in the counter display.

f. Assign zero phase to the 3336 signal output. This is a shifted function of the PHASE key.

g. Record the electronic counter reading with no phase shift (T1).

h. Change the phase of the 3336 output signal by one of these values:

+1° +10° +100°

i. Record the electronic counter reading with the test phase shift (T2).

j. Reset the 3336 output phase to zero degrees. The electronic counter should again display a time interval from 190 ns to 210 ns.

k. Repeat Steps e thru j until each phase increment has been measured. Reading T1 may change slightly from test to test and a new value should be recorded for each test increment.

l. Compute the actual time difference of each phase increment by subtracting T1 from T2. Record this value on the Performance Test Record and compare it to the upper and lower limits.

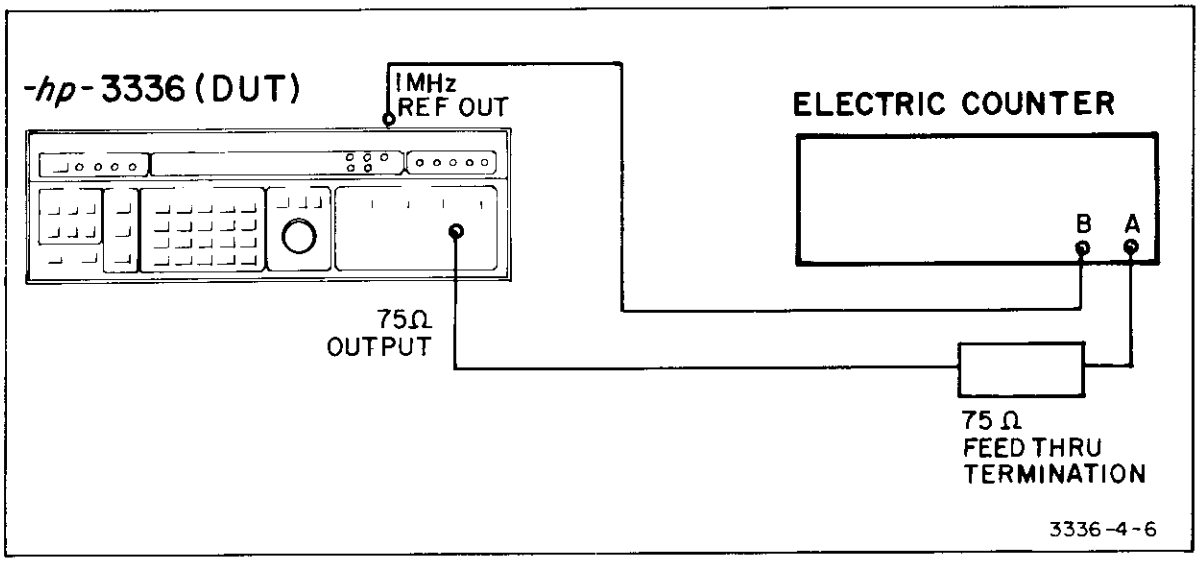
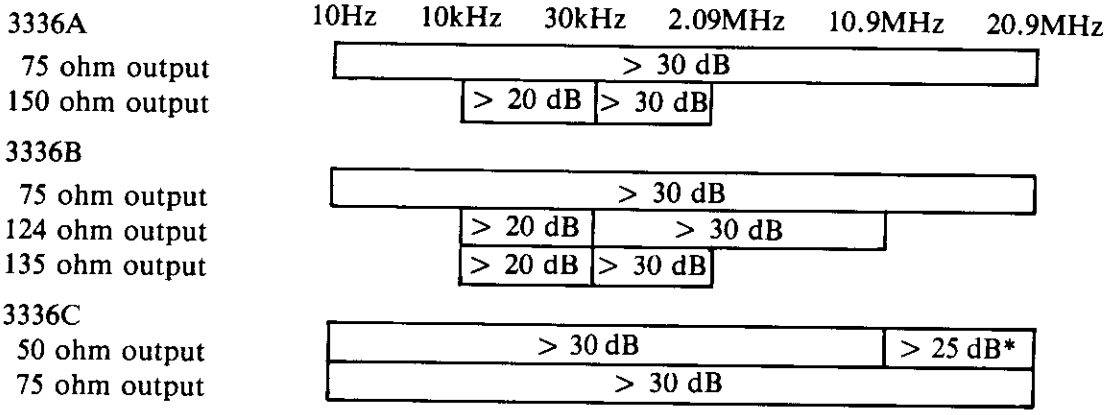


Figure 4-6. Phase Increment Accuracy Equipment Set Up.

4-22. On Carrier Return Loss.

4-23. This performance test verifies that the -hp- 3336 meets the On Carrier Return Loss specification in Table 4-1.

Specification:



***NOTE**

50Ω Return Loss from 10 MHz to 20.9 MHz is > 30 dB with Option 005.

Required Equipment:

Synthesizer	-hp- Model 3325A or 3335A
Wave Analyzer	-hp- Model 3581A/C
High Frequency Probe (diode detector)	-hp- Model 11096B
50 - 75 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B
75 ohm Directional Bridge**	-hp- Model 8721A/Option 008
50 ohm Directional Bridge (3336C only)**	-hp- Model 8721A
124 ohm Directional Coupler (3336B only)	-hp- Part No. 5061-1135
124 ohm Direction Coupler (3336B with Option 001)	-hp- Part No. 5061-1136
150 ohm Directional Coupler (3336A only)	-hp- Part No. 5061-1137
50 ohm Feedthru Termination (3336C only)	-hp- Model 11048C (2 required)
75 ohm Feedthru Termination	-hp- Model 11094B (2 required)
124 ohm Termination Resistor (3336B only) (2 × 248 ohm)	-hp- Part No. 0698-6793 (4 required)
150 ohm Termination Resistor (3336A only)	-hp- Part No. 0698-6774 (2 required)
Ohmmeter	-hp- Model 3455A

**NOTE

Directional Bridges are also part of Transmission/Reflection Kits:

50 ohm Transmission/Reflection Kit	*-hp- Model 11652A*
75 ohm Transmission/Reflection Kit	*-hp- Model 11652A Option 008*

a. Connect the equipment as shown in Figure 4-7. Use the appropriate impedance Directional Coupler and Termination for the output under test. For example, to test the 124 ohm output, use the 124 ohm Directional Coupler and 124 ohm Termination Resistors. To test the 75 ohm output, use the 75 ohm Direction Coupler and 75 ohm Feedthru Terminations.

NOTE

Make sure the frequency references of the synthesizer and the 3336 (DUT) are locked together.

b. Set the 3336 (DUT) output amplitude to maximum:

50 ohm – +8.76 dBm
75 ohm – +7.00 dBm
124 ohm – +1.76 dBm
150 ohm – +1.76 dBm

c. Set the 3336 (DUT) output frequency to one of the following test frequencies:

50 ohm – 100kHz, 1MHz, 10MHz, 20.9MHz
75 ohm – 100kHz, 1MHz, 10MHz, 20.9MHz
124 ohm – 100kHz, 1MHz, 10.9MHz
150 ohm – 100kHz, 1MHz, 2.09MHz

d. Turn Fast Leveling "ON". This test will not produce valid results if Fast Leveling is "OFF".

e. Set the reference synthesizer's output amplitude to −10 dBm for all test setups except when testing the 3336's 75 ohm output. Set the reference synthesizer's output amplitude to −4 dBm when testing the 75 ohm outputs.

f. Set the reference synthesizer's output frequency to the test frequency (selected in Step c) plus 15 Hz.

g. Tune the Wave Analyzer to lock to and measure the 15 Hz signal from the High Frequency Probe. Use a 3 Hz, or narrower, resolution bandwidth. If you have a -hp- Model 3581A/C Wave Analyzer, set the controls as follows:

SCALE.....90 dB
RESOLUTION BANDWIDTH.....3 Hz
SWEEP MODE.....Manual
AMPLITUDE REFERENCE LEVEL.....Normal
INPUT (3581C).....Unbalanced
INPUT SENSITIVITY.....as required
AFC.....OUT: Tune to 15 Hz
AFC.....PUSH IN after tuning to 15 Hz

h. Create an impedance mismatch factor of two by inserting a feedthru termination between the load port of the directional coupler and the 3336 under test. If the output under test is a balanced output, create a mismatch by placing a termination resistor across the 3336 output. The value of this resistor must be the same as the impedance of the output under test. (e.g. use a 50 ohm termination when testing the 50 ohm output.)

i. In all cases, adjust the wave analyzer's input sensitivity controls until it displays −9.5 dB. If the impedance mismatch is a factor of two, all the mismatches produced in Step h have a return loss of 9.54 dB.

j. Remove the Feedthru Termination or Termination Resistor and connect the Directional Coupler directly to the 3336 output under test.

k. Record the Wave Analyzer reading on the Performance Test Record for the output and frequency tested.

NOTE

Make sure the Wave Analyzer is tuned to the 15 Hz signal before recording the reading.

l. Repeat Steps c thru k until the return loss at all the test frequencies listed in Step c has been measured.

m. Repeat Steps b thru l until the return loss of all the 3336's signal outputs has been measured.

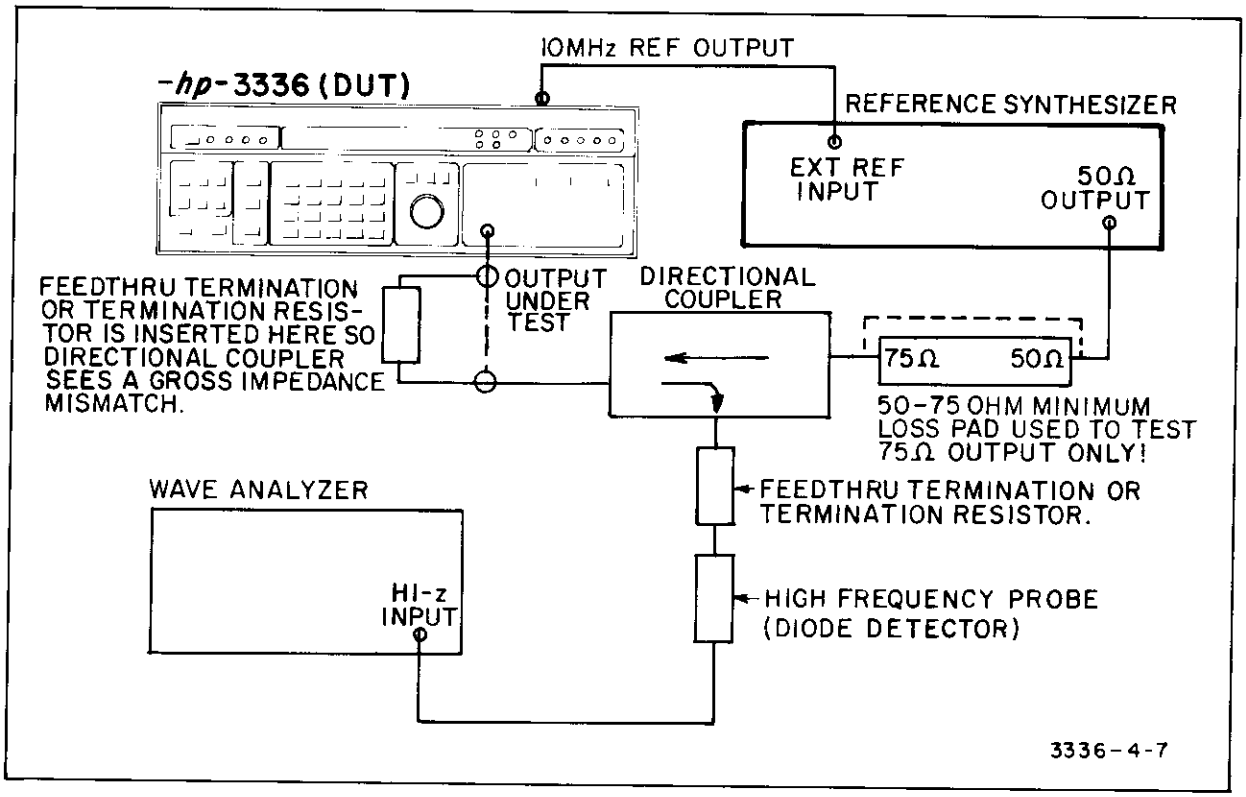


Figure 4-7. On Carrier Return Loss Equipment Set Up.

4-24. On Frequency Return Loss Measurement Technique.

Since this performance test is new, a brief conceptual discussion of the measure follows:

A small signal is launched, in the forward direction, into the active -hp- 3336 output. The addition of the 3336's output signal (f_C) and the small signal (f_O) at the 3336's output could be considered as the 3336 output signal with one sideband. Furthermore, this signal (the carrier and one sideband) is mathematically equivalent to the 3336 output signal (the carrier) with a pair of AM sidebands and a pair of PM sidebands, cancelling on one side of the carrier and reinforcing on the other side. The 3336's amplitude leveling circuits will compensate for any amplitude changes, and effectively cancel them at the Leveled Node (located on the other side of the output termination, inside the 3336). Since no AM components can exist at this Leveled Node, there will be no AM components reflected, either. Any reflected AM components seen at the output of the 3336 are solely due to the output termination impedance and, hence, are a measure of the "ON" Frequency Return Loss. A directional coupler introduces the small signal to the 3336's output and isolates the reflected signals. A diode detector recovers the AM components (recall that there are also PM sidebands) by demodulating the reflected signals and a wave analyzer, tuned to the modulating frequency, measures the relative magnitude of this signal and a signal from a known, gross impedance mismatch, used as a reference. To insure that the measurement is "ON" Frequency Return Loss, the frequency difference between f_C and f_O must be well within the bandwidth of the 3336's Amplitude Leveling circuits. When Fast Leveling is "ON", this bandwidth is from dc to 1 kHz. When Fast Levling is OFF, this bandwidth is from dc to 1 Hz. In this particular procedure, the frequency difference is 10 Hz, therefore, Fast Leveling must be ON. Since the only difference between Fast Leveling ON and OFF is the bandwidth of the leveling circuits, results obtained with Fast Leveling ON apply to the instrument when Fast Leveling is OFF.

$$\text{Return loss} = 20\log|(Zi - Zo)/(Zi + Zo)|$$

where: Zi is the ideal output impedance
Zo is the actual output impedance

4-25. Output Balance (3336A and 3336B only).

4-26. This performance test verifies that the -hp- 3336 meets the Balance specification in Table 4-1.

Specification:

Model 3336A	
150 ohm output	> 36 dB, 10 kHz to 2.09 MHz
600 ohm output	> 38 dB, 300 Hz to 50 kHz
Model 3336B	
124 ohm output	> 30 dB, 10 kHz to 10.9 MHz
135 ohm output	> 36 dB, 10 kHz to 2.09 MHz
600 ohm output	> 38 dB, 300 Hz to 50 kHz

Required Equipment:

AC Voltmeter		-hp- Model 400E or EL
Resistors (3 ea. required)		
R = 62 ohm (3336B only)	(3 required)	-hp- Part No. 0698-6800
R = 67.5 ohm (3336B only)	(3 required)	-hp- Part No. 0698-7364 (2 in parallel)
R = 75 ohm (3336A only)	(3 required)	-hp- Part No. 0698-7363
R = 300 ohm (3336A/3336B)	(6 required)	-hp- Part No. 0698-6319

a. Connect the equipment as shown in Figure 4-8A. Neither voltmeter input can be connected to ground.

b. Set the 3336 frequency to 10 kHz.

c. Set the 3336 amplitude to maximum. The maximum output amplitudes by output are:

124 ohm	+1.76 dBm
135 ohm	+1.76 dBm
150 ohm	+1.76 dBm
600 ohm	+7.00 dBm

d. Record the voltmeter reading, using the dB scale (V_{ref}).

e. Connect the equipment as shown in Figure 4-8B.

f. Set the 3336 frequency to each of the test frequencies listed below. For each frequency, take a voltage measurement, using the dB scale (V_{bal}).

OUTPUT	OUTPUT LEVEL	RESISTOR	TEST FREQUENCIES
124Ω	1.76 dBm	62Ω	10 kHz, 100 kHz, 1 MHz, 10 MHz
135Ω	1.76 dBm	67.5Ω	10 kHz, 100 kHz, 2.09 MHz
150Ω	1.76 dBm	75Ω	10 kHz, 100 kHz, 2.09 MHz
600Ω	7.00 dBm	300Ω	300 Hz, 10 kHz, 50 kHz

g. Subtract V_{bal} (Step d) from V_{ref} (Step f) and enter the results on the Performance Test Record for each test frequency.

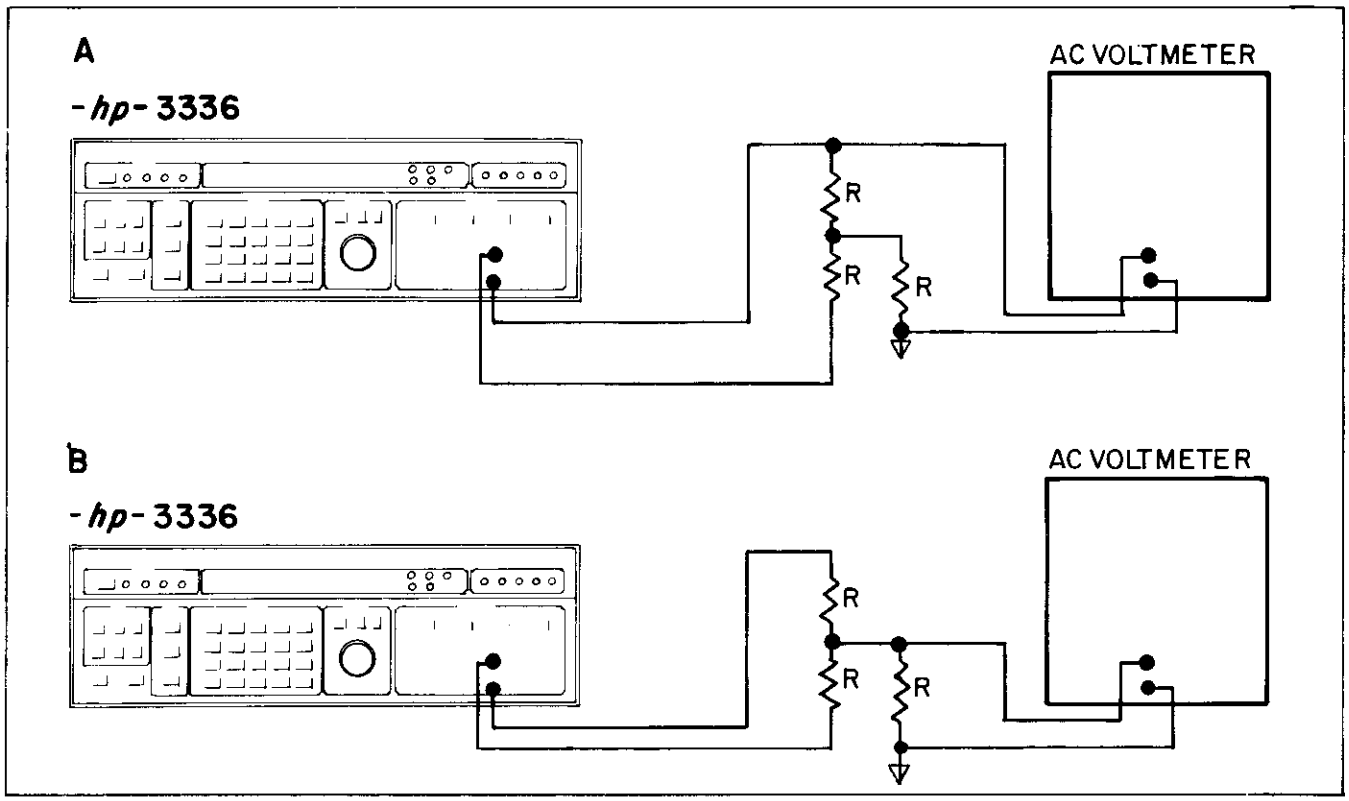


Figure 4-8. Equipment Set Up for Output Balance.

4-27. Harmonic Distortion.

4-28. This performance test verifies that the -hp- 3336 meets the Harmonic Distortion specification listed in Table 4-1.

Specification:

10Hz	30Hz	50Hz	10kHz	100kHz	1MHz	5MHz	20.9MHz	
−35dB	−50dB	−60dB			−55dB	−50dB		Fast Leveling OFF
			−50dB	−60dB	−55dB	−50dB		Fast Leveling ON

Required Equipment:

Spectrum Analyzer (low frequency)	-hp- Model 3580A
Spectrum Analyzer (high frequency)	-hp- Model 141T/ 8552B/8553B
50 ohm Feedthru Termination	-hp- Model 11048C
50-75 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B

NOTE

When making harmonic distortion measurements with a spectrum analyzer, make sure that the analyzer's harmonic distortion does not mask the distortion of the device under test. One technique to ensure this is to increase the analyzer's input attenuation, which results in lower signal levels at the analyzer's input. This yields better intermodulation and harmonic distortion performance. Adjust the analyzer's reference level controls to obtain the proper display. For good harmonic distortion performance in the -hp- Model 141T/8552B/8553B, the signal level at its mixer must be less than −40 dBm. If you are using this analyzer, set its input attenuation to 40dB.

a. This test will require two different setups: one for frequencies equal to or less than 10 kHz and one for frequencies greater than 10 kHz.

b. Set the 3336 controls as follows:

OUTPUT .....75 ohm
AMPLITUDE.....5.00 dBm
FAST LEVELING .....OFF

c. Perform Steps d through f for each configuration listed below.

3336 FREQUENCY	FAST LEVELING	SETUP
10 Hz	OFF	
30 Hz	OFF	
50 Hz	OFF	Figure 4-9A
10 kHz	OFF	
10 kHz	ON	
100 kHz	OFF	
100 kHz	ON	
1 MHz	OFF	
1 MHz	ON	Figure 4-9B
5 MHz	OFF	
5 MHz	ON	
20.9 MHz	OFF	
20.9 MHz	ON	

d. Tune the spectrum analyzer to display the fundamental frequency and at least four of its harmonics.

e. Adjust the analyzer's input sensitivity controls until the amplitude of the fundamental is 0 dB (full scale display).

f. Measure the value of the largest harmonic, relative to the fundamental, and record this value in the Performance Test Record.

g. Repeat Steps d - f until each of the conditions in the table above have been tested.

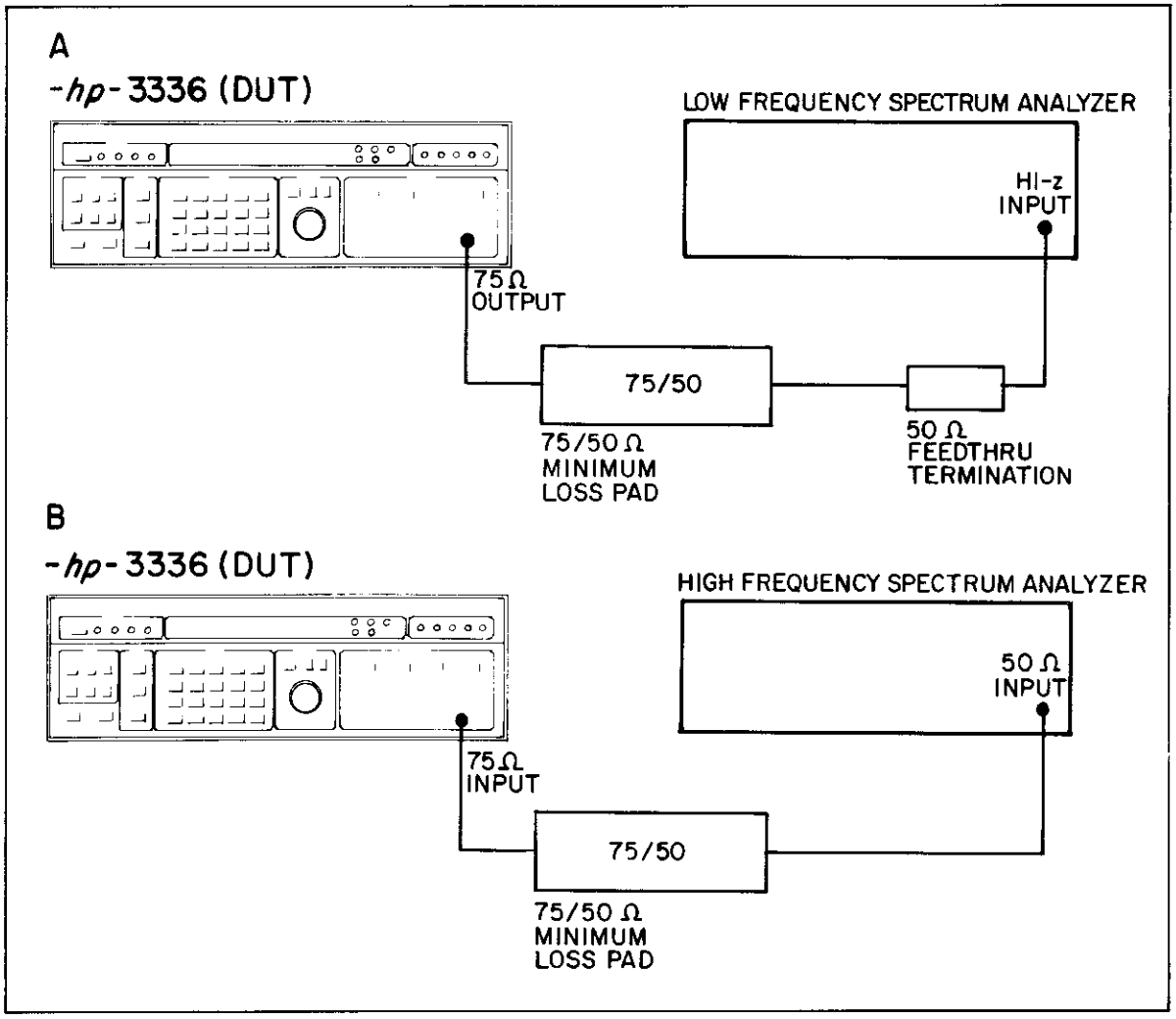


Figure 4-9. Harmonic Distortion Equipment Set Up.

4-29. Spurious Signal.

4-30. This performance test verifies that the -hp- 3336 meets the Spurious Signal specification in Table 4-1.

Specification: dc to 200 MHz except where noted.

All non-harmonically related signals from 0 Hz to 200 MHz will be more than 70 dB below the carrier or one of the following levels, whichever is greater:

Model 3336A	Without Option 005	With Option 005
75 ohm output	−100 dBm	−115 dBm
150 ohm output	−100 dBm (to 10 MHz)	−100 dBm (to 10 MHz)
600 ohm output	−100 dBm (to 10 MHz)	−100 dBm (to 10 MHz)
Model 3336B		
75 ohm output	−100 dBm	−115 dBm
124 ohm output	−100 dBm	−115 dBm
135 ohm output	−100 dBm	−115 dBm
600 ohm output	−100 dBm	−115 dBm
Model 3336C		
50 ohm output	−100 dBm	−115 dBm
75 ohm output	−100 dBm	−115 dBm

NOTE

Line related signals from the 600 ohm outputs will be more than 70 dB below the carrier or −83 dBm whichever is greater.

Required Equipment:

Spectrum Analyzer (High Frequency)	-hp- Model 141T/ 8553B/8552B
Spectrum Analyzer (Low Frequency)	-hp- Model 3582A
Synthesizer	-hp- Model 3335A
Mixer	-hp- Model 10534A
DC Voltmeter	-hp- Model 3455A
75 to 50 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B
50 ohm Feedthru Termination	-hp- Model 11054C
1 MHz Low Pass Filter	TT Electronics Model J903

a. Connect the equipment as shown in Figure 4-10A.

b. Set the 3336's amplitude of +7.00 dBm (75 ohm) and frequency to 20 MHz.

c. Tune the spectrum analyzer to the 3336's output signal and set a 0 dB reference level.

d. Without changing any controls which will affect the reference level, tune the spectrum analyzer to the following frequencies and measure their relative amplitude:

100kHz 1MHz 2MHz 30MHz

e. All spurious signals should be more than 70 dB below the reference level.

f. Set the 3336 sweep controls as follows:

SWEEP START FREQUENCY.....11 MHz
SWEEP STOP FREQUENCY.....19 MHz
SWEEP TIME.....5 seconds

g. Set the spectrum analyzer controls as follows:

START FREQUENCY.....10 MHz
SCAN WIDTH.....1 MHz/DIV
BANDWIDTH.....30 kHz
SCAN TIME.....20 ms/DIV

h. Press the 3336 "CONT" key.

i. Set the spectrum analyzer controls to display the 3336 output signal and a 2:1 mixer spur. As the 3336 output signal sweeps from 11 MHz to 19 MHz the 2:1 mixer spur will sweep from 19 MHz to 11 MHz. Measure the amplitude of the spur relative to the 3336 output signal (reference level).

j. All spurious signals should be more than 70 dB below the reference level.

k. Connect the equipment as shown in Figure 4-10B.

l. Set the 3336's amplitude to +7.00 dBm (75 ohm) and frequency to 1 kHz.

m. Tune the spectrum analyzer to the 3336 output signal at 1 kHz and set a 0 dB reference level. Using a battery powered spectrum analyzer enhances the accuracy of this part of the test.

n. Without changing any controls that will affect the reference level, tune the spectrum analyzer to the following frequencies and measure their amplitude relative to the 0 dB reference level:

60Hz 120Hz 180Hz

o. All spurious signals should be more than 70 dB below the reference level.

p. Connect the equipment as shown in Figure 4-10C.

q. Set the 3336's output amplitude to +2.7 dBm (75 ohm) and frequency to 20.001 MHz.

r. Make sure the frequency references of both synthesizers are locked together and set the reference synthesizer's output amplitude to +7.00 dBm (50 ohm) and frequency to 20 MHz.

s. Tune the spectrum analyzer to the 1 kHz signal from the mixer and low pass filter and set a 0 dB reference level.

t. Change the reference synthesizer output frequency to 20.001 MHz.

u. Increment the phase of the 3336's output signal until the dc output of the mixer is 0 Vdc, ± .01 V.

v. Disconnect the dc voltmeter to eliminate a possible noise source.

w. Tune the spectrum analyzer to the following frequencies and measure their amplitude relative to the reference level set in Step s.

1kHz 2kHz 3kHz 4kHz

x. Enter a Pass of Fail indication on the Performance Test Record. This test checked a number of the most important (largest) spurious signals. There may be other spurious signals present, however, they normally are well within the specification and need not be checked.

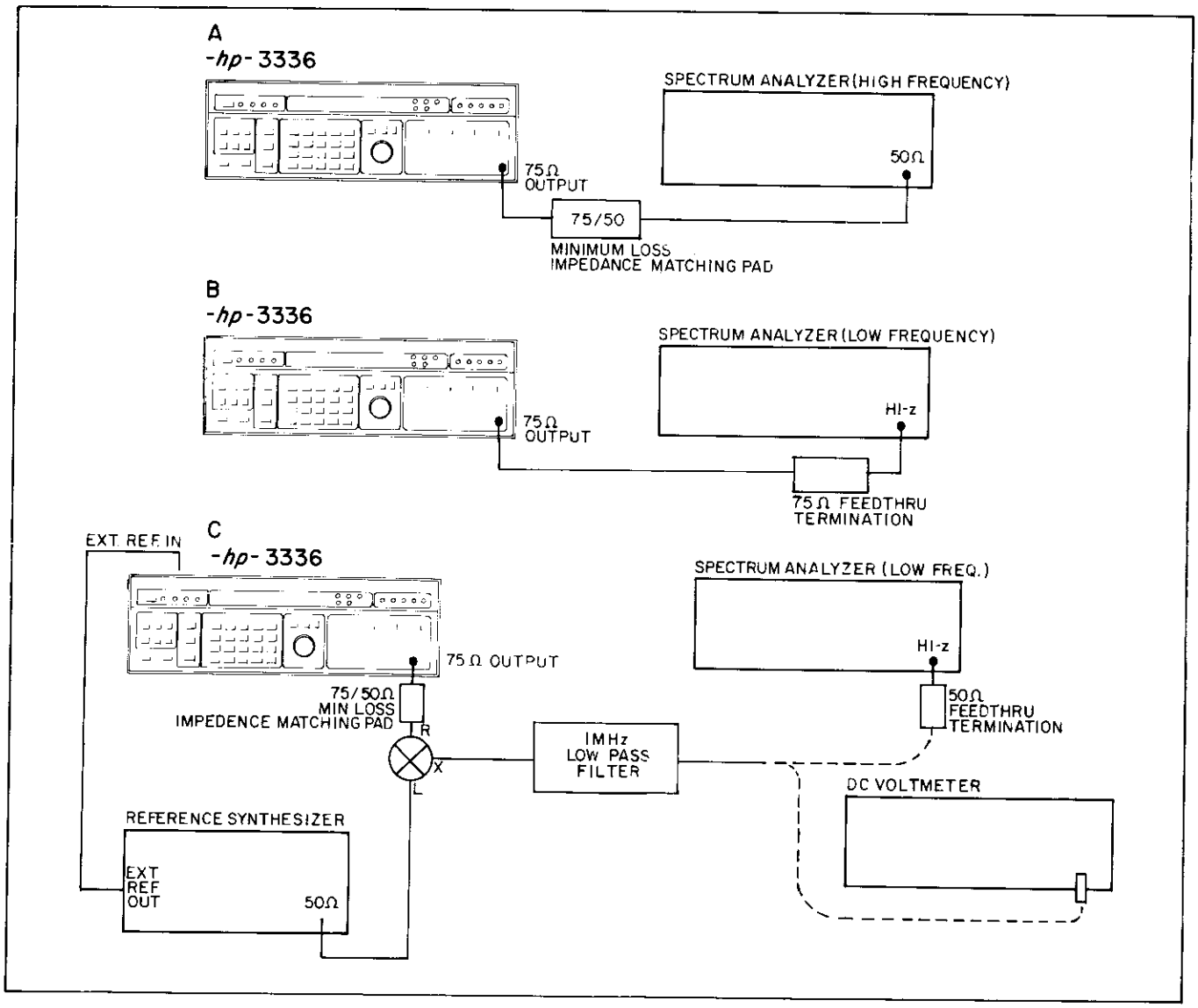


Figure 4-10. Spurious Signal Equipment Set Up.

4-31. Amplitude Modulation Envelope Distortion.

4-32. This procedure verifies that the -hp- 3336 meets the Amplitude Modulation Envelope Distortion specification listed in Table 4-1.

Specification:

All distortion related sidebands will be more than 30 dB below the first or fundamental sideband at 80% modulation. f_c = 20 MHz, f_m = 10 kHz.

Required Equipment:

Sine Wave Source	-hp- Model 3325A
Spectrum Analyzer	-hp- Model 141T/ 8552B/8553B
50-75 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B

a. Connect the equipment as shown in Figure 4-11.

b. Set the 3336 (DUT) controls as follows:

SIGNAL OUTPUT.....75 ohm
AMPLITUDE.....+7.00 dBm
FREQUENCY.....20 MHz
AMPLITUDE MODULATION.....On

c. Set the spectrum analyzer controls to display the carrier (center frequency = 20 MHz) and at least four orders of sidebands (frequency span = 100 kHz).

d. Set the frequency of the modulating signal to 10 kHz. Adjust the amplitude of the modulating signal until the first sideband is 7.96 dB below the carrier amplitude. This sideband to carrier relationship correpsonds to 80% amplitude modulation. Note, as the percent of modulation increases, the amplitude of the carrier will decrease slightly. This is normal and due to the 3336's leveling loop regulating the output power at a constant level.

e. Measure the amplitude of the distortion related sidebands relative to the first or fundamental sideband. Enter this value on the Performance Test Record.

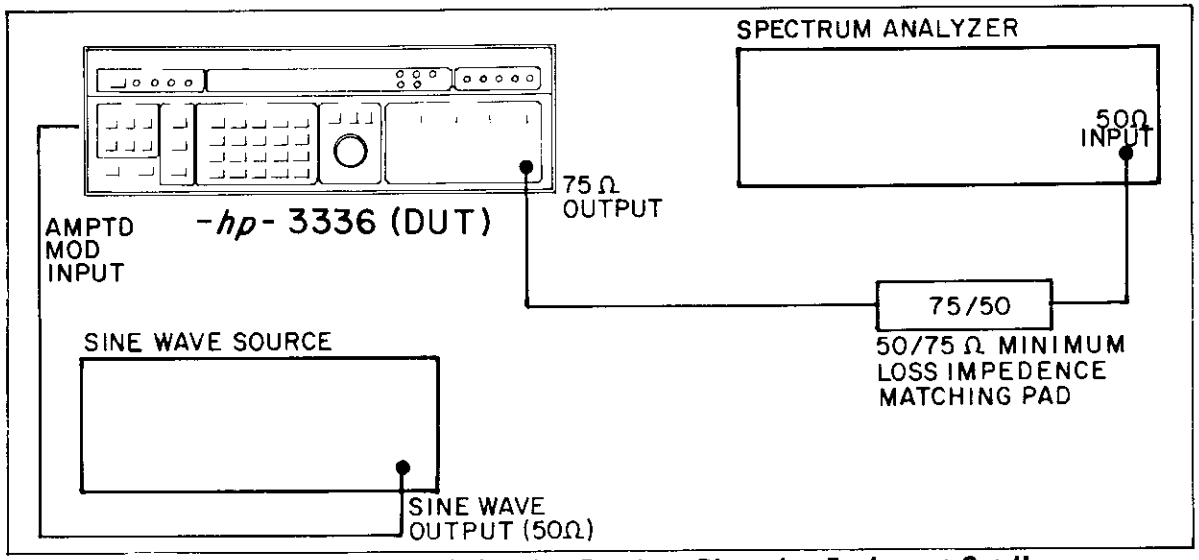


Figure 4-11. Amplitude Modulation Envelope Distortion Equipment Set Up.

4-33. Phase Modulation Linearity.

4-34. This performance test verifies that the -hp- Model 3336 meets the Phase Modulation Linearity specification in Table 4-1.

Specification:

The phase shift of the main signal, caused by the phase modulation input voltage, will be linear within .5% of the peak to peak phase deviation, compared to a best fit straight line.

Required Equipment:

dc Power Supply	-hp- Model 6216A
dc Voltmeter	-hp- Model 3455A
Electronic Counter	-hp- Model 5328A
75 ohm Feedthru Termination	-hp- Model 11094B

a. Connect the equipment as shown in Figure 4-12.

b. Set the 3336 controls as follows:

FREQUENCY.....1 MHz
OUTPUT.....75 ohm
AMPLITUDE.....+7.00 dBm
PHASE MODULATION.....ON

c. Set the electronic counter controls to measure the average time interval between input A and input B (T.I. AVG A→B). Set the number of intervals averaged to 10^6.

d. Set the power supply voltage to −5.000 V, ±.002 V. Use the dc voltmeter to adjust this voltage as precisely as possible. This is the first voltage (x_0) from the following list:

$x_0 = -5.000$ V	$x_3 = -2.000$ V	$x_6 = 1.000$ V	$x_9 = 4.000$ V
$x_1 = -4.000$ V	$x_4 = -1.000$ V	$x_7 = 2.000$ V	$x_{10} = 5.000$ V
$x_2 = -3.000$ V	$x_5 = 0.000$ V	$x_6 = 3.000$ V	

It may be easier to obtain an accurate 0.000 V by disconnecting the power supply and placing a short across the 3336's Phase Modulation input.

e. With the RPG, modify the phase of the 3336's main output until the electronic counter measures a time interval of 200 ns ± .5 ns. To achieve this accuracy, the final phase increments must be in .1° steps.

f. Without changing any other controls, set the dc power supply to the next voltage from the list in Step d. The voltages listed in Step d must be used in sequence and must be accurate to within .002 V.

g. Record the time interval (T_n) in column "T" of the work sheet at the end of this procedure.

h. Repeat Steps e thru g until time interval measurements have been taken for each voltage listed in Step d. The repeating sequence is:

1. Set the time interval to 200 ns.
2. Increment the dc voltage by 1 V.
3. Record the new time interval on the work sheet.

i. Each value entered in column "T" is the incremental time interval for a 1 volt input step, plus 200 ns. The accumulative time interval is the sum of all the preceeding incremental time intervals, less 200 ns per time interval. Find the accumulative time intervals (y_n) and enter the results in column "C", and in the "Measured Results" column on the Performance Test Record. If, for example, all the incremental time intervals are 700 ns, the accumulative time intervals would be:

0, 500 ns, 1000 ns, 1500 ns, . . . 5000 ns

j. Total all the entries in column "C".

k. Multiply the corresponding entries in column "A" and column "C" together and enter the results to 5 decimal places in column "D".

l. Total all the entries in column "D".

m. The general equations to find the slope and y intercept for a "best fit straight line" are rather involved, however, in this particular procedure they reduce to:

$$m = \frac{D}{110} \qquad b = \frac{C}{11}$$

n. Using the values for C and D from the work sheet and the formula from the previous step, compute values for m and b.

o. Using the formula $y = mx + b$, with the specific values m and b just found, compute a value y for each x recorded in column "A". Enter the results in the "Specification" column on the Performance Test Record.

p. Take the last entry in the "Specification" column and multiply it by .005. Enter this number in all the spaces in the "Tolerance" column.

q. In order for the 3336 to pass this performance test, the "Measured Results" must equal the corresponding "Specification", plus or minus the "Tolerance".

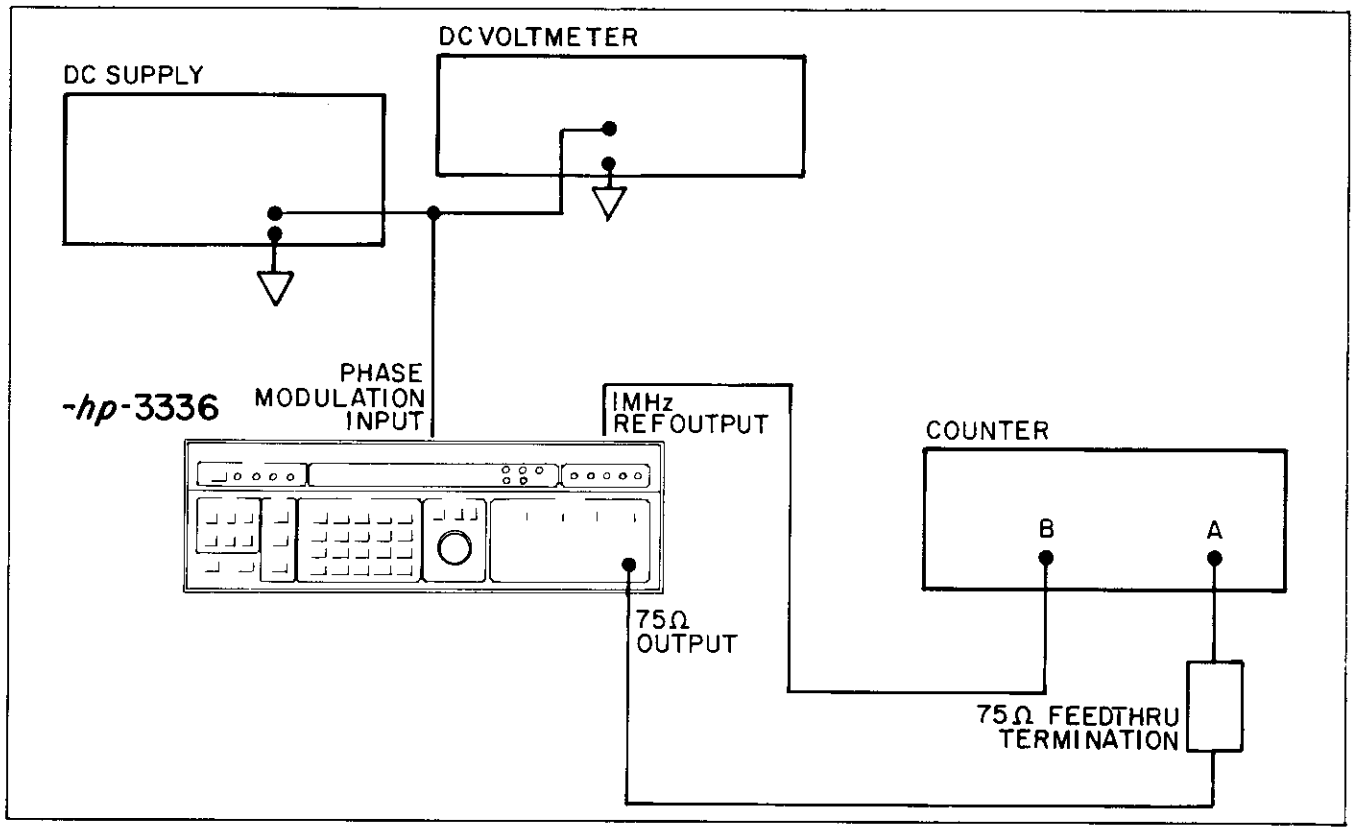


Figure 4-12. Phase Modulation Linearity Equipment Set Up.

4-35. X Drive Linearity.

4-36. This performance test verifies that the -hp- 3336 meets the X Drive Linearity specification in Table 4-1.

Specification:

The X Drive ramp will be linear within .1% of the final ramp votage, from 10% to 90%, compared to a best fit straight line.

Required Equipment:

System Voltmeter	-hp- Model 3437A
BNC to Triax Adapter	-hp- Part No. 1250-0595

a. Connect the equipment as shown in Figure 4-13.

b. Set the system voltmeter controls as follows:

RANGE.....10 V
NUMBER OF READINGS.....1
TRIGGER.....Ext

NOTE

The -hp- 3437A triggers on the negative going edge of the 3336's Z Blank signal. This occurs at the start of each sweep up.

c. Starting with the 3336 in its "turn on" condition, set the Sweep Time to .01 seconds and press the CONT key.

d. Set the system voltmeter delay to each of the following times (x_n). For each delay time, record the voltage reading (y_n) in column C of the work sheet at the end of this procedure and on the Performance Test Record in the "Measured Results" column. In both places, record this voltage to 2 decimal places.

x_0 = .001s	x_3 = .004s	x_6 = .007s
x_1 = .002s	x_4 = .005s	x_7 = .008s
x_2 = .003s	x_5 = .006s	x_8 = .009s

e. Total all the entries in column "C".

f. Multiply the corresponding entries in column "A" and column "C" together and enter the results to 5 decimal points in column "D".

g. Total all the entries in column "D".

h. The general equations to find the slope and y intercept for a "best fit straight line" are rather involved, however, in this particular procedure, they reduce to:

$$b = .527778C - 83.333D \qquad m = 16{,}667D - 83.333C$$

i. Using the values for C and D from the work sheet and the formula from the previous step, compute values for m and b.

j. Using the formula $y = mx + b$, with the specific values m and b just found, compute a value y for each x recorded in column "A". Enter the results in the "Specification" column on the Performance Test Record.

k. In order for the 3336 to pass this performance test, the "Measured Results" must equal the corresponding "Specification", plus or minus the "Tolerance".

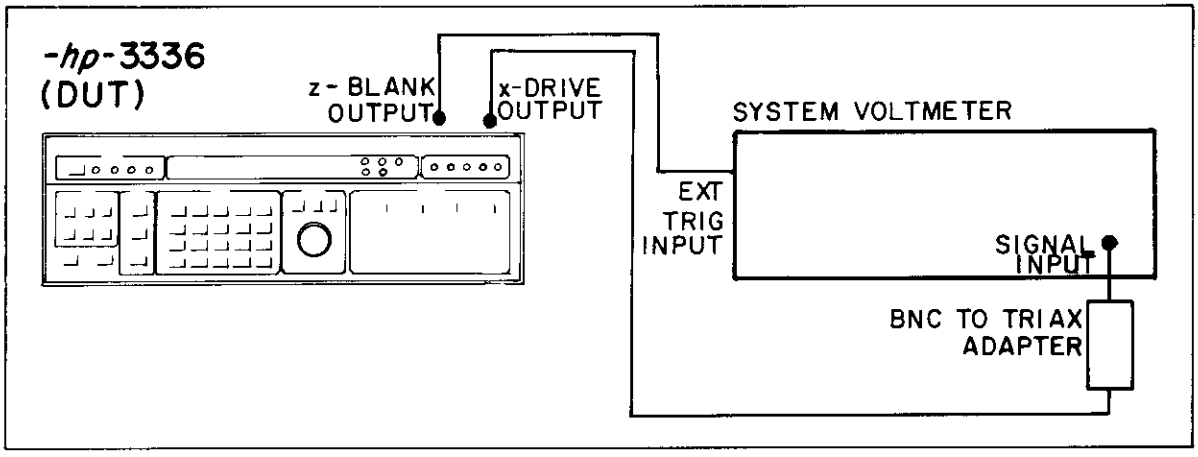


Figure 4-13. X-Drive Linearity Performance Test Equipment Set Up.

4-37. Integrated Phase Noise.

4-38. This performance test verifies that the -hp- 3336 meets the Integrated Phase Noise specification in Table 4-1.

Specification:

3336A/B: >72 dB for a 3kHz band centered 2 kHz either side of the 3336 carrier.

3336C: >60 dB for a 30 kHz band centered on the 3336 carrier, excluding 1 Hz about the carrier.

Required Equipment:

Low Phase Noise Synthesizer	-hp- Model 3335A
Mixer	-hp- Model 10534A
1 MHz Low Pass Filter	TT Electronics, Model J903
dc Voltmeter	-hp- Model 3455A
ac Voltmeter	-hp- Model 400FL
75 to 50 ohm Minimum Loss Impedance Matching Pad	-hp- Model 85428B
50 ohm Feedthru Termination	-hp- Model 11048C

15 kHz, noise equivalent, Low Pass Filter, consisting of:

Resistor: 10 k ohm	-hp- Part No. 0757-0340
Capacitor: 1600 pF	-hp- Part No. 0160-2223

a. Connect the equipment as shown in Figure 4-14. Make sure that the frequency references of the 3336 and the reference synthesizer are locked together.

b. Set the reference synthesizer controls as follows:

FREQUENCY.....20.001 MHz
AMPLITUDE.....+7.00 dBm

c. Set the 3336 (DUT) controls as follows:

FREQUENCY.....20 MHz
AMPLITUDE.....+2.7 dBm (75 ohm)

d. Record the ac voltmeter reading, using the dB scale (V_{ref}).

e. Change the reference synthesizer's frequency to 20 MHz.

f. Disconnect the ac voltmeter and connect the dc voltmeter in its place.

g. Modify the phase of the 3336's output, using the Tuning control in the Modify group, until the dc voltmeter reads 0 V, ± 10 mV.

h. Disconnect the dc voltmeter and reconnect the ac voltmeter.

i. Record the ac voltmeter reading, using the dB scale (V_{noise}).

j. Using the following formula, compute the integrated phase noise of the 3336:

Vref - Vnoise - 1.05 dB - 3 dB = integrated phase noise

NOTE

Subtract the 1.05 dB term in the formula above only if you are using an averaging voltmeter. Do not subtract 1.05 dB if you are using a true rms meter.

k. Enter the result in the Performance Test Record and compare it to the specification (>60 dB).

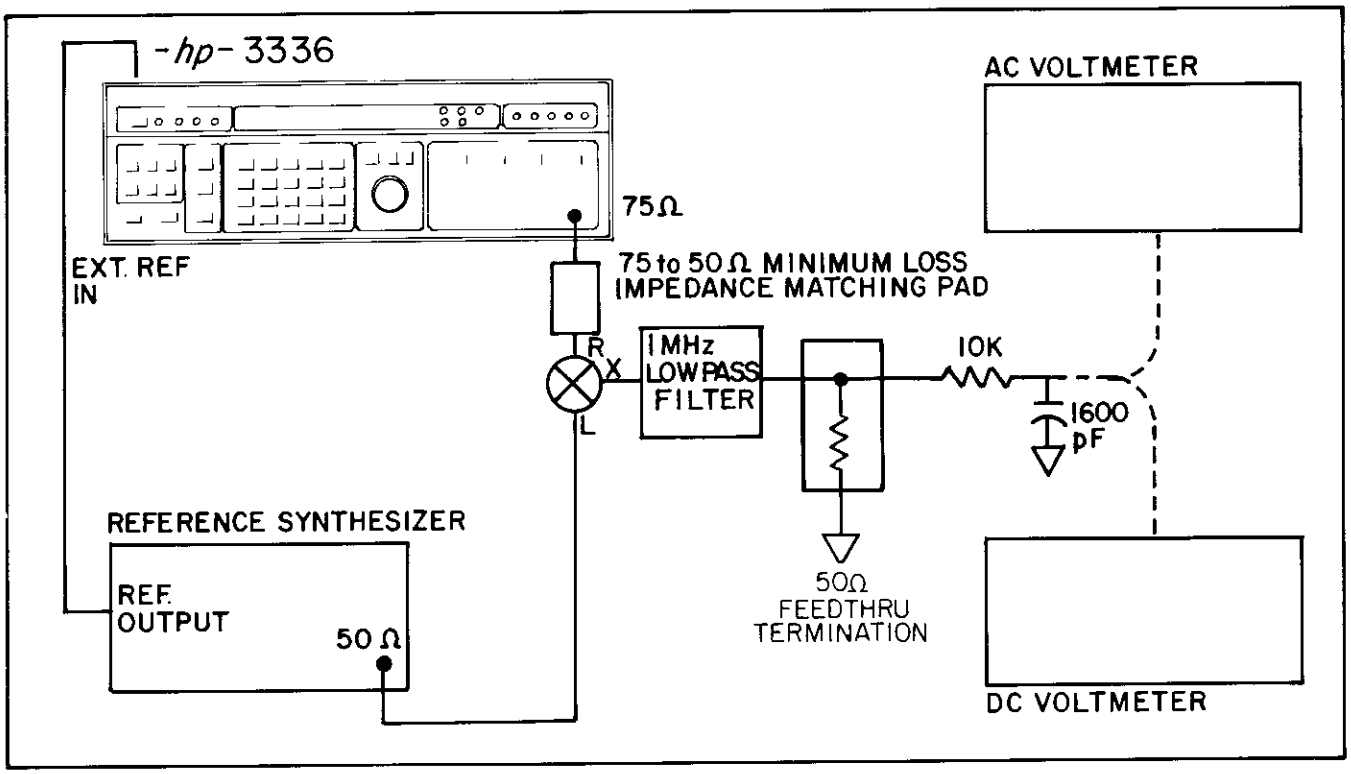


Figure 4-14. Integrated Phase Noise Equipment Set Up.

Phase Modulation Work Sheet

A	B	T	C	D
$x_0 =$ −5	$(x_0)^2 =$ 25	$T_0 =$ 200	$y_0 =$ 0	$-5y_0 =$ 0
$x_1 =$ −4	$(x_1)^2 =$ 16	$T_1 =$	$y_1 =$ ($y_1 = y_0 + T_1 - 200ns$)	$-4y_1 =$
$x_2 =$ −3	$(x_2)^2 =$ 9	$T_2 =$	$y_2 =$ ($y_2 = y_1 + T_2 - 200ns$)	$-3y_2 =$
$x_3 =$ −2	$(x_3)^2 =$ 4	$T_3 =$	$y_3 =$ ($y_3 = y_2 + T_3 - 200ns$)	$-2y_3 =$
$x_4 =$ −1	$(x_4)^2 =$ 1	$T_4 =$	$y_4 =$ ($y_4 = y_3 + T_4 - 200ns$)	$-1y_4 =$
$x_5 =$ 0	$(x_5)^2 =$ 0	$T_5 =$	$y_5 =$ ($y_5 = y_4 + T_5 - 200ns$)	$0y_5 =$ 0
$x_6 =$ +1	$(x_6)^2 =$ 1	$T_6 =$	$y_6 =$ ($y_6 = y_5 + T_6 - 200ns$)	$1y_6 =$
$x_7 =$ +2	$(x_7)^2 =$ 4	$T_7 =$	$y_7 =$ ($y_7 = y_6 + T_7 - 200ns$)	$2y_7 =$
$x_8 =$ +3	$(x_8)^2 =$ 9	$T_8 =$	$y_8 =$ ($y_8 = y_7 + T_8 - 200ns$)	$3y_8 =$
$x_9 =$ +4	$(x_9)^2 =$ 16	$T_9 =$	$y_9 =$ ($y_9 = y_8 + T_9 - 200ns$)	$4y_9 =$
$x_{10} =$ +5	$(x_{10})^2 =$ 25	$T_{10} =$	$y_{10} =$ ($y_{10} = y_9 + T_{10} - 200ns$)	$5y_{10} =$
A = 0	B = 110		C =	D =

X-Drive Linearity Work Sheet

A	B	C	D
x_0 = .001	$(x_0)^2$ = .000001	y_0 = _____	$.001y_0$ = _____
x_1 = .002	$(x_1)^2$ = .000004	y_1 = _____	$.002y_1$ = _____
x_2 = .003	$(x_2)^2$ = .000009	y_2 = _____	$.003y_2$ = _____
x_3 = .004	$(x_3)^2$ = .000016	y_3 = _____	$.004y_3$ = _____
x_4 = .005	$(x_4)^2$ = .000025	y_4 = _____	$.005y_4$ = _____
x_5 = .006	$(x_5)^2$ = .000036	y_5 = _____	$.006y_5$ = _____
x_6 = .007	$(x_6)^2$ = .000049	y_6 = _____	$.007y_6$ = _____
x_7 = .008	$(x_7)^2$ = .000064	y_7 = _____	$.008y_7$ = _____
x_8 = .009	$(x_8)^2$ = .000081	y_8 = _____	$.009y_8$ = _____
A = .045	B = .000285	C = _____	D = _____

PERFORMANCE TEST RECORD

HEWLETT—PACKARD MODEL 3336A/B/C

SYNTHESIZER/LEVEL GENERATOR

SERIAL NO. _____

Tested By: _____

Location: _____

Date: _____

FREQUENCY ACCURACY (4-12)

3336	19 999 900 Hz ≤ _____ ≤	20 000 100 Hz (should pass for one year)
3336 with Option 004	19 999 999.0 Hz ≤ _____ ≤	20 000 001.0 Hz (should pass for one week)

ABSOLUTE AMPLITUDE ACCURACY (4-14)

	Full Output	Full Output – 9.99 dB
3336A		
75 ohm output	.6096 ≤ _____ ≤ .6166	.1930 ≤ _____ ≤ .1952
150 ohm output	.4716 ≤ _____ ≤ .4770	.1493 ≤ _____ ≤ .1510
600 ohm output	1.7242 ≤ _____ ≤ 1.7441	.5459 ≤ _____ ≤ .5522
3336B		
75 ohm output	.6096 ≤ _____ ≤ .6166	.1930 ≤ _____ ≤ .1952
124 ohm output	.4288 ≤ _____ ≤ .4337	.1357 ≤ _____ ≤ .1373
135 ohm output	.4474 ≤ _____ ≤ .4526	.1416 ≤ _____ ≤ .1433
600 ohm output	1.7242 ≤ _____ ≤ 1.7441	.5459 ≤ _____ ≤ .5522
3336C		
50 ohm output	.6095 ≤ _____ ≤ .6166	.1930 ≤ _____ ≤ .1952
75 ohm output	.6096 ≤ _____ ≤ .6166	.1930 ≤ _____ ≤ .1952

AMPLITUDE FLATNESS (4-16)

	3336A	75 ohm	10 Hz	100 kHz	1 MHz	10 MHz	20.9 MHz
+	Reference Level	+5.00	+5.00	+5.00	+5.00	+5.00	+5.00
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		150 ohm	10 kHz	100 kHz	1 MHz	2.09 MHz	
+	Reference Level		+1.50	+1.50	+1.50	+1.50	
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		600 ohm	200 Hz	109 kHz			
+	Reference Level		+6.5	+6.5			
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						

	3336B	75 ohm	10 Hz	100 kHz	1 MHz	10 MHz	20.9 MHz
+	Reference Level		+5.00	+5.00	+5.00	+5.00	+5.00
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		124 ohm	10 kHz	100 kHz	1 MHz	10.9 MHz	
+	Reference Level		+1.50	+1.50	+1.50	+1.50	
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		135 ohm	10 kHz	100 kHz	1 MHz	2.09 MHz	
+	Reference Level		+1.50	+1.50	+1.50	+1.50	
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		600 ohm	200 Hz	109 kHz			
+	Reference Level		+6.50	+6.50			
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
	3336C	50 ohm	10 Hz	100 kHz	1 MHz	10 MHz	20.9 MHz
+	Reference Level		+8.50	+8.50	+8.50	+8.50	+8.50
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						
		75 ohm	10 Hz	100 kHz	1 MHz	10 MHz	20.9 MHz
+	Reference Level		+5.00	+5.00	+5.00	+5.00	+5.00
–	Amplitude Setting						
+	T.C. Error						
=	3336 Flatness						

ATTENUATOR ACCURACY (4-18)

	10 dB		
	1 MHz	10 MHz	20 MHz
V1			
V2			
20 log V1/V2			
+ Ref Attenuator Errors			
= 3336 Attenuator Error			

	20 dB		
	1 MHz	10 MHz	20 MHz
V1			
V2			
20 log V1/V2			
+ Ref Attenuator Errors			
= 3336 Attenuator Error			

	40 dB		
	1 MHz	10 MHz	20 MHz
V1			
V2			
20 log V1/V2			
+ Ref Attenuator Errors			
= 3336 Attenuator Error			

	70 dB		
	1 MHz	10 MHz	20 MHz
V1			
V2			
20 log V1/V2			
+ Ref Attenuator Errors			
= 3336 Attenuator Error			

PHASE INCREMENT ACCURACY (4-20)

Increment Size	Lower Limit		Measured Time (T2-T1)		Upper Limit
+1°	2.22 ns	≤		≤	3.33 ns
+10°	27.22 ns	≤		≤	28.33 ns
+100°	277.22 ns	≤		≤	278.33 ns

ON CARRIER RETURN LOSS (4-22)

3336A	100 kHz	1 MHz	2.09 MHz	10 MHz	20.9 MHz
75 ohm	_____ < −30	_____ < −30		_____ < −30	_____ < −30
150 ohm	_____ < −30	_____ < −30	_____ < −30		
3336B					
75 ohm	_____ < −30	_____ < −30		_____ < −30	_____ < −30
124 ohm	_____ < −30	_____ < −30	_____ < −30	_____ < −30	
3336C					
50 ohm	_____ < −30	_____ < −30		_____ < −30	_____ < −25*
75 ohm	_____ < −30	_____ < −30		_____ < −30	_____ < −30

*< −30 with Option 005.

BALANCE (4-25)

3336A	SPEC	300 Hz	10 kHz	50 kHz	100 kHz	2.09 MHz	10 MHz
150 ohm	> 36 dB		_____		_____	_____	
600 ohm	> 38 dB	_____	_____	_____			
3336B							
124 ohm	> 30 dB		_____		_____		_____
135 ohm	> 36 dB		_____		_____	_____	
600 ohm	> 38 dB	_____	_____	_____			

HARMONIC DISTORTION (4-27)

Fundamental Test Frequency	Largest Harmonic, Fast Leveling Off	Specification	Largest Harmonic, Fast Leveling On	Specification
10 Hz	_____	< −35 dB		
30 Hz	_____	< −50 dB		
50 Hz	_____	< −60 dB		
10 kHz	_____	< −60 dB	_____	< −50 dB
100 kHz	_____	< −60 dB	_____	< −60 dB
1 MHz	_____	< −60 dB	_____	< −60 dB
5 MHz	_____	< −55 dB	_____	< −55 dB
20.9 MHz	_____	< −50 dB	_____	< −50 dB

SPURIOUS SIGNAL (4-29)

Frequency	Source	all specs: < −70dB
100 kHz	Frequency Synthesis Clock	_____
1 MHz	Reference Output	_____
2 MHz	DAC Clock	_____
30 MHz	LO Feedthru	_____
60 Hz	Power Line	_____
120 Hz	Power Line	_____
180 Hz	Power Line	_____
1 kHz	API 1, 1st sideband	_____
2 kHz	API 1, 2nd sideband	_____
3 kHz	API 1, 3rd sideband	_____
4 kHz	API 1, 4th sideband	_____
19-11MHz	2:1 Mixer Spur	_____

AMPLITUDE MODULATION ENVELOPE DISTORTION (4-31)

Specification: > 30 dBc Result: _____

PHASE MODULATION LINEARITY (4-33)

Input Voltage	Specification	Tolerance	Measured Results
−5 V	_____	_____	_____
−4 V	_____	_____	_____
−3 V	_____	_____	_____
−2 V	_____	_____	_____
−1 V	_____	_____	_____
0 V	_____	_____	_____
+1 V	_____	_____	_____
+2 V	_____	_____	_____
+3 V	_____	_____	_____
+4 V	_____	_____	_____
+5 V	_____	_____	_____

X-DRIVE LINEARITY (4-35)

Specification (Tolerance)			Measured Results (Step d)		
10%	_____	±.0105V	Y_0 =	_____	
20%	_____	±.0105V	Y_1 =	_____	
30%	_____	±.0105V	Y_2 =	_____	
40%	_____	±.0105V	Y_3 =	_____	
50%	_____	±.0105V	Y_4 =	_____	
60%	_____	±.0105V	Y_5 =	_____	
70%	_____	±.0105V	Y_6 =	_____	
80%	_____	±.0105V	Y_7 =	_____	
90%	_____	±.0105V	Y_8 =	_____	

INTEGRATED PHASE NOISE (4-37)

Specification: >60 dB Measured Result: _____

WARNING

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only 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 should be removed.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains adjustment procedures required to make the -hp- 3336 meet its specifications listed in Table 4-1. These adjustments should be performed after repair and when the performance tests indicate a deficiency. To identify and locate the individual printed circuit assemblies inside the -hp-3336, refer to Figure 5-2 on page 5-13/14.

5-3. The equipment required to adjust the -hp- 3336 is listed in each adjustment procedure and in Table 4-2. Table 4-2 also gives the critical specifications for each piece of equipment. Other test equipment may be substituted if it meets or exceeds these critical specifications; however, the adjustment procedure may have to be modified slightly to account for the new equipment. For this reason, the adjustment procedures are in general terms and in some cases a discussion of the measurement technique is included.

5-4. If a series of adjustments must be performed, the order that they should be performed in is the order they are given in this section. An adjustment may affect one or more of the adjustments that follow it but should not affect those that precede it. It is recommended that a 30 minute warm-up precede any adjustment unless otherwise noted.

Adjustment	Paragraph
Power Supply Voltage	5-5
30 MHz Reference Oscillator Frequency	5-7
Option 004, High Stability Frequency Reference	5-9
VCO Range	5-11
API Current Sources	5-13
API Spur	5-15
Multiplier Input and Output Offset	5-17
2:1 Mixer Spur	5-19
−10.2 Vdc Reference Voltage	5-21
DAC Offset Voltage	5-23
Leveling Loop Amplifier Zero	5-25
Leveling Loop Bias	5-27
75 ohm Level Accuracy	5-29
Output Amplifier Flatness	5-31
124/135/150/600 ohm Level Accuracy	5-33
X Drive Final Voltage	5-35

5-5. Power Supply Voltage Adjustment.

5-6. This adjustment sets all three supply voltages within the operating tolerances of the -hp-3336.

WARNING

AC power line voltage is present at the rear panel and on the power supply printed circuit board (A2). When the front panel power switch is in the STBY (standby) position, line voltage is still applied to the instrument.

Required Equipment:

dc Voltmeter	-hp- Model 3466A

a. Measure the dc voltage at the −15V test point on the A2 Power Supply printed circuit board.

b. Adjust A2R22 until the voltage is −15V, ±0.03V.

c. Measure the dc voltage at the +5V and +15V test points. These voltages should be +5V, ±0.05V and +0.03V, respectively.

d. If necessary, readjust A2R22 until all three voltages are within tolerance.

5-7. 30 MHz Reference Oscillator Frequency Adjustment.

5-8. This procedure sets the frequency accuracy of the 30 MHz Reference Oscillator to within 5 parts per million.

Required Equipment:

Electronic Counter	-hp- Model 5328A with Option 010
75 ohm Feedthru Termination	-hp- Model 11094B

NOTE

The -hp- 3336 must be ON for at least 30 minutes before making this adjustment.

a. If the -hp- 3336 is equipped with Option 004, disconnect the special BNC to BNC adapter from the 10 MHz Oven Output and the Ext Ref Input.

b. Connect the 3336's 75 ohm output to the electronic counter using the 75 ohm Feedthru Termination at the electronic counter's Hi Z input.

c. Set the 3336 output amplitude to +7.00 dBm (maximum) and frequency to 20 MHz.

d. Adjust A3R30 until the counter reads 20 MHz as accurately as possible. The specification is 20 MHz, ±100 Hz.

e. If necessary, reconnect the special adapter removed in Step a.

5-9. Option 004, High Stability Reference Frequency Accuracy.

5-10. This procedure sets the frequency accuracy of the High Stability Frequency Reference, Option 004, to within 1 part in 10 million.

Required Equipment:

Electronic Counter	-hp- Model 5328A with Option 010
75 ohm Feedthru Termination	-hp- Model 11094B

NOTE

The -hp- 3336 must be connected to ac power for at least 72 hours before making this adjustment.

a. Make sure the special BNC to BNC adapter, supplied with Option 004, is connected between the 10 MHz Ref Output and the Ext Ref Input, and that the EXT REF annunciator is ON.

b. Connect the 3336's 75 ohm output to the electronic counter using the 75 ohm Feedthru Termination at the counter's Hi Z input.

c. Set the 3336 output amplitude to +7.00 dBm (maximum) and frequency to 20 MHz.

d. Set the electronic counter controls to resolve .1 Hz. On the -hp- 5328A, this may make the counter overflow. This overflow condition does not affect the accuracy of the measurement, and the overflow digit may be determined by changing the resolution to 1 Hz.

e. Adjust A9R7 until the counter reads 20 MHz as accurately as possible. The specification is 20 MHz, ± 1 Hz.

f. If A9R7 does not have enough range, remove the access screw from the Coarse Frequency Adjustment on the Oven assembly.

g. Adjust A9R7 to mechanical center and then, using a non-conductive tool, adjust the Coarse Frequency Adjustment until the counter reads 20 MHz as accurately as possible.

h. Replace the access screw and readjust A9R7.

5-11. Voltage Controlled Oscillator Range Adjustment.

5-12. This adjustment sets the low frequency tune voltage to the VCO and checks the VCO frequency versus tune voltage range.

Required Equipment:

dc Voltmeter	-hp- Model 3466A

a. With the -hp- 3336 in its turn-on condition, measure the dc voltage at test point A21TP11

b. Set the -hp- 3336 frequency to 60 MHz. Using a non-conductive tool, adjust A21L162 until the voltmeter reads -3.00Vdc ±.05V.

c. Set the frequency to 10 kHz. The voltmeter should read 10V ±2V.

5-13. Analog Phase Interpolation (API) Current Source Adjustment.

5-14. This procedure adjusts the API current sources, reducing the corresponding API phase modulation sidebands to their minimum value.

Required Equipment:

Spectrum Analyzer (low frequency)	-hp- Model 3580A
1 to 1 Probe	-hp- Model 10007B

a. Set the 3336 output frequency to 5 001 000 Hz.

b. Connect the spectrum analyzer to test point A21TP11 using a 1:1 probe.

c. Manually tune the spectrum analyzer to the 1kHz component. It may be necessary to misadjust A21R76 to find this signal; however, once it is found, the analyzer will not have to be retuned.

d. Adjust A21R76 until the 1 kHz signal is at its minimum amplitude.

e. Change the 3336 frequency to 5 000 100 Hz.

f. Adjust A21R74 until the 1 kHz signal is at its minimum amplitude.

g. Change the 3336 frequency to 5 000 001 Hz.

h. Adjust A21R88 until the 1 kHz signal is at its minimum amplitude.

i. The current sources that have been adjusted are API 1, API 2, and API 4. API 3 and API 5 are not adjustable.

5-15. Analog Phase Interpolation (API) Spur Adjustment.

5-16. This procedure minimizes the API 100 kHz spurs.

Required Equipment:

synthesizer	-hp- Model 3335A
impedance matching pad	-hp- Model 85428B
spectrum analyzer	-hp- Model 141T/ 8552B/8553B
DVM	-hp- Model 3466A or -hp- Model 3455A
1 MHz low pass filter	TT Electronics Inc. Model J903

a. Set up the 3335A as follows:

amplitude ..... +7.00 dBm (75 ohm output)
frequency ..... 20 MHz

b. Set up the 3336 as follows:

amplitude ..... −10 dBm
frequency ..... 20 MHz

c. Connect the DVM and adjust the phase of the 3336 to obtain 0 volts ±10 mV at the output of the filter, as shown in the following figure.

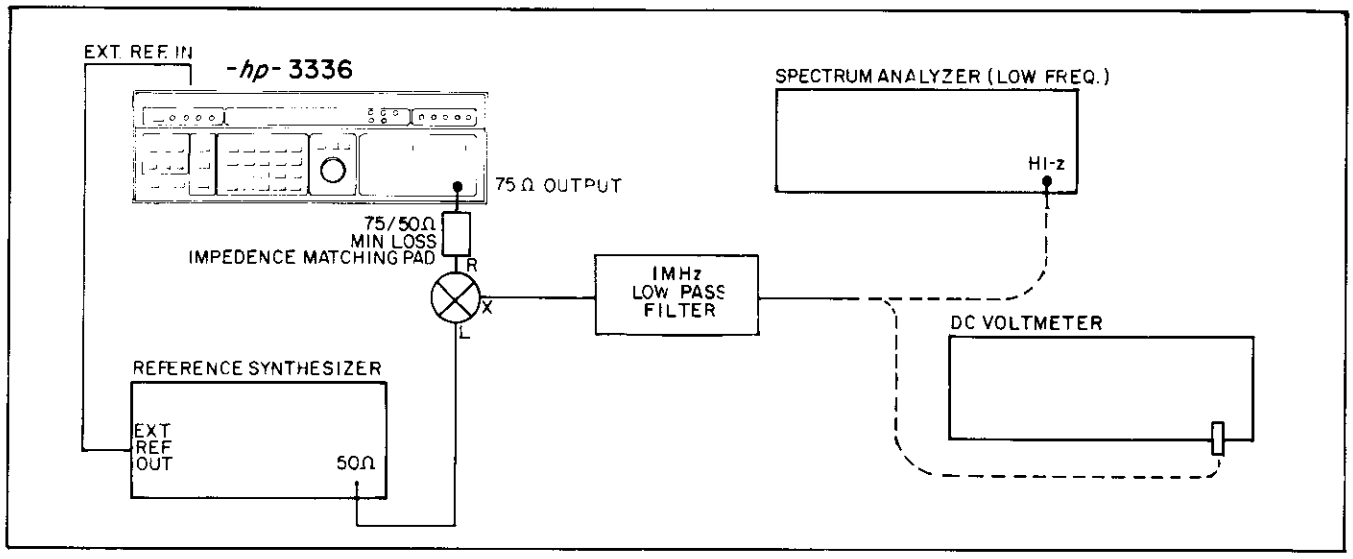


Figure 5-1. API 100 kHz Spur Adjustment Set Up

NOTE 1

This adjustment procedure applies only to newer -hp- 3336s with the A21 Frequency Synthesis board, not the original A1 board. On the old A1 assembly, R107 is not adjustable.

NOTE 2

Although A21TP11 is used as a monitoring point in the previous adjustment (API Current Source Adjustment), paragraph 5-13), it cannot be used with this adjustment set-up because the 141T/8552B/8553B has a 50 Ω input only.

d. Set up the spectrum analyzer as follows:

range. . . . . 0 - 11 MHz
center frequency . . . . . 100 kHz
scan width . . . . . 20 kHz/div
bandwidth . . . . . 3 kHz
scan time . . . . . 10 msec/div
video filter . . . . . 10 kHz
ref level . . . . . −40 dBm

e. Misadjust A21R107 until the 100 kHz spur is clearly visible.

f. Zoom in on that spur by adjusting the center frequency and scan width then the bandwidth and scan time until the analyzer is adjusted to:

center frequency . . . . . ~100 kHz
scan width . . . . . 0.1 kHz/div
bandwidth . . . . . 0.03 kHz
scan time . . . . . 0.2 sec/div

g. Switch the 8552B to manual scan mode and adjust the manual scan until the beam is on the spur.

h. Switch the 141T to non-storage

i. Adjust A21R107 to minimize the spur.

j. Return the analyzer to storage and internal sweep modes to make certain that the beam was centered on the spur.

k. It will not be possible to get the spur down into the noise floor, but it should be possible to get it down in the area of −60 dBm.

5-17 Multiplier Input and Output Offset Adjustment.

5-18 This procedure optimizes the balance of the voltage multiplier IC (A3U11).

Required Equipment:

oscilloscope	-hp- Model 1740A
function generator	-hp- Model 3312A
50 ohm feedthru termination	-hp- Model 11048C

a. Set the -hp- 3312A as follows:

Range	1 kHz
Dial	1
Offset	Cal
Amplitude	x10
Ampl Vernier	Center
Sym	Cal
Function	Square Wave

b. Set the -hp- 1740A as follows:

Channel	A
Volts/Div	0.05V
Main Trig	Ext
Time/Div	0.2msec
DC	Coupled

c. Set the -hp- 3336A/B/C as follows:

Frequency	10 kHz
Amplitude	7.00 dB

d. Connect +5Vdc to the rear panel AMPTD MOD input on the 3336.

e. Remove cable W23 on the A3 assembly.

f. Connect the 3312A 50 ohm output to J23.

g. Monitor A3 TP4 with the oscilloscope and a 10:1 scope probe.

h. Press AM ON (press blue button, then STORE 0-9 button).

i. Adjust A3R69 for minimum modulation.

j. Disconnect the +5Vdc source from the 3336 AMPTD MOD input.

k. Disconnect the 3312A from A3J23 and connect it to the AMPTP MOD input on the 3336.

l. Connect the 50 ohm feedthru termination to A3J23.

m. Adjust A3R33 for minimum modulation and adjust A3R68 for 0Vdc.

n. Disconnect the 3312A and the 50 ohm termination from the 3336 and reconnect cable W23

5-19. 2:1 Mixer Spur Adjustment.

5-20. This procedure minimizes the 2:1 intermodulation products of the mixer. The 2:1 spur is a product of the second harmonic of the VCO and the reference fundamental.

Required Equipment:

impedance matching pad	-hp- Model 85428B
spectrum analyzer	-hp- Model 141T/8553B/8552B

a. Set the 3336 as follows:

Frequency ..... 10 MHz
Amplitude ..... −2.99 dBm
Output ..... 75 ohm

b. Set the 141T/3583B/8582B as follows:

Range ..... 0 - 11 MHz
Center frequency ..... 10 MHz
Scan time ..... 1 msec/div
Bandwidth ..... 30 kHz
Scan width ..... 0.05 MHz
Input attenuation ..... 0 dB
Log ref level ..... −10 dB 10 dB/div
Video filter ..... 10 kHz

c. Connect the impedance matching pad between the 75 ohm output on the 3336 and the spectrum analyzer's input.

d. Adjust the center frequency of the spectrum analyzer to center the signal and adjust the log ref vernier to achieve a 0 dB signal.

e. while maintaining the signal in the center of the screen, adjust the spectrum analyzer as follows:

Bandwidth .....0.3 kHz
Scan width .....2 kHz/div
Scan time .....1 sec/div
Video filter .....10 Hz

f. Program the 3336 to 20 MHz and set the log ref level on the spectrum analyzer to −30 dB.

g. Switch the spectrum analyzer to manual scan mode and move the beam to the 10 MHz spur in the center of the screen, then switch to non-storage.

h. Turn on PHASE entry with MODIFY at 1° on the 3336.

i. Adjust the phase through 360° and find the worst case spur.

j. Adjust A3R115 to minimize the worst case spur. Adjust the phase through a full 360° again and make sure that the worst case is <50 dB on the screen (<70 dB below the signal).

5-21. −10.2 Vdc Reference Voltage Adjustment.

5-22. This procedure sets the dc reference voltage used in the DAC and the leveling loop.

Required Equipment:

dc voltmeter	-hp- Model 3455A

a. Connect the dc voltmeter to test point A4TP208.

b. Adjust A4R269 until the dc voltage at test point A4TP208 is −10.202V, ±.001V.

5-23. Digital-to-Analog Converter (DAC) Offset Voltage Adjustment

5-24. This adjustment compensates for the offset voltage in the DAC.

Required Equipment:

dc voltmeter	-hp- Model 3455A

a. Connect the dc voltmeter to test point A4TP AMPL.

b. Set the output amplitude to maximum (+8.76dBm, 50 ohm output or +7.00 dBm, 75 ohm output).

c. Adjust A4R40 (located between A4J4 and A4J9 — labeled DAC OS) until the dc voltmeter reads +10.000V, ±1mV.

5-25 Leveling Loop Amplifier Zero Adjustment.

5-26. This adjustment compensates for the voltage offsets of the leveling loop amplifier.

Required equipment:

oscilloscope	-hp- Model 1740A

a. Remove cable W24 from A4J24.

b. Place jumper A4TP207, located midway between A4J2 and A4J23, in the test position (away from the A3 assembly).

c. Place switches A4S1 and A4S2, located beside A4J2, to the test position (away from the A3 assembly).

d. Connect an oscilloscope probe to A4TP AMP ZERO, located beside A4S1.

e. Set the 1740A in the the ground mode with .005 volts/div and adjust the vertical position so that the trace is on the zero reference line in the center of the screen.

f. Put the oscilloscope in the dc mode and adjust A4R208 (labeled AMP ZERO - located beside A4J23) for zero dc offset at A4TP AMP ZERO.

g. Return switches A4S1 and A4S2 and jumper A4207 to their normal positions.

5-27. Leveling Loop Bias Adjustment.

5-28. This procedure balances the bias current to the thermal converter.

Required Equipment:

Oscillscope	-hp- Model 1740A

NOTE

The 3336 must be on for 30 minutes before making this adjustment.

a. Remove cable W24 from A4J24.

b. Ground test point A4TP201.

c. Connect the oscilloscope to test point A4TP AMP ZRO.

d. Set the oscilloscope to dc coupled, zero center, and 1 volt/div.

e. Adjust A4R212 (located between A4J40 and A4TP207) to center the signal and maintain it at the center of the screen.

f. Increase the sensitivity of the oscilloscope and readjust A4R212.

g. Repeat Step f until the oscilloscope is set at .005 Volts/div and the trace remains on the screen for at least 5 seconds.

h. Remove the short from A4TP201 and reconnect W24.

5-29. 75 ohm Output Level Accuracy Adjustment.

5-30. This adjustment sets the absolute amplitude accuracy of the unbalanced outputs by accurately setting the minimum and maximum values of the amplitude's dynamic range.

These values are set by adjusting the dc offset and gain of the amplitude reference amplifier.

Required Equipment:

ac voltmeter	-hp- Model 3455A with Option 001 or -hp- Model 3490A
50 ohm feedthru termination	-hp- Model 11048C
75 ohm feedthru termination	-hp- Model 11094B
75 ohm cable	

NOTE

The 3336 must be ON 30 minutes before attempting this adjustment.

a. Connect the ac voltmeter to one of the unbalanced outputs, using the proper feedthru termination at the voltmeter's input.

b. Set the output amplitude to −2.99 dBm using the 75 ohm output. Set the frequency to 10 kHz.

c. Adjust A4R259 until the ac voltmeter reads .1941 Vrms, ±.5 mV.

d. Set the output amplitude to +7.00 dBm.

e. Adjust A4R261 until the ac voltmeter reads .6130 Vrms, ±1 mV.

f. Repeat Steps b thru e until both voltages are within their tolerances. Go to Step h if it is not possible to set these voltages.

g. Set the output amplitude to +3.00 dBm.

h. The ac voltmeter should read .3868 Vrms, +1 mV. If this voltage is out of tolerance, perform the following adjustments and ther try this adjustment again.

- Multiplier Input and Output Offset (5-17)
- −10.2 Vdc Reference Voltage (5-21)
- DAC Offset Voltage (5-23)
- Leveling Loop Amplifier Zero (5-25)
- Leveling Loop Bias (5-27)

5-31. Output Amplifier Flatness Adjustment.

5-32. This adjustment optimizes the ac feedback in the output amplifier, insuring the flattest possible frequency response.

Required Equipment:

oscilloscope	-hp- Model 1740A
50 ohm feedthru termination	-hp- Model 11048C
75 ohm feedthru termination	-hp- Model 11094B

a. Set the -hp- 3336 controls as follows:

Active Output.....50 or 75 ohm
Amplitude .....Max (+7.00 dBm, 75 ohm)
Sweep Start Frequency.....1 MHz
Sweep Stop Frequency.....20.9 MHz
Sweep Time.....0.01 seconds
Sweep Type.....Linear
Fast Leveling.....ON

b. Connect the oscilloscope to test point A4TP203 using an ac coupled 10 to 1 probe.

c. Adjust A4C109, using a non-conductive tool, until the error voltage is reduced to its minimum peak to peak amplitude with no discontinuities.

5-33. 124/135/150/600 ohm Output Level Accuracy Adjustment.

5-34. These adjustments set the absolute amplitude accuracy of the balanced outputs.

NOTE

Perform the 75 ohm Output Level Adjustment before adjusting these output levels.

Required Equipment:

ac voltmeter	-hp- Model 3455A with Option 001 or -hp- Model 3490A
termination resistors	
124 ohm, 3336B only	-hp- Part No. 0698-6284
135 ohm, 3336B only	-hp- Part No. 0698-5197
150 ohm, 3336A only	-hp- Part No. 0757-0715
600 ohm, 3336A and 3336B	-hp- Part No. 0698-5405

NOTE

The 3336 must be ON for 30 minutes before attempting this adjustment.

a. Terminate a balanced output with the corresponding termination resistor.

b. Connect the ac voltmeter to the terminated output.

c. Activate the output and use the following table to determine:

—the -hp- 3336 amplitude setting
—the -hp- 3336 frequency setting
—the component to adjust
—the ac output voltage to adjust to
—the ac output voltage tolerance

Output	Freq. Setting	Amplitude Setting	Component To Adjust	Output Voltage	Voltage Tolerance
124 ohm	50 kHz	+1.76 dBm	A4R257	.4312	±1 mV
135 ohm	50 kHz	+1.76 dBm	A4R255	.4500	±1 mV
150 ohm	50 kHz	+1.76 dBm	A4R257	.4743	±1 mV
600 ohm	10 kHz	+7.00 dBm	A4R256	1.7341	±7.4 mV

e. Repeat Steps a thru c until all of the unbalanced outputs have been adjusted.

5-35. X Drive Final Voltage Adjustment.

5-36. This adjustment sets the final voltage of the X drive ramp to +10.5 Vdc.

Required Equipment:

dc voltmeter -hp- Model 3466A

a. Connect the dc voltmeter to the -hp- 3336 X Drive output.

b. Starting with the -hp- 3336 in turn-on condition, set the Sweep Time to .999 seconds.

c. Press the -hp- 3336 SINGLE key twice. The first actuation resets the sweep to the start conditions and the second starts a single sweep.

d. At the end of the sweep, the dc voltmeter should read +10.5 Vdc, ±.05 V. If the voltmeter reads less than +10.5 Vdc, adjust A4R6 slightly clockwise. If the voltmeter reads more than +10.5 Vdc, adjust A4R6 slightly counterclockwise.

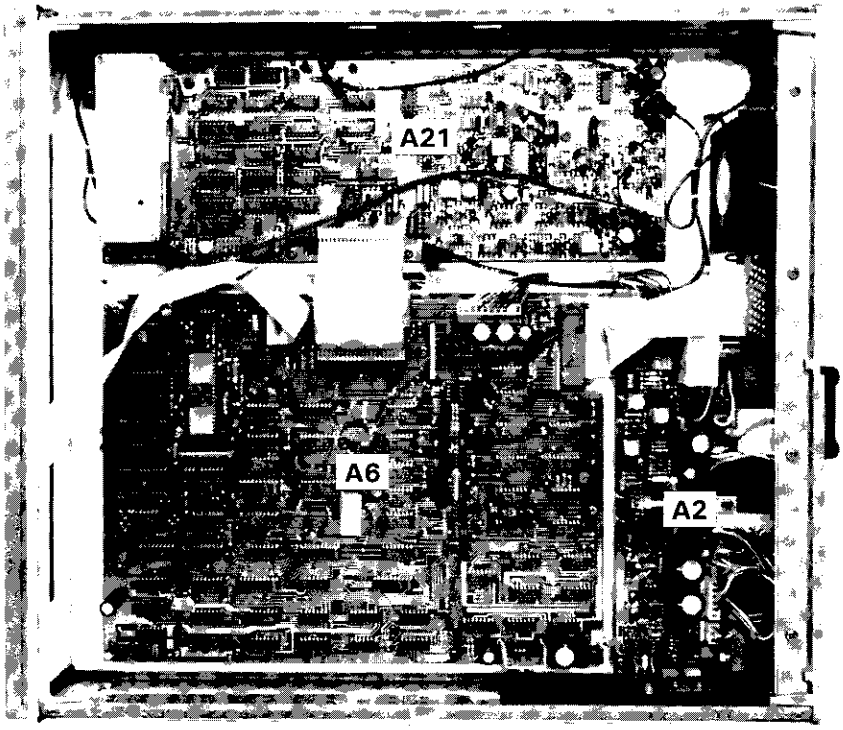
NOTE

The voltmeter will not respond directly to the adjustment of A4R6. The effect of the adjustment can only be seen after another single sweep.

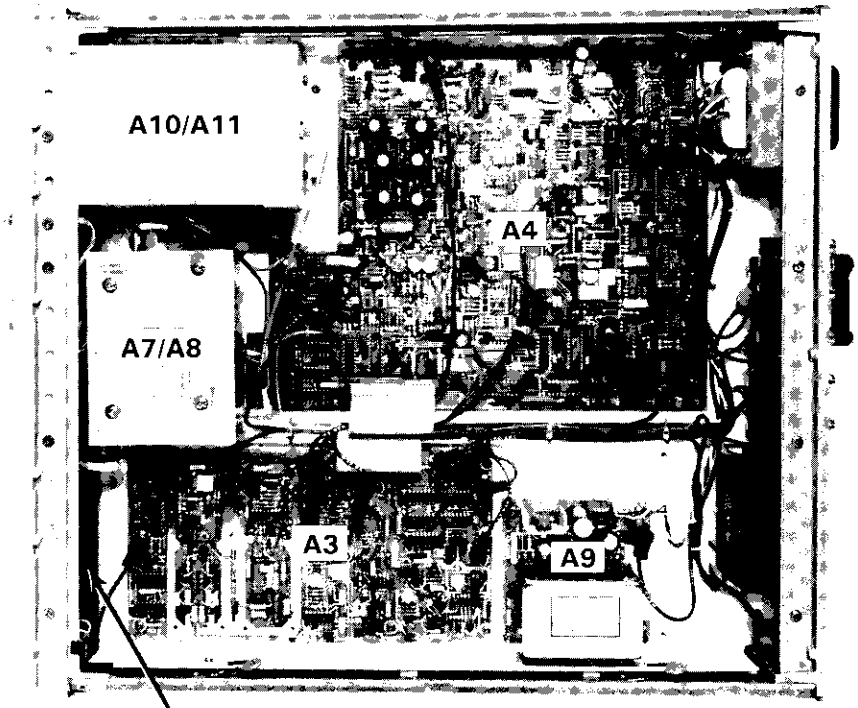
e. Press the SINGLE key twice to execute another single sweep.

f. Readjust A4R6 and execute single sweeps as necessary until the end voltage is +10.5 Vdc, ±.05 V.

g. Check the decay rate of the X Drive voltage. The final voltage should decay at less than 10 mV/second.



Top View



Bottom View

Figure 5-2. Location of Printed Circuit Assemblies.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-3 lists parts in alphanumeric order of their designators and indicates the description, -hp- Part Number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (Qty column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See List of Abbreviations in Table 6-1.)

c. Typical manufacturer of the part is a five-digit code. (See Table 6-2 for List of Manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed in Table 6-3 following their respective assemblies. General miscellaneous parts are listed at the conclusion of Table 6-3.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See List of Office Locations at the end of this manual.) Identify parts by their Hewlett-Packard part numbers. Include instrument Model and serial numbers.

6-6. NON–LISTED PARTS.

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

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

6-8. PROPRIETARY PARTS.

6-9. Items marked by a dagger (†) in the reference designator column are available only for repair and service of Hewlett-Packard instruments.

6-10. PRINTED CIRCUIT ASSEMBLIES.

6-11. Printed circuit assemblies are listed in Table 6-3. An itemized parts listing of each assembly is located in the service group associated with each printed circuit assembly.

6-12. ATTENUATOR EXCHANGE PROGRAM.

6-13. The repair of the attenuator used in the -hp- 3336 with Option 005 is not easy and is best done at the factory by experienced personnel. Furthermore, the equipment needed to verify the attenuator accuracy after it is repaired is expensive and not always immediately available. For these reasons an exchange program has been established that allows the customer to trade his bad attenuator for a fully certified rebuilt attenuator at a reasonable cost. For more information, contact your nearest -hp- Sales and Service Office and ask about the Blue Stripe Exchange program. A list of Sales and Service Offices can be found at the back of this manual.

Table 6-1. List of Abbreviations.

ABBREVIATIONS

Ag	silver	Hz	hertz (cycle(s) per second)	NPO	negative positive zero (zero temperature coefficient)	sl	slide
Al	aluminum	ID	inside diameter	ns	nanosecond(s) = 10^{-9} seconds	SPDT	single pole double-throw
A	ampere(s)	impg	impregnated	nsr	not separately replaceable	SPST	single-pole single-throw
Au	gold	incd	incandescent			Ta	tantalum
C	capacitor	ins	insulation(ed)	Ω	ohm(s)	TC	temperature coefficient
cer	ceramic			obd	order by description	TiO_2	titanium dioxide
coef	coefficient	kΩ	kilohm(s) = 10^{+3} ohms	OD	outside diameter	tog	toggle
com	common	kHz	kilohertz = 10^{+3} hertz			tol	tolerance
comp	composition			p	peak	trim	trimmer
conn	connection	L	inductor	pA	picoampere(s)	TSTR	transistor
		lin	linear taper	pc	printed circuit		
dep	deposited	log	logarithmic taper	pF	picofarad(s) 10^{-12} farads	V	volt(s)
DPDT	double-pole double-throw			piv	peak inverse voltage	vacw	alternating current working voltage
DPST	double-pole single-throw	mA	milliampere(s) = 10^{-3} amperes	p/o	part of	var	variable
		MHZ	megahertz = 10^{+6} hertz	pos	position(s)	vdcw	direct current working voltage
elect	electrolytic	MΩ	megohm(s) = 10^{+6} ohms	poly	polystyrene		
encap	encapsulated	met film	metal film	pot	potentiometer	W	watt(s)
		mfr	manufacturer	p-p	peak-to-peak	w/	with
F	farad(s)	ms	millisecond	ppm	parts per million	wiv	working inverse voltage
FET	field effect transistor	mtg	mounting	prec	precision (temperature coefficient, long term stability and/or tolerance)	w/o	without
fxd	fixed	mV	millivolt(s) = 10^{-3} volts			ww	wirewound
		μF	microfarad(s)				
GaAs	gallium arsenide	μs	microsecond(s)	R	resistor		
GHz	gigahertz = 10^{+9} hertz	μV	microvolt(s) = 10^{-6} volts	Rh	rhodium		
gd	guard(ed)	my	Mylar ®	rms	root-mean-square	*	optimum value selected at factory, average value shown (part may be omitted)
Ge	germanium			rot	rotary	**	no standard type number assigned selected or special type
gnd	ground(ed)	nA	nanoampere(s) = 10^{-9} amperes				
		NC	normally closed	Se	selenium		
H	henry(ies)	Ne	neon	sect	section(s)		® Dupont de Nemours
Hg	mercury	NO	normally open	Si	silicon		

DESIGNATORS

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

Table 6-2. Code List of Manufacturers.

Mfr. No.	Manufacturer Name	Address
01121	Allen-Bradley Co.	Milwaukee, WI 53204
01295	Texas Instr Inc Semicond Cmpnt Div.	Dallas, TX 75222
01928	RCA Corp Solid State Div.	Somerville, NJ 08876
03888	KDI Pyrofilm Corp.	Whippany, NJ 07981
04713	Motorola Semiconductor Products	Phoenix, AZ 85062
07263	Fairchild Semiconductor Div.	Mountain View, CA 94042
07716	TRW Inc Burlington Div.	Burlington, IA 52601
13606	Sprague Elect Co. Semiconductor Div.	Concord, NH 03301
18324	Signetics Corp.	Sunnyvale, CA 94086
19701	Mepco/Electra Corp.	Mineral Wells, TX 76067
20932	Emcon Div. ITW	San Diego, CA 92129
24046	Transitron Electronic Corp.	Wakefield, MA 01880
24546	Corning Glass Works (Bradford)	Bradford, PA 16701
26654	Varadyne Inc.	Santa Monica, CA 90404
27014	National Semiconductor Corp.	Santa Clara, CA 95051
28480	Hewlett-Packard Co. Corporate Hq.	Palo Alto, CA 94304
32293	Intersil Inc.	Cupertino, CA 95014
32997	Bourns Inc. Trimpot Prod. Div.	Riverside, CA 92507
34335	Advanced Micro Devices Inc.	Sunnyvale, CA 94086
51642	Centre Engineering Inc.	State College, PA 16801
56289	Sprague Electric Co.	North Adams, MA 01247
72136	Electro Motive Corp. Sub IEC	Willimantic, CT 06226
74970	Johnson E F Co.	Waseca, MN 56093
75042	TRW Inc. Philadelphia Div.	Philadelphia, PA 19108
75915	Littelfuse Inc.	Des Plaines, IL 60016
84411	TRW Capacitor Div.	Ogallala, NE 69153
91637	Dale Electronics Inc.	Columbus, NE 68601

6-12. ATTENUATOR EXCHANGE PROGRAM.

6-13. The repair of the attenuator used in the -hp- 3336 with Option 005 is not easy and is best done at the factory by experienced personnel. Furthermore, the equipment needed to verify the attenuator accuracy after it is repaired is expensive and not always immediately available. For these reasons an exchange program has been established that allows the customer to trade his bad attenuator for a fully certified rebuilt attenuator at a reasonable cost. For more information, contact your nearest -hp- Sales and Service Office and ask about the Blue Stripe Exchange program. A list of Sales and Service Offices can be found at the back of this manual.

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Au	gold	incd	incandescent			Ta	tantalum
C	capacitor	ins	insulation(ed)	Ω	ohm(s)	TC	temperature coefficient
cer	ceramic			obd	order by description	TiO_2	titanium dioxide
coef	coefficient	kΩ	kilohm(s) = 10^{+3} ohms	OD	outside diameter	tog	toggle
com	common	kHz	kilohertz = 10^{+3} hertz			tol	tolerance
comp	composition			p	peak	trim	trimmer
conn	connection	L	inductor	pA	picoampere(s)	TSTR	transistor
		lin	linear taper	pc	printed circuit		
dep	deposited	log	logarithmic taper	pF	picofarad(s) 10^{-12} farads	V	volt(s)
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DPST	double-pole single-throw	mA	milliampere(s) = 10^{-3} amperes	p/o	part of	var	variable
		MHZ	megahertz = 10^{+6} hertz	pos	position(s)	vdcw	direct current working voltage
elect	electrolytic	MΩ	megohm(s) = 10^{+6} ohms	poly	polystyrene		
encap	encapsulated	met film	metal film	pot	potentiometer	W	watt(s)
		mfr	manufacturer	p-p	peak-to-peak	w/	with
F	farad(s)	ms	millisecond	ppm	parts per million	wiv	working inverse voltage
FET	field effect transistor	mtg	mounting	prec	precision (temperature coefficient, long term stability and/or tolerance)	w/o	without
fxd	fixed	mV	millivolt(s) = 10^{-3} volts			ww	wirewound
		μF	microfarad(s)				
GaAs	gallium arsenide	μs	microsecond(s)	R	resistor		
GHz	gigahertz = 10^{+9} hertz	μV	microvolt(s) = 10^{-6} volts	Rh	rhodium		
gd	guard(ed)	my	Mylar ®	rms	root-mean-square	*	optimum value selected at factory, average value shown (part may be omitted)
Ge	germanium			rot	rotary	**	no standard type number assigned selected or special type
gnd	ground(ed)	nA	nanoampere(s) = 10^{-9} amperes				
		NC	normally closed	Se	selenium		
H	henry(ies)	Ne	neon	sect	section(s)		® Dupont de Nemours
Hg	mercury	NO	normally open	Si	silicon		

DESIGNATORS

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

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07263	Fairchild Semiconductor Div.	Mountain View, CA 94042
07716	TRW Inc Burlington Div.	Burlington, IA 52601
13606	Sprague Elect Co. Semiconductor Div.	Concord, NH 03301
18324	Signetics Corp.	Sunnyvale, CA 94086
19701	Mepco/Electra Corp.	Mineral Wells, TX 76067
20932	Emcon Div. ITW	San Diego, CA 92129
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24546	Corning Glass Works (Bradford)	Bradford, PA 16701
26654	Varadyne Inc.	Santa Monica, CA 90404
27014	National Semiconductor Corp.	Santa Clara, CA 95051
28480	Hewlett-Packard Co. Corporate Hq.	Palo Alto, CA 94304
32293	Intersil Inc.	Cupertino, CA 95014
32997	Bourns Inc. Trimpot Prod. Div.	Riverside, CA 92507
34335	Advanced Micro Devices Inc.	Sunnyvale, CA 94086
51642	Centre Engineering Inc.	State College, PA 16801
56289	Sprague Electric Co.	North Adams, MA 01247
72136	Electro Motive Corp. Sub IEC	Willimantic, CT 06226
74970	Johnson E F Co.	Waseca, MN 56093
75042	TRW Inc. Philadelphia Div.	Philadelphia, PA 19108
75915	Littelfuse Inc.	Des Plaines, IL 60016
84411	TRW Capacitor Div.	Ogallala, NE 69153
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
A2	03325-66502	9	1	POWER SUPPLY P.C. ASSEMBLY	28480	03325-66502
A2C1	0160-3508	9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C2	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C3	0160-3558	9	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A2C4	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A2C5	0180-2635	3	2	CAPACITOR-FXD 1000UF+50-10% 35VDC AL	28480	0180-2635
A2C6	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C7	0180-0309	4	1	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A2C8	0180-2635	3		CAPACITOR-FXD 1000UF+50-10% 35VDC AL	28480	0180-2635
A2C9	0180-4610	8	1		28480	0180-4610
A2C10	0160-3847	9	2	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A2C11	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C12	0160-4571	8	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A2C14	0180-1701	2	1	CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	1500685X0006A2
A2C15	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A2C16	0180-2823	1	1	CAPACITOR-FXD 470UF+50-10% 6.3VDC AL	28480	0180-2823
A2C17	0180-0423	3	2	CAPACITOR-FXD 100UF+50-10% 25VDC AL	28480	0180-0423
A2C18	0180-0423	3		CAPACITOR-FXD 100UF+50-10% 25VDC AL	28480	0180-0423
A2C19	0180-3008	6	1	CAPACITOR-FXD 470 UF 35V	28480	0180-3008
A2C20	0180-2823	1	1	CAPACITOR-FXD 470 UF 6.3V	28480	0180-2823
A2CR1	1901-0662	3	4	DIODE-PWR RECT 100V 6A	04713	MR751
A2CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A2CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A2CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A2CR5	1902-0025	4	1	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A2CR7	1902-3214		1	DIODE-BKDN 16.2V	28480	1902-3214
A2CR8	1901-0040	1	5	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR9	1902-0777	3	1	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
A2CR10	1884-0266	5	1	THYRISTOR-SCR 2N6400 TO-220AB VRRM=50	01928	2N6400
A2CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR15	1901-0518	8	1	DIODE-SCHOTTKY	28480	1901-0518
A2CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR17	1901-0535		1	DIODE SM SIG 10V	28480	1901-0535
A2CR18	1901-0518		1	DIODE 70V 410MW	28480	1901-0518
A2F2	2110-0202	1	1	FUSE .5A 250V SLO-BLO 1.25X.25 UL	75915	313.500
A2J2	1200-0661	6	2	SOCKET-XSTR 3-CONT	28480	1200-0661
A2J3	1200-0661	6		SOCKET-XSTR 3-CONT	28480	1200-0661
A2K1	0490-0745	9	1	RELAY 1C 6VDC-COIL 1A 115VAC	28480	0490-0745
A2L1	9100-3807	4	1	COIL-MLD 110NH 5% Q=50 .155DX.375LG-NOM	28480	9100-3807
A2P1	1251-3638	0	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-3638
A2P2	1251-3750	7	2	CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A2P3	1251-3750	7		CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A2P4	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A2Q4	1854-0094	4	1	TRANSISTOR NPN SI PD=200MW FT=350MHZ	28480	1854-0094
A2Q5	1853-0089	5	3	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A2Q6	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q7	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A2Q8	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q9	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q10	1854-0692	8	1	TRANSISTOR NPN SI PD=15W FT=50MHZ	04713	MJE223
A2Q11	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A2R1	0757-0283	6	2	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R2	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A2R3	0683-2035	3	3	RESISTOR 20K 5% .25W FC TC=-400/+800	01121	CB2035
A2R4	0811-2546	4	2	RESISTOR .56 5% .5W PW TC=0+-300	75042	BW-20-1/2-R56-J
A2R5	0683-3925	2	1	RESISTOR 3.9K 5% .25W FC TC=-400/+700	01121	CB3925
A2R6	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R8	0683-2035	3		RESISTOR 20K 5% .25W FC TC=-400/+800	01121	CB2035
A2R9	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R10	0811-0548	2	1	RESISTOR .47 5% .5W	28480	0811-0548
A2R11	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R12	0683-4715	0	1	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R13	0683-1525	4	1	RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
A2R14	0683-1015	7	4	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R15	0757-0404	3	1	RESISTOR 130 1%	28480	0757-0404
A2R16	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A2R17	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A2R18	0683-5125	8	1	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A2R19	0683-2705	4	1	RESISTOR 27 5% .25W FC TC=-400/+500	01121	CB2705
A2R20	0698-6360	6	2	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R21	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R22	2100-3296	8	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 17-TRN	28480	2100-3296
A2R23	0698-6619	8	1	RESISTOR 15K .1% .125W F TC=0+-25	28480	0698-6619
A2R24	0698-6320	8	1	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A2R25	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R26	0698-8191	5	1	RESISTOR 12.5K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1252-B
A2R27	0698-8060	7	1	RESISTOR 8.64K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-8641-B
A2R28	0698-3512	4	1	RESISTOR 1.18K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1181-F
A2R29	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A2R30	0683-1035	1	1	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A2R32	0683-4725	2	1	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A2R33	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A2R34	0683-1045	3	1	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A2R35	0683-2035	3		RESISTOR 20K 5% .25W FC TC=-400/+800	01121	CB2035
A2R36	0686-5115	2	1	RESISTOR 510 5%	28480	0686-5115
A2R37	0686-5115	2	1	RESISTOR 510 5% .5W CC TC=0+529	01121	EB5115
A2R41	0683-1005	5	1	RESISTOR 10 5% .25W	28480	0683-1005
A2R42	0683-1625	5	1	RESISTOR 1600 5% .25W	28480	0683-1625
A2R43	0683-3025	3	1	RESISTOR 3000 5% .25W	28480	0683-3025
A2S1	3101-1162	6	1	SWITCH-SL SPDT MINTR .5A 125VAC/DC PC	28480	3101-1162
A2S2	3101-2042	3	1	SWITCH-SL DPDT STD 2A 250VAC SLDR-LUG	28480	3101-2042
A2U1	1906-0096	7	1	DIODE-FW BRDG 200V 2A	04713	MDA202
A2U2	1826-0346	0	3	IC OP AMP GP DUAL 8-DIP-P	27014	LM358N
A2U3	1826-0346	0		IC OP AMP GP DUAL 8-DIP-P	27014	LM358N
A2U4	1826-0346	0		IC OP AMP GP DUAL 8-DIP-P	27014	LM358N
A2V1	0837-0120	0	1	VARISTOR 130V	28480	0837-0120
A2XF2	2110-0269	0	1	FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
				MECHANICAL PARTS		
A2MP1	03325-61101		1	HT SINK ASSY	28480	03325-61101
A2MP2	03325-21101		1	HT SINK	28480	03325-21101
A2MP3	0340-0564		3	INSUL - XSTR	28480	0340-0564
A2Q1	1853-0453		1	XSTR PNP SI	01698	TIP36
A2Q2	1854-0800		1	XSTR NPN SI	28480	1854-0800
A2Q3	1853-0450		1	XSTR PNP SI	02037	MJE371K
A2Q12	1853-0450	4	1	TRANSISTOR MJE371K	28480	1853-0450
A2Q13	1853-0066	8	1	TRANSISTOR 2N4250	28480	1853-0066
	7120-6712		1	LBL WARNING	28480	7120-6712
	0340-0620		1	INSULATOR	28480	0340-0620

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	03336-66503	3	1	FREQ. REF P.C. ASSEMBLY	28480	03336-66503
A3C1	0160-3558	9	8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C2	0160-3847	9	32	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C3	0160-0362	7	2	CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-0362
A3C4	0160-0362	7		CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-0362
A3C6	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C7	0160-2204	0	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3C8	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C9	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C11	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C12	0140-0191	8	1	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
A3C13	0140-0199	6	1	CAPACITOR-FXD 240PF +-5% 300VDC MICA	72136	DM15F241J0300WV1CR
A3C14	0160-2264	2	2	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2264
A3C16	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C17	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C18	0140-0204	4	1	CAPACITOR-FXD 47PF +-5% 500VDC MICA	72136	DM15E470J0500WV1CR
A3C19	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C21	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C22	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C23	0180-1746	5	6	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C24	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C26	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C27	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C28	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C29	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C31	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3C32	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C33	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C34	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C36	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C37	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C38	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C39	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C41	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C42	0160-3520	5	1	CAPACITOR-FXD 75PF +-1% 100VDC MICA	28480	0160-3520
A3C43	0160-2261	9	1	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3C44	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A3C46	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C47	0160-3085	7	1	CAPACITOR-FXD 510PF +-1% 300VDC MICA	28480	0160-3085
A3C49	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C51	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C52	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C53	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C54	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3C56	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C57	0160-2265	3	2	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A3C58	0160-2265	3		CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A3C59	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C61	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C101	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C106	0160-2252	8	1	CAPACITOR-FXD 6.2PF +-.25PF 500VDC CER	28480	0160-2252
A3C107	0160-2266	4	1	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A3C108	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C109	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A3C111	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A3C112	0160-2307	4	2	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3C113	0160-2260	8	1	CAPACITOR-FXD 13PF +-5% 500VDC CER 0+-30	28480	0160-2260
A3C114	0160-2307	4		CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3C116	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C117	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C118	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C119	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C120	0160-2244	8	3	CAPACITOR-FXD 3PF +-.25PF 500VDC CER	28480	0160-2244
A3C121	0140-0190	7	4	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C122	0160-2251	7	2	CAPACITOR-FXD 5.6PF +-.25PF 500VDC CER	28480	0160-2251
A3C123	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C124	0160-2244	8		CAPACITOR-FXD 3PF +-.25PF 500VDC CER	28480	0160-2244
A3C126	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C127	0160-2251	7		CAPACITOR-FXD 5.6PF +-.25PF 500VDC CER	28480	0160-2251
A3C128	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C129	0160-2244	8		CAPACITOR-FXD 3PF +-.25PF 500VDC CER	28480	0160-2244

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C151	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C152	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C153	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C154	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C156	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C157	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A3C158	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A3C201	0160-0128	3	1	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A3C202	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C203	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C204	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A3C205	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C206	0160-4383	0	1	CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A3C207	0160-4386	3	1	CAPACITOR-FXD 33PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-330J
A3C208	0160-0570	9	1	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A3C209	0160-0576	5	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C210	0160-3877	5	1	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A3C211	0160-4441	1	1	CAPACITOR-FXD .47UF +-10% 50VDC CER	28480	0160-4441
A3C300	0160-3874	2	1	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3CR1	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR3	1901-0518	8	2	DIODE-SCHOTTKY	28480	1901-0518
A3CR4	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A3CR6	1902-3149	9	1	DIODE-ZNR 9.09V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3149
A3CR7	1902-3030	7	1	DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
A3CR8	0122-0089	5	1	DIODE-VVC 29PF 10% C3/C25-MIN=5 BVR=30V	04713	MV109
A3CR9	1901-0040		1	DIODE SWG 30V 2 PF	28480	1901-0040
A3CR10	1901-0040		1	DIODE SWG 30V 2 PF	28480	1901-0040
A3CR101	1906-0207	2	1	DIODE-MATCHED	28480	1906-0207
A3J1	1251-6567		1	CONNECTOR	28480	1251-6567
A3J3	1251-2969	8	9	CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J5	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J6	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J7	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J8	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J9	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J10	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J11	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J15	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A3J19	1251-4822	6	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J20	1258-0141	8	1	CONNECTOR	28480	1258-0141
A3L1	9100-3551	5	1	COIL-MLD 1UH 5% Q=50 .155DX.375LG-NOM	28480	9100-3551
A3L2	9100-3458	1	5	CHOKE, WIDE BAND	28480	9100-3458
A3L3	9140-0210	1	5	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3L4	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3L5	9170-0894	0	3	CORE-SHIELDING BEAD	28480	9170-0894
A3L6	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3L7	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3L8	9100-3560	6	1	COIL-MLD 5.6UH 5% Q=45 .155DX.375LG-NOM	28480	9100-3560
A3L9	9140-0253	2	1	COIL-MLD 300NH 1% Q=45 .155DX.375LG-NOM	28480	9140-0253
A3L10	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A3L101	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A3L102	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A3L103	9140-0265	6	2	COIL-MLD 1.6UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0265
A3L104	9100-3552	6	1	COIL-MLD 1.5UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3552
A3L105	9140-0349	7	1	COIL-MLD 1.1UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0349
A3L106	9140-0265	6		COIL-MLD 1.6UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0265
A3L107	9100-0539	3	2	COIL-MLD 10UH 5% Q=55 .155DX.375LG-NOM	28480	9100-0539
A3L108	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A3L109	9170-0894	0		CORE-SHIELDING BEAD	28480	9170-0894
A3L111	9100-3315	9	2	COIL-MLD 820NH 5% .155DX.375LG-NOM	28480	9100-3315
A3L112	9100-3315	9		COIL-MLD 820NH 5% .155DX.375LG-NOM	28480	9100-3315
A3L113	9100-3546	8	4	COIL-MLD 1.3UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3546
A3L114	9100-3546	8		COIL-MLD 1.3UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3546
A3L116	9100-3546	8		COIL-MLD 1.3UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3546
A3L117	9100-3546	8		COIL-MLD 1.3UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3546
A3L118	9100-3345		1	INDUCTOR 2 UH 5%	28480	9100-3345
A3L151	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A3L152	9100-0539	3		COIL-MLD 10UH 5% Q=55 .155DX.375LG-NOM	28480	9100-0539
A3L153	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3L154	9100-3562	8	2	COIL-MLD 4.7UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3562
A3L155	9100-3562	8		COIL-MLD 4.7UH 5% Q=33 .155DX.375LG-NOM	28480	9100-3562
A3Q1	1853-0448	0	3	TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A3Q2	1855-0081	1	1	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A3Q3	1853-0089	5	1	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A3Q6	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q101	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3Q102	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A3Q201	1854-0795	2	3	TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A3Q202	1854-0215	1	1	TRANSISTOR 2N3904	28480	1854-0215
A3Q203	1854-0215	1	1	TRANSISTOR 2N3904	28480	1854-0215
A3R1	0683-4705	8	8	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R2	0698-3432	7	1	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A3R3	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R6	0683-2225	3	4	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A3R7	0698-3439	4	6	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3R8	0757-0397	3	5	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R9	0683-4715	0	2	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R10	0757-0401	0	5	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R11	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R12	0683-1245	5	1	RESISTOR 120K 5% .25W FC TC=-400/+900	01121	CB1245
A3R13	0683-4725	2	1	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A3R14	0683-1025	9	11	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R16	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R17	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A3R18	0757-0442	9	4	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R19	0683-1045	3	3	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R21	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R22	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3R23	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R24	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A3R26	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R28	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R29	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3R30	2100-3286	6	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 17-TRN	32997	3292W-1-103
A3R32	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R33	2100-3286	6	1	RESISTOR TMR 10K 10%	28480	2100-3286
A3R36	0698-0123	5	1	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A3R37	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R38	0757-0437		1	RESISTOR 4750 1% .125W	28480	0757-0437
A3R39	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R41	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R42	0757-0407	6	2	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A3R43	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R44	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R45	0698-3156	2	3	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R46	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R47	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R48	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R49	0683-1035	1	1	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R57	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R59	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R61	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R62	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R63	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R66	0698-3279	0	1	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A3R67	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R68	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A3R69	0698-4202	1	1	RESISTOR 8.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8871-F
A3R72	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R73	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R76	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R77	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R78	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R79	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R81	0698-3581	7	1	RESISTOR 13.7K 1%	28480	0698-3581
A3R82	0757-0273	4	3	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A3R83	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A3R84	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A3R86	0698-4475	0	1	RESISTOR 9.76K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-9761-F
A3R87	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R88	0757-0437	2	2	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A3R89	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A3R91	0698-4421	6	1	RESISTOR 249 1% .125W F TC=0+-100	24546	C4-1/8-T0-249R-F
A3R92	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R93	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R112	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A3R113	0698-3444	1	1	RESISTOR 316 1%	28480	0698-3444
A3R114	0698-3444	1	1	RESISTOR 316 1%	28480	0698-3444

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3R115	2100-0568	1	1	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A3R116	0757-0384	8	1	RESISTOR 20 1% .125W	28480	0757-0384
A3R117	0698-3444	1	1	RESISTOR 316 1%	28480	0698-3444
A3R118	0698-3444	1	1	RESISTOR 316 1%	28480	0698-3444
A3R119	0757-0275	6	2	RESISTOR 113 1% .125W F TC=0+-100	24546	C4-1/8-T0-113R-F
A3R120	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3R121	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R122	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R123	0757-0275	6		RESISTOR 113 1% .125W F TC=0+-100	24546	C4-1/8-T0-113R-F
A3R151	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R153	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R154	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R156	0683-1015	7	1	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A3R157	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A3R158	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3R159	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A3R160	0757-0276	7	1	RESISTOR 61.9 1%	28480	0757-0276
A3R161	0757-0276	7	1	RESISTOR 61.9 1%	28480	0757-0276
A3R162	8150-3375	5	1	JUMPER WIRE	28480	8150-3375
A3R163	8150-3375	5	1	JUMPER WIRE	28480	8150-3375
A3R164	0698-3581	7	1	RESISTOR 13.7K 1%	28480	0698-3581
A3R165	8150-3375		1	JUMPER WIRE	28480	2100-3096
A3R201	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3R202	0683-3625	9	1	RESISTOR 3.6K 5% .25W FC TC=-400/+700	01121	CB3625
A3R203	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R204	0757-0291	6	2	RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A3R205	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R206	0757-0384	8	4	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R207	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R208	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R209	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R210	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R211	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R213	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R214	0757-0291	6		RESISTOR 24.9 1% .125W F TC=0+-100	19701	MF4C1/8-T0-2492-F
A3R215	0683-1825	7	1	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
A3R216	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3T1	9100-4038	5	1	TRANSFORMER	28480	9100-4038
A3T2	08552-6044	1	1	TRANSFORMER-6-TURNS	28480	08552-6044
A3U1	1820-1991	1	1	IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS390N
A3U2	1820-0629	0	2	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A3U3	1820-0321	9	1	IC COMPARATOR GP TO-99	01295	SN72710L
A3U4	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A3U5	1820-0693	8	1	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A3U6	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
A3U7	1820-1924	0	1	IC INV TTL S HEX	18324	N8T93N
A3U8	1826-0043	4	1	IC OP AMP GP TO-99	01928	CA307T
A3U9	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A3U10	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A3U11	1826-0437	0	1	IC MULTIPLIER 14-DIP-C	04713	MC1495L
A3U12	1826-0476	7	1	IC SWITCH ANLG 8-DIP-P	01295	TL601CP
A3U13	1826-0111	7	1	IC OP AMP MC1458G	28480	1826-0111
A3U14	1858-0063	5	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	01928	CA3102E
A3U15	1858-0040	8	1	TRANSISTOR ARRAY	01928	CA3127E
A3U16	1858-0059	9	1	XSTR ARRAY 8P-DIP	28480	1858-0059
A3U17	1820-0802	1	1	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3U18	1820-1322	2	1	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A3U19	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A3Y1	0410-1115	1	1	CRYSTAL-QUARTZ 30.00000 MHZ	28480	0410-1115
				MECHANICAL PARTS		
A3MP1	03325-20601			SHIELD, TOP	28480	03325-20601
A3MP2	03325-20602			SHIELD, BOTTOM	28480	03325-20602
A3MP3	03325-04101		1	COVER - 1	28480	03325-04101
A3MP4	03325-04103		1	COVER - 3	28480	03325-04103

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	03336-66504	4	1	OUTPUT/DAC P.C. ASSEMBLY	28480	03336-66504
A4C1	0180-1701	2	1	CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A4C2	0160-3560	3	1	CAPACITOR-FXD 1UF +-2% 100VDC MET-POLYC	28480	0160-3560
A4C3	0160-3847	9	11	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C4	0160-4532	1	2	CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A4C5	0180-1746	5	6	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C6	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C7	0160-3879	7	4	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C26	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C27	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C28	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C29	0160-4571	8	1	CAPACITOR-FXD .1 UF 20%	28480	0160-4571
A4C31	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C32	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C33	0160-3466	8	1	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A4C34	0160-4532	1		CAPACITOR-FXD 1000PF +-20% 50VDC CER	28480	0160-4532
A4C35	0160-4571	8	3	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A4C36	0160-0162	5	2	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A4C37	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A4C38	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C39	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C41	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A4C42	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A4C43	0160-4137	2	1	CAPACITOR-FXD .01UF +-1% 100VDC POLYSTY	84411	863UW
A4C44	0160-0128	3	6	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C45	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C46	0160-5335		1	CAPACITOR-FXD 1.0 UF	28480	0160-5335
A4C47	0160-3558	9	29	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C48	0180-0210	6	2	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C49	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C50	0160-0576	5	1	CAPACITOR-FXD .1 UF 20% 50V	28480	0160-0576
A4C65	0160-4640	2	1	CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-4640
A4C66	0160-5335		1	CAPACITOR-FXD 1.0 UF	28480	0160-5335
A4C76	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C77	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A4C101	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A4C102	0140-0191	8	1	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
A4C103	0160-3878	6	3	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C105	0160-4640	2	1	CAPACITOR-FXD .1 UF	28480	0160-5306
A4C106	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C107	0160-4640	2	1	CAPACITOR-FXD .1 UF	28480	0160-5306
A4C108	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C109	0121-0451	3	1	CAPACITOR-V TRMR-AIR 1.7-11PF 250V	74970	187-0106-005
A4C110	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C111	0180-0374	3	3	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C112	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C113	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C114	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C115	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C116	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C117	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C118	0160-2252	8	1	CAPACITOR-FXD 6.2PF +-.25PF 500VDC CER	28480	0160-2252
A4C119	0160-4640	2	1	CAPACITOR-FXD .1 UF	28480	0160-5306
A4C120	0160-4640	2	1	CAPACITOR-FXD .1 UF	28480	0160-5306
A4C121	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C122	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C123	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C124	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C125	0160-4640	2	1	CAPACITOR-FXD .1 UF	28480	0160-5306
A4C126	0160-0570	9	5	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A4C127*	0140-0193	0	1	CAPACITOR-FXD 82PF 300V	28480	0140-0193
A4C127*	0160-2203	9	1	CAPACITOR-FXD 91PF 300V	28480	0160-2203
A4C128	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C130	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C131	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C132	0180-1838	6	1	CAPACITOR-FXD 75UF+75-10% 16VDC AL	56289	300756G016CC2
A4C133	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C134	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C135	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C136	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C137	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C138	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4C139	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C140	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C141	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C142	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C143	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C144	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C145	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C202*	0160-2150	5	1	CAPACITOR-FXD 33PF 300V	28480	0160-2150
A4C202*	0140-0192	9	1	CAPACITOR-FXD 68 PF 300V	28480	0140-0192
A4C203	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C205	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C207	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C208	0160-2204	0	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C209	0160-2246	0	1	CAPACITOR-FXD 3.6PF +-.25PF 500VDC CER	28480	0160-2246
A4C210	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C211	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C212	0160-4441	1	1	CAPACITOR-FXD .47UF +-10% 50VDC CER	28480	0160-4441
A4C213	0160-0155	6	2	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A4C214	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C215	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A4C216	0160-0155	6		CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A4C218	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C219	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C220	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A4C221	0160-0158	9	1	CAPACITOR-FXD 5600PF +-10% 200VDC POLYE	28480	0160-0158
A4C500	0160-2307	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A4C501	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A4C502	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A4C504	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A4C505	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C506	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A4C510	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A4C511	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A4CR1	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A4CR2	1901-0040	1	20	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR4	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR5	1902-3345	7	1	DIODE-ZNR 51.1V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3345
A4CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR101	1902-3030	7	1	DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
A4CR102	1902-3149	9	1	DIODE-ZNR 9.09V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3149
A4CR103	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR104	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR201	1901-0518	8	4	DIODE-SCHOTTKY	28480	1901-0518
A4CR202	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A4CR203	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR204	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR205	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A4CR206	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR207	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR208	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR209	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR210	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR211	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR212	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR213	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR214	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A4CR215	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A4CR216	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR217	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR218	1902-3265	0	1	DIODE-ZNR 25.5V 5% DO-7 PD=.4W TC=+.08%	28480	1902-3265
A4CR219	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR220	1902-0686	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
A4CR221	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR222	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR223	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4F1	2110-0343	1	3	FUSE .25A 125V FAST-BLO .281X.093	28480	2110-0343
A4F2	2110-0343	1		FUSE .25A 125V FAST-BLO .281X.093	28480	2110-0343
A4F101	2110-0343	1		FUSE .25A 125V FAST-BLO .281X.093	28480	2110-0343
A4J1	1251-6567		1	CONNECTOR	28480	1251-6567
A4J9	1251-2969	6	8	CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4J13, J14	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J30	1251-4504	1	1	CONNECTOR- 10-PIN M POST TYPE	28480	1251-4504
A4J101	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J102	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J103	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J201	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J202	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
A4J203	1251-4822		1	3 PIN CONN	28480	1251-4822
A4K201	0490-1137	5	1	RELAY-REED 1A 500MA 200VAC 5VDC-COIL	28480	0490-1137
A4L1	9100-2247	4	1	COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A4L26	9100-3458	1	8	CHOKE, WIDE BAND	28480	9100-3458
A4L27	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L76	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L77	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L78	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L101	9100-2486	3	1	COIL-MLD 330NH 5% Q=45 .156DX.375LG-NOM	28480	9100-2486
A4L102	9140-0348	6	1	COIL-MLD 360NH 5% Q=45 .155DX.375LG-NOM	28480	9140-0348
A4L103	9140-0265	6	2	COIL-MLD 1.6UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0265
A4L104	9140-0265	6		COIL-MLD 1.6UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0265
A4L105	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L106	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4L107	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
A4P203	1258-0141		1	JUMPER	28480	1258-0141
A4Q1	1855-0092	4	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0092
A4Q2	1855-0006	4	1	TRANSISTOR J-FET P-CHAN D-MODE SI	32293	IT110
A4Q3	1854-0692	8	1	TRANSISTOR NPN SI PD=15W FT=50MHZ	04713	MJE223
A4Q4	1855-0406	4	1	JFET P CH	28480	1855-0406
A4Q25	1855-0410	0	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0410
A4Q26	1853-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q27	1853-0066	8	2	TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q28	1854-0215	1	3	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A4Q101	1853-0448	0	0	TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A4Q102	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A4Q103	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A4Q104	1854-0233	3	1	TRANSISTOR NPN 2N3866	28480	1854-0233
	1205-0018	7	1	HEAT SINK TO-18-CS	28480	1205-0018
A4Q105	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
A4Q106	1854-0795	2	1	TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPSH10
A4Q107	1854-0378	7	3	TRANSISTOR NPN 2N5109 SI TO-39 PD=800MW	01928	2N5109
A4Q108	1853-0293	3	3	TRANSISTOR PNP 2N5583 SI TO-39 PD=1W	04713	2N5583
A4Q109	1853-0293	3		TRANSISTOR PNP 2N5583 SI TO-39 PD=1W	04713	2N5583
A4Q110	1854-0378	7		TRANSISTOR NPN 2N5109 SI TO-39 PD=800MW	01928	2N5109
A4Q111	1854-0378	7		TRANSISTOR NPN 2N5109 SI TO-39 PD=800MW	01928	2N5109
A4Q112	1853-0293	3		TRANSISTOR PNP 2N5583 SI TO-39 PD=1W	04713	2N5583
A4Q113	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A4Q201	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A4Q202	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A4Q203	1854-0404	0	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4R1	0683-2215	1	1	RESISTOR 220 5% .25W FC TC=-400/+600	01121	CB2215
A4R3	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A4R4	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4R5	0683-2225	3	8	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R6	2100-3253	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A4R7	0698-4817	4	1	RESISTOR 953K 1% .25W F TC=0+-100	28480	0698-4817
A4R8	0698-7850	1	1	RESISTOR 9.455K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-9455R-B
A4R9	0757-0410	1	2	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A4R11	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A4R12	0683-1035	1	7	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R13	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R14	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R15	0683-1025	9	6	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R19	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R20	0683-1835	9	1	RESISTOR 18K 5% .25W FC TC=-400/+800	01121	CB1835
A4R26	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R27	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R28	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R29	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R31	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R32	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R33	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R34	0683-5635	5	1	RESISTOR 56K 5% .25W FC TC=-400/+800	01121	CB5635
A4R36	0683-2235	5	1	RESISTOR 22K 5% .25W FC TC=-400/+800	01121	CB2235
A4R37	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R38	0757-0289	2	3	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A4R39	0757-0442	9	8	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R40	2100-0558	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A4R41	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A4R43	0683-2015	9	1	RESISTOR 200 5% .25W FC TC=-400/+600	01121	CB2015

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*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R44	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4R45	0683-4705	8	1	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A4R46	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R47	0683-2265	1	2	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A4R48	0683-4725	2	1	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A4R49	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R50	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R51	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R52	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R53	0698-6347	9	1	RESISTOR 1.5K .1% .125W F TC=0+-25	28480	0698-6347
A4R54	0698-6936	2	1	RESISTOR 156K .5% .125W F TC=0+-50	28480	0698-6936
A4R55	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R56	0757-0449	6	2	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A4R57	0699-0121	7	1	RESISTOR 2.05M 1% .125W F TC=0+-100	28480	0699-0121
A4R65	0683-1015	7	2	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A4R67	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R68	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A4R69	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A4R70	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R77	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A4R101	0698-4453	4	3	RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A4R102	0698-4453	4		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A4R103	0698-4453	4		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A4R104	0698-3437	2	3	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A4R105	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A4R106	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A4R107	0757-0368	8	3	RESISTOR 34 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R0-F
A4R108	0757-0368	8		RESISTOR 34 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R0-F
A4R109	0757-0368	8		RESISTOR 34 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R0-F
A4R110	0698-3558	8	4	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A4R111	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A4R112	0698-8353	1	2	RESISTOR 806K 1% .125W F TC=0+-100	28480	0698-8353
A4R113	0757-0384	8	4	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A4R114	0698-8353	1		RESISTOR 806K 1% .125W F TC=0+-100	28480	0698-8353
A4R115	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A4R116	0683-1815	5	1	RESISTOR 180 5% .25W FC TC=-400/+600	01121	CB1815
A4R117	0698-4123	5	8	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R118	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R119	0698-4539	7	1	RESISTOR 402K 1% .125W F TC=0+-100	28480	0698-4539
A4R120	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R121	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R122	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R123	0757-0277	8	6	RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R124	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4R125	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4R126	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R127	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R128	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R129	0699-0389	9	2	RESISTOR 5.1 1% .25W F TC=0+-100	28480	0699-0389
A4R130	0699-0389	9		RESISTOR 5.1 1% .25W F TC=0+-100	28480	0699-0389
A4R131	0760-0026	2	4	RESISTOR 75 2% 1W MO TC=0+-200	28480	0760-0026
A4R132	0760-0026	2		RESISTOR 75 2% 1W MO TC=0+-200	28480	0760-0026
A4R133	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A4R134	0757-0384	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A4R135	0698-0042	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4R136	0698-3488	3	2	RESISTOR 442 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A4R137	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R138	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R139	0698-3488	3		RESISTOR 442 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A4R140	0760-0026	2		RESISTOR 75 2% 1W MO TC=0+-200	28480	0760-0026
A4R141	0757-0346	2	3	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4R142	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4R143	0760-0026	2		RESISTOR 75 2% 1W MO TC=0+-200	28480	0760-0026
A4R144	0757-0280	3	9	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R145	0698-8155	1	1	RESISTOR 90 .1% 1W F TC=0+-25	07716	BR5-1-T9-50R0-B
A4R146	0757-0472	5	3	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A4R147	0698-4482	9	1	RESISTOR 17.4K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-1742-F
A4R148	0757-0284	7	1	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A4R149	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
A4R150	0698-8345	1	2	RESISTOR 634K 1% .125W F TC=0+-100	28480	0698-8345
A4R151	0698-7332	4	6	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A4R152	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R153	0683-0515	0	2	RESISTOR 5.1 5% .25W FC TC=-400/+500	01121	CB51G5
A4R154	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R155	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R156	0683-0515	3		RESISTOR 5.1 5% .25W FC TC=-400/+500	01121	CB51G5
A4R157	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A4R158	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A4R159	0757-0472	5		RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A4R160	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R161	0757-0273	4	3	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A4R162	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4R163	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R164	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R165	0757-0465	6	6	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R166	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R167	0698-8345	1		RESISTOR 634K 1% .125W F TC=0+-100	28480	0698-8345
A4R201 A	0698-3951	5	2	RESISTOR 10K (MATCHED TO A4R204)	28480	0698-3951
A4R202*	0698-4450	1	1	RESISTOR 324 1%	28480	0698-4450
A4R202*	0698-4424	9	1	RESISTOR 1400 1%	28480	0698-4424
A4R203	0683-1065	7	1	RESISTOR 10M 5% .25W FC TC=-900/+1100	01121	CB1065
A4R204	0698-3951	5		RESISTOR 10K (MATCHED TO A4R201)	28480	0698-3951
A4R205	0698-3952	6	4	RESISTOR 499K (MATCHED TO A4R206)	28480	0698-3952
A4R206	0698-3952	6		RESISTOR 499K (MATCHED TO A4R205)	28480	0698-3952
A4R207	0698-4095	4	1	RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A4R208	2100-3659	7	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 17-TRN	32997	3292W-1-203
A4R209	0698-3952	6		RESISTOR 499K (MATCHED TO A4R210)	28480	0698-3952
A4R210	0698-3952	6		RESISTOR 499K (MATCHED TO A4R209)	28480	0698-3952
A4R211	0757-0472	5		RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A4R212	2100-3096	6	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 17-TRN	32997	3292W-1-503
A4R213	0698-3459	8	1	RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A4R214	0757-0485	0	1	RESISTOR 681K 1% .125W F TC=0+-100	28480	0757-0485
A4R215	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4R216	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R217	0757-0270	1	2	RESISTOR 249K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2493-F
A4R218	0757-0270	1		RESISTOR 249K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2493-F
A4R219	0698-4308	8	1	RESISTOR 16.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1692-F
A4R220	0698-4517	1	1	RESISTOR 127K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1273-F
A4R221	0698-4528	4	1	RESISTOR 210K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2103-F
A4R222	0698-4470	5	1	RESISTOR 6.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6981-F
A4R223	0698-0064	5	1	RESISTOR 9.31K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-9311-F
A4R224	0698-4478	3	1	RESISTOR 10.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1072-F
A4R225	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A4R226	0698-4455	6	2	RESISTOR 536 1% .125W F TC=0+-100	24546	C4-1/8-T0-536R-F
A4R227	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R228	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R229	0683-1225	1	1	RESISTOR 1.2K 5% .25W FC TC=-400/+700	01121	CB1225
A4R230	0757-0454	3	2	RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A4R231	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R232	0698-4473	8	1	RESISTOR 8.06K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8061-F
A4R233	0698-4307	7	1	RESISTOR 14.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1432-F
A4R234	0698-8344	0	1	RESISTOR 604K 1% .125W F TC=0+-100	28480	0698-8344
A4R235	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A4R236	0757-0454	3		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A4R237	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R238	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R239	0757-0426	9	1	RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1301-F
A4R241	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R242	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R243	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A4R244	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A4R245	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A4R247	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R248	0698-8319	9	2	RESISTOR 10K 1% .1W F TC=0+-10	19701	5032J1/8-T13-1002-F
A4R249	0698-3955	9	1	RESISTOR 1.0K 1% .1W F TC=0+-10	28480	0698-3955
A4R250	0698-3179	9	1	RESISTOR 2.55K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2551
A4R251	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A4R252	0698-4497	6	3	RESISTOR 48.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4872-F
A4R253	0698-4497	6		RESISTOR 48.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4872-F
A4R254	0698-4497	6		RESISTOR 48.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4872-F
A4R255	2100-3214	0	3	RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	28480	2100-3214
A4R256	2100-3214	0		RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	28480	2100-3214
A4R257	2100-3214	0		RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	28480	2100-3214
A4R258	0698-8319	9		RESISTOR 10K 1% .1W F TC=0+-10	19701	5032J1/8-T13-1002-F
A4R259	2100-3089	7	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A4R260	0698-3953	7	1	RESISTOR 9.82K 1% .1W F TC=0+-10	28480	0698-3953
A4R261	2100-3296	8	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 17-TRN	28480	2100-3296
A4R262	0698-3954	8	1	RESISTOR 9.18K 1% .1W F TC=0+-10	28480	0698-3954
A4R263	0698-3957	1	1	RESISTOR 34.4K 1% .1W F TC=0+-10	28480	0698-3957
A4R264	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
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R265	0698-4455	6		RESISTOR 536 1% .125W F TC=0+-100	24546	C4-1/8-T0-536R-F
A4R266	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A4R267	0757-0445	2	3	RESISTOR 13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1302-F
A4R268	0698-7957	9	1	RESISTOR 9.8K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-7871-F
A4R269	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A4R270	0757-0430	5	1	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A4R271	0698-6625	6	1	RESISTOR 6K .1% .125W F TC=0+-25	28480	0698-6625
A4R272	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-49R9-F
A4R273	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A4R274	0757-0445	2		RESISTOR 13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1302-F
A4R275	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A4R276	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R277	0757-0486	1	1	RESISTOR 750K 1% .125W F TC=0+-100	28480	0757-0486
A4R278	0698-3458	7	1	RESISTOR 348K 1% .125W F TC=0+-100	28480	0698-3458
A4R279	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R2R0	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A4R2R1	0757-0445	2		RESISTOR 13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1302-F
A4R2R2	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A4R2R3	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A4R2R4	0698-3279	0	1	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A4R2R5	0698-3228	9	1	RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
A4R2R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R2R7	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A4R2R8	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A4R290	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R291	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4S1	3101-1341	3	2	SWITCH-SL SPDT SUBMIN .5A 125VAC/DC	28480	3101-1341
A4S2	3101-1341	3		SWITCH-SL SPDT SUBMIN .5A 125VAC/DC	28480	3101-1341
A4U1	1820-1196	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A4U2	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A4U3	1826-0476	7	1	IC-SW TL601CP	28480	1826-0476
A4U4	1826-0476	7	1	IC SWITCH ANLG R-DIP-P	01295	TL601CP
A4U5	1826-0304	0	1	BIFET LF355H	28480	1826-0304
A4U6	1820-1278	7	1	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A4U7	1820-1279	8	3	IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
A4U8	1820-1279	8		IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
A4U9	1820-1279	8		IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
A4U10	1820-1282	3	1	IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN74LS109AN
A4U11	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A4U12	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A4U13	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A4U14	1820-0693	8	1	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A4U15	1821-0001	4	1	TRANSISTOR ARRAY	01928	CA3046
A4U16	1826-0304	0	1	BIFET LF355H	28480	1826-0304
A4U17	1826-0304	0	1	BIFET LF355H	28480	1826-0304
A4U18	1820-1144	6	3	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A4U19	1958-0047	5	2	TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A4U20	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A4U21	1958-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A4U22	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A4U23	1826-0208	3	2	IC OP AMP GP 8-DIP-P	27014	LM310N
A4U24	1826-0416	5	1	IC LF13331-D AN SW	28480	1826-0416
A4U25	1826-0208	3		IC OP AMP GP 8-DIP-P	27014	LM310N
A4U26	1820-1730	6	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U27	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A4U28	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A4U29	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U30	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U31	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A4U32	1820-1091	6	1	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A4U41	1826-0416	5	1	IC 13331-D AN SW	28480	1826-0416
A4U42	1826-0416	5	1	IC 13331-D AN SW	28480	1826-0416
A4U101	1826-0522	4	4	IC OP AMP QUAD 14-DIP-P	01295	TL074CN
A4U102	1826-0522	4		IC OP AMP QUAD 14-DIP-P	01295	TL074CN
A4U103	1826-0522	4		IC OP AMP QUAD 14-DIP-P	01295	TL074CN
A4U104	1826-0522	4		IC OP AMP QUAD 14-DIP-P	01295	TL074CN
A4U105	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A4U106	1820-0321	9	1	IC COMPARATOR GP TO-99	01295	SN72710L
A4U107	1826-0111	7	1	IC OP AMP GP DUAL TO-99	04713	MC1458G
A4U201	1826-0035	4	1	IC OP AMP LOW-DRIFT TO-99	27014	LM308AH
A4U202	1854-0830	6	1	TRANSISTOR-DUAL NPN PD=500MW	27014	LM394
A4U203	1SB1-0021		1	RMS CONVERTER (POWER DETECTOR)	28480	1SB1-0021
				MECHANICAL PARTS		
A4MP1	1205-0033		6	HT SINK-SEMICON	28480	1205-0033
A4MP2	1205-0018		1	HT SINK-SEMICON	28480	1205-0018
	2140-0016	8	1	RPG LIGHT BULB	28480	2140-0016

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	03336-66505	5	1	KEYBOARD P.C. ASSEMBLY (33368)	28480	03336-66505
A5C1	0160-3847	9	5	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A5C2	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A5C3	0180-0062	6	1	CAPACITOR-FXD 300UF+75-10% 6VDC AL	28480	0180-0062
A5C4	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A5C5	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A5C6	0160-4571	8	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A5C7	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A5C8	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5CR1	1990-0533	4	14	LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR2	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR3	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR4	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR5	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR6	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR7	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR8	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR9	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR10	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR11	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR12	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR13	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR14	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A5CR15	1990-0486	6	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A5CR16	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A5CR17	1990-0665	3	15	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR18	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR19	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR20	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR21	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR22	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR23	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR24	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR25	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR26	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR27	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR28	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR29	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR30	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5CR31	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A5E1	03582-61620		1	RPG ASSY	28480	03582-61620
A5J2	1251-5041		1	CONNECTOR	28480	1251-5041
A5L1	9100-3334	2	1	COIL 25UH 10% .3D-NOM SRF=7MHZ	28480	9100-3334
A5Q1	1853-0016	8	8	TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q2	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q3	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q4	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q5	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q6	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q7	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5Q8	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A5R1	0683-2205	9	8	RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R2	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R3	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R4	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R5	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R6	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R7	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R8	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A5R9	0757-0280	3	1	RESISTOR 1000 1% .125W	28480	0757-0280
A5R11	0683-1325	2	8	RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R12	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R13	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R14	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R15	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R16	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R17	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R18	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A5R21	1810-0164	7	2	NETWORK-RES 9-SIP4,7K OHM X 8	91637	CSP09C07-472J
A5R22	1810-0164	7		NETWORK-RES 9-SIP4,7K OHM X 8	91637	CSP09C07-472J
A5R23	1810-0135	2	1	NETWORK-RES 6-SIP10,0K OHM X 5	28480	1810-0135
A5R24	1810-0055	5	1	NETWORK-RES 9-SIP10,0K OHM X 8	28480	1810-0055
A5R25	0811-3069	8	1	RESISTOR 1 5% .5W PW TC=0+-150	75042	BW20-1-1R0-J

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5SW1	5060-9436	7	38	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW35	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW36	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW37	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW38	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5SW39	3101-2441	6	1	SW-PSHBIN	28480	3101-2441
A5U1	1990-0592	5	11	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U2	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U3	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U4	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U5	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U6	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U7	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U8	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U9	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U10	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U11	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A5U12	1858-0047	5	3	TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A5U13	1820-1200	5	2	IC INV TTL LS HEX	01295	SN74LS05N
A5U14	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A5U15	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A5U16	1820-1200	5		IC INV TTL LS HEX	01295	SN74LS05N
A5U17	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A5U18	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A5U19	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A5U20	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A5U21	1820-1438	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257AN
	1200-0473		1	SOCKET-IC 16 DIP	28480	1200-0473
	1200-0638		1	SOCKET-IC 14 DIP	28480	1200-0638

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				NOTE KEYCAP DESIGNATORS CORRESPOND TO SWITCH DESIGNATORS. EXAMPLE: A5KS1 IS THE KEYCAP FOR A5SW1. KEYCAPS ALSO APPLY TO A15 AND A25 FRONT PANELS.		
A5KS1	5041-0943		1	KEYCAP LOCAL	28480	5041-0943
A5KS2	5041-0384		6	KEYCAP SMOKEPIPE	28480	5041-0384
A5KS3	5041-0384			KEYCAP SMOKEPIPE	28480	5041-0384
A5KS4	5041-0384			KEYCAP SMOKEPIPE	28480	5041-0384
A5KS5	5041-0384			KEYCAP SMOKEPIPE	28480	5041-0384
A5KS6	5041-0384			KEYCAP SMOKEPIPE	28480	5041-0384
A5KS7	5041-0384			KEYCAP SMOKEPIPE	28480	5041-0384
A5KS8	5041-0451		1	KEYCAP BLUEPIPE	28480	5041-0451
A5KS9	5041-0319		7	KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS10	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS11	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS12	5041-1822		1	KEYCAP - STORE	28480	5041-1822
A5KS13	5041-0817		1	KEYCAP - 7	28480	5041-0817
A5KS14	5041-0818		1	KEYCAP - 8	28480	5041-0818
A5KS15	5041-0816	9	1	KEYCAP - 9 (INVERT)	28480	5041-0816
A5KS16	5041-1819		1	KEYCAP - MHZ	28480	5041-1819
A5KS17	5041-1821		1	KEYCAP - RECALL	28480	5041-1821
A5KS18	5041-0814		1	KEYCAP - 4	28480	5041-0814
A5KS19	5041-0815		1	KEYCAP - 5	28480	5041-0815
A5KS20	5041-0816			KEYCAP - 6	28480	5041-0816
A5KS21	5041-1820		1	KEYCAP - KHZ	28480	5041-1820
A5KS22	5041-0946		1	KEYCAP - CLEAR	28480	5041-0946
A5KS23	5041-0811		1	KEYCAP - 1	28480	5041-0811
A5KS24	5041-0812		1	KEYCAP - 2	28480	5041-0812
A5KS25	5041-0813		1	KEYCAP - 3	28480	5041-0813
A5KS26	5041-1817		1	KEYCAP - HZ	28480	5041-1817
A5KS27	5041-0758		1	KEYCAP - DASH	28480	5041-0758
A5KS28	5041-1819		1	KEYCAP - 0	28480	5041-1819
A5KS29	5041-0808		1	KEYCAP - PERIOD	28480	5041-0808
A5KS30	5041-1798		1	KEYCAP - DEG	28480	5041-1798
A5KS31	5041-1818		1	KEYCAP - DBM	28480	5041-1818
A5KS32	5041-0285		1	KEYCAP PEARLPIPE	28480	5041-0285
A5KS33	5041-0922		2	KEYCAP - LEFT ARROW	28480	5041-0922
A5KS34	5041-0922	8	1	KEYCAP - RIGHT ARROW (INVERT)	28480	5041-0922
A5KS35	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS36	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS37	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS38	5041-0319			KEYCAP BLK W/LIGHT	28480	5041-0319
A5KS44	5041-0944		1	KEYCAP - POWER	28480	5041-0944

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	03336-66506	6	1	MICROPROCESSOR CONTROL P.C. ASSEMBLY	28480	03336-66506
A6C1	0160-0978	1	1	CAPACITOR-FXD 1500PF +-1% 500VDC MICA	28480	0160-0978
A6C2	0160-3847	9	23	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C3	0160-0337	6	2	CAPACITOR-FXD 160PF +-1% 300VDC MICA	28480	0160-0337
A6C4	0160-0337	6		CAPACITOR-FXD 160PF +-1% 300VDC MICA	28480	0160-0337
A6C5	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C6	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C7	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C19	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C20	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C21	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C22	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C23	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C24	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C25	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C26	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C27	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C28	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C29	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C30	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C31	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C32	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C33	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C34	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C35	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C36	0180-2823	1	4	CAPACITOR-FXD 470UF+50-10% 6.3VDC AL	28480	0180-2823
A6C37	0180-2823	1		CAPACITOR-FXD 470UF+50-10% 6.3VDC AL	28480	0180-2823
A6C38	0180-0692	8	2	CAPACITOR-FXD 220UF+50-10% 35VDC AL	00490	35VB8L220
A6C39	0180-0692	8		CAPACITOR-FXD 220UF+50-10% 35VDC AL	00490	35VB8L220
A6C40	0180-2823	1		CAPACITOR-FXD 470UF+50-10% 6.3VDC AL	28480	0180-2823
A6C42	0160-2204	0	2	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A6C43	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A6C51	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C52	0180-2823	1		CAPACITOR-FXD 470UF+50-10% 6.3VDC AL	28480	0180-2823
A6C53	0180-2826	4	1	CAPACITOR-FXD 1000UF+50-10% 16VDC AL	28480	0180-2826
A6C54	0160-3558	9	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A6C55	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A6C56	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C57	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A6C58	0160-3622	8	3	CAPACITOR-FXD .1UF +80-20% 100VDC CER	26654	2130Y5V100R104Z
A6C59	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	26654	2130Y5V100R104Z
A6C60	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	26654	2130Y5V100R104Z
A6C61	0160-2009	3	2	CAPACITOR-FXD 820PF +-5% 300VDC MICA	28480	0160-2009
A6C62	0160-2009	3		CAPACITOR-FXD 820PF +-5% 300VDC MICA	28480	0160-2009
A6C63	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A6CR1	1902-3153	5	1	DIODE-ZNR 9.31V 2% DO-7 PD=.4W TC=+.058%	28480	1902-3153
A6CR2	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6L1	9100-2459	0	1	COIL-MLD 121UH 1% Q=60 .156DX.375LG-NOM	28480	9100-2459
A6L2	9100-1637	4	1	COIL-MLD 120UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1637
A6L3	9100-3334	2	1	COIL 25UH 10% .3D-NOM SRF=7MHZ	28480	9100-3334
A6P1	1200-0473	8	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A6P2	1251-6567		1	CONNECTOR	28480	1251-6567
A6P3	1251-6567		1	CONNECTOR	28480	1251-6567
A6P4	1251-6567		1	CONNECTOR	28480	1251-6567
A6P5	1251-3750	7	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A6P52	1251-4245	7	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-4245
A6Q1	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q2	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6R1	0698-8344	0	1	RESISTOR 604K 1% .125W F TC=0+-100	28480	0698-8344
A6R2	0683-7525	6	1	RESISTOR 7.5K 5% .25W FC TC=-400/+700	01121	CB7525
A6R3	0683-6815	5	1	RESISTOR 680 5% .25W FC TC=-400/+600	01121	CB6815
A6R4	0683-1025	9	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A6R5	0683-1035	1	4	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A6R6	1810-0055	5	1	NETWORK - RES SIP 10K OHM X 8	28480	1810-0055
A6R7	0698-3279	9	1	RESISTOR 9.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A6R8*	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A6R9	1810-0076	0	1	NETWORK-RES 9-SIP 1.8K OHM X 8	28480	1810-0076
A6R10	0683-1825	7	3	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R11	0683-1825	7		RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
A6R12	0683-1825	7		RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
A6R13	1810-0140	9	1	NETWORK-RES 4-SIP22.0K OHM X 3	91637	CSP04C07-223J
A6R14	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A6R15	0683-3625	9	2	RESISTOR 3.6K 5% .25W FC TC=-400/+700	01121	CB3625
A6R16	0683-3625	9		RESISTOR 3.6K 5% .25W FC TC=-400/+700	01121	CB3625
A6R17	1810-0229	5	1	NETWORK-RES 8-SIP330.0 OHM X 7	01121	208A331
A6R18	1810-0055	5	1	NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0055
A6R19	0683-1515	2	1	RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
A6R20	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A6R21	0698-6619	8	1	RESISTOR 15K .1% .125W F TC=0+-25	28480	0698-6619
A6R22	0699-0107	9	1	RESISTOR 4.75K .1% .125W F TC=0+-25	28480	0699-0107
A6R23	0683-5115	6	4	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A6R24	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A6R26	0683-1835	9	1	RESISTOR 18K 5% .25W FC TC=-400/+800	01121	CB1835
A6R51	1810-0136	3	1	NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0136
A6R52	1810-0297	7	1	NETWORK-RES 8-SIP3.3K OHM X 7	28480	1810-0297
A6R53	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A6R54	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A6R55	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A6U1	1818-1111	2	1	IC-MEMORY ROM	28480	1818-1111
A6U2	1818-1110	1	1	IC-MEMORY ROM	28480	1818-1110
A6U3	1818-1109	8	1	IC-MEMORY ROM	28480	1818-1109
A6U4	1818-1112	3	1	IC-MEMORY ROM	28480	1818-1112
A6U5	1820-1197	9	8	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U6	1818-0438	4	1	IC NMOS 4K RAM STAT 450-NS 3-S	01295	TMS4045-45JL
A6U7	1820-1195	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A6U8	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	04713	MC1455P1
A6U9	1820-1691	8	1	IC MICPROC NMOS	28480	1820-1691
A6U10	1820-1759	9	6	IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U11	1818-0199	4	2	IC NMOS 1K RAM STAT 500-NS	34335	AM9112APC
A6U12	1818-0199	4		IC NMOS 1K RAM STAT 500-NS	34335	AM9112APC
A6U13	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A6U14	1820-1196	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A6U15	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A6U16	1820-1216	3	3	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U17	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U18	1820-0683	6	1	IC SN74SO4N	28480	1820-0683
A6U19	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U20	1820-1194	6	2	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A6U21	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A6U22	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U23	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U24	1820-1208	3	2	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A6U25	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U26	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U27	1820-1730	6	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U28	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U29	1820-1433	6	1	IC SHF-RGTR TTL LS 8-B SERIAL-IN PRL-OUT	01295	SN74LS164N
A6U30	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U31	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A6U32	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A6U33	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U34	1820-1112	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A6U35	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A6U36	1820-0684	7	1	IC SN74S05N	28480	1820-0684
A6U37	1820-1975	1	1	IC SHF-RGTR TTL LS NEG-EDGE-TRIG PRL-IN	01295	SN74LS165N
A6U38	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A6U39	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A6U40	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A6U41	1820-1206	1	1	IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
A6U42	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A6U43	1820-1873	8	1	IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
A6U44	1820-0477	6	1	IC OP AMP GP 8-DIP-P	18324	LM301AN
A6U45	1820-1430	3	1	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A6U46	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U51	1990-0444	6	1	OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A6U52	1990-0577	6	2	OPTO-ISOLATOR LED-PDIO/XSTR IF=50MA-MAX	28480	5082-4355
A6U53	1990-0577	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=50MA-MAX	28480	5082-4355
A6U54	1990-0461	7	2	OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	5082-4364
A6U55	1990-0461	7		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	5082-4364
A6U56	1820-0621	2	2	IC BFR TTL NAND QUAD 2-INP	01295	SN7438N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6U57	1820-1300	6	3	IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A6U58	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A6U59	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A6U60	1820-1416	5	2	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A6U61	1820-1440	5	1	IC LCH TTL LS QUAD	01295	SN74LS279N
A6U62	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U63	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A6U64	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A6U65	1826-0144	6	1	IC 7805 V RGLTR TO-220	04713	MC7805CP
A6U66	1820-1558	6	2	IC UART TTL QUAD	04713	MC3441AP
A6U67	1820-1558	6		IC UART TTL QUAD	04713	MC3441AP
A6U68	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U69	1820-0621	2		IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
A6U70	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U71	1820-1204	9	1	IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A6U72	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U73	1820-1281	2	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS139N
A6U74	1906-0096	7	1	DIODE-FW BRDG 200V 2A	04713	MDA202
A6U75	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
	0380-1188		1	HEX STANDOFF HP-IB TO REAR PANEL	28480	0380-1188

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7	03336-66507	8	1	ATTENUATOR P.C. ASSEMBLY	28480	03337-66507
A7C1	0160-4571	8	6	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A7C2	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A7C3	0160-3558	9	9	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C4	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A7C5	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A7C7	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C8	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C9	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C10	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C11	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C12	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C13	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C14	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A7C15	0160-2239	1	1	CAPACITOR-FXD 1.8PF +-.25PF 500VDC CER	28480	0160-2239
A7K1	0490-1141	1	4	RELAY	28480	0490-1141
A7K2	0490-1141	1		RELAY	28480	0490-1141
A7K3	0490-1141	1		RELAY	28480	0490-1141
A7K4	0490-1141	1		RELAY	28480	0490-1141
A7R1	0699-0065	8	2	RESISTOR 51.01 .25% .5W F TC=0+-50	28480	0699-0065
A7R2	0699-0065	8		RESISTOR 51.01 .25% .5W F TC=0+-50	28480	0699-0065
A7R3	0699-0273	0	1	RESISTOR 2.15K .1% .125W F TC=0+-25	28480	0699-0273
A7R4	0699-0274	1	1	RESISTOR 350 .1% .125W F TC=0+-25	28480	0699-0274
A7R5	0698-8258	5	1	RESISTOR 247.5 .1% .25W F TC=0+-25	19701	MF52C1/4-T9-247R5-B
A7R6	0698-7984	2	2	RESISTOR 61.1 .1% .5W F TC=0+-50	28480	0698-7984
A7R7	0698-7984	2		RESISTOR 61.1 .1% .5W F TC=0+-50	28480	0698-7984
A7R8	0698-7982	0	1	RESISTOR 71.16 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-71R16-B
A7R9	0698-7981	9	2	RESISTOR 96.25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-96R25-B
A7R10	0698-7981	9		RESISTOR 96.25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-96R25-B
A7R11	0698-8011	8	1	RESISTOR 25 .1% .25W F TC=0+-50	19701	MF52C1/4-T2-25R0-B
				MECHANICAL PARTS		
A7MP1	03336-60601		1	BOX ASY	28480	03336-60601
A7MP2	03336-64115		1	COVER	28480	03336-64115
A7C21	0160-4386		1	C-F 33 PF	04393	200-200-NPO-330J
A7C22	0160-3874		1	C-F 10 PF	28480	0160-3874
A7L1, L2	9100-2247		2	COIL 100 NH	28480	9100-2247

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8	03336-69210	5	1	REBUILT ATTENUATOR CONTROL P.C. ASSEMBLY (OPT 005) - EXCHANGE ASSEMBLY	28480	03336-69210
A8	03336-64210	5	1	NEW ATTENUATOR CONTROL P.C. ASSEMBLY (OPT 005)	28480	03336-64210
A8Q1	1853-0419	5	4	TRANSISTOR PNP SI PD=310MW FT=200MHZ	01295	2N4403
A8Q2	1853-0419	5		TRANSISTOR PNP SI PD=310MW FT=200MHZ	01295	2N4403
A8Q3	1853-0419	5		TRANSISTOR PNP SI PD=310MW FT=200MHZ	01295	2N4403
A8Q4	1853-0419	5		TRANSISTOR PNP SI PD=310MW FT=200MHZ	01295	2N4403
A8R1	0683-1025	9	5	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R2	0683-2025	1	5	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A8R3	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A8R4	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R5	0686-3305	8	1	RESISTOR 33 5%	28480	0686-3305
A8R6	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R7	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A8R8*	0757-0443	0	1	RESISTOR 11K 1% .125W	28480	0757-0443
A8R8*	0698-3359	7	1	RESISTOR 12.7K 1% .125W	28480	0698-3359
A8R8*	0698-3156	2	1	RESISTOR 14.7K 1% .125W	28480	0698-3156
A8R8*	0698-4482	9	1	RESISTOR 17.4K 1% .125W	28480	0698-4482
A8R8*	0757-0199	3	1	RESISTOR 21.5K 1% .125W	28480	0757-0199
A8R8*	0698-4488	5	1	RESISTOR 26.7 1% .125W	28480	0698-4488
A8R8*	0757-0123	3	1	RESISTOR 34.8K 1% .125W	28480	0757-0123
A8R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A8R10	0686-3305	8	1	RESISTOR 33 5%	28480	0686-3305
A8SL1	5060-9598	2	2	LATCH ASSEMBLY	28480	5060-9598
A8SL2	5060-9598	2		LATCH ASSEMBLY	28480	5060-9598
				MECHANICAL PARTS		
A8J1, J2, J3	1250-1486		3	CONNECTOR, SMA	28480	1250-1486
A8MP1	03335-89512		1	CONTACT, INPUT	28480	03335-89512
A8MP2	03335-89515		3	CONTACT, PASS THRU	28480	03335-89515
A8MP3	03335-89514		1	CONTACT, CROSSOVER	28480	03335-89514
A8MP4	03335-89513		2	CONTACT, BYPASS	28480	03335-89513
A8MP5	03335-89511		1	CONTACT, 50 OHM OUT	28480	03335-89511
A8MP6	8160-0256		8	FUZZ, BUTTON	28480	8160-0256
A8ZU1	03335-89503		1	10 DB PAD	28480	03335-89503
A8ZU2	03335-89502		1	20 DB PAD	28480	03335-89502
A8ZU3	03335-89501		1	10 DB PAD	28480	03335-89501
A8ZU4	03335-89506		1	25 OHM PAD	28480	03335-89506
A9	03325-66509	9	1	HIGH STAB FREQ. REF. P.C ASSEMBLY (OPTION 004)	28480	03325-66509
A9C1	0180-0692	8	1	CAPACITOR-FXD 220UF+50-10% 35VDC AL	00490	35V88L220
A9C2	0160-3847	9	2	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A9C3	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A9C4	0180-0693	9	1	CAPACITOR-FXD 1000UF+50-10% 25VDC AL	00490	25V88L1000
A9CR1	1901-0049	0	2	DIODE-PWR RECT 50V 750MA DO-29	28480	1901-0049
A9CR2	1901-0049	0		DIODE-PWR RECT 50V 750MA DO-29	28480	1901-0049
A9CR3	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A9E1	0960-0465		1	OSCILLATOR, HIGH STABILITY	28480	0960-0465
A9J1	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A9J19	1251-2969	8	1	CONNECTOR-PHONO SINGLE PHONO JACK, DIP	28480	1251-2969
A9Q1	1854-0053	5	1	TRANSISTOR NPN 2N2218 SI TO-5 PD=800MW	04713	2N2218
A9Q2	1853-0450	4	1	TRANSISTOR PNP SI TO-220AB PD=60W	04713	MJE371K
A9R1	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A9R2	0683-1035	1	1	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R3	0683-3325	6	1	RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
A9R4	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A9R5	0698-3498	5	1	RESISTOR 8.66K 1% .125W F TC=0+-100	24546	C4-1/8-T0-866R-F
A9R6	0698-3274	5	1	RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-3274
A9R7	2100-3252	6	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	28480	2100-3252
A9R8	0683-1015	7	1	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
A9R9	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A9U1	1820-0216	1	1	IC OP AMP GP 8-DIP-P	28480	1820-0216

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10	03336-66510	2	1	BALANCED OUTPUT P.C. ASSEMBLY (33368)	28480	03336-66510
A10C1	0160-3558	9	16	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C2	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C3	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C4	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C5	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C7	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C8	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C9	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C10	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C11	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C12	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C13	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C14	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C15	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C16	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10C17	0180-2973	2	1	CAPACITOR-FXD 10UF+50-10% 200VDC AL NPOL	56289	61D106F200DL2
A10C18	0160-0161	4	1	CAPACITOR-FXD .01UF 200V	28480	0160-0161
A10C19*	0160-2207	3	1	CAPACITOR-FXD 300PF 300V MICA	28480	0160-2207
A10C19*	0160-2208	4	1	CAPACITOR-FXD 330PF 300V MICA	28480	0160-2208
A10C19*	0160-2209	5	1	CAPACITOR-FXD 360PF 300V MICA	28480	0160-2209
A10C19*	0140-0200	0	1	CAPACITOR-FXD 390PF 300V MICA	28480	0140-0200
A10C20*	0160-2207	3	1	CAPACITOR-FXD 300PF 300V MICA	28480	0160-2207
A10C20*	0160-2208	4	1	CAPACITOR-FXD 330PF 300V MICA	28480	0160-2208
A10C20*	0160-2209	5	1	CAPACITOR-FXD 360PF 300V MICA	28480	0160-2209
A10C20*	0140-0200	0	1	CAPACITOR-FXD 390PF 300V MICA	28480	0140-0200
A10C21	0160-0573	2	6	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C22	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C23	0160-3914	1	4	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A10C24	0160-3468	0	2	CAPACITOR-FXD .12UF +-10% 80VDC POLYE	28480	0160-3468
A10C25	0160-2199	2	4	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A10C26	0160-0575	4	2	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A10C27	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A10C28	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A10C29	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C30	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C31	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A10C32	0160-0572	1	4	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A10C33	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A10C34	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C35	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A10C36	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A10C37	0160-3914	1		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A10C38	0160-3468	0		CAPACITOR-FXD .12UF +-10% 80VDC POLYE	28480	0160-3468
A10C39	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A10C40	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A10C41	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A10C42	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A10C43	0160-0161	4	1	CAPACITOR-FXD .01UF 200V	28480	0160-0161
A10C44	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A10K1	0490-1141	1	2	RELAY	28480	0490-1141
A10K2	0490-1141	1		RELAY	28480	0490-1141
A10L1	9140-0283	8	5	COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A10L2	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A10L3	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A10L4	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A10L5	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A10L6	9140-0266	7	2	COIL-MLD 1.8UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0266
A10L7	9140-0266	7		COIL-MLD 1.8UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0266
A10L8	9104-0351		1	COIL-MLD .18UH	28480	9104-0351
A10L9	9104-0351		1	COIL-MLD .18UH	28480	9104-0351
A10L10	9100-3314		1	COIL-MLD .15UH	28480	9100-3314
A10L11	9100-3314		1	COIL-MLD .15UH	28480	9100-3314
A10R1	0698-4445	4	2	RESISTOR 5.76K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5761-F
A10R2	0757-0276	7	2	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A10R3	0698-4445	4		RESISTOR 5.76K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5761-F
A10R4	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A10R5	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A10R6	0683-0275	9	4	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A10R7	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A10R8	0698-4446	5	1	RESISTOR 267 1% .125W F TC=0+-100	24546	C4-1/8-T0-267R-F
A10R9	0698-4384	0	2	RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F
A10R10	0698-4384	0		RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R11	0698-3510	2	1	RESISTOR 453 1% .125W F TC=0+-100	24546	C4-1/8-T0-453R-F
A10R12	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A10R13	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A10R14	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A10R15	0698-4449	8	1	RESISTOR 309 1% .125W F TC=0+-100	24546	C4-1/8-T0-309R-F
A10R16	0698-4382	8	1	RESISTOR 52.3 1%	28480	0698-4382
A10R17	0698-3445	2	1	RESISTOR 348 1% .125W	28480	0698-3445
A10R18	0698-4382	8	1	RESISTOR 52.3 1%	28480	0698-4382
A10T1	9100-0458	5	1	TRANSFORMER PULSE 50-600 OHMS	28480	9100-0458
A10T2	9100-3889	2	1	TRANSFORMER PULSE 50-124 OHMS	28480	9100-3889
	03336-61621		1	75 OHM CONN (3336B)	28480	03336-61621
				MECHANICAL PARTS		
A10MP1	03336-60606		1	OUTPUT BOX ASSY	28480	03336-60606
A10MP2	03336-61220		2	OUTPUT BOX SUPPORT	28480	03336-61220
A10MP3	03336-64111		1	OUTPUT BOX COVER	28480	03336-64111
A10MP4	03336-61201		1	OUTPUT BOX FRONT PANEL (3336B)	28480	03336-61201
A10MP4	03336-61202		1	OUTPUT BOX FRONT PANEL (3336B/001)	28480	03336-61202
A10MP5	5041-2304		1	INSUL INPUT (J1) 3336B	28480	5041-2304
A10MP5	5041-2303		1	INSUL INPUT (J1) 3336B/001	28480	5041-2303
A10MP6	5041-1469		1	INSUL INPUT (J2) 3336B	28480	5041-1469
A10MP6	5041-1466		1	INSUL INPUT (J2) 3336B/001	28480	5041-1466
A10MP7	5041-1467		1	INSUL INPUT (J3) 3336B	28480	5041-1467
A10MP8	5041-1600		1	INSUL INPUT (J4)	28480	5041-1600

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11	03336-66511	3	1	BALANCED OUTPUT P.C. ASSEMBLY (3336A)	28480	03336-66511
A11C1	0160-3558	9	1A	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C2	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C3	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C4	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C5	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C7	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C8	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C9	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C10	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C11	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C12	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C13	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C14	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C15	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C16	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11C18	0160-0161	4	1	CAPACITOR-FXD .01UF 200V	28480	0160-0161
A11C19*	0160-2207	3	1	CAPACITOR-FXD 300PF 300V MICA	28480	0160-2207
A11C19*	0160-2208	4	1	CAPACITOR-FXD 330PF 300V MICA	28480	0160-2208
A11C19*	0160-2209	5	1	CAPACITOR-FXD 360PF 300V MICA	28480	0160-2209
A11C19*	0140-0200	0	1	CAPACITOR-FXD 390PF 300V MICA	28480	0140-0200
A11C20*	0160-2207	3	1	CAPACITOR-FXD 300PF 300V MICA	28480	0160-2207
A11C20*	0160-2208	4	1	CAPACITOR-FXD 330PF 300V MICA	28480	0160-2208
A11C20*	0160-2209	5	1	CAPACITOR-FXD 360PF 300V MICA	28480	0160-2209
A11C20*	0140-0200	0	1	CAPACITOR-FXD 390PF 300V MICA	28480	0140-0200
A11C32	0160-0572	1	6	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C33	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C34	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C35	0160-2199	2	2	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A11C36	0160-3914	1	1	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-3914
A11C37	0160-0575	4	1	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A11C38	0160-3468	0	1	CAPACITOR-FXD .12UF +-10% 400VDC POLYE	28480	0160-3468
A11C39	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C40	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C41	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C42	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A11C43	0160-0161	4	1	CAPACITOR-FXD .01UF 200V	28480	0160-0161
A11C44	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A11K1	0490-1141	1	1	RELAY	28480	0490-1141
A11L1	9140-0283	8	5	COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A11L2	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A11L3	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A11L4	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A11L5	9140-0283	8		COIL-MLD 910NH 5% Q=50 .155DX.375LG-NOM	28480	9140-0283
A11L6	9140-0266	7	2	COIL-MLD 1.8UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0266
A11L7	9140-0266	7		COIL-MLD 1.8UH 5% Q=33 .155DX.375LG-NOM	28480	9140-0266
A11R1	0698-4445	4	2	RESISTOR 5.76K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5761-F
A11R2	0757-0276	7	2	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A11R3	0698-4445	4		RESISTOR 5.76K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5761-F
A11R4	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A11R12	0683-0275	9	2	RESISTOR 2.7 5% .25W FC TC=400/+500	01121	CB27G5
A11R13	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A11R14	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=400/+500	01121	CB27G5
A11R15	0698-4421	6	1	RESISTOR 619 1% .125W	28480	0698-4421
A11R16	0698-4386	2	1	RESISTOR 59 1%	28480	0698-4386
A11R17	0757-0418	9	1	RESISTOR 249 1% .125W	28480	0698-4421
A11R18	0698-4386	2	1	RESISTOR 59 1%	28480	0698-4386
A11T1	9100-0458	5	1	TRANSFORMER-PULSE 50-600 OHMS	28480	9100-0458
A11T2	9100-3869	2	1	TRANSFORMER-PULSE 50-120 OHMS;TURNS; PRI	28480	9100-3869
				MECHANICAL PARTS		
A11MP1	03336-60606		1	OUTPUT BOX ASSY	28480	03336-60606
A11MP2	03336-61220		2	OUTPUT BOX SUPPORT	28480	03336-61220
A11MP3	03336-64111		1	OUTPUT BOX COVER	28480	03336-64111
A11MP4	03336-61203		1	OUTPUT BOX FRONT PANEL (3336A)	28480	03336-61203
A11MP4	03336-61204		1	OUTPUT BOX FRONT PANEL (3336A/001)	28480	03336-61204
A11MP5	5041-2302		1	INSUL INPUT (J1) (3336A)	28480	5041-2302
A11MP5	5041-2301		1	INSUL INPUT (J1) (3336A/001)	28480	5041-2301
A11MP6	5041-1493		1	INSUL INPUT (J2)	28480	5041-1493
A11MP8	5041-1493		1	INSUL INPUT (J4)	28480	5041-1493
A12	03336-66512		1	HP-IB CONNECTOR/ADDRESS SWITCHES	28480	03336-66512
	2140-0016	8	1	RPG LIGHT BULB	28480	2140-0016

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15	03336-66515	7	1	KEYBOARD P.C. ASSEMBLY (3336A)	28480	03336-66515
A15C1	0160-3847	9	*	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A15C2	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A15C3	0180-0062	6	1	CAPACITOR-FXD 300UF+75-10% 6VDC AL	28480	0180-0062
A15C4	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A15C5	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A15C6	0160-4571	8	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A15C7	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A15C8	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A15CR1	1990-0533	4	10	LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR2	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR3	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR4	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR5	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR6	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR7	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR8	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR9	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR10	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR11	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR12	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR13	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR14	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A15CR15	1990-0486	6	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A15CR16	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A15CR17	1990-0665	3	10	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR18	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR19	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR20	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR21	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR22	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR23	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR24	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR25	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR26	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR27	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR28	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR29	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15CR31	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A15E1	03582-61620			RPG	28480	03582-61620
A15J2	1251-5041		1	CONNECTOR	28480	1251-5041
A15L1	9100-3334	2	1	COIL 25UH 10% .30-NOM SRF=7MHZ	28480	9100-3334
A15Q1	1853-0016	8	8	TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q2	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q3	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q4	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q5	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q6	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q7	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15Q8	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A15R1	0683-2205	9	8	RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R2	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R3	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R4	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R5	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R6	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R7	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R8	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A15R9	0757-0280	3	1	RESISTOR 1000 1% .125W	28480	0757-0280
A15R11	0683-1325	2	8	RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R12	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R13	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R14	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R15	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R16	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R17	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R18	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A15R21	1810-0164	7	2	NETWORK-RES 9-SIP4.7K OHM X 8	91637	CSP09C07-472J
A15R22	1810-0164	7		NETWORK-RES 9-SIP4.7K OHM X 8	91637	CSP09C07-472J
A15R23	1810-0135	2	1	NETWORK-RES 6-SIP10.0K OHM X 5	28480	1810-0135
A15R24	1810-0055	5	1	NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0055
A15R25	0811-3069	8	1	RESISTOR 1 5% .5W PW TC=0+-150	75042	BW20-1-1R0-J

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15SW1	5060-9436	7	37	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW35	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW36	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW38	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A15SW39	3101-2441	6	1	SW-PSHBTN	28480	3101-2441
A15U1	1990-0592	5	11	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U2	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U3	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U4	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U5	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U6	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U7	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U8	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U9	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U10	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U11	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A15U12	1858-0047	5	3	TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A15U13	1820-1200	5	2	IC INV TTL LS HEX	01295	SN74LS05N
A15U14	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A15U15	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A15U16	1820-1200	5		IC INV TTL LS HEX	01295	SN74LS05N
A15U17	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A15U18	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A15U19	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A15U20	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U21	1820-1438	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257N
	1200-0473		1	SOCKET-IC 16 DIP	28480	1200-0473
	1200-0638		1	SOCKET-IC 14 DIP	28480	1200-0638

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21	03325-66521	2	1	PC ASSEMBLY-FFS D/A	28480	03325-66521
C1	0140-0191	8	3	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
C2	0160-3847	9	29	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C3	0180-1861	5	3	CAPACITOR-FXD 27UF+-10% 10VDC TA	56289	150D276X9010B2
C4	0180-1746	5	6	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C6	0140-0191	8		CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
C7	0160-4571	8	5	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C8	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C9	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C10	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C11	0180-1861	5		CAPACITOR-FXD 27UF+-10% 10VDC TA	56289	150D276X9010B2
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0160-2250	6	1	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C15	0160-2222	2	1	CAPACITOR-FXD 1500PF +-5% 300VDC MICA	28480	0160-2222
C16	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C17	0160-4461	5	1	CAPACITOR-FXD 150PF +-2.5% 160VDC POLYP	28480	0160-4461
C18	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
C19	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C21	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C22	0160-5306		1	CAPACITOR-FXD .1UF	28480	0160-5306
C23	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C24	0140-0149	6	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA	72136	DM15F471J0300WV1CR
C26	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C27	0160-2243	7	1	CAPACITOR-FXD 2.7PF +-.25PF 500VDC CER	28480	0160-2243
C28	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
C29	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C31	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C32	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C33	0160-3847	9	1	CAPACITOR-FXD .01UF 50V	28480	0160-3847
C131	0140-0191	8		CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
C132	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C133	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C134	0160-4571	8	1	CAPACITOR-FXD .1UF +80V	28480	0160-4571
C135	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C136	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C137	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C138	0140-0206	6	1	CAPACITOR-FXD 270PF +-5% 500VDC MICA	72136	DM15F271J0500WV1CR
C139	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C140	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C141	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C142	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C143	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C144	0180-1861	5		CAPACITOR-FXD 27UF+-10% 10VDC TA	56289	150D276X9010B2
C145	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C162	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C163	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C164	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C167	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C168	0160-2204	0	3	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C169	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C171	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C173	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C174	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C176	0160-0571	0	1	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
C177	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C178	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C179	0160-4040	6	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4040
C181	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C182	0160-4441	1	1	CAPACITOR-FXD .47UF +-10% 50VDC CER	28480	0160-4441
C183	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C184	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C185	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C186	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C187	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C188	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C190	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C195	0160-3876	4	1	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
C196	0160-4263	9	2	CAPACITOR-FXD 100PF +-5% 200VDC CER	51642	150-100-NP0-101J
C197	0160-4263	9		CAPACITOR-FXD 100PF +-5% 200VDC CER	51642	150-100-NP0-101J

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21						
CR1	1901-0040	1	8	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR3	1901-0518	8	7	DIODE-SCHOTTKY	28480	1901-0518
CR4	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR6	1902-0777	3	2	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR7	1902-0777	3		DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR8	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR9	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR17	1902-3054	5	1	DIODE-ZNR 3.65V 5% DO-35 PD=.4W	28480	1902-3054
CR18	1902-0064	1	2	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
CR19	1902-0064	1		DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR131	1902-3030	7	1	DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
CR161	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR162	1901-0040	1	1	DIODE-SWG 30V 2PF -20V	28480	1901-0040
CR163	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR164	0122-0089	5	2	DIODE-VVC 29PF 10% C3/C25=MIN=5 BVR=30V	04713	MV109
CR165	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR166	0122-0089	5		DIODE-VVC 29PF 10% C3/C25=MIN=5 BVR=30V	04713	MV109
J1	1251-6567		1	CONNECTOR	28480	1251-6567
J3	1810-0294	4	1	NETWORK-RESISTOR 16 PIN DIP; RES	28480	1810-0294
J8	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J15	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J16	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J17A	1251-2969	8	7	CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J17B	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J18A	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
J18B	1251-2969	8		CONNECTOR-PHONO SINGLE PHONO JACK; DIP	28480	1251-2969
L1	9100-1622	7	2	INDUCTORRF-CH-MLD 24UH 5% .166DX.385LG	28480	9100-1622
L2	9100-1622	7		INDUCTORRF-CH-MLD 24UH 5% .166DX.385LG	28480	9100-1622
L3	9100-3458	1	3	CHOKE, WIDE BAND	28480	9100-3458
L132	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
L133	9170-0894	0	1	CORE-SHIELDING BEAD	28480	9170-0894
L161	9100-3458	1		CHOKE, WIDE BAND	28480	9100-3458
L162	9140-0460	3	1	COIL-VAR 351NH-429NH Q=120 PC-MTG	28480	9140-0460
L163	9100-0539	3	1	INDUCTORRF-CH-MLD 10UH 5% .166DX.385LG	28480	9100-0539
L165	9140-0349	7	1	INDUCTORRF-CH-MLD 1.1UH 5% .166DX.385LG	28480	9140-0349
Q1	1853-0448	0	6	TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
Q2	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
Q3	1854-0345	8	5	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
Q4	1853-0448	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
Q6	1853-0089	5	9	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q7	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q8	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q9	1854-0296	8	9	TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q10	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q11	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q12	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q13	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q14	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q16	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q17	1855-0305	2	1	TRANSISTOR J-FET 2N4117A N-CHAN D-MODE	17856	2N4117A
Q18	1855-0081	1	4	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
Q19	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
Q21	1855-0082	2	2	TRANSISTOR J-FET P-CHAN D-MODE SI	28480	1855-0082
Q22	1854-0215	1	5	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
Q23	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
Q24	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
Q25	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q26	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
Q27	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
Q28	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q29	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q31	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q32	1854-0830	6	1	TRANSISTOR-DUAL NPN	28480	1854-0830
Q33	1855-0082	2		TRANSISTOR J-FET P-CHAN D-MODE SI	28480	1855-0082
Q37	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
Q38	1853-0086	2	1	TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
Q39	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
Q41	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q42	1854-0296	8		TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
Q43	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21						
Q44	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q131	1853-0048	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
Q132	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q161	1853-0048	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
Q162	1854-0345	6		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
Q163	1854-0345	6		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
Q164	1854-0345	6		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
Q165	1854-0345	6		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
Q166	1853-0048	0		TRANSISTOR PNP SI TO-92 PD=625MW	04713	MPSH81
R1	0757-0395	1	2	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-TO-56R2-F
R2	0757-0419	0	3	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-TO-681R-F
R3	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-TO-681R-F
R4	0683-4705	8	23	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R6	0757-0421	4	3	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-TO-825R-F
R7	0683-4715	0	3	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R8	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R9	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-TO-196R-F
R11	0683-2205	9	4	RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
R12	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
R14	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-TO-619R-F
R16	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-7501-F
R17	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3481-F
R18	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1212-F
R19	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1781-F
R21	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R22	0683-1525	4	3	RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R23	0683-6815	5	2	RESISTOR 680 5% .25W FC TC=-400/+600	01121	CB6815
R24	0683-1825	7	1	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
R26	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-TO-56R2-F
R27	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1331-F
R28	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1331-F
R29	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R31	0683-3325	6		RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R32	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R33	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R34	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
R36	0757-0280	3	8	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
R37	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3831-F
R38	0698-0083	8	6	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
R39	0757-0401	0	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
R41	0683-6815	5		RESISTOR 680 5% .25W FC TC=-400/+600	01121	CB6815
R42	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3831-F
R43	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3831-F
R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
R46	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R47	0683-3325	6		RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R48	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R49	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-TO-287R-F
R51	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-TO-619R-F
R52	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1212-F
R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
R56	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
R57	0683-5105	4	1	RESISTOR 51 5% .25W	28480	0683-5105
R58	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R59	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R61	0683-1035	1	12	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R62	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R63	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-TO-681R-F
R64	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2151-F
R65	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
R66	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R67	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
R68	0698-3156	2	2	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1472-F
R69	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1472-F
R70	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
R71	0698-4207	6	1	RESISTOR 44.2K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4422-F
R72	0683-1025	9	11	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R73	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R74	2100-3211	7	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3211
R75	0757-0442	9	4	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
R76	2100-3096	6	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 17-TRN	32997	3292W-1-503

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21						
R77	0683-1065	7	1	RESISTOR 10M 5% .25W FC TC=-900/+1100	01121	CB1065
R78	0757-0488	3	1	RESISTOR 909K 1% .125W F TC=0+-100	28480	0757-0488
R79	0757-0401	6		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
R81	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R82	0683-5625	3	1	RESISTOR 5.6K 5% .25W FC TC=-400/+700	01121	CB5625
R83	0683-2025	1	1	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R84	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
R86	0757-0439	4	4	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R87	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R88	2100-3383	4	1	RESISTOR-TRMR 50 10% C TOP-ADJ 1-TRN	28480	2100-3383
R89	0683-4705	A		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R91	0698-0083	A		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
R92	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R93	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R94	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R96	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
R97	0683-2225	3	4	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
R98	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
R99	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
R101	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R102	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
R103	0683-4705	A		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R104	0683-2235	5	1	RESISTOR 22K 5% .25W FC TC=-400/+800	01121	CB2235
R106	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R107	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
R108	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
R109	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R111	0683-1015	7	1	RESISTOR 100 5% .25W	28480	0683-1015
R112	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
R113	0757-0416	7	3	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
R114	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
R116	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R117	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R118	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R119	0683-1835	9	1	RESISTOR 18K 5% .25W FC TC=-400/+800	01121	CB1835
R121	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R122	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
R123	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
R124	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R126	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R130	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
R132	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
R133	0698-3432	7	1	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
R134	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R135	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
R136	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R137	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R138	0683-1235	3	1	RESISTOR 12K 5% .25W FC TC=-400/+800	01121	CB1235
R140	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R141	0683-4725	2	2	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R142	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R143	0683-1015	7	1	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R144	0683-3325	6		RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R145	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R146	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R147	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R148	0683-7515	4	1	RESISTOR 750 5% .25W FC TC=-400/+600	01121	CB7515
R149	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R150	0683-3325	6		RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R151	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R152	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R161	0683-2415	3	1	RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
R162	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R163	0683-1045	3	3	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R164	0683-4735	4	2	RESISTOR 47K 5% .25W FC TC=-400/+800	01121	CB4735
R165	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R166	0683-4735	4		RESISTOR 47K 5% .25W FC TC=-400/+800	01121	CB4735
R167	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R168	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R169	0698-3516	0	1	RESISTOR 7.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7321-F
R170	0683-2425	5	1	RESISTOR 2.4K 5% .25W FC TC=-400/+700	01121	CB2425
R171	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
R172	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R173	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R174	0683-5125	8	1	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21						
R176	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R177	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
R179	0683-3915	0	3	RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R178	0757-0401	0	1	RESISTOR 100 1% .125W	28480	0757-0401
R181	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R182	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R183	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R184	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R186	0757-0280	3	1	RESISTOR 511 1% .125W	28480	0757-0280
R187	0698-4123	5	1	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R188	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R189	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
R191	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R192	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R193	0698-3279	0	2	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R194	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
R196	0757-0452	1	1	RESISTOR 27.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2742-F
R197	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
R198	0698-4474	9	1	RESISTOR 8.45K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8451-F
R199	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R202	0757-0401	0	1	RESISTOR 100 1% .125W	28480	0757-0401
R200	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
R201	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R203	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R204	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R205	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R206	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R207	0683-3315	4	1	RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
R208	0683-4325	8	1	RESISTOR 4.3K 5% .25W FC TC=-400/+700	01121	CB4325
R209	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R210	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R211	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R212	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R213	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
R214	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R215	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
R216	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
	1820-0681	4	4	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U1	1820-0817	8	1	IC FF ECL D-M/S DUAL	04713	MC10131P
U2	1821-0001	4	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	01928	CA3046
U4	1820-1196	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U5	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
U3	1810-0294	4	1	NETWORK-RESISTOR 16 PIN DIP	28480	1810-0294
U6	1820-0021	8	1	IC OP AMP GP TO-99	27014	LM310H
U7	1820-0629	0	8	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U8	1820-0697	2	1	IC-SN74S140N	28480	1820-0697
U9	1820-1279	8	2	IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
U10	1820-0043	4	1	IC OP AMP GP TO-99	01928	CA3077
U11	1820-1279	8		IC CNTR TTL LS DECD UP/DOWN SYNCHRO	01295	SN74LS190N
U12	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U13	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U14	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U15	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U17	1820-1322	2	1	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
U18	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U19	1820-2004	9	1	IC MISC NMOS	28480	1820-2004
U21	1820-0683	6		IC INV TTL S HEX 1-INP	01295	SN74S04N
U22	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U23	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U24	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U25	1820-0693	8	2	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
U26	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
U27	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U28	1820-1641	8	1	IC DRVR TTL LS BUS DRVR HEX 1-INP	01295	SN74LS365AN
U29	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U30	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U31	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
U32	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
U33	1826-0111	7	1	IC OP AMP MC1458G	28480	1826-0111
U34	1820-0802	1	1	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
MP1	03325-20601	3	1	SHIELD. TOP	28480	03325-20601
MP2	03325-20602	4	1	SHIELD. BOTTOM	28480	03325-20602
MP3	03325-04104	7	1	COVER - 2	28480	03325-04104
	2140-0016	8	1	RPG LIGHT BULB	28480	2140-0016

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25	03336-66525	9	1	KEYBOARD P.C. ASSEMBLY (3336C)	28480	03336-66525
A25C1	0160-3847	9	5	CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A25C2	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A25C3	0180-0062	6	1	CAPACITOR-FXD 300UF+75-10% 6VDC AL	28480	0180-0062
A25C4	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A25C5	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A25C6	0160-4571	8	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
A25C7	0160-3847	9		CAPACITOR-FXD .015UF +-20% 50VDC CER	28480	0160-3847
A25C8	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902B2
A25CR1	1990-0533	4	14	LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR2	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR3	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR4	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR5	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR6	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR7	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR8	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR9	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR10	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR11	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR12	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR13	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR14	1990-0533	4		LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A25CR15	1990-0486	6	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A25CR16	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A25CR17	1990-0665	3	13	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR18	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR19	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR20	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR21	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR22	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR23	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR24	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR25	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR26	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR27	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR29	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25CR30	1990-0665	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0665
A25E1	03582-61620			RPG	28480	03582-61620
A25J2	1251-5041		1	CONNECTOR	28480	1251-5041
A25L1	9100-3334	2	1	COIL 25UH 10% ,3D-NOM SRF=7MHZ	28480	9100-3334
A25Q1	1853-0016	8	8	TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q2	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q3	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q4	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q5	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q6	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q7	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25Q8	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
A25R1	0683-2205	9	8	RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R2	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R3	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R4	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R5	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R6	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R7	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R8	0683-2205	9		RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A25R9	0757-0280	3	1	RESISTOR 1000 1%	28480	0757-0280
A25R11	0683-1325	2	8	RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R12	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R13	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R14	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R15	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R16	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25R17	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25R1A	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
A25RP1	1810-0164	7	2	NETWORK-RES 9-SIP4.7K OHM X 8	91637	CSP09C07-472J
A25RP2	1810-0164	7		NETWORK-RES 9-SIP4.7K OHM X 8	91637	CSP09C07-472J
A25R23	1810-0135	2	1	NETWORK-RES 6-SIP10.0K OHM X 5	28480	1810-0135
A25R24	1810-0055	5	1	NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0055
A25R25	0811-3069	8	1	RESISTOR 1 5% .5W PW TC=0+-150	75042	BWN20-1-1R0-J
A25SW1	5060-9436	7	36	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW36	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW37	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A25SW39	3101-2441	6	1	SW-PSHBTN	28480	A25SW39
A25U1	1990-0592	5	11	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U2	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U3	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U4	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U5	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U6	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U7	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U8	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U9	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U10	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U11	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
A25U12	1858-0047	5	3	TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A25U13	1820-1200	5	2	IC INV TTL LS HEX	01295	SN74LS05N
A25U14	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A25U15	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A25U16	1820-1200	5		IC INV TTL LS HEX	01295	SN74LS05N
A25U17	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A25U18	1858-0047	5		TRANSISTOR ARRAY 16-PIN	13606	ULN-2003A
A25U19	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A25U20	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A25U21	1820-1438	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257AN
	1200-0473		1	SOCKET-IC 16 DIP	28480	1200-0473
	1200-0638		1	SOCKET-IC 14 DIP	28480	1200-0638

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS AND CHASSIS MOUNTED COMPONENTS		
B1	03325-61612		1	FAN (WITH CABLE)	28480	03325-61612
C1	0150-0012		1	C-F .01μF 1000 V	28480	0150-0012
C2	0150-0012	3	1	CAPACITOR-FXD .01 UF 1KV	28480	0150-0012
C3	0160-0012	4	1	CAPACITOR-FXD .01 UF 1KV	28480	0160-0012
C4	0160-0012	4	1	CAPACITOR-FXD .01 UF 1KV	28480	0160-0012
C5	0160-0012	4	1	CAPACITOR-FXD .01 UF 1KV	28480	0160-0012
C33	0160-4571		1	C-F .1 μF .20	28480	0160-4571
C202	0160-4571		1	C-F .1 μF .20	28480	0160-4571
C203	0160-4571		1	C-F .1 μF .20	28480	0160-4571
C205	0160-4571		1	C-F .1 μF .20	28480	0160-4571
	5041-2302	2	1	75 Ω CONN PLASTIC INSERT (3336A)	28480	5041-2302
	5041-2301	1	1	75 Ω CONN PLASTIC INSERT (3336A/001)	28480	5041-2301
	5041-1493		1	150 Ω CONN PLASTIC INSERT (3336A)	28480	5041-1493
	5041-1493		1	600 Ω CONN PLASTIC INSERT (3336A)	28480	5041-1493
	5041-1469	0	1	75 Ω CONN PLASTIC INSERT (3336B)	28480	5041-1469
	5041-1466	7	1	75 Ω CONN PLASTIC INSERT (3336B/001)	28480	5041-1466
	5041-2304		1	124 Ω CONN PLASTIC INSERT (3336B)	28480	5041-2304
	5041-2303	3	1	124 Ω CONN PLASTIC INSERT (3336B/001)	28480	5041-2303
	5041-1467		1	135 Ω CONN PLASTIC INSERT (3336B)	28480	5041-1467
	5041-1600	1	1	600 Ω CONN PLASTIC INSERT (3336B)	28480	5041-1600
E1	9100-3875		1	CONNECTOR, PWR	28480	9100-3875
F1	2110-0001		1	FUSE - 1 AMP 250V NB	04703	312001
F1	2110-0012		1	FUSE - .5 AMP 250V NB	28480	2110-0012
FX1	2100-0543		1	FUSE HOLDER	06328	FEC031.1603
FXC1	2110-0545		1	FUSE HOLDER CAP	06328	FEK031.1613
J1	03336-61614		1	50 OHM CONN (3336C)	28480	03336-61614
	03336-61612		1	75 OHM CONN (3336A)	28480	03336-61612
	03336-61615		1	75 OHM CONN (3336A/001)	28480	03336-61615
	03336-61610		1	75 OHM CONN (3336B)	28480	03336-61610
	03336-61611		1	75 OHM CONN (3336B/001)	28480	03336-61611
J2	03336-61613		1	75 OHM CONN (3336C)	28480	03336-61613
	1250-1116		2	124 OHM CONN (3336B)	28480	1250-1116
	1250-1053		2	124 OHM CONN (3336B/001)	28480	1250-1053
	1251-5586		1	150 OHM CONN (3336A)	28480	1251-5586
J3	1251-5790		2	135 OHM CONN (3336A)	05057	M-114B
J4	1251-5586		1	600 OHM CONN (3336A)	28480	1251-5586
	1251-5790		1	600 OHM CONN (3336B)	28480	1251-5790
J5 THRU J16	1250-1558		12	ADAPTER - COAX STR F-BNC F-RCA-PHONO	28480	1250-1558
MP1	03336-64302		1	PNL, DRESS LWR (3336A)	28480	03336-64302
MP1	03336-64301		1	PNL, DRESS LWR (3336B)	28480	03336-64301
MP1	03336-64303		1	PNL, DRESS LWR (3336C)	28480	03336-64303
MP2	5040-6928		1	DIVIDER STRIP	28480	5040-6928
MP3	03336-29301		1	PNL, DRESS UPR (3336A)	28480	03336-29301
MP3	03336-29302		1	PNL, DRESS UPR (3336B)	28480	03336-29302
MP3	03336-29303		1	PNL, DRESS UPR (3336C)	28480	03336-29303
MP4	03336-60201		1	FRONT SUB PANEL	28480	03336-60201
MP5	5020-8803		1	FRONT FRAME	28480	5020-8803
MP6	5040-7202		1	TRIM, TOP	28480	5040-7202
MP7	5020-8837		4	CORNER STRUT	28480	5020-8837
MP8	5060-9880		2	PNL, SIDE	28480	5060-9880
MP9	5040-7219		2	STRAP HDL CAP - FR	28480	5040-7219
MP10	5060-9804		2	STRAP HDL - 18 IN	28480	5060-9804
MP11	5040-7220		2	STRAP HDL CAP - R	28480	5040-7220
MP12	5060-9835		1	TOP COVER	28480	5060-9835
MP13	03336-60202		1	PNL, REAR	28480	03336-60202
MP14	5020-8804		1	REAR FRAME	28480	5020-8804
MP15	03336-66602		1	MAIN FRAME	28480	03336-66602
MP16	5040-4527		1	FASTENER	28480	5040-4527
MP17	5001-0439		2	TRIM, SIDE	28480	5001-0439
MP18	5060-9847		1	BTM COVER	28480	5060-9847
MP19	5040-7201		4	FOOT	28480	5040-7201
MP20	1460-1345		2	TILT, STAND	28480	1460-1345
MP21	03325-61101		1	HT SINK ASSY	28480	03325-61101
MP22	3150-0228		1	FILTER, SCREEN	28480	3150-0228
MP23	3150-0227		1	FILTER, FOAM	28480	3150-0227
MP24	3160-0201		1	FAN, GRILL	28480	3160-0201
MP25	1400-0783		6	CLAMP-CABLE .25-DIA .438-WD NYL	28480	1400-0783
MP26	5040-6898		1	LIGHT PIPE	28480	5040-6898
MP27	00310-48801		20	WASHER, SHLDR	28480	00310-48801
MP28	3050-0604		8	WASHER, FL	28480	3050-0604
MP29	0360-1089		4	TERMINAL, SLDR LUG	28480	3060-1089
R1	0683-1015		1	RESISTOR 100 5% .25W	01607	CB1015
T1	9100-0480		1	TRANSFORMER, POWER	28480	9100-0480

See introduction to this section for ordering information
*1Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS (CONT'D)		
W1	03336-61602		1	CABLE, SIGNAL 50 OHM (3336A/B)	28480	03336-61602
W1	03336-61614		1	CABLE, SIGNAL 50 OHM (3336C)	28480	03336-61614
W2	03336-61612		1	CABLE, SIGNAL 75 OHM (3336A)	28480	03336-61612
W2	03336-61615		1	CABLE, SIGNAL 75 OHM (3336A/001)	28480	03336-61615
W2	03336-61610		1	CABLE, SIGNAL 75 OHM (3336B)	28480	03336-61610
W2	03336-61611		1	CABLE, SIGNAL 75 OHM (3336B/001)	28480	03336-61611
W2	03336-61613		1	CABLE, SIGNAL 75 OHM (3336C)	28480	03336-61613
W3	P/O 03336-61601		1	CABLE, 20 - 60 MHZ	28480	P/O 03336-61601
	(8120-2585)			UNMARKED W3	28480	(8120-2585)
W4	P/O 03336-61601		1	CABLE, EXT LVL	28480	P/O 03336-61601
	(8120-2585)			UNMARKED W4	28480	(8120-2585)
W5	P/O 03336-61601		1	CABLE, SYNC	28480	P/O 03336-61601
	(8120-2585)			UNMARKED W5	28480	(8120-2585)
W6	03336-66512		1	CABLE, HP-IB, INCLUDES A12 PC BOARD	28480	03336-66512
W7	P/O 03336-61601		1	CABLE, AMPTD MOD	28480	P/O 03336-61601
	(8120-2585)			UNMARKED W7	28480	(8120-2585)
W8	P/O 03336-61601		1	CABLE, 100 KHZ	28480	P/O 03336-61601
	(8120-2585)			UNMARKED W8	28480	(8120-2585)
W9	P/O 03336-61601		1	CABLE, 2 MHZ	28480	P/O 03336-61601
	(8120-2587)			UNMARKED W9	28480	(8120-2585)
W10	P/O 03336-61601		1	CABLE, 1 MHZ REF OUT	28480	P/O 03336-61601
	(8120-2587)			UNMARKED W10	28480	(8120-2587)
W11	P/O 03336-61601		1	CABLE, EXT REF IN	28480	P/O 03336-61601
	(8120-2586)			UNMARKED W11	28480	(8120-2586)
W12	03325-61604		1	CABLE, Z BLANK	28480	03325-61604
W13	03325-61619		1	CABLE, MARKER	28480	03325-61619
W14	03325-61620		1	CABLE, X DRIVE	28480	03325-61620
W15	03325-61606		1	CABLE, VTO	28480	03325-61606
W16	03325-61607		1	CABLE, PHASE MODE	28480	03325-61607
W17	03325-61608		1	CABLE, PHASE DET	28480	03325-61608
W18	03325-61609		1	CABLE, S & H	28480	03325-61609
W19	03325-61610		1	CABLE, OVEN OUT (OPT 004)	28480	03325-61610
W22	03325-61611		1	CABLE, DC SUPPLY	28480	03325-61611
W23	03325-61603		1	CABLE, ALC	28480	03325-61603
W24	03325-61609		1	CABLE, MIXER	28480	03325-61609
W25	03325-61612		1	CABLE, FAN, INCLUDES FAN (B1)	28480	03325-61612
W26	03325-61613		1	CABLE, HP-IB POWER	28480	03325-61613
W27	03325-61614		1	CABLE, KEYBOARD, RIBBON	28480	03325-61614
W29	03325-61616		1	CABLE, OVEN POWER (OPT 001)	28480	03325-61616
W30	03336-61616		1	CABLE, ATTEN CONTROL	28480	03336-61616
W30	03336-61617		1	CABLE, ATTEN CONTROL (OPT 005)	28480	03336-61617
W31	8120-3108	9	1	CABLE, MULTICONDUCT	28480	8120-3108
W32	8120-3108	9	1	CABLE, MULTICONDUCT	28480	8120-3108
W33	8120-3108	9	1	CABLE, MULTICONDUCT	28480	8120-3108
W34	8120-1378		1	CABLE, AC POWER	28480	8120-1378
W35	03336-61601		1	CABLE ASSY, INCLUDES W3,W4,W5,W7,W8,W9, W10, W11	28480	03336-61601
W36	03336-61618		1	CABLE, OUTPUT CONTROL	28480	03336-61618
W37	03325-61625		1	CABLE, + 15 V UNREG	28480	03325-61625
W40	03336-61603	4	1	CABLE, SIGNAL 50 OHM, AMP OUT (3336A/B)	28480	03336-61603
W40	03336-61602	3	1	CABLE, SIGNAL 50 OHM (3336C)	28480	03336-61602
	1251-4288		1	STRAIN RLF (USED ON W27)	28480	1251-4288
	1250-1499		1	BNC TO BNC REF JUMPER	28480	1250-1499

See introduction to this section for ordering information
*Indicates factory selected value

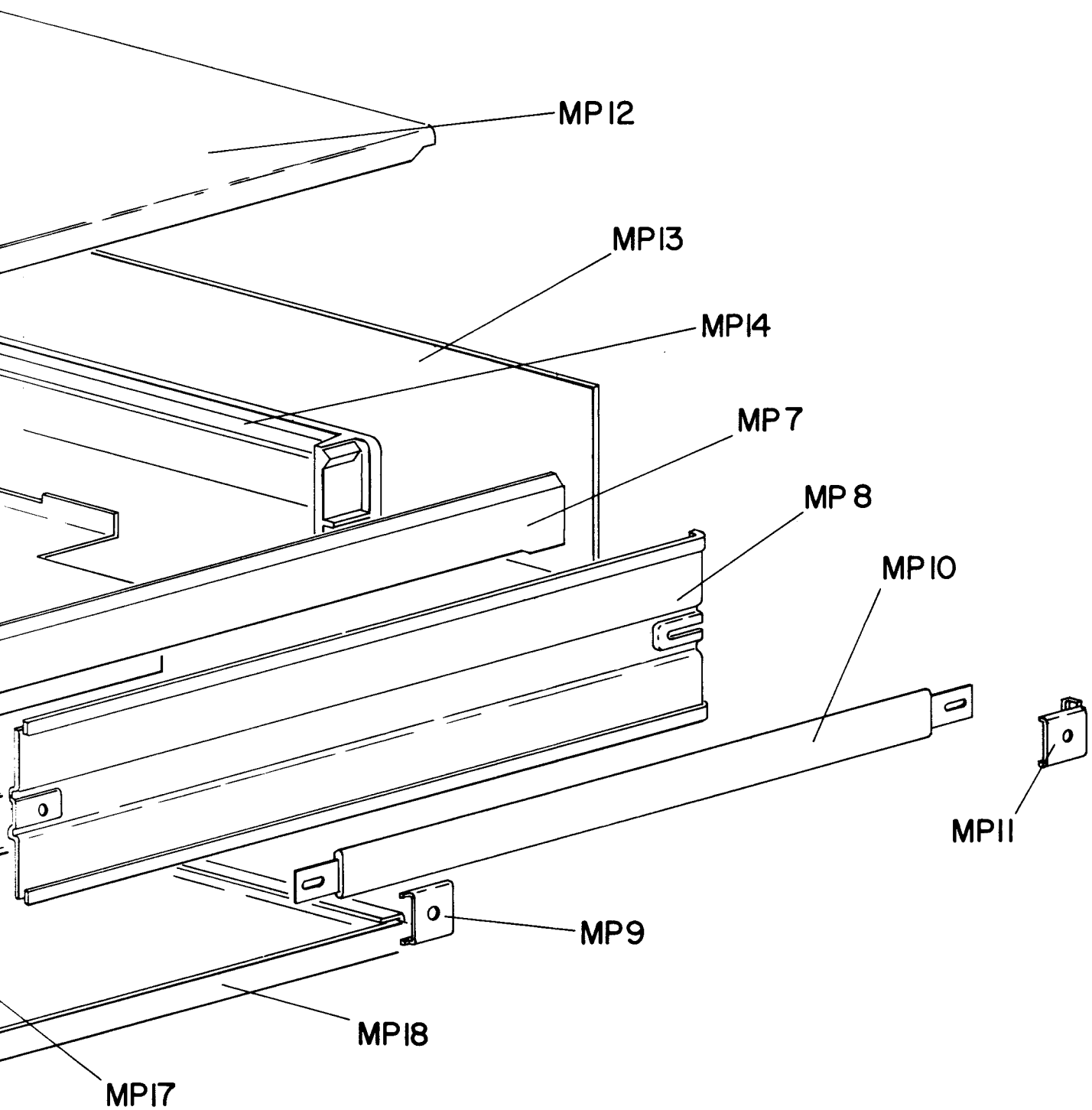
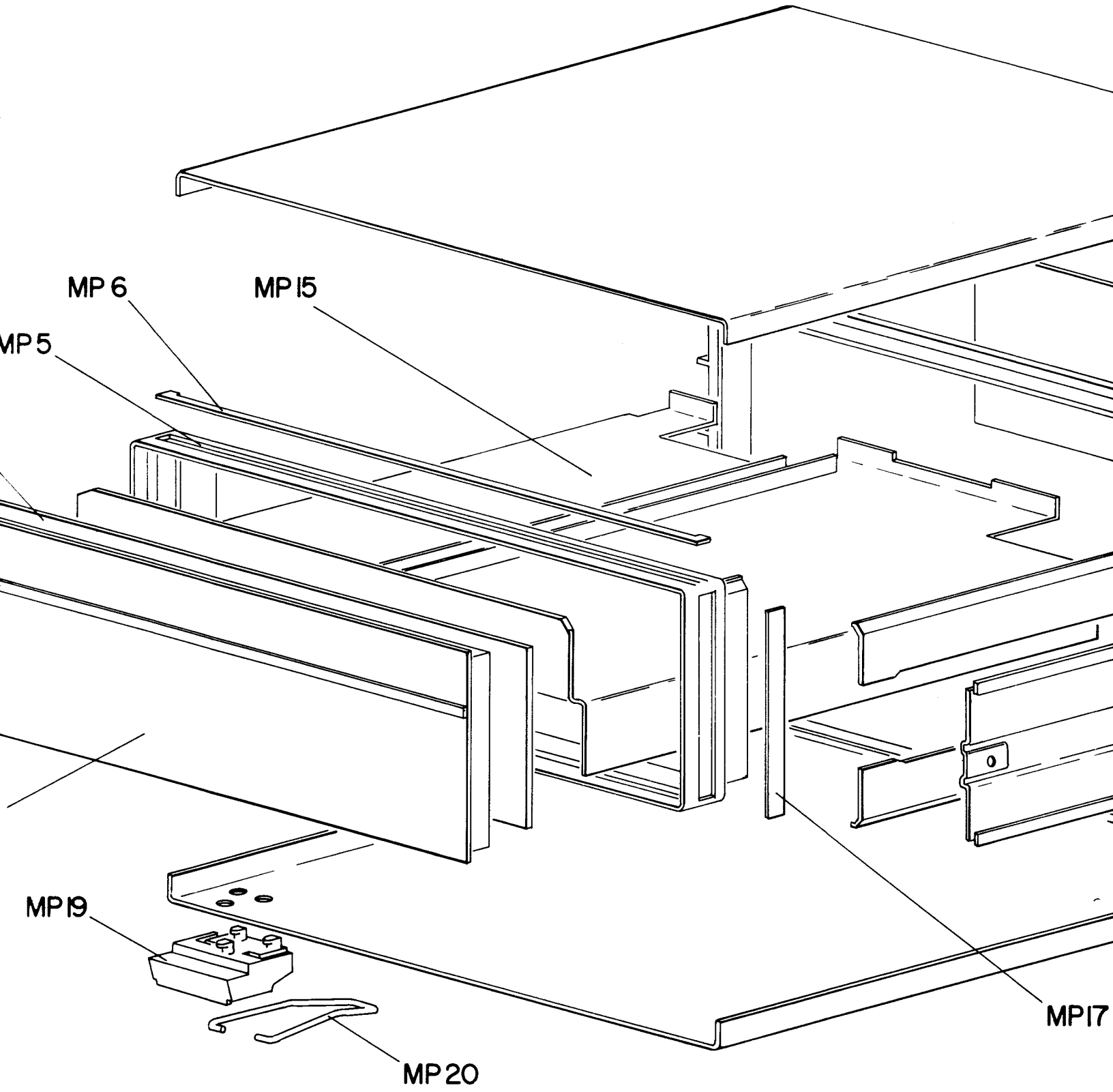
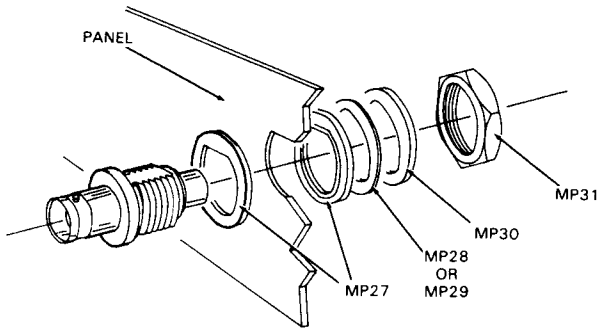
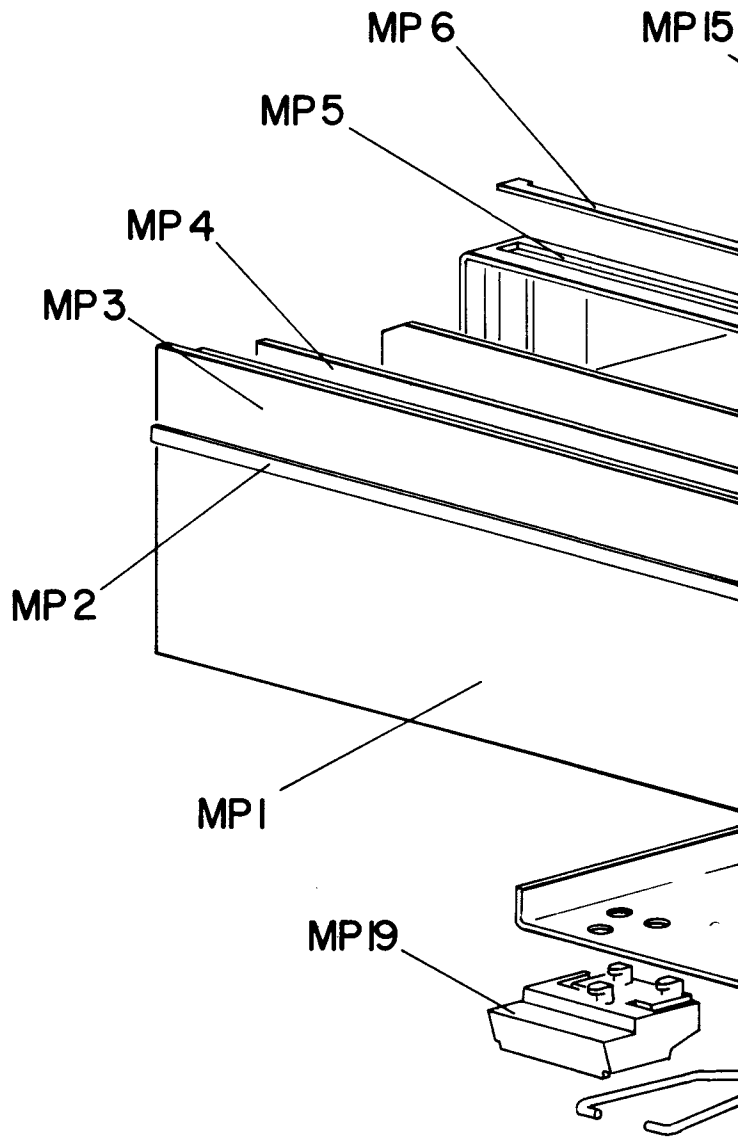


Figure 6-1. Location of Parts.


MP 6
MP 15
MP 5
MP 19
MP 17
MP 20


PANEL
MP31
MP30
MP28
OR
MP29
MP27


MP6
MP15
MP5
MP4
MP3
MP2
MP1
MP19

SECTION VII
MANUAL CHANGES

As changes are made in the instrument to improve performance and reliability, the other sections of the manual will be revised and this section will contain the information necessary to adapt the manual to earlier instruments.

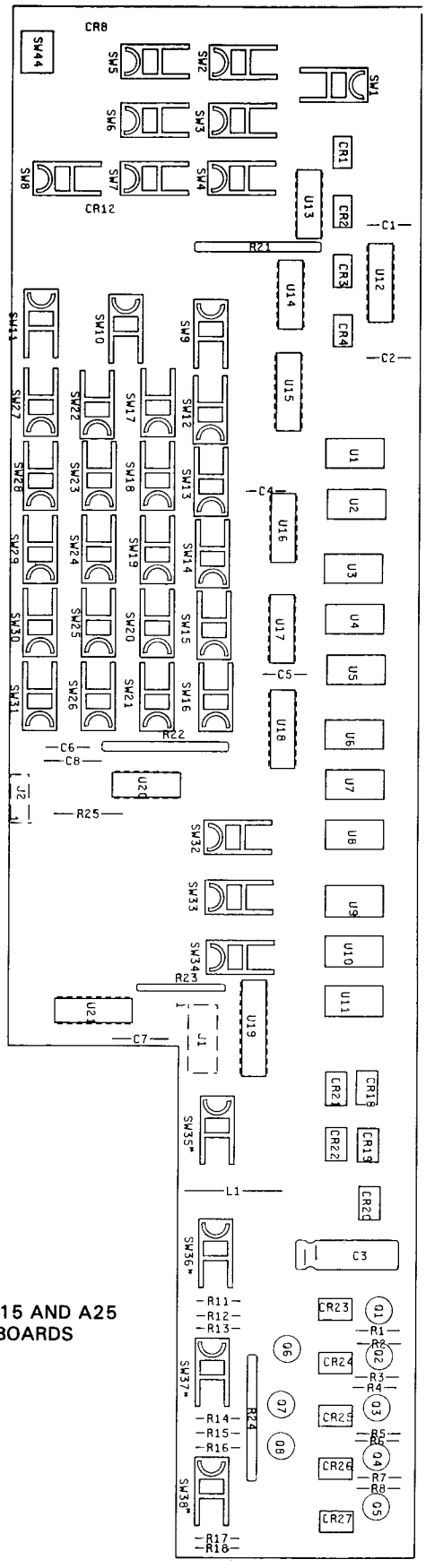
WARNING

These servicing instructions are for use by trained service personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

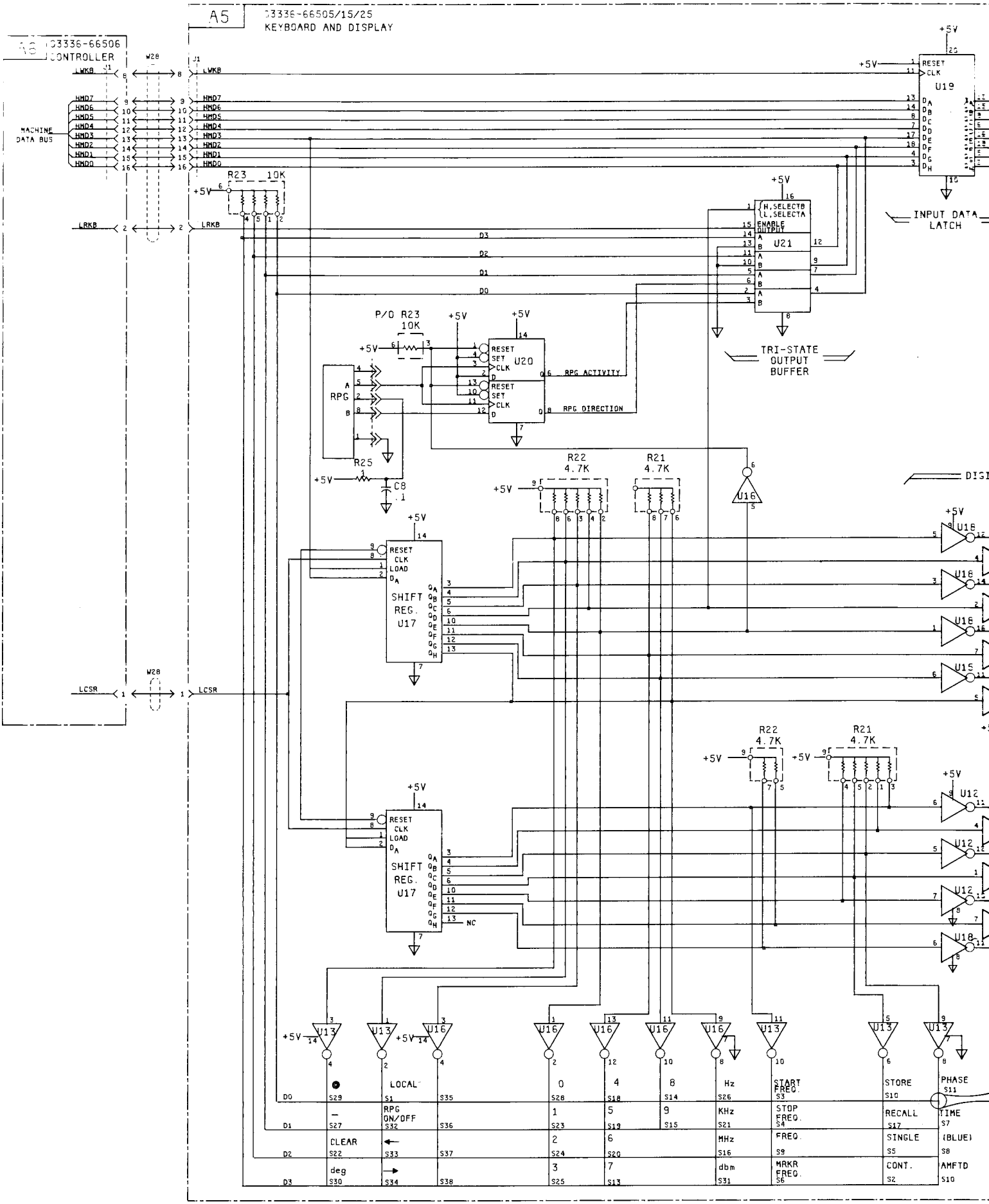
SECTION VIII
SERVICE

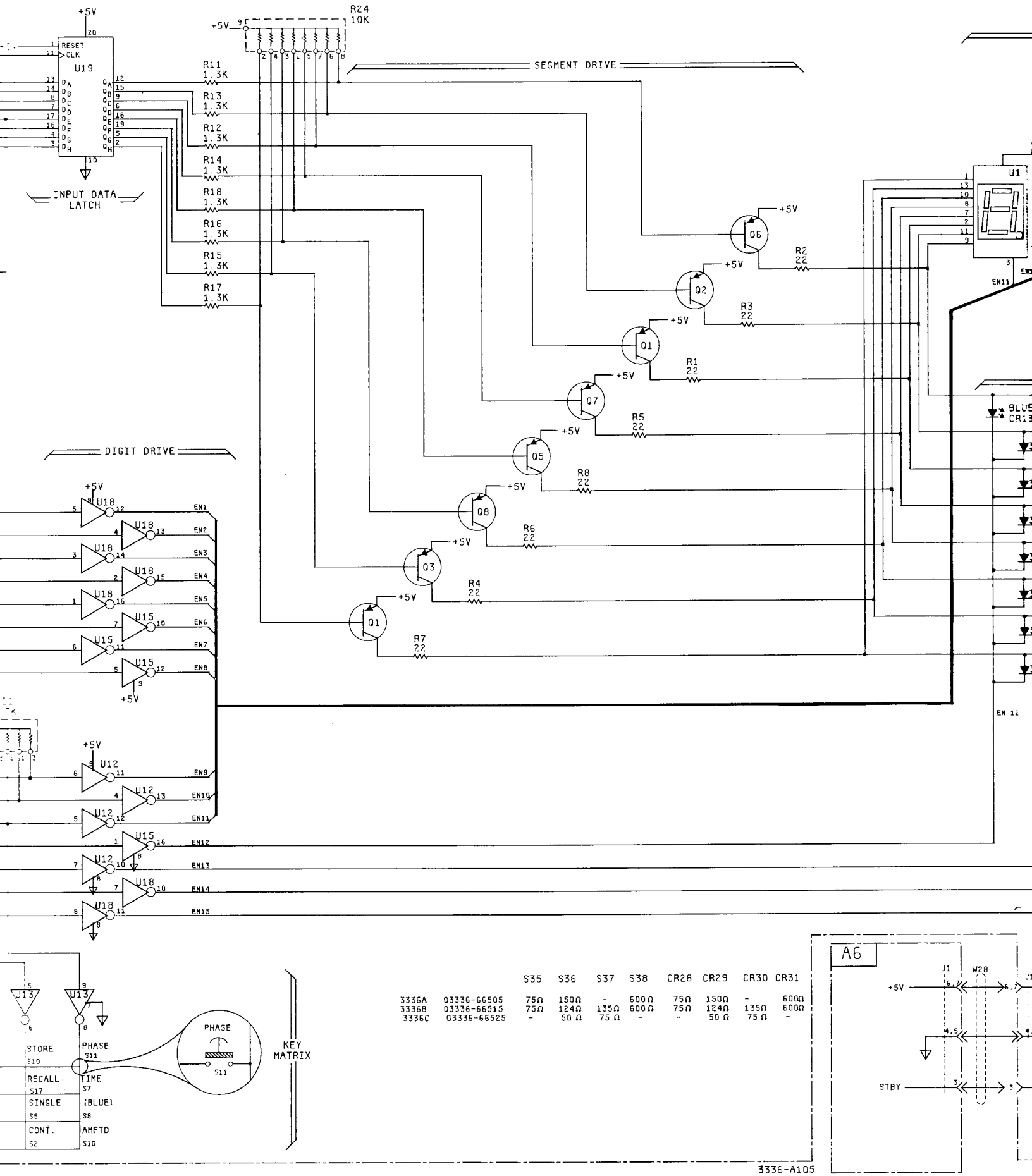
8-1. INTRODUCTION.

8-2. This section contains schematics, component locators and a block diagram for the -hp-3336A/B/C. Troubleshooting procedures and other service information are being developed at this time. If you want this information, fill out the pink manual insert, return it to Hewlett-Packard and at the first opportunity, a new Service Section will be returned to you.



SIMILAR TO A15 AND A25
CIRCUIT BOARDS


A5
03336-66505/15/25
KEYBOARD AND DISPLAY
A8 03336-66506
CONTROLLER
MACHINE DATA BUS
LWKB
HMD7
HMD6
HMD5
HMD4
HMD3
HMD2
HMD1
HMD0
LRKB
LCSR
W28
J1
R23 10K
+5V
U19
INPUT DATA LATCH
U21
TRI-STATE OUTPUT BUFFER
D3
D2
D1
D0
P/O R23 10K
U20
RPG
RPG ACTIVITY
RPG DIRECTION
R25
C8 .1
R22 4.7K
R21 4.7K
U16
SHIFT REG. U17
RESET
CLK
LOAD
NC
U13
U12
U18
U15
LOCAL
CLEAR
deg
RPG ON/OFF
0
1
2
3
4
5
6
7
8
9
Hz
KHz
MHz
dbm
START FREQ.
STOP FREQ.
FREQ.
MRKR FREQ.
STORE
RECALL
SINGLE
CONT.
PHASE
TIME
(BLUE)
AMPTD



		S35	S36	S37	S38	CR28	CR29	CR30	CR31
3336A	03336-66505	75Ω	150Ω	-	600Ω	75Ω	150Ω	-	600Ω
3336B	03336-66515	75Ω	124Ω	135Ω	600Ω	75Ω	124Ω	135Ω	600Ω
3336C	03336-66525	-	50 Ω	75 Ω	-	-	50 Ω	75 Ω	-

3336-A105

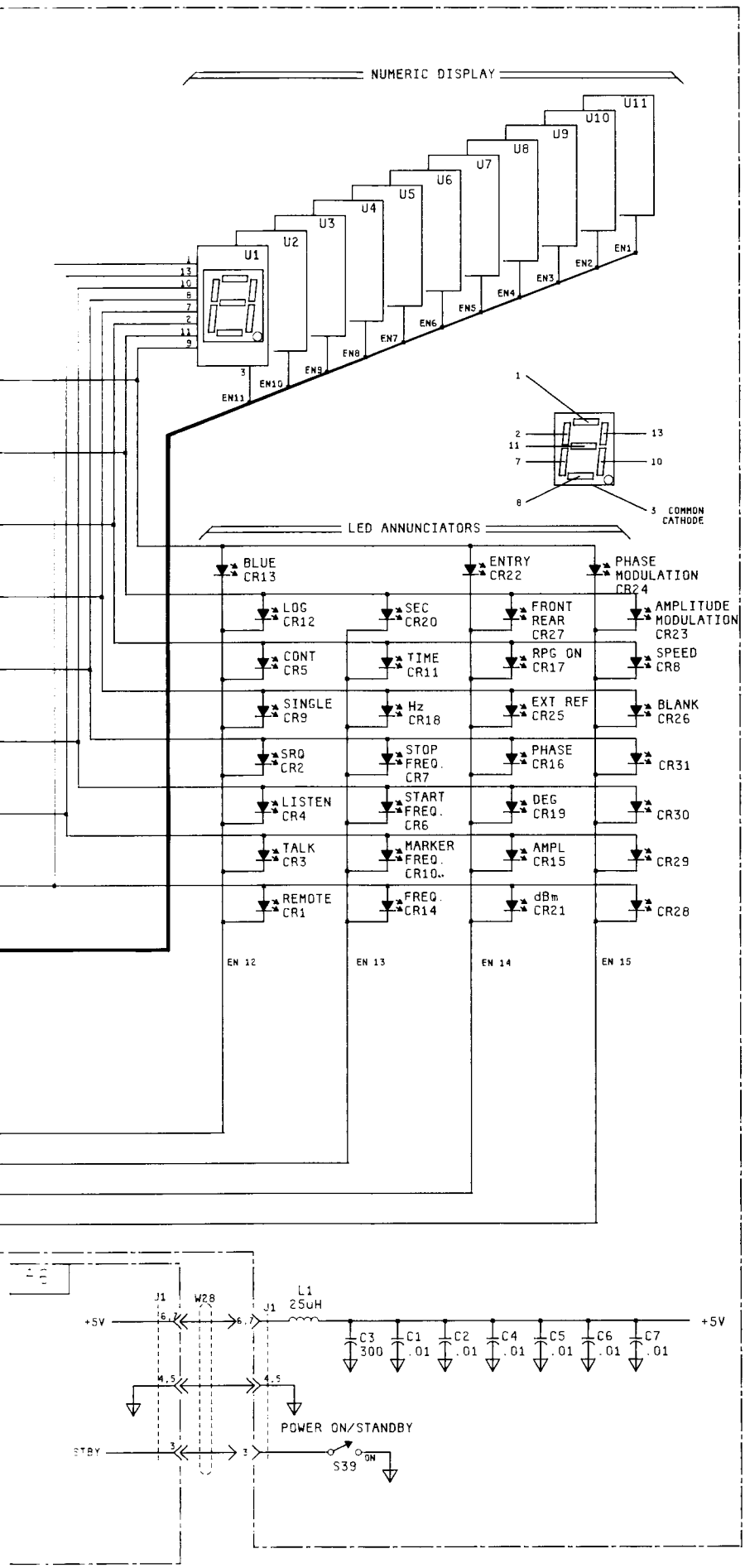
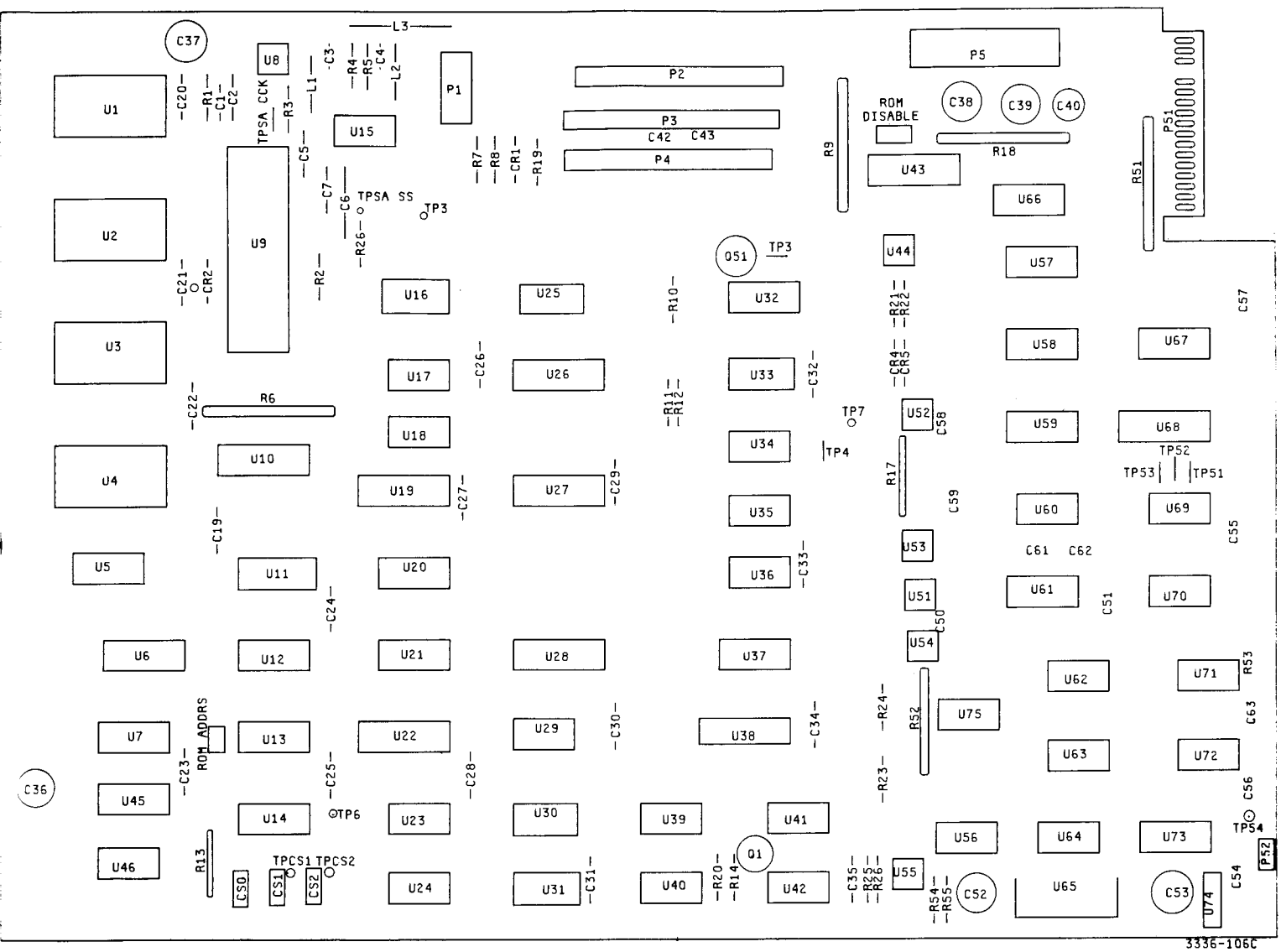
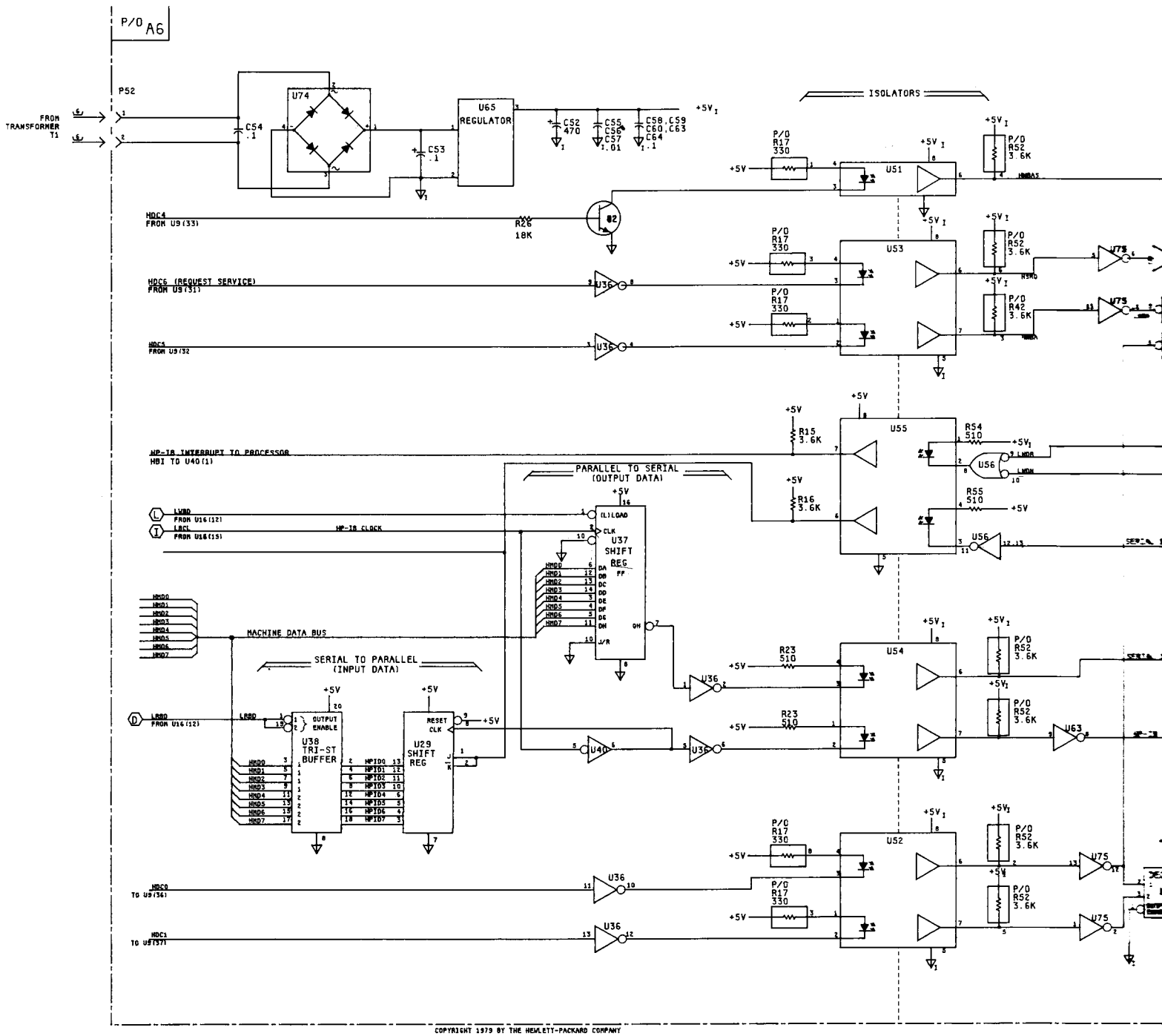


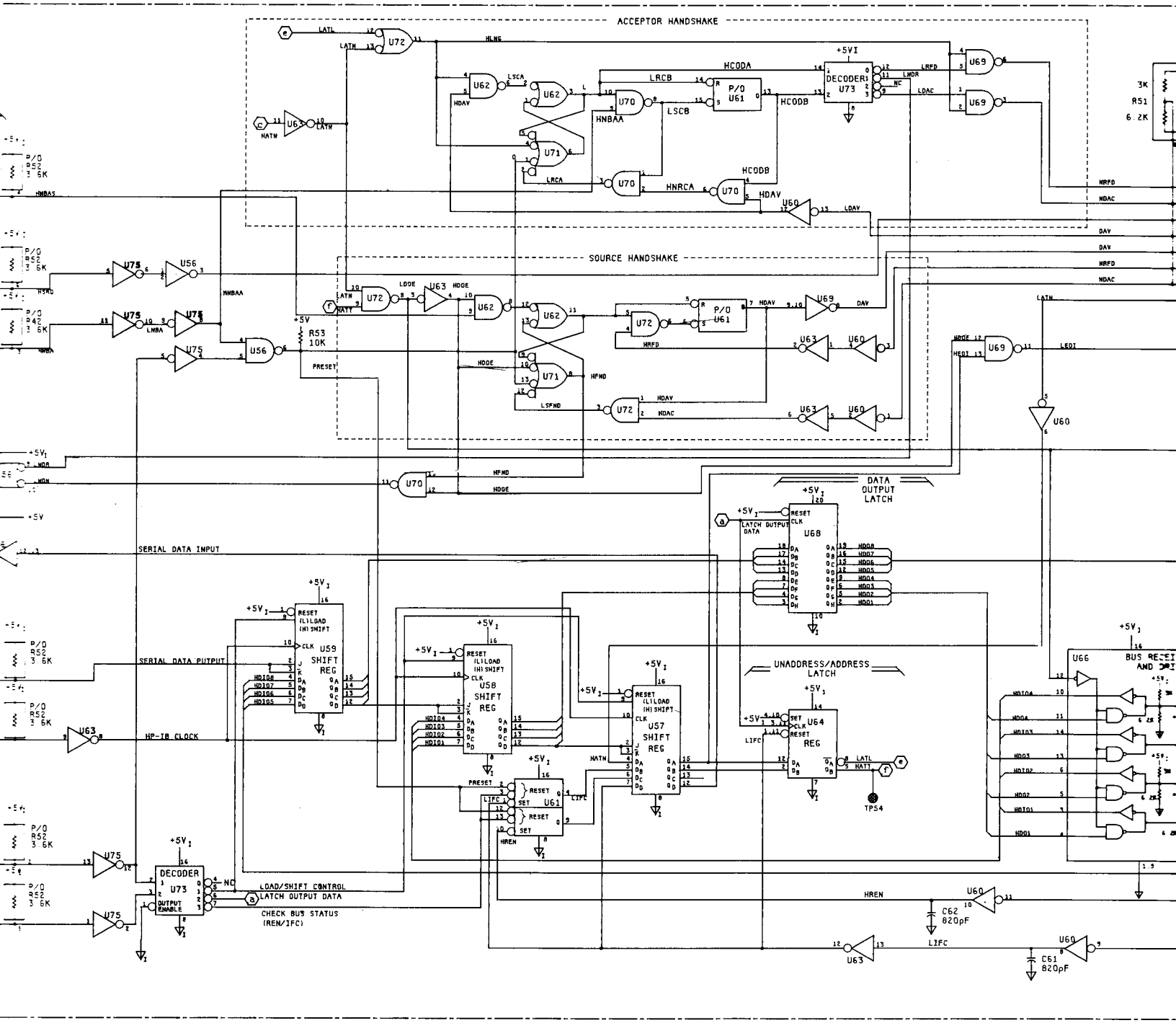
Figure 8-1. Keyboard and Display, A5/A15/A25.

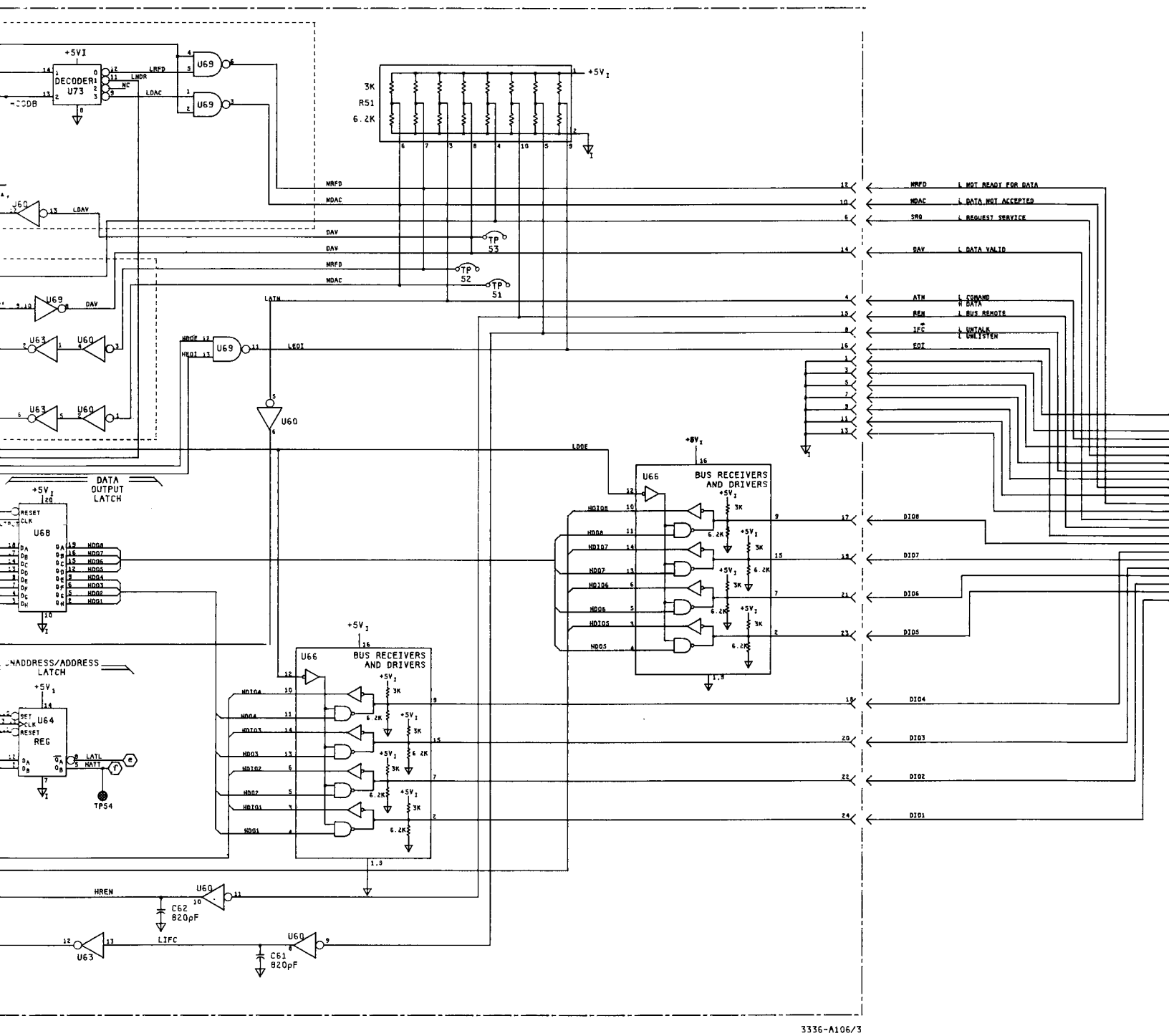


3336-106C

A6
03336-66506




ACCEPTOR HANDSHAKE
SOURCE HANDSHAKE
DATA OUTPUT LATCH
UNADDRESS/ADDRESS LATCH
SERIAL DATA INPUT
SERIAL DATA PUTPUT
HP-IB CLOCK
LOAD/SHIFT CONTROL
LATCH OUTPUT DATA
CHECK BUS STATUS (REN/IFC)
BUS RESET AND
U72
U62
U71
U70
U69
U60
U63
U56
U75
U73
U59
U58
U57
U68
U64
U61
U66
P/O U61
P/O U72
DECODER U73
SHIFT REG
LATCH
R53 10K
C62 820pF
C61 820pF
3K
R51 6.2K
TP54


DECODER
U73
LRFD
LWDR
LDAC
U69
3K
R51
6.2K
TP 53
TP 52
TP 51
WRFD
NDAC
DAV
LATN
LEDI
U60
U63
DATA OUTPUT LATCH
U68
RESET
CLK
HDD8
HDD7
HDD6
HDD5
HDD4
HDD3
HDD2
HDD1
ADDRESS/ADDRESS LATCH
U64
REG
LATL
WATT
TP54
U66
BUS RECEIVERS AND DRIVERS
HDI08
HDI07
HDI06
HDI05
HDI04
HDI03
HDI02
HDI01
LDDE
HREN
C62 820pF
C61 820pF
LIFC
MRFD L NOT READY FOR DATA
NDAC L DATA NOT ACCEPTED
SRQ L REQUEST SERVICE
DAV L DATA VALID
ATN L COMMAND OR DATA
REN L BUS REMOTE
IFC L UNTALK L UNLISTEN
EOI
DIO8
DIO7
DIO6
DIO5
DIO4
DIO3
DIO2
DIO1

3336-A106/3

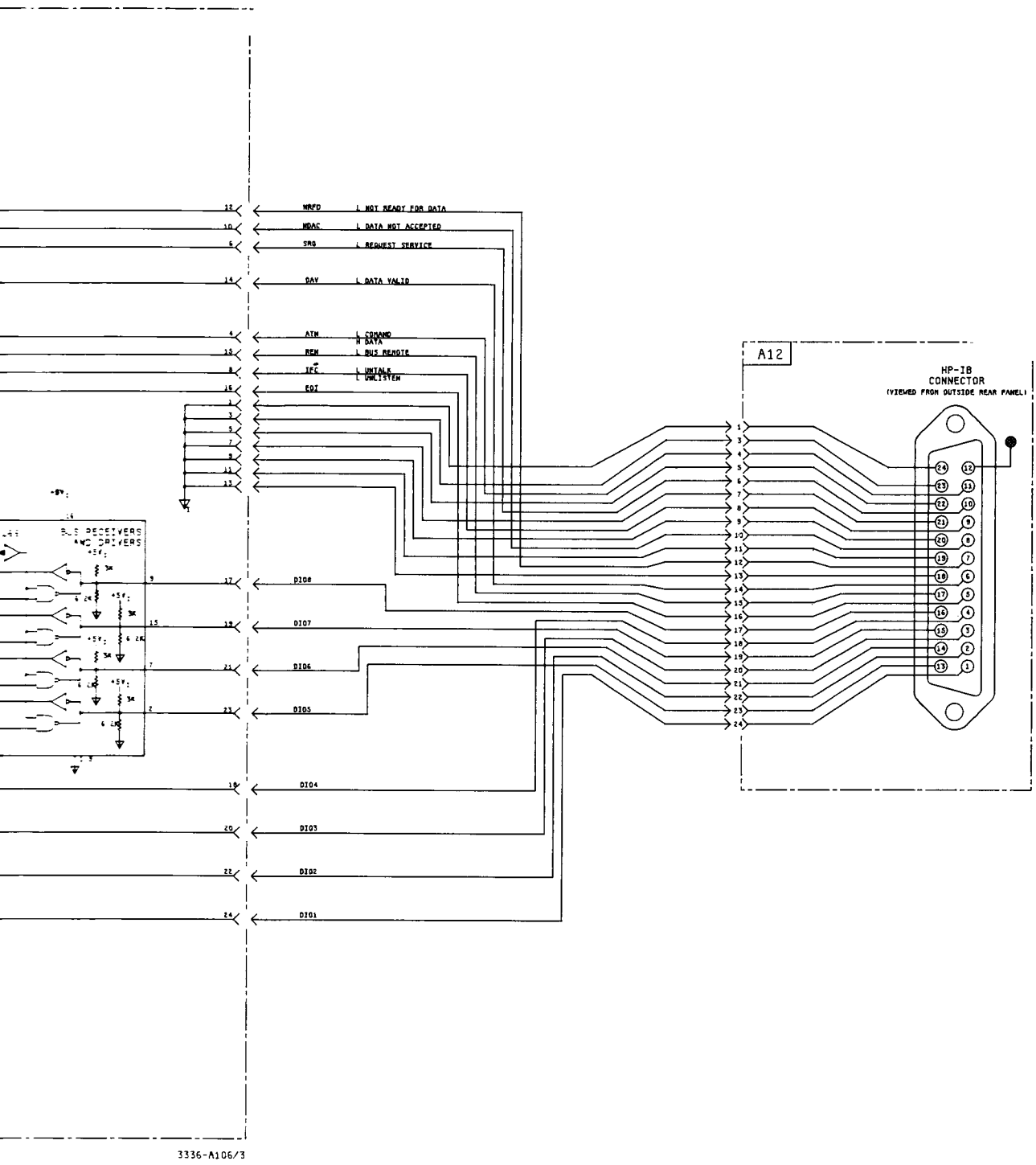
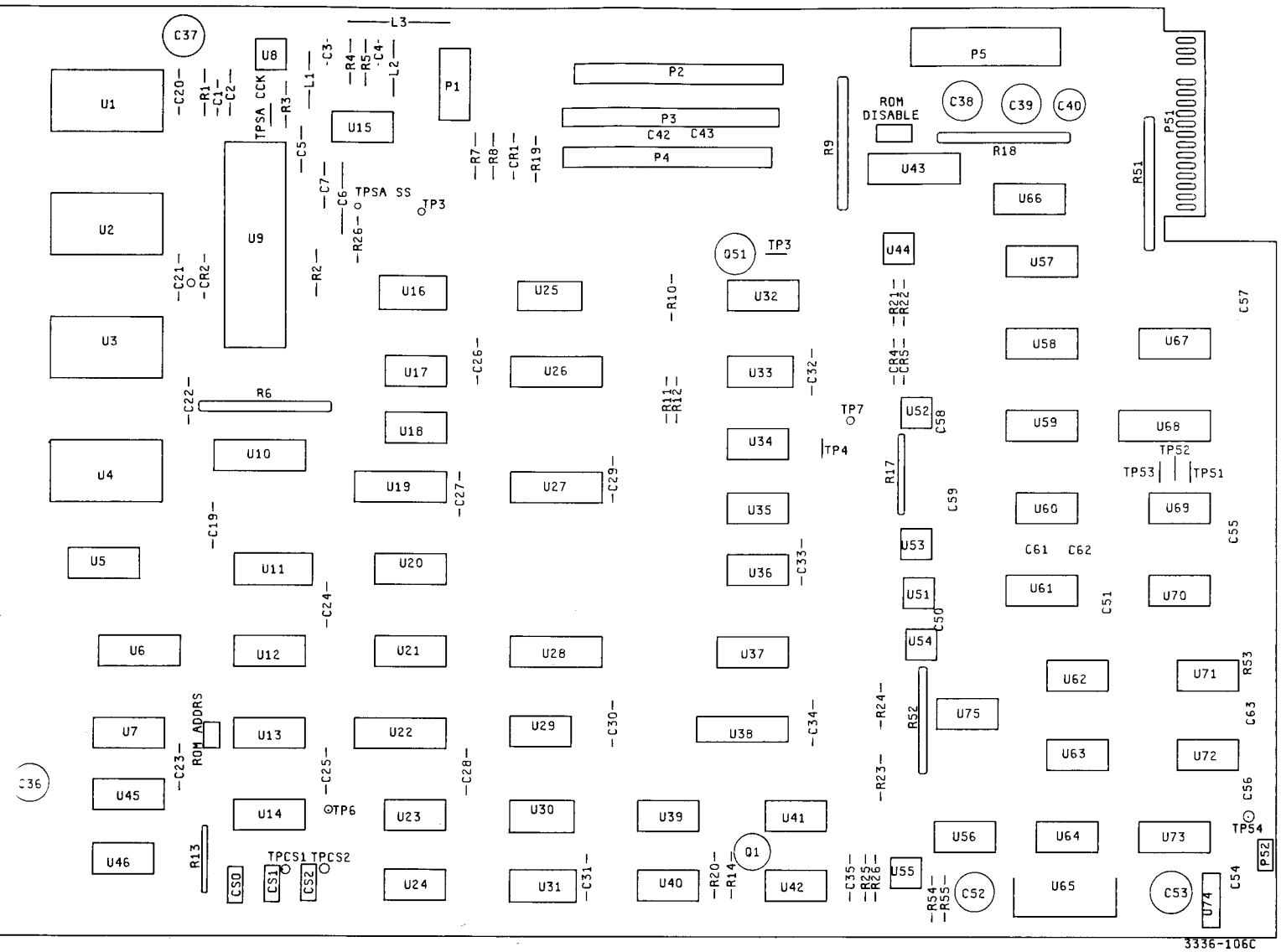
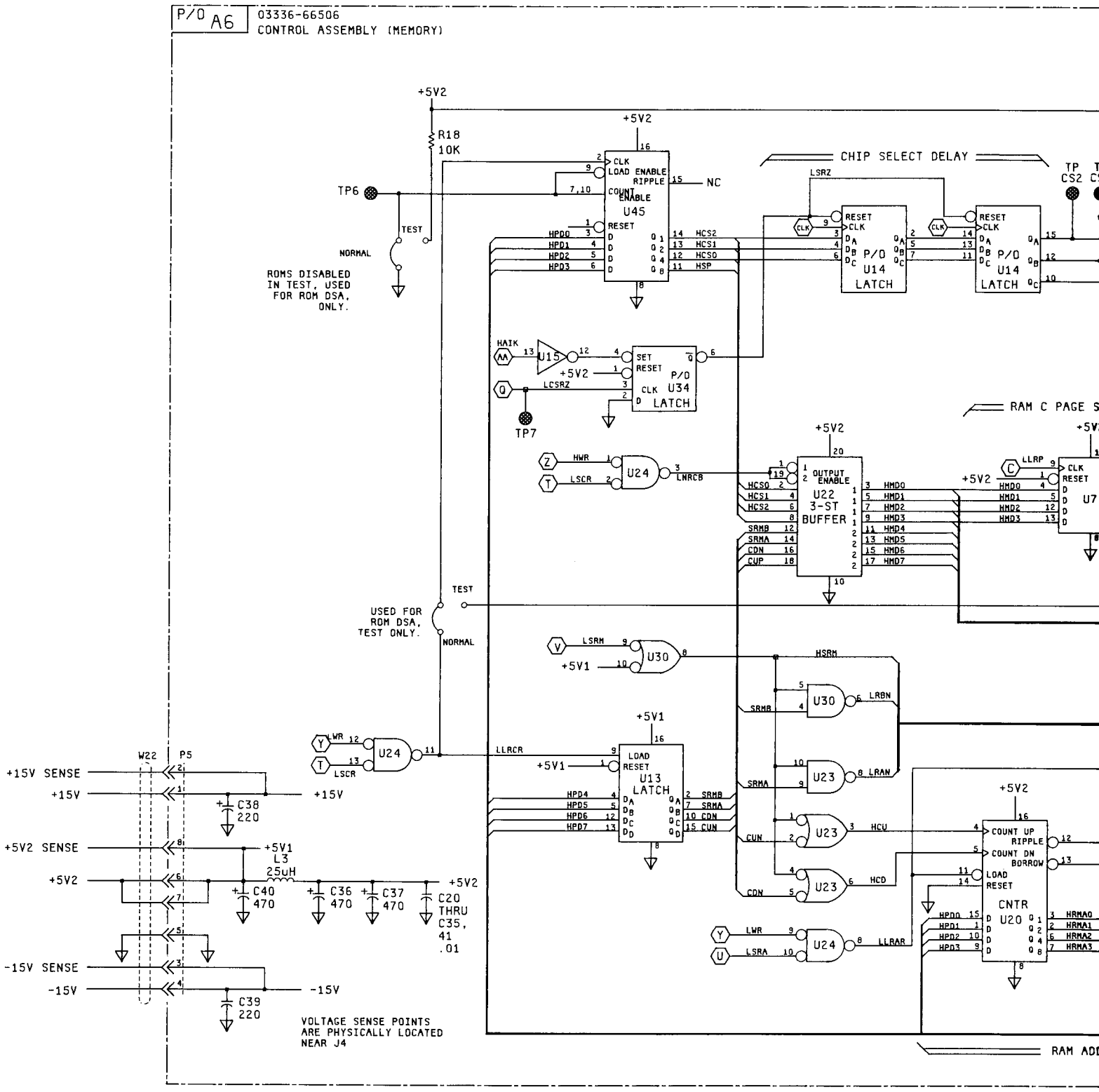


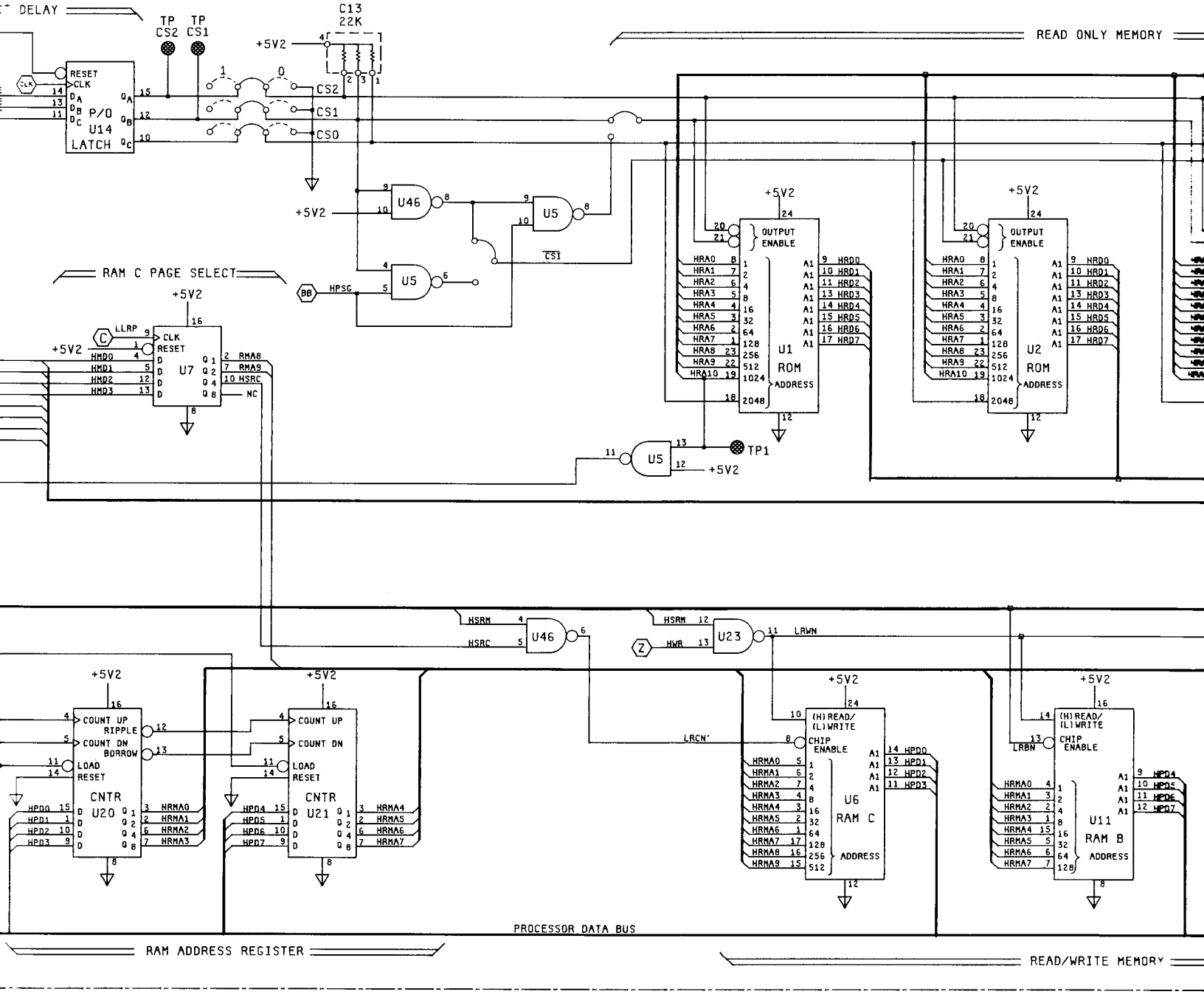
Figure 8-2. HP-IB Circuits, A6.



3336-106C

A6
03336-66506


P/O A6
03336-66506
CONTROL ASSEMBLY (MEMORY)
+5V2
R18
10K
TP6
TEST
NORMAL
ROMS DISABLED IN TEST, USED FOR ROM DSA, ONLY.
U45
LOAD ENABLE
RIPPLE COUNT ENABLE
RESET
NC
HPD0
HPD1
HPD2
HPD3
HCS2
HCS1
HCS0
HSP
CHIP SELECT DELAY
LSRZ
P/O U14 LATCH
HAIK
U15
P/O U34 LATCH
LCSRZ
TP7
RAM C PAGE S
U24
HWR
LSCR
LNRCB
U22 3-ST BUFFER
OUTPUT ENABLE
HCS0
HCS1
HCS2
SRMB
SRMA
CDN
CUP
HMD0
HMD1
HMD2
HMD3
HMD4
HMD5
HMD6
HMD7
LLRP
U7
USED FOR ROM DSA, TEST ONLY.
TEST
NORMAL
LSRM
U30
HSRM
LRBN
LRAN
U23
HCU
HCD
LLRCR
U13 LATCH
LOAD RESET
HPD4
HPD5
HPD6
HPD7
LLRAR
COUNT UP RIPPLE
COUNT DN BORROW
LOAD RESET
CNTR U20
HRMA0
HRMA1
HRMA2
HRMA3
RAM ADD
W22
P5
+15V SENSE
+15V
C38 220
+5V2 SENSE
+5V1 L3 25uH
C40 470
C36 470
C37 470
C20 THRU C35, 41 .01
-15V SENSE
-15V
C39 220
VOLTAGE SENSE POINTS ARE PHYSICALLY LOCATED NEAR J4



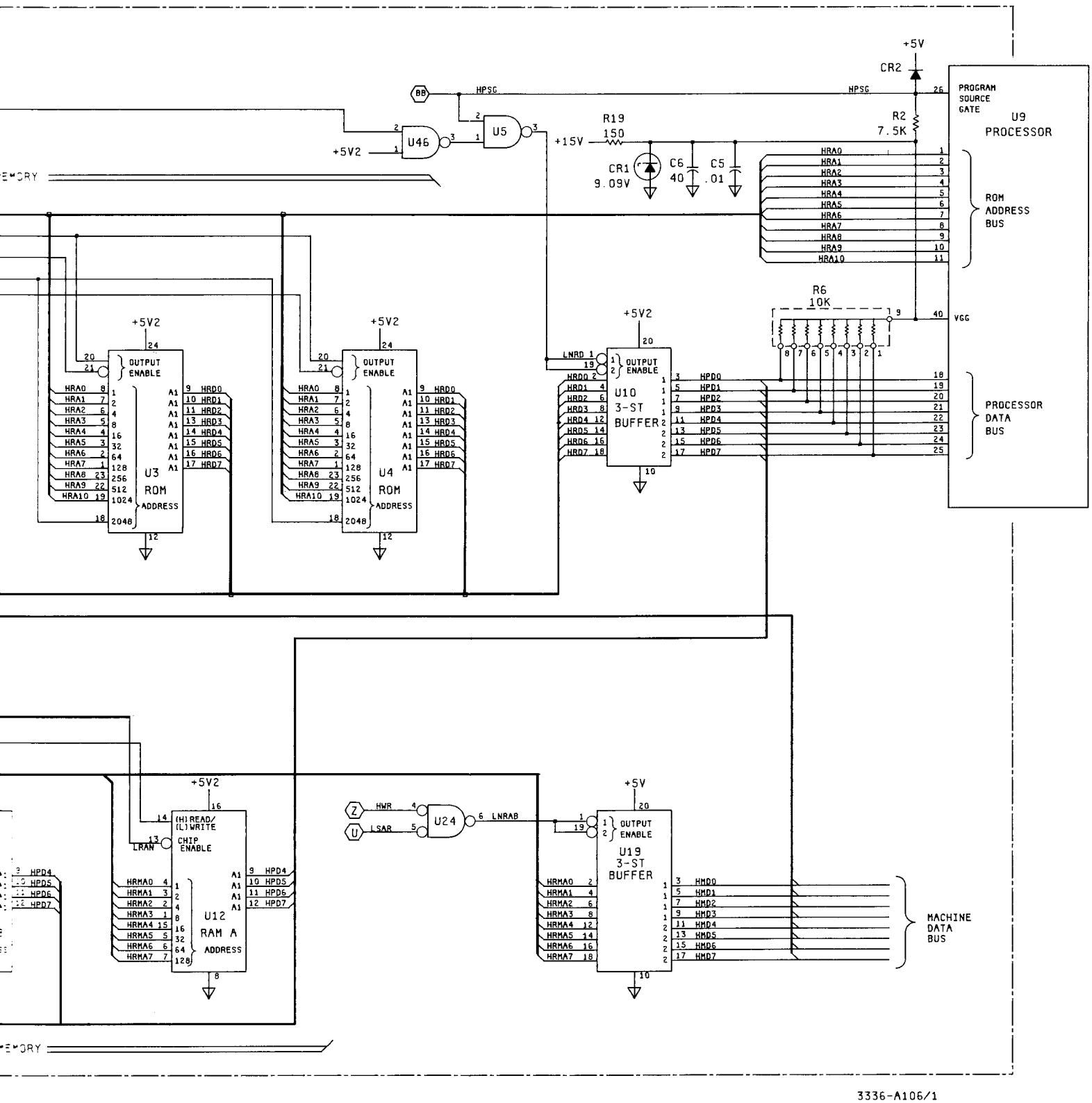
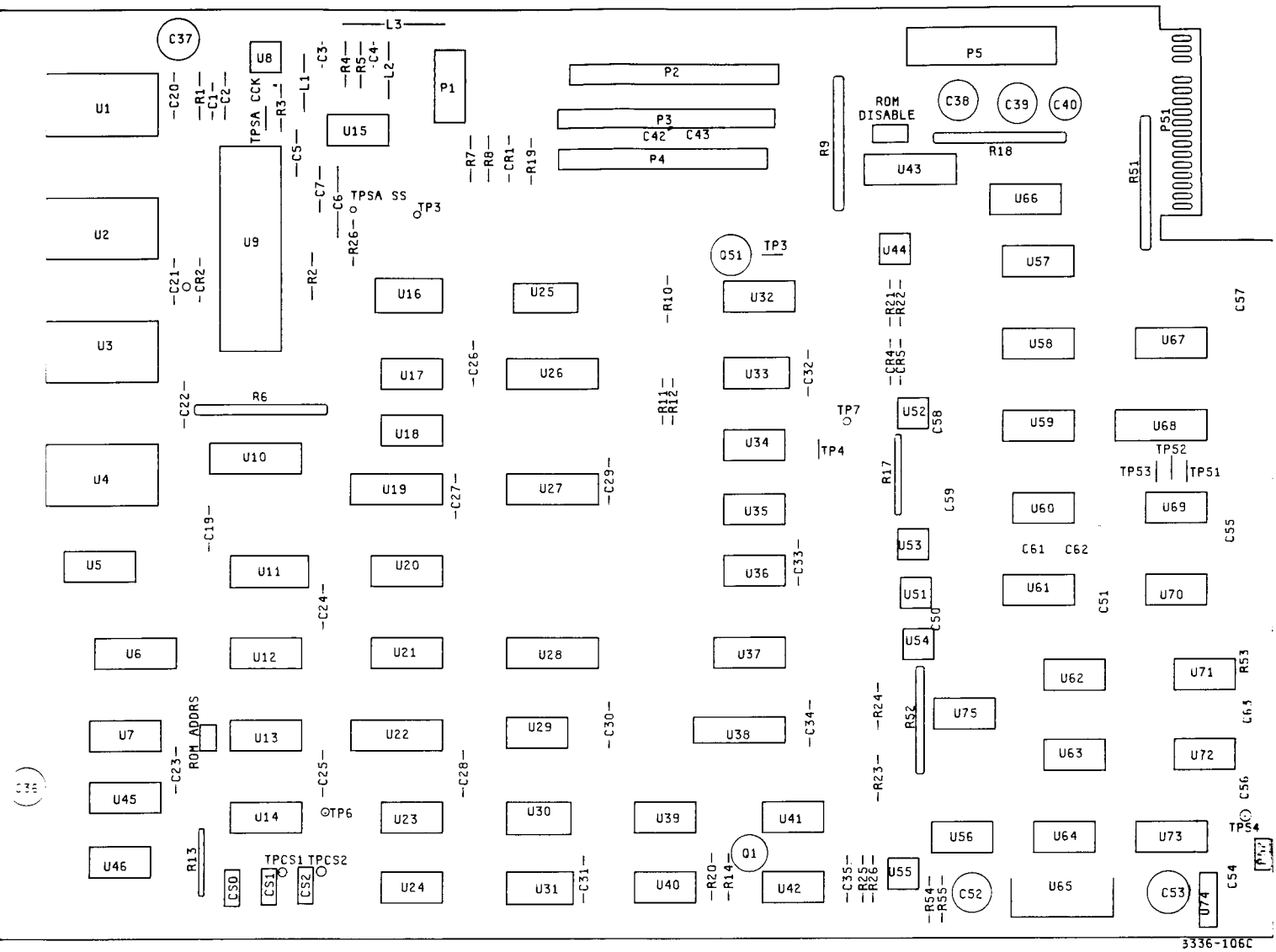
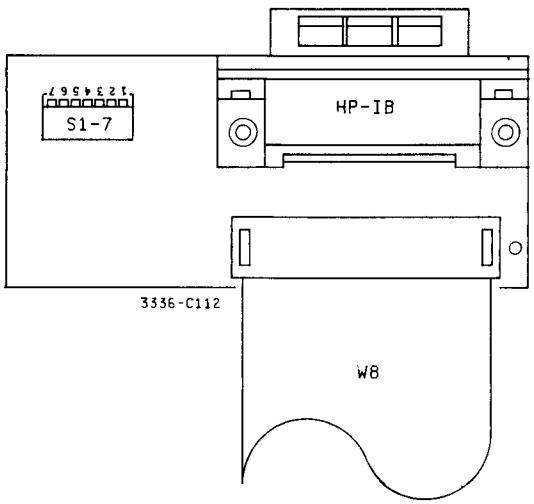


Figure 8-3. Microprocessor Control (Me

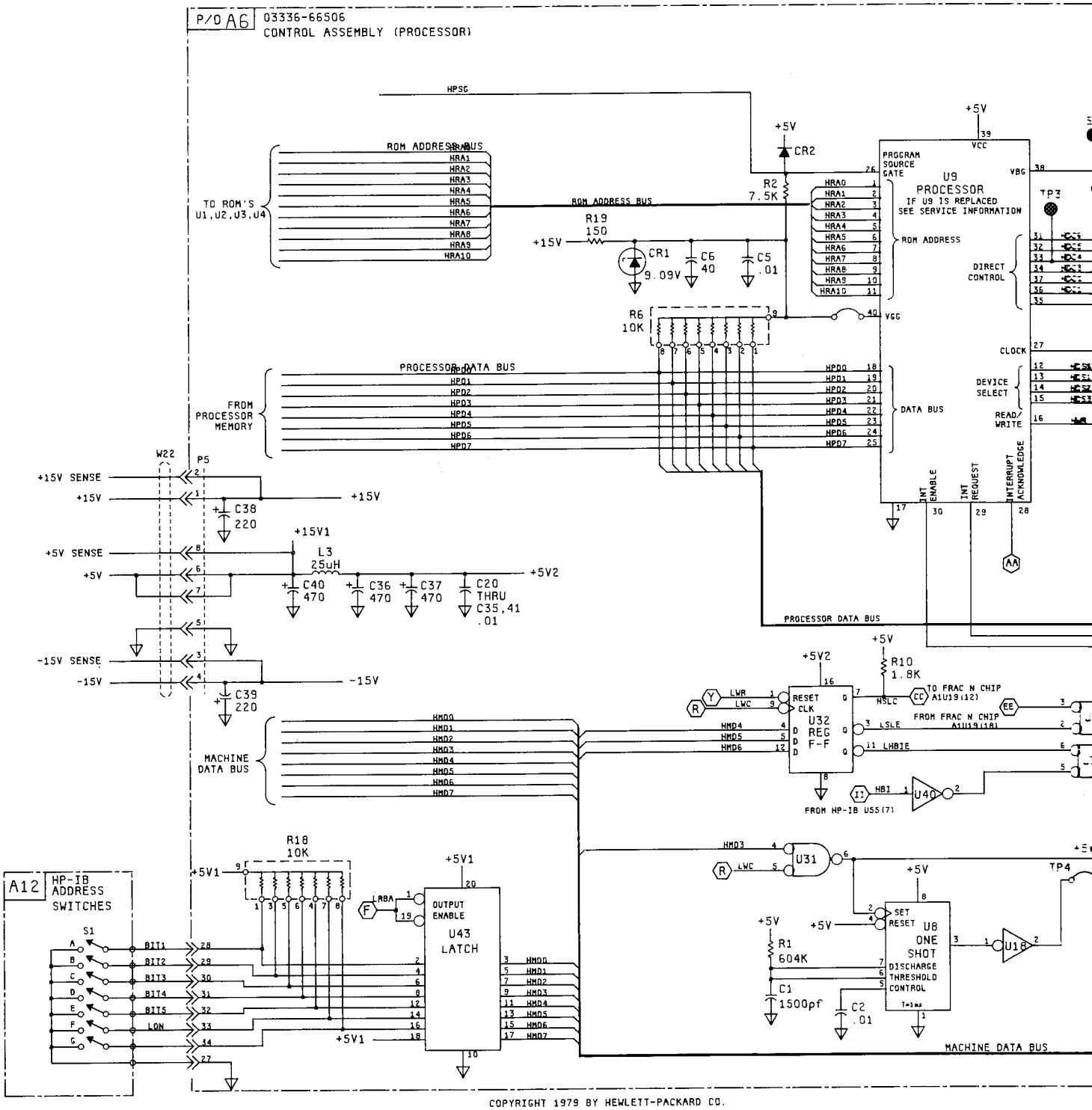


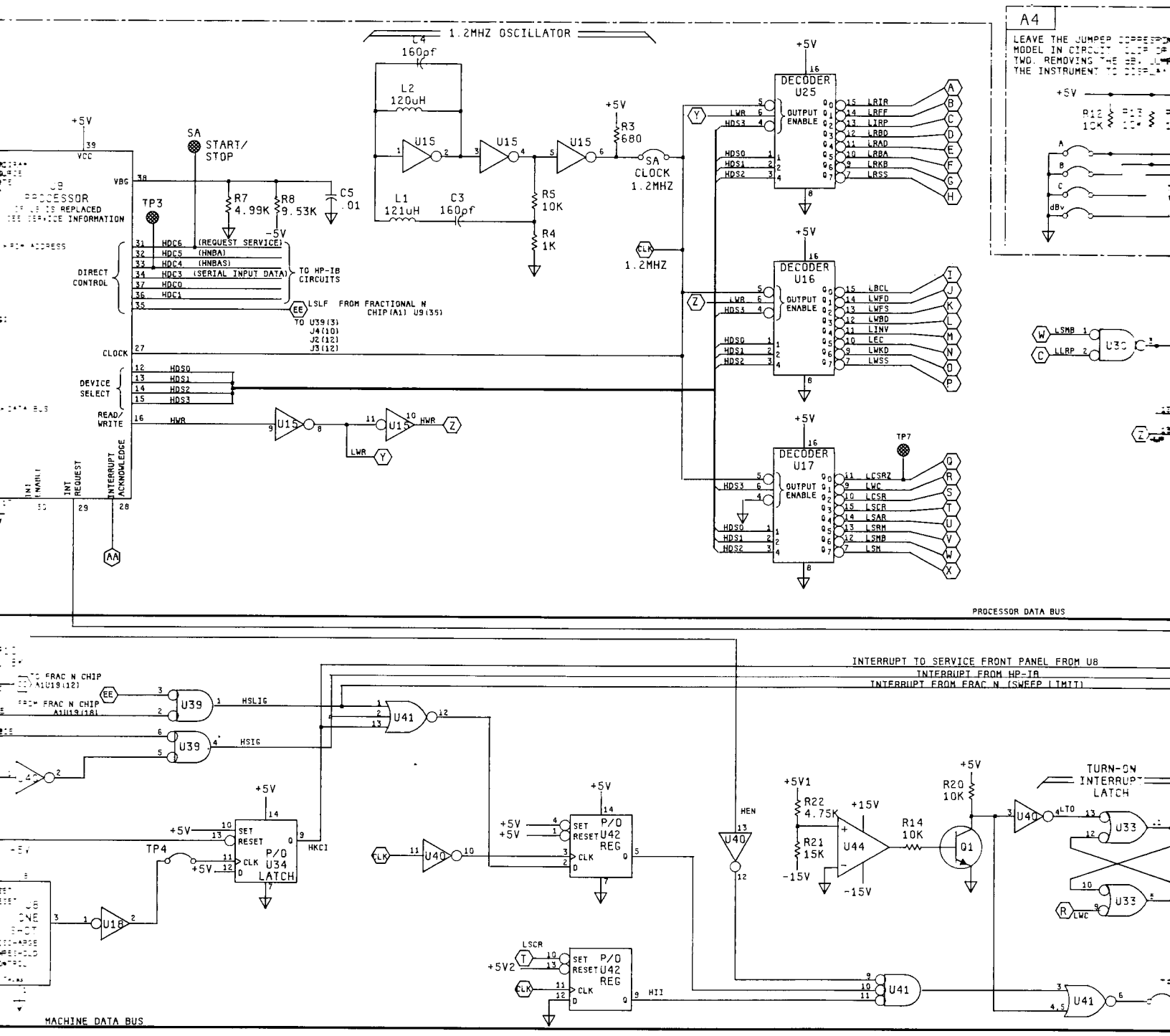
3336-106C

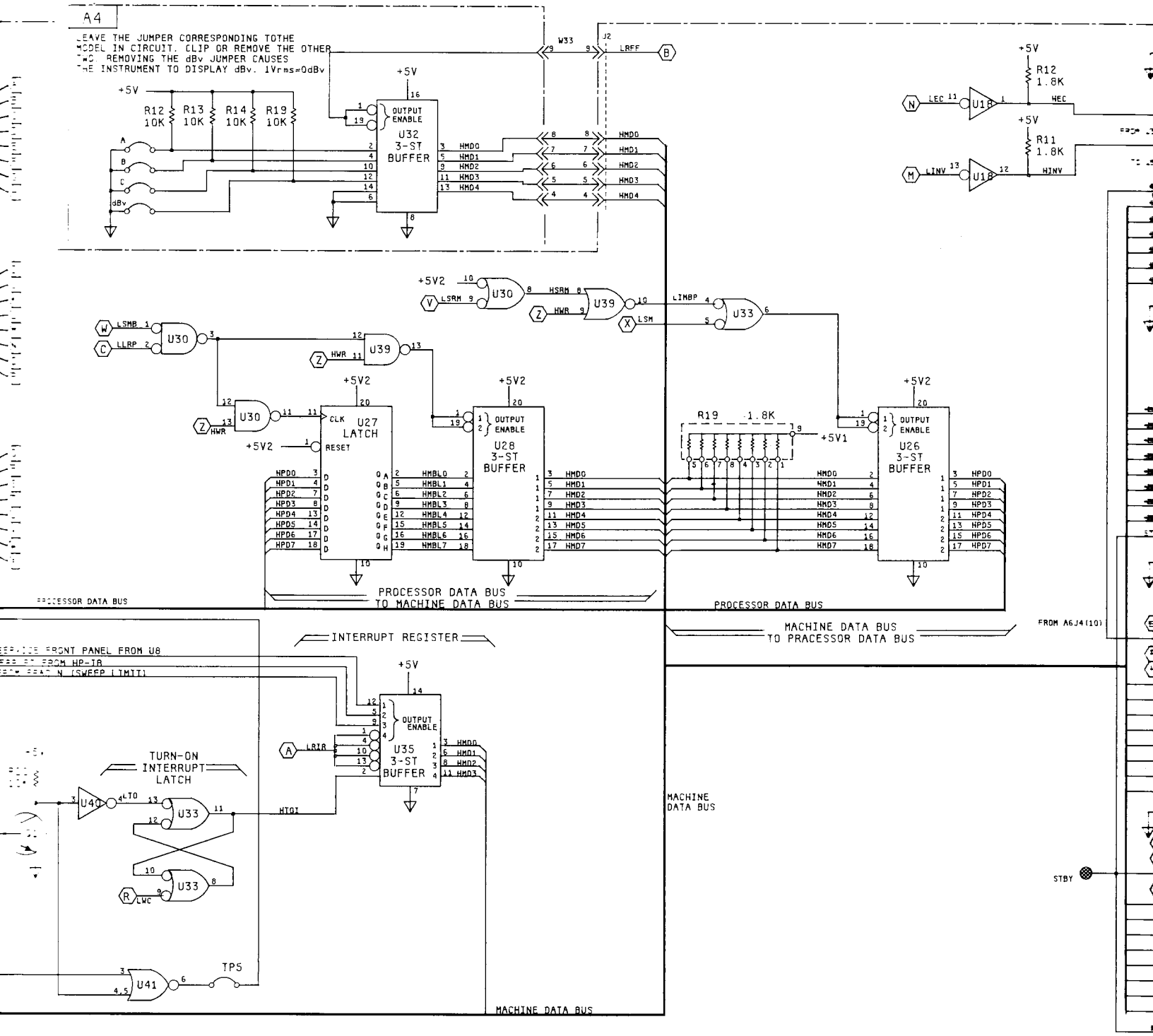
A6
03336-66506



A12
03336-66512




1.2MHZ OSCILLATOR
C4
160pf
L2
120uH
L1
121uH
C3
160pf
R5
10K
R4
1K
R3
680
U15
SA
START/
STOP
SA
CLOCK
1.2MHZ
CLK
1.2MHZ
+5V
-5V
VCC
VBG
R7
4.99K
R8
9.53K
C5
.01
TP3
PROCESSOR
DIRECT
CONTROL
DEVICE
SELECT
READ/
WRITE
CLOCK
INT
ENABLE
INT
REQUEST
INTERRUPT
ACKNOWLEDGE
HDC6 (REQUEST SERVICE)
HDC5 (HNBA)
HDC4 (HNBAS)
HDC3 (SERIAL INPUT DATA)
HDC0
HDC1
TO HP-IB
CIRCUITS
LSLF FROM FRACTIONAL N
CHIP(A1) U9(35)
TO U39(3)
J4(10)
J2(12)
J3(12)
HDS0
HDS1
HDS2
HDS3
HWR
LWR
DECODER
U25
OUTPUT
ENABLE
LRIR
LRFF
LRIP
LRBD
LRAD
LRBA
LRKB
LRSS
DECODER
U16
LBCL
LWFD
LWFS
LWBD
LINV
LEC
LWKD
LWSS
DECODER
U17
LCSRZ
LWC
LCSR
LSCR
LSAR
LSRM
LSMB
LSM
TP7
A4
LEAVE THE JUMPER
MODEL IN CIRCUIT
TWO. REMOVING
THE INSTRUMENT
PROCESSOR DATA BUS
INTERRUPT TO SERVICE FRONT PANEL FROM U8
INTERRUPT FROM HP-IB
INTERRUPT FROM FRAC N (SWEEP LIMIT)
TO FRAC N CHIP
A1U19(12)
FROM FRAC N CHIP
A1U19(18)
U39
HSLIG
HSIG
U41
U40
U18
U34
LATCH
P/O
HKCI
TP4
U42
REG
HEN
HII
LSCR
+5V2
+5V1
R22
4.75K
R21
15K
U44
+15V
-15V
R14
10K
R20
10K
Q1
TURN-ON
INTERRUPT
LATCH
U33
U30
LSMB
LLRP
LWC
MACHINE DATA BUS


A4
LEAVE THE JUMPER CORRESPONDING TOTHE MODEL IN CIRCUIT. CLIP OR REMOVE THE OTHER TWO. REMOVING THE dBv JUMPER CAUSES THE INSTRUMENT TO DISPLAY dBv. 1Vrms=0dBv
W33
J2
LRFF
+5V
R12 10K
R13 10K
R14 10K
R19 10K
A
B
C
dBv
U32 3-ST BUFFER
OUTPUT ENABLE
HMD0
HMD1
HMD2
HMD3
HMD4
R12 1.8K
R11 1.8K
LEC
HEC
LINV
HINV
U18
+5V2
U30
U39
U33
LSRM
HWR
LSM
LIMBP
LSMB
LLRP
U27 LATCH
CLK
RESET
U28 3-ST BUFFER
U26 3-ST BUFFER
R19 1.8K
+5V1
HPD0
HPD1
HPD2
HPD3
HPD4
HPD5
HPD6
HPD7
HMBL0
HMBL1
HMBL2
HMBL3
HMBL4
HMBL5
HMBL6
HMBL7
PROCESSOR DATA BUS TO MACHINE DATA BUS
PROCESSOR DATA BUS
MACHINE DATA BUS TO PRACESSOR DATA BUS
FROM A6J4(10)
INTERRUPT REGISTER
TURN-ON INTERRUPT LATCH
U40
U35 3-ST BUFFER
LRIR
HIGI
LWC
U41
TP5
MACHINE DATA BUS
STBY

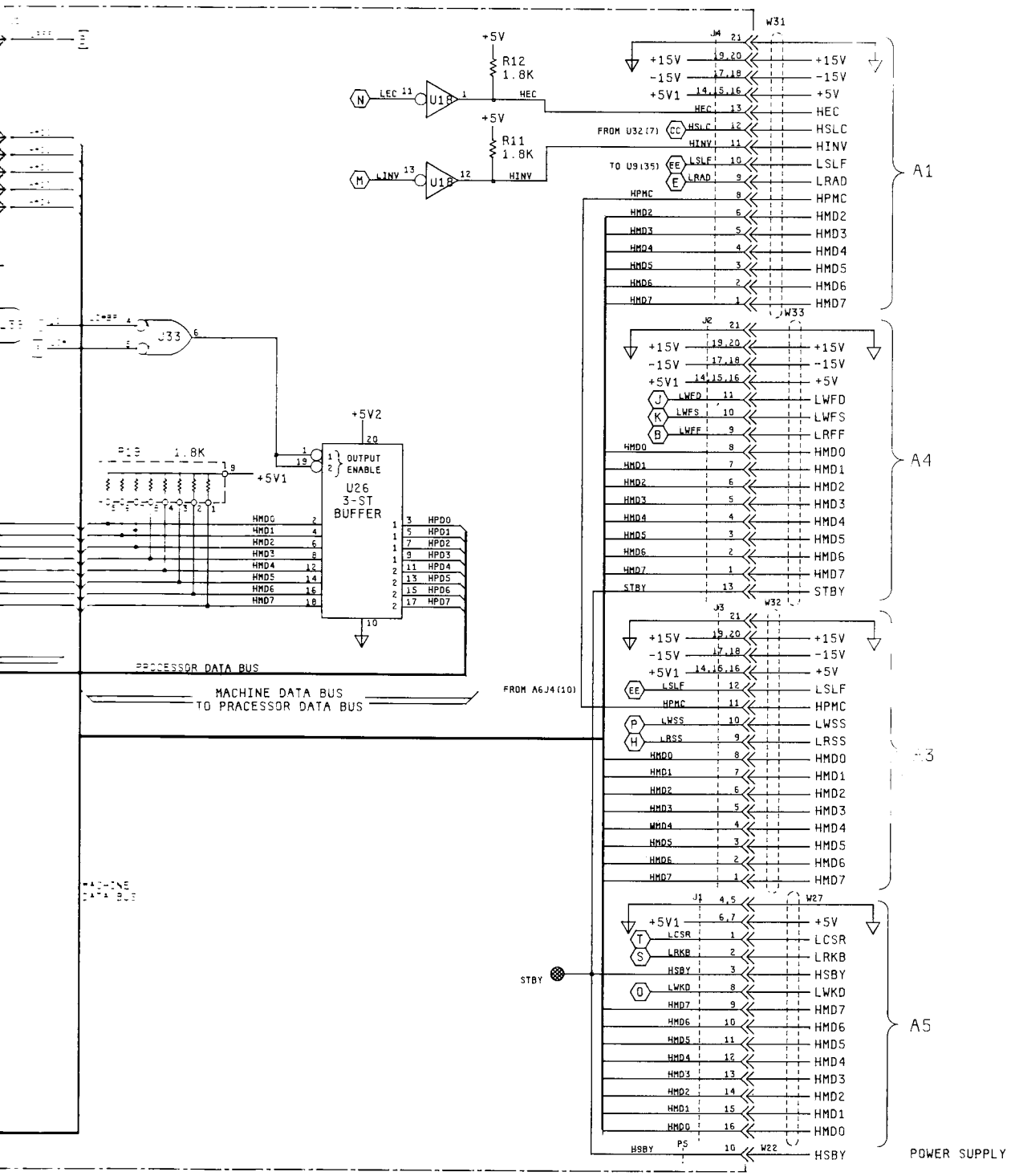
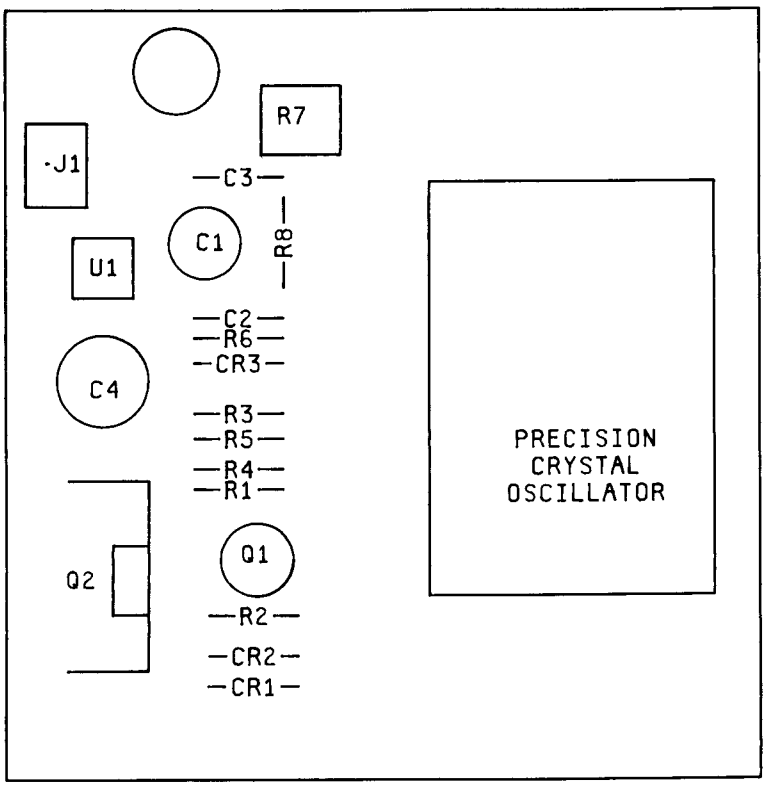
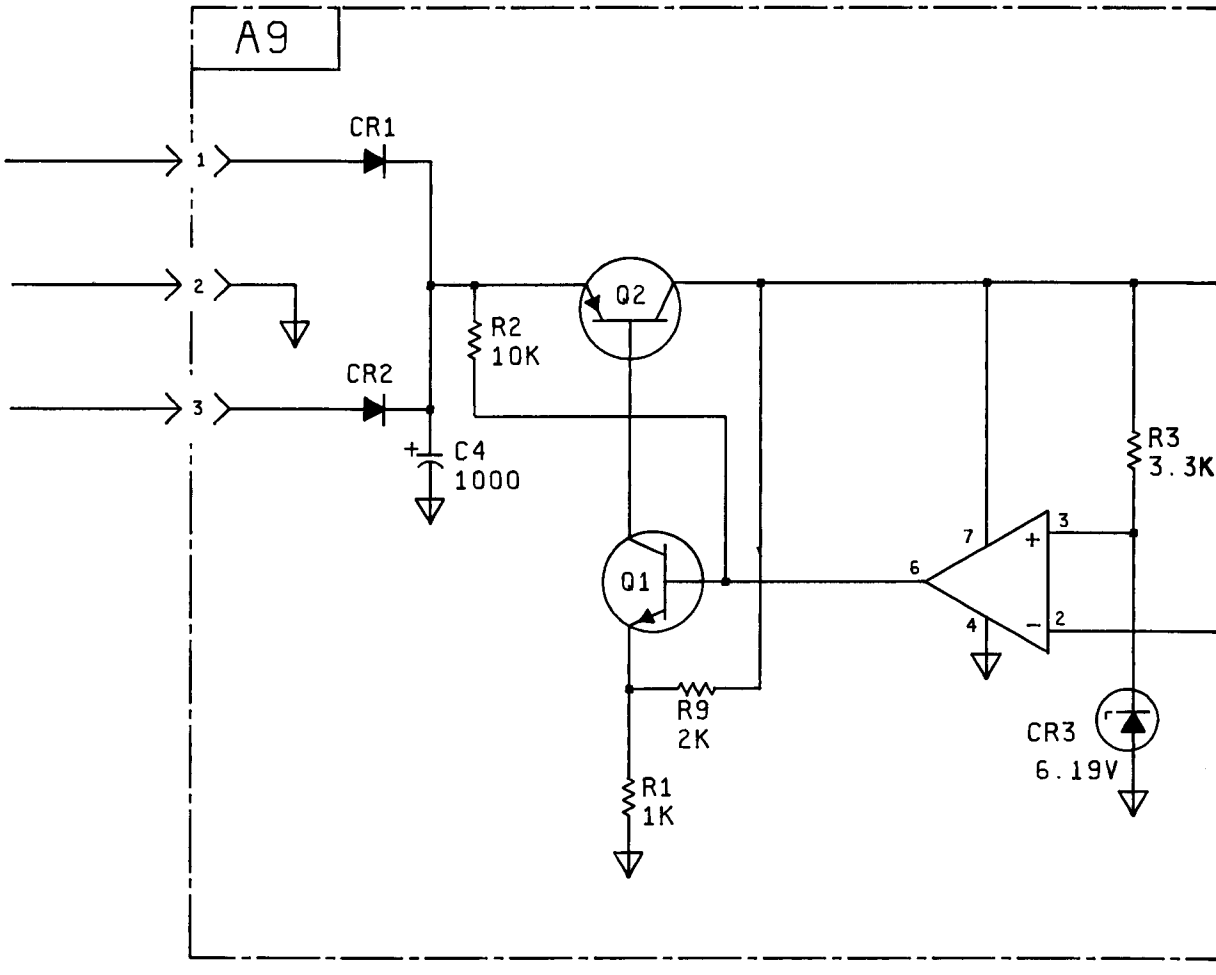


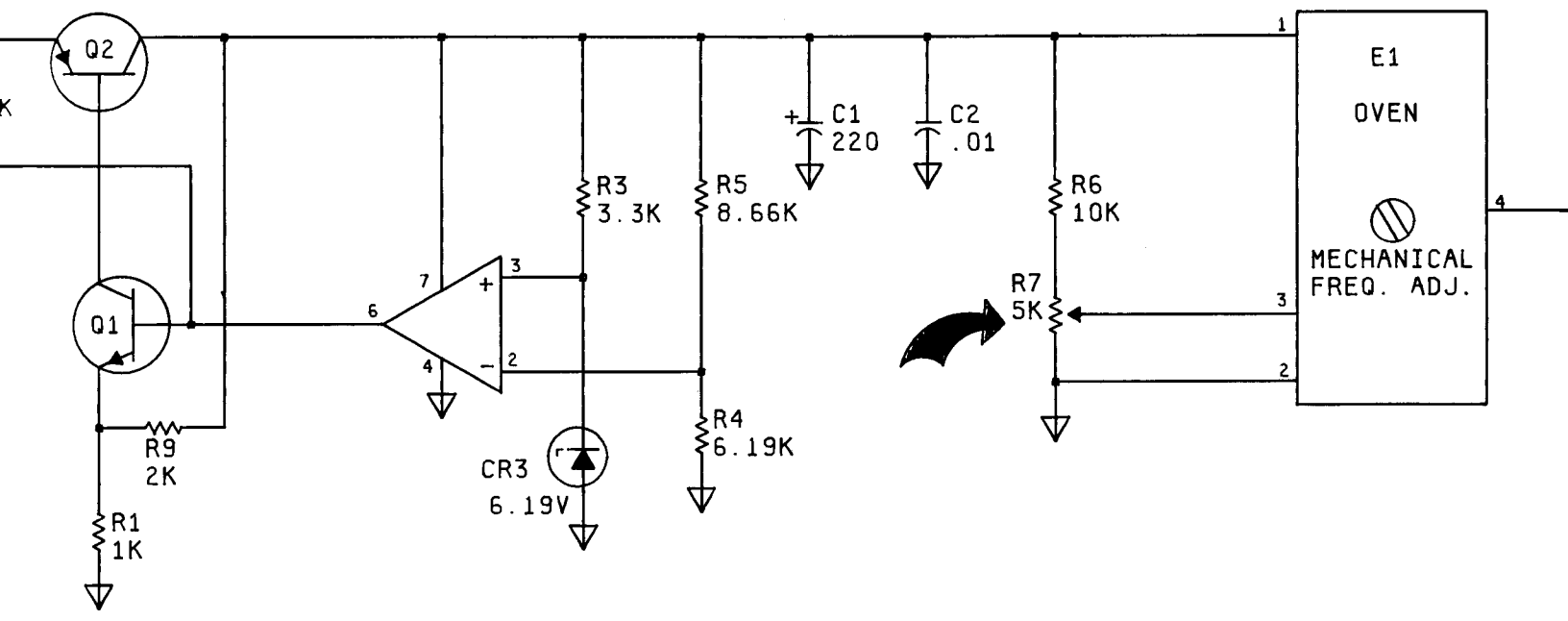
Figure 8-4. Microprocessor Control, A6.



3336-109C

A9
03325-66509


A9
CR1
1
2
3
CR2
R2
10K
Q2
C4
1000
Q1
R9
2K
R1
1K
7
6
4
3
2
+
−
R3
3.3K
CR3
6.19V


Q2
Q1
R1
1K
R9
2K
R3
3.3K
R5
8.66K
R4
6.19K
CR3
6.19V
C1
220
C2
.01
R6
10K
R7
5K
E1
OVEN
MECHANICAL
FREQ. ADJ.
1
2
3
4
6
7

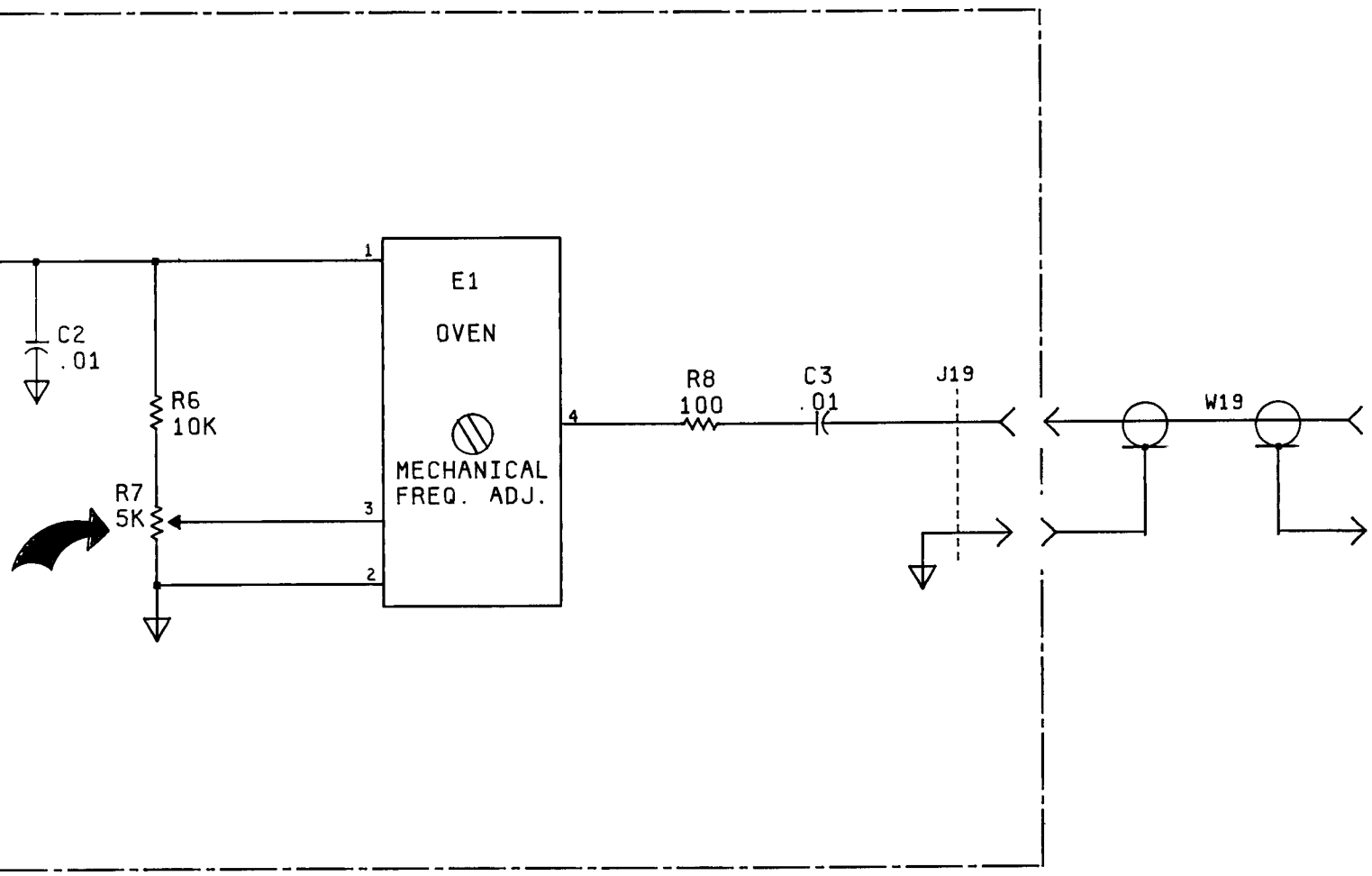
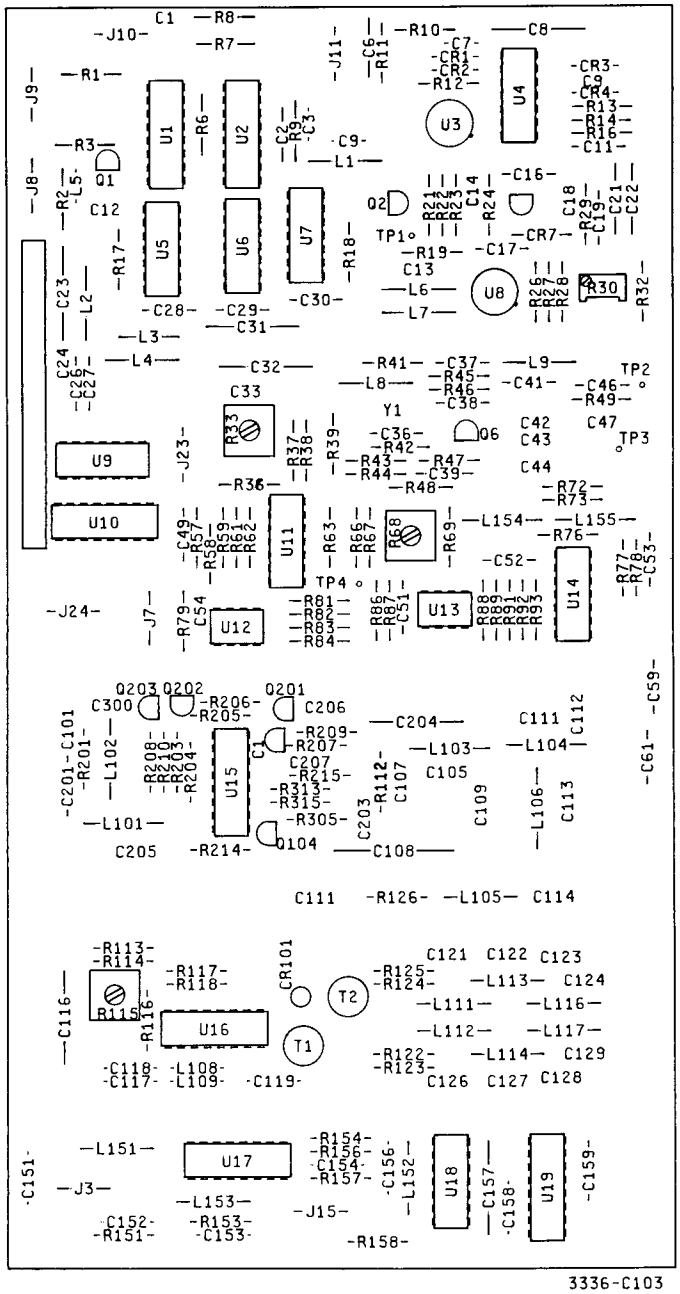
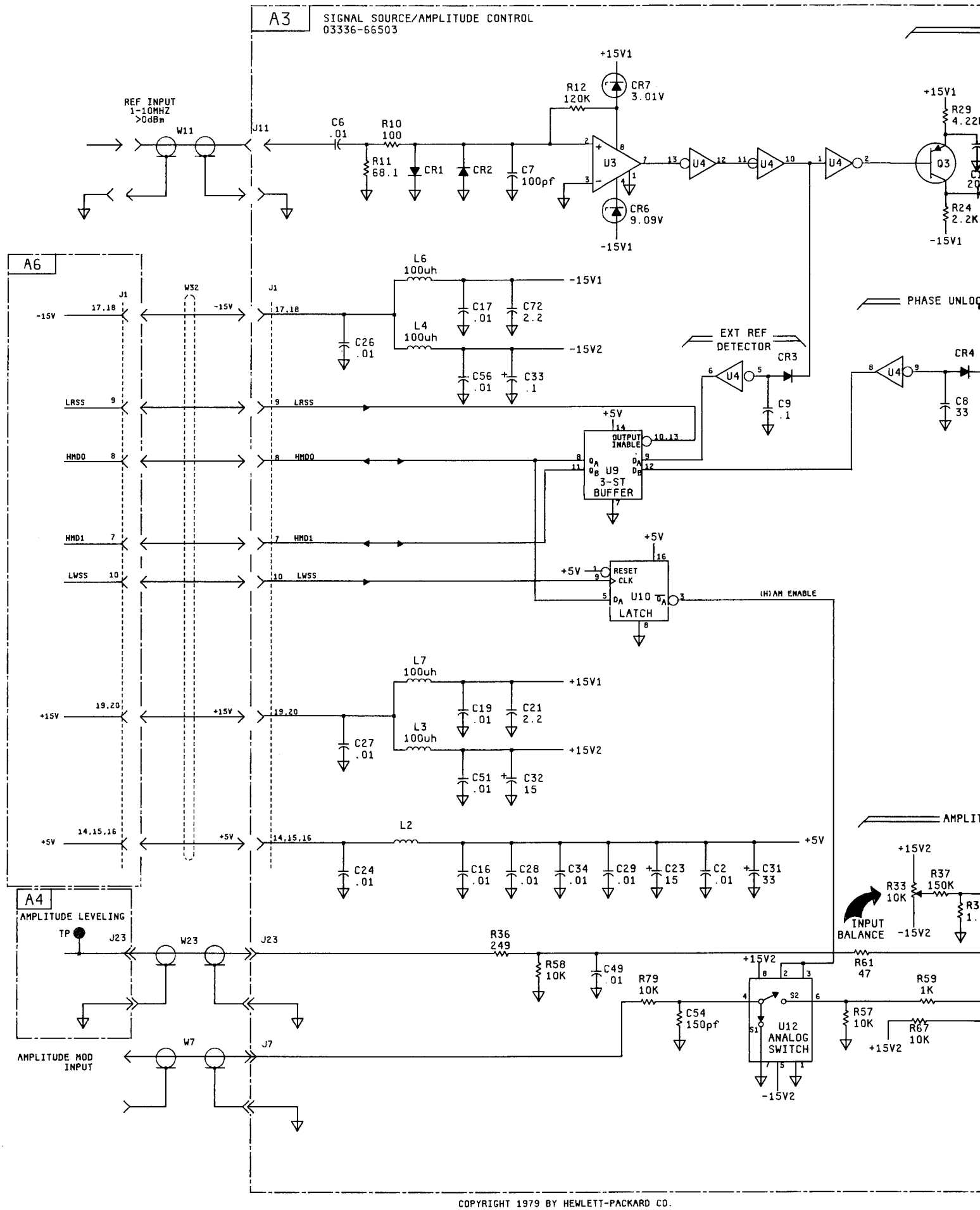
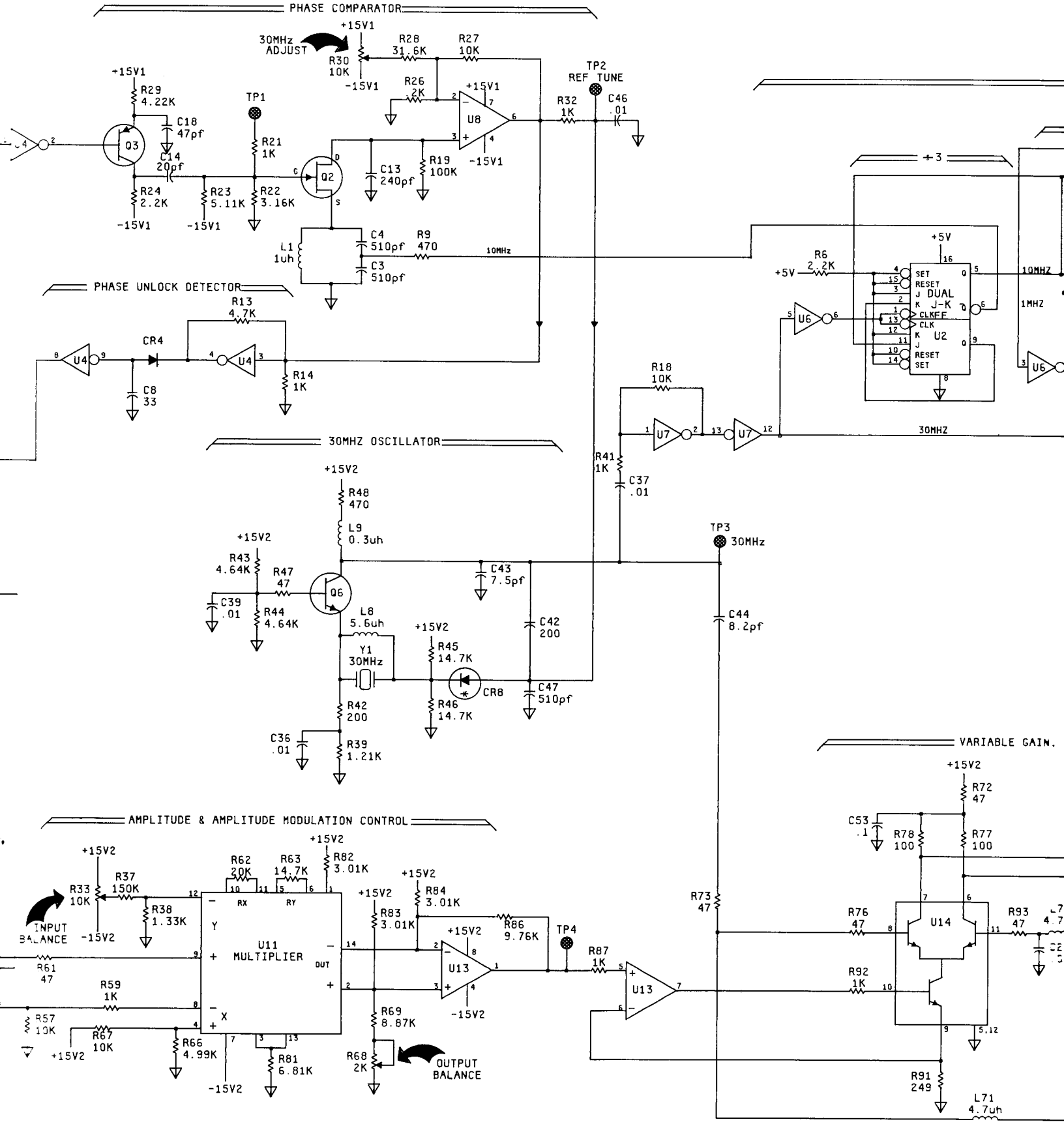


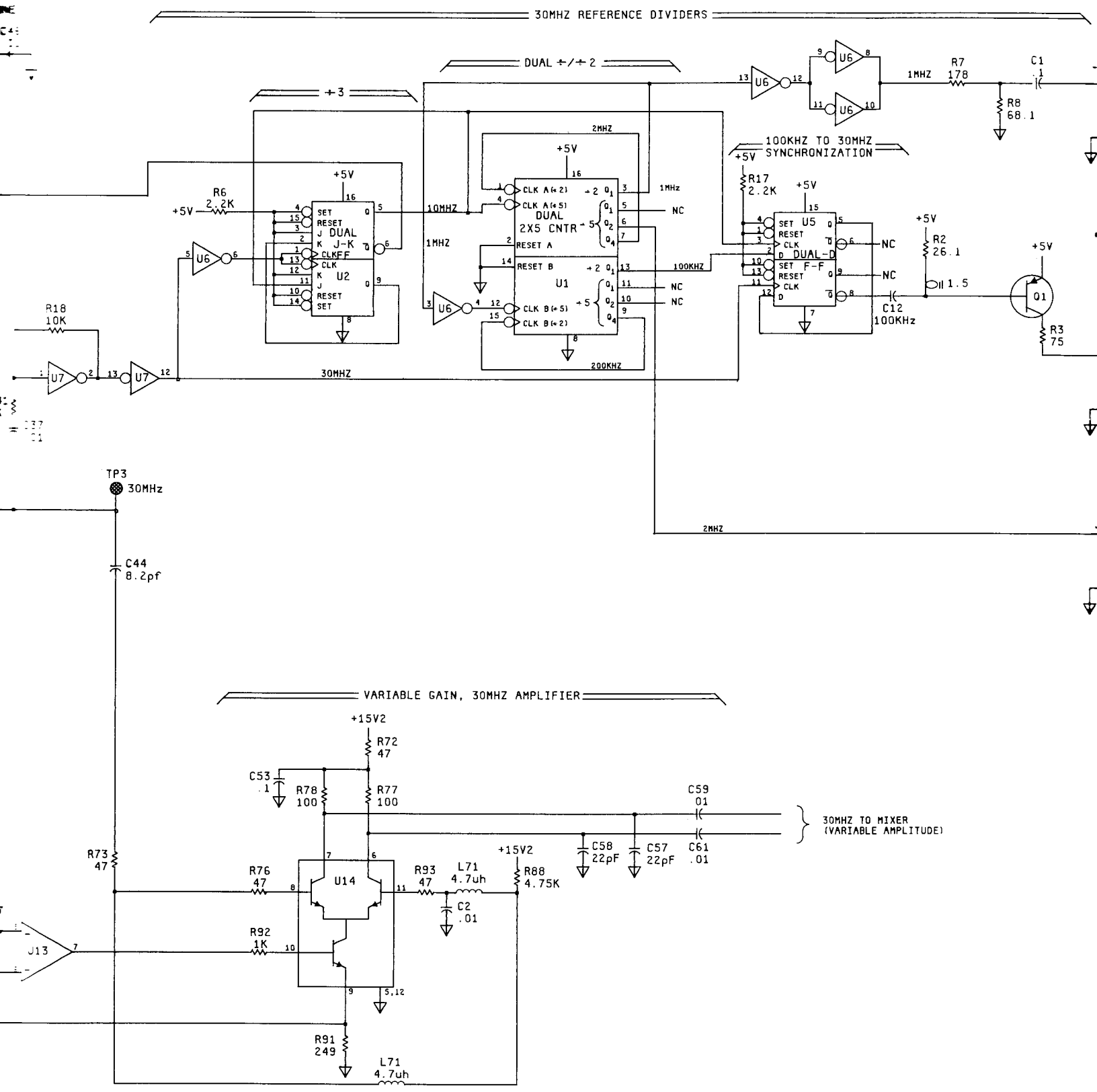
Figure 8-5. High Stability Reference Option 004, A9.

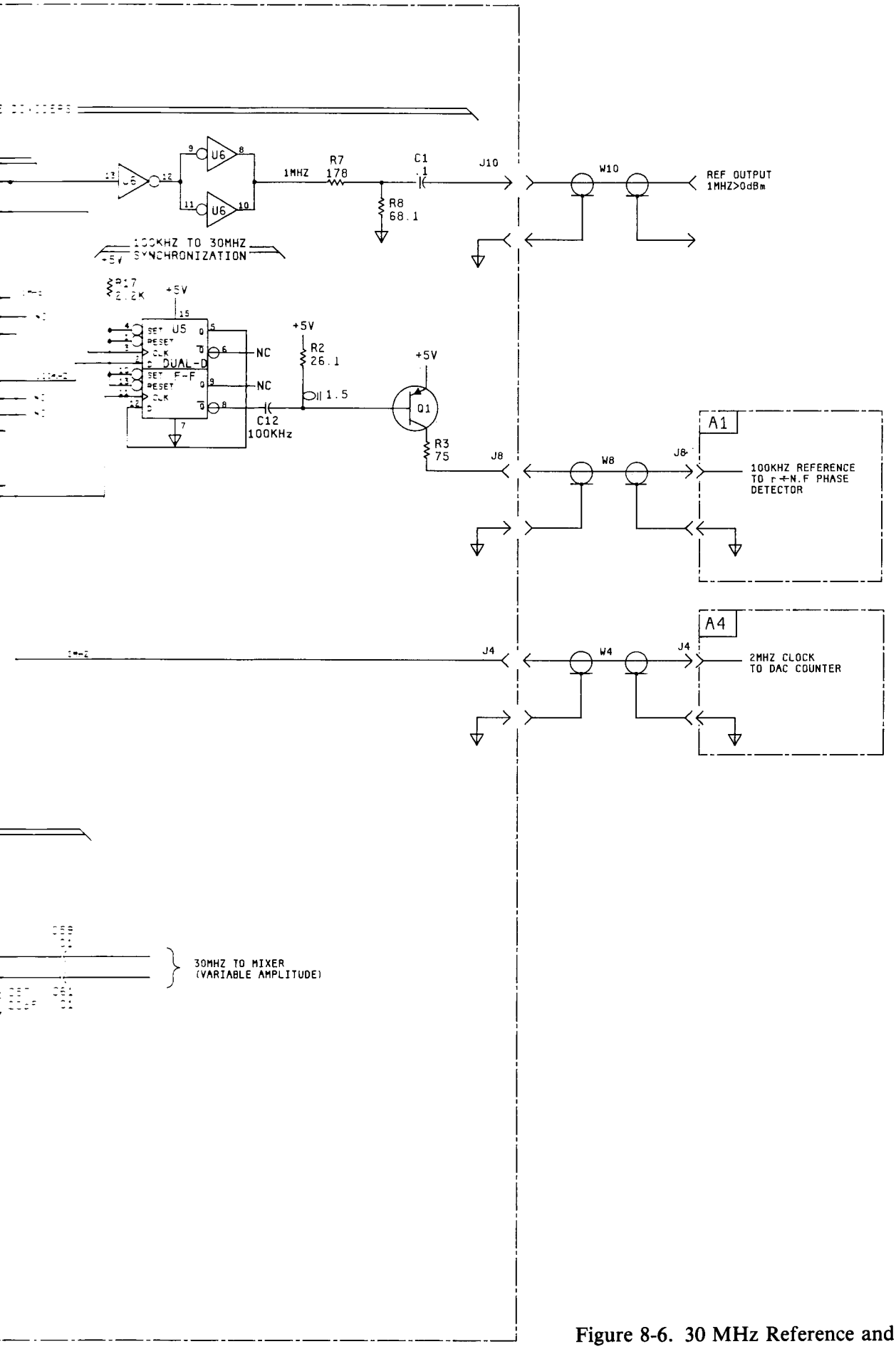


A3
03336-66503



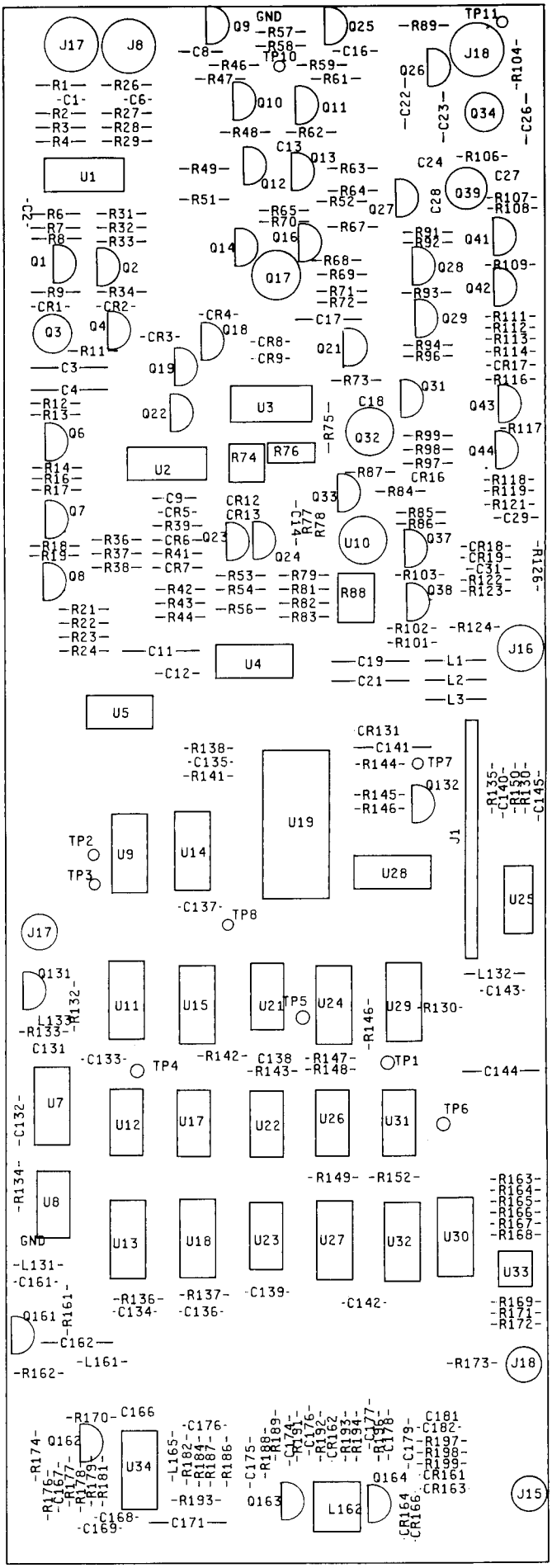

PHASE COMPARATOR
30MHz ADJUST
+15V1
R28 31.6K
R27 10K
R30 10K
-15V1
R26 2K
TP2 REF TUNE
R32 1K
C46 .01
U8
R29 4.22K
C18 47pf
Q3
C14 20pf
TP1
R21 1K
Q2
C13 240pf
R19 100K
R24 2.2K
R23 5.11K
R22 3.16K
L1 1uh
C4 510pf
C3 510pf
R9 470
10MHz
PHASE UNLOCK DETECTOR
R13 4.7K
CR4
U4
C8 33
R14 1K
+3
+5V
R6 2.2K
SET
RESET
J DUAL
K J-K
CLKFF
CLK
K U2
J
RESET
SET
10MHZ
1MHZ
U6
R18 10K
U7
30MHZ
30MHZ OSCILLATOR
R41 1K
C37 .01
+15V2
R48 470
L9 0.3uh
TP3 30MHz
R43 4.64K
R47 47
Q6
C43 7.5pf
C39 .01
R44 4.64K
L8 5.6uh
C42 200
C44 8.2pf
Y1 30MHz
R45 14.7K
CR8
C47 510pf
R42 200
R46 14.7K
C36 .01
R39 1.21K
VARIABLE GAIN.
AMPLITUDE & AMPLITUDE MODULATION CONTROL
R62 20K
R63 14.7K
R82 3.01K
R84 3.01K
R83 3.01K
R86 9.76K
TP4
R87 1K
R33 10K
R37 150K
R38 1.33K
INPUT BALANCE
U11 MULTIPLIER
RX
RY
X
Y
OUT
R61 47
R59 1K
R57 10K
R67 10K
R66 4.99K
R81 6.81K
R69 8.87K
R68 2K
OUTPUT BALANCE
U13
R73 47
R72 47
C53 .1
R78 100
R77 100
R76 47
U14
R93 47
R92 1K
R91 249
L71 4.7uh


30MHZ REFERENCE DIVIDERS
DUAL ÷/÷2
÷3
100KHZ TO 30MHZ SYNCHRONIZATION
+5V
R6 2.2K
R17 2.2K
R18 10K
R7 178
R8 68.1
R2 26.1
R3 75
C1 .1
C12 100KHz
Q1
U1
U2
U5
U6
U7
DUAL 2X5 CNTR
DUAL J-K
DUAL-D
F-F
10MHZ
1MHZ
2MHZ
100KHZ
200KHZ
30MHZ
NC
TP3 30MHz
C44 8.2pf
VARIABLE GAIN, 30MHZ AMPLIFIER
+15V2
R72 47
C53 .1
R78 100
R77 100
C59 01
C58 22pF
C57 22pF
C61 .01
30MHZ TO MIXER (VARIABLE AMPLITUDE)
R73 47
R76 47
R93 47
L71 4.7uh
R88 4.75K
C2 .01
R92 1K
R91 249
U14
U13

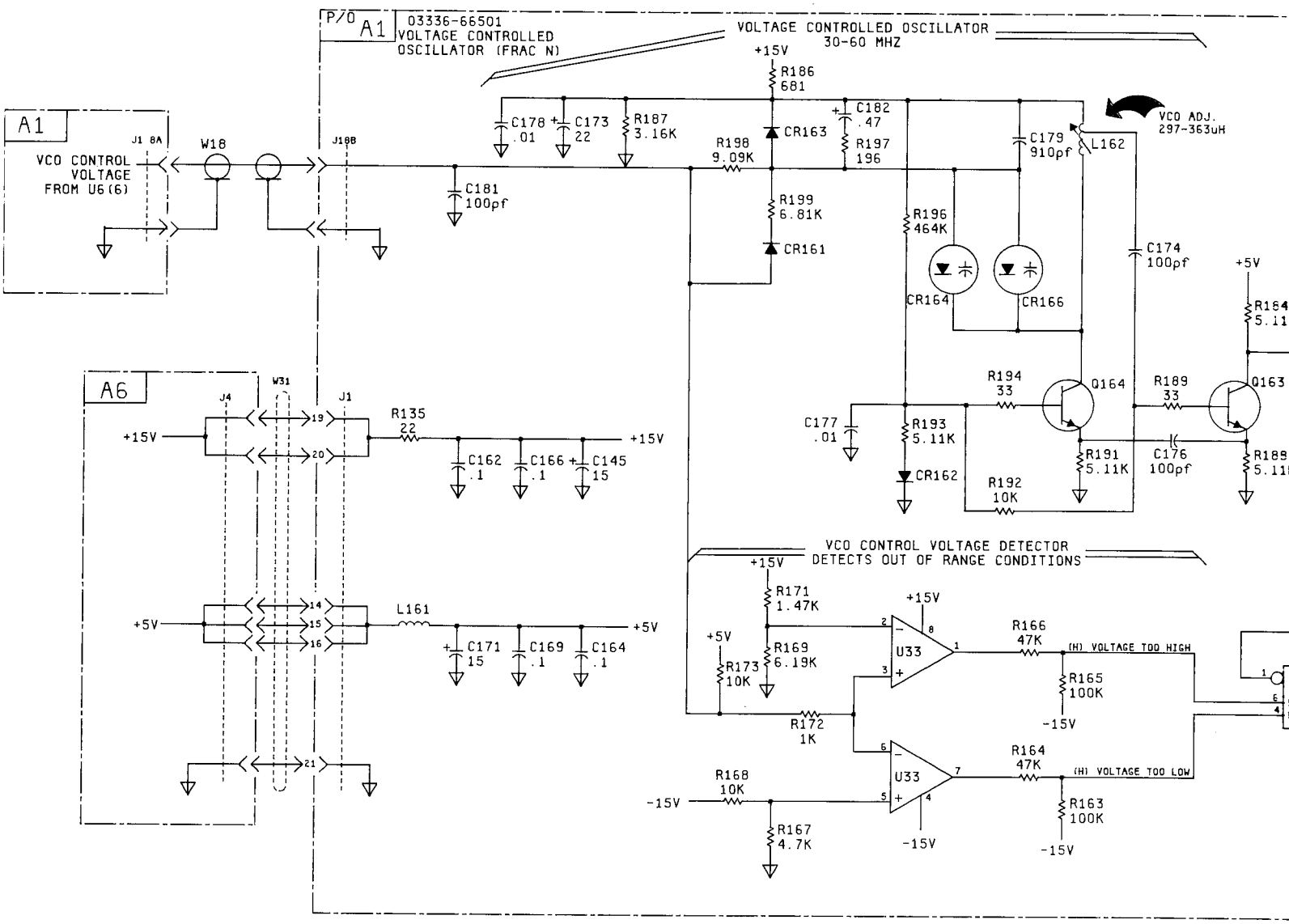


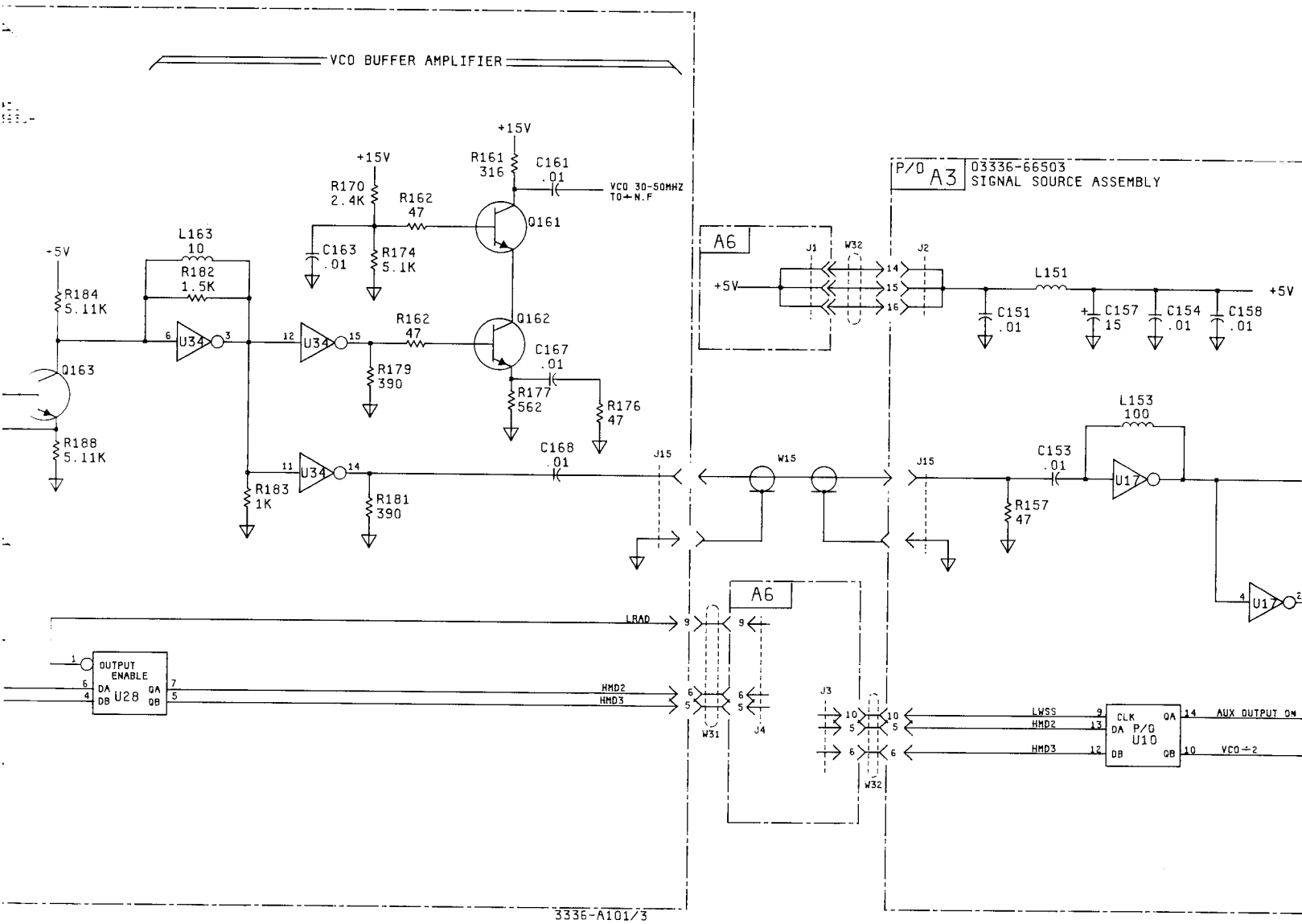
3336-A103/2

Figure 8-6. 30 MHz Reference and Dividers, A3.



A1
03325-66501


P/O A1
03336-66501
VOLTAGE CONTROLLED
OSCILLATOR (FRAC N)
VOLTAGE CONTROLLED OSCILLATOR
30-60 MHZ
A1
J1 8A
W18
J18B
VCO CONTROL
VOLTAGE
FROM U6(6)
+15V
R186
681
C178
.01
C173
22
R187
3.16K
C182
.47
R197
196
CR163
R198
9.09K
C179
910pf
L162
VCO ADJ.
297-363uH
C181
100pf
R199
6.81K
CR161
R196
464K
CR164
CR166
C174
100pf
+5V
R184
5.11
A6
W31
J4
J1
+15V
19
20
R135
22
C162
.1
C166
.1
C145
15
+15V
R194
33
Q164
R189
33
Q163
C177
.01
R193
5.11K
CR162
R191
5.11K
C176
100pf
R189
5.11
R192
10K
VCO CONTROL VOLTAGE DETECTOR
DETECTS OUT OF RANGE CONDITIONS
+15V
R171
1.47K
+15V
+5V
R173
10K
R169
6.19K
U33
R166
47K
(H) VOLTAGE TOO HIGH
R165
100K
-15V
R172
1K
R164
47K
(H) VOLTAGE TOO LOW
R168
10K
-15V
U33
R163
100K
-15V
R167
4.7K
-15V
+5V
14
15
16
L161
+5V
C171
15
C169
.1
C164
.1
+5V
21


VCO BUFFER AMPLIFIER
P/O A3 03336-66503
SIGNAL SOURCE ASSEMBLY
+15V
-5V
+5V
R161 316
C161 .01
VCO 30-50MHZ TO÷N.F
R170 2.4K
R162 47
Q161
L163 10
R182 1.5K
C163 .01
R174 5.1K
R184 5.11K
Q163
R188 5.11K
U34
R162 47
Q162
C167 .01
R179 390
R177 562
R176 47
C168 .01
R183 1K
R181 390
A6
J1
W32
J2
L151
C151 .01
C157 15
C154 .01
C158 .01
L153 100
C153 .01
U17
R157 47
J15
W15
LRAD
OUTPUT ENABLE
U28
HMD2
HMD3
W31
J4
J3
W32
LWSS
CLK
P/O U10
AUX OUTPUT ON
VCO÷2
3336-A101/3

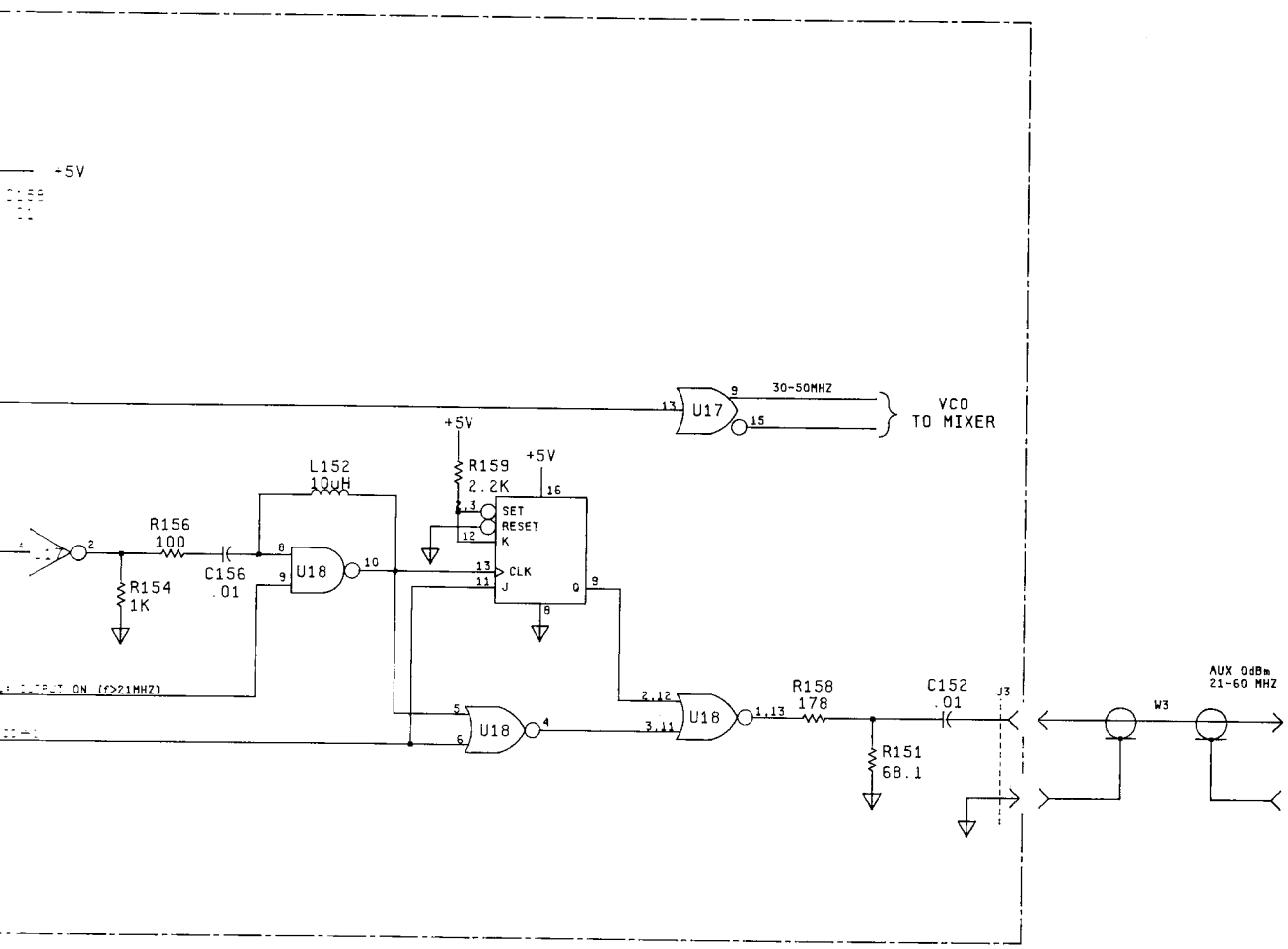
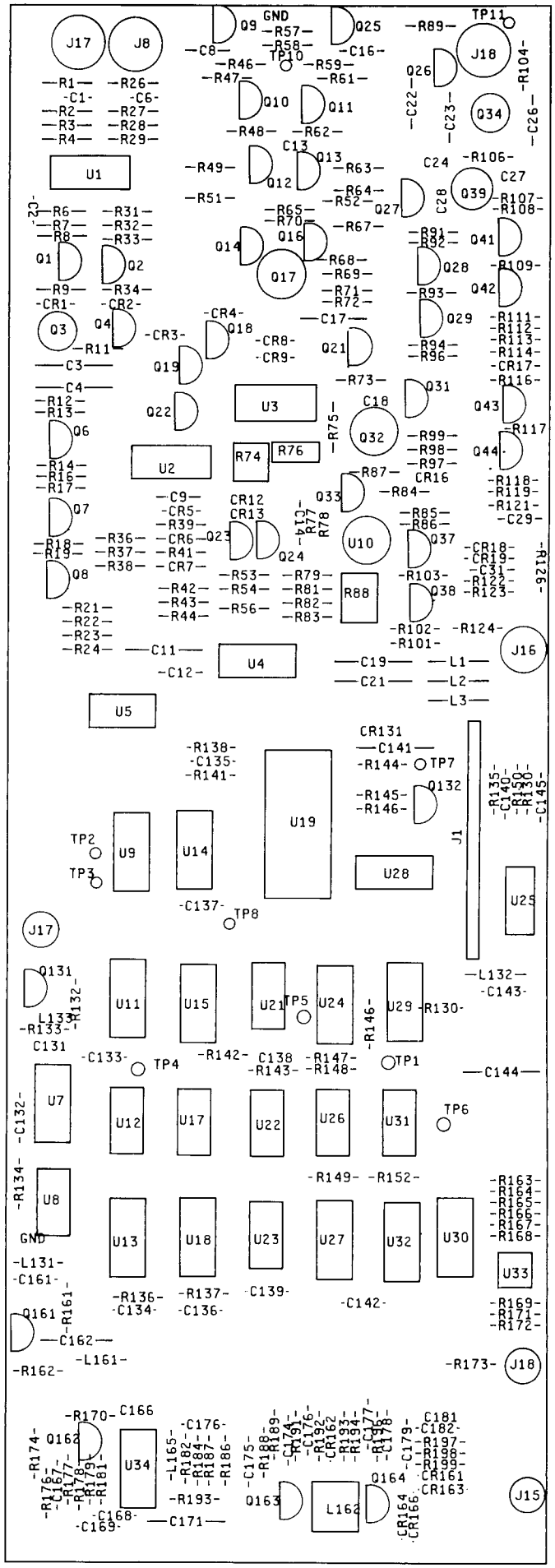
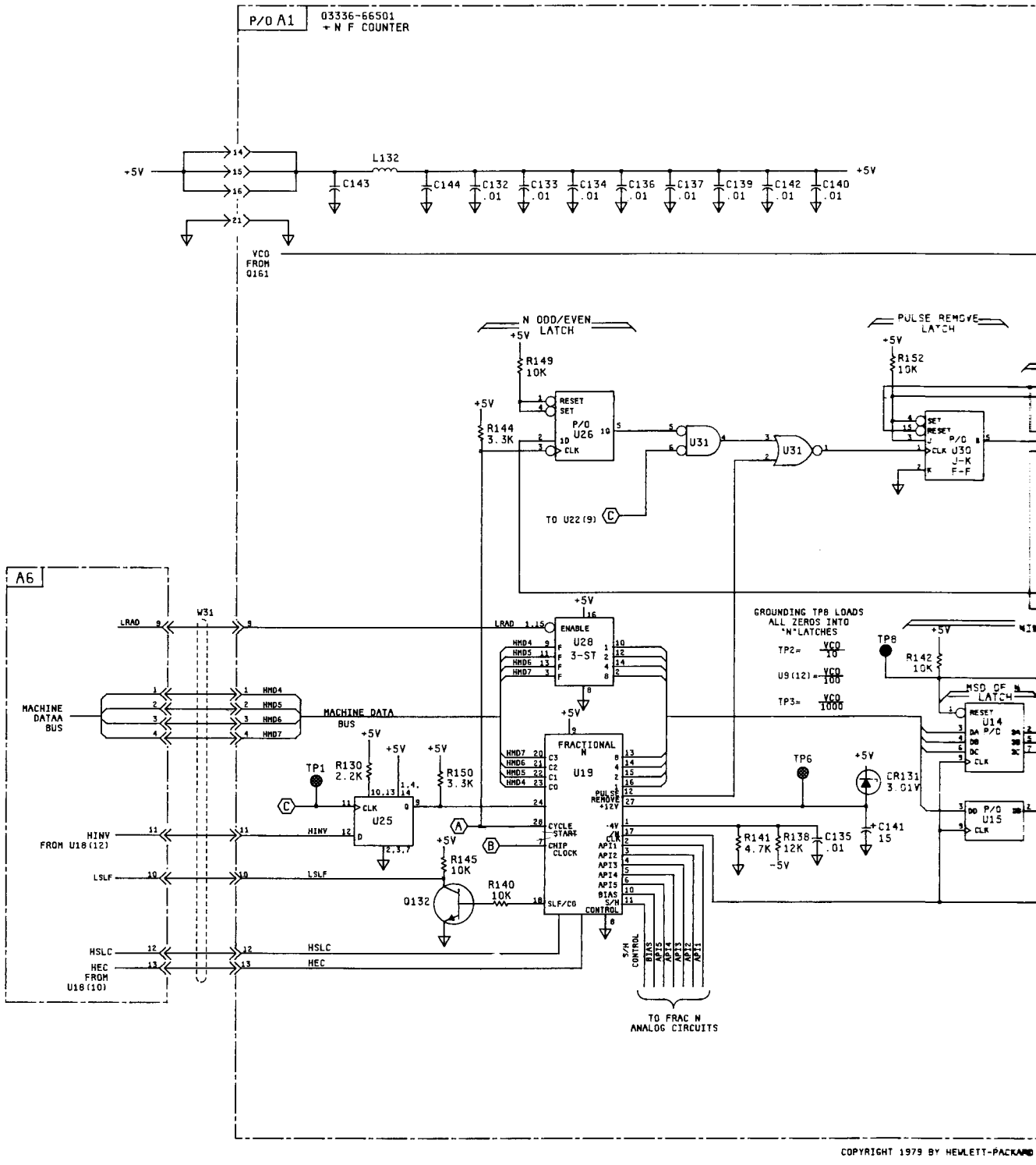


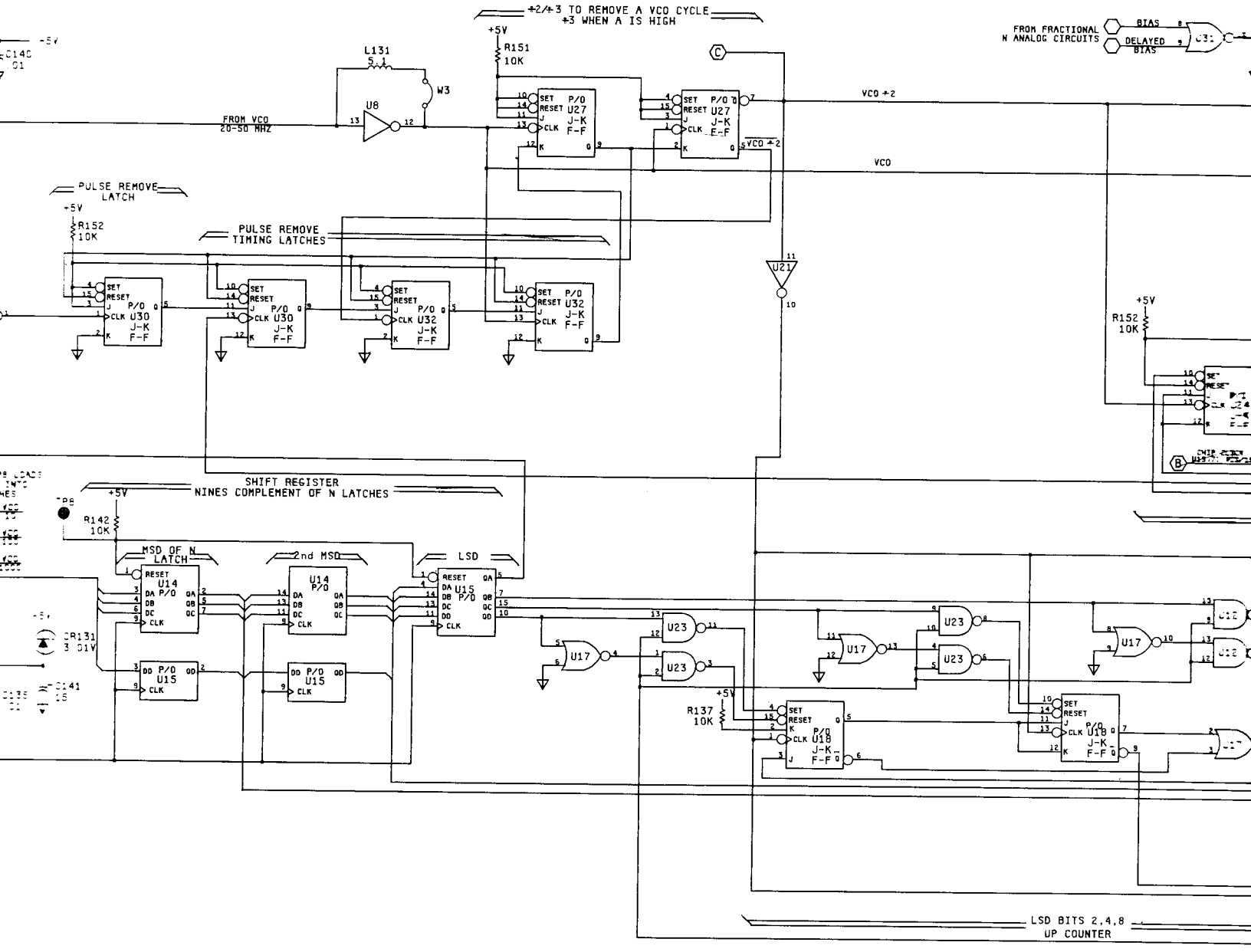
Figure 8-7. VCO and VCO Buffer, A1.

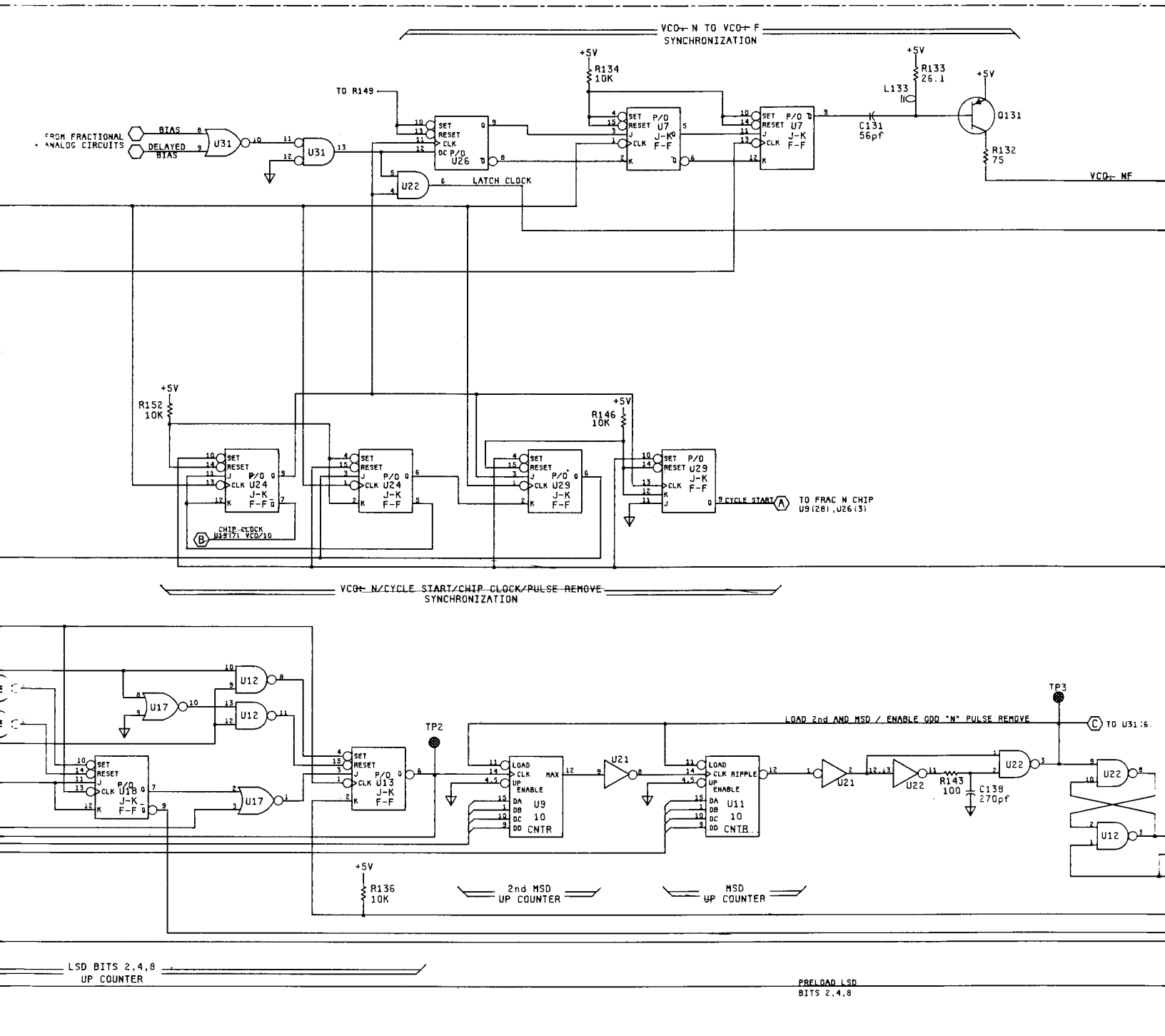


3336-101C

A1
03325-66501






VCO÷ N TO VCO÷ F
SYNCHRONIZATION
+5V
R134
10K
TO R149
FROM FRACTIONAL
ANALOG CIRCUITS
BIAS
DELAYED
BIAS
U31
U31
U26
U22
LATCH CLOCK
U7
J-K
F-F
C131
56pf
L133
+5V
R133
26.1
+5V
Q131
R132
75
VCO÷ NF
+5V
R152
10K
+5V
R146
10K
U24
J-K
F-F
U29
J-K
F-F
CYCLE START
TO FRAC N CHIP
U9(28),U26(3)
CHIP CLOCK
U19(7) VCO/10
VCO÷ N/CYCLE START/CHIP CLOCK/PULSE REMOVE
SYNCHRONIZATION
U12
U17
U18
J-K
F-F
U13
J-K
F-F
TP2
U9
10
CNTR
MAX
ENABLE
U21
U11
10
CNTR
RIPPLE
U22
R143
100
C138
270pf
TP3
LOAD 2nd AND MSD / ENABLE ODD 'N' PULSE REMOVE
TO U31
+5V
R136
10K
2nd MSD
UP COUNTER
MSD
UP COUNTER
LSD BITS 2,4,8
UP COUNTER
PRELOAD LSD
BITS 2,4,8

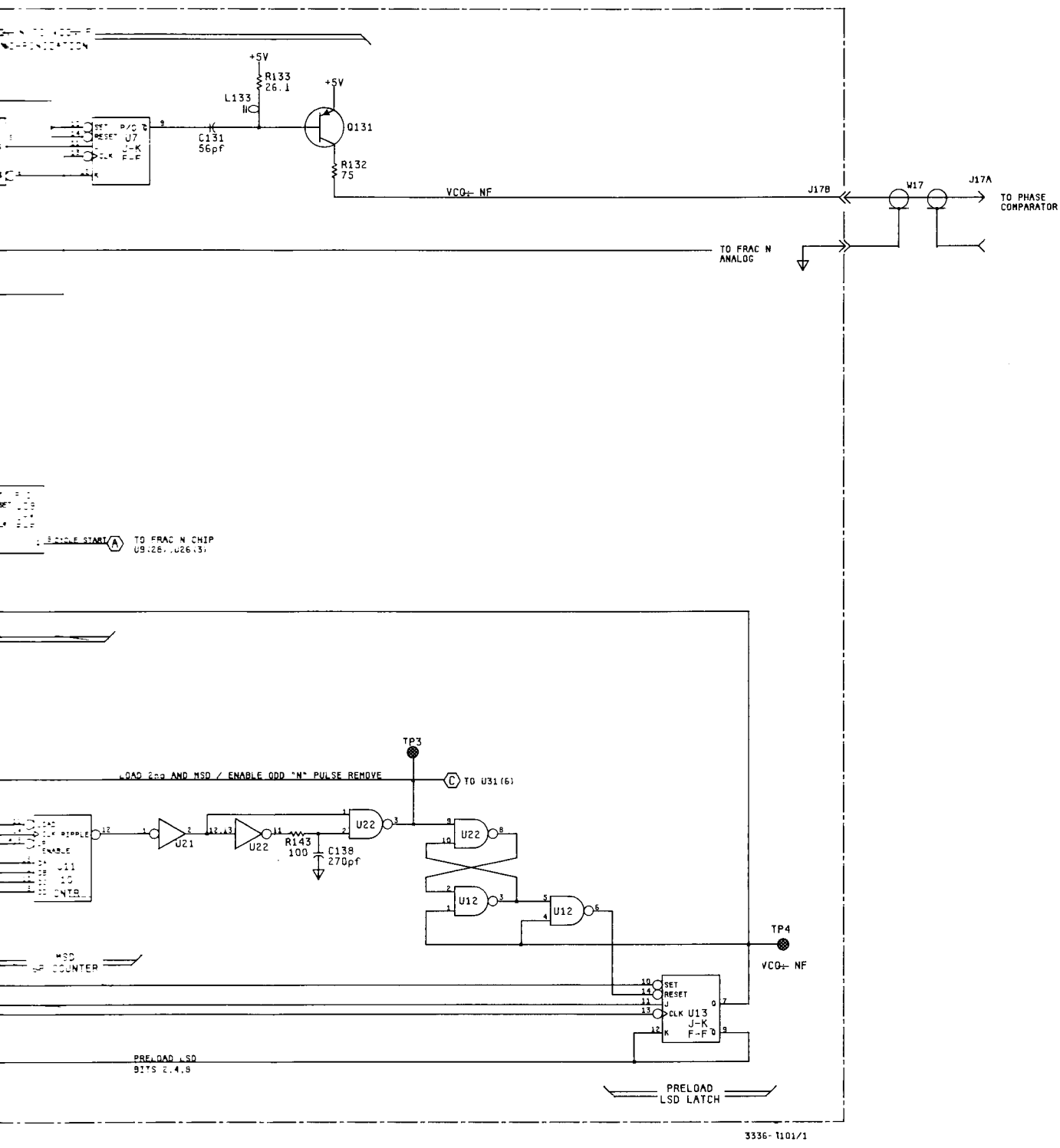
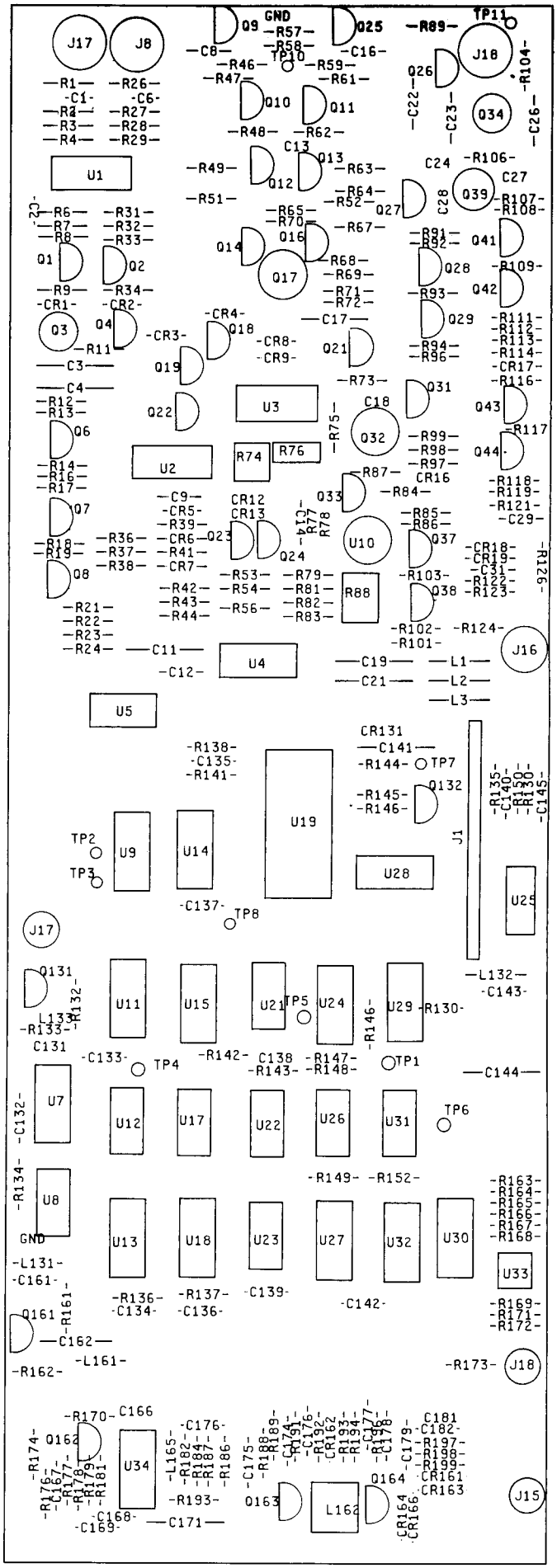
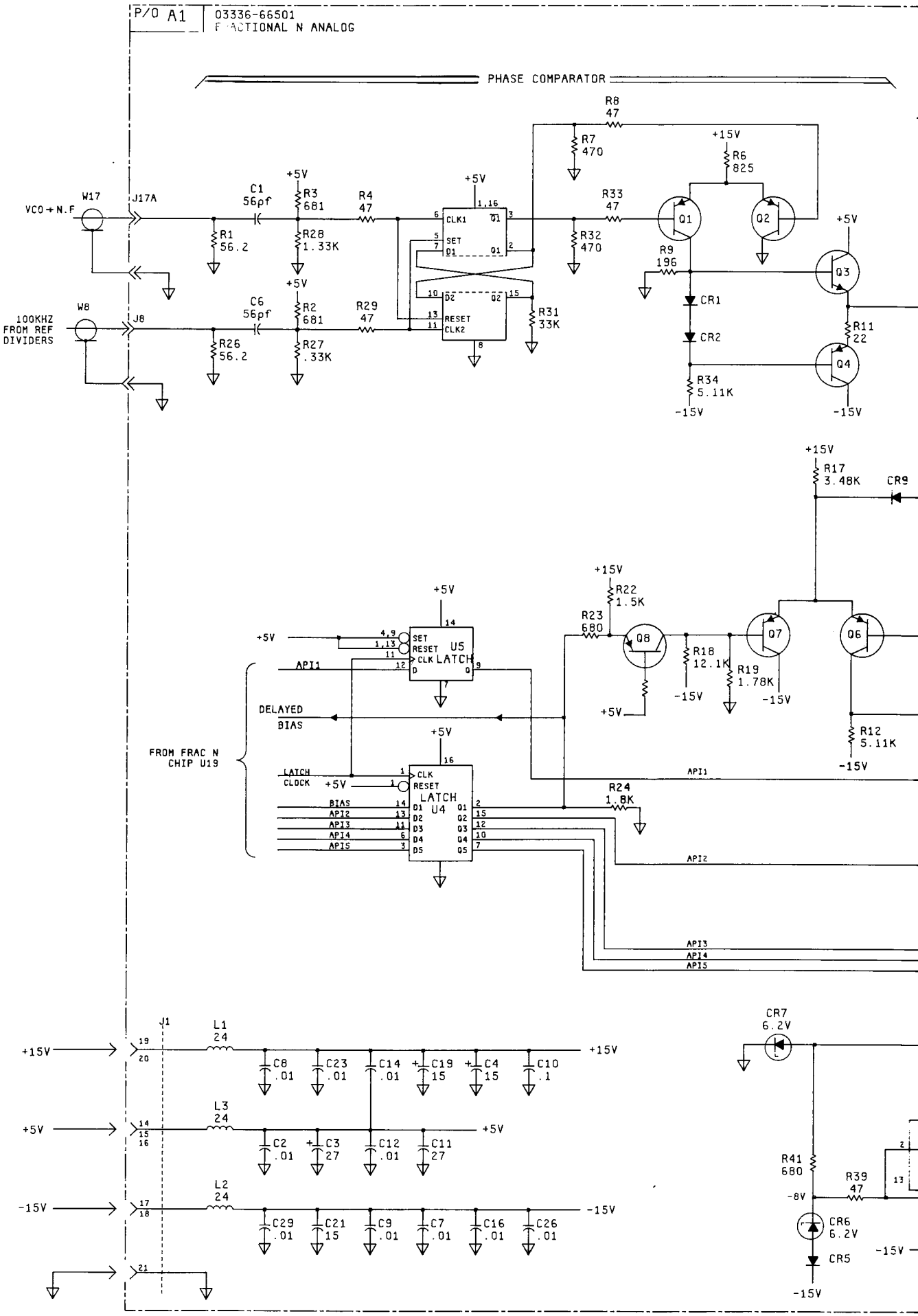


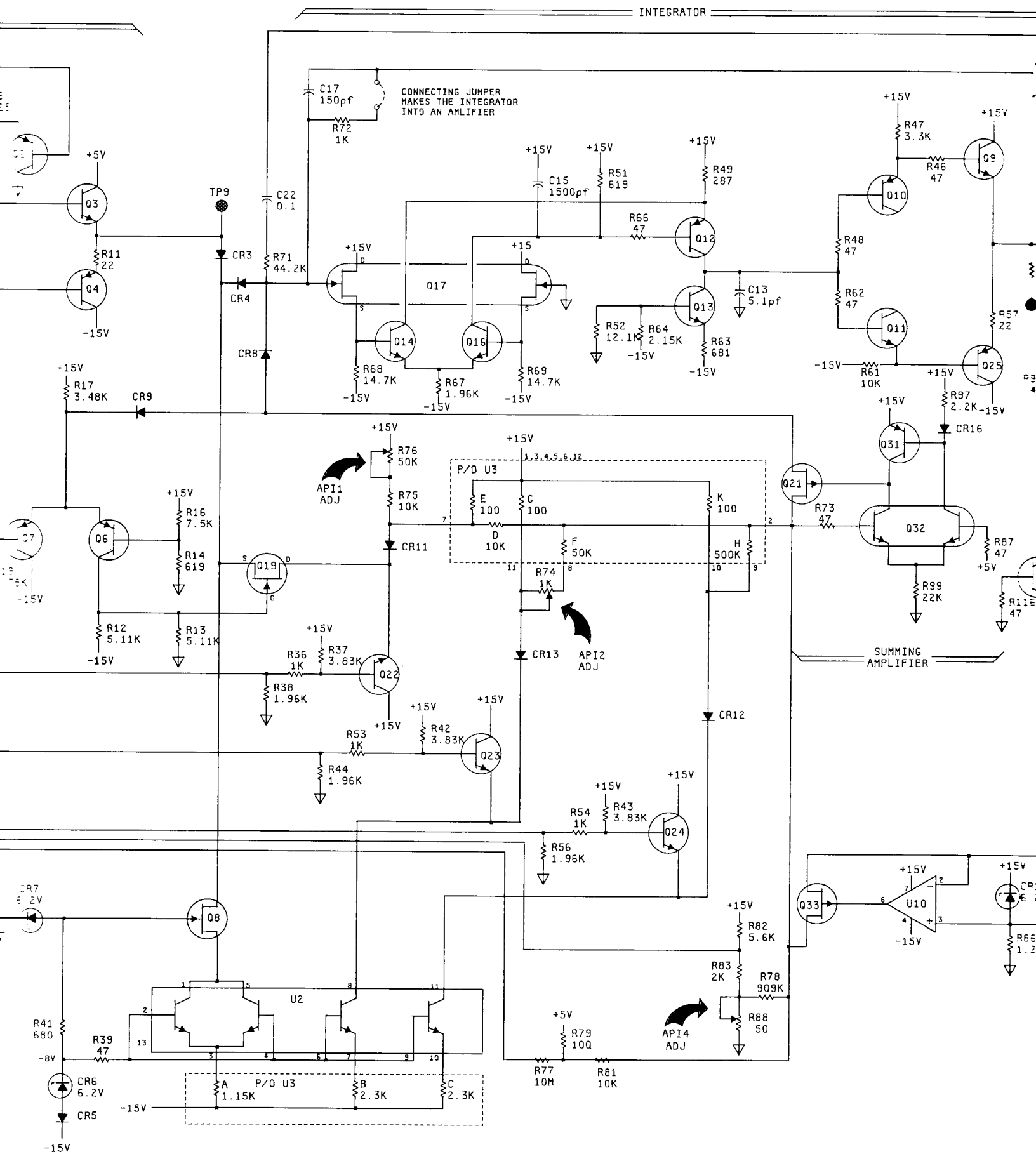
Figure 8-8. ÷ N.F Counter, A1.

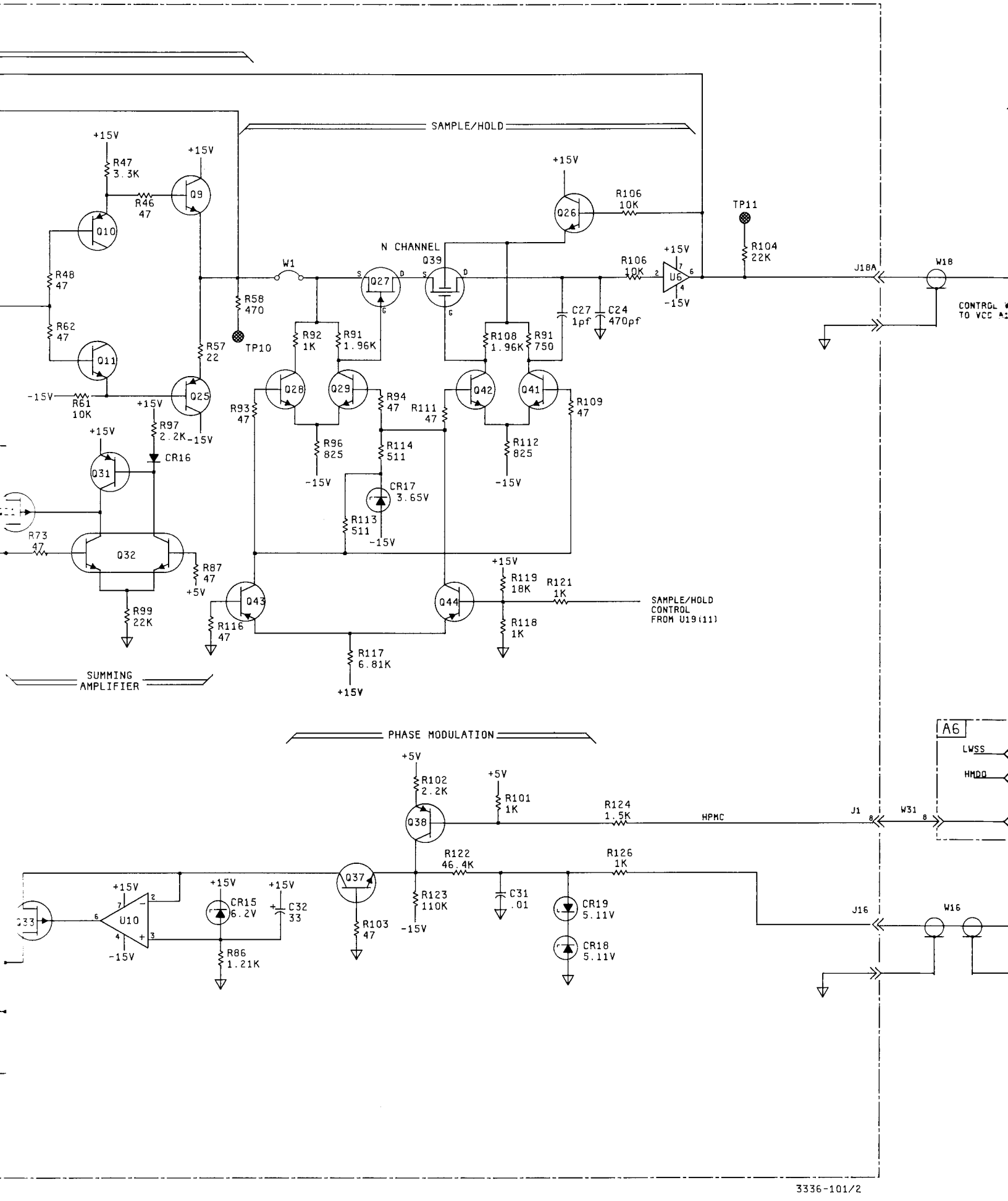

GND
TP11
TP10
J17
J8
J18
J16
J15
U1
U2
U3
U4
U5
U7
U8
U9
U10
U11
U12
U13
U14
U15
U17
U18
U19
U21
U22
U23
U24
U25
U26
U27
U28
U29
U30
U31
U32
U33
U34
J1
L162
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
Q9
Q10
Q11
Q12
Q13
Q14
Q16
Q17
Q18
Q19
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q31
Q32
Q33
Q34
Q37
Q38
Q39
Q41
Q42
Q43
Q44
Q131
Q132
Q161
Q162
Q163
Q164
R74
R76
R88
CR131
CR12
CR13
CR16
C13
C17
C18
C19
C21
C24
C27
C28
C131
C138
L1
L2
L3
L131
L132
L133
L134

3336-101C

P/O A1 | 03336-66501
FRACTIONAL N ANALOG






SAMPLE/HOLD
SUMMING AMPLIFIER
PHASE MODULATION
+15V
-15V
+5V
R47 3.3K
R46 47
Q9
Q10
R48 47
R62 47
Q11
R61 10K
Q25
R97 2.2K
CR16
Q31
R73 47
Q32
R87 47
R99 22K
R57 22
R58 470
TP10
W1
Q27
N CHANNEL Q39
Q26
R106 10K
TP11
R104 22K
J18A
W18
C27 1pf
C24 470pf
R92 1K
R91 1.96K
R108 1.96K
R91 750
Q28
Q29
Q42
Q41
R93 47
R94 47
R111 47
R109 47
R96 825
R114 511
R112 825
CR17 3.65V
R113 511
R119 18K
R121 1K
Q43
Q44
R116 47
R118 1K
R117 6.81K
SAMPLE/HOLD CONTROL FROM U19(11)
R102 2.2K
R101 1K
Q38
R124 1.5K
HPMC
J1
W31
A6
LWSS
HMDO
R122 46.4K
R126 1K
Q37
R123 110K
C31 .01
R103 47
CR19 5.11V
CR18 5.11V
J16
W16
U10
CR15 6.2V
C32 33
R86 1.21K
Q33

3336-101/2

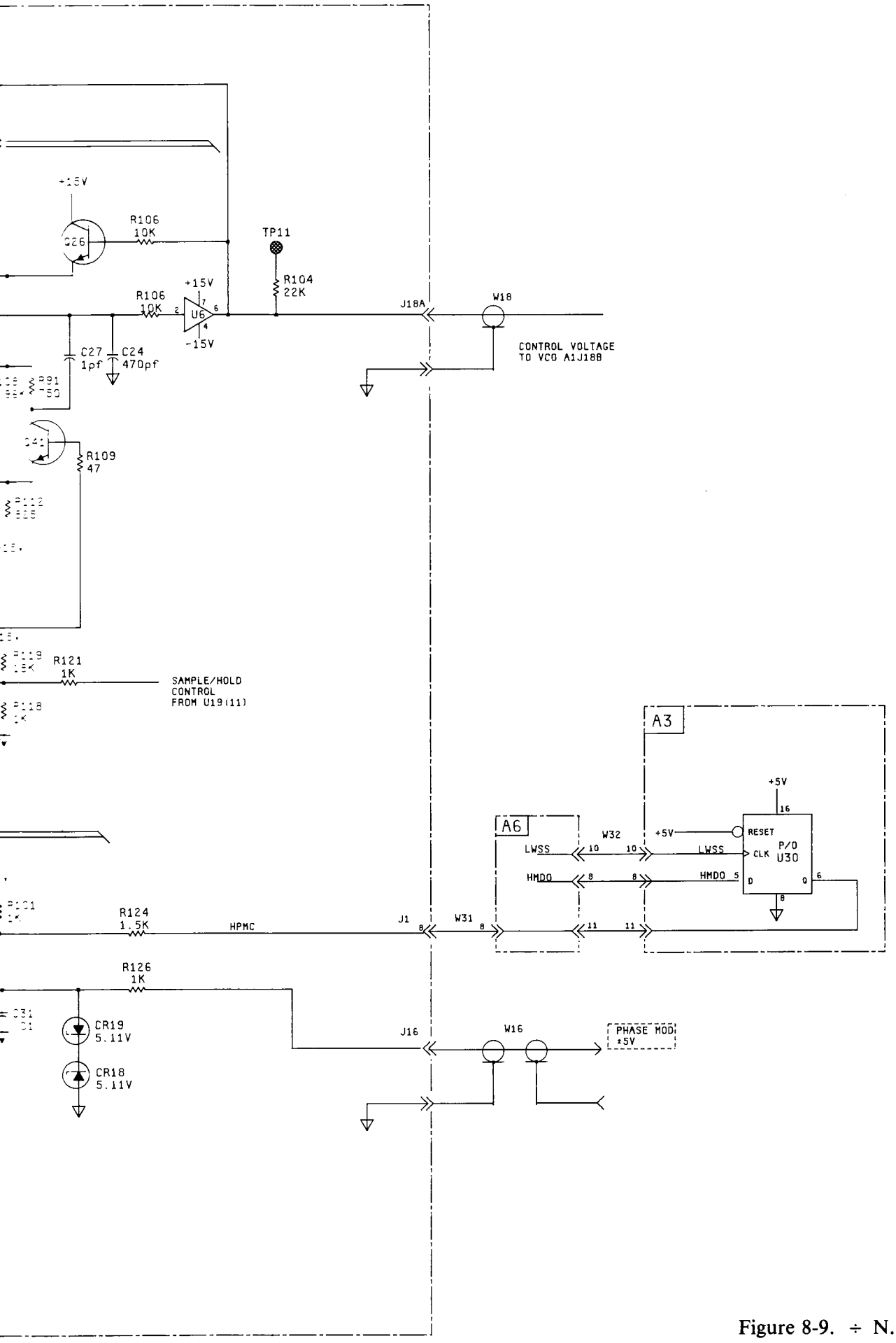
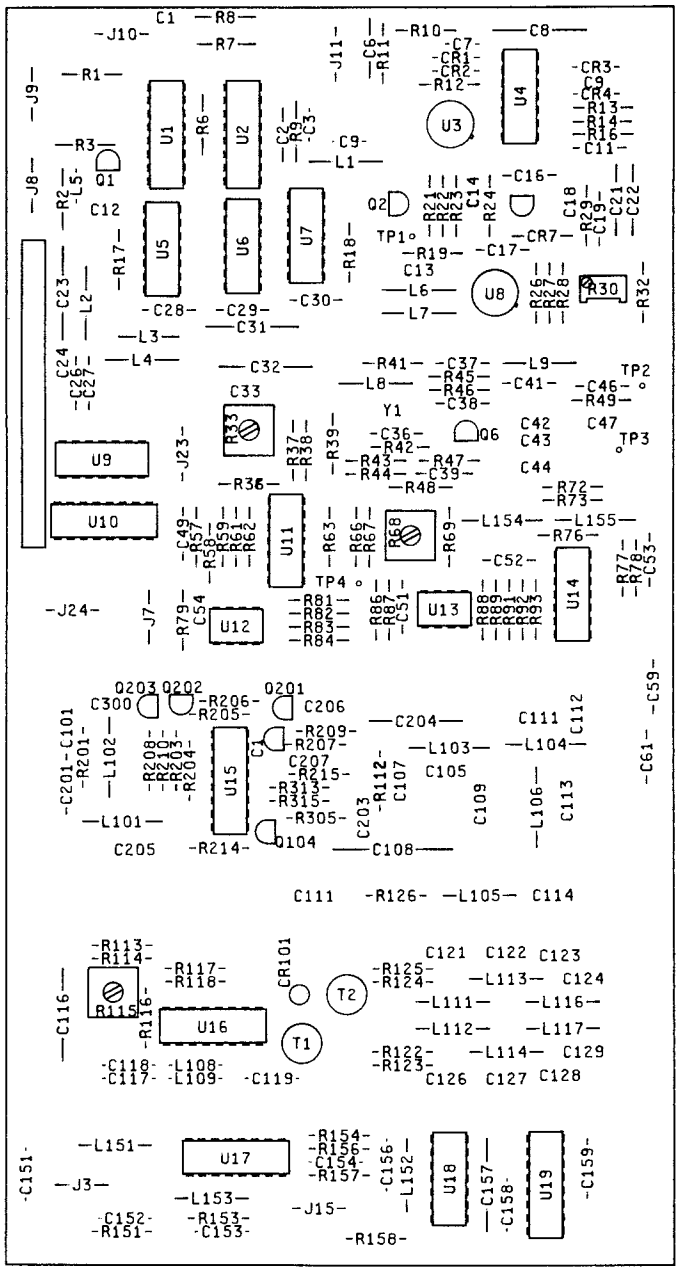
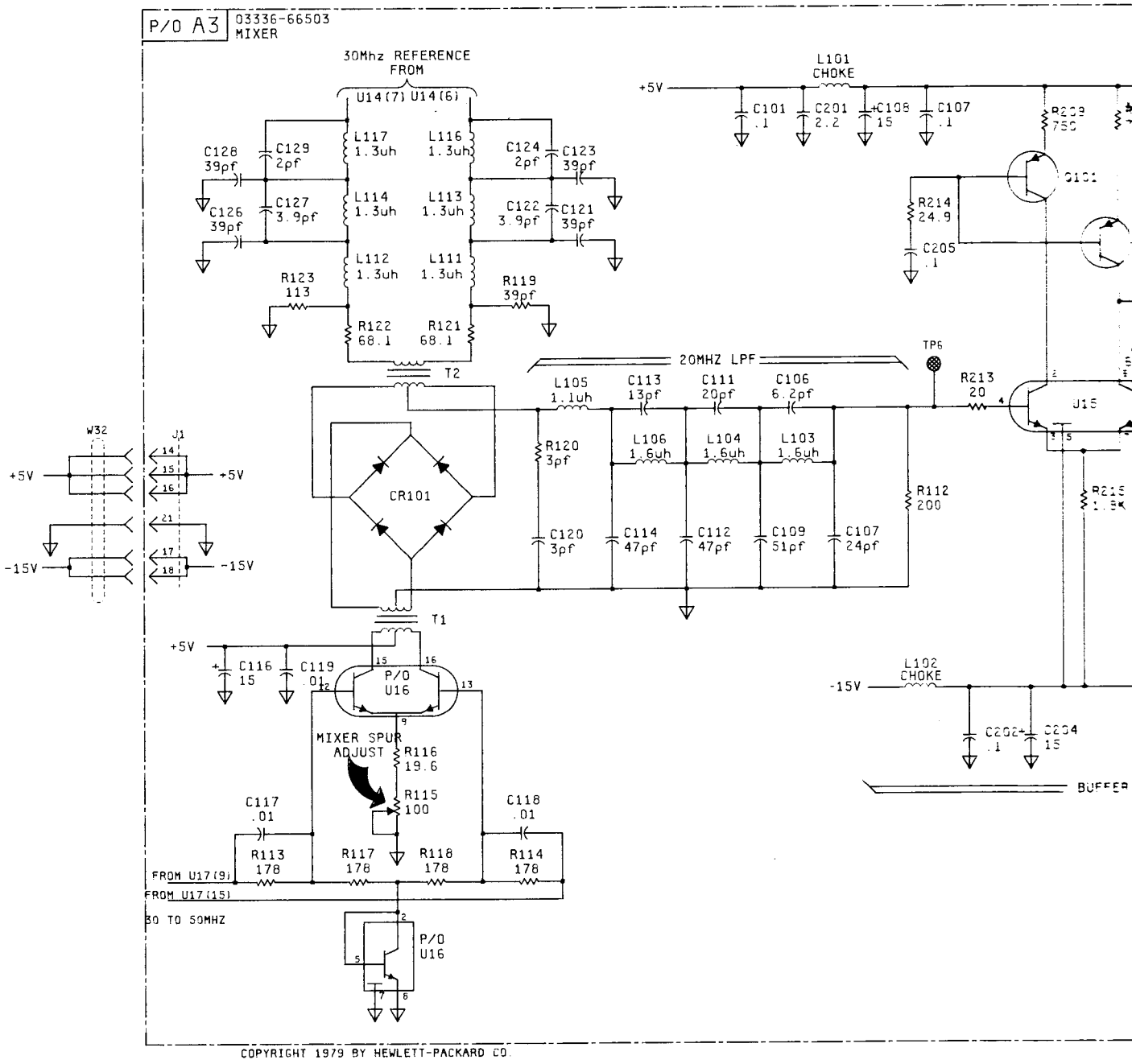


Figure 8-9. ÷ N.F Analog, A1.



3336-C103

A3
03336-66503



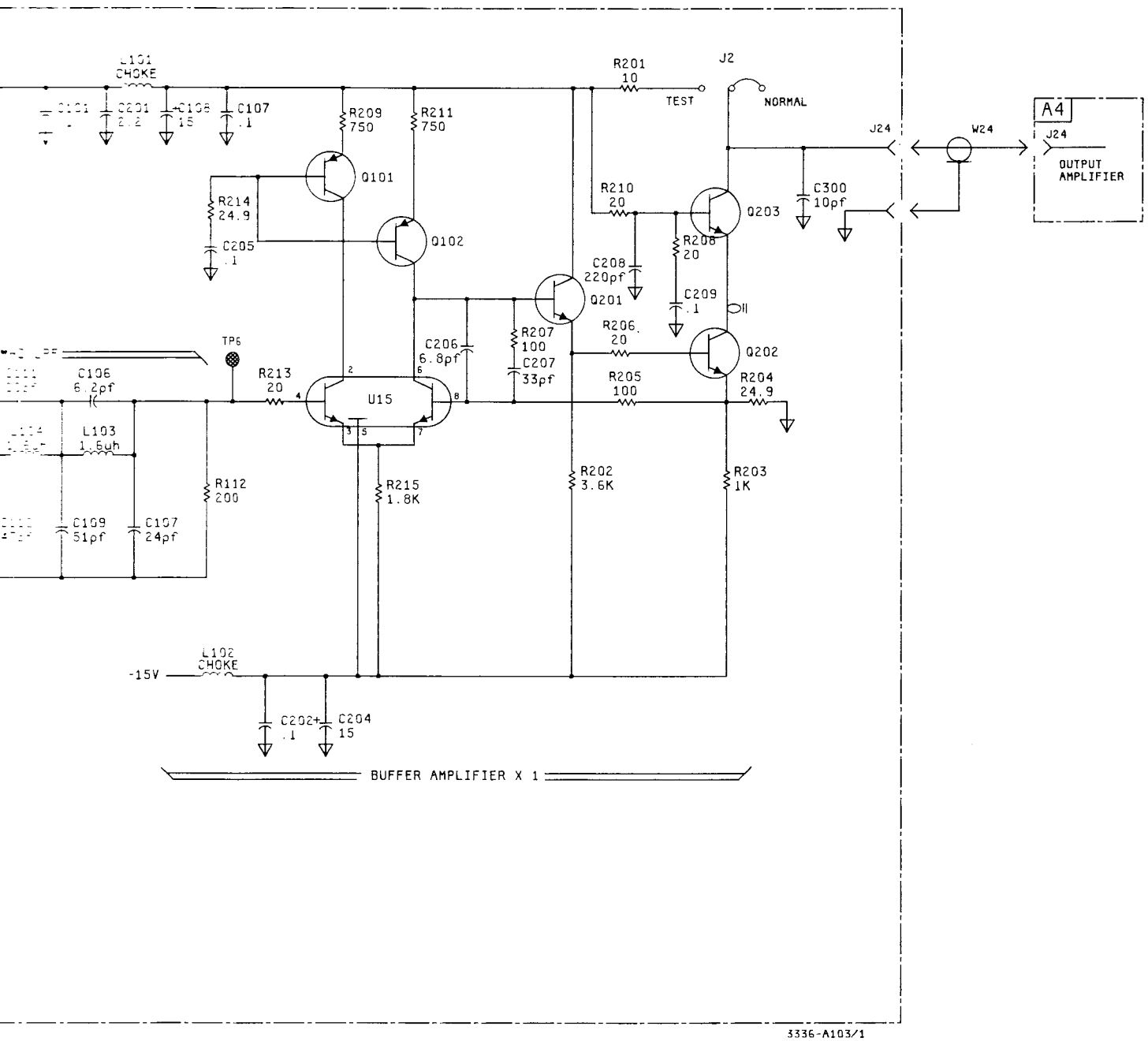
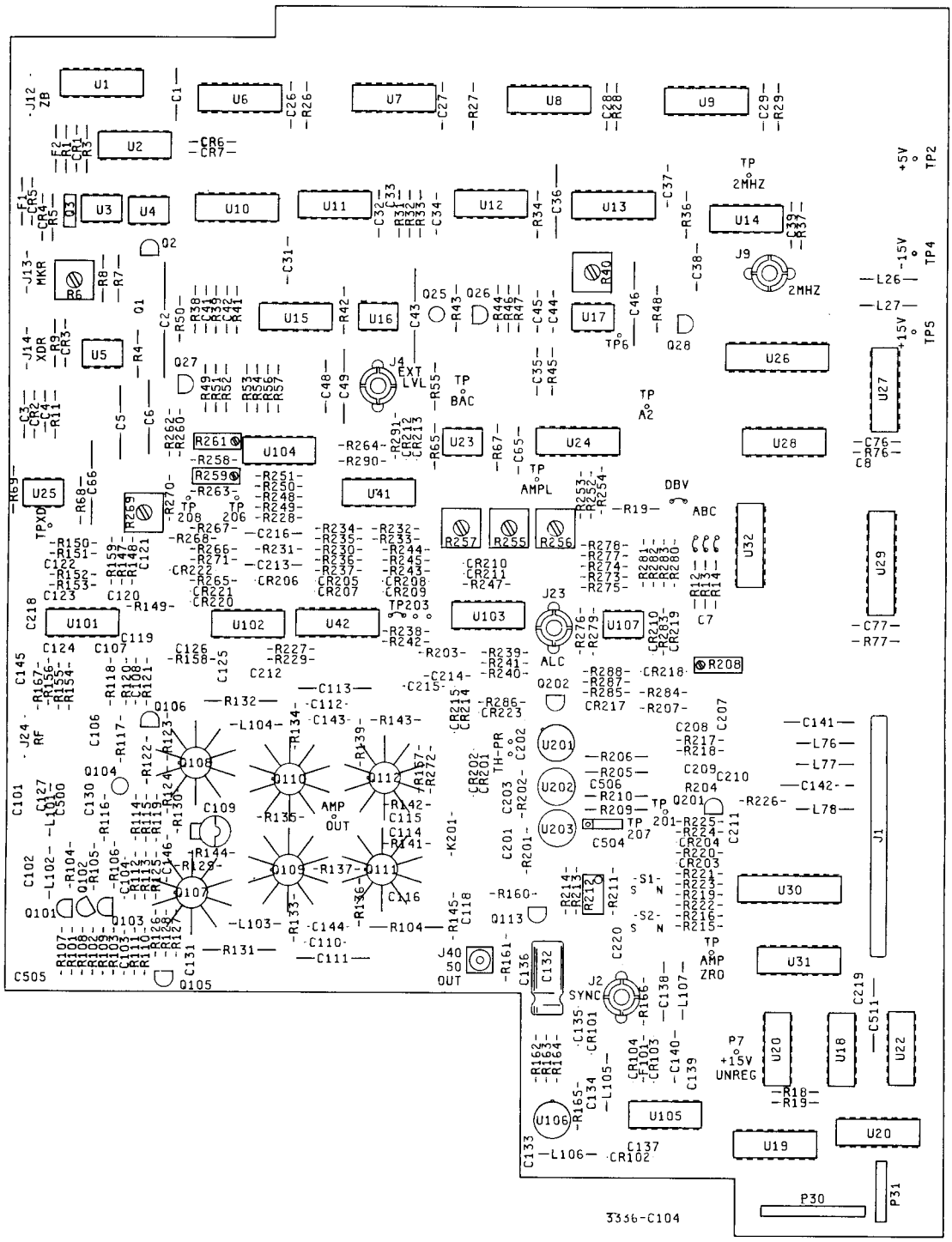
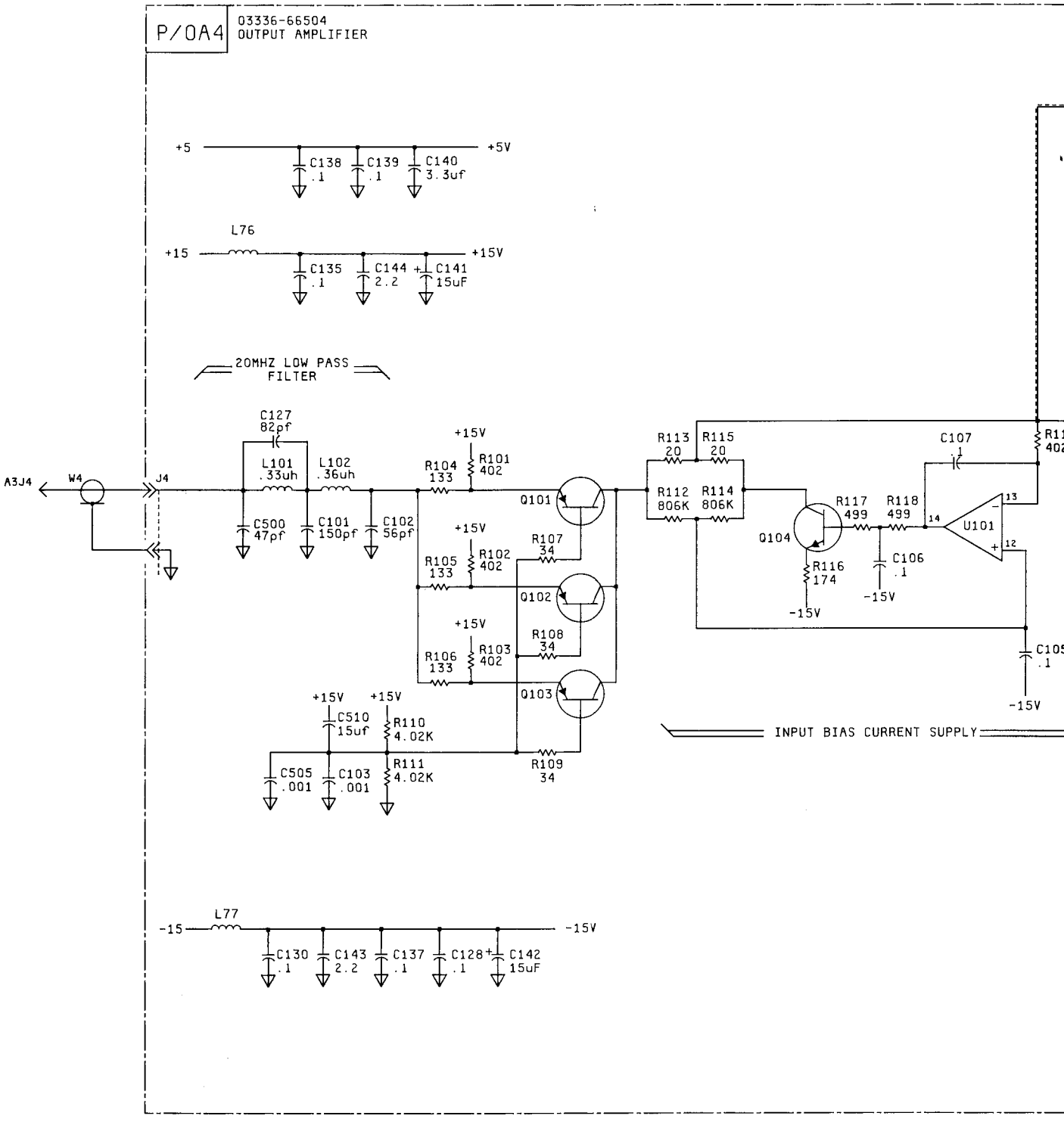
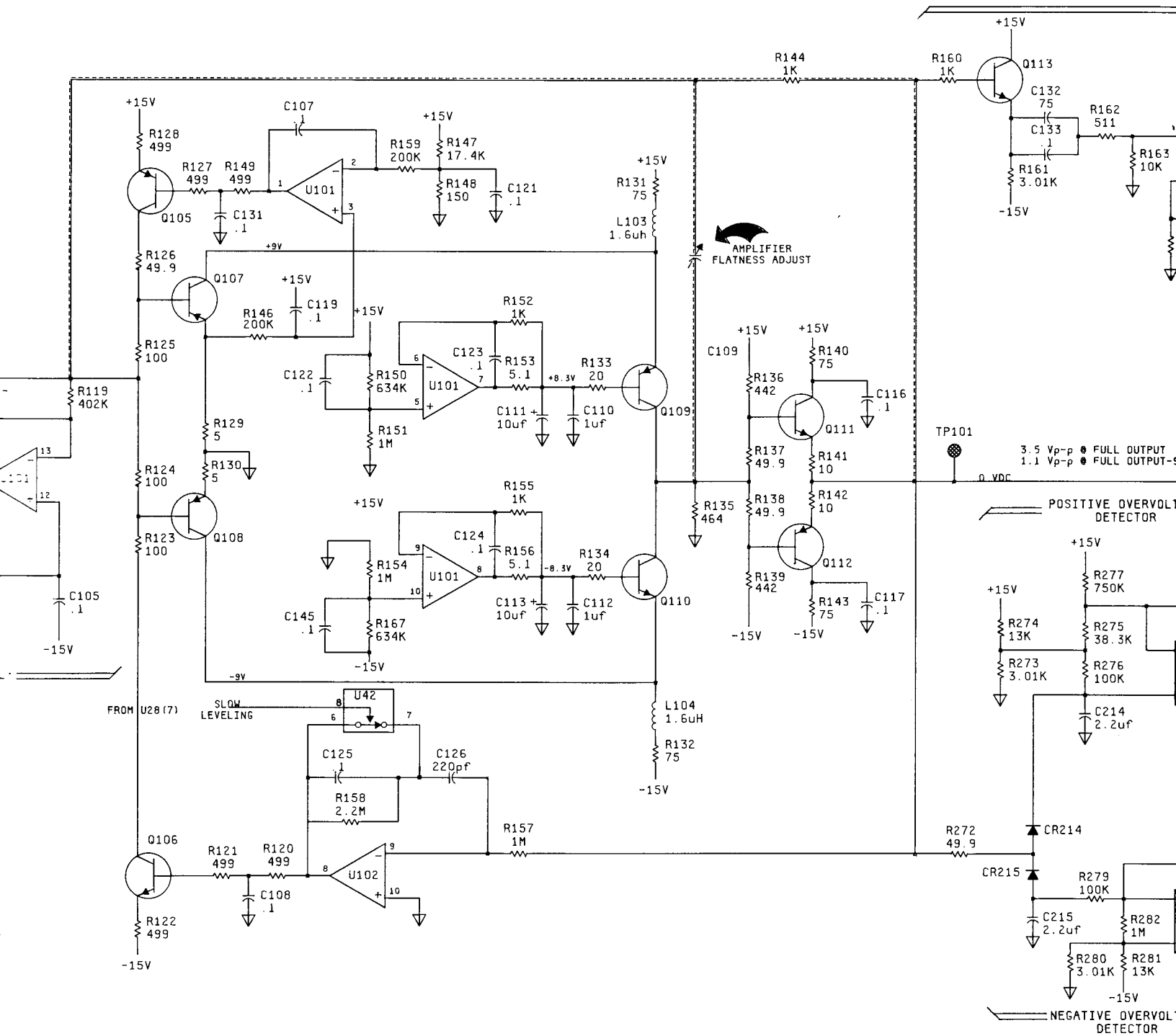


Figure 8-10. Mixer, A3.



A4
03336-66504


P/OA4
03336-66504
OUTPUT AMPLIFIER
+5
+5V
C138 .1
C139 .1
C140 3.3uf
L76
+15
+15V
C135 .1
C144 2.2
C141 15uF
20MHZ LOW PASS FILTER
C127 82pf
L101 .33uh
L102 .36uh
A3J4
W4
J4
C500 47pf
C101 150pf
C102 56pf
+15V
R104 133
R101 402
Q101
R105 133
R102 402
R107 34
Q102
R106 133
R103 402
R108 34
Q103
R109 34
+15V
C510 15uf
R110 4.02K
R111 4.02K
C505 .001
C103 .001
R113 20
R115 20
R112 806K
R114 806K
C107 .1
Q104
R117 499
R118 499
U101
R116 174
C106 .1
-15V
C105 .1
INPUT BIAS CURRENT SUPPLY
L77
-15
-15V
C130 .1
C143 2.2
C137 .1
C128 .1
C142 15uF


+15V
R128 499
C107 .1
R127 499
R149 499
U101
R159 200K
R147 17.4K
R148 150
C121 .1
Q105
C131 .1
R126 49.9
Q107
+9V
R146 200K
C119 .1
R125 100
R119 402K
R129 5
R130 5
R124 100
R123 100
Q108
C105 .1
-15V
R131 75
L103 1.6uh
AMPLIFIER FLATNESS ADJUST
R144 1K
R160 1K
Q113
C132 75
C133 .1
R161 3.01K
R162 511
R163 10K
R152 1K
C122 .1
R150 634K
U101
C123 .1
R153 5.1
+8.3V
R133 20
C111 10uf
C110 1uf
R151 1M
Q109
C109
R136 442
R140 75
C116 .1
Q111
R137 49.9
R141 10
TP101
3.5 Vp-p @ FULL OUTPUT
1.1 Vp-p @ FULL OUTPUT-9
0 VDC
R135 464
R138 49.9
R142 10
POSITIVE OVERVOLT DETECTOR
R155 1K
C124 .1
R156 5.1
-8.3V
R134 20
R154 1M
U101
C113 10uf
C112 1uf
C145 .1
R167 634K
Q110
Q112
R139 442
R143 75
C117 .1
R277 750K
R274 13K
R275 38.3K
R273 3.01K
R276 100K
C214 2.2uf
FROM U28(7)
SLOW LEVELING
U42
L104 1.6uH
R132 75
C125 .1
C126 220pf
R158 2.2M
R157 1M
Q106
R121 499
R120 499
U102
C108 .1
R122 499
R272 49.9
CR214
CR215
R279 100K
C215 2.2uf
R282 1M
R280 3.01K
R281 13K
NEGATIVE OVERVOLT DETECTOR

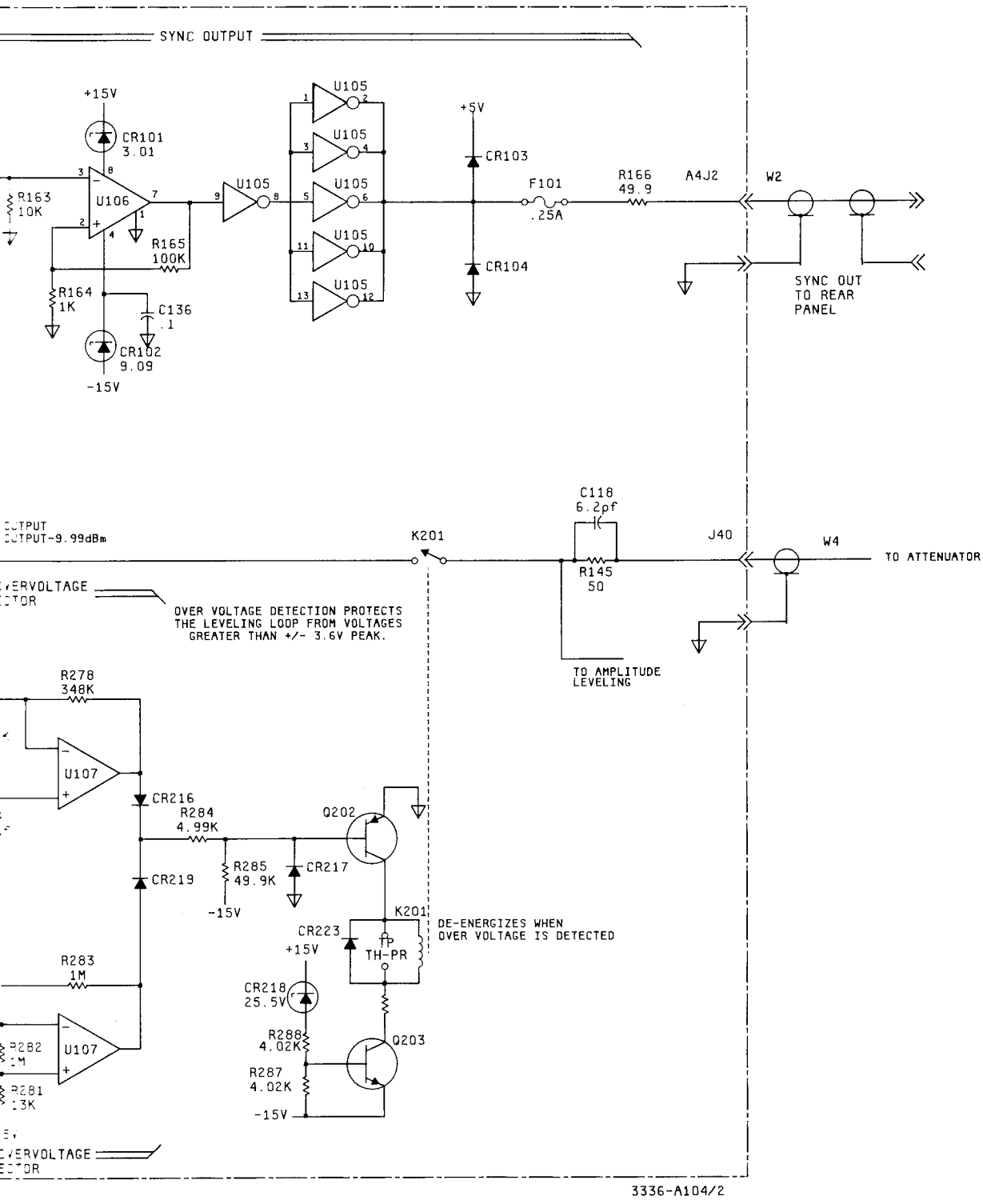
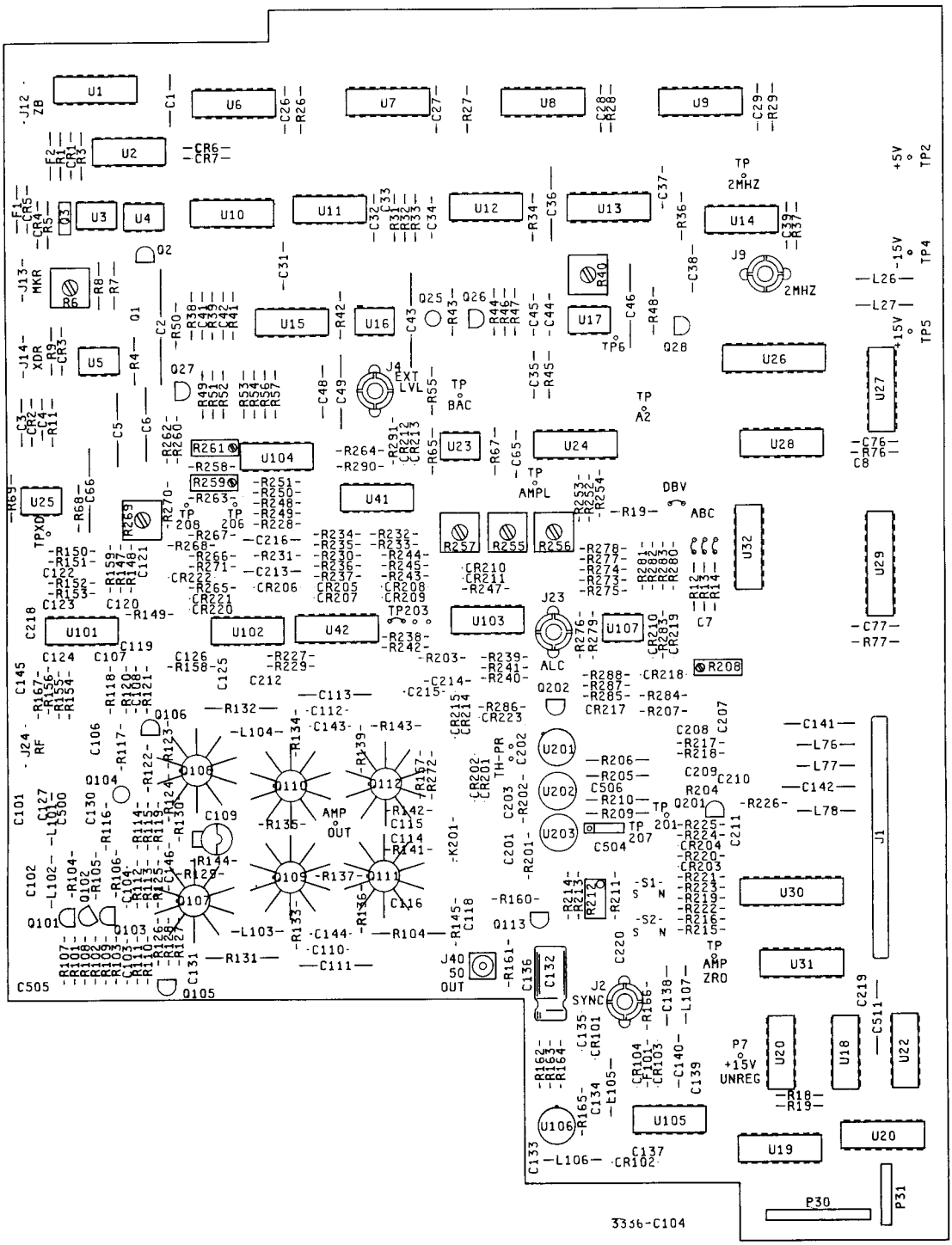
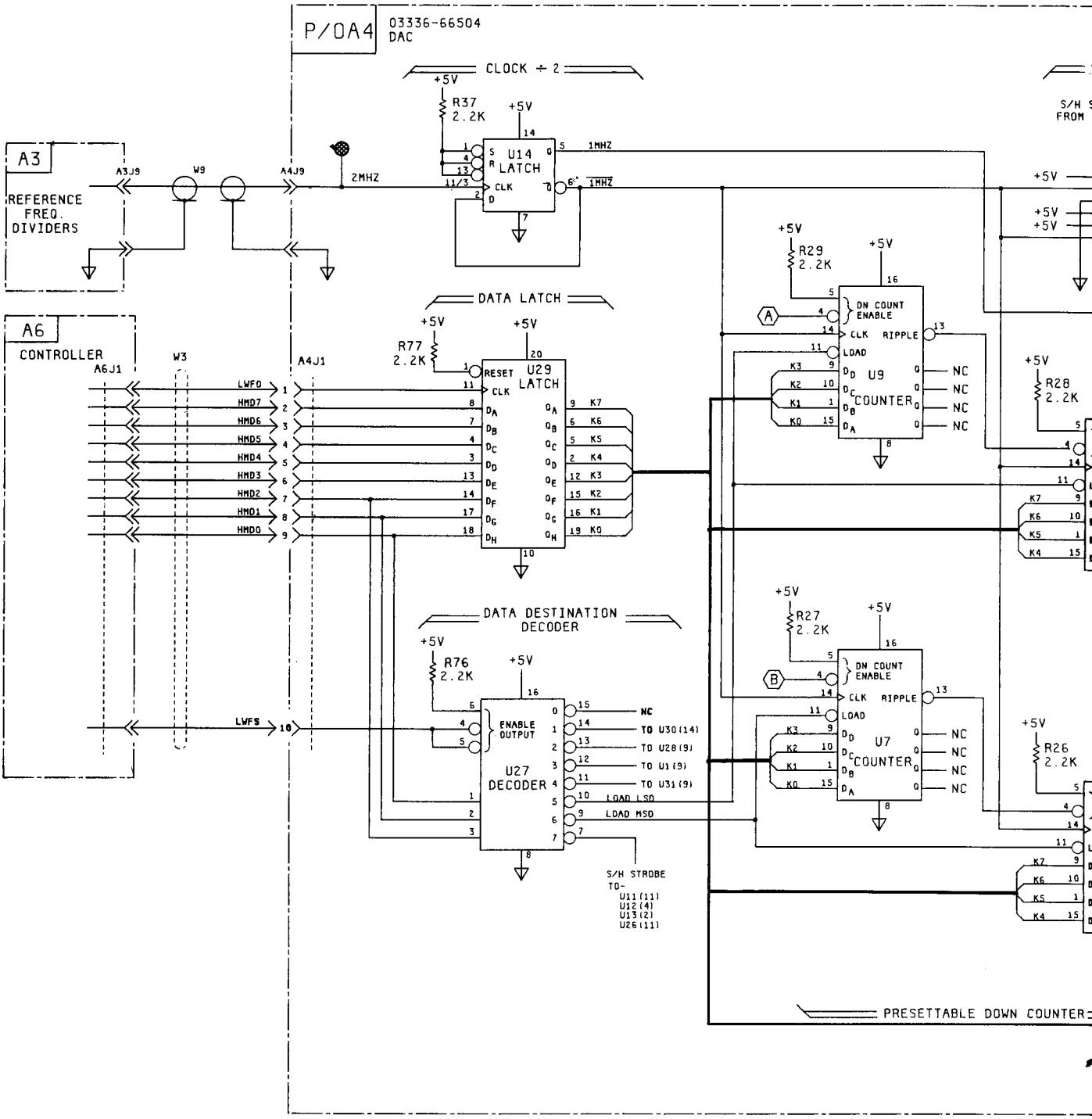
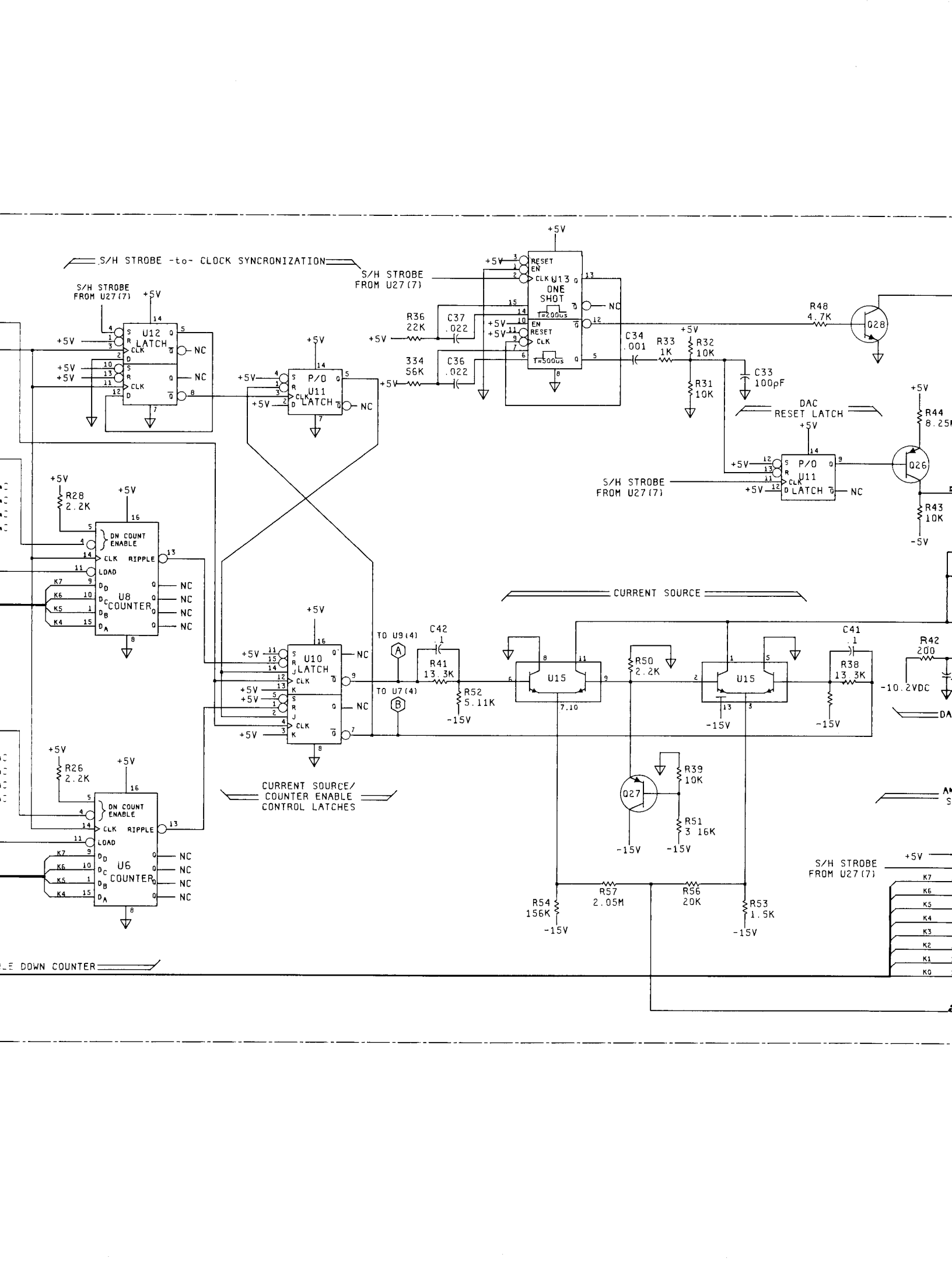


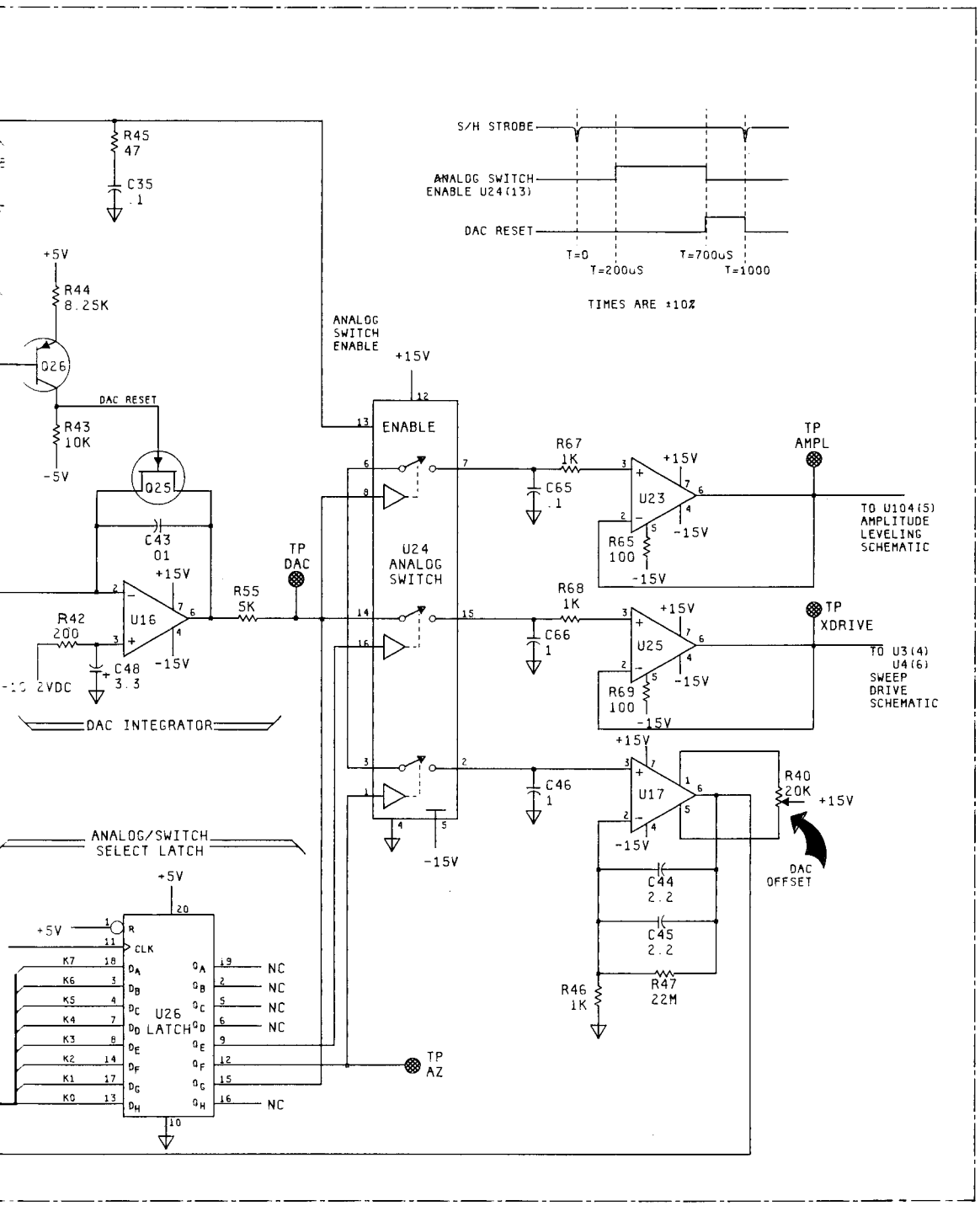
Figure 8-11. Output Amplifier, A4.



A4
03336-66504

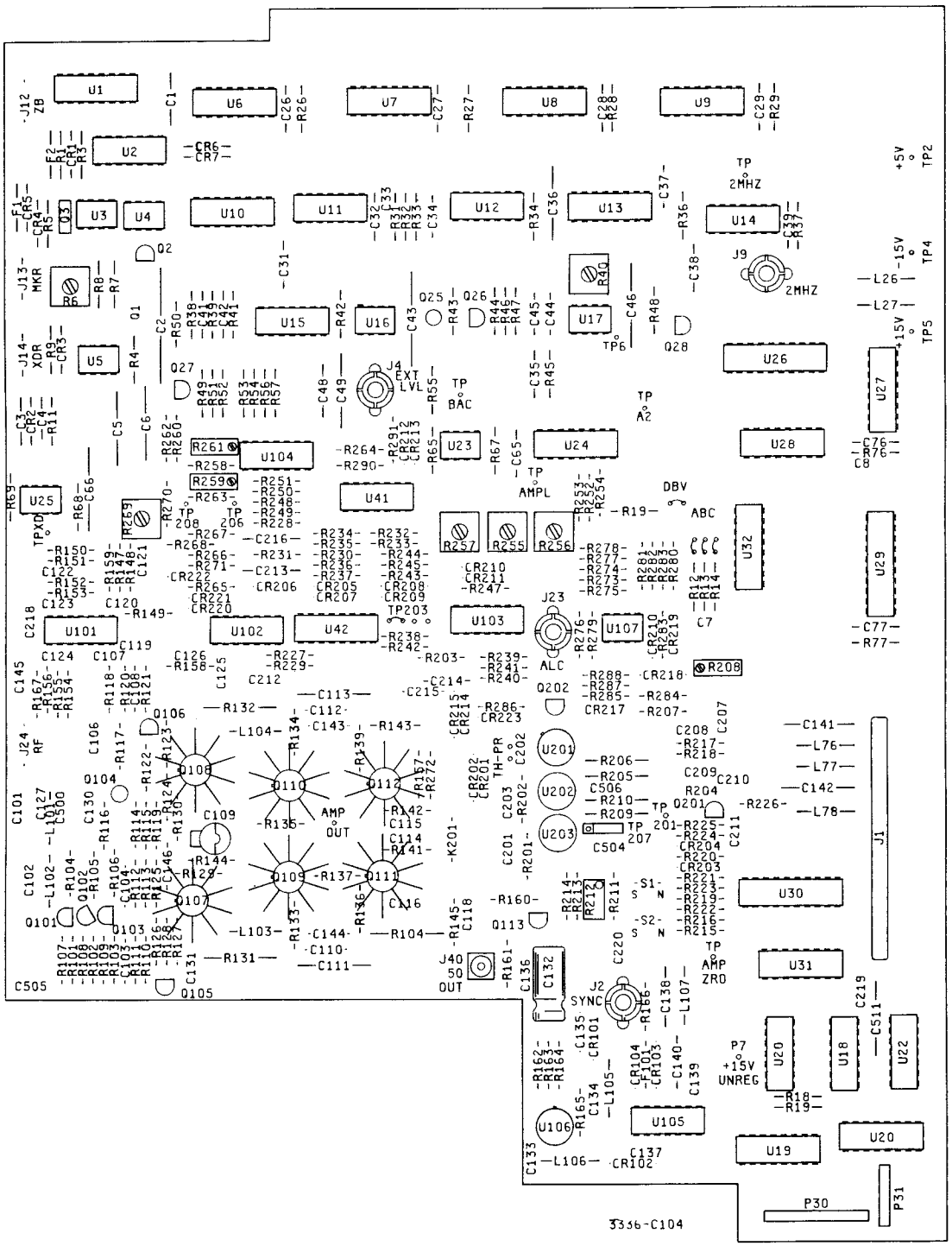



S/H STROBE -to- CLOCK SYNCRONIZATION
S/H STROBE FROM U27(7)
U12 LATCH
U11 LATCH
U13 ONE SHOT
T=200us
T=500us
R36 22K
C37 .022
334 56K
C36 .022
C34 .001
R33 1K
R32 10K
R31 10K
C33 100pF
R48 4.7K
Q28
DAC RESET LATCH
R44 8.25K
Q26
R43 10K
R28 2.2K
U8 COUNTER
DN COUNT ENABLE
CLK
RIPPLE
LOAD
U10 LATCH
TO U9(4)
TO U7(4)
C42 .1
R41 13.3K
R52 5.11K
CURRENT SOURCE
U15
R50 2.2K
C41 .1
R38 13.3K
R42 200
-10.2VDC
CURRENT SOURCE/ COUNTER ENABLE CONTROL LATCHES
R26 2.2K
U6 COUNTER
Q27
R39 10K
R51 3.16K
R54 156K
R57 2.05M
R56 20K
R53 1.5K
-15V
+5V
NC
DOWN COUNTER



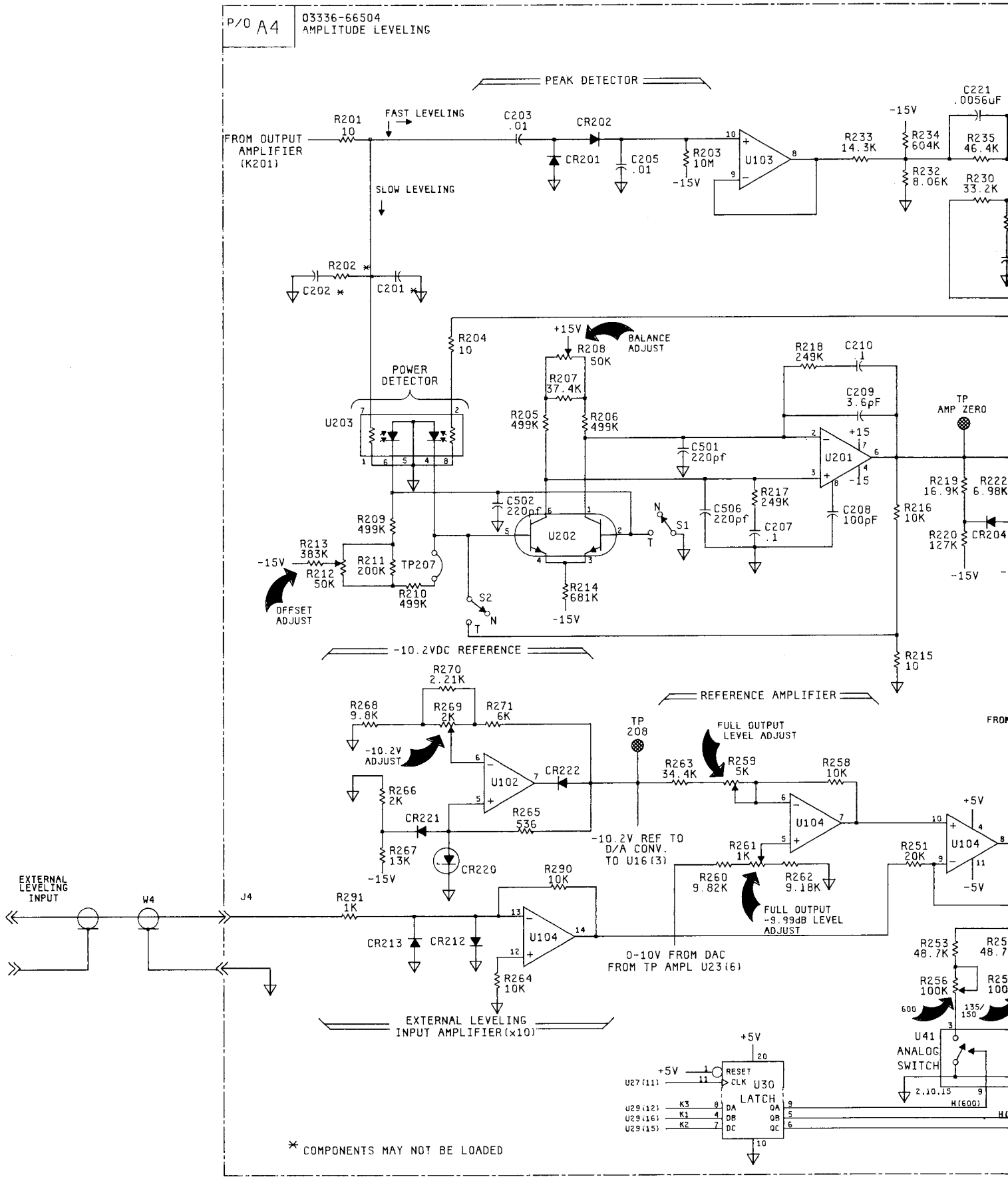
3336-A104/3

Figure 8-12. D to A Converter, A4.

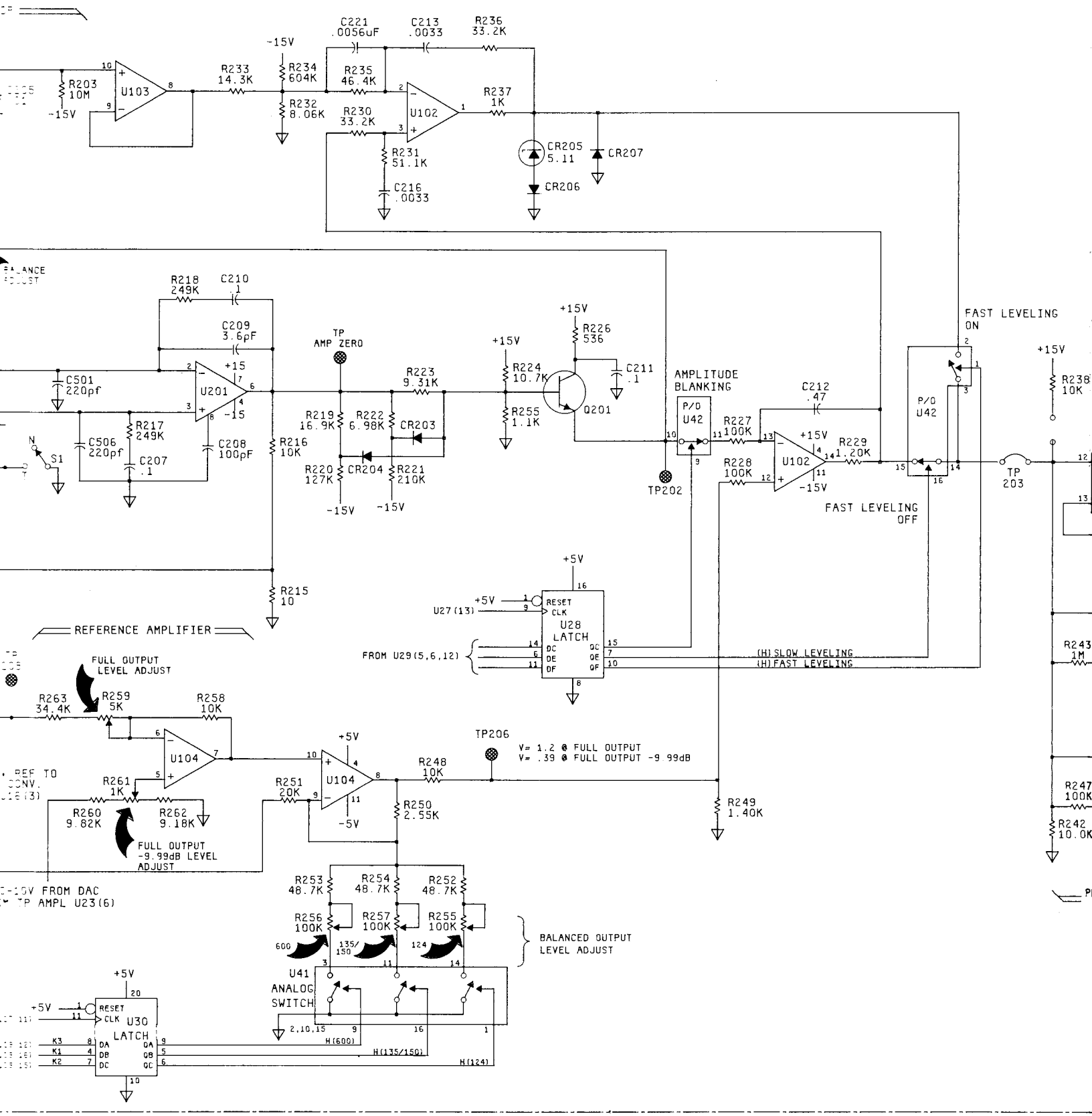


A4
03336-66504

P/O A4 | 03336-66504
AMPLITUDE LEVELING



* COMPONENTS MAY NOT BE LOADED


C221 .0056uF
C213 .0033
R236 33.2K
-15V
R233 14.3K
R234 604K
R235 46.4K
R203 10M
U103
R232 8.06K
R230 33.2K
U102
R237 1K
R231 51.1K
C216 .0033
CR205 5.11
CR207
CR206
R218 249K
C210 .1
C209 3.6pF
TP AMP ZERO
+15V
R226 536
R223 9.31K
R224 10.7K
C211 .1
Q201
AMPLITUDE BLANKING
P/O U42
C212 .47
FAST LEVELING ON
C501 220pf
U201
R217 249K
C506 220pf
C207 .1
C208 100pF
R216 10K
R219 16.9K
R222 6.98K
CR203
R220 127K
CR204
R221 210K
R255 1.1K
TP202
R227 100K
R228 100K
R229 1.20K
FAST LEVELING OFF
TP 203
R238 10K
R215 10
REFERENCE AMPLIFIER
+5V
U27(13)
U28 LATCH
FROM U29(5,6,12)
(H)SLOW LEVELING
(H)FAST LEVELING
FULL OUTPUT LEVEL ADJUST
R263 34.4K
R259 5K
R258 10K
U104
R261 1K
R260 9.82K
R262 9.18K
FULL OUTPUT -9.99dB LEVEL ADJUST
R251 20K
R248 10K
TP206
V= 1.2 @ FULL OUTPUT
V= .39 @ FULL OUTPUT -9.99dB
R249 1.40K
R250 2.55K
-5V
R253 48.7K
R254 48.7K
R252 48.7K
R256 100K
R257 100K
R255 100K
600
135/150
124
BALANCED OUTPUT LEVEL ADJUST
U41 ANALOG SWITCH
H(600)
H(135/150)
H(124)
U30 LATCH
K3
K1
K2
R243 1M
R247 100K
R242 10.0K

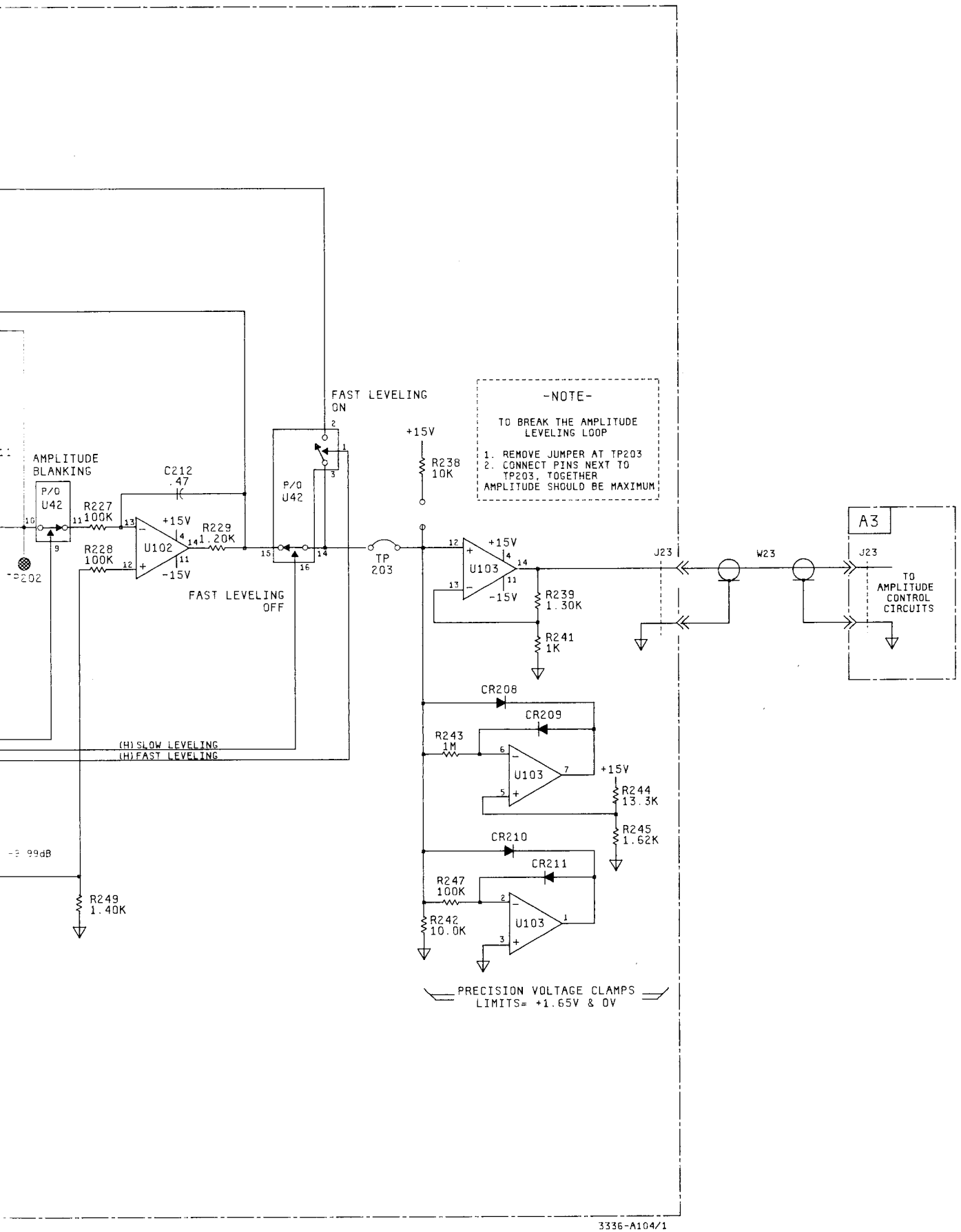
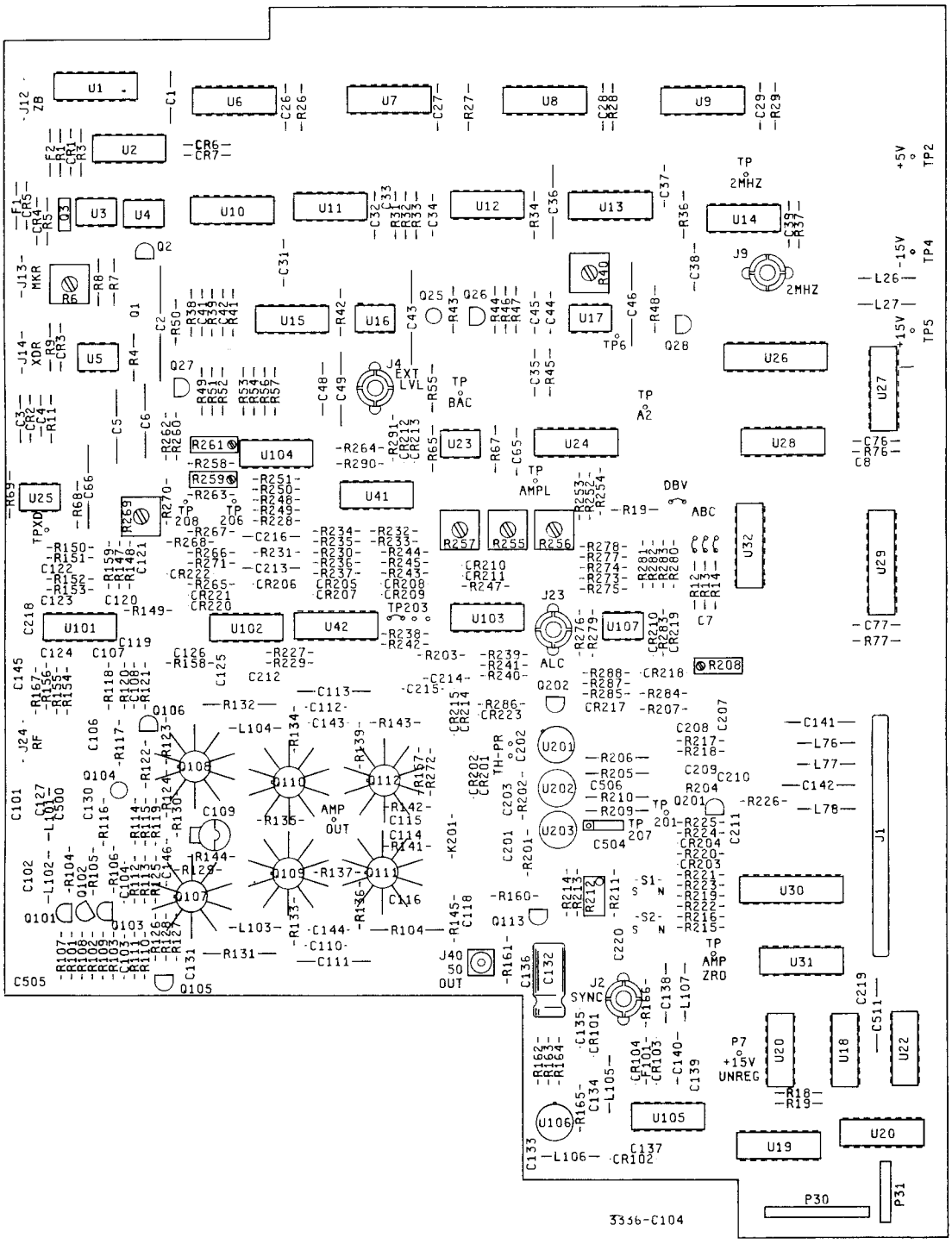
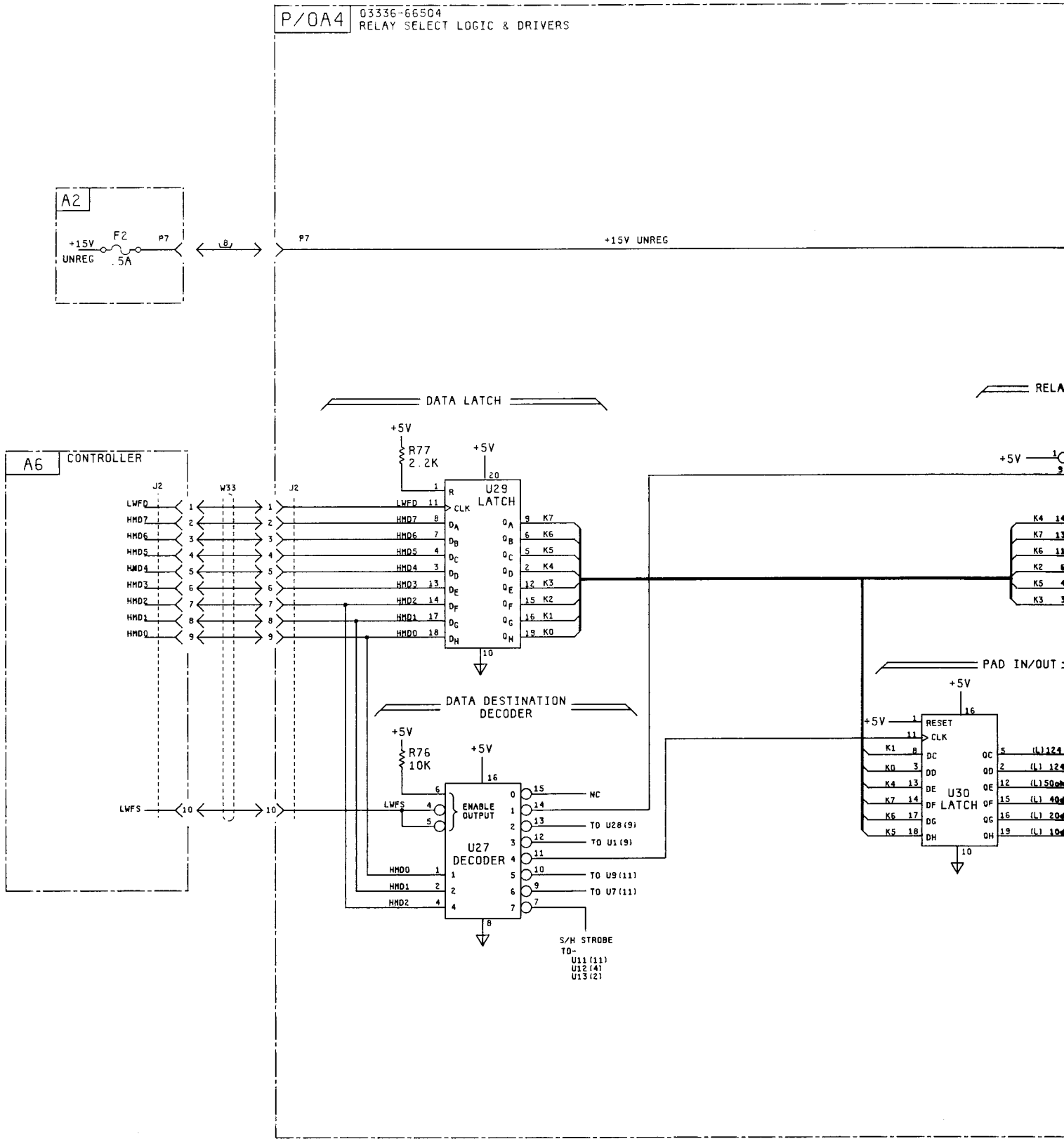


Figure 8-13. Amplitude Leveling, A4.



A4
03336-66504


P/OA4
03336-66504
RELAY SELECT LOGIC & DRIVERS
A2
+15V UNREG
F2
.5A
P7
8
P7
+15V UNREG
DATA LATCH
A6
CONTROLLER
J2
W33
J2
LWFD
HMD7
HMD6
HMD5
HMD4
HMD3
HMD2
HMD1
HMD0
LWFS
+5V
R77
2.2K
U29
LATCH
CLK
K7
K6
K5
K4
K3
K2
K1
K0
DATA DESTINATION
DECODER
R76
10K
U27
DECODER
ENABLE
OUTPUT
NC
TO U28(9)
TO U1(9)
TO U9(11)
TO U7(11)
S/H STROBE
TO-
U11(11)
U12(4)
U13(2)
PAD IN/OUT
U30
LATCH
RESET
CLK

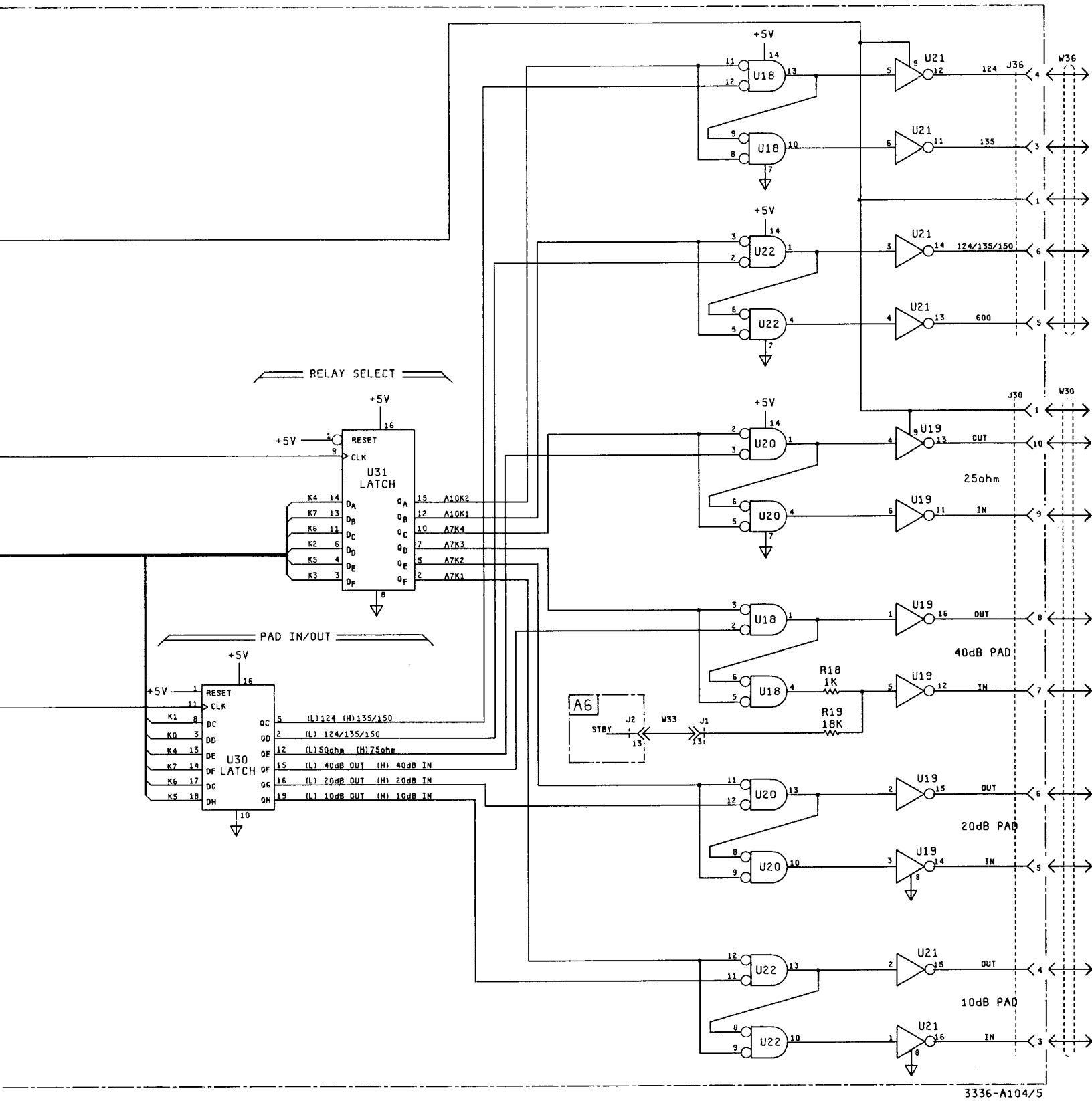

RELAY SELECT
PAD IN/OUT
U31 LATCH
U30 LATCH
RESET
CLK
+5V
A10K2
A10K1
A7K4
A7K3
A7K2
A7K1
(L)124 (H)135/150
(L) 124/135/150
(L)50ohm (H)75ohm
(L) 40dB OUT (H) 40dB IN
(L) 20dB OUT (H) 20dB IN
(L) 10dB OUT (H) 10dB IN
U18
U20
U22
U21
U19
124
135
124/135/150
600
J36
W36
J30
W30
OUT
IN
25ohm
40dB PAD
20dB PAD
10dB PAD
R18
1K
R19
18K
A6
STBY
J2
J1
W33
3336-A104/5

Figure 8-

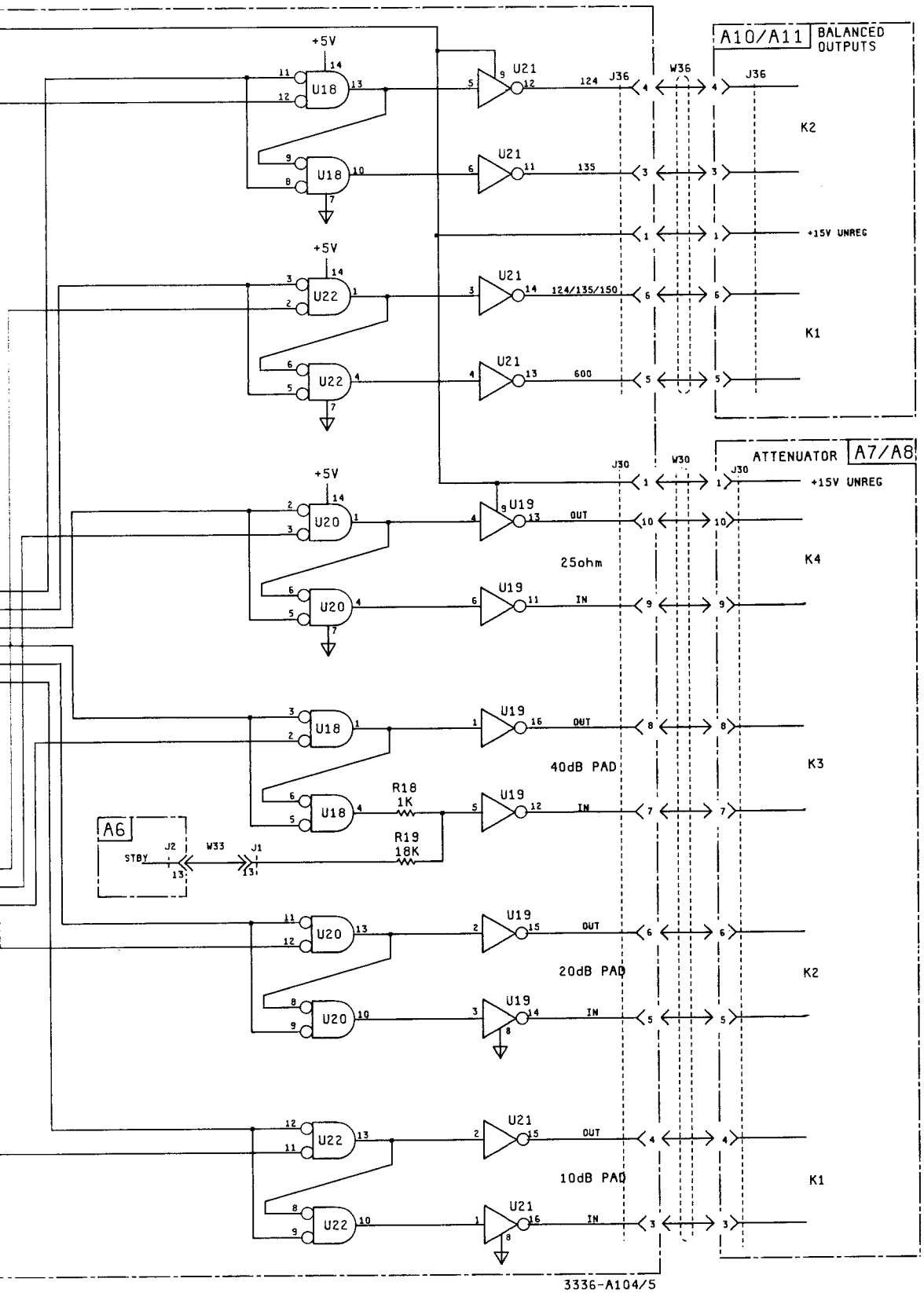
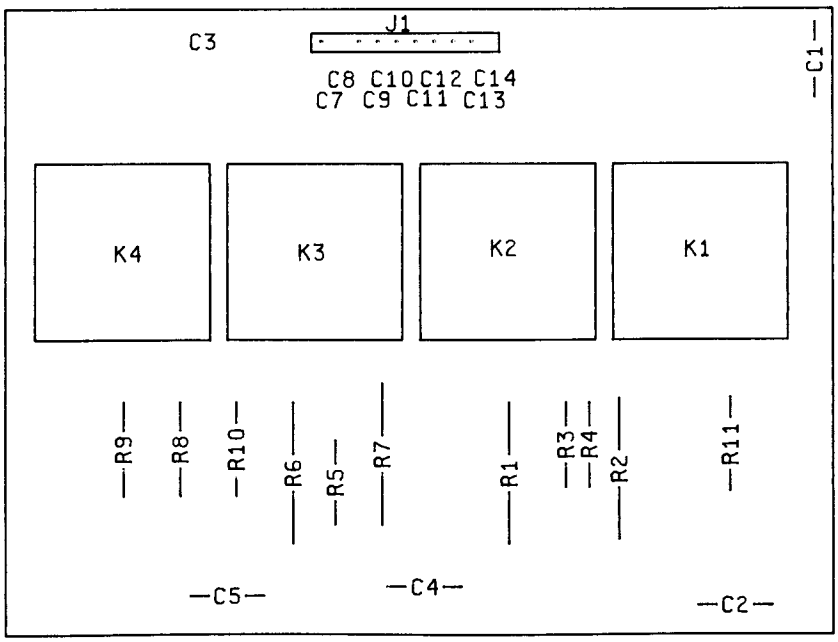
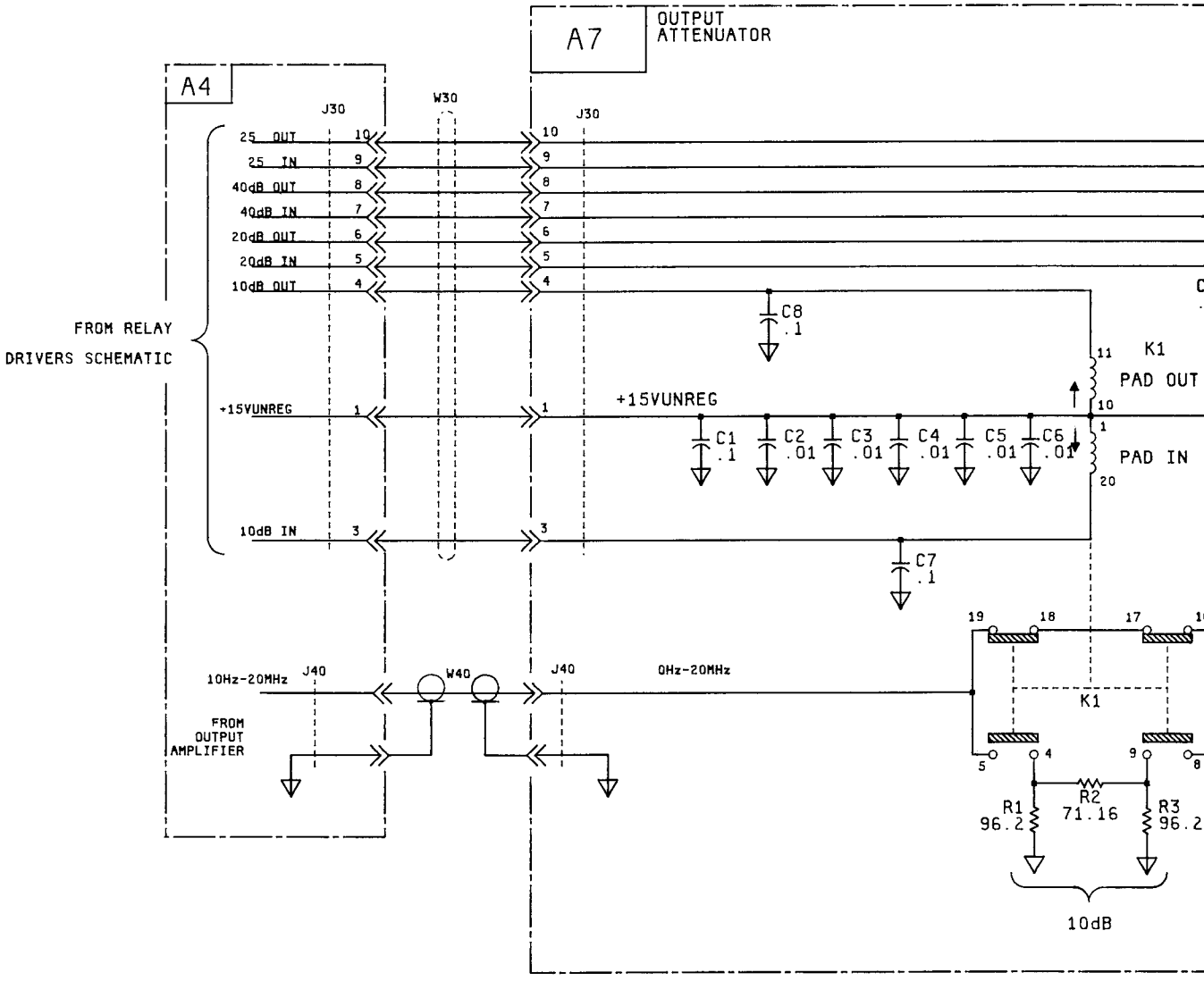


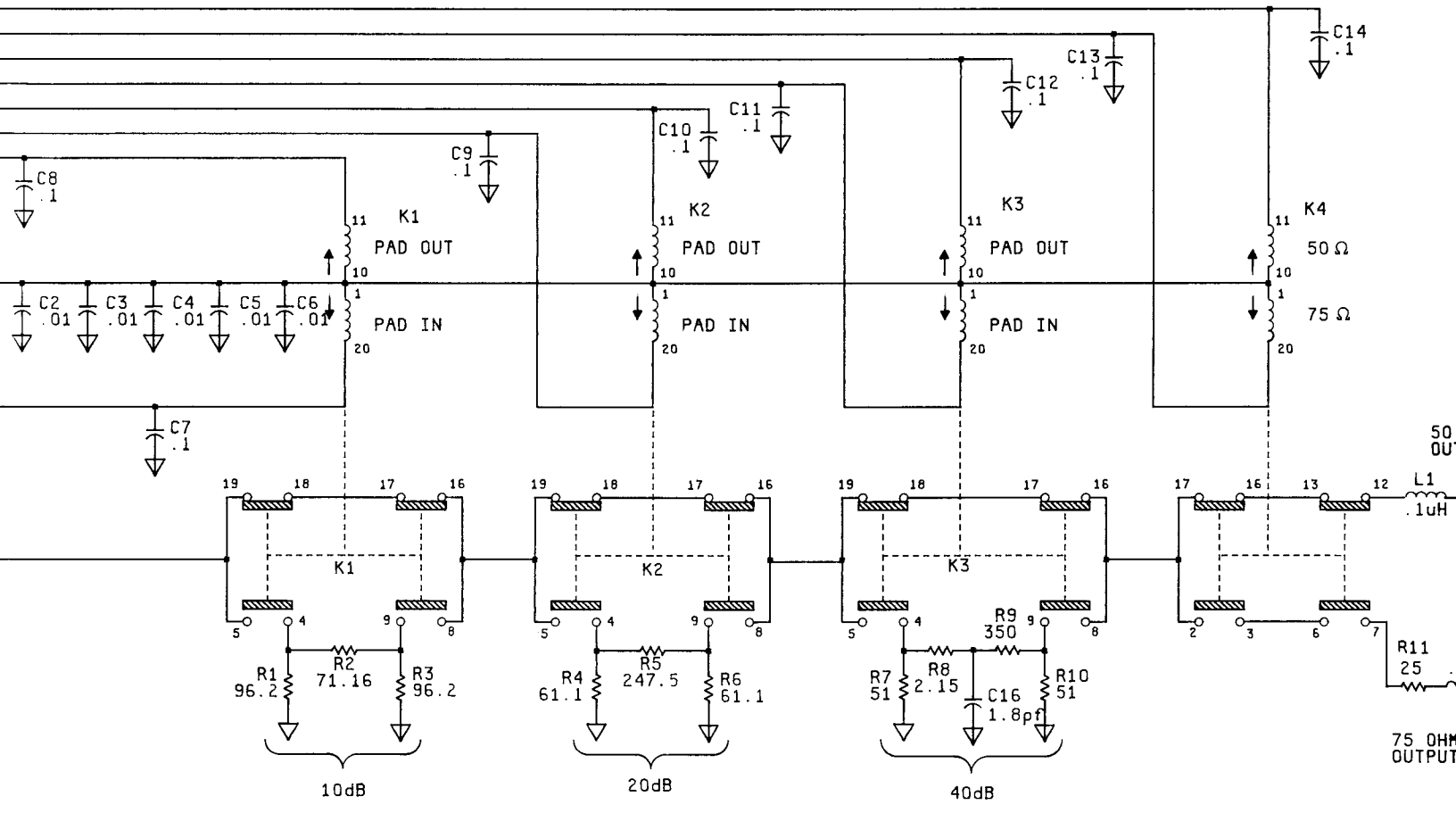
Figure 8-14. Relay Select Logic and Drivers, A4.



A7
03336-66507


A7
OUTPUT
ATTENUATOR
A4
J30
W30
J30
25 OUT
25 IN
40dB OUT
40dB IN
20dB OUT
20dB IN
10dB OUT
FROM RELAY
DRIVERS SCHEMATIC
+15VUNREG
10dB IN
C8
.1
K1
PAD OUT
PAD IN
C1
.1
C2
.01
C3
.01
C4
.01
C5
.01
C6
.01
C7
.1
10Hz-20MHz
J40
W40
J40
0Hz-20MHz
FROM
OUTPUT
AMPLIFIER
R1
96.2
R2
71.16
R3
96.2
10dB

TOR


C14 .1
C13 .1
C12 .1
C11 .1
C10 .1
C9 .1
C8 .1
K1
K2
K3
K4
PAD OUT
PAD IN
50 Ω
75 Ω
C2 .01
C3 .01
C4 .01
C5 .01
C6 .01
C7 .1
L1 .1uH
R1 96.2
R2 71.16
R3 96.2
R4 61.1
R5 247.5
R6 61.1
R7 51
R8 2.15
R9 350
R10 51
C16 1.8pf
R11 25
10dB
20dB
40dB
75 OHM OUTPUT

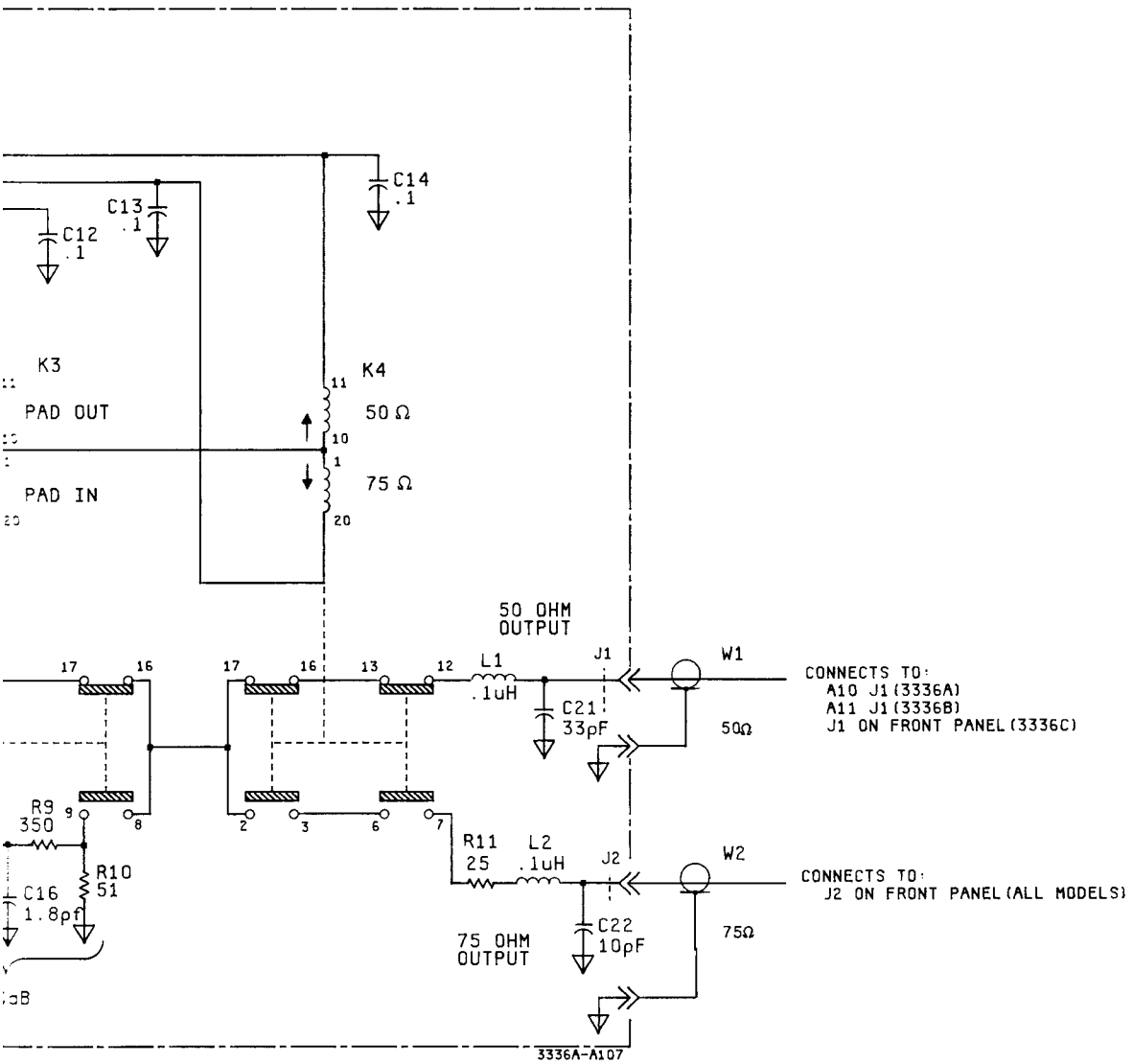
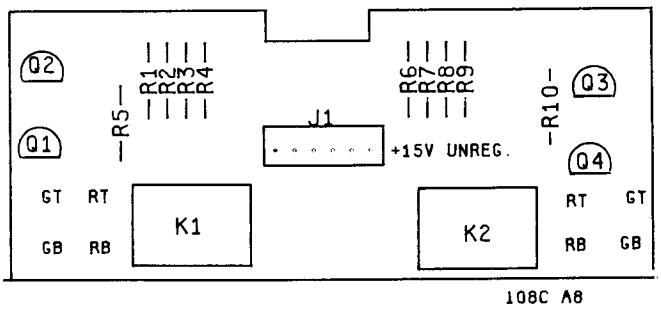
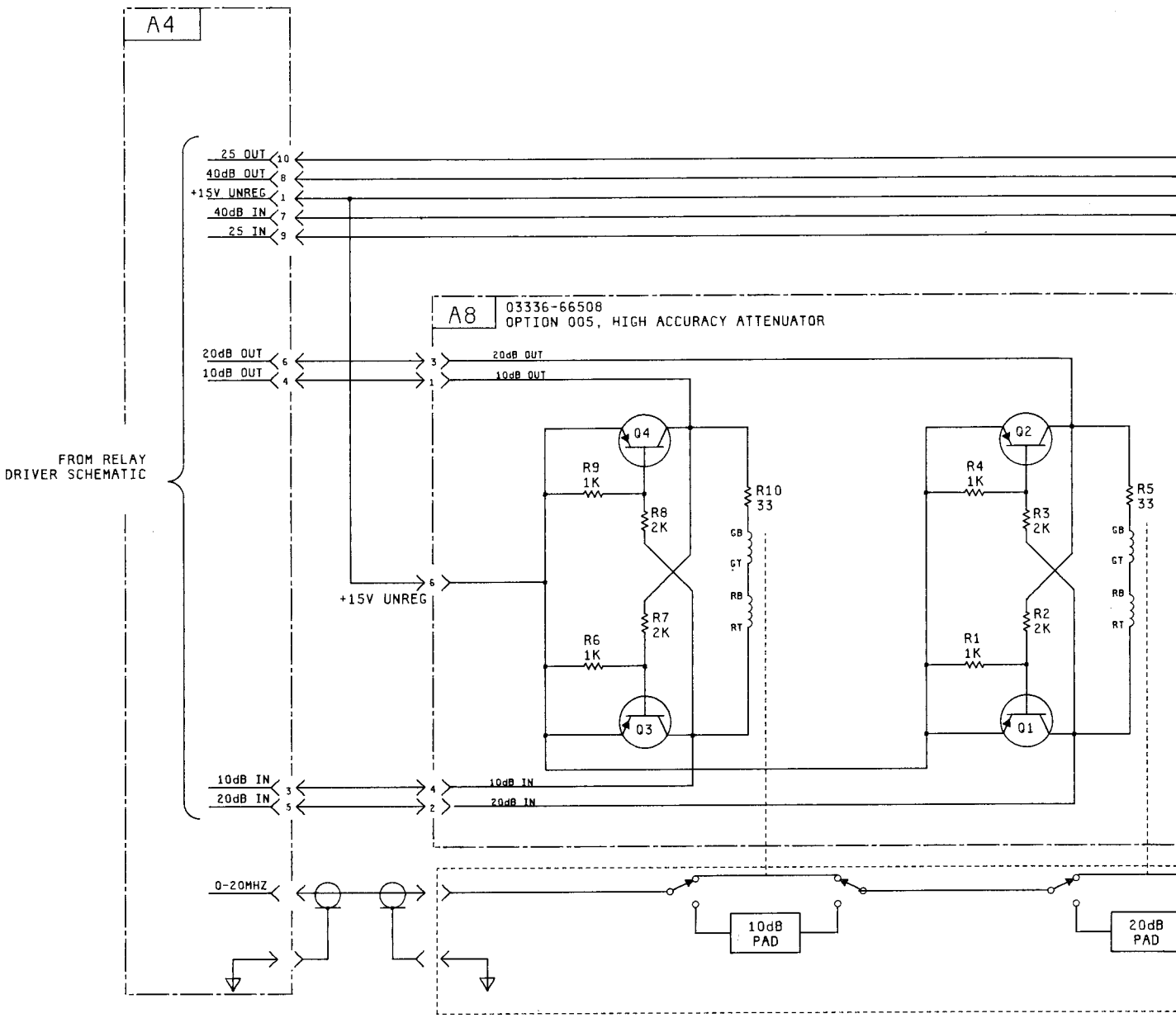
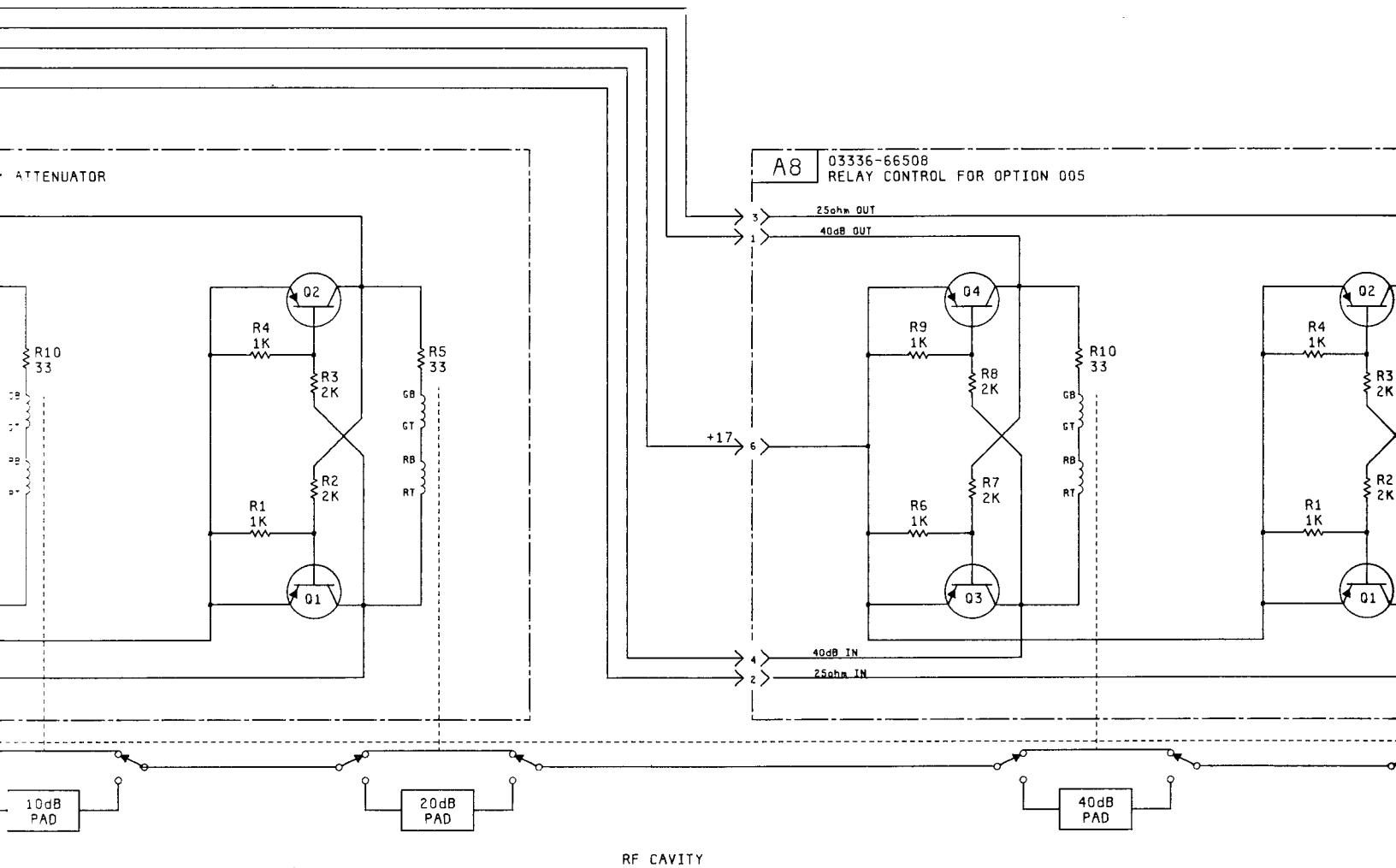


Figure 8-15. Attenuator, A7.



A8
03336-66508




ATTENUATOR
A8
03336-66508
RELAY CONTROL FOR OPTION 005
25ohm OUT
40dB OUT
+17
40dB IN
25ohm IN
R10
33
R4
1K
R3
2K
R2
2K
R1
1K
R5
33
R9
1K
R8
2K
R7
2K
R6
1K
Q1
Q2
Q3
Q4
GB
GT
RB
RT
10dB
PAD
20dB
PAD
40dB
PAD
RF CAVITY

ARD CO.

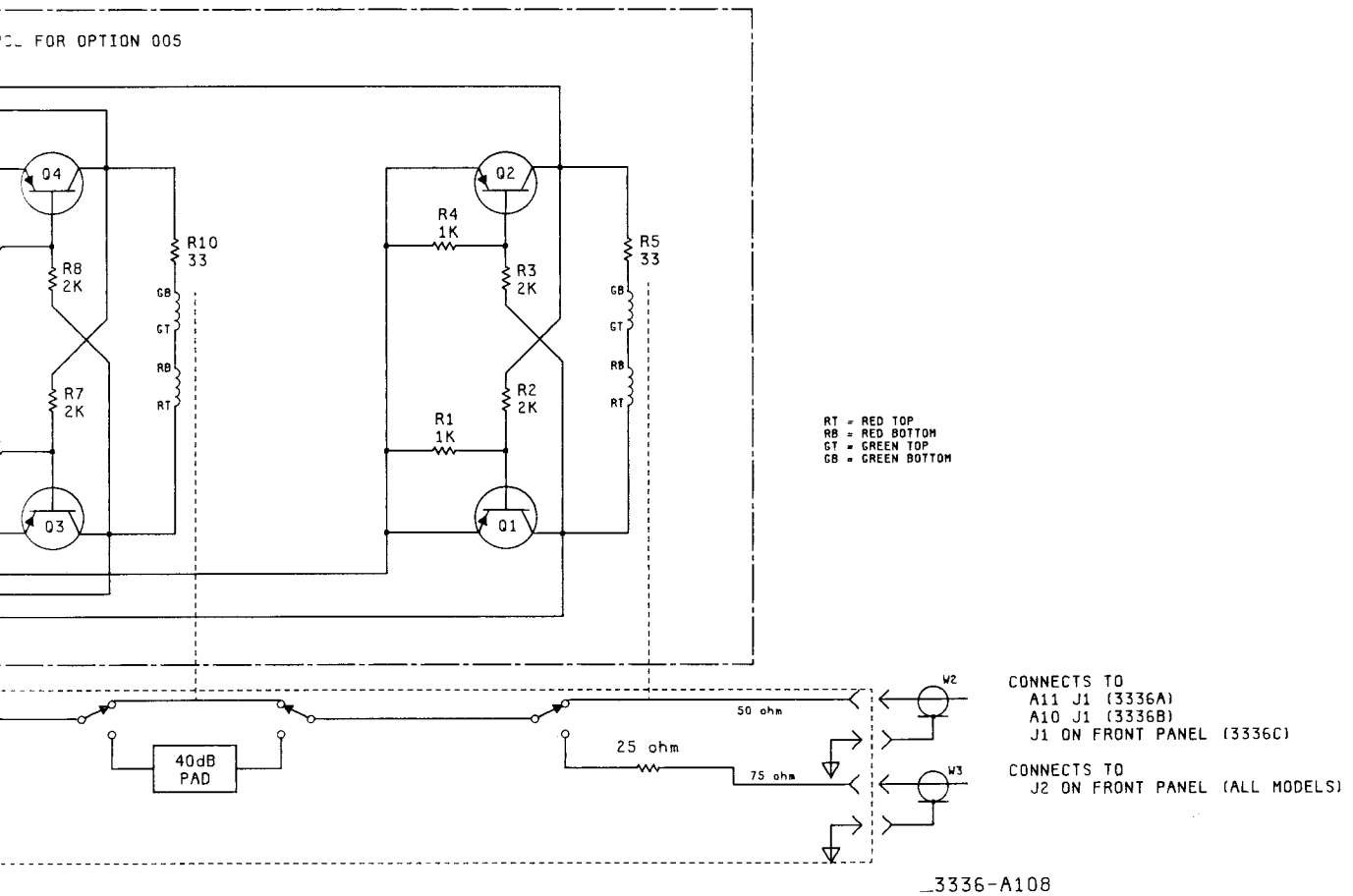
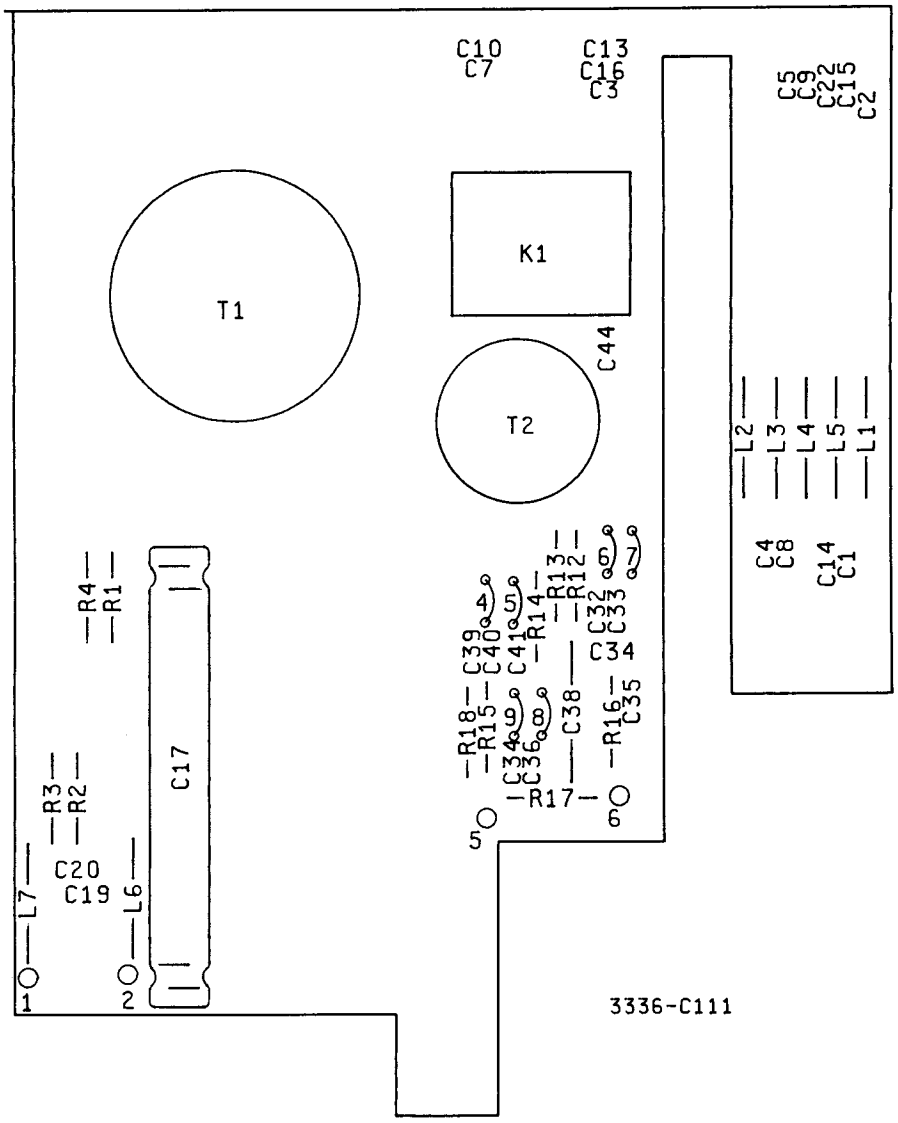
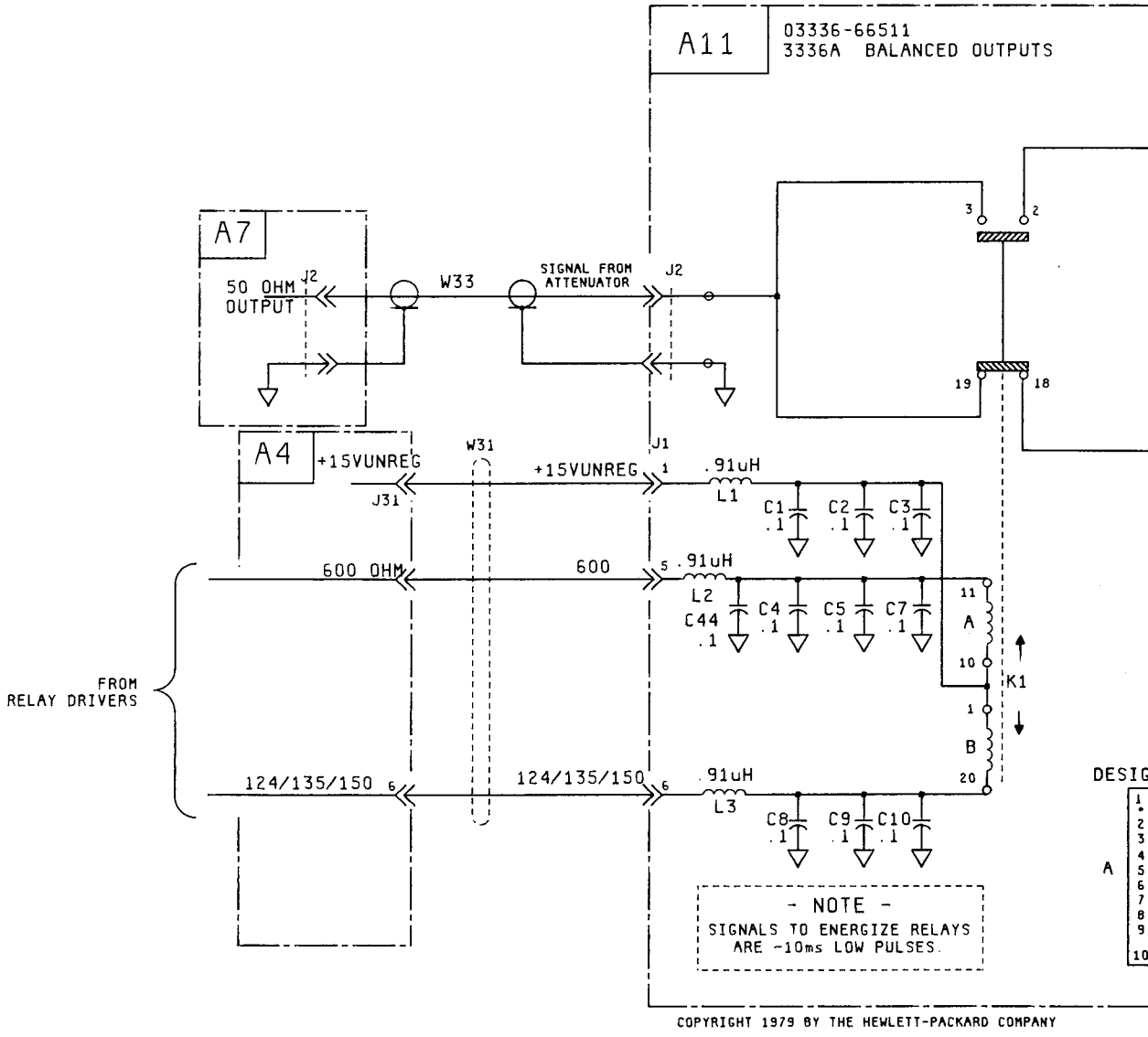


Figure 8-16. High Accuracy Attenuator Option 005, A8.

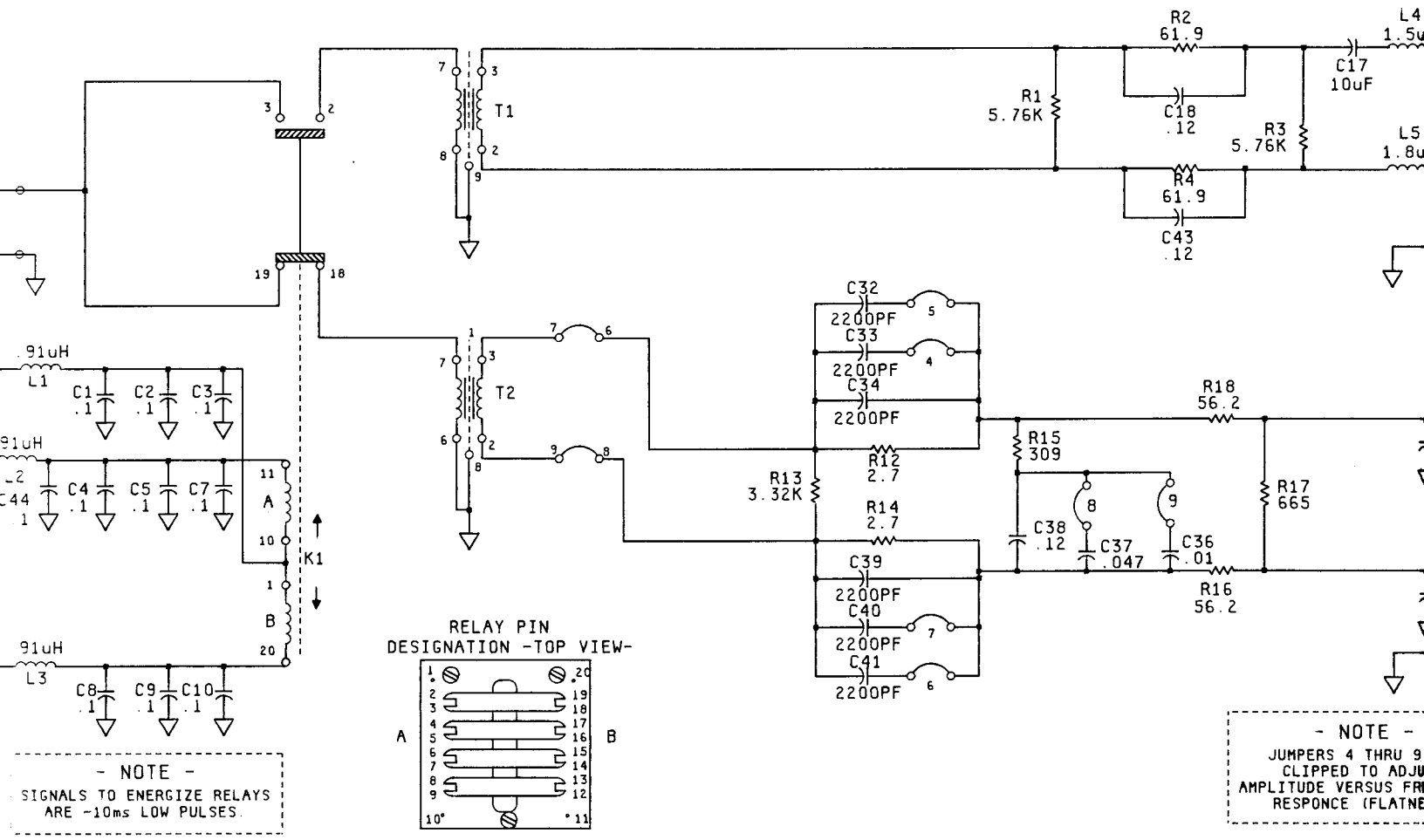


A11
03336-66511



A11

03336-66511
3336A BALANCED OUTPUTS



RELAY PIN
DESIGNATION -TOP VIEW-

- NOTE -
SIGNALS TO ENERGIZE RELAYS
ARE ~10ms LOW PULSES.

- NOTE -
JUMPERS 4 THRU 9
CLIPPED TO ADJU
AMPLITUDE VERSUS FR
RESPONCE (FLATNE

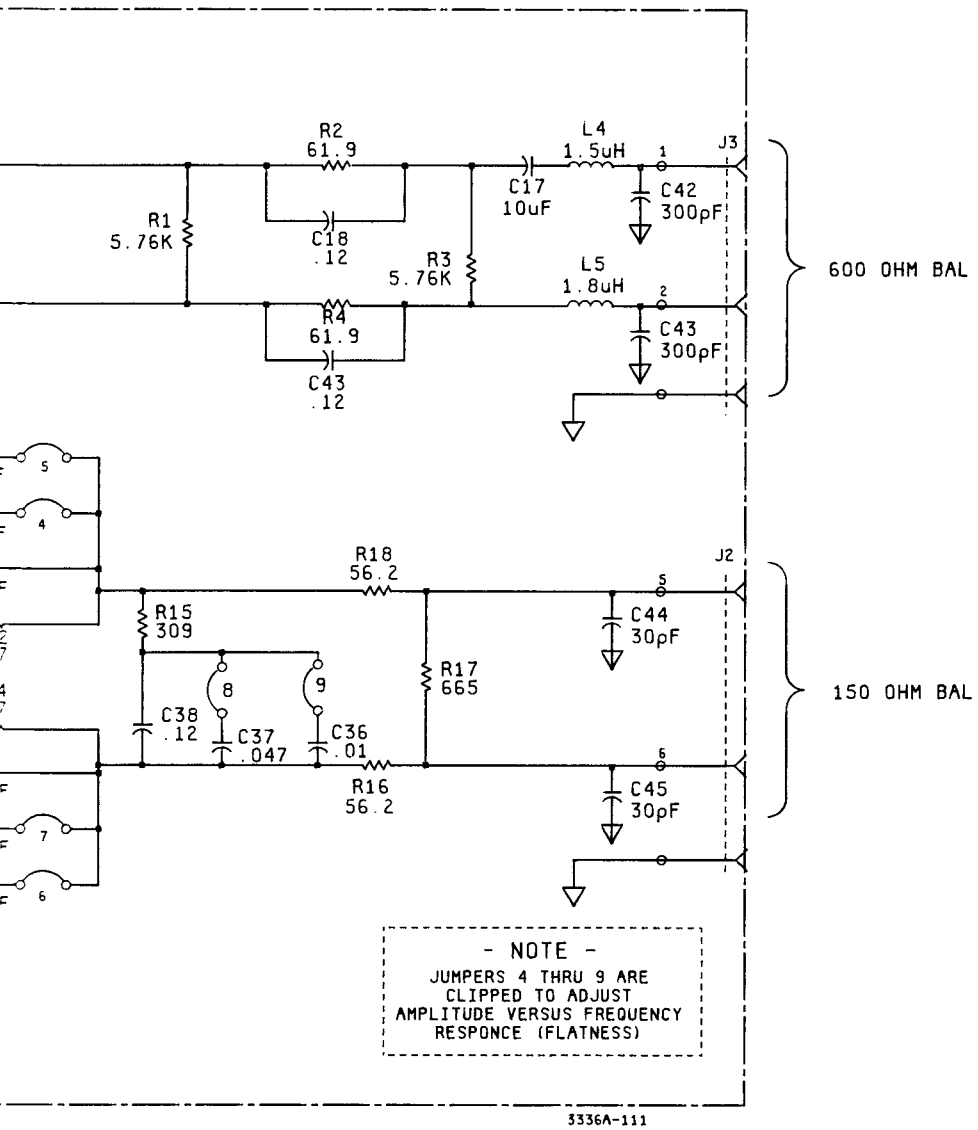
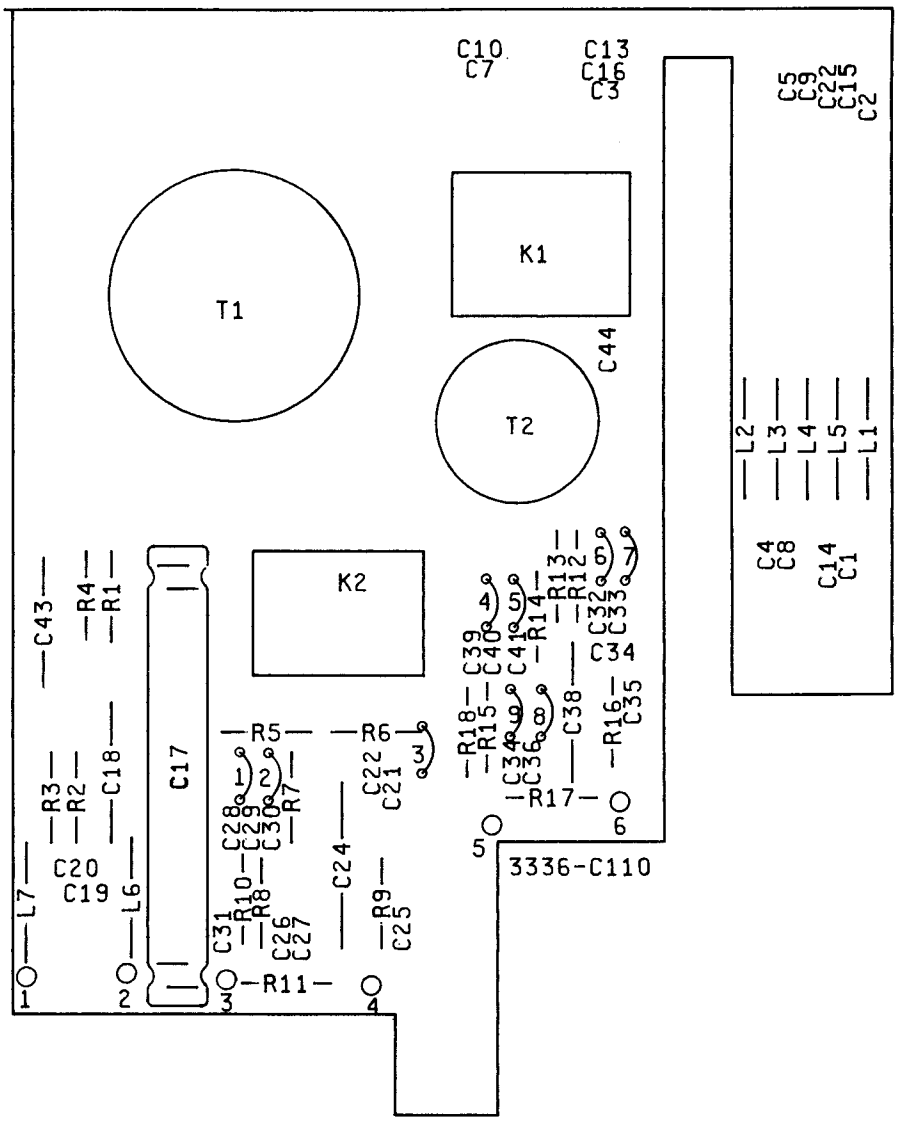
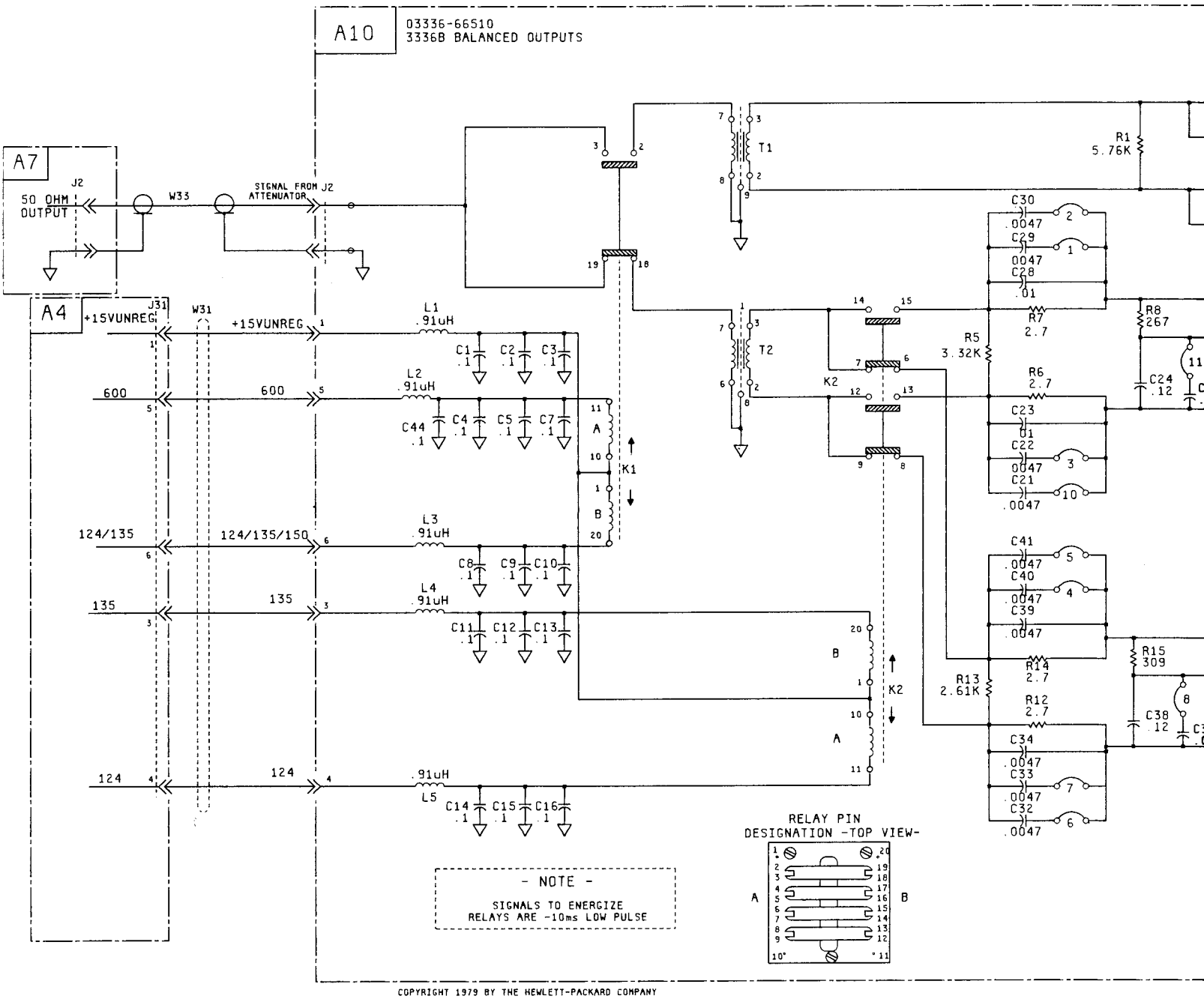


Figure 8-17. 3336A Balanced Outputs, A11.



A10
03336-66510



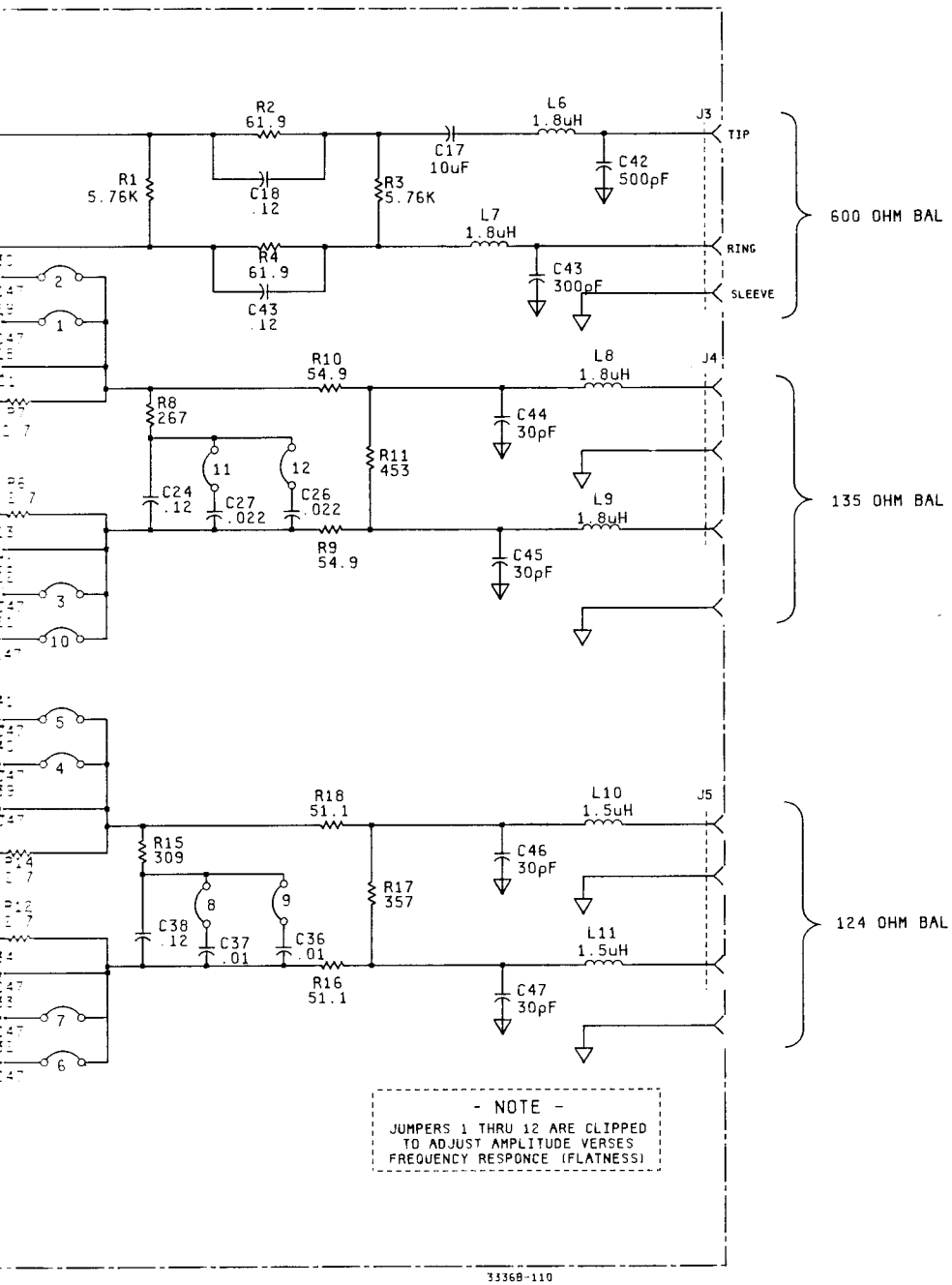
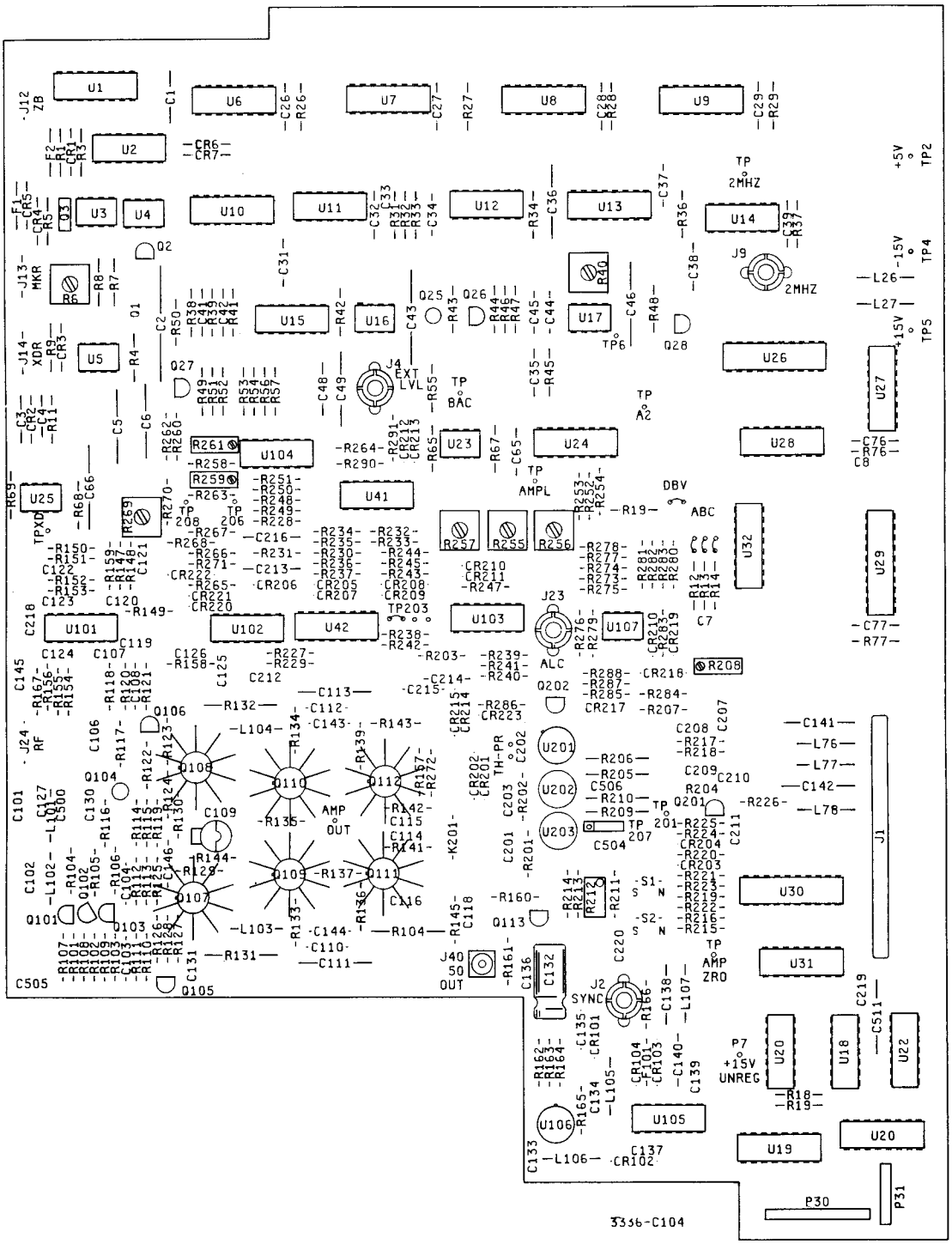
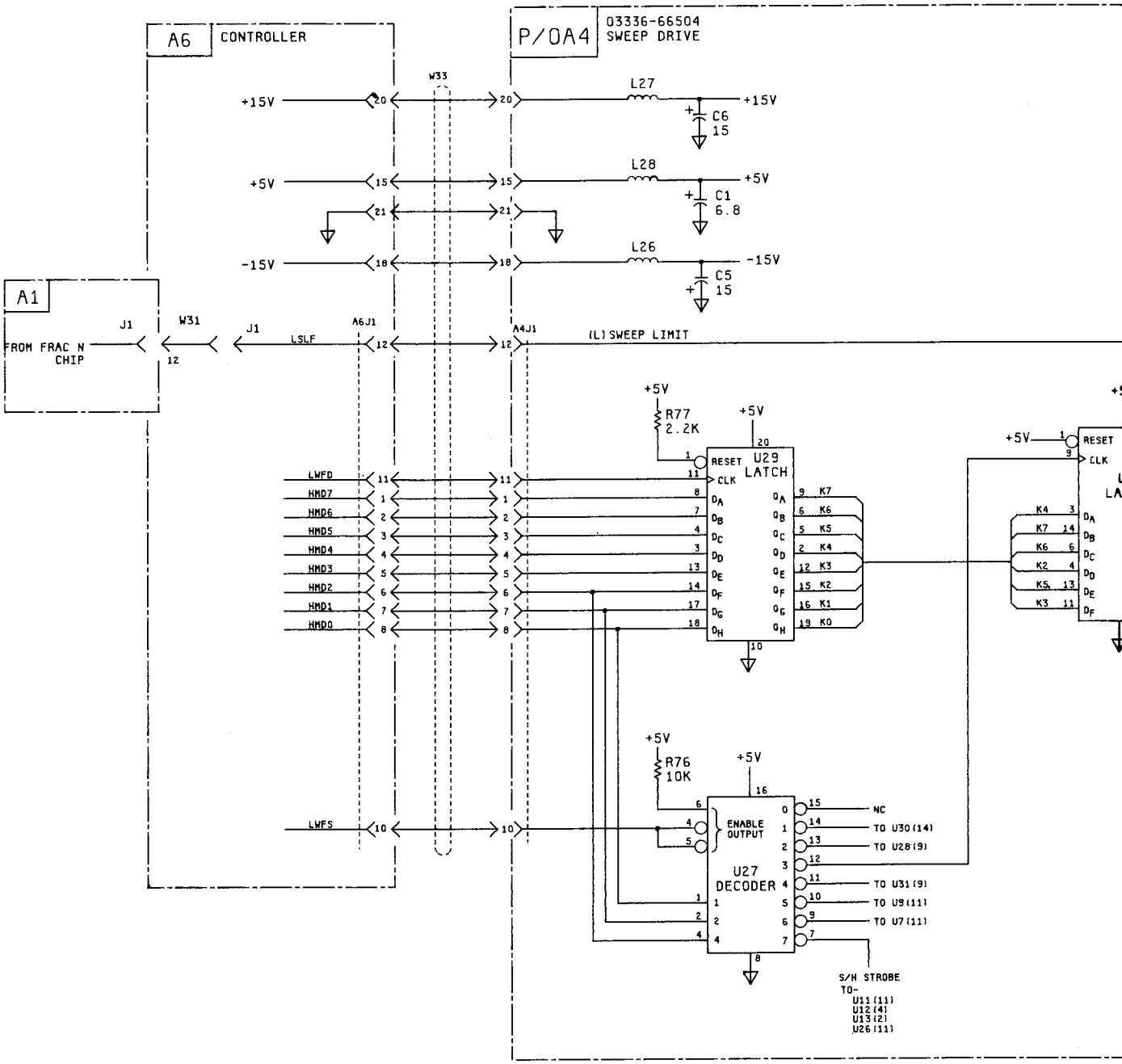
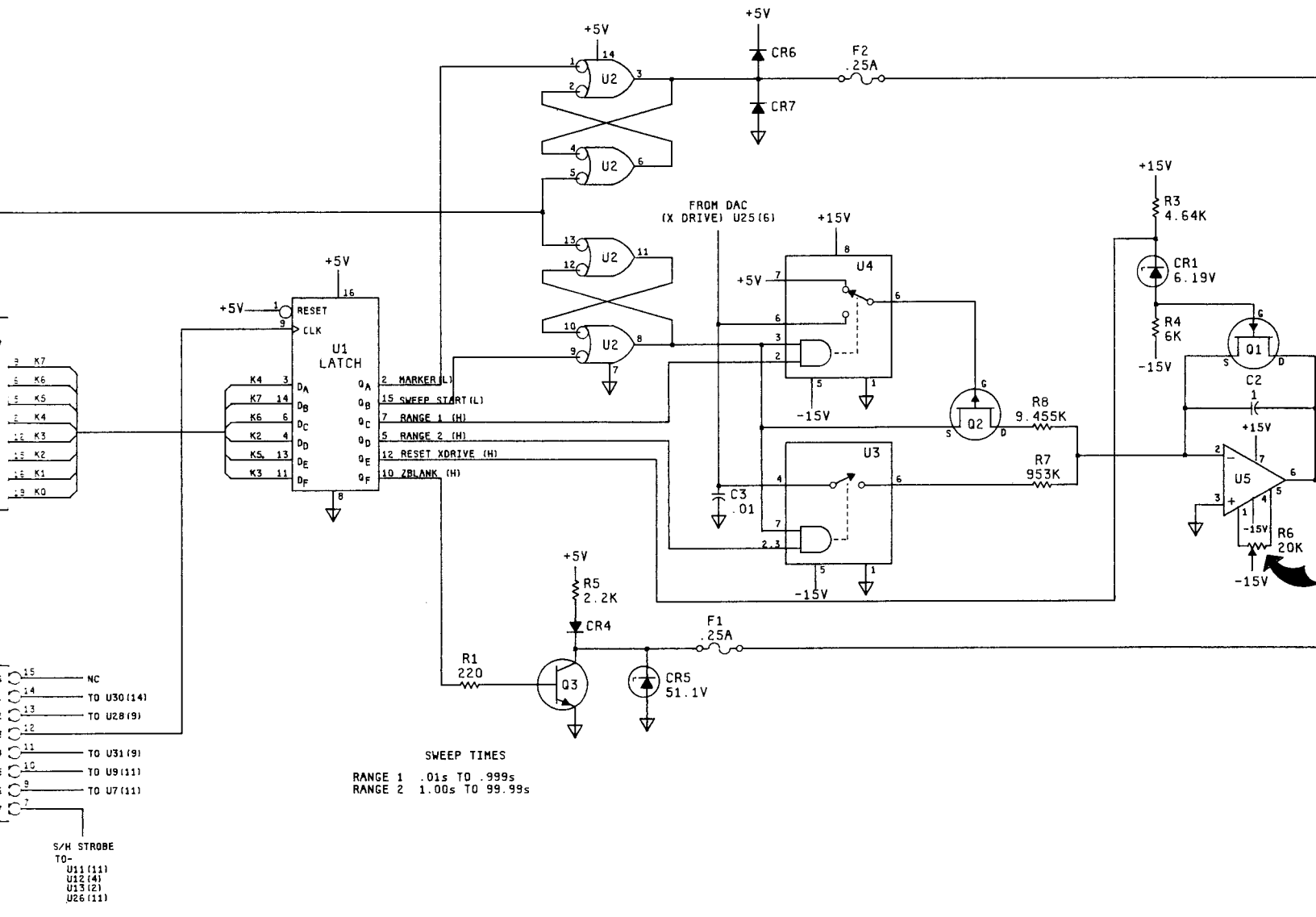


Figure 8-18. 3336B Balanced Outputs, A10.



A4
03336-66504


A6 CONTROLLER
P/OA4 03336-66504 SWEEP DRIVE
A1
FROM FRAC N CHIP
J1
W31
12
J1
LSLF
A6J1
A4J1
(L) SWEEP LIMIT
W33
+15V
-15V
+5V
L27
L28
L26
C6 15
C1 6.8
C5 15
R77 2.2K
R76 10K
U29 LATCH
RESET
CLK
LWFD
HMD7
HMD6
HMD5
HMD4
HMD3
HMD2
HMD1
HMD0
LWFS
K7
K6
K5
K4
K3
K2
K1
K0
U27 DECODER
ENABLE OUTPUT
NC
TO U30(14)
TO U28(9)
TO U31(9)
TO U9(11)
TO U7(11)
S/H STROBE TO-
U11(11)
U12(4)
U13(2)
U26(11)



SWEEP TIMES

RANGE 1 .01s TO .999s
RANGE 2 1.00s TO 99.99s

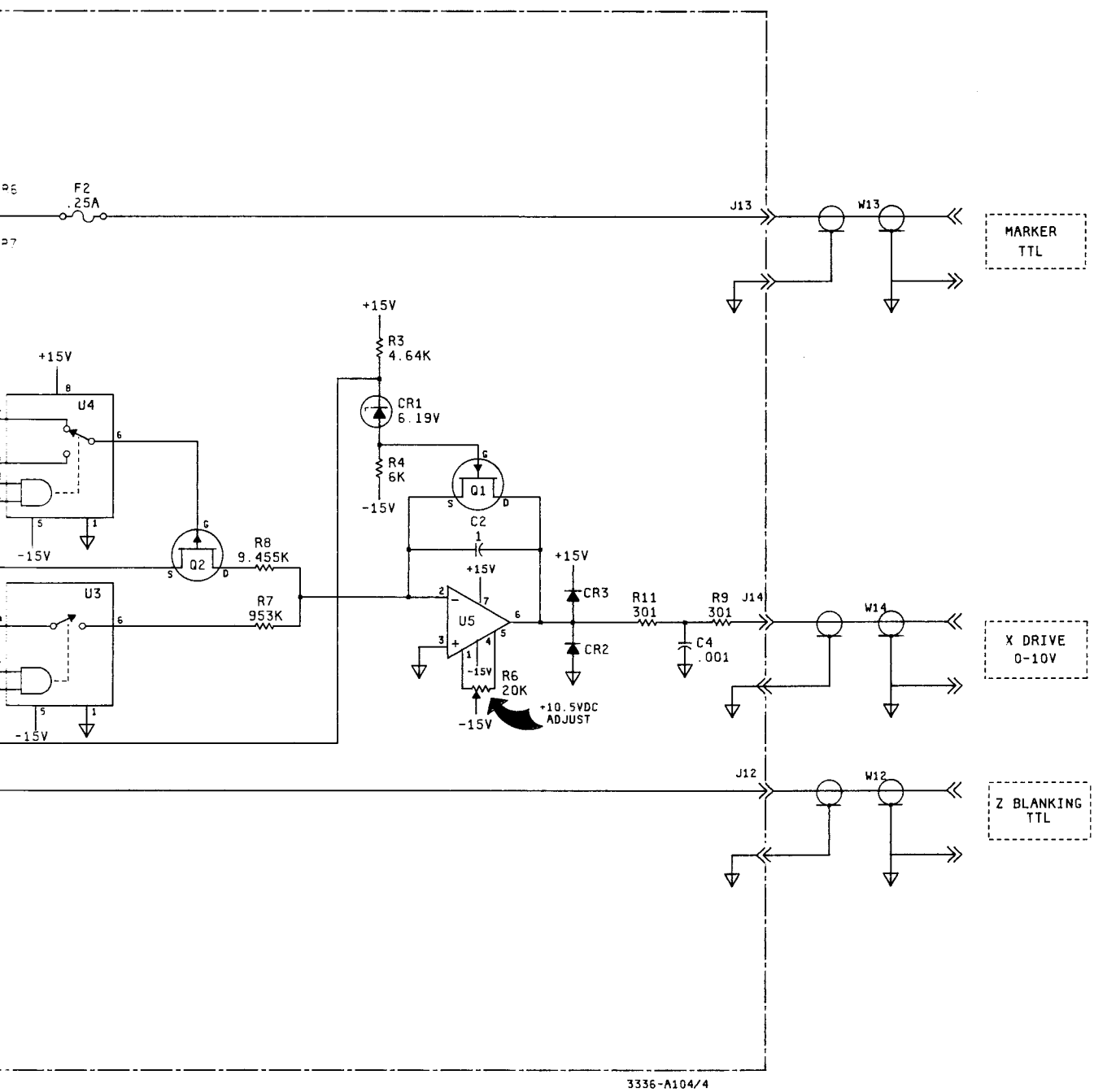
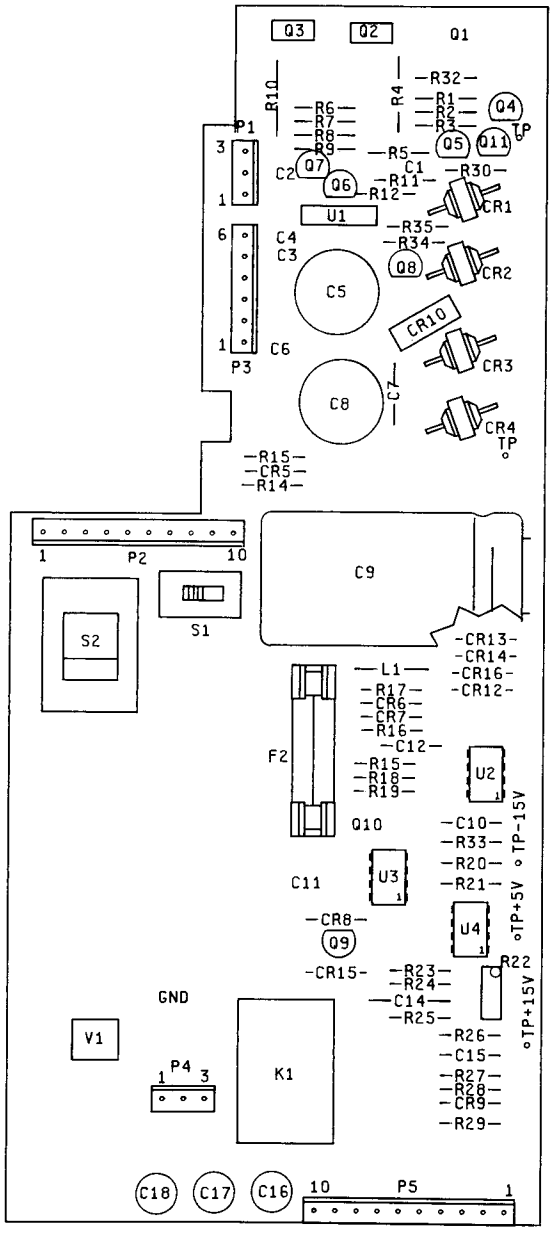
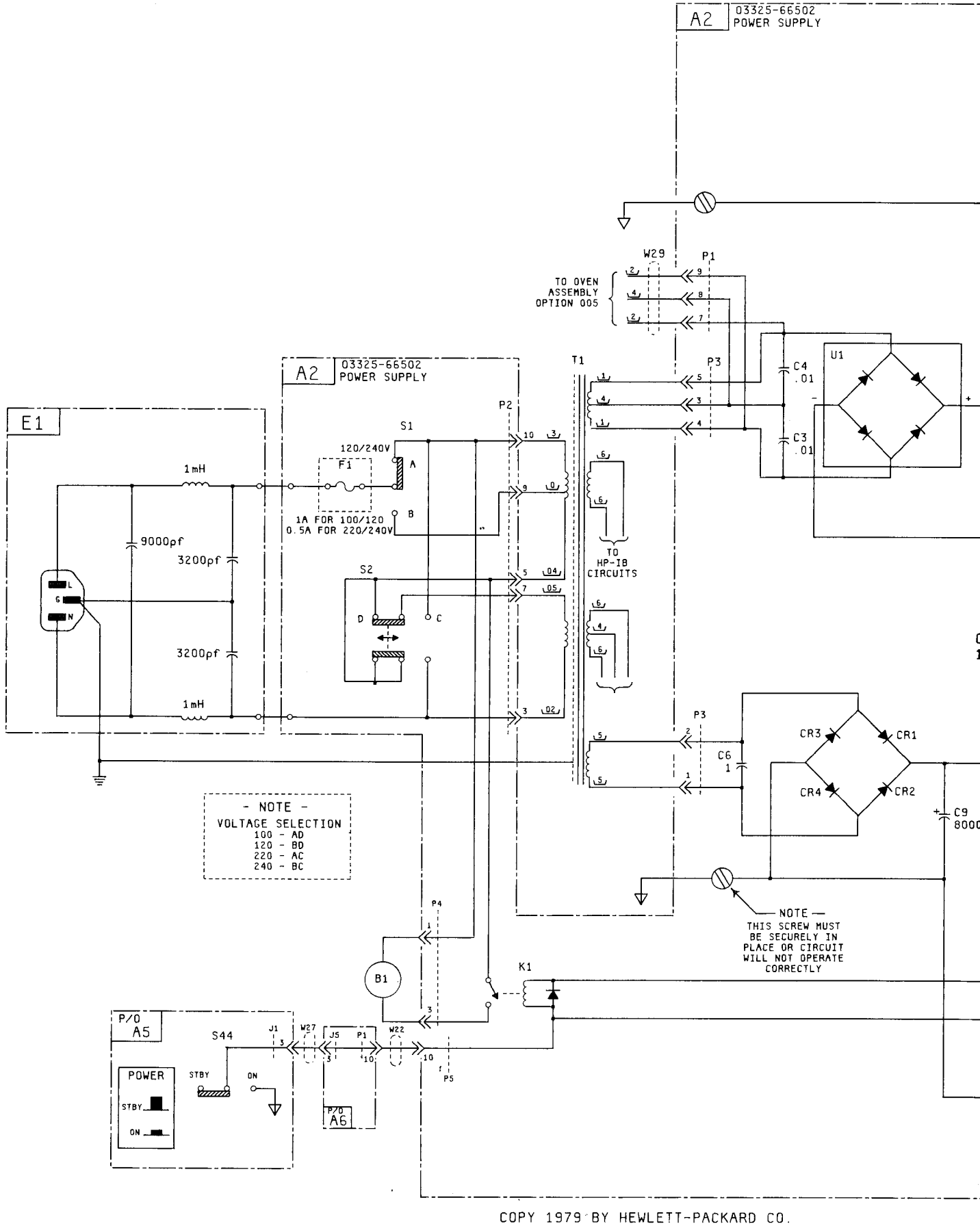


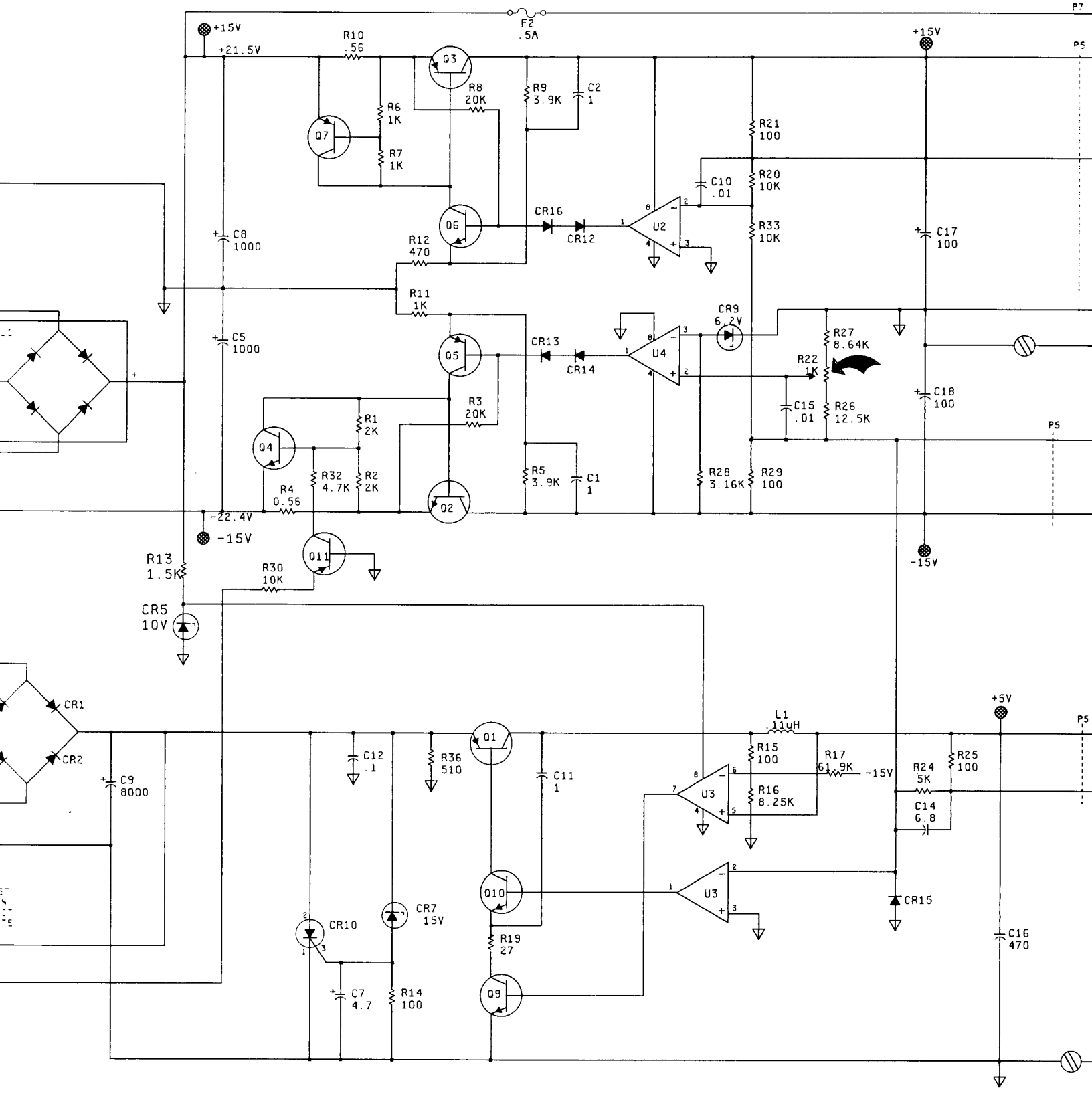
Figure 8-19. Sweep Drive Circuits, A4.



3336A-102C

A2
03325-66502




+15V
+21.5V
F2
.5A
P7
P5
R10
.56
Q3
R8
20K
R9
3.9K
C2
1
R6
1K
Q7
R7
1K
R21
100
C10
.01
R20
10K
Q6
CR16
CR12
U2
R33
10K
C17
100
C8
1000
R12
470
R11
1K
CR9
6.2V
C5
1000
Q5
CR13
CR14
U4
R27
8.64K
R22
1K
C15
.01
R26
12.5K
C18
100
R3
20K
R1
2K
Q4
R32
4.7K
R2
2K
R4
0.56
R5
3.9K
C1
1
R28
3.16K
R29
100
Q2
-22.4V
-15V
Q11
R13
1.5K
R30
10K
CR5
10V
CR1
CR2
C9
8000
C12
.1
R36
510
Q1
C11
1
L1
.11uH
R15
100
R17
61.9K
U3
R16
8.25K
R24
5K
C14
6.8
R25
100
+5V
Q10
CR10
CR7
15V
R19
27
U3
CR15
C16
470
C7
4.7
R14
100
Q9

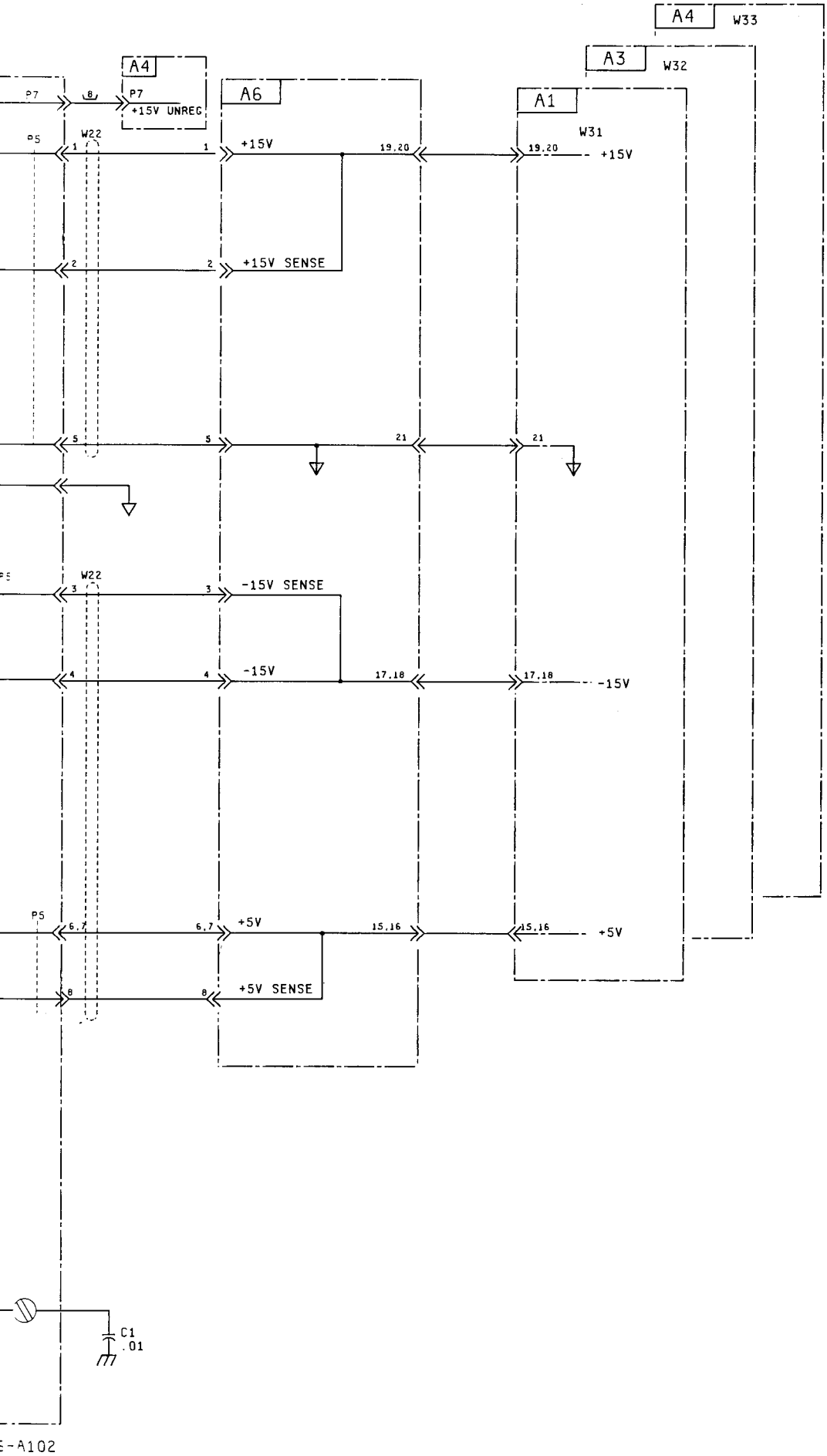
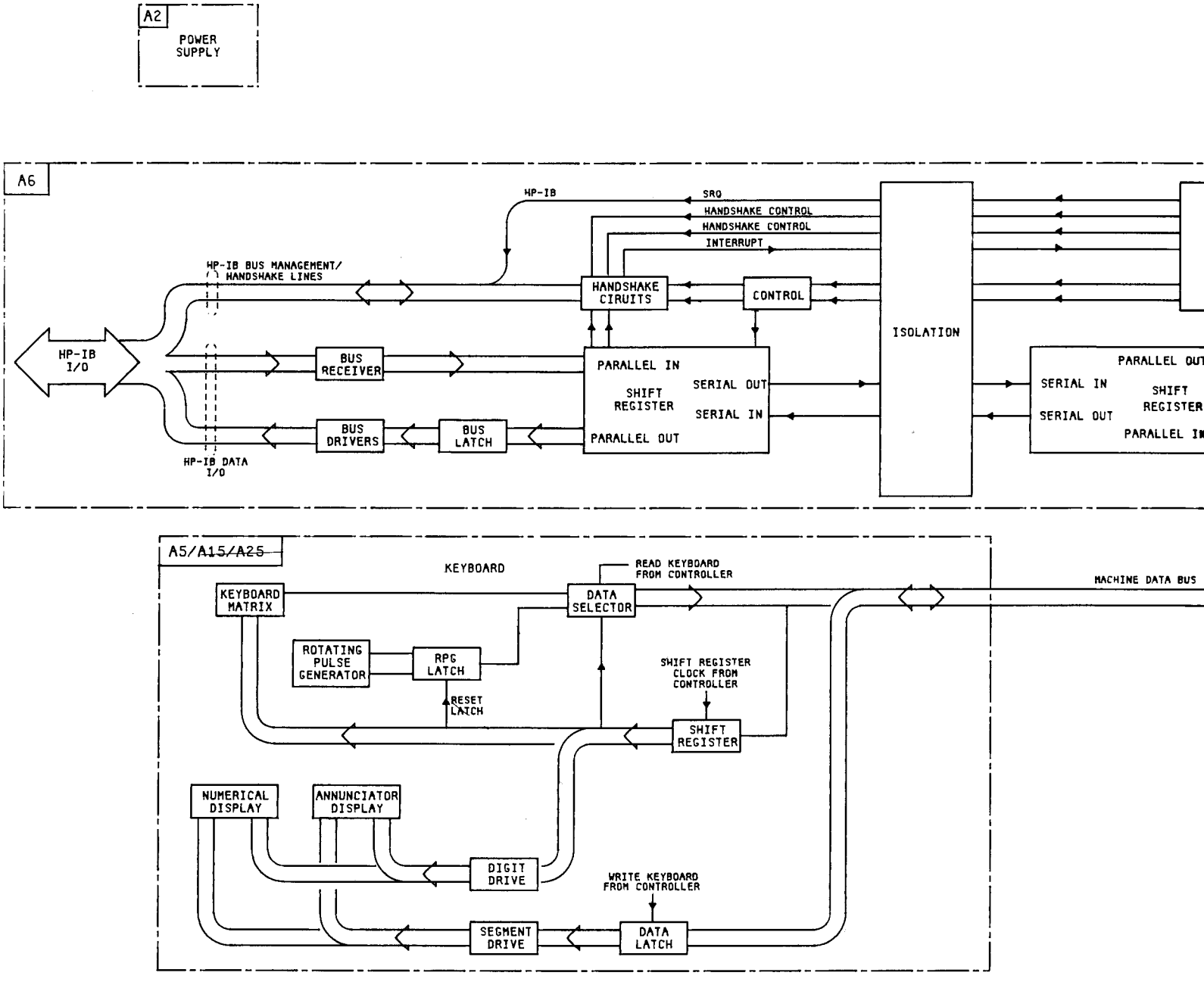
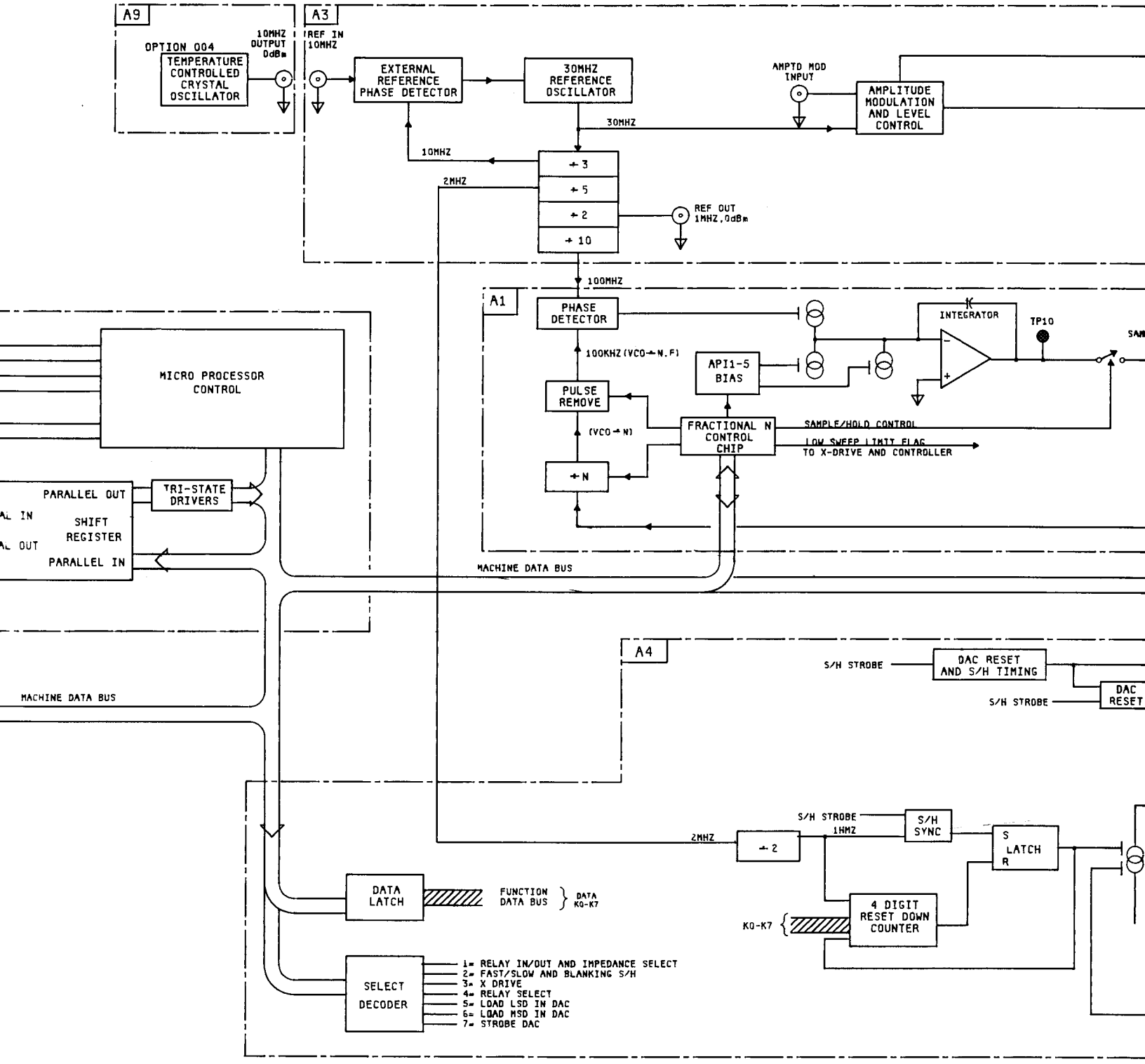
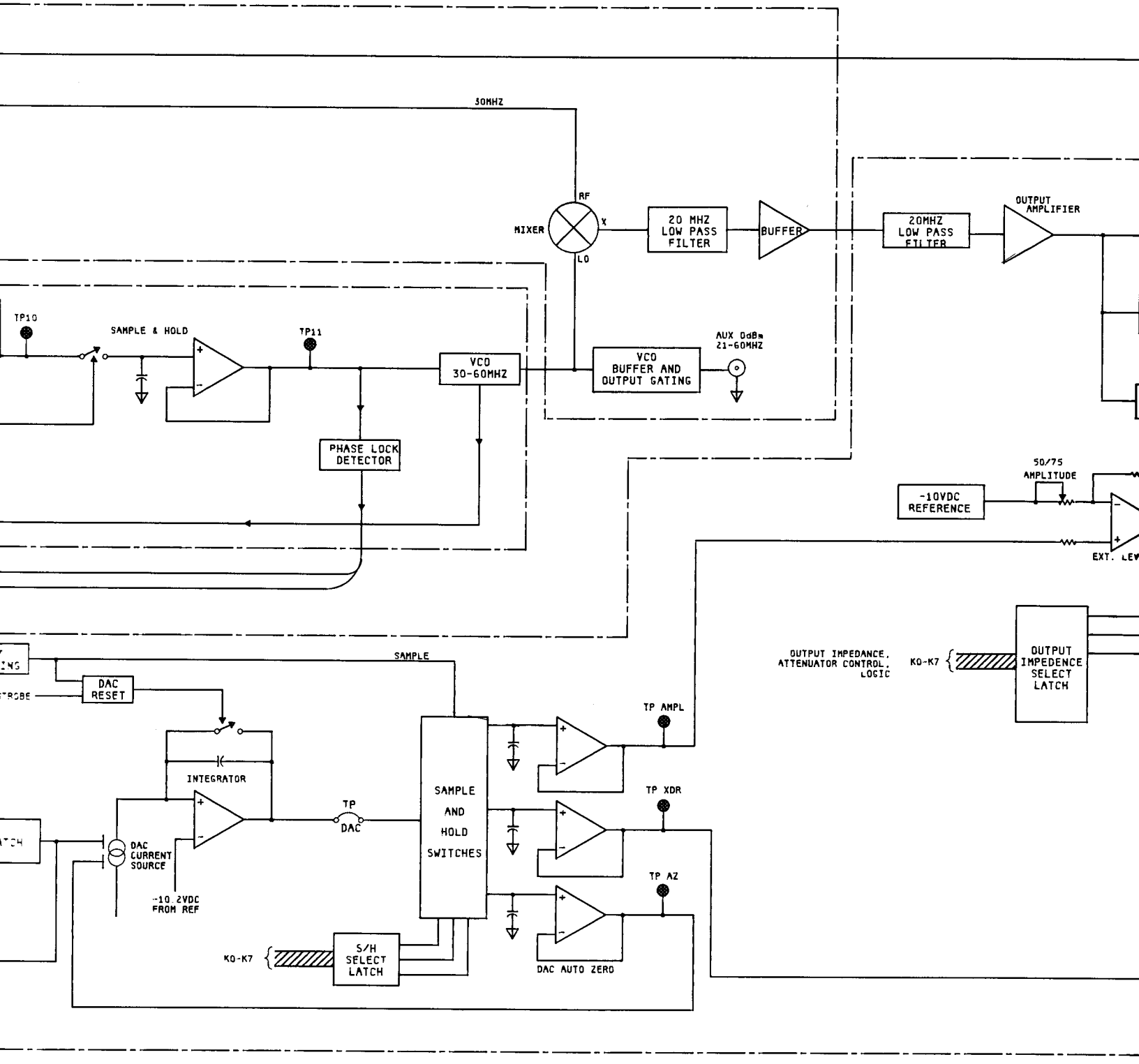
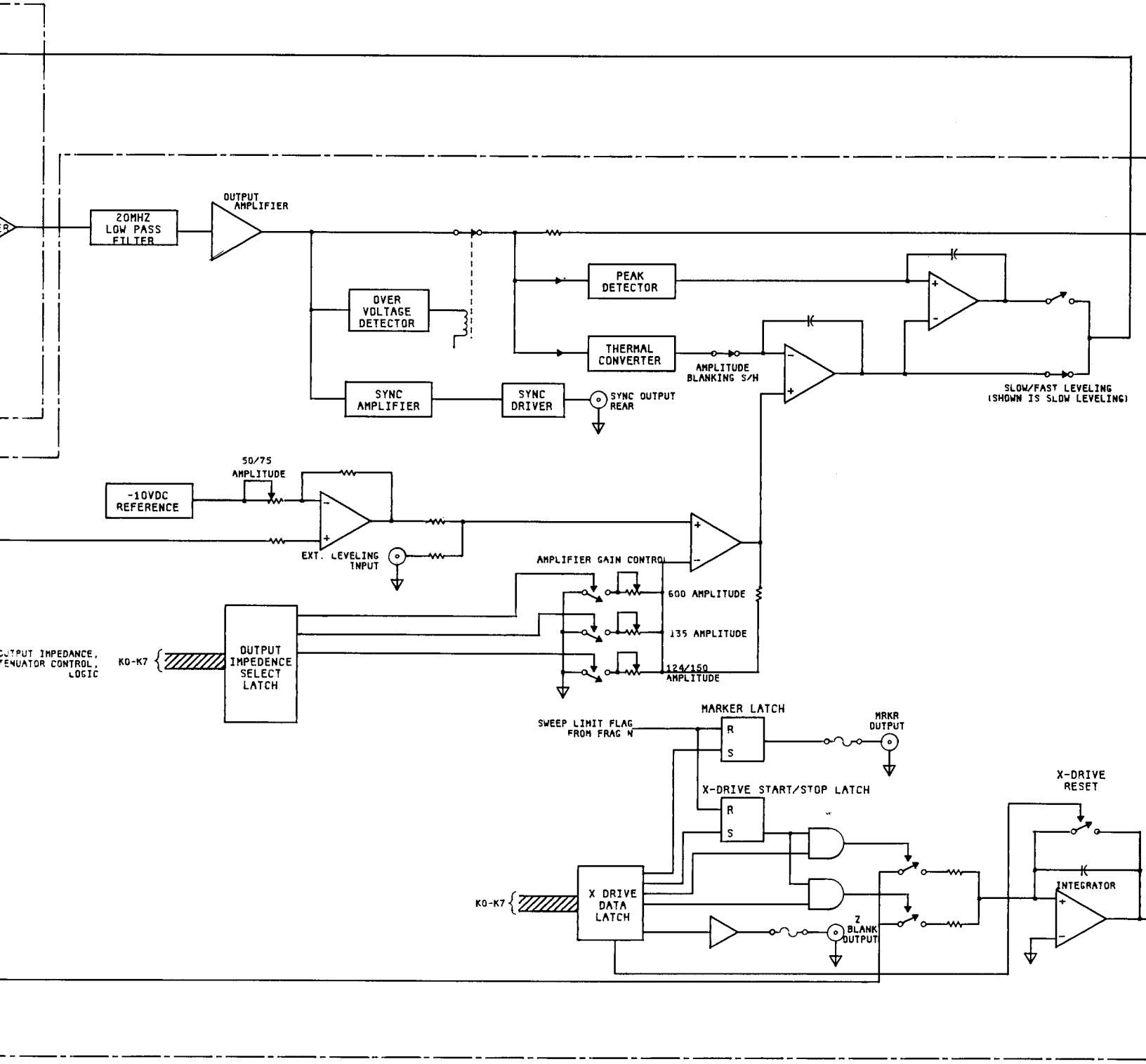


Figure 8-20. Power Supply, A2.


A2
POWER SUPPLY
A6
HP-IB
SRQ
HANDSHAKE CONTROL
HANDSHAKE CONTROL
INTERRUPT
HP-IB BUS MANAGEMENT/ HANDSHAKE LINES
HANDSHAKE CIRUITS
CONTROL
ISOLATION
HP-IB I/O
BUS RECEIVER
PARALLEL IN
SHIFT REGISTER
SERIAL OUT
SERIAL IN
PARALLEL OUT
BUS DRIVERS
BUS LATCH
HP-IB DATA I/O
SERIAL IN
SERIAL OUT
SHIFT REGISTER
A5/A15/A25
KEYBOARD
READ KEYBOARD FROM CONTROLLER
MACHINE DATA BUS
KEYBOARD MATRIX
DATA SELECTOR
ROTATING PULSE GENERATOR
RPG LATCH
RESET LATCH
SHIFT REGISTER CLOCK FROM CONTROLLER
SHIFT REGISTER
NUMERICAL DISPLAY
ANNUNCIATOR DISPLAY
DIGIT DRIVE
WRITE KEYBOARD FROM CONTROLLER
SEGMENT DRIVE
DATA LATCH


A9
OPTION 004
TEMPERATURE CONTROLLED CRYSTAL OSCILLATOR
10MHZ OUTPUT 0dBm
A3
REF IN 10MHZ
EXTERNAL REFERENCE PHASE DETECTOR
30MHZ REFERENCE OSCILLATOR
AMPTD MOD INPUT
AMPLITUDE MODULATION AND LEVEL CONTROL
30MHZ
10MHZ
2MHZ
÷ 3
÷ 5
÷ 2
÷ 10
REF OUT 1MHZ, 0dBm
100MHZ
A1
PHASE DETECTOR
INTEGRATOR
TP10
100KHZ (VCO ÷ N, F)
API1-5 BIAS
PULSE REMOVE
(VCO ÷ N)
FRACTIONAL N CONTROL CHIP
SAMPLE/HOLD CONTROL
LOW SWEEP LIMIT FLAG
TO X-DRIVE AND CONTROLLER
÷ N
MICRO PROCESSOR CONTROL
PARALLEL OUT
SHIFT REGISTER
PARALLEL IN
TRI-STATE DRIVERS
MACHINE DATA BUS
MACHINE DATA BUS
A4
S/H STROBE
DAC RESET AND S/H TIMING
DAC RESET
S/H STROBE
S/H STROBE
1HMZ
S/H SYNC
2MHZ
÷ 2
S LATCH R
DATA LATCH
FUNCTION DATA BUS
DATA K0-K7
K0-K7
4 DIGIT RESET DOWN COUNTER
SELECT DECODER
1= RELAY IN/OUT AND IMPEDANCE SELECT
2= FAST/SLOW AND BLANKING S/H
3= X DRIVE
4= RELAY SELECT
5= LOAD LSD IN DAC
6= LOAD MSD IN DAC
7= STROBE DAC


30MHZ
RF
MIXER
X
LO
20 MHZ LOW PASS FILTER
BUFFER
20MHZ LOW PASS FILTER
OUTPUT AMPLIFIER
TP10
SAMPLE & HOLD
TP11
VCO 30-60MHZ
VCO BUFFER AND OUTPUT GATING
AUX 0dBm 21-60MHZ
PHASE LOCK DETECTOR
50/75 AMPLITUDE
-10VDC REFERENCE
EXT. LEV
SAMPLE
DAC RESET
INTEGRATOR
TP DAC
DAC CURRENT SOURCE
-10.2VDC FROM REF
SAMPLE AND HOLD SWITCHES
TP AMPL
TP XDR
TP AZ
DAC AUTO ZERO
K0-K7
S/H SELECT LATCH
OUTPUT IMPEDANCE, ATTENUATOR CONTROL, LOGIC
K0-K7
OUTPUT IMPEDENCE SELECT LATCH


20MHZ LOW PASS FILTER
OUTPUT AMPLIFIER
OVER VOLTAGE DETECTOR
PEAK DETECTOR
THERMAL CONVERTER
AMPLITUDE BLANKING S/H
SLOW/FAST LEVELING (SHOWN IS SLOW LEVELING)
SYNC AMPLIFIER
SYNC DRIVER
SYNC OUTPUT REAR
50/75 AMPLITUDE
-10VDC REFERENCE
EXT. LEVELING INPUT
AMPLIFIER GAIN CONTROL
600 AMPLITUDE
135 AMPLITUDE
124/150 AMPLITUDE
OUTPUT IMPEDANCE, ATTENUATOR CONTROL, LOGIC
K0-K7
OUTPUT IMPEDENCE SELECT LATCH
MARKER LATCH
SWEEP LIMIT FLAG FROM FRAC N
MRKR OUTPUT
X-DRIVE START/STOP LATCH
X-DRIVE RESET
X DRIVE DATA LATCH
Z BLANK OUTPUT
INTEGRATOR

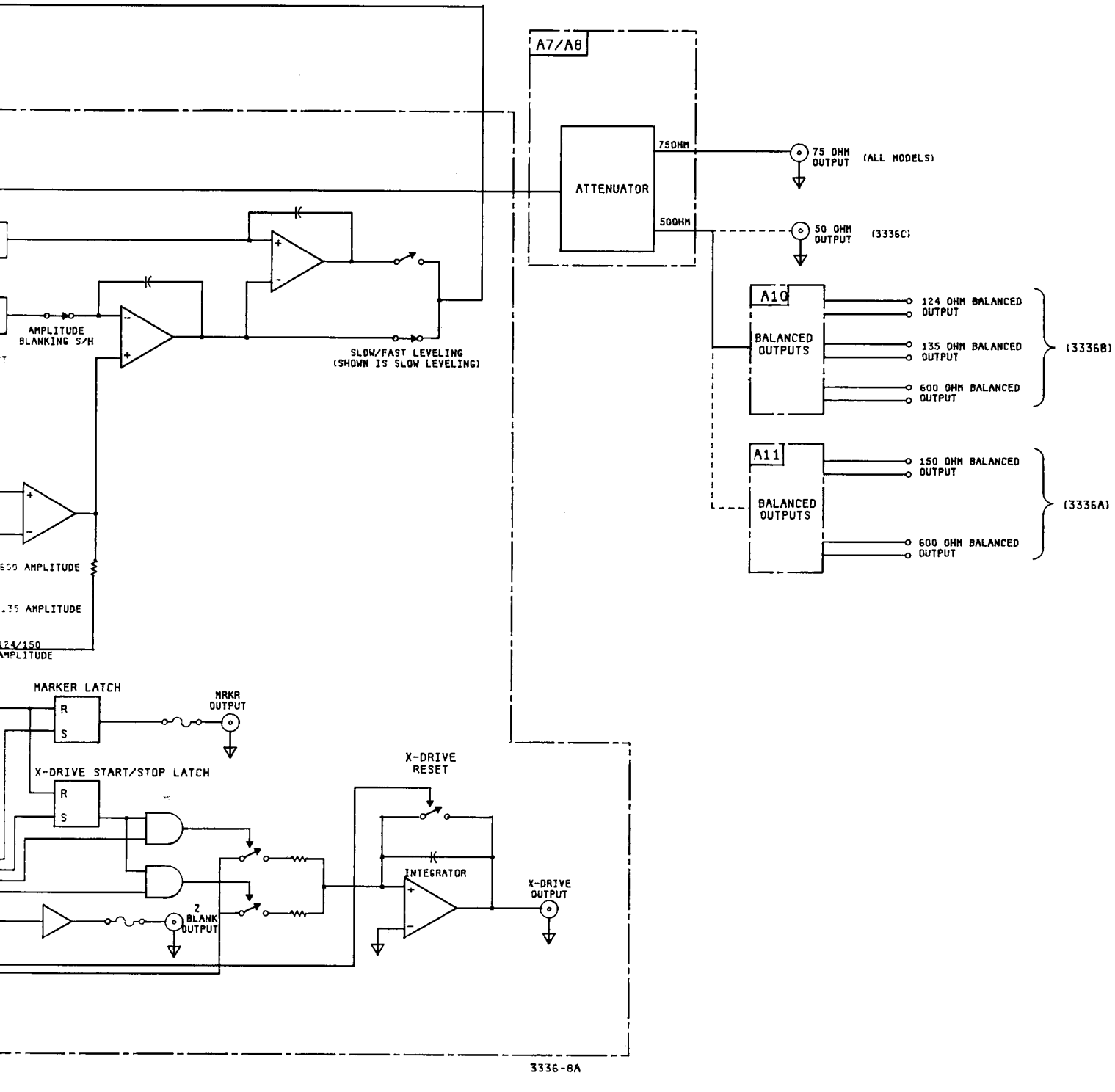


Figure 8-21. 3336A/B/C Block Diagram.