6062A

SYNTHESIZED RF SIGNAL GENERATOR

Instruction Manual

PN 794842
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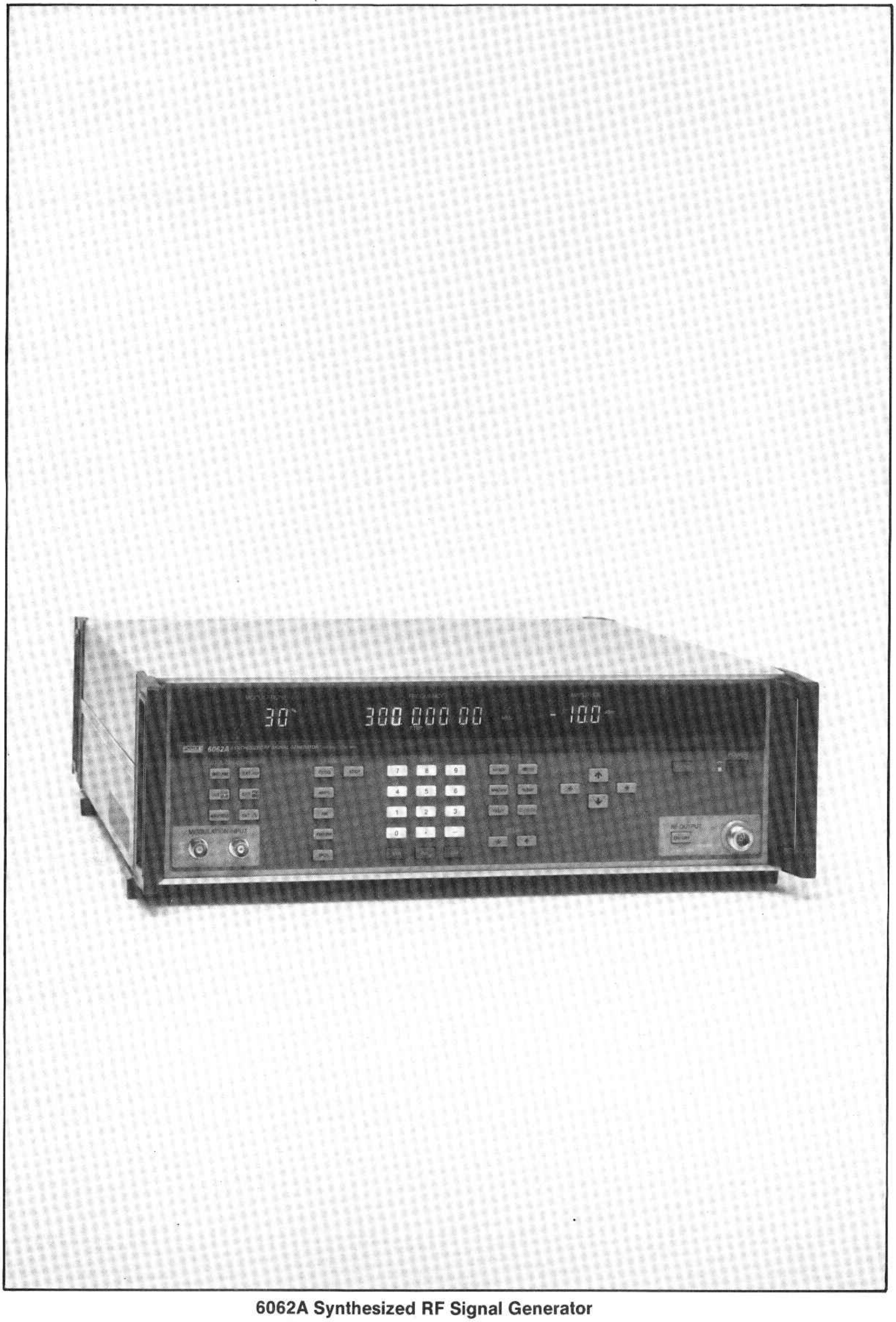


6062A Synthesized RF Signal Generator

Section 1
Introduction and Specifications

1-1. INTRODUCTION

The 6062A Synthesized RF Signal Generator (referred to as the Generator or instrument) is a fully-programmable, precision, synthesized signal generator. The Generator is designed for applications that require good modulation, frequency accuracy, and output level performance with moderate spectral purity. It is well suited for testing a wide variety of RF components and systems including filters, amplifiers, mixers, and radios, particularly on-channel radio testing.

1-2. UNPACKING THE GENERATOR

The shipping container should include a 6062A Synthesized RF Signal Generator, an Operator Information Card, a Getting Started Manual, an Instruction Manual, a line power cord and two BNC dust caps. Any accessories ordered for the Generator are shipped in a separate container.

Section 2, Installation and Operation, gives instructions on inspecting the new Generator and explains what to do if the instrument arrives with shipping damage. Reshipment information is also included.

1-3. SAFETY

This instruction manual contains information, warnings, and cautions that should be followed to ensure safe operation and to maintain the Generator in a safe condition.

The Generator is designed primarily for indoor use, and it may be operated in temperatures from 0 to 50°C without degradation of its safety.

WARNING

TO AVOID ELECTRIC SHOCK, USE A POWER CORD THAT HAS A THREE-PRONG PLUG. IF A PROPER POWER CORD IS NOT USED, THE 6062A CASE CAN DEVELOP AN ELECTRICAL POTENTIAL ABOVE EARTH GROUND.

CAUTION

To avoid damage to the 6062A, check that the rear panel line voltage selection card and fuse are correct for the line voltage in your area. The correct line voltage and fuse combinations are:

LINE VOLTAGE	FUSE
100/120V ac, ±10%, 47 to 63 Hz	1.5 amp
220/240V ac, ±10%, 47 to 63 Hz	.75 amp

1-4. OPERATOR INFORMATION CARD

The Operator Information Card has an adhesive backing so it can be affixed to the top of the Generator in bench applications or to the operator console in remote applications. A copy of the card is located at the end of Section 7 of this manual as a convenient reference or for duplication.

1-5. GENERATOR DESCRIPTION

Fundamental features of the Generator are as follows:

- 0.10- to 1050-MHz frequency range in 10-Hz steps
- 1050- to 2100-MHz frequency range in 20-Hz steps
- +16 to -137-dBm level range in 0.1-dB steps from 0.10 to 1050 MHz
- +13 to -137-dBm level range in 0.1-dB steps from 1050 to 2100 MHz
- AM, FM, ϕM, and Pulse, internal or external
- Internal 400- and 1000-Hz modulation oscillator
- Relative frequency and amplitude
- Volts/dBm conversion
- Store/recall memory
- Instrument (or controller) prompted software compensation
- Master/slave for frequency, amplitude, and modulation functions (IEEE-488 Interface controlled.)
- Fluorescent display
- 5¼-inches high, rack mountable

1-6. Controller Functions

The Generator's microprocessor controls all operator interface functions, performs background operations such as status checks, and updates (strobes) the front panel displays. Whether the operator is using local control with the front panel, or remote control with the IEEE-488 Interface, the microprocessor provides self test and diagnostic capability. Economical instrument performance is achieved by using software compensation and accuracy-enhancement circuitry.

1-7. LOCAL CONTROL

The value of the basic output parameters of the Generator (i.e., amplitude, frequency, or modulation) can be controlled in three ways:

- Direct numeric entry
- Incrementing or decrementing the bright digit
- Step-up or step-down entry where the operator can program the step size via the front panel

Other controls provide selection of the modulation control, internal/external frequency reference, instrument status, and special function modes. Refer to Tables 2-1 and 2-2 for a more complete discussion.

1-8. DISPLAY FIELD

The programmed values of modulation, frequency, and amplitude are displayed in the three display fields. In addition, when the operator presses the [STATUS] key, uncal and reject entry codes are displayed. The display also prompts the operator during the software compensation procedures.

1-9. REMOTE-CONTROL PROGRAMMING

The IEEE-488 Interface allows the Generator to be remotely controlled with any IEEE-488 bus controller. The operator can also use the instrument on the IEEE-488 bus without a controller in a listen-only or talk-only mode by selecting the appropriate Generator rear panel IEEE-488 switch settings.

All instrument controls can be controlled remotely except the POWER ON/OFF and the rear panel REF INT/EXT switches. The IEEE-488 Interface provides additional commands not available with local control, such as data transfer and individual control of internal I/O control bits.

The IEEE-488 Interface allows two Generators to track amplitude, frequency, or modulation in a master/slave configuration when the operator uses the front panel step-up and step-down entries on one of the instruments. For instance, frequency tracking is convenient for tests involving mixers, and amplitude tracking is useful for two-tone intermodulation testing.

1-10. Frequency

The specified frequency range is 0.10 to 2100 MHz. The frequency is synthesized from a 10-MHz reference and provides an output resolution of 10 Hz from 0.10 to 1050 MHz, and 20 Hz from 1050 to 2100 MHz. The relative frequency mode allows the operator to program the frequency in relation to a center frequency or an offset frequency. This is convenient for testing filters and mixers. The output frequency stability and accuracy depends on the reference, whether that reference is internal or external.

1-11. Reference

The internal frequency reference is a 10-MHz ambient crystal oscillator. If Option -130 High Stability Reference or Option -132 Medium Stability Reference is installed, the internal oscillator is locked to the option oscillator.

With the REF INT/EXT switch set to EXT, the Generator can be operated from an external 1-, 2-, 2.5-, 5-, or 10-MHz, 0.3 to 4V peak-to-peak sine or square-wave reference applied to the REF IN connector. In either position of the REF INT/EXT switch, the selected reference is available as a 10-MHz signal at the rear panel 10 MHz OUT connector.

1-12. Amplitude

The Generator has two specified signal level ranges:

+16 to -137 dBm (1.41V to 0.1 μV) over a frequency range of 0.10 to 1050 MHz
+13 to -137 dBm (1V to 0.033 μV) over a frequency range of 1050 to 2100 MHz.

The programming limits are +17 and -147.4 dBm, which correspond to limits of 1.58V to 0.01 μV. The level entry can be in dBm or volts, or it can be converted from one to the other. The relative amplitude mode allows the operator to account for cascaded gain or loss by displaying the level relative to the initial setting.

1-13. Modulation

The Generator has internal and external amplitude, frequency, phase, and pulse modulation capabilities. The internal modulation oscillator is selectable between 400 and 1000 Hz. AM depths of 0 to 99% are available in 1% steps. FM deviation ranges of 1, 10, 100, and 400 kHz are available in steps of 1, 10, 100 Hz, and 1 kHz, respectively. ϕM deviation ranges of 0.10, 1.0, 10.0, and 40.0 radians (rad) are available in steps of 0.001, 0.01, 0.1, and 0.1 radians, respectively. The internal Pulse duty cycle is approximately 50%. External Pulse allows rates from dc up to 16 MHz, and duty cycles from 0 to 100%.

1-14. OPTIONS AND ACCESSORIES

The following options are available for the Generator:

Option -130 High-Stability (Ovened) Reference
Option -132 Medium-Stability Reference
Option -830 Rear Panel RF Output, MOD Input, and Pulse MOD Input

Section 6 provides more detailed information on the options.

The following accessories are included with each Generator:

DESCRIPTION	PART NUMBER	QUANTITY
Operator Information Card	797928	1
Getting Started Manual	794859	1
Instruction Manual	794842	1
Line Power Cord	284174	1
BNC Dust Cap	478982	2

The following accessories are available for the Generator:

DESCRIPTION	ACCESSORY NO.
Rack Mount Kit. Includes M05-205-600 (5 1/4-inch Rack Mount Ears) and M00-280-610 (24-inch Rack Slides)	Y6001
IEEE-488 Shielded Cable, 1 meter	Y8021
IEEE-488 Shielded Cable, 2 meters	Y8022
IEEE-488 Shielded Cable, 4 meters	Y8023
Attenuator, 50 ohms, 6 dB, BNC	Y9100
Attenuator, 50 ohms, 14 dB, BNC	Y9101
Attenuator, 50 ohms, 20 dB, BNC	Y9102
50 ohms Feed-through Termination, BNC	Y9103
Coaxial Cable, 50 ohms, 3 feet, BNC (m) both ends	Y9111
Coaxial Cable, 50 ohms, 6 feet, BNC (m) both ends	Y9112
Min-Loss Pad, 50 ohms to 75 ohms	Y9301
Adapter, N to BNC, 75 ohms	Y9307
Adapter, N to BNC, 50 ohms	Y9308
Coaxial Cable, N male to N male, 6 ft	Y9315
Cap, Non-Shorting, BNC	Y9316
50 ohms Termination, N	Y9317
50 ohms Coaxial Switch	PM 2122/02
Test Team Software	PM 2240/002

1-15. RECOMMENDED TEST EQUIPMENT

The test equipment recommended for the performance tests, calibration adjustments, and troubleshooting are listed in Table 4A-1. This equipment is assumed to be calibrated to the manufacturer's specifications. If the recommended test equipment is not available, equivalent test equipment can be substituted.

1-16. MNEMONICS

The mnemonics used in the schematics, block diagrams, wiring diagrams, truth tables, and the text are listed in Figure 7-1.

1-17. SIGNAL GENERATOR SPECIFICATIONS

Unless otherwise noted, the following performance is guaranteed over the specified environmental and ac power line conditions 20 minutes after turn-on. Table 1-1 lists the Generator specifications.

Table 1-1. 6062A Synthesized RF Signal Generator Specifications

Warranted performance, 20 minutes after power-on within operating temperature range.

FREQUENCY (9 1/2-Digit Display)

RANGE	0.1 to 2100.0 MHz in 4 bands; 0.1 to 244.99999 MHz, 245 to 511.99999 MHz, 512 to 1049.99999 MHz, 1050 to 2100.0 MHz.
RESOLUTION	10 Hz from 0.1 to 1050 MHz, 20 Hz from 1050 to 2100 MHz.
ACCURACY	Same as reference (See REFERENCE).
REFERENCE (Internal)	The unit operates on an internal free-air 10-MHz crystal oscillator with an ageing rate of <±0.5 ppm/month and <±10 ppm for 25°C, ±25°C. Internal reference signal (10-MHz) available at rear connector, level >0 dBm, terminated in 50-ohms.
REFERENCE (External)	Accepts 1-, 2-, 2.5-, 5-, or 10-MHz signal. Level of 0.3 to 4.0 Vpp into 50-ohms termination.

AMPLITUDE (3 1/2-Digit Display)

RANGE (Indicated)	+16 (+16 peak with AM enabled) to -137 dBm, from 0.1 to 1049.99999 MHz. +13 (+13 peak with AM enabled) to -137 dBm, from 1050 to 2100 MHz. (Autoranging 6-dB step attenuator).
RESOLUTION	0.1 dB (<1% or 1 nV in volts). Annunciators for dB, dBm, V, mV, uV, dB mV, and dB uV.
ACCURACY	±1 dB from +16 to -127 dBm from 1 to 1049.99999 MHz. * ±1.5 dB from +13 to -127 dBm from 1050 to 2100 MHz. ±2.0 dB from +16 to -127 dBm from 0.1 to .99999 MHz. * ±1.5 dB at temperatures other than 23°C ±5°C

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

SOURCE VSWR	<1.5:1 below +1 dBm, <2.0:1 elsewhere.
SPECTRAL PURITY (CW ONLY)	
SPURIOUS	<-60 dBc for offsets greater than 10 kHz and frequencies from 0.1 to 1049.99999 MHz. <-54 dBc for offsets greater than 10 kHz and frequencies from 1050 to 2100 MHz. NOTE Fixed frequency spurs are <-60 dBc or <-140 dBm whichever is larger. NOTE dBc refers to decibels relative to the carrier frequency, or in this case, relative to the signal level.
HARMONICS	<-30 dBc for levels ≤ +13 dBm and frequencies ≥1 MHz, <-25 dBc elsewhere.
SUBHARMONICS	<-45 dBc for output frequencies from 1050 to 2100 MHz.
RESIDUAL FM (rms in 0.3- to 3-kHz band)	<12 Hz for 0.1 to 244.99999 MHz, <6 Hz for 245 to 511.99999 MHz, <12 Hz for 512 to 1049.99999 MHz, <24 Hz for 1050 to 2100 MHz.
RESIDUAL FM (rms in 0.05- to 15-kHz band)	<18 Hz for 0.1 to 244.99999 MHz, <9 Hz for 245 to 511.99999 MHz, <18 Hz for 512 to 1049.99999 MHz, <36 Hz for 1050 to 2100 MHz.
RESIDUAL AM (in 0.05- to 15-kHz Band)	<-60 dBc.
AMPLITUDE MODULATION (2-Digit Display)	
DEPTH RANGE	0 to 99%.
RESOLUTION	1%.
ACCURACY	±(2% + 4% of setting) for internal rates to peak amplitude of +13 dBm for frequencies of 1 MHz to 2100 MHz. ±(3% + 5% of setting) for internal rates to peak amplitude of +13 dBm for frequencies of 0.1 to .99999 MHz.

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

DISTORTION .... <1.5% total harmonic distortion (THD) to 30% AM, <3% THD to 70% AM, <5% THD to 90% AM for frequencies of 10 to 1049.99999 MHz and peak amplitude < +13 dBm.

<3% THD to 70% AM, and <5% THD to 90% AM for frequencies of 1050 to 2100 MHz and peak amplitude < +13 dBm.

<3% THD to 30% AM, <5% THD to 70% AM, and <7% THD to 90% AM for frequencies of 0.1 to 9.99999 MHz and peak amplitude <6 dBm.

BANDWIDTH (3 dB) .... 20 Hz to 50 kHz. DC to 50 kHz by special function. (Note-- valid for RF frequency - Mod frequency ≥150 kHz)

INCIDENTAL FM .... <0.3 fm for internal rates, 30% or less AM, and frequencies from 0.1 to 1049.99999 MHz.
<0.6 fm for internal rates, 30% or less AM, and frequencies from 1050 to 2100 MHz.

FREQUENCY MODULATION (3-Digit Display)

DEVIATION RANGES .... 0 to 999 Hz, 1 to 9.99 kHz, 10 to 99.9 kHz, and 100 to 400 kHz.

MAXIMUM DEVIATION

Mod Rate	Max Dev	RF Frequency
fm ≥.2 kHz	400 kHz	1050 to 2100 Mhz
	200 kHz	512 to 1049.99999 MHz
	100 kHz	245 to 511.99999 Mhz
	200 kHz	0.1 to 244.99999 Mhz
fm <.2 kHz	Lower of above or:	
	2 fm fo	245 to 2100 MHz
	2 fm(fo+800)	0.1 to 244.99999 MHz

Where: fm = mod frequency in kHz

fo = RF frequency in MHz
Deviation is in kHz

Specs apply where:
RF Frequency - Dev ≥150 kHz
RF Frequency - Mod Rate ≥150 kHz

RESOLUTION .... 3 digits.

ACCURACY .... ± (7% + 10 Hz) for rates of 0.3 to 20 kHz. Does not include effects of Residual FM.

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

DISTORTION	<1% THD for rates of 0.3 to 20 kHz. Does not include effects of Residual FM.
BANDWIDTH (3 dB)	20 Hz to 100 kHz. (Note-- valid for RF Frequency - Mod Frequency ≥150 kHz)
INCIDENTAL AM	<1% AM at 1 kHz rate, for the maximum deviation or 50 kHz, whichever is less. Valid for RF Frequency ≥1 MHz.
PHASE MODULATION (3 digit display)	
DEVIATION RANGES	0 to .099 rad, .100 to .999 rad, 1.00 to 9.99 rad, and 10.0 to 40.0 rad.
MAXIMUM DEVIATION	20 rad from 0.1 to 244.99999 MHz. 10 rad from 245 to 511.99999 MHz. 20 rad from 512 to 1049.99999 MHz. 40 rad from 1050 to 2100 MHz.
RESOLUTION	3 digits
ACCURACY	±(7% + .01 rad) at 1 kHz rate. Does not include effects of Residual FM.
DISTORTION	<1% THD for 1 kHz rate. Does not include effects of Residual FM.
BANDWIDTH (3 dB)	20 Hz to 10 kHz. (Note-- valid for RF Frequency - Mod Frequency ≥150 kHz)
INCIDENTAL AM	<1% AM at 1 kHz rate.
PULSE MODULATION (RF Frequencies from 10 to 2100 MHz)	
ON/OFF RATIO	80 dB minimum
RISE & FALL TIMES	<15 nsec
LEVEL ERROR	for pulse widths ≥50 nsec, power in the pulse within ±0.5 dB of measured CW level.
DUTY CYCLE (ext mod)	0-100%
REP RATE (ext mod)	DC-16 MHz
INTERNAL MODULATION	internal rates, approx 50% duty cycle.
EXTERNAL PULSE MODULATION	The pulse input is TTL compatible and 50 ohm terminated with an internal active pull-up. It can be modeled as 1.2 V in series with 50 ohms at the pulse modulation input connector. The instrument senses input terminal voltage and turns the RF off when the terminal voltage drops below 1 ± 0.1 V. Max allowable applied voltage, ±10V.
PULSE MODULATION (RF Frequencies <10 MHz)	
RISE & FALL TIMES	≤2 X period of RF Frequency.

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

LEVEL ERROR	for pulse widths ≥10 X period of RF Frequency, power in the pulse will be within ±0.5 dB of the measured CW level.

Other specifications are the same as for the 10 to 2100 MHz range.

NON-VOLATILE MEMORY

50 instrument states are retained for typically 2 years, even with the power mains disconnected.

REVERSE POWER PROTECTION

PROTECTION LEVEL	up to 25 watts from a 50 ohm source. up to 25 VDC. Instrument output is AC coupled.
TRIP/RESET	Flashing RF OFF annunciator indicates a tripped condition. Pushing RF ON/OFF button will reset instrument. Protection is provided when instrument is off.

IEEE-488

INTERFACE FUNCTIONS	SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1.

MODULATION SOURCE

INTERNAL	0.4 or 1 kHz, ±3% for 20 to 30°C; add ±0.1%/°C outside this range.
EXTERNAL	±5V max.; 1V peak provides indicated modulation index. Nominal input impedance is 600 ohms.
MODES	Any combination of AM and FM or ØM, internal or external, may be used. If external AM and FM or ØM are enabled, the modulation input Z will drop to approximately 560 ohms. Pulse modulation is completely independent and can be used in conjunction with any other form(s) of modulation.

GENERAL

TEMPERATURE	
Operating	0 to 50°C (32 to 122°F).
Non-Operating	-40 to 75°C (-40 to 167°F).
HUMIDITY RANGE	
Operating	95% to 30°C, 75% to 40°C, 45% to 50°C.
ALTITUDE	
Operating	Up to 10,000 ft.
VIBRATION	
Non-Operating	5 to 15 Hz at 0.06 inch, 15 to 25 Hz at 0.04 inch, and 25 to 55 Hz at 0.02 inch, double amplitude (DA).

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

SHOCK	
Non-Operating	Bench handling per MIL T 28800C Class 5, Style E.
ELECTROMAGNETIC COMPATIBILITY	The radiated emissions induce <3 uV (<1 uV of the Generator's output signal) into a 1-inch diameter, 2-turn loop, 1-inch from any surface as measured into a 50-ohm receiver.

Also complies with the following standards:

CE03 of MIL-STD-461B (Power and interconnecting leads), 0.015 to 50 MHz.

RE02 of MIL-STD-461B (14 kHz to 10 GHz).

FCC Part 15 (j), class A.

CISPR 11.

	Width	Height	Depth
SIZE	43 cm 17 in	13.3 cm 5.25 in	50.8 cm 20 in

POWER	100, 120, 220, 240V ac ±10%, 47 to 63 Hz, <180 VA (<15 VA, with Option -130 installed, and the Generator turned off (standby).
WEIGHT	<15.7 kg (35 lbs).
OPTION -130 HIGH-STABILITY REFERENCE	
AGING RATE	<±5 x 10 -10/day, after 21 days continuous operation.
TEMPERATURE STABILITY	<±2 x 10 -10/°C (Oven remains powered in standby).
OPTION -132 MEDIUM-STABILITY REFERENCE	
AGING RATE	<±1 x 10^{-7}/month after 5 days continuous operation.
TEMPERATURE STABILITY	<±1 x 10^{-7}/°C (0 to 50°C) (no powered standby).
OPTION -651 LOW-RATE EXTERNAL FM	
MAXIMUM DEVIATION	9.99 kHz.
DROOP	<15% on a 10-Hz square wave.
BANDWIDTH (3dB)	0.5 Hz to 100 kHz (typical).
MAX DC INPUT	±10 mV.
INCIDENTAL AM	<1% AM at 1-kHz rate and deviation <10 kHz.

Table 1-1. 6062A Synthesized RF Signal Generator Specifications (cont)

SUPPLEMENTAL CHARACTERISTICS

The following characteristics are provided to assist in the application of the Generator and to describe the typical performance that can be expected.

FREQUENCY SWITCHING SPEED .... <100 mS to be within 100 Hz.

AMPLITUDE SWITCHING SPEED .... <100 mS to be within 0.1 dB.

AMPLITUDE RANGE .... Programmable from +17 to -147.4 dBm. Fixed-range, selected by special function, allows for more than 12 dB of vernier without switching the attenuator.

AMPLITUDE ACCURACY............... ±2.0 dB from -127.1 to -137 dBm from 0.1 to 2100 MHz.

NOISE (at 20-kHz offset) .... <-116 dBc/Hz from 0.10 to 244.99999 MHz.
<-122 dBc/Hz from 245 to 511.99999 MHz.
<-116 dBc/Hz from 512 to 1049.99999 MHz.
<-110 dBc/Hz from 1050 to 2100 MHz.

RESIDUAL FM (typical)

Freq Range	.3 - 3 kHz	.05 - 15 kHz	CCIT
0.1 - 244.99999 MHz	8 Hz	12 Hz	7 Hz
245 - 511.99999 MHz	4 Hz	6 Hz	3.5 Hz
512 - 1049.99999 MHz	8 Hz	12 Hz	7 Hz
1050 - 2100 MHz	16 Hz	24 Hz	14 Hz

EXTERNAL MODULATION .... Annunciators indicate when a 1V peak signal is applied, ±2%, over a 0.02- to 100-kHz band.

IEEE .... All controls except the power switch and the internal/external reference switch are remotely programmable via IEEE-488 Interface (Std 488-1978). All status including the option complement are available remotely. The Store/Recall memory data may be transferred via an external controller. In talk-only, the appropriate commands are generated when the front panel step-up and step-down entries are made to control another 6062A, 6060A, 6060B ,6070A, or 6071A. (6070/71A only have FREQUENCY STEP.)

FREQUENCY DRIFT .... <1 ppm/hr after 1 hour warmup at constant ambient temperature using internal free-air crystal.

PULSE MODULATION

PULSE DELAY....................... OFF/ON 80 nsec typ
ON/OFF 65 nsec typ

Section 2
Installation and Operation

2-1. INTRODUCTION

This section describes how to install and operate the Generator. This section contains information for an initial inspection, setting up the instrument, general operating information, and local and remote operation.

2-2. INITIAL INSPECTION

The Generator is shipped in a special protective container that should prevent damage during shipment. Check the shipping order against the contents of the container, and report any damage or short shipment to the place of purchase or the nearest Fluke Technical Service Center. Instructions for inspection and claims are included on the shipping container.

If reshipment of the Generator is necessary, please use the original shipping container. If the original container is not available, use a container that provides adequate protection during shipment. It is recommended that the Generator be protected by at least three inches of shock-absorbing material on all sides of the container. Do not use loose fill to pad the shipping container. Loose fill allows the Generator to settle to one corner of the shipping container, which could result in the Generator being damaged during shipment.

2-3. SETTING UP THE GENERATOR

The following paragraphs describe how to set up the Generator for operation. This information includes: line power requirements, line voltage selection procedures, fuse replacement procedures, and rack mounting instructions.

2-4. Line Power Requirements

The Generator uses a line voltage of 100 or 120V ac rms (± 10%) with a 1.5A fuse; or 220V or 240V ac (± 10%) with a 0.75A fuse. The line frequency must be between 48 to 63 Hz. The power consumption of the instrument is <180 VA with a full option complement.

2-5. Line Voltage and Fuse Selection

CAUTION

Verify that the intended line power source matches the line voltage setting of the Generator before plugging in the line power cord.

Refer to Figure 2-1 to set the line voltage of the Generator to match the available source. Figure 2-1 also shows how to replace the line fuse of the Generator. The correct fuse value for each of the four line voltages is listed on a plate attached to the rear panel of the Generator.

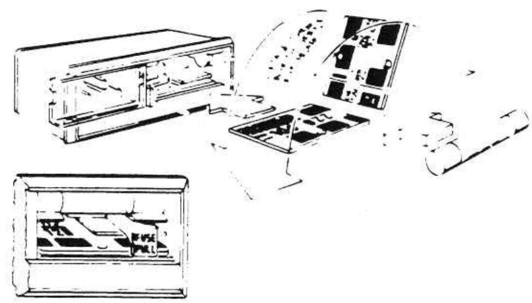


Figure 2-1. Fuse/Filter/Line Voltage Selection Assembly

2-6. IEEE-488 Address

The IEEE-488 address can be selected using the switches located next to the IEEE-488 connector on the rear panel. Talk-only and listen-only modes can also be selected on this switch.

NOTE

To meet the specified radiated emissions, the IEEE-488 connector must be terminated with a shielded IEEE-488 cable, such as a Fluke Y8021.

2-7. RACK OR BENCH MOUNTING THE GENERATOR

CAUTION

Allow at least 3 inches of clearance behind and on each side of the Generator to ensure proper air circulation.

The Generator may be placed directly on a work bench or mounted in a standard (24-inch deep) equipment rack. Use the Fluke Y6001 Rack Mount Kit for mounting the Generator on an equipment rack. Instructions for installing the Generator with the Rack Mount Kit are provided in the kit. The outside dimensions of the Generator are shown in Figure 2-2. The Rack Mount Kit is composed of the following parts:

5¼-inch Rack Adapter, P/N M05-205-600
24-inch Rack Slides, P/N M00-280-610

2-8. GENERAL OPERATING INFORMATION

The following paragraphs contain general information on the operation of the Generator. This includes all the information required to familiarize the operator with the instrument and the differences between local and remote operation.

2-9. Familiarization

The Generator normally operates on an internal reference oscillator. However, if desired, the Generator can be operated on an external reference by setting the rear panel REF INT/EXT switch to EXT and connecting the external reference to the REF IN connector.

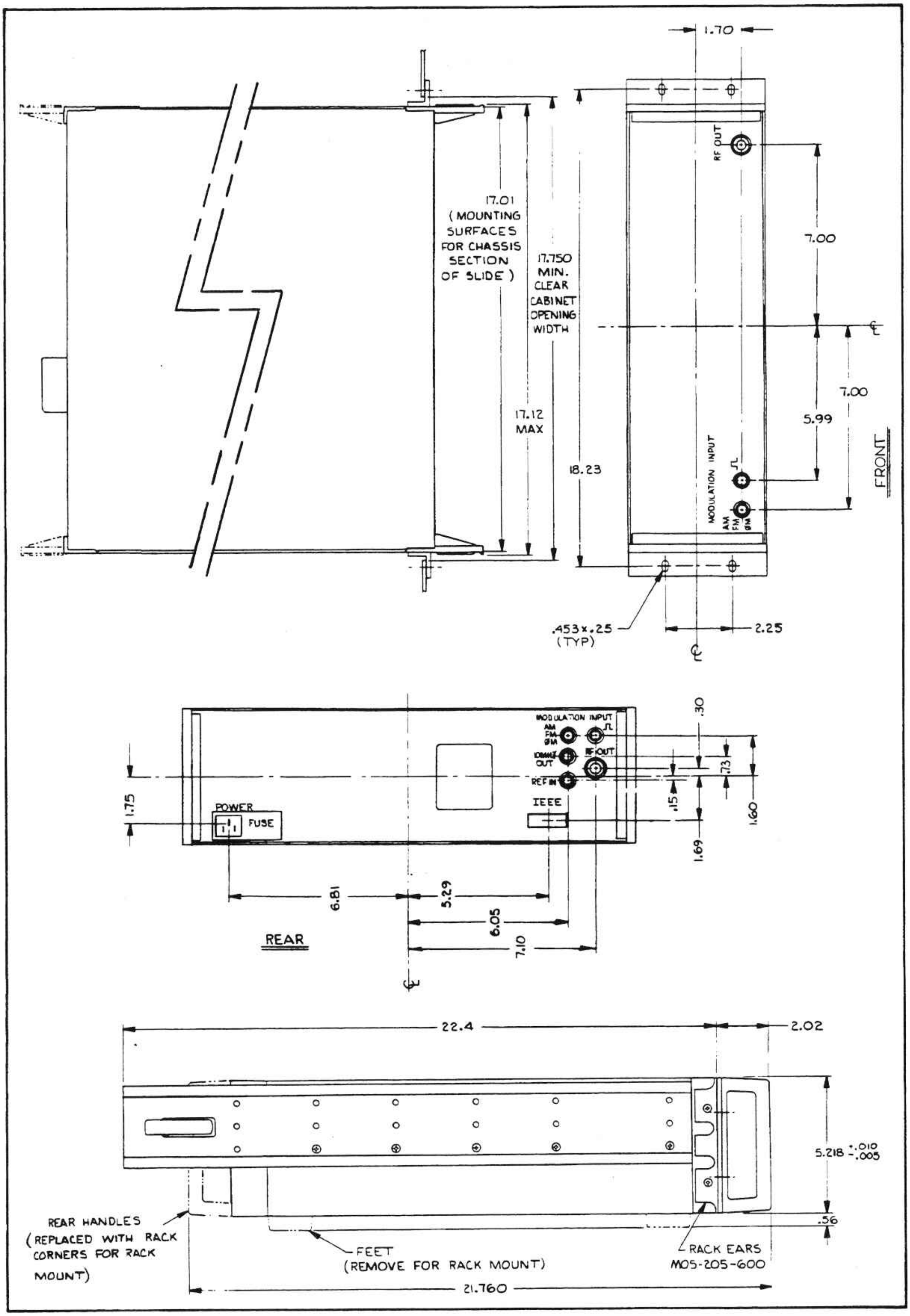


Figure 2-2. 6062A Outside Dimensions

CAUTION

When the Generator is operating on the internal reference, a 10-MHz signal is present at the 10 MHz OUT connector on the rear panel. To meet the specified radiated emissions, this connector must be terminated with a BNC non-shorting dust cap. A dust cap, JF 478982, is supplied with the Generator. If a cable is connected, it must be a double-shielded coaxial cable such as RG-223 terminated in a 50-ohm load.

CAUTION

Output spectral degradation occurs if the Generator is operated on internal reference with an external reference signal applied.

Figure 2-3 shows the front panel controls, indicator, and connectors and Table 2-1 describes the features.

Figure 2-4 shows the rear panel controls, connectors, and switches and Table 2-2 describes the features.

2-10. Local Versus Remote Operation

Two modes of controlling the output of the Generator are local operation and remote operation. In the local operation mode, the operator uses the keys on the front panel to control the Generator. The remote operation mode uses an IEEE-488 controller to control the Generator through the IEEE-488 Interface. An overview of local operation is presented under the heading Local and Remote Control Operations. The local and remote control operations that have similar entry methods are also described under Local and Remote Control Operations. The paragraphs under the heading Remote Operation contain information on commands or descriptions that pertain only to remote operations.

2-11. Power-On Sequence

When the Generator is turned on, a power-on sequence starts. During the power-on sequence, the microprocessor tests the analog circuitry, the program ROM, the scratch-pad RAM, the compensation memory, and the front panel displays. The front panel displays are tested by lighting all segments for a brief period at the same time the rest of the self tests are performed.

If any of the self tests fail, an error code is displayed. If the operator initiates any front panel entry before the power-on sequence is completed, the self test is aborted, and the Generator is set to the state it was in when turned off. Table 2-3 lists the Instrument Preset State. Power-on instrument settings that relate to the IEEE-488 Interface are described in the Remote Operation paragraphs in this section. More detail on the power-on self tests are explained in Section 4D.

2-12. Changing Output Parameters

The six parameters of the Generator (i.e., frequency, amplitude, amplitude modulation (AM), frequency modulation (FM), phase modulation (ϕM), and pulse modulation) may be individually changed by at least one of three methods:

Function Entry
Bright-Digit Edit Entry
Step Entry

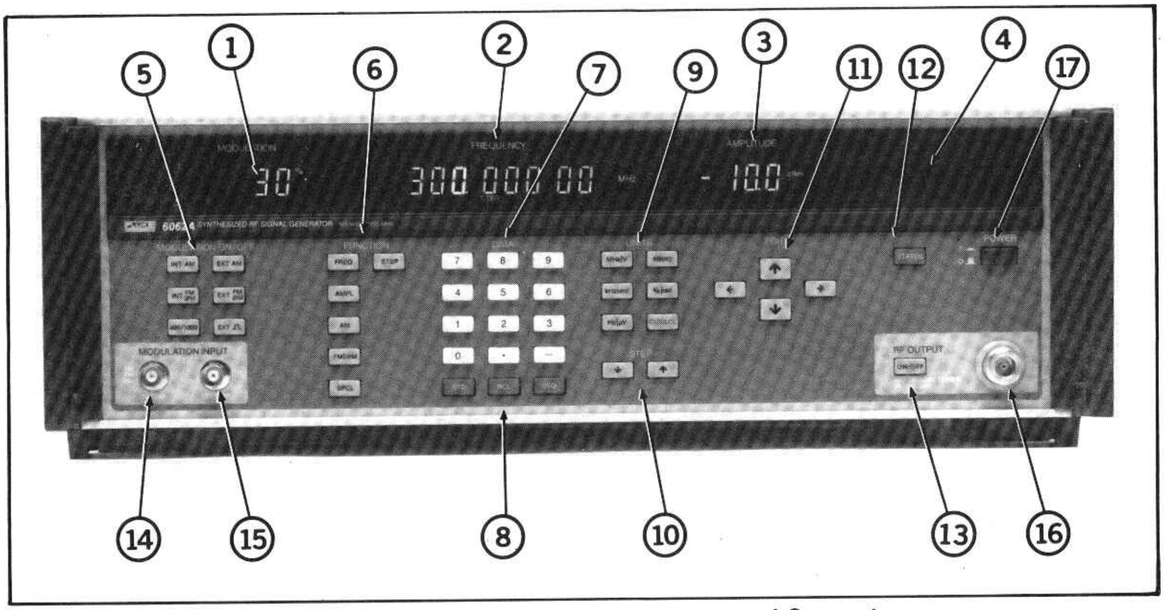


Figure 2-3. Front Panel Controls, Indicators, and Connectors

Table 2-1. Front Panel Controls, Indicators, and Connectors

①	MODULATION DISPLAY FIELD	A three-digit display, with associated indicators used to display the AM depth, FM deviation, source of modulation signal, and modulation frequency.
	INT AM	Indicates that the internal modulation oscillator signal is amplitude modulating the Generator.
	EXT AM	Indicates that the Generator is amplitude modulated by the signal connected to the MOD INPUT connector.
	INT FM	Indicates that the internal modulation oscillator signal is frequency modulating the Generator.
	EXT FM	Indicates that the Generator is frequency modulated by the signal connected to the MOD INPUT connector.
	INT ØM	Indicates that the internal modulation oscillator signal is phase modulating the Generator.
	EXT ØM	Indicates that the Generator is phase modulated by the signal connected to the MOD INPUT connector.
	INT ⎍	Indicates that the internal modulation oscillator signal is pulse modulating the Generator.
	EXT ⎍	Indicates that the Generator is pulse modulated by the signal connected to the PULSE MODULATION INPUT connector.
	STEP	Indicates that the Step [^] or [v] keys (Step Entry) affect the current Modulation display value.
	%	Indicates that the value displayed is the AM Depth in percent.
	kHz DEV	Indicates that the value displayed is the FM Deviation in kHz.
	rad	Indicates that the value displayed is the Phase Modulation Deviation in radians.

Table 2-1. Front Panel Controls, Indicators, and Connectors (cont)

	dBm	Indicates that the value displayed is the target level in dBm when performing a level compensation procedure.
	400 Hz	Indicates that the internal modulating frequency is 400 Hz.
	1000 Hz	Indicates that the internal modulating frequency is 1000 Hz.
	EXT HI	Indicates that the external modulation signal is more than 2% above the nominal 1V peak requirement for calibrated operation.
	EXT LO	Indicates that the external modulation signal is more than 2% below the nominal 1V peak input requirement.
(2)	FREQUENCY DISPLAY FIELD	A 9-digit display, with six indicators used to display the output frequency of the Generator. Also used to display the special function code, status error codes, or the memory location being stored or recalled, as well as relative and actual frequency, when REL is lit, and step frequency.
	STEP	Indicates that the STEP [^] or [v] keys (Step Entry) affect the output frequency.
	REL	Indicates that the displayed frequency is relative to a reference frequency.
	COMP	Indicates that the compensation memory protection switch on the A2 Controller PCA is set to the enabled position.
	FM	Indicates that an FM compensation procedure is in progress
	OUT	Indicates that an Output compensation procedure is in progress
	ATT	Indicates that an Attenuator compensation procedure is in progress.
(3)	AMPLITUDE DISPLAY FIELD	A 3 1/2- (and sign) digit display, with six indicators, used to display the output amplitude of the Generator into a 50-ohm load.
	STEP	Indicates that the STEP [^] or [v] keys (Step Entry) affect the output amplitude.
	REL	Indicates that the displayed amplitude is relative to a reference amplitude.
	dBm	Indicates that the output amplitude is in decibels relative to one milliwatt.
	V	Indicates that the output amplitude is in volts.
	uV	Indicates that the output amplitude is in microvolts.
	mV	Indicates that the output amplitude is in millivolts.
(4)	STATUS DISPLAY FIELD	The status display field is composed of 11 indicators used to denote the current status of the Generator or instrument entry.
	EXT REF	Indicates that the rear panel REF switch is in the EXT (external) position.

Table 2-1. Front Panel Controls, Indicators, and Connectors (cont)

	REJ ENTRY	Lights when an invalid entry is made.
	UNCAL	Lights when a parameter entry is outside its specified range. This indicator flashes when any of the internal DAC's are over or under-flow or when any abnormal operation is detected.
	RF OFF	Lights when the RF OUTPUT is disabled.
	REMOTE	Lights when the Generator is in the remote (IEEE-488 Interface) mode of operation.
	ADDR	Lights when the Generator is addressed to listen or talk.
	SRQ	Lights when the Generator has asserted the IEEE-488 SRQ signal.
(5)	MODULATION ON/OFF	Used to select type, source, and frequency of modulation. With the exception of the [400/1000] key, these keys operate as independent push-on/push-off switches for the given function. Any combination is allowed.
	INT AM	Enables internal amplitude modulation at the frequency annunciated by the 400/1000 Hz indicator.
	INT FM ØM	Enables internal frequency modulation at the frequency annunciated by the 400/1000 Hz indicator.
	EXT AM	Enables external amplitude modulation using the signal applied to the MOD INPUT connector.
	EXT FM ØM	Enables external frequency modulation using the signal applied to the MOD INPUT connector.
	EXT ⎍	Enables external pulse modulation using the signal applied to the PULSE MODULATION INPUT connector.
	400/1000	Alternately sets the internal modulation oscillator's frequency to 400 or 1000 Hz. Selected frequency is displayed only when INT AM, FM, ØM, or internal pulse is enabled.
(6)	FUNCTION	With the exception of the [STEP] and [SPCL] keys, these keys operate as interlocked switches that select the parameter to be entered or edited. For the [FREQ], [AMPL], [AM], and [FM] FUNCTION keys, the bright digit appears in the corresponding display of the selected function.
	FREQ	Selects the frequency parameter of the Generator to be programmed by using the DATA, EDIT, or STEP entry keys.
	AMPL	Selects the amplitude parameter of the Generator to be programmed by using the DATA, EDIT, or STEP entry keys.
	AM	Selects the amplitude modulation (AM) parameter of the Generator to be programmed by using the DATA, EDIT, or STEP entry keys.
	FM|ØM	Selects the frequency modulation (FM), or phase modulation (ØM) parameter of the Generator to be programmed by using the DATA, EDIT, or STEP entry keys.

Table 2-1. Front Panel Controls, Indicators, and Connectors (cont)

	SPCL	Enables the special function mode. Special functions are called up by a two-digit code, that is entered by using the DATA keys. Refer to the paragraphs on Special Function in this section for a detailed description and a list of the special functions.
	STEP	After one of the four parameter functions has been selected for programming, pressing this key allows you to program a step-wise change to that parameter. The step increase or decrease is then performed every time the STEP [^] or [v] keys are pressed.
7	DATA	A ten-digit (plus sign and decimal key) keypad used for entering a parameter's value, the special function code, or a memory recall/store location.
8	Memory	
	STO	Used with the DATA keys to store the current instrument state in a memory location. Memory locations 01 through 50 are available.
	RCL	Used with the DATA keys to recall an instrument state from a memory location. Memory locations 01 through 50 are available for operator-stored states; memory location 98 contains the Instrument Preset State (see Table 2-3.)
	SEQ	Sequentially recalls, in increasing location order, the instrument states stored in memory. While the [SEQ] key is pressed, successive memory locations are displayed. When the key is released, the location last displayed is recalled.
9	UNITS	These keys, with the exception of [CLR/LCL], serve as the terminating keystroke of a function entry, thereby causing the Generator to be programmed. The amplitude units keys are also used during Amplitude Units Conversion entries.
	MHz|V	Used with the [FREQ], [FM], and [AMPL] function keys to program the numerical DATA entries in terms of megahertz (frequency or frequency modulation) or volts (amplitude).
	dB(m)	Used with the [AMPL] function key to program the numerical DATA entries in terms of decibels per milliwatt.
	kHz|mV	Used with the [FREQ], [FM], and [AMPL] function keys to program the numerical DATA in terms of kilohertz (frequency or frequency modulation) or millivolts (amplitude).
	%|rad	Used with the [AM] function key to program the numerical DATA entries in terms of percentage AM depth. Also used with the [FM|ØM] function key to program the numerical DATA entries in terms of radians.
	Hz|uV	Used with the [FREQ], [FM], and [AMPL] function keys to program the numerical DATA in terms of hertz (frequency or frequency modulation) or microvolts (amplitude).
	CLR|LCL	When the Generator is in local operation, this key is used to clear the current entry and returns the Generator to the previous state. When the instrument is in remote operation, this key is used to return local control.

Table 2-1. Front Panel Controls, Indicators, and Connectors (cont)

(10)	STEP	These two keys work in conjunction with the STEP Function key. These keys repeat while they remain pressed.
	[^]	After a parameter is set to the step function mode, and the STEP indicator appears in the display field, this key increments the parameter by the step value previously programmed.
	[v]	After a parameter is set to the step function mode, and the STEP indicator appears in the display field, this key decrements the parameter by the step value previously programmed.
(11)	EDIT	These keys are used to position the bright digit within a display field and to increase or decrease the bright digit value. All four keys repeat while they remain pressed. The function keys are used to move the bright digit to the desired display field.
	[^]	Increases the bright-digit value.
	[<]	Moves the bright digit one digit to the left.
	[v]	Decreases the bright-digit value.
	[>]	Moves the bright digit one digit to the right.
(12)	STATUS	A push and hold key that displays the Uncal and Reject Entry status codes in the MODULATION, FREQUENCY, and AMPLITUDE display fields.
(13)	ON/OFF	A push-on/push-off key (with a corresponding RF OFF indicator in the STATUS display field) that enables or disables the output of the Generator.
(14)	Connector	A BNC connector for input of a 1V peak, external modulation signal.
(15)	Connector	A BNC connector for input of a 1V peak, external pulse modulation signal.
(16)	Connector	A standard RF connector at the output of the Generator.
(17)	POWER	A push-on/push-off detent switch that applies line power to the Generator.

These different methods all accomplish the same result but use different approaches for different reasons. One is to reduce the chance of error during complex test procedures that require continuously resetting parameters. Another is in the case when a test is partly under remote control and only some of the parameters require changes.

2-13. FUNCTION ENTRY

Changing an instrument parameter with the Function Entry method consists of:

- Selecting the function to be changed
- Entering the new numerical value of the parameter
- Selecting the units of the numerical value (megahertz, millivolts, etc).

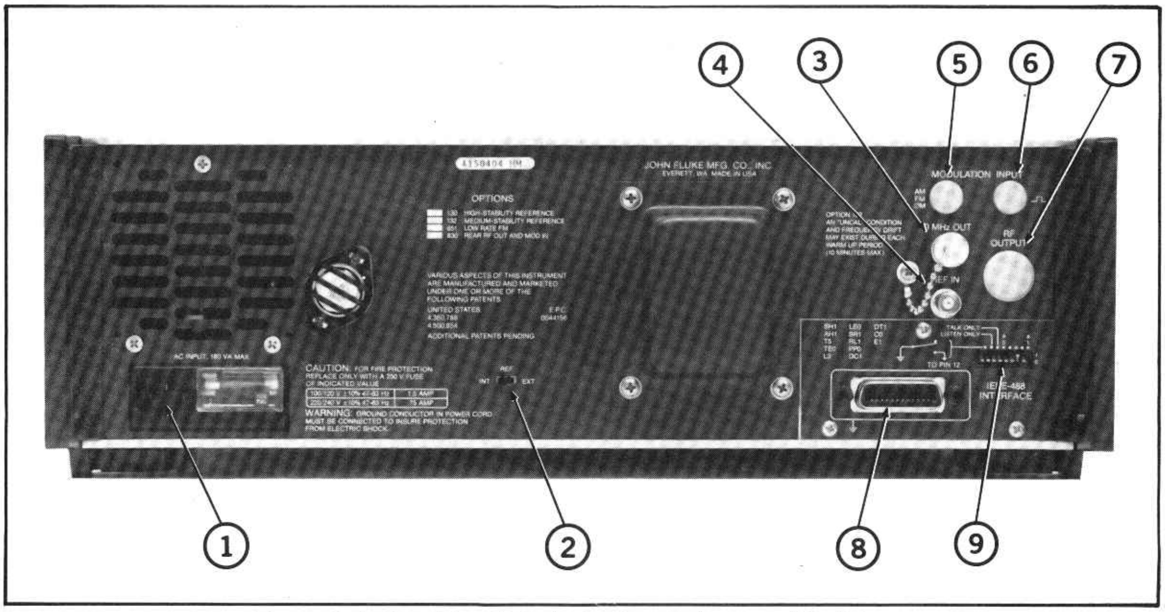


Figure 2-4. Rear Panel Controls, Connectors, and Switches

Table 2-2. Rear Panel Controls, Connectors, and Switches

1	AC INPUT	Permits operation from 100, 120, 220, or 240V ac. The number visible through the window on the selector card indicates the nominal line voltage to which the Generator must be connected. The line voltage is selected by orienting the selector card appropriately. A 1 1/2-ampere fuse is required for 100/120V operation and a 3/4-ampere fuse is required for 220/240V operation.
2	REF INT/EXT	Permits selection of the Generator frequency reference. When set to INT, the Generator operates on the internal reference, which is either the standard oscillator, the high-stability oscillator (if the Option -130 is installed) or the medium-stability oscillator (if the Option -132 is installed). In any case, the internal 10-MHz reference signal is available at the 10 MHZ OUT connector. When set to EXT, the Generator reference is the 10-MHz signal applied to the external REF IN connector.
3	10 MHZ IN/OUT	Connector (BNC) provides the 10-MHz reference signal.
4	REF IN	Connector (BNC) is present to accept a 1-, 2-, 2.5-, 5-, or 10-MHz, 0.3 to 4V p-p sine or square wave signal into nominally 50 ohms.
5	MOD INPUT	Connector (BNC) is present only with the Option -830 to accept a 1V peak external modulation signal.
6	⎍ MOD INPUT	Connector (BNC) is present only with the Option -830 to accept a 1V peak external pulse modulation signal.
7	RF OUTPUT	Connector (type N) is present only with the Option -830 to provide the Generator output signal.
8	IEEE CONNECTOR	Allows remote operation of the Generator via the IEEE-488 bus.
9	IEEE ADDRESS SWITCH	Allows the selection of the Generator bus address.

Table 2-3. Instrument Preset State

FUNCTION	SETTING
Frequency	300.00000 MHz
Frequency Step	1.00000 MHz
Amplitude	-10.0 dBm
Amplitude Step	1 dB
Modulation Rate	1000 Hz
AM Depth	30%
AM Depth Step	1 %
FM Deviation without/with Option -651	5.0/.5 kHz
FM Deviation Step without/with Option -651	100/10 Hz
Modulation Display	AM Depth
Bright-Digit Location	Frequency Bright Digit
Frequency Bright-Digit Position	1 MHz
Amplitude Bright-Digit Position	1 dBm
AM Bright-Digit Position	1 %
FM Bright-Digit Position without/with Option -651	10/1 Hz
Special Functions	20,30,40,50,60,70,80,90
INT AM	Off
EXT AM	Off
INT FM	Off
EXT FM	Off
EXT PULSE	Off
Step Function	Frequency Step

The command syntax for function entries is:

Select Function — Enter Data — Select Unit

1. Select one of the four parameters using the FUNCTION keys. The bright digit appears in the corresponding display field. The presence of the bright digit in the display field indicates that the value of the selected parameter is ready to be programmed or changed.

2. Enter the numeric data with the DATA keys. The numerics appear in the appropriate display field.

3. Select a UNITS key. This gives the data its absolute value and causes the microprocessor to internally program the Generator to the new state.

For the amplitude and frequency functions, the entered data programs the displayed value. If the relative mode is enabled, the displayed value may be different from the actual output value.

Once a function is selected, the selected parameter or feature remains in the active programming mode until a new function is selected. Data for a selected parameter must be followed by a unit value and must be within the range specified for the function. The display field flashes, and the REJ ENTRY status indicator flashes if the entered data is not within the specified range. A rejected entry does not affect the output of the Generator. The output of the Generator remains at its previous values until a new value is accepted.

The function entry may be terminated at any time by the [CLR | LCL] key or by selecting another function.

2-14. BRIGHT-DIGIT EDIT ENTRY

Changing an instrument parameter by the bright-digit edit entry method is the fastest way to make vernier (incremental) changes to one of the four parameters. The EDIT keys are used with the four parameter FUNCTION keys to position the bright digit in the desired display field and then increase or decrease the bright-digit value.

The command syntax for bright-digit edit entries is:

Select Display Field — Position Bright Digit — Change Bright-Digit Value

1. Use one of the four FUNCTION keys to position the bright digit in the appropriate display field.

2. Use the [→] or [←] EDIT keys to position the bright digit to the desired resolution, and use the [↑] or [↓] EDIT keys to increase or decrease the value of the bright digit.

The position of the bright digit within a display field is maintained when the bright digit is moved from one display field to another and then back to the original display field.

The repeat rate of the [↑] or [↓] EDIT keys may be changed to a faster or slower rate (a medium repeat rate is the default) with a special function code (see Table 2-4). Refer to the paragraphs on Special Function later in this section for the method and code.

2-15. STEP ENTRY

Changing parameters by the step entry method allows the operator to preset stepwise increments of a parameter, then change that parameter (by the amount programmed in the step function) with a single keystroke.

The command syntax for step entries is:

Select Step Function — Enter Data — Select Units — Change Parameter

1. Select the parameter to be changed stepwise using one of the FUNCTION keys followed by the [STEP] key to enable the step function.

2. Program the numeric step amount using the DATA keys.

3. Select a UNIT key to give the data its absolute value.

4. The parameter value can now be changed by increments of the programmed step amount by using the [↑] or [↓] STEP keys.

While the [STEP] key is pressed, the display field of the selected parameter shows the step amount. The STEP indicator is lit in the display field currently affected by the [STEP] key.

The repeat rate of the [↑] or [↓] STEP keys may be changed to a faster or slower rate (a medium repeat rate is the default) with a Special Function code. Refer to the paragraphs on Special Functions for the method and code.

A step entry is ignored when the result of that step entry would cause the value of the parameter to exceed its programmable limit.

2-16. Status and Clear

The [STATUS] key allows the operator to interrogate the Generator for an explanation of uncalibrated or rejected entry operation (UNCAL or REJ ENTRY indicator is lit). Refer to the paragraphs on Status and Clear Entry later in this section for a complete list of status codes.

Table 2-4. Special Functions

SPECIAL FUNCTION	OPERATION
00	Clear all special functions.
02	Initiate self tests.
03	Display test. See Section 3.
04	Key test. See Section 3.
07	Set SRQ.
08	Reset SRQ.
09	Display software revision level. Information appears in the MODULATION and FREQUENCY display fields for 5 seconds or until another key is pressed.
10	Display IEEE-488 mode and address
11	Display self-test results. Zeros in the display fields indicate that the self tests have passed. See Section 4.
12	Turn on displays.
13	Turn off all displays. All other functions still operate.
14	Initialize memory locations to Instrument Preset State. Sto ? appears in the FREQUENCY display field for 5 seconds. If during this time, the [STO] key is Pressed, all memory locations are initialized.
15	Latch test. See Section 4.
16	Display option loading. See Interrogate Commands in this section.
17	Initiate self test with RF on. See Section 4.
20	Disable Relative Frequency. See Relative Function in this section.
21	Enable Relative Frequency. See Relative Function in this section.
30	Disable Relative Amplitude. See Relative Function in this section.
31	Enable Relative Amplitude. See Relative Function in this section.
40	Disable Internal Pulse Modulation. See Modulation Entry in this section
41	Enable Internal Pulse Modulation. See Modulation Entry in this section
50	Select dBm Amplitude Display Mode. See Amplitude Units Selection in this section.
51	Select dBmV Amplitude Display Mode. See Amplitude Units Selection in this section.
52	Select dBuV Amplitude Display Mode. See Amplitude Units Selection in this section.
60	Disable DC AM mode. See Modulation Entry in this section.
61	Enable DC AM mode. See Modulation Entry in this section.
70	Set repeat rate for EDIT and STEP keys to medium.
71	Set repeat rate for EDIT and STEP keys to fast.
72	Set repeat rate for EDIT and STEP keys to slow.
75	Display Compensation Memory status. See Section 4.
76	Repair Compensation Memory Errors. See Section 4.
77	Load FM MEC PROM data into Compensation Memory. See Section 4
78	Load Output MEC PROM data into Compensation Memory. See section 4.
79	Load Attenuator MEC PROM data into Compensation Memory. See section 4.
80	Enable Amplitude correction. Normal operation.
81	Disable Amplitude correction. RF output level may be up to 12 dB low.
82	Disable attenuator correction. Useful as a troubleshooting tool. RF input to attenuator is flat.
83	Program alternate 24 dB attenuation. See Section 4.
84	Program alternate 24 dB attenuation. See Section 4.
85	Program alternate 24 dB attenuation. See Section 4.
86	Program alternate 24 dB attenuation. See Section 4.
90	Disable Amplitude Fixed Range. See Amplitude Fixed Range in this section.
91	Enable Amplitude Fixed Range. See Amplitude Fixed Range in this section.
95	Initiate FM Keyboard Compensation Procedure. See Section 4E.
96	Initiate Output Keyboard Compensation Procedure. See Section 4E.
97	Initiate Attenuator Keyboard Compensation Procedure. See Section 4E.
98	Initiate Output with Default Attenuator Data Keyboard Compensation Procedure. See Section 4E.

The [CLR | LCL] key may be used to clear a partial DATA entry or clear the flashing REJ ENTRY indicator.

2-17. RF Output On/Off

The RF OUTPUT [ON/OFF] key allows the operator to enable or disable the RF output of the Generator. This feature is useful in zeroing a power meter, finding the noise floor of a system, or determining the presence or source of an unknown signal.

At power-on, the RF output of the Generator assumes the state it was in when the Generator was turned off. Pressing the RF OUTPUT [ON/OFF] key disables the output of the Generator and causes the RF OFF indicator (in the STATUS display field) to light. If the RF ON/OFF was off at power-on, pressing the [ON/OFF] key will enable output.

2-18. Modulation On/Off and Rate

The MODULATION ON/OFF keys allow the operator to select any combination of modulation or no modulation. The MODULATION display field indicates what combination of modulation has been selected. Each modulation key is a push-on push-off type (except the [400/1000] key).

The [400/1000] key toggles the internal modulation oscillator between 400 and 1000 Hz. The 400 Hz and 1000 Hz indicators are lit only when Internal AM, FM, ϕM, or Pulse modulation is enabled.

2-19. Memory

Memory entry using the [STO] key allows the operator to save up to 50 complete front panel settings for later recall. No memory location needs to be specified for the sequence operation.

The command syntax for memory entries is:

Select Memory Function — Enter Memory Location

1. Store the current front panel setting by pressing the [STO] key (located below the DATA keys). The last memory location stored or recalled is displayed in the FREQUENCY display field.

2. Use the DATA keys to enter the two-digit memory location code. The location code must contain both digits (e.g., 01, 02, ...50). The two-digit code appears in the FREQUENCY display field as it is entered.

3. Recall a front panel setting by pressing the [RCL] key (located below the DATA keys). The last memory location stored or recalled is displayed in the FREQUENCY display field.

4. Use the DATA keys to enter the memory location code of the desired front panel setting. Remember, the location code must contain both digits of the memory location code.

Memory location 98 contains the Instrument Preset State that can be recalled at any time.

The [SEQ] key allows the front panel settings stored in memory to be sequentially recalled. This process is activated by pressing the [SEQ] key at any time. When the [SEQ] key is pressed, the memory location code of the currently recalled setting appears in the FREQUENCY display field, and the location is recalled. When the last memory location is reached (50), the [SEQ] key starts over at 01. The [SEQ] key repeats while pressed.

2-20. Software Compensation Procedures

The software compensation procedures allow the operator to update the instrument-specific compensation data after making related repairs. These procedures are easy to use and may be performed via the front panel (local) or under computer control (remote) through the IEEE-488 Interface. The local procedures enable secondary functions for many of the keys. Each remote procedure enables a special set of compensation commands and disallows much of the standard IEEE-488 command set. See Section 4E, Software Compensation Procedures, for details.

2-21. Special Function

Special function entries allow the operator to enable several special operating functions in the Generator. For example, special functions allow the operator to change the repeat rate of the STEP and EDIT keys, start the self tests, display the results of the power-on self tests, display the IEEE-488 address, enable relative and fixed-range features, and disable or enable special attenuation features. A complete list of the special functions available is presented in Table 2-4.

The command syntax for special function entries is:

Select Special Function — Enter Special Function Code

1. Select the special function by pressing the [SPCL] key.

2. The special function code is entered using the DATA keys.

2-22. LOCAL AND REMOTE CONTROL OPERATIONS

The following paragraphs describe local and remote operations that have similar entry methods for each Generator function. The functions are arranged in alphabetical order. The syntax of the command and allowable data ranges are for each function. Other information is also presented.

2-23. Amplitude and Frequency Entry

The following information describes how to control the carrier frequency and amplitude by the FUNCTION-DATA-UNIT entry sequence. This method applies to both normal and relative operations. The frequency display is a fixed-point display in MHz. The amplitude display is fixed point while displaying dBm but is floating point when displaying voltage units.

The RF OUTPUT [ON/OFF] must be enabled for the Generator to produce an output. (See the reference material on RF OUTPUT ON/OFF Entry.)

Command Syntax:

Select Function — Enter Data — Select Unit

Summary:

	COMMAND	RANGE	RESOLUTION	NOTES
Set Frequency				
Local:	[FREQ] -- DATA -- [MHz|V] [kHz|mV] [Hz|uV]	0.1 to 2100 MHz	10/20 Hz	1,2,3
Remote:	"FR" -- float -- "GZ" "MZ" "KZ" "HZ"	0.1 to 2100 MHz	10/20 Hz	1,2,4
Set Amplitude				
Local:	[AMPL] -- DATA -- [dB(m)] [MHz|V] [kHz|mV] [Hz|uV]	-137 to +13/16 dBm 0.032 uV to 1.41/1.58 V	0.1 dBm 3 digits	3,5,6
Remote:	"AP" -- float -- "DB" "V" "MV" "UV" "NV"	-137 to +13/16 dBm 0.032 uV to 1.41/1.58 V	0.1 dBm 3 digits	4,5,6

Example:

Set Frequency to 10.7 MHz and Amplitude to -7.5 dBm.

Local: [FREQ] [1] [0] [.] [7] [MHz|V]
[AMPL] [-] [7] [.] [5] [dB(m)]

Remote: "FR10.7MZ,AP-7.5DB"

Notes:

1. Frequency ranging occurs at 245, 512, and 1050 MHz.
2. Frequency may be programmed with 10 Hz resolution when frequency $<$1050 MHz, and with 20 Hz resolution when frequency $\geq$1050 MHz.
3. FUNCTION ([FREQ] or [AMPL]) remains selected until another FUNCTION or [STEP], [STO], [RCL], or [SPCL] is pressed.
4. Floating-point number is indicated by the word float.
5. Amplitude uncalibrated range from -147.4 to -137.1 dBm. Also uncalibrated from +16.1 to +17 dBm when frequency $<$1050 MHz, and from +13.1 to +17 dBm when frequency $\geq$1050 MHz.
6. Amplitude ranging occurs at 1/2V, 1/4V, 1/8V, ... $1/2^{23}$V with AM off and 1/4V, 1/8V, 1/16V, ... $1/2^{24}$V with AM on.

Related Operations:

Amplitude Fixed Range
Amplitude Units Conversion
Amplitude Units Selection
Bright-Digit Edit Entry
Relative Function
Step Entry

2-24. Amplitude Fixed Range

The following information describes how to use the Fixed-Range special function. This special function fixes the current amplitude range (holds the currently selected step of the Step Attenuator). This function allows monotonic and nontransient level control over a limited range around those levels where the Step Attenuator normally autoranges. This level control may be accomplished with the Bright-Digit Edit Entry only.

The level vernier in fixed range has at least 18 dB of range (the specified accuracy range is 12 dB).

Command Syntax:

Select Fixed Range — Enable or Disable

Summary:

	COMMAND	NOTES
Enable Fixed Range		
Local:	[SPCL] [9] -- [1]	1
Remote:	"SP" "9" -- "1"	
Disable Fixed Range		
Local:	[SPCL] [9] -- [0]	2
Remote:	"SP" "9" -- "0"	

Example:

Set the Generator for monotonic and nontransient amplitude control (Bright-Digit Edit only) over the range of the vernier level control below 0.25V.

```
Local:   [AMPL] [.] [2] [5] [MHz|V]   [SPCL] [9] [1]

Remote:  "AP.25V,SP91"
```

Notes:

1. The amplitude range is fixed only for Bright-Digit Edit operations. Other methods of changing the amplitude cause the step attenuator to autorange if necessary.

2. With amplitude fixed range disabled, amplitude ranging occurs at 1/2V, 1/4V, 1/8V, ... $1/2^{23}$V with AM off and 1/4V, 1/8V, 1/16V, ... $1/2^{24}$V with AM on.

Related Operations:

Bright-Digit Edit Entry
Relative Function

2-25. Amplitude Units Conversion

The following information describes how to convert the displayed amplitude level from dBm to volts and from volts to dBm. The output of the Generator does not change during these operations.

Command Syntax:

Select Amplitude Function — Select Unit

Summary:

```
                             COMMAND              NOTE

Convert dBm to volts:

    Local:   [AMPL] -- [MHz|V]                     1
                       [kHz|mV]
                       [Hz|uV]

    Remote: "AP"    -- "V"                         1
                       "MV"
                       "UV"
                       "NV"

Convert volts to dBm:

    Local:   [AMPL] -- [dB(m)]

    Remote: "AP"    -- "DB"
```

Example:

Change the displayed amplitude of -10.0 dBm to its voltage equivalent.

```
Local:   [AMPL] [MHz|V]

Remote: "APV"
```

Note:

1. Any voltage unit is accepted since the microprocessor automatically selects the units appropriate for the value being displayed.

Related Operations:

Relative Function
Amplitude Units Selection

2-26. Amplitude Units Selection

The following information describes how to select the alternate level display units. When the level is displayed as a dB quantity, units of dBm, dBmV or dBμV may be selected by special function. Entering the special function code converts the displayed quantity to the selected units but does not change the output of the Generator.

Command Syntax:

Select Amplitude Units — Select Unit

Summary:

```
                          COMMAND                  NOTE

Select dBm Display Units

    Local:   [SPCL] [5] -- [0]

    Remote: "SP" "5"    -- "0"

Select dBmV Display Units

    Local:   [SPCL] [5] -- [1]

    Remote: "SP" "5"    -- "1"

Select dBuV Display Units

    Local:   [SPCL] [5] -- [2]

    Remote: "SP" "5"    -- "2"
```

2-27. Bright-Digit Edit Entry

The following information describes how to use a Bright-Digit Edit Entry to change an instrument parameter. The output frequency, amplitude, and modulation indexes can be modified with this entry method.

The RF OUTPUT [ON/OFF] must be enabled for the Generator to produce an output. (See the reference material on RF OUTPUT [ON/OFF] Entry.)

Command Syntax:

Select Display Field — Position Bright Digit — Change Bright-Digit Value

Summary:

```
                                COMMAND                        NOTES

Edit Frequency

    Local:   [FREQ] -- EDIT [<]/[>] -- EDIT [^]/[v]            1,2

    Remote: "FB"    -- float "GZ"    -- "KF" float             3,4,5
                         "MZ"
                         "KZ"
                         "HZ"
```

```
Edit Amplitude

    Local:  [AMPL] -- EDIT [<]/[>] -- EDIT [^]/[v]          1,2

    Remote: "AB"   -- float "DB"   -- "KA" float            3,4,5
                        "V"
                        "MV"
                        "UV"
                        "NV"

Edit FM/ØM Deviation

    Local:  [FM|ØM] -- EDIT [<]/[>] -- EDIT [^]/[v] 1,2

    Remote: "DB"   -- float "GZ"   -- "KD" float            3,4,5
                        "MZ"
                        "KZ"
                        "HZ"
                        "RD"

Edit AM Depth

    Local:  [AM]   -- EDIT [<]/[>] -- EDIT [^]/[v]          1,2

    Remote: "PB"   -- float "PC"   -- "KP" float            3,4,5
```

Example 1:

Edit the displayed amplitude of 9.7 to 10.0 dBm.

Local: Put the bright digit in the amplitude display by pressing [AMPL]. Select the least significant digit in that display by pressing EDIT [>] until the bright digit is on that digit. Increase the value of that digit by pressing EDIT [^] three times.

Remote: "AB.1DB,KA3"

Example 2:

Edit the displayed FM Deviation from 5.0 to 3.0 kHz.

Local: Put the bright digit in the FM display by pressing [FM]. Select the 1-kHz digit by pressing the EDIT [>] or EDIT [<] until the bright digit is on that digit. Decrease the value of that digit by pressing EDIT [v] twice.

Remote: "DB1KZ,KD-2"

Notes:

1. The bright-digit field remains selected until another display field is selected.

2. The bright-digit position is maintained for each of the four functions so that the bright digit can be moved from one display to another and back without losing its position in the previous display field.

3. Floating-point number is indicated by the word float.

4. In remote, the bright digit is positioned within a display field using a decade value and associated unit. Minus signs are ignored.

5. In remote, the bright digit is moved to the corresponding field and is increased or decreased by the signed integer following the "KF,KA,KD,KP" messages. The generic edit command "KB" may also be used to edit up or down the current bright-digit position. Positive integers do not require a sign.

Related Operations:

Relative Function
Amplitude Fixed Range

2-28. Memory Entry

The following information describes how to use the memory function to store and recall front panel settings. The Generator has 50 memory locations that are retained for 2 years with the power off.

The sequence feature allows the operator to recall successive memory locations.

Command Syntax:

Select Memory Function — Enter Memory Location

Summary:

	COMMAND	NOTES
Store		
Local:	[STO] -- [n] [n]	1,2,3
Remote:	"ST" -- int	1,4
Recall		
Local:	[RCL] -- [n] [n]	1,2,3
Remote:	"RC" -- int	1,4
Sequence		
Local:	[SEQ]	5,6
Remote:	"SQ"	5

Example:

Recall the Instrument Preset State (located in memory location 98). Change the frequency parameter to 302 MHz, then store the new front panel setting in memory location 06.

```
Local:  [RCL] [9] [8]   EDIT [^] [^]  [STO] [0] [6]

Remote: "RC98,KF2,ST6"
```

Notes:

1. The memory locations available for operator use are 01 through 50. Additionally, the following special memory locations are available:

   Memory location 00 contains a backup-memory location. After a recall (or sequence) operation it contains the last front panel setting. After a store operation, it contains the data in the stored memory location before the store operation. Thus, a recall operation can be reversed by recalling location 00.

   Memory location 98 contains the Instrument Preset State.

   Memory location 99 contains the present instrument state.

2. In local control, two data digits must be entered to specify the memory location. The recall or store is performed when the second digit is released.

3. The last memory location specified (used for sequence operations) is displayed while the [STO] or [RCL] button is pressed.

4. An unsigned integer is indicated with int.

5. The sequence operation recalls the next higher memory location, starting from the last memory location stored or recalled. No memory location needs to be specified. When the highest location is reached, the sequence starts over again at location 01.

6. While [SEQ] is pressed, the next memory location number is displayed and the memory location is recalled. This key is repeating.

2-29. Modulation Entry

The following information describes how to preset the modulation index (AM depth or FM/ϕM deviation), internal modulation rate (400 or 1000 Hz), and how to select the modulation source (internal and/or external).

The FUNCTION-DATA-UNIT method of selecting the modulation index is summarized in the following command syntax. The indices may also be modified using Bright-Digit Edit or Step Entry. Since there is only one modulation display, the modulation index displayed is determined by the last modulation FUNCTION key pressed.

Command Syntax:

Select Function — Enter Data — Select Unit

Summary:

	COMMAND	RANGE	RESOLUTION	NOTES
Set AM Depth				
Local:	[AM] -- DATA -- [%]	0 to 99%	1%	1,2
Remote:	"AM" -- float -- "PC"	0 to 99%	1%	1,2,3
Set FM Deviation				

```
Local:   [FM|ØM] -- DATA  -- [MHz|V]     0 to 400 kHz  3 digits     1,4,5
                             [kHz|mV]
                             [Hz|uV]
                             [%|rad]     0 to 40.0 rad 3 digits

Remote: "FM" -- float -- "GZ"            0 to 400 kHz   3 digits  1,3,4,5
                          "MZ"
                          "KZ"
                          "HZ"
                          "RD"           0 to 40.0 rad  3 digits
```

Summary:

```
                    COMMAND                                        NOTES

   Select Modulation Rate

      Local:   [400/1000]                                          6

      Remote: "MR" "0" or "1"                                      7
```

Summary:

```
                    COMMAND                                        NOTES

   Enable or Disable AM, DCAM, FM/ØM or Pulse Modulation

      Local:   [INT AM]                                            8,9
               [INT FM ØM]
               [EXT AM]
               [EXT FM ØM]
               [EXT ⎍ ]

               [SPCL] [4] -- [0] or [1]                            10
               [SPCL] [6] -- [0] or [1]                            11

      Remote: "AI" "0" or "1"                                      12
              "FI" "0" or "1"
              "AE" "0" or "1"
              "FE" "0" or "1"
              "PE" "0" or "1"

              "PI" "0" or "1"                                      10,12
              "DA" "0" or "1"                                      11,12
```

Example:

Set the FM deviation to 5 kHz, set the modulation rate to 400 Hz, and modulate the carrier internally.

```
Local:   [FM|ØM] [5] [kHz] [INT FM] [400/1000]

Remote: "FM5KZ,MR0,FI1"
```

Notes:

1. This operation does not change the Generator output unless the corresponding modulation is enabled.
2. Uncalibrated if peak amplitude exceeds +16 dBm when frequency <1050 MHz, or +13 dBm when frequency ≥1050 MHz.
3. Floating-point number is indicated with the word float.
4. Uncalibrated if FM is enabled and FM deviation is above (frequency -150 kHz).
5. The maximum FM deviation is dependent on the output frequency. Deviations up to 400 kHz or 40.0 radians may be entered regardless of the output frequency; however, the UNCAL indicator is flashed if the limits specified in Table 4D-14 are exceeded. The maximum deviations are reduced to 40.0 kHz and 4.00 rad if the low-rate FM option is installed.
6. Toggles between 400 or 1000 Hz only. An indicator shows selected rate only if internal modulation is on.
7. "0" selects a modulation rate of 400 Hz; "1" selects 1000 Hz.
8. These are ON/OFF operations; any combination is allowed.
9. Two indicators EXT HI and EXT LO are lit when external AM or FM is on to indicate that the external modulation signal is 2% above or 2% below the nominal 1V peak input requirement.
10. Internal pulse modulation can be enabled by special function or by the alternate IEEE-488 command "PI". It can be enabled with any combination of the above modulations.
11. The dc coupled AM mode can be enabled by special function or by the alternate IEEE-488 command "DA". The dc coupled AM mode works in conjunction with External AM and only affects the output of the Generator if External AM is also enabled.
12. "0" turns the modulation source off; "1" turns it on.

Related Operations:

Bright-Digit Edit
Entry Step Entry

2-30. Relative Function

The following paragraphs describe how to change frequency and amplitude using the relative mode. There are two steps:

1 Setting the reference

2 Changing the parameter relative to that reference

Setting the reference is done by setting the parameter to the desired value and then enabling the relative mode for that parameter. This causes the REL indicator to light and the displayed value to be zero in the corresponding display. The Generator output does not change during these operations. In the relative mode, the usual means of changing the parameter may be used; i.e., Function, Step, or Bright-Digit Edit Entry.

In the relative frequency mode, the actual frequency is the sum of the reference and the displayed frequency. The actual frequency may be displayed by pressing the [FREQ] key. If the 10/20 Hz frequency resolution boundary is crossed using the step or edit functions while in the relative frequency mode, a 10-Hz rounding quantity may be applied to the displayed frequency.

In the relative amplitude mode, the actual amplitude is the sum of the reference and the displayed amplitude when the reference and the displayed quantities have the same units. However, with mixed units (volts and dB), the actual amplitude is the voltage value scaled by the dB value. The actual amplitude may be displayed by pressing the [AMPL] key.

Command Syntax:

Select Relative Function — Enable or Disable

Summary:

	COMMAND	NOTE
Frequency		
Local:	[SPCL] [2] -- [0] or [1]	1
Remote:	"SP" "2" -- "0" or "1"	1
Amplitude		
Local:	[SPCL] [3] -- [0] or [1]	1
Remote:	"SP" "3" -- "0" or "1"	1

Example:

Set the amplitude to -15 dBV; i.e., 15 dB below 1 volt.

Local: [AMPL] [1] [MHz|V] [SPCL] [3] [1] [AMPL] [-] [1] [5] [dB(m)]

Remote: "AP1V,SP31,AP-15DB"

Note:

1. 1 enables the relative function; 0 disables the relative function.

Related Operations:

Amplitude and Frequency Entry
Bright-Digit Edit Entry
Step Entry

2-31. RF OUTPUT ON/OFF Entry

The following information describes how to enable the output of the Generator using the RF OUTPUT [ON/OFF] key and the corresponding remote code.

Command Syntax:

RF Output On/Off

Summary:

COMMAND	NOTE
RF Output On	
Local: RF OUTPUT [ON/OFF] when RF OFF is on	1
Remote: "R01"	1
RF Output Off	
Local: RF OUTPUT [ON/OFF] when RF OFF is off	
Remote: "R00"	

Note:

1. Turning the RF Output on resets the RPP circuitry if it has tripped.

2-32. Special Function Entry

The following information describes how to use the Special Function Entry to use the special operating functions of the Signal Generator. Table 2-4 lists the special functions available.

The special function code is a two-digit number. The first digit indicates the classification of the special function, and the second digit specifies the particular special function.

The special function is executed when the second special function code digit is entered. There are ten classes of special functions. The special functions in the 0(n) and 1(n) class cause an action to be performed. Classes 2(n) through 9(n) cause an instrument state to change. The status of classes 2(n) through 9(n) appears (left to right) in the frequency display field when the [SPCL] key is pressed. Table 2-4 describes the special functions available with the Generator.

Command Syntax:

Select Special Function — Enter Special Function Code

COMMAND	NOTE
Local: [SPCL] -- [n] [n]	
Remote: "SP" -- int	1

Example:

Change the repeat rate of the EDIT and STEP keys to slow.

```
Local:  [SPCL] [7] [2]

Remote: "SP72"
```

Note:

1. Unsigned integer is indicated with int.

Related Operations:

Fixed Range
Relative Function

2-33. Status and Clear Entry

The status entry allows the operator to interrogate the Generator for an explanation of either uncalibrated operation (UNCAL indicator is lit) or rejected entry operation (the REJ ENTRY indicator in lit).

When either the UNCAL or REJ ENTRY indicator is lit, press and hold the [STATUS] key to display the Uncalibrated or Rejected Entry Error Code Message. These messages provide detailed information on the nature of the uncalibrated or rejected entry condition. Table 2-5 contains a list and explanation of all the Uncalibrated Error Code Messages. Table 2-6 contains a list and explanation of all the rejected entry error code messages.

The [CLR | LCL] key may be used to clear a partial DATA entry or clear the flashing REJ ENTRY indicator. Press the [STATUS] key while an UNCAL indication exists to display the uncal error codes in three fields:

Flashing codes (denoted by *) indicate abnormal operation or aberrated output. Non-flashing codes indicate operation outside the specified range.

Press the [STATUS] key while the REJ ENTRY indication exists to display the reject entry error codes:

2-34. Step Entry

The following information describes how to use the step entry function to change an instrument parameter. The RF OUTPUT [ON/OFF] must be enabled for the Generator to produce an output. (See the RF OUTPUT [ON/OFF] Entry information covered earlier in this section.)

Command Syntax:

Select Step Function — Enter Data — Select Units — Change Parameter

Summary:

```
                   COMMAND              RANGE           RESOLUTION     NOTES

     Frequency

        Local:   [FREQ][STEP]--DATA --[MHz|V] --STEP [^]/[v]
                                      [kHz|mV]
                                      [Hz|uV]
                                 0 to 2100 MHz    10 Hz
```

```
        Remote: "FS"         --float--"GZ"       --"FU"/"FD"
                                      "MZ"
                                      "KZ"
                                      "HZ"
                                  0 to 2100 MHz    10 Hz              1,2

    Amplitude

        Local: [AMPL][STEP]--DATA --[dB(m)]   -- STEP [^]/[v]
                                     [MHz|V]
                                     [kHz|mV]
                                     [Hz|uv]
                                  0 to 164 dB      0.1 dB
                                  0 nV to 1999 V   3 digits

        Remote: "LS"         --float--"DB"       --"LU"/"LD"
                                      "V"
                                      "MV"
                                      "UV"
                                      "NV"
                                  0 to 164 dB      0.1 dB             1,2
                                  0 nV to 1999V    3 digits           1,2

    FM/ØM deviation

        Local:  [FM|ØM][STEP]  --DATA --[MHz|V] -- STEP [^]/[v]
                                        [kHz|mV]
                                        [Hz|uV]
                                        [%|rad]
                                  0 to 400 kHz     3 digits            3
                                  0 to 40.0 rad    3 digits

        Remote: "DS"         --float--"GZ"       --"DU"/"DD"
                                      "MZ"
                                      "KZ"
                                      "HZ"
                                      "RD"
                                  0 to 400 kHz     3 digits            1,2,3
                                  0 to 40.0 rad    3 digits

    AM depth

        Local:  [AM][STEP]   --DATA --[%]        -- STEP [^]/[v]
                                  0 to 99%         1%

        Remote: "PS"         --float--"PC"       --"PU"/"PD"
                                  0 to 99%         1%                 1,2
```

Example:

Recall the Instrument Preset State: [RCL] [9] [8]. Step the displayed frequency of 300 MHz, in 10-MHz steps, to 270 MHz.

```
Local:  [FREQ]   [STEP]   [1] [0] [MHz|V]   [v] [v] [v]STEP

Remote: "FS10MZ,FD,FD,FD"
```

Notes:

1. Floating-point number is indicated with the word float.

Table 2-5. UNCAL Error Codes

CODE	DESCRIPTION
000 000 000	= No UNCAL conditions
002 000 000	= FM Dev/ØM > (freq -150 kHz)
*004 000 000	= Excess FM Dev/ØM, main or reference PLL unlocked
*010 000 000	= FM DAC at full scale
200 000 000	= Multiple COMP memory checksum errors. See Compensation Memory Status in Section 2.
*000 010 000	= Main or reference PLL unlocked
000 000 001	= Level vernier > 12 dB below bottom of range
000 000 002	= Peak amplitude > +16 dBm for freq < 1050 MHz or > +13 dBm for freq >= 1050 MHz
*000 000 004	= Amplitude unleveled
*000 000 010	= Fixed-range level vernier at 0
*000 000 020	= Fixed-range level vernier at full scale
*000 000 040	= RPP tripped
000 000 100	= Level < -137 dBm
000 000 200	= Level correction disabled
*000 000 400	= RF off

Flashing codes (denoted by *) indicate abnormal operation or aberrated output. Non-flashing codes indicate operation outside specified range.

Table 2-6. REJect ENTRY Codes

CODE	DESCRIPTION
000 000 000	= No rejected entries
001 000 000	= FM Dev/ØM not between 0 and 400 kHz (40.0 kHz with Option -651)
002 000 000	= FM Dev/ØM Step not between 0 and 400 kHz (40.0 kHz with Option -651)
004 000 000	= AM Depth not between 0 and 99%
010 000 000	= AM Depth Step not between 0 and 99%
020 000 000	= IEEE-488 command syntax error
040 000 000	= IEEE-488 input value out of range
100 000 000	= MEC compensation PROM error
200 000 000	= IEEE edit or step operation beyond allowed range
400 000 000	= Invalid frequency in COMP memory
000 001 000	= Frequency not between 100 kHz and 2100 MHz
000 002 000	= COMP switch not enabled or low-rate FM option not disabled
000 004 000	= Frequency Step not between 0 and 2100 MHz
000 010 000	= COMP data may not be stored if procedure incomplete
000 020 000	= Invalid compensation command
000 040 000	= Invalid memory location
000 100 000	= Invalid data in memory
000 200 000	= Special function not allowed
000 400 000	= COMP data range error
000 000 001	= Output amplitude not between 10 nV and 1.58V
000 000 002	= Insufficient resolution for units conversion
000 000 004	= Units conversion to volts not allowed with reference in volts
000 000 010	= Units conversion to dB not allowed with reference in volts
000 000 020	= Amplitude Step not between 0 and 164 dB or 0 and 1999V
000 000 040	= Units conversion of Amplitude or FM/ØM Step not allowed
000 000 100	= Amplitude or FM/ØM step and current display not in same units
000 000 200	= COMP data from IEEE-488 out of range or edit beyond COMP limits
000 000 400	= Internal compensation data transfer error

2. Entering the step size from IEEE-488 does not select the step function. For example, "FS10MZ" does not select the step function; "FD" or "FU" must be used to select the frequency step function. The generic step up/down commands "SU" and "SD" may be used to step the current step function.

3. If the Low-Rate FM option is installed, the range of FM deviation steps is 0 to 40.0 kHz, and the range of ϕM deviation steps is 0 to 4.00 rad.

Related Operations:

Relative Function

2-35. REMOTE OPERATION (IEEE-488 INTERFACE)

The following paragraphs describe how to operate the Generator using the IEEE-488 Interface (referred to as remote operation). The interface allows the operator to program the Generator and operate instrument functions via the IEEE-488 bus (with the exception of the front panel POWER switch and the rear panel REF INT/EXT switch). The IEEE-488 Interface also provides additional programming features not accessible from the front panel.

The rest of this section is divided into two parts: the first part describes how to set up the Generator for operation on the IEEE-488 bus and gives some typical programming examples. The first part also includes a complete list of the programming commands recognized by the Generator software.

The second part describes the implementation of the IEEE-488 Interface and programming features that are accessible only from the IEEE-488 Interface. The second part also includes typical timing data, provided as an aid to system programmers. This information can assist in writing programs that have greater speed and efficiency.

The Generator can be used with any IEEE-488 controller in the normal addressed mode. The following two additional modes are available for operation without a controller:

Listen-only mode
Talk-only mode

In the listen-only mode, the Generator responds to all data messages on the IEEE-488 bus. In the talk-only mode, the Generator sends commands on the IEEE-488 bus to program another 606xA Generator (or a 607xA with some restrictions).

2-36. Setting Up the IEEE-488 Interface

Figure 2-5 shows a 6062A Signal Generator connected to a 1722A via the IEEE-488 bus.

Use the following procedure to set up the Generator with the IEEE-488 Interface:

1. Connect a standard IEEE-488 cable between the Generator and the IEEE-488 device.

NOTE

The IEEE-488 Interface signal SHIELD (pin 12) can be disconnected (when using an IEEE-488 cable without a metallic hood) from instrument ground. To do this, use the left most address switch (as viewed from the rear panel).

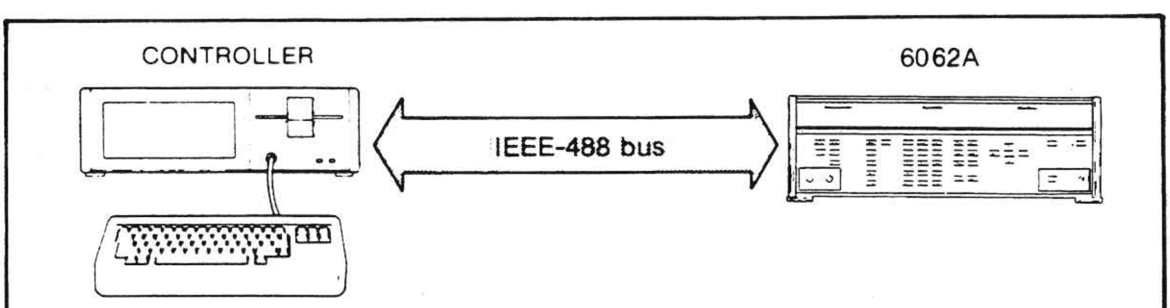


Figure 2-5. 6062A Synthesized RF Signal Generator Connected to a 1722A

2. Select the IEEE-488 address and mode as follows:

   a. Set both the LISTEN ONLY and TALK ONLY switches (located on the rear panel of the Generator) to 0 (down). Set switches a1 through a5 to the desired address 0 through 30. For example, for an address of 1, set switches a2, a3, a4, and a5 to 0 (down), and set switch a1 to 1 (up).

   b. For talk-only operation, set the TALK ONLY switch to 1 (up).

   c. For listen-only operation, set the LISTEN ONLY switch to 1 (up) and set the TALK ONLY switch to 0 (down).

3. Verify the address and mode:

   a. Press the [SPCL] and the [1] [0] keys. Verify that the selected address appears in decimal in the FREQUENCY display field.

   b. If the talk-only mode or listen-only mode has been selected, "to" or "lo" appears to the left of the address in the FREQUENCY display field.

NOTE

The address switches are continuously monitored except when in remote. The TALK ONLY and LISTEN ONLY switches are only read when the Generator is powered on.

2-37. Programming Commands

After the address and mode have been set, the Generator can be programmed by an IEEE-488 controller or from another generator. Tables 2-7 and 2-8 and the programming examples following them provide the basic information on how to program the Generator.

Table 2-7. Index of IEEE-488 Commands

FUNCTION	COMMAND HEADERS
Amplitude Entry	AP, SP3x, RA, SP5x, SP8x, SP9x
Binary Learn Commands	LI, LM
Clear Commands	CB, CE, CL
Compensation Mode Commands	CM
Compensation Procedure Commands	CF, CP, IC, IH
Edit Entry	AB, DB, FB, PB, KB, KA, KD, KF, KP
Frequency Entry	FR, SP2x, RF
Interface Mode Commands	EM, RM, TM, VM, UM, @
Interrogate Commands	IA, ID, IE, II, IL, IO, IR, IS, IT, IU, IV, IZ
Memory Entry	RC, ST, SQ
Modulation Entry	AM, AE, AI, SP6x, DA, FM, FE, FI, MR, MF, PE, SP4x, PI
Monitor Commands	IB, OB, OD, RB, RW, DW, WB, WW, XA, XB, XD, XR
RF ON/OFF Entry	RO
Special Function Entry	SP
SRQ Commands	IM, SM, XF
Step Entry	FS, LS, PS, DS, SU, SD, FU, FD, LU, LD, PU, PD, DU, DD
Trigger Commands	CT, TR

Table 2-8. IEEE-488 Commands

COMMAND USE	COMMAND HEADER	COMMAND NUMERIC	COMMAND SUFFIX	COMMENTS
AMPLITUDE ENTRY				
Program Amplitude	AP	float	 V MV UV NV DB	Program displayed amplitude in units of: volts millivolts microvolts nanovolts dB, dBm, dBmV or dBuV
Convert Amplitude Units	AP	none	V MV UV NV DB	Change amplitude units to: volts volts volts volts dB, dBm, dBmV or dBuV
Relative Amplitude	SP	30/31	none	Disable/enable relative amplitude operation
Relative Amplitude	RA	0/1		Alternate programming command for disable/enable relative amplitude operation.
Amplitude Display Units	SP	50 51 52	none	Select dBm units Select dBmV units Select dBuV units
Level Correction	SP	80 81 82	none	Enable all level correction. Disable all level correction. Disable attenuator correction.
Amplitude Fixed Range	SP	90/91	none	Disable/enable amplitude fixed-range operation.
BINARY LEARN COMMANDS				
Store a Front Panel Setup	LI	int	string	The Generator stores the string into the memory location specified by int. See the Command Description paragraph for decoding the learn string.
Send a Front Panel Setup	LM	int	none	The Generator responds with the contents of the memory location specified by int. See the Command Descriptions paragraph for decoding the learn string.
CLEAR COMMANDS				
Clear IEEE-488 Output Buffer	CB	none	none	Clears IEEE-488 output buffer.
Clear error	CE	none	none	Clears the IEEE-488 rejected entry status.

Table 2-8. IEEE-488 Commands (cont)

Device Clear	CL	none	none	Clears the instrument state and exits all compensation procedures.
COMPENSATION MODE COMMANDS				
Compensation Mode	CM	none	AT FM OD OT SV EX	Begin Attenuator compensation procedure. Begin FM compensation procedure. Begin Output with default attenuator compensation procedure. Begin Output compensation procedure. Save compensation data and exit compensation procedure. Exit compensation procedure without saving the data.
COMPENSATION PROCEDURE COMMANDS				
Compensation FM Entry	CF	float	GZ MZ KZ HZ	Accept FM deviation reading from modulation analyzer during FM compensation procedure.
Compensation Amplitude Entry	CP	float	DB	Accept amplitude reading from power meter during level compensation procedure.
Interrogate Compensation Step Data	IC	none	FR TG	Interrogate the frequency of the current compensation procedure step. Interrogate the target level or FM deviation of the current compensation procedure step.
Interrogate Het Adjustment Data	IH	none	none	Interrogate the frequency and level offset necessary to make the het compensation adjustment. For example, "+0000120000.,+00000000.30"<EOR> indicates the adjustment should be made at 120 kHz and the level needs to be adjusted up .3 dB.
EDIT ENTRY				
Position Amplitude Bright Digit	AB	float	V MV UV NV DB	Position the bright digit in the AMPLITUDE display with the stated resolution. For example, enter "AB10MV" for a 10-mV resolution.
Position FM Bright Digit	DB	float	GZ MZ KZ HZ RD	Position the bright digit in the FM display with the stated resolution. For example, enter "DB1KZ" for a 1-kHz resolution.

Table 2-8. IEEE-488 Commands (cont)

Position Frequency Bright Digit	FB	float	GZ MZ KZ HZ	Position the bright digit in the FREQUENCY display with the stated resolution. For example, enter "FB1MZ" for a 1-MHz resolution.
Position AM Bright Digit	PB	float	PC	Position the bright digit in the AM display with the stated resolution. For example, enter "PB1PC" for a 1% resolution.
Edit	KB	float	none	Edit the current bright digit by float counts.
Edit Amplitude	KA	float	none	Move the bright digit to the AMPLITUDE display and edit amplitude by float counts.
Edit FM	KD	float	none	Move the bright digit to the FM display and edit FM by float counts.
Edit Frequency	KF	float	none	Move the bright digit to the FREQUENCY display and edit frequency by float counts.
Edit AM	KP	float	none	Move the bright digit to the AM display and edit AM by float counts.
FREQUENCY ENTRY				
Frequency Programming	FR	float	 GZ MZ KZ HZ	Program displayed frequency in units of: gigahertz megahertz kilohertz hertz
Relative Frequency	SP	20/21	none	Disable/enable relative frequency operation.
Relative Frequency	RF	0/1	none	Alternate programming command for disable/enable relative frequency operation.
INTERFACE MODE COMMANDS				
Error Mode	EM	0/1	none	Disable/enable the clear error mode. If disabled, the IEEE-488 error status is cleared only when interrogated. If enabled, the error status is cleared when a new message is processed.
Record Mode	RM	0/1	none	Disable/enable the record mode. If disabled, the message unit is a command. If enabled, a message unit is a record. The message unit is the smallest group of characters that the Generator processes.

Table 2-8. IEEE-488 Commands (cont)

Record Terminator Mode	TM	0/1	none	Selects the LF/CR character as the record terminator. The record terminator is used on input in the record mode and is sent following all output.
Output Valid Mode	VM	0/1	none	Disable/enable the output valid mode. In the output valid mode, the Generator waits to process commands until the RF output has become valid.
Unbuffered Mode	UM	0/1	none	Disable/enable the unbuffered mode. If disabled, all input is buffered. If enabled, only one message unit is buffered.
"@" Modes	@	int	none	The "@" command may be used as an alternate method of programming interface modes.
INTERROGATE COMMANDS				
Interrogate Attenuator Counts	IA	none	none	The Generator responds with seven counts. Each count indicates the total number of actuations for one of the seven attenuator sections in the Generator.
Instrument Identification	ID	none	none	The Generator responds with its model number, for example, "6062A".
Elapsed Time Indicator	IE	none	none	The Generator responds with the total operating time since the Generator was manufactured.
Interface Modes	II	none	none	Interrogate the interface modes selected. The Generator responds with an unsigned integer.
Interrogate Error Log	IL	none	none	The Generator responds with ten error log entries. Each entry is an uncal error code or a self test result and the elapsed time of when the error was logged.
Option Loading	IO	none	none	Interrogate the option loading. The Generator responds with the message: d1, d2, d3 d1 is the instrument code. d2 is the digital and synthesizer options. d3 is the output options. See the Interrogate Commands paragraphs for details.

Table 2-8. IEEE-488 Commands (cont)

Rejected Entry	IR	none	none	Interrogates the rejected entry error codes. The Generator responds with three octal fields: "AAAAAA,BBBBBB,CCCCCC". See Table 2-6 for a list of rejected entry error codes.
Serial Number	IS	none	none	Interrogates the instrument serial number.
Self Test	IT	none	none	Interrogates the results of the self tests. The Generator responds with the self-test results. See paragraph 4D-20 for self-test codes.
UNCAL	IU	none	none	Interrogates the uncalibrated output error codes. The Generator responds with three octal fields: "AAAAAA,BBBBBB,CCCCCC". See Table 2-5 for a list of uncal error codes.
Software Version	IV	none	none	Interrogate the software version. The Generator responds with the status message: "Vxx.x" where x's are decimal digits representing the current software revision level.
Compensation Memory Status	IZ	none	none	Interrogates the compensation memory status. The Generator Responds with three fields: "AAAAAA,BBBBBB,CCCCCC". See Table 4D-7 for a list of status codes.
MEMORY ENTRY				
Recall	RC	int	none	Recall the front panel setup stored at the memory location specified by int.
Store	ST	int	none	Store the current front panel setup at the memory location specified by int.
Sequence	SQ	none	none	Sequence (recall) to the next higher memory location.
MODULATION ENTRY				
Program AM	AM	float	PC	Program AM depth in percent.
External AM	AE	0/1	none	Disable/enable external AM
Internal AM	AI	0/1	none	Disable/enable internal AM

Table 2-8. IEEE-488 Commands (cont)

DC coupled AM	SP	60/61	none	Disable/enable DC coupled AM
DC coupled AM	DA	0/1	none	Alternate programming command for disable/enable DC coupled AM operation
Program FM	FM	float	 GZ MZ KZ HZ RD	Program FM deviation in units of: gigahertz megahertz kilohertz hertz radians
External FM	FE	0/1	none	Disable/enable external FM
Internal FM	FI	0/1	none	Disable/enable internal FM
Program Mod Freq	MR	0/1	none	Program modulation frequency to 400 Hz/1000 Hz.
Program Mod Freq	MF	float	 GZ MZ KZ HZ	Program modulation frequency in units of: gigahertz megahertz kilohertz hertz
External Pulse	PE	0/1		Disable/enable external pulse modulation
Internal Pulse	SP	40/41		Disable/enable internal pulse modulation
Internal Pulse	PI	0/1		Alternate programming command for disable/enable internal pulse modulation operation
MONITOR COMMANDS				
Input Bit	IB	none	BIT Designator	Respond with the value of the designated hardware bit.
Output Bit	OB	0/1	BIT Designator	Set the designated hardware bit to 0 or 1.
Output Dac	OD	int	DAC Designator	Set the value of the designated hardware DAC to the value specified by int.
Read Byte	RB	int	none	Read the value of the addressed byte. The Generator responds with an unsigned integer.
Read Word	RW	int	none	Read the value of the addressed word. The Generator responds with an unsigned integer.

Table 2-8. IEEE-488 Commands (cont)

Define Write Address	DW	int	none	Defines the address to be used by the write byte/word commands.
Write Byte	WB	int	none	Write int into the address specified with the define write address command.
Write Word	WW	int	none	Write int into the address specified with the define write address command.
Read Attenuation	XA	none	none	Read the current attenuation. The Generator responds with an unsigned integer.
Write Attenuation	XB	none	none	Change attenuation to 6dB times the unsigned integer. The integer can be 0 to 23.
Set Frequency Direct	XD	float	GZ MZ KZ HZ	Set the frequency hardware directly to the specified synthesizer frequency.
RF Output	XR	0/1	none	"XR0" programs all attenuation. "XR1" restores attenuation to its previous state.
RF ON/OFF ENTRY				
RF Output	RO	0/1	none	Turn RF output off/on.
SPECIAL FUNCTION ENTRY				
Special Functions	SP	00 02 03 04 07/08 09 10 11 12/13 14 15 16 17 20/21 30/31 40/41 50 51 52 60/61 70 71 72 75 76 77-79		Clears all special functions Initiates self test Display check Key check Set/reset SRQ Display S/W rev and instr ID Display IEEE-488 address Display self-test results Turn on/off display Initialize memory Latch test Display option loading Initiates self test with RF on Disable/enable relative freq Disable/enable relative ampl Disable/enable internal pulse Select dBm ampl display units Select dBmV ampl display units Select dBuV ampl display units Disable/enable DC AM Medium key repeat rate Fast key repeat rate Slow key repeat rate Display COMP memory status Repair COMP memory errors Copy MEC PROM data

Table 2-8. IEEE-488 Commands (cont)

		80 81 82 83-86 90/91 95-98		Enable all level correction Disable all level correction Disable attenuator correction Program alternate 24dB attens Disable/enable ampl fixed-rng Local COMP procedures
SRQ COMMANDS				
Interrogate SRQ Mask	IM	none	none	Interrogate the SRQ mask. The Generator responds with the decimal value of the SRQ mask.
Set SRQ	SM	int	none	The SRQ mask is set to int.
Local Operation Alert Mode	XF	0/1	none	Disable/enable a mode to set SRQ each time a local entry is made. This SRQ is enabled by setting the front panel bit in the SRQ mask.
STEP ENTRY				
Program FREQ STEP Size	FS	float	 GZ MZ KZ HZ	Program frequency step size in units of: gigahertz megahertz kilohertz hertz
Program AMPL STEP Size	LS	float	 V MV UV NV DB	Program amplitude step size in units of: volts millivolts microvolts nanovolts dB
Program AM STEP Size	PS	float	PC	Program AM step size in percent.
Program FM STEP Size	DS	float	 GZ MZ KZ HZ RD	Program FM step size in units of: gigahertz megahertz kilohertz hertz radians
Step Up/Down	SU/SD	none	none	Step the currently selected step function up/down one step.
Step Up/Down Frequency	FU/FD	none	none	Change the current step function to frequency and step frequency up/down one step.
Step Up/Down Amplitude	LU/LD	none	none	Change the current step function to amplitude and step amplitude up/down one step.

Table 2-8. IEEE-488 Commands (cont)

Step Up/Down AM	PU/PD	none	none	Change the current step function to AM and step AM up/down one step.
Step Up/Down FM	DU/DD	none	none	Change the current step function to FM and step FM up/down one step.
TRIGGER COMMANDS				
Configure Trigger	CT	string	none	Configures the trigger. Each time a trigger command or a group execute trigger interface message is received, the Generator executes the string of commands. The string record must end with a record terminator.
Trigger	TR	none	none	Trigger command. Equivalent to the group execute interface message. Upon processing the trigger command, the Generator executes the string, which has been preprogrammed with the configure trigger command.

More details about the commands can be found in two places. Commands that are available from the front panel are described earlier in this section (Local and Remote Operation). Those commands that are only available from the IEEE-488 Interface are described in the Command Descriptions paragraphs later in this section.

Table 2-7 is an index for the IEEE-488 Commands used in Table 2-8. This index is a list of the command headers according to function. Table 2-8 lists all the remote commands that are recognized by the Generator. The commands are listed alphabetically by function.

2-38. Programming Examples

The following three examples show how to use the IEEE-488 bus and how to use a variety of controllers to program the Generator. In the first example, a Fluke 1722A Controller is used to program the Generator. In the second example, two Generators are configured to track each other in frequency. In the third example, a 1722A is used to program the Generator with the frequency step up controlled by the trigger command.

2-39. PROGRAMMING EXAMPLE 1

Use the following procedure to program the Generator with a Fluke 1722A Instrument Controller to this state:

Frequency	210 MHz
Amplitude	6 dBm
Modulation Freq.	1000 Hz
FM	5 kHz
Internal FM	ON
AM	15%
External AM	ON

1. Connect the Generator to the controller with an IEEE-488 cable.

2. Set the address switch of the Generator as follows (as viewed from the rear of the instrument):

   00000010

3. Enter the following program into the controller:

```
1    ! Fluke 1722A BASIC program to control a 6062A.
2    ! The Address of the 6062A is 2.
3    A% = 2%
10   ! Clear the 6062A so that it is in a known state.
15   INIT PORT 0
20   REMOTE @A% \ CLEAR @A%
100  ! SET THE 6062A.
110  PRINT @A%, "FR210MZ,AP6DB,MR1,FM5KZ,FI1,AM15PC,AE1"
999  END
```

4. Run the program by typing on the controller "RUN ⟨RETURN⟩".

2-40. PROGRAMMING EXAMPLE 2

The 6062A Synthesized RF Signal Generator can be connected to another signal generator in a master-slave configuration. In the following example, two generators are configured to track each other in frequency. This configuration may be used to track frequency, amplitude, AM, or FM.

1. Connect two signal generators together with an IEEE-488 cable.

2. Set the rear panel address switch of the first generator (talker) as follows:

   00100000

   Cycle the power of the first generator so the software will read the talk only switch.

3. Set the rear panel address switch of the second generator (listener) as follows:

   01000000

   Cycle the power of the second generator so the software will read the listen only switch.

4. Manually program the talker generator as follows:

FUNCTION	VALUE	KEY SEQUENCE
Frequency	210 MHz	[FREQ] [2] [1] [0] [MHz|V]
Step Function	Frequency	[FREQ] [STEP]
Frequency Step	1.25 kHz	[1] [.] [2] [5] [kHz|mV]

5. Manually program the listener generator as follows:

FUNCTION	VALUE	KEY SEQUENCE
Frequency	195 MHz	[FREQ] [1] [9] [5] [MHz|V]
Step Function	Frequency	[FREQ] [STEP]
Frequency Step	1.25 kHz	[1] [.] [2] [5] [kHz|mV]

6. On the talker generator, press the [↑] STEP or [↓] STEP keys. Each time the key is pressed, the frequency of both generators increases or decreases by 1.25 kHz (the Frequency Step) at frequencies 15 MHz apart.

Different functions on each generator can be programmed to track in the master-slave configuration. In other words, while the master generator can be programmed to step increase 25 kHz FM, the slave generator can be programmed to step 25% AM.

NOTE

To use the step feature for other functions, change the step function on the generators to the desired functions.

2-41. PROGRAMMING EXAMPLE 3

In the following example, the Generator is programmed by a Fluke 1722A Instrument Controller (via the IEEE-488 bus) to the same state as in Programming Example 1. Additionally, the frequency step size is set to 1.25 kHz, and the trigger buffer is programmed to execute the step up command when the trigger command is received. The SRQ mask of the Generator is set to generate an SRQ when the RF output has settled and the Generator is ready for more input from the bus.

The program then enters a loop where it waits for the ready SRQ, sends the GET (group execute trigger) interface message to step up the frequency, and waits again. At this time, do the following:

1. Connect the Generator to the controller with an IEEE-488 cable.

2. Set the rear panel address switch of the Generator as follows:

   00000111

3. Enter the following program into the controller:

```
1   ! Fluke 1722A BASIC program to control a 6062A.
2   ! The address of the 6062A is 7.
3   A% = 7%
10  ! Clear the 6062A so that it is in a known state.
15  INIT PORT 0
20  REMOTE @A% \ CLEAR @A%
100 ! Set the 6062A.
110 PRINT @A%, "FR210MZ,AP6DB,MR1,FM5KZ,FI1,AM15PC,AE1"
120 ! Set the frequency step, output valid mode,
121 ! and configure the trigger buffer.
130 PRINT @A%, "FS1.25KZ,VM1,CTSU"
140 ! Set the SRQ mask to enable "output valid" SRQ
150 PRINT @A%, "SM16"
160 ! Wait for above commands to finish processing
170 WAIT 1000 \ S% = SPL (A%)
180 ! Trigger the first step up
190 TRIG @A%
300 ! Wait for SRQ
310 ON SRQ GOTO 800
320 WAIT FOR SRQ
800 OFF SRQ
810 ! Check the serial poll response
820 S% = SPL(A%)
830 IF (S% AND 64%+16%) < > 80% THEN PRINT s%;" Bad Serial Poll Response"
840 ! Trigger the next step up
850 TRIG @A%
860 ! Resume operation-- waiting for next SRQ
870 RESUME 300
999 END
```

4. Run the program by typing on the controller "RUN ⟨RETURN⟩".

2-42. IEEE-488 Interface Functions

The Generator implements a subset of IEEE-488 Interface functions defined by the IEEE Standard 488-1978. Table 2-9 summarizes the IEEE-488 Interface functions implemented.

2-43. Address Mode

In the address mode, the Generator may be operated from local (using the front panel keys) or from remote (using the IEEE-488 Interface). The following paragraphs describe the operation of the Generator in both states and transitions between the states.

The available IEEE-488 messages and their descriptions for the address mode of operation are presented in Table 2-10.

2-44. LOCAL OPERATION

The Generator powers up in the local mode. When in local mode, the following conditions are present:

The front panel indicator REM, is not lit.

Device trigger (GET), device clear (DCL), and selected device clear (SDC) interface messages are ignored.

All device-dependent messages are ignored.

If the data output was requested while the Generator was in the remote mode, the data output of a talker may be sent.

2-45. GOING FROM LOCAL TO REMOTE

The Generator switches from local to remote when the "my listen address message" (MLA) is received, and the Remote Enable (REN) signal is true.

2-46. REMOTE OPERATION

When in the remote mode, the following conditions are present:

The front panel REM indicator is lit.

Device trigger (GET), device clear (DCL), and selected device clear (SDC) interface messages are processed.

All device-dependent messages are processed during the remote mode.

Table 2-9. IEEE-488 Interface Function List

FUNCTION	DESCRIPTION
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T5	Basic talker, Talk only, Serial poll, Unaddressed if MLA
TE0	No extended talker capability
L3	Basic listener, Listen only, Unaddressed if MTA
LE0	No extended listener capability
SR1	Complete service request capability
RL1	Complete remote/local capability
PP0	No parallel poll capability
DC1	Complete device clear capability
DT1	Complete device trigger capability
C0	No controller capability
E1	Open-collector drivers

Table 2-10. IEEE-488 Address Mode Message Descriptions

MESSAGE	DESCRIPTION
pon Power-On	
Talker Operation	When powered up, the Generator generates a Power-On message (pon) and clears its output buffer. The Generator is not addressed to talk when powered up.
Listener Operation	The Generator is not addressed to listen when the power is turned on.
Service Request Operation	The state of the Service Request (SRQ) signal on pon is determined by the SRQ mask. The SRQ mask is the same as when the power was removed. Therefore, if the SRQ mask enables the power on, output valid, or ready SRQs, the SRQ signal will be true during pon.
MTA My Talk Address	
Talker Operation	The Generator is addressed to talk upon receipt of the MTA message. The front panel ADDR indicator is lit while the Generator is addressed to talk.
Listener Operation	The Generator unlistens when the MTA message is received.
MLA My Listen Address	
Talker Operation	The Generator untalks when the MLA message is received.
Listener Operation	The Generator is addressed to listen when the MLA message is received. The front panel ADDR indicator of the Generator is lit while the Generator is addressed to listen.
Data	
Talker Operation	The Generator sends data to the IEEE-488 bus only when requested by a programming data message. Message formats are described in the Command Description paragraphs. An End of Record (EOR) character is sent with EOI asserted following all outputs. The EOR character is either a carriage return or a line feed, depending on the setting of the terminator mode. The parity bit is always zero. Multiple output requests are buffered until the buffer is full. Processing of programming data messages is stopped until the buffer is no longer full. The buffer can be cleared with the Clear Buffer command ("CB"). The buffer is also cleared on power up (pon), with a Clear Command ("CL"), or with a Device Clear interface message (DCL or SDC).
Listener Operation	Command syntax, error processing, and input buffer overflow are described in the paragraphs on Command Processing. Refer to Table 2-8 for a list of IEEE-488 commands that are recognized by the Generator.
IFC Interface Clear	
Talker Operation	The Generator untalks and unlistens when the IFC message is received.

Table 2-10. IEEE-488 Address Mode Message Descriptions (cont)

MESSAGE	DESCRIPTION
Listener Operation	The Generator unlistens and untalks when the IFC message is received.
OTA Other Talk Address	
Talker Operation	The Generator untalks when the OTA message is received.
SPE Serial Poll Enable	
Talker Operation	After receiving the SPE message, the Generator responds with the serial poll status byte, if addressed to talk.
SPD Serial Poll Disable	
Talker Operation	After receiving the SPD message, the Generator resumes normal talk operation.
ULA Unlisten Address	
Listener Operation	The Generator unlistens when the ULA message is received.
RSV Request Service	
Service Operation	The front panel SRQ indicator is lit when the rsv message is sent. The Generator may request service for several reasons. Each reason for service request can be individually masked with the set mask command ("SM"). The service request mask can be interrogated with the interrogate mask command ("IM").
DCL Device Clear	
Clear Operation	The DCL message is ignored when in local. When the DCL message is received (during remote operation) the Generator is cleared. Any characters in the input buffer are cleared followed by the same operation as the clear command ("CL"). The operation of the DCL message is identical to the operation of the selected device clear (SDC) message. The cleared state of the Generator is described in the paragraphs on Power-On Conditions.
SDC Selected Device Clear	
Clear Operation	The SDC message is ignored during local operation. When the SDC message is received (during remote operation), the Generator is cleared. Any characters in the input buffer are cleared followed by the same operation as the clear command ("CL"). The operation of the SDC message is identical to the operation of the device clear (DCL) message. The cleared state of the Generator is described in the paragraphs on Power-On Conditions.

Table 2-10. IEEE-488 Address Mode Message Descriptions (cont)

MESSAGE	DESCRIPTION
GET Group Execute Trigger	
Trigger Operation	The GET message is ignored during local operation. When the GET message is received (during remote operation), the Generator executes a command string that has been preprogrammed with the Configure Trigger command ("CT"). The operation of the GET message is identical to the operation of the Trigger ("TR") command.
Undefined IEEE-488 Commands	All undefined IEEE-488 commands are acknowledged by the Generator handshake sequence, but no action is taken.

2-47. GOING FROM REMOTE TO LOCAL

The Generator switches from remote to local mode in one of the following ways: The IEEE-488 Go To Local (GTL) message is received, the remote enable signal REN is false, or a Return To Local (rtl) message is generated by pressing the front panel [CLR | LCL] key (if the Generator is not in the local lockout mode).

The Generator enters the local lockout mode when the Local Lockout message (LLO) is received. The Generator exits the local lockout mode to the local mode when REN is false.

When switching from remote to local, unprocessed commands in the input buffer are processed until the input buffer is cleared or a front panel entry is made. Switching to local has no effect on the contents of the output buffer.

2-48. Talk-Only Mode

Figure 2-6 shows two generators connected together with the IEEE-488 Bus.

To select the talk-only mode, set the TALK ONLY address switch to 1 (up). If the TALK-ONLY address switch and the LISTEN-ONLY address switch are set to 1, the talk-only mode is selected.

In the talk-only mode, the listener, remote/local, service request, device clear, and device trigger interface functions do not apply.

If the talk-only mode is selected, the Generator is always addressed to talk and the front panel ADDR indicator is always lit. The Step Up ("SU") or Step Down ("SD") message is sent when the [↑] STEP or [↓] STEP front panel keys are pressed. This output is not buffered, and if no listener is connected to the IEEE-488 Interface, no output will be sent. A carriage return followed by line feed (with the EOI signal true) are always sent as the end of record. The Generator must be cycled off/on to exit from the talk-only mode.

2-49. Listen-Only Mode

To select the listen-only mode, set the LISTEN ONLY address switch to 1 (up). If the talk-only address switch and the listen-only address switch are set to 1, the talk-only mode is selected.

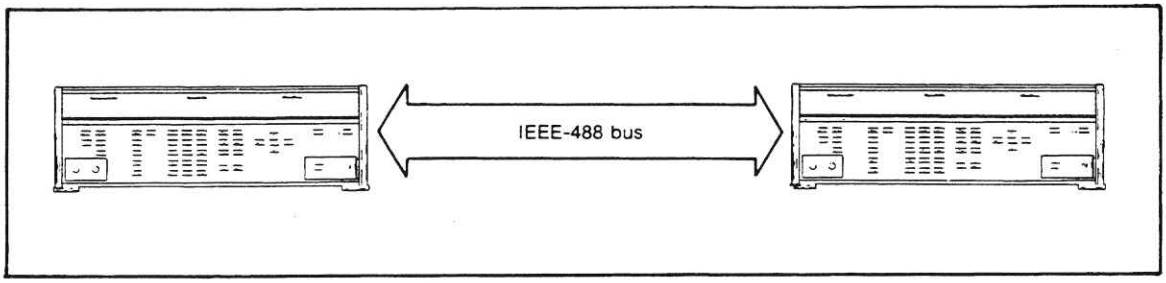


Figure 2-6. 6062A IEEE-488 Bus Connected to a 6062A IEEE-488 Bus

If the listen-only mode is selected, the Generator is always addressed to listen, and the front panel ADDR indicator is always lit. The Generator listens and responds to all data messages on the IEEE-488 Interface. The response to data messages is the same as in the addressed mode of operation except that requests for talker output are ignored.

In the listen-only mode, the talker, remote/local, service request, device clear, and device trigger interface functions do not apply.

2-50. Command Syntax

The Generator IEEE-488 bus commands alphabet consists of the letters A through Z (upper and lower case letters are treated equally), digits 0 through 9, and the following special characters:

@ . , ; + - CR LF

Spaces, tabs characters, and the parity bit are ignored.

The IEEE-488 commands for the Generator consist of the following three parts:

Header
Numeric
Suffix

The header is always required, but the numeric and suffix may be optional. This rule gives the following four possible combinations:

⟨HEADER⟩
⟨HEADER⟩ ⟨NUMERIC⟩
⟨HEADER⟩ ⟨NUMERIC⟩ SUFFIX⟩
⟨HEADER⟩ ⟨SUFFIX⟩

Multiple commands may be separated with one of the end of string (EOS) characters ";" or ",". Use of EOS characters facilitates recovery in the event of a syntax error and will also enhance readability.

2-51. COMMAND HEADER SYNTAX

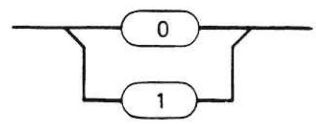
The command header is a two alpha-character string. A list of the IEEE-488 command headers used on the Generator is presented in Table 2-8. The header determines the syntax of the numeric and suffix as listed in the table.

2-52. NUMERIC DATA SYNTAX

There are four types of numeric data: Boolean, unsigned integer, floating point, and trigger string. The following paragraphs describes each of the four numeric data formats. A syntax diagram is included for each format.

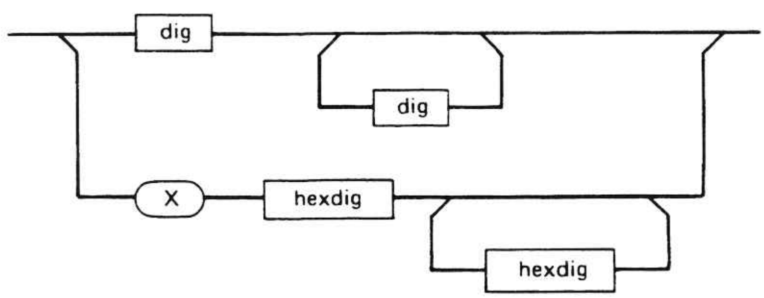
1. Boolean

   Boolean numeric data must be either a "0" or a "1". All other characters will result in a syntax error.



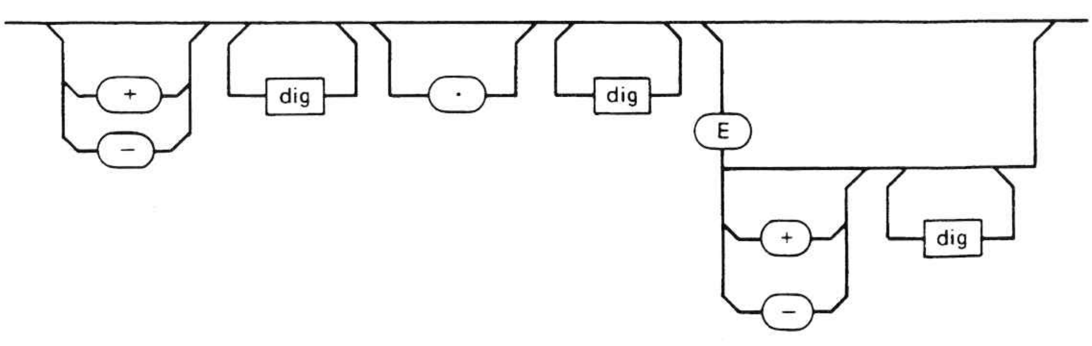
2. Unsigned Integer

   Unsigned integers may be specified in decimal or in hexadecimal. Any number of decimal digits are accepted. However, values greater than 65,535 are rejected. Hexadecimal numbers are preceded by an "X". Only four hexadecimal digits are accepted. Specifying a number in hexadecimal for the read word and read byte commands causes the response to be sent in hexadecimal. Decimal digits may be the numerals 0 through 9. Hexadecimal digits may be the hexadecimal digits 0 through F.



3. Floating Point

   The floating-point numeric data format is the most flexible format. Digits may be the numerals 0 through 9. Any number of digits is accepted for both the number and the exponent. However, numbers greater than 2,147,483,629 are truncated, and exponents greater than 32,749 are rejected.

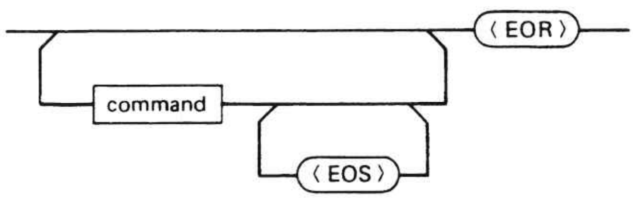


4. Trigger String

The trigger string numeric data is a string of Generator commands terminated with an EOR. The string may be up to 71 characters, not including the EOR. Commands in the string are not checked for validity until the trigger string is executed with the trigger command.

EOR is the end of record character. This character is selected with the terminator mode command. "TM0" selects the linefeed character. "TM1" selects the carriage return character. The IEEE-488 interface signal EOI asserted with any other character is also considered an end of record.

EOS is an end of string character, use either ";" or ",".



2-53. SUFFIX SYNTAX

Suffixes are always one or two alpha-characters. Certain suffixes are used to scale the numeric (the same as the front panel UNITS keys). Other suffixes mnemonically designate hardware components. The five types of suffixes are described in Table 2-11.

2-54. Command Descriptions

The following paragraphs describe the remote IEEE-488 Interface operating commands that are not accessible from the front panel of the Generator. IEEE-488 Interface commands that are accessible from the front panel of the Generator are described earlier in this section (Local and Remote Operation).

2-55. BINARY LEARN COMMANDS

Front panel setups are stored in the memory of the Generator in a packed binary format. The binary learn commands are used to transfer this binary data between an IEEE-488 controller and the Generator. These commands allow the operator to minimize the amount of programming commands needed to program the entire instrument state. The binary learn commands are:

"LM" Learn Memory
"LI" Learn Interface

The syntax for the Learn Memory ("LM") command is as follows:

"LM" Memory Location Code

The Generator responds to the "LM" command with a string of 66 ASCII characters followed by an ⟨EOR⟩ (end of record character). This string represents the front panel settings (in a packed binary format) that were stored in the memory location specified.

Table 2-11. Suffix Types

SUFFIX TYPE	SUFFIX	MNEMONIC	EQUIVALENT EXPONENT
Frequency	GZ	gigahertz	9
	MZ	megahertz	6
	KZ	kilohertz	3
	HZ	hertz	0
Amplitude	V	volts	0
	MV	millivolts	-3
	UV	microvolts	-6
	NV	nanovolts	-9
	DB	dB, dBm, dBmV, or dBuV	0
AM	PC	percent	0
FM	GZ	gigahertz	9
	MZ	megahertz	6
	KZ	kilohertz	3
	HZ	hertz	0
	RD	radians	0
DAC/BIT Designators	DAC and BIT designators are two alpha-character mnemonics that refer to hardware dacs and bits. Refer to the paragraphs on Monitor Commands for a complete list of designators.		
Learn Suffix	A learn suffix is a string of ASCII characters that contain coded memory location contents. Refer to the paragraphs on Binary Learn Commands for decoding of the learn string.		

NOTE

The ⟨EOR⟩, end of record character, is sent with EOI asserted. "TM0" selects the linefeed character, and "TM1" selects the carriage return character.

Example:

IEEE-488 Command: "LM98"

Response:

"BOABAAAAPPJMAAAKAAAAAAAAABBOBKDAAAAAPECEAABPEAAABAACEBB AGCLKKABAEAM" EOR

Refer to Figure 2-7 for information on how to decode this learn string.

The syntax for the Learn Interface "LI" command is as follows:

"LI" Memory Location Code: Learn String

Character Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Character	B	O	A	B	A	A	A	A	P	P	J	M	A	A	A	K	A	A

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
A	A	A	A	A	A	B	B	O	B	K	D	A	A	A	A	A	P	E	C	E	A	A

42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
B	P	E	A	A	A	B	A	A	C	E	B	B	A	G	C	L	K	K	A	B	A	E	A	M

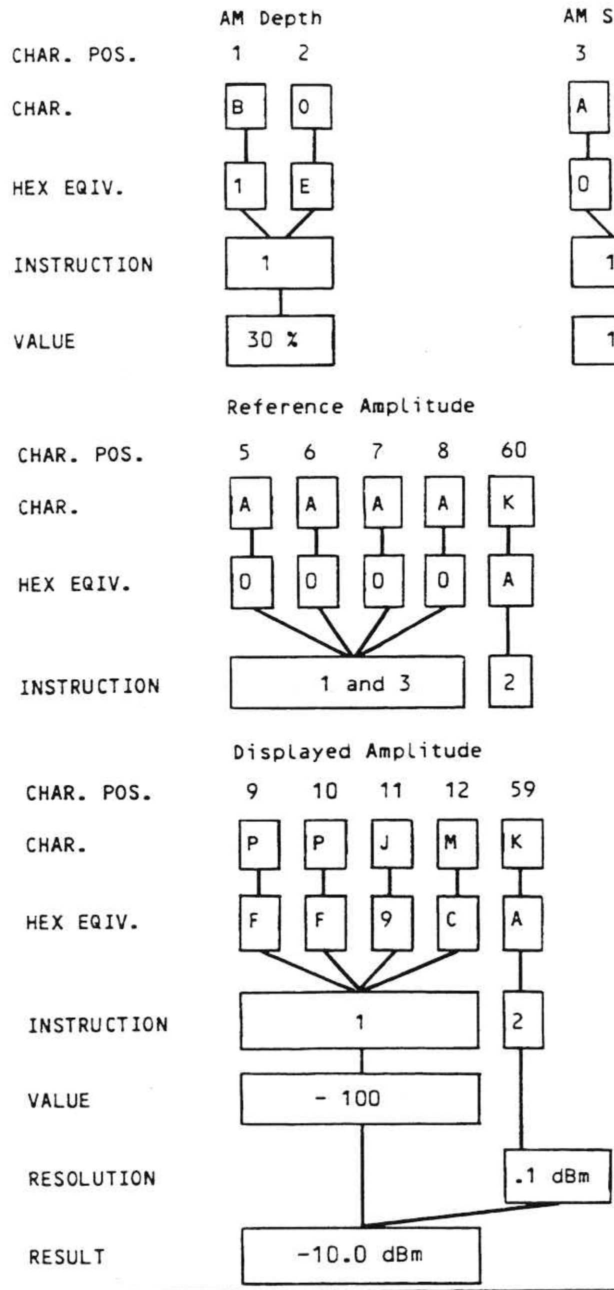


Figure 2-7. Learn String Example

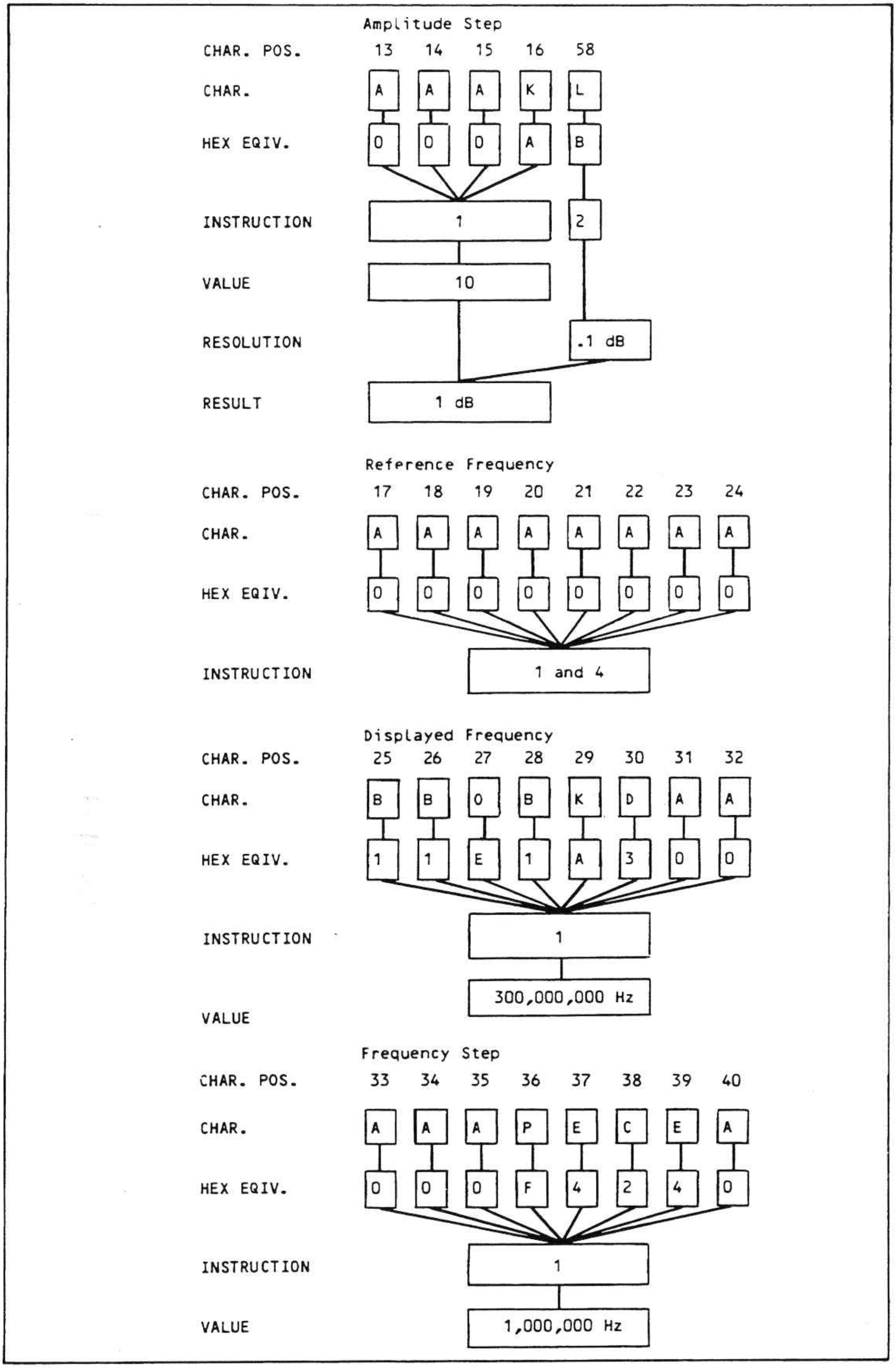


Figure 2-7. Learn String Example (cont)

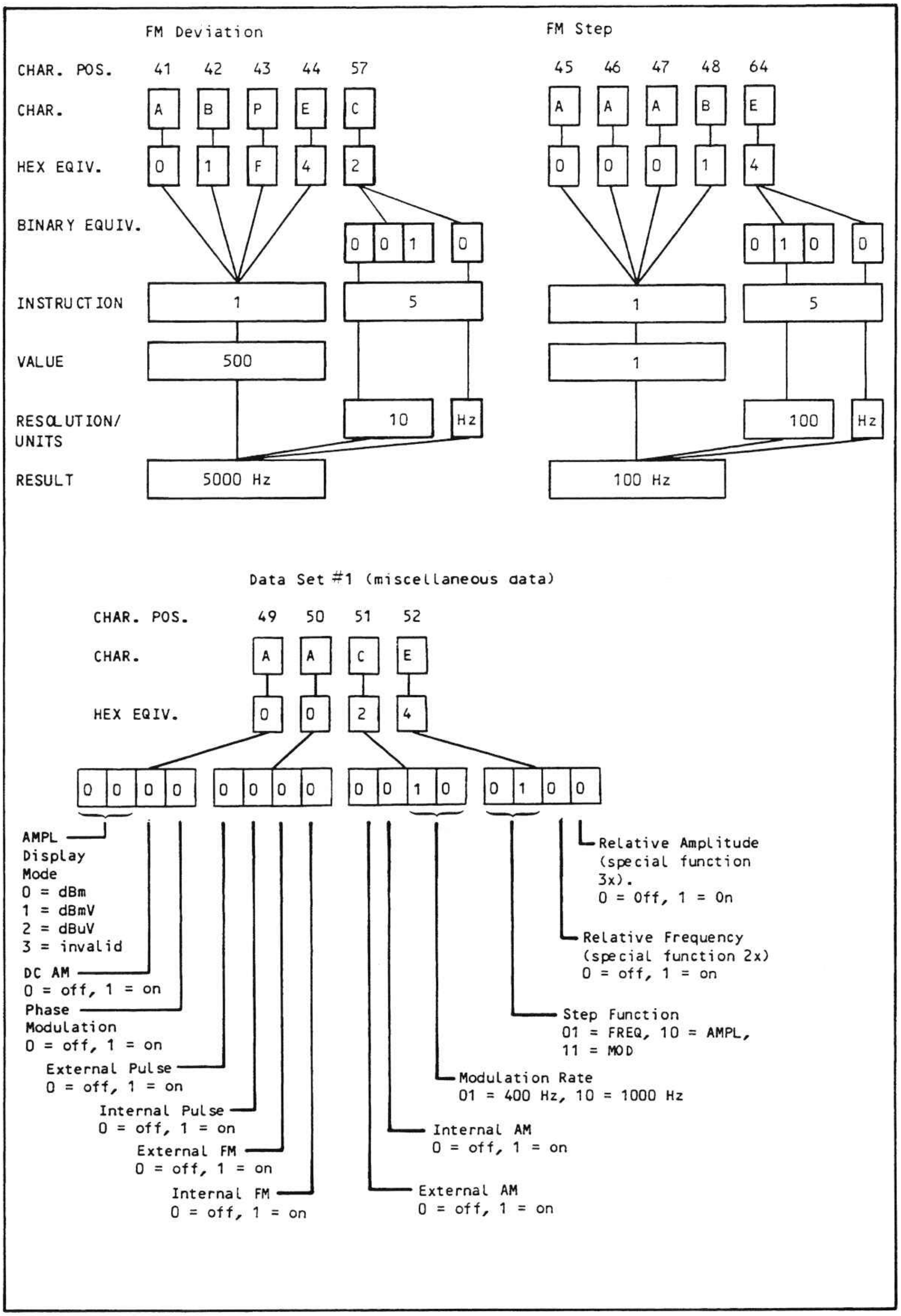


Figure 2-7. Learn String Example (cont)

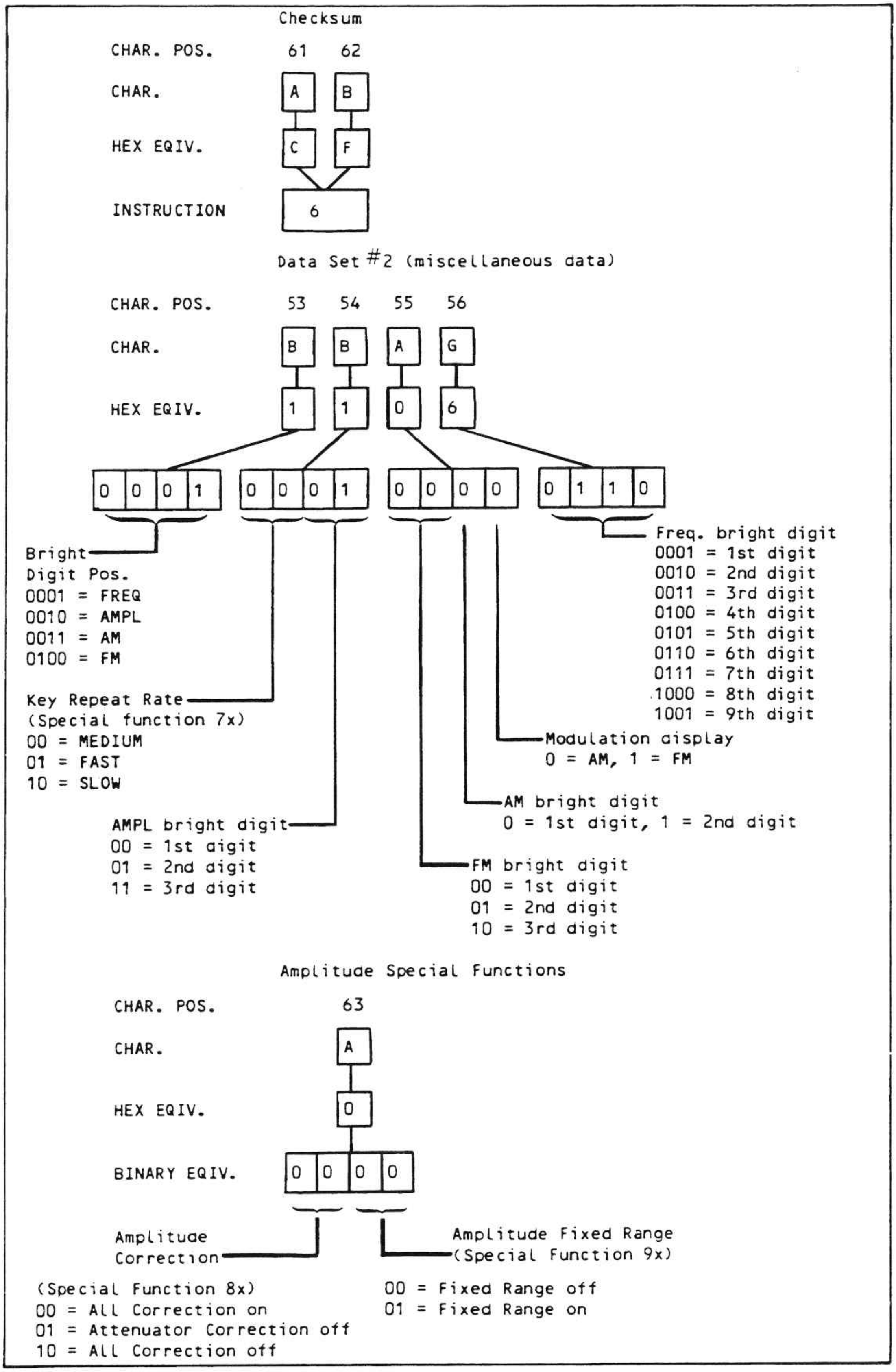


Figure 2-7. Learn String Example (cont)

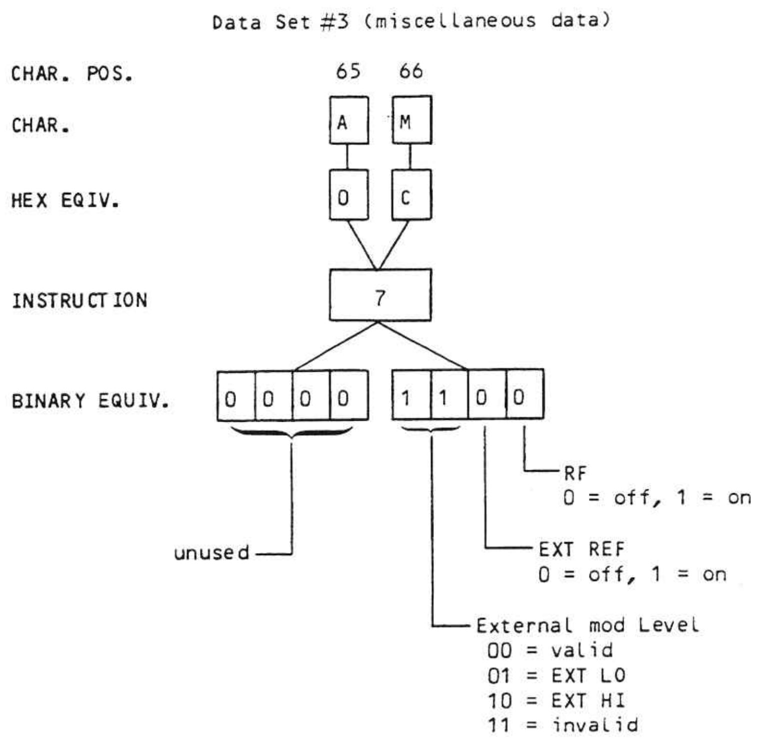


Figure 2-7. Learn String Example (cont)

The Generator stores the learn string in the memory location designated by the memory location code. If the memory location specified is 99, the instrument is programmed to the data sent in the learn string.

Example:

To program the Generator to the Instrument Preset State:

"LI99BOABAAAAPPJMAAAKAAAAAAAABBOBKDAAAAAPECEAABPEAAABAAC EBBAGCLKKABAEAM"

Note that the binary learn string in this example is the same as the learn string returned from memory location 98, which contains a record of the Instrument Preset State.

Instructions:

1. Convert the hexadecimal number to a signed decimal number as follows:
   a. Multiply the most significant hexadecimal digit by 16.
   b. Add the next significant digit to the value obtained in step a.
   c. Multiply the sum of step b by 16, and add in the next hexadecimal digit until the least significant hexadecimal digit has been added.

   NOTE

   If the hexadecimal number started with an 8 through F, the number is negative. Perform step d for negative numbers.

   d. Subtract 16 from the number raised to the power of the number of digits.

Example of Instruction 1:

To convert hexadecimal number 1E:

$(1 * 16) + 14 = 30$

(Since the most significant digit is 1, the number is not negative.)

To convert hexadecimal number FF9C:

$((((15 * 16) + 15) * 16) + 9) * 16) + 12 = 65436$

(Since the most significant digit is F, the number is negative.)

Using Step d; $16^4 = 65536$, $65436 - 65536 = -100$. The signed decimal equivalent to FF9C is -100.

2. Amplitude quantities have a number and a resolution associated with them. This applies to the Displayed Amplitude, Reference Amplitude, and Amplitude Step.

   Use the following procedure to identify the resolution of an amplitude quantity:

   a. If the resolution is A or B (hexadecimal), the resolution of the number is 0.1 dBm or 0.1 dB units.

Example of Instruction 2:

The Displayed Amplitude (in Figure 2-7) is -100 with a resolution of A.

a. The actual displayed amplitude is -10.0 dBm.

b. If the stored resolution is 0 through 9 (hexadecimal), the amplitude quantity is in volts. To convert the number to the actual amplitude in nanovolts, multiply the amplitude number by the power of ten represented by the resolution.

   Example: An amplitude step of 12, with a resolution of 6 would be an actual amplitude step of 1.2,000,000 nV or 12 mV.)

3. If the Relative Amplitude mode is off, the data stored in the reference amplitude location is not used.

4. If the Relative Frequency mode is off, the data stored in the reference frequency location is not used.

5. FM and FM Step quantities have a number and a resolution associated with them. The resolution nibble is comprised of a 3-bit resolution value and a single bit units value. If the units value is 0, the FM quantity is in Hertz. If the units value is 1, it is a ϕM quantity in radians.

   To convert the number to the FM quantity in Hz, multiply the number by the power of ten represented by the resolution.

   Example: The FM number (in this figure) is 500 with a resolution of 10 Hz. The actual FM deviation is 5000 Hz.

   To convert the number to the ϕM quantity in radians, multiply the number by the power of ten represented by the resolution, then divide the result by 1000.

   Example: A deviation of 123 with a resolution of 1 and units of 1 would be a ϕM deviation of 1.23 radians.

   If the Low-Rate FM option is installed, the FM quantity adjusted by the resolution has a resolution of 0.1 Hz. The ϕM quantity is derived exactly as it is without the option. The resolution remains the same, however, the range is reduced by a factor of 10.

6. The checksum data is calculated by adding the data in the learn string, two hexadecimal digits at a time. The total, including the checksum, should add up to a number whose least significant two hexadecimal digits are 01.

7. Only the current state of these parameters is relevant, so they are only valid when learning memory location 99. Learn strings from all other memory locations have characters 65 and 66 set to "AM". These parameters are provided as status information only and cannot be set using the learn interface command.

NOTE

The memory location code must be an unsigned integer indicating the memory location to be learned. Memory location 99 refers to the current instrument settings. Memory location 98 refers to the Instrument Preset State as listed in Table 2-3.

The characters in the learn string correspond to each Generator function. A description of how to interpret the characters in the learn string is given in Figure 2-7. Table 2-12 shows the conversion from the learn string to the hexadecimal character.

2-56. CLEAR COMMANDS

The following IEEE-488 clear commands are recognized by the Generator:

"CB" Clear IEEE-488 input buffer
"CE" Clear IEEE-488 rejected entry error status
"CL" Clear instrument

The "CB" command can be used to clear the Generator output buffer. The output buffer should be cleared at the beginning of any remote program to synchronize data output. The output buffer is also cleared at power-on with the "CL" clear Generator command, or the buffer is cleared by the SDC and DCL clear interface messages.

The "CE" command can be used to explicitly clear the error status. The error status is also cleared when it is interrogated with the "IR" command, or the "CL" clear Generator command, or the SDC and DCL clear.

The "CL" command is used to clear the instrument state. The same actions are performed with the SDC and DCL clear interface messages. (In addition, the input buffer is cleared with the clear interface messages.) The following IEEE-488 commands are performed with the clear Generator command: "RC98, RO1, CE, CB, RM0, TM0, EM0, VM0, UM0, SM192, SP08, XF0, DW0, CT"<EOR>. If a Software Compensation Procedure is in progress, it is exited immediately and all measured data is discarded.

2-57. INTERFACE MODE COMMANDS

Interface mode commands are used to configure the Generator for different modes of IEEE-488 interface operation. Since the Generator knows when its RF output has settled, it can be configured to synchronize itself with the controller. This eliminates WAIT statements in the program, which are normally used to allow time for the output of the controlled device to settle. Table 2-13 lists the interface mode commands.

Table 2-12. Learn Character to Hexadecimal Conversion

LEARN CHARACTER	HEXADECIMAL EQUIVALENT	DECIMAL EQUIVALENT
A	0	0
B	1	1
C	2	2
D	3	3
E	4	4
F	5	5
G	6	6
H	7	7
I	8	8
J	9	9
K	A	10
L	B	11
M	C	12
N	D	13
O	E	14
P	F	15

Table 2-13. Interface Mode Commands

COMMAND	DESCRIPTION	COMMAND STATUS
"EM"	Error Mode	1 = on, 0 = off
"RM"	Record Mode	1 = on, 0 = off
"TM"	Select Terminator	1 = CR, 0 = LF
"UM"	Unbuffered Mode	1 = on, 0 = off
"VM"	Valid Mode	1 = on, 0 = off

The error mode selects when the IEEE-488 rejected entry status is cleared. If turned on, the error status is cleared when a new message is processed. If turned off, the status is cleared only when interrogated with the "IR" (interrogate rejected entry) command or when explicitly cleared with the "CE" (clear error command).

The record mode selects whether the message unit is a record or a command. When turned on, the message unit is a record. When turned off, the message unit is a command.

The terminator mode selects the character used as the record terminator. The terminator character is not used for command processing unless the record mode is enabled. When turned on, the record terminator CR (carriage return) is used. If turned off, the record terminator LF (line feed) is used. The record terminator character is the last character in all IEEE-488 messages sent from the Generator.

The unbuffered mode selects when messages from the IEEE-488 interface are processed. When turned on, messages are read from the IEEE-488 interface only when the microprocessor is ready to process them. In this mode, the input buffer will contain a maximum of one message. (A message may be one command or one record, depending on the setting of the record mode.) When turned off, messages are read from the IEEE-488 Interface to the input buffer of the Generator at the fastest rate. In this mode, the input buffer may contain up to 80 characters.

The valid mode selects when messages are processed by the Generator microprocessor. When the valid mode is turned on, processing of a new message is begun only after the RF output has settled and become valid. When the valid mode is turned off, a new message is processed immediately after the completion of the previous message.

The interface modes can also be programmed using the command, "@" n (where n is an integer). The interface modes are set to the value of n, where n is the sum of the codes for the desired modes. The integer codes for the interface modes that can be programmed using the "@" n commands are as follows:

Terminator Mode= 1
Record Mode = 2
Valid Mode = 4
Unbuffered Mode= 8
Error Mode = 16

For example, to select the record mode and valid mode, the command is "@" 6.

Interface Mode Example:

In this example, the RF output of the Generator is connected to a circuit that is being measured by a voltmeter. The output of the Generator must be settled before the voltmeter is given the command to make a measurement.

A Fluke 1722A program might look something like:

```
PRINT @1, "CL,TM1,RM1,VM1,UM1"  ! initialize the 6060, select modes
PRINT @1, "FR100MZ,AP-25DB"     ! program the 6060
PRINT @2, "?"                   ! trigger the voltmeter
INPUT @2, "R$"                  ! get the reading
```

The entire record is transferred into the Generator before processing begins. In this example, processing begins when the record terminator CR is received. The following character (LF in this case) will not be received into the Generator until the entire record is processed and the output has settled. No wait statement is needed between setting up the Generator and taking the measurement because the Generator will not handshake the LF character until its output has settled.

NOTE

A record is a string of characters separated by ⟨EOR⟩. A message is the smallest group of characters that the Generator can process when it is programmed from the IEEE-488 Interface.

NOTE

The output valid state of the Generator occurs 45 ms after any hardware has been changed.

2-58. INTERROGATE COMMANDS

Interrogate commands allow the status of the Generator to be given over the IEEE-488 Interface. These commands consist of headers only. The interrogate commands available on the IEEE-488 interface are:

"IA" Attenuator Actuation Log
"ID" Instrument ID
"IE" Elapsed Time Indicator
"II" Interface Mode Status
"IL" Hardware UNCAL and Self-Test Error Log
"IO" Option Loading
"IR" IEEE-488 Rejected Entry Status
"IS" Serial Number
"IT" Self-Test Results
"IU" UNCAL (uncalibrated) Status
"IV" Software Revision Level
"IZ" Compensation Memory Checksum Status

The "IA" command interrogates the attenuator actuation log. Each time an attenuator pad is removed from the RF path, the corresponding counter in non-volatile memory is incremented. This means that if an attenuator pad is removed then inserted, the count will only increment once. The Generator responds to the "IA" command with seven counts (one for each pad). The counts are separated by commas, and the response is terminated with the end of record character (⟨EOR⟩).

Example:

Attenuator Section	Number of Actuations
A6DBL	102
A12DBL	99
A241L	1028
A242L	9
A243L	19,092
A244L	3908
A245L	412

The response to the "IA" command will be:

0000000102,0000000099,0000001028,0000000009,0000019092,0000003908, 0000000412⟨EOR⟩

When the "ID" command is sent, the Generator responds with its instrument model number (and end of record character) as in "6062A"⟨EOR⟩.

When the "IE" command is sent, the Generator responds with the time the instrument has been in operation since it was manufactured. The time is 9 digits, a decimal point, a 10th digit and the ⟨EOR⟩ character. The time is in .1 hour units. For example, "000003459.3"⟨EOR⟩ indicates 3459.3 hours of operation since manufacture.

The "II" command interrogates the current selection of interface modes. A 5-digit integer followed by the ⟨EOR⟩ character is the sum of the modes selected as follows:

Terminator mode = 1
Record mode = 2
Valid mode = 4
Unbuffered mode = 8
Error mode = 16

The "IL" command interrogates the ten-entry error log in non-volatile memory. An error can be either a failed self test or an uncalibrated condition as a result of a hardware status line (UNLOKL or UNLVLL). The elapsed time since the instrument was manufactured is also logged with the error.

Each of the ten error log entries consists of an uncalibrated (uncal) code or self-test code, followed by a semicolon (";") followed by the elapsed time, followed by the end of record character (⟨EOR⟩). The format of the uncal code, self-test code, and elapsed time are identical to the response when interrogating the uncal code ("IU"), the self-test code ("IT"), and elapsed time ("IE") respectively.

In response to the IEEE-488 command interrogate error log ("IL") command, ten error log entries will be sent, with the most recent error sent first.

Example of an error log:

000,000,002,000;000039012.2⟨EOR⟩ Self-test error (non-volatile memory failure) at 39012.2 hours since manufacture.

000,-000,002,000;000039012.1⟨EOR⟩ Self-test error (non-volatile memory failure) and the self-test sequence was aborted as indicated by the "-". This error occurred at 39012.1 hours since the Generator was manufactured.

000000,000000,000006;000020243.2⟨EOR⟩ Amplitude became unleveled at 20243.2 hours since manufacture (third number = 4). In addition, the peak amplitude was set to > +13 dBm as indicated by the second uncal code (third number = 2).

000000,000000,000000;000000000.0⟨EOR⟩ This special code means that there are no errors. One or more of the error log entries will be this code when less than ten errors have been logged since the Generator was manufactured.

The number of characters in this response is much larger than the 80 characters in the output buffer. Therefore, if the entire response is not transferred to the IEEE-488 controller, the Generator will not be able to respond to further programming commands. Any remaining portion of the response that is not to be transferred can be cleared only by sending a device clear to the Generator.

The "IO" command interrogates the Generator for its option complement. The returned record contains three integers, separated by commas, that indicate configuration of options. For the 6062A, the first number is always 4, which indicates that the Generator being interrogated is in fact a 6062A. The two remaining numbers are the sum of the option related numbers as follows:

2nd Number

4 = -130 High-Stability Reference Option
8 = -651 Low-Rate FM Option
16 = -132 Medium-Stability Reference Option

3rd Number

2 = -830 Rear Panel RF Output, MOD Input, and Pulse MOD Input Option

For example, "4,12,2" would indicate a 6062A with Options -651, -130, and -830.

The "IR" command interrogates the Generator for rejected entry error status. (See Table 2-6 for a list of rejected entry codes.) The returned record is the sum of errors that have been detected while processing IEEE-488 commands. The status is cleared when interrogated with the "IR" command. The status can also be explicitly cleared with the "CE" command and is also cleared on the "CL" command and the clear interface messages DCL and SDC.

The "IS" command interrogates the Generator for the serial number. The serial number is an eight character ASCII string terminated with an ⟨EOR⟩. The returned record is similar to the following:

"01230000" ⟨EOR⟩

The "IT" command interrogates the Generator for the self-test results. The self-test results are reported in four fields. Any non-zero codes indicate that some tests have failed. Table 2-14 shows the self-test error code format. The self tests are performed at power-on and can also be initiated with special function 02. Further details of the self-test results are listed in the Section 4 of this manual.

Table 2-14. Self-Test Error Codes

```
            MOD            FREQ          AMPL
            aaa      -bbb      ccc       ddd

      aaa = Modulation (AM and FM) test results
      -   = If displayed, indicates the self test did not complete
      bbb = Frequency test results
      ccc = Digital test results
      ddd = Amplitude test results
```

The "IU" command interrogates the Generator for the UNCAL entry status. (See Table 2-5 for a list of the UNCAL Error Codes.)

The "IV" command interrogates the Generator for its current software revision level. The returned record is similar to the following:

"V1.0" ⟨EOR⟩.

This means that the software revision level is Version 1.0.

The "IZ" command interrogates the Generator for the compensation memory status. The status is returned as three fields similar separated by commas, to the following:

"000010,100001,000000" ⟨EOR⟩

See the paragraphs on Compensation Memory Status located in Section 4D for details.

2-59. MONITOR COMMANDS

The Generator monitor commands are intended for troubleshooting and maintenance procedures. They allow the instrument hardware to be programmed to states not normally possible with the regular programming commands.

CAUTION

The output of the Generator is not guaranteed if the Generator hardware has been changed with these monitor commands.

There are three types of monitor commands: Input/Output, Read/Write, and Hardware Control. Table 2-15 lists the Input/Output types of monitor commands. Table 2-16 lists the Read/Write types of monitor commands. Table 2-17 lists the Hardware Control types of monitor commands.

2-60. SRQ COMMANDS

The Generator asserts the SRQ bus management line on the IEEE-488 Interface bus whenever the Generator requires service. The controller can then perform a serial poll to determine the need for service. The set mask command is used to designate those needs that require service. The SRQ commands are as follows:

"SM" Set SRQ Mask
"IM" Interrogate SRQ Mask
"XF" Local Operation Alert Mode

Table 2-15. Input/Output Monitor Commands

COMMAND NAME	COMMAND	VALUE	DESIGNATOR NAME		LOCATION
Read Input Bit	"IB"		"EX"	exrefl	A2, U11-7
			"HS"	hsoptl	A2, U11-17
			"IE"	ieinl	A2, U11-8
			"LF"	lrfm	A2, U40-8
			"MH"	mlevhi	A2, U40-13
			"ML"	mlevlo	A2, U40-7
			"RO"	roptl	A2, U40-17
			"RP"	rppl	A2, U11-11
			"RT"	rptrpl	A2, U11-14
			"SR"	shrefl	A2, U40-4
			"TQ"	trseql	A2, U40-3
			"UK"	unlok	A2, U11-3
			"UV"	unlvl	A2, U11-18
			"XA"	extra-a	A2, U40-14
			"XB"	extra-b	A2, U40-18
Set Output Bit	"OB"	0 or 1	"CL"	clr	A2, U17-12
			"DA"	dcam	A6, U13-19
			"EA"	extam	A6, U13-12
			"EF"	extfm	A6, U13-6
			"EP"	ext pulse	A6, U13-16
			"FE"	fmen	A4, U19-19
			"FP"	front-panel	A2, U17-5
			"HO"	haocth	A6, U9-2
			"HT"	het	A6, U9-6
			"IA"	intam	A6, U13-9
			"IF"	intfm	A6, U13-5
			"IP"	int pulse	A6, U13-15
			"LP"	mid	A6, U9-5
			"MA"	rmux0	A4, U32-5
			"MB"	rmux1	A4, U32-2
			"MF"	mf400l	A6, U13-2
			"MG"	module-gate	A2, U17-15
			"MS"	trmodl	A4, U32-15
			"NE"	nven	A2, U17-9
			"PM"	phase mod	A6, U23-12
			"RI"	rinh	A4, U32-9
			"RR"	rprst	A2, U17-6
			"SE"	shen	A4, U32-12
			"SH"	shet	A4, U32-16
			"VH"	vcohl	A6, U23-9
			"VQ"	vcoq	A6, U23-15
			"XA"	x2l	A6, U9-19
			"XB"	x2fl1	A6, U9-16
			"XC"	x2fl2	A6, U9-15
			"XD"	x2fl3	A6, U9-12
			"XE"	x2fl4	A6, U9-9
			"XO"	xoenl	A4, U32-6
			"YA"	extra-a	A2, U17-19
			"YB"	extra-b	A2, U17-2
			"YC"	extra-c	A2, U17-16
Set Output DAC	"OD"	(integer value)	(DAC	location)	
		0-255	"AM"	AM dac	A6 U19
		0-127	"AT"	attenuator	A2, U27-5, 6, 9, 12, 15, 16, 19
		0-4095	"FM"	FM dac	A6, U25-4 through 15
		0-7	"FR"	FM range	A4, U19-12,15,16
		0-1023	"KN"	kn dac	A4, U27-4 through 13
		0-1023	"KV"	kv dac	A4, U29-4 through 13
		0-16383	"LE"	level dac	A6, U21
		0-255	"TC"	temp.comp.dac	A6, U19

Table 2-16. Read/Write Monitor Commands

COMMAND NAME	COMMAND SYNTAX	NOTES
Read byte	"RB" memory location	1
Read word	"RW" memory location	1
Define write address	"DW" memory location	2
Write byte	"WB" value	2
Write word	"WW" value	2

Notes

1. The Generator responds to these commands with the value of the byte or word in the memory location addressed. The memory location must be an unsigned integer. The value returned is followed by an <EOR>. If the memory location is specified in hexadecimal, then the value is returned in hexadecimal preceded by an "X".

2. The Define Write Address command specifies the write address used with the Write Byte and Write Word commands. When the Write Byte and Write Word commands are used, the specified data will be written to that write address.

Table 2-17. Hardware Control Monitor Commands

COMMAND NAME	COMMAND SYNTAX	NOTES
Read attenuation	"XA"	1
Set attenuation	"XB" integer	1
Set synthesizer frequency	"XD" floating point decimal "MZ"	2
RF on/off	"XR" "0" or "1"	3

Notes

1. The current settings of the Attenuator can be read or set. The attenuation is a number from 0 to 23 where the number specifies the multiple of 6-dB attenuation. Zero indicates no attenuation, and 23 is the maximum attenuation. Only the attenuators are changed with the "XB" command. The value of the attenuation will be output on the "XA" command as an unsigned integer followed by <EOR>.

2. The "XD" command can be used to program the Generator to the specified frequency. Only the synthesizer circuits on the Synthesizer PCB is programmed. No offset is added, no filters are programmed, no VCO compensation is calculated, and no level correction is calculated.

3. "XR0" programs all attenuation, and "XR1" restores the attenuator to its previous state.

The SRQ mask is set to the sum of the reason values listed in Table 2-18. These reason values correspond to the allowable reasons that will be requiring service. The SRQ Mask is set by the following command sequence:

"SM" Sum of Reasons

Table 2-18. SRQ Mask and Status Values

VALUE	REASON	TRUE	FALSE
1	Ready	Input buffer is empty and no commands are being processed.	Input buffer is not empty or commands are being processed.
2	Rejected Entry	IEEE-488 rejected entry; error code is not zero.	IEEE-488 rejected entry error; code is zero.
4	Uncalibrated	RF output is not calibrated. (Front panel 'UNCAL' indicator is lit.)	RF output is calibrated. (Front panel 'UNCAL' indicator is not lit.)
8	Power on	Instrument has powered up.	Special function 08.
16	Output valid	RF output is settled.	RF output is not settled.
32	Not Used		
64	RQS	SRQ mask ANDed with currently set values is not zero.	Reason for SRQ goes away or serial poll is performed.
128	Front panel	Special function 07.	Special function 08.

The Generator asserts SRQ when one of the allowed reasons becomes true. The serial poll response is the sum of those values for reasons that are currently true, independent of the setting of the SRQ mask. For example, if the rejected entry SRQ is enabled with "SM2" and a rejected entry occurs, the serial poll response will indicate that the Generator generated the SRQ (value of 64) and that a rejected entry occurred (value of 2). In addition, other values may be set. The default SRQ mask is 192.

The "IM" command interrogates the current SRQ mask, and an integer is returned.

The "XF" command enables a mode that causes an SRQ to be generated any time the Generator processes an entry. In this mode, a front panel SRQ is generated (i.e., the serial poll response indicates that a front panel SRQ is the cause of the SRQ). This mode is enabled and disabled with its own command, not through the Set SRQ Mask commands (as are all other SRQs). The Alert Mode is enabled/disabled as follows:

"XF0" = Alert Mode off, "XF1" = Alert Mode on.

2-61. TRIGGER COMMANDS

The Generator has the ability to preprogram a command string of arbitrary Generator programming commands. This command string is executed whenever the trigger command "TR" or the IEEE-488 group execute trigger interface message (GET) is received. This method of programming the Generator can be used when a long string of commands is to be sent to the Generator over and over. The programming time is shortened by the time required to transmit the string of characters from the controller to the Generator.

The trigger commands are as follows:

"CT" Configure Trigger
"TR" Execute Trigger Buffer

The configure trigger command is followed by a string of any Generator programming commands up to 71 characters in length. The validity of the programming commands is not checked until the trigger buffer is executed. The power-on value of the trigger string is null (nothing).

The trigger command causes execution of the trigger buffer, which has been preprogrammed with the configure trigger command "CT". The trigger buffer can also be executed by sending the IEEE-488 group execute trigger interface message (GET).

2-62. Command Processing

The following paragraphs describe how IEEE-488 commands are processed by the Generator. Command processing is a term for how commands are executed and how errors are handled.

2-63. COMMAND EXECUTION

The execution of the IEEE-488 commands depends on the selection of interface modes with one exception: if an IEEE-488 input is buffered and the buffer becomes full, command execution starts and no further input is accepted until there is room in the input buffer. For more details, refer to the paragraphs on Interface Modes.

2-64. ERROR HANDLING

The Generator detects two types of errors while processing IEEE-488 commands: syntax errors and processing errors. All errors are accumulated until the error status is interrogated or is explicitly cleared. The IEEE-488 rejected entry status is interrogated with the "IR" command. The error status is cleared with one of the following commands:

"CE" Clear Error Command
"CL" Clear Command
"DCL" or "SDC" Clear Interface Messages

The error status is also cleared at power-on.

The SRQ mask can be set to assert SRQ when an error is detected. The SRQ is unasserted when the error status is cleared.

Syntax errors are commands that do not have the correct syntax for the specified header. For example, "FE5" is a syntax error because the external FM command requires a Boolean numeric field. Unrecognized headers are also syntax errors. An IEEE-488 syntax error causes all commands from the point of the error up to the next string terminator or record terminator to be ignored.

Processing errors are commands that are syntactically valid, but the requested value is outside the range of programmable values. For example, "FR99GZ" is syntactically correct, but the Generator cannot be programmed to a frequency of 99 gigahertz. Command processing continues with the next command.

2-65. Timing Data

The programming time can be broken down into four groups: transfer of commands to Generator, command parsing time, software programming time, and instrument settling time.

The total programming time depends on the selection of the interface modes. In some modes, programming steps are performed in parallel and can increase throughput. The following paragraphs give some typical timing data for the above four programming steps and describes how the interface modes affect their relative timing.

2-66. TRANSFER OF COMMANDS TO GENERATOR

The maximum rate of transfer is 0.4 to 0.5 ms per character. With most IEEE-488 controllers, all characters sent with a single output or print statement is transferred together at the maximum rate. The total time to transfer commands to the Generator is obtained by multiplying the number of characters by the rate of transfer.

2-67. COMMAND-PARSING TIME

Command-parsing time is the sum of the time required to process the header, the numeric, and the suffix. Some commands do not have numerics or suffixes. Table 2-19 gives the typical time it takes to process the different components of a command.

2-68. SOFTWARE PROGRAMMING TIME

The minimum time required to process a command is 25 ms. Most of the commands that do not program the hardware (such as storing step values) are programmed in 25 ms. Table 2-20 gives the typical time value for programming the different functions in the Generator.

2-69. INSTRUMENT-SETTLING TIME

The software-programming time typically exceeds the setting time of the RF circuitry, therefore the instrument-settling time can generally be excluded from throughput calculations. The exception is when level correction is disabled. Disabling level correction reduces the software-programming time by 10 ms but does not affect the switching time of the frequency programming circuitry. A 10 ms settling delay should be added if level correction is disabled and a settled RF output is required.

2-70. TIMING OPTIMIZATION

Timing depends upon the interface modes selected. Refer to the paragraphs on Interface Mode Commands for a complete description of the interface modes.

The transfer of commands from the IEEE-488 controller to the Generator can never be processed in parallel with anything else. The transfer of commands usually happens simultaneously, regardless of which interface mode is selected.

The parsing of the command and programming the new instrument state is performed one message unit at a time. The record mode selects a command or a record as the message unit. The record mode off ("RM0") is slower since there is extra processing between message units, and the message unit is smaller.

If the valid mode is enabled, the processing of message units is delayed until the Generator has settled from the previous message. While the RF output is typically settled before the software finishes processing the command, enabling the valid mode adds an additional delay to ensure that the output is settled before the next command is processed.

If the output of the Generator does not need to be settled between programming strings, the valid mode should be turned off to speed up processing. If the output does not need to be settled between commands, but needs to be settled between records, enable the valid mode and the record mode. The instrument processes commands within the record as fast as possible and waits for the output to settle only between records.

2-71. Power-On Conditions

The instrument parameters at power-on are listed in Table 2-21. The remote clear commands can be used to reset all parameters except the last memory location and the remote/local state.

Table 2-19. Command-Parsing Time

COMMAND COMPONENT	TIME
Header	2 ms
Boolean Numeric	1 ms
Unsigned Integer Numeric	2 ms + 1 ms per character
Floating-Point Numeric	2 ms + 1 ms per character
Trigger-String Numeric	10 ms + 0.5 ms per character
Suffix	1 to 1.5 ms
Learn-Interface Suffix	40 ms

Table 2-20. Typical Programming Time of the Generator Functions

FUNCTION	TIME (IN ms)	NOTES
Frequency	70	1, 2, 3, 4
Amplitude in Volts	60	1, 2, 4, 5
Amplitude in dBm	95	1, 2, 4, 5
AM Depth	50	2, 4
FM Deviation	35	4
Modulation Frequency	25	
Enable/Disable AM	55	2,
Enable/Disable FM	25	
Recall 98	190	6, 5
RF Output On	50	2
RF Output Off	35	

Notes

1. May take up to 5 ms longer if the relative mode is enabled.
2. Can save 10 ms if all level correction is disabled with special function 81.
3. Add 20 ms when frequency changes from greater than or equal to 245 MHz to less than 245 MHz.
4. Edits and steps may take up to 5 ms longer than the programming function directly.
5. Add 15 ms when the Attenuator settings change.
6. Recalls vary considerably depending on the stored data. Maximum is approximately 250 ms.

Table 2-21. IEEE-488 Power-On State

INSTRUMENT PARAMETER	STATE	NOTES
Memory location parameters	same as power off	1
RF on/off	same as power off	
Last memory location	same as power off	2
Remote/local state	local	
IEEE output buffer	cleared	
IEEE input buffer	cleared	
Valid mode	same as power off	
Record terminator	same as power off	
Unbuffered mode	same as power off	
Record mode	same as power off	
SRQ mask	same as power off	
Trigger configuration	same as power off	
SRQ interface signal	may be asserted	3

Notes

1. The contents of memory location 98 (Instrument Preset State) is listed in Table 2-3.
2. The last memory location is used for sequence operations.
3. If the SRQ mask has the power on, output valid, or ready SRQ enabled, the SRQ interface signal is asserted on power-on.

Section 3
Theory of Operation

3-1. INTRODUCTION

This section of the manual describes the theory of operation for the Generator. The following four major topics are covered:

General Description
Functional Description
Software Operation
Detailed Circuit Descriptions

The General Description briefly explains the functions and components of the three major sections of the Generator. The Functional Description covers the main output parameters, amplitude, frequency, and modulation. The Software Operation section describes the software and how it affects the hardware. The Detailed Circuit Description is a comprehensive explanation of the operation of each circuit assembly.

3-2. GENERAL DESCRIPTION

The Generator has three major sections. The front panel section includes the keyboard and display for local control. The module section includes the frequency, level, modulation, and control circuits. The rear panel section includes the power supply, cooling fan, and assorted external connectors.

3-3. Front Panel Section

The front panel section of the Generator provides the operator interface. It includes the primary controls, connectors, and indicators of the Generator. All front panel keys and displays (except the power switch that controls the power supply directly) are monitored and handled by the A2 Controller PCA located in the module section.

3-4. Module Section

The module section is a multi-compartmented, shielded enclosure that includes the circuits that generate the instrument stimulus functions: frequency, modulation, and amplitude. The A2 Controller PCA is also located here. The A2 Controller PCA governs the Generator operation and determines if any options are installed by checking the option status bits at power-on. The optional Low-Rate FM PCA is also located in this section of the instrument.

3-5. Rear Panel Section

The rear panel section includes the power supply, the cooling fan, various external connectors, the IEEE-488 Interface, and the optional High-Stability Reference PCA.

The power supply is a linear design providing two +15V, -15V, +5V, +37V, +18V, and 6V ac to the Generator. All the power supplies are series-pass regulated except the 6V ac filament supply and the +18V supply, which provides power to the Attenuator/Reverse Power Protector (RPP) relays. A fuse/filter/line-voltage selector allows the Generator to operate from any common supply voltage.

The dc fan is powered from the unregulated +5V supply. The fan operates only when line power is available and the front panel POWER switch is ON.

The Option -130 High-Stability Reference operates whenever the instrument is plugged into an active ac outlet, regardless of the position of the instrument POWER switch.

3-6. FUNCTIONAL DESCRIPTION

The following paragraphs describe the key output parameters of the Generator: level, amplitude modulation, frequency, frequency modulation, phase modulation, and pulse modulation.

3-7. Level

Level control is provided by two separate circuits, a step attenuator and a vernier level DAC. The A8 Attenuator/RPP Assembly provides coarse level control in 6.02-dB steps. Fine level control is provided by a vernier level DAC that varies the leveling-loop control voltage. The microprocessor automatically controls the step attenuator and the vernier level DAC. The microprocessor also applies level correction to compensate for the Generator frequency response.

Each Generator has level correction data for both the Output Assembly (A6 + A7) and the A8 Attenuator/RPP Assembly. The level correction data is stored in the compensation memory located on the A2 Controller PCA. The level correction data is based on the measurements of each assembly during calibration of the Generator.

The level correction data is applied only to the vernier level DAC and does not affect the coarse level control provided by the Attenuator/RPP Assembly. In other words, all Generators have the same attenuator pads inserted at a selected level even though the correction data is different for each Generator.

To improve level accuracy in relation to temperature, the Generator uses a software temperature compensation technique. This technique uses data that is the same for all Generators.

3-8. Amplitude Modulation

The output of the level DAC is the leveling loop control voltage. The Generator output signal is amplitude modulated by varying this control voltage with the modulating signal. A 1V peak modulating signal from the internal modulation oscillator or from the external MOD INPUT connector is applied to the AM DAC (a multiplying digital-to-analog converter). The multiplying factor of this DAC, corresponding to the programmed percentage of modulation, is calculated by the A2 Controller PCA.

The modulation signal from the AM DAC is summed with a fixed dc reference voltage. The composite signal (dc plus modulation) is applied to the level DAC (a level control-multiplying DAC). The multiplying factor for this DAC is also handled by the A2 Controller PCA and corresponds to the programmed signal level. The multipling factor also includes the level correction information stored in the compensation memory.

The operation of the ALC loop causes the amplitude of the RF signal to conform to this varying control voltage, thus causing amplitude modulation of the Generator output.

3-9. Pulse Modulation

An input pulse signal triggers a comparator that drives a TTL gate. The gate output is converted to a differential drive signal that controls transistor level shifters. These differential signals then drive a single-pole single-throw switch located in the main signal path before the final amplifier. An input voltage below 1V turns the switch off if pulse is enabled; otherwise, the switch is on.

3-10. Frequency

The 0.1-MHz to 2100-MHz frequency coverage is divided into the following four bands:

HET band	0.1 to 244.99999 MHz
mid band	245 to 511.99999 MHz
high band	512 to 1049.99999 MHz
X2 band	1050 to 2100 MHz

The high and mid bands are derived directly from a voltage-controlled oscillator (VCO) followed by a binary divider which is part of the main phase-locked loop (PLL).

The PLL synthesizes the mid band using a modified N-divider loop with a single-sideband mixer (SSB) in the feedback path. The reference frequency for the loop is 1 MHz, which would normally provide 1-MHz steps in a conventional N-divider loop. However, this Generator provides 0.02-MHz steps by using a modified N-divider with a pulse deletion circuit which is controlled by a rate multiplier.

Additional resolution is gained by introducing a signal from the subsynthesizer circuit into the main PLL through the SSB mixer in the feedback path. This signal provides internal frequency steps of 5 Hz. The subsynthesizer consists of a 14-bit rate multiplier followed by a divide-by-1000 circuit.

The main PLL bandwidth varies with the programmed frequency (due to N changing and variations in the VCO tuning coefficient). The A2 Controller PCA uses compensation to program the phase detector gain via the KN DAC to maintain constant loop bandwidth. By keeping the loop bandwidth constant, loop stability and modulation transfer is controlled, thus ensuring accurate, wideband FM.

3-11. Frequency Modulation

Frequency modulation is achieved by applying the modulation signal simultaneously to both the PLL VCO and the phase detector. Modulating either the PLL VCO or the phase detector alone results in FM with a high-pass filter characteristic, or phase modulation with a low-pass filter characteristic. The filter characteristic cutoff frequencies are equal to the PLL bandwidth.

The modulating signal applied to the PLL VCO and the phase detector is adjusted in amplitude by the KV DAC to compensate for variations in the VCO tuning coefficient. This compensation is done automatically by the A2 Controller PCA using compensation data measured on the VCO in each Generator. The compensation data is stored in the compensation memory.

By integrating the modulation signal applied to the phase detector and simultaneously applying the modulation signal to the PLL VCO, the two effects are complementary and result in a flat FM response.

3-12. Phase Modulation

Phase modulation is achieved by differentiating the modulation input signal (internal or external) before applying the modulating signal to the frequency modulating circuits. The display is correspondingly changed to indicate deviation in radians.

3-13. SOFTWARE OPERATION

The Generator software is executed on a Texas Instruments TMS 9995 microprocessor located in the A2 Controller PCA. The instrument program is stored in 64K bytes of ROM. A battery backed CMOS RAM contains 4K bytes of scratch pad RAM, 2K bytes of non-volatile memory for front panel setups, and 2K bytes of non-volatile compensation memory. A 2K byte EEPROM contains a redundant copy of the instrument specific compensation data. In addition, there are 250 bytes of scratch pad RAM built into the microprocessor. The software provides the following general functions:

Interfaces with the front panel keys and the IEEE-488 Interface to provide access to the Generator functions.

Configures the Generator functional blocks to produce the required output, and then applies linearization and compensation data to optimize the instrument performance and resolution.

Implements a set of self test and diagnostic functions.

Provides software compensation procedures that allow the user to generate the instrument specific compensation data.

3-14. User Interface

The Generator software is implemented with a simple operating system that allows several tasks to operate in a round-robin fashion on an equal priority basis. Input and output to both the front panel and the IEEE-488 Interface execute at a higher priority and are handled as interrupt routines.

At power-on, the software performs an instrument self test and initializes both the RAM and the Generator hardware. Three tasks are continuously in operation:

Service task
Key task
IEEE-488 task

The service task checks the status signals. The key task and IEEE-488 task process user input. A fourth task is activated only when needed to process certain UNCAL (uncalibrated) or REJ ENTRY (rejected entry) conditions that cause the instrument STATUS display to flash.

3-15. Amplitude Control

Amplitude is programmed using a 23-step (6.02 dB per step) A8 Attenuator/RPP Assembly and a 14-bit vernier level DAC (located on the A6 Output Control PCA). The level DAC settings depend on a combination of the programmed output level and amplitude correction data.

The amplitude correction data compensates for level variations that are dependent on the output frequency of the Generator. Correction factors are stored in the compensation memory.

3-16. Attenuators

There is one 6-dB, one 12-dB, and five 24-dB sections on the A8 Attenuator/RPP Assembly. These sections are programmed in combination to provide coarse level control in 6-dB steps. The indicated voltages at which the attenuator sections change steps are 2-x volts, where

x = 1, 2, 3, ...23 for non-AM, or

x = 2, 3, 4, ...24 for AM operation

Table 4D-18 lists the attenuator sections programmed for various displayed levels.

3-17. Level DAC

The level DAC setting is calculated from the Generator output level. If level correction is enabled, the level DAC setting is further modified by the data stored in the compensation memory.

To minimize level transients that could damage external circuitry, the following sequence is used in programming the attenuator sections and the level DAC when the attenuator setting is changed:

1. The level DAC is programmed to zero.
2. The attenuator sections are reprogrammed for correct attenuation.
3. After a 5-ms wait to allow the attenuator sections to settle, the level DAC settings are programmed.

3-18. Temperature Compensation

The temperature compensation DAC (TC DAC) data is stored in the Generator software as a function of the output frequency (F_o). This data is the same for each Generator.

3-19. Reverse Power Protector

The reverse power protector (RPP) protects the Generator from damaging voltages applied to the RF OUTPUT connector. The status line RPTRPL indicates whether the RPP circuitry has tripped. If the RPP trips, the RF output is programmed off, and the RF OFF indicator flashes. The RPP circuitry is reset by the operator turning the RF OUTPUT on. This causes the A2 Controller PCA to reset the RPP by toggling RPRSTL and programming the RF on.

3-20. Frequency Reference Control

Programming of the frequency reference control bits depends on the setting of the INT/EXT reference switch as well as if either the Option -130 High-Stability Reference or the Option -132 Medium-Stability Reference are installed.

3-21. Frequency Control

The output frequency (F_o) is programmable with 10-Hz resolution from 0.1 MHz to 1050 MHz and with 20-Hz resolution from 1050 MHz to 2100 MHz. The filter and band control bits are programmed in nine bands and are determined by the output frequency (F_o). A synthesizer frequency is determined for each band.

The programming data of the KV and KN DACs are calculated from the synthesizer frequency and the instrument-specific VCO compensation data.

3-22. Modulation On/Off

The nine modulation modes are:

Internal AM
External AM
External DC AM
Internal FM
External FM
Internal ϕM
External ϕM
Internal Pulse
External Pulse

The modulation modes can be programmed separately or in combination (only FM and ϕM are exclusive). The AM depth and FM deviation DACs are always programmed whether or not modulation is enabled. When enabling or disabling modulation, only the modulation control bits are programmed. The External DC AM mode is enabled if both external AM and the DC AM special function are enabled. Table 4D-20, Modulation ON/OFF Control, lists the control states for each modulation choice.

3-23. Modulation Frequency

The two internal modulation frequencies of 400 Hz and 1000 Hz are programmed with a single control bit MF400L. Table 4D-21, Modulation Frequency Control, lists the MF400L control states.

3-24. Amplitude Modulation

The Generator allows amplitude modulation depth programming from 0 to 99% with 1% resolution. When the combination of signal amplitude and programmed AM depth exceeds +16 dBm peak from 0.1 MHz to 1050 MHz or +13 dBm peak above 1050 MHz, the UNCAL indicator lights to warn that the output level is no longer guaranteed. Amplitude modulation depth is programmed using the 8-bit AM DAC. A setting of 200 on the AM DAC corresponds to 100% AM modulation.

3-25. Frequency Modulation

Frequency modulation (FM) is programmable with three digits of resolution in four decade ranges. The FM DAC is a 12-bit DAC programmed to the FM deviation in Hz divided by the resolution. In addition, the FM DAC is scaled to compensate for the effects of the frequency doubling circuitry. The FM/ϕM modes are selected by the control bit PMODL. Table 4D-15, FM Deviation Control, lists the FM DAC, FM Range, and PMODL bit settings.

The maximum programmable FM deviation is dependent on the RF output frequency. FM deviations up to 400 kHz may be entered regardless of the output frequency. However, the UNCAL indicator is flashed and the FM DAC is clamped at full scale if the entry is beyond the allowed upper limit for that frequency band. Table 4D-14, FM Deviation Limits, lists the maximum programmable deviation in each frequency band.

3-26. ϕ Modulation

Phase modulation (ϕM) is programmable with three digits of resolution in four decade ranges. Phase modulation is internally normalized to 10 kHz, then programmed as FM deviation. The ϕM index is multiplied by 10 kHz (regardless of the modulation frequency) to get the equivalent FM deviation used to calculate the FM DAC and FM range bits. Table 4D-16, Phase Modulation Control, lists the FM DAC, FM range, and PMODL bit settings.

The maximum programmable phase modulation deviation is dependent on the RF output frequency. Phase modulation deviations up to 40.0 radians may be entered regardless of the output frequency. However, the UNCAL indicator is flashed and the FM DAC is clamped at full scale if the entry is beyond the allowed upper limit for that frequency band. Table 4D-14, FM Deviation Limits, lists the maximum programmable phase modulation deviation in each frequency band.

3-27. Compensation Memory

The compensation memory contains the instrument specific compensation data for the VCO, Output, and Attenuator assemblies. The integrity of this data is crucial to the performance of the Generator. Two redundant copies of the data are kept in two separate non-volatile memory ICs.

Hardware and software protection schemes guard against accidental destruction of the data. The compensation switch on the A2 Controller PCA must be set to the ON position when updating the compensation memory.

The compensation memory self test verifies the CRC checksums of each data segment. A detailed report of the compensation memory status can be interrogated from the front panel or the IEEE-488 interface. If compensation memory errors are detected by the self test, the Generator only uses the valid data segments. See Section 4D for more information on the compensation memory.

3-28. Self Test

At power-on, the Generator automatically self tests the digital and analog circuits. If the Generator fails any self test, the test results are automatically displayed as error codes. Several special functions are available for additional tests (see Section 4D). In addition, the microprocessor continuously monitors two status signals, UNLVL (unleveled) and UNLOK (unlocked).

The self tests can also be initiated by using the [SPCL] [0] [2] keys. The results of the self test can be displayed in the four display fields with [SPCL] [1] [1] keys and can also be transmitted using the IEEE-488 Interface.

Self tests 1 through 5 are digital checks that indicate the general functionality of the A2 Controller PCA. Self tests 6 through 10 use the two status signals UNLVL and UNLOK to test the general functionality of the RF circuitry.

During the self-test sequence, all attenuator sections are programmed ON (maximum attenuation) to prevent unwanted signals at the output. In addition, the Generator is programmed to the internal frequency reference.

The self-test error codes and descriptions are listed in Section 4D. A brief description of the different Generator self tests are as follows:

Test 1. The Generator's RAM is verified by writing to each memory location and reading the data back. Both the off-chip RAM and the on-chip RAM are tested.

Test 2. The compensation data in the compensation EEPROM and in the battery-backed RAM is verified. The CRC checksum in each data segment (VCO, Output, and Attenuator) in both memory ICs are checked.

Test 3. Each memory location of the non-volatile RAM is checked with a checksum.

Test 4. The data in each word of the two software EPROMs is successively summed and rotated. The result of this procedure is compared with a checksum for each EPROM.

Test 5. The IEEE-488 circuitry is verified by the microprocessor writing data to the IEEE-488 chip and then reading it back.

Test 6. The low-pass and band-pass filters on the A6 Output Control PCA are tested by setting the frequency within the pass band of the filters and verifying that the output is leveled. The frequency is then set outside of the pass band of the filters and the output should be unleveled.

Test 7. The synthesizer operation is verified by programming the Generator to a normal operating frequency and checking to see that the instrument is locked. Next the Generator is programmed to a synthesizer frequency below 225 MHz and then above 550 MHz and is checked to see that the instrument becomes unlocked.

Test 8. The PLL operation is verified by forcing a large change in frequency. When this is done, the Generator should become unlocked and then lock again.

Test 9. Frequency modulation is verified by simulating an overmodulation condition, then checking the unlocked indicator. This is done by programming internal FM off and the KN DAC to zero.

Test 10. Amplitude modulation is verified by overmodulating the carrier and then checking the unleveled indicator. This is done by programming a high output level and programming INT AM on with a high AM depth.

3-29. Special Functions

There are several special function self tests that are used as troubleshooting aids. Refer to Section 4 for detailed information regarding these troubleshooting tests.

3-30. Software Compensation Procedures

The software compensation procedures provide the user with the ability to generate the instrument-dependent FM, output, and attenuator compensation data. Section 4E, Software Compensation Procedures, describes the procedures in detail.

3-31. Status Signals

Four status signals indicate which option is installed in the Generator. These status bits are interrogated at power-on as follows:

- HSOPTL indicates Option -130 High-Stability Reference is installed.
- MSREFL indicates Option -132 Medium-Stability Reference is installed.
- LRFML indicates Option -651 Low-Rate FM is installed.
- ROPTL indicates Option -830 Rear Panel RF Output, MOD Input, and Pulse MOD connectors are installed.

The status of the rear panel REF EXT/INT reference switch is continuously monitored with the EXREFL bit. The state of this bit is used by the A2 Controller PCA to display the EXTREF indicator on the front panel and to program the reference source.

The RF output of the Generator is considered calibrated whenever the UNCAL indicator is off. If the calibrated limit of the Generator is exceeded, the UNCAL indicator is lit but not flashing. However, the RF output is still considered usable.

The UNCAL indicator flashes when the output of the instrument is considered unusable. This is the result of a severe overrange condition or when one of the following analog status signals becomes active.

- RPTRPL indicates that the RPP circuitry has tripped. If this occurs, the RF output is programmed off to provide additional protection to the instrument. The RF OFF and UNCAL indicators flash to indicate that RPP has tripped.
- UNLOKL indicates one of several conditions. The PLL could be out-of-lock, the reference circuits could be out-of-lock, or the signal could indicate FM over-modulation (if FM is on). The UNCAL indicator flashes for any of these circumstances.
- UNLVLL indicates that the output is unleveled. This could also be th result of amplitude over-modulation. With this condition, the UNCAL indicator flashes.

3-32. DETAILED CIRCUIT DESCRIPTIONS

The Generator is divided into three major sections: the front panel section, the module section, and the rear panel section.

The front panel section is mounted in a sheet metal housing and consists of the A1 Display PCA, a switch circuit board and elastomeric switches. The front panel section also includes the display lens, the MOD INPUT connector, and the PULSE INPUT connector.

All the front panel control keys, except the POWER ON/OFF button, consist of an elastomeric membrane sandwiched between the switch circuit board and the front panel sheet metal housing. The switch circuit board consists of a 6-by-8 matrix of open switch contact pads. When a key is pressed, a conductive pad on the back of the elastomeric membrane connects a set of contact pads. The A2 Controller PCA software senses what row and column of the matrix are connected when a key is pressed.

The module section consists of a cast module frame with gasketed covers and includes the following electrical assemblies:

A2 Controller PCA
A4 Synthesizer PCA
A5 VCO PCA
A6 Output Control PCA
A7 Output PCA
A8 Attenuator/RPP Assembly

The rear panel section consists of a fuse, a filter, a line-voltage selector circuit board, a transformer, the POWER ON/OFF switch and cable, the A9 Power Supply PCA, the A3 IEEE-488 Interface PCA, and a fan. The line-voltage selector circuit board accommodates four line voltages: 100, 120/220, and 240 volts. The line-voltage is determined by the orientation of the line-voltage selector circuit board.

The transformer, with its two primary windings, accepts the four voltages and produces the necessary five secondary voltages. The A9 Power Supply PCA rectifies, filters, and regulates these secondary voltages to produce the dc voltages required by the Generator. The dc fan is connected to the unregulated +5V supply.

NOTE

The power supply for Option -130 High-Stability Reference is separate. It has an automatic changeover switch for different input line voltages.

3-33. A1 Display PCA

The A1 Display PCA provides a readout of the programmed modulation, frequency, amplitude parameters, and status information. This displayed information and the bright digit are controlled by the A2 Controller PCA under the direction of the instrument software. The display is comprised of two vacuum fluorescent displays and their associated control circuitry. The two displays are refreshed as four groups of nine display fields (usually a digit) each. The four groups share the digit (grid) strobes but have individual segment (anode) strobes.

3-34. DATA COMMUNICATIONS

Display data is sent through a byte-wide bidirectional data bus from the A2 Controller PCA and is latched by U1 through U5, and U19 on the A1 Display PCA. Latch select signals DIG1L, DIG2L, SEG1L, SEG2L, SEG3L, and SEG9L determine which latch receives the data. Level-shifting buffer drivers U6 through U10 interface the TTL latches directly to the +37V anodes of the vacuum fluorescent displays.

3-35. DISPLAY FILAMENT VOLTAGE

The 6.0V ac filament voltage for the display is derived from a center-tapped winding on the Power Supply PCA transformer (T1). The ac filament voltage is biased at +6.2V above ground by circuitry on the A9 Power Supply PCA to provide a cutoff potential for the displays.

3-36. BRIGHT-DIGIT EFFECT

The bright-digit effect is achieved by providing three extra refresh cycles (strobes) to the specified digit. A grid current-limiting resistor (R3) provides uniform digit brightness by controlling electron depletion from the display cathode filaments.

3-37. SWITCHBOARD INTERFACE

The digit strobe data latched by U1 is buffered by open collector inverters (U13 and U15) and strobes the front panel switch matrix. The switch columns are strobed in unison with the display fields. The switch matrix status is read by the tri-state buffer (U14).

3-38. DISPLAY BLANKING

Monostable (U11) and NOR gate (U12) clear the display if new field or segment strobes are not received. This protects the display if the microprocessor stops refreshing. The display can be blanked manually by pressing [SPCL] [1] [3], which sets the signal CLRL and the output of U11 low, thus clearing latches U2 through U5. To restore the display, press [SPCL] [1] [2].

3-39. MODULATION-LEVEL INDICATOR

The external modulation-level indicator warns the operator when the modulation signal is not set to 1V peak (±2% typically). The external modulation signal is compared in the dual-comparator (U16) with internal references of 0.98 and 1.02V. Two status bits, MLEVLO and MLEVHI, are at the output of the 0.5 second dual one-shot (U17). If either of these reference voltages are exceeded, the two status bits are sensed by the A2 Controller PCA, which controls the EXT HI and EXT LO indicators in the MODULATION display field.

3-40. A2 Controller PCA

The A2 Controller PCA, under the direction of the instrument software, handles the data interface between the front panel, remote interface, and Generator functions. The A2 Controller PCA is located in a top side compartment of the module section.

The A2 Controller PCA consists of the following functional groups:

- Microprocessor and its interface circuitry
- Attenuator control interface
- Front panel interface
- IEEE-488 Interface
- Memory ICs and addressing circuitry
- Module I/O circuitry
- Reset circuit
- Status and control latches

3-41. MICROPROCESSOR

The heart of the A2 Controller PCA is U1, a TMS9995 16/8 bit microprocessor. The digital system clock signal is generated by an oscillator comprised of gates from U5 and crystal U41. L3 and C61 form a band-pass filter, which ensures that the crystal will oscillate at its fundamental frequency. When bidirectional buffer U4 is enabled, it provides additional drive current to the data bus signals. When U4 is disabled, it isolates the microprocessor from the system data bus. Buffers U33, U34, and U10 provide extra drive current to the microprocessor address and control signals.

3-42. ATTENUATOR CONTROL INTERFACE

The attenuator control signals are latched by U27. Darlington drivers U30 and U31 control the A8A1 Relay Driver/RPP PCA.

3-43. FRONT PANEL INTERFACE

Data is transferred to and from the front panel circuitry through tri-state bidirectional data buffer U18. This buffer is active when a front panel latch is addressed and the buffer control signal from U17 is low. Otherwise, the buffer is in the high-impedance state. The front panel latch select lines are decoded by U36. To reduce RF emissions from the Generator, low-pass filters and bypass capacitors comprised of the following components are used on the following signals:

SIGNALS	COMPONENTS
Signal CLRL	R6 and C51
Latch select SEG1L	R7 and C53
Latch select SEG2L	R8 and C54
Latch select SEG3L	R9 and C55
Latch select SEG9L	R10 and C56
Latch select DIG1L	R11 and C57
Latch select DIG2L	C46
Buffer select KBINL	C49
Signal MLEVHI	C47
Signal MLEVLO	C48

In addition, capacitors C58 and C59 bypass the display filament supplies, and capacitor C43 is used to bypass the -15 volt supply. LC filters comprised of L1 and C50, and L2 and C52 are used on the +5 volt and +37 volt supplies to the front panel circuitry.

3-44. IEEE-488 INTERFACE

Tri-state bidirectional buffer U3 buffers the data bus to the IEEE-488 interface. Address and control lines to the interface are buffered by tri-state buffer U2. These buffers are in the high-impedance state when the interface is not addressed.

The active low interrupt signal IEINTL, from the IEEE-488 interface, is connected to the level four interrupt on the microprocessor. R1 and C22 form a low-pass filter to suppress digital emissions from the Generator.

3-45. MEMORY

The program instructions and constant data are stored in two 32K-byte EPROMs, U21 and U22. The scratch pad RAM, non-volatile front panel setups, and one copy of the compensation memory are contained in the battery-backed CMOS RAM U25. The 2K-byte EEPROM U24 contains a redundant copy of the compensation memory.

The compensation switch protects the compensation memory from accidental destruction. The switch is connected directly to the enable input of tri-state buffer U46. When disabled, the buffer disconnects the write enable input of the EEPROM from the microprocessor write enable signal. The decoder PAL U20 decodes the memory selects and provides the bank switching logic. U20 also contains the write protection logic for the battery-backed portion of the compensation memory.

3-46. MODULE I/O

Control data is transferred to the RF circuitry (located in the module section) through a byte-wide unidirectional data bus. Control data is retained on the RF circuitry in latches. Select lines BSEL0L and BSEL1L, and address lines BAB2 through BAB0 are decoded into individual latch enables on the various RF circuitry. Tri-state buffers U15 and U16 on the address and data lines provide extra drive current and allow these signals to float when inactive.

Flip-flop U42 gates the module I/O select pulse from U8 with the system clock, to delay the leading edges of BSEL0L and BSEL1L, thus providing adequate latch setup times. D-flip-flop U9 latches address lines BAB2 through BAB0 to provide adequate address hold times.

3-47. RESET

Comparator U7 and its associated circuitry generate the active low reset signal to the TMS9995. The reset signal is generated on power-up or if the +5V supply drops below +5V.

At power-up, R5 and C4 provide a slow-rising input signal to the Schmitt Trigger inverter pair U44. The output of the second inverter pulls the microprocessor reset input low, then drives it high after approximately 100 milliseconds. When the +5V supply is up, a reference voltage is set at the negative terminal (U7 pin 2). This reference voltage is one diode drop below the voltage at the positive terminal (U7 pin 3). When power is lost, the voltage at the positive terminal falls below the reference voltage held by C3, and the output of U7 is immediately pulled low. This discharges C4 and resets the microprocessor.

3-48. STATUS AND CONTROL

Tri-state buffers U11 and U40 read the three hardware fault detector status signals (UNLVL, UNLOKL, and RPTRPL), the four option status signals (HSOPTL, MSREFL, LRFML, and ROPTL), and the status of the REF INT/EXT and compensation memory switches. Control and buffer enable signals are latched by U17.

3-49. A3 IEEE-488 Interface PCA

The IEEE-488 Interface uses an NECμPD7210 Talker/Listener IC (U1) to handle all IEEE-488 standard communications protocol. All data, address, and control lines to the 7210 are buffered on the A2 Controller PCA. Two MC3447 open-collector bus drivers (U3 and U4) interface the 7210 directly to the IEEE-488 bus.

Tri-state buffer U6 provides the status of the IEEE-488 rear panel address switches when interrogated. These switches determine the IEEE-488 bus address and talk-only (to) or listen-only (lo) modes. When opened, the switch just to the left of the IEEE-488 bus connector disconnects the bus shield ground from the system ground.

3-50. A4 Synthesizer PCA

The A4 Synthesizer PCA provides frequency control and modulation of the Generator output. The A4 Synthesizer PCA is located on the top side of the module section. Together with the A5 VCO PCA and a 10-MHz reference frequency, the A4 Synthesizer PCA simultaneously generates a high-band signal that spans 490 to 1050 MHz and a mid-band signal that spans 245 to 512 MHz.

The high-band and mid-band signals are coupled to the A6 Output Control PCA. Heterodyning extends the Generator frequency coverage down to 0.1 MHz, and multiplying extends the Generator frequency coverage up to 2100 MHz.

The A4 Synthesizer PCA consists of the following functional circuits that are described in the following paragraphs:

10-MHz Reference
Sub-Harmonic Reference
Main PLL
FM Processing
800/40 MHz PLL
Subsynthesizer

3-51. 10-MHZ REFERENCE

The Generator's reference is the internal 10-MHz crystal oscillator. If Option -130 High-Stability Reference or Option -132 Medium-Stability Reference is installed, the internal crystal oscillator is locked to that oscillator. The internal oscillator can also be locked to an external reference of 1, 2, 2.5, 5, or 10 MHz.

The internal 10-MHz crystal oscillator (XO) is a crystal Y1 and a FET transistor Q39. The frequency is adjusted by C240 and R230. The oscillator signal from Q39 is buffered by Q40, converted to TTL by U55-B, and branches to both the subharmonic phase detector U68, and the 10-MHz rear output via the 10-MHz bandpass filter C247 and L73. In addition, the 10-MHz reference is sent to both the 800/40-MHz loop-phase detector via U59, and the main loop-phase detector via U58.

3-52. Subharmonic Reference

Comparator U67 forms an ac-to-TTL converter. Diodes CR20 and CR21 precondition the REF IN signal to protect the comparator. Resistors R148, R149, R153, and R217 provide hysteresis to prevent oscillation when there is no input.

MOS switch U70 connects the control voltage of the 10-MHz crystal oscillator to a bias network R229, R230, and R231, or to the loop amplifier, thus closing a phase-locked loop.

The phase detector and loop amplifier are made up of U68, Q26, Q27, Q38, and U69. The signal from the external reference input, through the ac-to-TTL converter or the enhanced stability options, is applied to the flip-flop clock input U68-3 via U54. The 10-MHz signal from the crystal oscillator goes to the other flip-flop clock input, U68-11. The two flip-flops are connected. Therefore, the width of the pulse that switches Q38 is the difference in time of these two signals (U68-3 and U68-11). The phase detector operating point is set by R223 and R224.

The output of the loop amplifier is applied as the control signal to the frequency control input of the 10-MHz crystal oscillator through the control switch U70. The control switch U70 is controlled by the A2 Controller PCA through the control line SHENL. This line is enabled when the rear panel REF INT/EXT switch is set to EXT or when the enhanced stability options are present.

An out-of-lock detector is formed with one-shot U71. The out-of-lock detector provides a status output to the A2 Controller PCA that indicates the 10-MHz oscillator is not locked. An out-of-lock condition causes the loop amplifier to have a low-frequency beat note that triggers the one-shot to act as a pulse stretcher.

The output of the one-shot is an active-low signal and is combined through diode CR29 with other signals to form the UNLOK status signal.

3-53. MAIN PHASE-LOCK LOOP

The main phase-lock loop (PLL) is a fractional divider PLL with a single-sideband mixer (SSB) in the feedback path. The oscillator for this loop is a separate PCA, the A5 VCO PCA. All the remaining PLL circuitry is on the A4 Synthesizer PCA.

The key signals to the main PLL are the 1-MHz reference signal from the 10-MHz reference circuit, the 245- to 512-MHz signal from the binary divider, and the 20- to 40-kHz signal from the subsynthesizer circuit. The fractional division technique provides 20-kHz frequency resolution.

The SSB mixer, in conjunction with the subsynthesizer, provides additional 5-Hz resolution at the synthesizer frequency. This corresponds to 10-Hz resolution on the high band.

The main PLL consists of the VCO, the binary divider, the SSB mixer, the triple-modulus prescaler, the N-Divider, the phase detector, and the loop amplifier. All but the VCO are described in the following paragraphs. The VCO is discussed in paragraphs 3-62.

3-54. Binary Divider and Single-Sideband Mixer

The 490- to 1050-MHz signal from the VCO, via J107, is coupled to the binary divider U1. Regulator Q1 provides +5V for the divider. One output of U1 is coupled to the A6 Output Control PCA through J104. The other output is amplified by Q2 and Q3. This signal is split into two quadrature (90 degrees phase difference) signals by a 3-dB coupler U6.

This signal, and two other audio quadrature signals from U10, are summed in the double-balanced mixers U7 and U8 to produce two double-sideband suppressed-carrier signals. Because of the phase relationship of the outputs of the mixers, the summing of the two composite signals (in resistor network R21 and R22) results in the upper-sideband component being suppressed. The predominate remaining signal is the lower-sideband signal.

The lower-sideband signal, spanning 245 to 512 MHz in 20-kHz steps, is amplified by U9 and applied to the N-Divider where it is divided down to 1 MHz.

3-55. N-Divider

The main components of the N-Divider are:

Triple-Modulus Prescaler (divide by 20/21/22) U18, U19, U20 and N-Divider Custom Gate Array U17

The triple-modulus prescaler (see Figure 3-1), consists of a divide by 10/11 U20, divide by 2 U18A, synchronizing flip-flop U18B, and quad NOR gates U19. If all the inputs (E1, E2, E3, E4, and E5) to the 10/11 divider are low, the prescaler divides by 11, and the total division to the output (U20 pin 7) is 22. If any of the inputs are high, the prescaler divides by 10, and the total division is 20.

If inputs E1 and E3 are low, the modulus of the 10/11 divider is controlled by the output of the divide by 2 U18A. Consequently, the prescaler divides by 10 half the time and by 11 the other half, resulting in a divide by 21. U20 contains the ECL-to-TTL converter. U18B synchronizes the changing of the modulus with the clocking of the subsequent stages. The N-divider is clocked by the composite prescaler output U18A.

The operation of the triple-modulus prescaler is shown in Figure 3-1. The prescaler operates in conjunction with the N-divider gate array shown in Figure 3-2.

The N-Divider gate-array contains two 5-bit binary counters (A and N), a BCD two-decade rate multiplier, and latches to interface to the microprocessor. The operation of the N and A counters is described in the following paragraphs.

At the beginning of a count cycle, a number is loaded into the A and N counters. The A counter is not at its terminal count, so the output is high, and the mode line (MODE L) is low. This causes the prescaler to divide by 21 (or 22, TRMODL = low). The mode line stays low for 31-A counts, where A is the programmed number. The mode line goes high, and the prescaler divides by 20 (or 21, TRMODL = low) for 31-N counts.

The total division is:

$$(P+1)*(31-A) + P*((31-N)-(31-A)) \text{ or } P*(31-N) + (31-A)$$

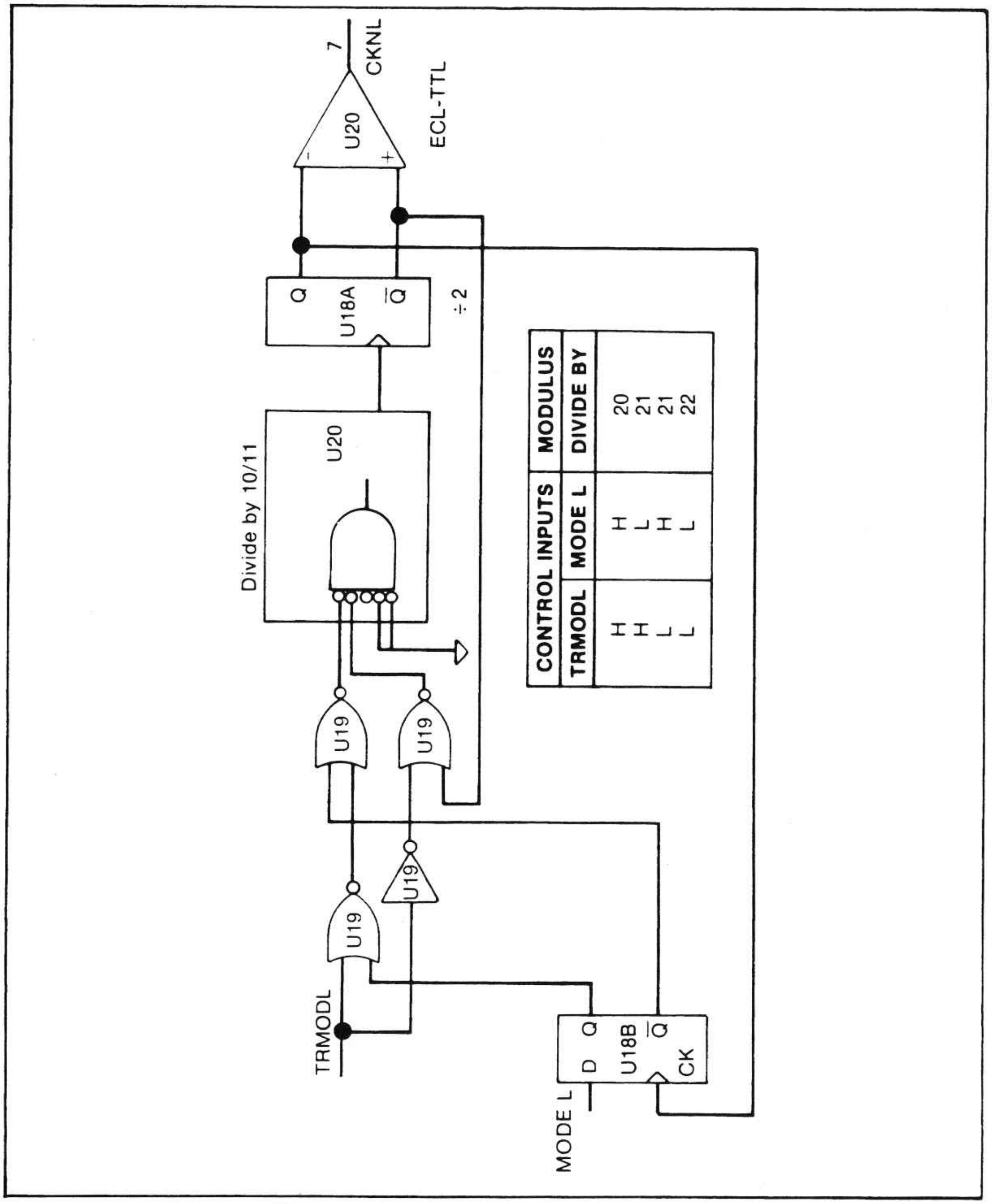


Figure 3-1. Triple-Modulus Prescaler Operation

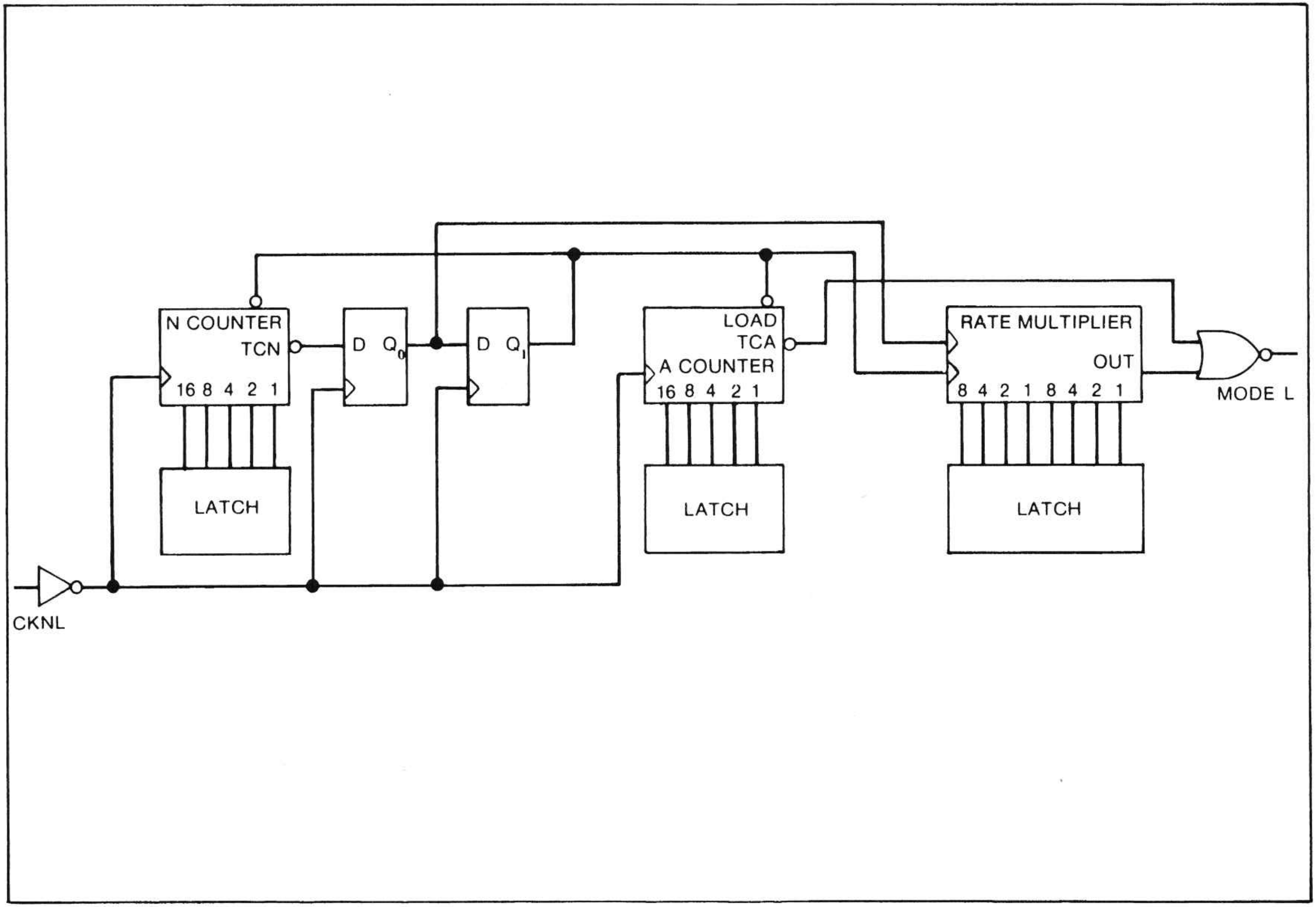


Figure 3-2. N-Divider Operation

On the 31st count, the counters are reinitialized. Figure 3-3 shows the timing for the A-counter programmed to 26 and the N-counter programmed to 18. Only the CKNL and MODE L signals shown in Figure 3-2 are accessible at U17 pin 6 and 22, respectively. Figure 3-3 show the N-Divider timing diagram.

The N-Divider gate array includes a two-decade rate multiplier that produces the fractional part of the division. The N-Divider gate array produces a pulse train with a programmed number of pulses for a 100-cycle frame of the 1-MHz N-divider output.

The programmed number ranges between zero and 98 in steps of two, corresponding to 20-kHz steps at the mid-band output frequency. The flip-flops in the rate multiplier get set up on count 29, and on count 30 a pulse may or may not be present, depending on the programming of the rate multiplier. This is the shaded pulse in the timing diagram (Figure 3-3).

Irregularly spaced rate-multiplier pulses cause the mode line to go low, and the prescaler divides by P+1 at a rate equal to the rate multiplier programming. At a division of 255, the N and A counters are normally programmed to 15, which means the divider is always dividing by 21. Consequently, there is no place to slip in the rate-multiplier pulses.

A 20/21 dual-modulus prescaler will not allow division from 245 to 525 without holes. For example, 252 is 0 frames of 20 and 12 frames of 21. Consequently, there is no place to slip in the rate-multiplier pulses. It is not possible to divide by 253.

By using a triple-modulus prescaler, these problems are solved. Continuing with the previous example, 252 is 12 frames of 21 and 0 frames of 22. The deleter allows the prescaler to divide by 22 at a rate equal to the rate-multiplier frequency. Number 253 is 11 frames of 21 and 1 frame of 22. A software algorithm determines whether to operate in the 20/21 mode (TRMODL = 1) or 21/22 mode (TRMODL =0).

The frequency at the output of the N-divider gate array is $(F_o - Fs - Fd)/N$; where F_o is the VCO output frequency, Fs is the subsynthesizer frequency, and Fd is the fractional-division frequency.

3-56. Phase Detector

The 1-MHz reference signal from divide-by-10 U58, and the 1-MHz signal from the N-divider U17 are connected to a digital phase-frequency detector (U43, U44, U45). If the N-divider output is greater than the reference frequency, the level at TP38 is high. When the output of the level shifter Q16 is above ground, CR12 is turned off. This allows current from Q19 to flow through CR13 into the integrator, decreasing the voltage at the integrator output U48 pin 6, which then lowers the frequency of the VCO until the reference and the N-divider output are the same frequency.

Similarly, if the N-divider output frequency is below the reference, TP39 is low and the voltage at the output of level shifter Q17 is below ground. This results in turning off CR15 and allowing current from R108 to flow through CR14 out of the integrator. This raises the voltage at the output of the integrator, which raises the VCO frequency. If the phase between the reference and N-Divider output slips more than two cycles in either direction, the corresponding phase-detector output is high or low. This provides twice the integrator current during acquisition as a conventional phase-frequency detector.

R107 provides a small bias current to the integrator to bias the phase detector at approximately 2.5 radians; consequently, the down-pump is normally always on. If the up-pump comes on, indicating an over-modulation condition, the pulses are detected by the one-shot U47, which produces the UNLOK status that is then sensed by the A2 Controller PCA.

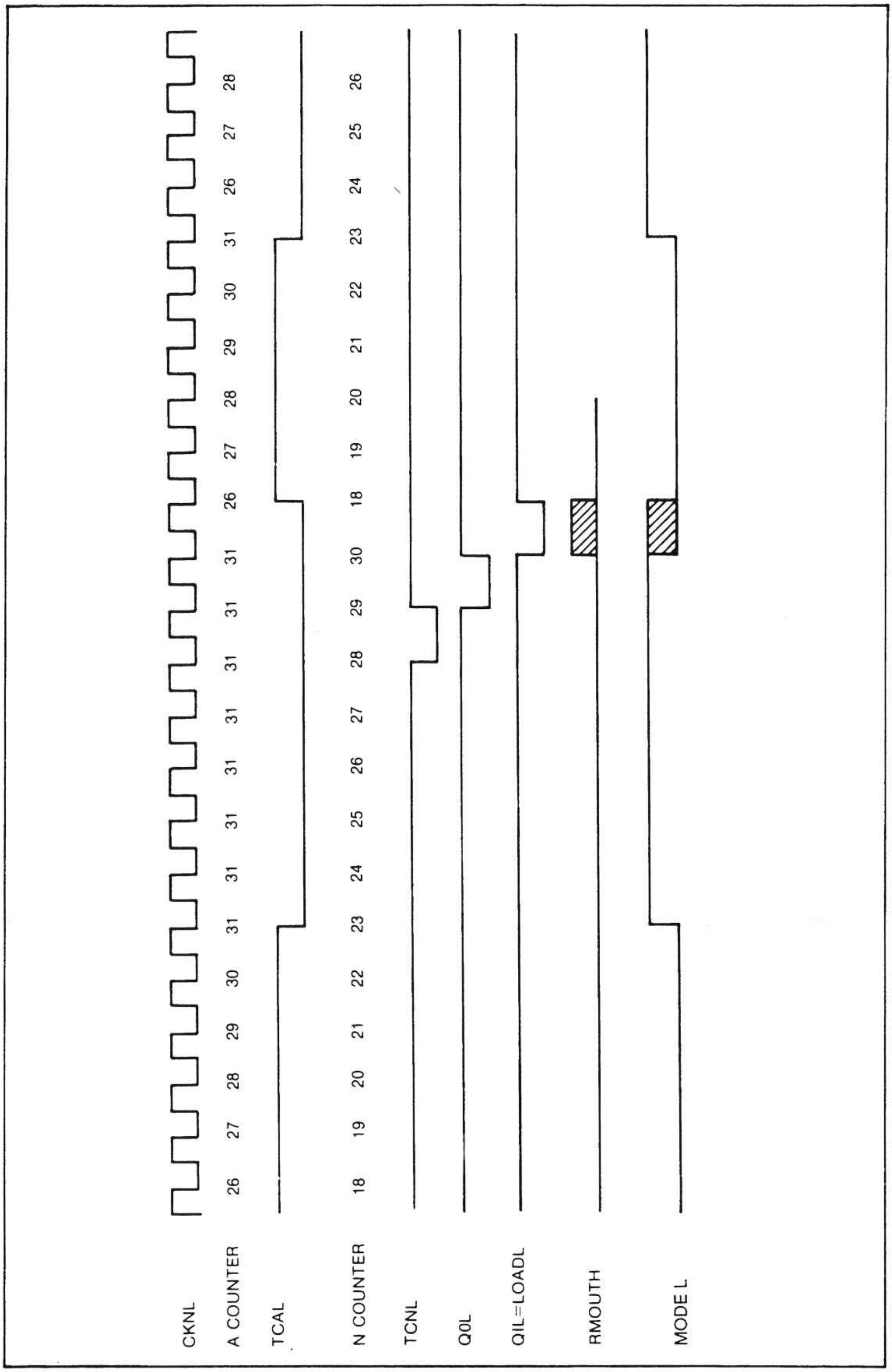


Figure 3-3. N-Divider Timing Diagram

For flat FM response, it is necessary for the PLL bandwidth to be constant at all VCO frequencies. Two factors cause the loop bandwidth to change: the VCO tuning coefficient (Kv) and the divider ratio (N).

During calibration of the VCO, the Kv is measured at many frequencies across the band, and compensation data is stored in the compensation memory. The instrument software uses this data along with N to control the PLL bandwidth in a compensating manner. The PLL bandwidth is controlled by changing the current to the down-pump via the KN DAC, U27, and the voltage-to-current converter, U46, Q18, and Q19.

3-57. Loop Amplifier

The loop amplifier-integrator consists of operational amplifier U48, C118, and R91. Capacitors C121 and C119 filter the 1-MHz reference. The output of the integrator is connected to a multi-pole LC filter (R92, C123, C99, C124, C126, C125, L49, L50, and R93) that attenuates the delete rate (20 and 40 kHz), and reference 1-MHz spurs.

Diodes CR9 and CR10 stabilize the loop during switching. The filter is buffered by the Darlington emitter-follower Q20, which is biased at 10 mA by Q21. Additional lead/lag compensation is provided by R99, R101, and C131. Proper termination for the filter is provided by R93 and Q22. The voltage for the loop amplifier is regulated to approximately +30V by Q15.

Amplifier U49 is a precision clamp to keep the VCO frequency above a minimum value for oscillation and below a maximum above which the N-divider would not divide correctly. The photoisolator U50 detects when the clamp is active, indicating an out-of-lock condition. This signal is ORed with the signal from one-shot U47 and sent to the microprocessor as the UNLOK status.

3-58. FM PROCESSING

To provide FM accuracy, the FM modulation signal (FMV) from the A6 Output Control PCA is first processed by the KV DAC (U28 and U29) to compensate for the VCO tuning coefficient. The KV DAC setting is proportional to 1/Kv, where Kv is the tuning coefficient. This correction is stored in the compensation memory on the A2 Controller PCA.

Range switching is provided by resistors R77, R78, R79, and FETs Q10, Q11, and Q12. Comparator U42 converts TTL levels to 0V (on), and -15V (off) required by the FETs. U41C buffers the range switch, and in conjunction with R82, provides an overall FM adjustment. At this point, the audio signal splits into two paths. The path that connects to the integrator, U41A, is for modulation frequencies inside the loop bandwidth.

The path that sums with the VCO control voltage at P102 is for frequencies outside the loop bandwidth. U41D is an active high-pass filter that compensates for the non-ideal integrator and the ac coupling to the VCO tuning port.

The output of U41D is summed with the VCO control voltage via R88 and C117. FET Q13 allows the FM to be turned off. The audio signal is also processed by integrator U41A, R85, R86, and C115. The audio signal is ac coupled into the phase-detector integrator via R89, R90, C116, and FET Q14. (Resistor R90 adjusts the low frequency FM gain). This integrator makes the phase modulation produced at the phase detector appear as FM.

3-59. 800/40 MHz PLL

When the Generator is operated in the HET band, the 800-MHz oscillator is locked to the 10-MHz Reference and provides a local oscillator for the heterodyne circuit on the A6 Output Control PCA. It also provides a 40-MHz signal to the subsynthesizer clock generator.

The 800-MHz VCO is connected to the divide-by-four U61, followed by a divide-by-five U62 and U63, providing 40 MHz to the subsynthesizer clock generator through selector U64. When the Generator is not in the HET band, the 800-MHz oscillator and the first divide-by-four are disabled by turning off Q28 (HET).

The 40-MHz oscillator consisting of U64, L66, and CR24, is selected by U64. The 40-MHz balanced ECL signal from U64 drives the two-phase clock generator. A self-biased gate U65 converts ECL to TTL. U66 divides the 40-MHz signal by four to produce a 10-MHz signal that is compared against the 10-MHz reference in the phase-detector U59 and U65.

Op-amp U60, resistor network Z9, and capacitors C181, C185, C186, and C201 integrate the phase detector pulses to produce a dc control voltage for the 800-MHz VCO and the 40-MHz VCO.

3-60. 800-MHz VCO

The 800-MHz VCO is a low noise, limited range, voltage-controlled oscillator for the 800-MHz PLL. The basic oscillator uses two active devices operating as negative resistance elements, coupled symmetrically to a resonator made up of two varactors and an adjustable capacitor. Each device is followed by an amplifier and isolation pad. This provides two coherent outputs of +5 dBm to the PLL and 0 dBm to the A6 Output Control PCA.

The oscillator transistors Q32 and Q35 are biased at 13 mA by R182 and R191. The voltage at the collectors of Q32 and Q35 is typically +2.5V. The two 6-dB amplifiers Q33 and Q37 are biased so that the voltage at their emitters is about +0.3V, and the voltage at their bases is about +1V with the collectors at +6.5V.

The PLL control voltage from U60 provides the tuning voltage for the dual varactors CR26 and CR27. The adjustable capacitor C206 is set to provide +16V on the varactor to optimize the VCO noise characteristic. The output attenuators consisting of R186, R187, R189, R197, R198, and R200 provide isolation for the outputs. The VCO signal is coupled to the A6 Output Control PCA by a through-the-plate coaxial connector P108 at the 0 dBm level. The other VCO signal is connected to the divider U61 to provide the feedback for the PLL.

3-61. SUBSYNTHESIZER

The subsynthesizer consists of the clock generator U34, U35, Q4, Q5, the gate-array U33, the divide by 500 U15 and U16, and the low-pass filter L11 and L17. Internal to the subsynthesizer gate-array U33 are a divide-by-two, a 3½-decade-rate multiplier, and associated latches.

The balanced 40-MHz ECL clock signal is converted to TTL in Q4 and Q5 and converted to a two-phase 20-MHz clock in U34, U35.

The input frequency to the rate multiplier is 20 MHz. The output frequency can be programmed from zero to 19.995 MHz in 5-kHz steps. This signal is ORed with the other phase of the 20-MHz clock to produce 20 MHz to 39.995 MHz at U33 pin 1. It is also divided by 2 for the output at U33 pin 23, by 10 in U15, and again by 50 in U16 to produce 20 to 39.995 kHz in 5-Hz steps. This TTL signal at TP11 is filtered by L11, L17, and C41, C42, C48, C50, and C51. Op-amp U10 forms an active quadrature generator and the output pins 14 and 8 are offset by 90 degrees. These two signals are the 20- to 40-kHz inputs for the Main PLL single-sideband mixer.

3-62. A5 VCO PCA

The A5 VCO PCA is the heart of the main PLL. It produces the signal that is further processed to become the Generator output. The A5 VCO PCA is located in a bottom side compartment of the module section.

The A5 VCO PCA tunes over a frequency range of 490 to 1050 MHz in four bands, programmed by binary control signals Q and H/L, as follows:

Band	Frequency Range (MHz)	Q	H/L
L1	512 - 639.99999	0	0
L2	640 - 729.99999	1	0
H1	730 - 889.99999	1	1
H2	890 - 1050	0	1

The control voltage varies from about +2V to +16V in each of the four bands, and varies approximately linearly with frequency in each band. The A5 VCO PCA contains two oscillator circuits of similar design, but with different element values and transmission line lengths, to cover 490 to 730 MHz (L bands oscillator) and 730 to 1050 MHz (H bands oscillator).

Each oscillator uses a transistor (Q1, Q2) configured as a negative resistance device. The voltage at the collector of Q1 is about 7.2V at 1050 MHz, and the voltage at the collector of Q2 is about 8.1V at 700 MHz. Each oscillator transistor is coupled loosely to a resonator that consists of a microstrip transmission line in series with a varactor diode (CR1, CR2) and a switchable value capacitor circuit (C3, C4, C7, C8, and associated components).

Each oscillator operates in two bands, selected by switching the capacitance value from varactor cathode to ground. For the H bands oscillator, C3 is selected for H2 band operation, while C3 in parallel with C4 is selected for H1 band. For the L bands oscillator, C7 is selected for L2 band operation, while C7 in parallel with C8 is selected for L1 band. The PLL control voltage from the A4 Synthesizer PCA at P202 provides the tuning voltage for varactor diodes CR1 and CR2.

The +13-dBm nominal signal from each oscillator is applied to a 12-dB attenuator that provides isolation (R8-R10, R14-R16), and then to a low-pass filter that attenuates harmonics to -15 dBc nominal (C16, C17, C24, C25). A PIN diode switch selects the signal from the ON oscillator, while the other oscillator is disabled by shorting the resonator to ground with a PIN diode switch (CR3, CR4, CR9, CR10). The signal is then applied to a signal-splitter/attenuator that provides further isolation (R18, R19, R20, R23, R24).

One signal-splitter output goes to 11-dB amplifier U1. This amplifier provides further isolation and also boosts the signal to about +3 dBm. The boosted signal is connected to the A6 Output Control PCA by a plug-in capacitor, C1. This capacitor allows either the A5 VCO PCA or the A6 Output Control PCA to be removed independently from the module section without the use of a soldering iron.

The other signal-splitter output goes to series-connected 11-dB amplifiers U2 and U3. Two amplifiers are required for adequate isolation from the A4 Synthesizer PCA. The +3-dBm output signal from U3 is connected to the A4 Synthesizer PCA by a through-the-plate coaxial connector P204.

Amplifiers U1, U2, and U3 are biased at about +1.5V at their inputs and +4.5V at their outputs.

The binary band control signals Q and H/L are connected from the A6 Output Control PCA to the A5 VCO PCA with a cable assembly W1 that plugs onto connector pins on the A6 Output Control PCA. The control signals are level shifted by dual operational amplifier U4, which acts as a comparator.

3-63. Output Assembly (A6 and A7)

The A6 Output Control PCA and A7 Output PCA are intimately associated. The following paragraphs describe the circuitry of the two PCAs as a single assembly (Output Assembly). The Output Assembly accepts RF signals from the A4 Synthesizer PCA and the A5 VCO PCA and command signals from the A2 Controller PCA. The Output Assembly provides a 0.1- to 2100-MHz RF signal to the A8 Attenuator/RPP Assembly.

The Output Assembly reduces harmonic distortion components in the RF signal, controls RF signal amplitude, and introduces AM and Pulse. Also, the Output Assembly generates the low (heterodyne) frequency band from 0.1 to 245 MHz though mixing, and the X2 frequency band from 1050 to 2100 MHz by doubling the high band. The Output Assembly also generates a modulation signal to provide internal AM, FM, ϕM, and Pulse, and provides a digital interconnect path between the A2 Controller and the A4 Synthesizer PCAs.

3-64. RF PATH

The RF path begins with the two RF signals from the VCO and the Synthesizer assemblies. The SPDT (single-pole double-throw) bandswitch circuit selects between the 512- to 1050-MHz signal at P6 and the 245- to 512-MHz signal at P7. The selected signal is applied to buffer amplifier U38 and U39.

The 245- to 512-MHz signal directly generates the 245- to 512-MHz mid-band output signal. The 512- to 1050-MHz signal generates the high-band output signal directly and the 0.1- to 245-MHz low-band output signal by mixing with an 800-MHz LO signal. The 1050- to 2100-MHz X2 frequency band is generated from the high band with a frequency doubler.

The buffer amplifier consists of an input attenuator followed by monolithic RF amplifiers U38 and U39 and has 7-dB gain. Following the buffer amplifier is a printed low-pass filter and a X2-band select switch consisting of PIN diodes CR7 through CR10. This switch either routes the signal to a low-pass filter circuit for frequencies from 245 to 1050 MHz, or to a doubler circuit for 1050 to 2100 MHz.

For operation in the 245- to 1050-MHz frequency band, the RF signal is routed through CR8 to a cascade of low-pass filters. These filter circuits consist of combinations of discrete components and printed traces that suppress harmonics in the RF output signal. The first filter section is switched into the RF path via PIN diodes CR12 through CR16 by asserting MIDH when the Generator is operated in the mid band (245 to 512 MHz). PIN diodes CR17 through CR19 select capacitors C16, C18, and C20 whenever HAOCTH is asserted to change the section cutoff frequency from 512 to 350 MHz. The third section provides harmonic filtering for the two higher bands, 512 to 730 MHz, and 730 to 1050 MHz. PIN diodes CR20 through CR22 select capacitors C24, C26, and C28 to change the cutoff frequency from 1050 to 730 MHz whenever HAOCTH is not asserted.

For operation in the X2 band from 1050 to 2100 MHz, the RF signal is directed through CR7 to the frequency doubler and associated filters on the A6 Output Control PCA. The control signal X2L is asserted at -15V. A signal of approximately +9 dBm (±2 dB) at the input of U1 becomes +14 dBm (±1 dB) at the input to balance T1. U1 and U2 operate as a limiter to control the amplitude and limit signal variations to this point. T1 generates a balanced drive for rectifier CR26 with a resulting second harmonic of +4 dBm (±2 dB) at the output of C134. In addition, a strong fundamental component and third harmonic are also present.

The remaining circuitry splits the signal into four frequency bands: 1050 to 1250 MHz, 1250 to 1450 MHz, 1450 to 1750 MHz, and 1750 to 2100 MHz. The circuitry then acts as a bandpass filter for the signal, leaving only the desired second harmonic. Filter 1 is the topmost filter on the 9-layer stripline quad filter pca. When CR27 is on, CR29 is on, and CR28 is off, a signal is delivered through this filter. Logic signal X2FL1L is at -15V to produce this result. Meanwhile, X2FL2L, X2FL3L, X2FL4L are at +15V to turn off the other three parallel paths. The other three paths operate in a similar manner. Operation can be observed by switching frequency and observing voltages at the coil end of appropriate resistors. (See Table 3-1.)

Table 3-1. Bandpass Logic States

BAND/MHz	R47	R48	R49	R50	R51	R52	R53	R54
1050 to 1250	-0.8V	-0.8V	+14V	+0.8V	+0.8V	+0.8V	+0.8V	+0.8V
1250 to 1450	+14V	+0.8V	-1.6V	-0.8V	+0.8V	+0.8V	+0.8V	+0.8V
1450 to 1750	+14V	+0.8V	+14V	+0.8V	-1.6V	-0.8V	+0.8V	+0.8V
1750 to 2100	+14V	+0.8V	+14V	+0.8V	+0.8V	+0.8V	-1.6V	-0.8V

The output signal from the switched filters is amplified by U8 (8 dB gain) to a level of 3 dBm (±2.5dB) at the input to the RF modulator. CR43 and CR44 serve as a switch to turn off this signal when 0.245 to 1.05 GHz is being sent to the modulator. Likewise, CR45 and CR46 exclude the lower frequencies when 1.05 to 2.1 GHz is required.

The amplitude modulator on the A7 Output PCA consists of PIN diodes CR1 through CR7 and associated components, and receives the RF signal from the A6 Output Control PCA through W1. The modulator is a voltage-controlled variable attenuator that provides AM and output level control. Modulator control voltage is determined by the leveling-loop circuitry. The leveling loop is described later in this section.

U1, U2, U3, Q2, and associated components follow the modulator in the signal path and form a four-stage, 25-dB gain, 245- to 2100-MHz amplifier. This amplifier drives a 3-dB power splitter that consists of resistors R28 through R31 and associated printed transmission lines.

One power-splitter output drives the leveling-loop detector diode CR8. The other output goes to a 2-dB gain buffer amplifier that includes Q4 and associated components. The HET band switch follows the buffer amp and consists of PIN diodes CR10 through CR15 and biasing components. In the 245-to 2100-MHz position, the signal passes through diodes CR11 through CR14 to the pulse modulator, U5 through U7. The output amplifier follows the pulse modulator and consists of FET Q9 and associated components. This low distortion amplifier has 9-dB gain and output capability of 19 dBm.

For low-band operation (0.1 to 245 MHz), the signal from the power splitter is routed through CR10 and W2 to the HET band circuitry on the A6 Output Control PCA. The RF signal first passes through an adjustable attenuator, R61 through R66, and then to the RF port of U3 (a double-balanced mixer). The signal frequency at the mixer RF port varies from 800.1 to 1045 MHz. The 800-MHz local oscillator (LO) signal for the mixer comes from the A4 Synthesizer PCA through P8 and is amplified by Q37. This fixed-tuned amplifier has 13 dB of gain and provides a 10-dBm signal at the mixer LO port.

The mixer 0.1- to 245-MHz output signal is passed through a diplexing low-pass filter (C194 through C205, R59, R60) that suppresses unwanted mixer spurious products while maintaining a 50-ohm load at the mixer IF port. The filtered IF signal is amplified by a three-stage IF amplifier Q34, Q35, Q36 and associated components.

The IF amplifier gain increases with frequency and is nominally 35 dB at 0.1 MHz and 37 dB at 245 MHz. This gain characteristic compensates for the increasing loss with frequency of the mixer and the diplexing low-pass filter. The output of the IF amplifier passes through W3 to a 245-MHz low-pass filter on the A7 Output PCA (C53, C54, C55 and printed inductors L14 and L15). Following this filter, the signal passes through PIN diode CR15, the pulse modulator, and the output amplifier. The +15V power supply for the LO and IF amplifiers is switched off by Q20 when the instrument is operating in the 245- to 2100-MHz bands to avoid introducing spurious products in the instrument output.

3-65. LEVELING LOOP

The leveling loop accepts the unleveled 245- to 2100-MHz signal from the switchable low-pass filters and doubler-filter circuits on the A6 Output Control PCA. The leveling loop generates a leveled signal at the power splitter output on the A7 Output PCA that feeds the buffer amplifier. The leveled signal is proportional to the leveling loop control voltage that is generated by the level-control circuit. The signal amplitude at the other output of the power splitter is detected by a Schottky detector diode, CR8.

The Schottky detector diode CR8 generates a temperature-dependent dc voltage. This is a non-linear function of the applied RF voltage, thus temperature compensation and linearization are necessary. The detector diode signal is low-pass filtered by L10 and C35, and is offset by the voltage across temperature-compensating diode CR9. Q25, Q26, and associated components on the A6 Output Control PCA form a current source circuit that provides bias current for CR9 and CR8.

The offset detector-diode voltage at U29-A pin 5 on the A7 Output Control PCA is linearized by amplifier U29-A and its associated feedback components. Potentiometer R113 provides detector linearity adjustment. Thus, the voltage at U29-A pin 7 is proportional to the RF voltage at detector-diode CR8.

This voltage is divided and applied to the loop-integrator amplifier at U29-B pin 2. This amplifier drives the modulator through a modulator-linearizer circuit and maintains the voltage level (via the ALC loop) at U29-B pin 2 equal to that on pin 3. The voltage on pin 3 is a function of the leveling loop control voltage applied to R121 (available on TP7). R121, R122, CR64, and CR57 form an additional detector-linearizing network that is active for low RF levels. Amplitude modulation is achieved by summing an appropriately scaled modulation signal with the dc leveling loop control voltage applied to R121.

The amplitude modulator on the A7 Output PCA consists of PIN diodes CR1 through CR7 and associated components. Attenuation through the modulator is a function of bias current through the PIN diodes. This current is provided by the modulator-linearizer circuit on the A6 Output Control PCA. U31 and associated components provide modulator series diode current, while U32 and associated components provide shunt diode current.

Modulator attenuation is approximately proportional to the modulator control voltage on TP8. Proportionality is required to maintain constant leveling loop bandwidth as modulator attenuation varies. Minimum attenuation is obtained with a modulator control voltage of 10V, while maximum attenuation is obtained with 0V.

Comparator U15-D and associated components form an unleveled-indicator circuit. The comparator senses the modulator control voltage at U29-B pin 1. This voltage is normally less than +11V, and the comparator output is high. If the modulator control voltage exceeds +11V, the modulator attenuation is at a minimum, and the leveling loop becomes inoperative (unleveled). This condition could be due to a fault or some abnormal operation such as over modulation. In this case, the comparator output (UNLVLL) goes low. The A2 Controller PCA senses this low and causes the front panel UNCAL indicator to flash and displays an unleveled status if interrogated.

3-66. LEVEL CONTROL

The instrument output level is set by the level-control circuit. Inputs to this audio signal processing circuit are the internal and external modulation signals, a dc reference voltage, and the digital control commands. The circuit output is the leveling-loop control voltage that provides vernier level control of the Generator output. Digitally encoded level, modulation depth, and temperature-compensation information are provided by the A2 Controller PCA.

Selection of the internal or external dc- or ac-coupled modulating signal, or no modulation, is made by analog switches U27-A, U27-B, U27-C, and Op-amp U28-B. The selected buffered modulation signal at U28-B pin 7 is applied to pin 4 of U19, a dual 8-bit DAC. U19, with U20-A, acts as a digitally programmed variable attenuator and controls AM depth.

Binary AM depth control information from the A2 Controller PCA is applied to DAC U19. The output at U20-A pin 7 is the modulation signal scaled to the programmed AM depth. This signal is summed by Op-amp U20-B with a dc reference current provided by CR50. The output at U20-B pin 8 is called the 1+AM signal. This signal provides the desired AM depth when scaled by the level DAC and applied to the leveling loop. AM depth adjustment is provided by potentiometer R97 and AM DAC offset by R46.

The instrument RF output amplitude is temperature compensated in a frequency-dependent manner as follows. The 1+AM signal is applied to pin 18 of dual 8-bit DAC U19, the DAC B reference input. The DAC output, at U20-C pin 1, is the 1+AM signal attenuated by an RF frequency-dependent factor provided by the A2 Controller PCA using constants stored in the Generator firmware. This voltage is applied to a resistor/thermistor network that includes R77, R78, R80, and RT79.

The network output is the 1+AM signal attenuated by an RF frequency and temperature-dependent factor, and is applied to summing Op-amp U20-D. The 1+AM signal is also applied to this summing amplifier. Thus, the voltage at U20-D pin 14 is the temperature-compensated and scaled 1+AM signal.

This signal is applied to the reference input of level DAC U21. This 14-bit DAC, with Op-amp U35-A, controls the Output Assembly RF output amplitude. The DAC output voltage, U35-A pin 7, is the temperature-compensated 1+AM signal multiplied by a factor proportional to the 14-bit level control number provided by the A2 Controller PCA. This voltage is the leveling loop control voltage. The Generator RF output level adjustment is provided by potentiometer R82, and DAC offset voltage adjustment is provided by potentiometer R86.

3-67. MODULATION OSCILLATOR

The modulation oscillator generates a leveled sine wave of 400 Hz or 1 kHz and is the modulation source for the internal AM, FM, ϕM, and pulse functions. The oscillator is a level-controlled Wien-Bridge type and consists of Op-amps U22-A, U22-B,. and associated components. Frequency is determined by the series RC time constant of the components between pins 5 and 7 of U22-B and by the parallel RC time constant of the components from U22 pin 5 to ground. The modulation-frequency control line, MF400L, originating at latch U13, selects either 400-Hz or 1-kHz operation, and is selected by switching resistors with JFETs Q22 and Q23.

The amplitude of oscillation is controlled by an ALC loop that varies the resistance on U22-B pin 6 to ground. This resistance, comprised of R107 and the drain resistance of Q24, is nominally 2 kΩ. The oscillator signal amplitude is sensed by rectifier CR52. The average current through CR52 is made equal to the reference current in R100 by integrator-amplifier U22-A. Level adjustment is set by potentiometer R99. Temperature compensation is provided by R101, R102, and CR51.

3-68. FM and ϕM DEVIATION CONTROL

The FM and ϕM modulation signal source and deviation control circuits are on the Output Assembly. Analog switches U26-A, U26-C, and Op-amp U28-A select the internal or external FM signal or no modulation. ϕM is obtained by differentiating the modulating signal and selecting either external or internal modulation with analog switches U26-B and U26-D. The selected and buffered modulating signal at U28-A pin 1 is applied to FM DAC U25. This DAC provides fine control of the FM deviation. (The coarse control FM circuitry is part of the A4 Synthesizer PCA.) The output of the DAC, at U35-B pin 1, is the modulation signal multiplied by a factor proportional to the 12-bit FM deviation control provided by the A2 Controller PCA.

For output frequencies below 245 MHz, and from 512 to 1050 MHz, the FM DAC setting is halved to account for the effective frequency doubling that occurs on these bands. For frequencies above 1050 MHz, the FM DAC setting is quartered to account for the effective frequency quadrupling in this band.

3-69. PULSE MODULATION CONTROL

External modulation is provided by the user controlling the voltage at the external modulation input connector. This input is one input to comparator U33. The reference input, composed of R147 and R148, is held at 1V. The connector input is held high by R144, R145, and R146 at 1.2V. This input can be lowered with TTL, a resistor less than 150 ohms, a pulse generator, or even a sine-wave generator. Lowering this input brings the output of the comparator (U33A) high. If EXTPUH is high (pulse modulation on), then U34A output is low, which brings U34C high. U4A converts this to a differential drive with the base of Q7 and Q8 high, and the base of Q5 and Q6 low. Level shifting resistors R49 through R52 translate this into 0V at pin A, and -6V at pin B for the "off" switch condition.

For internal pulse, the comparator U33B is driven by the internal oscillator of the instrument. This signal is combined with external pulse to produce the final drive logic.

3-70. A8 Attenuator/RPP Assembly

The A8 Attenuator/RPP Assembly consists of an A8A1 Relay Driver/RPP PCA and an A8A2 Attenuator/RPP PCA. The A8 Attenuator/RPP Assembly is enclosed in a metal housing mounted on the top side of the module section.

The A8 Attenuator/RPP Assembly, controlled by the microprocessor, provides coarse control of the Generator output level. The high-level signal from the Output Assembly (A6 and A7) is applied to the A8 Attenuator/RPP Assembly which provides 0 to 138 dB of attenuation (in 6-dB steps) to this signal before going to the Generator RF OUTPUT connector.

Compensation data for the attenuator in each Generator is stored in the compensation memory located on the A2 Controller PCA. The instrument program uses this data to correct for the combined deviations of the attenuator sections in use. For more details on level correction, refer to the paragraphs on Amplitude Control.

The A8 Attenuator/RPP Assembly provides an attenuation range from 0 to 138 dB in 6-dB steps, and consists of seven independently cascaded 50-ohm attenuation sections, a 6-dB, a 12-dB, and five 24-dB sections. Each section consists of a DPDT relay and a pi attenuator pad.

One relay position (when power is applied to the relay), provides a straight path for the RF signal. The other position (no power applied to the relay), inserts the attenuator pad into the RF signal path. All seven relays are inside individual shielded compartments in the attenuator housing.

The control of the attenuator relays is latched via U27, the open-collector drivers U30 and U31 on the A2 Controller PCA, and transistor drivers on the A8A1 Relay Driver/RPP PCA. For calibration and troubleshooting purposes, special functions 83 through 86 allow the direct selection of four of the five 24-dB attenuators. The other 24-dB attenuator is selected by programming the appropriate level (-12 dBm).

Coupling capacitor C8 protects against dc or low-frequency power. The diode limiter, consisting of CR2 and CR3, provides protection against medium RF power levels and short-term (fast acting) protection against high RF power levels. Long-term (latched) protection is provided by relay K8 whenever the reverse RF power exceeds a preset level.

RF power detected by CR1 is compared with the preset voltage in one section of comparator U1. When the detected voltage exceeds the set value, the output of U1 pin 14 goes negative, turning off Q8 and Q9. This deactivates K8 to the protect position. In the protect position, the Generator output is disconnected from the output connector.

CR11 and R34 form a latching network so that K8 remains in the protect position until the RF output is reset by an RF ON entry. The output of the comparator is buffered and sent as RPTRPL to the A2 Controller PCA for processing. The A2 Controller PCA annunciates the RPP trip condition by flashing the UNCAL and RF OFF indicators.

3-71. A9 Power Supply PCA

The bridge rectifiers in the power supply are used in either a bridge or full-wave center-tapped configuration with capacitor input filters. Table 3-2 lists the rectifier configurations as well as the component designations for the various supplies.

The two +15V, the -15V, and the +5V supplies use conventional three-terminal IC regulators with internal current-limiting and temperature protection. All three +15V regulators have reverse-voltage protection diodes CR3, CR4, and CR8.

The +37V regulator voltage is adjustable via R3. A +6.2V supply is developed from the +37V supply through resistor R4 and zener diode CR7. The +6.2V supply is then applied to the center tap of the 6V ac filament supply. This provides grid bias for the front panel displays. All regulators (except +37V) have their common reference terminals brought out to an external ground point (P2) on the module section to reduce power supply ripple.

Triac U6 is a voltage surge protector to protect against line voltage surges as well as overvoltage in case of a wrong setting of the selector switch.

Switch S1 is the REF INT/EXT reference selection switch and is not functionally part of the power supply.

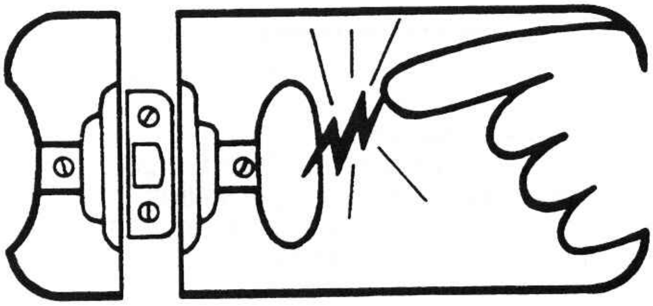
Table 3-2. Power Supply Rectifier Configurations

SUPPLY	RECT.	CONFIG.	CAP	REGULATOR		REMARKS
+37	CR6	Bridge	C11	A9	U4	Adjustable
+15	CR2	CT/FW	C2	"	U5	Fixed
+15	CR2	CT/FW	C2	"	U1	Fixed
-15	CR2	CT/FW	C5	"	U2	Fixed
+5	CR5	CT/FW	C8	A3	U3	Fixed
+18	CR1	Bridge	C1			Unregulated relay supply
FIL	6V ac with center-tap biased at 6.2V dc.					

static awareness

A Message From

John Fluke Mfg. Co., Inc.



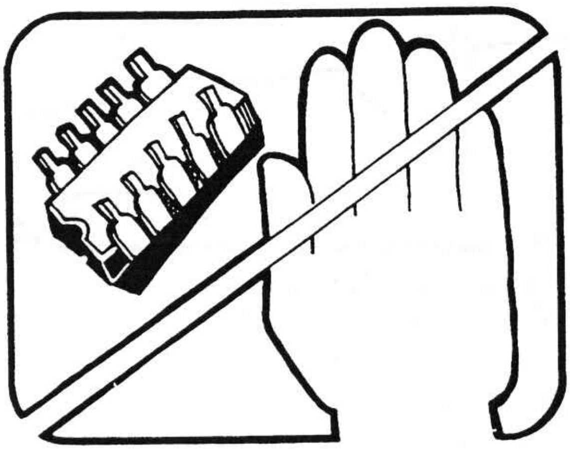
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

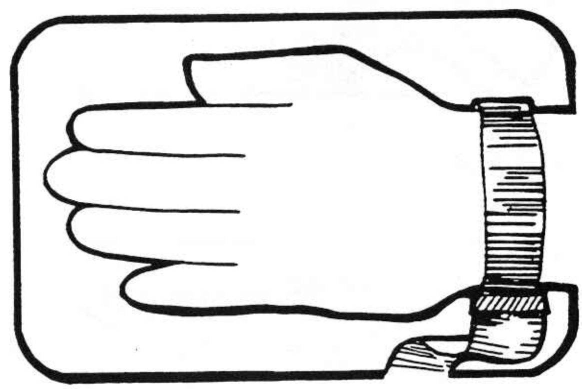
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol

" ⊗ "

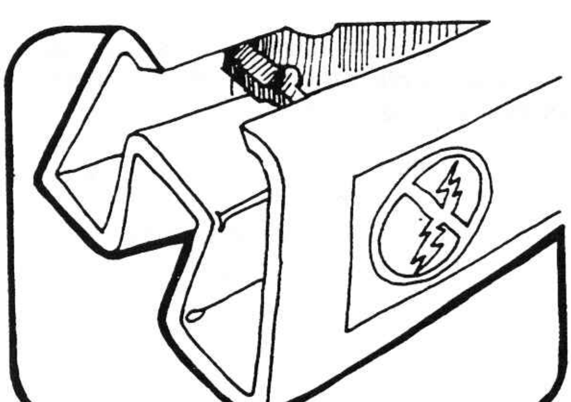
The following practices should be followed to minimize damage to S.S. devices.



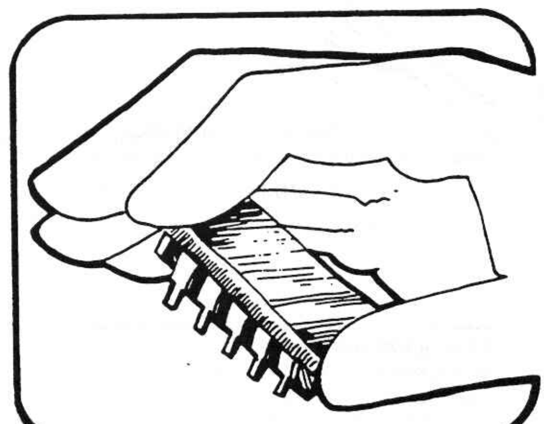
1. MINIMIZE HANDLING



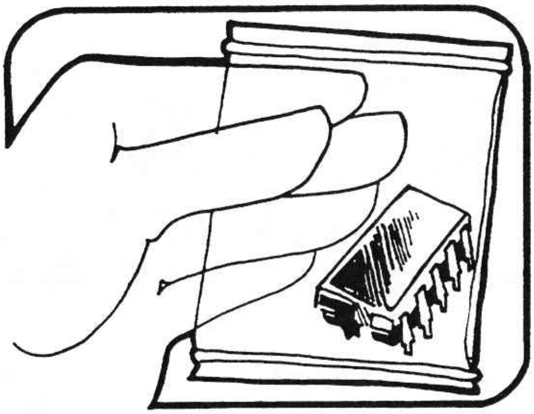
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



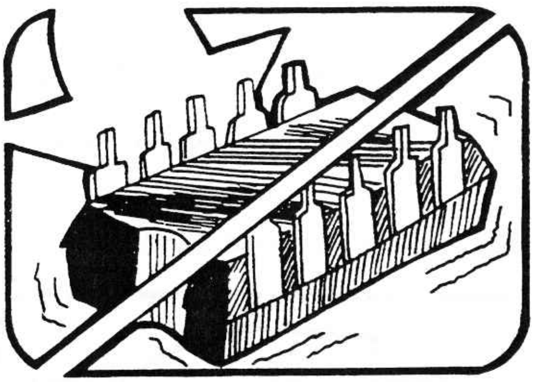
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



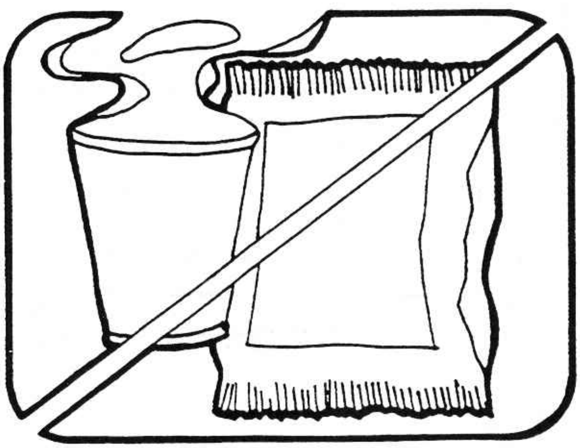
4. HANDLE S.S. DEVICES BY THE BODY



5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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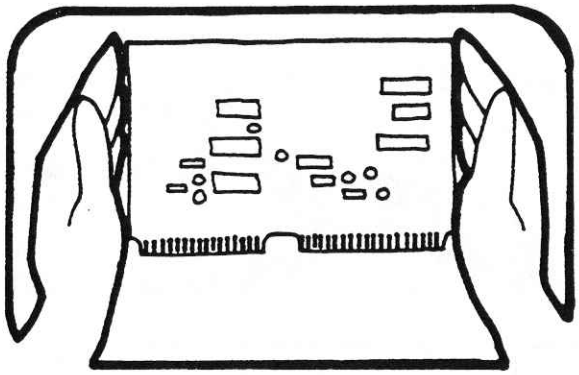
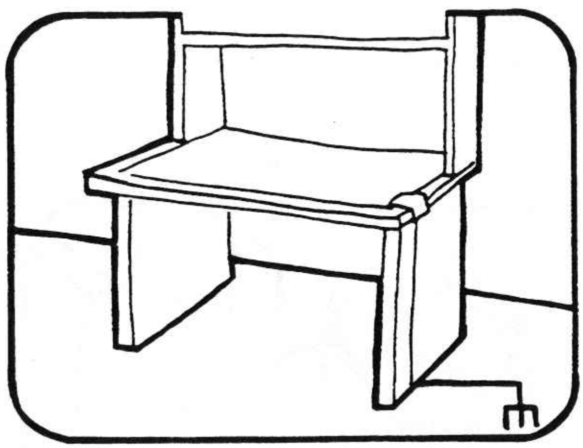


8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

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Section 4
Maintenance

4-1. INTRODUCTION

This section of the manual presents warranty information and service methods. Performance Tests are presented in Section 4A, Access Procedures are in Section 4B, Calibration Adjustments are in Section 4C, Troubleshooting and Repair information is in Section 4D, and the Software Compensation Procedures are in Section 4E.

Each Generator is warranted for a period of one year following delivery to the original purchaser. The warranty is located in the front of this manual.

4-2. SERVICE METHODS

The Generator is designed to be easily and economically serviced. The Generator may be returned to Fluke for service, or it can be serviced and repaired if necessary, by module replacement or component replacement.

4-3. Fluke Service

Fluke Service may be the easiest. See Section 2 for shipping requirements, and see Section 7 for a list of the Fluke Technical Service Centers. A cost estimate will be provided if requested, or if the instrument purchase date is beyond the warranty period.

4-4. Module Replacement

If the Generator develops a problem, see Section 4D for information on identifying the faulty module. With a modest amount of technical knowledge and test equipment, the operator can identify the faulty module and replace it through the Module Exchange Program. This method takes only a day or two to restore the Generator to proper working order. Very little or no calibration is required, depending on the module replaced.

4-5. Parts Replacement

Parts replacement requires more equipment and service capability but usually offers the best economy and quickest turnaround. It involves part replacement at the customer's facility.

Most faults are detected by the built-in self tests or the UNCAL status circuits. By noting the self-test error code and interrogating the UNCAL status code, the service technician learns where the problem is. By applying normal signal tracing and troubleshooting procedures (see Troubleshooting in Section 4D of this manual), the fault can be quickly identified.

The faulty component is replaced, then (if necessary), the instrument is recalibrated using Calibration Adjustments in Section 4C of this manual. The Performance Tests explained in

Section 4A of this manual are used to verify the Generator performance after repair or recalibration of the Generator.

Some assemblies have some parts which, if replaced, may invalidate the data stored in the compensation memory. These assemblies are the A5 VCO PCA, the A8 Attenuator/RPP Assembly, the A6 Output Control PCA, and the A7 Output PCA. The critical parts on each of these assemblies are listed at the bottom of the approriate parts lists (located in Section 5). The Software Compensation Procedures can be used to recompensate the instrument when these parts are replaced.

Section 4A
Performance Tests

4A-1. INTRODUCTION

The information in the following paragraphs describes the performance tests for the key parameters of the Generator. Instrument specifications are used as the performance standard. These covers-on performance tests may be used as an acceptance test upon receipt of the instrument, as an indication that repair and/or calibration is required, or as a performance verification after completing repairs or calibration of the instrument. Individual performance tests can be used as troubleshooting aids.

The Generator being tested (UUT) must be warmed up with all covers in place for at least 20 minutes before starting the performance tests.

Fluke recommends that calibration be performed once a year.

4A-2. TEST EQUIPMENT

Table 4A-1 gives a list of the recommended test equipment for the performance tests and adjustment procedures as well as recommended test equipment for troubleshooting the Generator. Figure 4A-1 shows a Two-Turn Loop.

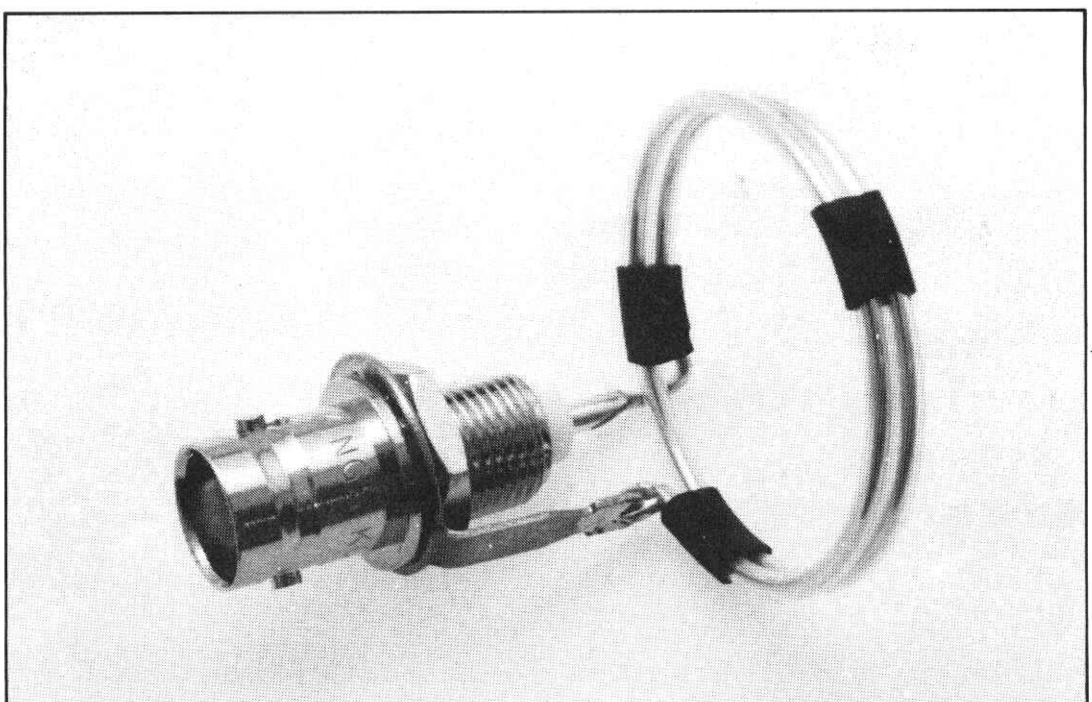


Figure 4A-1. Two-Turn Loop

NOTE

There are two types of High-Frequency Synthesized Signal Generators (HFSSG) called out in Table 4A-1. One is recommended for low-residual characteristics and the other is needed for high-frequency tests >1 GHz. For proper test results, be certain to use the type specified in the list of equipment that preceeds each procedure.

4A-3. POWER-ON TEST

This performance test is the built-in self test that performs a simple functional check of the instrument.

REQUIREMENT:

The Generator successfully passes the self test.

REMARKS:

The test is begun each time the Generator is turned on. Press any of the FUNCTION keys or the [CLR/LCL] key to abort the test.

PROCEDURE:

1. Start the test with the power off.
2. Press the POWER button on. The Generator automatically starts the self tests, which include lighting all indicators and every segment of the display. This test takes five seconds.

If the instrument fails any of the self tests, the results are shown in the four display fields. See the paragraphs on Self Test Description located in Section 4D for the interpretation of the test failure codes.

If the Generator passes the self test, it is automatically returned to the same front panel condition that existed prior to power-on. The IEEE-488 Interface is programmed to local control.

4A-4. FREQUENCY ACCURACY TEST

The internal timebase is compared to that of a Frequency Standard.

REQUIREMENTS:

The frequency of the UUT timebase is within the specified limits.

TEST EQUIPMENT:

Frequency Standard
Frequency Counter

REMARKS:

This procedure is for a UUT with a standard timebase. If the UUT has the optional timebases installed (Option -130 or -132), use the procedure in Section 6 to verify that the optional timebase frequency is within specified limits.

Table 4A-1. Recommended Test Equipment

INSTRUMENT NAME	MINIMUM REQUIREMENT	MANUFACTURER DESIGNATION	NOTES (1)
DVM	5 1/2-Digit, 0.3% DC-20 kHz	JF 8840A-09	A,P
DMM	3 1/2-Digit, 1% DC and 1 KHz	JF 8020B	A,P,T
Wideband Amplifier	> 25-dB gain, 0.4 to 1050 MHz NF < 9 dB.	HP 8447D-010	P
RF-Spectrum Analyzer	0.1 to 2.9 GHz, 1-kHz BW	HP 71100A	P,T
Oscilloscope	Four-trace 300 MHz, 5-mV/Div	TEK 2465-11	T,P
FET Probe	DC-900 MHz	TEK 6201	T
RF Voltmeter	0.01 to 700 MHz, 0.01 to 3V +/- 10%	HI RF 801	T, 2
Frequency Counter	0.1-1050 MHz; 10 Hz res; 0.1V	JF 7220A	A,P,T
Modulation Analyzer	Input: 0.15 to 1300 MHz, 0 to +20 dBm AM: 10 to 90%, +/- 1%, FM: 0.1 to 100 kHz dev +/- 1% External LO capability	HP 8901A w/Option -003	A,P,T
Distortion Analyzer	1 to 10% rng, +/-1 dB, 0.4 and 1 kHz	HP 339B	A,P,T
Power Meter	Instrumentation accuracy < +/-1%	HP 436A	A,P,T
Power Sensor (High-Level)	-30 to 20 dBm; VSWR < 1.2 for 0.4 to 1 MHz, < 1.1 for 1 to 2000 MHz, <1.3 for >2000 MHz	HP 8482A	
Power Sensor (Low-Level)	-67 to -20 dBm; VSWR < 1.4 for 10 to 30 MHz <1.15 for 30 to 2100 MHz	HP 8484A	
Attenuator, 60 dB	0.1 to 2100 MHz VSWR <1.15	Narda 777C	P,4
LF Synthesized Signal Generator	10 Hz to 11 MHz, 10 Hz steps, 1V pk, Spurs and Harm < -50 dB,	JF 6011A	A,P
HF Synthesized Sig-Gen (Low Residual)	10 to 1050 MHz	JF 6071A	P,T
HF Synthesized Sig-Gen (Local Oscillator)	.1 to 2100 MHz	JF 6062A	P,T
Frequency Standard	House Standard, 10 MHz	---	A,P
Test Cable	Dual pin to BNC	JF 732891	A,T
Adapter, Coax	50-ohm, Type-N(m) to BNC(f)	JF Y9308	A,P,T
Adapter, Service	50-ohm, Module output to SMA	JF 744177	T
Two-Turn Loop	For Leakage test (See Figure 4A-1.)	Homebuilt	P,T,3
VSWR Bridge	10 to 2000 MHz	Wiltron 60N50	P
50-Ohm Termination	Type-N	JF Y9317	P

Table 4A-1. Recommended Test Equipment (cont)

INSTRUMENT NAME	MINIMUM REQUIREMENT	MANUFACTURER DESIGNATION	NOTES (1)
Coaxial Cable, 50 ohm	3 ft, BNC both ends	Y9111	A,P,T
Coaxial Cable, 50 ohm	6 ft, BNC both ends	Y9112	A,P,T
Screwdriver, electric	Set to 7 inch-pounds torque	Jergens-CL6500/CLT50	A,T
Power Supply, Variable	0 to 30V dc	Lambda	T
Microwave Converter	1.3 to 2.1 GHz	HP 11793A	P
Measuring Receiver Set	10 to 1300 MHz	HP 8902A	P
Sensor Module	0.1 to 2600 MHz	HP 11722A	P
Amplifier	1300 to 2100 MHz 30 dB gain	PSC-F864M (Cain White)	P
Pulse Generator	50-nSec pulse width, 10 MHz repetition rate	HP 8012B	P
BNC Termination	50 ohm	Midwest Microwave 2048M	P
Detector	3-GHz bandwidth, 5-nsec risetime	Krytar D101	P

Notes
1. A = Adjustment; P = Performance Test; T = Troubleshooting.
2. Helper Instruments.
3. Two-Turn, 1-inch diameter loop made of £18 enamel wire soldered to a BNC connector.
4. VSWR verified and actual attenuation calibrated to +/- 0.2 dB by the operator at application frequencies.

PROCEDURE:

1. Connect the Frequency Standard output to the 10 MHZ REF IN connector on the Frequency Counter and switch the Counter to EXT REF.
2. Switch the UUT to internal reference.
3. Connect the UUT REF OUT connector to the Frequency Counter CHANNEL A input connector.
4. Verify that the counter display is 10 MHz ±25 Hz.

4A-5. SYNTHESIS TEST

The Generator output frequency is measured at several programmed frequencies using a Frequency Counter operating on a common reference with the Generator.

REQUIREMENT:

The Generator's measured and programmed frequencies agree within ± one count.

TEST EQUIPMENT:

Frequency Counter

REMARKS:

Failing this test indicates the need to repair and/or recalibrate the A4 Synthesizer PCA and/or the A5 VCO PCA.

PROCEDURE:

1. Connect the UUT 10 MHz OUT to the Frequency Counter 10-MHz reference input, and connect the UUT RF OUTPUT to the Frequency Counter input.
2. Set the UUT REF INT/EXT switch to INT.
3. Program the UUT to [RCL] [9] [8].
4. Program the UUT frequency to 111.11111 MHz.
5. Program the UUT frequency step to 111.11111 MHz.
6. Verify that the reading on the Frequency Counter agrees with the UUT frequency ± one count as the frequency is stepped from 111.11111 to 999.99999 MHz.

4A-6. HIGH-LEVEL ACCURACY TEST

The output power is measured using a Power Meter at various frequencies. First the step attenuator is set for zero attenuation; then each attenuator section is individually programmed. Finally, the output level accuracy and attenuator section errors are computed.

If a Measuring Receiver (along with a Microwave Convertor and Amplifier) is available for level testing, then proceed directly to the Alternate-Level Accuracy Test procedure.

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REQUIREMENT:

The output level accuracy, the attenuator section errors, and the sum of the attenuator section errors at each test frequency are:

$< \pm 2$ dB from 0.1 to .99999 MHz
$< \pm 1$ dB from 1 to 1049.99999 MHz
$< \pm 1.5$ dB from 1050 to 2100 MHz

REMARKS:

Failing this performance test indicates the need to repair or replace the A6 Output Control PCA, the A7 Output PCA, and/or the A8 Attenuator/RPP Assembly. To determine which assembly is at fault, refer to Section 4D in this manual for troubleshooting procedures.

The test frequencies of this procedure provide reasonable confidence of the amplitude accuracy of the UUT. However, additional test frequencies may be included in this test.

This test verifies the high-level accuracy of the Generator and verifies that the amplitude correction factors for the individual attenuator sections are correct. This test, in conjunction with the mid-level accuracy and low-level accuracy tests, verifies the overall level performance of the UUT.

PROCEDURE:

1. Calibrate and zero the Power Meter.
2. Program the UUT to [RCL] [9] [8].
3. Connect the Power Sensor to the UUT RF OUTPUT.
4. Program the UUT frequency to 0.1 MHz.
5. Select each attenuator section by programming the UUT amplitude to the levels shown in Table 4A-2, and record the measured power at each level.
6. Compute the output power error for each programmed level of Table 4A-2 by subtracting the programmed power in dBm from the measured power in dBm. These errors must not exceed the requirement stated above.
7. Subtract the measured power for section zero from the sum of the measured power for that section plus the nominal attenuation for that section. This is done for attenuator sections 1 through 7 only. (Example, (-M0+M1+6) for section 1.) The eight section errors and their sum must not exceed the requirement. Table 4A-3 shows the parameters of the high-level accuracy test.

Table 4A-2. High-Level Accuracy Test Conditions

ATTENUATION		OUTPUT POWER				
SECTION	NOMINAL	PROGRAMMED LEVEL (dBm)	MEASURED POWER (dBm)	ERROR (dB)	SECTION ERROR (dB)	LIMIT (dB)
0	0	+12	M0	MØ-12	MØ-12	see test requirements
1	6	+ 6	M1	M1-6	-MØ+M1+6	
2	12	0	M2	M2-0	-MØ+M2+12	"
3	24	-12	M3	M3+12	-MØ+M3+24	"
4	24	-12 [SPCL] [8][3]	M4	M4+12	-MØ+M4+24	"
5	24	-12 [SPCL] [8][4]	M5	M5+12	-MØ+M5+24	"
6	24	-12 [SPCL] [8][5]	M6	M6+12	-MØ+M6+24	"
7	24	-12 [SPCL] [8][6]	M7	M7+12	-MØ+M7+24	"
					Sum of Errors	"

Table 4A-3. High-Level Accuracy Test Conditions Sample

ATTENUATION		OUTPUT POWER		ERROR (dB)	SECTION ERROR (dB)	LIMIT (dB)
SECTION	NOMINAL	PROGRAMMED LEVEL (dBm)	MEASURED POWER (dBm)			
0	0	+12	+12.2	+0.2	+12.2-12.0	= +0.2
1	6	+ 6	+05.9	-0.1	-12.2+5.9+6	= +0.3
2	12	0	-00.2	-0.2	-12.2-0.2+12	= -0.4
3	24	-12	-12.1	-0.1	-12.2-12.1+24	= -0.3
4	24	-12 [SPCL][8][3]	-11.8	+0.2	-12.2-11.8+24	= +0.0
5	24	-12 [SPCL][8][4]	-12.0	+0.0	-12.2-12.0+24	= -0.2
6	24	-12 [SPCL][8][5]	-12.3	-0.3	-12.2-12.3+24	= -0.5
7	24	-12 [SPCL][8][6]	-11.9	+0.1	-12.2-11.9+24	= -0.1
					Sum of Errors	= -1.0

NOTE

To test attenuator sections 4 through 7, program the Generator to -12 dBm, and key in [SPCL][8][3] through [8][6], respectively.

8. Repeat steps 4 through 7 with the UUT programmed to each of the following frequencies:

   120, 244, 245, 850, 1050, 1051, 1500, 1800, and 2100 MHz

Table 4A-3 is an example of this procedure in which the measured power and the error calculations are shown. This example is for one frequency, and these measurements and calculations are repeated at other frequencies. In this case, the section errors and the sum of the section errors are within the test limits and, therefore, the unit passed the high-level accuracy test.

4A-7. MID-LEVEL ACCURACY TEST

The level accuracy is verified using a Power Meter with a Low-Level Power Sensor. This verification is done from -24 to -66 dBm at frequencies of 10, 120, 244, 245, 850, 1050 , 1051, 1500, 1800, and 2100 MHz.

REQUIREMENT:

Amplitude accuracy is:

$< \pm 2$ dB from 0.1 to .99999 MHz
$< \pm 1$ dB from 1 to 1049.99999 MHz
$< \pm 1.5$dB from 1050 to 2100 MHz

TEST EQUIPMENT:

Power Meter
Power Sensor (Low-Level)

REMARKS:

This test, in conjunction with the High-Level Accuracy Test and the Low-Level Accuracy Test, verifies the overall level performance of the UUT.

It is convenient to use the UUT RF ON/OFF control when zeroing the Power Meter.

PROCEDURE:

1. Program the UUT to [RCL] [9] [8], 10 MHz and -24 dBm.
2. Calibrate the Power Meter.
3. Zero the Power Meter.
4. Connect the Power Meter and Power Sensor to the UUT RF OUTPUT.
5. Measure the UUT output power (in dBm) with the Power Meter. It should agree with the programmed level within the requirement.
6. Repeat step 5 for levels of -30, -36, -42, -48, -54, -60, and -66 dBm.
7. Repeat steps 5 and 6 for frequencies of 120, 244, 245, 850, 1050, 1051, 1500, 1800, and 2100 MHz.

4A-8. LOW-LEVEL ACCURACY TEST

An RF Spectrum Analyzer and two amplifiers are used to verify the UUT level accuracy at -127 dBm and at frequencies of 10, 120, 244, 245, 850, 1050, 1051, 1500, 1800, and 2100 MHz.

REQUIREMENT:

Amplitude accuracy is:

$< \pm 2$ dB from 0.1 to .99999 MHz
$< \pm 1$ dB from 1 to 1049.99999 MHz
$< \pm 1.5$ dB from 1050 to 2100 MHz

TEST EQUIPMENT:

Wideband Amplifier
1.3- to 2.1-GHz Amplifier
60-dB Attenuator
RF Spectrum Analyzer
Power Meter
Power Sensor (Low-Level)

REMARKS:

This test, in conjunction with the Mid-Level Accuracy and High-Level Accuracy Test, verifies the overall level performance of the UUT.

Failing this test, but passing the High-Level Accuracy Test, probably indicates a leak-around problem in the UUT attenuator. Service tip: Check for a broken feed-through filter or improper mechanical assembly, i.e., loose screws and/or damaged or misplaced gaskets.

It is convenient to use the UUT RF ON/OFF control when zeroing the Power Meter.

PROCEDURE:

1. Program the UUT to [RCL] [9] [8], 10 MHz, and -67 dBm.
2. Calibrate, then connect the Power Meter with a low-level Power Sensor to the UUT RF OUTPUT.
3. Zero the Power Meter.
4. With the Power Meter, measure the UUT output power (in dBm) and record the measurement as the variable P.
5. Connect UUT RF OUTPUT through the 60-dB Attenuator and the Wideband Amplifier to the input of the RF Spectrum Analyzer. Use well shielded cables to avoid leakage that could affect the measurement.
6. Adjust the RF Spectrum Analyzer to display the signal, using a resolution bandwidth of 1 kHz and a vertical display of 1 dB/Div.
7. Adjust the reference level so that the response is at a convenient reference point on the display (e.g., 2 dB below top scale). This signal response corresponds to a level of (P-A) dBm, where A is the value of the 60-dB Attenuator.
8. Program the UUT to a level of -127 dBm, remove the 60-dB Attenuator, and note the difference in the resulting response on the RF Spectrum Analyzer from the previous response (P-A). The actual UUT output level is (P-A) plus this difference and should agree with the programmed level to within the requirement.
9. Repeat steps 4 through 8 for frequencies of 120, 244, 245, 850, and 1050 MHz.
10. Substitute the 1.3- to 2.1-GHz Amplifier for the Wideband Amplifier and repeat steps 4 through 8 for frequencies of 1500, 1800, and 2100 MHz.

4A-9. ALTERNATE-LEVEL ACCURACY TEST

A Measuring Receiver is used to verify the UUT level accuracy at various amplitude and frequency settings that test all level ranges of the UUT on all RF bands.

REQUIREMENTS:

Amplitude accuracy is:

$< \pm 2$ dB from 0.1 to .99999 MHz from +16 to -127 dBm
$< \pm 1$ dB from 1 to 1049.99999 MHz from +16 to -127 dBm
$< \pm 1.5$ dB from 1050 to 2100 MHz from +13 to -127 dBm

TEST EQUIPMENT:

Measuring Receiver
Sensor Module
Microwave Converter
HFSSG (Local Oscillator type)
1.3- to 2.1-GHz Amplifier
Power Supply

REMARKS:

This test is a more comprehesive test then the High-Level, Mid-Level, and Low-Level Accuracy tests.

Failing this test at levels above approximately -50 dBm, indicates the need to repair or replace the A6 Output Control PCA, the A7 Output PCA, or the A8 Attenuator/RPP Assembly.

Failing this test at lower levels probably indicates an RF-leakage problem with the A8 Attenuator/RRP Assembly. Check for loose connectors, loose screws, improper gasketing or a broken feed-through filter.

Because of operational subtleties in Measurement Receivers and the intent to reduce the risk of measurement errors, the following procedure is written around the use of the H.P. 8902A as the Receiver and the H.P. 11793A as the Microwave Converter.

NOTE

The calibration factors for the Sensor Module must be stored into the Measurement Receiver's Cal Factor Table prior to performing calibrated RF power measurements. Correctly entered Cal Factors can be verified on the H.P. 8902A by using special functions 37.5 and 37.6 (refer to owner's manual).

PROCEDURE:

1. Level Measurements Below 1300 MHz

   a. Perform the Power Meter "zero" and "self-calibration" for the Measurement Receiver (refer to owner's manual).

   b. Connect all instruments as shown in Figure 4A-2A.

   c. Program the UUT to [RCL] [9] [8], 10 MHz, +13 dBm, and [AMPL] [STEP] 6.1 dB.

   d. Program the Measurement Receiver to RF-POWER mode and toggle the [LOG/LIN] button to display dBm. To enable the correct cal factor selection, tune the internal L.O. on the Measurement Receiver to that of the UUT RF output ([1] [0] [MHz] for the first frequency).

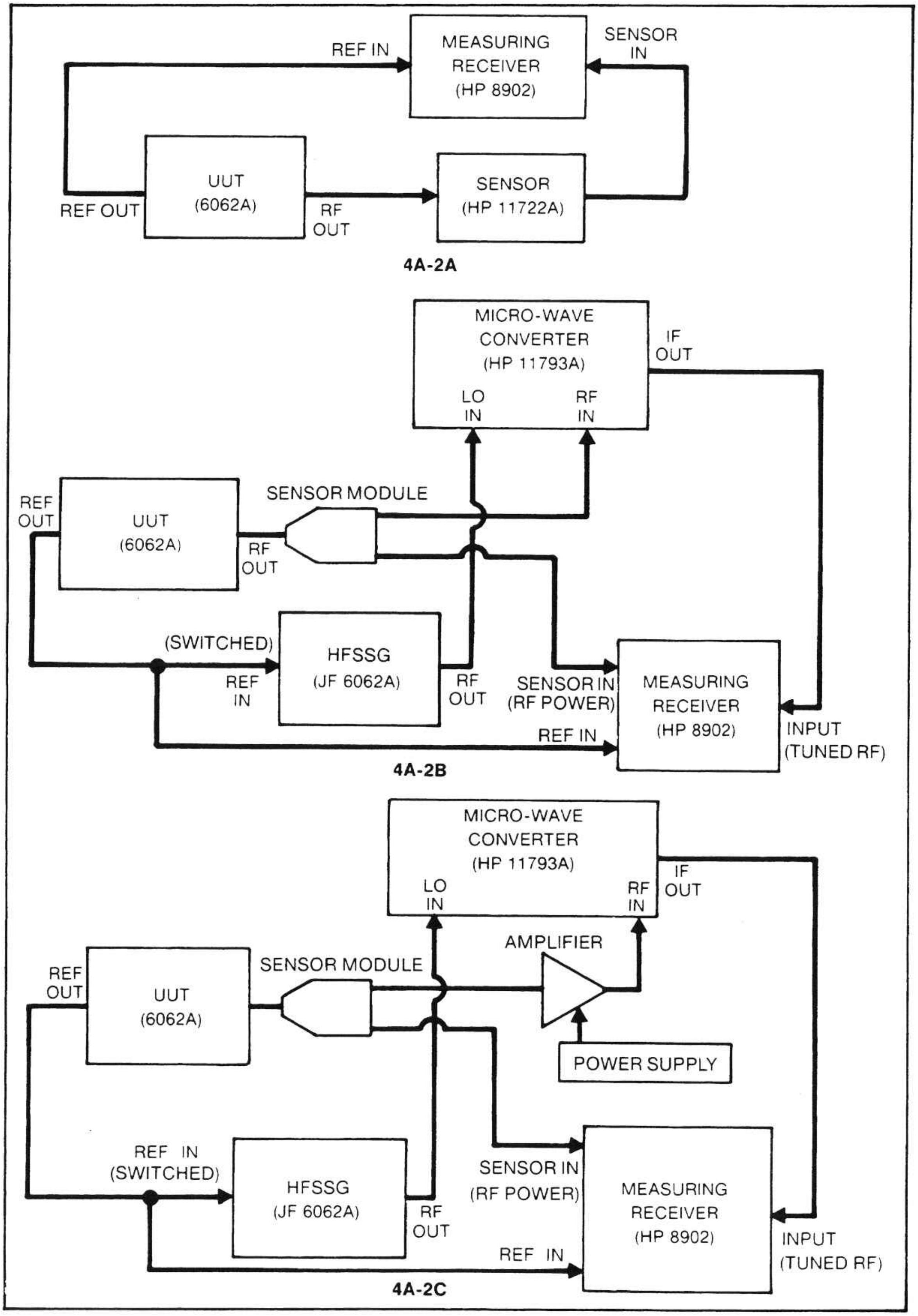


Figure 4A-2. Alternate-Level Accuracy Test Equipment Setup

e. Step the UUT level from +13 dBm to -11.4 dBm using the STEP [↓] key. Verify that each level measured with the Measuring Receiver agrees with the UUT programmed level and is within ±1 dB.

f. Select TUNED-RF LEVEL on the Measuring Receiver, wait for a displayed reading, and then press the CALIBRATE button. Verify that the Recal annunciator goes out and a stable reading is displayed again.

g. Step the UUT from -11.4 to -127.3 dBm, again observing that each stepped level is within ±1 dB.

NOTE

When the Recal annunciator on the Measurement Receiver lights while stepping through UUT levels, press the CALIBRATE button on the Measuring Receiver and wait for a stable reading.

h. Repeat steps d through g for each of the following UUT frequencies:

120, 244, 245, 380, 511, 850, and 1049 MHz

2. Level Measurements Above 1300 MHz

NOTE

RF frequencies above 1300 MHz must be down-converted through a Microwave Converter to a useable IF frequency before measurements can be made. Therefore, the Measurement Receiver must be put into a Frequency-Offset mode so its internal L.O. can adust between the RF and IF frequencies. For proper measurements in this mode, the Sensor Module calibration factors must once again be loaded into a special Frequency-Offset cal factor table (for the H.P. 8902A press [27.1] [SPCL] to get into the Frequency-Offset cal factor table and then enter or verify the Sensor Module cal factors the same way as in the normal mode by using special functions 37.n).

a. Set up the equipment as shown in Figure 4A-2B.

b. Program the UUT to 1400 MHz and +13 dBm.

c. Program the Local Oscillator (HFSSG) to the UUT frequency +120.53 MHz (1520.53 MHz in this case) and +8 dBm.

d. Program the Measurement Receiver to the Frequency mode and then to the special Frequency-Offset mode. (On the H.P. 8902A program [27.3] [SPCL], then the HFSSG frequency (1520.53 MHz), followed by the UUT frequency (1400 MHz)). The displayed reading should be the UUT output (1400 MHz in this case).

e. Program the Measurment Receiver to RF Power mode and toggle the [LOG LIN] button to display dBm.

f. Step the UUT from +13 dBm down to -11.4 dBm ,observing that each stepped level is within ±1.5 dB.

g. Program the Measuring Receiver to the Tuned RF Level mode, wait for a stable reading, then press the CALIBRATE button. Verify the Recal annunciator goes out and a stable reading is displayed.

h. Step the UUT from -11.4 dBm down to -84.6 dBm observing that each stepped level is within ±1.5 dB.

When the Recal annunciator on the Measurement Receiver lights while stepping through UUT levels, press the CALIBRATE button on the Measuring Receiver and wait for a stable reading.

NOTE

The following steps incorporate the use of a Level Amplifier (required for the Microwave Converter) for UUT levels < -90 dBm. The amplifier must be gain-corrected at each new frequency.

i. Observe the displayed reading at the -84.6 dBm level and note this as the reference. Disconnect the RF cable leading from the UUT to the Microwave Converter RF-input and insert the Level Amplifier (refer to Figure 4A-2C).

j. Wait for the Measurment Receiver to regain the signal and stabilize. Observe the new reading. Subtract the previously obtained reference reading in step i from this amplified reading and note it as the amplifier gain.

Example: -54.5 (amplified reading) - (-84.6) (reference reading) = +30.1 (amplifier gain)

k. Step the UUT from -84.6 dBm down to -127.3 dBm observing that each stepped level minus the amplifier gain is within ±1.5 dB.

Reading - Amplifier Gain = UUT RF level

l. Repeat steps c through k for each of the following UUT frequencies (programming the HFSSG to the UUT frequency +120.53 MHz) and observe a ±1.5 dB measurement:

1600, 1900 and 2100 MHz

NOTE

If using a Local Oscillator (HFSSG) whose frequency range does not extend to 2250.53 MHz, it will be required to program the HFSSG frequency 120.53 MHz lower than the UUT frequency at the higher frequency levels. In this case use a UUT frequency of 1900 MHz as the switchover point. At 1900 MHz, program the HFSSG to 1779.47 MHz and then the H.P. 8902A to [27.3] [SPCL] [1779.47] [MHz] [1900] [MHz].

4A-10. OUTPUT LEAKAGE TEST

The output signal leakage is verified using a 1-inch diameter Two-Turn Loop. The induced signal is measured with an RF Spectrum Analyzer and compared to a 1-μV reference established at each reference frequency. The Two-Turn Loop must be 1 inch away from any surface of the UUT.

REQUIREMENT:

Radiated emissions induce < 1 μV of the Generator's output signal.

TEST EQUIPMENT:

Wideband Amplifier
1.3- to 2.1-GHz Amplifier
RF Spectrum Analyzer
Two-Turn Loop
Type-N Termination
A screen room may be required, depending on the RF environment.

REMARKS:

Failing this test probably indicates a broken feed-through filter or improper mechanical assembly, i.e., loose screws and/or damaged or misplaced gaskets.

PROCEDURE:

1. Connect the UUT RF OUTPUT to the Wideband Amplifier input, and connect the Wideband Amplifier output to the RF Spectrum Analyzer input. Use well shielded cables to avoid leakage that could affect the measurement.
2. Program the UUT to [RCL] [9] [8].
3. Program the UUT to -107 dBm.
4. Adjust the RF Spectrum Analyzer to display the UUT signal for a convenient reference. Make this adjustment using a vertical scale of 10 dB/division, a resolution bandwidth of 3 kHz, and a span/division of 5 kHz/division.
5. Disconnect the Wideband Amplifier from the UUT and terminate UUT OUTPUT with the Type-N Termination.
6. Connect the Two-Turn Loop to the Wideband Amplifier input.

7. Program the UUT to +13 dBm.

8. Verify that the leakage indicated by the RF Spectrum Analyzer is less than -107 dBm (1 μV), by moving the Two-Turn Loop over the UUT surface at a distance of 1 inch.

9. Repeat steps 3 through 8 at 550, 850, and 1050 MHz.

10. Replace the Wideband Amplifier with the 1.3- to 2.1-GHz Amplifier and repeat steps 3 through 8 at 1100, 1700, and 2100 MHz.

4A-11. HARMONIC, SPURIOUS, AND SUBHARMONIC TEST

The Harmonic and Spurious Test uses an RF Spectrum Analyzer to compare the level of the harmonic, spurious, and subharmonic signals to the desired signal at various programmed frequencies.

REQUIREMENTS:

RF harmonics <-30 dBc for levels ≤ +13 dBm and frequencies ≥ 1 MHz, <-25 dBc elsewhere.

Spurious (non-harmonic) <-60 dBc for offsets >10 kHz and frequencies from 0.1 to 1049.99999 MHz; <-54 dBc for offsets greater than 10 kHz and frequencies from 1050 to 2100 MHz.

Subharmonics <-45 dBc for output frequencies from 1050 to 2100 MHz.

TEST EQUIPMENT:

RF Spectrum Analyzer

PROCEDURE:

1. Connect the UUT RF OUTPUT to the RF Spectrum Analyzer input.

2. Program the UUT to [RCL] [9] [8].

3. Program the UUT to +16 dBm and 0.1 MHz.

4. Set the RF Spectrum Analyzer controls to display the UUT output signal and its harmonics (at least three harmonics wherever possible). Be careful not to overload the analyzer input. Overloading the RF Spectrum Analyzer causes it to generate harmonics, thus invalidating the test.

5. Verify that all the harmonics are more than 25 dB below the fundamental signal.

6. Program the UUT to 13.0 dBm.

7. Verify that all the harmonics are more than 30 dB below the fundamental signal for the following frequencies:

50 240, 300, 450, 600, 750, 1000, 1200, and 1400 MHz

8. Program the UUT to 185 MHz and 16.0 dBm.

9. Verify that the spur at 245 MHz is < -60 dBc.
10. Program the UUT to 244 MHz.
11. Verify that the spur at 312 MHz is < -60 dBc.
12. Program the UUT to 244.99 MHz and 7.0 dBm.
13. Set the RF Spectrum Analyzer controls for the appropriate reference level, center frequency, span, and resolution to display the UUT signal and spur frequencies (with appropriate noise floor and signal resolution) for the following steps:
    a. Verify the spurs at the offsets of 20, 30, 35, and 40 kHz are < -60 dBc.
    b. Verify the spurs at the offsets of 1 and 10 MHz are < -60 dBc.
    c. Verify the spurs at 10, 20, and 30 MHz are < -60 dBc.
    d. Verify the spurs at 800 and 1044.99 MHz are < -60 dBc.
    e. Program the UUT to 920 MHz.
    f. Verify the spur at 460 MHz is < -60 dBc.
    g. Program the UUT to 1249 MHz.
    h. Verify the subharmonic at 1873.5 MHz is < -45 dBc.
    i. Program the UUT to 1749 MHz.
    j. Verify the spur at 1311.75 MHz is < -54 dBc.
    k. Program the UUT to 2100 MHz.
    l. Verify the subharmonic at 1050 MHz is < -45 dBc.
    m. Program the UUT to 1450 MHz.
    n. Verify the subharmonic at 725 MHz is < -45 dBc.
    o. Program the UUT to 1740 MHz.
    p. Verify the subharmonic at 870 MHz is < -45 dBc.

4A-12. MODULATION TESTS

The following tests use a Modulation Analyzer to verify modulation accuracy and residual and incidental modulation of the UUT. The modulation distortion is verified by measuring the demodulated output of the Modulation Analyzer with a Distortion Analyzer. The internal modulation oscillator frequency is measured using a Frequency Counter on the demodulated output of the Modulation Analyzer. Table 4A-4 lists the requirements for the modulation tests.

REMARKS:

Failing these performance tests indicate the need for repair and/or recalibration of the associated circuitry.

Table 4A-4. Modulation Tests Requirements

REQUIREMENTS PARAMETER	SPECIFICATION
MOD FREQ	< +/- 3% at 0.4 or 1 kHz for 20 to 30° C; add +/- 0.1%/°C outside this range.
AM ACCURACY	< +/- (2% + 4% of setting) for internal rates, for peak amplitudes of +16 dBm or less, and for frequencies of 1 MHz to 1049.99999 MHz. < +/- (2% + 4% of setting) for internal rates, for peak amplitudes of +13 dBm or less, and for frequencies of 1050 MHz to 2100 MHz. < +/- (3% + 5% of setting) for internal rates, for peak amplitudes of +16 dBm or less, and for frequencies from .1 to .99999 MHz.
AM DISTORTION	< 1.5% THD up to 30% AM, < 3% to 70%, < 5% to 90%, at internal rates and frequencies of 1 MHz to 1049.99999 MHz. < 3% THD up to 70% AM, and < 5% THD to 90% AM at internal rates and frequencies of 1050 MHz to 2100 MHz. < 3% THD up to 30% AM, < 5% to 70%, < 7% to 90%, at internal rates and frequencies of .1 to .99999 MHz.
RESIDUAL AM	< 0.1% rms (-60 dBc) in a 0.05- to 15-kHz bandwidth.
INCIDENTAL FM	< 0.3 fm for internal rates, < 30% AM, and frequencies from .1 to 1049.99999 MHz. < 0.6 fm for internal rates, < 30% AM, and frequencies from 1050 to 2100 MHz.
FM ACCURACY	< +/- (7% + 10 Hz) for rates of 0.3 to 20 kHz.
FM DISTORTION	< 1% THD for rates of 0.3 to 20 kHz.
RESIDUAL FM	rms in a 0.3- to 3-kHz band: < 12 Hz for .1 to 244.99999 MHz < 6 Hz for 245 to 511.99999 MHz < 12 Hz for 512 to 1049.99999 MHz < 24 Hz for 1050 to 2100 MHz rms in a 0.05- to 15-kHz band: < 18 Hz for .1 to 244.99999 MHz < 9 Hz for 245 to 511.99999 MHz < 18 Hz for 512 to 1049.99999 MHz < 36 Hz for 1050 to 2100 MHz
INCIDENTAL AM	< 1% AM at 1-kHz rate and for deviation < 50 kHz.

Where residual noise affects the Modulation Analyzer measurements accuracy, apply correction methods provided by the Modulation Analyzer manufacturer.

The UUT settings in this procedure are chosen to provide a strong confidence of the modulation performance of the UUT throughout its range. However, performance may also be checked at other instrument settings if desired.

The FM deviation accuracy depends upon software correction data stored in the compensation EEPROM derived from the measured data of the particular VCO PCA installed in the Generator.

TEST EQUIPMENT:

Modulation Analyzer
Distortion Analyzer
Frequency Counter
Low-Frequency Synthesized Signal Generator (LFSSG)
HFSSG (Low Residual type)
DVM

NOTE

The following procedures must be done in sequential order to ensure that the proper equipment is connected and appropriate programs are enabled.

PROCEDURE:

1. Internal Modulation Oscillator Frequency Test

   a. Connect the UUT RF OUTPUT to the Modulation Analyzer input.

   b. Connect the Modulation Analyzer modulation output to the Frequency Counter input.

   c. Program the Modulation Analyzer to measure AM depth in a 0.05 to 15-kHz bandwidth.

   d. Program the UUT to [RCL] [9] [8].

   e. Program the UUT for 90% INT AM at a 1-kHz rate and a level of +1 dBm.

   f. Verify that the Counter reads between 970 and 1030 Hz.

   g. Program the UUT to a modulation frequency of 400 Hz.

   h. Verify that the Counter reads between 388 and 412 Hz.

2. Internal AM Accuracy Test

   a. Measure the mean AM depth, (+PEAK plus -PEAK)/2, using the Modulation Analyzer.

   b. Verify that the mean AM depth is between 84.4 and 95.6%.

c. Program the UUT to a modulation frequency of 1 kHz.

d. Verify that the mean AM depth is between 84.4 and 95.6%.

3. AM Accuracy and Distortion Test

a. Connect the output of the LFSSG to the UUT MOD INPUT and the DVM (use a BNC T connector).

b. Program the UUT for a frequency of 0.2 MHz, 1 dBm level, and EXT AM at 30% AM depth.

c. Program the LFSSG for 1 kHz at 0.7071V rms as measured by the DVM.

d. Connect the modulation output of the Modulation Analyzer to the input of the Distortion Analyzer.

e. Set the Distortion Analyzer to measure the THD of the 1-kHz modulation signal.

f. Verify that the mean AM depth (+PEAK plus -PEAK)/2, is between 25.5 and 34.5%.

g. Verify that the THD is less than 3%.

h. Program the remaining combinations of RF frequency, level, and AM depth listed in Table 4A-5.

Table 4A-5. AM Test Conditions

FREQUENCY (MHz)	LEVEL (dBm)	AM (%)
0.2	1	30
		70
		90
	10	30
		70
		90
244.9	1	70
		90
	10	70
		90
245	1	70
		90
	10	70
		90
512	1	70
		90
	10	70
		90
1050	1	70
		90
	7	70
		90
1250	1	70
		90
	7	70
		90

i. Verify that the mean AM depth (for each combination) is between the allowed limits and that the THD is less than the allowed limit. The allowed limit depends on programmed depth, RF frequency, and level as shown in Table 4A-6.

j. Disconnect the LFSSG from the UUT.

Table 4A-6. AM Depth Range

	PROGRAMMED DEPTH (%)	MEAN AM DEPTH (%) MIN.	MAX.	MAXIMUM THD (%)
1 to 2100 MHz	30	26.8	33.2	1.5 (3%,1050 to 2100 MHz)
	70	65.2	74.8	3
	90	84.4	95.6	5
	70	63.5	76.5	5
	90	82.5	97.5	7

4. Incidental FM Test

a. Program the UUT for 30% INT AM at 1 kHz, at 1049.9 MHz, and 10 dBm.

b. Program the Modulation Analyzer to measure peak FM deviation in a 0.3- to 3-kHz bandwidth.

c. Verify that the incidental FM is less than 300 Hz.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the Modulation Analyzer.

5. Residual AM Test

a. Program the UUT to 100 MHz, +7 dBm, and no modulation.

b. Program the Modulation Analyzer to measure rms (or average) AM in a 0.05- to 15-kHz bandwidth.

c. Verify the residual AM is less than 0.1% rms (or 0.09% average).

6. FM Accuracy and Distortion Test

a. Connect the output of the LFSSG to the UUT MOD INPUT connector and the DVM (use a BNC T connector).

b. Program the Modulation Analyzer to measure peak FM in a 0.05- to 20-kHz bandwidth.

c. Program the UUT frequency to 245 MHz, 7 dBm, 99.9 kHz deviation (9.99 kHz if the Generator has Option -651), and EXT FM.

d. Set the LFSSG to 10 kHz and adjust its level so the DVM reads 707.1 mV rms.

e. Set the Distortion Analyzer to measure distortion at 10 kHz.

f. Verify that the Modulation Analyzer reading is between 93 and 107 kHz (9.3 and 10.7 kHz if the Generator has Option -651 installed), and verify that the THD is less than 1% as the UUT frequency is stepped up to 1045 MHz in 50-MHz steps. (Tip: use the instrument FREQ STEP feature.)

g. Set the LFSSG to 0.4 kHz, and adjust its level so the DVM reads 707.1 mV rms.

h. Program the Modulation Analyzer to measure FM in a 0.05- to 3-kHz bandwidth.

i. Set the Distortion Analyzer to measure distortion at 0.4 kHz.

j. Verify that the Modulation Analyzer reading is between 93 and 107 kHz (9.3 and 10.7 kHz if the Generator has Option -651 installed), and verify that the THD is less than 1% as the UUT frequency is stepped down to 245 MHz in 50-MHz steps.

k. Program the UUT to 9.99 kHz deviation. (Skip to step m if the UUT has Option -651 installed.) then set the LFSSG to 4 KHz.

l. Verify that the Modulation Analyzer reading is between 9.3 and 10.7 kHz.

m. Program the UUT to 0.999 kHz deviation.

n. Verify that the Modulation Analyzer reading is between 0.93 and 1.07 kHz.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the Modulation Analyzer.

o. Disconnect the LFSSG from the UUT.

7. ϕM Accuracy Test

a. Connect the LFSSG output to the UUT MOD INPUT connector and the DVM (use a BNC T connector).

b. Program the UUT to [RCL] [9] [8], EXT ϕM, and 10 radians phase deviation.

c. Program the LFSSG for .3 kHz and .7071V rms, as measured by the DVM.

d. Program the Modulation Analyzer to measure ϕM + peak in a 15-Hz to 15-kHz bandwidth.

e. Verify that the Modulation Analyzer reading is between 9.3 and 10.7 radians.

f. Program the LFSSG for 10 kHz and .7071V rms, as measured by the DVM.

g. Verify that the Modulation Analyzer reading is between 9.3 and 10.7 radians.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the Modulation Analyzer.

8. Incidental AM Test

   a. Program the UUT for 50-kHz deviation, INT FM on at 1 kHz, EXT FM off, a level of 7 dBm, and a frequency of 11 MHz.

   b. Program the Modulation Analyzer to measure peak AM in a 0.3- to 3-kHz bandwidth.

   c. Verify that the incidental AM is less than 1%.

9. Residual FM Test

   a. Program the UUT for a frequency of 10.03999 MHz and no modulation.

   b. Program the HFSSG to 11.53999 MHz and 1.0 dBm.

   c. Connect the HFSSG output to the Modulation Analyzer external LO input connector.

   d. Program the Modulation Analyzer to measure average FM in the .3 to 3 kHz bandwidth.

   e. Verify that the Modulation Analyzer reading is less than 10 Hz.

   f. Verify that the Modulation Analyzer reading is less than 10 Hz average at the following UUT frequencies. Program the external LO to a frequency 1.5 MHz higher than the UUT frequency in each case.

      89.03999, 90.03999, and 244.03999 MHz

   g. Verify that the Modulation Analyzer reading is less than 5 Hz average at the following UUT frequencies. Program the external LO to a frequency 1.5 MHz higher than the UUT frequency in each case.

      319, 364, and 511 MHz

   h. Verify that the Modulation Analyzer reading is less than 10 Hz average at the following UUT frequencies. Program the external LO to a frequency 1.5 MHz higher than the UUT frequency in each case.

      512.002, 639.002, 640.002, 729.002, 730.002, 889.002, 890.002, and 1049.002 MHz

   i. Change the Modulation Analyzer to measure average FM in the .05 to 15 kHz bandwidth.

   j. Program the LO to a frequency 1.5 MHz higher than the UUT frequency in each case.

k. Verify that the Modulation Analyzer reading is less than 16 Hz average at the UUT frequencies in step h.

l. Verify that the Modulation Analyzer reading is less than 8 Hz average at the UUT frequencies in step g.

m. Verify that the Modulation Analyzer reading is less than 16 Hz average at the UUT frequencies in step f.

4A-13. VSWR TESTS

The VSWR (voltage standing-wave ratio) tests use a VSWR bridge and a Spectrum Analyzer to verify VSWR of the UUT.

REQUIREMENTS:

The output VSWR is less than 1.5:1 for output levels $< +1$ dBm; $<$ 2:1 elsewhere.

EQUIPMENT REQUIRED:

VSWR Bridge
RF Spectrum Analyzer
HFSSG

REMARKS:

The UUT settings in this procedure are chosen to provide confidence in the VSWR performance of the UUT throughout its range. However, performance also may be checked at other levels.

NOTE

The following procedures must be done in sequential order to ensure that the proper equipment is connected and appropriate programs are enabled.

PROCEDURE:

1. Mid-Frequency Band at Low-Level Test

   a. With the UUT on, reset the UUT by selecting [RCL] [9] [8].

   b. Program the UUT to 1 MHz at +0.9 dBm.

   c. Select the special function fixed range on the UUT by pressing [SPCL] [9] [1].

   d. Using the EDIT function on the UUT, edit the amplitude to -30.1 dBm. Verify that the UNCAL annunciator illuminates.

NOTE

This procedure leaves the output attenuators set as they would be for a +0.9 dBm output level, but uses the electronic control to turn down the RF level coming out of the UUT.

e. Connect the UUT to the Device Under Test port of the VSWR Bridge.

f. Connect the RF Spectrum Analyzer to the RF OUT port of the VSWR Bridge.

g. Connect the HFSSG to the RF IN port of the VSWR Bridge.

h. Program the HFSSG to 10 MHz at +13 dBm.

i. Set the RF Spectrum Analyzer to display approximately 10 to 250 MHz and set the reference level to +10 dBm.

j. Step the HFSSG from 10 to 240 MHz in 10-MHz steps. Locate the frequency at which the reflected signal (displayed by the RF Spectrum Analyzer) is maximum and record this level. This is the point with worst-case VSWR.

k. Disconnect the UUT from the VSWR Bridge and record the new level.

l. Calculate the return loss (difference) between the two recorded levels. The difference must be at least 14 dB (14 dB of return loss = 1.5:1 VSWR).

2. High-Frequency Bands at Low-Level Test

a. Program the UUT to 500 MHz at +0.9 dBm.

b. Select the special function fixed range on the UUT by pressing [SPCL][9][1].

c. Using the EDIT function on the UUT, edit the amplitude to -30.1 dBm.

d. Connect the UUT to the Device Under Test port of the VSWR Bridge.

e. Set the RF Spectrum Analyzer to cover a frequency span of 250 to 2100 MHz.

f. Step the HFSSG from 250 to 2100 MHz in 50-MHz steps. Locate the frequency at which the reflected signal is maximum and record this level.

g. Disconnect the UUT from the VSWR bridge and record the new level.

h. Calculate the return loss between the two recorded levels. The difference must be at least 14 dB.

3. High-Frequency Bands at High-Level Test

a. Program the UUT to +10 dBm.

b. Select the special function fixed range on the UUT by pressing [SPCL][9][1].

c. Using the EDIT function on the UUT, edit the amplitude to -30 dBm.

d. Connect the UUT to the Device Under Test port of the VSWR Bridge.

e. Step the HFSSG from 250 to 2100 MHz in 50-MHz steps. Locate the frequency at which the reflected signal is maximum and record this level.

f. Disconnect the UUT from the VSWR Bridge and record the new level.

g. Calculate the return loss between the two recorded levels. The difference must be at least 9.5 dB (9.5 dB of return loss = 2:1 VSWR).

4. Mid-Frequency Band at High-Level Test

   a. Program the UUT to 1 MHz at +10 dBm.

   b. Select the special function fixed range on the UUT by pressing [SPCL][9][1].

   c. Using the EDIT function on the UUT, edit the amplitude to -30 dBm.

   d. Connect the UUT to the Device Under Test port of the VSWR Bridge.

   e. Set the RF Spectrum Analyzer to display approximately 10 to 250 MHz.

   f. Step the HFSSG from 10 to 240 MHz in 10-MHz steps. Locate the frequency at which the reflected signal is maximum and record this level.

   g. Disconnect the UUT from the VSWR Bridge and record the new level.

   h. Calculate the return loss between the two recorded levels. The difference must be at least 9.5 dB.

   i. Reset the UUT by selecting [RCL][9][8].

4A-14. PULSE TESTS

The Pulse Tests check the static and dynamic operation of pulse modulation.

REQUIREMENTS:

Proper pulse operation is tested by checking: static on/off ratio greater than 80 dB, dynamic rise and fall time <15 nS, and level error <0.5 dB.

TEST EQUIPMENT:

RF Spectrum Analyzer
Pulse Generator
Power Meter
Power Sensor (High-Level)
50-Ohm Termination
Oscilloscope
Detector

NOTE

The following procedures must be done in sequential order to ensure that the proper equipment is connected and appropriate programs are enabled.

PROCEDURE:

1. Static Test

   a. Program the UUT to 2100 MHz and +10 dBm.

   b. Connect a 50 ohm termination to the Pulse Modulation input connector.

   c. Connect the UUT RF OUTPUT to the RF Spectrum Analyzer input.

d. Set the RF Spectrum Analyzer controls to display the output of the UUT using a span of approximately 50 kHz and a resolution bandwidth of approximately 1 kHz.

e. Activate pulse modulation by pressing the External Pulse key on the UUT.

f. Observe the level change on the RF Spectrum Analyzer. The change should exceed 80 dB.

g. Deactivate external pulse by pressing the External Pulse key on the UUT and repeat steps d through f for UUT frequencies of 10, 100, 500, 1050, 1500, and 2000 MHz.

2. Dynamic Test

a. Program the UUT to 2100 MHz, +10 dBm, and external pulse modulation.

b. Remove the 50 ohm termination at the UUT's Pulse Modulation input connector, then connect the Pulse Generator to the UUT pulse input connector.

c. Set the Pulse Generator to a repetition rate of 5 MHz, +3V pulse level, and roughly a 50% duty cycle. If the Pulse Generator's output is not 50 ohm impedance, then carefully monitor the pulse input at the UUT for correct level and without signal distortion.

d. Connect the output of the UUT to the Detector.

e. Terminate the Detector into 50 ohms at the Oscilloscope input.

f. Set the timebase of the Oscilloscope to 10 nS/division (or smaller using the magnifier).

g. Use the Oscilloscope channel to invert the detector output signal.

h. Trigger the Oscilloscope on this signal.

i. Set the variable position and gain on the Oscilloscope so that the signal extends from 0% to 100% on the graticule.

j. Measure the rise/fall time from the 90% to the 10% coordinates.

k. Verify that the rise/fall time is <15 nS.

l. Repeat steps f through k at 1500, 1050, and 500 MHz. The timebase of the Oscilloscope should also be readjusted if necessary.

m. Remove the Detector and reconnect the UUT directly into the Oscilloscope (still terminated at 50 ohms).

n. Change the repetition rate of the Pulse Generator to .5 MHz.

o. Verify that the rise/fall time is <15 nS for RF frequencies of 100 and 50 MHz.

3. Level Error Test

a. Remove the UUT and reconnect the Pulse Generator directly into the Oscilloscope. If the Pulse Generator's output is 50 ohm impedance, then terminate the Oscilloscope input at 50 ohms.

b. Set the Pulse Generator to 5-MHz repetition rate, +3V level, and 50% duty cycle.

c. Adjust the Oscilloscope position and gain controls for easy full scale viewing.

d. Readjust the pulse duty cycle for exactly 50% as measured at the 1V level of the Oscilloscope.

e. Remove the Pulse Generator from the Oscilloscope and reconnect it to the pulse input of the UUT. If the Pulse Generator's output is not 50 ohm impedance, then carefully monitor the pulse input at the UUT for correct level and without signal distortion.

f. Program the UUT to 244 MHz, +7 dBm, and external pulse modulation.

g. Connect the UUT output to the RF Spectrum Analyzer input.

h. Set the RF Spectrum Analyzer to observe a three line spectra on either side of the center line spectra. The center spectra may be verified by turning pulse modulation off. (A convenient spectrum analyzer setting is 5 MHz./div span and 100-kHz resolution bandwidth.)

i. Adjust the duty cycle of the Pulse Generator for exactly 50% duty cycle by nulling the second line from the center line (approximately 10-MHz offset). A null of at least -30 dBc should be established.

j. Replace the RF Spectrum Analyzer with the Power Meter and set the Power Meter to the reference setting.

k. Turn the UUT pulse modulation off and note the meter reading. The difference between the meter reading and 3.01 dB is the pulse level error. This error should be less than .5 dB.

l. Repeat steps f through k for 2100, 1049, and 50 MHz.

Section 4B
Access Procedures

4B-1. INTRODUCTION

The information in this section describes the general access procedures for the following major assemblies.

Front Panel Section
Rear Panel Section
A2 Controller PCA
A4 Synthesizer PCA
A5 VCO PCA
A6 Output Control PCA
A7 Output PCA
A8 Attenuator/RPP Assembly

Access to all other assemblies is straightforward and, therefore, not described in this section.

4B-2. LOCATION OF MAJOR ASSEMBLIES

The location of the major assemblies is illustrated in Section 5.

Information on exchanging modules is presented in Section 4D.

4B-3. ACCESS INSTRUCTIONS

Access instructions for each assembly of the Generator are provided in the following paragraphs. Before performing any disassembly of the Generator, remove the power cord from the rear panel power receptacle and remove the exterior top and bottom instrument covers.

To install the assemblies, reverse the disassembly steps. Be certain the pin connectors and filter sockets are straight when replacing the pca's.

4B-4. Removing the Front Panel Section

1. Disconnect the MODULATION INPUT wire W6 at J103, located on the back of the A1 Display PCA.

2. Disconnect the PULSE MODULATION INPUT cable W26 from module connector J7.

3. Disconnect the front panel display ribbon cable from the A2 Controller PCA.

4. Remove the decals from both front panel handles. Since removing the decals ruins them, attach new decals to maintain a proper instrument appearance. The part number for the decal is listed in Section 5.

5. Remove the five flathead screws from each front panel handle. The front panel section can now be removed.

4B-5. Removing the Rear Panel Section

1. Disconnect W9 and W10 (the A4 Synthesizer PCA and A2 Controller PCA power cables) from the A9 Power Supply PCA.

2. If the Medium-Stability Reference option is installed, disconnect the power cable from J5 on the A9 Power Supply PCA.

3. If the High-Stability Reference option is installed, disconnect the oscillator power cable from the auxiliary power supply.

4. Remove the A3 IEEE-488 Interface PCA from the back of the rear panel.

5. Remove the inside part of the 10 MHz OUT and the REF IN BNC connectors.

6. Remove the decals for both rear panel handles. Since removing the decals ruins them, attach new decals to maintain a proper instrument appearance. The part number for the decal is listed in Section 5.

7. Remove the five flathead screws from each handle and swing the rear panel assembly out from the instrument.

8. If necessary, detach the rear panel assembly from the Generator by removing the front panel power switch and the cable ties that attach W15 to the chassis side.

4B-6. Removing the A2 Controller PCA

1. Remove the number 6 screws holding the top module cover. (The number 10 screws are adjustment-access screws and need not be removed.)

2. Remove the cover.

3. Disconnect the front panel display ribbon cable from the A2 Controller PCA.

4. Remove the A3 IEEE-488 Interface PCA from the back of the rear panel.

5. Disconnect W9 and W24 from the A2 Controller PCA.

6. Remove the number 6 screws holding the pca, then carefully remove the pca.

4B-7. Removing the A4 Synthesizer PCA

1. Disconnect the 10 MHz OUT and the REF IN cables at connectors J2 and J112, and remove the nuts and lockwashers from J2 and J112.

2. Remove the number 6 screws holding the top module cover. (The number 10 screws are adjustment-access screws and need not be removed.)

3. Remove the cover.

4. Remove the number 6 screws holding the pca.

5. Carefully remove the A4 Synthesizer PCA.

4B-8. Removing the A5 VCO PCA

1. Remove the number 6 screws holding the bottom module cover. (The number 10 screws are adjustment-access screws and need not be removed.)

2. Remove the cover.

3. Remove the plug-in coupling capacitor between the A6 Output Control and A5 VCO PCAs.

4. Disconnect cable W1 from the A6 Output Control PCA.

5. Remove the number 6 screws holding the pca.

6. Remove the A5 VCO PCA.

4B-9. Removing the A6 Output Control PCA

1. Remove the number 6 screws holding the bottom module cover. (The number 10 screws are adjustment-access screws and need not be removed.)

2. Remove the cover.

3. Remove the plug-in coupling capacitor between the A6 Output Control and the A5 VCO PCAs.

4. Disconnect cable W1 from the A6 Output Control PCA.

5. Disconnect the three RF cables and the three control cables (which are part of the A7 Output PCA) from the A6 Output Control PCA.

6. Disconnect the pulse modulation input cable from connector J7.

7. Remove the four screws holding U4 and the filter barrier.

8. Remove the number 6 screws holding the pca.

9. Carefully remove the A6 Output Control PCA.

4B-10. Removing the A7 Output PCA

1. Remove the number 6 screws holding the bottom module cover. (The number 10 screws are adjustment-access screws and need not be removed.)

2. Remove the module cover.

3. Disconnect the three RF cables and the three control cables (which are part of the A7 Output PCA) from the A6 Output Control PCA.

4. Remove the number 6 screws holding the Pulse Modulator cover, and remove the cover.

5. Remove the two number 6 screws holding the modulator barrier.

6. Remove the number 6 and number 4 screws holding the pca. Do NOT remove the two number 0 screws that hold Q9, nor the two nuts nearby.

7. Carefully remove the A7 Output PCA.

4B-11. Removing the A8 Attenuator/RPP Assembly

1. Disconnect the SMA connector (which leads to the RF output) from the A8A2 Attenuator/RPP PCA.

2. Disconnect the cable from the A8A1 Relay Driver/RPP PCA.

3. Remove the 13 screws holding the assembly. (Do not remove the 7 screws that hold the A8A1 Relay Driver/RPP PCA to the attenuator housing.)

4. Remove the A8 Attenuator/RPP Assembly.

Section 4C
Calibration Adjustments

4C-1. INTRODUCTION

The adjustment procedures for the Generator are described in the following paragraphs. The recommended test equipment for calibration is denoted by an A in Table 4A-1.

Adjustment procedures for the A1 Display, A4 Synthesizer, A6 Output Control and A9 Power Supply PCAs, are covered in this section. Adjustment procedures for the High-Stability Reference, Medium-Stability Reference, and Low-Rate FM options are given in Section 6.

4C-2. SAFETY

This is a Safety Class I instrument. It is provided with a protective earth terminal. Warnings and cautions are for your protection and for preventing damage to the equipment. Please take them seriously.

WARNING

BECAUSE SOME SERVICE PROCEDURES DESCRIBED HERE ARE DONE WITH POWER APPLIED TO THE SIGNAL GENERATOR AND WITH PROTECTIVE COVERS REMOVED, SERVICE SHOULD BE DONE ONLY BY TRAINED SERVICE PERSONNEL WHO UNDERSTAND THE HAZARDS INVOLVED. WHERE SERVICE CAN BE PERFORMED WITHOUT POWER APPLIED, THE SIGNAL GENERATOR SHOULD BE UNPLUGGED FROM THE LINE POWER.

DO NOT INTERRUPT THE PROTECTIVE GROUNDING CONNECTION. TO DO SO WOULD CREATE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY. SECURE THE INSTRUMENT AGAINST UNINTENDED OPERATION IF IT IS LIKELY THAT THIS PROTECTION HAS BEEN IMPAIRED. USE ONLY 250V FUSES OF THE PROPER CURRENT RATING.

CAUTION

To avoid damage to the Generator, unplug the instrument before removing any printed circuit assembly (pca).

4C-3. A1 DISPLAY PCA ADJUSTMENT

The following procedure covers the adjustment of R16, the external modulation level indicator adjustment.

TEST EQUIPMENT:

DVM

REMARKS:

The external modulation level indicator adjustment is independent of other adjustments and assumes proper circuit operation.

Adjustment R16 is located below TP1 on the rear of the A1 Display PCA, just above the POWER switch.

PROCEDURE:

Adjust R16 for 0.98V at TP1.

1. Gain access to the rear of the A1 Display PCA by removing the top instrument cover.
2. Connect the DVM to measure the dc voltage at TP1 relative to the chassis.
3. Adjust R16 for +0.9800 ±.0005V dc.

4C-4. A4 SYNTHESIZER PCA ADJUSTMENTS

Each of the following adjustment procedures is independent; that is, they can be done individually or in any sequence. Figure 4C-1 shows the top view of the module plate.

The following are routine adjustments for the A4 Synthesizer PCA:

- R230 10-MHz Adjustment
- R82 FM Cal Adjustment
  R90 Low-Rate Deviation Adjustment
  R87 FM Flatness Adjustment

The following only need adjustment if the associated circuits are repaired:

- L49 20-kHz Notch Filter Adjustment
  L50 40-kHz Notch Filter Adjustment
- R104 VCO Upper Clamp Adjustment
- C206 800-MHz Oscillator Adjustment
- C240 10-MHz Lock-Range Centering Adjustment

4C-5. Reference Frequency Adjustment, R230

TEST EQUIPMENT:

Frequency Standard
Oscilloscope

REMARKS:

The accuracy of the reference frequency adjustment depends on the accuracy of the Frequency Standard.

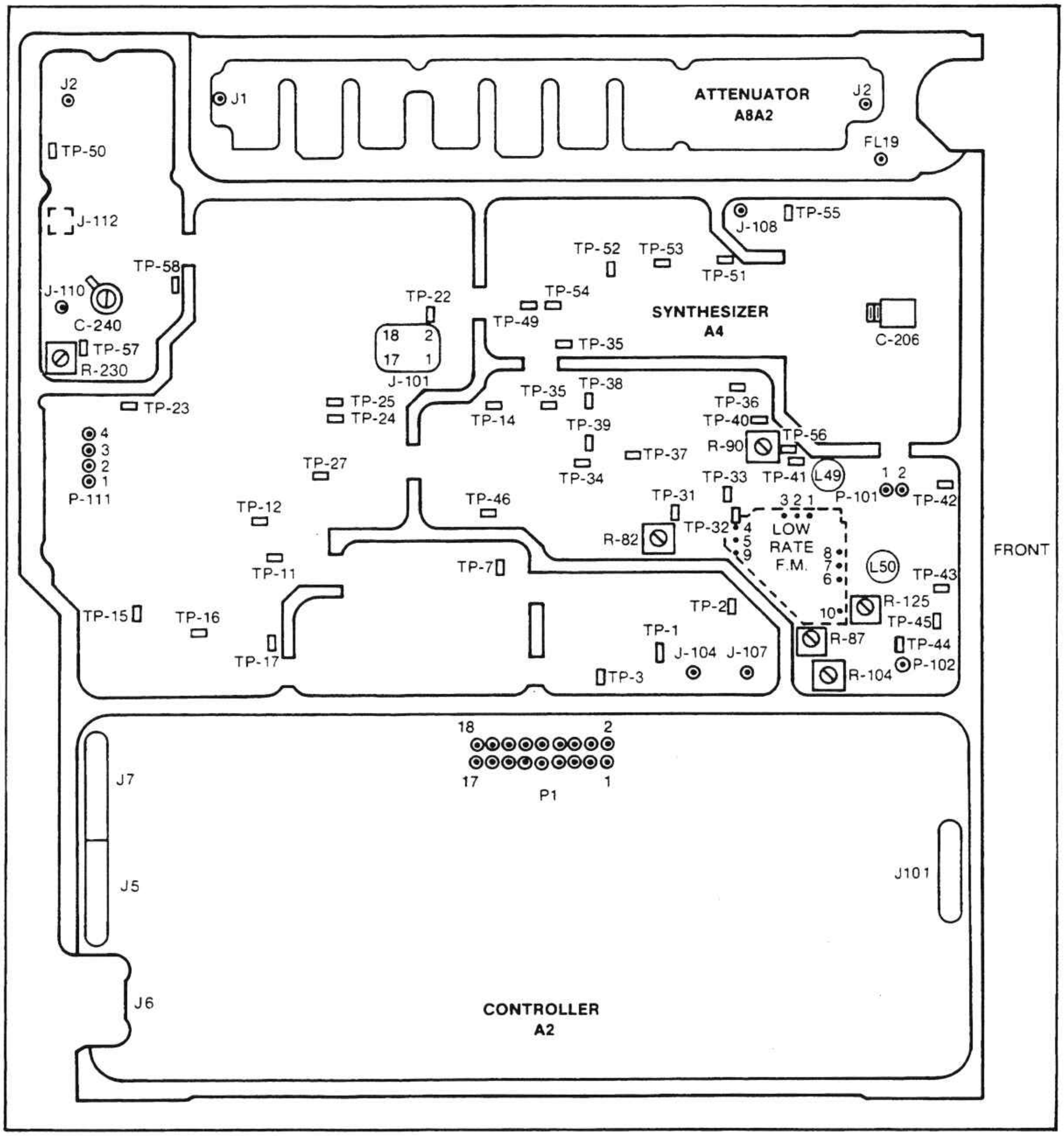


Figure 4C-1. Module Plate, Top View

The Generator may be equipped with either Option -130 High-Stability Reference, or Option -132 Medium-Stability Reference. The frequency reference operation and adjustment procedure depend on this configuration. That is, the instrument reference may be the 10-MHz crystal oscillator, the High-Stability Reference, the Medium-Stability Reference, or an external signal.

Skip the following procedure if the UUT is equipped with the High-Stability Reference or Medium-Stability Reference, and use the adjustment procedures in Section 6 of this manual.

PROCEDURE:

The UUT reference waveform is viewed on the Oscilloscope while triggering on the Frequency Standard. The 10-MHz adjustment R230 is adjusted for a stationary display.

1. Remove the instrument top cover and the 10-MHz adjustment R230 access screw from the module plate cover.
2. Connect the UUT rear panel 10 MHz OUT to the Oscilloscope vertical input.
3. Connect the Frequency Standard output to the Oscilloscope external trigger input.
4. Set the UUT rear panel REF INT/EXT switch to INT, and set the vertical controls of the Oscilloscope to display the UUT 10-MHz signal.
5. Set the Oscilloscope for external triggering, and adjust the timebase for 0.1 us/div.
6. Adjust R230 for a drift of less than one cycle per second.

4C-6. FM Adjustments, R82, R90, and R87

TEST EQUIPMENT:

Modulation Analyzer
Low Frequency Synthesized Signal Generator (LFSSG)
DVM

REMARKS:

The FM cal adjustment R82 sets the overall deviation accuracy. The low-rate deviation adjustment R90 equalizes the low and high rate deviation. The FM flatness adjustment R87 equalizes the deviation across the band from 0.2 to 10 kHz.

PROCEDURE:

The FM deviation of the UUT, as measured with the Modulation Analyzer, is adjusted to agree with the programmed deviation at 10-, .2- and 0.5-kHz rates by adjusting R82, R90, and R87, respectively.

1. Remove the instrument cover and the FM cal, FM flatness, and low-rate deviation adjustment access screws from the cover of the module plate.
2. Connect the output of the LFSSG to the UUT MOD IN connector and to the DVM using a BNC tee.
3. Connect the UUT RF OUTPUT to the Modulation Analyzer input.
4. Program the Modulation Analyzer to measure FM + peak. No filters should be active.
5. Program the UUT to [RCL] [9] [8], 385.5 MHz, 7 dBm, EXT FM, 99.9-kHz deviation.
6. Program the LFSSG to 10 kHz and 0.7071V rms as measured by the DVM.
7. Adjust R82 for 100.0 kHz, as measured by the Modulation Analyzer.
8. Program the LFSSG to 0.2 kHz and 0.7071V rms, as measured by the DVM.
9. Adjust R90, the low-rate deviation for 100.0 kHz, as measured on the Modulation Analyzer.

10. Program the LFSSG to .5 kHz

11. Adjust R87 for 100.0 kHz as measured on the Modulation Analyzer.

12. Repeat steps 6 through 11 until the deviation flatness is 100.0 kHz ±0.3 kHz.

13. Turn the UUT EXT FM off and note the Modulation Analyzer peak deviation (noise) reading.

14. Turn the UUT EXT FM on.

15. Program the LFSSG to 10 kHz and 0.7071V rms as measured by the DVM.

16. With the Modulation Analyzer, alternately measure +peak and -peak FM, and adjust R82 so the readings are symmetrical about 99.9 kHz plus the noise noted in step 13.

4C-7. 20-kHz and 40-kHz Notch Filter Adjustments, L49 and L50

TEST EQUIPMENT:

RF Spectrum Analyzer
Low-Frequency Synthesized Signal Generator (LFSSG)

REMARKS:

The 20- and 40-kHz notch filter adjustments are normally not required unless L49, L50, C123, C99, C124, C126 or C125 are replaced or unless the Generator has been subjected to severe usage.

PROCEDURE:

The 20-kHz and 40-kHz notch adjustments, L49 and L50, are adjusted for sideband level nulls using the RF Spectrum Analyzer.

1. Remove the instrument and the module plate top covers.

2. Connect the LFSSG to TP56 (high) and TP36 (low) using clip leads.

3. Program LFSSG to 20 kHz and 0.2V rms, terminated.

4. Connect the UUT RF OUTPUT to the RF Spectrum Analyzer input.

5. Program the UUT to 300 MHz and +13 dBm.

6. Adjust the RF Spectrum Analyzer to display the signal centered on the display.

7. Set the span to 10 kHz/division and 1-kHz bandwidth. The 20-kHz sidebands should be visible.

8. Adjust L49 to minimize the 20-kHz sidebands.

9. Program the LFSSG to 40 kHz.

10. Adjust L50 to minimize the 40-kHz sidebands.

4C-8. VCO Voltage-Clamp Adjustments, R104 and R125

TEST EQUIPMENT:

Frequency Counter
DMM

REMARKS:

The VCO voltage-clamp adjustment is normally required when either the A5 VCO PCA or the A4 Synthesizer PCA has been replaced or when either of these assemblies has been subjected to repair or modifications.

PROCEDURE:

The UUT PLL is disabled to cause the VCO frequency to be at the limits of its range.

1. Remove the instrument and module plate top covers of the UUT.
2. Connect the UUT rear panel 10 MHz OUT to the Frequency Counter 10-MHz reference input, and connect the UUT RF OUTPUT to the Frequency Counter input.
3. Program the UUT to [RCL] [9] [8], 500 MHz and +13 dBm.
4. Using a short clip lead, carefully short TP14 to ground to cause the VCO to go to the upper frequency limit.
5. Adjust R104 for 530 MHz ±1 MHz.
6. Remove the shorting clip lead from the ground terminal.
7. Program the UUT for 250 MHz (still at +13 dBm).
8. Using the short clip lead, carefully short TP35 to ground to cause the VCO to go to its lower frequency limit.
9. Adjust R125 for 237 MHz ±1 MHz.
10. Remove the shorting clip lead from the UUT.

NOTE

On earlier units, adjustment R125 was not present. In these cases the frequency measured in step 9 should be less than 240 MHz.

4C-9. 800-MHz Oscillator Adjustment, C206

TEST EQUIPMENT:

Frequency Counter
DMM

REMARKS:

The 800-MHz oscillator adjustment is normally not required unless components in the 800-MHz oscillator are replaced or the Generator has been subjected to severe usage.

PROCEDURE:

The PLL control voltage operating point is adjusted to 16V while the loop is phase locked.

1. Remove the instrument and the module plate top covers.

2. Program the UUT to [RCL] [9] [8], 200 MHz.

3. Connect the DMM to measure voltage between TP53 and the chassis.

4. Adjust C206 for 16.0V ±0.5V.

4C-10. 10-MHz Lock-Range Centering Adjustment, C240

TEST EQUIPMENT:

Frequency Standard
Low-Frequency Synthesized Signal Generator (LFSSG)
Oscilloscope
BNC Tee

REMARKS:

The UUT reference output and the LFSSG signal are viewed simultaneously on the oscilloscope for frequencies near the limit of the lock-in range. The 10-MHz crystal oscillator is adjusted for a stable display on the oscilloscope at both upper and lower limits. The external reference input level to the Generator is reduced to determine sensitivity.

PROCEDURE:

1. Remove the Generator top cover and the 10-MHz adjustment access screw from the the module plate. (See Figure 4C-1 for 10-MHz adjustment location.)

2. Connect the Frequency Standard to the reference input of the LFSSG.

3. Connect the LFSSG output to the Oscilloscope vertical input channel 1 using a BNC tee, and then connect the cable to the UUT 10 MHz IN using a cable less than three feet in length.

4. Connect the UUT rear panel 10 MHz OUT to Oscilloscope vertical input channel 2.

5. Program the LFSSG to 10 MHz and 0 dBm.

6. Set the UUT rear panel REF INT/EXT switch to EXT.

7. Set the vertical controls of the Oscilloscope to display both the LFSSG output and the UUT 10-MHz signal. Set the triggering to channel 1, and adjust the timebase for 0.1us/div.

8. Edit the LFSSG to 220 Hz above 10 MHz (10.00022 MHz).

9. If the signals are unlocked, adjust C240 for a locked condition. Verify that the UNCAL indicator is not lit.

10. Adjust C240 clockwise until the two waveforms are not synchronized (break lock). Verify that the UNCAL indicator is flashing.

11. Turn C240 counterclockwise to the first stable, locked point.

12. Edit the LFSSG to 220 Hz below 10 MHz (9.99978 MHz).

13. Verify the locked condition; the two wave forms are synchronized and the UNCAL indicator is not lit.

14. Program the LFSSG to 10 MHz.

15. Reduce the level of LFSSG until the signals displayed on the Oscilloscope indicate an unlock condition.

16. Increase the LFSSG level until the Oscilloscope display first indicates the locked point. Verify that this level is less than 300 mV peak-to-peak as measured with the Oscilloscope.

17. Perform the Reference Frequency Adjustment procedure described earlier.

4C-11. OUTPUT ASSEMBLY (A6 + A7) ADJUSTMENTS

The following procedures cover all of the adjustments on the A6 Output Control PCA and A7 Output PCA:

- R86, level DAC offset
- R46, AM DAC offset
- R99, modulation oscillator level
- C214, external ϕM deviation
- C217, internal ϕM deviation
- R113, detector offset
- R97, AM depth
- R82, RF level
- R63, het level

The following adjustments, as well as TP7 and TP1, are accessible by removing the nine number-10 access screws in the module cover. Refer to Figure 4C-2 to identify the access screw corresponding to a particular adjustment.

Any adjustment can be made independently unless it is noted that it interacts with another adjustment. Interdependent adjustments must be done in the sequence presented. If more than one adjustment is necessary, do them in the sequence presented.

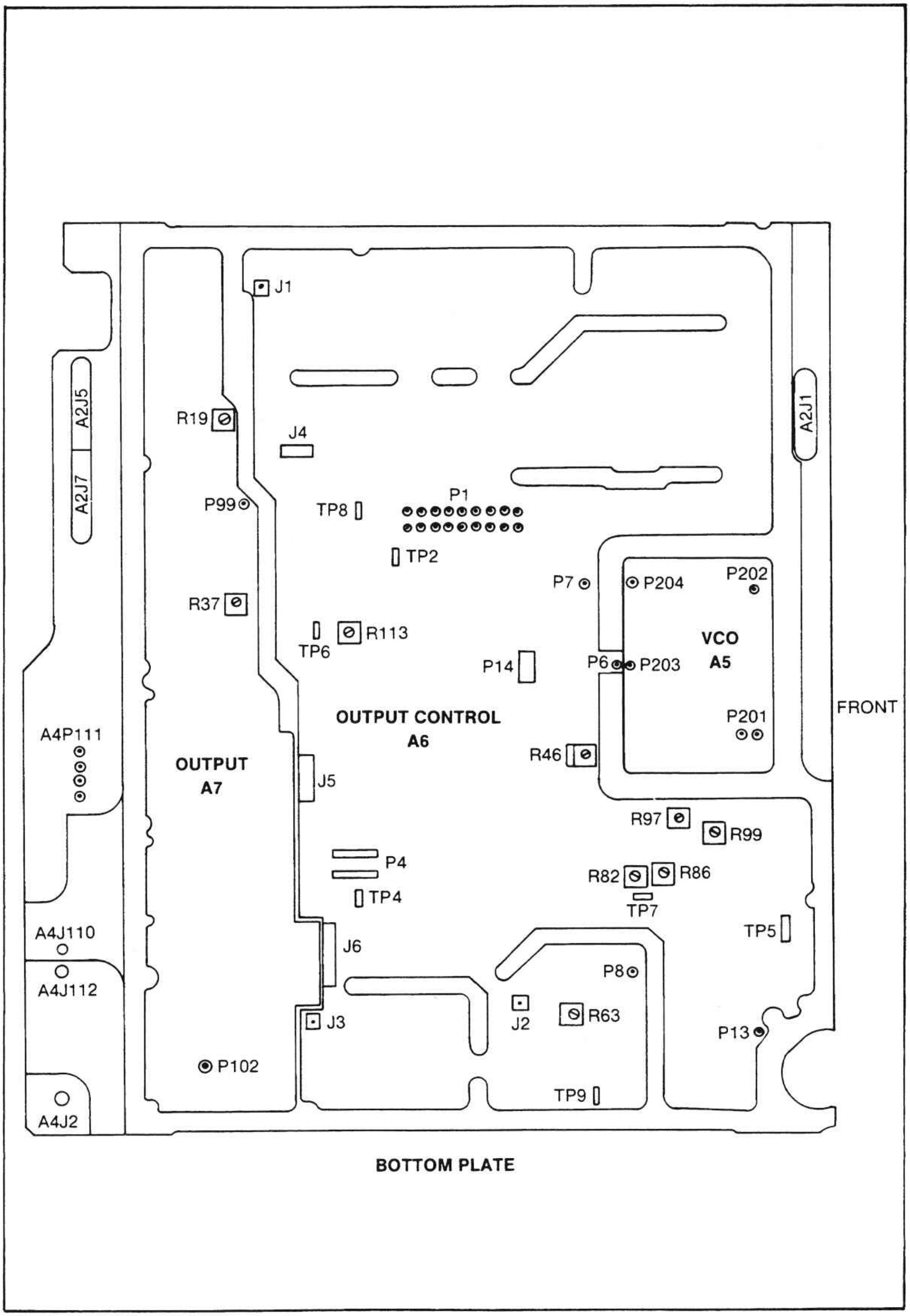


Figure 4C-2. Module Plate, Bottom View

4C-12. Level DAC Offset Adjustment, R86

TEST EQUIPMENT:

DVM

REMARKS:

The level DAC offset adjustment is normally required only when U35 or any associated components are replaced or when the adjustment has been changed or has shifted.

CAUTION

This adjustment directly affects the output level and should not be adjusted indiscriminately.

PROCEDURE:

The level DAC offset, R86, is adjusted for 0 ±0.5 mV at TP7 with the RF OUTPUT off.

1. Access R86 by removing the bottom instrument cover and removing the access screws for TP7 and R86.
2. Program the UUT to [RCL] [9] [8], and program the RF OUTPUT to OFF.
3. Connect the DVM to measure the voltage between TP7 and the power distribution connection point on the module plate.
4. Adjust R86 for an indication of 0 mV ±0.5 mV. .
5. Program the UUT RF OUTPUT to ON.
6. Replace the access screws.

4C-13. AM DAC Offset Adjustment, R46

TEST EQUIPMENT:

DVM

REMARKS:

The AM DAC offset adjustment is normally required only when U20 or any associated components are replaced or when the adjustment has been changed or has shifted.

CAUTION

This adjustment directly affects the output level and should not be adjusted indiscriminately.

PROCEDURE:

The AM DAC offset, R46, is adjusted for 0 ±0.5 mV at TP1 with AM off.

1. Access R46 by removing the bottom instrument cover and removing the access screws for TP1 and R46.

2. Program the UUT to [RCL] [9] [8].

3. Connect the DVM to measure the voltage between TP1 and the power distribution connection point on the module plate.

4. Adjust R46 for an indication of 0 mV ±0.5 mV.

5. Replace the access screws.

4C-14. Modulation Oscillator Level Adjustment, R99

The modulation oscillator level adjustment sets the modulation oscillator level.

TEST EQUIPMENT:

Modulation Analyzer
DVM
Low Frequency Synthesized Signal Generator (LFSSG)

REMARKS:

The modulation oscillator level adjustment, R99, is normally required only when components in the modulation oscillator or modulation switching circuits have been replaced or the adjustment has been changed or has shifted.

PROCEDURE:

The AM depth, with internal modulation, is adjusted via R99 to equal the AM depth with a 1-volt peak external modulation signal as measured with the Modulation Analyzer.

1. Access R99 by removing the bottom instrument cover and the access screw for R99.

2. Connect the output of the LFSSG to the UUT MOD IN connector and the DVM using a BNC tee.

3. Program the UUT to [RCL] [9] [8], 350 MHz, 7 dBm, and EXT AM at 90% AM depth.

4. Program the LFSSG for 1 kHz and a voltage of 0.7071V rms, as measured by the DVM.

5. Connect the UUT RF OUTPUT connector to the Modulation Analyzer RF input.

6. Program the Modulation Analyzer to measure + Peak AM in a 0.3-to 15-kHz bandwidth.

7. Note the measured AM depth reading with the Modulation Analyzer.

8. Turn off the UUT EXT AM control and turn on the INT AM control.

9. Program the UUT for 1000-Hz modulation frequency.

10. Adjust R99 for an AM depth equal to that noted in step 7.

11. Turn off the UUT INT AM control.

12. Replace the access screw.

4C-15. External ϕM Deviation Adjustment, C214

TEST EQUIPMENT:

Modulation Analyzer
DVM
Low-Frequency Synthesized Signal Generator (LFSSG)

REMARKS:

The external ϕM deviation adjustment is normally required only when the adjustment has been changed or has shifted.

PROCEDURE:

Adjust C214 for equal frequency deviation as measured with the modulation analyzer for the following two UUT setups:

EXT FM, 100 kHz deviation, external 10 kHz modulation signal EXT ϕM, 10 radians deviation, external 10 kHz modulation signal

1. Access C214 by removing the bottom instrument cover and the access screw for C214.
2. Connect the output of the LFSSG to the UUT MOD IN connector and the DVM using a BNC tee.
3. Program the UUT to [RCL] [9] [8], EXT FM, and 100 kHz FM deviation.
4. Program the LFSSG for 10 kHz and .7071V rms as measured by the DVM.
5. Connect the UUT RF OUTPUT connector to the Modulation Analyzer RF input.
6. Program the Modulation Analyzer to measure + peak FM in a .3- to 15-kHz bandwidth.
7. Note the measured FM deviation.
8. Program the UUT to 10 radians phase deviation.
9. Adjust C214 for a measured frequency deviation equal to that noted in step 7.
10. Replace the external ϕM deviation adjustment access screw.

4C-16. Internal ϕM Deviation Adjustment, C217

TEST EQUIPMENT:

Modulation Analyzer
DVM
Low-Frequency Synthesized Signal Generator (LFSSG)
BNC Tee

REMARKS:

The internal ϕM deviation adjustment is normally required only when the adjustment has been changed or has shifted.

PROCEDURE:

Phase deviation, with internal modulation, is adjusted via C217 to equal phase deviation with a 1.05 kHz 1V peak external modulation signal as measured with the Modulation Analyzer.

1. Access C217 by removing the bottom instrument cover and the access screw for C217.
2. Connect the output of the LFSSG to the UUT MOD IN connector and the DVM using a BNC tee.
3. Program the UUT to [RCL] [9] [8], EXT ϕM, and 10 radians phase deviation.
4. Program the LFSSG for 1.05 kHz and .7071V rms as measured by the DVM.
5. Connect the UUT RF OUTPUT connector to the Modulation Analyzer RF input.
6. Program the Modulation Analyzer to measure + peak phase deviation in a .3- to 3-kHz bandwidth.
7. Note the measured phase deviation reading with the Modulation Analyzer.
8. Turn off the UUT EXT ϕM control and turn on the INT ϕM control.
9. Program the UUT for 1000 Hz modulation frequency.
10. Adjust C217 for measured phase deviation equal to that measured in step 6.
11. Replace the internal ϕM deviation access screw.

4C-17. Detector Offset Adjustment, R113

The detector offset adjustment sets the detector offset voltage.

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate cover in place before continuing with this adjustment procedure.

This adjustment is normally required only when components in the detector or detector linearizer circuits have been replaced or when the adjustment has been changed or has shifted. If the detector offset is adjusted, perform the AM depth adjustment.

CAUTION

The detector offset adjustment directly affects the output level and should not be adjusted indiscriminately.

PROCEDURE:

The detector offset adjustment, R113, is adjusted to provide a 30-dB change in output power for a 30-dB change in the level DAC. This is done while operating in fixed range.

1. Access R113 by removing the instrument bottom cover.
2. Program the UUT to [RCL] [9] [8], 350 MHz and 12 dBm.
3. Program the UUT to [SPCL] [9] [1]. This special function enables amplitude fixed range.
4. Remove the detector offset adjustment access screw from the bottom module plate cover.
5. Zero the Power Meter.
6. Connect the Power Sensor to the UUT RF OUTPUT connector.
7. Program the UUT to +12 dBm.
8. Note the Power Meter reading.
9. Program the UUT for -18 dBm using the EDIT keys. (Be certain to use the EDIT keys to change the amplitude for this step.)
10. Adjust the detector offset adjustment, R113, for a Power Meter reading 30 dB ±0.1 dB below the reading obtained in step 8.
11. Repeat the previous four steps until the difference between the power measurements is 30 ±0.1 dB. This adjustment should require three or fewer iterations.
12. Program the UUT to +17 dBm using the EDIT keys. Note the Power Meter reading.
13. Program the UUT for +2 dBm using the EDIT keys.
14. Verify that the Power Meter reading is 15 dB ±0.2 dB below the previous reading.
15. Program the UUT for [SPCL] [0] [0]. This disables amplitude fixed range.
16. Disconnect the Power Sensor from the UUT, and replace the detector offset adjustment access screw.

4C-18. AM Depth Adjustment, R97

TEST EQUIPMENT:

DVM
Modulation Analyzer
Low-Frequency Synthesized Signal Generator (LFSSG)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this adjustment procedure.

CAUTION

The AM depth adjustment directly affects the output level and should not be adjusted indiscriminately.

he AM depth adjustment is normally required only when components in the AM signal processing circuits have been replaced, or the adjustment has been changed or shifted. If this adjustment is made, it is necessary to perform the RF level adjustment after the AM depth adjustment has been made.

PROCEDURE:

Adjust the AM depth adjustment, R97, for 90% AM depth as measured with the Modulation Analyzer when the UUT is programmed to 90% AM.

1. Remove the AM depth adjustment access screw from the bottom module plate cover.
2. Connect the output of the LFSSG to the UUT MOD IN connector and to the DVM using a BNC Tee.
3. Program the UUT to [RCL] [9] [8], 350 MHz, +1 dBm, and EXT AM at 90% AM depth.
4. Program the LFSSG for 1 kHz and a voltage of 0.7071 rms, as measured by the DVM.
5. Connect the UUT RF OUTPUT connector to the Modulation Analyzer input.
6. Program the Modulation Analyzer to measure AM + Peak, in a 0.05-to 15-kHz bandwidth.
7. Alternately measure + PEAK and - PEAK, and adjust the AM depth adjustment, R97, until the readings are symmetrical about 90%.
8. Replace the AM depth adjustment access screw.

4C-19. RF Level Adjustment, R82

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this adjustment procedure.

This adjustment is required if any of the following events occur:

- The Output Assembly A6 and A7, or the A8 Attenuator/RPP Assembly has been replaced.
- The AM depth adjustment is made.
- The level DAC or any associated components are replaced.
- The RF level adjustment has been inadvertently changed or shifted.

CAUTION

The RF level adjustment directly affects the output level and should not be adjusted indiscriminately.

PROCEDURE:

With the UUT programmed to +9 dBm, adjust the RF level adjustment, R82, for +9-dBm output as measured with the Power Meter.

1. Program the UUT to [RCL] [9] [8], 350 MHz and +9 dBm.
2. Zero the Power Meter.
3. Remove the RF level adjustment access screw from the bottom module plate cover.
4. Connect the Power Sensor to the UUT RF connector.
5. Adjust RF level adjustment, R82, for a reading of exactly +9 dBm on the Power Meter.
6. Replace the RF level adjustment access screw.

4C-20. Het Level Adjustment, R63

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this adjustment procedure.

This adjustment is normally required only when components in the het band circuits have been replaced or when the adjustment has been changed or has shifted.

CAUTION

This adjustment directly affects the output level and should not be adjusted indiscriminately.

PROCEDURE:

With the UUT programmed to +9 dBm, adjust the het level adjustment, R63, for equal output power at 100 and 350 MHz.

1. Program the UUT to [RCL] [9] [8], 350 MHz and +9 dBm.
2. Zero the Power Meter.
3. Remove the het level adjustment access screw from the bottom module plate cover.
4. Connect the Power Sensor to the UUT RF OUTPUT connector. Note the Power Meter reading.

5. Program the UUT to 100 MHz.

6. Adjust het level adjustment, R63, for a reading equal to that previously noted.

7. Replace the het level adjustment access screw.

4C-21. A9 POWER SUPPLY PCA ADJUSTMENT

The following procedure covers the +37V adjustment, R3, on the A9 Power Supply PCA. This is the only adjustment on the A9 Power Supply PCA.

TEST EQUIPMENT:

DMM

REMARKS:

This adjustment is accessible through a hole in the bottom lip of the rear panel.

See Figure 4C-3 for the location of the power supply test points.

PROCEDURE:

R3 is adjusted for +37V as measured at TP5.

1. Remove the UUT top and bottom instrument covers.

2. Connect the DMM to TP5 with the ground lead (black wire) connected to the power distribution connection point on the module plate.

3. Program the UUT to [RCL] [9] [8].

4. Adjust R3 for a DMM reading of +37.00 ±0.05V.

5. Verify the other supply voltages at the following test points:

TP	Voltage Limits
11	14.5 to 15.7
3	14.5 to 15.7
2	-14.5 to -15.7
4	4.85 to 5.20
1	17.4 to 22.6

NOTE

The voltage at TP1 depends on the line voltage. The limits shown are for a line voltage exactly equal to the line voltage selector setting, i.e., 100, 120, 220, or 240V ac.

6. Remove the test leads, and reinstall the top and bottom instrument covers.

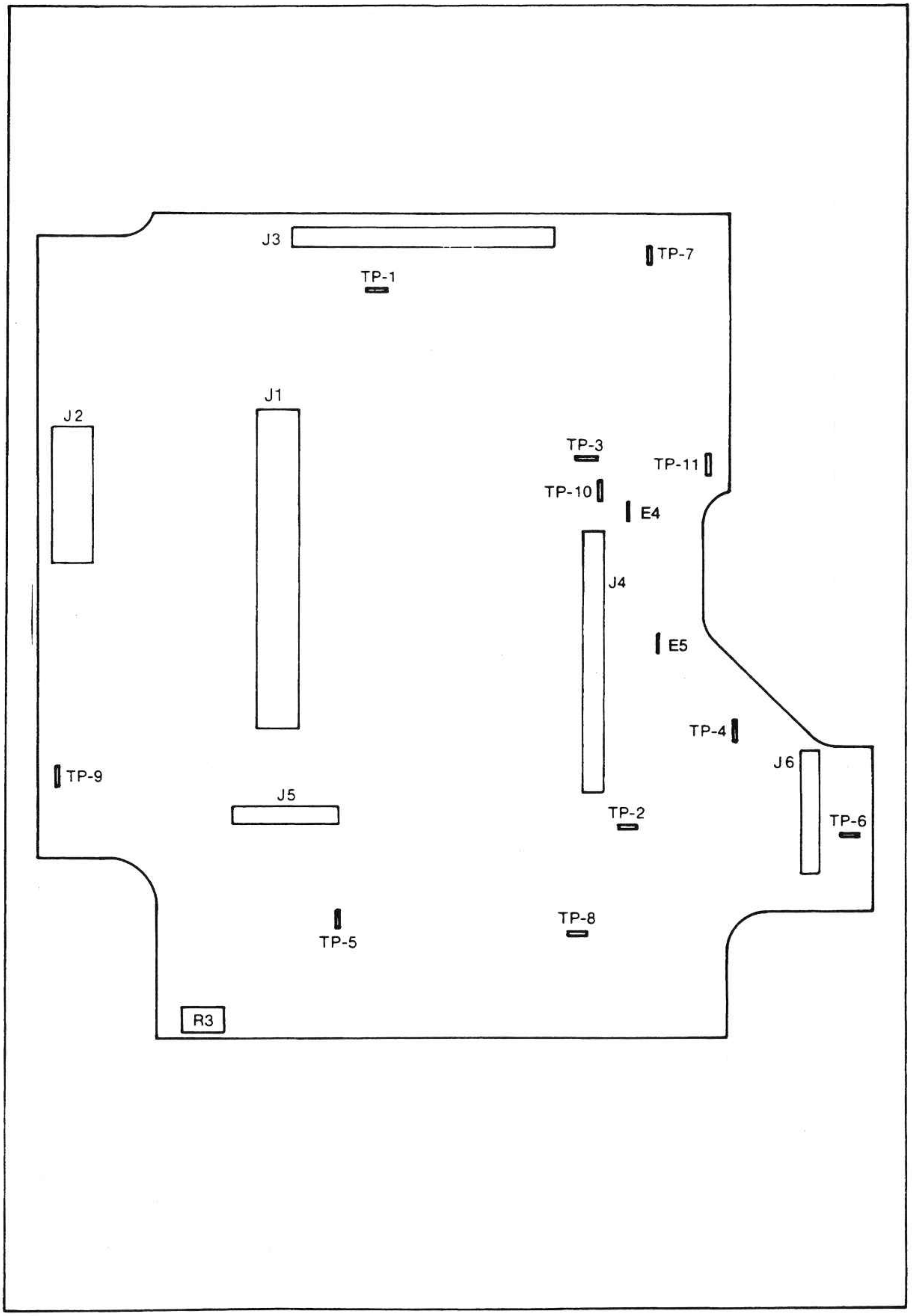


Figure 4C-3. Power Supply Test Points

Section 4D
Troubleshooting and Repair

4D-1. INTRODUCTION

The Generator is usually most easily repaired by identifying the defective module and replacing it through the Module Exchange Program. Alternatively, the operator may wish to troubleshoot down to the component level and replace the defective part. This section of the manual provides the necessary information for both repair methods.

After any module repair or replacement, the adjustments or comments in the following paragraphs particular to the module should be completed, followed by the appropriate performance tests. Generator problems are generally caused by operator error, out-of-spec performance, or by catastrophic failure. The correction strategy is different in each case.

Although most operator errors are detected and indicated, some are not, and therefore, may be mistaken for out-of-spec conditions. Those operator errors that are detected are indicated by either a steady or flashing UNCAL indicator. Refer to Table 1-1 for the specifications of the Generator, and see Section 2 for more information on Generator operation.

Out-of-spec performance is usually corrected by performing the appropriate calibration adjustment procedure(s). Use the performance tests located in Section 4B to determine which parameters need adjustment.

If the problem is not an operator error and is not corrected by adjustment, the Generator has a catastrophic failure. The task is then to isolate the fault and make appropriate repairs. The UNCAL and self-test failure codes usually provide a good indication of the cause of the problem. In this situation, using the performance tests may help to determine which parameters are not affected.

4D-2. MODULE REPLACEMENT

This repair method involves identifying and replacing the problem module. The replacement module may be obtained through the Module Exchange Program or from your spare module stock, which may then be restored using the Module Exchange Program.

Use the information in the Troubleshooting portion of this section to diagnose the problem. To help identify the problem module, call your local Fluke Technical Center for troubleshooting assistance. Once the Fluke service technician believes the problem module is identified, a replacement module can be shipped prepaid by an overnight air carrier.

After verifying that the replacement module corrects the problem, return the defective module in the shipping container, and include the prepaid return shipping papers and label.

NOTE

The A5 VCO PCA, Output Assembly (A6 + A7), and A8 Attenuator/RPP Assembly are individually compensated. The compensation data is stored in an EPROM and delivered with the associated module.

To order a replacement module, use the part number for the assembly shown in Table 4D-1 and identify the assembly as a module exchange part. To order any new assembly, refer to Section 5 for the part number and other ordering information. Note that two versions of the A4 Synthesizer PCA are available: one with the Low-Rate FM option, and one without the option. The following paragraphs describe the available exchange modules, and how to install them. Adjust the Generator, if necessary, after installation.

4D-3. A1 Display PCA

After installing a new A1 Display PCA, the external modulation level indicator adjustment should be done. The procedure is presented under A1 Display PCA Adjustment located in Section 4C of this manual.

4D-4. A2 Controller PCA

The A2 Controller PCA comes complete with a new compensation EEPROM and a new battery-backed CMOS RAM. However, the new compensation memory ICs do not contain valid compensation data. The compensation data from the old A2 Controller PCA must be transferred to the new A2 Controller PCA.

After installing the new A2 Controller PCA, label both the compensation EEPROM (U24), and the battery-backed RAM (U25) on both the old and the new pca's. Swap the compensation EEPROM from the old pca with the same part on the new pca. Power-up the Generator, and enter [SPCL] [7] [5]. See the paragraphs on Compensation Memory Status later this in section for an explanation of the status codes. If the compensation memory status confirms that the old compensation EEPROM contains valid data, enter [SPCL] [7] [6]. The special function will copy the compensation data from the EEPROM into the battery-backed RAM. Leave the old EPROM in the new A2 Controller PCA.

Table 4D-1. Module Exchange Assemblies

ASSEMBLY NO.	DESCRIPTION	MEC P/N	COMPENSATION EPROM
A1	Display PCA	798009	
A2	Controller PCA	798058	
A3	IEEE-488 Interface PCA	774562	
A4	Synthesizer PCA	798173	
A4 w/-651	Synthesizer w/Low-Rate FM	798223	
A5	VCO PCA	798017	X
* A6	Output Control PCA	798041	
* A7	Output PCA	798025	
--	Output Assembly (A6 + A7)	812651	X
A8	Attenuator/RPP Assembly	808444	X
A8A1	Relay Driver/RPP PCA	798033	
* A8A2	Attenuator/RPP PCA	812644	
A9	Power Supply PCA	744052	
* Software compensation required if the assembly is exchanged.			

If the results indicate that the EEPROM does not contain valid data, swap the compensation EEPROMs back to where they were originally. Then swap the battery-backed RAM ICs, power-up the Generator again, and enter [SPCL] [7] [5]. If the compensation memory status confirms that the old battery-backed RAM contains valid data, enter [SPCL] [7] [6]. The special function will copy the compensation data from the battery-backed RAM to the compensation EEPROM. If the compensation data in the battery-backed RAM is also invalid, the compensation data has been destroyed. If this is the case, the data must be regenerated using the Software Compensation Procedures (Section 4D of this manual), or by a Fluke Service Center.

Remember to set the option status switches. No adjustments are required.

4D-5. A3 IEEE-488 Interface PCA

The A3 IEEE-488 Interface PCA comes complete with panel, frame, and connector and is ready to plug in. No adjustments are required after installation.

4D-6. A4 Synthesizer PCA

There are two versions of the A4 Synthesizer PCA available under the Module Exchange Program. One version has the Low-Rate FM option installed on the A4 Synthesizer PCA and the other does not. Therefore, when ordering a replacement A4 Synthesizer PCA, be sure to specify whether or not the Generator being repaired has the Low-Rate FM option.

Also, before replacing the A4 Synthesizer PCA, it is important to note what other options are in the Generator. If the Low-Rate FM option is present, verify that S1 on the pca option is set for Low-Rate operation (see Section 6).

After the new A4 Synthesizer PCA has been installed, perform the FM, VCO Upper Clamp, and 10-MHZ Adjustments described in the A4 Synthesizer Adjustments located in Section 4C of this manual. Perform any other adjustments related to the options.

4D-7. A5 VCO PCA

The A5 VCO PCA comes with a compensation EPROM that is installed on the A2 Controller PCA. The compensation data must be transferred to the Compensation Memory. (See Updating Compensation Memory with Module Exchange Data further on in this section.) Following the A5 VCO PCA installation and data transfer, the FM and VCO Upper Clamp Adjustments should be done. These adjustments are presented under the A4 Synthesizer Adjustments located in Section 4C of this manual.

A plug-in coupling capacitor is used to interconnect the A5 VCO and A6 Output Controller PCAs, thus eliminating the need for a soldering iron when replacing this pca.

4D-8. Output Assembly (A6 + A7)

The Output Assembly consists of the A6 Output Control PCA, the A7 Output PCA, and a compensation EPROM. This EPROM is installed on the A2 Controller PCA, and the compensation data must be transferred to the compensation memory. (See Updating Compensation Memory With Module Exchange Data further on in this section.) After the installation of A6 and A7 and the data transfer, perform the level DAC offset, the AM DAC offset, the RF Level, the het level, and the FM adjustments given in Section 4C of this manual.

A plug-in coupling capacitor is used to interconnect the A5 VCO PCA and the A6 Output Control PCA, thus eliminating the need for a soldering iron when replacing these pca's.

If the Generator is equipped with the Low-Rate FM option, it is necessary to add a jumper around C84 and C85 on the new A6 Output Control PCA before installing it.

4D-9. A8 Attenuator/RPP Assembly

The A8 Attenuator/RPP Assembly comes complete with the housing, A8A1 Relay Driver/RPP PCA, A8A2 Attenuator/RPP PCA, and a compensation data EPROM. This EPROM is installed on the A2 Controller PCA and the compensation data must be transferred to the compensation memory. (See Updating Compensation Memory with Module Exchange Data further on in this section.) After the new A8 Attenuator/RPP Assembly is installed, perform the RF Level Adjustment procedure on the Output Assembly (A6 + A7), presented in Section 4C of this manual.

4D-10. A9 Power Supply PCA

The A9 Power Supply PCA comes complete with the 5V regulator (U1) and a set of insulated washers for all of the chassis-mounted regulators.

No adjustment is required after installation of the new pca, but the power supply voltages should be verified. Use the last step of the A9 Power Supply PCA Adjustment procedure in Section 4C to verify the power supply voltages.

4D-11. UPDATING COMPENSATION MEMORY WITH MODULE EXCHANGE DATA

After installing the VCO, Output, or Attenuator/RPP module exchange assemblies, the data in the corresponding compensation EPROM must be loaded into the compensation memory. The module exchange EPROM is installed in a socket on the A2 Controller PCA. The compensation data is transferred by one of three special functions, depending on which of the three assemblies has been replaced.

Perform the following steps to update the compensation memory with the new module exchange data:

1. Verify that the Generator power is off.
2. Remove the top cover of instrument to access the top cover of the module.
3. Remove the 6 screws to access the controller compartment.
4. Install the module exchange EPROM into the socket on the A2 Controller PCA labeled U26.
5. Remove the controller switch access cover.
6. Power-up the Generator.
7. Set the controller switch #6 to on.
8. Verify that the COMP annunciator on the front panel is lit.
9. Enter [SPCL] [7] [7] to transfer the VCO data; [SPCL] [7] [8] to transfer the Output data; or [SPCL] [7] [9] to transfer the Attenuator data.
10. Respond to the prompt "Vco Sto ?", "Out Sto?", or "Att Sto?" by pressing the [STO] key. The message "—Sto—" is displayed for 5 seconds for the VCO and Output, and 12 seconds for the Attenuator while the data is transferred.

CAUTION

Do not turn the POWER switch off or change the compensation switch until the store operation is complete. Doing so could damage the contents of the compensation memory.

11. Set the controller switch #6 to off.
12. Verify that the COMP annunciator is no longer lit.
13. Turn the power off and remove the module exchange EPROM, if desired.
14. Install the controller compartment access cover.
15. Replace the instrument top cover.

4D-12. PARTS REPLACEMENT

An experienced technician should be able to isolate the defective component and replace it after reading Section 3, Theory of Operation, and the troubleshooting information contained in this section. The schematics are presented in Section 8.

Most parts are replaced using ordinary methods. The parts requiring special attention are the chip components. To replace the chip components use a 600° F soldering iron, such as an Ungar 50T7, with a number 76 heater, a number 88 tip, and 2% silver solder paste, such as Electro Science Fabrication SP - 37D1 or similar wire solder.

Replacement of some components necessitates performing portions of the software compensation procedure located in Section 4E. These components are noted in Section 5, List of Replaceable Parts.

4D-13. TROUBLESHOOTING

To isolate a fault, it is important to note the conditions under which the symptoms are observed and if the symptoms change with different states of the instrument. The states of the instrument that should be noted are things such as different RF bands or levels, only when FM is on, only under remote control, etc.

If the symptom is a blank front panel or no response to keystrokes, the fault is most likely a digital problem or a power supply problem. If the power supply and cables are good, go to the Digital and Control Troubleshooting paragraphs in this section.

If the front panel appears to function properly but the RF output is abnormal, or there is a flashing UNCAL indication, the cause is probably an analog circuit problem (although it could be a control problem).

A properly operating front panel indicates that the majority of the A2 Controller PCA circuitry is functional. It is possible, however, that a digital control problem could exist and cause the RF output to be incorrect. If a digital problem is suspected, go to the Digital and Control Troubleshooting paragraphs after checking the power supply.

4D-14. Special Functions

There are several special function self tests that can be used to assist the technician in troubleshooting the Generator. A few of the special functions used during troubleshooting are described in the following paragraphs. For a complete list of all special functions, see Table 2-4.

- Special Function 03, Display check

  The front panel displays are checked by pressing the [SPCL] [0] [3] keys. When this is done the microprocessor lights all display segments. This test is terminated by pressing any key on the instrument. This mode is retained in non-volatile memory, thus returning the Generator to the display check mode if it is interrupted by a power failure.

- Special Function 04, Key check

  Check the normally open front panel keys by entering [SPCL] [0] [4]. For each key pressed, a key address code is displayed in the FREQUENCY display field. Pressing the [CLR | LCL] key exits this check. The test also times out after approximately eight seconds if no keys are pressed.

- Special Function 15, Latch Test

  Special function 15 initiates a built-in latch control test that is useful in verifying that the A2 Controller PCA is sending valid data to the latches of the Output and Synthesizer PCAs. This special function sends an alternating bit pattern (10101010 binary) to each 8-bit latch, and displays "Latch AA". Pressing the EDIT [↓] key changes the bit pattern to 01010101, and "Latch 55" is displayed. Pressing the EDIT[↑] key changes the pattern back to 10101010. Pressing any other key causes the instrument to exit the test.

CAUTION

This special function is intended as a troubleshooting tool to check the operation of the digital circuitry and the latches on the analog assemblies. Since the Generator is programmed to an abnormal state, its output is turned off by programming full attenuation.

- Special Function 17, Initiate Self Tests With RF ON

  Special function 17 initiates a special troubleshooting self test. This special function initiates the self tests with the RF output enabled so that diagnostic equipment may be connected. It stops after each self test failure, leaving the Generator configured as it was when the failure was detected. Press any front panel key to resume the test. Refer to the paragraphs on Self-Test Description later in this section for details of the individual tests.

CAUTION

The RF output may reach +17 dBm during this test. Equipment that may be damaged by this power level should be disconnected from the system.

- Special Functions 83 through 86 Alternate Attenuators

  Special functions 83 through 86 program alternate 24-dB attenuators. The alternate 24-dB attenuators are normally used only when programmed levels are too low to be verified with a power meter during service. These special functions allow the alternate attenuators, A242L through A245L, to be programmed one at a time, thus keeping the level high. The first 24-dB attenuator, denoted A241L, is automatically programmed for levels between -17.0 dBm and -11.1 dBm with AM off. These special functions allow the other attenuators, A242L through A245L, to be programmed in the same range.

These special functions also turn off relative amplitude, amplitude fixed range, and all modulation. In addition, they turn RF and level correction on. If the level is not in the specified range, -12 dBm will be programmed. Any new entry that normally programs the attenuator, causes the default (normal) attenuators to be programmed.

4D-15. UNCAL Conditions

There are two hardware fault detectors, the unlock detector on the A4 Synthesizer PCA, and the unleveled detector on the A7 Output PCA. These two fault detectors are constantly monitored by the A2 Controller PCA, and if asserted, cause a flashing UNCAL indication. The detectors are also used during the self test to check the general health of the Generator.

It is very important to interrogate and note the UNCAL code if there is an UNCAL indication.

If the unit has an UNCAL condition, interrogate the UNCAL code by pressing the [STATUS] key and interpret the code (see Table 2-5). Take note if the code indicates that either UNLOK or UNLVL conditions have been asserted. Other codes denote overrange or underrange conditions (operator errors) that should be cleared but are not pertinent to troubleshooting.

Usually the unleveled UNCAL code indicates a problem on the A6 Output Control PCA or the A7 Output PCA, whereas an unlocked UNCAL code indicates a problem on the A4 Synthesizer PCA or the A5 VCO PCA. Be aware that it is possible to have an unleveled UNCAL condition due to a problem with the A4 Synthesizer PCA that is not detected by the UNLOK detector.

It is a good idea to check for a different UNCAL code when other RF bands, levels or functions (FM or AM) are selected. This provides a more complete analysis of the symptoms. For example, if the code indicates that UNLOK is asserted only with FM on, and not with FM off, it may be indicating an overmodulation condition. See Table 1-1 for the FM limitations.

The last ten hardware uncal codes and self-test errors are logged in the non-volatile memory. Reviewing a history of the error conditions is especially useful in diagnosing intermittent failures. The error log entries can only be interrogated through the IEEE-488 interface. See Section 2 for details.

4D-16. Self-Test Description

The self test is started whenever the Generator is turned on. It may also be started by pressing [SPCL] [0] [2]. If the Generator fails any of the self tests, the self-test failure report is displayed until any key is pressed. The self-test report can also be displayed by pressing [SPCL] [1] [1]. The report is presented in four fields as shown in Figure 4D-1.

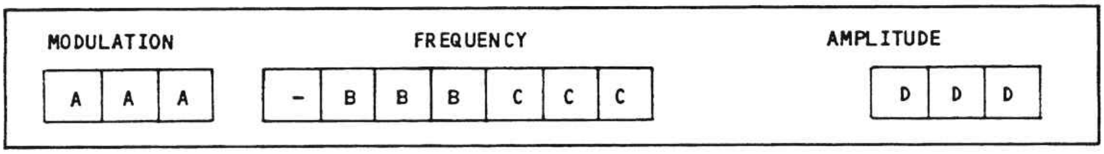


Figure 4D-1. Self-Test Display Field

A minus sign in the FREQUENCY display field indicates that the self test was aborted by a front panel entry.

The four groups (denoted by the A's, B's, C's and D's) in the self-test report correspond to test categories. These tests are described below, including a tabulation of the instrument state, and the test codes that result if any test fails to achieve the expected result. Understanding how these tests are done can provide more meaning to the results and can assist in understanding how they relate to other symptoms. A successful self test is reported with all zeros.

During the self test, the step attenuator is programmed to maximum attenuation, and the internal frequency reference is selected. The analog circuit tests make use of the unleveled (UNLVL) and unlocked (UNLOK) status detectors, whereas the digital circuit tests make use of write/read techniques.

4D-17. AM AND FM TESTS

Codes in the AAA field are primarily the result of the AM and FM tests. During these tests, level correction is applied. During the five AM tests, a normal AM depth (which should produce a leveled condition), and an abnormally high AM depth, (which should provide an unleveled condition, is set for each modulation frequency. During the two FM tests, a normal FM deviation is set, (which should produce a locked condition), and the circuitry is then programmed to simulate an overmodulation condition (which should produce an unlocked condition). The two FM tests are not performed if the Option -651 Low-Rate FM is installed. Table 4D-2 shows the AM test, and Table 4D-3 shows the FM tests.

Table 4D-2. AM Tests

ERROR CODE (AAA BBB CCC DDD)	FREQ (MHZ)	LEVEL (DBM)	AM (%)	MOD FREQ (HZ)	EXPECTED RESULT
001 000 000 000	2100.00000	10.7	30	400	Leveled
002 000 000 000	2100.00000	17.0	127	400	Unleveled
004 000 000 000	2100.00000	10.7	30	1000	Leveled
010 000 000 000	2100.00000	17.0	127	1000	Unleveled
100 000 000 000	1049.99999	13.7	30	1000	Leveled

Table 4D-3. FM Tests

ERROR CODE (AAA BBB CCC DDD)	FREQ (MHZ)	LEVEL (DBM)	MOD FREQ (HZ)	KNDAC	FM DAC	INTFM	FM RANGE	EXPECTED RESULT
020 000 000 000	350	-10	400	Normal	4095	ON	4	Locked
040 000 000 000	350	-10	400	0	4095	OFF	4	Unlocked

4D-18. SYNTHESIZER TESTS

Codes in the BBB field are primarily the result of the synthesizer tests. In the first three test steps, the A4 Synthesizer PCA main PLL operation is verified by programming a large change in frequency. This should cause a momentary unlocked condition that should clear as the frequency settles to the new frequency.

The synthesizer is checked by programming 225 MHz, which is outside the normal operating frequency range, and should result in an unlocked condition. Next, 385 MHz is programmed, which should result in a locked condition. Finally, 550 MHz is programmed, which is again outside the normal range, and should result in an unlocked condition. Table 4D-4 shows the synthesizer test results.

4D-19. DIGITAL TESTS

Codes in field CCC are primarily the result of the digital tests. The IEEE-488 Interface is verified by writing data to the IEEE-488 chip (A3U1), then reading it back. The checksum of each memory location of the non-volatile RAM is verified.

The RAM is verified by writing data to each memory location and checking that the same data can be read back. Both the off-chip RAM (A2U25) and the on-chip RAM (A2U1) are tested in this manner. The RAM test is only done during the power-on self test.

The compensation data in the battery-backed RAM (A2U25) and in the compensation EEPROM (A2U24) is checked by verifying the CRC checksums. A self-test error is reported if any checksums are invalid, or if the compensation data in both memory ICs is not identical. If compensation memory errors are detected, the software adjusts its internal pointers to use only the good data segments. If both memory ICs have invalid data in a particular data segment, the UNCAL indicator is lit to warn that the performance of the Generator may be degraded.

All compensation memory errors are reported as a single self test code. A detailed description of the compensation memory errors can be interrogated from the front panel or from the IEEE-488 Interface. Refer to the paragraphs on Compensation Memory Status later in this section.

The data in each address location of the two EPROMs (A2U21 and A2U22) are successively summed and rotated. The result of this procedure is compared with a checksum for each EPROM. Table 4D-5 shows the digital test results.

4D-20. FILTER TESTS

Codes in the DDD field are the result of the output filter tests. During these tests, the level is programmed to +13.0 dBm with level correction applied. The low-pass filters on the A6 Output Control PCA are tested by setting the frequency near the high end of each of the four half-octave non-het bands and checking for a leveled condition. Then, the frequency is set above the cutoff frequencies of two of the filters, and the output is checked for an unleveled condition.

The band-pass filters that operate in the double band are tested by setting the frequency at each of the filter band edges and verifying that the output is leveled. Then, the frequency is set to the top and bottom of the double band with all filters disabled. The output should be unleveled.

Table 4D-4. Synthesizer and Reference Test Results

ERROR CODE (AAA BBB CCC DDD)	MAX. SYNTH.FREQ. (MHZ)	WAIT (MS)	EXPECTED RESULT
000 001 000 000	245	120	Locked
000 002 000 000	525	5	Unlocked
000 004 000 000	525	95	Locked
000 010 000 000	225	120	Unlocked
000 020 000 000	385	120	Locked
000 040 000 000	550	120	Unlocked

Table 4D-5. Digital Test Results

ERROR CODE (AAA BBB CCC DDD)	DIGITAL TEST
000 000 001 000	IEEE-488 interface test
000 000 002 000	Non-Volatile Memory test
000 000 004 000	RAM test
000 000 010 000	Compensation Memory test
000 000 100 000	Lower program EPROM checksum
000 000 200 000	Upper program EPROM checksum

Table 4D-6 shows the filter test results. Due to the number of filter tests, there are filter test codes in fields AAA, BBB, and CCC as well as field DDD.

4D-21. Compensation Memory Status

The compensation memory status information is updated whenever the digital self tests are run. A detailed report of the compensation memory status is given when interrogated by pressing [SPCL] [7] [5] from the front panel or through the IEEE-488 Interface using the "IZ" command.

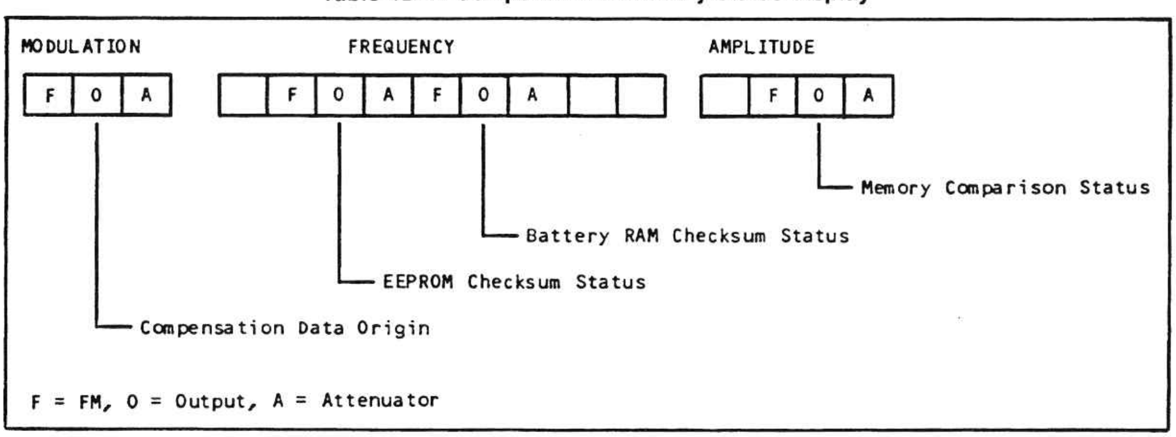
The status is reported in four groups: the data origin, the EEPROM checksum status, the battery-backed RAM checksum status, and the memory comparison status. While each of the status groups report different information, each group is comprised of three digits, which give the status of the FM, output, and attenuator data segments respectively. Table 4D-7 shows the format of the compensation memory status display.

The data origin group shows how the compensation data in each of the data segments was generated. The compensation data can be generated by the Fluke factory or service center, module exchange, or by using the Software Compensation Procedures. (Refer to Section 4E.)

Table 4D-6. Filter Test Results

ERROR CODE (AAA BBB CCC DDD)	FREQ (MHZ)	MIDL	HAOCTL	X2L	X2FL1L	X2FL2L	X2FL3L	X2FL4L	EXPECTED RESULT
000 000 000 001	349.99999	0	0	1	1	1	1	1	leveled
000 000 000 002	511.99999	0	1	1	1	1	1	1	leveled
000 000 000 004	729.99999	1	1	1	1	1	1	1	leveled
000 000 000 010	1049.99999	1	0	1	1	1	1	1	leveled
000 000 000 020	490.00000	0	0	1	1	1	1	1	unleveled
000 000 000 040	1024.00000	1	1	1	1	1	1	1	unleveled
000 000 000 100	1250.00000	1	1	0	0	1	1	1	leveled
000 000 000 200	1250.00000	1	1	0	1	0	1	1	leveled
000 000 000 400	1450.00000	1	1	0	1	0	1	1	leveled
200 000 000 000	1450.00000	1	1	0	1	1	0	1	leveled
400 000 000 000	1750.00000	1	1	0	1	1	0	1	leveled
000 200 000 000	1750.00000	1	1	0	1	1	1	0	leveled
000 400 000 000	1050.00000	1	1	0	1	1	1	1	unleveled
000 000 400 000	2100.00000	1	1	0	1	1	1	1	unleveled

Table 4D-7. Compensation Memory Status Display



The EEPROM and battery-backed RAM checksum status group reports invalid CRC checksums. A 1 in the corresponding digit signifies that the data segment has an invalid checksum, and a 0 signifies that the checksum is valid. When interrogated through the IEEE-488 Interface, the EEPROM and battery-backed RAM status words are output together as a single 6-digit word.

The memory comparison status group reports an error if the corresponding data segments in the two memory ICs do not have identical data, yet both have valid checksums. This condition could arise when swapping the compensation memory ICs as part of the A2 Controller PCA module exchange procedure. While this situation should rarely occur, it must be detected so that corrective action can be taken.

4D-22. Repairing Compensation Memory Checksum Errors

Maintaining two redundant copies of the compensation data makes it possible to repair many compensation memory checksum errors. As long as one copy of the compensation data is valid, it may be copied to the other memory IC. Each data segment (FM, output, or attenuator) is handled independently.

Special function 76 attempts to repair all detected compensation memory checksum errors. It checks the compensation memory status and copies each good data segment to the corresponding bad segment in the other memory IC. The message —Sto— is displayed in the frequency field while the special function is working. If both data segments have invalid data, the special function cannot repair either checksum. If all checksums are valid, the special function does not display the —Sto— message, nor does it transfer any data.

The special function also resolves the situation where both memory ICs have valid checksums, but the data is not identical. Priority is given to the data in the compensation EEPROM, thus copying the affected data segments in the compensation EEPROM to the battery-backed RAM. This is why it is suggested that the compensation EEPROM be swapped when using the module exchange procedures for exchanging the A2 Controller PCA.

After completing the updates, the special function executes the compensation memory self test (if there are any unresolved errors) and displays the updated status for 5 seconds.

4D-23. Check Output Signal

Check the output signal with an RF Spectrum Analyzer or a Counter at various frequencies on each of the RF bands and at the state where an UNCAL condition exists. If the frequency is incorrect or erratic, check the power supply first. Go to the paragraphs on troubleshooting the A2 Synthesizer PCA if the power supply functions properly. Table 4D-8 shows the band, filter, and frequency programming data for the output frequency (at the source). Table 4D-9 lists the VCO Band Control signals.

The RF Spectrum Analyzer can also be used to check to see if the modulation functions are generally working. If a modulation problem exists, go to the appropriate AM or FM troubleshooting paragraphs (further on in this section) after checking the power supply.

If the frequency is stable and correct, but the output level is abnormal, the problem is most likely in either the A6 Output Control PCA or the A7 Output PCA. Check the power supply, then go to the Level Troubleshooting paragraphs later in this section.

With a clear knowledge of the symptoms and the conditions under which the UUT fails, the next task is to isolate the problem. Remove the top and bottom instrument covers and visually inspect the interior for loose cables, connectors, etc. Also be alert for the characteristic odor of burned resistors.

Table 4D-8. Band, Filter, and Frequency Programming Data

OUTPUT FREQUENCY (Fo)	MIDL	HAO CTL	HETL	SHE TL	X2L	X2FL 1L	X2FL 2L	X2FL 3L	X2FL 4L	SYNTH.FREQ(Fs)
0.1 - 244.99999 MHz	1	1	0	0	1	1	1	1	1	(800 + Fo)/ 2
245 - 349.99999 MHz	0	0	1	1	1	1	1	1	1	Fo
350 - 511.99999 MHz	0	1	1	1	1	1	1	1	1	Fo
512 - 729.99999 MHz	1	1	1	1	1	1	1	1	1	Fo / 2
730 - 1049.99999 MHz	1	0	1	1	1	1	1	1	1	Fo / 2
1050 - 1249.99999 MHz	1	1	1	1	0	0	1	1	1	Fo / 4
1250 - 1449.99999 MHz	1	1	1	1	0	1	0	1	1	Fo / 4
1450 - 1749.99999 MHz	1	1	1	1	0	1	1	0	1	Fo / 4
1750 - 2100.00000 MHz	1	1	1	1	0	1	1	1	0	Fo / 4

Table 4D-9. VCO Band Control

SYNTHESIZER FREQUENCY (Fs)	VCOHL	VCOQ
220.00000 - 319.99999 MHz	0	0
320.00000 - 364.99999 MHz	0	1
365.00000 - 444.99999 MHz	1	1
445.00000 - 550.00000 MHz	1	0
1 = TTL High 0 = TTL Low		

WARNING

DO NOT INTERRUPT THE PROTECTIVE GROUNDING CONNECTION. TO DO SO WOULD CREATE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY. SECURE THE INSTRUMENT AGAINST UNINTENDED OPERATION IF IT IS LIKELY THAT THIS PROTECTION HAS BEEN IMPAIRED. USE ONLY 250V FUSES OF THE PROPER CURRENT RATING.

WARNING

BECAUSE THE PROCEDURES DESCRIBED HERE ARE DONE WITH POWER APPLIED TO THE GENERATOR, AND WITH PROTECTIVE COVERS REMOVED, TESTING SHOULD BE DONE ONLY BY TRAINED SERVICE PERSONNEL WHO UNDERSTAND THE HAZARDS INVOLVED.

CAUTION

To prevent damage to the Generator, turn off the instrument before removing any pca.

4D-24. Check Power Supply Voltages

CAUTION

To prevent damage to the Generator, turn off the instrument before disconnecting any power distribution cables.

Check all power supply voltages. Table 4D-10 gives the expected dc and ripple voltages (relative to ground connection on the module plate) at key test points. These characteristics apply for [RCL][9][8]. If one supply voltage is unusually low, this could indicate an abnormal load on that supply due to a fault. To isolate the fault, check the abnormal voltage before and after disconnecting the power cable (one at a time) to the A2 Controller PCA, A4 Synthesizer PCA, A8 Attenuator/RPP Assembly, and the cable from the A2 Controller PCA to the front panel.

The unregulated dc and ripple voltages are those expected with a line voltage of 120V ac at 60 Hz. The dc voltages are expected values as measured with a digital voltmeter with respect to the power supply ground connection on the module plate.

The ripple voltages are expected values as measured with an oscilloscope with respect to the power supply ground connection on the module plate, and are the peak-to-peak values of the 120-Hz waveform.

The characteristics of the unregulated +18V relay supply depend directly on the line voltage and the load (the state of the instrument). For example, at 120V ac the following characteristics apply:

At 50 MHz and 13 dBm, Vdc is typically 19.0V with .25V (peak-to-peak) ripple.

At 50 MHz and RF off, Vdc is typically 20.0V with 0V ripple.

Table 4D-10. Power Supply Characteristics

SUPPLY	UNREGULATED VOLTAGES			REGULATED VOLTAGES		
	@TP	V dc	Ripple(Vpp)	@TP	V dc	Ripple(mVpp)
+37	9	47	0.5	5	36.9 to 37.1	2
+15 Syn	7	22	0.5	11	14.5 to 15.7	0.5
+15 Out				3	" "	"
-15	8	-23	0.2	2	-14.5 to -15.7	"
+5	10	9	1	4	4.75 to 5.25	1
+18	1	23	0.35	None	None	None

4D-25. DIGITAL AND CONTROL TROUBLESHOOTING

If the symptoms indicate a digital or control problem, the following suggestions may help you isolate the fault to a particular functional circuit. Refer to the schematic diagrams in Section 8, and refer to Section 3 for the theory of operation.

Verify that all assemblies are receiving the correct voltages from the power supply.

The most obvious symptom of failure in the A2 Controller PCA is a blank front panel. A properly operating front panel indicates that most of the A2 Controller PCA circuitry is functional. If the front panel is totally blank or unresponsive to any keystrokes, check the microprocessor kernel first. See the paragraphs entitled Microprocessor Kernel in this section.

If the front panel is operating correctly but the RF output is incorrect, determine if the fault is on the A2 Controller PCA side of connector P1. The control to most of the audio and RF analog circuitry passes through P1 via buffers U15 and U16 on the A2 Controller PCA.

4D-26. Control Activity

Control activity can be checked by verifying data activity on the data and address lines of P1. Program the bright digit for 100-Hz resolution in the FREQUENCY display. While pressing the EDIT [↑] key, use an oscilloscope to observe the activity on P1. Pressing one of the EDIT keys sends bursts of frequency and level control data through the buffers.

Although it is difficult to determine if the data (BD0-7) and address (BAB0-2) signals on P1 are valid at any given time, the most common failures seen at this point are totally inactive signals. Between bursts, the data and address signals are in the high impedance state (tri-stated). Be careful not to confuse this high impedance state with total inactivity. Observing these signals on a known good unit may be helpful.

If signals are found to be totally inactive, inspect the buffer control signals on U15 (pin 1), and U16 (pins 1 and 19) of the A2 Controller PCA. If the buffer control signals are active, check the buffer inputs that correspond to the inactive outputs. If the inputs to the buffers are inactive, trace the signals back and determine the fault location. However, if the buffer inputs show activity, remove the A2 Controller PCA and check for short circuits on the associated feed-through filters. If the feed-through filters do not have short circuits, replace the buffer and again check the signals.

If all data and address signals show activity and their timing roughly corresponds to the select signals BSEL0L and BSEL1L, assume for now that the A2 Controller PCA is sending the correct data and continue on.

4D-27. Latch Control

Use the [SPCL] [1] [5] keys to check each available latch on the RF circuit boards to verify that the correct data is reaching them. Passing this test is a good indication that the fault is not in the A2 Controller PCA.

If an IEEE-488 Bus Controller is available, additional bit-level control of the hardware is available by using the monitor commands. (See Section 2.) These commands allow you to directly program the DACs or read and write data to any desired location.

4D-28. Microprocessor Kernel

Connect an oscilloscope probe to the external clock input of U1 pin 2 on the A2 Controller PCA. There should be a symmetrical 10-MHz square wave with adequate TTL logic levels. If the signal deviates from this description, refer to Section 3, to assist you in troubleshooting the clock oscillator circuit.

4D-29. Power Reset

Connect an oscilloscope probe to the RESET input (pin 22) of U1. The signal should generate a low to high transition on power-up and remain high during normal operation. Turning the power off and on generates an active low reset pulse to U1. If a problem with the reset circuit is suspected, refer to Section 3 and troubleshoot the reset circuitry.

4D-30. Microprocessor Inputs

Input pins to U1, CRUIN (pin 13), INT1 (pin 15), HOLD (pin 18), NMI (pin 21), and READY (pin 23), should all be high. If any of these signals are not high, correct the fault before continuing on.

4D-31. IEEE-488 Interrupt

Verify that the IEEE-488 Interface interrupt signal, IEINTL, is in the inactive (high) state. If IEINTL is active, either troubleshoot the interface to the IEEE-488 Interface or temporarily bend out pin 14 of U1 and tie it to +5V through a resistor.

After completing these steps, there should be activity on the address, data, and control lines as the microprocessor executes instructions.

4D-32. Microprocessor Bus

The dynamic nature of microprocessor bus circuitry makes it very difficult to verify the data transmitted at any given time. However, most common bus faults show recognizable symptoms. Look at each of the data (D0 to D7), address (A0 to A15), and bus control (CLKOUT, DBINL, WEL, MEML) signals with an oscilloscope.

Suspect inactive signals or signals that enter invalid logic states. Also compare the driver inputs and outputs of buffered signals. A combination of observation and experience is helpful here. An ohmmeter or a pulse generator may be useful in further investigating suspected signals.

4D-33. Address Decoder

Several levels of address decoding are used to select all the memory and I/O devices. The inputs to the address decoders come from the buses and present challenges similar to troubleshooting the buses. A suggested approach is to first choose a decoding path to a particular device or group of devices. Start at the highest level of decoding, and one at a time verify that each part in the path is good.

4D-34. Display and Controls

If the display shows signs of activity but has missing or bright digits or segments, the problem is most likely in U18 on the A2 Controller PCA or on one of the data latches or drivers on the A1 Display PCA. If the display is blank and the A2 Controller PCA is operational, check the various power supplies and the display blanking circuitry on the A1 Display PCA.

Two special-function service tests are available to test the front panel indicators and keys. [SPCL] [0] [3] keys check the front panel displays by lighting all segments. The service test is aborted by pressing any key on the Generator.

The [SPCL] [0] [4] keys allow all normally open keys to be checked. As each key is pressed, its row and column address is displayed in the center of the FREQUENCY display field. See Table 4D-11 for the address codes for each key. This test is exited by a clear entry.

4D-35. SYNTHESIZER TROUBLESHOOTING

NOTE

All frequencies mentioned are synthesized; hence, they are exact (coherent with the 10-MHz reference), unless noted as approximate.

If the Generator level is inaccurate or an unleveled condition exists, the Output Assembly, (A6 + A7), is probably at fault. If an unlock condition exists, the problem is in the A4 Synthesizer PCA or the A5 VCO PCA. If the output frequency is in error or erratic, there is probably a problem with the A4 Synthesizer PCA. However, if the unlocked condition only occurs when using an external reference, the problem is probably in the subharmonic reference circuitry.

Table 4D-11. Address Codes for the Front Panel Keys

KEY	CODE
[INTAM]	1
[INT FM ØM]	2
[400/1000]	3
[EXTAM]	4
[EXT FM ØM]	5
[EXT ⎍]	6
[FREQ]	9
[AMPL]	10
[AM]	11
[FM|ØM]	12
[SPCL]	13
[STEP]	14
[7]	15
[4]	16
[1]	17
[0]	18
[STO]	19
[8]	20
[5]	21
[2]	22
[.]	23
[RCL]	24
[9]	25
[6]	26
[3]	27
[-]	28
[SEQ]	29
[MHz|V]	30
[kHz|V]	31
[Hz|uV]	32
STEP[v]	33
[dB(m)]	34
[%|rad]	35
[CLR|LCL]	(Exit Test)
STEP[↑]	37
EDIT[←]	38
EDIT[↑]	40
EDIT[↓]	41
EDIT[→]	43
[STATUS]	45
RF[ON/OFF]	46

If the unlocked condition exists with REF INT/EXT set to INT, be sure no signal is applied to the REF IN connector. An external signal applied (while operating on internal reference) can cause the main loop to unlock.

Next, check to see if the frequency is stuck high or low. A good way to do this is to check the dc voltage at TP44. If it is around 1.5V, go to the Reference Circuitry Check in the following paragraphs.

If the voltage is around 22V, the problem is associated with the main PLL; i.e., VCO, UHF binary divider, buffer amplifier, SSB mixer, triple-modulus prescaler, or N-Divider.

Table 4D-12 shows the characteristics of the signals at the various test points on the A4 Synthesizer PCA. The range of the signal and the expected value for a typical instrument state are given. The values in the TYPICAL column are for the UUT programmed to 160.11999 MHz, INT FM on at 1 kHz, and 99.9 kHz deviation.

4D-36. Reference Circuitry Check

There should be a 10-MHz square wave at U55 pin 12. If there is no signal at this point, the problem is in the internal 10-MHz crystal oscillator. The frequency should change as R230 is adjusted. The dc voltage at TP57 should vary from 4 to 6V as R230 is adjusted. If there is an external signal connected, with the switch set to EXT, there should be a TTL signal at U67 pin 11. The same signal should appear at U68 pin 3. If either of the enhanced stability options is present, with the switch set to INT, there should also be a 10-MHz TTL signal at U68 pin 3. If the loop is locked, there should be a stable DC voltage at the output of the loop amp, U69 pin 6.

Table 4D-13 shows the relationship between various reference frequency configurations and the control of the reference circuitry.

4D-37. Main Phase-Lock Loop

If the voltage at TP44 is around 22V, connect a variable power supply to TP41. This allows the frequency of the VCO to be controlled directly. Use an RF Spectrum Analyzer or Counter to monitor the output of the Generator.

Program the UUT to 640 MHz. If the power supply can be adjusted to obtain an output frequency of approximately 640 MHz, the VCO is probably okay. If this is the case, proceed to the next paragraph. If the power supply cannot be adjusted to obtain approximately 640-MHz output frequency, troubleshoot the VCO or the circuitry between TP41 and TP44.

Program the UUT to 320 MHz. If you can adjust the power supply to obtain approximately 320-MHz output from the VCO, the VCO and binary divider are probably okay. If this is the case, proceed to paragraph 4D-41. If you cannot change the frequency, the problem is either the VCO or the UHF binary divider, U1.

Check the signal at TP1. It should be the same as the output frequency. The level after the buffer amplifier Q3, Q4 at TP3 (use RF test cable), should be approximately +3 dBm. The signal at TP17 should be a single-sideband signal with the lower sideband component (the desired signal) at about -20 dBm. If the only signal is the carrier frequency (same frequency as TP3), check the quadrature generator and the subsynthesizer circuitry. The signal out of the triple-modulus prescalar should be approximately 16 MHz (with the output frequency set to approximately 320 MHz). The output of the N-Divider, TP14, should be approximately 1 MHz.

Table 4D-12. A4 Synthesizer PCA Test Points

TEST POINT	SIGNAL TYPE	RANGE	TYPICAL	FUNCTION
TP1	RF	245 to 525 MHz	480.059995 MHz; -7 dBm	All frequency digits
TP2	GROUND			
TP3	RF	245 to 525 MHz	480.059995 MHz; +4 dBm	All frequency digits
TP7	GROUND			
TP11	TTL	20 to 39.995 kHz	39.995 kHz	10-K, 1-K, 100-, and 10-Hz Digits
TP12	TTL	1 to 1.99975 MHz	1.99975 MHz	10-K, 1-K, 100-, and 10-Hz Digits
TP13	GROUND			
TP14	TTL	1 MHz (AL)	1 MHz	1-MHz and lower digits
TP15	TTL	0.02 to 1 MHz	20 kHz	
TP16	TTL	12 to 26 MHz	24 MHz	All frequency digits
TP17	RF	245 to 525 MHz	480.02 MHz; -17 dBm	All frequency digits
TP22	AUDIO	0 to 0.7V rms	0.68V rms	FM Deviation
TP23	GROUND			
TP24	TTL	20 MHz, 12.5 ns (AH)	20 MHz	
TP25	TTL	20 MHz, 12.5 ns (AH)	20 MHz	
TP26	GROUND			
TP27	TTL	10 to 19.9975 MHz	19.9975 MHz	10-K, 1-K, 100- and 10-Hz Digits
TP31	GROUND			
TP32	AUDIO	0 to 0.8V rms	0.18V rms	FM Deviation, and Frequency
TP33	AUDIO	0 to 0.8V rms	0.18V rms	FM Deviation, and Frequency
TP34	DC	30 +/- 0.5V	30V dc	
TP35	TTL	1 MHz	1 MHz	1-MHz Reference
TP36	GROUND			
TP37	DC	-1 to -6v	-2.7V dc	Frequency
TP38	TTL	1 MHz 200 ns (AH)	1 MHz 200 ns	
TP39	TTL	1 MHz 10 ns (AL)	1 MHz 10 ns	
TP40	DC	2 to 22V	17.7V dc	Frequency
TP41	DC	2 to 22V	17.3V dc	Frequency
TP42	GROUND			
TP43	DC	2 to 22V	17.3V dc	Frequency
TP44	DC	2 to 22V	16.2V dc	Frequency
TP45	GROUND			
TP46	TTL	low = unlocked high = locked	TTL high	
TP49	TTL	10 MHz 20 ns (AL)	10 MHz, 20 nS	
TP50	TTL	10 MHz	10 MHz	
TP51	GROUND			
TP52	TTL	10 MHz 10 ns (AL)	10 MHz, 10 nS	
TP53	DC	7.5 +/- 1V 16 +/- 2v	 16V dc	Above 245 MHz Below 245 MHz
TP54	TTL	10 MHz	10 MHz	
TP55	RF	800 MHz	800 MHz; -10 dBm	Below 245 MHz
TP56	INPUT			To test low-pass filters

NOTE: AH = active high
AL = active low

Table 4D-13. Frequency Reference Control

OPTION INSTALLED	INT/EXT REF	BIT				
HIGH-STABILITY/ MEDIUM-STABILITY	INT/EXT	RMUX1H	RMUX0H	RINH	XOENL	SHENL
NO	INT	0	0	0	0	1
	EXT	0	0	0	0	0
YES	INT	0	1	0	1	1
	EXT	0	0	0	0	0
1 = TTL High 0 = TTL Low						

As the UUT frequency is programmed, the frequency at TP14 should change since the divide ratio is being changed. If the frequency is not 1 MHz and/or it doesn't change, the problem is probably with the N-Divider gate array U17 or the interface to the microprocessor.

If both the reference (at TP35) and the N-Divider signals at the phase detector are 1 MHz, the loop should lock when the operator removes the variable power supply. If the loop does not lock, check the KNV voltage at TP37. With the Generator programmed to 320 MHz, TP37 should be approximately -2 to -3V. If this voltage is not correct, check the DAC U27, latches U26 and U30, and op-amp U28. This voltage should also change as the operator changes the Generator frequency.

If the KN DAC appears to function, the problem is with the phase detector. Reconnect the variable power supply as before, and adjust the voltage for an approximate 1-MHz signal at U44 pin 3. With this frequency slightly above 1 MHz, TP38 should be high and TP39 should be low.

With this frequency slightly below 1 MHz, TP38 should be low and TP39 should be high. The only remaining circuitry is the loop amp U48 and the current source, U46, Q18, and Q19.

If the loop is locked, but the 1-, 10-, or 100-MHz digits cannot be programmed, the problem is either the N-divider or the interface to the microprocessor. If the 100- or 10-kHz digit is inoperative or if the frequency jumps as the 1-MHz digit is programmed, the problem is likely the triple-modulus prescalar. If the lower order (1-kHz, 100-Hz, 10-Hz) digits cannot be programmed, the problem is the subsynthesizer or single-sideband mixer.

4D-38. Subsynthesizer and HET (800 MHz), 40-MHz Loop

The frequency at TP24 and TP25 should be 20 MHz. The frequency at U64 pins 14 and 15 should be 40 MHz. If the 40-MHz signal is present, but not the 20-MHz, the problem is most likely with Q4, Q5, U35, or U34. If the 40-MHz signal is in error, the problem is in the 40-MHz loop.

Check the frequency at the 40-MHz VCO, U64 pin 3. It should be 40 MHz. If it is not, lift the op-amp end of R169, and connect it to a variable power supply set to approximately 6V. The signal at U64 pin 3 should be approximately a 40-MHz ECL (emitter-coupled logic) level (approximately 3.2 to 4.2V) signal. By varying the supply voltage, the frequency should change. A similar signal should be present at U64 pin 2. Check to see if U64 pin 11 is ECL low (approximately 3.2V).

The output of TTL buffer U65 pin 8 should be approximately 40 MHz. The output of the divide-by-4 U66 should be approximately 10 MHz. Once again, if the frequency is greater than 10 MHz, pulses should exist at TP52, and the output of op-amp U60 pin 6 should be low. If the frequency is below 10 MHz, pulses should exist at TP49, and the op-amp should be high (approximately 24V). The loop should lock when the operator reconnects R169.

If the TP checks are all right and the 800-MHz oscillator is not locked when in the HET band, the problem is either with the 800-MHz VCO, the divide-by-4 (U61), the divide-by-5 (U62, U63), or the logic that controls the switched +5V.

Program the UUT to 320 MHz. The frequency at TP27 (the output of the subsynthesizer gate array U33) should be 10 MHz if the input signals are correct. The frequency at TP12 should be 1 MHz, and TP11 should be 20 kHz. There should be a 20-kHz sine wave at the hot end of R33. The signals at the output of the active quadrature generator, U10 pin 8 and U10 pin 14 should be approximately 300 mV p-p sine waves that are 90 degrees apart in phase. Use a dual-trace oscilloscope for verification.

The frequency at TP27 should change 500 kHz for a 1-kHz change in the programmed frequency, and 50 kHz for a 100-Hz change, etc.

4D-39. FM Circuitry

Program the UUT to 500 MHz, INT FM, 99.9-kHz deviation, and 1-kHz modulation frequency. There should be a 2V p-p 1-kHz sine wave at TP22. Program 50-kHz deviation, and the level should drop to 1V p-p. Reprogram the deviation to 99.9-kHz. The level of the output of the KV DAC, U28 pin 7 will be approximately .9V p-p depending on the FM correction value (KV) in the EPROM.

The signals at TP32 and TP33 should be approximately the same, depending on how R87 is set. The output of the audio integrator should be about 1V p-p. To check the FM range, program the UUT to 9.99-kHz deviation. The ac voltage at TP32 should drop to 10% of the 99.9-kHz value. Program 999 Hz, and the voltage should drop to 1% of the 99.9-kHz value.

The INT/EXT FM selection is done on the A6 Output Control PCA. The controls are listed in Table 4D-21.

Tables 4D-14, 4D-15, and 4D-16 provide FM range and FM DAC (10 bits) control information.

Table 4D-14a. FM Deviation Limits w/o Low-Rate FM Option

RF OUTPUT FREQUENCY BAND (MHz)	MAXIMUM PROGRAMMABLE FM DEVIATION W/O LOW-RATE FM OPTION	MAXIMUM PROGRAMMABLE ØM DEVIATION W/O LOW-RATE FM OPTION
.100 - 244.99999	204 kHz	20.4 rad
245 - 511.99999	102 kHz	10.2 rad
512 - 1049.99999	204 kHz	20.4 rad
1050 - 2100.00000	400 kHz	40.0 rad

Table 4D-14b. FM Deviation Limits With Low-Rate FM Option

RF OUTPUT FREQUENCY BAND (MHz)	MAXIMUM PROGRAMMABLE FM DEVIATION WITH LOW-RATE FM OPTION	MAXIMUM PROGRAMMABLE ØM DEVIATION WITH LOW-RATE FM OPTION
.100 - 244.99999	20.4 kHz	2.04 rad
245 - 511.99999	10.2 kHz	1.02 rad
512 - 1049.99999	20.4 kHz	2.04 rad
1050 - 2100.00000	40.0 kHz	4.00 rad

Table 4D-15a. FM Deviation Control w/o Low-Rate FM Option

FM DEVIATION (Hz)	FM 0 - 11 (bits) W/O LOW-RATE FM OPTION	FMRN (bits)	PMODL (bit)
0 - 999	(FM Deviation * 4)/fb	1	1
1000 - 9990	(FM Deviation * .4)/fb	2	1
10000 - 99990	(FM Deviation * .04)/fb	4	1
100000 - 400000	(FM Deviation * .04)/fb	4	1

Table 4D-15b. FM Deviation Control With Low-Rate FM Option

FM DEVIATION (Hz)	FM 0 - 11 (bits) WITH LOW-RATE FM OPTION	FMRN (bits)	PMODL (bit)
0 - 99.9	(FM Deviation * 40)/fb	1	1
100 - 999	(FM Deviation * 4)/fb	2	1
1000 - 9990	(FM Deviation * .4)/fb	4	1
10000 - 40000	(FM Deviation * .4)/fb	4	1
fb = 2 HET band fb = 1 Synthesizer band fb = 2 VCO band fb = 4 Double band			

Table 4D-16a. Phase Modulation Control w/o Low-Rate FM Option

PHASE MODULATION (rad)	FM 0 - 11 (bits) W/O LOW-RATE FM OPTION	FMRN (bits)	PMODL (bit)
0 - .099	(ØM Deviation * 40000)/fb	1	0
.100 - .999	(ØM Deviation * 4000)/fb	2	0
1.00 - 9.99	(ØM Deviation * 400)/fb	4	0
10.0 - 40.0	(ØM Deviation * 400)/fb	4	0

Table 4D-16b. Phase Modulation Control With Low-Rate FM Option

PHASE MODULATION (rad)	FM 0 - 11 (bits) WITH LOW-RATE FM OPTION	FMRN (bits)	PMODL (bit)
0 - .009	(ØM Deviation * 400000)/fb	1	0
.010 - .099	(ØM Deviation * 40000)/fb	2	0
.100 - .999	(ØM Deviation * 4000)/fb	4	0
1.00 - 4.00	(ØM Deviation * 4000)/fb	4	0
fb = 2 HET band fb = 1 Synthesizer band fb = 2 VCO band fb = 4 Double band			

4D-40. LEVEL TROUBLESHOOTING

If the Generator level is inaccurate or an unleveled condition exists, the Output Assembly, (A6 + A7), or the A8 Attenuator/RPP Assembly is probably at fault. If an unleveled condition exists, the problem is in the circuitry ahead of the detector. Go to the paragraph titled Unleveled Condition in this section.

If there is no unleveled condition, the problem is likely in the circuitry following the ALC loop, which includes the buffer amp Q4, the heterodyne circuit, the pulse modulator, the output amplifier Q9, and the A8 Attenuator/RPP Assembly. If the level problem only exists below 245 MHz, troubleshoot the heterodyne circuitry. If the level problem only exists above 1050 MHz, troubleshoot the X2 circuitry. If the problem is not frequency dependent and if the level is accurate above +7 dBm but inaccurate below +7 dBm, then the A8 Attenuator/RPP Assembly is at fault.

4D-41. Output Assembly Test Point Signal Information

Table 4D-17 presents the nominal characteristics of the signals at the various test points on the Output Assembly (A6 + A7). Not only the range of the signal, but also the expected value for the instrument preset state [RCL] [9] [8], are given.

4D-42. ATTENUATOR LEVEL CONTROL

Table 4D-18 lists the A8 Attenuator/RPP Assembly sections that are inserted in the RF output path for the various level ranges of the Generator. This information is useful in isolating a faulty section. The sections are labeled by the control line mnemonics at latch U27 on the A2 Controller PCA. Note that the section is inserted in the RF output path when there is no power applied to the relay.

If the level problem exists above +7 dBm, the through path (0 dB attenuation) of the A8 Attenuator/RPP Assembly may be faulty.

4D-43. Attenuator Check

Attenuator problems are most likely to be relay contact problems.

To isolate the faulty attenuator section, connect a power meter to the RF OUTPUT connector, and check the nominal levels per Table 4D-19 at both 0.1-and 2100-MHz frequencies.

The through-path operation of the A8 Attenuator/RPP Assembly can be roughly checked by removing the instrument and module bottom covers. Program the frequency to 1 MHz and the level to +13 dBm. Measure (with a high-impedance probe and an RF voltmeter or an oscilloscope) the level at P102 of the A7 Output PCA with a power meter connected to the RF OUTPUT connector. If the voltmeter measures a nominal 1V rms, but the power meter does not read +13 dBm, then the signal is not getting through the attenuator module, and the A8A2 Attenuator/RPP PCA is at fault.

If the level problem is subtle rather than catastrophic, a more accurate check is required to determine if the fault is the A8 Attenuator/RPP or the Output Assembly. Such a check is made by removing the A8 Attenuator/RPP Assembly, attaching an adapter (6062A-4234, P/N 808477) to the interconnect point, and making power meter measurements of the Output Assembly (A6 + A7), output. Use [SPCL] [8] [2] to disable the attenuator correction factors. The level at this point should be flat over 0.1 to 2100 MHz, within typically 0.2 dB and should agree with the programmed level within 2 dB.

If the problem has been isolated to the Output Assembly and there are no self-test errors or flashing UNCAL condition, the problem is probably in the circuits following the ALC loop. If the problem is only in the het band (frequency <245 MHz), check the het band switch and controls, the het band circuits (mixer, filter, and amplifier), and the local oscillator signal (800 MHz, nominal -10 dBm at TP9). If the problem is at all frequencies, see paragraph 4D-40.

4D-44. Unleveled Condition

If there are self-test failures and/or unleveled indications, the problem is probably in, or prior to, the ALC loop. If the problem is isolated to a specific frequency band (or bands) and other bands work properly, check signal inputs and controls to the various filters and circuits that precede the modulator. See Table 4D-8 for band definition. If all frequency bands are affected, the leveling ALC loop or associated controls and inputs are probably at fault.

Table 4D-17. A6 Output Control PCA Test Points

TEST POINT	SIGNAL TYPE	RANGE	TYPICAL FOR RCL 98	SIGNAL DESCRIPTION
TP1	dc	+/- 15 mV	0 mV	AM dac offset
TP2	dc+audio	+14V to 0V	2.6V	Detector Linearizer output
TP3	n.a.	This test point is an input for factory test of ALC loop.		
TP4	dc+audio	0 to .70V rms	0V rms	FM modulation to synthesizer
TP5	dc+audio	400 or 1000 Hz .71V rms	400 Hz .71V rms	Modulation Oscillator output
TP6	dc+audio	0 to 2V dc	.45V dc	Detector diode voltage.
TP7	dc+audio	0.04 to 3.0V dc nominal	1.0V dc	Leveling loop control voltage.
TP8	dc+audio	-14 to +14V dc nominal	2.0V dc	Modulator control voltage.
TP9	RF	800 MHz. -8 dBm	no signal	Het mixer LO signal

Table 4D-18. Attenuator Level Control

AMPLITUDE RANGE IN DBM				ATTENUATOR SECTIONS INSERTED INDICATED BY X						
AM Off		AM On		A6DBL	A12DBL	A241L	A242L	A243L	A244L	A245L
7.0	19.0	1.0	19.0							
1.0	6.9	-5.0	0.9	X						
-5.0	0.9	-11.0	-5.1		X					
-11.0	-5.1	-17.0	-11.1	X	X					
-17.0	-11.1	-23.1	-17.1			X				
-23.1	-17.1	-29.1	-23.2	X		X				
-29.1	-23.2	-35.1	-29.2		X	X				
-35.1	-29.2	-41.1	-35.2	X	X	X				
-41.1	-35.2	-47.1	-41.2			X	X			
-47.1	-41.2	-53.2	-47.2	X		X	X			
-53.2	-47.2	-59.2	-53.3		X	X	X			
-59.2	-53.3	-65.2	-59.3	X	X	X	X			
-65.2	-59.3	-71.2	-65.3			X	X	X		
-71.2	-65.3	-77.2	-71.3	X		X	X	X		
-77.2	-71.3	-83.3	-77.3		X	X	X	X		
-83.3	-77.3	-89.3	-83.4	X	X	X	X	X		
-89.3	-83.4	-95.3	-89.4			X	X	X	X	
-95.3	-89.4	-101.3	-95.4	X		X	X	X	X	
-101.3	-95.4	-107.4	-101.4		X	X	X	X	X	
-107.4	-101.4	-113.4	-107.5	X	X	X	X	X	X	
-113.4	-107.5	-119.4	-113.5			X	X	X	X	X
-119.4	-113.5	-125.4	-119.5	X		X	X	X	X	X
-125.4	-119.5	-131.4	-125.5		X	X	X	X	X	X
-147.0	-125.5	-147.0	-131.5	X	X	X	X	X	X	X

Table 4D-19. Attenuator Levels

ATTENUATOR	PROG LEVEL	SPECIAL FUNCTION	OBSERVED LEVEL (NOMINAL)
6dB	+6dBm	--	+6dBm
12dB	0dBm	--	0dBm
24dB #1	-12dBm	--	-12dBm
24dB #2	-12dBm	83	-12dBm
24dB #3	-12dBm	84	-12dBm
24dB #4	-12dBm	85	-12dBm
24dB #5	-12dBm	86	-12dBm

The unlevel indication can result if the RF signal at the input to the A7 Output PCA is excessively low. This signal can be measured at connector J1 on the A6 Output Control PCA with a power meter, and typically varies from -4 to +4 dBm, depending on frequency. A power reading well outside this range indicates a problem in the RF path on the A6 Output Control PCA.

TP8 (modulator control voltage) is also a good place to monitor. With the instrument programmed to +16 dBm, the voltage on TP8 should be between +2 and +9V dc (+4 to +8V dc typical). Another place to monitor is TP7 (ALC control voltage). With the instrument programmed for [RCL] [9] [8], the voltage here should be approximately 1.0V dc. With the RF output switched off, the voltage at TP7 should be 0V dc.

When the problem is isolated to a specific area, use the schematic, theory of operation, test point chart, and normal troubleshooting techniques to isolate the fault.

4D-45. AM TROUBLESHOOTING

The following paragraphs provide information that help the operator trace an AM problem to a specific circuit on the Output Assembly (A6 + A7).

4D-46. Internal/External AM

If an AM problem exists, determine if the problem occurs with internal AM, external AM or both. This check is done by connecting a 1V peak (2V p-p), 1-kHz signal source to the external MOD INPUT of the UUT and measuring AM depth with a Modulation Analyzer. Program the UUT to external AM and then to internal AM at 1-kHz internal modulation rate. The measured AM should agree with the programmed depth within a few percent.

Tables 4D-20 and 4D-21 provide control information for modulation and modulation frequency selection.

If the internal AM does not agree, but external AM is okay, the modulation oscillator is likely at fault. If external AM is bad, but internal AM is okay, the problem is somewhere between the external MOD INPUT and the AM DAC.

If both the external and internal AM fail, the problem is probably being caused by either the modulation signal-processing circuit or the leveling loop. To determine which circuit is faulty, perform the ALC Loop Control Voltage procedure.

4D-47. ALC Loop Control Voltage

Use the following steps to determine which circuit is faulty:

1. Connect a 1V peak (2V p-p), 1-kHz signal source to the external MOD INPUT.
2. Program the UUT for 350 MHz, 7 dBm, 71% AM depth, and EXT AM ON.
3. Measure the ac and the dc voltage at TP7. The rms voltage should be nominally 50% of the dc voltage.
4. Program the UUT for 35% AM depth. The rms voltage should be nominally 25% of the dc voltage.

If the UUT fails this test, the problem lies somewhere between the EXT MOD input and TP7 (ALC loop-control voltage). To further localize the problem, the same test can be done by measuring the ac voltage at U21 pin 1 (input to level DAC). If the measured ac voltage does not change as programmed AM depth is changed, either the AM DAC or its control is at fault. The AM DAC U19, is an 8-bit DAC and is set to twice the programmed AM depth, e.g., 180 for 90% AM.

If the UUT passes this test, then the ALC loop control voltage is correct, and the problem is in the ALC loop. A likely cause of excessive AM depth error and harmonic distortion is detector non-linearity. The following test checks detector linearity.

Table 4D-20. Modulation ON/OFF Control

DC AM	EXT AM	INT AM	DCAML	EXTAML	INTAML
Off	Off	Off	1	1	1
Off	Off	On	1	1	0
Off	On	Off	1	0	1
Off	On	On	1	0	0
On	Off	Off	1	1	1
On	Off	On	1	1	0
On	On	Off	0	1	1
On	On	On	0	1	0

EXT FM ØM	INT FM ØM	EXTFML	INTFML	FMENH
Off	Off	1	1	0
Off	On	1	0	1
On	Off	0	1	1
On	On	0	0	1

EXT PULSE	INT PULSE	EXTPUL	INTPUL
Off	Off	1	1
Off	On	1	0
On	Off	0	1
On	On	0	0

1 = TTL High
0 = TTL Low

Table 4D-21. Modulation Frequency Control

FREQUENCY	MF400L
400 Hz	0
1 kHz	1

1 = TTL High
0 = TTL Low

4D-48. Detector Linearity

Use the following steps to check the detector linearity:

1. Install the plate covers and let the UUT warm up at room temperature for one hour.

2. Program the UUT for 350 MHz, +17 dBm, modulation OFF.

3. Program [SPCL] [9] [1] to enable amplitude fixed range.

4. Measure power with a power meter at the UUT RF OUTPUT. Note the reading.

5. Program the UUT for 2 dBm using the EDIT keys. The measured power should be 15 dB ±0.2 dB below the reading noted in step 4. Be certain to use EDIT keys to change amplitude.

6. Program the UUT for -13 dBm using the EDIT keys. The measured power should be 30 dB ±0.4 dB below the noted reading. Be certain to use EDIT keys to change amplitude.

7. Program the UUT for [SPCL] [0] [0].

If the UUT fails this test, the problem is likely to be in the detector or detector-linearizer circuit. If the UUT passes the test, the problem is confined to the other ALC loop elements, and is likely to be a bandwidth problem associated with the loop amplifier or the modulator or modulator-linearizer circuit.

4D-49. RPP Control

When servicing the A8A1 Relay Driver/RPP PCA, use the three dual-pin test points to aid in the troubleshooting of the pca. The RPP can be tripped (to the protect position) by momentarily shorting the two points of TP1. The RPP can be reset by momentarily shorting TP2. Shorting TP3 reduces the level required to trip the Attenuator/RPP, so it trips on the Generator's output. This provides a convenient way to verify the operation of the entire trip circuitry, although at a reduced trip level.

To check the trip function with TP3 shorted, it is best to program the Generator to an output level of +10 dBm and terminate the instrument output in 50 ohms. Then program it for fixed amplitude range ([SPCL] [9] [1]). This allows the level to be varied from a low value up to the maximum value without any transients that might otherwise trip the RPP. Then, starting at a low level, such as -10 dBm (with the RPP reset), increase (EDIT) the UUT level in 1-dB steps until the RPP trips. RPP trip normally occurs between +10 and +15 dBm.

Section 4E
Software Compensation Procedures

4E-1. INTRODUCTION

The A5 VCO PCA, Output Assembly (A6 + A7), and A8 Attenuator/RPP Assembly are software compensated with data stored in the compensation memory. If any components on these assemblies that affect the software compensation are replaced, the data in the memory needs to be updated. This section provides the necessary information and defines the procedures used to update the compensation data.

The local compensation procedures can be performed with a minimal amount of test equipment. If an IEEE-488 controller is available, remote commands can be used to automate the compensation procedures. Both the local and remote procedures are easy to use, since the software in the Generator does most of the work.

4E-2. SOFTWARE COMPENSATION DESCRIPTION

The compensation memory is protected from accidental damage by the compensation switch #6 on the A2 Controller PCA. The switch must be set on to perform any of the compensation procedures described in this section. The COMP annunciator on the front panel will be lit to indicate that the switch is set on. The switch must be set off at the end of the procedure.

These compensation procedures are to be used after certain repairs have been made to the hardware. Initial adjustments to the hardware are necessary to set the hardware to a nominal state. Final calibration adjustments at the end of the procedure are also needed to fully calibrate the instrument.

The compensation procedures are used if a repair is made involving a component that affects the software compensation. Those components are identified in the List of Replaceable Parts section. Table 4E-1 lists the commands that are used to initiate the compensation procedures. The FM Compensation Procedure is used if a repair is made on the A5 VCO PCA.

There are three level-compensation procedures: output, output with default attenuator data, and attenuator.

Output compensation is normally performed if a repair is made on either the A6 Output Control PCA or the A7 Output PCA. Attenuator compensation is normally done if a repair is made on the A8 Attenuator/RPP Assembly. Refer to the paragraphs on Level Compensation Notes (further on in this section) for instructions on selecting the correct level compensation procedure.

Each compensation procedure involves adjusting a DAC (digital-to-analog converter) to match the target value. The RF output is measured with an external power meter or modulation analyzer. This sequence is repeated until all data has been measured.

Table 4E-1. Software Compensation Commands

DESCRIPTION	LOCAL SPECIAL FUNCTION	REMOTE IEEE-488 COMMAND
FM Compensation Procedure	95	cmfm
Output Compensation Procedure	96	cmot
Attenuator Compensation Procedure	97	cmat
Output Compensation Procedure with Default Attenuator Data	98	cmod

In the local procedures, the EDIT keys are used to increase and decrease the DAC adjustment. If the measured value is a long way from the target value, the [RCL] key may be used to program the same DAC adjustment as previously programmed. This will often be close to the desired value.

The STEP [↑]/[↓] keys are used to step to the next or previous measurement step. Previous measurements can also be reviewed in this manner. It is a good idea to review the data before storing it in memory.

The [STO] key is used to store the measured data in the compensation memory. The [STO] key must be pressed twice to store the data. All measurement steps in the procedure must be measured before the data can be stored.

At any time in the procedure, the [CLR | LCL] key can be used to abort the procedure. The [CLR | LCL] button must be pressed twice to abort the procedure. All data measured so far in the procedure will be discarded.

In the remote procedures, an IEEE-488 controller programs external instruments to make measurements. These measurements are sent to the Generator, which adjusts its internal settings accordingly. The Generator indicates when it is ready for a new measurement by responding to the interrogate compensation frequency command "IC FR". The target value can also be interrogated by the controller at each measurement step. The frequency and target value can be used to program the measurement equipment for more accurate and/or faster operation. A special frequency code is returned when all measurement steps have been measured.

The controller must send the store command "CM SV" at the end of the procedure to save the new data. The procedure can be aborted at any time with the exit command "CM EX", or the clear command "CL".

Table 4E-2 lists the errors that are detected during a compensation procedure.

4E-3. Compensation Accuracy Notes

Proper use of the software compensation procedures will restore the operating specifications of the Generator. However, failure to follow the guidelines in this section may result in less than optimal or out-of-spec operation.

First, the equipment used in these procedures must be of sufficient accuracy. Refer to Table 4A-1 for the test equipment requirements.

Second, the test equipment must be calibrated according to its manufacturer's instructions.

Table 4E-2. Software Compensation Rejected Entry Codes

ERROR CODE	DESCRIPTION
000 000 200	Compensation data from IEEE-488 out of range or EDIT [^] / [v] operation past the top / bottom of the DAC.
000 000 400	Internal compensation data transfer error. Check hardware with self test.
000 002 000	Compensation switch not on or low-rate FM option (-651) not disabled.
000 010 000	Attempt to store compensation data without measuring data at all steps.
000 020 000	Invalid IEEE-488 compensation command or invalid [RCL] entry.
000 400 000	Not enough level compensation available or FM data range error.
020 000 000	IEEE-488 command syntax error.
040 000 000	IEEE-488 input value out of range.
100 000 000	MEC compensation PROM error. PROM ID not correct or checksum error.
400 000 000	Invalid frequency in level compensation data.

Third, during both the Output and Attenuator Compensation Procedures, CAL factors for the Power Meter must be set for each new frequency. For the Output Compensation Procedures only, the Power Meter must be zeroed once at the beginning. For the Attenuator Compensation Procedure, it is sufficient to zero the Power Meter once at the beginning and then at the first 24-dB attenuator (target level of -14 dBm) at each frequency.

Fourth, level measurements (output and attenuator), must be made with the High-Level Power Sensor at the RF OUTPUT connector. Do not use a length of cable between the RF OUTPUT connector and the Power Sensor.

Finally, for the local procedures, the FM and Attenuator Compensation Procedures may take many minutes. The operator must exercise care to insure that the measured value matches the target value for each measurement step.

4E-4. Level Compensation Notes

All level compensation procedures (output, attenuator, and output with default) involve making measurements at the front or rear panel RF OUTPUT connector. The level being measured includes both the output and attenuator circuits. This means that errors in one circuit may be compensated for when the operator is performing the compensation procedure for the other circuit. The resultant mixing of the corrections is usually not a problem since the level seen at the RF output connector includes the sum of both the output and attenuator corrections. However, in some situations, additional steps may be necessary.

If the compensation data of the output and attenuator circuits are both generated by the user, the level compensation data may be mixed. At the Fluke factory or with module exchange (MEC) assemblies, each circuit is compensated for separately so the level compensation data is never mixed.

To determine the data origin of the compensation memory, press [SPCL] [7] [5] from the front panel, or send "IZ" from the IEEE-488 interface. The number displayed (three digits) in the MODULATION field or the first number sent to the IEEE-488 interface indicates the data origin. The first digit is for FM, the second for Output, and the third for Attenuator data type. Table 4E-3 lists the data origin codes.

Even if the level compensation data has been mixed, the amount of mixing may be small and the normal compensation procedures will work. If the amount of mixing is large, the maximum allocation for compensation may be exceeded when trying to perform the procedure.

The maximum compensation allowed for the attenuator section is 8.0 dB. The maximum range of the compensation values allowed for the output section is 4.0 dB without the rear output option (Option -830) and 4.8 dB when the option is installed. Table 4E-4 summarizes the maximum allocation for each of the level circuits. The composite correction limits (output + attenuator) are 12.0 dB without the rear output option and 12.8 dB when the option is installed.

The output compensation limit checks are performed on the het band measurements (freq <245 MHz) and the non-het band measurements separately. The limit check is partioned because the highest level in the het band is adjusted to be 3 dB lower than the highest level outside of the het band.

For example, if the rear output option (Option -830) is not installed, all measurements at frequencies below 245 MHz must be within a 4.0-dB range and all measurements at frequencies above 245 MHz must also be within a 4.0-dB range, but there may be a 3-dB offset between the two ranges. As a result, the het band may require more than 4 dB of total compensation. This is not a problem since the attenuators do not require much correction at frequencies below 245 MHz so the sum of the output and attenuator corrections will not exceed the 12-dB composite correction limit.

There is no way to tell before running the compensation procedure if the maximum allocation will be exceeded. If the store operation at the end of the procedure is rejected with error code 000 400 000, the maximum allocation has been exceeded. If the circuits are operating correctly, there are two possible causes for this error.

First, if the het circuitry on the A7 Output PCA has been repaired, and the HET Level Adjustment (see Section 4C) has been performed, a more exact adjustment may need to be performed. This is done from the front panel as described in the Het Compensation Adjustment procedure found later in this section. From the IEEE-488 interface, the adjustment data is available over the bus as described in the Remote Level Compensation Procedure.

Second, too much mixing of compensation data has occurred. The Output Compensation Procedure with Default Attenuator Data ([SPCL][9][8] or "CMOD") must be used to reduce the mixing. In this procedure, the output is compensated using the last Fluke factory or MEC data for the attenuator circuit. Following this procedure, the Attenuator Compensation Procedure must be performed.

Table 4E-3. Compensation Memory Data Origin

CODE	ORIGIN
0	= Factory generated data
1	= MEC data
2	= User generated data
3	= Data is corrupt

Table 4E-4. Maximum Level Compensation Allocation

CIRCUIT	REAR OUTPUT OPTION	MAXIMUM COMPENSATION
Attenuator	N/A	8.0 dB
Output	NO	4.0 dB
Output	YES	4.8 dB

This mixing of level compensation data also means that when any of the Output or Attenuator PCAs are replaced with the Module Exchange Program, the compensation procedure for the other circuit may need to be performed. If the data of both the Output and Attenuator are generated by the user prior to exchanging the module, the appropriate compensation procedure must be performed. In all other cases, no compensation procedures are needed.

4E-5. LOCAL AND REMOTE COMPENSATION ADJUSTMENTS

The following paragraphs describe the manual adjustments required to perform the software compensation procedures. These adjustments are required for both local and remote procedures. The operator should also read the appropriate compensation procedure before making any adjustments to the Generator. See the paragraphs on Local Compensation Procedures and Remote Compensation Procedures.

4E-6. Initial FM Compensation Adjustments

TEST EQUIPMENT:

Modulation Analyzer
Low-Frequency Synthesized Signal Generator (LFSSG)
DVM

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this procedure.

This procedure is required prior to performing the FM Compensation Procedures (both local and remote).

CAUTION

Do not turn the power off while the compensation switch is set on. The compensation switch protects the compensation memory from accidental damage during power on and power off.

PROCEDURE:

1. Access the top module cover by removing the top instrument cover.
2. Remove the controller switch access cover.
3. If the Option -651 is installed, turn the power off and electrically disconnect the option as follows:
    a. Set controller switch #3 off.
    b. Remove the Option -651 access cover.
    c. Set the switches to the NORMAL positions as shown in Table 651-1.
    d. Turn the power on.
4. Perform the VCO Upper-Clamp Adjustment as described in in Section 4C.
5. Set compensation switch #6 on. Verify that the COMP annunciator is lit on the front panel.
6. Connect the UUT RF OUTPUT to the Modulation Analyzer.

7. Connect the output of the LFSSG to the UUT MOD INPUT connector and the DVM. (Use a BNC T connector.)

8. Press [EXT FM] to turn external FM on.

9. Set the LFSSG to 10 kHz and adjust its level until the DVM reads 707.1 mV rms.

4E-7. Final FM Compensation Adjustments

REMARKS:

This procedure is required following both of the FM Compensation Procedures (local and remote).

PROCEDURE:

1. Set compensation switch #6 off.

2. Verify that the COMP annunciator is not lit on the front panel.

3. Perform the FM Adjustments, R82, R90, and R87 as described in Section 4C.

4. If the Low-Rate FM option was removed in during the Initial FM Adjustments, turn the power off and electrically connect the option as follows:

   a. Set controller switch #3 on.

   b. Set the Low-Rate FM switches to the LOW-RATE FM positions as shown in Table 651-1.

   c. Replace the Low-Rate FM cover.

4. Replace the controller switch access cover.

5. Replace the top instrument cover.

4E-8. Initial Output Compensation Adjustments

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this compensation procedure.

This procedure is required prior to performing either local or remote output compensation procedures.

CAUTION

Do not turn the power off while the compensation switch is set on. The compensation switch protects the compensation memory from accidental damage during power on and power off.

PROCEDURE:

1. Access the top module cover by removing the top instrument cover.
2. Remove the controller switch access cover.
3. Set compensation switch #6 on.
4. Verify that the COMP annunciator is lit on the front panel.
5. Perform the Output Assembly Adjustments as described in Section 4C.
6. Connect the UUT RF OUTPUT to the Power Sensor.

4E-9. Final Output Compensation Adjustments

REMARKS:

This procedure is required following both local and remote output compensation procedures.

PROCEDURE:

1. Set controller switch #6 off.
2. Verify that the COMP annunciator is not lit on the front panel.
3. Replace the controller switch access cover.
4. Perform the RF Level Adjustment as described in Section 4C.
5. Replace the top instrument cover.

4E-10. Initial Attenuator Compensation Adjustments

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this compensation procedure.

This procedure is required prior to performing either the local or remote attenuator compensation procedures.

CAUTION

Do not turn the power off while the compensation switch is set on. The compensation switch protects the compensation memory from accidental damage during power on and power off.

PROCEDURE:

1. Access the top module cover by removing the top instrument cover.
2. Remove the controller switch access cover and set compensation switch #6 on.
3. Verify that the COMP annunciator is lit on front panel.
4. Connect the UUT RF OUTPUT to the Power Sensor.
5. Program the UUT to 1 MHz, +10.0 dBm, [SPCL] [8] [2].
6. Measure the RF level. If this is more than +10.0 dBm ±0.5 dB, the A7 Output PCA or A8 Attenuator/RPP Assembly is not operating correctly. Refer to Section 4D for troubleshooting and repair information.

4E-11. Final Attenuator Compensation Adjustments

REMARKS:

This procedure is required following both local and remote attenuator compensation procedures.

PROCEDURE:

1. Set compensation switch #6 off.
2. Verify that the COMP annunciator is not lit on the front panel.
3. Replace the controller switch access cover.
4. Perform the RF Level Adjustment as described in Section 4C.
5. Replace the top instrument cover.

4E-12. Het Compensation Adjustment

REMARKS:

If the Output Compensation Procedure (either local or remote) cannot be stored because the maximum compensation allocation has been exceeded, follow this procedure to adjust the het level.

CAUTION

Do not turn the power off or change the compensation switch until the store operation is complete. Doing so could damage the contents of the compensation memory.

PROCEDURE:

1. Review each measurement step in the Output Compensation Procedure with the STEP [↓] key.
2. Note the minimum level DAC adjustment in the non-het band (L1) and in the het band (L2).

3. Note the frequency at which the minimum level DAC adjustment occurs in the het band. (Frequencies below 245 MHz are in the het band.)

4. Step up to the frequency noted in step 3 using the STEP [↑] key.

5. Note the RF level as measured by the Power Meter (L3).

6. Calculate the following: L3 - L1 + L2 -3 dB

7. Adjust R63 for a reading equal to the level calculated in step 6.

8. Press and hold the STEP [↓] key until the first measurement step is reached.

9. Set the CAL factor on the Power Meter for the displayed frequency.

10. Use the EDIT [↑] and [↓] keys until the Power Meter reads 10 dBm.

11. Press STEP [↑] to go to the measurement step.

12. Repeat steps 9 through 11 until the last frequency in the het band is reached.

13. Press [STO]. Sto ? will be displayed.

14. Press [STO] again to confirm and store the data in the compensation memory. —Sto— will be displayed for approximately 10 seconds until the store operation is complete.

15. Perform the Final Output Compensation Adjustments procedure described earlier in this section.

4E-13. LOCAL COMPENSATION PROCEDURES

Table 4E-5 summarizes the operation of the front panel keys used during the local compensation procedures. All other keys are ignored.

NOTE

If IEEE-488 programming commands are received while running a local compensation procedure, all data from the procedure will be lost. Make sure that the IEEE-488 cable is not connected when running any of the local compensation procedures.

4E-14. FM Compensation Procedure

The FM Compensation Procedure involves adjusting the KV DAC (U28 and U29 on the A2 Synthesizer PCA) until the measured FM deviation is 99.9 kHz. This sequence is repeated for each of 281 frequencies. This procedure typically takes 45 minutes to perform, excluding the initial and final adjustments.

The target FM deviation of 99.9 kHz is displayed in the MODULATION field. The RF frequency is displayed in the FREQUENCY field. The frequencies are 245.5 to 525.5 MHz in 1-MHz increments. The KV DAC value is displayed in the AMPLITUDE field. A sample display is shown in Figure 4E-1.

Table 4E-5. Summary of Local Software Compensation Entries

BUTTON	ACTION
[CLR|LCL]	Abort compensation procedure. Clr ? will be displayed. Press [CLR|LCL] again to confirm. Press any other button to resume procedure.
EDIT [^]	Increase the DAC adjustment.
EDIT [v]	Decrease the DAC adjustment.
EDIT [<]	Move bright-digit to the left for coarse DAC adjustment.
EDIT [>]	Move bright-digit to the right for fine DAC adjustment.
[STATUS]	Display UNCAL or REJected ENTRY code. See Table 2-5 for a list of UNCAL codes. See Table 4E-2 for a list of REJected ENTRY codes.
STEP [^]	Store displayed DAC adjustment and go to the next step. For new steps, the DAC is programmed to the data currently in the compensation memory. For previously measured steps, the DAC is programmed to data from the current procedure.
STEP [v]	Review previously measured step.
[STO]	Store compensation data and exit procedure. All steps in the procedure must be measured before the data can be stored. Sto ? will be displayed. Press [STO] again to confirm. Press any other button to resume procedure.
[RCL]	Restore DAC adjustment from previous step.
RF [ON/OFF]	Turn RF output off and on. Used when zeroing a Power Meter. When RF output is off, only the RF [ON/OFF] button is allowed.

```
EXT  99.9 kHz      COMP      295.500 00 MHz      230
FM                  FM        STEP
```

Figure 4E-1. Sample FM Compensation Display

TEST EQUIPMENT:

Modulation Analyzer
Low-Frequency Synthesized Signal Generator (LFSSG)
DVM

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this compensation procedure.

This adjustment is required only if a repair is made on the A5 VCO PCA involving a component that affects the software compensation.

CAUTION

Do not turn the power off or change the compensation switch until the store operation is complete. Doing so could damage the contents of the compensation memory.

PROCEDURE:

1. Perform the Initial FM Compensation Adjustments procedure described earlier in this section.
2. Program the Modulation Analyzer to measure peak FM in a 0.05- to >200-kHz bandwidth.
3. Press [SPCL] [9] [5] to enter the FM compensation mode.
4. Verify that the FM annunciator is lit below the COMP annunciator.
5. Use the EDIT [↑] and [↓] keys until the Modulation Analyzer reads 99.9 kHz.
6. Press STEP [↑] to go to the next measurement step.
7. Repeat steps 5 and 6 until the measurement step at 525.5 MHz has been completed.
8. Press [STO]. Sto ? will be displayed.
9. Press [STO] again to confirm and store the data in compensation memory. —Sto— will be displayed for approximately 8 seconds until the store operation is complete.
10. Perform the Final FM Compensation Adjustments procedure described earlier in this section.

4E-15. Output Compensation Procedures

The Output Compensation Procedures involve adjusting the level DAC (U21 on the A6 Output Control PCA) until the measured RF level is 10 dBm. This sequence is repeated for each of up to 60 frequencies. This procedure typically takes 10 minutes to perform, excluding the initial and final adjustments.

The target RF output level of 10 dBm is displayed in the MODULATION field. The RF frequency is displayed in the FREQUENCY field. The frequencies may vary from instrument to instrument. The level DAC adjustment is displayed in the AMPLITUDE field. A sample display is shown in Figure 4E-2.

```
10 dBm      COMP      300.000 00 MHz      1.23 dB
             OUT           STEP
```

Figure 4E-2. Sample Output Compensation Display

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this compensation procedure.

This procedure is required if a repair is made on either the A6 Output Control PCA or the A7 Output PCA involving a component that affects the software compensation. It is also required in certain situations if level compensation procedures have been used before. Refer to the paragraphs earlier in this section on Level Compensation Notes.

This procedure covers both the Output Compensation Procedure (special function 96) and the Output Compensation Procedure with Default Attenuator Data (special function 98).

CAUTION

Do not turn the power off or change the compensation switch until the store operation is complete. Doing so could damage the contents of the compensation memory.

PROCEDURE:

1. Perform the Initial Output Compensation Adjustments described earlier in this section.

2. Press [SPCL] [9] [6] to enter output compensation mode. Verify that the OUT annunciator is lit below the COMP annunciator.

   OR

   Press [SPCL] [9] [8] to enter output compensation mode with default attenuator compensation data. Verify that the OUT and ATT annunciators are lit below the COMP annunciator.

3. Press RF OUTPUT [ON/OFF].

4. Zero the Power Meter.

5. Press RF OUTPUT [ON/OFF].

6. Set the CAL factor on the Power Meter for the displayed frequency.

7. Use the EDIT [↑] and [↓] keys until the Power Meter reads 10 dBm.

8. Press STEP [↑] to go to the next measurement step.

9. Repeat steps 6 through 8 until the last measurement step has been completed (frequency of 2100 MHz).

10. Press [STO]. Sto ? will be displayed.

11. Press [STO] again to confirm and store the data in the compensation memory. —Sto— will be displayed for approximately 10 seconds until the store operation is complete.

NOTE

If the store operation is rejected (flashing —Sto—), press [STATUS] to determine the cause of the rejected entry. If the display indicates not enough level compensation available (code 000 400 000), refer to the Het Compensation Adjustment procedure described earlier in this section.

12. Perform the Final Output Compensation Adjustments procedure described earlier in this section.

4E-16. Attenuator Compensation Procedure

The Attenuator Compensation Procedure involves adjusting the level DAC (U21 on the A6 Output Control PCA) until the measured RF level matches the target level. This sequence is repeated for each attenuator at every frequency. There are eight measurement steps (seven attenuators plus the through-path) and up to 30 frequencies at which the attenuator compensation is measured. This procedure typically takes 45 minutes to perform.

The target RF output level is displayed in the MODULATION field. Table 4E-6 lists the target levels for each of the attenuators. The RF frequency is displayed in the FREQUENCY field. The frequencies may vary from instrument to instrument. The level DAC adjustment is displayed in the AMPLITUDE field. A sample display is shown in Figure 4E-3.

TEST EQUIPMENT:

Power Meter
Power Sensor (High-Level)

REMARKS:

The UUT must be operated at room temperature for at least one hour with the module plate covers in place before continuing with this compensation procedure.

This adjustment is required if a repair is made on the A8 Attenuator/RPP Assembly involving a component that affects the software compensation. It is also required in certain situations if level compensation procedures have been used before. Refer to the paragraphs on Level Compensation Notes.

CAUTION

Do not turn the POWER switch off or change the compensation switch until the store operation is complete. Doing so could damage the contents of the compensation memory.

Table 4E-6. Attenuator Target Levels

ATTENUATOR	TARGET LEVEL
None	10 dBm
A6DBL	4 dBm
A12DBL	-2 dBm
A241L	-14 dBm
A242L	-14 dBm
A243L	-14 dBm
A244L	-14 dBm
A245L	-14 dBm

```
-2 dBm      COMP      300.000 00 MHz      1.23 dB
             ATT          STEP
```

Figure 4E-3. Sample Attenuator Compensation Display

PROCEDURE:

1. Perform the Initial Attenuator Compensation Adjustments procedure described earlier in this section.

2. Press [SPCL] [9] [7] to enter the attenuator compensation mode.

3. Verify that the ATT annunciator is lit below the COMP annunciator.

4. Press RF OUTPUT [ON/OFF].

5. Zero the Power Meter.

6. Press RF OUTPUT [ON/OFF].

7. Set the CAL factor on the Power Meter for the displayed frequency for each new frequency (target level of 10 dBm).

8. Press the EDIT [↑] and [↓] keys until the Power Meter reads the target value.
   Press Step[↓] and Step[↑] to verify correct data.

9. Press STEP [↑] to go to the next measurement step.

10. For the first 24-dB attenuator (target level of -14 dBm), the Power Meter must be zeroed.

11. Repeat steps 7 through 10 until the last measurement step (fifth 24-dB attenuator at frequency of 2100 MHz) has been measured.

12. Press [STO]. Sto ? will be displayed.

13. Press [STO] again to confirm and store the data in the compensation memory. —Sto— will be displayed for approximately 45 seconds until the store operation is complete.

14. Perform the Final Attenuator Compensation Adjustments procedure described earlier in this section.

4E-17. REMOTE COMPENSATION PROCEDURES

The remote compensation commands can be used to automate the compensation procedures with an IEEE-488 controller. The remote procedures are easier to use and are less prone to errors than their corresponding local procedures.

The IEEE-488 controller program for all of the compensation procedures consists of the following elements:

Initialize meter
Initiate 6062A compensation mode
Loop
  Ask 6062A for frequency
  Exit loop if frequency is special code
  Get reading from meter
  Send meter reading to 6062A
  End of loop
Store compensation data
Exit 6062A compensation mode

This simple program makes it easy to automate the compensation procedures. There is no need to know how many steps are in each procedure or anything about the internal workings of the 6062A. The programmer must only know how to program the external measurement instruments. Sample programs are provided later in this section.

For the FM Compensation Procedures, the meter is a Modulation Analyzer set to measure FM deviation. For the Level Compensation Procedures, the meter is a Power Meter or a Modulation Analyzer set to measure RF power. The programmer must be familiar with these measurement instruments to ensure that the readings are settled. In addition, for the level procedures, calibration factors must be applied to the readings, and the measurement instrument must be zeroed periodically.

Table 4E-7 lists the IEEE-488 commands that are used for the remote software compensation procedures. All IEEE-488 commands not listed in the table are rejected while performing one of the compensation procedures. Furthermore, the software compensation commands are rejected unless one of the software compensation procedures is being performed.

4E-18. Remote FM Compensation

The Remote FM Compensation procedure is initiated with the "cmfm" command.

The main loop of the compensation program involves asking the Generator for the frequency, getting the frequency, getting a reading from the modulation analyzer, and sending the reading to the Generator. The Generator will use the reading to adjust the KV DAC (U28 and U29 on the A2 Synthesizer PCA) closer to the desired target FM deviation of 99.9 kHz. The Generator will continue to adjust the DAC until two successive readings are received within the error tolerance. Then it will program the next measurement step.

When all the measurement steps have been measured, the Generator will send the special frequency code "9E+09"⟨EOR⟩ in response to the interrogate command "ICFR". This should be used to exit the main loop of the compensation program. To save the measured data, use the "cmsv" command.

Table 4E-7. Software Compensation IEEE-488 Commands

COMMAND USE	COMMAND HEADER	NUMERIC	SUFFIX	COMMENTS
SOFTWARE COMPENSATION MODE COMMANDS				
Compensation Mode	CM	none	AT	Begin Attenuator compensation procedure.
			FM	Begin FM compensation procedure.
			OD	Begin Output with default attenuator compensation procedure.
			OT	Begin Output compensation procedure.
			SV	Save compensation data and exit compensation procedure.
			EX	Exit compensation procedure without saving the data.
SOFTWARE COMPENSATION PROCEDURE COMMANDS				
Compensation FM Entry	CF	float	GZ MZ KZ HZ	Accept FM deviation reading from modulation analyzer during FM compensation procedure.
Compensation Amplitude Entry	CP	float	DB	Accept amplitude reading from power meter during level compensation procedure.
Interrogate Compensation Step Data	IC	none	FR	Interrogate the frequency of the current compensation procedure step.
			TG	Interrogate the target level or target FM deviation of the current compensation procedure step.
Interrogate Het Adjustment Data	IH	none	none	Interrogate the frequency and level offset necessary to make the het compensation adjustment. For example, "+000120000,+00000000.30"<EOR> indicates the adjustment should be made at 120 kHz and the level needs to be adjusted up .3 dB.
CLEAR COMMANDS				
Clear IEEE-488 Output Buffer	CB	none	none	Clear IEEE-488 output buffer.
Clear Error	CE	none	none	Clear the IEEE-488 rejected entry status.
Device Clear	CL	none	none	Exit the compensation procedure and clear the instrument state.
INTERROGATE COMMANDS				
REJected ENTRY	IR	none	none	Interrogates the rejected entry error codes. The Generator responds with three octal fields: "AAAAAA,BBBBBB,CCCCCC". See Table 4E-2 for a list of rejected entry error codes.

Table 4E-7. Software Compensation IEEE-488 Commands (cont)

UNCAL	IU	none	none	Interrogates the uncali-brated output error codes. The Generator responds with three octal fields: "AAAAAA,BBBBBB,CCCCCC". See Table 2-5 for a list of uncal error codes.
Compensation Memory Status	IZ		none	Interrogates the compensation memory status. The Generator Responds with three fields; "AAAAAA,BBBBBB,CCCCCC". See Table 4D-7 for a list of status codes.
RF ON/OFF ENTRY				
RF Output	RO	0/1	none	Turn RF output off/on.

The programmer must initialize the Modulation Analyzer to measure peak FM deviation in a 0.05- to >200-kHz bandwidth. The programmer must also ensure that readings sent to the Generator are fully settled.

The sample program in this section is written in BASIC for a Fluke 1720A or 1722A Instrument Controller and uses an HP 8901 Modulation Analyzer to make the FM deviation measurements. The program is easy to modify for another IEEE-488 controller or another measurement instrument.

The sample program could be enhanced in a number of areas. It may run faster if the modulation analyzer is programmed directly to the new frequency. It may also run faster if the programmer writes a more sophisticated subroutine to get FM deviation readings.

Ideally the average of the positive and negative peak FM deviation should be measured. If the Modulation Analyzer does not have an average mode, a positive peak measurement and a negative peak measurement could be made and averaged. This is not usually necessary since the positive and negative peak values are adjusted to be the same.

Some manual adjustments must be made prior to and after running the FM Compensation program. Refer to the Initial FM Compensation Adjustments and Final FM Compensation Adjustments described earlier in this section.

A program similar to the following can be used to generate the FM compensation data.

```
10    !
11    ! Disclaimer:
12    !
13    !     This program is provided "AS IS".  No indemnity or warranties
14    !     are provided, whether expressed or implied.  FLUKE specifically
15    !     disclaims the implied warranties or merchantability and fitness
16    !     for the purpose or use.  In no event shall FLUKE be liable for
17    !     any loss of data, use, profits or goodwill, or for special,
18    !     incidental, consequential or other similar damages.
19    !
20    ! Fluke 6062A Signal Generator FM compensation control program.
30    ! Runs on a Fluke 1720A or 1722A controller.
40    !
50    ! Initialization
60    !
70    INIT PORT 0%
80    A% = 2%                        ! IEEE-488 address of Signal Generator
90    AM% = 14%                      ! IEEE-488 address of Modulation Analyzer
100   PRINT @ A%,"cl" \ WAIT 500     ! initialize Signal Generator
```

```
110  GOSUB 3000                              ! initialize Modulation Analyzer
120  !
130  PRINT @ A%,"cmfm"                       ! enter FM compensation mode
140  PRINT @ A%,"ir" \ INPUT LINE @ A%,A$ \ A$ = LEFT(A$,20)
150  IF (A$ = "000000,000000,000000") THEN GOTO 1000
160       PRINT "There is an error with the 6062A."
170       PRINT "Rejected Entry code: ";A$
180       STOP
1000 !
1010 ! Main loop
1020 !
1030      ! get frequency, exit main loop on last frequency
1040      PRINT @ A%,"icfr" \ INPUT @ A%,F
1050      IF (F = 9E9) GOTO 2000
1060      !
1070      ! check for synthesizer unlocked condition which may occur
1080      !  if the COMP memory contains bad data.  If unlocked, send
1090      !  a small dummy reading to 6062A to increase the KV DAC
1100      !  (don't read the meter).
1110      WAIT 100 \ PRINT @A%,"iu" \ INPUT LINE @ A%,A$ \ A$ = LEFT(A$,6)
1120      IF (A$ = "000004") THEN RD = 100 \ GOTO 1180
1130      !
1140      ! get modulation analyzer reading
1150      GOSUB 4000                         ! reading -> RD
1160      !
1170      ! send modulation analyzer reading to 6062A
1180      PRINT @ A%,"cf";RD;"hz"
1190 GOTO 1000
2000 !
2010 ! Store results
2020 !
2030 PRINT @ A%,"cmsv"                       ! save data in compensation memory
2040 WAIT 5000                               ! wait 5 seconds for store to complete
2050 PRINT @ A%,"ir" \ INPUT LINE @ A%,A$ \ A$ = LEFT(A$,20)
2060 IF (A$ = "000000,000000,000000") THEN GOTO 2900
2070      PRINT "The store operation failed."
2080      PRINT "Rejected Entry code: ";A$
2090      STOP
2900 LOCAL
2910 END

3000 !
3010 ! Subroutine to initialize HP 8901 Modulation Analyzer
3020 !
3030      PRINT @ AM%,"AUM2T0"          ! Automatic operation, FM, Free Run
3040      PRINT @ AM%,"H1L0D1"          ! 50 Hz HP Filter on, LP Filters off, Peak+
3050 RETURN

4000  !
4010  ! Subroutine to get readings from HP 8901 Modulation Analyzer
4020  ! Give the modulation analyzer 700 msec to settle.  Then get
4030  ! readings until two are within 100 hz.  Get one more reading
4035  ! and return the average of all three.
4040  !
4050  INPUT @ AM%,R1
4060  !
4070  WAIT 700
4100    INPUT @ AM%,RD
4110    IF ABS(RD-R1) <= 100 THEN GOTO 4200
4120    R1 = RD
4130    GOTO 4100
4200  R1 = RD + R1
4210  INPUT @ AM%,RD
4220  RD = (RD + R1)/3
4230  RETURN
```

4E-19. Remote Level Compensation

The remote level compensation procedures are initiated with the "cmot", "cmat", or "cmod" for the Output, Attenuator, and Output with Default Attenuator Data Compensation Procedures respectively. The sequence for running the procedures is so similar that one program can be written to perform all three procedures.

The main loop of the compensation program involves asking the Generator for the frequency, getting the frequency, getting a reading from the power meter, and sending the reading to the Generator. The Generator will use the reading to adjust the level DAC (U21 on the A6 Output Control PCA), closer to the desired target level. The target level for the output procedures is +10 dBm. The target levels for the attenuator procedure are listed in Table 4E-6. The Generator will continue to adjust the DAC until two successive readings are received within the error tolerance. Then it will program the next measurement step.

When all the measurement steps have been measured, the Generator will send the special frequency code "9E+09"<EOR> in response to the interrogate command "ICFR". This should be used to exit the main loop of the compensation program. To save the measured data, use the "cmsv" command.

The programmer must initialize the power meter to measure dBm. The programmer must also ensure that readings sent to the 6062A are fully settled and that calibration factors are applied to the readings.

The power meter must also be zeroed periodically. This should be done at the beginning of the program for all procedures. For the attenuator procedures, the meter should also be zeroed for the first 24-dB attenuator (target level of -14 dBm). This can be checked by interrogating the target level.

The sample program in this section is written in BASIC for a Fluke 1720A or 1722A Instrument Controller and uses an HP 463A Power Meter to make the RF level measurements. The program is easy to modify for another IEEE-488 controller or another measurement instrument.

The sample program could be made faster by writing a more sophisticated subroutine to get readings from the power meter.

If the output compensation procedure fails because there is not enough level compensation available, the Het Compensation Adjustment may need to be performed. The "ih" command can be used to interrogate the frequency and level at which to make the adjustment on the A6 Output Control PCA. Exit the compensation mode, and program the Generator to +10 dBm and the interrogated frequency. Measure the RF level. Adjust R63 on the A6 Output Control PCA for a level equal to the measured level plus the interrogated level.

Some manual adjustments must be made prior to and after running the level compensation program. These are described earlier in this section entitled as follows:

Initial Output Compensation Adjustments
Final Output Compensation Adjustments
Initial Attenuator Compensation Adjustments
Final Attenuator Compensation Adjustments

A program similar to the following can be used to generate the output or attenuator compensation data.

```
10    !
11    ! Disclaimer:
12    !
13    !     This program is provided "AS IS".  No indemnity or warranties
14    !     are provided, whether expressed or implied.  FLUKE specifically
15    !     disclaims the implied warranties or merchantability and fitness
16    !     for the purpose or use.  In no event shall FLUKE be liable for
17    !     any loss of data, use, profits or goodwill, or for special,
18    !     incidental, consequential or other similar damages.
19    !
20    ! Fluke 6062A Signal Generator Level compensation control program.
30    ! Runs on a Fluke 1720A or 1722A controller.
40    !
50    INIT PORT 0
60    A% = 2%                          ! IEEE-488 address of Signal Generator
70    AP% = 13%                        ! IEEE-488 address of Power Meter
80    PRINT @ A%, "cl" \ WAIT 500      ! initialize Signal Generator
90    GOSUB 3000                       ! initialize Power Meter
100   GOSUB 7000                       ! set up CAL factor tables
500   !
510   ! Ask operator which compensation mode to use
520   !
530   MD% = 0%                         ! default is output
540   PRINT "Enter compensation mode:"
550   PRINT "    0 for output"
560   PRINT "    1 for attenuator"
570   PRINT "    2 for output with default attenuator"
580   INPUT MD%
```

```
590  IF (MD% < 0 OR MD% > 2%) GOTO 500
600  IF (MD% = 0%) THEN MD$ = "ot"
610  IF (MD% = 1%) THEN MD$ = "at"
620  IF (MD% = 2%) THEN MD$ = "od"
630  !
640  PRINT @ A%,"cm";MD$               ! enter compensation mode
650  PRINT @ A%,"ir" \ INPUT LINE @ A%,A$ \ A$ = LEFT(A$,20)
660  IF (A$ = "000000,000000,000000") THEN GOTO 800
670      PRINT "There is an error with the 6062A."
680      PRINT "Rejected Entry code: ";A$
690      STOP
800  !
810  GOSUB 5000                        ! zero power meter
820  TL = 10                           ! flag used to determine when to zero meter
1000 !
1010 ! Main loop
1020 !
1030     ! get frequency, exit main loop on last frequency
1040     PRINT @ A%,"icfr" \ INPUT @ A%,F
1050     IF (F = 9E9) GOTO 2000
1060     !
1070     ! zero power meter before measuring first 24 dB attenuator
1080     !   (target level changes from -2 dBm to -14 dBm).
1090     PRINT @ A%,"ictg" \ INPUT @A%,T
1100     IF ((T = -14) AND (TL = -2)) THEN GOSUB 5000  ! zero power meter
1110     TL = T
1120     !
1130     ! get power meter reading
1140     GOSUB 4000                    ! reading -> RD
1150     !
1160     ! send power meter reading to 6062A
1170     PRINT @ A%,"cp";RD;"db"
1180 GOTO 1000

2000 !
2010 ! Store results
2020 !
2030 PRINT @ A%,"cmsv"                 ! save data in compensation memory
2040 WAIT 45000                        ! wait 45 seconds for store to complete
2050 PRINT @ A%,"ir" \ INPUT LINE @ A%,A$ \ A$ = LEFT(A$,20)
2060 IF (A$ = "000000,000000,000000") THEN GOTO 2900
2070 IF (MD$ <> "at") AND (A$ = "000000,000400,000000") THEN GOTO 2500
2080     PRINT "The store operation failed."
2090     PRINT "Rejected Entry code: ";A$
2100     STOP
2500     !
2510     ! Handle not enough level compensation case
2520     !
2525     LOCAL @AP%
2530     PRINT @ A%,"ih" \ INPUT @ A%,F,L
2540     PRINT @ A%,"cmex,fr";F;"mz,ap10db"
2550     PRINT "Not enough level compensation available."
2560     M$ = "higher" \ IF (L<0) THEN M$ = "lower"
2570     PRINT "Adjust R227 on Output PCA for a power reading ";ABS(L);
2580     PRINT " dB ";M$ \ PRINT "than it currently is."
2590     PRINT "Rerun level compensation when adjustment is complete."
2600     LOCAL \ STOP
2900 LOCAL
2910 END

3000 !
3010 ! Subroutine to initialize HP 436A Power Meter
3020 ! P$ is used when zeroing the power meter too
3030 !
3040     P$ = "D+9H"           ! dBm mode, no CAL factor, auto range, Hold
3050     PRINT @ AP%,P$
3060     PRINT @ AP%,"I"       ! get first reading
3070     INPUT LINE @ AP%,RD$  ! throw it away
3080 RETURN

4000 !
4010 ! Subroutine to get readings from HP 436A Power Meter
4020 !
4030 ! Get two readings within .01 dB, then read eight
4040 !   more and return the average of all ten.
4050 !
4060     ! set delay to 200 ms or 400 ms if 24 dB pad
4070     WT% = 200%
4080     IF( T = -14 ) THEN WT% = 400%
4090     !
4100     ! wait 2 seconds
4110     WAIT 2000 \ PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4120     !
4130     R1 = VAL(RIGHT(RD$,4))
4480     !
4490     ! get settled reading
4500     !
4510         WAIT WT% \ PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4520         RD = VAL(RIGHT(RD$,4))
4530         IF ABS(RD-R1) <= .01 THEN GOTO 4600
4540         R1 = RD
4550     GOTO 4500
4580     !
4590     ! The reading is in the settled range, now average more.
4600     R1 = R1 + RD     ! sum includes last 2 readings
4605     AV = 10.0
```

```
4610     FOR I% = 1% TO (AV-2)
4620        PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4630        RD = VAL(RIGHT(RD$,4))
4640        R1 = R1 + RD
4650     NEXT I%
4660     RD = R1 / AV
4670     !
4800     GOSUB 6000                  ! power meter CAL factor -> CF
4810     RD = RD + CF
4840 RETURN

5000 !
5010 ! Subroutine to zero HP 436A Power Meter
5020 ! P$ is set up in the power meter initialization routine
5030 !
5040     PRINT @ A%,"ro0" \ WAIT 3000
5050     PRINT @ AP%,"Z1T" \ WAIT 30
5060     PRINT @ AP%,P$ \ WAIT 5000
5070     PRINT @ A%,"ro1" \ WAIT 30
5080 RETURN

6000 !
6010 ! Subroutine to compute power meter CAL factor
6020 !
6030     ! use first data point if frequency is low
6040     CF = 10 * LOG(1/CA(1%))
6050     IF (F/1.0E6 <= FR(1%)) THEN RETURN
6060     !
6070     ! use last data point if frequency is high
6080     CF = 10 * LOG(1/CA(30%))
6090     IF (F/1.0E6) >= FR(30%) THEN RETURN
6100     !
6110     ! search table for closest frequency points
6120     I% = 1%
6130     IF (F/1.0E6 < FR(I%)) THEN GOTO 6500
6140     I% = I% + 1%
6150     GOTO 6130
6500     !
6510     ! interpolate between frequency points
6520     D = (F/1.0E6 - FR(I%-1%)) / (FR(I%)-FR(I%-1%))
6530     C = ( D * (CA(I%)-CA(I%-1%)) ) + CA(I%-1%)
6540     !
6550     ! convert ratio to dB
6560     CF = 10 * LOG(1/C)
6570 RETURN

7000 !
7010 ! Subroutine to set up CAL factor tables
7020 !
7030     ! Number of frequencies used - Maximum of 30
7040     DATA 11
7050     ! List of Frequencies, in MHz
7060     DATA   .1,    .3,     1,     3,    10
7070     DATA   30,   100,   300,  1000,  1700,  2100
7080     ! CAL factors to match the frequency list
7090     DATA .969, .994, .996, .999, .997,
7100     DATA .999, .991, .988, .986, .988, .987,
7110     !
7120     DIM FR(30%), CA(30%)
7130     !
7140     READ N% \ IF (N% > 30%) THEN N% = 30%
7150     FOR I% = 1% TO N%
7160        READ FR(I%)                  ! load frequency table
7170     NEXT I%
7180     !
7190     FOR I% = 1% TO N%
7200        READ CA(I%)                  ! load CAL factor table
7210     NEXT I%
7220     !
7230     FOR I% = N%+1% TO 30%
7240        FR(I%) = FR(N%)              ! fill in rest of tables
7250        CA(I%) = CA(N%)
7260     NEXT I%
7270 RETURN
```

Section 5
List of Replaceable Parts

TABLE OF CONTENTS

5-1. INTRODUCTION

This section contains an illustrated list of replaceable parts for the 6062A. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator
- An indication if the part is subject to damage by static discharge
- Description
- Fluke stock number
- Manufacturers supply code
- Manufacturers part number or generic type
- Total quantity
- Any special notes (i.e., factory-selected part)

CAUTION

A ϟ symbol indicates a device that may be damaged by static discharge.

5-2. HOW TO OBTAIN PARTS

Electrical components may be ordered directly from the manufacturer by using the manufacturers part number, or from the John Fluke Mfg. Co., Inc. and its authorized representatives by using the part number under the heading FLUKE STOCK NO. A list of manufacturers supply codes is provided at the end of this section. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representatives.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Fluke stock number
- Description (as given under the DESCRIPTION heading)
- Quantity
- Reference designator
- Part number and revision level of the pca containing the part.
- Instrument model and serial number

5-3. MANUAL STATUS INFORMATION

The Manual Status Information table that precedes the parts list defines the assembly revision levels that are documented in the manual. Revision levels are printed on the component side of each pca.

5-4. SERVICE CENTERS

A list of service centers is located at the end of this section.

MANUAL STATUS INFORMATION

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	REVISION LEVEL
A1	Display PCA	798009	D
A2	Controller PCA	798058	D
A3	IEEE-Interface PCA	774562	F
A4	Synthesizer PCA	798173	AG
A5	VCO PCA	798017	J
A6	Output Control PCA	798041	AF
A7	Output PCA	798025	P
A8A1	Relay Driver/RPP PCA	798033	E
A8A2	Attenuator/RPP PCA	812644	K
A9	Power Supply PCA	744052	L
-130	High Stability Reference PCA	744102	F
-132	Medium Stability Reference PCA	792788	D
-651	Low-Rate FM PCA	744110	A

Table 5-1. 6062A Final Assembly

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	ϟ DISPLAY PCA	798009	89536	798009	1	
A 2	ϟ CONTROLLER PCA	798058	89536	798058	1	
A 3	ϟ IEEE-488 INTERFACE PCA	738617	89536	738617	1	
A 4	ϟ SYNTHESIZER PCA	792812	89536	792812	1	
A 5	ϟ VCO PCA	798017	89536	798017	1	
A 6	ϟ OUTPUT CONTROL PCA	798041	89536	798041	1	1
A 7	ϟ OUTPUT PCA	798025	89536	798025	1	1
A 8	ATTENUATOR/RPP ASSEMBLY	808444	89536	808444	1	
A 9	ϟ POWER SUPPLY PCA	744052	89536	744052	1	
A 12	ϟ SWITCH PWB	738591	89536	738591	1	
B 1	FAN,12VDC,34CFM,3.15"SQ	706598	82877	FL12A308	1	
C 1	CAP,CER,1000PF,+-5%,50V,COG,STL LEADS	876557	04222	SR215A102JAA ORT W/STL	1	
C 2	CAP,CER,270PF,+-5%,100V,COG	614586	04222	SR151A271JAA	1	
C 23	CAP,CER,0.01UF,+80-20%,100V,Z5V	149153	60705	562CZ5UCK101AF103Z	1	
E 1	TERM,RING,3/8 & 7/64,SOLDR	441972	79963	761	1	
E 2, 3	TERM,RING #6,3/32 - 2 PLACES,SOLDR	132399	78189	2104-06-00	2	
F 1	FUSE,.25X1.25,1.5A,250V,FAST	109330	71400	AGC1-1/2	1	
FL 1	FILTER,RF,BOLT TYPE,1000PF	769919	00779	842848-1	1	
H 3, 17,158	WASHER,FLAT,STL,.149,.375,.031	110270	86928	5202-12-31	3	
H 6,157,196- H 198,452	NUT,HEX,LOCK,SS,4-40	558866 558866	72962	558866	6	
H 7, 97-115	SCREW,FH,P,LOCK,STL,8-32,.375	114116	74594	114116	20	
H 8,117,123- H 134,469	METAL PART,STAMPED,HOLE PLUG,.250	101766 101766	18310	790.3002	15	
H 12, 35, 60- H 62,137,138, H 142-145,199- H 201	SCREW,PH,P,LOCK,STL,6-32,.250	152140 152140 152140 152140	74594	152140	14	
H 14, 21,146- H 155,161-176, H 436	SCREW,PH,P,LOCK,SS,6-32,.750	376822 376822 376822	74594	376822	29	
H 22,156,177, H 437	SCREW,PH,P,LOCK,SS,4-40,.375	256164 256164	74594	256164	4	
H 23,178	SCREW,PH,P,LOCK,SS,6-32,.312	424713	78189	511 041800 00	2	
H 25, 30,179- H 181,185-187	SCREW,CAP,SCKT,SS,8-32,.375	295105 295105	74594	295105	8	
H 28,412-430, H 438	SCREW,FHU,P,LOCK,SS,6-32,.250	320093 320093	74594	320093	21	
H 29,182-184, H 310-410,439, H 455-457	SCREW,PH,P,LOCK,MAG SS,6-32,.281	772236 772236 772236	74594	772236 1	09	
H 31,188-190	NUT,HEX,ELASTIC STOP,STL,8-32,.172	306308	10059	F21NTM-82	4	
H 32,191,192	SCREW,FHU,P,LOCK,SS,8-32,.250	320101	74594	320101	3	
H 33,193-195	WASHER,SHLDR,NYL,0.113X0.245X0.070	807560	86928	A364-164	4	
H 36,204-206	SCREW,PH,P,SS,8-32,2.750	800441	2M530	800441	4	
H 37,207-213	WASHER,FLAT,SS,.174,.375,,.030	176743	86928	5710-31-30-P	8	
H 39,214	WASHER,SHLDR,FIBER,.140,.312,.062	110387	86928	5604-47	2	
H 40,215,216, H 221,222	NUT,HEX,ELAST STOP,STL,6-32,.125	110841 110841	72962	F21NTM-62	5	
H 41,223,224	WASHER,LOCK,INTRNL,STL,.267ID	110817	86928	5855-18-Z1	3	
H 42,225-227	WASHER,FLAT,ALUM,0.125X0.250X0.062	381749	86928	5712-22-.063	4	
H 43- 46	SCREW,PH,P,LOCK,SS,8-32,.375	559054	74594	559054	4	
H 47, 48	SCREW,PH,P,LOCK,STL,4-40,.250	740746	74594	740746	2	
H 49- 55	SCREW,PH,P,LOCK,SS,6-32,.625	412841	74594	412841	7	
H 56- 59	SCREW,PH,P,LOCK,SS,6-32,.500	320051		COMMERCIAL	4	
H 63- 82	SCREW,PH,P,LOCK,STL,4-40,.187	820779	26233	P37	20	
H 83- 92	SCREW,PH,P,LOCK,STL,4-40,.500	740761	74594	740761	10	

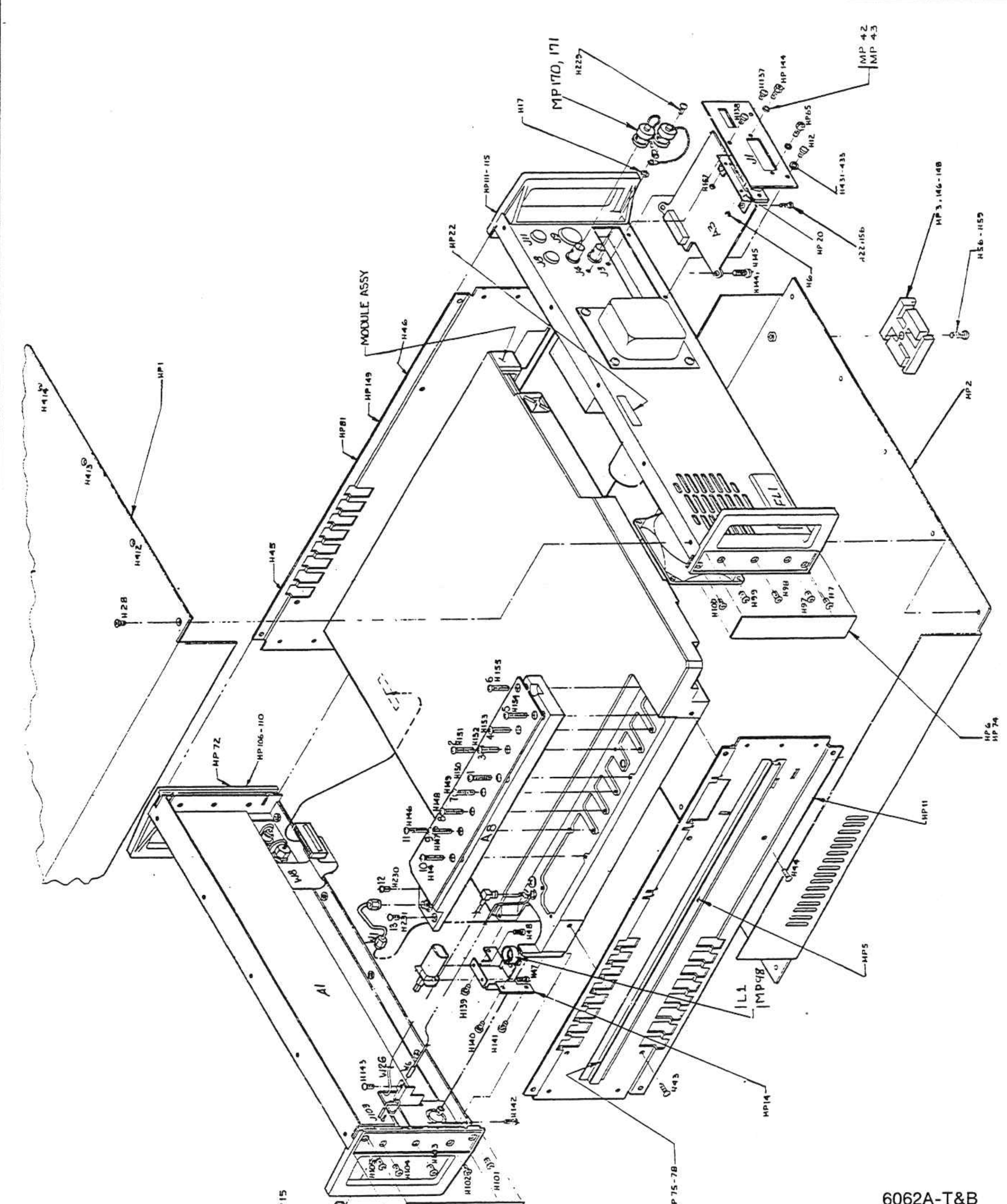
Table 5-1. 6062A Final Assembly (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
H 93- 96	WASHER,FLAT,FIBER,.196,.500,.031	333989	86928	5600-8-32	4	
H 139-141,160, H 229-309,451	SCREW,PH,P,LOCK,MAG SS,6-32,.375	783225 783225	74594	783225	86	
H 159,450	SCREW,PH,P,LOCK,STL,10-32,.250	218941	74594	218941	2	
H 202,203	SCREW,PH,P,SEMS,STL,6-32,.625	272591		COMMERCIAL	2	
H 228	SPACER,.250 HEX,M-F,BR,6-32,.600	838292	51506	14040	1	
H 431-433	WASHER,FLAT,SS,.146,.270,.016	260471	86928	5710-23-15-P	3	
H 434,435	WASHER,SPRING,STL,.138,.281,.020	571968	51506	571968	2	
H 458-468	WASHER,FLAT,TEFLON,.105,.255,.016	147645	86928	5612-124-31	11	
J 2	ADAPTER,COAX,SMA(M),N(M)	516963	21845	SF1132-6002	1	
J 7	ADAPTER,SMB(M),SMB(M)	800458	00779	228553-1	1	
L 1	CORE,TOROID,FERRITE,20X14.5X7.5MM	493551	54583	H5C2-T20-7.5-14.5	1	
MP 1	TOP COVER	704866	89536	704866	1	
MP 2	BOTTOM COVER	704874	89536	704874	1	
MP 3,146-148	FOOT, SINGLE BAIL TYPE (DARK UMBER)	653923	89536	653923	4	
MP 4, 6, 72, MP 74	DECAL, REAR CORNER	685214 685214	22670	685214	4	
MP 5,149	SIDE TRIM 18"	525998	22670	525998	2	
MP 7, 75- 79	GASKET,SHIELDING,MONEL MESH	520320	53217	20-90190	6	
MP 8	DECAL, OPERATION	797928	22670	797928	1	
MP 11, 81	CHASSIS SIDE	657627	89536	657627	2	
MP 13, 27, 45, MP 84- 94, 98, MP 158	CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	172080 172080 172080	06383	SST-1M	16	
MP 14	BRACKET, POWER SWITCH	774489	89536	774489	1	
MP 15	PUSHBUTTON, LG RECT. GREEN CL REPL	420893	89536	420893	1	
MP 18	DECAL,DATA DISK	535294	89536	535294	1	
MP 19	COVER PLATE, IEEE	774075	89536	774075	1	
MP 20	IEEE MTG BRKT	657650	89536	657650	1	
MP 22	LABEL,ADHES,VINYL,BAR CODE,1.500,.312	844712	22670	844712	2	
MP 23	COVER, OUTPUT, PLATED	797944	89536	797944	1	
MP 24	COVER, SYNTHESIZER, PLATED	794958	89536	794958	1	
MP 26, 44, 82, MP 83,157,163	CABLE TIE ANCHOR,ADHSV,.160TIE	407908 407908	06383	ABMM-A-C	6	
MP 28	BARRIER, 9-LAYER FILTER, PLATED	812529	89536	812529	1	
MP 29	MODULATOR BARRIER	808550	89536	808550	1	
MP 30, 99-108	AIDE,PCB PULL	541730	89536	541730	11	
MP 31,109-120	GASKET,SHIELDING,MONEL MESH,CIRCULAR	720664	53217	20-11101	13	
MP 32	COVER, PULSE MODULATOR, PLATED	797951	89536	797951	1	
MP 33, 46,134, MP 151	CORNER BRACKET	657601 657601	89536	657601	4	
MP 34	SWITCH, RUBBER, LEFT	797894	0K392	797894	1	
MP 35	SWITCH, RUBBER, CENTER	797902	0K392	797902	1	
MP 37	DECAL, FRONT PANEL	797886	22670	797886	1	
MP 38	DECAL, LENS	797910	22670	797910	1	
MP 39	LENS DISPLAY	657718	60204	657718	1	
MP 40, 47,135, MP 136	CORNER HANDLE, FRONT 5.25 INCH, DK UM	656173 656173	89536	656173	4	
MP 41	BRACKET, RF OUTPUT, PLATED	774471	89536	774471	1	
MP 42, 43	WASHER,FLAT,MYLAR,.205,.309,.007	240820	86928	5622-25-7	2	
MP 48	REAR PANEL	794875	89536	794875	1	
MP 49,137,138	SHOCK MOUNT, PS,7116	732941	5P059	732941	3	
MP 50,139	PLUG, BUTTON	760231	89536	760231	2	
MP 51	BUSHING COVER RF OUTPUT	538256	89536	538256	1	
MP 52,140-142	INSUL PART,POWER,SI,.750,.500	534453	55285	7403-09FR-54	4	

Table 5-1. 6062A Final Assembly (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
MP 53	INSUL PART,TO-3,SI,1.650,1.140	473165	55285	7403-09FR-05	1	
MP 55	TRANSFORMER COVER, PAINTED	731307	89536	731307	1	
MP 56,143	CABLE ACC,CLAMP,.500 ID,SCREW MOUNT	100974	06915	N8B	2	
MP 57	FAN SKIRT	792721	89536	792721	1	
MP 58	RETAINER,AUX PWR SUPPLY CONN	748640	89536	748640	1	
MP 61	CORD,LINE,5-15/IEC,3-18AWG,SVT,7.5 FT	284174	70903	17239	1	
MP 62, 95, 96	METAL PART,STAMPED,HOLE PLUG,.500	101774	18310	790-3008	3	
MP 65,144	CONN ACC,MICRO-RIBBON,SCREW LOCK	854737	05791	LT43026	2	
MP 66	SHIELD, DISPLAY	812818	2M021	812818	1	
MP 67	HEAT DIS,HORIZ,1.860,1.062,.500,TO-3	740738	98978	7-423BA	1	
MP 68,121-123, MP 154	GROUND STRIP,BECU,SPRING FINGER	756445 756445	34641	97-500-08	10	
MP 70	ϟ SHIELD, SWITCH RF	716852	89536	716852	1	
MP 73	SWITCH,RIGHT CONDUCTIVE ELASTOMERIC	731356	0K392	731356	1	
MP 125-132,162	GROUND STRIP,BECU,SPRING FINGERS	811661	34641	97-520-08	9	
MP 145	AMPLIFIER SHIELD	812727	89536	812727	1	
MP 155	FRONT PANEL SM	657593	89536	657593	1	
MP 156	BUSHING INSULATION R.F.OUTPUT	537803	89536	537803	1	
MP 159	ϟ ASSEMBLY, MODULE FILTER	848093	89536	848093	1	
MP 170,171	CONN ACC,COAX,BNC,CAP	478982	00779	1-330022-2	2	
T 1	TRANSFORMER, POWER	717959	89536	717959	1	
TM 1	6062A INSTRUCTION MANUAL	794842	89536	794842	1	
TM 2	MANUAL, GETTING STARTED	794859	89536	794859	1	
TM 3	IEEE REFERENCE GUIDE	812636	89536	812636	1	
U 1	ϟ IC,VOLT REG,FIXED,+5 VOLTS,3 AMP,TO-3	453944	27014	LM223K	1	
W 1	CABLE ASSEMBLY, SEMI-RIGID W 1	731380	98291	731380	1	
W 2	CABLE ASSY,RF,REF IN	748699	89536	748699	1	
W 3, 28	CABLE ASSY,RF,REF IN/OUT	748681	89536	748681	2	
W 6	CABLE ASSY,MOD INPUT,MODULE	738542	89536	738542	1	
W 7	CABLE ASSY MOD INPUT FRONT	738500	89536	738500	1	
W 9	CABLE ASSEMBLY, CONTROLLER-POWER	738534	89536	738534	1	
W 10	CABLE ASSEMBLY SYNTHESIZER-POWER	738526	89536	738526	1	
W 15	CABLE, LINE FILTER	774588	89536	774588	1	
W 24	CABLE ASSEMBLY, ATTENUATOR (RELAY)	752725	89536	752725	1	
W 27	WIRE FOR TEST & BUTTONUP	847140	89536	847140	1	
XU 1, 2	SOCKET,1 ROW,PWB,0.100CTR,7 POS	520809	30035	SS-109-1-07	2	

NOTES:
ϟ Static sensitive part.
1. Software compensation required if assembly is replaced.



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(1 of 5)

Figure 5-1. 6062A Final Assembly

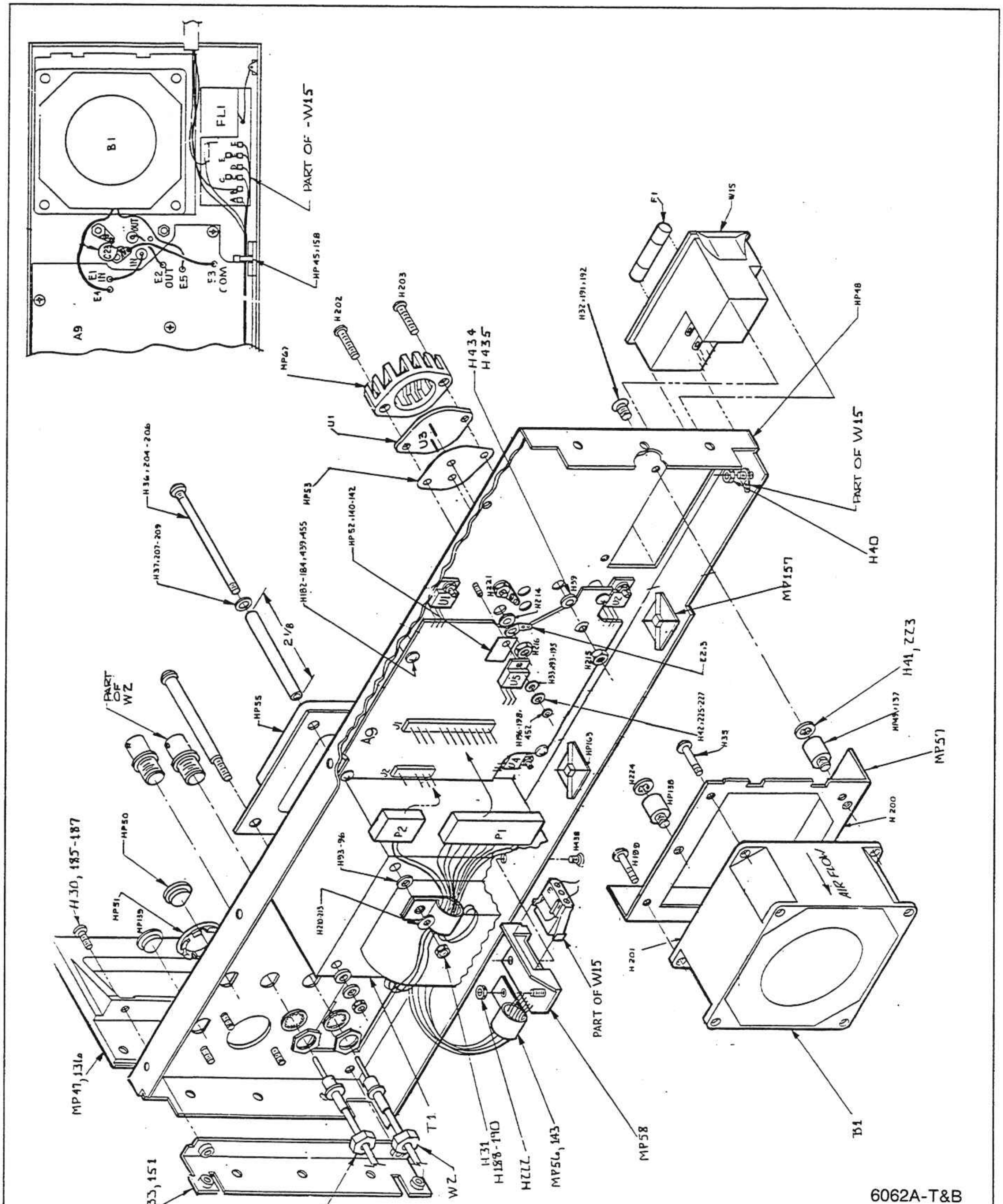


Figure 5-1. 6062A Final Assembly (cont)

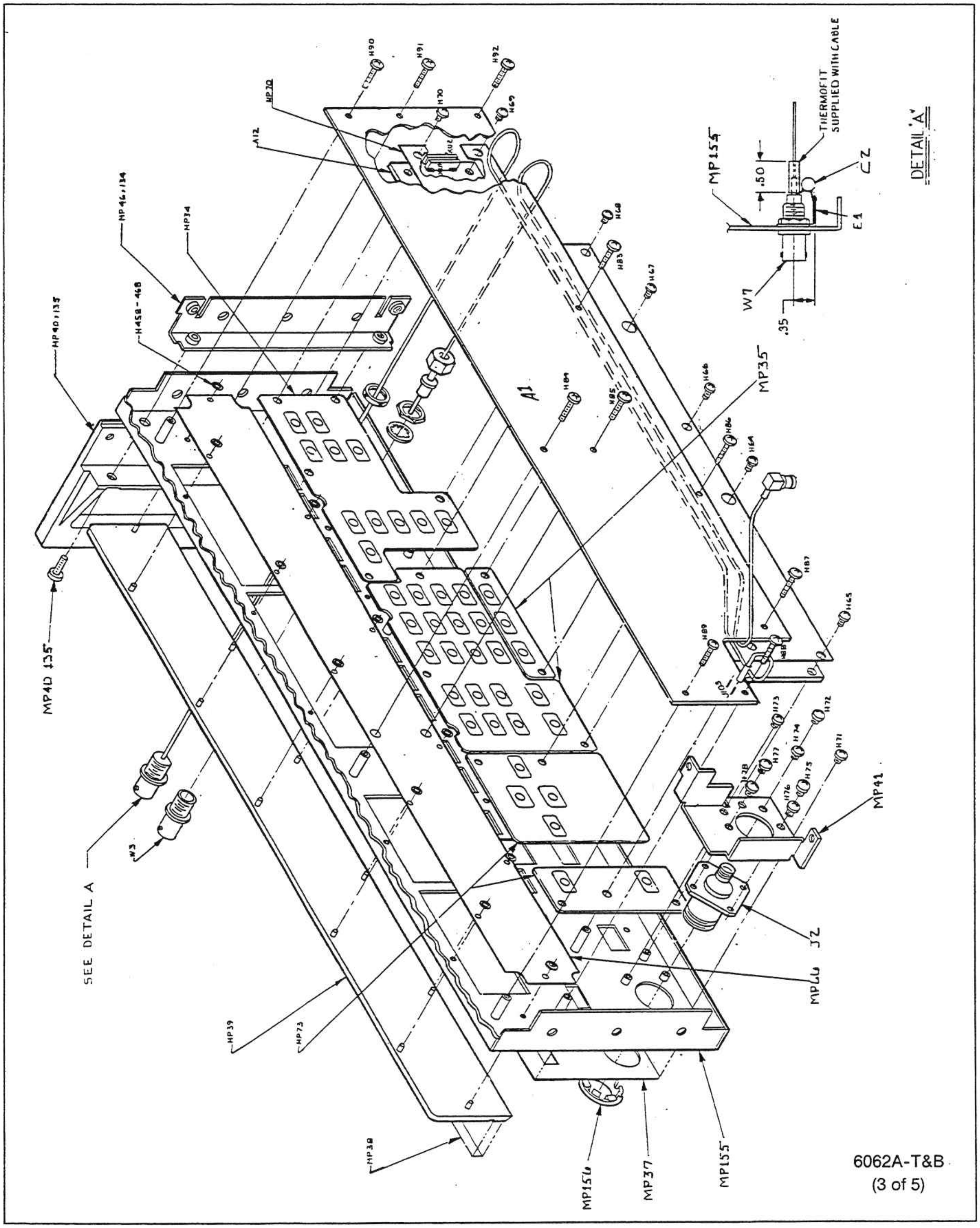
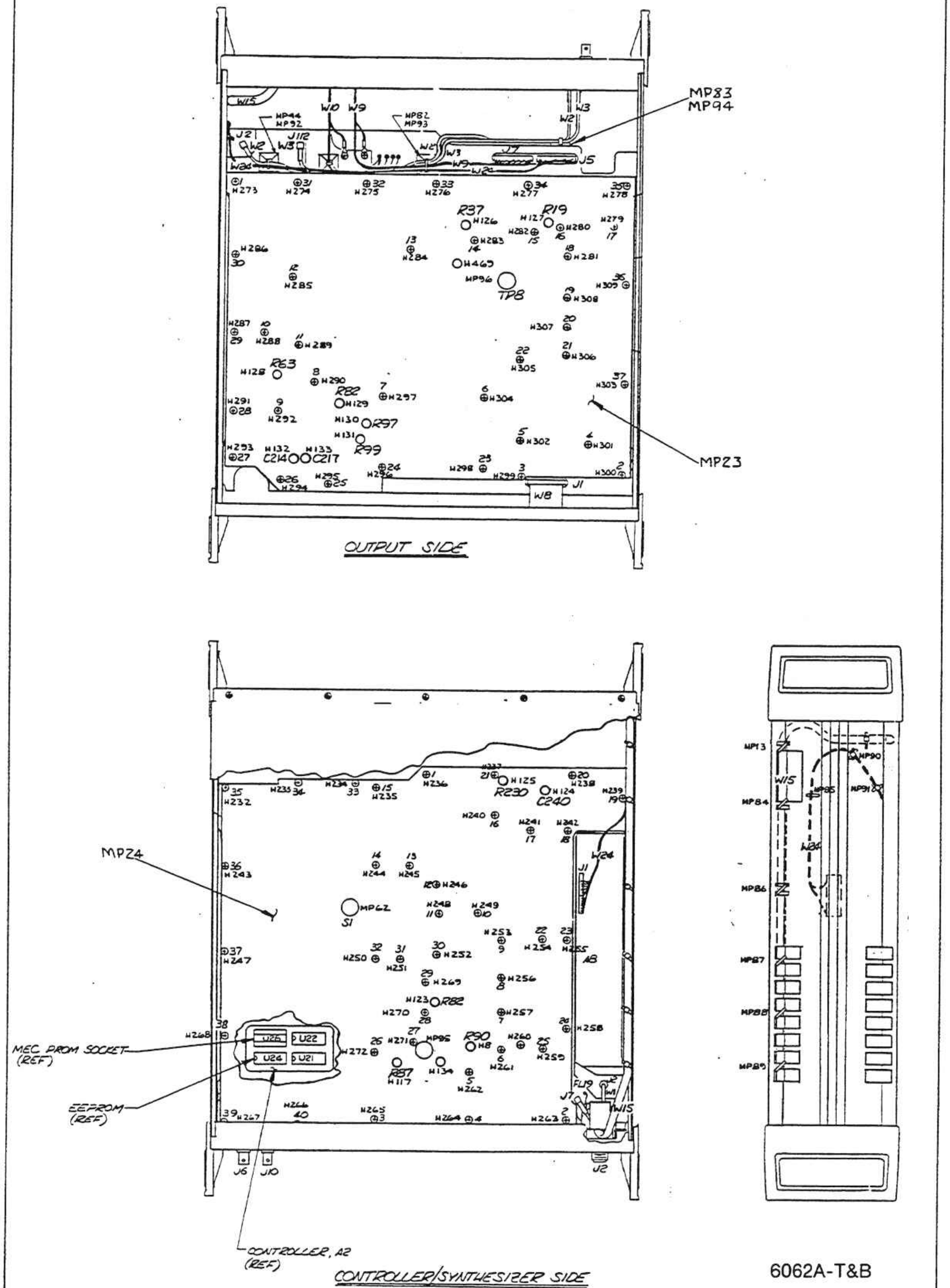


Figure 5-1. 6062A Final Assembly (cont)



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(4 of 5)

Figure 5-1. 6062A Final Assembly (cont)

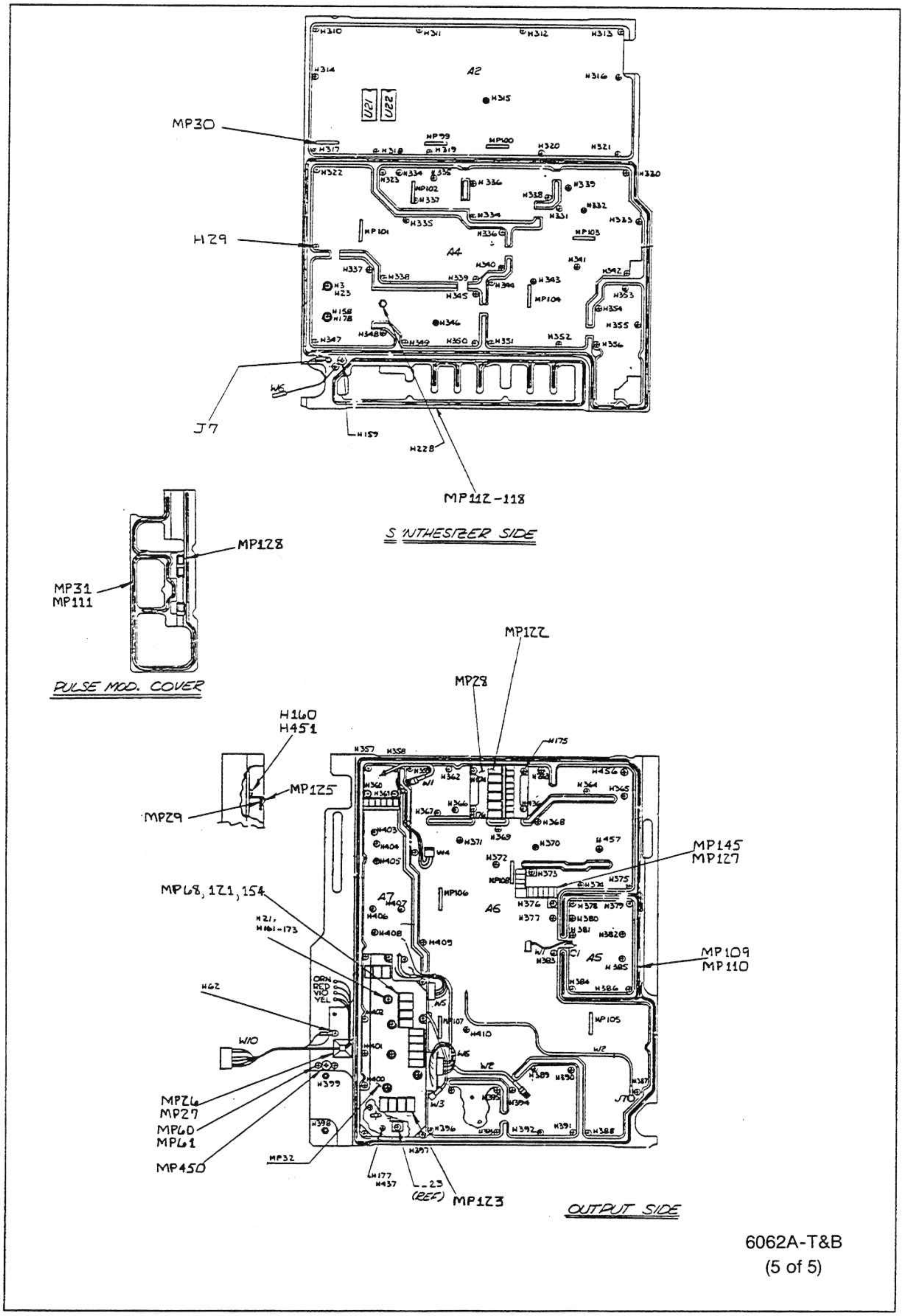
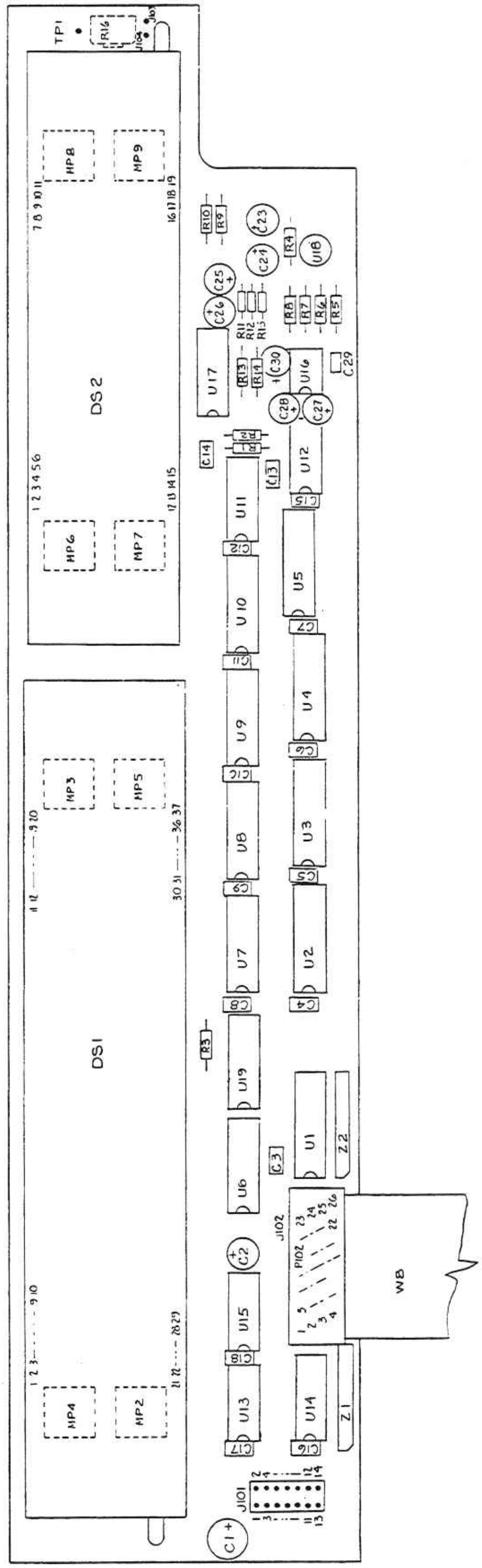


Figure 5-1. 6062A Final Assembly (cont)

Table 5-2. A1 Display PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,AL,10UF,+-20%,63V,SOLV PROOF	816843	62643	KME63T10RM5X11RP	1	
C 2, 27, 28, C 30	CAP,TA,10UF,+-20%,10V	176214 176214	56289	199D106X0010EA2	4	
C 3, 4, 9- C 14, 16, 17	CAP,POLYES,0.1UF,+-10%,50V	649913 649913	68919	MKS2104K50B	10	
C 5- 8, 15, C 18	CAP,POLYES,0.1UF,+-10%,50V	696484 696484	68919	MKS2-104K50B	6	
C 23, 24	CAP,TA,10UF,+-20%,20V	330662	56289	199D106X0020CA2	2	
C 25, 26	CAP,TA,39UF,+-20%,6V	163915	56289	199D396X0006DA2	2	
C 29	CAP,CER,1000PF,+-20%,100V,X7R	816181	04222	SR071C102MAA	1	
DS 1	DISPLAY,VACUUM FLUORESCENT,FREQUENCY	792713	0BW21	792713	1	
DS 2	DISPLAY VACUUM FLUORESCENT AMPLITUDE	698464	0BW21	698464	1	
J 101	PIN,SINGLE,PWB,0.025 SQ	267500	00779	87623-1	14	
J 103,104	PIN,SINGLE,PWB,0.058 DIA	233411	00779	60599-3	2	
MP 2- 9	FOOT,RUBBER,ADHES,BLK,.50 SQ,.12 THK	543488	28213	SJ-5008	8	
R 1, 2	RES,CF,100K,+-5%,0.25W	573584	59124	CF1/4 104J	2	
R 3	RES,CF,620,+-5%,0.25W	641092	59124	CF1/4 621J	1	
R 4	RES,MF,9.09K,+-1%,0.125W,100PPM	720573	91637	CMF-55 9091F T-1	1	
R 5	RES,MF,31.6K,+-1%,0.125W,100PPM	720060	91637	CMF-55 3162F T-1	1	
R 6	RES,MF,8.06K,+-1%,0.125W,100PPM	720524	91637	CMF-55 8061F T-1	1	
R 7	RES,MF,2K,+-1%,0.125W,100PPM	719815	91637	CMF-55 2001F T-1	1	
R 8	RES,MF,48.7K,+-1%,0.125W,100PPM	720300	91637	CMF-55 4872F T-1	1	
R 9, 10	RES,CF,30K,+-5%,0.25W	574251	59124	CF1/4 303J	2	
R 11- 14	RES,CC,10K,+-10%,0.125W	246975	01121	BB3035	4	
R 15	RES,CC,560,+-10%,0.125W	115303	01121	BB5611	1	
R 16	RES,VAR,CERM,5K,+-10%,0.5W	288282	80294	3386S-1-502	1	
TP 1	TERM,FASTON,TAB,.110,SOLDER	512889	00779	62395-1	1	
U 1- 4	ϟ IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	4	
U 5	ϟ IC,LSTTL,HEX D F/F,+EDG TRG,W/CLEAR	393207	01295	SN74LS174N	1	
U 6- 10	ϟ IC,BIPLR,8CHNL FLOURESCNT DISPLY DRVR	535799	56289	UDN-6118A	5	
U 11, 17	ϟ IC,LSTTL,RETRG MONOSTAB MULTIVB W/CLR	404186	01295	SN74LS123N	2	
U 12	ϟ IC,LSTTL,DUAL 4 INPUT AND GATE	408708	27014	DM74LS21N	1	
U 13, 15	ϟ IC,TTL,HEX INVERTER W/OPEN COLLECTOR	288605	27014	DM7416N	2	
U 14	ϟ IC,LSTTL,HEX BUFFER W/NOR ENABLE	483800	27014	DM74LS367AN	1	
U 16	ϟ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 18	ϟ BANDGAP REF DIODE, 1.22V, 35PPM TC	634154	27014	LM385BX-1.2	1	
U 19	ϟ IC,LSTTL,DUAL D F/F,+EDG TRG,W/CLR	393124	01295	SN74LS74AN	1	
W 8	CABLE ASSEMBLY, CONTROLLER-DISPLAY	738476	89536	738476	1	
Z 1	RES,CERM,SIP,10 PIN,9 RES,100K,+-2%	461038	91637	CSC10A-01-104G	1	
Z 2	RES,CERM,SIP,10 PIN,9 RES,10K,+-2%	414003	91637	CSC10A-01-103G	1	
NOTES:	ϟ Static sensitive part.					

Replaced w/ 698456



6062A-1611

Figure 5-2. A1 Display PCA

Table 5-3. A2 Controller PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,AL,47UF,+50-20%,16V	436006	62643	SM16VB-47	1	
C 2, 6, 7, C 10- 13, 16, C 18, 19, 21, C 23- 25, 28- C 31, 34, 35, C 39, 41, 42, C 44, 45	CAP,POLYES,0.22UF,+-10%,50V	706028 706028 706028 706028 706028 706028 706028	68919	MKS1224K50B	25	
C 3	CAP,TA,0.47UF,+-20%,35V	161349	56289	199D474X0035AA2	1	
C 4, 5	CAP,TA,10UF,+-20%,20V	330662	56289	199D106X0020CA2	2	
C 22, 46- 49, C 51, 53- 57	CAP,CER,220PF,+-10%,1000V,Z5F	368605 368605	60705	562C0B0CK102EC221K	11	
C 43, 50, 52, C 58, 59	CAP,CER,2000PF,+100-0%,1000V,Z5U	105569 105569	60705	562CZ5UCK102AE202P	5	
C 60	CAP,CER,100PF,+-10%,1000V,S3N	105593	60705	561CR3LCK102EF101K	1	
C 61	CAP,CER,56PF,+-2%,100V,C0G	512970	04222	SR151A560GAA	1	
CR 1	⚡ DIODE,SI,BV= 75.0V,IO=150MA,500MW	698720	65940	1N4448	1	
J 1, 5, 7	PIN,SINGLE,PWB,0.025 SQ	267500	00779	87623-1	53	
J 6	HEADER,2 ROW,.100CTR,RT ANG,26 PIN	512590	00779	1-87230-3	1	
L 1, 2, 4	CHOKE,6TURN	320911	89536	320911	3	
L 3	INDUCTOR,4.7UH,+-10%,7MHZ,SHLD	174722	24759	MR-4.70K	1	
P 1, 2	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	19	
R 1, 6- 11	RES,CF,180,+-5%,0.25W	573048	59124	CF1/4 181J	7	
R 2, 13	RES,CF,4.7K,+-5%,0.25W	573311	59124	CF1/4 472J	2	
R 3	RES,CF,20K,+-5%,0.25W	573444	59124	CF1/4 203J	1	
R 4	RES,CF,390K,+-5%,0.25W	573667	59124	CF1/4 394J	1	
R 5	RES,CF,100K,+-5%,0.25W	573584	59124	CF1/4 104J	1	
R 12	RES,CF,100,+-5%,0.25W	573014	59124	CF1/4 101J	1	
R 14, 15	RES,CF,1.3K,+-5%,0.25W	573204	59124	CF1/4 132J	2	
S 1	SWITCH,MODULE,SPST,DIP,SEALED,6 POS	831909	00779	5-435166-1	1	
U 1	⚡ IC,NMOS,16 BIT MICROCOMPUTER	640417	01295	MP9572N	1	
U 2	⚡ IC,LSTTL,HEX BUFFER W/NOR ENABLE	483800	27014	DM74LS367AN	1	
U 3, 4, 18	⚡ IC,LSTTL,OCTL BUS TRNSCVR W/3-ST OUT	477406	01295	SN74LS245N	3	
U 5	⚡ IC,LSTTL,HEX INVERTER	393058	01295	SN74LS04N	1	
U 7	⚡ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 8	⚡ IC,LSTTL,TRIPLE 3 INPUT NAND GATE	393074	27014	DM74LS10N	1	
U 9	⚡ IC,LSTTL,HEX D F/F,+EDG TRG,W/CLEAR	393207	01295	SN74LS174N	1	
U 10	⚡ IC,STTL,QUAD 2 INPUT OR GATE	604629	01295	SN74S32N	1	
U 11, 40	⚡ IC,LSTTL,OCTAL D TRANSPARENT LATCHES	504514	27014	DM74LS273N	2	
U 14	⚡ IC,LSTTL,2-4 LINE DEMUX	393165	01295	SN74LS139AN	1	
U 15, 16, 33, U 34	⚡ IC,LSTTL,OCTL LINE DRVR W/3-STATE OUT ⚡	429035 429035	01295	SN74LS244N	4	
U 17, 27	⚡ IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	2	
U 20	⚡ IC,16L8A, LOG ARRAY,6062A-90201	811620	50364	811620	1	
U 21	PROM, PROGRAMMED, 27256, FIRST HALF	797985	89536	797985	1	
U 22	PROM, PROGRAMMED, 27256, SECOND HALF	797977	89536	797977	1	
U 24	IC, NMOS, 2K X 8 EEPROM, 350 NS	811075	60395	X2816BP-25	1	
U 25	⚡ IC,CMOS,8K X 8 STAT RAM,200 NSEC,NVM	810804	0B0A9	DS1225Y-200	1	
U 30, 31	⚡ IC,ARRAY,7 TRANS,NPN,DARLINGTON PAIRS	454116	01295	ULN2003AN	2	
U 35, 36	⚡ IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	27014	DM74LS138N	2	
U 37	⚡ IC,LSTTL,QUAD 2 INPUT OR GATE	393108	01295	SN74LS32N	1	
U 42	⚡ IC,LSTTL,DUAL JK F/F,-EDG TRIG	414029	01295	SN74LS112N	1	
U 44	⚡ IC,LSTTL,HEX INVERTER W/SCHMT TRIG	483180	27014	DM74LS14N	1	
U 46	⚡ IC,LSTTL,QUAD BUS BFR W/3-STATE OUT	472746	27014	DM74LS125AN	1	
XU 1	SOCKET,IC,40 PIN	429282	00779	2-640379-1	1	
XU 20	SOCKET,IC,20 PIN	454421	00779	2-640464-1	1	

Table 5-3. A2 Controller PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
XU 21, 22, 25	SOCKET,IC,28 PIN	448217	91506	228-AG39D	3	
XU 24, 26	SOCKET,IC,24 PIN	376236	00779	2-640361-1	2	
XU 30, 31	SOCKET,IC,16 PIN	276535	00779	2-640358-1	2	
Y 1	CRYSTAL,10MHZ,+-0.01%,HC-18/U	520239	89536	520239	1	
Z 1	RES,CERM,SIP,10 PIN,9 RES,4.7K,+-2%	484063	91637	CSC10A-01-472G	1	
Z 2- 5	RES,CERM,SIP,10 PIN,9 RES,10K,+-2%	414003	91637	CSC10A-01-103G	4	
NOTES:	ϟ Static sensitive part.					

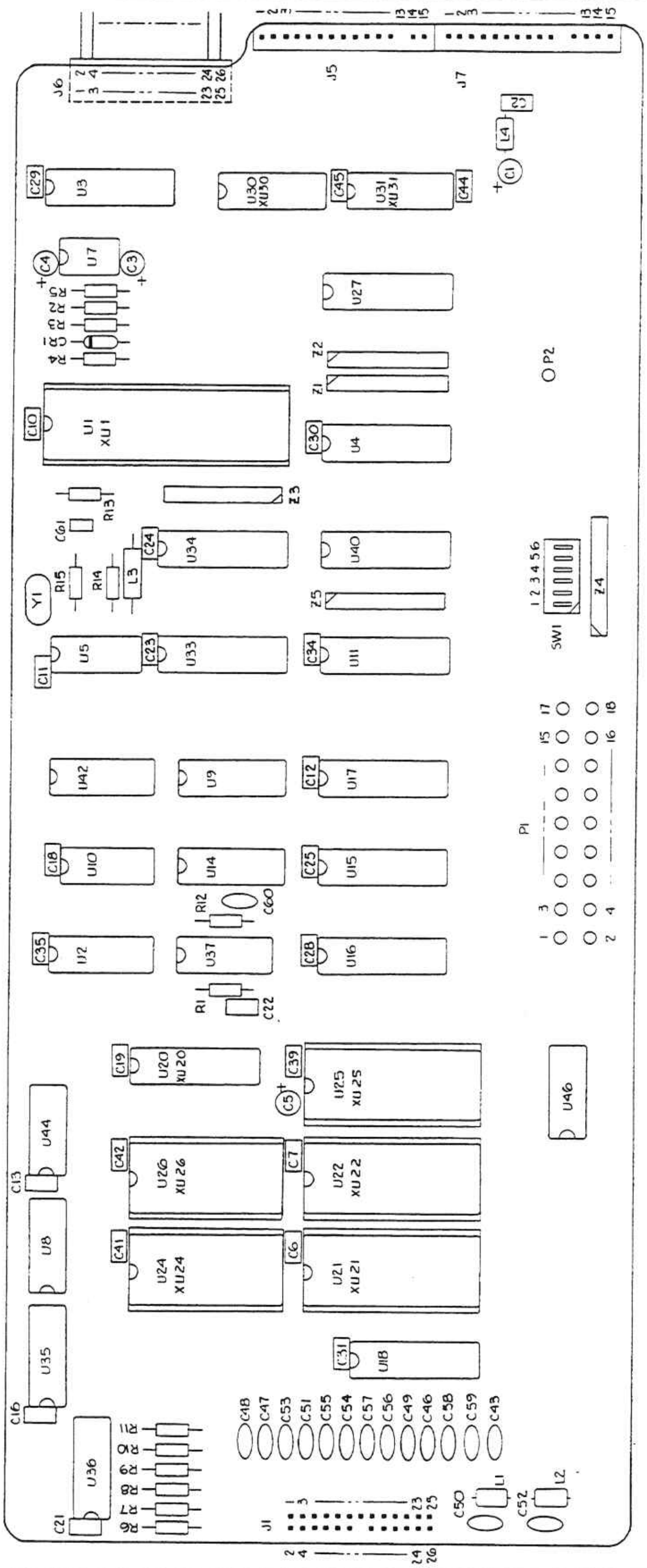


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Figure 5-3. A2 Controller PCA

Table 5-4. A3 IEEE-488 Interface PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 4, 6,3 C 7, 9- 11	CAP,POLYES,0.22UF,+-10%,50V	706028 706028	68919	MKS1224K50B	9	
H 1, 2	BOARD SPACER	856224	89536	856224	2	
J 1	CONN,MICRO-RIBBON,REC,PWB,RA,24 POS	658039	00779	553811-1	1	
L 1- 3	CHOKE,6TURN	320911	89536	320911	3	
P 1	SOCKET,2 ROW,PWB,0.100C,RT ANG,26 POS	543512	00779	2-535512-0	1	
R 1	RES,CF,1K,+-5%,0.25W	343426	59124	CF1/4 102J	1	
S 1	SWITCH,DIP,SPST,PIANO,SEALED,8 POS	658567	00779	1-435802-5	1	
U 1	ϟ IC,NMOS,GPIB TALKER/LISTENER/CNTRLR	773143	33297	UPD7210 (C OR D)	1	
U 3, 4	ϟ IC,LSTTL,OCTL IEEE-488 BUS TRANSCVR	524835	04713	MC3447P3	2	
U 6	ϟ IC,LSTTL,OCTAL D TRANSPARENT LATCHES	504514	27014	DM74LS273N	1	
U 7	ϟ IC,LSTTL,OCTL BUS TRNSCVR W/3-ST OUT	477406	01295	SN74LS245N	1	
U 8	ϟ IC,TTL,QUAD 2 INPUT AND GATE	393066	01295	SN74LS08N	1	
Z 1- 4	RES,CERM,SIP,10 PIN,9 RES,10K,+-2%	414003	91637	CSC10A-01-103G	4	
NOTES:	ϟ Static sensitive part.					

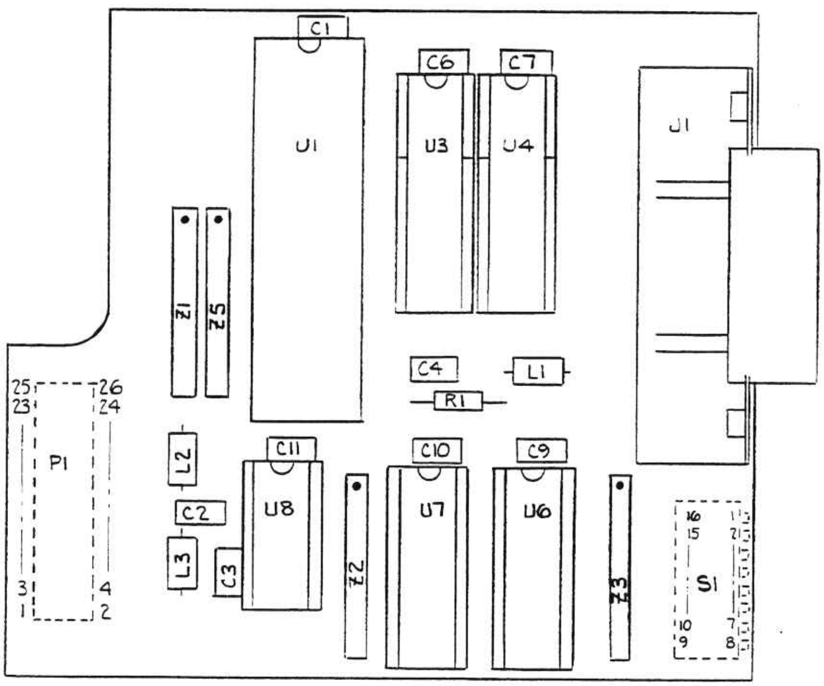

Figure 5-4. A3 IEEE-488 Interface PCA

Table 5-5. A4 Synthesizer PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 2	CAP,CER,2.7PF,+-0.5PF,50V,COG,0805	519793	04222	08055A2R7DA1.65R	2	
C 3, 4, 6, C 9- 12, 15- C 18, 20, 23, C 62, 98,100, C 181,182,185, C 186,189,190, C 193,196,198, C 199,215	CAP,CER,1000PF,+-20%,100V,X7R	837542 837542 837542 837542 837542 837542 837542 837542	04222	SR151C102MAA	27	
C 5, 14, 22, C 27, 30, 31, C 36, 37, 49, C 55, 59- 61, C 63, 65, 69, C 70, 72- 74, C 76- 81, 83, C 84, 87, 88, C 101-106,108, C 110,112,120, C 122,132,133, C 135,138,140- C 145,151,152, C 157,158,164, C 165,168,169, C 174,175,180, C 184,188,191, C 192,194,195, C 200,244-246, C 250,251,253	CAP,POLYES,0.1UF,+-20%,50V	837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526 837526	4U402	MKT1823 104 05 6	75	
C 7, 13, 39, C 40, 43, 52, C 53,205,231- C 234	CAP,CER,470PF,+-20%,100V,X7R	837617 837617 837617 837617	04222	SR151C471MAA	12	
C 8, 21	CAP,CER,6.8PF,+-0.25PF,100V,COH	512327	51406	RPE110COH6R8C1	2	
C 19	CAP,CER,4.7PF,+-0.25PF,100V,COH	362772	51406	RPE110COH4R7C1	1	
C 24, 26, 28, C 64, 89,137, C 139,146,252	CAP,CER,100PF,+-2%,100V,COG	837609 837609 837609	04222	SR151A101GAA	9	
C 25	CAP,CER,10PF,+-5%,50V,COG,0805	494781	51406	GRH708COG100J200PB	1	
C 29, 38,171, C 202	CAP,CER,47PF,+-2%,100V,COG	812123 812123	04222	SR291A470GAA	4	
C 32	CAP,POLYPR,470PF,+-1%,100V	844811	68919	FKP2 471F 100V	1	
C 33	CAP,POLYPR,100PF,+-1%,100V	844803	68919	FKP2 101F 100V	1	
C 34	CAP,POLYPR,330PF,+-1%,100V	844808	68919	FKP2 331F 100V	1	
C 35	CAP,POLYPR,1000PF,+-1%,100V	844816	68919	FKP2 102F 100V	1	
C 41, 42	CAP,POLYES,0.047UF,+-10%,50V	714709	68919	MKS2473K50B	2	
C 48	CAP,POLYES,0.015UF,+-10%,50V	714691	68919	MKS2-153K50B	1	
C 50,207	CAP,POLYES,0.082UF,+-10%,50V	807859	68919	MKS2-823K50B	2	
C 51	CAP,POLYES,0.1UF,+-10%,50V	649913	68919	MKS2104K50B	1	
C 54, 71, 91, C 127,166	CAP,TA,10UF,+-20%,10V	176214 176214	56289	199D106X0010EA2	5	
C 58, 82,107, C 150	CAP,TA,39UF,+-20%,6V	163915 163915	56289	199D396X0006DA2	4	
C 75, 85, 86, C 95,242,243	CAP,CER,22PF,+-2%,100V,COG	512871 512871	04222	SR151A220GAA	6	
C 92, 93,128	CAP,TA,10UF,+-20%,35V	417683	56289	199D106X0035DA2	3	
C 94	CAP,TA,10UF,+-20%,50V	800516	56289	199D106X0050FA2	1	
C 99	CAP,POLYST,0.0075UF,2%,100V	484121	84411	1263UW7522%100V	1	
C 109,111	CAP,TA,15UF,+-20%,20V	519686	56289	199D156X0020DA2	2	
C 113,114	CAP,POLYES,0.22UF,+-10%,50V	706028	68919	MKS1224K50B	2	
C 115	CAP,POLYPR,0.0786UF,+-1%,50V	422998	84411	JF-86.07861%50V	1	
C 116,117	CAP,TA,3.3UF,+-20%,20V	436071	56289	199D335X0020BA2	2	
C 118,183,187	CAP,POLYES,0.47UF,+-10%,50V	697409	68919	MKS2474K50B	3	
C 119,121	CAP,CER,1000PF +-5%,50V,COG	528539	04222	SR215A102JAA	2	
C 123	CAP,POLYST,0.022UF,+-5%,100V	484147	84411	1263UW2235%100V	1	

Table 5-5. A4 Synthesizer PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 124	CAP,POLYST,0.056UF,+-5%,100V	284877	84411	1263UW5645%100V	1	
C 125	CAP,POLYST,0.027UF,+-5%,100V	484154	84411	1263UW02735%100V	1	
C 126	CAP,POLYST,0.0015UF,+-2%,100V	484113	84411	1263UW1522%100V	1	
C 129,130	CAP,TA,82UF,+-20%,20V	357392	56289	199D826X0020FA2	2	
C 131	CAP,POLYCA,10UF,+-10%,50V	807164	84411	JF126-10610%50V	1	
C 134	CAP,TA,15UF,+-20%,6V	161935	56289	199D156X0006BA2	1	
C 136	CAP,TA,2.2UF,+-10%,15V	364216	56289	199C225X9015AA2	1	
C 153,154,160, C 254	CAP,CER,4700PF,+-20%,100V,X7R	362871 362871	04222	SR151C472MAA	4	
C 155,156,159, C 161,162,167, C 248	CAP,TA,10UF,+-20%,20V	330662 330662 330662	56289	199D106X0020CA2	7	
C 163	CAP,POLYES,0.022UF,+-10%,50V	715268	68919	MKS2-223K50B	1	
C 170	CAP,CER,33PF,+-2%,100V,C0G	513226	04222	SR151A330GAA	1	
C 173,208,209	CAP,AL,220UF,+50-20%,16V	435990	62643	SM16VB-220	3	
C 176	CAP,POLYES,0.27UF,+-10%,50V	807867	68919	MKS2-274K50B	1	
C 177	CAP,POLYES,0.15UF,+-10%,50V	714790	68919	MKS2-154K50B	1	
C 178	CAP,TA,6.8UF,+-20%,35V	363713	56289	199D685X0035DA2	1	
C 179	CAP,CER,2200PF,+-20%,100V,X7R	358291	04222	SR151C222MAA	1	
C 197,219,227, C 247	CAP,CER,10PF,+-2%,100V,C0G	512343 512343	51406	RPE110A100G1	4	
C 201	CAP,CER,68PF,+-2%,100V,C0G	362756	04222	SR291A680GAA	1	
C 204	CAP,CER,330PF,+-5%,100V,C0G	528620	04222	SR151A331JAA	1	
C 206	CAP,VAR,0.8-10PF,250V,AIR	229930	51406	MVM010W-3	1	
C 210,211,214, C 216,218,224- C 226,228,230	CAP,CER,180PF,+5%,100V,C0G	837625 837625 837625	04222	SR151A181JAA	10	
C 212,222	CAP,CER,1000PF,+-10%,50V,X7R,0805	484378	04222	08055C102KAT060R	2	
C 213,223	CAP,CER,6.8PF,+-0.5PF,50V,C0G,0805	479196	04222	08055A6R8DAT1.65R	2	
C 217	CAP,CER,4.3PF,+-0.5PF,50V,C0G,0805	514216	51406	GRH708C0G4R3D200PB	1	
C 220	CAP,CER,3.9PF,+-0.25PF,100V,C0J	512947	51406	RPE110C0J3R9C1	1	
C 221	CAP,AL,470UF,+-20%,16V,SOLV PROOF	772855	62643	KME16T471M10X12.5MC	1	
C 240	CAP,VAR,1 TO 10PF,250V,AIR	733212	91293	8052	1	
C 249	CAP,TA,47UF,+-20%,10V	733246	56289	199D476X0010DG2	1	
CR 2	ϟ FALLOUT FROM 387217	731976	89536	731976	1	
CR 5- 8, 17, CR 18, 20, 21	ϟ DIODE,SI,BV-75V,IO-150MA,500MW ϟ	203323 203323	09214	IN4448	8	
CR 11	ϟ ZENER,UNCOMP,10.0V,10%,12.5MA,0.4W	113324	04713	1N961A	1	
CR 12- 15, 29	ϟ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	313247	28480	5082-6264 T25	5	
CR 16	ϟ ZENER,UNCOMP,8.2V,5%,20.0MA,0.4W	386771	04713	1N756	1	
CR 22, 24, 28	DIODE,SI,VARACTOR,P1V- 30V,HYPER ABRU	722140	33297	IS2208B	3	
CR 26, 27	DIODE,SI,VARACTOR,PIV-28V,18PF	912126	50579	BB505B(Q62702-B37)	2	
CR 30	ϟ DIODE,SI,PIN,DUAL,SOT-23	821108	50579	BAR14-1(Q62702-A772)	1	
J 2,112	CONN,COAX,SMB(M),PWB OR PANEL	512095	98291	051-051-0429-220	2	
J 101,102	SOCKET,1 ROW,PWB,0.100CTR,9 POS	436774	30035	SS-109-1-09	2	
J 104,107,108, J 110	SOCKET,SINGLE,PWB,FOR 0.034-0.037 PIN	732826 732826	00779	2-332070-7	4	
L 1, 18, 21, L 23, 29- 32, L 34, 65	CHOKE,6TURN	320911 320911 320911	89536	320911	10	
L 2, 71, 72	INDUCTOR,0.10UH,+-10%,400MHZ,SHLD	257154	24759	MR-0.10J&K	3	
L 3, 4, 19, L 20, 40- 42, L 44, 56- 58	INDUCTOR,0.68UH,+-10%,221MHZ,SHLD	320937 320937 320937	24759	MR-0.68J&K	11	
L 5, 10, 63, L 64	CORE,TOROID,FERRITE,.047X.138X.118	321182 321182	0LUA3	56-590-65-4B	4	
L 11	INDUCTOR,150UH,+-5%,10.5MHZ,SHLD	174763	24759	MR-150J	1	

Table 5-5. A4 Synthesizer PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
L 17	INDUCTOR,220UH,+-5%,9.4MHZ,SHLD	147835	24759	MR-220J	1	
L 43	INDUCTOR,10UH,+-10%,53MHZ,SHLD	249078	24759	MR-10J&K	1	
L 49	INDUCTOR ADJ 8.4MH	704999	89536	704999	1	
L 50	INDUCTOR ADJ 11.1MH	705004	89536	705004	1	
L 54	INDUCTOR,270UH,+-5%,8MHZ,SHLD	186270	24759	MR-270J	1	
L 59	INDUCTOR, 125UH	738484	89536	738484	1	
L 62	INDUCTOR,470UH,+-5%,6.5MHZ,SHLD	147827	24759	MR-470J	1	
L 66	INDUCTOR,0.82UH,+-10%,200MHZ,SHLD	320945	24759	MR-0.82J&K	1	
L 67, 68	CORE,TOROID,FERRITE,.079X.185X.291	219535	25088	B62110-A5030-X025-C	2	
L 70	INDUCTOR,0.044UH,+-15%,500MHZ,SHLD	249110	72259	249110	1	
L 73	INDUCTOR,22UH,+-10%,38MHZ,SHLD	147843	24759	MR-22J&K	1	
MP 1	COMPONENT HOLDER	422865	98159	2829-75-2	1	
MP 2	BRACKET, SMB	774455	89536	774455	1	
P 101,102,111- P 115	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056 544056	00779	50871-1	7	
P 118-125	PIN,SINGLE,PWB,0.025 SQ	277418	00779	1-87022-3	8	
Q 1	ϟ IC,VOLT REG,FIXED,+5 VOLTS,0.1 AMPS	429910	04713	MC78L05ACP	1	
Q 2, 22	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	04713	2N3906	2	
Q 3	ϟ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	723379	61636	BFR96S	1	
Q 4, 5, 41, Q 42	ϟ TRANSISTOR,SI,PNP,HI-SPEED SWITCH ϟ	369629 369629	04713	MPS5771	4	
Q 10- 12	ϟ TRANSISTOR,SI,N-JFET,TO-92	604678	17856	J2464	3	
Q 13, 14	ϟ TRANSISTOR,SI,N-DMOS FET,TO-72	783308	17856	SD215DE	2	
Q 15, 21, 23	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,TO-92	218396	04713	2N3904	3	
Q 16, 17	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	248351	04713	MPS918	2	
Q 18, 19	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	225599	07263	2N4250	2	
Q 20	ϟ TRANSISTOR,SI,NPN,DARLINGTON	381798	04713	MPSA13	1	
Q 26, 27, 38	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	218081	04713	MPS6520	3	
Q 28	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	418707	07263	MPS6562	1	
Q 32, 35	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	483156	33297	NE02135D-T1	2	
Q 33, 37	ϟ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	535013	04713	BFR91	2	
Q 39, 40	ϟ TRANSISTOR,SI,N-JFET,UHF/VHF USE	403634	17856	J2765	2	
R 1	RES,CC,68,+-5%,0.5W	178384	01121	EB6805	1	
R 2,159,201, R 209,250	RES,CF,0.51,+-5%,0.25W	381954 381954	59124	CF1/4 0R51J	5	
R 3, 45	RES,CF,51,+-5%,0.125W	740050	59124	RDS21/8-510J	2	
R 5, 14, 15	ϟ RES,CERM,15,+-5%,.125W,200PPM,1206	756940	91637	CRCW1206-150JB	3	
R 6, 7	ϟ RES,CERM,390,+-5%,.125W,200PPM,1206	740498	91637	CRCW1206-3900JB	2	
R 9	RES,CC,1K,+-5%,0.125W	643932	01121	BB1025	1	
R 10, 44, 94, R 154,169,170	RES,CF,1K,+-5%,0.25W	343426 343426	59124	CF1/4 102J	6	
R 11, 73	RES,CF,3.3K,+-5%,0.25W	348813	59124	CF1/4 332J	2	
R 12,102,119, R 129	RES,CF,10K,+-5%,0.25W	348839 348839	59124	CF1/4 102J	4	
R 13	RES,CC,270,+-5%,0.5W	159616	01121	EB2715	1	
R 20,147,186, R 218,219	RES,MF,47.5,+-1%,0.25W,100PPM	799700 799700	91637	CCF-50 47R5F	5	
R 21, 22	RES,CC,15,+-10%,0.125W	261800	01121	BB1531	2	
R 23, 24, 40, R 228	RES,CF,56,+-5%,0.25W	342618 342618	59124	CF1/4 560J	4	
R 25, 32	RES,MF,51.1,+-1%,0.25W,100PPM	799650	91637	CCF-50 51R1F	2	
R 26, 31, 65, R 101	RES,MF,100,+-1%,0.125W,100PPM	168195 168195	91637	CMF-55 1000F T-1	4	
R 27	RES,MF,18.2K,+-1%,0.125W,100PPM	236810	91637	CMF-55 1822F T-1	1	
R 28	RES,MF,10.7K,+-1%,0.125W,100PPM	293613	91637	CMF-55 1072F T-1	1	

Table 5-5. A4 Synthesizer PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 29	RES,MF,11.3K,+-1%,0.125W,100PPM	293639	91637	CMF-55 1132F T-1	1	
R 30	RES,MF,28.7K,+-1%,0.125W,100PPM	235176	91637	CMF-55 2872F T-1	1	
R 33,161	RES,CF,51,+-5%,0.25W	414540	59124	CF1/4 510J	2	
R 39	RES,CF,200,+-5%,0.25W	441451	59124	CF1/4 201J	1	
R 41	RES,CF,270,+-5%,0.25W	348789	59124	CF1/4 271J	1	
R 42	RES,CF,180,+-5%,0.25W	441436	59124	CF1/4 181J	1	
R 43	RES,CF,91,+-5%,0.25W	441683	59124	CF1/4 910J	1	
R 46,165,167, R 171,172,177, R 211	RES,MF,511,+-1%,0.25W,100PPM	799684 799684 799684	91637	CCF-50 5110F	7	
R 48,117,118	RES,CF,220,+-5%,0.25W	342626	59124	CF1/4 221J	3	
R 49	RES,MF,39.2,+-1%,0.25W,100PPM	799775	91637	CCF-50 39R2F	1	
R 50	RES,MF,82.5,+-1%,0.25,100PPM	799783	91637	CCF-50 82R5F	1	
R 51	RES,MF,130,+-1%,0.25W,100PPM	854406	91637	CCF-50 1300F	1	
R 55	RES,CF,2.7K,+-5%,0.25W	386490	59124	CF1/4 272J	1	
R 56- 58, 66- R 69,124,127, R 133-139,210, R 212	RES,MF,100,+-1%,0.25W,100PPM	799668 799668 799668 799668	91637	CCF-50 1000F	18	
R 72	RES,CF,51K,+-5%,0.25W	376434	59124	CF1/4 513J	1	
R 74,100,103	RES,CF,1.5K,+-5%,0.25W	343418	59124	CF1/4 152J	3	
R 75	RES,MF,4.22K,+-1%,0.125W,100PPM	168245	91637	CMF-55 4221F T-1	1	
R 76	RES,MF,10K,+-1%,0.125W,100PPM	168260	91637	CMF-55 1002F T-1	1	
R 77	RES,MF,90K,+-0.1%,0.25W,50PPM	225763	91637	CMF-60 9002B T-2	1	
R 78	RES,MF,9K,+-0.1%,0.25W,50PPM	236695	91637	CMF-60 9001C T-2	1	
R 79	RES,MF,1K,+-0.1%,0.25W,50PPM	225813	91637	CMF-60 1001B T-2	1	
R 80, 88	RES,MF,4.99K,+-1%,0.125W,100PPM	168252	91637	CMF-55 4991F T-1	2	
R 81,182,191	RES,MF,1K,+-1%,0.125W,100PPM	168229	91637	CMF-55 1001F T-1	3	
R 82, 87	RES,VAR,CERM,5K,+-10%,0.5W	327569	80294	3386R-1-502	2	
R 83	RES,CF,75K,+-5%,0.25W	394130	59124	CF1/4 753J	1	
R 84	RES,MF,6.49K,+-1%,0.125W,100PPM	294900	91637	CMF-55 6491F T-1	1	
R 85,223	RES,MF,6.04K,+-1%,0.125W,100PPM	285189	91637	CMF-55 6041F T-1	2	
R 86	RES,CF,200K,+-5%,0.25W	441485	59124	CF1/4 204J	1	
R 89	RES,MF,5.11K,+-1%,0.125W,100PPM	294868	91637	CMF-55 5111F T-1	1	
R 90	RES,VAR,CERM,1K,+-10%,0.5W	275750	80294	3386R-1-102	1	
R 91	RES,MF,3.83K,+-1%,0.125W,100PPM	235143	91637	CMF-55 3831F T-1	1	
R 92, 93,113- R 115	RES,MF,499,+-1%,,0.125W,100PM	168211 168211	91637	CMF-55 4990F T-1	5	
R 95	RES,CF,9.1K,+-5%,0.25W	441691	59124	CF1/4 912J	1	
R 96	RES,CF,820,+-5%,0.25W	442327	59124	CF1/4 821J	1	
R 97	RES,CF,6.8K,+-5%,0.25W	368761	59124	CF1/4 682J	1	
R 98,121	RES,CF,100,+-5%,0.25W	348771	59124	CF1/4 101J	2	
R 99	RES,MF,1.5K,+-1%,0.125W,100PPM	313098	91637	CMF-55 1501F T-1	1	
R 104	RES,VAR,CERM,20K,+-10%,0.5W	335760	80294	3386R-1-203	1	
R 105	RES,CF,10K,+-5%,0.25W	697102	59124	CF1/4 103J	1	
R 106	RES,CF,470,+-5%,0.25W	854567	59124	CF1/4 471J	1	
R 107	RES,MF,3.48K,+-1%,0.125W,100PPM	260687	91637	CMF-55 3481F T-1	1	
R 108,116	RES,MF,1.27K,+-1%,0.125W,100PPM	267369	91637	CMF-55 1271F T-1	2	
R 109,111	RES,CC,510,+-5%,0.5W	108951	01121	EB5115	2	
R 110,112	RES,CF,36,+-5%,0.25W	442236	59124	CF1/4 360J	2	
R 120,163	RES,CF,4.7K,+-5%,0.25W	348821	59124	CF1/4 472J	2	
R 122	RES,CF,8.2K,+-5%,0.25W	441675	59124	CF1/4 822J	1	
R 123	RES,CF,33K,+-5%,0.25W	348888	59124	CF1/4 333J	1	
R 125	RES,VAR,CERM,5K,+-20%,0.5W	226084	80294	3329H-1-502	1	
R 145	RES,MF,301,+-1%,0.25W,100PPM	799916	91637	CCF-50 3010F	1	

Table 5-5. A4 Synthesizer PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 146	RES,MF,18.2,+-1%,0.25W,100PPM	799817	91637	CCF-50 18R2F	1	
R 148,153,162, R 225,226	RES,MF,10K,+-1%,0.25W,100PPM	799635 799635	91637	CCF-50 1002F	5	
R 149,217,240	RES,CC,330,+-5%,0.125W	643965	01121	BB3315	3	
R 150	RES,CC,1.2K,+-10%,0.125W	115329	01121	BB1221	1	
R 151,222	RES,MF,1K,+-1%,0.25W,100PPM	799791	91637	CCF-50 1001F	2	
R 152	RES,CF,470,+-5%,0.25W	343434	59124	CF1/4 471J	1	
R 160	RES,CF,750,+-5%,0.25W	441659	59124	CF1/4 751J	1	
R 164	RES,CF,300,+-5%,0.25W	441519	59124	CF1/4 301J	1	
R 178,179	RES,CF,5.6,+-5%,0.25W	441618	59124	CF1/4 5R6J	2	
R 180,192	RES,MF,178,+-1%,0.125W,100PPM	442996	91637	CMF-55 1780F T-1	2	
R 181,193	RES,MF,1.05K,+-1%,0.125W,100PPM	293530	91637	CMF-55 1051F T-1	2	
R 183,194	RES,MF,3.24K,+-1%,0.125W,100PPM	223578	91637	CMF-55 3241F T-1	2	
R 184,195,197, R 200	RES,MF,182,+-1%,0.25W,100PPM	799726 799726	91637	CCF-50 1820F	4	
R 185,199	RES,MF,249,+-1%,0.125W,100PPM	168203	91637	CMF-55 2490F T-1	2	
R 187,189	RES,MF,121,+-1%,0.25W,100PPM	799734	91637	CCF-50 1210F	2	
R 188,196	RES,MF,12.1,+-1%,0.25W,100PPM	799742	91637	CCF-50 12R1F	2	
R 190	RES,CF,5.1,+-5%,0.25W	441287	59124	CF1/4 5R1J	1	
R 198,241	RES,MF,30.1,+-1%,0.25W,100PPM	799692	91637	CCF-50 30R1F	2	
R 213,214,242	RES,MF,200,+-1%,0.25W,100PPM	799759	91637	CCF-50 2000F	3	
R 220	RES,CC,270,+-5%,0.125W	512764	01121	BB2715	1	
R 221	RES,CF,15K,+-5%,0.25W	348854	59124	CF1/4 153J	1	
R 224	RES,MF,15K,+-1%,0.125W,100PPM	285296	91637	CMF-55 1502F T-1	1	
R 227	RES,MF,100K,+-1%,0.125W,100PPM	248807	91637	CMF-55 1003F T-1	1	
R 229	RES,MF,9.09K,+-1%,0.125W,100PPM	221663	91637	CMF-55 9091F T-1	1	
R 230	RES,VAR,CERM,2K,+-20%,0.5W	226076	80294	3329H-1-202	1	
R 231	RES,MF,4.02K,+-1%,0.125W,100PPM	235325	91637	CMF-55 4021F T-1	1	
R 232	RES,CF,1.3K,+-5%,0.25W	441394	59124	CF1/4 132J	1	
R 233	RES,MF,681,+-1%,0.25W,100PPM	782052	91637	CCF-50 6810F	1	
R 234	RES,CC,15K,+-5%,0.25W	148114	01121	CB1535	1	
R 235	RES,CF,1M,+-5%,0.25W	348987	59124	CF1/4 105J	1	
R 236	RES,CC,560,+-5%,0.125W	782839	91637	BB5615	1	
R 237	RES,CC,100,+-10%,0.125W	261826	01121	BB1011	1	
R 238,239	RES,CC,390,+-5%,0.125W	782821	91637	BB3915	2	
TO 35	TERM,FASTON,TAB,.110,SOLDER	512889	00779	62395-1	15	
TP 1, 3, 14, TP 17, 35, 55	PIN,SINGLE,PWB,0.025 SQ	267500 267500	00779	87623-1	6	
U 1	ϟ IC,BIP,2.4 GHZ DIVIDE BY 2 PRESCALER	887018	33297	UPB581C	1	
U 2	ϟ IC,AMPLIFIER,WIDEBAND,1000 MHZ,SOT143	887013	33297	UPC1688G	1	
U 3	ϟ IC,AMPLIFIER,WIDEBAND,1900 MHZ,SOT143	887005	33297	UPC1675G	1	
U 7, 8	MIXER,DOUBLE BALANCED,1 - 500 MHZ	733105	1AV65	SBL-1-27	2	
U 9	ϟ IC,BPLR,MONOLITHIC VHF-UHF AMPLIFIER	723387	33297	UPC1654A	1	
U 10	ϟ IC,OP AMP,QUAD,JFET INPUT,14 PIN DIP	483438	01295	TL084CN	1	
U 15, 58	ϟ IC,STTL,100MHZ DIV BY 2,DIV BY 5 CNTR	473835	01295	SN74S196N	2	
U 16	ϟ IC,LSTTL,DUAL DIV BY 2,DIV BY 5 CNTR	483594	01295	SN74LS390N	1	
U 17	ϟ IC,STTL, 360 CELL GATE ARRAY	723718	61271	MB112T301	1	
U 18, 62, 63	ϟ IC,ECL,DUAL D M/S F/F,+EDG TRG	837252	04713	MC10H131L	3	
U 19	ϟ IC,ECL,QUAD 2 INPUT NOR GATE	851613	04713	MC10H102P	1	
U 20	ϟ IC,ECL,600MHZ DIV BY 10,DIV BY 11 CNT	504423	07263	11C90DCQR	1	
U 26, 30- 32	ϟ IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR	454892	01295	SN74LS273N	4	

Table 5-5. A4 Synthesizer PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 27, 29	⚡ IC,CMOS,10BIT DAC,10BIT ACCUR,CUR OUT	802280	24355	AD7533LN	2	
U 28	⚡ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495192	27014	LF353N	1	
U 33	⚡ IC,STTL, 360 CELL GATE ARRAY	723700	61271	MB112T302	1	
U 34	⚡ IC,FTTL,QUAD 2 INPUT NAND GATE	654640	04713	MC74F00N	1	
U 35, 66	⚡ IC,FTTL,DUAL D F/F,+EDG TRG,W/CL&SET	659508	04713	MC74F74N	2	
U 37	⚡ IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	27014	DM74LS138N	1	
U 38	⚡ IC,LSTTL,OCTL LINE DRVR W/3-STATE OUT	429035	01295	SN74LS244N	1	
U 41	⚡ IC,OP AMP,QUAD JFET INPUT,14 PIN DIP	659748	01295	TL074CN	1	
U 42	⚡ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	1	
U 43, 44, 59, U 68	⚡ IC,STTL,DUAL D F/F,+EDG TRG,W/SET&CLR ⚡	418269 418269	01295	SN74S74N	4	
U 45, 54, 65	⚡ IC,STTL,QUAD 2 INPUT NAND GATE	363580	01295	SN74S00N	3	
U 46	⚡ IC,ARRAY,5 TRANS,5 ISO: 2-PNP,3-NPN	418954	34371	CA3096E	1	
U 47, 71	⚡ IC,LSTTL,RETRG MONOSTAB MULTIVB W/CLR	412734	27014	DM74LS122N	2	
U 48, 60, 69	⚡ IC,OP AMP,JFET INPUT,8 PIN DIP	472779	27014	LF356N	3	
U 49	⚡ IC,OP AMP,SELECTED GBW 600KHZ	418566	18324	LM358	1	
U 50	⚡ ISOLATOR,OPTO,LED TO TRANSISTOR,DUAL	454330	25088	ILCT-6-254	1	
U 55	⚡ IC,STTL,HEX INVERTER	418004	27014	DM74S04N	1	
U 61	⚡ IC,ECL,DIVIDE BY 4 PRESCALER	722157	34371	CA3199E	1	
U 64	⚡ IC,ECL,TRIPLE 2/3 INPUT OR/NOR GATE	723437	04713	MC10105P1	1	
U 67	⚡ IC,COMPARATOR,HI-SPEED,14 PIN DIP	386920	27014	LM361N	1	
U 70	⚡ IC,CMOS, SPDT ANALOG SWITCH	723742	17856	DG301ACJ	1	
W 1, 2	CABLE ASSY, RF JUMPER	716985	89536	716985	2	
XU 48, 50	SOCKET,IC,8 PIN	478016	00779	2-640463-1	2	
Y 1	CRYSTAL,10MHZ,+-0.001%,HC-35/U	536565	71034	BK3-1B	1	
Z 1	RES,CERM,DIP,16 PIN,8 RES,10K,1%	501841	80294	4116R-001-103-F	1	
Z 5	RES,CERM,SIP,10 PIN,9 RES,510,+-2%	478800	91637	CSC10A-01-511G	1	
Z 6	RES,CERM,SIP,6 PIN,5 RES,100K,+-2%	412726	91637	CSC06A-03-104G	1	
Z 9	RES,CERM,DIP,16 PIN,8 RES,1K,+-5%	358119	91637	MDP16-03-102J	1	
Z 10	RES,CERM,SIP,6 PIN,5 RES,510,+-2%	459974	91637	CSC06A-01-511G	1	
NOTES:	⚡ Static sensitive part.					

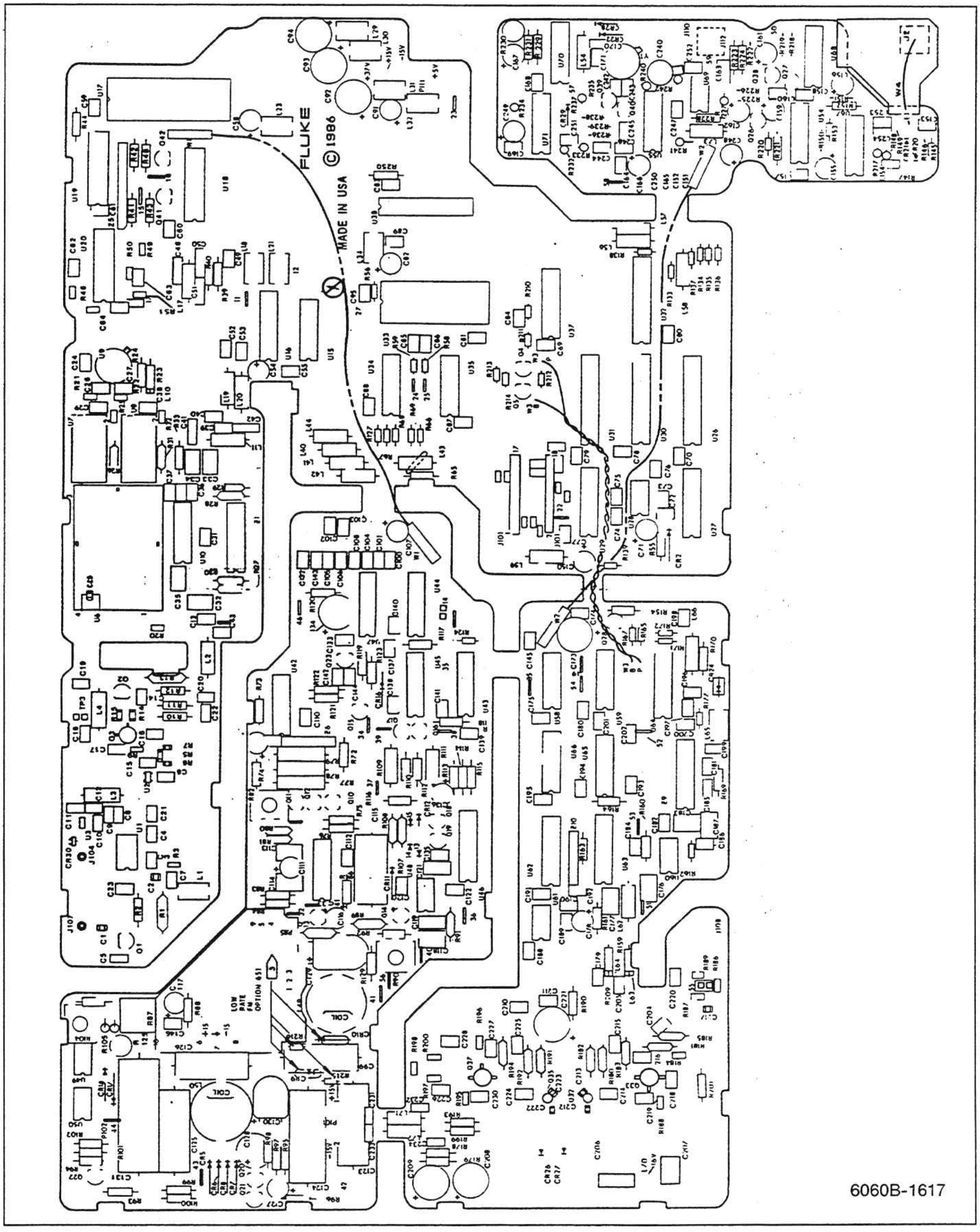

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Figure 5-5. A4 Synthesizer PCA

Table 5-6. A5 VCO PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,CER,1800PF,+-5%,50V,COG	528547	04222	SR215A182JAA	1	
C 2, 5, 6, C 9, 11, 14, C 19, 22, 26- C 28, 31, 32, C 34, 37- 40	CAP,CER,100PF,+-5%,50V,COG,0805	514133 514133 514133 514133 514133	51406	GRH708C0G101J050PB	18	
C 3, 4, 7	CAP,PORC,1.8PF,+-0.1PF,50V,0505	800854	51406	MA181R8B	3	
C 8	CAP,PORC,3.6PF,+-0.1PF,50V,0505	806380	51406	MA183R6B	1	
C 10, 15, 18, C 23, 29, 33	CAP,POLYES,0.1UF,+-20%,50V	732883 732883	68919	MKS02104P50V	6	
C 13, 25	CAP,CER,4.7PF,+-0.25PF,50V,COG,0805	806760	04222	08055A4R7CAT	2	
C 16	CAP,CER,3.3PF,+-0.5PF,50V,COG,0805	514208	51406	GRH708C0G3R3D200PB	1	
C 17	CAP,CER,1.8PF,+-0.25PF,50V,COG,0805	806745	04222	08055A1R8CAT	1	
C 21	CAP,CER,10PF,+-5%,50V,COG,0805	494781	51406	GRH708C0G100J200PB	1	
C 24	CAP,CER,2.7PF,+-0.25PF,50V,COG,0805	806752	04222	08055A2R7CAT	1	
C 35, 36	CAP,AL,470UF,+-20%,16V,SOLV PROOF	772855	62643	KME16T471M10X12.5MC	2	
CR 1, 2	DIODE,SI,VARACTOR,PIV=28V,18PF	912126	50579	BB505B(Q62702-B37)	2	
CR 3, 4, 6, CR 9- 11	ϟ DIODE,SI,PI,RF CUR CONTR,EPXY STRPLN ϟ	773234 773234	59365	MX2070	6	
CR 7, 13	ϟ DIODE,SI,PIN,RF SWITCHING	904693	28480	QPND-4241	2	
CR 8	ϟ DIODE,SI,PIN,RF SWITCHING	875591	8A233	BA483-143	1	
L 1, 3, 5, L 7, 8	INDUCTOR,0.12UH,+-10%,1000MHZ	800912 800912	52763	S5087227-013	5	
L 2, 4, 6	INDUCTOR,0.18UH,+-10%,770MHZ	800920	52763	S5087227-213	3	
P 201,202,205	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	3	
P 203	SOCKET,SINGLE,PWB,FOR 0.012-0.022 PIN	376418	22526	75060-012	1	
P 204	PIN TEST BASE	698472	20584	698472	1	
Q 1	ϟ TRANSISTOR,SI,NPN,SM SIGNAL,HI FT	535153	33297	NE21935	1	
Q 2	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	483156	33297	NE02135D-T1	1	
R 1, 36	ϟ RES,CERM,1.2K,+-5%,.125W,200PPM,1206	746412	91637	CRCW1206-1201JB	2	
R 2	ϟ RES,CERM,1K,+-5%,.125W,200PPM,1206	745992	91637	CRCW1206-1001JB	1	
R 3, 4, 17	ϟ RES,CERM,2K,+-5%,.125W,200PPM,1206	746461	91637	CRCW1206-2001JB	3	
R 5, 11	RES,MF,200,+-1%,0.25W,100PPM	799759	91637	CCF-50 2000F	2	
R 6	RES,MF,464,+-1%,0.25W,100PPM	801282	91637	CCF-50 4640F	1	
R 7, 13	RES,MF,301,+-1%,0.25W,100PPM	799916	91637	CCF-50 3010F	2	
R 8, 10, 14, R 16	ϟ RES,CERM,82,+-5%,.125W,200PPM,1206 ϟ	740480 740480	91637	CRCW1206-82R0JB	4	
R 9, 15	ϟ RES,CERM,91,+-5%,.125W,200PPM,1206	756338	91637	CRCW1206-91R0JB	2	
R 12, 31	RES,MF,681,+-1%,0.25W,100PPM	782052	91637	CCF-50 6810F	2	
R 18	ϟ RES,CERM,390,+-5%,.125W,200PPM,1206	740498	91637	CRCW1206-3900JB	1	
R 19	ϟ RES,CERM,47,+-5%,.125W,200PPM,1206	720631	91637	CRCW1206-47R0JB	1	
R 20	ϟ RES,CERM,120,+-5%,.125W,200PPM,1206	747683	91637	CRCW1206-1200JB	1	
R 21, 25, 27	RES,CF,240,+-5%,0.25W	376624	59124	CF1/4 241J	3	
R 22	RES,CF,91,+-5%,0.25W	441683	59124	CF1/4 910J	1	
R 23	ϟ RES,CERM,180,+-5%,.125W,200PPM,1206	720649	91637	CRCW1206-1800JB	1	
R 24	ϟ RES,CERM,68,+-5%,.125W,200PPM,1206	747675	91637	CRCW1206-68R0JB	1	
R 26	RES,CF,47,+-5%,0.25W	441592	59124	CF1/4 470J	1	
R 28, 29	RES,CF,20,+-5%,0.25W	442202	59124	CF1/4 20R0J	2	
R 30	RES,MF,10K,+-1%,0.25W,100PPM	799635	91637	CCF-50 1002F	1	
R 32, 35	ϟ RES,CERM,330,+-5%,.125W,200PPM,1206	746370	91637	CRCW1206-3300JB	2	
R 33, 34	RES,CF,56,+-5%,0.25W	342618	59124	CF1/4 560J	2	
U 1- 3	ϟ IC,BPLR,MONOLITHIC UWAVE AMP,SEL GAIN	867049	28480	QPMA-0385	3	
U 4	ϟ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495192	27014	LF353N	1	
W 1	CABLE ASSY, VCO	798207	89536	798207	1	

Table 5-6. A5 VCO PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
NOTES:	ϟ Static sensitive part. If any of the following components are replaced, the Generator must be re-calibrated: C2 -4, 6-8, 10, 11, 13-19, 21-25 CR 1-4, 6-11, 13 L1 -8 R1 , 2, 6-17, 28, 29, 32, 35 Q1 , 2					

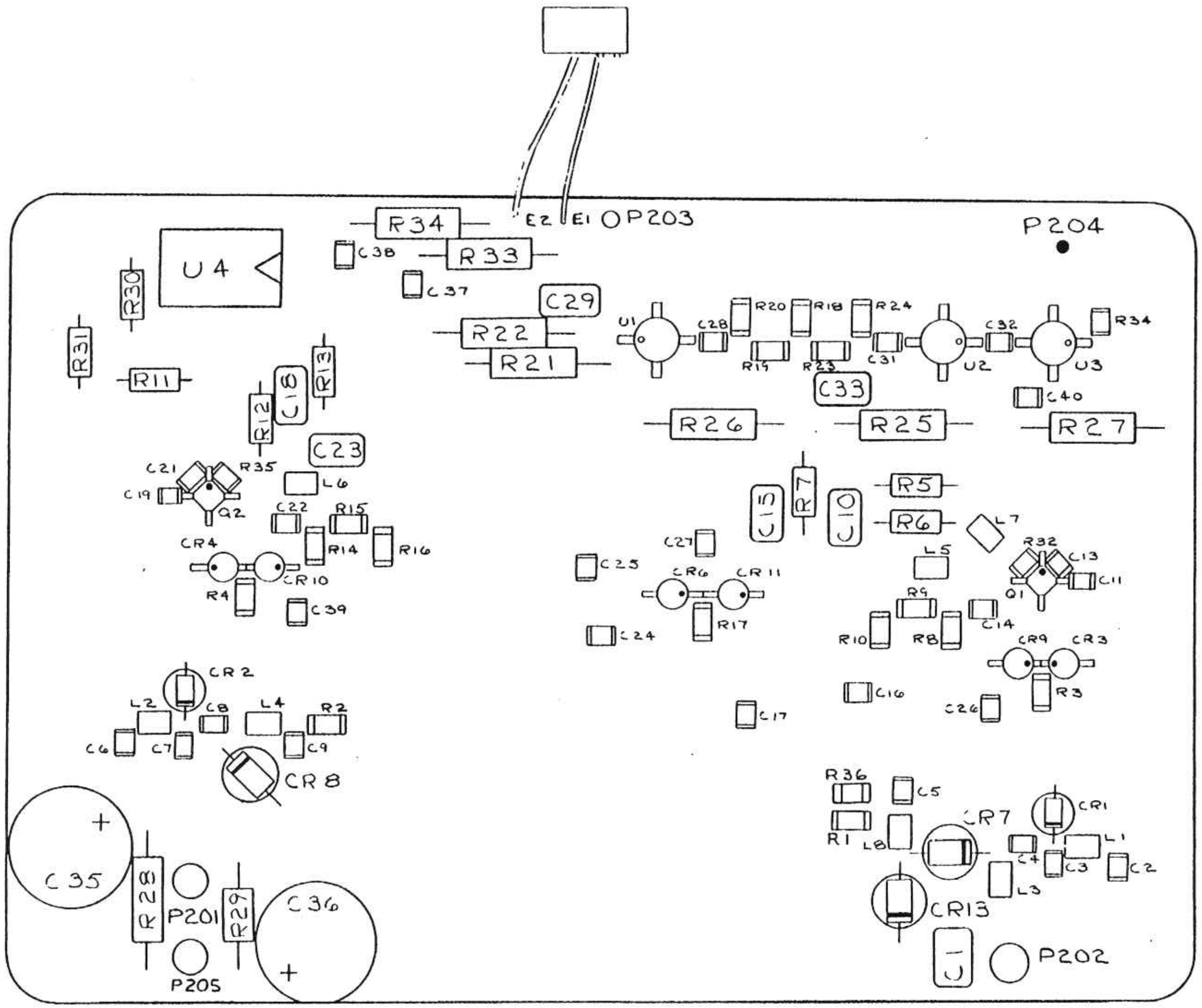

Figure 5-6. A5 VCO PCA

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Table 5-7. A6 Output Control PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 3, 14, C 15, 59	CAP,CER,1000PF,+-20%,100V,X7R	402966 402966	04222	SR151C102MAA	5	
C 2, 5, 7, C 10, 11, 35, C 43, 44, 46, C 47, 49, 50, C 52- 57,134, C 151-153,155- C 157,159-161, C 163-172,220- C 224,227,229, C 230	CAP,CER,100PF,+-5%,50V,COG,0805	514133 514133 514133 514133 514133 514133 514133 514133 514133 514133	51406	GRH708C0G101J050PB	46	
C 4, 6, 8, C 13, 23, 25, C 27, 29, 33, C 36- 38, 41, C 51, 65- 78, C 87, 88, 90, C 94,206	CAP,CER,100PF,+-2%,100V,COG	512848 512848 512848 512848 512848 512848 512848	04222	SR151A101GAA	33	
C 9,197	CAP,CER,10PF,+-2%,100V,COG	512343	51406	RPE110A100G1	2	
C 16, 18, 20, C 21	CAP,CER,5.6PF,+-0.25PF,100V,COH	512954 512954	51406	RPE110C0H5R6C1	4	
C 17	CAP,CER,3.9PF,+-0.25PF,100V,COJ	512947	51406	RPE110C0J3R9C1	1	
C 19,198	CAP,CER,2.7PF,+-0.25PF,100V,COJ	363705	51406	RPE110C0J279C1	2	
C 22,208,209	CAP,CER,3.3PF,+-0.25PF,100V,COJ	519330	51406	RPE110C0J3R3C1	3	
C 24, 26	CAP,CER,2.2PF,+-0.25PF,100V,COG	362731	04222	SR15A2R2CAT	2	
C 28	CAP,CER,1.8PF,+-0.25PF,100V,COK	512897	51406	RPE110C0K1R8C1	1	
C 31,195,200- C 203,210	CAP,CER,4.7PF,+-0.25PF,100V,COH	362772 362772	51406	RPE110C0H4R7C1	7	
C 32, 34, 81, C 91, 93, 95- C 131,150,175, C 177-185,187- C 189,207	CAP,POLYES,0.1UF,+-20%,50V	732883 732883 732883 732883 732883	68919	MKS02104P50V	57	
C 39	CAP,CER,4.7PF,+-0.25PF,50V,COG,0805	806760	04222	08055A4R7CAT	1	
C 58	CAP,TA,220UF,+-20%,6V	408682	56289	199D227X006FA2	1	
C 60, 62, 63, C 213,216	CAP,CER,33PF,+-2%,100V,COG	513226 513226	04222	SR151A330GAA	5	
C 61, 92,225	CAP,TA,22UF,+-20%,25V	357780	56289	199D220X0025DES	3	
C 64	CAP,CER,47PF,+-2%,100V,COG	512368	04222	SR151A470GAA	1	
C 79, 80	CAP,POLYPR,0.0786UF,+-1%,50V	422998	84411	JF-86.07861%50V	2	
C 82	CAP,TA,2.2UF,+-20%,35V	485185	56289	199D225X0035BA2	1	
C 83	CAP,TA,4.7UF,+-20%,25V	161943	56289	199D475X0025BA2	1	
C 84, 85,218, C 219	CAP,AL,47UF,+50-20%,16V	436006 436006	62643	SM16VB-47	4	
C 86	CAP,TA,0.47UF,+-20%,35V	161349	56289	199D474X0035AA2	1	
C 89,214,217	CAP,VAR,10-120PF,50V,CER	631416	51406	TZ03R121FR174	3	
C 133	CAP,CER,1.2PF,+-0.25PF,100V,COK	543256	59660	8111-100-COK-1R2C	1	
C 135,136	CAP,CER,1.5PF,+-0.25PF,100V,COK	529909	51406	RPE110C0K1R5C1	2	
C 137,138	CAP,AL,4.7UF,+-20%,35V	603993	62643	LL35VB4R7M5X11LLV	2	
C 139,149	CAP,CER,1000PF,+-20%,50V,X7R,0805	514059	04222	08055C102MAT060R	2	
C 140,142	CAP,AL,22UF,+-20%,16V,SOLV PROOF	614750	62643	SRAC16VB22RM5X7C3	2	
C 141,143,146, C 147	CAP,AL,15UF,+-20%,35V	614024 614024	74840	RLR156RM050M	4	
C 144,145,148	CAP,CER,0.01UF,+-20%,50V,Z5U	614214	04222	SR155E103MAA	3	
C 190,204	CAP,CER,6.8PF,+-0.25PF,100V,COH	512327	51406	RPE110C0H6R8C1	2	
C 191	CAP,CER,39PF,+-2%,100V,COG	512962	04222	SR151A390GAA	1	
C 192,193,205	CAP,CER,27PF,+-2%,100V,COG	362749	04222	SR151A270GAA	3	
C 194,199	CAP,CER,8.2PF, -0.25PF,100V,COH	715359	51406	RPE110C0H8R2C1	2	
C 196	CAP,CER,12PF,+-2%,100V,COG	376871	59660	8101-100-COG-126G	1	
C 212,215	CAP,POLYST,0.0015UF,+-2%,100V	484113	84411	1263UW1522%100V	2	
C 226,228	CAP,CER,12PF,+-5%,50V,COG,0805	514232	51406	GRM708C0G120J200PB	2	

Table 5-7. A6 Output Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
CR 1- 4, 6- CR 10, 12- 22	⚡ DIODE,SI,PIN, RF ATTENUATING ⚡	508077 508077	96341	MA 4P523	20	
CR 5	⚡ DIODE,SI,PIN,SMALL SIGNAL,UHF & VHF	402776	28480	5082-3379 T-25	1	
CR 23, 48, 58, CR 65, 66, 68- CR 70	⚡ DIODE,SI,BV-75V,IO-150MA,500MW ⚡ ⚡	203323 203323 203323	09214	IN4448	8	
CR 26	⚡ DIODE,SI,RECT,BRIDGE,5V,1MA,SCHOTTKY	800953	96341	MA4E807	1	
CR 27, 29- 31, CR 33- 36, 38, CR 39, 42- 47, CR 67	⚡ DIODE,SI,PIN,EPOXY STRIPLINE ⚡ ⚡ ⚡	773176 773176 773176 773176	59365	MPN-7484-E26	17	
CR 28, 32, 37, CR 40, 41	⚡ DIODE,SI,PIN,LOW INDUCTANCE ⚡	773168 773168	59365	MPN7410-L20	5	
CR 49, 59	⚡ ZENER,UNCOMP,5.1V,5%,20.0MA,0.4W	159798	04713	1N751	2	
CR 50	⚡ ZENER,COMP,6.3V,2%,50PPM,7.5MA	172148	04713	CZG20121RL	1	
CR 51, 52, 61, CR 62	⚡ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL ⚡	313247 313247	28480	5082-6264 T25	4	
CR 53, 54	⚡ ZENER,UNCOMP,4.3V,5%,20.0MA,0.4W	180455	14552	1N749	2	
CR 55, 56	⚡ DIODE,SI,BV-50V,IO-150MA,SELECTED VF	234468	27014	1M916B	2	
CR 57, 64	⚡ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	535195	28480	5082-2800	2	
CR 60	⚡ ZENER,UNCOMP,15.0V,5%,8.5MA,0.4W	266601	04713	1N965	1	
H 1	SPACER,SWAGE,.250 RND,BR,6-32,.100	352021	55566	3045B632B14-MOD.-.100	1	
H 2	SCREW,PH,P,LOCK,STL,6-32,.187	381087	74594	381087	1	
H 3, 4	COMPONENT HOLDER	422865	98159	2829-75-2	2	
J 1- 3	CONN,COAX,SMB(M),PWB	352450	98291	51-051-0000-220	3	
J 4- 6	PIN,SINGLE,PWB,0.025 SQ	267500	00779	87623-1	20	
L 3, 50- 52	CHOKE,6TURN	320911	89536	320911	4	
L 4, 6, 18, L 21, 22, 25, L 26, 29, 30, L 33, 34, 36, L 38, 40, 44, L 46	INDUCTOR,0.12UH,+-10%,1000MHZ	800912 800912 800912 800912 800912 800912	52763	S5087227-013	16	
L 8- 10	INDUCTOR,0.68UH,+-10%,221MHZ,SHLD	320937	24759	MR-O.68J&K	3	
L 13, 14	INDUCTOR,390UH,+-5%,6.9MHZ,SHLD	186288	24759	MR-390J	2	
L 15	INDUCTOR,220UH,+-5%,9.4MHZ,SHLD	147835	24759	MR-220J	1	
L 45	CORE,TOROID,FERRITE,.047X.138X.118	321182	OLUA3	56-590-65-4B	6	
MP 4	⚡ PWB, QUAD BANDPASS FILTER	794933	89536	794933	1	
MP 5- 7, 11, MP 12, 24, 27, MP 42, 43, 53- MP 55	INDUCTOR,10 TURNS	463448 463448 463448 463448	89536	463448	12	
MP 19	CHOKE, TWO 3-TURN BEADS	808543	89536	808543	1	
MP 56	SHIELD, HET	774190	89536	774190	1	
MP 57	GROUND STRIP,BECU,SPRING FINGERS	811661	34641	97-520-08	1	
P 1, 45- 52	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	19	
P 4	HEADER,1 ROW,.100CTR,10 PIN	478693	00779	103747-0	1	
P 5	HEADER,1 ROW,.100CTR,4 PIN	417329	00779	103747-4	1	
P 6	SOCKET,SINGLE,PWB,FOR 0.012-0.022 PIN	376418	22526	75060-012	1	
P 7, 8	PIN TEST BASE	698472	20584	698472	2	
P 31- 44	SOCKET,SINGLE,PWB,FOR 0.026-0.033 PIN	811539	00779	50864-1	14	
Q 3, 4, 7, Q 8, 11, 12, Q 15, 16, 19, Q 20	⚡ TRANSISTOR,SI,PNP,SMALL SIGNAL ⚡ ⚡ ⚡	418707 418707 418707 418707	07263	MPS6562	10	
Q 5, 6, 9, Q 10, 13, 14, Q 17, 18, 21	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL ⚡ ⚡	330803 330803 330803	04713	MPS6560	9	
Q 22, 23	⚡ TRANSISTOR,SI,N-JFET,TO-92,SWITCH	261578	17856	J2317	2	
Q 24	⚡ TRANSISTOR,SI,N-JFET,TO-92	376475	27014	SF50072	1	

Table 5-7. A6 Output Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Q 25, 31- 33	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	04713	2N3906	4	
Q 26	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,TO-92	218396	04713	2N3904	1	
Q 28	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	225599	07263	2N4250	1	
Q 34	ϟ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	535013	04713	BFR91	1	
Q 35, 36	ϟ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	723379	61636	BFR96S	2	
Q 37	ϟ TRANSISTOR,SI,NPN,SMALL SIG,MICROWAVE	483172	33297	NE73435	1	
R 1, 4, 19, R 23- 29,130	RES,CF,1K,+-5%,0.25W	343426 343426	59124	CF1/4 102J	11	
R 2	RES,CF,22,+-5%,0.125W	557215	59124	RDS21/8-220/J	1	
R 3	RES,CF,51,+-5%,0.125W	740050	59124	RDS21/8-510J	1	
R 5, 62, 65	RES,CF,160,+-5%,0.125W	740092	59124	RDS21/8-161J	3	
R 6, 7	RES,CF,75,+-5%,0.125W	740068	59124	RDS21/8-750J	2	
R 8	RES,CC,430,+-5%,0.5W	109058	01121	EB4311	1	
R 9,174	RES,CC,300,+-5%,0.5W	108829	01121	EB3015	2	
R 10- 13, 84, R 142	RES,CF,47,+-5%,0.25W	441592 441592	59124	CF1/4 470J	6	
R 14- 17	RES,CF,22,+-5%,0.25W	381145	59124	CF1/4 220J	4	
R 20	RES,MF,1K,+-1%,0.25W,100PPM	799791	91637	CCF-50 1001F	1	
R 21, 69,149, R 176	RES,CF,10K,+-5%,0.25W	348839 348839	59124	CF1/4 102J	4	
R 31	RES,CF,3K,+-5%,0.25W	441527	59124	CF1/4 302J	1	
R 32, 36, 43, R 47, 48, 50, R 52- 54, 57, R 58	RES,CF,2K,+-5%,0.25W	441469 441469 441469 441469	59124	CF1/4 202J	11	
R 33, 37, 44	RES,MF,287,+-1%,0.125W,100PPM	443002	91637	CMF-55 2870F T-1	3	
R 34	RES,CF,360,+-5%,0.25W	352286	59124	CF1/4 361J	1	
R 35, 45	RES,CC,150,+-5%,0.5W	186056	01121	EB1515	2	
R 38	RES,MF,287,+-1%,0.5W,100PPM	807776	91637	CMF-65 2870F T-1	1	
R 39, 40	RES,MF,348,+-1%,0.5W,100PPM	245761	91637	CMF-65 3480F T-1	2	
R 41, 73	RES,MF,8.45K,+-1%,0.125W,100PPM	221671	91637	CMF-55 8451F T-1	2	
R 42	RES,MF,6.65K,+-1%,0.125W,100PPM	294918	91637	CMF-55 6651F T-1	1	
R 46, 86	RES,VAR,CERM,10K,+-10%,0.5W	309674	80294	3386R-1-103	2	
R 49, 51	RES,CF,1.5K,+-5%,0.25W	343418	59124	CF1/4 152J	2	
R 55, 56	RES,MF,383,+-1%,0.5W,100PPM	150847	91637	CMF-65 3830F T-1	2	
R 59, 60	RES,CF,100,+-5%,0.125W	557223	59124	RDS21/8-101/J	2	
R 61, 66	RES,CF,68,+-5%,0.125W	830893	59124	RDS21/8-680/J	2	
R 63	RES,VAR,CERM,100,+-10%,0.5W	275735	80294	3386R-1-101	1	
R 64	RES,CF,33,+-5%,0.125W	830885	59124	RDS21/8-330/J	1	
R 67	RES,CC,1K,+-5%,0.125W	643932	01121	BB1025	1	
R 70,129,132, R 153,162,163, R 175,180	RES,CF,4.7K,+-5%,0.25W	348821 348821 348821	59124	CF1/4 472J	8	
R 71	RES,CF,270,+-5%,0.25W	348789	59124	CF1/4 271J	1	
R 72	RES,CF,620,+-5%,0.25W	442319	59124	CF1/4 621J	1	
R 75,103,106, R 123,157	RES,MF,10K,+-1%,0.125W,100PPM	168260 168260	91637	CMF-55 1002F T-1	5	
R 76	RES,MF,3.4K,+-1%,0.125W,100PPM	260323	91637	CMF-55 3401F T-1	1	
R 77	RES,MF,18.2K,+-1%,0.125W,100PPM	236810	91637	CMF-55 1822F T-1	1	
R 78	RES,MF,1.4K,+-1%,0.125W,100PPM	344333	91637	CMF-55 1402F T-1	1	
R 80	RES,MF,887,+-1%,0.125W,50PPM	320382	91637	CMF-55 8870F T-2	1	
R 82	RES,VAR,CERM,500,+-10%,0.5W	325613	80294	3386R-1-501	1	
R 83	RES,MF,100,+-1%,0.125W,100PPM	168195	91637	CMF-55 1000F T-1	1	
R 85,143	RES,CF,56K,+-5%,0.25W	441626	59124	CF1/4 563J	2	
R 87	RES,CF,1M,+-5%,0.25W	348987	59124	CF1/4 105J	1	
R 88, 94	RES,MF,71.5,+-1%,0.125W,100PPM	393603	91637	CMF-55 71R5F T-1	2	

Table 5-7. A6 Output Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 89, 95	RES,MF,4.99K,+-1%,0.125W,100PPM	168252	91637	CMF-55 4991F T-1	2	
R 90, 92	RES,MF,3.32K,+-1%,0.125W,100PPM	312652	91637	CMF-55 3321F T-1	2	
R 91, 93	RES,MF,34.8,+-1%,0.125W,100PPM	343897	91637	CMF-55 8060F T-1	2	
R 96,115	RES,MF,49.9K,+-1%,0.125W,100PPM	268821	91637	CMF-55 4992F T-1	2	
R 97	RES,VAR,CERM,20K,+-10%,0.5W	335760	80294	3386R-1-203	1	
R 98	RES,CF,4.3K,+-5%,0.25W	441576	59124	CF1/4 433J	1	
R 99	RES,VAR,CERM,100K,+-10%,0.5W	369520	32997	3386R-1-104	1	
R 100	RES,MF,147K,+-1%,0.125W,100PPM	291344	91637	CMF-55 1473F T-1	1	
R 101	RES,MF,301K,+-1%,0.125W,100PPM	289488	91637	CMF-55 3013F T-1	1	
R 102	RES,MF,23.2K,+-1%,0.125W,100PPM	291351	91637	CMF-55 2322F T-1	1	
R 104	RES,MF,6.34K,+-1%,0.125W,100PPM	267344	91637	CMF-55 6341F T-1	1	
R 105,125	RES,MF,1.54K,+-1%,0.125W,100PPM	289066	91637	CMF-55 1541F T-1	2	
R 107	RES,MF,1.69K,+-1%,0.125W,100PPM	321414	91637	CMF-55 1691F T-1	1	
R 108	RES,MF,4.02K,+-1%,0.125W,100PPM	235325	91637	CMF-55 4021F T-1	1	
R 109	RES,MF,681,+-1%,0.125W,100PPM	543785	91637	CMF-55 6810F T-1	1	
R 110,114,137, R 139	RES,MF,20K,+-1%,0.125W,100PPM	291872 291872	91637	CMF-55 2002F T-1	4	
R 111	RES,MF,100K,+-1%,0.125W,100PPM	248807	91637	CMF-55 1003F T-1	1	
R 112	RES,MF,66.5K,+-1%,0.125W,100PPM	289082	91637	CMF-55 6652F T-1	1	
R 113	RES,VAR,CERM,2K,+-10%,0.5W	309666	80294	3386R-1-202	1	
R 116	RES,MF,21.5K,+-1%,0.125W,100PPM	168278	91637	CMF-55 2152F T-1	1	
R 117	RES,MF,34.8K,+-1%,0.125W,100PPM	261487	91637	CMF-55 3482F T-1	1	
R 118	RES,MF,16.9K,+-1%,0.125W,100PPM	267146	91637	CMF-55 1692F T-1	1	
R 119	RES,MF,2.55K,+-1%,0.125W,100PPM	325498	91637	CMF-55 2551F T-1	1	
R 120,147	RES,MF,499,+-1%,,0.125W,100PPM	168211	91637	CMF-55 4990F T-1	2	
R 121	RES,MF,1K,+-1%,0.125W,100PPM	168229	91637	CMF-55 1001F T-1	1	
R 122	RES,MF,37.4K,+-1%,0.125W,100PPM	226241	91637	CMF-55 3742F T-1	1	
R 124	RES,CF,1,+-5%,0.25W	357665	59124	CF1/4 1R0J	1	
R 126	RES,MF,3.48K,+-1%,0.125W,100PPM	260687	91637	CMF-55 3481F T-1	1	
R 127,133	RES,MF,24.3K,+-1%,0.125W,100PPM	719922	91637	CMF-55 2432F T-1	2	
R 128	RES,MF,6.04K,+-1%,0.125W,100PPM	285189	91637	CMF-55 6041F T-1	1	
R 131	RES,MF,124K,+-1%,0.125W,100PPM	288407	91637	CMF-55 1243F T-1	1	
R 134	RES,MF,80.6K,+-1%,0.125W,100PPM	281121	91637	CMF-55 8062F T-1	1	
R 135	RES,MF,15.4K,+-1%,0.125W,100PPM	261651	91637	CMF-55 1542F T-1	1	
R 136	RES,MF,374,+-1%,0.125W,100PPM	320002	91637	CMF-55 3740F T-1	1	
R 138	RES,MF,29.4K,+-1%,0.125W,100PPM	235135	91637	CMF-55 2942F T-1	1	
R 140	RES,MF,3.74K,+-1%,0.125W,100PPM	272096	91637	CMF-55 3741F T-1	1	
R 141	RES,MF,17.4K,+-1%,0.125W,100PPM	236802	91637	CMF-55 1742F T-1	1	
R 144,146	RES,MF,130,+-1%,0.5W,100PPM	151134	91637	CMF-65 1300F T-1	2	
R 145	RES,MF,205,+-1%,0.5W,100PPM	513960	91637	CMF-65 2050F T-1	1	
R 148	RES,MF,124,+-1%,0.125W,100PPM	343905	91637	CMF-55 1240F T-1	1	
R 150,151	RES,CF,560,+-5%,0.25W	385948	59124	CF1/4 561J	2	
R 152,156	RES,CF,33K,+-5%,0.25W	348888	59124	CF1/4 333J	2	
R 154	RES,MF,15K,+-1%,0.125W,100PPM	285296	91637	CMF-55 1502F T-1	1	
R 155	RES,MF,3.16K,+-1%,0.125W,100PPM	235291	91637	CMF-55 3161F T-1	1	
R 158	RES,MF,1.21K,+-1%,0.125W,100PPM	229146	91637	CMF-55 1211F T-1	1	
R 159	ϟ RES,CERM,33,+-5%,.125W,200PPM,1206	746248	91637	CRCW1206-33R0JB	1	
R 160,161	ϟ RES,CERM,180,+-5%,.125W,200PPM,1206	746321	91637	CRCW1206-1800JB	2	
R 164,165	RES,CF,15,+-5%,0.125W	740027	59124	RDS21/8-150J	2	
R 166,169,172	RES,CF,11,+-5% 0.125W	740019	59124	RDS21/8-110J	3	
R 167,168,170, R 171	RES,CF,18,+-5%,0.125W	740035 740035	59124	RDS21/8-180J	4	
R 173	RES,MF,5.36K,+-1%,0.125W,100PPM	370981	91637	CMF-55 5361F T-1	1	

Table 5-7. A6 Output Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 177	ϟ RES,CERM,91,+-5%,.125W,200PPM,1206	756338	91637	CRCW1206-91R0JB	1	
R 178,179	ϟ RES,CERM,150,+-5%,.125W,200PPM,1206	746313	91637	CRCW1206-1500JB	2	
R 181	RES,MF,33.2,+-1%,0.125W,100PPM	296681	91637	CMF-55 33R2F T-1	1	
R 182	RES,CC,1K,+-5%,0.5W	108597	01121	EB1025	1	
R 183	ϟ RES,CERM,18,+-5%,.125W,200PPM,1206	816132	91637	CRCW1206-18R0JB	1	
R 184,185	ϟ RES,CERM,300,+-5%,.125W,200PPM,1206	746362	91637	CRCW1206-3000JB	2	
R 186	RES,CF,100K,+-5%,0.25W	348920	59124	CF1/4 104J	1	
R 187	RES,CF,47K,+-5%,0.25W	348896	59124	CF1/4 473J	1	
R 188	RES,MF,2K,+-1%,0.125W,100PPM	235226	91637	CMF-55 2001F T-1	1	
RT 79	THERMISTOR,DISC,NEG.,10K,+-10%,25C	104596	50273	140-103LAG-A01	1	
TP 1- 4, 7, TP 8	TERM,FASTON,TAB,.110,SOLDER	512889 512889	00779	62395-1	6	
U 1	ϟ IC,BPLR,AMP,UWAVE,MSA0885 SPECIAL	836593	24539	PST-J9127 WITH DOT	1	
U 2	ϟ IC,HYBRID,WIDEBAND AMPLIFIER	773184	04713	MWA330	1	
U 3	MIXER,DOUBLE BALANCED,1 - 1000 MHZ	525493	15542	TFM-2-8	1	
U 8	ϟ IC,BPLR,MONOLITHIC AMP, 2.5GHZ	800979	24539	MSA0435	1	
U 9, 13, 23, U 24	ϟ IC,LSTTL,OCTAL D F/F,+EDG TRG,W/CLEAR ϟ	454892 454892	01295	SN74LS273N	4	
U 10- 12	ϟ IC,OP AMP,QUAD,LOW POWER	741397	27014	LF444CN	3	
U 14, 15, 37	ϟ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	3	
U 16	ϟ IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	27014	DM74LS138N	1	
U 18	ϟ IC,LSTTL,TRIPLE 3 INPUT AND GATE	393082	27014	DM74LS11N	1	
U 19	ϟ IC,CMOS,DUAL 8 BIT DAC,CURRENT OUTPUT	722272	24355	AD7528JN	1	
U 20	ϟ IC,OP AMP,QUAD JFET INPUT,14 PIN DIP	659748	01295	TL074CN	1	
U 21	ϟ IC,CMOS,14BIT DAC,12BIT ACC,CUR OUT	773101	24355	AD7534KN	1	
U 22, 29, 35	ϟ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495192	27014	LF353N	3	
U 25	ϟ IC,CMOS,12 BIT MULTIPLYING DAC	722264	24355	AD7541AJN	1	
U 26, 27	ϟ IC,CMOS,QUAD BILATERAL SWITCH	408062	04713	MC14066BCP	2	
U 28	ϟ IC,OP AMP,DUAL,LO OFFST,VOLT,LO-DRIFT	685164	27014	LF412CN	1	
U 30	ϟ IC,VOLT REG,FIXED,-8 VOLTS,1.5 AMPS	407635	04713	MC7908CT	1	
U 31, 32	ϟ IC,OP AMP,LO-OFF VOLTAGE,LO-DRIFT	685156	27014	LF411CN	2	
U 33	ϟ IC,COMPARATOR,HI-SPEED,14 PIN DIP	647115	18324	NE522N	1	
U 34	ϟ IC,STTL,QUAD 2 INPUT NAND GATE	363580	01295	SN74S00N	1	
U 36	ϟ IC,LSTTL,QUAD 2 INPUT OR GATE	393108	01295	SN74LS32N	1	
U 38, 39	ϟ IC,BPLR,MONOLITHIC UWAVE AMP,SEL GAIN	867049	28480	QPMA-0385	2	
W 1	SEMI-RIGID CABLE,PREPPED	808600	89536	808600	1	
W 2	CABLE ASSY	812545	89536	812545	1	
W 3	SEMI-RIGID CABLE, .086, PREPPED	812594	89536	812594	1	
W 5	CABLE ASSY, RF JUMPER	716985	89536	716985	1	
XU 4- 18	PIN,SINGLE,PWB,0.025 SQ	277418	00779	1-87022-3	15	
Z 1	RES,CERM,SIP,10 PIN,9 RES,10K,+-2%	414003	91637	CSC10A-01-103G	1	
Z 2	RES,CERM,DIP,16 PIN,8 RES,10K,1%	501841	80294	4116R-001-103-F	1	
Z 3, 4	RES,CERM,SIP,8 PIN,4 RES,1K,+-2%	714345	91637	CSC08A-03-102G	2	
Z 5	RES,CERM,SIP,8 PIN,7 RES,10K,+-2%	412924	91637	CSC08A-01-103G	1	

NOTES: ϟ Static sensitive part.
If any of the following components are replaced, the Generator must be re-calibrated
C190-205,210
R33,37,44,59-66,79,165--172
Q34-36
U3

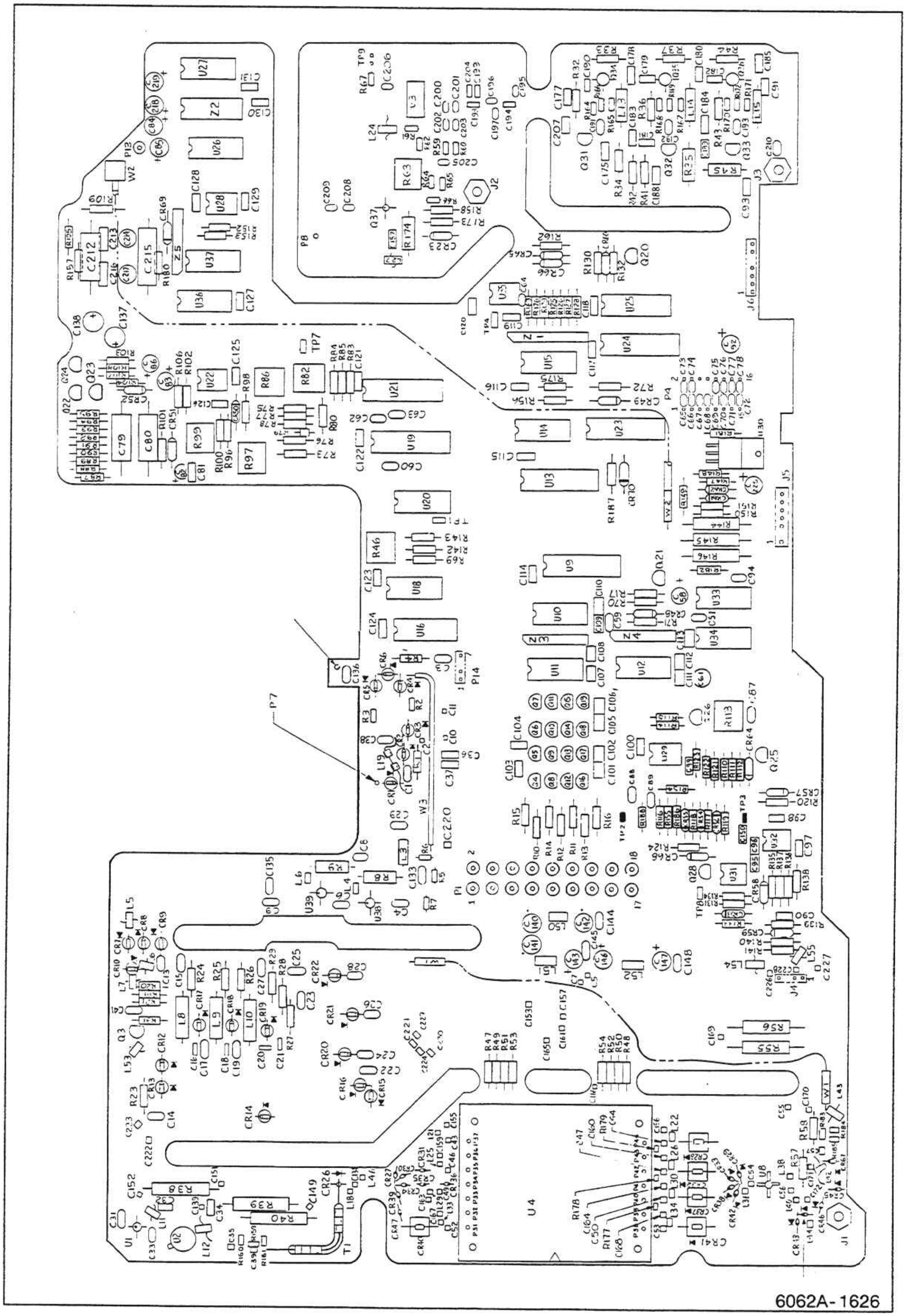

Figure 5-7. A6 Output Control PCA

Table 5-8. A7 Output PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 14, 16- C 20, 22, 24, C 29, 30, 35- C 37, 41- 43, C 47- 52, 75	CAP,CER,100PF,+-5%,50V,C0G,0805	514133 514133 514133 514133 514133	51406	GRH708C0G101J050PB	36	
C 15, 21, 26, C 33, 34, 46	CAP,CER,47PF,+-5%,50V,C0G,0805	494633 494633	04222	08055A470JAT050R	6	
C 23, 25, 27, C 38- 40, 62, C 63, 65, 72	CAP,POLYES,0.1UF,+-20%,50V	732883 732883 732883	68919	MKS02104P50V	10	
C 28	CAP,PORC,0.3PF,+-0.1PF,50V	807198	51406	MA180R3BPT	1	
C 31, 32	CAP,CER,2.7PF,+-0.5PF,50V,C0G,0805	519793	04222	08055A2R7DA1.65R	2	
C 44	CAP,CER,1.0PF,+-0.5PF,50V,C0G,0805	512129	51406	GRH708C0G1R0D200PB	1	
C 45	CAP,CER,1.8PF,+-0.25PF,50V,C0G,0805	806745	04222	08055A1R8CAT	1	
C 53, 55	CAP,CER,8.2PF,+-0.5PF,50V,C0G,0805	713982	51406	GRH708C0G8R2D200PB	2	
C 54	CAP,CER,18PF,+-5%,50V,C0G,0805	514224	51406	GRM708C0G180J200PB	1	
C 56- 61	CAP,CER,12PF,+-5%,50V,C0G,0805	514232	51406	GRM708C0G120J200PB	6	
C 64, 71	CAP,CER,0.15UF,+-20%,50V,X7R,1812	631465	04222	18125C154MA1080B	2	
C 66	CAP,TA,1UF,+-10%,35V	161919	56289	199D105X0035AA2	1	
C 67	CAP,TA,10UF,+-20%,15V	193623	56289	199D106X0015CA2	1	
C 68	CAP,CER,0.047UF,+-10%,50V,X7R,1505	514273	04222	15055C473KAT050B	1	
C 69	CAP,CER,0.027UF,+-5%,50V,X7R,1206	811687	04222	12065C273KAT060B	1	
C 70	CAP,CER,0.039UF,+-5%,50V,X7R,1206	811679	04222	12065C393JAT060B	1	
C 73	CAP,CER,4.7PF,+-0.25PF,50V,C0G,0805	806760	04222	08055A4R7CAT	1	
C 74	CAP,CER,0.68PF,+-0.25PF,100V,M7J	485011	51406	RPE110M7J684C1	1	
CR 1- 7, 10, CR 15	⚡ DIODE,SI,PI,RF CUR CONTR,EPXY STRPLN	773234 773234	59365	MX2070	9	
CR 8	⚡ DIODE,SI,SCHOTTKY BARRIER,MATCHED PR	820555	28480	QSCH-5463	1	
CR 11- 14	⚡ DIODE,SI,PIN,SELECTED CT & RS 7402-CT	773192	59365	MX2636 (E28)	4	
CR 16	⚡ DIODE,SI,BV=75V,IO=150MA,500MW	203323	09214	IN4448	1	
FL 1	FILTER,RF,PIN SLEEVE STYLE,400PF	875125	00779	859652-1	1	
FL 2- 5	FILTER,RF,PIN-SLEEVE STYLE,2000PF	807271	00779	859612-1	4	
H 1, 2	SCREW,RH,SL,STL,0-80,.375	811562	2M530	811562	2	
H 3, 4	NUT,HEX,LOCK,SS,4-40	558866	72962	558866	2	
H 5, 6	NUT,S-STL,MINIATURE,CLINCH,0-80	811570	46384	MS-080-1	2	
H 7, 8	SCREW,FH,P,LOCK,SS,4-40,.375	256024	74594	256024	2	
H 9- 11	COMPONENT HOLDER	422865	98159	2829-75-2	3	
J 99	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	1	
L 1- 5, 16, L 20, 21	CHOKE, TWO 3-TURN BEADS	808543 808543	89536	808543	8	
L 6- 13	INDUCTOR,0.12UH,+-10%,1000MHZ	800912	52763	S5087227-013	8	
L 17	INDUCTOR,390UH,+-5%,6.9MHZ,SHLD	186288	24759	MR-390J	1	
L 18	CHOKE,6TURN	320911	89536	320911	1	
L 19, 22	INDUCTOR,56UH,+-5%,25MHZ,SHLD	461525	24759	MR-56J&K	2	
L 23	INDUCTOR,10 TURNS	463448	89536	463448	1	
MP 103	FET HEAT SINK, PLATED	808469	89536	808469	1	
P 102	PIN TEST BASE	698472	20584	698472	1	
Q 1, 3	⚡ TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	04713	2N3906	2	
Q 2, 4	⚡ TRANSISTOR,SI,NPN,MICROWAVE	810895	33297	NE56803	2	
Q 5- 8	⚡ TRANSISTOR,SI,PNP,HI-SPEED SWITCH	369629	04713	MPS5771	4	
Q 9	⚡ FET SCHOTTKY-GATE GAAS, TESTED	830026	89536	830026	1	
R 1, 3, 31	⚡ RES,CERM,270,+-5%,.125W,200PPM,1206	811331	91637	CRCW1206-271JB	3	
R 2	⚡ RES,CERM,18,+-5%,.125W,200PPM,1206	816132	91637	CRCW1206-18R0JB	1	
R 4, 12	⚡ RES,CERM,1K,+-5%,.125W,200PPM,1206	745992	91637	CRCW1206-1001JB	2	
R 5, 6, 9, R 10, 22	⚡ RES,CERM,75,+-5%,.125W,200PPM,1206	811323 811323	91637	CRCW1206-75R0JB	5	

Table 5-8. A7 Output PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 7, 8	ϟ RES,CERM,39,+-5%,.125W,200PPM,1206	811299	91637	CRCW1206-39R0JB	2	
R 11, 45, 46, R 53, 55	ϟ RES,CERM,470,+-5%,.125W,200PPM,1206 ϟ	747733 747733	91637	CRCW1206-471JB	5	
R 13, 14, 16, R 30, 44	ϟ RES,CERM,390,+-5%,.125W,200PPM,1206 ϟ	811349 811349	91637	CRCW1206-391JB	5	
R 15, 50, 52	RES,MF,121,+-1%,0.5W,100PPM	801019	91637	CMF-65 1210F T-1	3	
R 17	RES,MF,130,+-1%,0.5W,100PPM	151134	91637	CMF-65 1300F T-1	1	
R 18	RES,MF,10K,+-1%,0.125W,100PPM	719476	91637	CMF-55 1002F T-1	1	
R 19	RES,VAR,CERM,20,+-20%,0.5W	275727	80294	3386R-1-200	1	
R 20, 38	RES,MF,15K,+-1%,0.125W,100PPM	719690	91637	CMF-55 1502F T-1	2	
R 21, 39, 57	ϟ RES,CERM,2K,+-5%,.125W,200PPM,1206	746461	91637	CRCW1206-2001JB	3	
R 23, 40	ϟ RES,CERM,180,+-5%,.125W,200PPM,1206	720649	91637	CRCW1206-1800JB	2	
R 24, 25, 34, R 66	ϟ RES,CERM,22,+-5%,.125W,200PPM,1206 ϟ	746230 746230	91637	CRCW1206-22R0JB	4	
R 26	RES,MF,80.6,+-1%,0.5W,100PPM	158790	91637	CMF-65 80R6F T-1	1	
R 28	ϟ RES,CERM,200,+-5%,.125W,200PPM,1206	746339	91637	CRCW1206-2000JB	1	
R 29	ϟ RES,CERM,300,+-5%,.125W,200PPM,1206	746362	91637	CRCW1206-3000JB	1	
R 32	ϟ RES,CERM,120,+-5%,.125W,200PPM,1206	747683	91637	CRCW1206-1200JB	1	
R 33, 35	ϟ RES,CERM,220,+-5%,.125W,200PPM,1206	746347	91637	CRCW1206-2200JB	2	
R 36	RES,MF,5.62K,+-1%,0.125W,100PPM	720417	91637	CMF-55 5621F T-1	1	
R 37	RES,VAR,CERM,5K,+-10%,0.5W	327569	80294	3386R-1-502	1	
R 41, 42	ϟ RES,CERM,27,+-5%,.125W,200PPM,1206	811315	91637	CRCW1206-27R0JB	2	
R 43	RES,MF,66.5.+-1%,0.5W,100PPM	800847	91637	CMF65 66R5 F T-1	1	
R 47	RES,CC,470,+-5%,0.5W	108787	01121	EB4711	1	
R 48	RES,CF,1K,+-5% 0.25W	343426	59124	CF1/4 102J	1	
R 49, 51	RES,CF,20,+-5%,0.25W	442202	59124	CF1/4 20R0J	2	
R 54	ϟ RES,CERM,10,+-5%,.125W,200PPM,1206	746214	91637	CRCW1206-10R0JB	1	
R 56	ϟ RES,CERM,3.9K,+-5%,.125W,200PPM,1206	746545	91637	CRCW1206-3900JB	1	
R 58	RES,CF,24K,+-5%,0.25W	442384	59124	CF1/4 243J	1	
R 59	RES,CF,47K,+-5%,0.25W	348896	59124	CF1/4 473J	1	
R 60	RES,MF,39.2K,+-1%,0.125W,100PPM	236414	91637	CMF-55 3922F T-1	1	
R 61	RES,MF,34.8K,+-1%,0.125W,100PPM	261487	91637	CMF-55 3482F T-1	1	
R 62	RES,CF,100K,+-5%,0.25W	348920	59124	CF1/4 104J	1	
R 63	RES,CC,36,+-5%,3W	811471	01121	GM3605	1	
R 64, 65	ϟ RES,CERM,150,+-5%,.125W,200PPM,1206	746313	91637	CRCW1206-1500JB	2	
R 67- 70	RES,CF,24,+-5%,0.125W	740043	59124	RDS21/8-240J	4	
R 71	RES,CF,160,+-5%,0.125W	740092	59124	RDS21/8-161J	1	
U 1, 2	ϟ IC,BPLR,SELECT GAIN MSA 0404 @ 2GHZ	773226	24539	SMA85-2025	2	
U 3	ϟ IC,BPLR,MONOLITHIC MICROWAVE AMP	773200	24539	SMA86-0313	1	
U 4	ϟ IC,STTL,DUAL DIFFERENTIAL LINE DRIVER	801308	07263	UA9638TC	1	
U 5- 7	ϟ IC,GAAS,MMIC SPST RF SWITCH	800961	26805	SW-902	3	
U 8	ϟ IC,OP AMP,SELECTED GBW 600KHZ	418566	18324	LM358	1	
VR 17	ϟ ZENER,UNCOMP,9.1V,5%,14.0MA,0.4W	386557	04713	1N960B	1	
W 1	CABLE ASSY RF	808568	89536	808568	1	
W 2	CABLE ASSY, RF	808576	89536	808576	1	
W 3	CABLE ASSY, RF	808584	89536	808584	1	
W 4	CABLE ASSY, MODULATOR CONTROL	808519	89536	808519	1	

Table 5-8. A7 Output PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
W 5	CABLE ASSY, HET/FUNDAMENTAL CONTROL	808527	89536	808527	1	
W 6	CABLE ASSY, PULSE MODULATOR CONTROL	808535	89536	808535	1	
NOTES:	ϟ Static sensitive part. If any of the following components are replaced, the Generator must be re-calibrated: C31,32,34,44,53-55,64,68-71 CR8-15 L10,19,22 Q2,4,9 R23-25,28-35,41,45,53-55,63-66 U5-7					

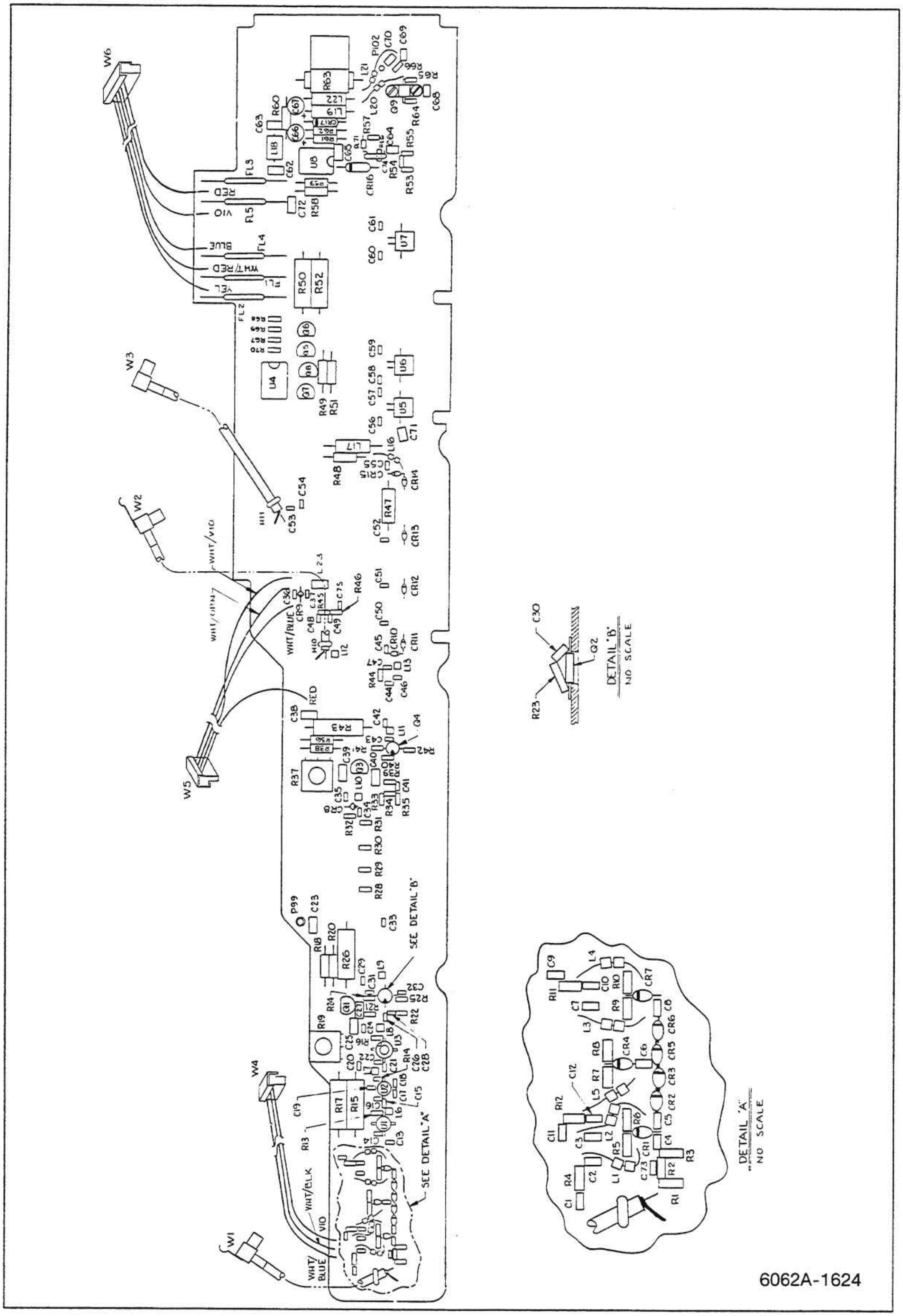

Figure 5-8. A7 Output PCA

Table 5-9. A8 Attenuator/RPP Assembly

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	ϟ RELAY DRIVER/RPP PCA	794982	89536	794982	1	
A 2	ϟ ATTENUATOR/RPP PCA	797852	89536	797852	1	1
H 49-55	SCREW,PH,P,LOCK,SS,6-32,.625	412841	74594	412841	7	
MP 1	ϟ ASSEMBLY, ATTENUATOR MODULE FILTER	848098	89536	848098	1	
U 1	IC,2K X 8,EPROM	454603	50088	ET2716Q	1	
NOTES:	ϟ Static sensitive part. 1. Software compensation required if assembly is replaced.					

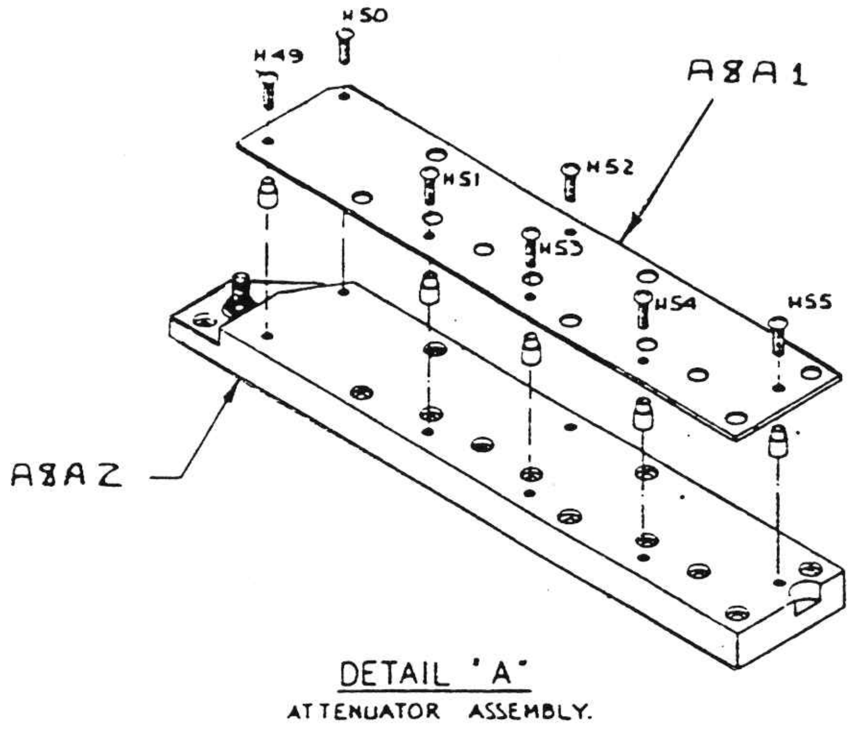

Figure 5-9. A8 Attenuator/RPP Assembly

Table 5-10. A8A1 Relay Driver/RPP PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 7, 11	CAP,POLYES,0.1UF,+-20%,50V	837526	40402	MKT1823 104 05 6	8	
C 8, 9, 12, C 13	CAP,CER,0.01UF,+-20%,100V,X7R	875489 875489	04222	SR151C103MAA	4	
C 10, 16	CAP,CER,0.22UF,+-20%,50V,Z5U	831982	04222	SR295E224MAA	2	
C 14	CAP,AL,22UF,+-20%,35V,SOLV PROOF	817056	62643	KMA35T220M6X7FT	1	
C 15	CAP,TA,4.7UF,+-20%,50V	832675	56289	199D475X0050DG2	1	
CR 1- 7, 15	⚡ ZENER,UNCOMP,30.0V,10%,4.2MA,0.4W	272633	04713	1N972BJAN	8	
CR 8, 9, 18	⚡ ZENER,UNCOMP,4.7V,5%,20.0MA,0.4W	524058	04713	1N750	3	
CR 10	⚡ ZENER,COMP,6.4V,5%,1PPM,2MA	381988	04713	SZG20120	1	
CR 11- 14, 16, CR 17	⚡ DIODE,SI,BV= 75.0V,IO=150MA,500MW ⚡	698720 698720	65940	1N4448	6	
J 1	HEADER,1 ROW,.100CTR,15 PIN	758011	00779	1-641126-5	1	
L 1- 10	CHOKE,6TURN	320911	89536	320911	10	
L 11	INDUCTOR,82UH,+-10%,14MHZ,SHLD	542290	24759	MR-82J&K	1	
L 12, 13	INDUCTOR,47UH,+-5%,26.5MHZ,SHLD	147850	24759	MR-47J	2	
MP 2- 8	SPACER,SWAGE,.250 RND,BR,.150,.250	423855	55566	1533B.150B14	7	
P 1- 11	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	11	
Q 1- 7, 9	⚡ TRANSISTOR,SI,PNP,T092	698290	04713	MPS6562	8	
Q 8	⚡ TRANSISTOR,SI,NPN,SELECTED IEBO,TO-92	685404	27014	SX14073A,SX12398	1	
R 1, 4, 7, R 10, 13, 16, R 19, 38	RES,CF,510,+-5%,0.25W	573139 573139 573139	59124	CF1/4 511J	8	
R 2, 5, 8, R 11, 14, 17, R 20, 39, 41	RES,CF,4.7K,+-5%,0.25W	573311 573311 573311	59124	CF1/4 472J	9	
R 3, 6, 9, R 12, 15, 18, R 21, 40	RES,CF,1,+-5%,0.25W	572883 572883 572883	59124	CF1/4 1R0J	8	
R 22, 23, 29, R 35, 36, 42, R 45	RES,CF,1K,+-5%,0.25W	573170 573170 573170	59124	CF1/4 102J	7	
R 24	RES,CF,30K,+-5%,0.25W	574251	59124	CF1/4 303J	1	
R 25, 30, 31, R 37, 49	RES,CF,10K,+-5%,0.25W	573394 573394	59124	CF1/4 103J	5	
R 27	RES,MF,1.07K,+-1%,0.125W,100PPM	344325	91637	CMF-55 1071F T-1	1	
R 28	RES,MF,422,+-1%,0.125W,100PPM	288506	91637	CMF-55 4220F T-1	1	
R 32	RES,MF,1.5K,+-1%,0.125W,100PPM	719682	91637	CMF-55 1501F T-1	1	
R 33	RES,CF,56,+-5%,0.25W	641068	59124	CF1/4 560J	1	
R 34	RES,CF,100K,+-5%,0.25W	573584	59124	CF1/4 104J	1	
R 43	RES,CF,13K,+-5%,0.25W	573410	59124	CF1/4 133J	1	
R 44	RES,CF,2K,+-5%,0.25W	573238	59124	CF1/4 202J	1	
R 46	RES,CF,470,+-5%,0.25W	573121	59124	CF1/4 471J	1	
R 47	RES,CF,12K,+-5%,0.25W	573402	59124	CF1/4 123J	1	
R 48	RES,CF,4.3K,+-5%,0.25W	641100	59124	CF1/4 432J	1	
TP 1	HEADER,1 ROW,.100CTR,6 PIN	478669	00779	103747-6	1	
U 1	⚡ IC,OP AMP,QUAD,JFET INPUT,14 PIN DIP	483438	01295	TL084CN	1	
NOTES:	⚡ Static sensitive part.					

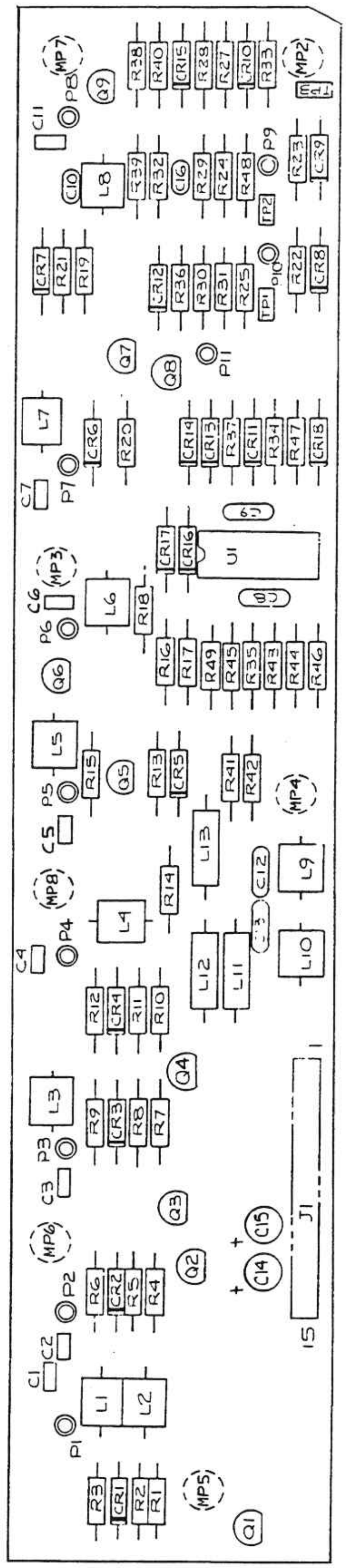

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Figure 5-10. A8A1 Relay Driver/RPP PCA

Table 5-11. A8A2 Attenuator/RPP PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 9	CAP,CER,1000PF,+-20%,50V,X7R,0805	514059	04222	08055C102MAT060R	2	
C 2, 3, 5, C 6	CAP,TA,4.7UF,+-20%,15V	745976 745976	56289	195D475X0015V2T	4	
C 4, 7	CAP,POLYES,0.1UF,+-20%,50V	732883	68919	MKS02104P50V	2	
C 8	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	51406	GRM42-6Y5V221Z050PB	1	
CR 1	ϟ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	535195	28480	5082-2800	1	
CR 2, 3	DIODE, LOW VSWR	819029	89536	819029	2	
H 1- 8	RELAY WASHER	803247	89536	803247	8	
H 13,411	SCREW,PH,P,LOCK,MAG SS,6-32,.375	783225	74594	783225	2	
J 1	SOCKET,SINGLE,PWB,FOR 0.034-0.037 PIN	732826	00779	2-332070-7	1	
J 2	CONN,COAX,SMA(M),PWB OR PANEL	512087	21845	2985-6011	1	
K 1, 3, 4, K 6, 7	RELAY,ARMATURE,2 FORM C,18VDC	816413 816413	01526	3SDS5002G1	5	
K 2, 5, 8	RELAY, SCREENED, HIGH FREQUENCY	812669	89536	812669	3	
L 1, 2	CHOKE,6TURN	320911	89536	320911	2	
P 1- 11	SOCKET,SINGLE,PWB,FOR .042-.049 PIN	544056	00779	50871-1	11	
R 1, 2, 8, R 9, 12, 13, R 19, 20, 23, R 24	ϟ RES,CERM,200,+-1%,.125W,100PPM,1206 ϟ ϟ ϟ	772798 772798 772798 772798	91637	CRCW1206-2000FB	10	
R 3, 4, 10, R 11, 14, 15, R 21, 22, 25, R 26	ϟ RES,CERM,56.2,+-1%,.125W,100PPM,1206 ϟ ϟ ϟ	772756 772756 772756 772756	91637	CRCW1206-56R2FB	10	1
R 5	ϟ RES,CERM,93.1,+-1%,.125W,100PPM,1206	772772	91637	CRCW1206-93R1FB	1	1
R 6, 7	ϟ RES,CERM,82.5,+-1%,.125W,100PPM,1206	772764	91637	CRCW1206-82R5FB	2	1
R 16	ϟ RES,CERM,37.4,+-1%,.125W,100PPM,1206	772749	91637	CRCW1206-37R4FB	1	1
R 17, 18	ϟ RES,CERM,150,+-1%,.125W,100PPM,1206	772780	91637	CRCW1206-1500FB	2	1
R 27	RES,CC,10K,+-10%,0.125W	246975	01121	BB3035	1	1
R 28	RES,CC,130,+-5%,0.125W	756411	01121	BB1315	1	1

NOTES:

ϟ Static sensitive part.

1. Mount parts color side up.

If any of the following components are replaced, the Generator must be re-calibrated
C8
CR1-3
K1-8
J1,2
R1-28

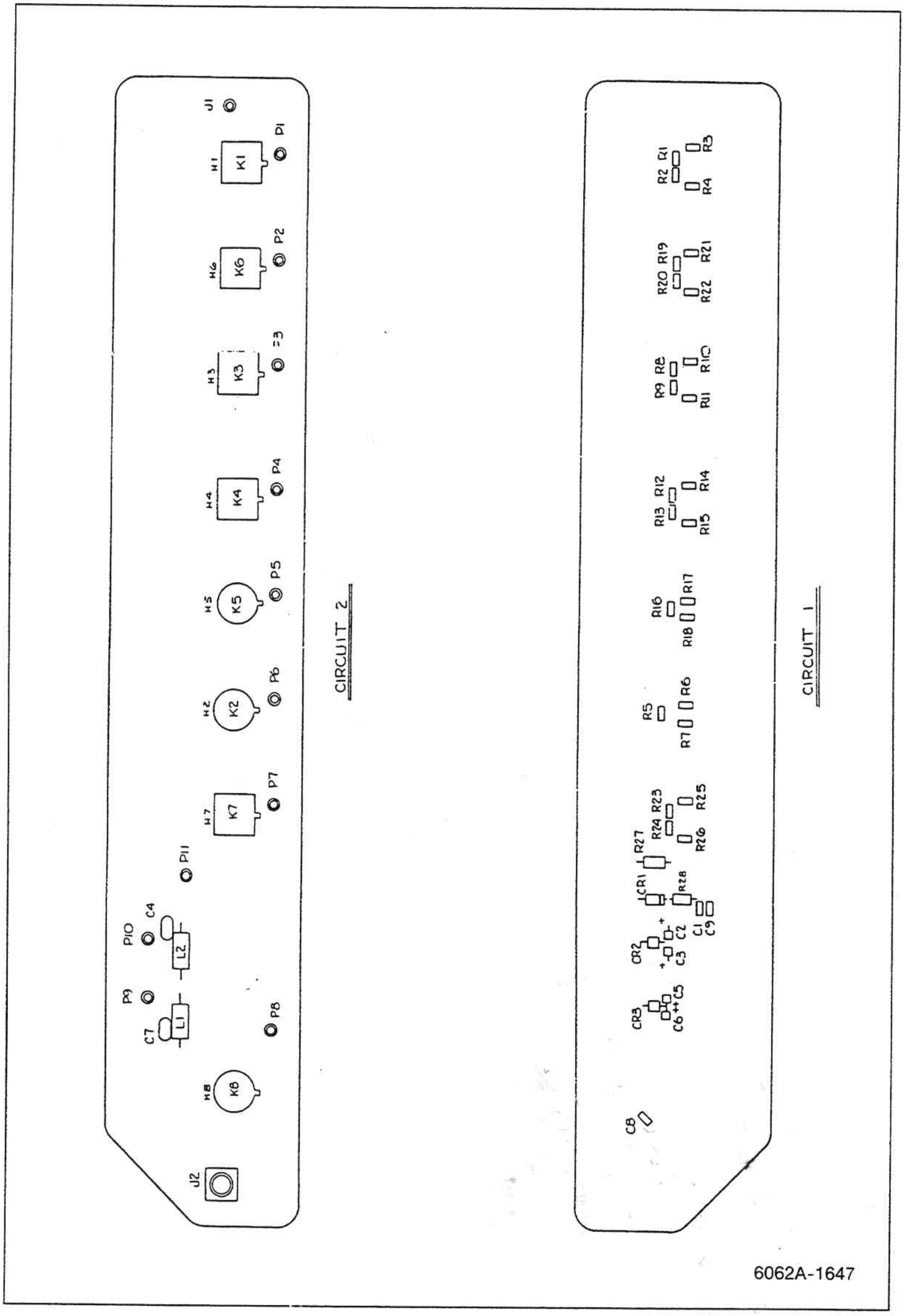
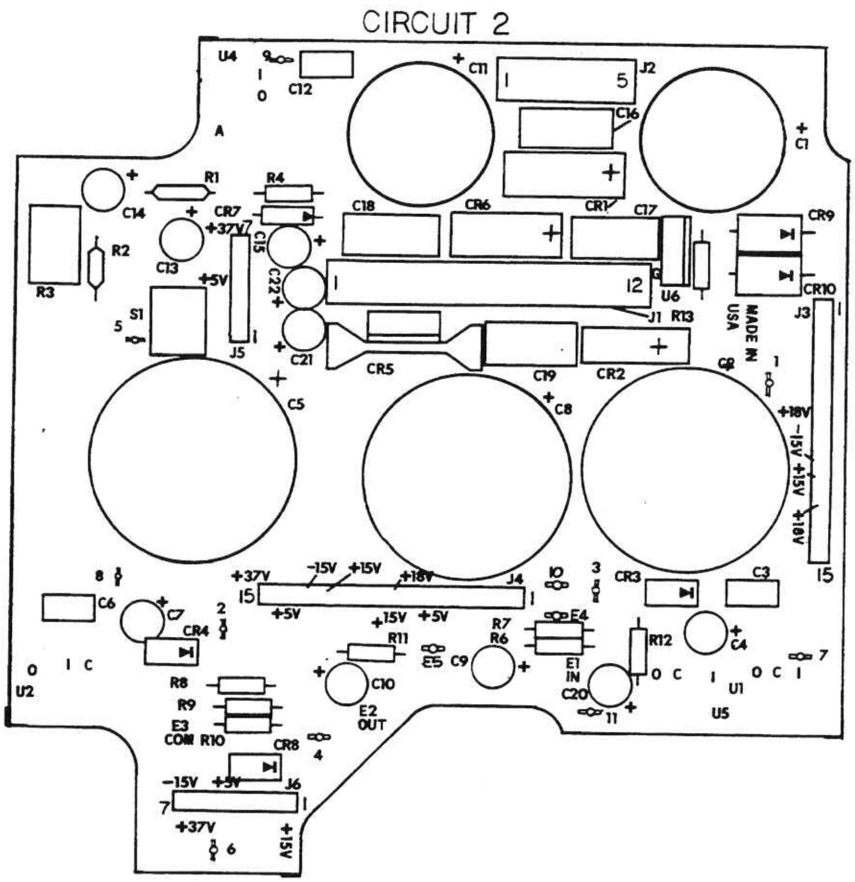


Figure 5-11. A8A2 Attenuator/RPP PCA

Table 5-12. A9 Power Supply PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,AL,2200UF,+30-10%,35V,SOLV PROOF	715334	62643	KME35VN222K23X27LLV	1	
C 2, 5	CAP,AL,10000UF,+30-10%,35V,SOLV PROOF	614990	62643	KME35VN103K31X42LLV	2	
C 3, 6, 12	CAP,CER,0.1UF,+-20%,50V,X7R	573808	04222	SR215C104MAA	3	
C 4, 7, 15, C 20	CAP,TA,6.8UF,+-20%,35V	363713 363713	56289	199D685X0035DA2	4	
C 8	CAP,AL,15000UF,+30-10%,25V,SOLV PROOF	732958	62643	KME25VN153K31X42LLV	1	
C 9, 21, 22	CAP,TA,2.2UF,+-20%,20V	161927	56289	199D225X0020BA2	3	
C 10	CAP,TA,22UF,+-20%,15V	423012	56289	199D226X0015DA2	1	
C 11	CAP,AL,470UF,+30-10%,80V,SOLV PROOF	574160	62643	KME80VN471K23X27LLV	1	
C 13, 14	CAP,TA,4.7UF,+-20%,50V	363721	56289	199D475X0050DA2	2	
C 16- 19	CAP,POLYES,0.22UF,+-10%,100V	436113	68919	MKS4224K100V	4	
CR 1, 2, 6	DIODE,SI,RECT,BRIDGE,BV=100V,IO=2.0A	392910	14936	2KBP01M	3	
CR 3, 4, 8	DIODE,SI,100 PIV,1.0 AMP	698555	04713	1N4002	3	
CR 5	DIODE,SI,45PIV,7.5A,DUAL SCHOTTKY	741322	04713	MBR1545CT	1	
CR 7	ϟ ZENER,UNCOMP,6.2V,5%,20.0MA,0.4W	325811	04713	1N753	1	
E 1- 5	TERM,FASTON,TAB,.110,SOLDER	512889	00779	62395-1	16	
H 1	SCREW,PH,P,LOCK,STL,4-40,.250	740746	74594	740746	1	
H 3	NUT,HEX,STL,4-40	110635		COMMERCIAL	1	
J 1	HEADER,1 ROW,.156CTR,12 PIN	512160	00779	1-641202-2	1	
J 2	HEADER,1 ROW,.156CTR,5 PIN	512186	00779	641202-5	1	
J 4	HEADER,1 ROW,.100CTR,15 PIN	758011	00779	1-641126-5	1	
J 5	HEADER,1 ROW,.100CTR,6 PIN	758003	00779	641126-6	1	
J 6	HEADER,1 ROW,.100CTR,7 PIN	757997	00779	641126-7	1	
MP 1	HEAT DIS,VERT,1.25X.875X.25,TO-220	524934	13103	6025B-TT	1	
R 1	RES,MF,249,+-1%,0.125W,100PPM	168203	91637	CMF-55 2490F T-1	1	
R 2	RES,MF,6.65K,+-1%,0.125W,100PPM	294918	91637	CMF-55 6651F T-1	1	
R 3	RES,VAR,CERM,1K,+-10%,0.5W	285155	80294	3386S-1-102	1	
R 4	RES,CF,10K,+-5%,0.25W	348839	59124	CF1/4 102J	1	
R 6- 9	RES,CF,5.1,+-5%,0.25W	441287	59124	CF1/4 5R1J	4	
R 10, 13	RES,CF,220,+-5%,0.25W	342626	59124	CF1/4 221J	2	
R 11	RES,CF,1,+-5%,0.25W	357665	59124	CF1/4 1R0J	1	
R 12	RES,CF,0.51,+-5%,0.25W	381954	59124	CF1/4 0R51J	1	
S 1	SWITCH,SLIDE,DPDT	452862	79727	GS113-(0018)-G20-32	1	
U 1	ϟ IC,VOLT REG,FIXED,+15 VOLTS,1.5 AMPS	413187	01295	UA7815CKC3	1	
U 2	ϟ IC,VOLT REG,FIXED,-15 VOLTS,1.5 AMPS	413179	04713	MC7915CT	1	
U 4	ϟ IC,VOLT REG,ADJ,1.2 TO 37 V,1.5 AMPS	460410	27014	LM317T	1	
U 5	ϟ IC,VOLT REG,FIXED 15VOLTS,1.5A	772830	04713	TL780-15CKC	1	
U 6	ϟ THYRISTOR,SI,TRIAC,VBO=200V,8.0A	413013	04713	T2800BT	1	
VR 9, 10	ϟ ZENER,UNCOMP,62.0V,5%,20MA,5.0W	559567	04713	1N5372B	2	
NOTES:	ϟ Static sensitive part.					



6060A-1631

Figure 5-12. A9 Power Supply PCA

Federal Supply Codes for Manufacturers

00779
AMP, Inc.
Harrisburg, PA

01121
Allen-Bradley Co.
Milwaukee, WI

01295
Texas Instruments Inc.
Semiconductor Group
Dallas,TX

01526
Genicom Corp.
Waynesboro, VA

04222
AVX Corp.
AVX Ceramics Div.
Myrtle Beach, SC

04713
Motorola Inc.
Semiconductor Products Sector
Phoenix, AZ

05791
Lyn-Tron Inc.
Burbank, CA

06383
Panduit Corp.
Tinley Park, IL

06915
Richco Plastic Co.
Chicago, IL

07263
Fairchild Semiconductor
North American Sales
Cupertino, CA

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, NY

0B0A9
Dallas Semiconductor corp
Dallas, TX

0BW21
Noritake Co. Inc.
Burlington, MA

0K392
Shin-Etsu Silicones of America
(S P America)
Torrance, CA

0LUA3
Philips Components
Slatersville, RI

10059
Barker Engineering Corp.
Kenilworth, NJ

12020
Ovenaire
Div. of Electronic Technologies
Charlottesville, VA

13103
Thermalloy Co., Inc.
Dallas, TX

14552
Microsemi Corp.
(Formerly Micro-Semiconductor)
Santa Ana, CA

14936
General Instrument Corp.
Power Semiconductor Div.
Hicksville, NY

15542
Mini-Circuits Laboratory
Div of Scientific Components Corp.
Brooklyn, NY

17856
Siliconix Inc.
Santa Clara, CA

18310
Concord Electronics Corp.
New York, NY

18324
Signetics Corp.
Military Products Div.
Orem, UT

1AV65
Mini-Circuits
c/o Robtron Inc.
Brooklyn, NY

20584
Enochs Inc.
Indianapolis, IN

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, FL

22526
DuPont, El DeNemours & Co. Inc.
DuPont Connector Systems
New Cumberland, PA

22670
GM Nameplate, Inc.
Seattle, WA

24355
Analog Devices Inc.
Norwood, MA

24539
Avantek, Inc.
Santa Clara, CA

24759
Lenox-Fugle Electronics Inc.
South Plainfield, NJ

25088
Siemens Corp.
Iselin, NJ

26233
Nylok Fastener Corp.
Carson, CA

26805
M/A-COM Omni Spectra Inc.
Microwave Connector Div.
Sub of M/A-Com Inc.
Waltham, MA
Formerly Omni Spectra

27014
National Semiconductor Corp.
Santa Clara, CA

28213
Minnesota Mining & Mfg. Co.
Consumer Specialties Div. 3M Center
Saint Paul, MN

28480
Hewlett-Packard Co.
Corporate HQ
Palo Alto, CA

2M021
EFAB Mfg. Inc.
Charlottesville, VA

2M530
John Perine
Seattle, WA

30035
Jolo Industries Inc.
Garden Grove, CA

30800
General Instrument Corp.
Capacitor Div.
Hicksville, NY

32997
Bourns Inc.
Trimpot Div.
Riverside, CA

33297
NEC Electronics USA Inc.
Electronic Arrays Inc. Div.
Mountain View, CA

34371
Harris Corp.
Harris Semiconductor Products Group
Melbourne, FL

34641
Instrument Specialties Co.,Inc.
Euless, TX

46384
Penn Engineering & Mfg. Corp.
Danboro, PA

4U402
Roederstein Electronics Inc.
Statesville, NC

50088
SGS - Thomson Microelectronics Inc.
Formerly Thomson Components-Mostek Corp.
Carrollton, TX

50273
Fenwal Electronics Inc.
Milford, MA

50364
MMI/AMD
Formerly Monolithics Memories Inc.
Santa Clara, CA

50579
Siemens Components Inc.
Optoelectronics Div.
Cupertino, CA

Federal Supply Codes for Manufacturers (cont)

51406
Murata Erie, No. America Inc.
Symrna, GA

51506
Accurate Screw Machine Co.
(ASMCO) Nutley, NJ

52763
Stettner-Electronics Inc.
Chattanooga, TN

53217
Technical Wire Products Inc.
DBA Tecknit Inc.
Santa Barbara, CA

54583
TDK Electronics Corp.
Port Washington, NY

55285
Bercquist Co. Inc., The
Minneapolis, MN

55566
RAF Electronic Hardware Inc.
Seymour, CT

56289
Sprague Electric Co.
Nashua, NH

56878
SPS Technologes Inc.
Aerospace & Industrial Products Div.
Jenkintown, PA

59124
KOA-Speer Electronics Inc.
Bradford, PA

59365
Metelics Corp.
Sunnyvale, CA

59660
Tusonix Inc.
Tucson, AZ

5P059
Tech Products Corp.
Dayton, Ohio

60204
Fleck Co Inc.
Auburn, WA

60395
Xicor Inc.
Milpitas, CA

60705
Cera-Mite Corp.
(formerly Sprague)
Grafton, WI

61271
Fujitsu Microelectronics Inc
San Jose, CA

61636
Philips ECG Inc.
Div. of North American Philips Corp
Ottawa, OH

62643
United Chemi-con Inc.
Rosemont, IL

65940
Rohm Corp
Irvine, CA

68919
Inter-Technical Group Inc., The
Wima Division
Elmsford, NY

70903
Cooper Belden Electronic Wire & Cable
Geneva, IL

71034
Bliley Electric Co.
Erie, PA

71400
Bussman
Div. of Cooper Industries Inc.
St. Louis, MO

72259
Nytronics Inc.
New York, NY

72962
Elastic Stop Nut
Div. of Harvard Industries
Union, NJ

74594
Component Resources Inc.
Div of EPI International Corp.
Beaverton, OR

74840
Illinois Capacitor Inc.
Lincolnwood, IL

78189
Illinois Tool Works Inc.
Shakeproof Div.
Elgin, IL

79727
C - W Industries
Southampton, PA

79963
Zierick Mfg. Corp.
Mount Kisco, NY

80294
Bourns Instruments Inc.
Riverside, CA

82877
Rotron Inc.
Custom Div.
Woodstock, NY

84411
American Shizuki Corp.
Ogallala opns
Ogallala, NE

86928
Seastrom Mfg. Co. Inc.
Glendale, CA

89536
John Fluke Mfg. Co., Inc.
Everett, WA

8A233
Philips ECG Inc.
Div. of North American Philips Corp.
Williamsport, PA

91293
Johanson Mfg. Co.
Boonton, NJ

91506
Augat, Inc.
Attleboro, MA

91637
Dale Electronics Inc.
Columbus, NE

96341
M/A-Com Inc.
Burlington, MA

98159
RubberTeck Inc.
Gardena, CA

98291
Sealectro Corp.
BICC Electronics
Trumbill, CT

98978
IERC
(International Electronic Research Corp.)
Burbank, CA

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I & E Division
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TLX: TX61511.PHEMB BEL/BRMS

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TLX: (781) 2424331 FLUKJPJ

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TLX: K24283 MYOUNG

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46700 Petaling Jaya
Selangor
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TLX: 1171038 FAIRME

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Phillips Nederland
Test & Measurement Division
Postbox 115
5000 AC Tilburg
TEL: 31-13-390172
TLX: 52683 FLUKE

New Zealand
Phillips Customer Support
Scientific & Industrial
2 Wagener Place
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Auckland
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Sandstuveien 70
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I.I. Chundrigar Road
P.O. Box 5323
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TLX: (952) 24494 PIO PK

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CH-8027 Zurich
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TLX: 815 780 11

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Commercial Building,
344 Min Sheng East Road
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TLX: (785) 11111 SCHMIDT

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2102/31 Ramkamhaeng Road
Bangkok 10240
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TLX: (788) 82796 HUAMARK TH

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Inonu Caddesi 78/80
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TLX: 24192 phtr trtrxibph

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Libertad 2525
Montevideo
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TLX: (398) COAUR UY23010

Venezuela
Coasin C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Apartado de Correos Nr-70-136
Los Ruices
Caracas 1070-A
TEL: 58 2 241-0309, 241-1248
TLX: (395) 21027 EMVEN VC

Section 6
Options

6-1. INTRODUCTION

This section includes the theory of operation, a circuit description, and maintenance instructions for each option.

Option -130
High-Stability Reference

130-1. INTRODUCTION

Option -130 High-Stability Reference, with the rear panel REF INT/EXT switch set to INT, configures the Generator's reference to be supplied by the High-Stability Reference option.

130-2. OPERATION

The High-Stability Reference option consists of the auxiliary power supply and an ovened oscillator (Y1). The auxiliary power supply is mounted inside the Generator on the rear panel. The ovened oscillator is mounted inside the instrument on the side rail. Only the auxiliary power supply is field repairable, and it is described in this section.

130-3. CIRCUIT DESCRIPTION

The auxiliary power supply is connected directly to the line power on the fuse/filter/line-voltage selector assembly to supply power to the ovened oscillator even when the Generator POWER switch is off. The auxiliary power supply includes a linear-regulated supply and an automatic line-voltage selector circuit.

The linear-regulated supply consists of a diode rectifier bridge CR1, filter capacitor C1, voltage regulator U1, and associated resistors R2, R3, and R4. The circuit associated with CR3, Q1 and U2, provides automatic line voltage selection between two line-voltage ranges. This is implemented by configuring the rectifier circuit as a bridge rectifier for the lower line voltages or as a center-tapped, full-wave rectifier for the higher line voltages.

At low line voltages (less than approximately 150V ac), transistor Q1 is conducting, thus grounding the minus terminal of rectifier CR1 and causing diode CR3 to be reverse biased. This causes the full secondary voltage of T1 to be rectified by the bridge rectifier, CR1.

When the line voltage is greater than 180V ac, (there is approximately 30V hysteresis), the comparator U2 turns off transistor Q1. Diode CR3 becomes forward biased, and the transformer center tap is effectively grounded. The voltage applied to the rectifier CR1 is then half the secondary voltage.

The comparator U2 input voltages are set by resistors R1, R6, R9, and zener diode CR4. U2 controls the base of transistor Q1. The comparator switching point is set between the low and high line voltages, with sufficient hysteresis to accommodate variations in input loading. At very low line voltages, the resistor diode combination R10 and CR5, from the 37V output of the main power supply, augment the auxiliary power supply.

The ovened oscillator output is disabled when the control line EXREFL is set low, (i.e., when the REF INT/EXT switch is set to EXT during external reference operation). The status line

HSOPTL, normally at +5V, is pulled to ground when the High-Stability Reference option is installed.

130-4. ADJUSTMENTS

TEST EQUIPMENT:

Frequency Standard
Oscilloscope
Two 3-ft 50-ohm coaxial cables

REMARKS:

For the best results in the frequency accuracy adjustment, the Generator should be operated at room temperature for at least three hours before continuing with the adjustment procedures. The voltage adjustment (R4) should be made after the first half hour of the three-hour Generator warmup period has begun.

PROCEDURE:

1. Adjust the High-Stability Reference power-supply voltage.
2. View the UUT reference and the Frequency Standard waveforms on the Oscilloscope while triggering on the Frequency Standard.
3. Adjust the ovened oscillator FREQ ADJ, COARSE, and then FINE for a stationary display.

130-5. Voltage Adjustment

Use the following procedure to make the voltage adjustment to the High-Stability Reference option:

1. Remove the top instrument cover.
2. Connect the DMM to the UUT (the positive lead to TP1 and the negative lead to TP3).
3. Adjust R4 for 23.4 $\pm$ 0.1V.
4. Remove the DMM connections from the UUT and replace the top cover (temporarily).
5. Wait the remaining Generator warmup time.
6. Perform the Frequency Adjustment procedure.

130-6. Frequency Adjustment

Use the following procedure to make the frequency adjustment to the High-Stability Reference option:

1. Remove the top instrument cover and the two FREQ ADJ access screws from the top of the ovened oscillator.

2. Connect the Frequency Standard signal to the Oscilloscope vertical input channel 1, 50-ohms termination.

3. Connect the UUT rear panel 10 MHz OUT to the Oscilloscope vertical input channel 2, 50-ohms termination.

4. Set the UUT rear panel UUT REF INT/EXT switch to INT.

5. Set the vertical controls of the Oscilloscope to display the UUT 10-MHz signal and the Frequency Standard 10-MHz signal.

6. Set the Oscilloscope for internal triggering on channel 1, and adjust the timebase for 0.1 μs/div.

7. Adjust the Oscilloscope COARSE.

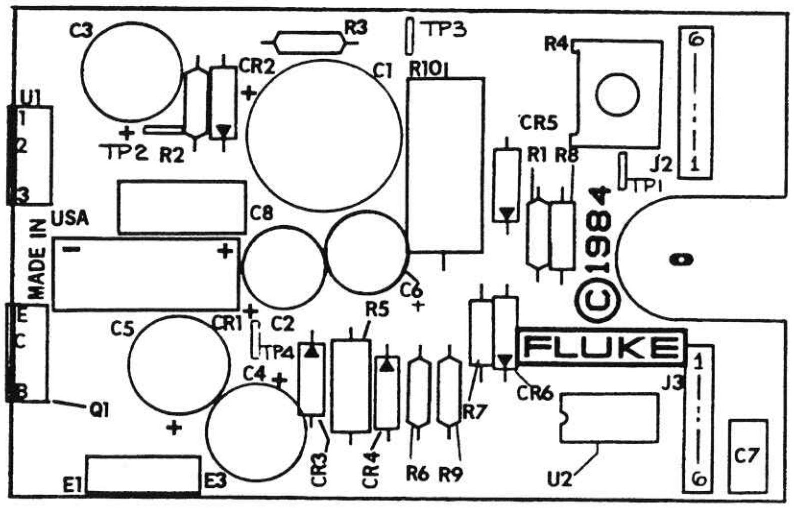
8. Adjust the FINE controls for a drift of less than one cycle in 10 seconds (for 0.01 ppm or better if desired).

130-7. LIST OF REPLACEABLE PARTS

Tables 130-1 and 130-2 list replaceable parts for the Option -130. Figure 130-2 is the component location diagrams for the Option -130.

Table 130-1. A3A2A1 High-Stability Reference PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,AL,470UF,+-20%,50V,SOLV PROOF	854620	62643	SXE50VB471M18X15M[illegible]	1	
C 2, 6	CAP,TA,4.7UF,+-20%,50V	363721	56289	199D475X0050DA2	2	
C 3, 4	CAP,TA,10UF,+-20%,35V	417683	56289	199D106X0035DA2	2	
C 5	CAP,AL,100UF,+50-20%,50V	649731	62643	SM50VB101M10X16LLV	1	
C 7	CAP,POLYES,0.1UF,+-10%,50V	696484	68919	MKS2-104K50B	1	
C 8	CAP,POLYES,0.1UF,+-10%,100V	393439	68919	MKS4-104-K-100V	1	
CR 1	DIODE,SI,RECT,BRIDGE,BV=200V,IO=1.5A	296509	30800	KBP 02M	1	
CR 2, 3, 5	DIODE,SI,100 PIV,1.0 AMP	698555	04713	1N4002	3	
CR 6	ϟ DIODE,SI,BV=75V,IO=150MA,500MW	203323	09214	IN4448	1	
H 4, 12	SCREW,FHU,P,LOCK,STL,4-40,.312	268193	74594	268193	2	
H 5, 13	WASHER,SHLDR,NYLON,.113,.245	485417	86928	5607-50	2	
H 6, 14	NUT,CAP,EXT.LOCK,STL,4-40	195255	78189	501-040800-00	2	
H 7, 27- 29	SCREW,FH,P,LOCK,STL,4-40,.250	114884	74594	114884	4	
H 9, 33	SCREW,PH,P,LOCK,MAG SS,6-32,.375	783225	74594	783225	2	
H 10, 11	NUT,HEX,LOCK,SS,4-40	558866	72962	558866	2	
H 15, 16	SCREW,BTNH,SCKT,STL,4-40,1.250	528315	56878	38030-94-C-20	2	
H 17- 20	SCREW,PH,P,LOCK,SS,4-40,.375	256164	74594	256164	4	
H 21- 26	SCREW,PH,P,LOCK,STL,6-32,.250	152140	74594	152140	6	
H 30- 32	NUT,HEX,ELAST STOP,STL,6-32,.125	110841	72962	F21NTM-62	3	
J 2- 11	PIN,SINGLE,PWB,0.025 SQ	267500	00779	87623-1	10	
MP 1	TRANSFORMER RETAINER,HIGH STABILITY	716977	89536	716977	1	
MP 2	TRANSFORMER MOUNT, HIGH STABILITY REF	716878	89536	716878	1	
MP 3, 4	INSUL PART,POWER,SI,.750,.500	534453	55285	7403-09FR-54	2	
MP 5, 10	CABLE TIE ANCHOR,ADHSV,.160TIE	407908	06383	ABMM-A-C	2	
MP 6, 11	CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	172080	06383	SST-1M	2	
MP 7	PIN,SMA ADAPTER,HIGH STAB REF CABLE	716845	89536	716845	1	
MP 8	BLOCK,SMA ADAPTER,PLATED HS REF 900	745158	89536	745158	1	
MP 9	ADAPTER, SMA(F),SMA(F)	614768	21845	SF2992-6001	1	
MP 12	MOUNTING PLATE, HIGH STABILITY OSC	716860	89536	716860	1	
Q 1	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP120T	1	
R 1	RES,MF,49.9K,+-1%,0.125W,100PPM	268821	91637	CMF-55 4992F T-1	1	
R 2	RES,MF,249,+-1%,0.125W,100PPM	168203	91637	CMF-55 2490F T-1	1	
R 3	RES,MF,4.02K,+-1%,0.125W,100PPM	235325	91637	CMF-55 4021F T-1	1	
R 4	RES,VAR,CERM,500,+-10%,0.5W	325613	80294	3386R-1-501	1	
R 5	RES,CC,2.7,+-5%,0.5W	218743	01121	EB2R75	1	
R 6, 9	RES,MF,6.34K,+-1%,0.125W,100PPM	267344	91637	CMF-55 6341F T-1	2	
R 7	RES,CF,4.7K,+-5%,0.25W	348821	59124	CF1/4 472J	1	
R 8	RES,CF,10K,+-5%,0.25W	348839	59124	CF1/4 102J	1	
R 10	RES,CC,100,+-10%,2W	109934	01121	HB1011	1	
T 1	TRANSFORMER, AUXILIARY	731281	89536	731281	1	
TP 1- 4	TERM,FASTON,TAB,.110,SOLDER	512889	00779	62395-1	4	
U 2	ϟ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 10	ϟ IC,VOLT REG,ADJ,1.2 TO 37 V,1.5 AMPS	460410	27014	LM317T	1	
VR 4	ϟ ZENER,UNCOMP,6.2V,5%,20.0MA,0.4W	325811	04713	1N753	1	
W 4	CABLE ASSY HS 10MHZ	738567	98291	738567	1	
W 13	CABLE ASSY,HS OSCILLATOR	748715	89536	748715	1	
W 14	CABLE ASSY,AUX PWR SUPPLY	748707	89536	748707	1	
Y 1	OSCILLATOR,10MHZ,OVENIZED	512079	12020	49-22A-10MHZ	1	
NOTES:	ϟ Static sensitive part.					



6060A-1632

Figure 130-1. A3A2A1 High Stability Reference PCA

Option -132
Medium-Stability Reference

132-1. INTRODUCTION

The Option -132 Medium-Stability Reference, provides the Generator with a medium-stability frequency reference.

132-2. OPERATION

The Medium-Stability Reference option is selected as as the Generator's reference when the rear panel REF INT/EXT switch is set to INT.

NOTE

The Medium-Stability Reference option does not have standby power nor is the oven kept warm during external reference operation. Therefore, each time the Medium-Stability Reference is selected, a warm-up time is required to meet specifications. The warm-up time is typically 5 to 10 minutes. (See Table 1-2 for specification details.)

132-3. CIRCUIT DESCRIPTION

The Option -132 Medium-Stability Reference PCA consists of an ovened oscillator (Y1) and an ac-to-TTL converter. The pca is field repairable and is described in the following paragraphs. The ovened oscillator (Y1) is not field repairable.

The pca is mounted on the left side rail and is connected to the +5V power supply and to control signals via cable W25. The output is connected to the A4 Synthesizer PCA through cable W24.

Two NAND gates of U1 are used to convert the oscillator's ac-coupled output to a TTL signal. Another NAND gate of U1 and transistor Q1 control the power for the oven and oscillator circuit of Y1.

When the REF INT/EXT switch is set to EXT for external reference operation, the control line EXREFL is set low. This disables the oven and oscillator circuit of Y1 and also disables the ac-to-TTL converter to prevent it from oscillating spuriously.

132-4. ADJUSTMENT

This procedure is used to adjust the frequency of the Medium-Stability Reference option. For the best results, the Generator should be warmed up for one hour at room temperature before proceeding with the adjustment procedure.

TEST EQUIPMENT:

Frequency Standard
Oscilloscope
Two 3-ft, 50-ohm coaxial cables

REMARKS:

In this procedure, the waveforms of the UUT and the Frequency Standard are viewed on the Oscilloscope while triggering on the Frequency Standard. The ovened oscillator's FREQ ADJ control is then adjusted for a stationary display.

NOTE

An alternative method of adjustment is to count the 10-MHz reference signal at the 10 MHz OUT connector with a counter that has a suitably stable and accurate reference.

PROCEDURE:

1. Turn the Generator on, set the REF INT/EXT switch to INT, and then wait 1 hour. (If the Generator has already warmed up for at least 40 minutes, it is sufficient to wait an additional 20 minutes after the REF INT/EXT switch is set to INT.)
2. Remove the top instrument cover. The frequency adjustment control is accessed through the upper rear left side.
3. Connect the Frequency Standard's output signal to the Oscilloscope's vertical input channel 1, with 50-ohms termination.
4. Connect the UUT rear panel 10-MHz OUT to the Oscilloscope's vertical input channel 2, with 50-ohms termination.
5. Set the vertical controls of the Oscilloscope to display the UUT's 10-MHz signal and the Frequency Standard's 10-MHz signal.
6. Set the Oscilloscope for internal triggering on channel 1, and adjust the timebase for 0.1 us/division.
7. Adjust the Oscillator FREQ for a drift of less than one cycle in 10 seconds (or a counter frequency within 0.1 Hz of 10 MHz) for 0.01 ppm or better if desired.

132-5. LIST OF REPLACEABLE PARTS

A list of replaceable parts for Option -132 is shown in Table 132-1. A component location diagram for Option -132 is shown in Figure 132-1.

Table 132-1. A5A1 Medium-Stability Reference PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 3, 5- C 8	CAP, POLYES, 0.1UF, +-20%, 50V	732883 732883	68919	MKS02104P50V	6	
C 2	CAP, TA, 10UF, +-20%, 10V	176214	56289	199D106X0010EA2	1	
C 4	CAP, CER, 1000PF, +-20%, 100V, X7R	816181	04222	SR071C102MAA	1	
H 1, 3, 4	SCREW, PH, P, LOCK, STL, 6-32, .250	152140	74594	152140	3	
H 2, 5	SCREW, PH, P, LOCK, MAG SS, 6-32, .281	772236	74594	772236	2	
H 6	SCREW, PH, P, LOCK, STL, 4-40, .250	740746	74594	740746	1	
H 7	NUT, HEX, LOCK, SS, 4-40	558866	72962	558866	1	
H 8	INSULATOR OSCILLATOR	487710	89536	487710	1	
J 1	CONN, COAX, SMB (M), PWB, RT ANG	353243	26805	5164-5003-09	1	
J 2	HEADER, 1 ROW, .100CTR, 6 PIN	758003	00779	641126-6	1	
L 1	CHOKE, 6TURN	320911	89536	320911	1	
MP 1	SPACER, SWAGE, .250 RND, BR, 4-40, .125	335596	55566	3045B440B14-MOD.=.125	1	
MP 2- 4	SPACER, SWAGE, .250 RND, BR, 6-32, .250	446351	55566	3047B632B14-MOD.=.250	3	
MP 5	↯ PWB, 50 OHM PIN ADAPTER	792770	89536	792770	1	
P 1	PIN TEST BASE	698472	20584	698472	1	
Q 1	↯ TRANSISTOR, SI, BV= 80V, 40W, TO-220	504944	27014	2N6107	1	
R 1	RES, CF, 100, +-5%, 0.25W	348771	59124	CF1/4 101J	1	
R 2	RES, CF, 120, +-5%, 0.25W	442293	59124	CF1/4 121J	1	
R 3, 5	RES, CF, 2.2K, +-5%, 0.25W	343400	59124	CF1/4 222J	2	
R 4	RES, CF, 1.5K, +-5%, 0.25W	343418	59124	CF1/4 152J	1	
R 6	RES, CF, 1K, +-5%, 0.25W	343426	59124	CF1/4 102J	1	
TP 1	TERM, FASTON, TAB, .110, SOLDER	512889	00779	62395-1	1	
U 1	↯ IC, STTL, QUAD 2 INPUT NAND GATE	363580	01295	SN74S00N	1	
W 24	CABLE ASSY	546366	89536	546366	1	
W 25	CABLE ASSY, CONTROL, MED STAB REF OPT	792804	89536	792804	1	
Y 1	OSCILLATOR, 10MHZ, OVENIZED	484410	12020	OSC85-13-10MHZ	1	
NOTES:	↯ Static sensitive part.					

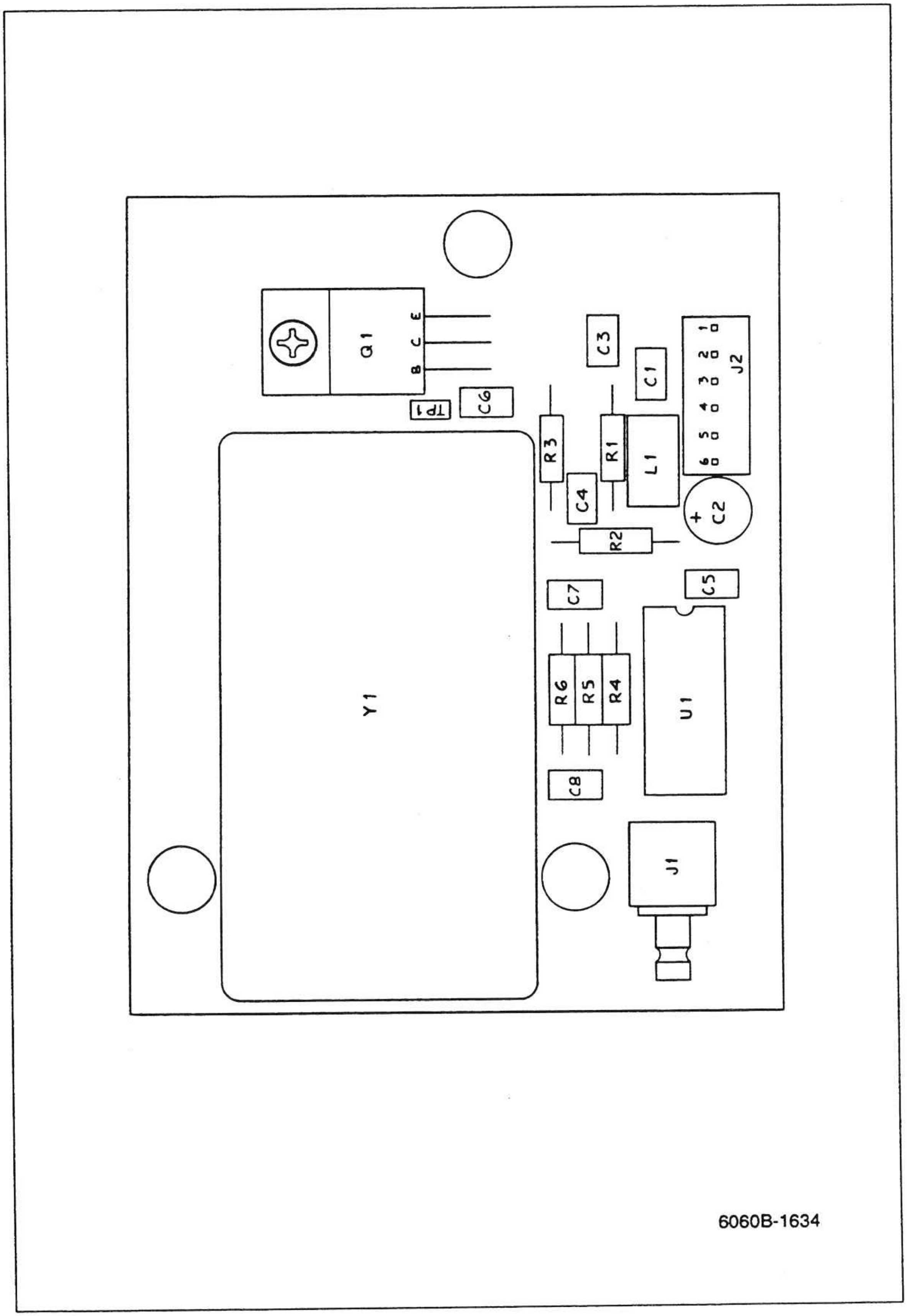


Figure 132-1. A5A1 Medium Stability Reference PCA

Option -651
Low-Rate Fm

NOTE

The Low-Rate FM Option -651 is no longer available.

651-1. INTRODUCTION

The Option -651 Low-Rate FM extends the FM 3-dB bandwidth to a lower frequency (approximately 0.5 Hz instead of 20 Hz). This option makes the Generator useful for testing FM radios that use sub-audio tones or low-rate digital techniques.

The option consists of a small printed circuit assembly mounted atop the A4 Synthesizer PCA. When installed, certain components are removed from the A4 Synthesizer PCA, the option switch #3 is set on the A2 Controller PCA, and a coupling capacitor is shorted on the A7 Output PCA. A DIP switch on the Low-Rate FM PCA allows the Generator to be configured for Low-Rate FM or standard (normal) operation (except that the coupling capacitor on the A7 Output PCA is shorted in both states). The DIP switch settings are listed in Table 651-1.

651-2. OPERATION

Operation of the Generator with the Low-Rate FM option is the same as operation of a standard instrument except that the FM deviation and ϕM ranges are limited to 40.0 kHz and 4.00 radians respectively.

651-3. CIRCUIT DESCRIPTION

The Low-Rate FM option allows frequency modulation at very low rates for use in digital modulation testing. In the low-rate mode, ac coupling capacitor C401 and C402 are shorted. To prevent any dc current from entering the loop amplifier (U48) and changing the phase-detector operating point, the voltage at the output of the audio integrator (U41-1) is kept at zero volts.

Keeping the voltage at the output of U41 at zero volts is accomplished with a voltage-zeroing loop consisting of U1. The positive terminal of this op-amp monitors the output voltage of the audio integrator through R8. The negative terminal is connected to ground at R9. By feeding current through R7 back to the negative input of the audio integrator (U41), its output voltage is kept at 0V. This is a lead-lag circuit with a low frequency break of approximately 0.3 Hz.

Potentiometer R4 adjusts the compliance of the voltage-zeroing loop. Part of the active high-pass filter (U41) is disabled by connecting the previous stage directly to C114. Since the maximum deviation is limited to 40.0 kHz, the gain of the audio integrator and the VCO summing network (R88, C117, C146) is decreased by a factor of ten. The Generator can be reconfigured back to the normal mode by programming the DIP switches on the option pca (see Table 651-1).

Table 651-1. Low-Rate FM DIP Switch

NORMAL	LOW-RATE FM
1. Closed	Open
2. Open	Closed
3. Closed	Open
4. Closed	Open
5. Not Applicable	Not Applicable
6. Open	Closed

651-4. PERFORMANCE TEST

The Generator is externally frequency modulated with a low-frequency square-wave signal. The droop of the demodulated signal is measured using a spectrum analyzer as an FM demodulator (slope detection is used).

REQUIREMENT:

FM droop is less than 15% with 10 Hz external square wave modulation.

REMARKS:

When using the RF Spectrum Analyzer as an FM demodulator using slope detection, it is important to operate the RF Spectrum Analyzer detector in a linear range. This can be checked by stepping the UUT frequency up 5 kHz and then down 5 kHz from the operating point and noting that the display moves equal amounts. If it doesn't, tune the RF Spectrum Analyzer slightly and check for linearity again.

TEST EQUIPMENT:

Low-Frequency Synthesized Signal Generator (LFSSG)
RF Spectrum Analyzer

PROCEDURE:

1. Remove the top instrument cover and the synthesizer module plate covers.
2. Connect the LFSSG TTL output through a 604-ohm resistor and a 320 μF, 6V capacitor to the UUT MOD INPUT. This provides a square wave approximately 2V p-p at the Generator's MOD input.
3. Program the LFSSG to 10 Hz and any level around 1V.
4. Program the UUT to the [RCL] [9] [8] and 3-kHz deviation. This provides a 300-MHz signal at -10 dBm.
5. Connect the input of the RF Spectrum Analyzer to the UUT RF OUTPUT.
6. Set the RF Spectrum Analyzer so that the signal response is at the top of the display using linear detection.
7. Program the UUT for EXT FM.

8. Using a 10-kHz resolution bandwidth and zero Span/Div, adjust either the Generator frequency or the RF Spectrum Analyzer tuning for slope detection to obtain a square-wave display.

9. Adjust Time/Div and Trigger as necessary to obtain a stable square-wave display.

10. Verify that the droop of the demodulated FM is less than 15%. For example, if the displayed square-wave amplitude (vertical edge) is 3.4 divisions, then the droop should be less than 0.51 divisions (0.15 x 3.4).

651-5. ADJUSTMENT

TEST EQUIPMENT:

DMM

PROCEDURE:

1. Program the UUT to [RCL] [9] [8] and 9.99 kHz deviation

2. Set the rear panel EXT/INT FM switch to EXT, with no external modulation signal applied.

3. With the DMM, measure the dc voltage at A2A9 U1-6.

4. Adjust R4 for 0V ± 0.1V.

651-6. LIST OF REPLACEABLE PARTS

Table 651-2 lists replaceable parts for the Option -651. Figure 651-1 is the component location diagram for the Option -651.

Table 651-2. Low-Rate FM PCA
(See Figure 651-1.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	---DESCRIPTION---	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
C 1, 2		CAP,POLYES,0.1UF,+-20%,50V	732883	89536	732883	2		
C 3		CAP,POLYES,0.47UF,+-10%,50V	697409	89536	697409	1		
C 4		CAP,TA,3.3UF,+-20%,20V	436071	01884	196D335X0020KA1	1		
C 6		CAP,CER,100PF,+-2%,100V,COG	512848	51406	RPE121	1		
C 7		CAP,CER,10PF,+-2%,100V,COG	512343	89536	512343	1		
R 1		RES,MF,30.1K,+-1%,0.125W,100PPM	168286	91637	MFF1-83012F	1		
R 2		RES,MF,24.3,+-1%,0.125W,100PPM	281816	91637	CMF5524R2F	1		
R 3		RES,MF,3.32K,+-1%,0.125W,100PPM	312652	91637	CMF553321F	1		
R 4		RES,VAR,CERM,100K,+-10%,0.5W	369520	11236	360T-104A	1		
R 5, 7		RES,CC,6.8M,+-5%,0.25W	394064	01121	CB	2		
R 6		RES,CF,200K,+-5%,0.25W	441485	80031	CR251-4-5P200K	1		
R 8, 9		RES,CF,1.2M,+-5%,0.25W	348995	80031	CR251-4-5P1M2	2		
R 11		RES,MF,4.99K,+-1%,0.125W,100PPM	168252	91637	MFF1-84991	1		
R 13		RES,MF,49.9K,+-1%,0.125W,100PPM	268821	91637	CMF554992F	1		
S 1		SWITCH,MODULE,SPST,DIP,6 POS	454124	89536	454124	1		
U 1	*	IC,OP AMP,JFET INPUT,8 PIN DIP	472779	12040	LF386N	1		
XU 1		SOCKET,IC,8 PIN	478016	91506	308-AG39D	1		

An * in 'S' column indicates a static-sensitive part.

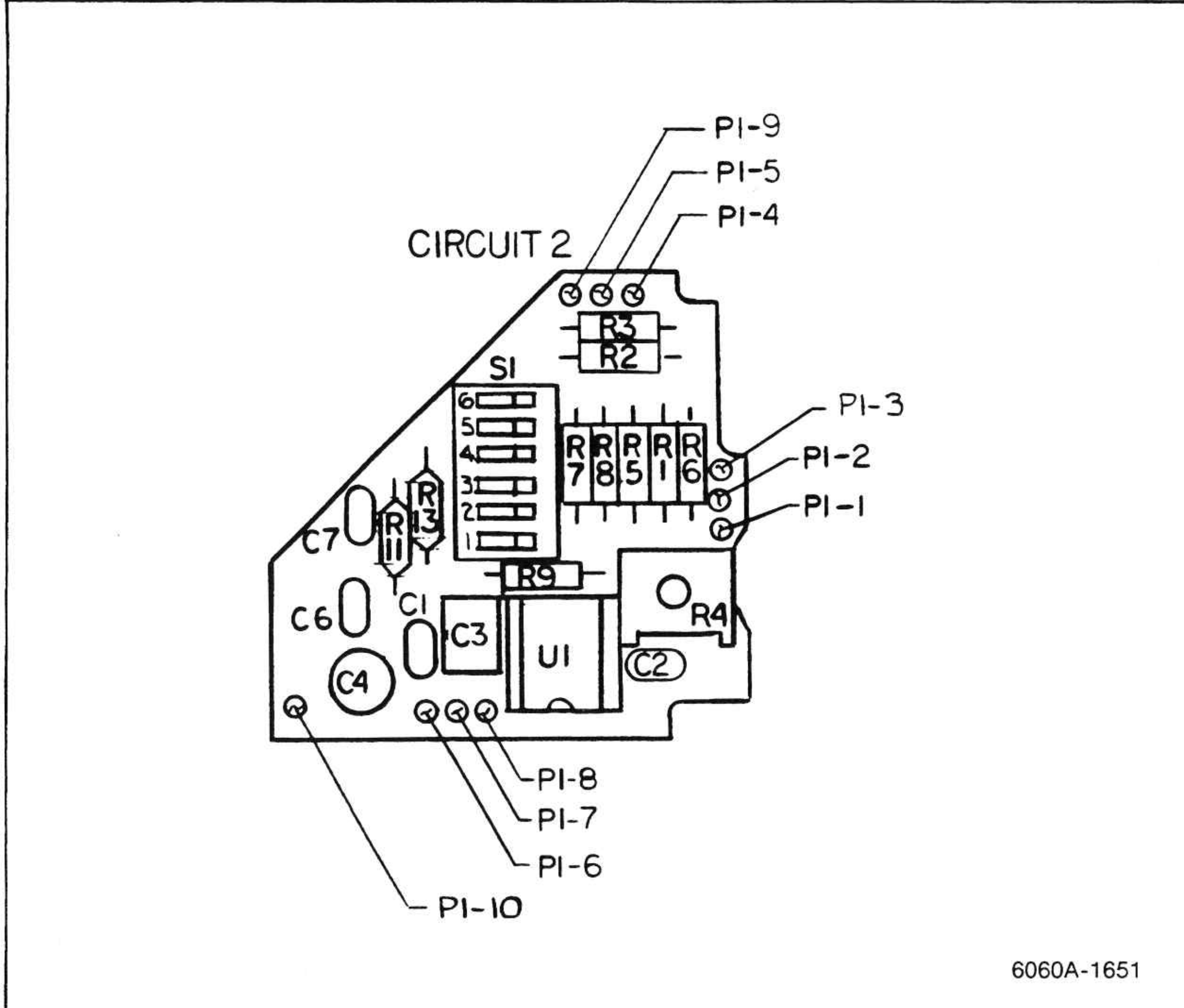


Figure 651-1. Option -651 Low-Rate FM PCA

Option -830
Rear Panel RF Output, MOD Input, and Pulse MOD Input

830-1. INTRODUCTION

The Option -830 Rear Panel RF Output, MOD Input, and Pulse MOD Input moves the RF OUTPUT and MOD INPUT connectors from the front panel to the rear panel of the Generator. A longer semi-rigid coaxial SMA cable assembly (W17) replaces the standard cable (W1). The option switch on the A2 Controller PCA is set to indicate that the option is installed.

830-2. OPERATION

The additional signal loss of this longer cable is compensated using instrument-independent correction data stored in the compensation memory. The A2 Controller PCA applies this correction data only when the rear panel RF Output and MOD Input option switch is set on the A2 Controller PCA.

830-3. CIRCUIT DESCRIPTION

This option does not change the operation or specifications of the Generator.

830-4. MAINTENANCE

This option does not change the performance tests, calibration, adjustment, or service of the Generator.

Section 7
Schematic Diagrams

CONTENTS

MNEMONIC	DESCRIPTION	SIGNAL TYPE *
A 0-15	Address	B
A12DB	Attenuator 12-dB Section Control	L
A24(1-5)	Attenuator 24-dB Section Controls	L
A6DB	Attenuator 6-dB Section Control	L
BAB 0-3	Module Section Address	H
BD 0-7	Module Section Data	B
BSEL 0,1	Module Section Select	L
CKN	N-Divider Clock	L
CLR	Display Clear	L
D 0-7	Data	B
DBIN	Read Enable	L
DD 0-7	Display Data	B
DIG	Display Digit Select	L
EXREF	External Reference Control	L
EXTAM	External AM Control	L
EXTFM	External FM Control	L
FIL 1,2	Display Filament Supply	AC+DC
FM 0-9	FM Deviation DAC Control	H
FMEN	FM Enable	H
FMRNG 0-2	FM Range Control	H
FMV	FM Audio	AF
HAOCT	Half-Octave Control	H
HET	Het (Low) Band Control	L
HSOPT	High-Stability Option Installed	L
IEA 13-15	IEEE Address Bus	B
IEADR	IEEE Address Latch Enable	L
IECS	IEEE Chip Enable	L
IED 0-7	IEEE Data Bus	B
IEDB	IEEE Read Enable	L
IEIN	IEEE Option Installed	L
IEINT	IEEE Interrupt	L
IEW	IEEE Write Enable	L
INTAM	Internal AM Control	L
INTFM	Internal FM Control	L
KBIN	Keyboard Input Select	H
KN 0-9	PLL Gain Compensation DAC	H
KNV	Main PLL Gain Compensation Voltage	DC
KV 0-9	VCO Compensation DAC Control	H
LEV 0-11	RF Level DAC Control	H
LRFM	Low-Rate FM Option Installed	L
MF400	Modulation Frequency Control	L
MID	Mid Band Control	L
MLEVHI	External Modulation High-Level Status	H
MLEVLO	External Modulation Low-Level Status	H
MODE	Triple-Modulus Prescaler	L
NVCS	NVM RAM Chip Select	L
NVEN	NVM Enable	L
NVIN	NVM Installed	L
RIN	10-MHz Output Buffer Enable	H
RMUX0,1	Reference Multiplexer Select	H
ROPT	Rear Output Option Installed	L
RPP	RPP Option Installed	L
RPRST	RPP Reset Control	H
RPTRP	RPP Tripped Status	L
SEG 1-3,9	Display Segment Select	L
SHEN	Sub-Harmonic Reference Control	L
SHET	Synthesizer Heterodyne Control	L
SHREF	Sub-Harmonic Ref Option Installed	L
SHTUNE	Sub-Harmonic Ref Tuning Voltage	DC
TBOUT	Output Test Bit	H
TBSYN	Synthesizer Test Bit	H
TRMOD	Triple-Modulus Prescalar Select	L
TRSEQ	Remote Sequence Trigger	L
TUNE	Main PLL Tuning Voltage	DC
UNLOK	PLL Unlocked or Overmodulated Status	L
UNLVL	ALC Loop Unleveled Status	L
WE	Write Enable	L
XOEN	10-MHz Crystal Oscillator Control	L

* Six SIGNAL types are listed in the following:

DC= DC Control
AC= Line Frequency
AF= Audio (modulation) Signal
L = Logic (binary) signal, active low at the source
H = Logic (binary) signal, active high at the source
B = Dynamic bus

Figure 7-1. Mnemonics

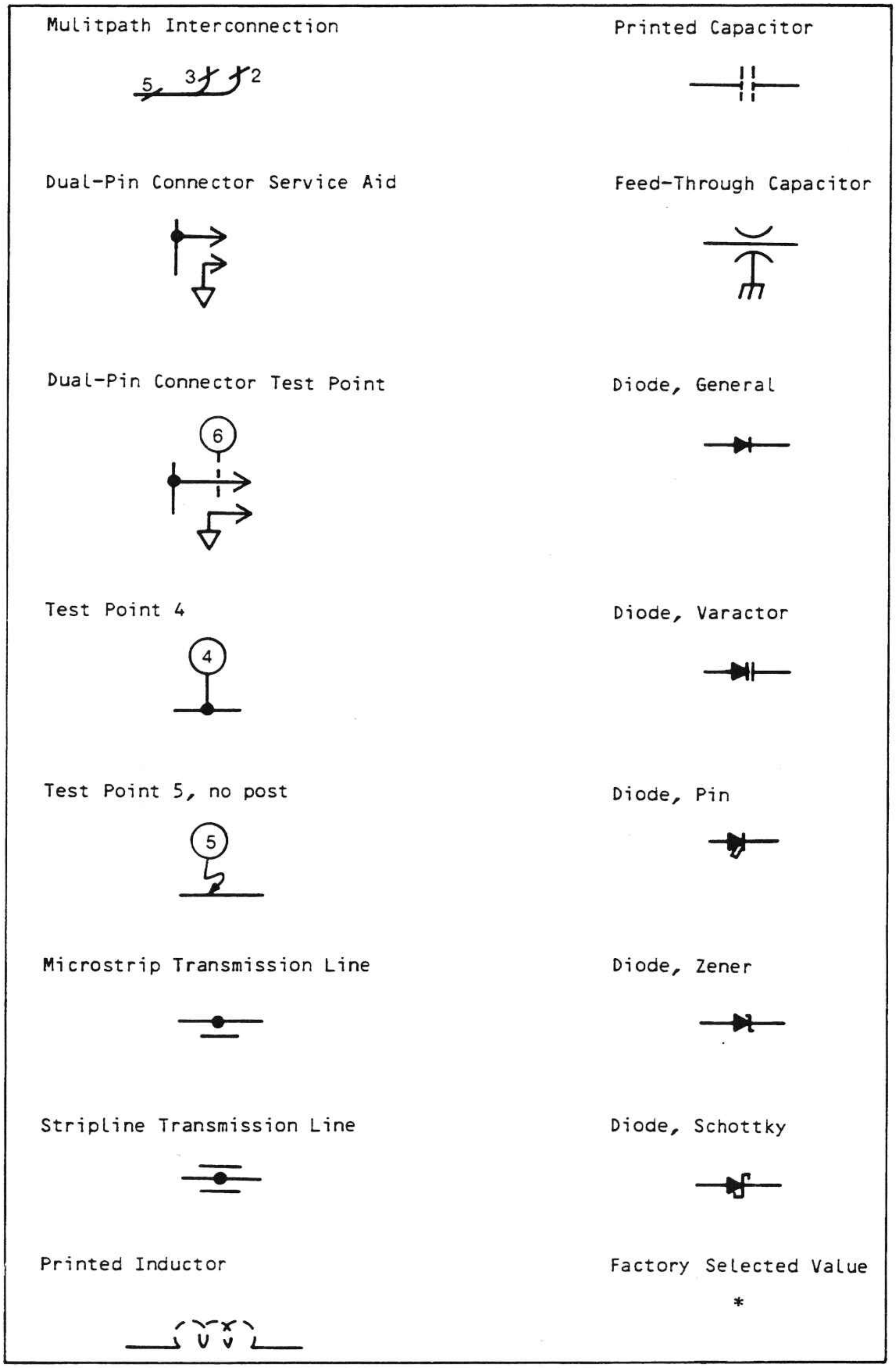


Figure 7-2. Schematic Symbols

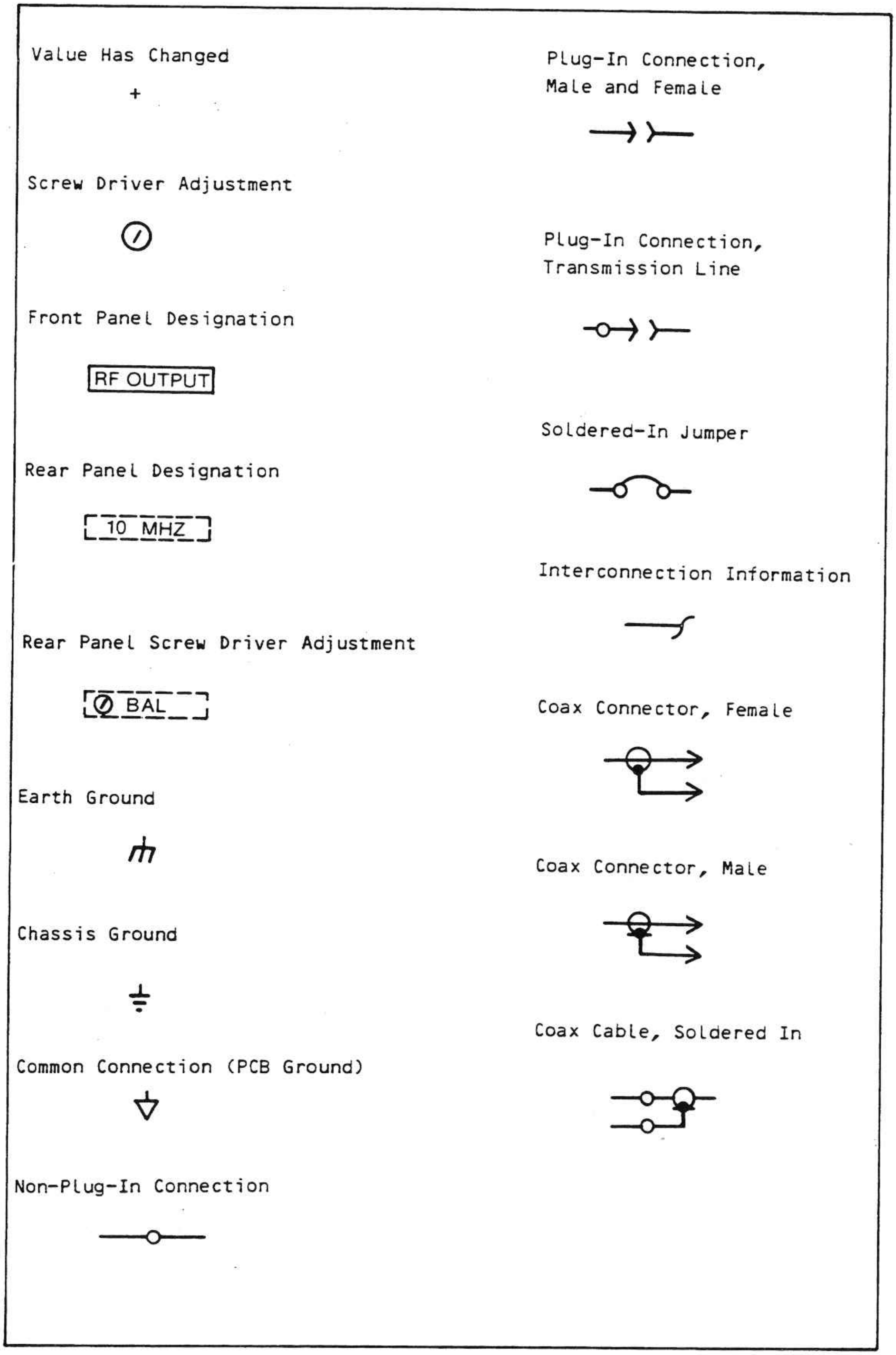


Figure 7-2. Schematic Symbols (cont)

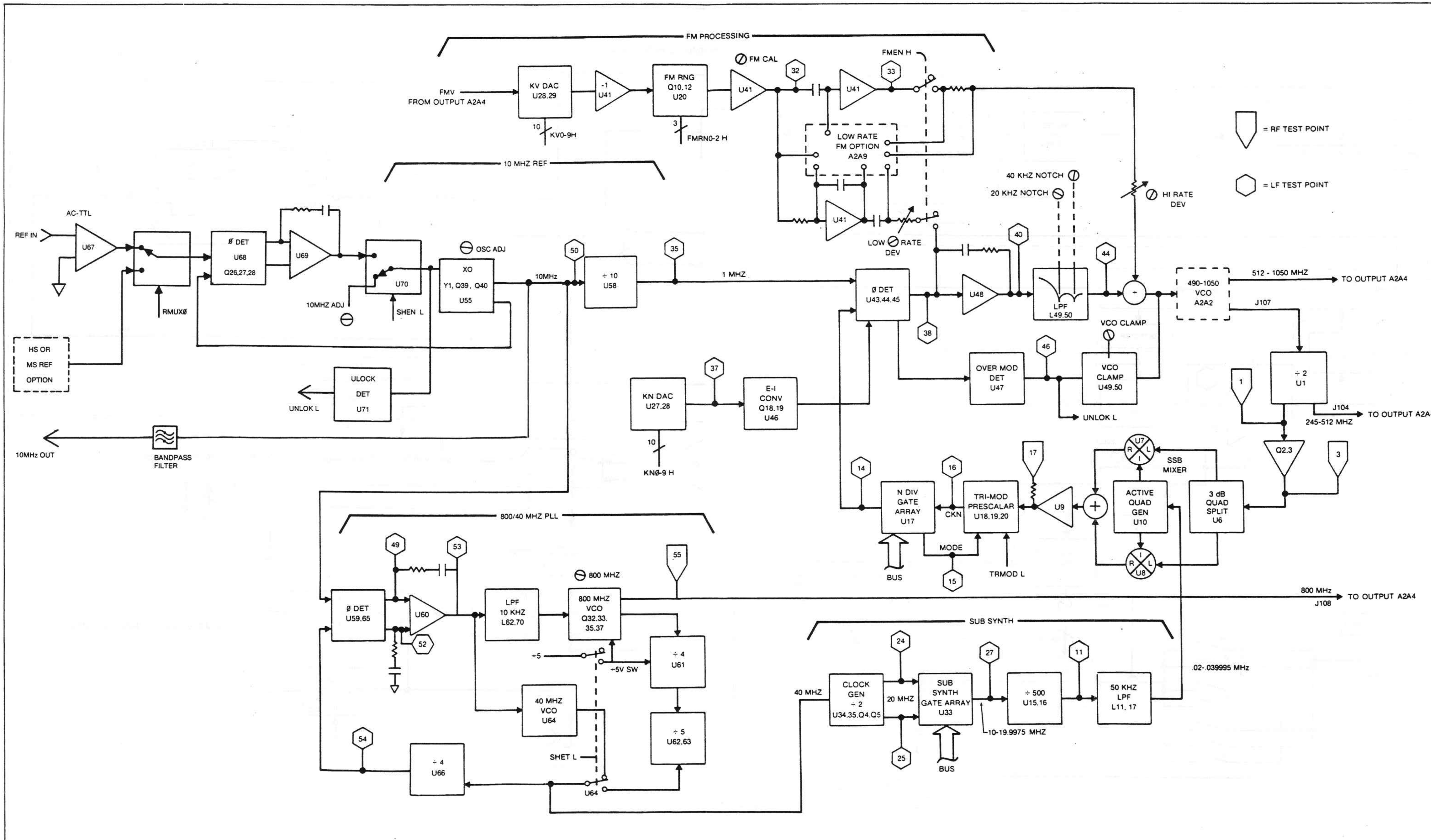


Figure 7-3. Synthesizer Block Diagram

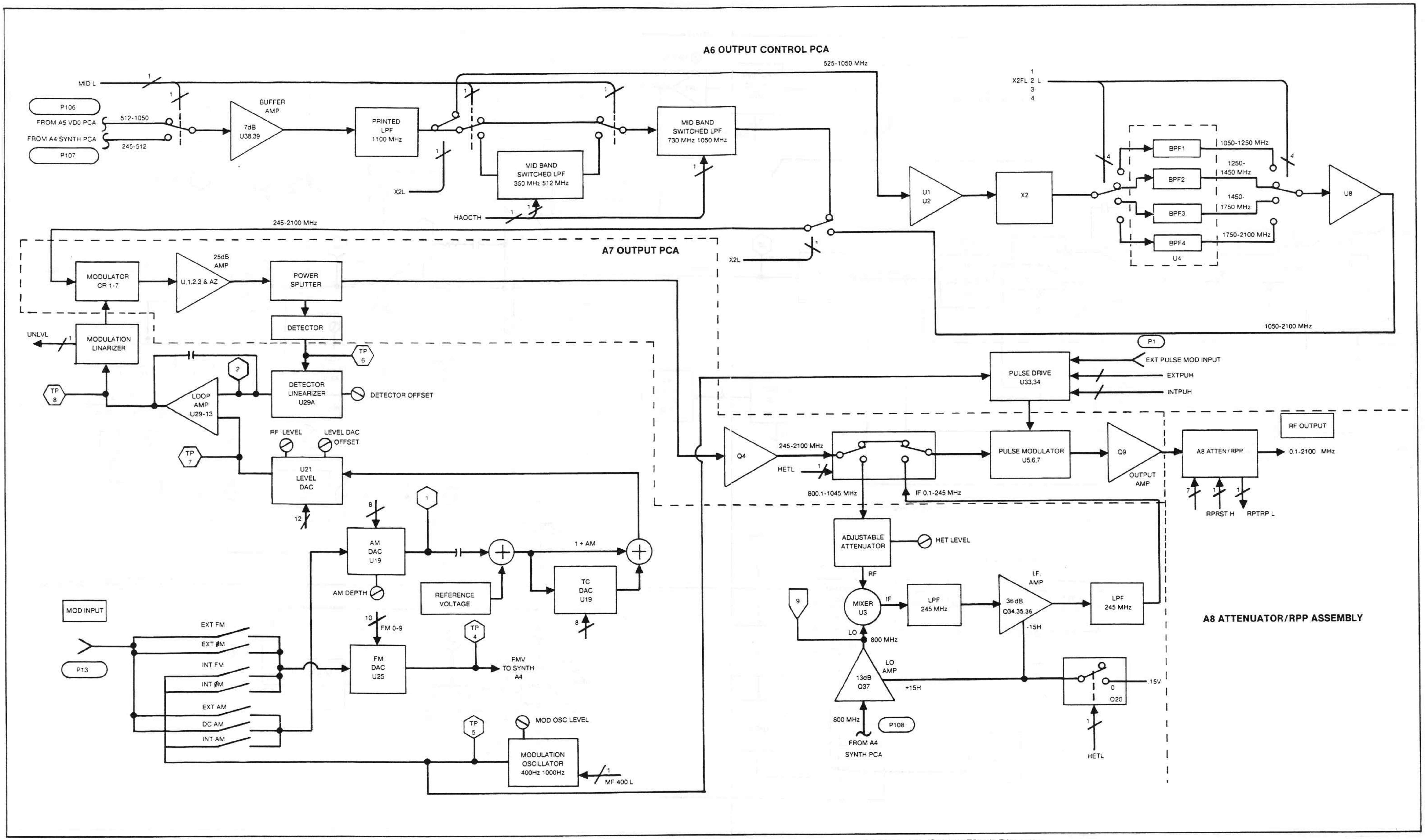


Figure 7-4. Output Block Diagram

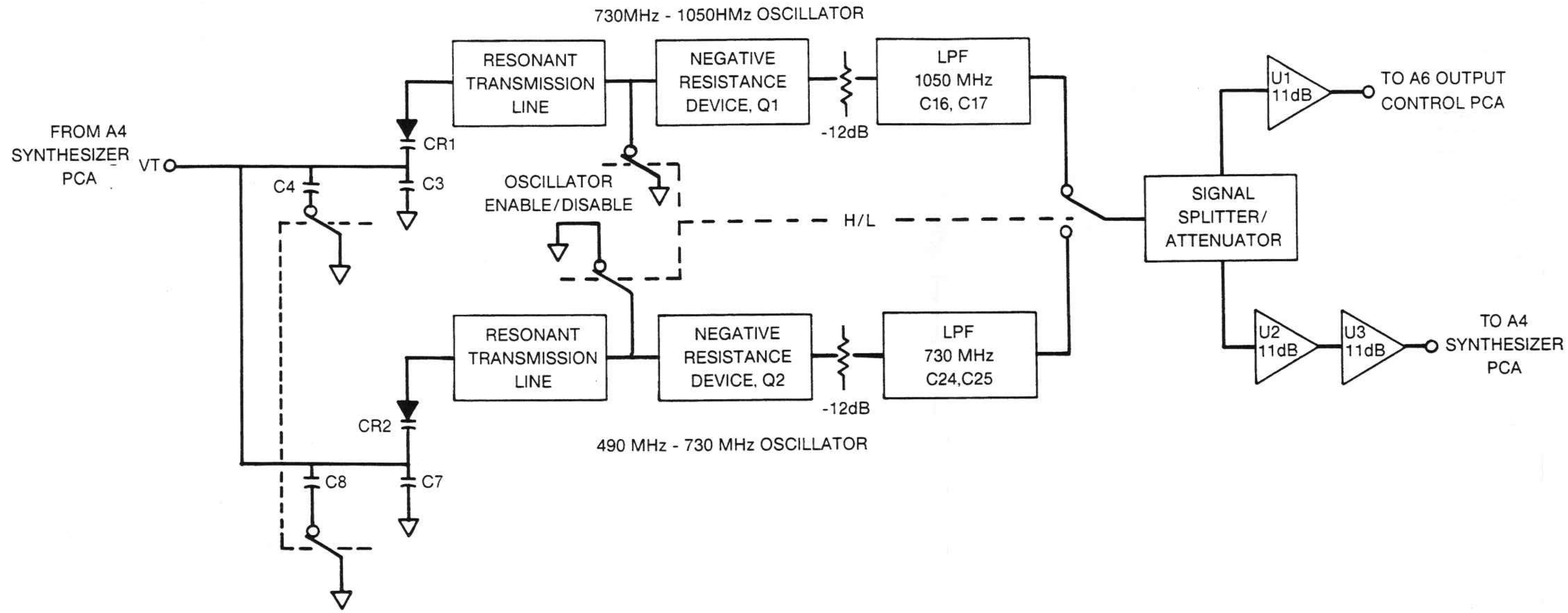


Figure 7-4. Output Block Diagram (cont)

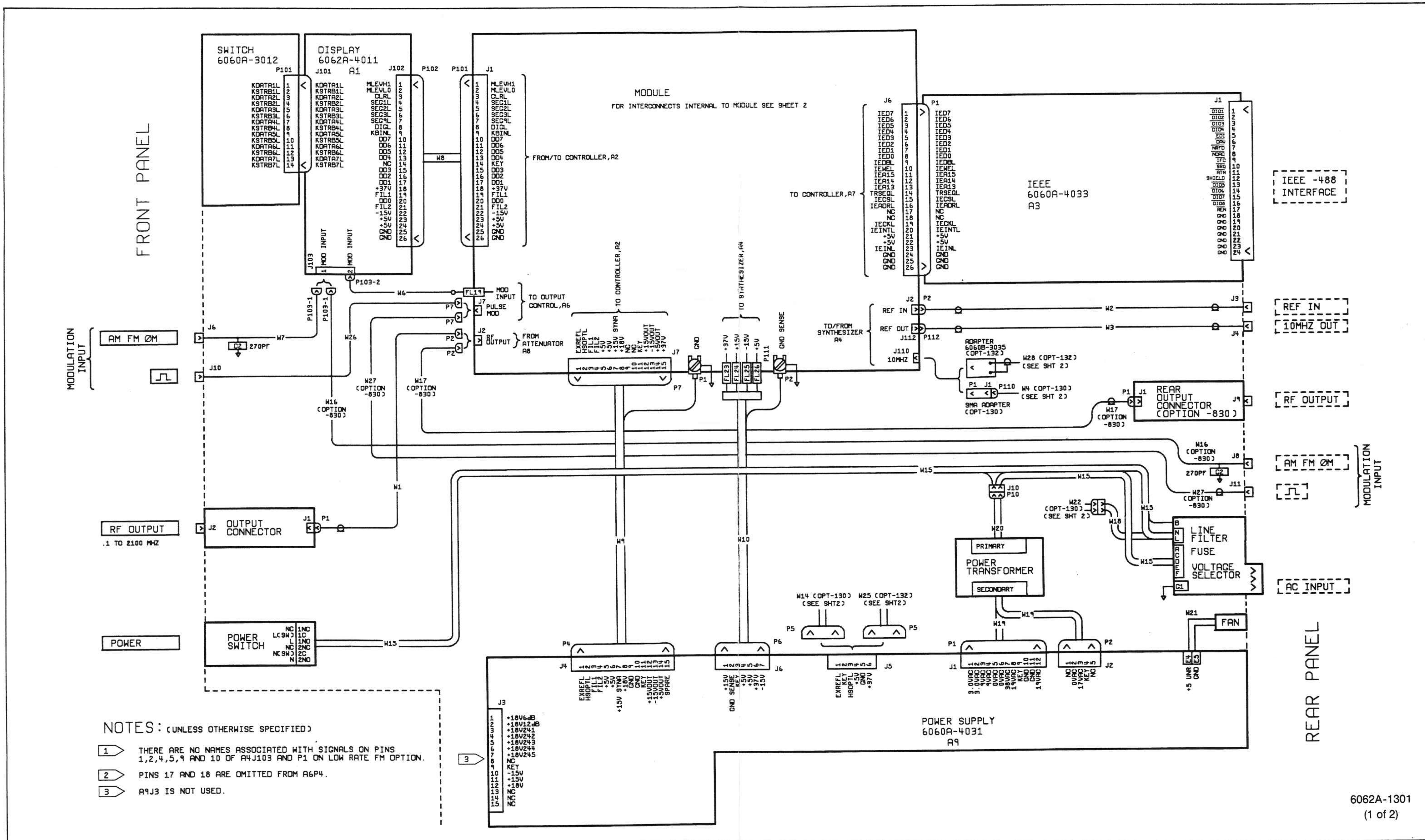


Figure 7-5. Interconnection Diagram

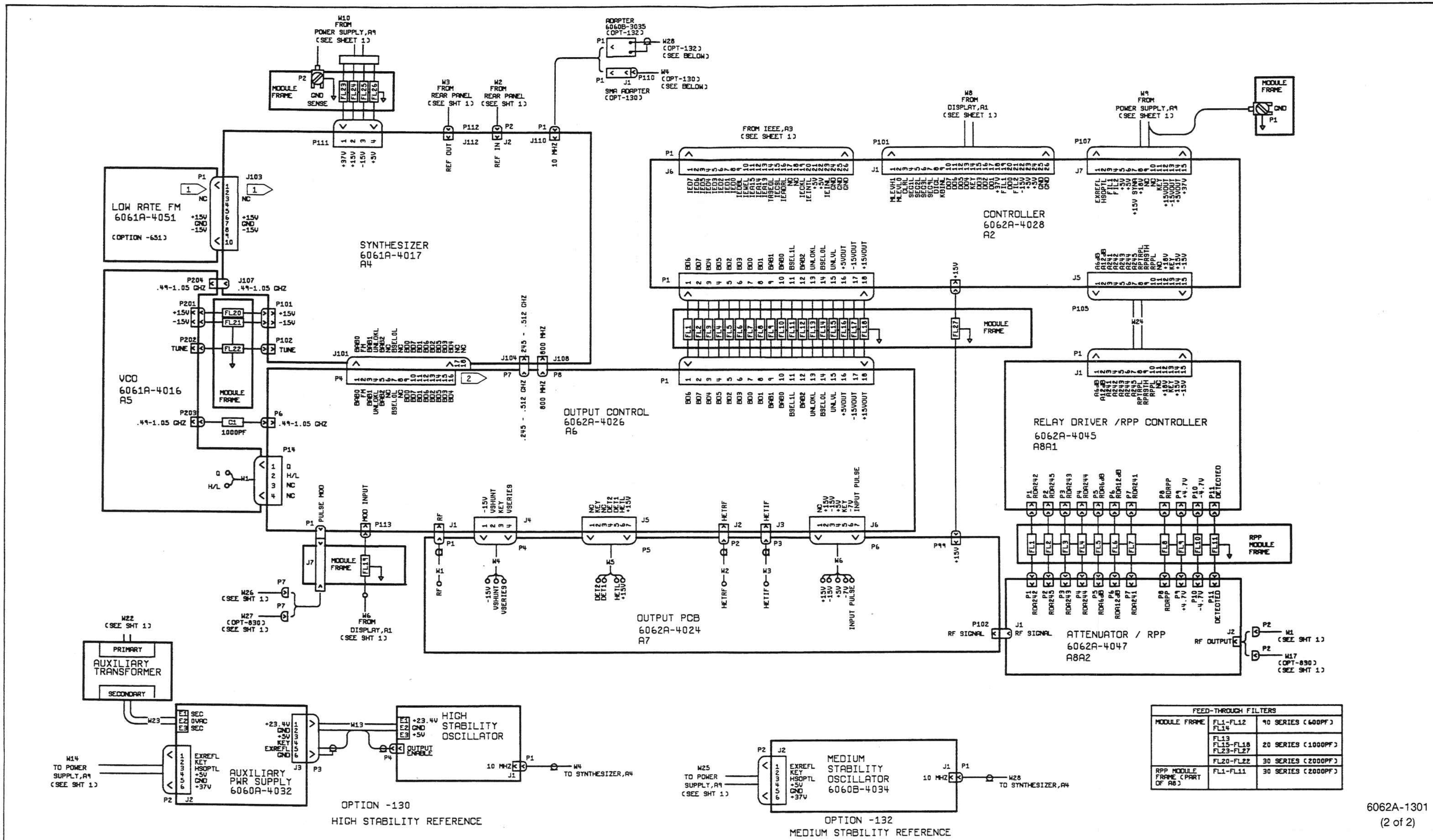


Figure 7-5. Interconnection Diagram (cont)

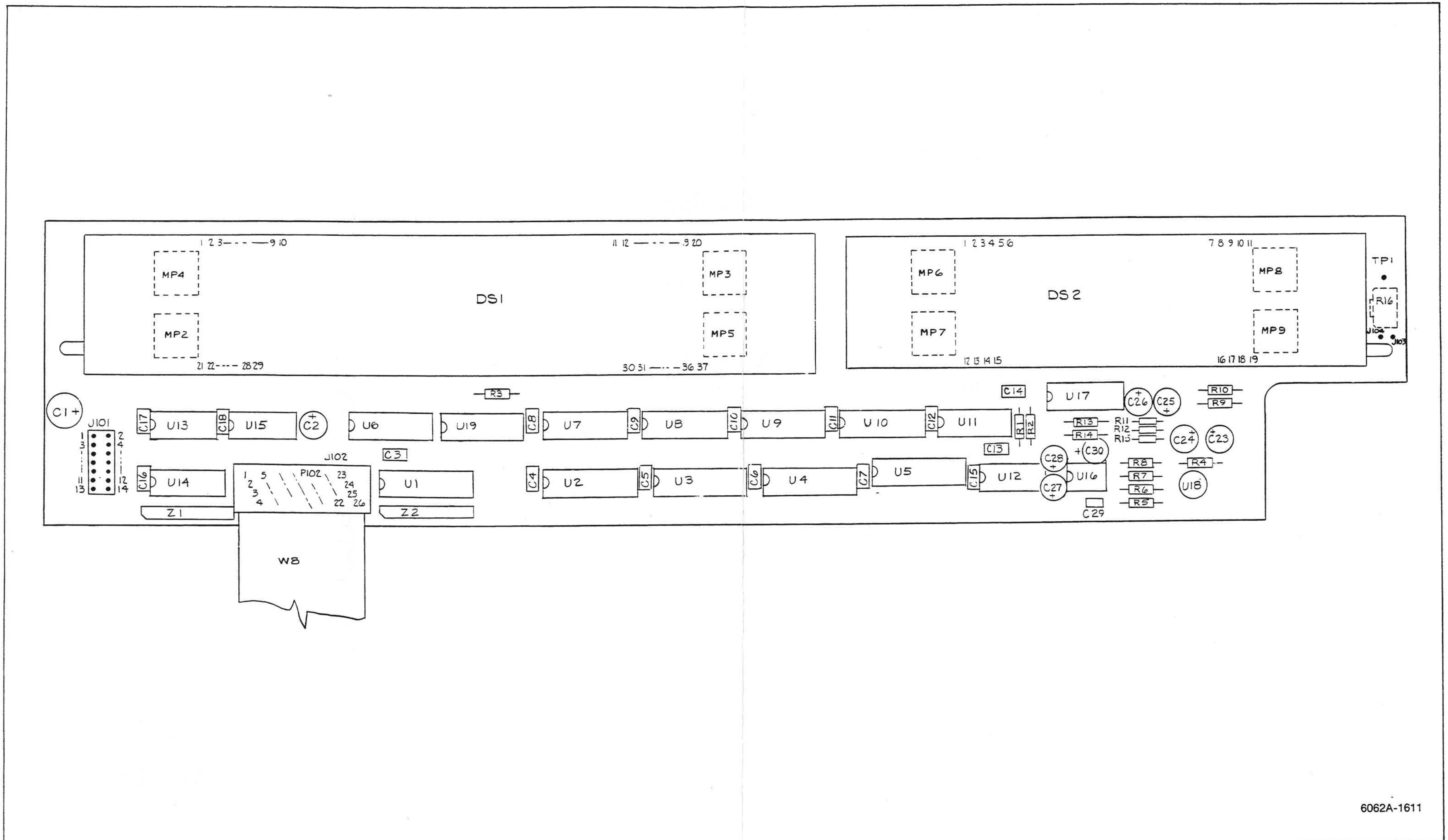
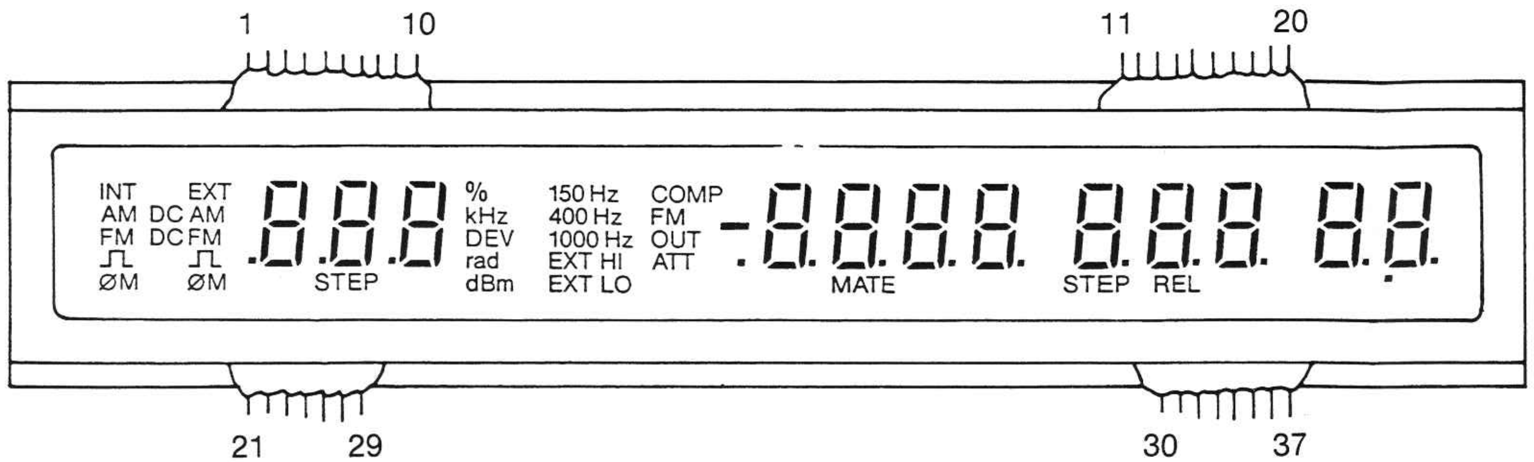
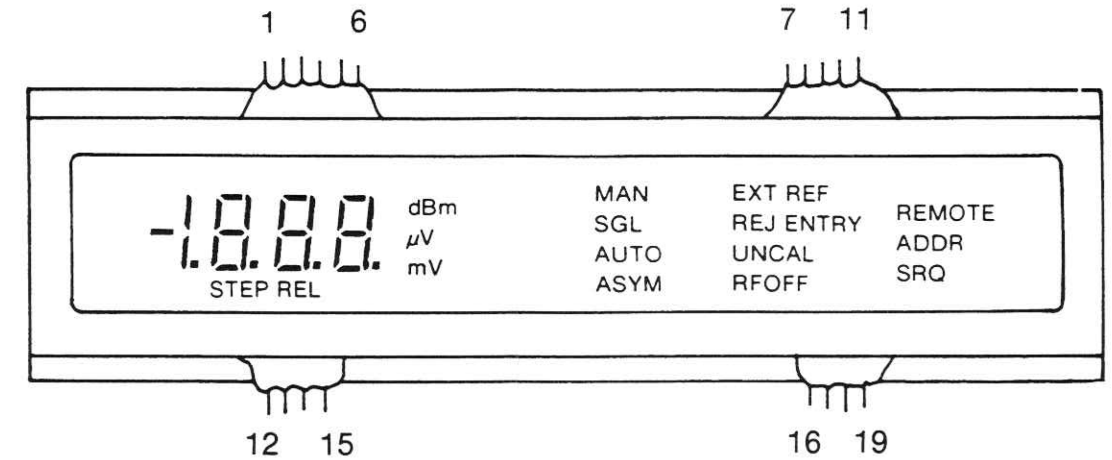


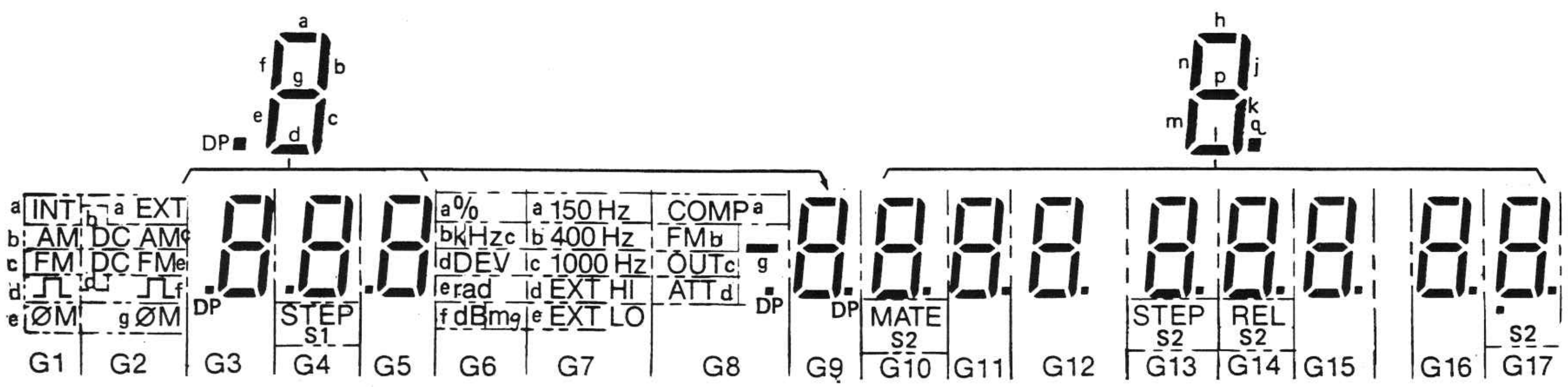
Figure 7-6. A1 Display PCA

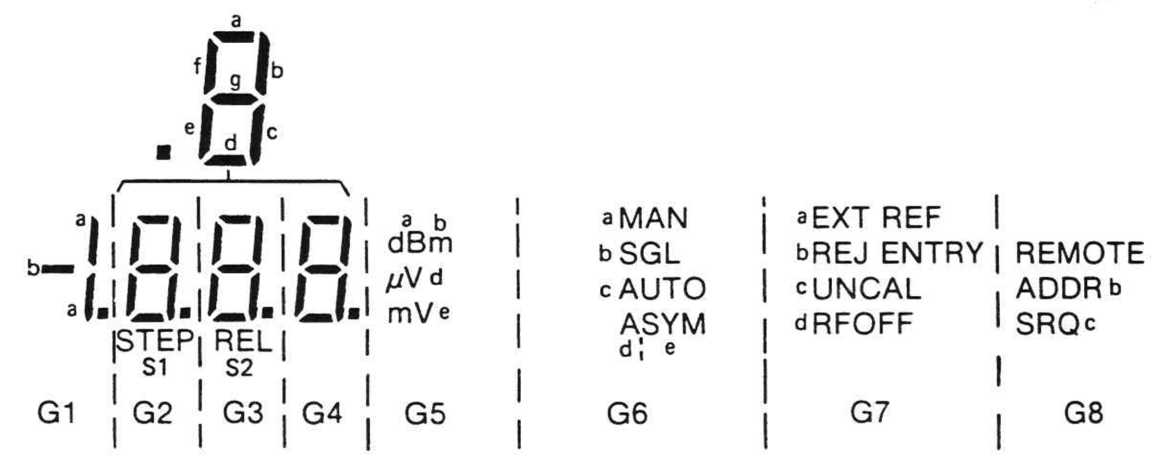
MODULATION FREQUENCY DISPLAY



AMPLITUDE DISPLAY







PIN NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CONNECTION	F	P_{S1}	P_{DP}	P_d	P_c	P_e	P_g	P_f	P_b	P_a	P_h	P_j	P_n	P_p	P_m	P_k	P_l	P_q	P_{S2}	F

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17

PIN NO	1	2	3	4	5	6	7	8	9	10
CONNECTION	F	P_{S1}	P_{np}	P_c	P_g	P_a	P_b	P_f	P_e	P_d

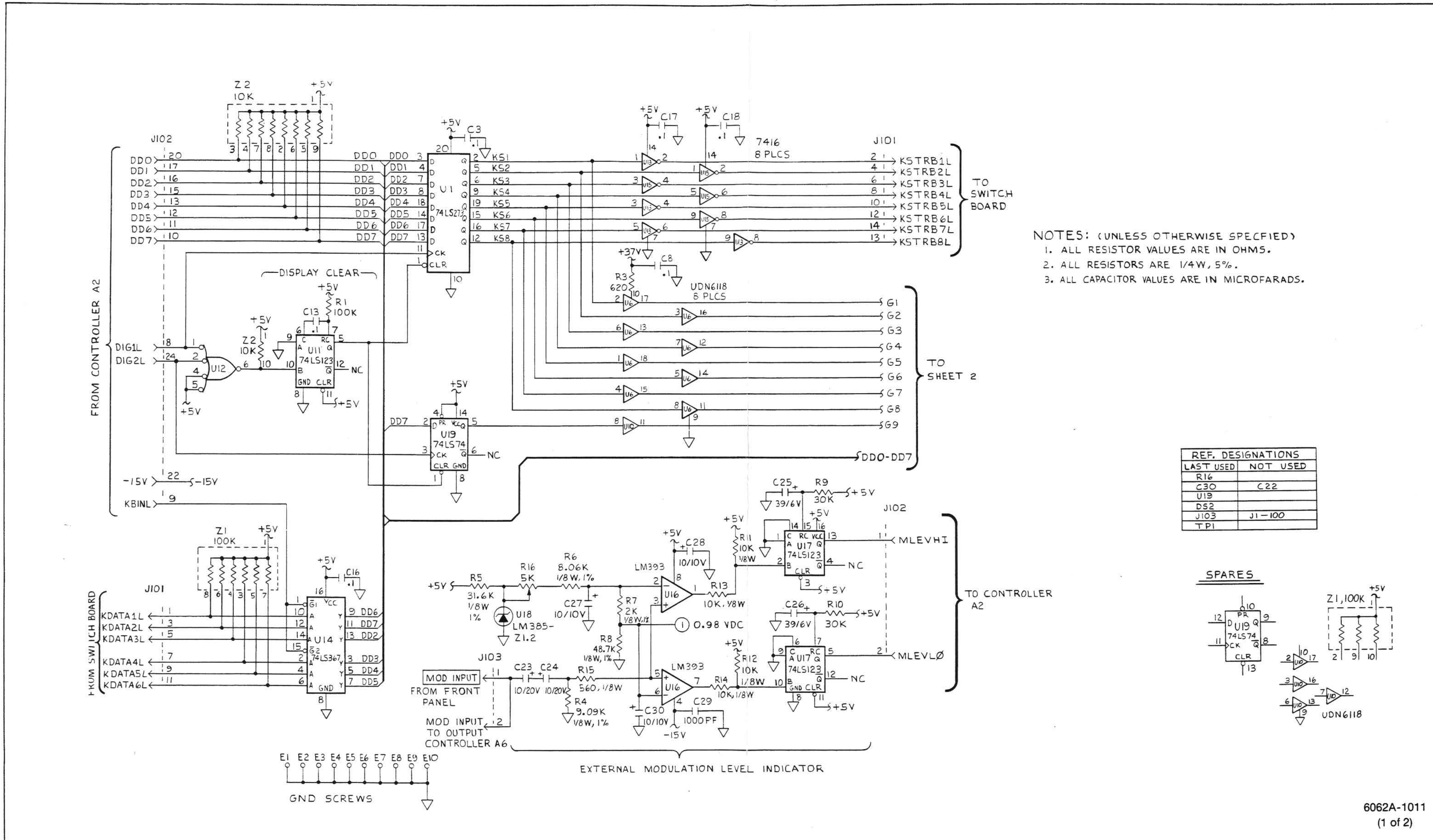
11	12	13	14	15	16	17	18	19
F	G1	G2	G3	G4	G5	G6	G7	G8

DISPLAY CONNECTION INFORMATION

NOTES:

F Denotes Filament
G Denotes Grid (numeric suffix identifies display field)
P Denotes Plate (subscript identifies display segment)

Figure 7-6. A1 Display PCA (cont)



NOTES: (UNLESS OTHERWISE SPECFIED)

1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4W, 5%.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.

REF. DESIGNATIONS	
LAST USED	NOT USED
R16	
C30	C22
U19	
DS2	
J103	J1—100
TP1	

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Figure 7-6. A1 Display PCA (cont)

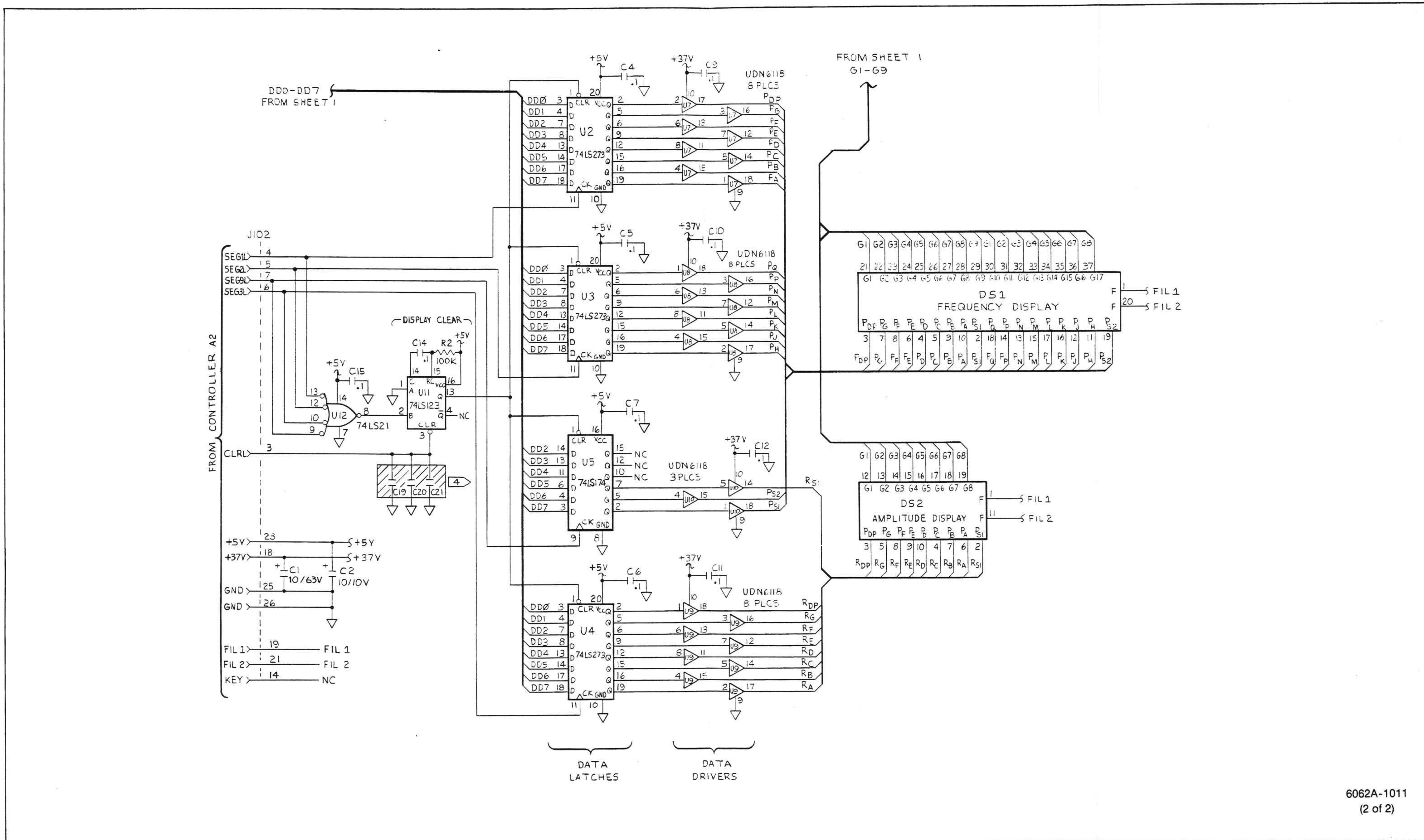
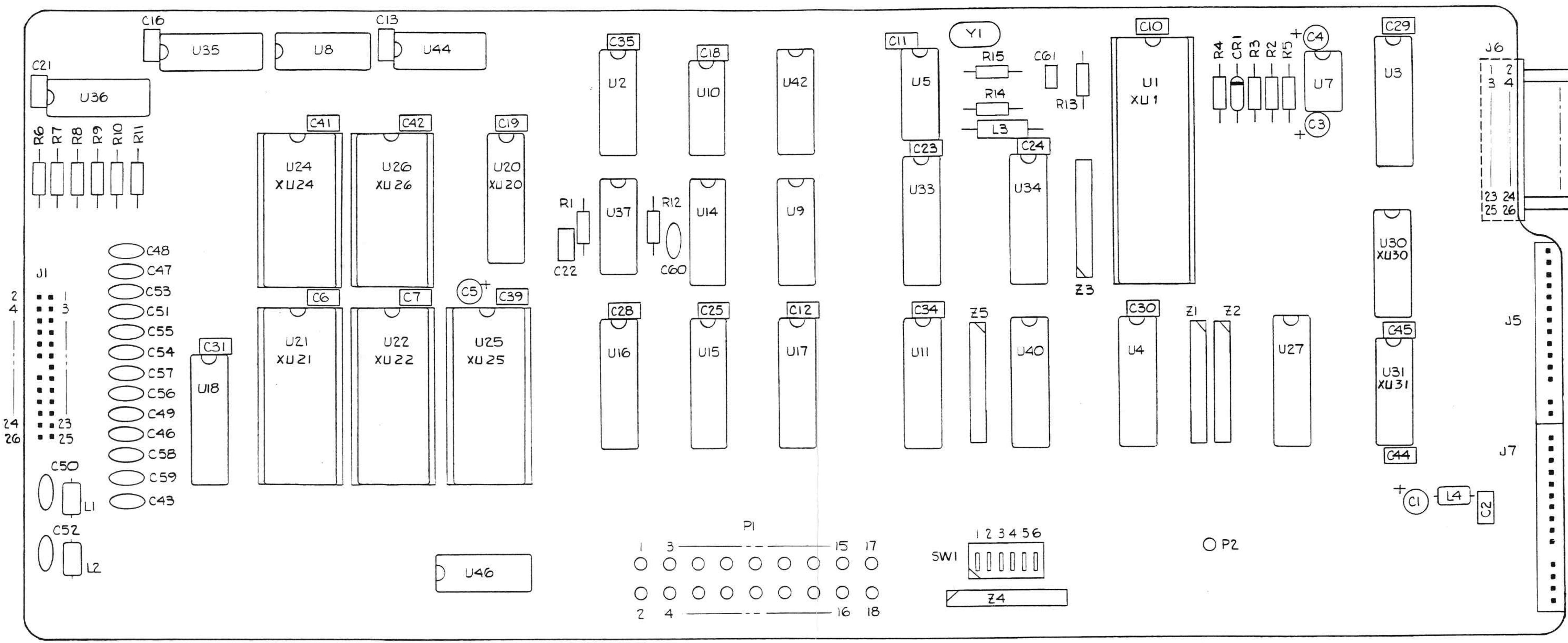


Figure 7-6. A1 Display PCA (cont)



SWITCH SETTINGS

(SECTIONS NOT LISTED SHALL BE IN "OFF" POSITION)

SWITCH SECTION SET IN "ON" POSITION	FUNCTION
1	SUBHARMONIC REFERENCE INSTALLED OPTION -131
3	LOW RATE FM INSTALLED OPTION -651
4	REAR OUTPUT INSTALLED OPTION -830
6	COMP ENABLE

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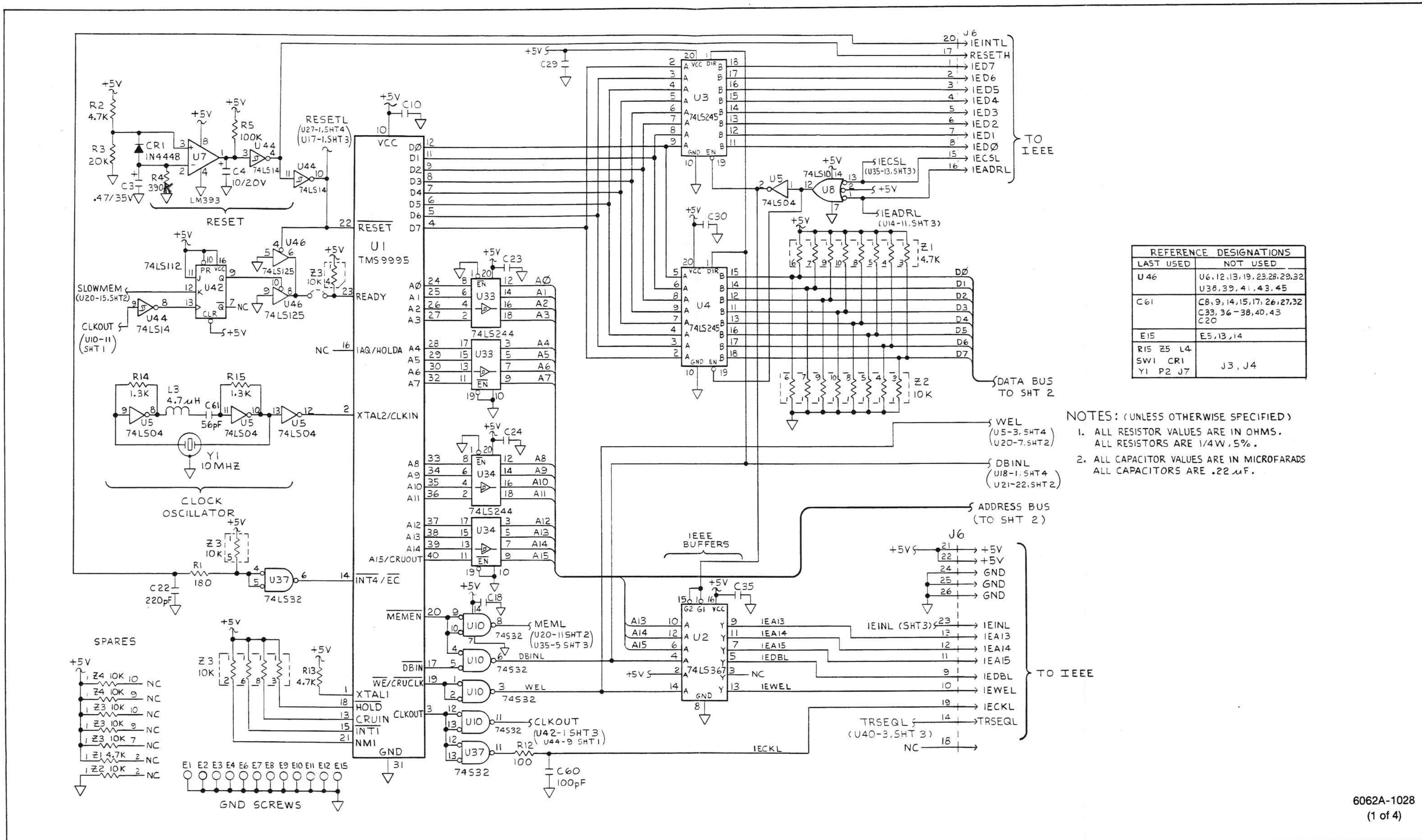
Figure 7-7. A2 Controller PCA



REFERENCE DESIGNATIONS	
LAST USED	NOT USED
U46	U6,12,13,19,23,28,29,32 U36,39,41,43,45
C61	C8,9,14,15,17,26,27,32 C33,36-38,40,43 C20
E15	E5,13,14
R15 Z5 L4 SW1 CR1 Y1 P2 J7	J3, J4

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS. ALL RESISTORS ARE 1/4W, 5%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ALL CAPACITORS ARE .22 µF.

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Figure 7-7. A2 Controller PCA (cont)

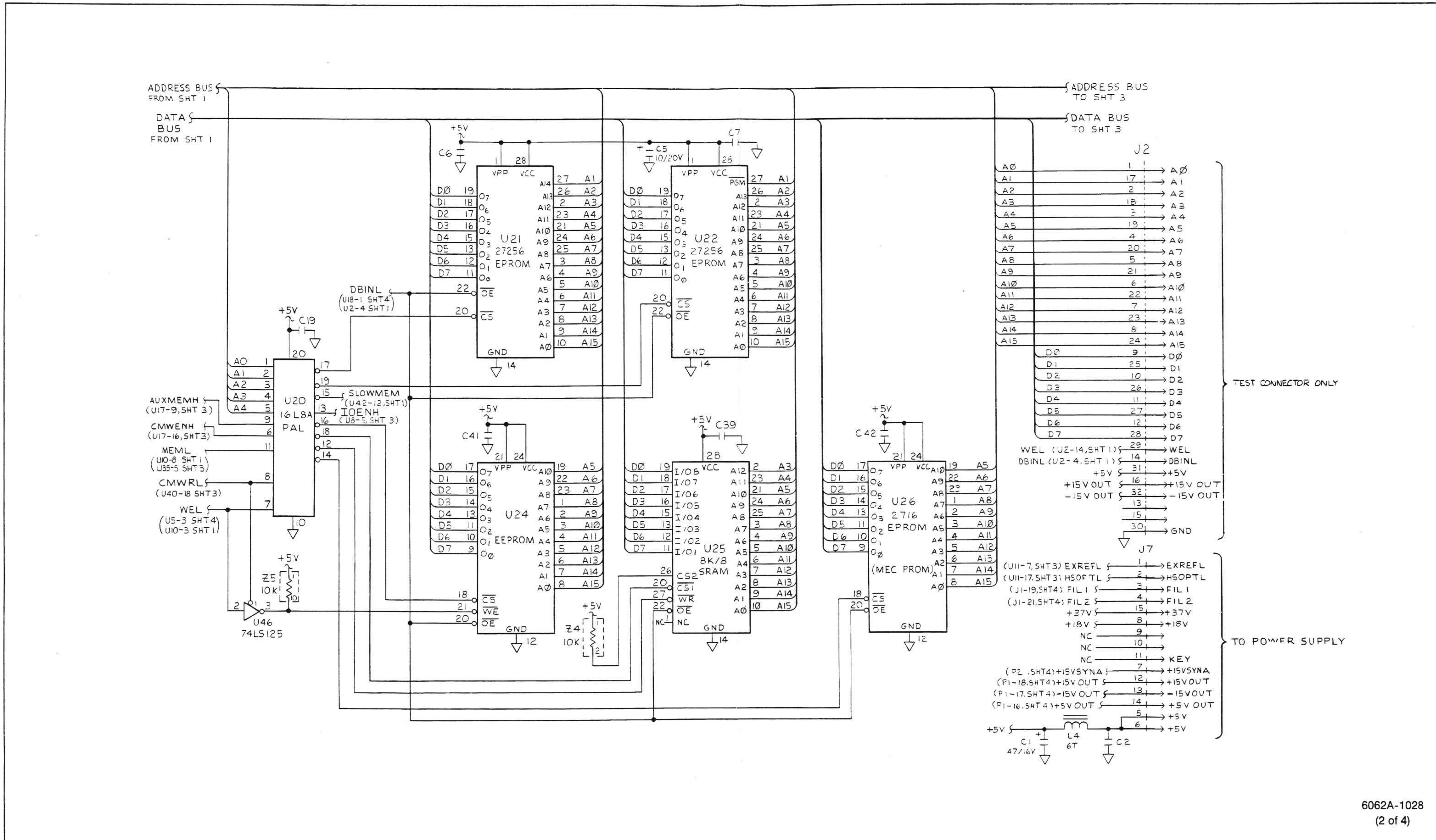


Figure 7-7. A2 Controller PCA (cont)

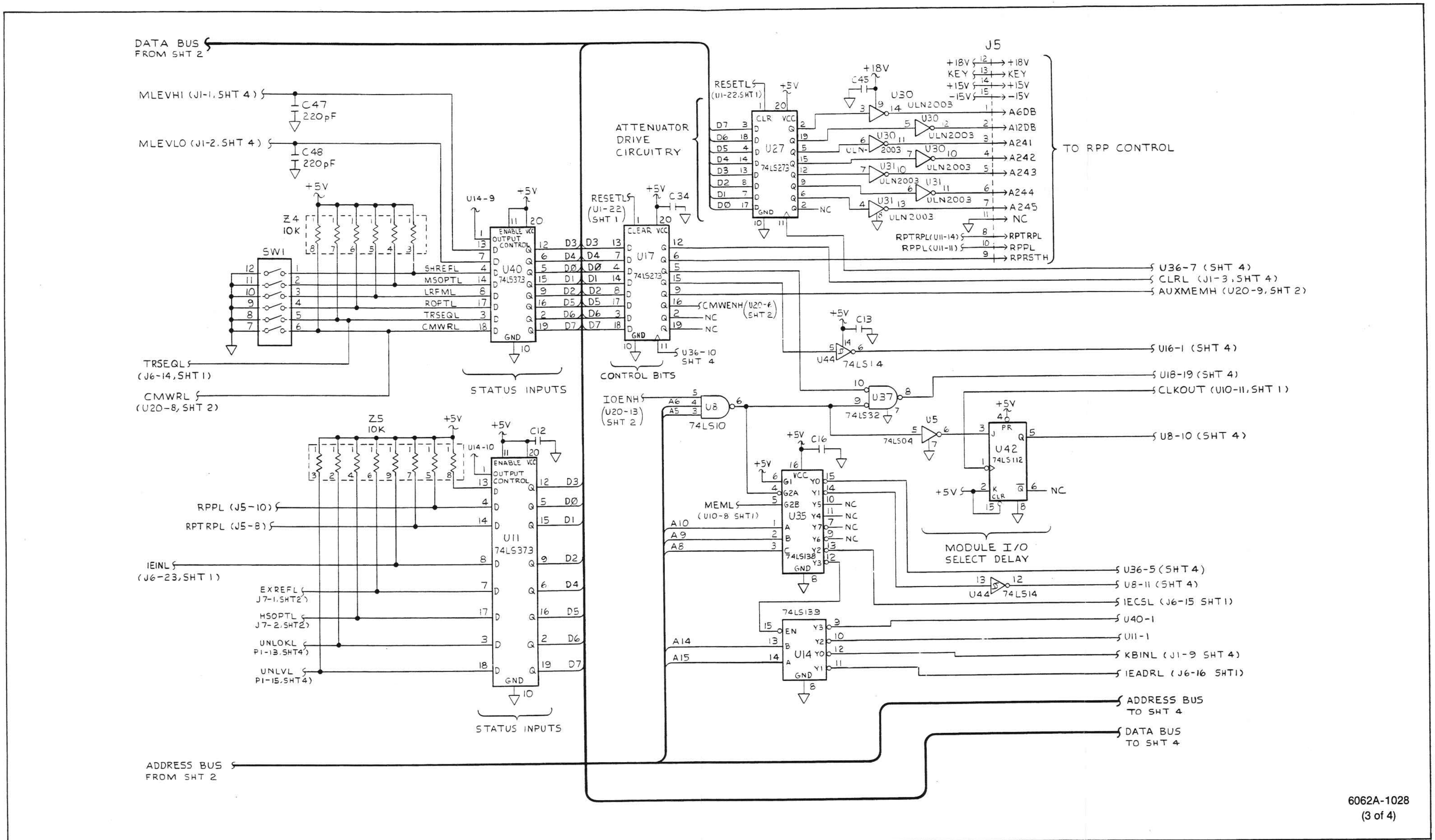


Figure 7-7. A2 Controller PCA (cont)

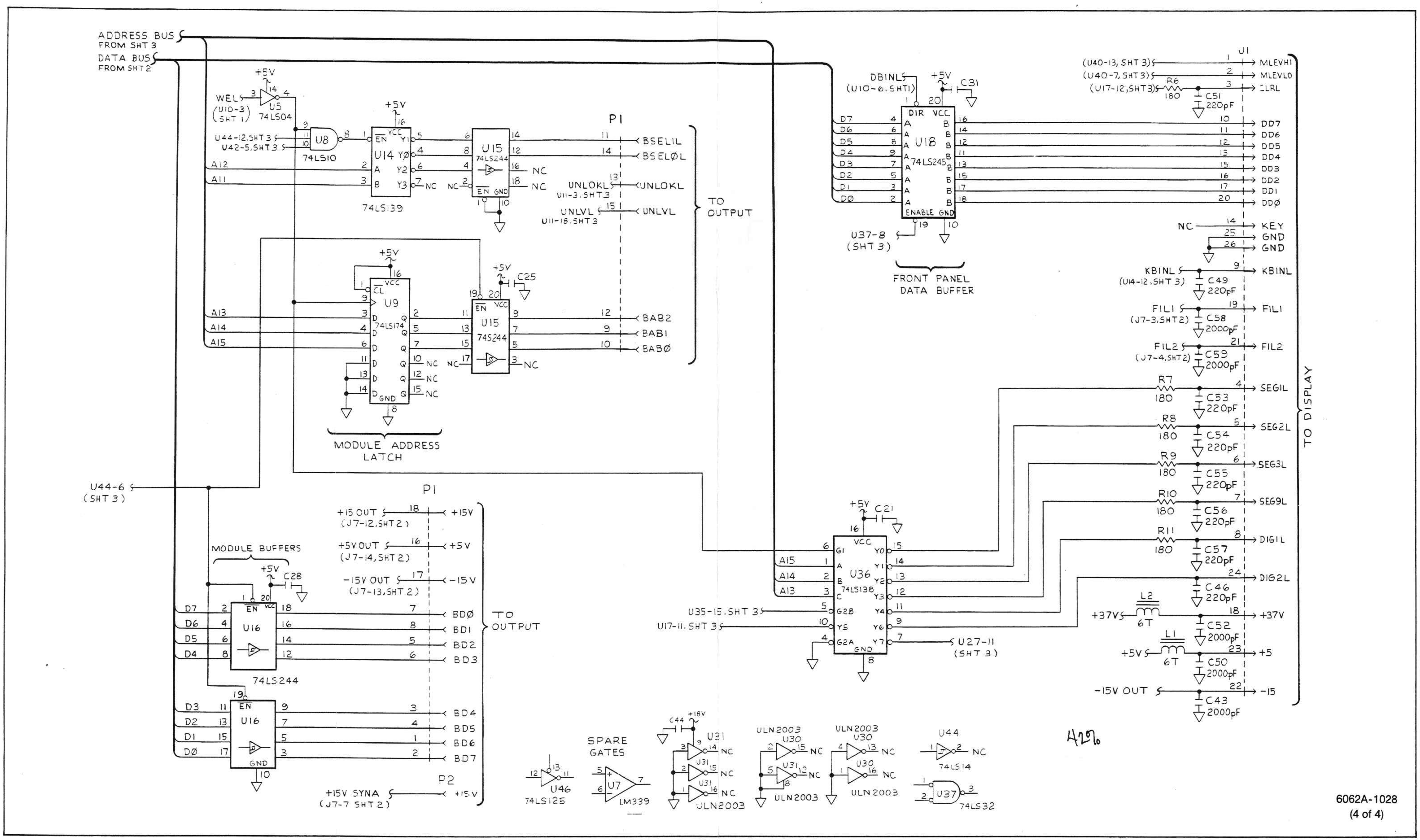


Figure 7-7. A2 Controller PCA (cont)

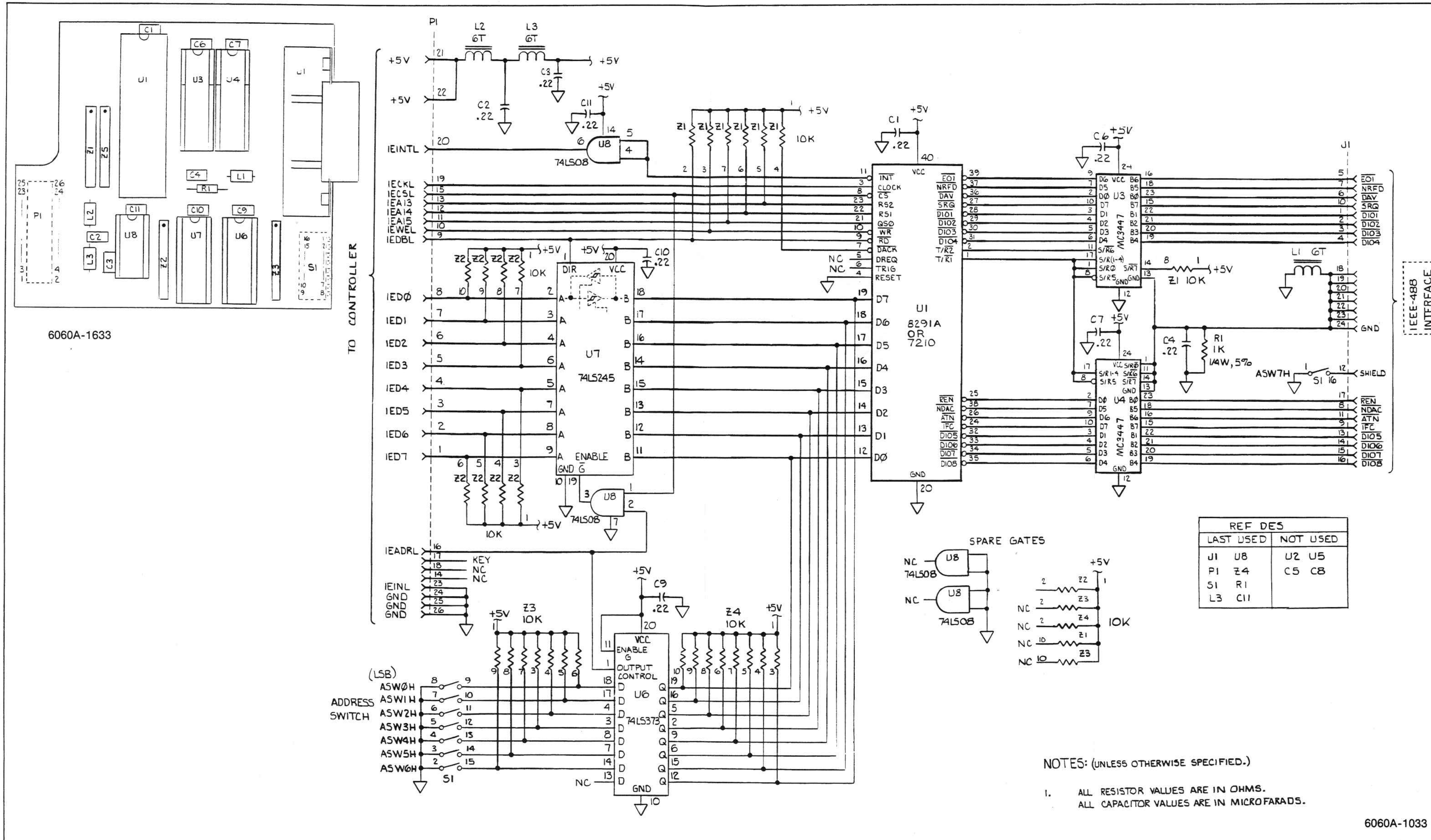


Figure 7-8. A3 IEEE-488 Interface PCA

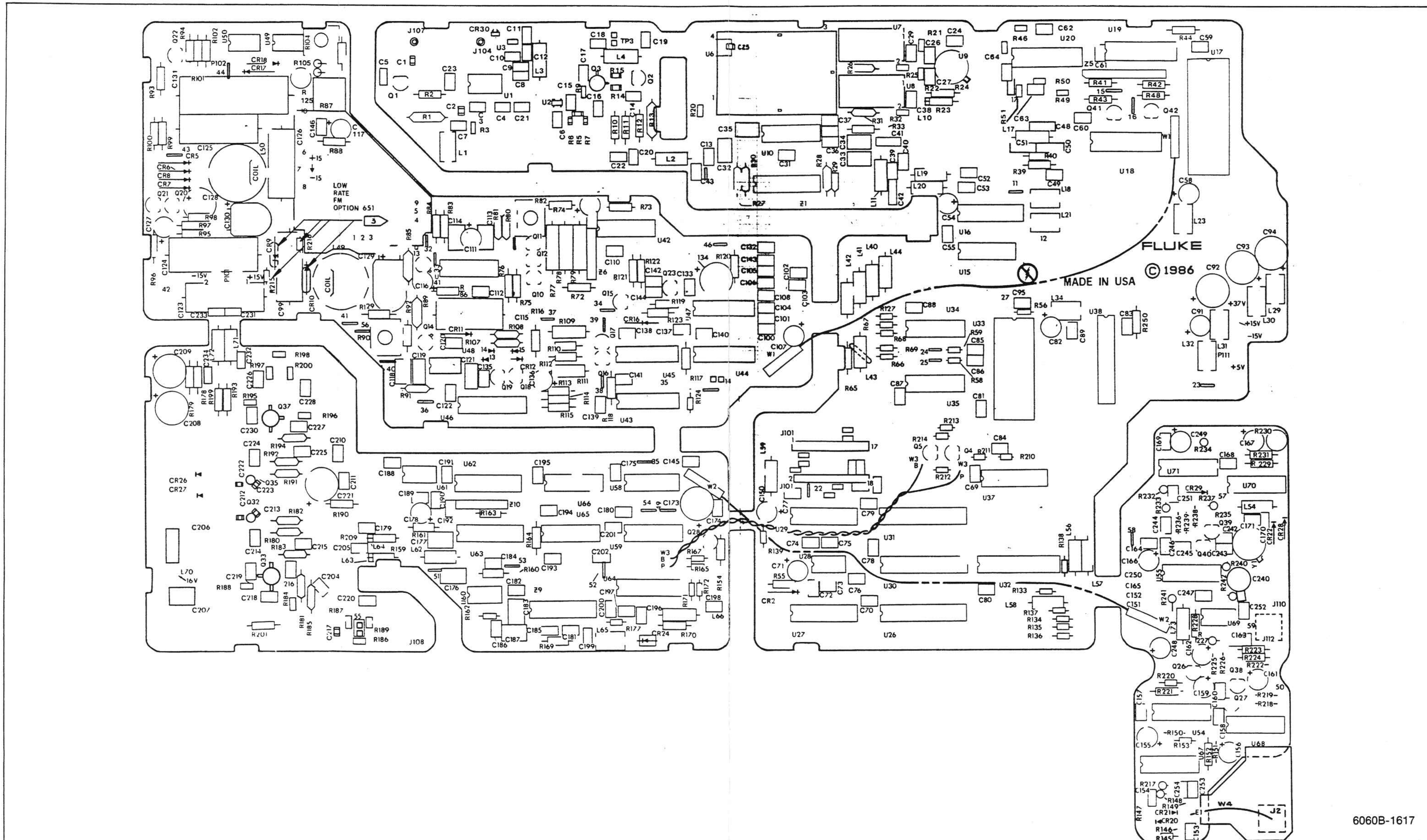


Figure 7-9. A4 Synthesizer PCA

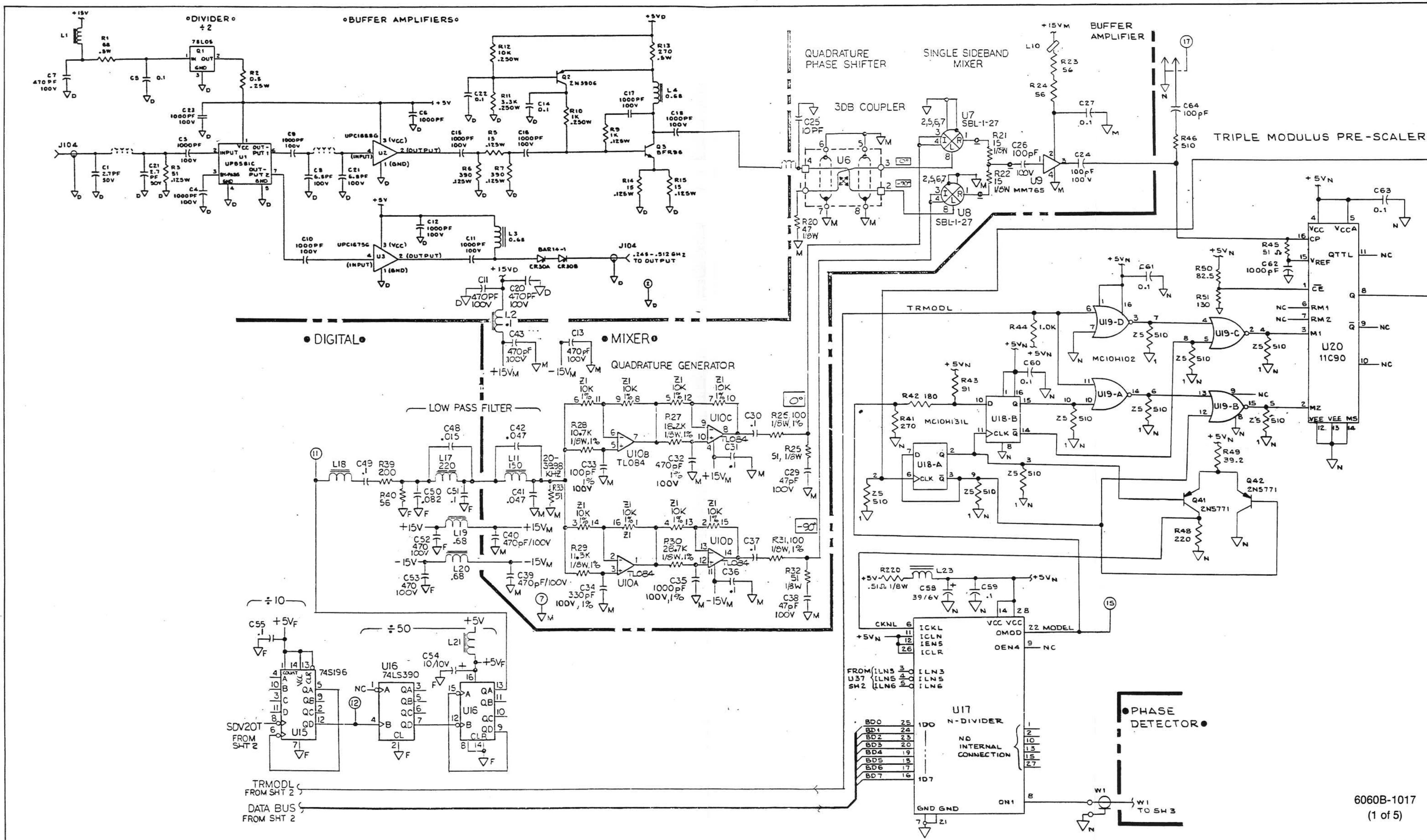


Figure 7-9. A4 Synthesizer PCA (cont)

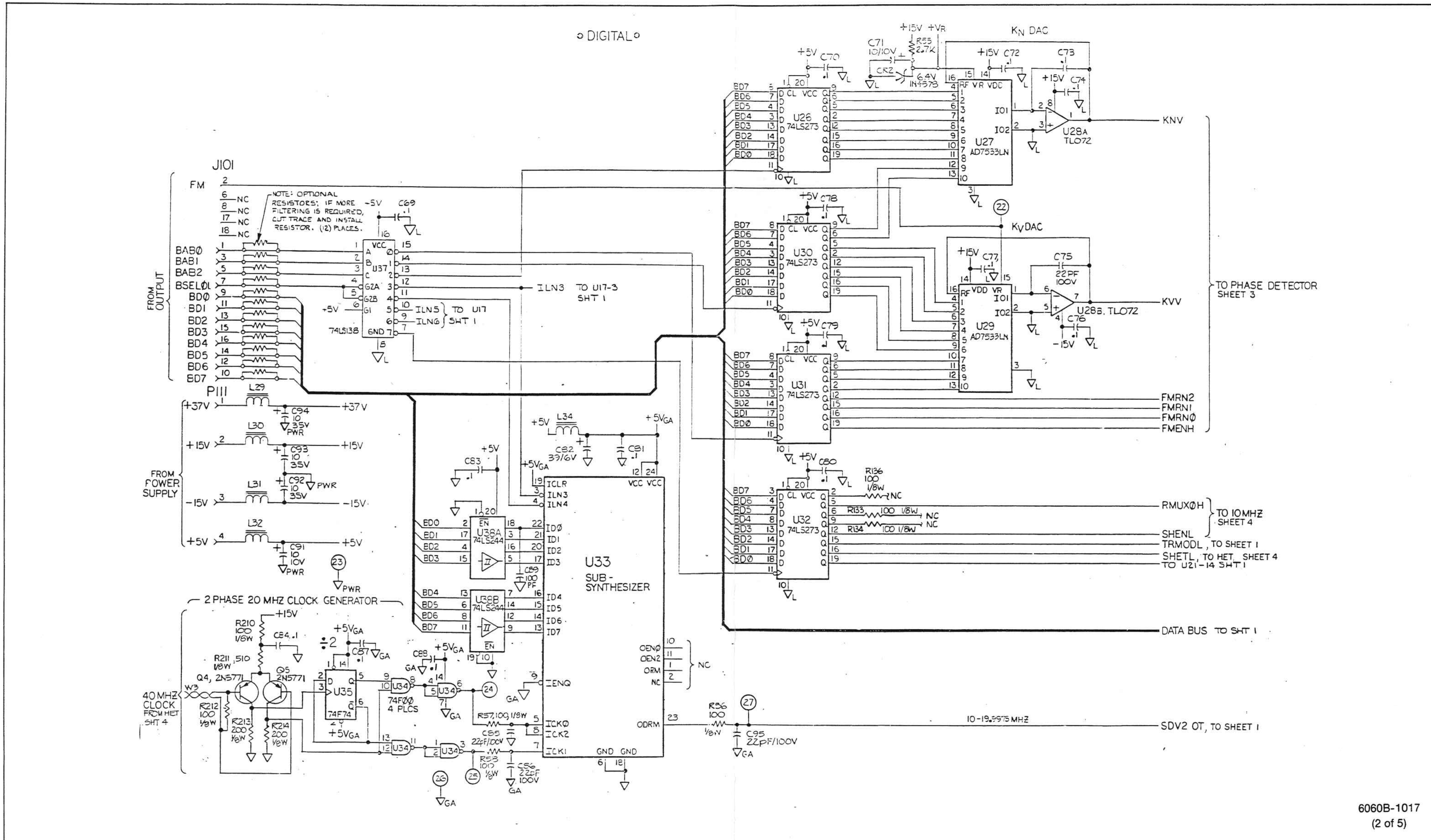


Figure 7-9. A4 Synthesizer PCA (cont)

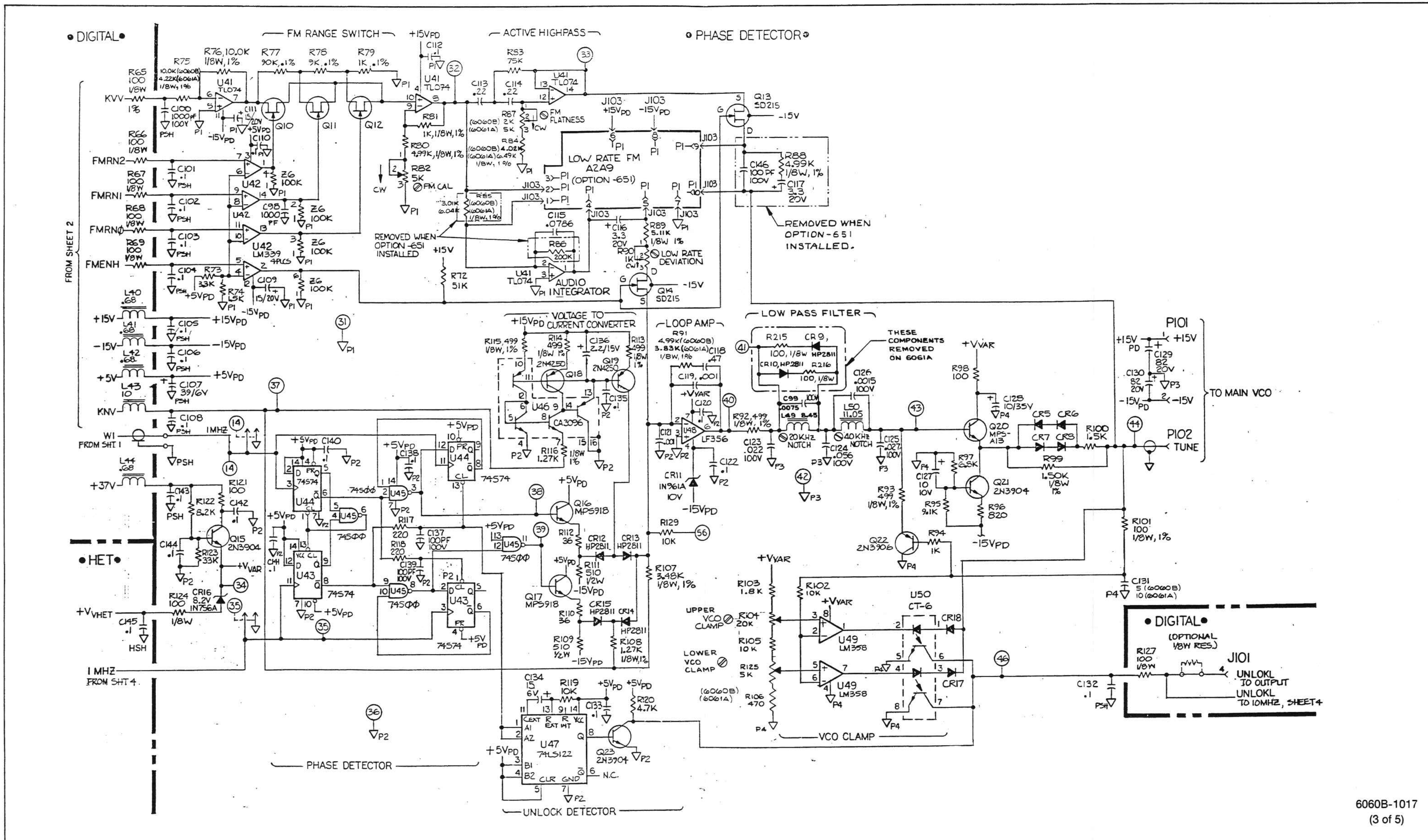


Figure 7-9. A4 Synthesizer PCA (cont)

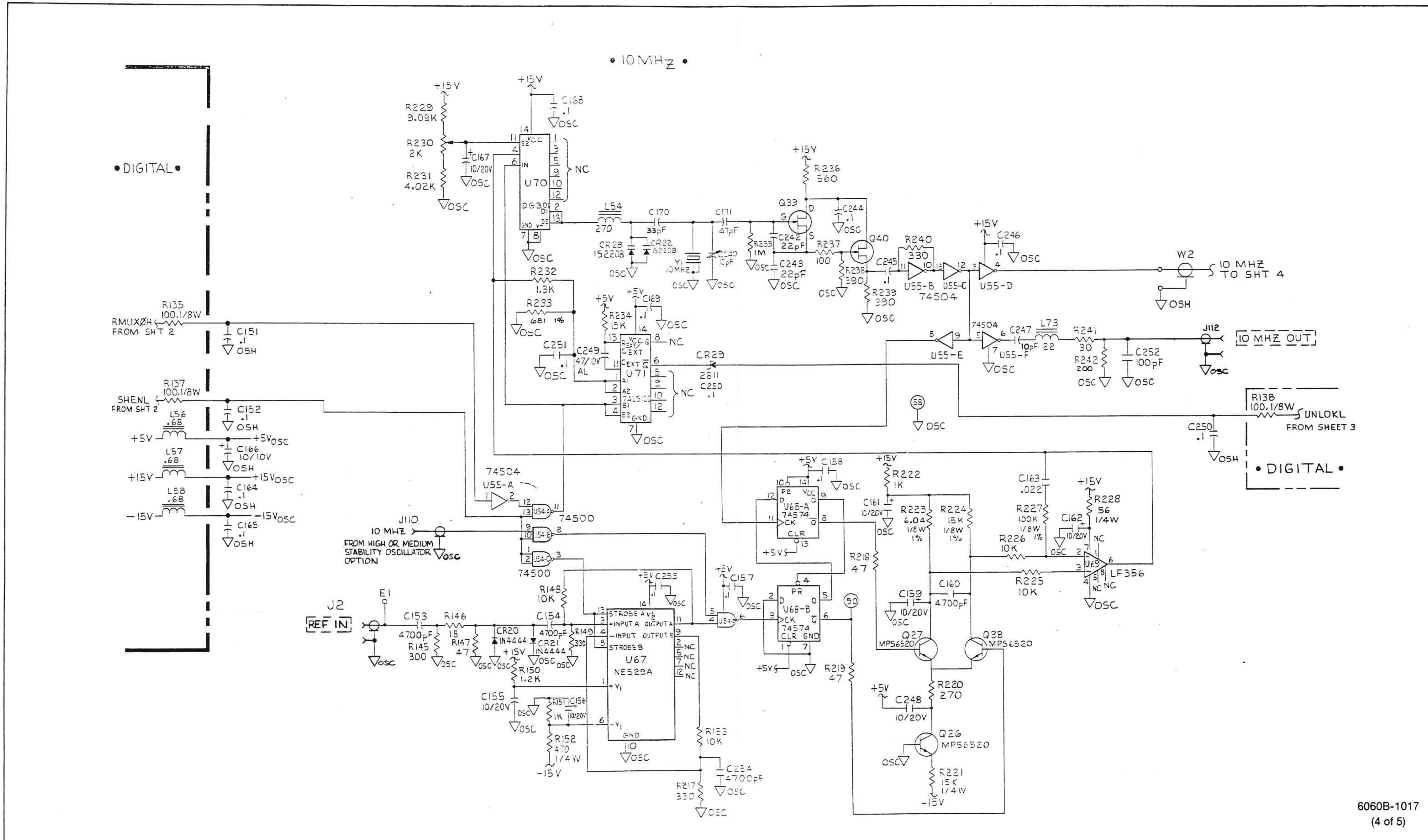


Figure 7-9. A4 Synthesizer PCA (cont)

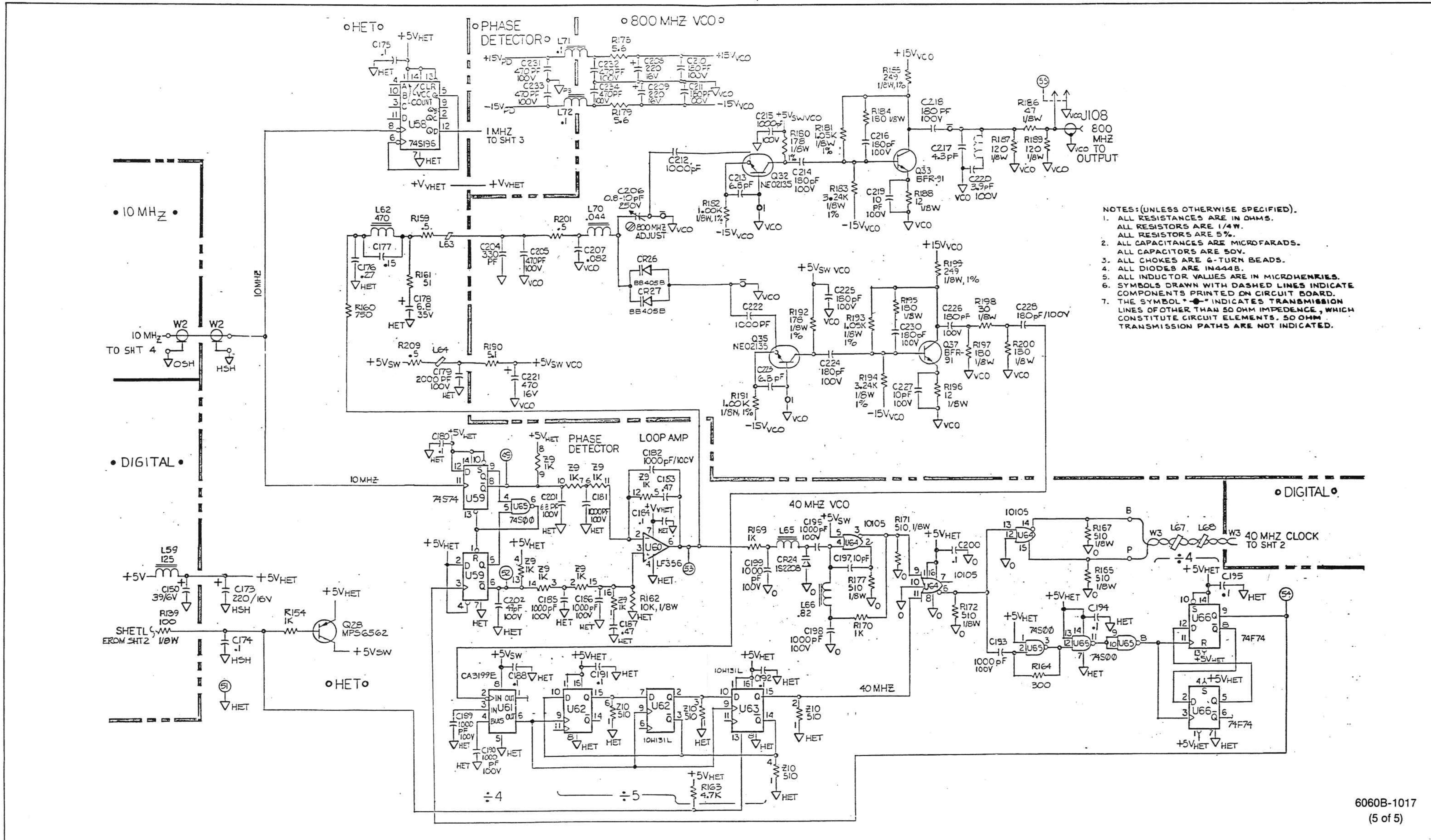


Figure 7-9. A4 Synthesizer PCA (cont)

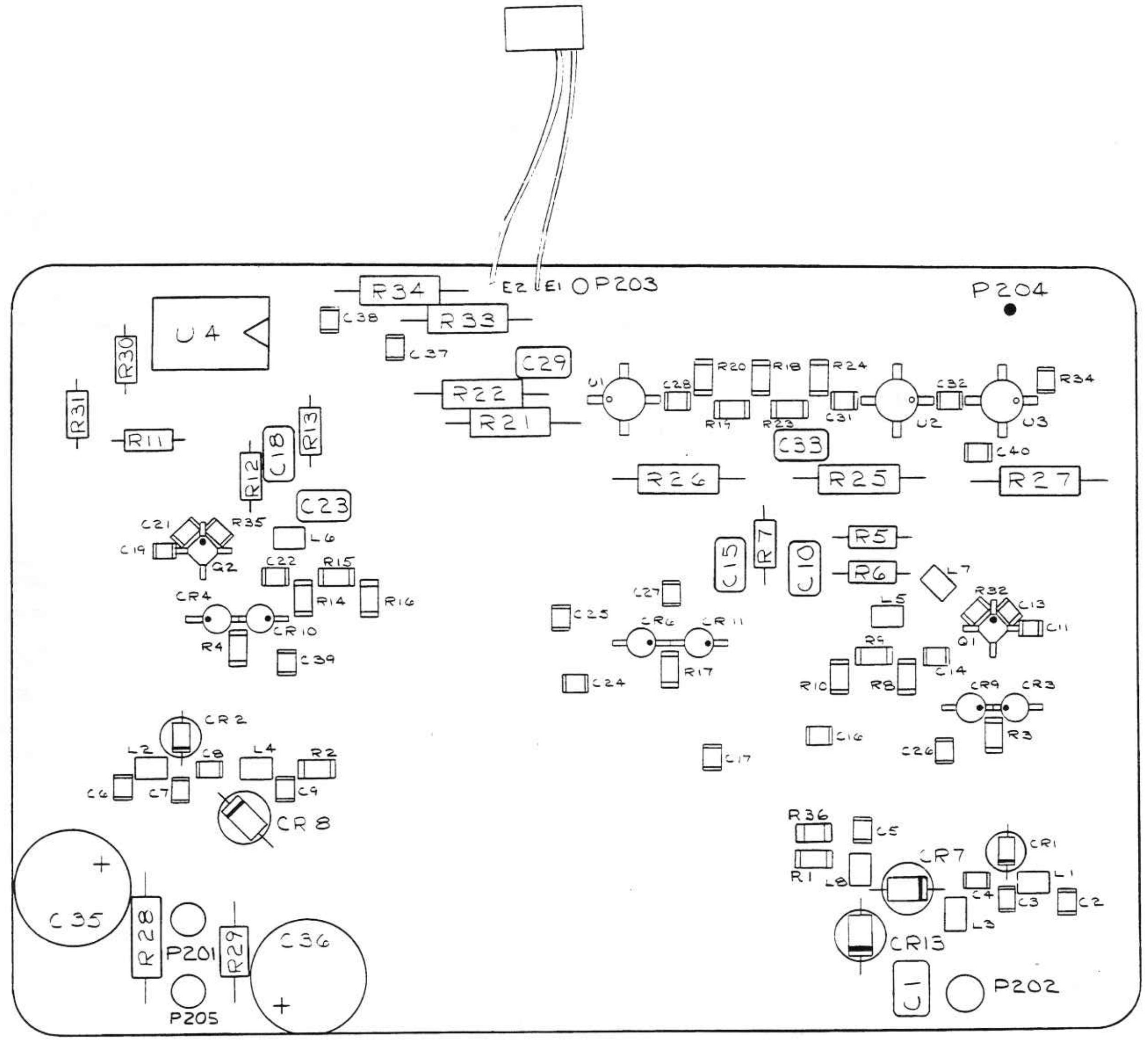
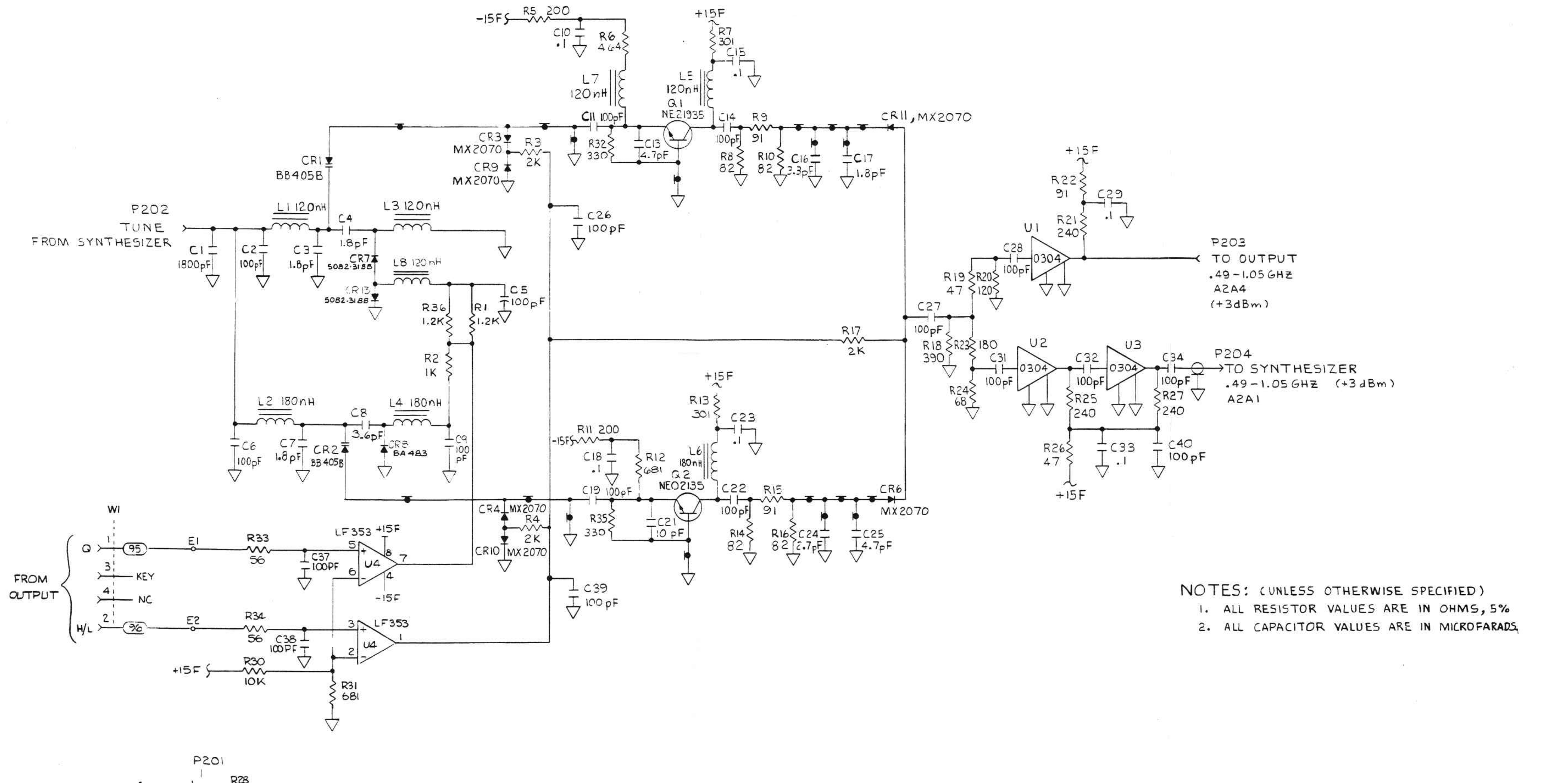


Figure 7-10. A5 VCO PCA



REFERENCE DESIGNATIONS	
LAST USED	NOT USED
R36	
C40	C12,20,30
Q2	
CR13	CR12
L8	
P204	P1-201
E2	
U4	

Figure 7-10. A5 VCO PCA (cont)

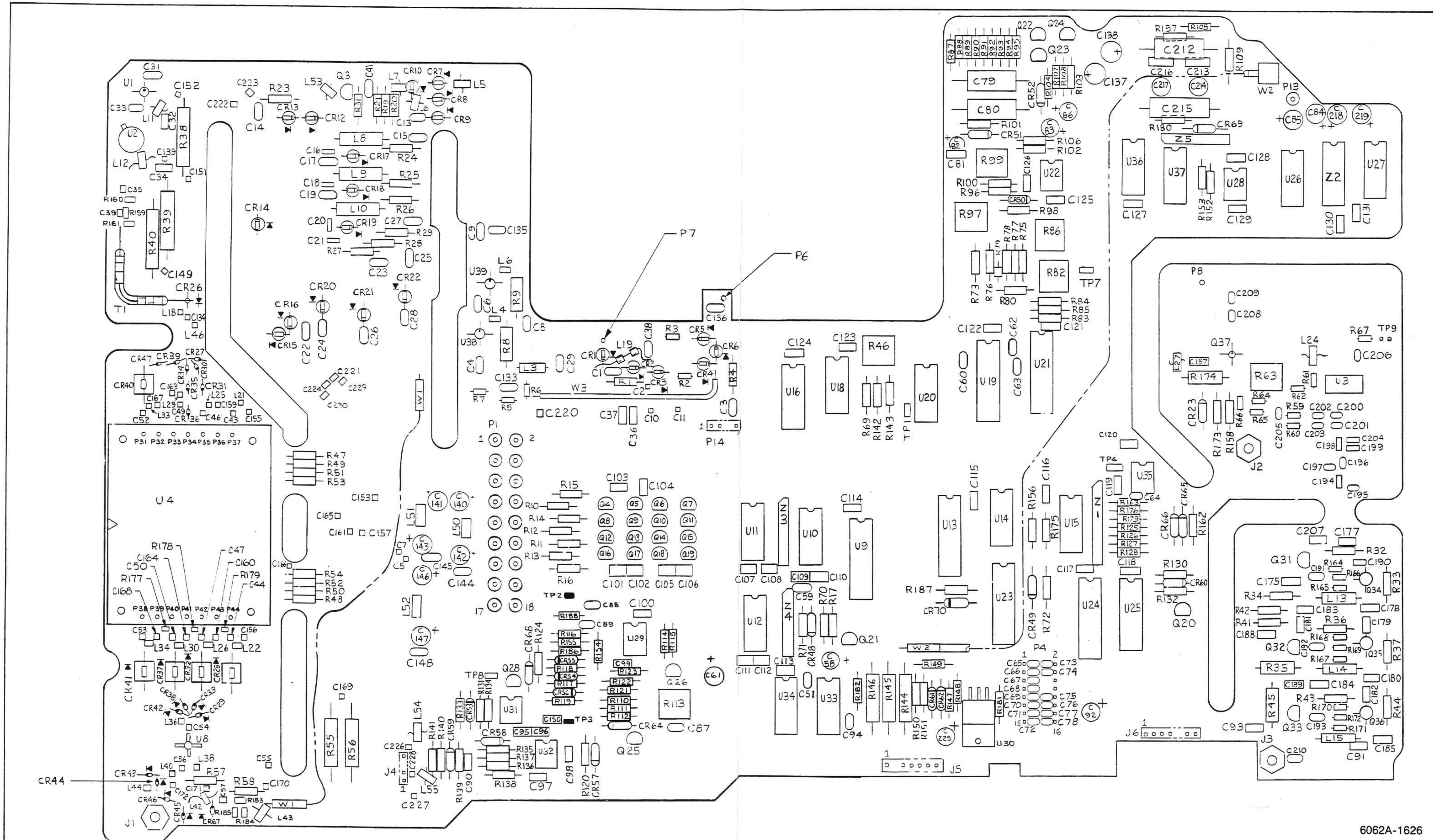


Figure 7-11. A6 Output Control PCA

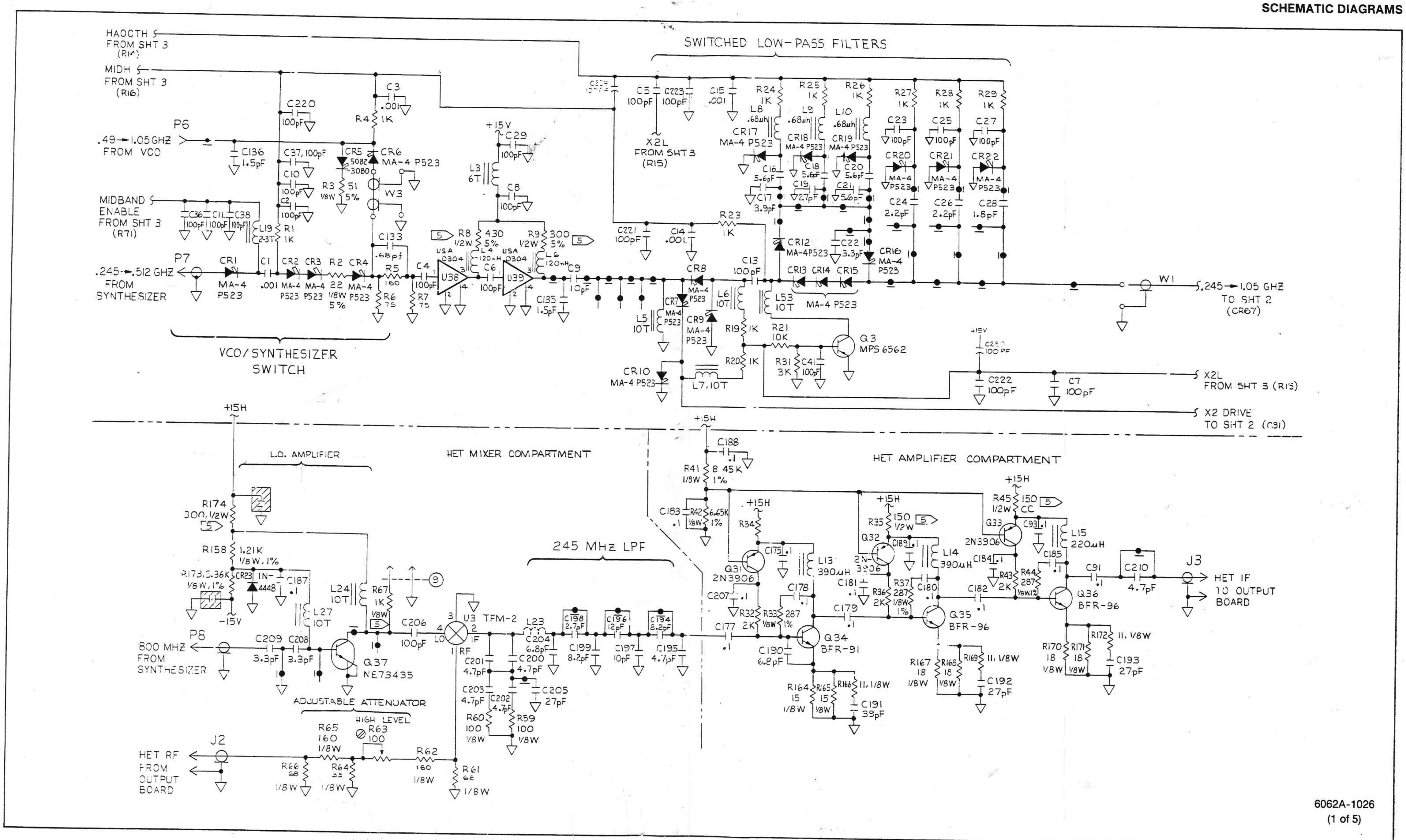
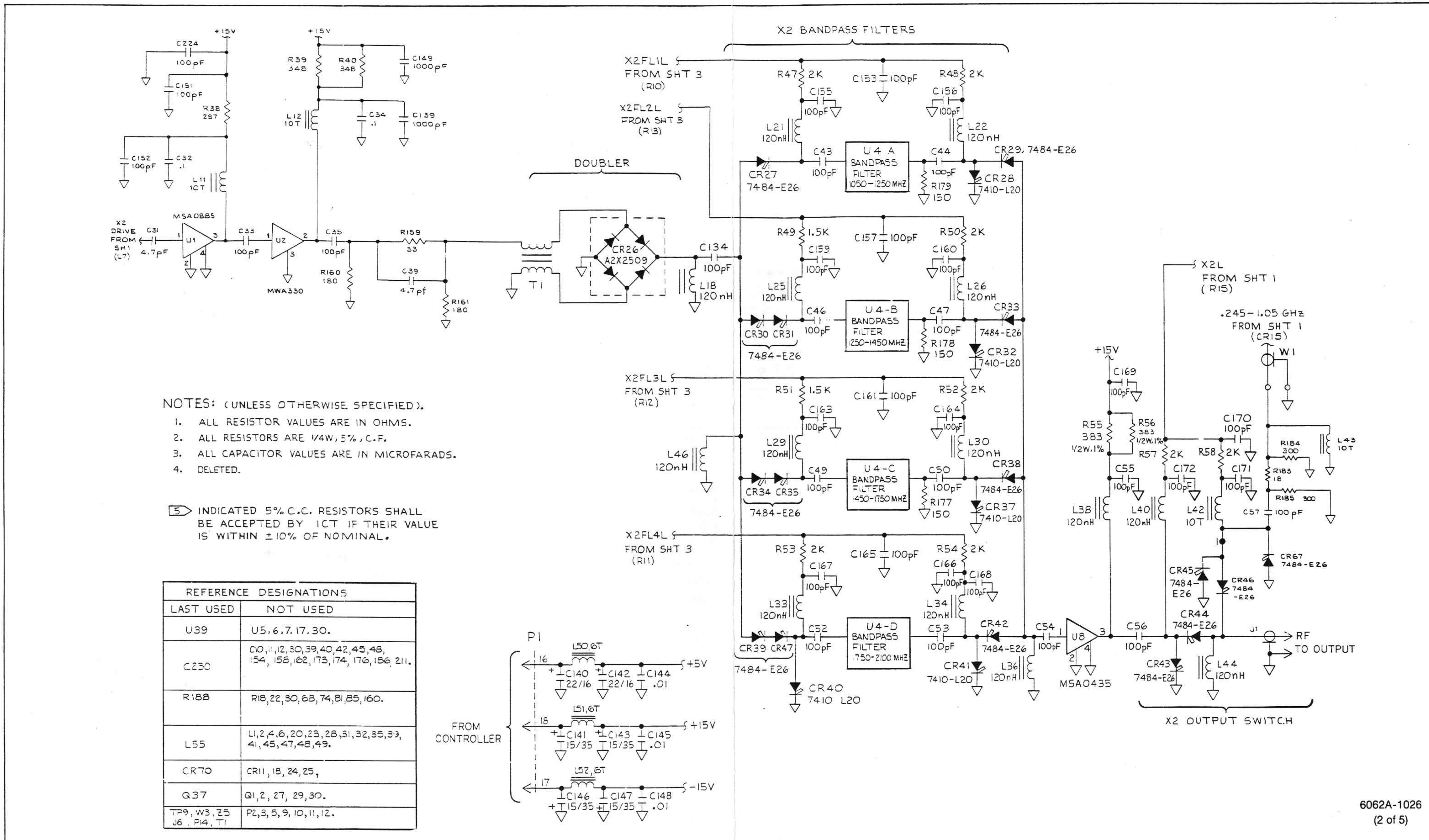


Figure 7-11. A6 Output Control PCA (cont)



NOTES: (UNLESS OTHERWISE SPECIFIED).

1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4W, 5%, C.F.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. DELETED.

[5] INDICATED 5% C.C. RESISTORS SHALL BE ACCEPTED BY ICT IF THEIR VALUE IS WITHIN ±10% OF NOMINAL.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
U39	U5, 6, 7, 17, 30.
C230	C10, 11, 12, 30, 39, 40, 42, 45, 48, 154, 158, 162, 173, 174, 176, 186, 211.
R188	R18, 22, 30, 68, 74, 81, 85, 160.
L55	L1, 2, 4, 6, 20, 23, 28, 31, 32, 35, 39, 41, 45, 47, 48, 49.
CR70	CR11, 18, 24, 25,
Q37	Q1, 2, 27, 29, 30.
TP9, W3, Z5, J6, P14, T1	P2, 3, 5, 9, 10, 11, 12.

Figure 7-11. A6 Output Control PCA (cont)

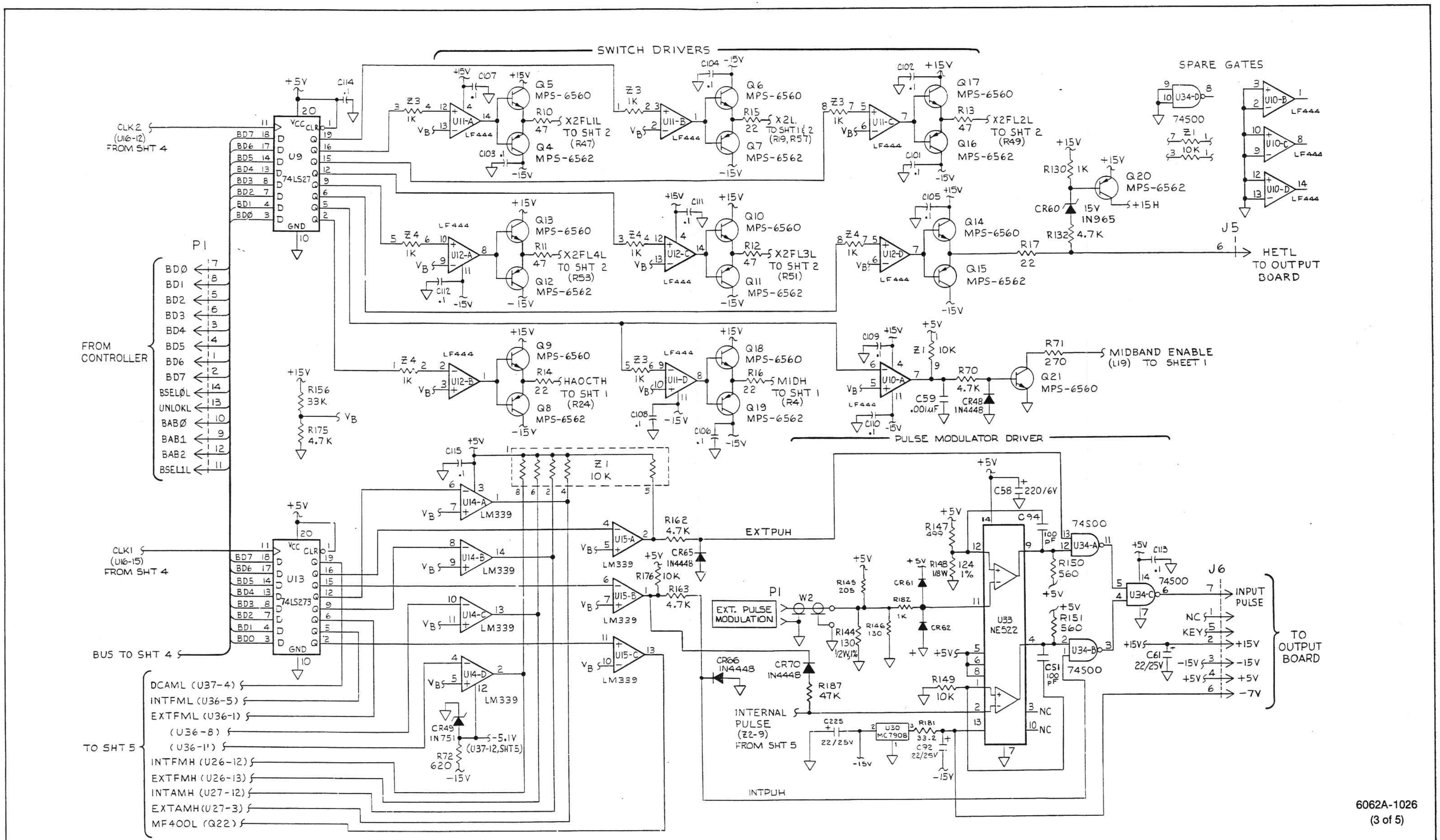


Figure 7-11. A6 Output Control PCA (cont)

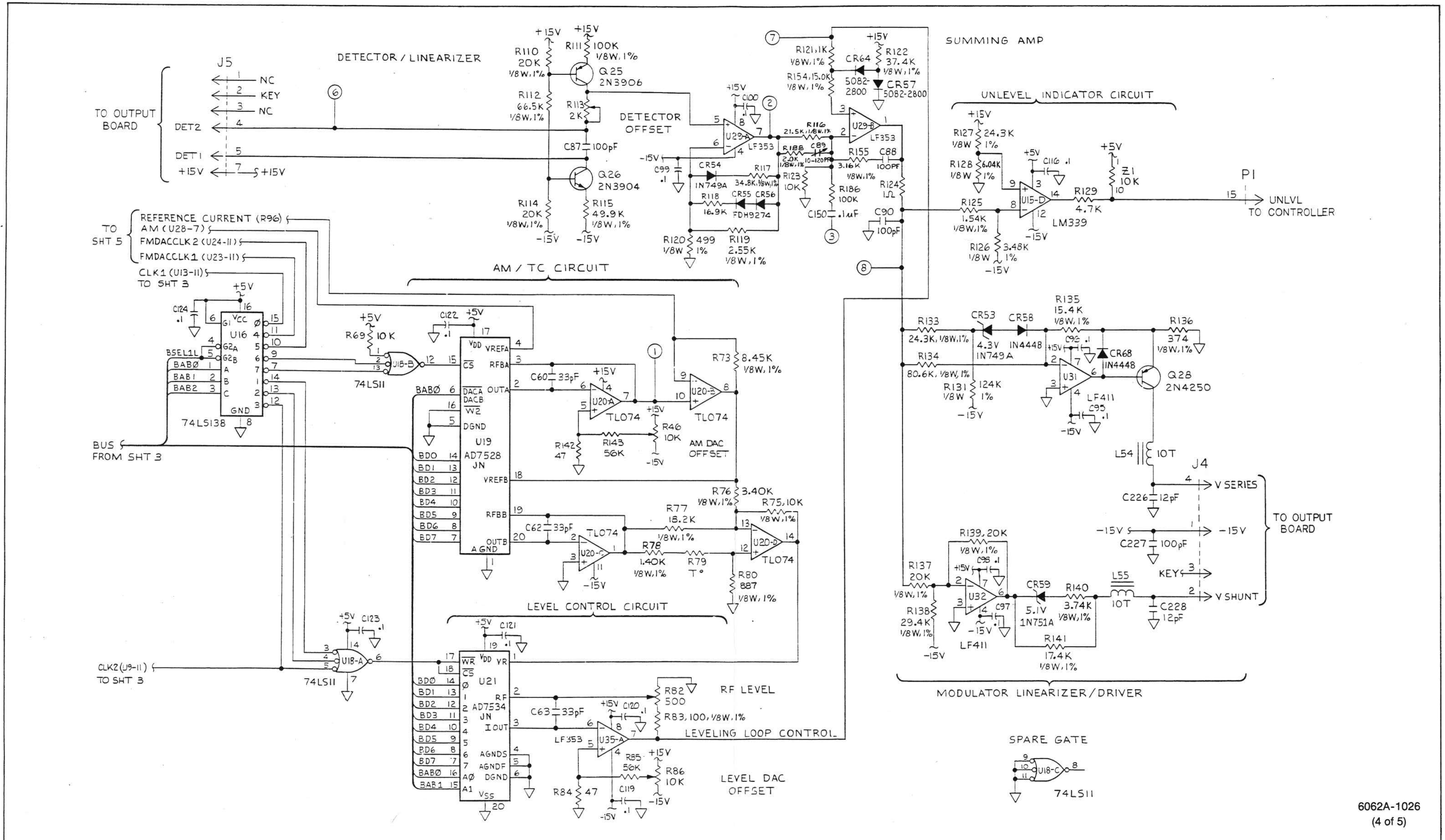


Figure 7-11. A6 Output Control PCA (cont)

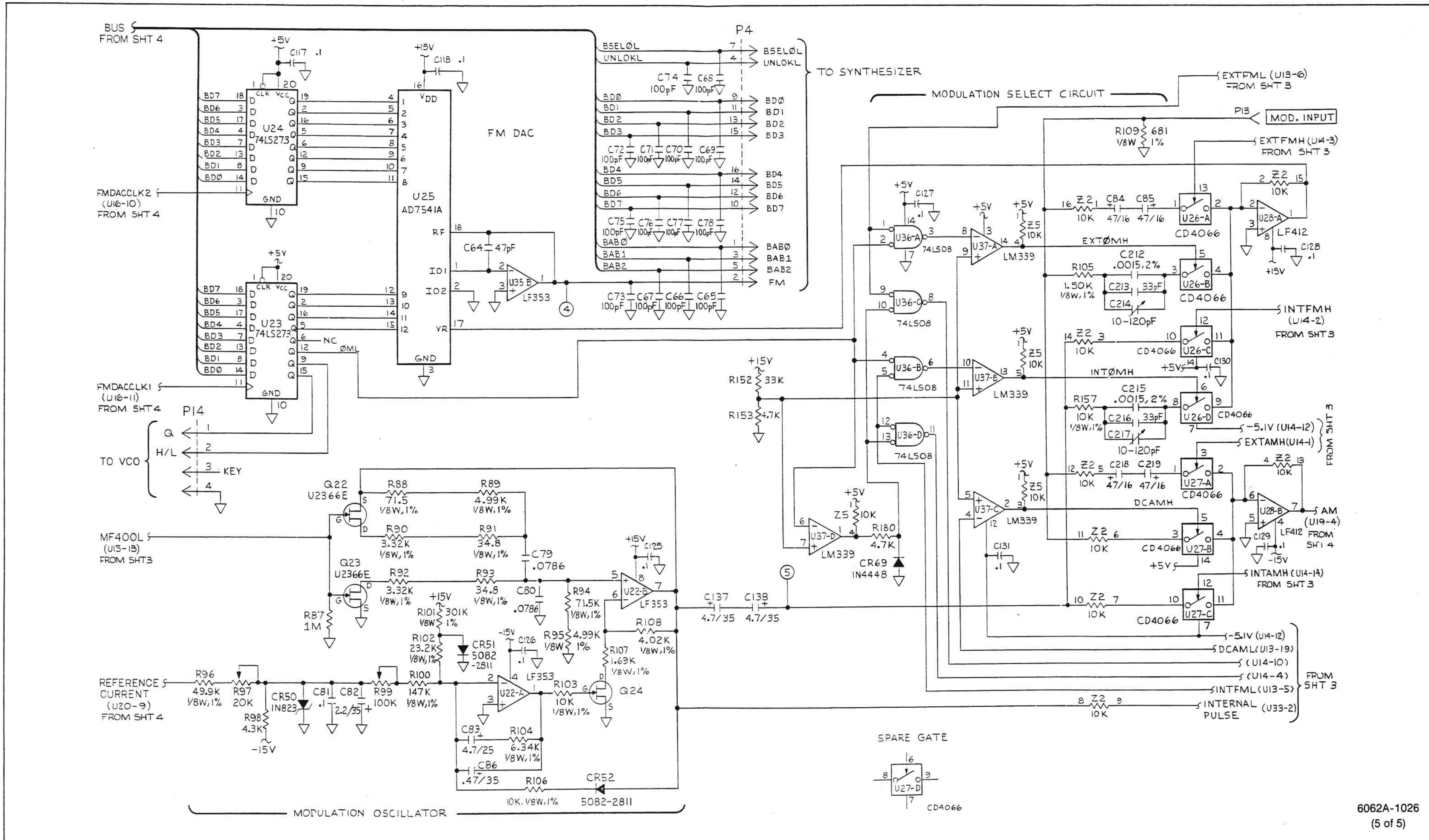


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Figure 7-11. A6 Output Control PCA (cont)

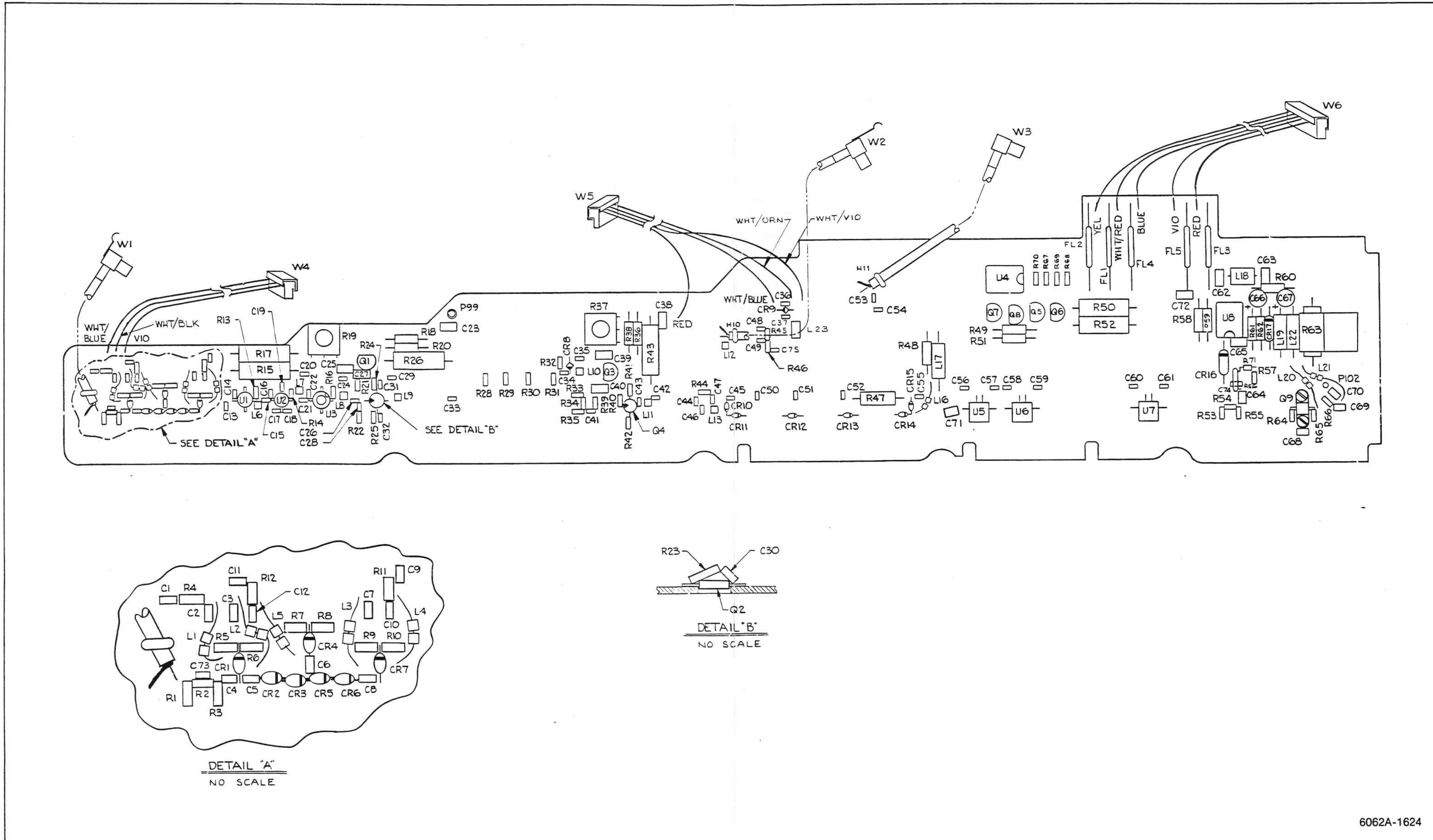
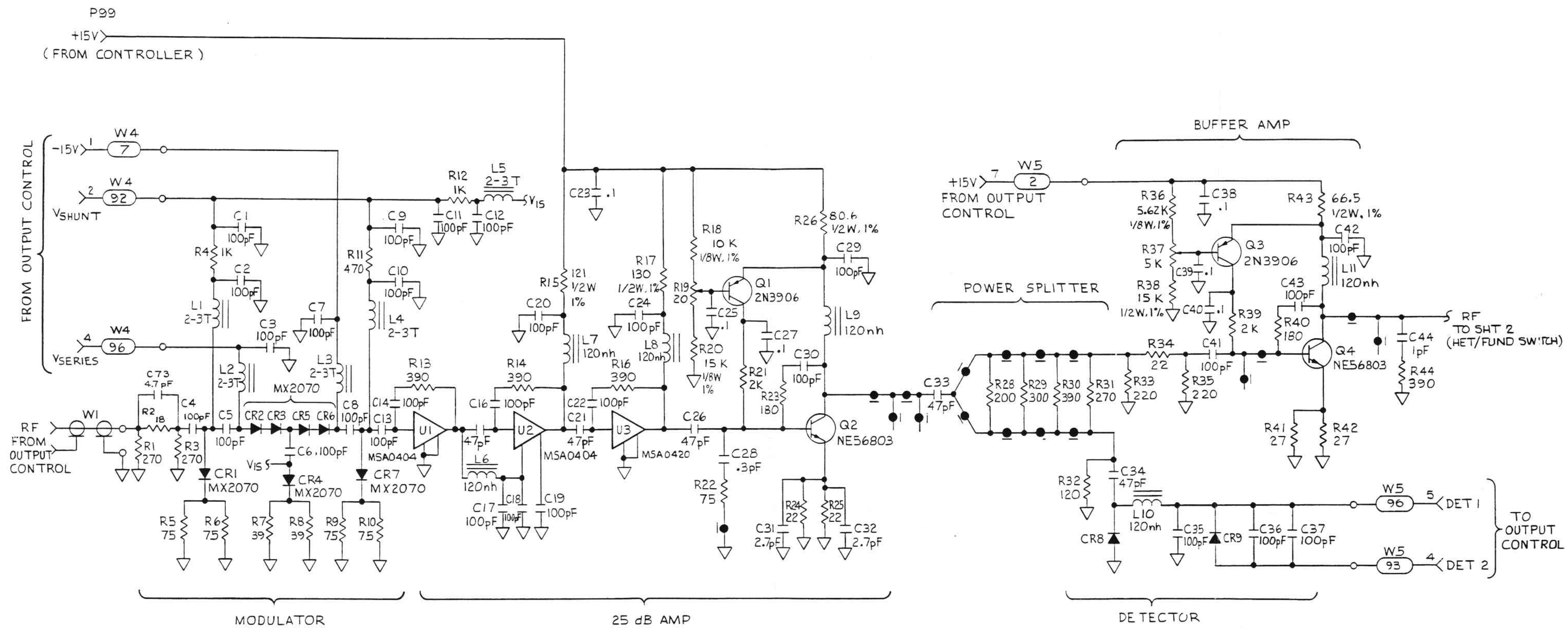


Figure 7-12. A7 Output PCA



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4W, 5%.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. INDICATED 5% CC RESISTORS SHALL BE ACCEPTED BY ICT IF THEIR VALUE IS WITHIN ±10% OF NOMINAL.
5. THE SYMBOL "—●—" INDICATES TRANSMISSION LINES OF OTHER THAN 50 OHM IMPEDANCE WHICH CONSTITUTE CIRCUIT ELEMENTS. 50 OHM TRANSMISSION PATHS ARE NOT INDICATED.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
R71	R27
CR17	—
Q9	—
U8	—
C75	—
L23	—
E4 W6 FL5	—

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Figure 7-12. A7 Output PCA (cont)

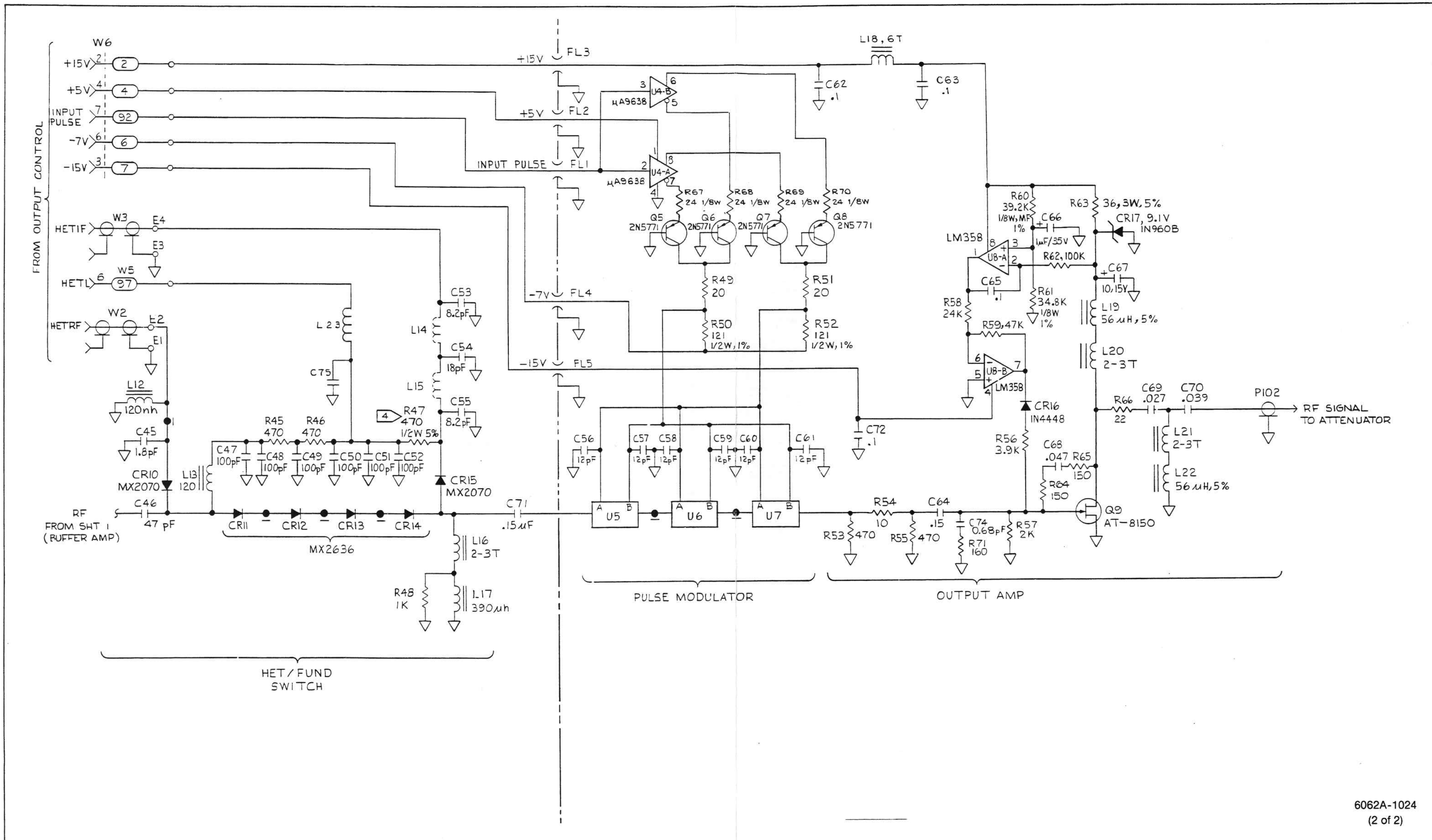


Figure 7-12. A7 Output PCA (cont)

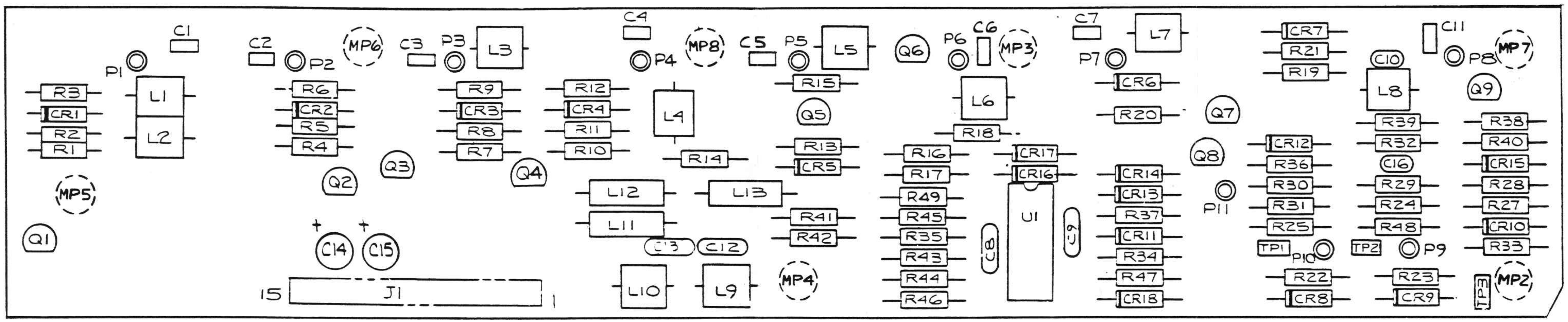


Figure 7-13. A8A1 Relay Driver/RPP PCA

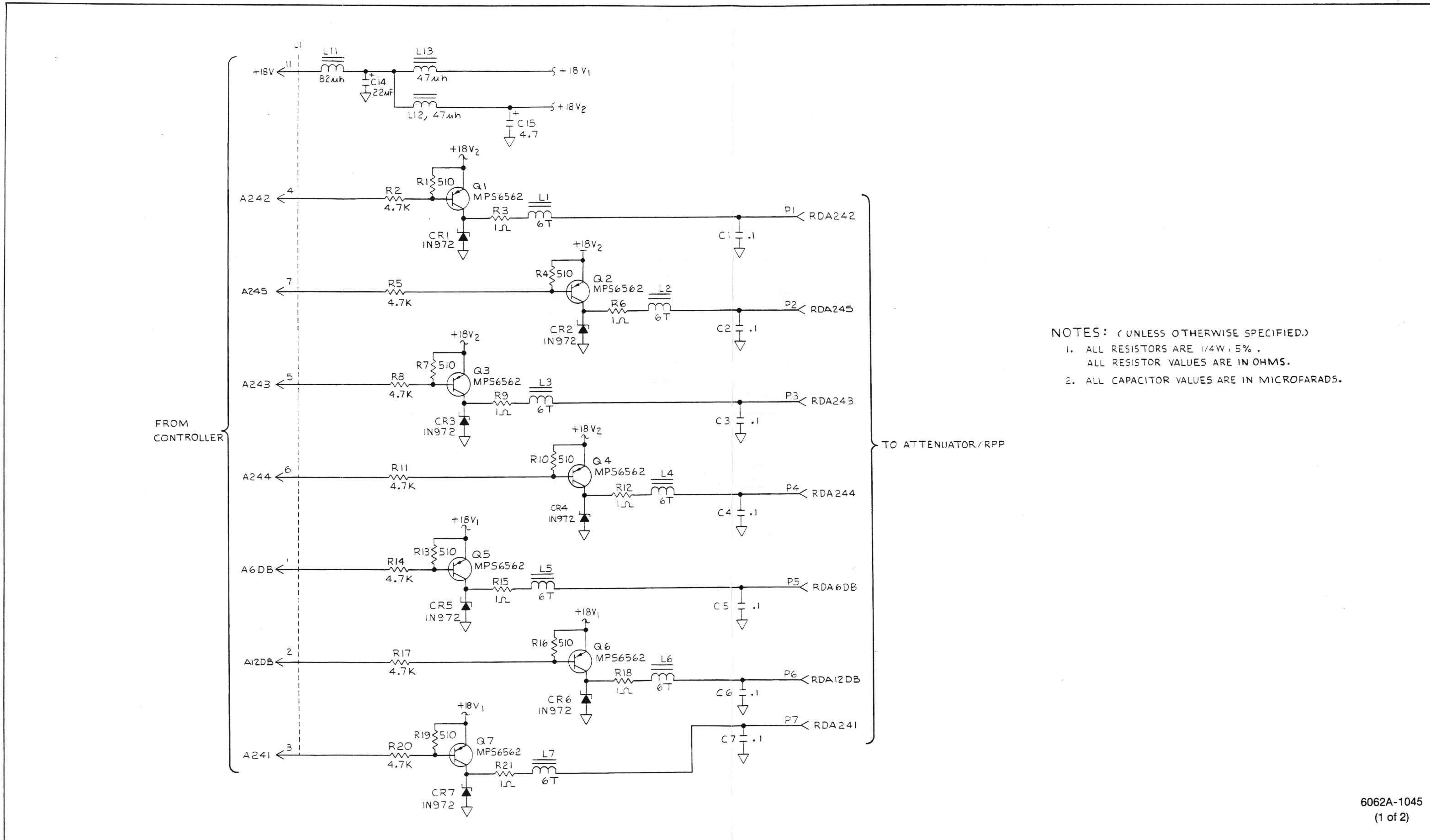


Figure 7-13. A8A1 Relay Driver/RPP PCA (cont)

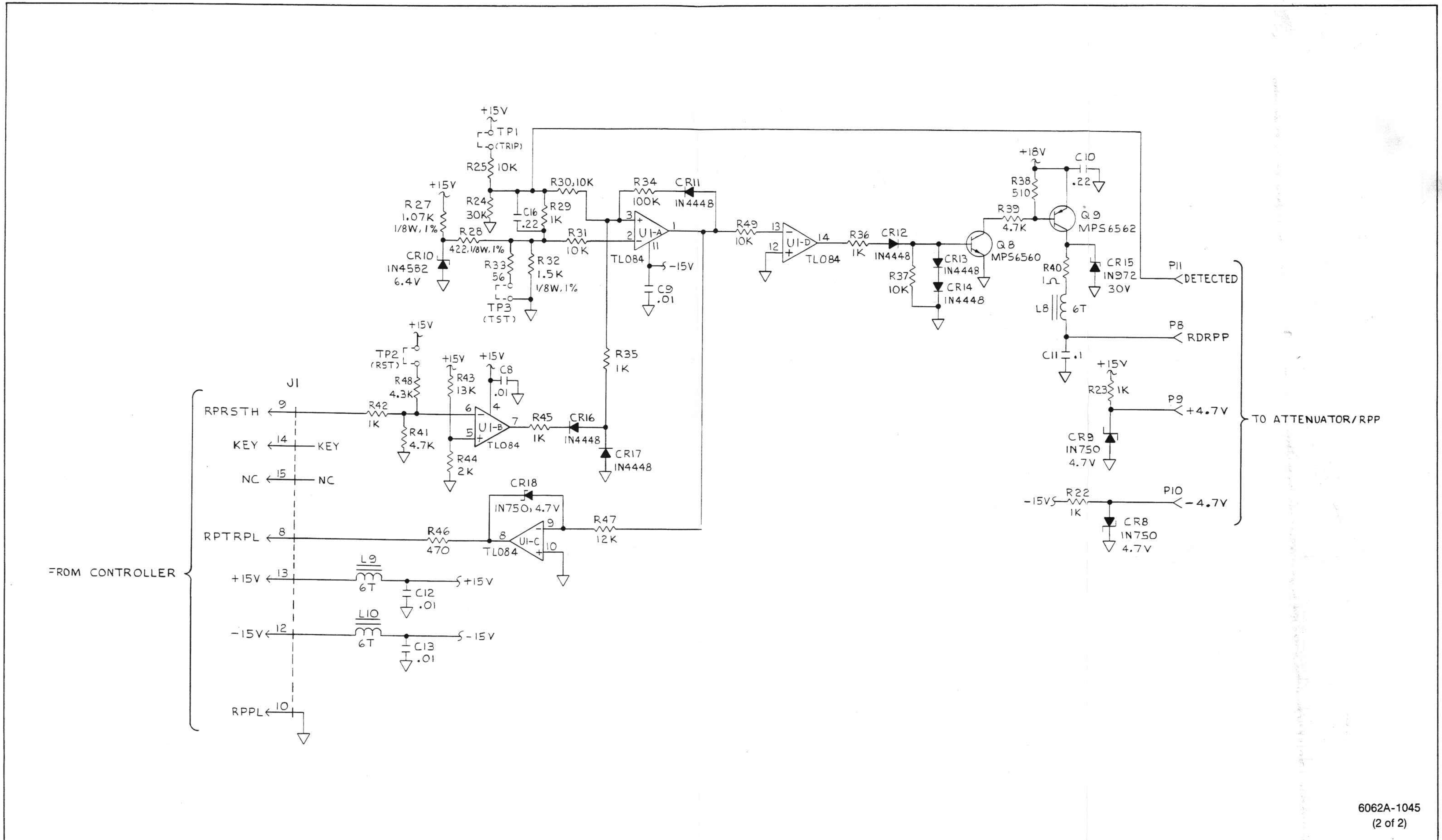
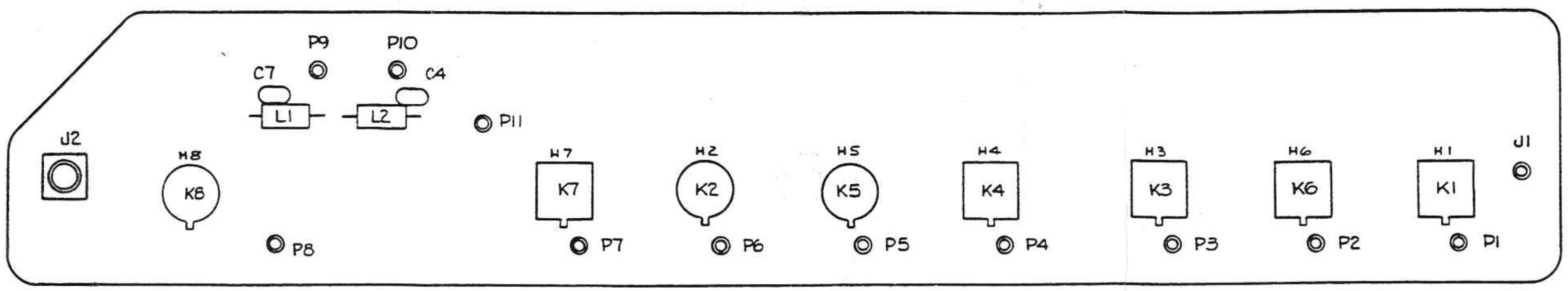
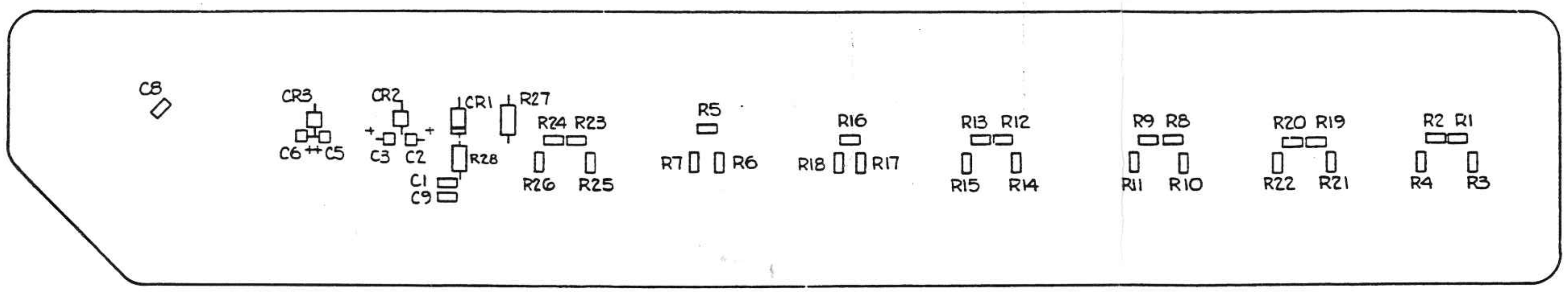


Figure 7-13. A8A1 Relay Driver/RPP PCA (cont)



CIRCUIT 2

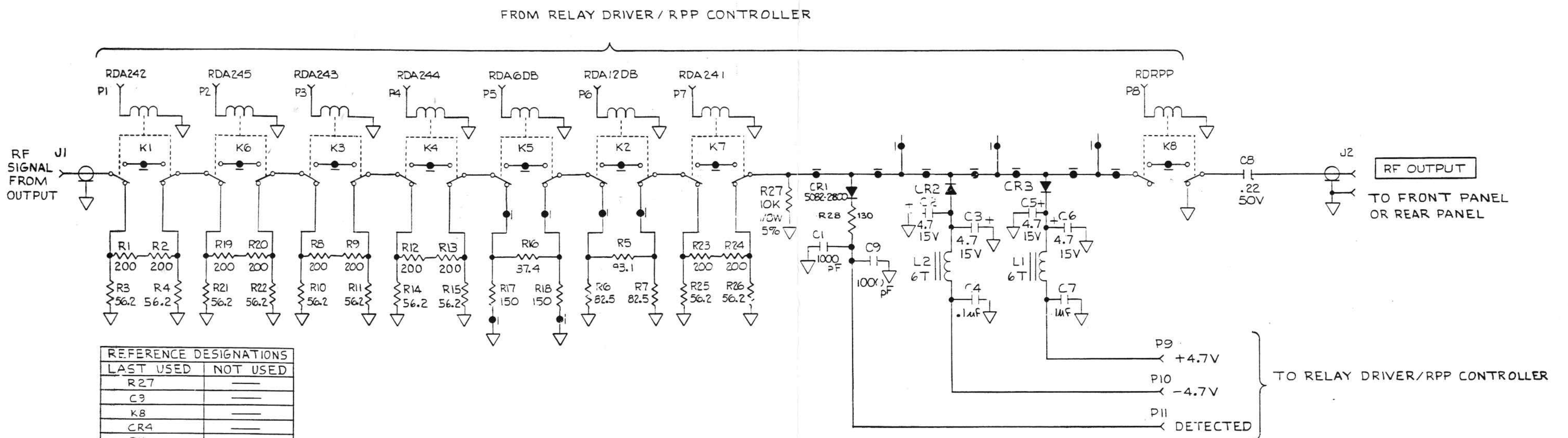


CIRCUIT 1

6062A-1647

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS. ALL RESISTORS ARE 1/8W, ± 1%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. THE SYMBOL —●— INDICATES TRANSMISSION LINES OF OTHER THAN 50 OHM IMPEDANCE WHICH CONSTITUTE CIRCUIT ELEMENTS. 50 OHM TRANSMISSION PATHS ARE NOT INDICATED.



REFERENCE DESIGNATIONS	
LAST USED	NOT USED
R27	—
C9	—
K8	—
CR4	—
P11	—
L2	—
J2	—

6062A-1047

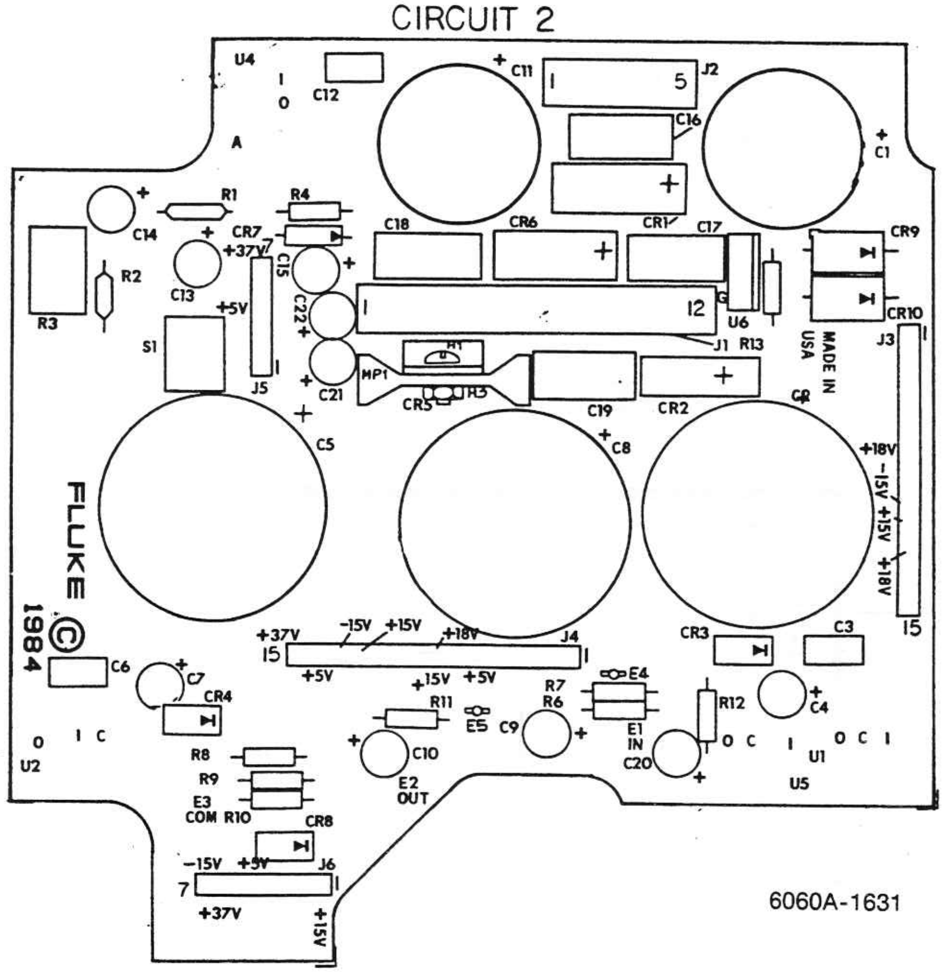
Figure 7-14. A8A2 Attenuator/RPP PCA

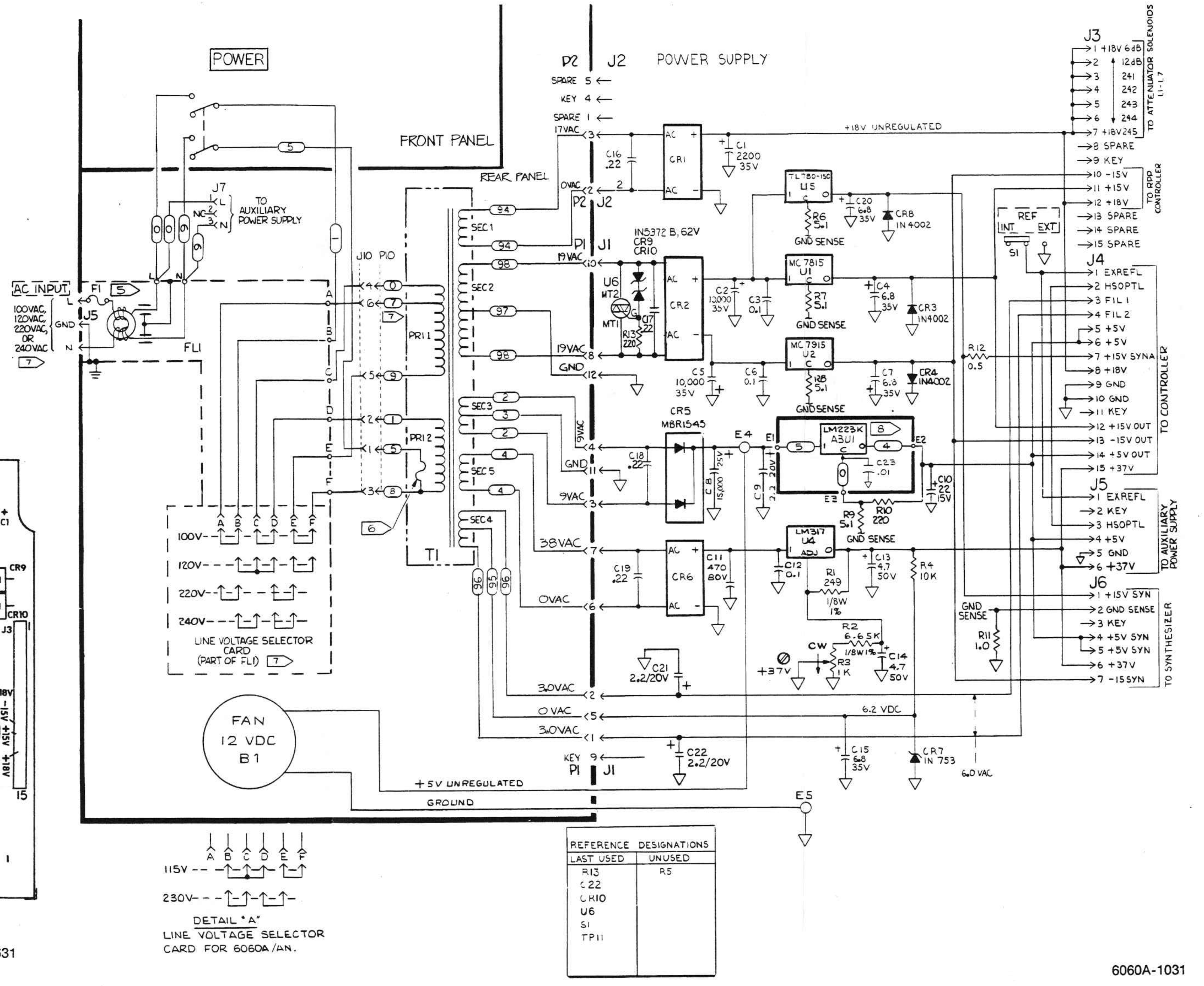
NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCES IN OHMS. ALL RESISTORS 1/4W, 5%.
2. ALL CAPACITANCES IN MICROFARADS.

[5] RATING OF F1:
1.5A WHEN AC INPUT IS 100/120 VAC
.75A WHEN AC INPUT IS 220/240 VAC

[6] THERMAL PROTECTOR INTERNAL TO T1.





REFERENCE DESIGNATIONS	
LAST USED	UNUSED
R13	R5
C22	
CR10	
U6	
S1	
TP11	

Figure 7-15. A9 Power Supply PCA

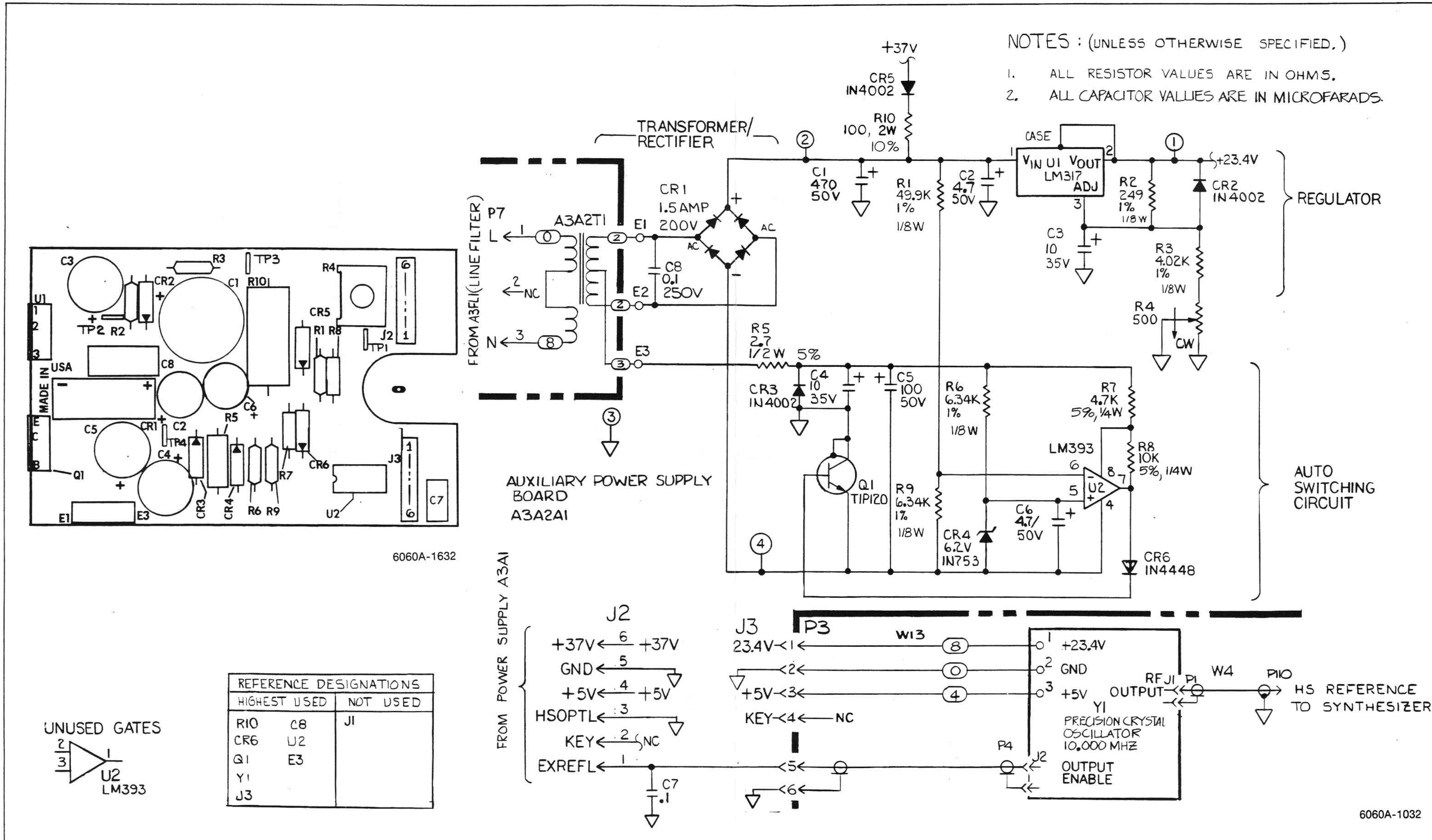


Figure 7-16. Option -130 High-Stability Reference PCA

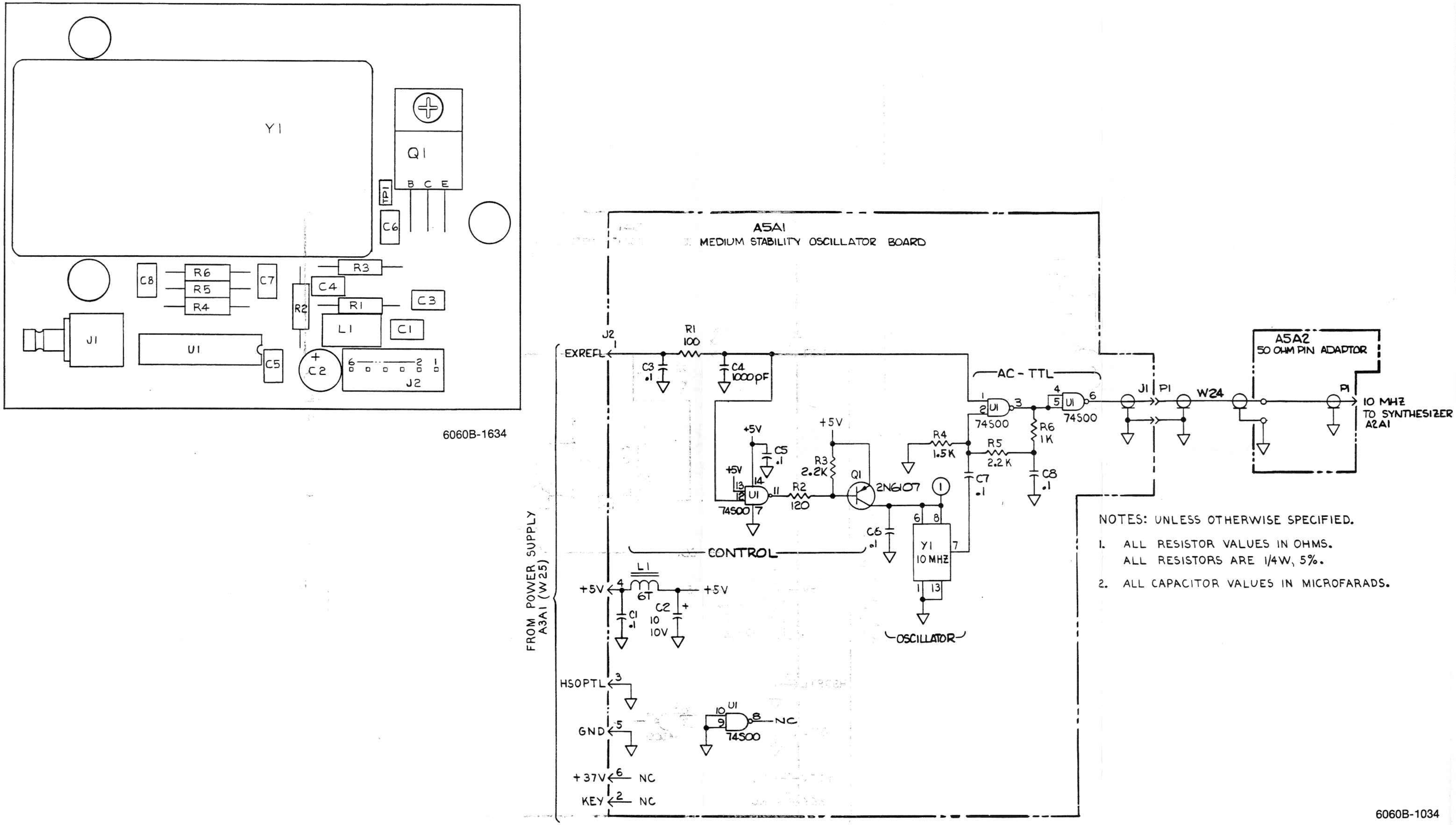
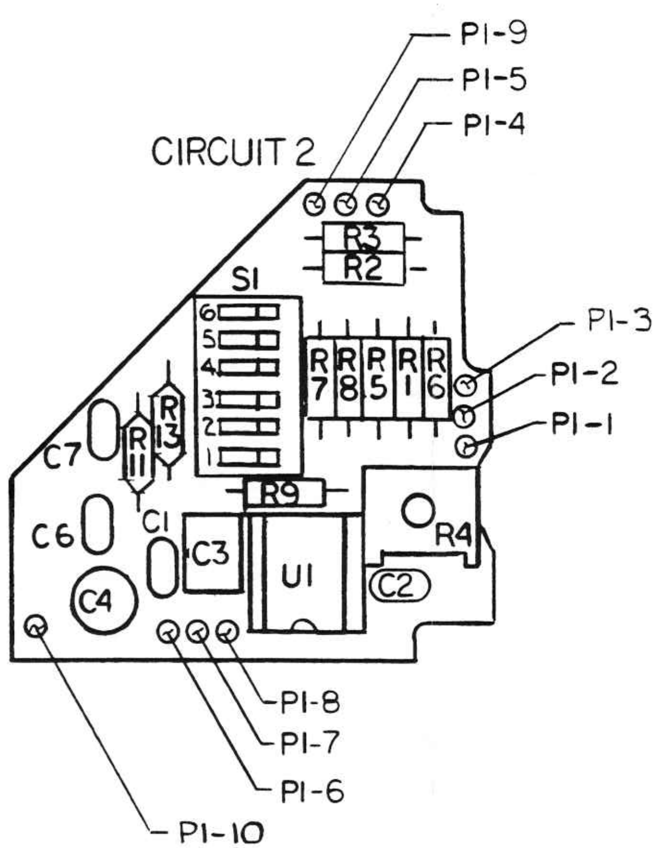


Figure 7-17. Option -132 Medium-Stability Reference PCA



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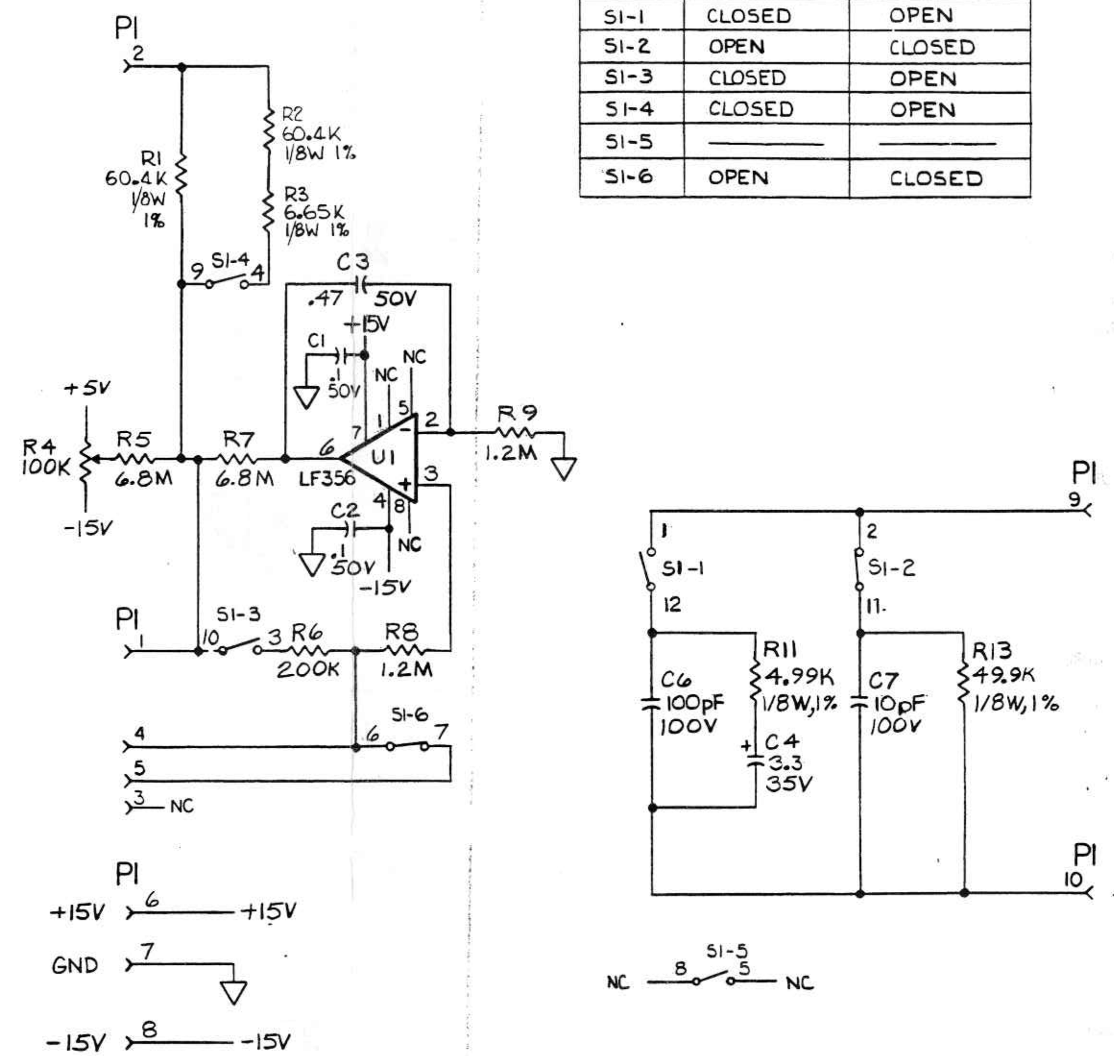

OPTION SWITCH SETTINGS		
SWITCH	NORMAL FM	LOW RATE FM
S1-1	CLOSED	OPEN
S1-2	OPEN	CLOSED
S1-3	CLOSED	OPEN
S1-4	CLOSED	OPEN
S1-5	———	———
S1-6	OPEN	CLOSED

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTOR VALUES ARE IN OHMS
2. ALL RESISTORS ARE 1/4W, 5%, CF.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. S1 IS SHOWN SET IN LOW RATE FM POSITIONS.

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C7	C5
R13	R10,12
P1	
S1	
U1	

6060A-1051

Figure 7-18. Option -651 Low-Rate FM PCA

FLUKE 6062A OPERATOR INFORMATION CARD

REJECTED ENTRY CODES (Press the [STATUS] key to display codes)

000 000 000 = no rejected entries.
001 000 000 = FM Dev/ØM not between 0 and 400 kHz (40.0 kHz with option -651)
002 000 000 = FM Dev/ØM Step not between 0 and 400 kHz (40.0 kHz with option-651)
004 000 000 = AM Depth not between 0 and 99%
010 000 000 = AM Depth Step not between 0 and 99%
020 000 000 = IEEE-488 command syntax error
040 000 000 = IEEE-488 input value out of range
100 000 000 = MEC compensation PROM error
200 000 000 = IEEE edit or step operation beyond allowed range
400 000 000 = Invalid frequency in COMP memory

000 001 000 = Frequency not between 100 kHz and 2100 MHz
000 002 000 = COMP switch not enabled or low-rate FM option not disabled
000 004 000 = Frequency Step not between 0 and 2100 MHz
000 010 000 = COMP data may not be stored if procedure incomplete
000 020 000 = Invalid compensation command
000 040 000 = Invalid memory location
000 100 000 = Invalid data in memory
000 200 000 = Special function not allowed
000 400 000 = COMP data range error

000 000 001 = Output amplitude not between 10 nV and 1.58V
000 000 002 = Insufficient resolution for units conversion
000 000 004 = Units conversions to volts not allowed with reference in volts
000 000 010 = Units conversions to dB not allowed with reference in volts
000 000 020 = Amplitude Step not between 0 and 164 dB or 0 and 1999V
000 000 040 = Units conversion of Amplitude or FM/ØM Step not allowed
000 000 100 = Amplitude or FM/ØM step and current display not in same units
000 000 200 = COMP data from IEEE-488 out of range or edit beyond COMP limits
000 000 400 = Internal compensation data transfer error

UNCAL CODES (Press the [STATUS] key to display codes)

Flashing codes (denoted by *) indicate abnormal operation or aberrated output.
Non-flashing codes indicate operation outside specified range.

000 000 000 = no uncal conditions
002 000 000 = Excess FM Dev/ØM for output freq < .350 MHz
* 004 000 000 = Excess FM Dev/ØM, main or reference PLL unlocked
* 010 000 000 = FM DAC at full scale
200 000 000 = Multiple COMP memory checksum errors
* 000 010 000 = Main or reference PLL unlocked
000 000 001 = Level vernier>12 db below bottom of range
000 000 002 = Peak amplitude > +16 dBm for freq < 1050 MHz or > +13 dBm for freq >= 1050 MHz
* 000 000 004 = Amplitude unleveled
* 000 000 010 = Fixed-range level vernier at 0
* 000 000 020 = Fixed-range level vernier at full scale
* 000 000 040 = RPP tripped
000 000 100 = Level < -137 dBm
000 000 200 = Level correction disabled
* 000 000 400 = RF off

SPECIAL FUNCTION OPERATION (Press the [SPCL] key, then press the 2-digit code)

The two-digit code consists of a class numeric followed by a mode numeric. The activated modes of classes 2 through 9 are shown in the FREQUENCY display field while the [SPCL] key is pressed. For example, reading from left to right, 01000201 indicates that relative-amplitude, slow key-repeat-rate, and amplitude fixed-range are selected.

Code	Function	Code	Function
00	Clears all special functions	30/31	Disable/enable relative ampl
02	Initiates self test	40/41	Disable/enable internal pulse
03	Display check	50/51/52	Select dBm/dBmV/dBuV ampl mode
04	Key check	60/61	Disable/enable DC AM
07/08	Set/reset SRQ	70/71/72	Medium/fast/slow key-rep-rate
09	Display S/W rev & instr ID	75	Display COMP memory status
10	Display IEEE-488 address	76	Repair COMP memory errors
11	Display self test results	77/78/79	Copy FM/Output/Atten MEC PROM data
12/13	Turn on/off Display	80	Enable amplitude correction
14	Initialize Memory	81	Disable all level correction
15	Latch test	82	Disable attenuator correction
16	Display Option Loading	83-86	Program alternate 24 dB atten
17	Initiates self test with RF on	90/91	Disable/enable ampl fixed-rng
20/21	Disable/enable relative freq	95-98	Keyboard compensation procedures

SELF TEST RESULTS (Press the [SPCL] [1] [1] keys to display the results)

The self test results are reported in the four display fields as follows:

aaa bbb ccc ddd

AM/FM Tests · Freq Tests · Digital Tests · Ampl Tests

Self Test Incomplete

000 000 000 000 indicates all tests passed.

MEMORY

Instrument settings may be stored in locations 01 through 50 and later recalled from Non-Volatile Memory. Location 98 contains the Instrument Preset State.

REV 0 P/N 797928

Figure 7-19. Operator Information Card