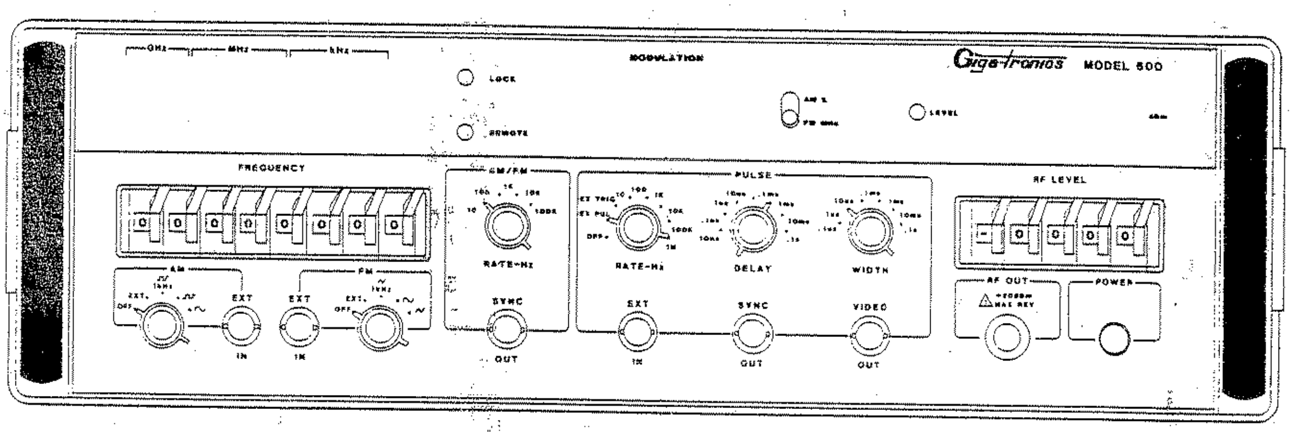
Giga-tronics
INCORPORATED

OPERATION & MAINTENANCE MANUAL

SERIES 600

SYNTHESIZED MICROWAVE

SIGNAL GENERATOR



This manual applies to all Series 600 instruments. For information regarding instrument configuration and options, see page iii.

Shipping Assembly Part Number: see page iii.

Manual Part Number: 304AM04500

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510 -

WARRANTY

All Giga-tronics instruments are warranted against defective materials and workmanship for one year from date of shipment. Giga-tronics will at its option repair or replace products that are proven defective during the warranty period.

This warranty DOES NOT cover damage resulting from improper use, nor workmanship other than Giga-tronics service.

There is no implied warranty of fitness for a particular purpose, nor is Giga-tronics liable for any consequential damages.

Specification and price change privileges are reserved by Giga-tronics.

NOTES REGARDING THE TEXT

This manual employs the convention of indicating exponents by a capital 'E' (for example, 10E4 = 10000, and 6 X 10E-3 = .006).

Block diagram symbols used in the manual are defined at the beginning of Section Three.

SERIES 600 CONFIGURATION DATA

SHIPPING ASSEMBLY NUMBERS

This operation and maintenance manual is valid for all Series 600 instruments. The instruments in the series differ primarily in their frequency ranges, which are indicated by a suffix in the model number. Each instrument contains a frequency assembly appropriate to its frequency range. For instruments which include the .01-2 GHz range, see the Special Configurations section.

Model	Shipping Assembly#	Frequency Assembly#
600/2-8	304DA01400	304CA08600
600/6-12*	304DA01401	304CA08601
600/10-18	304DA01402	304CA08602
600/6-12	304DA01403	304CA08603

* (version featuring reverse power protection)

OPTIONS, SPECIAL CONFIGURATIONS, MODIFICATIONS

Consult the "Config." line on the Model/Serial/Config. sticker affixed to the rear panel of the instrument. If this line is blank, there are no options installed in the instrument. If the line contains one or more two digit numbers (e.g., '06') the standard options corresponding to those numbers are installed in the instrument. Information concerning them will be found in Section 8 of this manual.

If the "Config." line of the Model/Serial/Config. sticker contains a three digit number (e.g., '052') there is a combination of standard or special options, and/or special modifications, installed in the instrument. Information concerning them will be found in section 9.2 of this manual.

Instruments that include the downconverter range (.01-2 GHz) require modifications described in section 9.1 of this manual.

SERIAL NUMBERS

This instrument has a six digit serial number. The first two digits are a prefix indicating instrument type (the 600 series is signified by the following prefixes: 41, 42, 43, 44, 45, 46, 47, 48, 49, 60, 61, and 62). The last four digits of the serial number are a sequential suffix.

MANUAL CHANGES

Differences may exist between the manual and the instrument for which it is supplied, due to errors or circuit changes. These differences are described in Section 10, with reference to instruments by serial number.

TABLE OF CONTENTS

ILLUSTRATIONS

GENERAL INFORMATION

In addition to the front matter presented here, this manual contains ten sections which describe various aspects of Series 600 synthesized microwave signal generators:

SECTION ONE -- Operating Information

This section is a user's guide to the instrument and its controls.

SECTION TWO -- Performance Specifications

The instrument's performance parameters are specified in this section.

SECTION THREE -- Theory of Operation

This section provides a description (at the block diagram level) of the Series 600 and its method of operation, offered as an aid to understanding for the purpose of maintenance and applications.

SECTION FOUR -- Calibration and Testing

Procedures for inspection, calibration, and performance testing are outlined in this section.

SECTION FIVE -- Maintenance

This section presents step-by-step procedures for maintenance and troubleshooting.

SECTION SIX -- Parts Lists

This section provides complete lists of all parts and their sources.

SECTION SEVEN -- Diagrams

This section provides schematic diagrams, descriptions, and parts placement diagrams for all circuits.

SECTION EIGHT -- Options

This section describes options available for the Series 600.

SECTION NINE -- Special Configurations

This section describes special modifications, if any, that are applicable to this instrument.

SECTION TEN -- Manual Changes

This section contains errata information, and notations of any changes made to the instrument since the printing of the manual.

INTRODUCTION

Purpose and Function

The purpose and function of Series 600 instruments is to synthesize a range of microwave frequencies at a variety of power levels and in a variety of modulation modes.

Capabilities

The Series 600 Synthesized Microwave Signal Generator is capable of generating output signals in one of three frequency ranges, depending on instrument configuration (2-8, 5.4-12.5 or 10-18 GHz) with output power levels from +10 to -119 dBm; the RF output can be internally or externally modulated in AM, FM and pulse modulation modes.

Performance Characteristics

The Series 600 generates its output signals under manual control, or under remote computer control via the IEEE-488 General Purpose Interface Bus. Complete performance specifications are given in Section 2 of this manual.

Weight and Dimensions

The Series 600 has a weight of 40 lbs (nominal); the dimensions are 5.25 inches (height) by 16.75 inches (width) by 18 inches (depth).

Power Requirements

100/120/220/240 VAC ± 10%, 50-400 Hz, 200 W max.

Environmental Requirements

The Series 600 is type tested to MIL-T-28800C, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications, except as follows:

Non-operating temperature range is -40°C to +70°C.
Relative humidity is limited to 95% noncondensating.
Altitude and EMI requirements are not specified.
Warm-up time is 20 minutes.

Items Furnished

In addition to options and/or accessories specifically ordered, items furnished with the instrument are:

1 ea. - Operation and Maintenance Manual, Part No. 304AM04500
1 ea. - 6 ft. power cord
2 ea. - PC Extender Board
1 ea. - PC Card Extractor
1 set. - Test Data

Items Required

An IEEE-488 interface cable is needed for remote control operation. Appropriate RF output cabling (made to fit the female type N output connector) can be ordered in the form of Accessory A001 (Cable Kit).

Tools and Test Equipment

No special tools are required to operate the Series 600; signal sources used for external modulation should meet the parameters set out in Section 2 of this manual. Test equipment required for calibration or performance verification is described in Section 4.

Storage

Storage of the instrument should be limited to an environment that does not exceed the temperature range of -40°C to +70°C.

Cooling

A cooling fan is installed in the instrument. The cooling air intake and exhaust are both located on the instrument's rear panel. Care must be taken to avoid obstructing the flow of air into and out of the instrument.

Cleaning

The air inlet screen should be cleaned whenever a significant amount of dirt or dust has accumulated. Whenever the instrument covers are removed, the interior should be blown out with low velocity dry air.

Installation and Preparation for Use

The instrument is shipped in an operational condition and no special installation procedures are required. A warm-up time of 20 minutes is recommended.

Receiving Inspection

When the instrument is received, check the carton for evidence of damage. If damage is found, notify the carrier immediately, and open the carton only in the carrier's presence.

Use care in removing the instrument from the carton and check immediately for evidence of shipping damage: loose or broken control knobs, bent or broken connectors, dents or scratches on the panels, etc.

Each Giga-troncs instrument must pass rigorous inspections and tests prior to shipment. Upon receipt, it should immediately be subjected to a performance check to insure that its operation has not been impaired during shipment. The performance verification procedure is described in Section 4 of this manual.

Preparation for Reshipment

To protect the instrument during reshipment, use the best packaging materials available. If possible, re-use the original shipping container. If this is not possible, a strong carton (350 lbs/in^2 bursting strength) or a wooden box should be used.

Wrap the instrument in heavy paper or plastic before placing it in the shipping container. Completely fill the areas on all sides of the instrument with packaging material, taking extra precautions to protect the front and rear panels.

Seal the package with strong tape or metal bands. Mark the outside of the package "FRAGILE -- DELICATE INSTRUMENT".

If corresponding with the factory or local Giga-tronics sales office regarding reshipment, please reference the full model number and serial number. If the instrument is being reshipped for repair, be sure to enclose all available pertinent data regarding the problem that has been found.

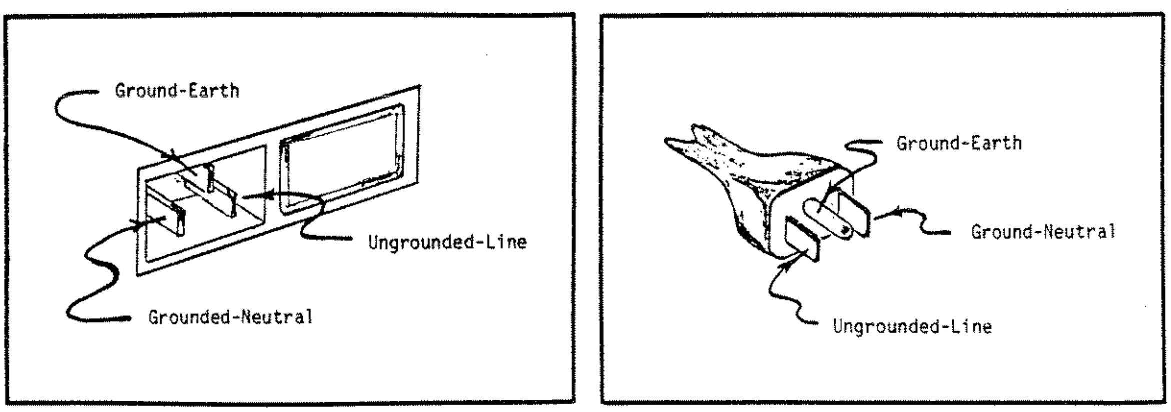


Figure 0.1: Power Line Connection

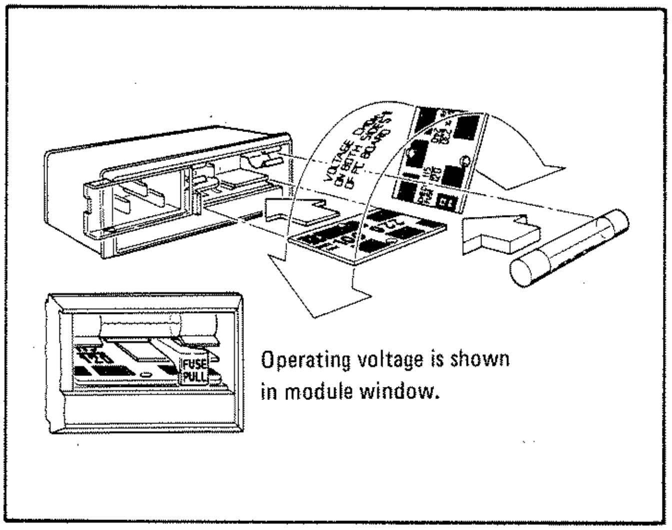


Figure 0.2: Voltage Selector/Fuse Holder

Safety Precautions

C A U T I O N

The instrument can be damaged if operated with the line voltage selector set inappropriately for the applied line voltage. Before operating the instrument, make sure that the instrument power requirements are compatible with the power source to be used. The instrument has been designed for international use over a broad range of voltages: 100, 120, 220, or 240, $\pm$ 10%, at 50-400 Hz. The Series 600 uses an internationally approved connector that includes voltage selection, fuse, and filter for RFI protection.

W A R N I N G

The instrument has a 3-wire power cord with a 3-terminal polarized plug for connection to the power source and safety-ground. The ground or safety ground is connected directly to the chassis; therefore, if a 3-to-2 wire adapter is used, be sure to connect the ground lead from the adapter to earth ground. Failure to do this could cause the instrument to float above earth ground, posing a shock hazard.

Voltage Selection

To select the correct operating line voltage, proceed as follows:

Open the cover door and rotate the fuse-pull to the left; remove fuse.

Select the operating voltage by orienting the PC board in order to position the desired voltage label on the top left side. Push the board firmly into the module slot.

Rotate the fuse-pull back into the normal position and reinsert the fuse into the holder, using care to select the correct fuse value.

Fuse Selection

When the instrument is shipped from the factory, it is set for a particular power line voltage (normally 120V for domestic shipping destinations). The power line fuse for this setting is a 2.0A 3AG Slo-Blo. If the instrument is set to operate on a 240V power line, the fuse must be changed to a 1.0A 3AG Slo-Blo.

OPERATING INFORMATION

1.0 THE FRONT PANEL

The instrument's major controls and connections are located on the front panel and are illustrated in Figure 1.1; the various functional sections of the front panel are described below.

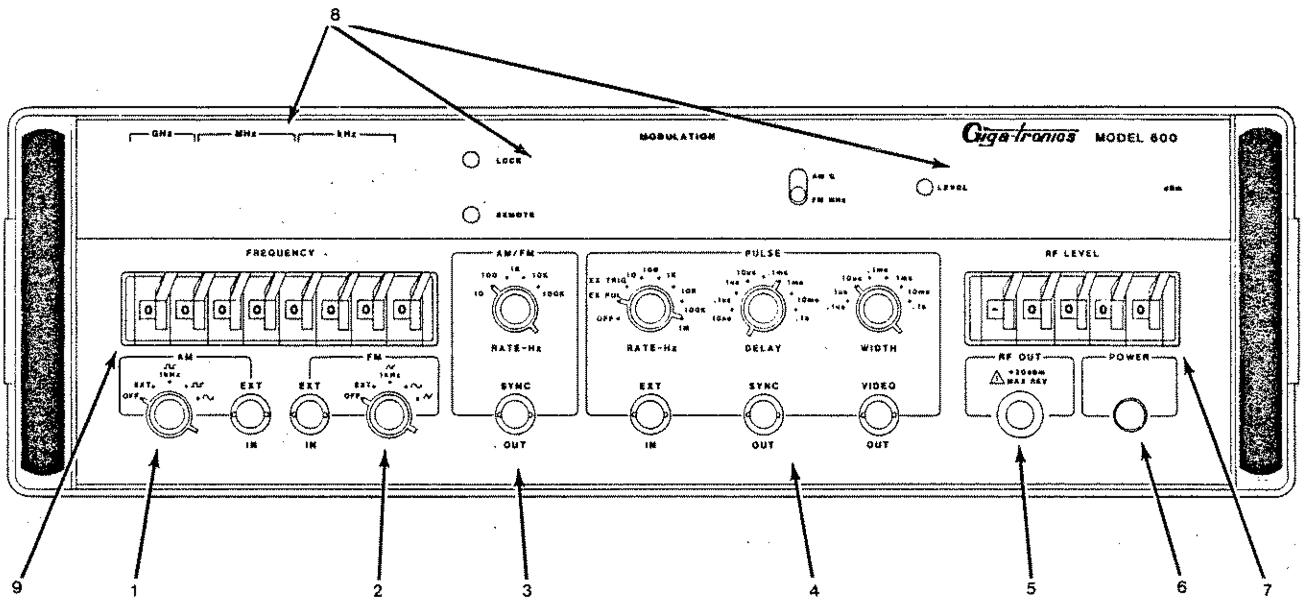


Figure 1.1: Series 600 Front Panel

1. Amplitude Modulation
2. Frequency Modulation
3. AM/FM Rate
4. Pulse Modulation
5. RF Output
6. Line Power
7. RF Level Setting
8. Displays
9. Frequency Setting

Amplitude Modulation

MODULATION MODE (5-position switch/knob) -- This control is used to select any of four AM modes and to vary modulation depth.

'OFF' -- Turns amplitude modulation off.

'EXT' -- Selects external AM.

'1 kHz' -- Selects internal AM with a fixed 1 kHz square modulation waveform.

'⎍⎍' -- Selects internal AM with a variable-rate square modulation waveform.

'∿' -- Selects internal AM with a variable-rate sinusoidal modulation waveform.

KNOB -- Used to vary the depth of modulation; the percentage may be read on the modulation display.

EXT IN (BNC connector) -- Accepts an external modulation signal for use in amplitude modulation.

Frequency Modulation

MODULATION MODE (5-position switch/knob) -- This control is used to select any of four FM modes and to vary deviation.

'OFF' -- Turns frequency modulation off.

'EXT' -- Selects external FM.

'1 kHz' -- Selects internal FM with a fixed 1 kHz triangular modulation waveform.

'∿' -- Selects internal FM with a variable-rate sinusoidal modulation waveform.

'/\/' -- Selects internal FM with a variable-rate triangular modulation waveform.

KNOB -- Used to vary the deviation; the amount of deviation in MHz may be read on the modulation display.

EXT IN (BNC connector) -- Accepts an external modulation signal for use in frequency modulation.

AM/FM

RATE (4-position switch/vernier) -- This control is used to select the modulation rate for internal AM or internal FM. Each of the four positions covers a range of one decade, with the vernier used to vary the frequency within each range; the full range is 10 Hz to 100 kHz.

SYNC OUT (BNC connector) -- Provides a TTL-level square wave at the frequency selected by the AM/FM rate control, for use in synchronizing auxiliary devices to the internal AM or internal FM modulation waveform.

Pulse Modulation

RATE (8-position switch/vernier) -- This control is used to select the pulse modulation mode, as well as to select the modulation rate for internal pulse modulation.

'OFF' -- Turns pulse modulation off.

'EX PUL' -- Selects the external pulse mode, in which the modulation waveform follows an external modulation input.

'EX TRIG' -- Selects the external trigger mode, in which the rising edges of the modulation waveform are triggered by the rising edges of an external modulation input; delay and width are independently adjustable.

'10-1M' -- These five switch positions are used to select the rate of internal modulation; each position covers a range of one decade, with the vernier used to vary the rate within each range. The full range is 10 Hz to 1 MHz. When the switch is in any of these five positions, the internal pulse modulation mode is selected. Delay and width are independently adjustable.

EXT IN (BNC connector) -- Accepts a TTL-level modulation input signal for use in external pulse and external trigger modes.

DELAY (7-position switch/vernier) -- This control is used, in the internal pulse mode and in the external trigger mode, to vary the delay between the internal or external trigger, available at the SYNC output, and the modulation waveform, available at the VIDEO output. (During operation in the external pulse mode, the internal delay generator is disabled.) Each of the seven positions covers a range of one decade, with the vernier used to vary the delay within each range. The full range is 10 nanoseconds to 100 milliseconds.

SYNC OUT (BNC connector) -- Provides TTL-level high pulses coincident with the rising edges of the internally generated or externally applied modulation waveform. The pulses have a fixed width of approximately 50 nanoseconds and are intended for use in synchronizing auxiliary devices. This output does not reflect pulse delay, and is disabled during operation in the external pulse mode.

WIDTH (6-position switch/vernier) -- This control is used to vary the width of the modulation pulses. Each position covers a range of one decade, with the vernier used to vary the rate within each range. The full range is 50 nanoseconds to 100 milliseconds. During operation in the external pulse mode, the internal pulse-width generator is disabled.

VIDEO OUT (BNC connector) -- Provides a TTL-level waveform which follows the pulse modulation waveform. This output reflects pulse delay and is intended for use in synchronizing auxiliary devices.

RF Output

RF OUT (type N connector) -- Provides the RF output over the entire frequency range of the instrument.

Line Power

POWER (pushbutton) -- Used to switch the instrument's power supply on and off; when the button is in the "off" position the transformer primary is disconnected from the AC source.

RF Level Setting

RF LEVEL (leverwheel switches) -- These switches are used to set the RF output level over a range of -110 to +10 dBm in increments of 0.1 dB. The level selection may be read on the RF level display.

Displays

RF LEVEL READOUT (fluorescent display) -- This 5-digit display is used to indicate the RF output level selected.

LEVEL (LED) -- This indicator lights when the instrument is leveled.

MODULATION READOUT (fluorescent display) -- This 4-digit display is used to indicate modulation depth in percent (AM mode) and to indicate deviation in MHz (FM mode).

AM/FM (switch) -- This lever switch is used to select the modulation display mode (AM depth or FM deviation).

LOCK (LED) -- This indicator lights when the RF output is phase-locked to the internal or external master reference.

REMOTE (LED) -- This indicator lights when the instrument is under remote control, via the IEEE-488 interface.

FREQUENCY READOUT (fluorescent display) -- This 8-digit display is used to indicate the selected RF output frequency.

Frequency Setting

FREQUENCY (leverwheel switches) -- These switches are used to select the frequency of the RF output in increments of 1kHz.

1.1 THE REAR PANEL

The rear panel houses input and output connectors used to interface the instrument with other devices. The different functional sections are illustrated in Figure 1.2 and described below.

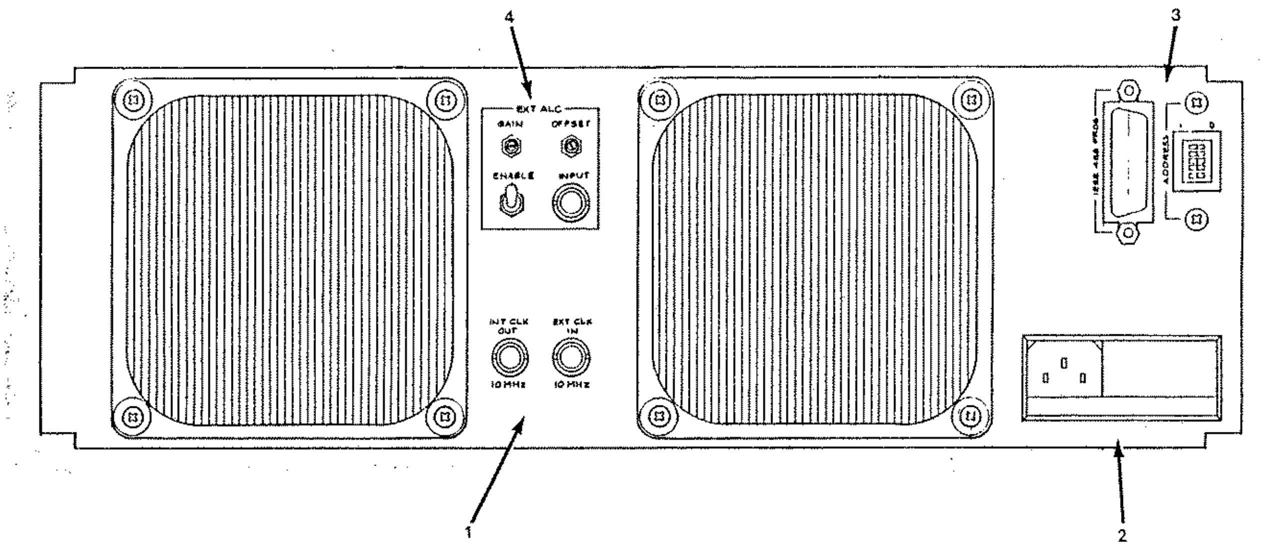


Figure 1.2: Series 600 Rear Panel

1. Master Reference Section
2. Line Power & Fuse Section
3. Interface Section
4. External ALC Section

Master Reference Section

INT CLK OUT, 10 MHz (BNC connector) -- Provides a sample of the 10 MHz internal reference frequency, at 2 Vpp into 50 ohms.

EXT CLK IN, 10 MHz (BNC connector) -- Accepts an external 10 MHz reference input at 1 Vpp, which is automatically substituted for the internal reference frequency.

Line Power and Fuse Section

POWER INPUT (AC plug) -- A 3-terminal polarized connector with the safety ground wired to the chassis.

LINE SELECTION (PC board) -- This card can be oriented four ways to select four different line voltages: 100, 120, 220 and 240 volts.

FUSE HOLDER -- This socket retains the power fuse, which should be a 2.5A 3AG Slo-Blo for 100/120 volt operation, or a 1.25A 3AG Slo-Blo for 220/240 volt operation.

Interface Section

REMOTE (24-pin connector) -- Provides an interface connection between the instrument and other equipment, in accordance with the GPIB IEEE-488-1978 format.

ADDRESS (5-place DIP switch) -- Used to set the GPIB address of the instrument in the form of a 5-bit binary number.

External ALC Section

ENABLE (switch) -- When this switch is in the enable position, the leveling system is programmed to ignore the instrument's internal detector and use instead an external detector input.

INPUT (BNC connector) -- Accepts an input signal from an external detector.

GAIN (potentiometer) -- This screwdriver adjustment is used to calibrate the instrument's leveling system to match the slope of an external detector's transfer curve.

OFFSET (potentiometer) -- This screwdriver adjustment is used to calibrate the instrument's leveling system to match the intercept point of an external detector's transfer curve.

1.2 Front Panel Operation

The following part of section one provides step by step operating procedures for common functional setups.

The basic function of series 600 instruments is to synthesize microwave signals within a given frequency range. Controls are provided to allow selection of frequency, output level, and modulation mode.

ERROR MESSAGES

The instrument's computer system uses the frequency readout to display error messages when certain controls have been incorrectly set. The following table defines the errors:

Error 1 -- Frequency requested is out of range.

Error 2 -- Level requested is out of range.

Error 3 -- IEEE address switches on rear panel have been set to an invalid address of 31 (all ones).

Error 10 -- Illegal input command (remote operation).

Error 11 -- Illegal input number (remote operation).

Setting Output Frequency and Level (No Modulation)

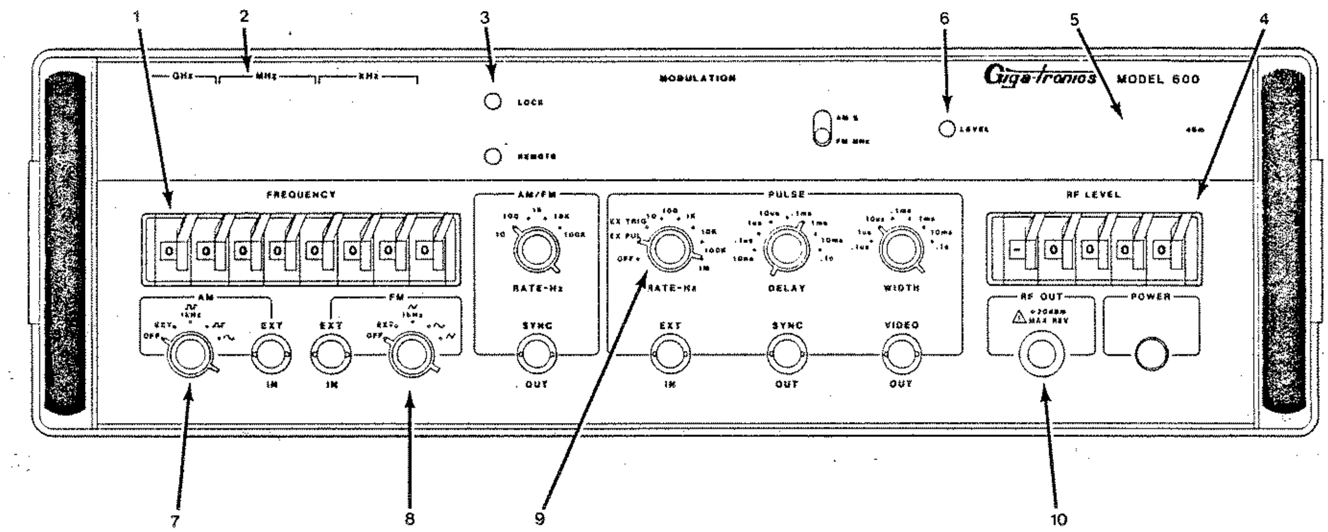


Figure 1.3: Frequency and level settings.

1. Select frequency (leverwheel switches)
2. Read selected frequency on display
3. Verify 'LOCK' indicator is lit
4. Select RF level (leverwheel switches)
5. Read selected level on display
6. Verify 'LEVEL' indicator is lit
7. AM off
8. FM off
9. PM off
10. RF output is available at 'RF OUT' connector

Amplitude-Modulating the RF Output: External AM

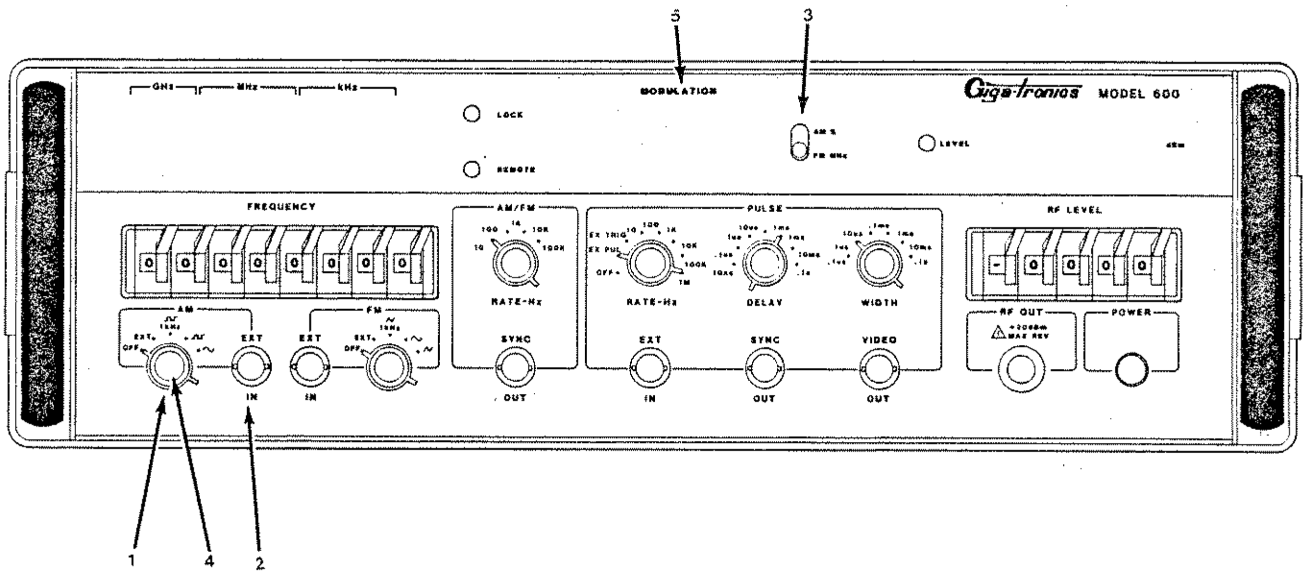


Figure 1.4: External AM

1. Select 'EXT'

2. Apply external modulation signal at 'EXT IN' connector

3. Select 'AM%' (modulation display mode)

4. Adjust modulation depth

5. Modulation depth is displayed on modulation readout

NOTE: If desired, operation in the AM mode can be simultaneous with operation in the other modulation modes.

Amplitude-Modulating the Output: Internal AM

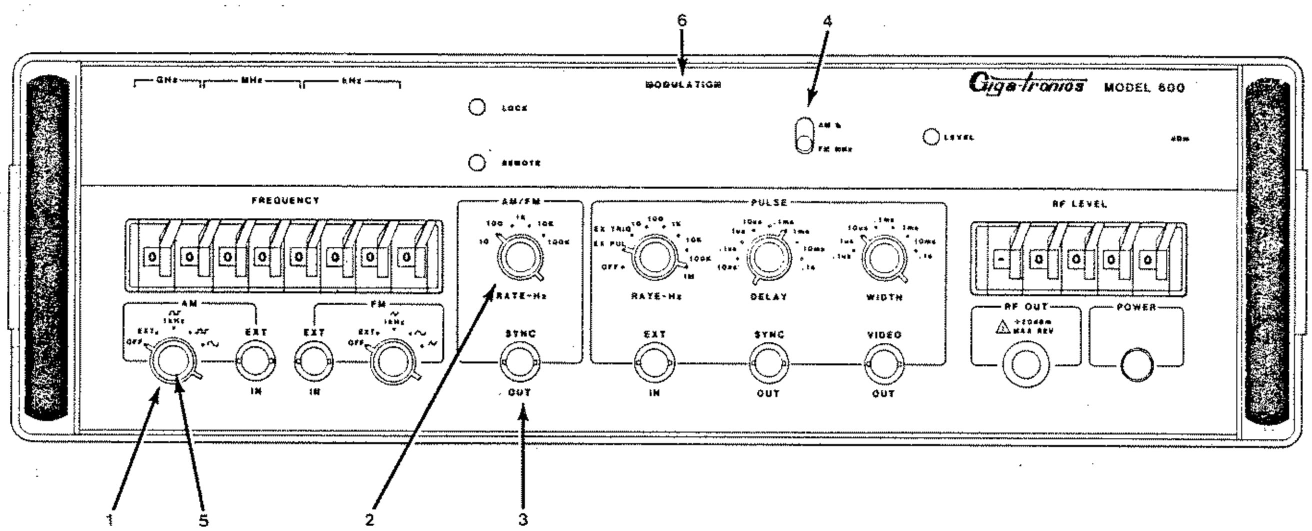


Figure 1.5: Internal AM

1. Select internal AM mode: fixed 1 kHz square, variable square, or variable sine

2. Select rate (variable-rate modes only)

3. Modulation sync-signal is available at 'SYNC OUT' connector

4. Select "AM%"

5. Adjust modulation depth

6. Modulation depth is displayed on modulation readout

NOTE: If desired, operation in the AM mode can be simultaneous with operation in the other modulation modes.

Frequency-Modulating the Output: External FM

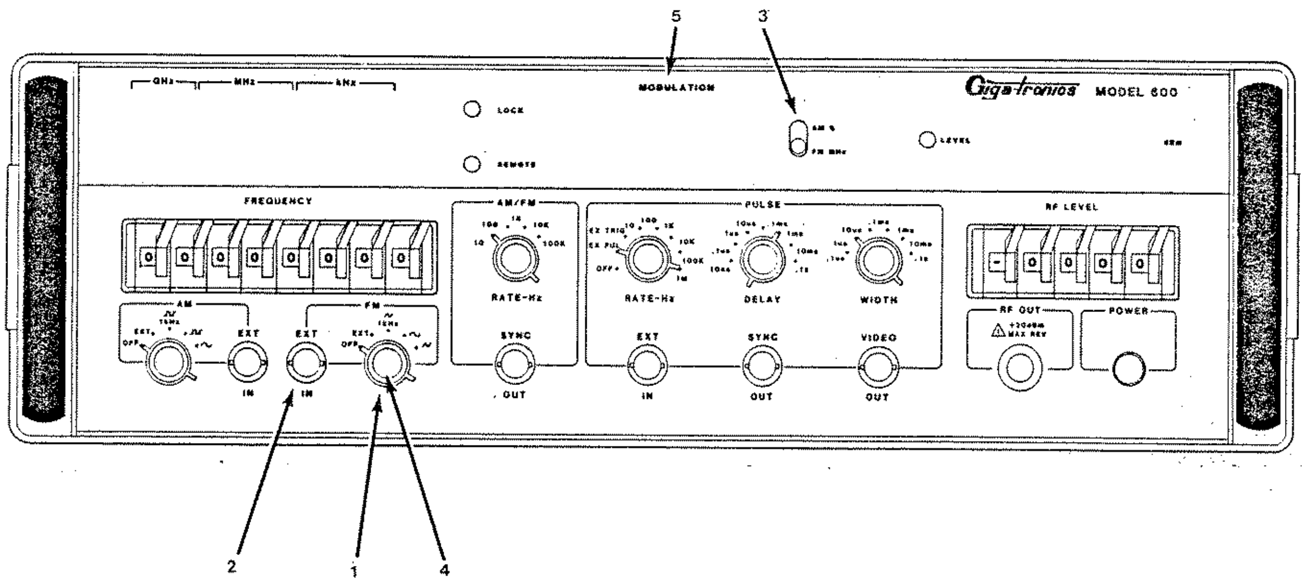


Figure 1.6: External FM

1. Select 'EXT'

2. Apply external modulation signal at 'EXT IN' connector

3. Select 'FM MHz' (modulation display mode)

4. Adjust deviation

5. Deviation is displayed on modulation readout

NOTE: If desired, operation in the FM mode can be simultanteous with operation in the other modulation modes.

Frequency-Modulating the Output: Internal FM

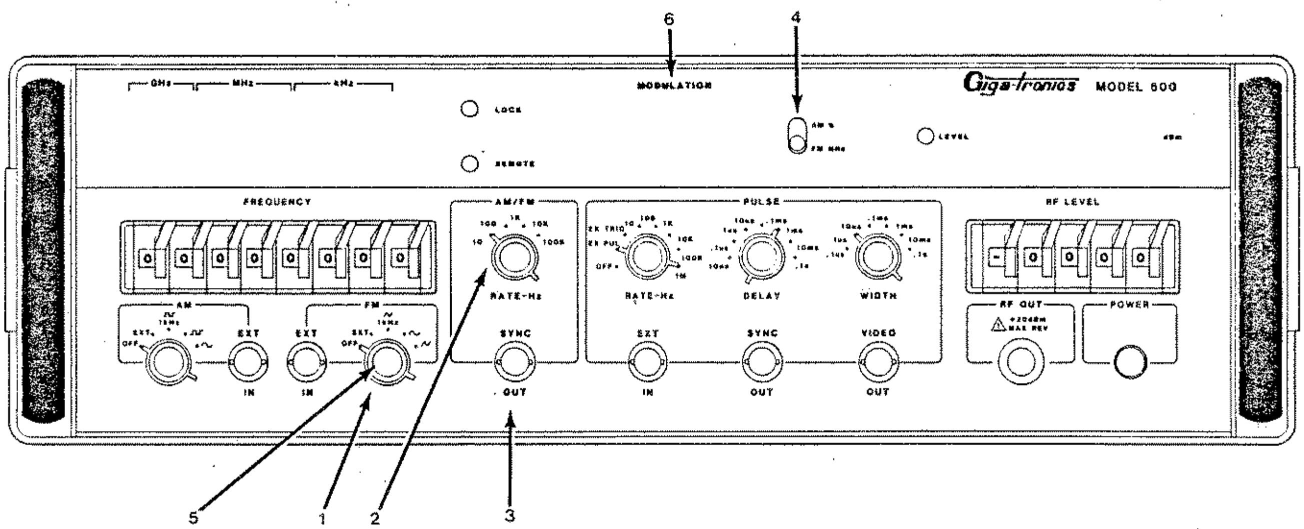


Figure 1.7: Internal FM

1. Select internal FM mode: fixed 1 kHz triangle, variable sine, or variable triangle

2. Select rate (variable-rate modes only)

3. Modulation sync-signal is available at 'SYNC OUT' connector

4. Select 'FM MHz'

5. Adjust deviation

6. Deviation is displayed on modulation readout

NOTE: If desired, operation in the FM mode can be simultaneous with operation in the other modulation modes.

Pulse-Modulating the Output: External Pulse Mode

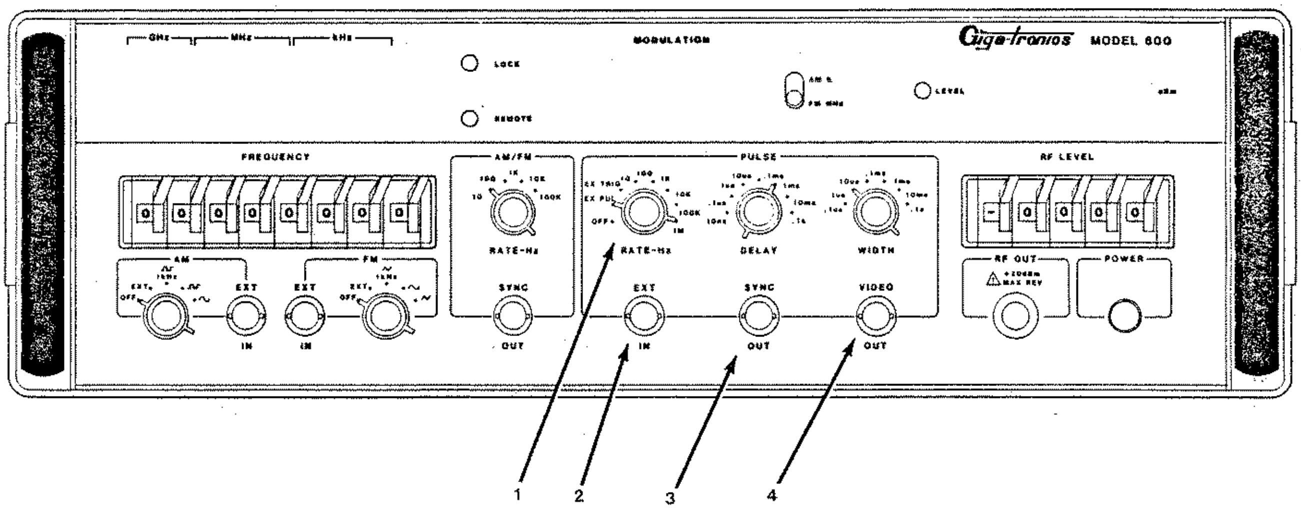


Figure 1.8: External pulse mode

1. Select 'EX PUL'

2. Apply external modulation signal at 'EXT IN' connector

3. Modulation sync pulses are available at 'SYNC OUT' connector

4. Modulation waveform is available at 'VIDEO OUT' connector

NOTE: If desired, operation in pulse modulation mode can be simultaneous with operation in the other modulation modes.

Pulse-Modulating the Output: External Trigger Mode

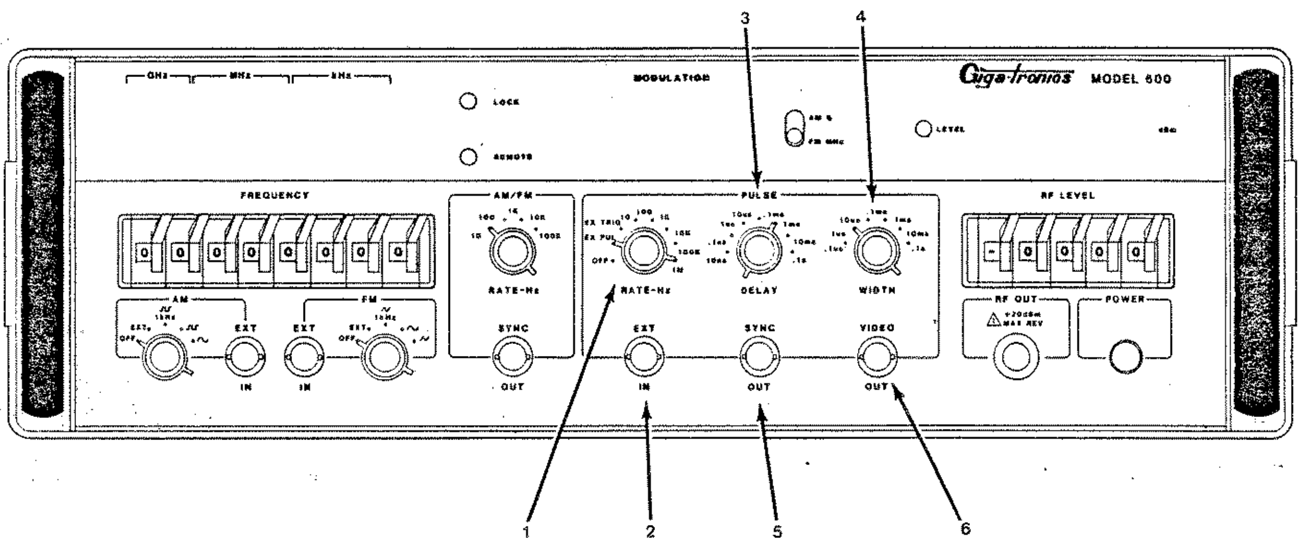


Figure 1.9: External trigger mode

1. Select 'EX TRIG'

2. Apply external modulation waveform at 'EXT IN' connector

3. Adjust pulse delay

4. Adjust pulse width

5. Modulation sync pulses are available at 'SYNC OUT' connector

6. Modulation waveform is available at 'VIDEO OUT' connector

NOTE: If desired, operation in pulse mode can be simultaneous with operation in the other modulation modes.

Pulse-Modulating the Output: Internal Pulse Mode

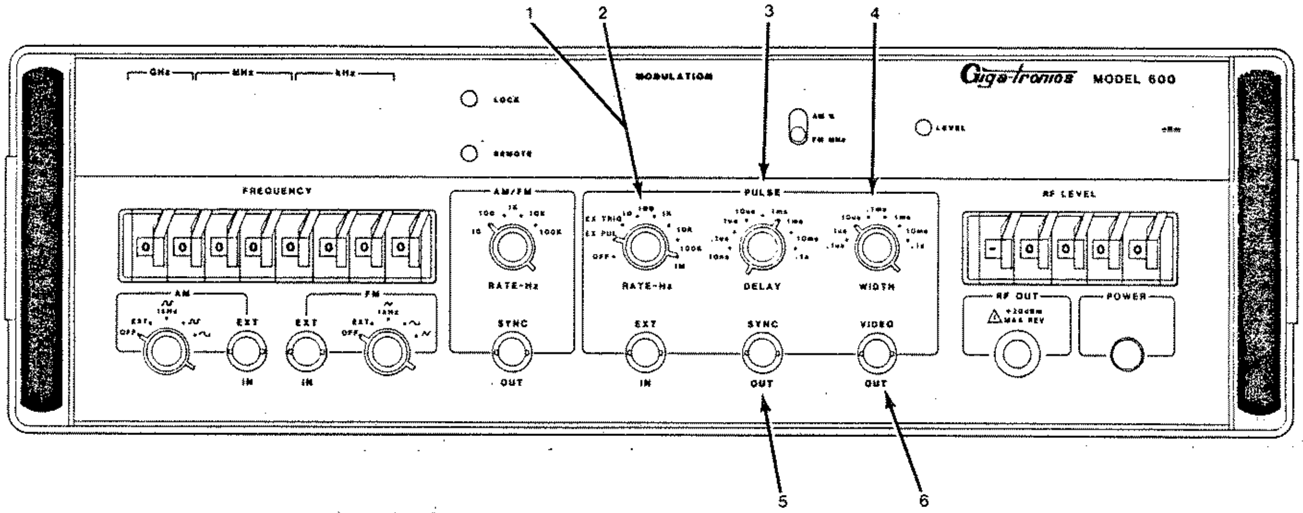


Figure 1.10: Internal pulse mode

1. Select internal pulse mode (place the 'RATE' switch in any of the five internal pulse rate positions)

2. Adjust pulse rate

3. Adjust pulse delay

4. Adjust pulse width

5. Modulation sync pulses are available at the 'SYNC OUT' connector

6. Modulation waveform is available at the 'VIDEO OUT' connector

NOTE: If desired, operation in pulse mode can be simultaneous with operation in the other modulation modes.

1.3 Rear Panel Operation

The following part of section one provides step by step operating procedures for functions implemented on the rear panel.

External ALC

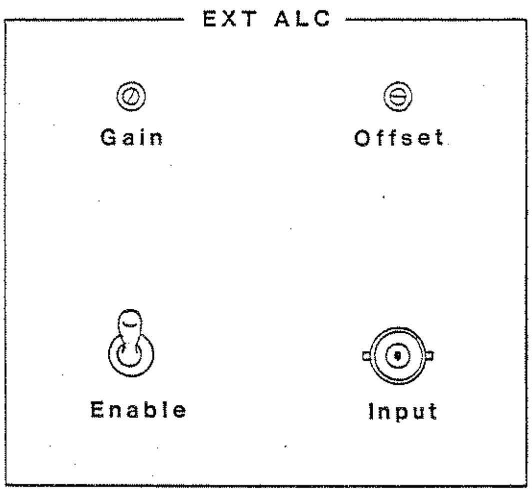


Figure 1.11: External ALC

The external ALC function provides remote leveling capability. The circuit is designed to operate with a directional coupler/diode detector having a standard negative output. Gain and offset adjustments permit calibration of the instrument to match individual detectors. Note that losses in the cable between the instrument RF output and the remote detector will place a limit on both maximum output and leveling range.

1. Connect the remote cable and detector to the instrument output. Connect the coupler/detector output to the rear panel 'EXT ALC' input.

2. Connect a power meter to the detector output and set the 'EXT ALC' switch to the 'ENABLE' position.

3. With the instrument's RF level set to +4 dBm, adjust the rear panel 'GAIN' for a power meter reading of +4 dBm.

4. Set the RF level to -4 dBm and adjust 'OFFSET' for a power meter reading of -4 dBm.

5. Repeat steps 3 and 4 as needed.

External Master Reference

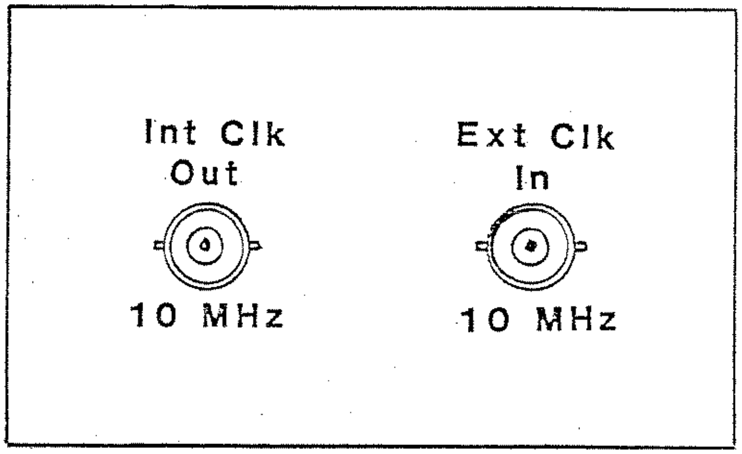


Figure 1.12 External master reference

The clock output provides a buffered 10 MHz signal derived from either the internal master reference or any external signal applied. This output will drive a 50 ohm load to >1 Vpp.

The clock input accepts an external 10 MHz standard with an amplitude between .5 and 5 Vpp. The accuracy of the standard must be within 1 part per million to insure that the instrument will lock to it. The instrument will automatically switch to the external reference when a signal is present.

1.4 External Programming (IEEE-488 Interface)

The Series 600 permits data bus control in accordance with the IEEE Standard Digital Interface for Programmable Instruments IEEE-STD 488-1978.

The following subsets of the standard are implemented:

SH1	Source Handshake	Complete Capability
AH1	Acceptor Handshake	Complete Capability
T8	Talker	Basic Talker, No Serial Poll No Talk Only, Unaddress if MLA
TE0	Extender Talker	No Capability
L4	Listener	Basic Listener, No Listen Only, Unaddressed if MTA
LE0	Extended Listener	No Capability
SR0	Service Request	No Capability
RL2	Remote/Local	No Local Lockout
PP0	Parallel Poll	No Capability
DC0	Device Clear	No Capability
DT0	Device Trigger	No Capability
C0	Controller	No Capability

1.4.1 IEEE-488 Hardware Configuration

INTERFACE CONNECTOR

The following table indicates the pin assignments for the rear panel 24 pin IEEE-488 interface connector.

Contact	Signal Line
1	D101
2	D102
3	D103
4	D104
5	E01
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	Shield
13	D105
14	D106
15	D107
16	D108
17	REN
18	GND (6)
19	GND (7)
20	GND (8)
21	GND (9)
22	GND (10)
23	GND (11)
24	GND Logic

The contact assignments are those required by the IEEE-488 standard. Thus, most users need only connect a standard interface cable between their controller and the 600 interface connector.

ADDRESS ASSIGNMENT

The remote control address is assigned by the five small switches next to the interface connector. Switch 1 is the LSB; and switch 5 is the MSB. Thus, to assign the 600 an address of 6 (listen address '&' and talk address 'F'), the switches would be set as follows:

Switch number	1	2	3	4	5
Switch setting	0	1	1	0	0

SYNTAX CONFIGURATION

The standard remote control syntax (as described in this manual) is enabled by setting S7 on the CPU PC board (A4) to the on (up) position. S7's off position is reserved for enabling a special syntax which might be required in unusual applications. The instrument is normally shipped from the factory with S7 set to the on position.

1.4.2 General Command Structure

CHARACTER REPRESENTATION

In this manual, the ASCII characters sent in a message will be represented in single quotes.

e.g.: 'MESSAGE' corresponds to a string of seven bytes whose hexadecimal values are $4D, $45, $53, $53, $41, $47, $45.

Special characters will be represented as follows:

'<CR>'	Carriage return, $0D
'<LF>'	Line Feed, $0A
'b'	One or more spaces $20
'z'	Zero or more spaces
's'	One space
'd'	Decimal digit

COMMAND INTERPRETATION

The 600 uses a 40 character buffer to accept and store characters sent to it via the interface. Multiple sequential spaces are compressed to a single space character for storage in the buffer. The buffer's contents are interpreted and the buffer is reset upon receipt of a character sent with the EOI line asserted or upon receipt of any of the following delimiter characters:

'<CR>' '<LF>' ',' ':' ';' '/' '\'

Multiple commands may be sent in a single message if they are separated from each other by a space or one of the above delimiter characters. If the commands are separated by spaces, they will not be interpreted until the entire message has been sent. (Note that if spaces are used to separate commands, care must be taken to assure that the 40 character buffer does not overflow: buffer overflow may cause some commands to be ignored.) If the commands are separated by delimiters, each command will be interpreted individually upon receipt. Unless the delimiter used is a carriage return, a potential problem exists when entering multiple commands separated by delimiters: if one of the commands is entered erroneously, it will be ignored and the correct commands accepted after only a momentary error display. The error message may not be displayed long enough to be read.

COMMAND FORMAT

Each command consists of a verb, followed by zero or more spaces, followed by an argument.

e.g.: 'AMzSINE' AM is the verb and SINE is the argument

'FAz12.3E+3 FA is the verb and 12.3E+3 is the argument

NUMERIC ARGUMENTS

Frequency and level setting commands use numeric arguments (represented in command descriptions as 'n'). The format for numeric arguments (described below) is sufficiently flexible that no special formating will be necessary when using most IEEE-488 controllers. Signed or unsigned numbers are acceptable. Integers or decimal fractions are permitted and may be followed by a signed or unsigned one or two digit exponent. Leading zeroes are permitted, but spaces within a number are not permitted. The integer and optional fractional part are each restricted to a maximum length of 10 digits.

The following are examples of valid numeric arguments:

'b25.7' / '-32.1' / '0.3' / '2958.763E-2'

'6E-10' / '-000.000000001E+10' / 'b7b' / '1E6'

1.4.3 Command Descriptions

Each subsection describes a verb and its valid arguments. Most commands perform functions in a way that is similar to the 600's front panel controls, except where noted.

'AM' (set amplitude modulation mode)

'AMzOFF': amplitude modulation off
'AMzEXT': external AM
'AMzFIXED': internal AM, fixed 1 kHz square wave
'AMzSQR': internal AM, variable-rate square wave
'AMzSINE': internal AM, variable-rate sine wave

'FM' (set frequency modulation mode)

'FMzOFF': frequency modulation off
'FMzEXT': external FM
'FMzFIXED': internal FM, fixed 1 kHz triangle wave
'FMzSINE': internal FM, variable-rate sine wave
'FMzTRI': internal FM, variable-rate triangle wave

'PULSE' (set pulse modulation mode)

'PULSEzOFF': pulse modulation off
'PULSEzEXT': external pulse mode
'PULSEzTRIG': external trigger mode
'PULSEzINTzA': internal pulse mode, 10-100 Hz range
'PULSEzINTzB': internal pulse mode, 100 Hz-1 kHz range
'PULSEzINTzC': internal pulse mode, 1-10 kHz range
'PULSEzINTzD': internal pulse mode, 10-100 kHz range
'PULSEzINTzE': internal pulse mode, 100 kHz-1 MHz range

NOTE: If the range suffix is omitted from the 'PULSEzINT' command, the instrument defaults to the 'B' range (100 Hz to 1 kHz).

'DELAY' (set pulse delay--not applicable to external pulse mode)

'DELAYzA': 10-100 nanosecond range
'DELAYzB': 100 nanosecond-1 microsecond range
'DELAYzC': 1-10 microsecond range
'DELAYzD': 10-100 microsecond range
'DELAYzE': 100 microsecond-1 millisecond range
'DELAYzF': 1-10 millisecond range
'DELAYzG': 10-100 millisecond range

'WIDTH' (set pulse width--not applicable to external pulse mode)

'WIDTHzA': 100 nanosecond-1 microsecond range
'WIDTHzB': 1 microsecond-10 microsecond range
'WIDTHzC': 10 microsecond-100 microsecond range
'WIDTHzD': 100 microsecond-1 millisecond range
'WIDTHzE': 1 millisecond-10 millisecond range
'WIDTHzF': 10 millisecond-100 millisecond range

'PANEL' (enable front panel modulation vernier)

'PANELzAM': front panel AM rate vernier activated
'PANELzFM': front panel FM rate vernier activated
'PANELzRATE': front panel pulse rate vernier activated
'PANELzDELAY': front panel pulse delay vernier activated
'PANELzWIDTH': front panel pulse width vernier activated

'PRESET' (substitute preset pot for front panel modulation vernier)

'PRESETzAM': preset AM rate pot activated
'PRESETzFM': preset FM rate pot activated
'PRESETzRATE': preset pulse rate pot activated
'PRESETzDELAY': preset pulse delay pot activated
'PRESETzWIDTH': preset pulse width pot activated

'EXTALC' (enable/disable external ALC)

'EXTALCzON': Enables
'EXTALCzOFF': Disables

'DISPLAY' (enable/disable front panel fluorescent displays)

'DISPLAYzON': Enables
'DISPLAYzOFF': Disables

(NOTE: in the disabled mode, brackets at the left and right digits of the displays serve as a standby indication)

1.4.4 Set Frequency Command

This command requires a numeric argument, specifying the frequency in MHz. For instruments with Option 03 (1 kHz Resolution), up to three digits may be given to the right of the decimal, permitting the frequency to be specified to the nearest 1 kHz (e.g., 'n' = 4499.325 specifies 4.499325 GHz). Digits exceeding the frequency resolution of the instrument are ignored.

'FAzn' (set frequency to 'n')

1.4.5 Set Level Command

The set level command requires a numeric argument, specifiying a level in dBm with .1 dB resolution. Digits specifying a finer resolution are rounded to the nearest .1 dB.

The 'LEVEL' command causes appropriate values for the step attenuator and leveling loop programming to be computed from the argument. The computation causes the step attenuator to switch at argument values which are evenly divisible by 10 (e.g., between '-29.9' and '-30.0).

'LEVELzn' (set output level to 'n')

The argument specifies the output level in dBm. Valid argument ranges are:

$-119.9 \leq$ 'n' $\leq +15.0$

LEVELING LOOP RANGE LIMITATIONS

The leveling loop range is limited by the maximum output power which the instrument can produce. At very low levels, the on/off ratio of the instrument's PIN attenuators may also limit the loop's range. When the loop's dynamic range is exceeded, the front panel level light will go out.

'ERRORs2' will be issued upon receipt of invalid level command arguments. Leveling loop accuracy is reduced at very low levels (below about -11 dB).

1.4.6 Self-Test Command

This command causes the 600 to perform a lock/level test across its frequency range, in increments specified by a numeric argument. The frequency increment 'n' is in MHz. For instruments with Option 03 (1 kHz Resolution), up to three digits may be given to the right of the decimal, allowing the increment to be specified to the nearest 1 kHz. Digits exceeding the frequency resolution of the instrument are ignored.

'TESTzn' (perform self-test in steps of 'n' MHz)

1.4.7 Reply Messages

A reply message will be sent over the interface by the 600 whenever it is addressed to talk. If unaddressed in the middle of a message, any remaining characters are cleared from the output buffer. EOI is asserted during the last character ('<LF>') of each message. The type of message sent is determined by the 'SEND' commands described in the following subsections. If an error condition exists, a 'SENDzERROR' type message will be sent instead of the message type requested except for 'SENDzNUL' which always returns a nul line (<CR><LF>').

'SENDzNUL' Nul line.

Message will be a nul line ('<CR><LF>') even if an error condition is present.

'SENDzFREQ' Frequency message.

The value sent always represents frequency in MHz.

'SENDzPOWER' Power message.

The value sent represents power in dB or dBm, as appropriate, and is always signed as an integer in the following form: P INT ± xxx.x. If no valid power reading is available, the message is sent with 'n' = '-----'.

'SENDzSTATUS' Status message.

The message sent is:
'sLOCKsdsLEVELsdsCALsd<CR><LF>'
where each 'd' is either '1' or '0' to represent true or false.
'LOCK' and 'LEVEL' are true when their corresponding front panel lights are on.
'CAL' is always 0.

'SENDzERROR' Error message.

The message sent is <CR><LF> if no error exists. When an error condition does exist, the mesage sent is 'sERRORsdd', where 'dd' is the error code displayed on the front panel.

STATUS MESSAGE

The message normally sent is:
'sLOCKsdsLEVELsds<CR><LF>'
where each 'd' is either '1' or '0' to represent true or false. 'LOCK' and 'LEVEL' are true when their corresponding front panel lights are on.

ERROR MESSAGE

When an error condition exists, the message sent is 'sERRORsdd' where 'dd' is the error code displayed on the front panel. Individual error messages are as follows:

ERROR 1 -- requested frequency out of range
ERROR 2 -- requested level out of range
ERROR 3 -- generator set to illegal bus adress (all switches on)
ERROR 10 -- illegal input word (remote)
ERROR 11 -- illegal input number (remote)

1.4.8 Interface Initialization Values

The IEEE-488 interface is initialized upon assertion of IFC by the controller, upon instrument power up (CPU reset), and whenever the rear panel address switch settings are changed. The 600's remote control data are initialized to a "no modulation" condition. Frequency and output level are initialized to the minimum values.

SECTION TWO

PERFORMANCE SPECIFICATIONS

Frequency Characteristics

FREQUENCY RANGE: 5.4-12.5 GHz

FREQUENCY RESOLUTION: 1 MHz (standard)
1 kHz (instruments with option 03)

FREQUENCY ACCURACY/STABILITY: Same as time base

INTERNAL TIME BASE FREQUENCY/ACCURACY: 10 MHz, ± 1 X 10E-6

INTERNAL TIME BASE STABILITY: <1 X 10E-6/year (standard)
<1 X 10E-9/day (with option 06)

EXTERNAL TIME BASE: 10 MHz, ± 1 X 10E-6 or better, 0.5 Vpp (overrides internal time base)

TIME BASE OUTPUT: Buffered 10 MHz, 2 Vpp into 50 ohms (derived from internal or external time base)

Spectral Purity

HARMONICS, SUBHARMONICS: <-40 dBc

SPURIOUS (NON-HARMONICS): <-55 dBc

POWER LINE/FAN RELATED: <-45 dBc

SSB PHASE NOISE: <-75 dBc/Hz (typical) at 10 kHz offset, 1 Hz BW

Output Characteristics

OUTPUT LEVEL RANGE: -110 dBm to +10 dBm

OUTPUT LEVEL RESOLUTION: 0.1 dB

OUTPUT LEVEL ACCURACY: ± 2 dB

LEVEL FLATNESS: ± 1 dB

LEVEL DISPLAY FORMAT: 5-digit display; 0.1 dB resolution

OUTPUT IMPEDANCE: 50 ohms, nominal

OUTPUT CONNECTOR: type-N female

OUTPUT VSWR: <2:1

EXTERNAL ALC: Negative crystal detector; gain and offset adjustments provided

REVERSE POWER PROTECTION: Will accept the following signal levels at the output connector without resulting damage: 4 W average power, 3.5 kW peak power

Pulse Modulation Characteristics

PULSE RATE: 10 Hz to 1 MHz (internal or external)

PULSE DELAY: 10 nanoseconds to 100 milliseconds

PULSE WIDTH: 100 nanoseconds to 100 milliseconds (internal), >100 nanoseconds (external), >75% duty factor

RISE/FALL TIMES: <50 nanoseconds (RF, SYNC, and VIDEO outputs)

SETTLING TIME: ± 1 dB within 100 nanoseconds

ON/OFF RATIO: >80 dB

EXTERNAL MODULATION INPUT: TTL compatible, 10 Hz to 1 MHz, positive level for RF "on"

SYNC OUTPUT: +1 V pulse into 50 ohms, width approx. 50 nanoseconds, follows modulation rate

VIDEO OUTPUT: TTL compatible, follows modulation rate and width

Amplitude Modulation Characteristics

MODULATION RATE: 10 Hz to 50 kHz (3 dB points referenced to 1 kHz), square or sine (internal), any waveform (external) 1 kHz fixed square (internal)

DEPTH: 0 to 82% (0 to 20 dBm), min

INPUT SENSITIVITY: 1 Vpp = 50% modulation at 1 kHz rate

INPUT IMPEDANCE: 600 ohms, BNC

DISTORTION: <10% at 1 kHz rate, 50% depth (sine wave)

DISPLAY ACCURACY: ± 10% at 1 kHz rate, 50% depth

Frequency Modulation Characteristics

MODULATION RATE: 10 Hz to 1 MHz (external)
10 Hz to 100 kHz sine or triangle (internal)
1 kHz fixed triangle (internal)

DEVIATION: ± 5 MHz, peak

INPUT SENSITIVITY: 2 Vpp for maximum deviation

INPUT IMPEDANCE: 50 ohms (nominal), BNC

DISTORTION: <5% at 500 kHz rate, 5 MHz peak deviation

DISPLAY ACCURACY: ± 10% at 100 kHz rate, 3 MHz peak deviation

General

REMOTE INTERFACE: IEEE STD 488-1978

WARM-UP TIME: 20 minutes, max

OPERATING TEMPERATURE RANGE: 0 to +50°C

ENVIRONMENTAL REQUIREMENTS: Type tested to MIL-T-28800C, type III, Class 5, Style E, Color R

POWER: 100/120/220/240 VAC ± 10%, 50-400 Hz, 200 watts max

DIMENSIONS: 16.75" X 5.25" X 18"; 40 lbs nominal

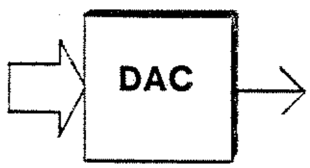
CALIBRATION INTERVAL: 9 months

THEORY OF OPERATION

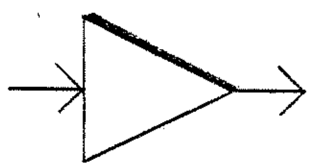
GLOSSARY OF SYMBOLS

The following is a glossary of the block-diagram symbols used in this manual. Some of them are unusual figures devised to meet the special descriptive requirements of microwave synthesizers.

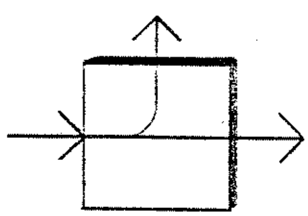
DIGITAL INFORMATION -- Data or instructions coded in binary form, used by the system computer to control the instrument and its various circuits.



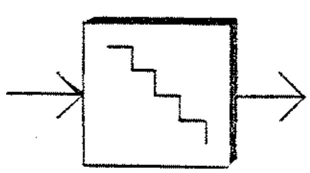
DIGITAL TO ANALOG CONVERTER -- A circuit which receives a binary number in digital code, and produces an output analog signal, the amplitude of which is proportional to the binary number.



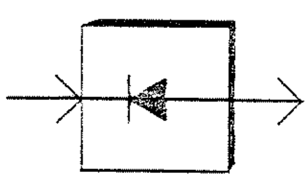
AMPLIFIER/DRIVER/BUFFER -- A circuit which conditions the analog output of one circuit to make it compatible with the input requirements of another circuit.



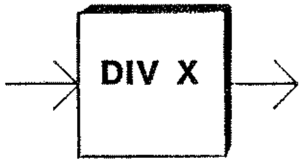
COUPLER -- A device which, by induction, takes a sample of the signal passing through it for use in auxilliary circuits.



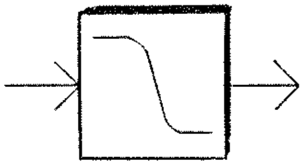
STEP-ATTENUATOR -- A programmable device which attenuates (reduces the power of) the signal passing through it by fixed increments.



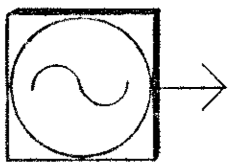
DETECTOR -- A device used to measure the power level of the RF signal applied to it. The detector produces a negative voltage proportional in amplitude to the detected power.



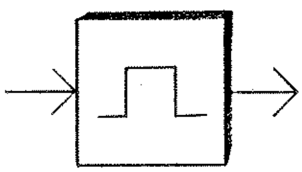
FREQUENCY DIVIDER -- A circuit which accepts a frequency input, and produces a frequency output equal to the input divided by some number.



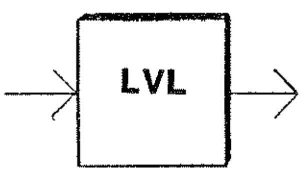
LOW-PASS FILTER -- A circuit designed to pass relatively low frequencies while suppressing relatively high frequencies; often used to block undesired harmonics.



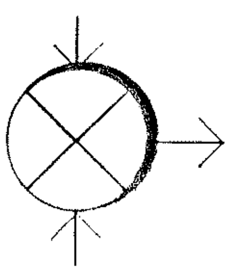
MASTER REFERENCE -- The highly stable fixed 10 MHz signal to which all oscillators in the system are phase-locked. The standard timebase is a quartz oscillator built into the instrument; any external 10 MHz source can be substituted for it simply by connecting the source to the reference input.



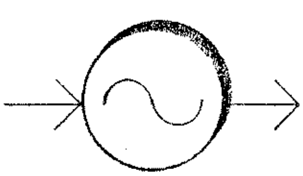
PULSE MODULATOR -- A PIN diode circuit used as a solid-state switch in order to turn the signal passing through it on and off; located inside the RF module.



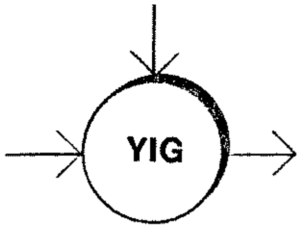
LEVELER -- A PIN diode circuit used as a variable attenuator in order to control the power of the signal passing through it; located inside the RF module.



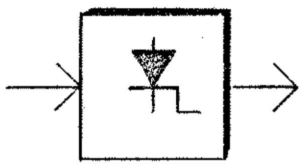
MIXER -- A device which produces an "intermediate frequency" (IF) equal to the difference between its two input frequencies, or equal to the sum of its two input frequencies.



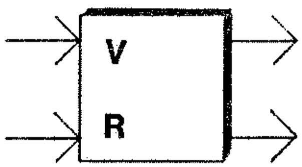
VOLTAGE CONTROLLED OSCILLATOR (VCO) -- An oscillator, the output frequency of which can be adjusted by means of a control voltage.



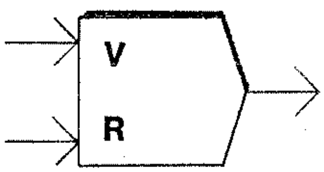
YIG-TUNED TRANSISTOR OSCILLATOR (YIG) -- A microwave frequency oscillator, named for its tuning element which is composed of Yttrium-Iron-Garnet. Coarse and fine frequency adjustment are performed by controlling the current through two tuning coils.



STEP-RECOVERY DIODE MULTIPLIER -- A device that produces an output signal rich in harmonic multiples of the input frequency.



PHASE DETECTOR -- A circuit which compares two frequency inputs (a fixed reference frequency and a variable frequency), determines the phase relationship between them, and generates output pulses having widths proportional to the degree of phase difference. The pulses appear at either of two outputs, depending on whether the variable input leads or lags the reference.



PHASE LOCK LOOP -- A circuit which combines a phase detector with a filter and amplifier. The filter and amplifier covert the phase detector pulse outputs into a control signal, which tunes the variable oscillator so that the phase difference between the two phase detector inputs is reduced.

GENERAL CONFIGURATION OF THE INSTRUMENT

The Model 600 is a single-band microwave generator which employs a YIG oscillator, tuned by a phase lock loop system, to synthesize its RF output. All output frequencies are phase locked to a 10 MHz master reference, and may be selected in increments of 1 MHz (1 kHz for instruments with option 03). Output power is controlled by a leveling system, and may be selected in increments of 0.1 dB; a 10 dB step attenuator on the output is used to adjust the power in larger increments. The RF output may be internally or externally modulated in a variety of AM, FM and pulse modulation modes. Internal function generators offer a choice of modulation signals. Remote operation is made possible by an IEEE-488 interface bus. All functions of the instrument are controlled by an internal computer.

Circuit boards A1 through A4 are plugged into the CPU bus board (A102) and constitute the internal computer. A5, also plugged into the CPU bus, is the level control board.

Circuit boards A6 through A13 are plugged into the RF bus board (A103); these are the high-frequency circuits used to synthesize the instrument's output signal, including the phase lock loops and the YIG driver. The RF bus board itself also houses the FM driver circuit. Circuit boards A9 and A10 are present only in instruments with option 03 (1 kHz Resolution).

The microwave deck includes the YIG oscillator, the RF module, the enclosed 300 MHz oscillator board (A104), the enclosed 110 MHz oscillator/multiplier board (A113), and the 10 dB step attenuator.

The modulation generator board (A105), together with the smaller delay/width generator board which is mounted on it (A106), are located at the base of the front panel.

The power supply is located behind and adjacent to the CPU bus.

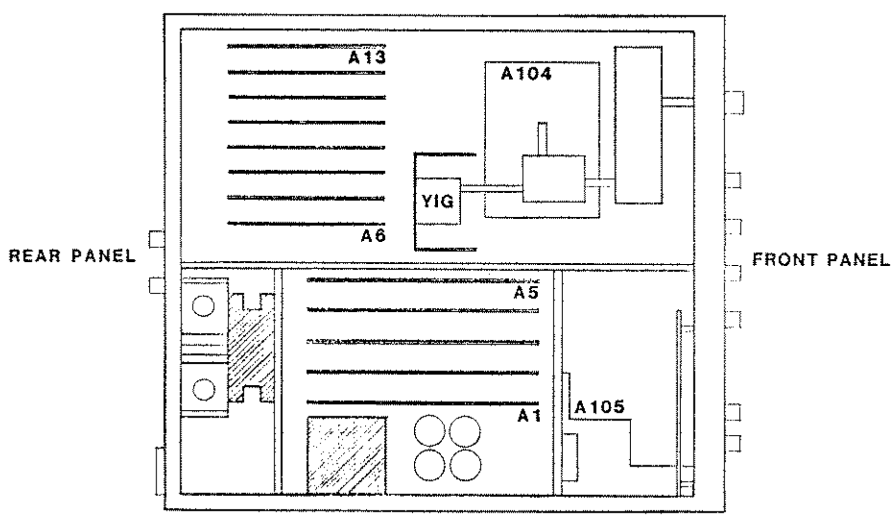


Figure 3.1: Series 600 Interior Layout

THE COMPUTER

An internal computer is used to control the Model 600. The computer is organized around a Motorola 6809 microprocessor with its internal clock controlled by a 3.579 MHz crystal. This clock frequency was selected to minimize beat notes generated by its harmonics and the various frequencies generated within the instrument.

The microprocessor controls, and communicates with, other circuits by means of Peripheral Interface Adapters or PIAs. These devices act as windows through which information and instructions are transmitted to and from the 6809's 8-bit data bus. The data bus is used to send control signals (including multiple-bit numbers in parallel) to the various functional sections of the instrument, and also to take in data from those locations. Digital/analog and analog/digital conversion are used by the computer in order to generate and measure analog signals.

The microprocessor's 16-bit address bus can access up to 64K of memory. Much of this memory capability is not presently used by the Model 600, so there remains room for expansion. Because control software can be rewritten more readily than control hardware can be rebuilt, Giga-tronics's memory-intensive approach has made this an extremely adaptable instrument.

Giga-tronics produces its own computer software, which is stored in PROM devices on the memory board (A2); also in that location are RAM devices used for temporary data storage. A "reset" PROM located on the CPU board itself (A4) contains initialization data, level characterization data, and other information unique to the individual instrument.

The microprocessor, the PIAs, and the semiconductor memory devices will be referred to collectively as the computer. The computer generates and receives digital data required for operation of almost every instrument function. It receives and interprets the operator's commands, through either the front panel switches or the remote interface; it returns information to the operator, through either the front panel displays or the remote interface; it selects appropriate reference frequencies, intermediate frequencies and divisors to generate the RF output; it tunes the YIG oscillator; it activates the appropriate harmonic filter line for the RF path; it controls the power level and the modulation of the RF output; it monitors the functioning of the instrument and supplies error messages and fault indicators to the operator.

THE RF PATH

Coupling, leveling, modulation, filtering, and attenuation of the output signal are accomplished in the path between the YIG oscillator and the instrument's RF output connector. Some power loss inevitably takes place in this RF path; Giga-tronics has cut this loss to a minimum, by using printed microstrip conductors and miniature components to create a hybrid circuit which incorporates most of the above functions into a single module. This clustering of RF circuits greatly reduces the power loss inherent in designs requiring multiple transitions and connectors.

Samples of the RF output signal are required by two circuits outside the RF path. Microstrip couplers located within the module are used to return portions of the RF signal to the output phase lock loop (by way of the sampling mixer) and to the level detector.

A leveler circuit within the module, consisting of PIN diodes, functions as a variable attenuator. A signal from the level control circuit regulates current through these diodes in order to adjust output power.

The output of a YIG oscillator is not spectrally pure. Harmonics of the fundamental frequency are usually present at amplitudes of -12 to -20 dBc. Low-pass filters (consisting of shaped microstrip elements) are used to eliminate these harmonics, and the path through the RF module is subdivided into either two or three filter lines, depending on output bandwidth. The switching of these paths is performed by PIN diode circuits, rather than by mechanical switches, for increased reliability.

The filter switch circuits are also used to pulse-modulate the RF output (the pulse modulation input is applied to the switch that controls the appropriate filter line). A second pulse modulation input is used to switch a 50 ohm termination into the RF path ahead of the filter switches during pulse "off" intervals. This is necessary because, during the "off" period, the RF path is opened and loses its output termination. If an additional termination were not switched into the circuit, reflected power would be picked up by the level coupler and would interfere with level control.

The output of the RF module is applied to the 10 dB step attenuator, which is connected directly to the front panel. Interconnections between components in the RF path are made through semi-rigid coaxial cable (waveguide is not required for the frequencies generated by instruments in the 600 series).

AMPLITUDE CONTROL

The output amplitude of the instrument is controlled by a combination of fixed-step attenuation and closed-loop leveling.

The output stage of the synthesizer consists of a step attenuator which provides up to 110 dB of attenuation in 10 dB increments. Finer control of the output level is provided by the closed loop leveling system, also referred to as Automatic Leveling Control or ALC.

The level control circuit is basically a loop amplifier with multiple inputs, of which one is feedback from the level detector, a device which returns a negative voltage proportional to the square of detected power. The RF measured by the detector is coupled from the output path by a circuit in the RF module (during operation in the external ALC mode, a remote detector is substituted for the internal one). The detector signal is amplified and applied to the summing junction of the leveling loop amplifier; it may be considered the "variable" input, in that it changes in response to the loop amplifier's output.

The "reference" input to the loop amplifier is a composite of three signals: a correction voltage from the temperature compensation circuit (A112), a fixed leveling input which the system computer programs by means of a digital to analog converter, and the AM signal, if any, from the modulation generator board (A105). The AM signal is processed by a logarithmic amplifier to give it the same logarithmic characteristic as the other two inputs, so that all three can be combined by a summing amplifier. The combined signal is processed by an antilogarithmic amplifier on its way to the loop amplifier.

The loop amplifier output is applied to an amplifier which drives the PIN diode leveler in the RF module; the amplifier drives the leveler so as to balance the "reference" input against an equal and opposite "variable"

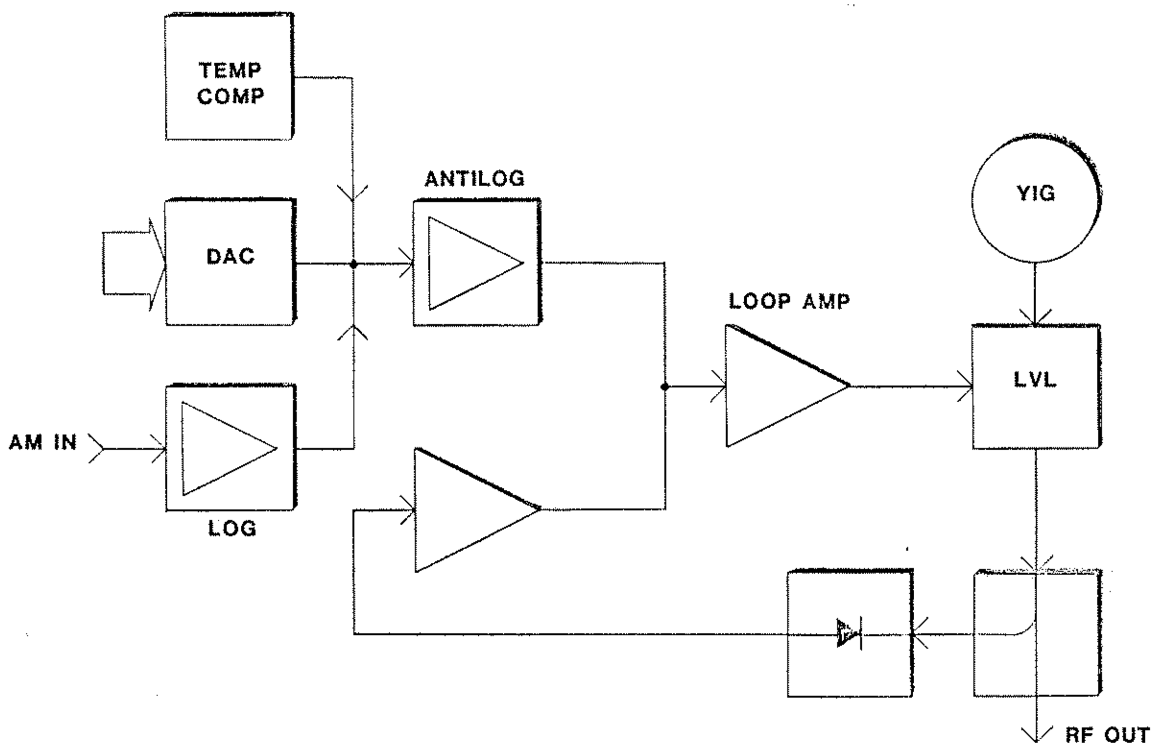


Figure 3.2: Amplitude Control

feedback input. In other words, the leveler adjusts RF power until the detector feedback input just cancels the other input to the loop amplifier.

In setting the leveling reference (through the programming of a digital to analog converter), the system computer includes compensation factors from a level-characterization table stored in the instrument's "reset" PROM (see A4). This data is individual to the instrument and is compiled during production testing.

AMPLITUDE MODULATION

As described above, one component of the reference input to the loop amplifier in the level control circuit (A5) is an amplitude modulation input. This input comes from the modulation generator board (A105), where it is derived from the internal or external modulation signal. This board also houses the logic circuits by which the modulation mode is selected under either local or remote control, as well as the function generator used to produce internal modulation signals.

The AM input to the level control circuit (processed by a log amplifier to match it to the logarithmic characteristic of the computer's leveling reference and the temperature compensation input) supplies the leveling loop amplifier with a variable, rather than a fixed, leveling reference. The level control circuit furnishes a modulated control voltage to the leveler in the RF module in order to match the modulation of the reference. The result is an amplitude modulated RF output, with a modulation depth of up to 70%.

PULSE MODULATION

Pulse modulation is performed by means of path-switching circuits in the RF module. Depending on output bandwidth, there will be either two or three filter paths through the module, of which only one is active at a time. PIN diode circuits are used to switch these lines on and off; pulse modulation is accomplished by shutting off the active path intermittently (a positive voltage at the filter line's control pin on the outside of the module shuts the path off). By this method, an on/off ratio of greater than 80 dB can be achieved.

The drive signals used in pulse modulation originate on the pulse generator board (A106) and the modulation generator board (A105), and are derived from the internal or external modulation signals by circuits which also furnish the sync and video outputs. The internal signal generator, as well as the width and delay generators, are located on these boards, as are the logic circuits by which the modulation mode is selected under either local or remote control.

FREQUENCY MODULATION

Frequency modulation of the RF output is achieved by modifying the fine tuning of the YIG oscillator. The current supply to the YIG's fine tuning coil is controlled by the FM driver (A103), which in turn is controlled by the output phase lock loop circuit (A6). Normally, the PLL's driver output is derived from the outputs of the phase comparator, suitably filtered and amplified. During operation in the FM mode, however, this phase comparator signal is summed with a modulation signal, providing a modulated drive and resulting in a frequency modulated output from the YIG oscillator.

The FM signal furnished to the output PLL originates on the modulation generator board (A105), and is derived from the internal or external modulation signal. This board also houses the logic circuits by which the modulation mode is selected under local or remote control, as well as the function generator used to produce internal modulation signals.

FREQUENCY SYNTHESIS

The output frequency of the Model 600 is produced by a YIG oscillator. Coarse tuning of the YIG is performed by the YIG driver circuit (A13), a programmable current source which the system computer controls by means of a digital to analog converter and amplifier. This current source (connected to the YIG's "tuning" coil) can bring the YIG frequency within 50 MHz of the desired value. Fine tuning of the YIG is accomplished by the output phase lock loop, which supplies a controlled tuning current to the YIG's "FM" coil. The synthesis process used by the Model 600 involves up to six phase lock loops, depending on output frequency resolution. The following is an introduction to phase lock loop circuits.

PHASE LOCK LOOPS

The purpose of a phase lock loop (PLL) is to control a variable frequency oscillator so that its output frequency has the same accuracy and stability as that of a fixed reference oscillator. It works by comparing two frequency inputs, one fixed and one variable, and supplying a correction signal to the variable oscillator in order to achieve and maintain a constant phase relationship between the two inputs. The following discussion refers specifically to the phase lock loop circuits used in Giga-tronics signal generators, and is not meant to encompass all types of phase lock loops.

The stability and accuracy of a reference frequency (for example, the signal produced by a 10 MHz crystal oscillator) can be transferred to a voltage controlled oscillator (VCO) by means of a phase lock loop. The 10 MHz signal is applied to the reference input of the PLL, and the VCO output frequency is fed back to the variable input of the PLL. A phase detector in the PLL circuit compares the two inputs and determines whether the variable input is leading or lagging the reference. The phase detector has two outputs; pulses

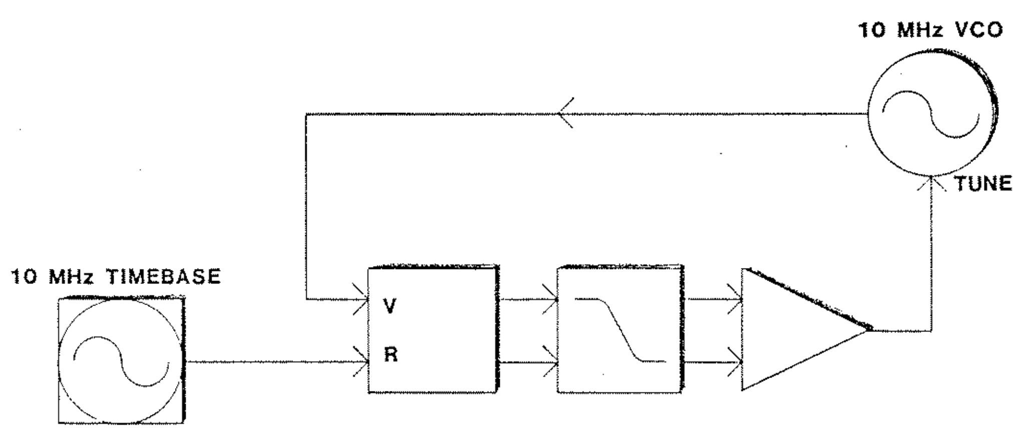


Figure 3.3: Elementary phase lock loop

appear at one of them (which one depends on whether the variable input is leading or lagging), and the width of the pulses is proportional to the degree of phase difference. The pulses are averaged by a low pass filter and DC amplifier into a correction signal, which causes the VCO frequency to increase or decrease in order to reduce the phase difference between the two input frequencies. When the phase error is eliminated, the frequencies are equal, the loop is said to be "locked", and the VCO frequency acquires the accuracy and stability of the reference input.

Although the variable input to the phase detector should equal the frequency of the reference input, it need not equal the frequency of the the VCO. If a frequency divider is introduced between the VCO and the variable input, the VCO can be run at a frequency that is a multiple of the reference frequency. For example, if the VCO output is divided by ten before being applied to the phase detector input, the VCO can run at 100 MHz and still be phase locked to a 10 MHz reference. A frequency divider which intervenes between the VCO and the phase detector's variable input is called a prescaler. If the prescaler is programmable (that is, if it can be set to a given divisor), a variety of frequencies can be phase locked to a single reference frequency.

Since the output frequency must be some multiple of the reference frequency input to the phase detector, the reference frequency limits the resolution of the system: with a 10 MHz timebase, frequencies of 70 MHz or 80 MHz could be generated, but not 73 MHz. This is because digital frequency dividers can perform integer divisions only; the prescaler cannot be programmed to "divide by 7.3". However, if the reference frequency applied to the phase detector is itself programmable, this difficulty can be overcome, either by using a 1 MHz reference frequency and dividing the output by 73, or by using a 7.3 MHz reference and dividing the output by 10.

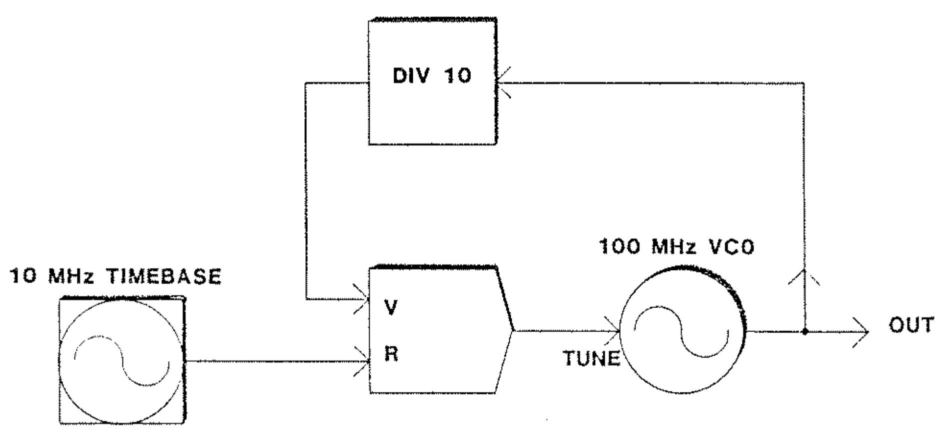


Figure 3.4: 100 MHz phase lock loop.

MICROWAVE FREQUENCY SYNTHESIS

Digital synthesis of microwave frequencies is impeded by two inherent difficulties. First, these frequencies are well above the operating range of digital logic circuits. Second, the bandwidths required tend to be large; even a single-band unit such as the Model 600 must cover an output range of several thousand MegaHertz. A requirement for fine frequency resolution over so wide a range complicates the synthesis process.

In the Model 600, RF mixers are used to downconvert microwave signals to more workable frequencies. Generally, a mixer provides an intermediate frequency equal to the difference between two high-frequency inputs. For example, a step-recovery diode multiplier and an RF mixer (used in a combination known as a sampling mixer) are used to derive a low frequency I.F. equal to the difference between the output microwave signal and some harmonic of a stable 100 MHz input. The various reference signals used to synthesize the output are generated at, or mixed down to, frequencies low enough to drive digital circuits (usually below 200 MHz).

The problem of bandwidth, insofar as it limits frequency resolution, is overcome through the use of compounded PLL circuits to produce reference frequencies programmable in 1 MHz increments over a wide range. For an instrument with Option 03, six different phase detectors are employed in the loops within loops which synthesize the output signal; the benefit purchased by this seemingly high degree of complexity is an output resolution of 1 kHz (one part in 8 million for a Model 600 having an 8 GHz output bandwidth).

THE SYNTHESIS NETWORK

All output frequencies are synthesized by the output PLL, and are ultimately phase locked to the 10 MHz master reference. The synthesizer can be analyzed as two parallel branches connecting the master reference to the output PLL's reference and variable inputs. The variable branch includes feedback from the output YIG oscillator.

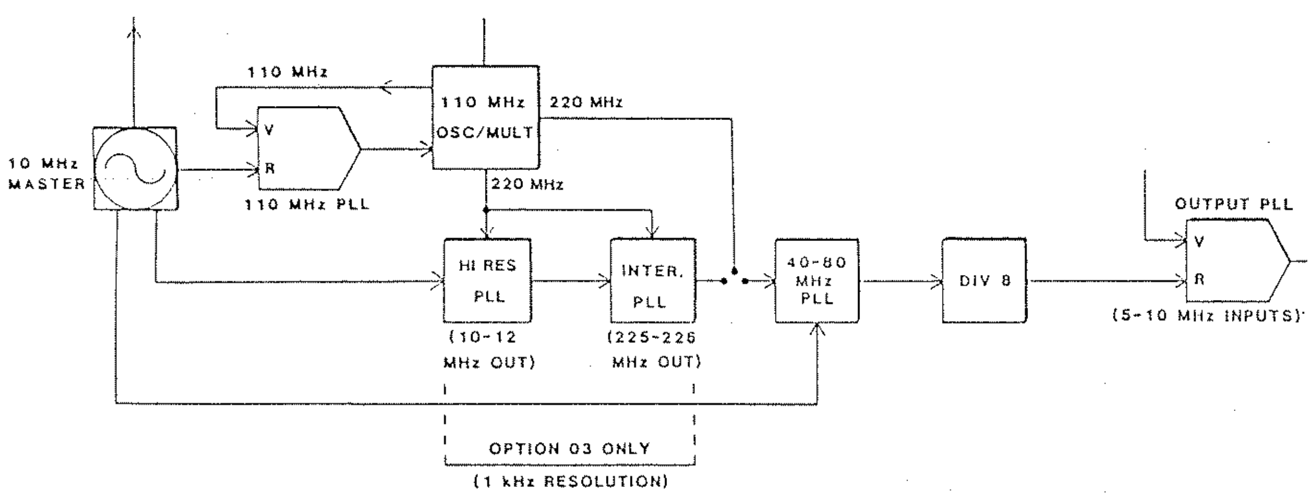


Figure 3.5: The reference branch

THE REFERENCE BRANCH

1 -- 10 MHz master reference (see A12)
2 -- 110 MHz PLL (A12)
3 -- 110 MHz oscillator/multiplier (A113)
3 -- high resolution PLL (A10, Option 03 only)
4 -- intermediate PLL (A9, Option 03 only)
5 -- 40-80 MHz PLL (A8)
6 -- divide-by-8 (A7)
7 -- output PLL, reference input (A6)

The master reference is the instrument's 10 MHz timebase (either the built-in oscillator or an externally applied reference signal -- see the 10 MHz input/output circuit located on the A12 PC board).

The 110 MHz PLL is used to phase lock the 110 MHz voltage controlled oscillator (on the A113 board) to the 10 MHz timebase. A sample of the VCO frequency is divided by 11 and applied to the variable input of a phase comparator; the timebase is the reference input. The phase comparator output is used to generate a tuning voltage for the VCO. The PLL increases or decreases the oscillator frequency until the phase detector inputs match. The 110 MHz oscillator/multiplier generates the 220 MHz and 330 MHz reference signals that are required by other circuits (including the High Resolution PLL and the intermediate PLL in instruments with Option 03). It contains a 110 MHz VCO (tuned by the PLL circuit described above), a frequency doubler (for the 220 MHz reference), and a frequency tripler (for the 330 MHz reference).

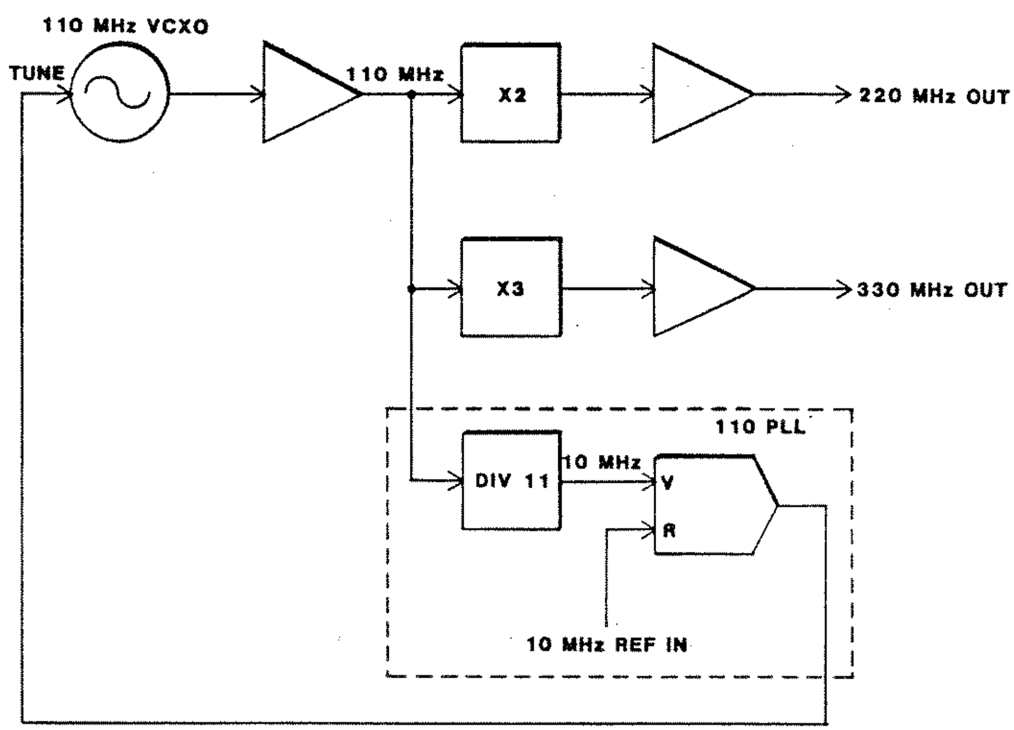


Figure 3.6: 110 MHz Oscillator/Multiplier and Phase Lock Loop

The High Resolution PLL is a programmable source, generating frequencies in 2 kHz increments between 10 and 12 MHz. It is used in instruments with option 03 (1 kHz Resolution). A 250-300 MHz VCO, with a divide-by-25 circuit on its output, is the source of the 10-12 MHz signal. The VCO is tuned by a phase lock loop circuit, but its output is not fed back directly to the phase comparator because the 250-300 MHz frequency range is too high. Instead, the VCO frequency is applied to a mixer. The other mixer input is the 220 MHz reference signal from A113. The 30-80 MHz IF from the mixer is applied to a programmable divider; the divider output (50 kHz when the loop is locked) is applied to the phase comparator's variable input. The reference input is the 10 MHz timebase, divided by 200 for a fixed 50 kHz reference. The PLL tunes the VCO until the two comparator inputs match. The 10-12 MHz output is used by the intermediate PLL as a reference.

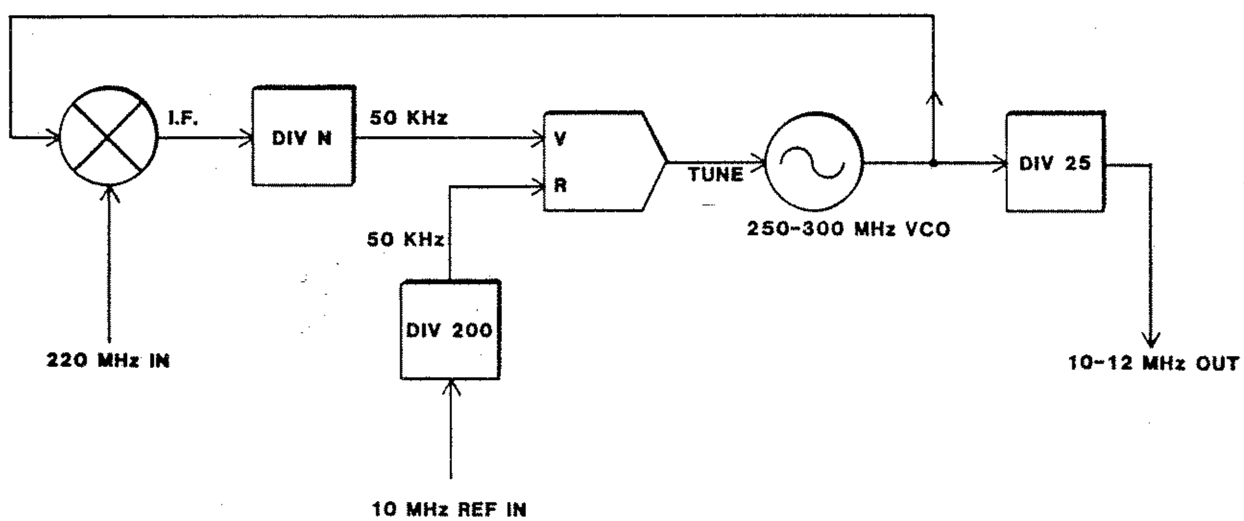


Figure 3.7: High Resolution Phase Lock Loop

The intermediate PLL is a programmable source, generating frequencies in 1 kHz increments between 225 and 226 MHz. It is used in instruments with Option 03 (1 kHz Resolution). A VCO is the source of the 225-226 MHz output. The VCO frequency is fed back to a mixer, where it is combined with the 220 MHz reference input from A113. The resulting 5-6 MHz IF is applied to the variable input of the phase comparator. The 10-12 MHz reference signal from A10 is divided by two and applied to the reference input of the phase detector. The PLL circuit tunes the VCO so as to equalize these two inputs. The 225-226 MHz output is used by the 40-80 MHz PLL as a reference.

The 40-80 MHz PLL is a programmable source, generating frequencies between 40 and 80 MHz. The output frequency is an IF generated by mixing the output of a 266-305 MHz VCO with the 225-226 MHz reference input from the intermediate PLL (A9). In instruments without Option 03, this 225-226 input is replaced by the 220 MHz reference from A113. The VCO is tuned by a PLL circuit; its output is fed back through a frequency divider having a fixed divisor of four, followed by a programmable divider which reduces the feedback signal to 250 kHz and applies it to the variable input of the phase detector. The reference input to the phase detector (also 250 kHz) is obtained by dividing the 10 MHz reference input by 40. The phase lock loop circuit tunes the VCO until these two inputs match.

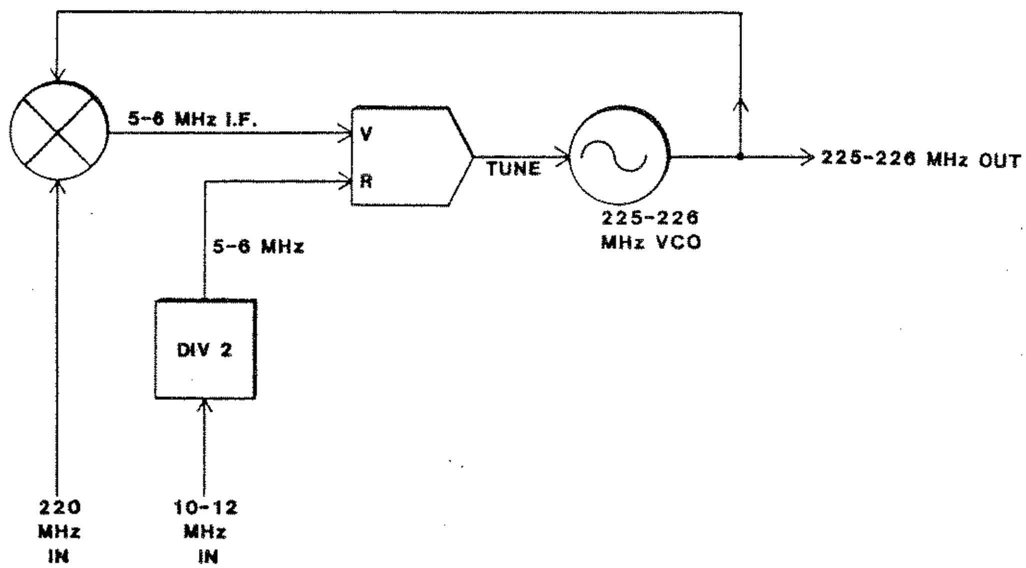


Figure 3.8: Intermediate Phase Lock Loop

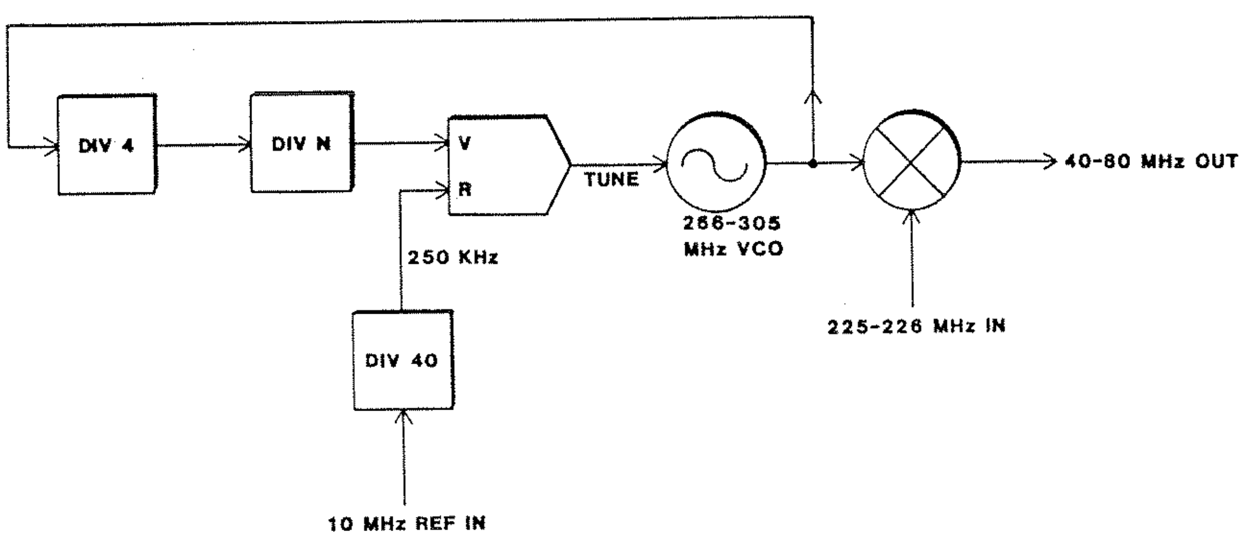


Figure 3.9: 40-80 MHz Phase Lock Loop

The divide-by-8 circuit is a binary frequency divider which accepts the 40-80 MHz reference and divides it by 8; the output signal (a 5-10 MHz reference programmable in 0.125 kHz increments) is the reference input to the output PLL circuit.

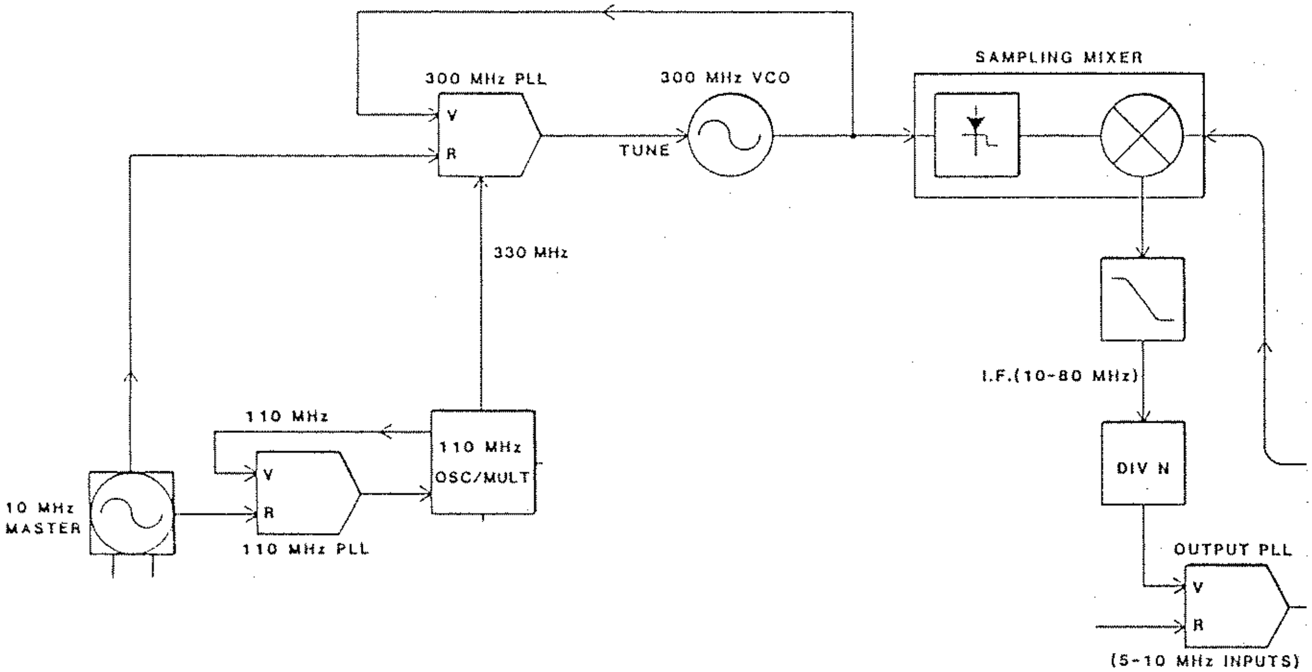


Figure 3.10: The Variable Branch

THE VARIABLE BRANCH

This branch consists of circuits in the following sequence:

1 -- 10 MHz master reference (see A103)
2 -- 110 MHz PLL (A12)
3 -- 110 MHz oscillator/multiplier (A113)
4 -- 300 MHz PLL (A11)
5 -- 300 MHz VCO/driver (A104)
6 -- sampling mixer/IF amplifier (A104)
7 -- divide-by-N (A7)
8 -- output PLL, variable input (A6)

The 10 MHz master reference and the 110 MHz PLL are the same circuits used in the reference branch.

The 110 MHz oscillator/multiplier also supplies a 330 MHz reference input to the 300 MHz PLL.

The 300 MHz PLL is a programmable source, generating frequencies in 1 MHz steps between 284 and 319 MHz. A VCO, tuned by a phase lock loop circuit, generates the output frequency. The VCO frequency is mixed with the 330 MHz input (from circuit board A113) to produce an IF which is then applied to a programmable divider; the IF is reduced to 1 MHz and applied to the variable input of the phase detector. The reference input, also 1 MHz, is obtained by dividing the 10 MHz reference input by 10. The PLL tunes the VCO until these two phase detector inputs match.

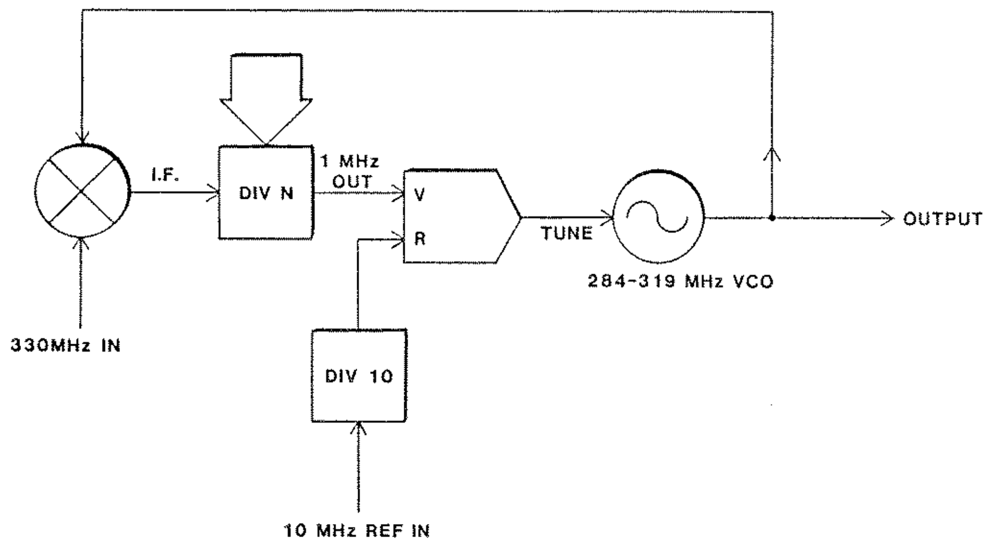


Figure 3.11: 300 MHz PLL/VCO

The 300 MHz VCO/driver is controlled by the 300 MHz PLL. Its output is amplified and used to drive the multiplier input of the sampling mixer.

The sampling mixer has a step recovery diode multiplier on one of its inputs (the input driven by the 300 MHz VCO). The multiplier produces a series of frequency components that are harmonics of the input. The other input to the mixer is a signal coupled from the output of the YIG oscillator. The mixer combines the YIG frequency with the harmonics of the VCO frequency, yielding a great variety of intermediate frequency (IF) components. The IF output is amplified and filtered in order to pass only IFs within a 10-80 MHz range. In this way the output is limited to a single IF component, derived from the difference between the YIG frequency and one of the VCO's harmonics. The IF (a signal programmable over a range of 10 to 80 MHz) is applied to the divide-by-N circuit.

The divide-by-N circuit is a programmable frequency divider; the computer programs it to divide the IF by 2, 4, or 8 in order to produce an output frequency in the range of 5 to 10 MHz. The output is applied to the variable input of the output phase lock loop. The amplified and filtered phase detector output of the PLL is further amplified by the FM driver circuit (see A103) before being applied to the YIG's FM coil. The YIG is tuned in order to adjust the sampling mixer IF and thus equalize the reference and variable inputs to the PLL.

The various programmable frequencies are set by the computer, in accordance with a complex algorithm, to produce the requested output frequency.

CALIBRATION AND TESTING

CALIBRATION PROCEDURE

1.0 Required Test Equipment

1.1 Frequency counter covering output frequency range of Series 600; time base accuracy better than 1 part in 10E9; IEEE-488 interface.

1.2 Computer/controller: any unit equipped with IEEE-488 interface, such as HP9825, HP85, PET 2001.

1.3 Power meter/sensor (HP436A with 8485A or equivalent).

1.4 Spectrum analyzer (HP8566 or equivalent, with external mixers as required).

1.5 Oscilloscope (Tektronix 2465 or equivalent).

1.6 Detector (Wiltron 70S50B or equivalent).

1.7 50 ohm termination (Tektronix 011-0049-01 or equivalent).

1.8 Pulse generator (Wavetek 802 or equivalent).

1.9 Low distortion sine wave generator (Wavetek 182A or equivalent).

1.10 FM test fixture (described in this procedure).

1.11 Distortion analyzer (HP 339A or equivalent).

1.12 Modulation meter (Wavetek 4101 or equivalent).

2.0 Master Oscillator Calibration

2.1 Turn on Unit Under Test and allow a 20 minute warmup, covers on.

2.2 Connect the 10 MHz output on the rear panel of the UUT to the oscilloscope vertical input. Adjust oscilloscope for a mid to full scale display; .1 ms/cm timebase setting.

2.3 Connect the output from the frequency standard (10 MHz) to the oscilloscope external trigger input and adjust the oscilloscope to trigger on this signal.

2.4 Remove the UUT top cover and adjust the master oscillator frequency adjust (located under a screw-in cap) until the scope display stands still. Use the X10 expander for more resolution.

2.5 Replace the screw-in cap on the oscillator.

3.0 Output Oscillator Tracking

The frequency range of the output YIG oscillator varies for different models in the 600 series. The MIN and MAX calibration frequencies should be within about 1 GHz of the limits of the instrument's frequency range (for example, an output oscillator having a range of 10-18 GHz should be calibrated at 11 and 17 GHz).

3.1 Turn on UUT, all modulation off, minimum frequency. Allow a 20 minute warmup, covers off.

3.2 Set output for 0 dBm and connect the frequency counter to the front panel RF OUT connector.

3.3 Connect the oscilloscope to the A6 (Output PLL) test point (DC coupled, 1V/cm, GND @ center).

3.4 Adjust the YIG oscillator driver (A13) so that the test point voltage is 0 $\pm$ .5V with the counter reading the selected frequency to 1 MHz resolution. Use the following steps:

STEP	FREQUENCY	ADJUSTMENT
1	"MIN"	(A13) MIN POT
2	"MAX"	(A13) MAX POT
3	(Repeat 1 & 2 as required)	

3.5 Starting at the minimum output frequency, increment the frequency in 100 MHz steps, monitoring the A6 test point. Readjust the appropriate controls, if necessary, to maintain the voltage within 1V of ground across the band.

4.0 RF Output Amplitude Calibration

4.1 Turn on UUT, all modulation off, minimum frequency, level set to -4 dBm. Allow a 20 minute warmup, covers off.

4.2 Adjust the "-4" pot on the A5 board (Level Control) for a reading of -4 dBm as measured by a power meter.

4.3 Set the output level to +4 dBm, and adjust the "+4" pot for a reading of +4 dBm on the power meter.

4.4 Set the output level to +9 dBm, and adjust the "+9" pot for a reading of +9 dBm on the power meter.

4.5 Repeat 4.2, 4.3 and 4.4 as needed.

5.0 AM/FM Rate (start of front panel calibration)

5.1 Turn on UUT, minimum frequency, level set to -4 dBm, modulation set to AM SINE. Allow a 20 minute warmup, covers off.

5.2 Monitor AM/FM SYNC OUT with the oscillocope. The output should be a rectangular wave at levels of zero and +4 Vpp; the duty cycle is not necessarily 50%.

5.3 Turn the AM/FM RATE switch to the second lowest range (100 Hz-1 kHz), vernier fully CCW (minimum setting). Adjust R77 (A105) for a rate of <100 Hz (roughly, 90 Hz).

5.4 Verify a rate of >1 kHz with the vernier fully CW (maximum setting).

5.5 Verify that the higher settings cover their full rate ranges with the vernier at minimum and maximum positions:

First range <10 Hz min, >100 Hz max.
Third range <1 kHz min, >10 kHz max.
Fourth range <10 kHz min, >100 kHz max.

6.0 AM/FM Modulation Meter

6.1 Use the ohm meter to verify the resistance between the center pins and ground for the AM EXT IN and FM EXT IN connectors (the reading should be 600 ohms for the AM input, 50 ohms for FM).

6.2 Turn on UUT, all modulation off, minimum frequency. Allow a 20 minute warmup, covers off.

6.3 Adjust the "DISP ZERO" pot on the A5 board for a modulation meter reading of 0.00% (AM position) and 0.00 MHz (FM position). Both AM and FM verniers should be fully CCW.

6.4 Monitor AM/FM SYNC OUT with the oscilloscope. Adjust AM/FM RATE to 50 kHz and verify the sync output is a square wave, 0 to +4 volts.

6.5 Turn the AM switch to the SINE setting and turn the AM vernier fully CW.

6.6 Turn the FM switch to the SINE setting and turn the FM vernier fully CCW.

6.7 Monitor the AM output (A105, pin 10) with the oscilloscope. Adjust R93 (A105) for a 50 kHz sine wave at 2 Vpp.

6.8 Adjust the "MCAL" A5R23 pot on the A5 board for a modulation meter reading of 99.0% (AM position).

6.9 Turn the FM vernier fully CW; verify a modulation meter reading of >5 MHz (FM position).

6.10 Adjust the AM vernier for a modulation meter reading of 50.0% (AM position); verify that the AM output (A105 pin 10) is at 1 Vpp.

6.11 Adjust the FM vernier for a modulation meter reading of 2.50 MHz (FM position); verify that the FM output (A105 pin 9) is at 1 Vpp.

6.12 Turn the AM switch to the SQUARE setting; adjust R72 (A105) to read an AM output (A105 pin 10) at 50 kHz (square wave), 1 Vpp. Verify a modulation meter reading of 50.0% (AM position).

6.13 Without permitting the AM vernier to move, turn the AM switch back to the SINE setting and verify that the modulation meter reading is still 50.0% (AM position).

6.14 Without permitting the AM vernier to move, turn the AM switch to 1 kHz SQUARE; adjust R80 (A105) for a modulation meter reading of 50.0% (AM position). AM output (A105 pin 10) should be at 1 Vpp.

6.15 Monitor the AM output (A105 pin 10) with the oscilloscope. Adjust R64 (A105) for a duty cycle of 50%. Adjust R68 (A105) for a frequency of 1.000 kHz. Repeat as necessary.

6.16 Without permitting the AM vernier to move, turn the AM switch to the EXT setting. Turn AM vernier fully CW. Apply a 10 kHz sine wave at 2.3 Vpp at the AM external input connector. Verify a modulation meter reading of 50.0%, $\pm$ .9% (AM position) and that the AM output (A105 pin 10) is a 10 kHz sine wave at 1 Vpp.

6.17 Turn the AM switch OFF, vernier CCW. Set AM/FM rate to 50 kHz.

6.18 Turn the FM switch to the SINE setting, and adjust the FM vernier for a modulation meter reading of 2.50 MHz (FM).

6.19 Without permitting the FM vernier to move, turn the FM switch to the TRIANGLE setting (AM/FM rate still at 50 kHz). Adjust R65 (A105) for a modulation meter reading of 2.50 MHz (FM position). Verify that the FM output (A105 pin 9) is a 50 kHz triangle wave at 1 Vpp.

6.20 Without permitting the FM vernier to move, turn the FM switch to the 1 kHz TRIANGLE setting. Adjust R61 (A105) for a modualtion meter reading of 2.50 MHz (FM position). Verify that the FM output (A105 pin 9) is a 1.000 kHz triangle wave at 1 Vpp.

6.21 Set UUT to EXT FM, with FM vernier fully CW. Apply a 10 kHz sine wave at 2 Vpp (as measured into 50 ohms) at the FM external input connector. Verify a modulation meter reading of 2.5 MHz ± .1 MHz (FM position) and that the FM output (A105 pin 9) is a 10 kHz sine wave at 1 Vpp. Turn the FM vernier fully CW; verify a modulation meter reading of 5 MHz ± .1 MHz (FM position).

7.0 External Pulse Modulation

7.1 Select EX PUL mode; apply a 10 kHz square wave (TTL levels) at the pulse EXT IN connector.

7.2 Monitor VIDEO OUT with the oscilloscope. Verify that the output is a 10 kHz square wave with levels of zero and +1.1 V (measured into 50 ohms).

7.3 Select EX TRIG mode. Turn the WIDTH switch to 10 us - .1 ms, with the vernier midrange. Verify that the output frequency is 10 kHz, and adjust the pulse width to 20 us by means of the WIDTH vernier.

8.0 Remote AM and FM

8.1 Attach UUT to an instrument controller via the IEEE-488 interface bus. Set UUT device address to 6.

8.2 Initialize UUT by sending the following command:

OUTPUT 706 "FAxxxx,LEVELO" (where "xxxx" represents any valid frequency).

8.3 Monitor the AM output (A105, pin 10) with the oscilloscope.

OUTPUT 706 "AM SINE"
OUTPUT 706 "PANEL AM" (enables AM vernier)

Set the AM vernier to 30%, as measured by the internal modulation meter (AM position). Set the AM/FM vernier to 50 kHz, as measured by the oscilloscope.

8.4 OUTPUT 706 "PRESET AM"

Adjust R84 (A105) for a modulation meter reading of 50%. Verify a 50 kHz sine wave at 1 Vpp (A105 pin 10).

8.5 OUTPUT 706 "AM SQR"

Verify a modulation meter reading of 49-51%, and a 50 kHz square wave at 1 Vpp (A105 pin 10).

8.6 OUTPUT 706 "AM FIXED"

Verify a modulation meter reading of 49-51%, and a 1 kHz square wave at 1 Vpp (A105 pin 10).

8.7 OUTPUT 706 "AM EXT"

Apply a 10 kHz sine wave (2 Vpp) at the AM external input connector. Verify a modulation meter reading of 49-51%, and a 10 kHz sine wave at 1 Vpp (A105 pin 10).

8.8 OUTPUT 706 "AM OFF"

Verify that the modulation meter reading and the modulation waveform (A105 pin 10) drop to zero. Monitor the FM output (A105 pin 9) with the oscilloscope.

8.9 OUTPUT 706 "FM SINE"
OUTPUT 706 "PANEL FM" (enables FM vernier)

Adjust the FM vernier for a modulation meter reading of 1 MHz (FM position). Verify a 50 kHz sine wave at 1 Vpp (A105 pin 9).

8.10 OUTPUT 706 "PRESET FM"

Adjust R81 (A105) for a modulation meter reading of 2.50 MHz. Verify a 50 kHz sine wave at 1 Vpp (A105 pin 9).

8.11 OUTPUT 706 "FM TRI"

Verify a modulation meter reading of 2.45 to 2.55 MHz. Verify a 50 kHz triangular wave at 1 Vpp (A105 pin 9).

8.12 OUTPUT 706 "FM FIXED"

Verify a modulation meter reading of 2.45 to 2.55 MHz. Verify a 1 kHz triangular wave at 1 Vpp (A105 pin 9).

8.13 OUTPUT 706 "FM EXT"

Apply a 10 kHz sine wave (2 Vpp) at the FM external input connector. Verify a modulation meter reading of 2.45 to 2.55 MHz. Verify a 10 kHz sine wave at 1 Vpp (A105 pin 9).

8.14 OUTPUT 706 "FM OFF"

Verify that the modulation meter reading and the modulation waveform (A105 pin 9) both drop to zero.

9.0 Remote Pulse Modulation

9.1 Monitor pulse VIDEO OUT with the oscilloscope.

9.2 Send the following commands via the remote interface:

OUTPUT 706 "PULSE INT A" (selects 10 Hz - 100 Hz rate range)
OUTPUT 706 "DELAY G" (selects 10 ms - .1 s delay range)
OUTPUT 706 "WIDTH F" (selects 10 ms - .1 s width range)
OUTPUT 706 "PANEL RATE" (enables pulse rate vernier)
OUTPUT 706 "PANEL DELAY" (enables pulse delay vernier)
OUTPUT 706 "PANEL WIDTH" (enables pulse width vernier)

9.3 Turn the pulse WIDTH and RATE verniers across their ranges to verify that the pulses on VIDEO OUT vary correctly in rate and width. Using both pulse SYNC OUT and pulse VIDEO OUT, turn the

DELAY vernier across its range to verify that the pulse delay varies correctly. Repeat for the following settings:

9.4 OUTPUT 706 "PULSE INT A" (10 Hz - 100 Hz range)
OUTPUT 706 "DELAY F" (1 ms - 10 ms range)
OUTPUT 706 "WIDTH F" (10 ms - .1 s range)

9.5 OUTPUT 706 "PULSE INT B" (100 Hz - 1 kHz range)
OUTPUT 706 "DELAY E" (100 us - 1 ms range)
OUTPUT 706 "WIDTH E" (1 ms - 10 ms range)

9.6 OUTPUT 706 "PULSE INT C" (1 kHz - 10 kHz range)
OUTPUT 706 "DELAY D" (10 us - 100 us range)
OUTPUT 706 "WIDTH D" (100 us - 1 ms range)

9.7 OUTPUT 706 "PULSE INT D" (10 kHz - 100 kHz range)
OUTPUT 706 "DELAY C" (1 us - 10 us range)
OUTPUT 706 "WIDTH C" (10 us - 100 us range)

9.8 OUTPUT 706 "PULSE INT D" (10 kHz - 100 kHz range)
OUTPUT 706 "DELAY B" (100 ns - 1 us range)
OUTPUT 706 "WIDTH B" (1 us - 10 us range)

9.9 OUTPUT 706 "PULSE INT E" (100 kHz - 1 MHz range)
OUTPUT 706 "DELAY A" (10 ns - 100 ns range)
OUTPUT 706 "WIDTH A" (100 ns - 1 us range)

9.10 Apply 10 kHz square wave to PULSE EXT IN. Send the following command:

OUTPUT 706 "PULSE EXT"

Verify 10 kHz square wave output at VIDEO OUT. Send the following commands:

OUTPUT 706 "PULSE TRIG"
OUTPUT 706 "WIDTH C"
OUTPUT 706 "PANEL WIDTH"

Vary the pulse WIDTH vernier, and verify that the pulse width as monitored on VIDEO OUT varies across a range of 10 us - 100 us, and that the pulse repetition rate is 10 kHz.

9.11 Send the following commands:

OUTPUT 706 "PULSE OFF"

Verify that pulse VIDEO OUT is +1.1 volts DC, and that pulse SYNC OUT is at zero volts.

9.12 Send the following commands:

OUTPUT 706 "PULSE INT D" (selects 10 - 100 kHz rate range)
OUTPUT 706 "DELAY B" (selects 100 ns - 1 us delay range)
OUTPUT 706 "WIDTH C" (selects 10 us - 100 us width range)
OUTPUT 706 "PRESET RATE" (rate vernier disabled)
OUTPUT 706 "PRESET DELAY" (delay vernier disabled)
OUTPUT 706 "PRESET WIDTH" (width vernier disabled)

9.13 Adjust the preset rate pot (R52, A105) for a pulse rate of 10 kHz. Adjust the preset delay pot (R38, A105) for a pulse delay of 1 us. Adjust the preset width pot (R35, A105) for a pulse width of 20 us.

NOTE: The preset values shown above are set prior to shipment from the factory; the user has the option of changing them.

10.0 Amplitude Modulation Performance

10.1 Connect the UUT's RF OUT to the spectrum analyzer. Connect the 10 MHz IF output from the spectrum analyzer to the input of the external modulation meter. Connect the AF output of the external modulation meter to the input of the distortion analyzer.

10.2 Set the UUT to an output frequency in the middle of its range, at +5 dBm with all modulation off. Center the output signal on the spectrum analyzer.

10.3 Monitor Test Point 2 on the A5 board with the oscilloscope, and adjust the "Zero" pot on that board for a reading of zero volts DC.

10.4 Monitor AM/FM SYNC OUT with the oscilloscope. Turn the AM switch to the internal SINE mode. Set the AM/FM RATE switch and vernier to read 1 kHz on the oscilloscope. Adjust the AM vernier for an internal modulation meter reading of 50% (AM position).

10.5 Set analyzer to "zero span" (time domain), linear vertical display, internal trigger mode. Adjust the "AM" pot on the A5 board for an external modulation meter reading of 50%.

10.6 Adjust the AM vernier for an internal modulation meter reading of 20%, and verify an external modulation meter reading of 10-30%.

10.7 Adjust the AM vernier for an internal modulation meter reading of 80%, and verify an external modulation meter reading of 70-90%.

NOTE: If there is an unacceptable error at the 20% or the 80% modulation setting, readjust the 50% point (see step 12.4 above) to compensate.

10.8 Adjust the AM vernier for an internal modulation meter reading of 82%. Verify a distortion meter reading of <10%.

10.9 Attach a detector to the UUT's RF OUT connector. Monitor the detector's signal with the oscilloscope (terminate the detector into a 50 ohm load). Set the scope to 5 mV/div.

10.10 RF output at +5, AM at 1 kHz SINE. Adjust the AM vernier to see a waveform 6 divisions high on the scope (for that setting the internal modulation meter reading should be roughly 35%).

10.11 Check the AM frequency response: vary AM RATE across each range, and verify that the amplitude of the detector output waveform is between 4 and 8 divisions at all AM rates.

11.0 Frequency Modulation Performance

11.1 In order to calibrate and test the frequency modulation circuits, a special test fixture must be assembled. The recommended FM test fixture includes an RF splitter, two delay lines of unequal length, and an RF mixer. The RF output of the UUT is divided by the splitter into two signals, unequally delayed. The required differential delay can be obtained by using two coaxial cables of, for example, 5 and 10 inches in length. The outputs of these delay lines are furnished to the two inputs of the RF mixer. For certain frequencies which may be identified by experiment, the mixer will produce a DC voltage near zero. The number of "null" frequencies can be increased by making the delay lines longer in absolute terms or by increasing the ratio between their lengths. If the output becomes frequency modulated, the mixer output voltage will change, and the voltage variation will be proportional to FM deviation. The polarity of the voltage change may be either directly or inversely related to the direction of frequency deviation. When voltage levels have been established for different frequencies, the mixer output can be monitored on an oscilloscope to provide a continuous display of FM deviation.

11.2 Connect the FM test fixture to the RF OUT connector of the UUT. Monitor the mixer output with the oscilloscope (5 mV/div). Set the UUT to a null frequency (that is, at a frequency for which the mixer output voltage is zero); +5 dBm out, no modulation.

11.3 Establish the voltages at 5 MHz above and 5 MHz below the null frequency. Adjust the oscilloscope gain and the UUT output power level (near +5 dBm) in order to place the null point at the center of the screen and the 5 MHz deviation points at 3 divisions above and 3 divisions below the null point.

11.4 Set the UUT to the FM internal SINE mode. Adjust the FM vernier for a modulation meter reading of 5 MHz deviation (FM position).

11.5 Adjust the "CAL" pot on the A6 PC board in order to align the peaks of the modulated mixer output with the 5 MHz deviation points (6 divisions, peak to peak).

11.6 Verify that peak to peak deviation is less than 8 divisions, and greater than 4 divisions, at all FM rates up to 1 MHz (check each range).

11.7 Verify that the appropriate waveforms are visible in the other FM modes: 1 kHz TRIANGLE, variable TRIANGLE, and EXT (with a signal from the function generator applied to the FM input).

REQUIRED TEST EQUIPMENT

0.1 Frequency counter covering output frequency range of Series 600; time base accuracy better than 1 part in 10E9; IEEE-488 interface.

0.2 Computer/controller: any unit equipped with IEEE-488 interface, such as HP9825, HP85, PET 2001.

0.3 Power meter/sensor: HP436A with 8485A.

0.4 Spectrum analyzer: HP8566 or equivalent, with external mixers as required.

0.5 Oscilloscope: Tektronix 2465 or equivalent.

0.6 Detector: Wiltron 70S50B or equivalent.

0.7 50 ohm termination: Tektronix 011-0049-01 or equivalent.

0.8 Pulse generator: Wavetek 802 or equivalent.

0.9 Low distortion sine wave generator: Wavetek 182A or equivalent.

0.10 FM test fixture (see section 12.11 this calibration procedure).

0.11 Distortion analyzer: HP 339A or equivalent.

0.12 Modulation meter: Wavetek 4101 or equivalent.

Refer to the test data sheet at the end of this section for specifications not cited in the test procedure.

Record values as required on the test data sheet.

1.0 FREQUENCY RANGE

1.1 Allow UUT to warm up (power on) for at least 20 minutes. 1 hour for units with Option 06.

Connect RF output to frequency counter. Run UUT self-test routine in 100 MHz steps (set frequency switches to 90100.000) and monitor counter to verify frequency accuracy.

2.0 MAXIMUM OUTPUT AMPLITUDE

2.1 Connect RF output to power meter. Run UUT self-test in 50 MHz steps (90050.000) at +10 dBm, and monitor power meter to verify power within specification across the frequency range of UUT.

3.0 OUTPUT POWER ACCURACY

3.1 Perform the UUT self-test as in step 2.1 above, at 0 dBm and -4 dBm; power accuracy should be ± 2 dBm and flatness should be ± 1 dB.

4.0 FREQUENCY ACCURACY AND RESOLUTION

4.1 Check each frequency digit from 0 to 9 (as applicable) for correct UUT display and counter reading.

5.0 SPECTRAL PURITY/STEP ATTENUATOR

5.1 Perform spectral purity test as required by Test Data Sheet.

5.2 Perform On/Off test as follows:

Set HP-8566:	Set UUT:
Span = 200 kHz	Pulse Rate = 50 Hz
Center & Top Ref Level	Pulse Width = 40 msec
Span = 0 Hz	Pulse Delay = off
VBW = 300 Hz	
Trigger = Video	

5.3 Perform 10 dB step attenuator test as follows:

Set HP-8566	Set UUT:
Span = 50 kHz	RF level = 0 dB
Center & Top Ref Level	Frequency = max
	Modulation = off

Decrement RF level in 10 dB steps, and verify level accuracy ± 2 dBm. At -60 dBm change HP-8566 span to 200 Hz and step the reference level down five times (to about -50 dBm). Continue the test to -110 dBm. If more range is needed, set HP 8566 attenuator to 0 dB.

6.0 AM FUNCTIONS

Set UUT:
Pulse off   Frequency -- any
FM -- off   Level -- +5
AM -- sine, (vernier 30%/AM; reading may fluctuate at rates <100 Hz)

6.1 AM/FM 'SYNC OUT' to scope (2 V/div, DC); scope Ch 2 output to counter. Verify frequency range, duty cycle 50%, ± 5%, TTL levels (<.5V and >3V).

6.2

AM/FM RATE (Hz)	CW	CCW
10-100	> 100 Hz	< 10 Hz
100-1k	> 1 k	< 100
1k-10k	> 10 k	< 1 k
10 k-100 k	> 100 k	< 10 k

6.3 Attach detector to RF output, scope detectors output, 5m V/div. 50ohms. Set AM/FM rate to approx. 5 kHz. Verify sine wave on scope.

6.4 Set AM switch to square, verify square wave on detector's output and a mod meter reading of 30% ± 10% (AM%).

6.5 Set AM switch to square 1 kHz fixed verify 1 kHz square wave on dectectors output.

6.6 Set AM venier to 50% on mod meter (AM%). Set AM switch to external Connect AM/FM "sync out" to AM "ext in". Verify 20% to 40% on the modulation meter (AM%).

7.0 FM FUNCTIONS

Set UUT:
Pulse -- off   Level -- +5
AM -- off   AM/FM Rate -- 5 kHz
FM -- sine, max (vernier CW)

7.1 Attach FM fixture to RF out, use one of the frequencys listed on FM test fixture. Scope FM fixture output 5mV/div. A.C. Verify sine wave and a mod meter reading of > 5.0 MHz (FM MHz).

7.2 Set FM switch to triangle. Verify triangle wave on FM fixtures output.

7.3 Set FM switch to triangle fixed 1 kHz. Verify 1 kHz triangle wave on fixtures output.

7.4 Set FM vernier to 5 MHz on mod meter (FM MHz). Set FM switches to external. Connect AM/FM 'sync out' to FM 'ext in'. Verify 0.30 ± .10 on modulation meter (FM MHz).

8.0 PULSE MODULATION FUNCTIONS

8.1 Connect PULSE 'VIDEO OUT' to oscilloscope channel 2 (50 ohms, 500 mV/div). Connect PULSE 'SYNC OUT' to oscilloscope channel 1 (50 ohms, 500 mV/div). Trigger scope on CH1, display CH2. Connect CH2 output to frequency counter. Set pulse delay to minimum. Verify pulse rate in the following settings:

SET RATE, VERNIER	SET WIDTH, VERNIER	VERIFY RATE
10/100 CCW	10 ms/.1 s center	<10 Hz
10/100 CW	1 ms/10 ms center	>100 Hz
100/1K CCW	as above	<100 Hz
100/1K CW	.1 ms/1 ms center	>1 kHz
1K/10K CCW	as above	<1 kHz
1K/10K CW	10 us/.1 ms center	>10 kHz
10K/100K CCW	as above	<10 kHz
10K/100K CW	1 us/10 us center	>100 kHz
100K/1M CCW	as above	<100 kHz
100K/1M CW	.1 us/1 us center	>1 MHz

8.2 With pulse delay at minimum, verify pulse width in the following settings:

SET RATE, VERNIER	SET WIDTH, VERNIER	VERIFY WIDTH
10/100 CCW	10 ms/.1 s CCW	<10 ms
as above	10 ms/.1 s CW (slowly)	>100 ms

SET RATE, VERNIER	SET WIDTH, VERNIER	VERIFY WIDTH
10/100 center	1 ms/10 ms CW	>10 ms
100/1K center	1 ms/10 ms CCW	<1 ms
as above	.1 ms/1 ms CW	>1 ms
1K/10K center	.1 ms/1 ms CCW	<.1 ms
as above	10 us/.1 ms CW	>.1 ms
10K/100K center	10 us/.1 ms CCW	<10 us
as above	1 us/10 us CW	>10 us
100K/1M center	1 us/10 us CCW	<1 us
as above	.1 us/1 us CW	>1 us
as above	.1 us/1 ms CCW	<100 ns

8.3 Verify pulse delay in the following settings:

SET RATE, VERNIER	SET DELAY, VERNIER	SET WIDTH, VERNIER	VERIFY DELAY
10/100 CCW	10 ms/.1 s CCW	10 ms/.1 s CCW	<10 ms
as above	10 ms/.1 s CW (slowly)	as above	>100 ms
as above	1 ms/10 ms CW	as above	>10 ms
100/1K center	1 ms/10 ms CCW	1 ms/10 ms CCW	<1 ms
as above	.1 ms/1 ms CW	as above	>1 ms

1K/10K center	.1 ms/1ms CCW	.1 ms/1 ms CCW	<.1 ms
as above	10 us/.1 ms CW	as above	>.1 ms
10K/100K center	10 us/.1 ms CCW	10 us/.1 ms CCW	<10 us
as above	1 us/10 us CW	as above	>10 us
100K/1M center	1 us/10 us CCW	1 us/10 us CCW	<1 us
as above	.1 us/1 us CW	.1 us/1 us CCW	>1 us
as above	.1 us/1 us CCW	as above	<.1 us

SET RATE, VERNIER	SET DELAY, VERNIER	SET WIDTH VERNIER	VERIFY DELAY	
as above	10 ns/.1 us CW	as above	>100 ns	
as above	10 ns/.1 us CCW	as above	<10 ns	(Display CH1 & CH2; measure between rising edges at 50% points.)

8.4 Video Out vs RF Out

Set RF level to +5dBm. Using two coaxial cables of equal length, connect a level detector between UUT 'RF OUT' and channel 1 of the scope (50 ohms, 10 mV/div), and connect UUT 'VIDEO OUT' to channel 2 of the scope (50 ohms, 500 mV/div). Display CH1 and CH2; trigger scope on CH2 (+slope). Adjust CH1 volts/div vernier for waveforms of equal amplitude on both channels. Verify rising edges at 50% points are no more than 10 ns apart. (Note: The detector's negative output inverts its rising edge.)

8.5 Ext Trigger

Set UUT:
AM -- ext
AM/FM Rate -- 10K/100K, vernier CCW
AM/FM Sync Out -- connect to pulse ext in
Pulse Rate -- ext trig

Delay -- off
Width -- 10 us/.1 ms, vernier CCW

Connect scope channel 2 to PULSE 'VIDEO OUT' (50 ohms, 500 mV/div). Trigger scope on CH2, and display CH2. Adjust pulse width to about 40 us. Verify a modulation rate of 8 kHz ± 2 kHz.

8.6 Ext Pulse

Set pulse rate to ex pul. Verify a 50% duty cycle, ± 10%. Verify a modulation rate of 8 kHz, ± 2 kHz.

9.0 REMOTE MODULATION

Attach UUT to instrument controller via the IEEE-488 interface bus. Set UUT device address to 6.

Initialize UUT by sending the following command:

OUTPUT 706 "FAxxxx,LEVELO" (where "xxxx" represents any valid frequency).

9.1 Send the following commands and verify appropriate AM functions:

OUTPUT 706 "AM SINE" (internal AM, variable-rate sine)
OUTPUT 706 "PANEL AM" (front panel AM rate vernier activated)
OUTPUT 706 "PRESET AM" (preset AM rate pot activated)
OUTPUT 706 "AM SQR" (internal AM, variable-rate square wave)
OUTPUT 706 "AM FIXED" (internal AM, fixed 1 kHz square wave)
OUTPUT 706 "AM EXT" (external AM)
OUTPUT 706 "AM OFF" (AM deactivated)

9.2 Send the following commands and verify appropriate FM functions:

OUTPUT 706 "FM SINE" (internal FM, variable-rate sine)
OUTPUT 706 "PANEL FM" (front panel FM rate vernier activated)
OUTPUT 706 "PRESET FM" (preset FM rate pot activated)
OUTPUT 706 "FM TRI" (internal FM, variable-rate triangle wave)
OUTPUT 706 "FM FIXED" (internal FM, fixed 1 kHz triangle wave)
OUTPUT 706 "FM EXT" (external FM)
OUTPUT 706 "FM OFF" (FM deactivated)

9.3 Send the following commands and verify appropriate Pulse Modulation functions:

OUTPUT 706 "PULSE INT A" (10 Hz-100 Hz rate range selected)
OUTPUT 706 "DELAY G" (10 ms - .1 s delay range selected)
OUTPUT 706 "WIDTH F" (10 ms - .1 s width range selected)
OUTPUT 706 "PANEL RATE" (pulse rate vernier enabled)
OUTPUT 706 "PANEL DELAY" (pulse delay vernier enabled)
OUTPUT 706 "PANEL WIDTH" (pulse width vernier enabled)

9.3.1 Rate, Width and Delay ranges:

OUTPUT 706 "PULSE INT A" (10 Hz - 100 Hz)
OUTPUT 706 "DELAY F" (1 ms - 10 ms)
OUTPUT 706 "WIDTH F" (10 ms - .1 s)

OUTPUT 706 "PULSE INT B" (100 Hz - 1 kHz)
OUTPUT 706 "DELAY E" (100 us - 1 ms range)
OUTPUT 706 "WIDTH E" (1 ms - 10 ms range)

OUTPUT 706 "PULSE INT C" (1 kHz - 10 kHz)
OUTPUT 706 "DELAY D" (10 us - 100 us)
OUTPUT 706 "WIDTH D" (100 us - 1 ms)

OUTPUT 706 "PULSE INT D" (10 kHz - 100 kHz)
OUTPUT 706 "DELAY C" (1 us - 10 us)
OUTPUT 706 "WIDTH C" (10 us - 100 us)

OUTPUT 706 "PULSE INT D" (10 kHz - 100 kHz)
OUTPUT 706 "DELAY B" (100 ns - 1 us)
OUTPUT 706 "WIDTH B" (1 us - 10 us)

OUTPUT 706 "PULSE INT E" (100 kHz - 1 MHz)
OUTPUT 706 "DELAY A" (10 ns - 100 ns)
OUTPUT 706 "WIDTH A" (100 ns - 1 us)

9.3.2 Send the following commands and verify appropriate Pulse functions:

OUTPUT 706 "PULSE EXT" (external pulse mode)
OUTPUT 706 "PULSE TRIG" (external trigger mode)
OUTPUT 706 "PRESET RATE" (preset pulse rate pot activated)
OUTPUT 706 "PRESET DELAY" (preset pulse delay pot activated)
OUTPUT 706 "PRESET WIDTH" (preset pulse width pot activated)
OUTPUT 706 "PULSE OFF" (pulse modulation deactivated)

10.0 PULSE SHAPE

10.1 Check 50 us pulse width and 500 ns pulse width for each frequency shown on the test data sheet, as follows.

10.2 Set UUT:
RF Out -- +5 dBm
Pulse Rate -- 1K/10K, vernier CW
Pulse Delay -- off
Pulse Width -- 10 us/.1 ms, vernier centered

10.3 Adjust RF level and scope to get 5 divisions and centered, 10% and 90% are at +2 and -2 divisions. Verify overshoot and undershoot are <2 dBc.

10.4 Set pulse rate to off. Verify CW level equals the pulse level, $\pm$ 1dB.

10.5 Set pulse rate to 100K/1M, vernier CW. Set pulse width to 100 ns/1 us, vernier centered. Verify rise time and fall time are within specification and record values. Adjust RF level as required.

10.6 Repeat 10.2 through 10.5 for each frequency shown on the test data sheet.

11.0 MISCELLANEOUS FUNCTIONS

11.1 Check 'INT CLK 10 MHz' with scope (2 Vpp into 50 ohms).

11.2 Connect 'INT CLK OUT' to 'EXT CLK IN'; verify UUT unlocks.

11.3 EXTERNAL ALC

11.3.1 Set EXT ALC to enable position. Verify level display shows "-.----", UUT unleveled.

11.3.2 Connect 18 GHz directional coupler/detector to UUT RF Out. Connect detector output to EXT ALC input. Connect power meter to coupler RF output.

11.3.3 Adjust RF level switches to read +4 dBm on display. Adjust EXT ALC GAIN to read +4 dBm on power meter.

11.3.4 Set RF level switches to read -4 dBm on display. Adjust EXT ALC OFFSET to read -4 dBm on power meter.

11.3.5 Repeat 11.3.3 and 11.3.4 as required.

11.4 LEVEL CHECK

11.4.1 Connect power meter to UUT RF Out. Set UUT RF Level switches to 0.0 dBm. Increase level setting in .1 dB steps, to +0.9 dBm; verify steps on power meter, ± 0.1 dB.

11.4.2 Increase level setting in 1 dB steps, to 9 dBm; verify steps on power meter, ± 0.5 dB.

12.0 AM Depth and Distortion; FM Deviation

12.1 Connect the UUT's RF OUT to the spectrum analyzer. Connect the 10 MHz IF output from the spectrum analyzer to the input of the external modulation meter. Connect the AF output of the external modulation meter to the input of the distortion analyzer.

12.2 Set the UUT to an output frequency listed in the test data sheet, at +3 dBm, with all modulation off. Center the output signal on the spectrum analyzer.

12.3 Monitor AM/FM SYNC OUT (the output is a square wave) with the oscilloscope. Turn the AM switch to the internal SINE mode. Set the AM/FM RATE switch and vernier to read 1 kHz on the oscilloscope.

12.4 Set analyzer to "zero span" (time domain), linear vertical display, internal trigger mode. Adjust the AM vernier for an internal modulation meter reading of 80%. Verify an external modulation meter reading of 70-90%.

12.5 Adjust the AM vernier for an internal modulation meter reading of 20%, and verify an external modulation meter reading of 10-30%.

12.6 Adjust the AM vernier for an internal modulation meter reading of 50%, and verify an external modulation meter reading of 40-60%.

12.7 Verify a distortion meter reading within specification. Record in table on data sheet. Repeat 12.2 - 12.7 for other frequencys in table.

12.8 Attach a detector to the UUT's RF OUT connector. Monitor the detector's signal with the oscilloscope (terminate the detector into a 50 ohm load). Set the scope to 5 mV/div.

12.9 RF output at +5, AM at 1 kHz SINE. Adjust the AM vernier to see a waveform 6 divisions high on the scope (for that setting the internal modulation meter reading should be roughly 35%).

12.10 Check the AM frequency response: vary AM RATE across the 10 Hz - 50 kHz range, and verify that the amplitude of the detector output waveform is between 4 and 8 divisions throughout this range.

12.11 (Frequency Modulation Performance) In order to calibrate and test the frequency modulation circuits, a special test fixture must be assembled. The recommended FM test fixture includes an RF splitter, two delay lines of unequal length, and an RF mixer. The RF output of the UUT is divided by the splitter into two signals, unequally delayed. The required differential delay can be obtained by using two coaxial cables of, for example, 5 and 10 inches in length. The outputs of these delay lines are furnished to the two inputs of the RF mixer. For certain frequencies which may be identified by experiment, the mixer will produce a DC voltage near zero. The number of "null" frequencies can be increased by making the delay lines longer in absolute terms or by increasing the ratio between their lengths. If the output becomes frequency modulated, the mixer output voltage will change, and the voltage variation will be proportional to FM deviation. The polarity of the voltage change may be either directly or inversely related to the direction of frequency deviation. When voltage levels have been established for different frequencies, the mixer output can be monitored on an oscilloscope to provide a continuous display of FM deviation.

12.12 Connect the FM test fixture to the RF OUT connector of the UUT. Monitor the mixer output with the oscilloscope (5 mV/div). Set the

UUT to a null frequency (that is, at a frequency for which the mixer output voltage is zero -- see list of frequencies); +5 dBm out, no modulation.

12.13 Establish the voltages at 5 MHz above and 5 MHz below the null frequency. Adjust the oscilloscope gain and the UUT output power level (near +5 dBm) in order to place the null point at the center of the screen and the 5 MHz deviation points at 3 divisions above and 3 divisions below the null point.

12.14 Set the UUT to the FM internal SINE mode. Adjust the FM vernier for a modulation meter reading of 5 MHz deviation (FM position).

12.15 Verify that peak to peak deviation is less than 8 divisions, and greater than 4 divisions, at all FM rates from 10 Hz to 1 MHz (external mode). Check each frequency range.

12.16 Verify that the appropriate waveforms are visible in the other FM modes: 1 kHz TRIANGLE, variable TRIANGLE, and EXT (with a signal from the function generator applied to the FM input).

TEST DATA SHEET -- MODEL 600

Quality Assurance ______________ Tested By ________________________

Date _________ S/N _________ Model ____________________________

[X]

1. Frequency Range

[ ] 1.1 UUT is locked and leveled throughout its frequency range at +10dBm

2. Maximum Output Amplitude

[ ] 2.1 Maximum power exceeds +10dBm, $\pm$ 2dBm, throughout UUT's frequency range

3. Output Power Accuracy

[ ] 3.1 UUT meets the required power accuracy throughout its frequency range, accuracy $\pm$ 2dBm and flatness $\pm$ 1dB.

4. Frequency Accuracy ($\pm$ 1×10^{-6}) and Resolution

[ ] 4.1 1 MHz digit function

[ ] 4.2 10 MHz digit function

[ ] 4.3 100 MHz digit function

[ ] 4.4 1 GHz digit function

[ ] 4.5 10 GHz digit function

5. Spectral Purity/Step Attenuator

5.1 &5.2 Record readings for all of the following frequencies that are available in the instrument being tested (table on following page). Frequencies are in MHz. RF level setting is 0 dBm. The second harmonic for each frequency is given in brackets.

FREQUENCY	SECOND HARMONIC	SPURIOUS (SPAN: 1 GHz TO 50 kHz)	NOISE @10 kHz 1 Hz BW	LINE/FAN RELATED	ON/OFF RATIO
spec:	≤ -40 dB	≤ -55 dB	≤ -75 dB	< -40 dB (-45 dB Typ)	≥ 80 dB
5447.742 [10895.434]	________	________	________	________	______
9182	n/a	________	________	________	______
12317	n/a	________	________	________	______

[ ] 5.3 10 dB Step Attenuator, accuracy ± 2dBm. Tested @ Fmin + 47 MHz

6. AM Functions

[ ] 6.1 AM/FM Sync Out (TTL levels)

[ ] 6.2 AM/FM Rate -- Variable (10-100, 100-1K, 1K-10K, 10K-100K)

[ ] 6.3 AM Sine wave, variable rate

[ ] 6.4 AM Square wave, variable rate, modulation reading >90%.

[ ] 6.5 AM Square wave, fixed 1.000 kHz

[ ] 6.6 External AM

7. FM Functions

[ ] 7.1 FM Sine wave, variable rate, modulation reading >5.0 MHz

[ ] 7.2 FM Triangle wave, variable rate

[ ] 7.3 FM Triangle wave, fixed 1.000 kHz

[ ] 7.4 External FM

8. Pulse Modulation Functions

[ ] 8.1 Internal Pulse Rate (10 Hz to 1 MHz)

[ ] 8.2 Pulse Width (100 ns to 100 ms)

[ ] 8.3 Pulse Delay (10 ns to 100 ms)

[ ] 8.4 Video Out vs. RF Out

[ ] 8.5 External Trigger

[ ] 8.6 External Pulse

9. Remote Modulation

[ ] 9.1 Remote AM

[ ] 9.2 Remote FM

[ ] 9.3 Remote Pulse Modulation

10. Pulse Shape

Record readings for all of the following frequencies that are available in the instrument being tested.

FREQUENCY	RISE TIME	FALL TIME
spec:	$\leq$ 50 ns	$\leq$ 50 ns
6500	________	________
8500	________	________
11500	________	________

11. Miscellaneous Functions

[ ] 11.1 10 MHz INT CLK Output, 2 Vpp into 50 ohms

[ ] 11.2 10 MHz EXT CLK

[ ] 11.3 External ALC

[ ] 11.4 Level check (1 dB & .1 dB increments)

12. AM Depth and Distortion; FM deviation

Record readings for all of the following frequencies that are available in the instrument being tested.

FREQUENCY	AM DEPTH (%)	AM DISTORTION
spec:	50% $\pm$ 10%	$\leq$ 10% @ 1 kHz
6500	________	________
8500	________	________
11500	________	________

FM DEVIATION 5 MHz $\pm$ 3dB

[ ] 6514

[ ] 11213

MAINTENANCE

5.0 Introduction

During the warranty period of the instrument, it is recommended that no user initiated service work be performed without first communicating with the factory (or our authorized representative). Often the problem can be readily isolated to a particular plug-in module, for which a replacement can be sent.

C A U T I O N

This instrument contains many MOS and CMOS devices; be sure to use appropriate anti-static procedures whenever it is necessary to handle them.

The larger integrated circuits are plugged into locking sockets. To release the locking mechanism, insert a small screwdriver in the slot at the "pin 1" end of the socket. Press down gently and tilt the screwdriver toward the socket. The IC may now be removed easily. To insert, just press the IC firmly into place, making certain all pins are straight and centered in their guides.

Never remove an IC from its socket unnecessarily.

It may become necessary to work on the interior of the instrument while it is plugged in and power is on; circuit boards may be placed on extender cards for the purpose of observing their operation within the system. However, circuit boards and other electronic devices must not be inserted into or removed from the instrument while power is being applied to it! Always unplug the instrument before making such changes.

5.1 Troubleshooting Procedure

If the instrument appears to be operating abnormally, the following procedure may be used to isolate the problem and identify the probable cause. Nine major areas of potential failure are discussed:

- 5.1.1 -- Instrument does not function; displays are blank or erratic.
- 5.1.2 -- No measurable output power.
- 5.1.3 -- RF output is at wrong power level.
- 5.1.4 -- RF output frequency is unlocked.
- 5.1.5 -- RF output is locked, but at the wrong frequency.
- 5.1.6 -- FM malfunction.
- 5.1.7 -- AM malfunction.
- 5.1.8 -- Pulse malfunction.
- 5.1.9 -- IEEE-488 interface malfunction.

EACH PROBLEM AREA IS ANALYZED WITH REFERENCE TO THE TROUBLESHOOTING NOTES INCLUDED IN SECTION 5.2. (e.g., "SEE NOTE 5").

Refer to 5.1.9 (IEEE-488 interface malfunction) for any problem which occurs only while the instrument is under remote control.

Some improper control settings will cause an error message to be displayed; see page 1-7 for a list of error messages.

5.1.1 GENERAL FAILURE

Symptoms: The instrument does not respond appropriately to commands given via the front panel controls or IEEE-488 interface; the readouts are blank, erratic, or fixed in one state.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check computer (see note 2).

5.1.2 LOSS OF RF OUTPUT

Symptoms: No measurable power is present at the output connector, regardless of the RF level setting. The front panel 'LEVEL' indicator may or may not be lit.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check 10 dB step attenuator (see note 3).

Check modulator (see note 4).

Check YIG oscillator (see note 5).

5.1.3 INCORRECT OUTPUT LEVEL

Symptoms: Output power is at a level other than that selected by the RF level setting. The front panel 'LEVEL' indicator may or may not be lit.

RECOMMENDATIONS:

Before proceeding, be sure that the selected RF level is within the capability of the instrument. Although the instrument must meet a maximum power specification, the actual maximum will be somewhat in excess of this, and will vary for different frequencies. When exceeding the normal power range, the 'LEVEL' indicator may go out and the instrument's RF output may fall below the level requested.

Check power supplies (see note 1).

If level error is a 10 dB multiple (e.g., -20 dBm instead of +10 dBm), check 10 dB step attenuator (see note 3).

Check leveler (see note 6).

Check detector (see note 7).

Check level control circuit (see note 8).

5.1.4 OUTPUT FREQUENCY UNLOCKED

Symptoms: The 'LOCK' indicator on the front panel is dark whenever any phase lock loop circuit in the instrument is unlocked. The output frequency will drift; the degree of frequency error depends on where the fault is.

RECOMMENDATIONS:

Check power supplies (see note 1).

Determine which loop is unlocked (see note 9). If more than one is unlocked, work backwards from the output PLL as described below.

Check output PLL (see note 10).

Where fault is isolated to the output PLL's variable input, check the 'divide-by-N' circuit on the frequency divider board (see note 11).

Check 300 MHz oscillator (see note 12).

Check 300 MHz PLL (see note 13).

Check YIG driver (see note 14).

Check 110 MHz oscillator/multiplier (see note 15).

Check 110 MHz PLL (see note 16).

Check 10 MHz master reference (see note 17).

Where fault is isolated to the output PLL's reference input, check the 'divide-by-8' circuit on the frequency divider board (see note 18).

Check 40-80 MHz PLL (see note 19).

Check intermediate PLL (see note 20).

Check 10-12 MHz PLL (see note 21).

Check 110 MHz oscillator/multiplier (note 15).

Check 110 MHz PLL (note 16).

Check 10 MHz master reference (see note 17).

5.1.5 OUTPUT LOCKED, BUT FREQUENCY INCORRECT

Symptoms: The 'LOCK' indicator is illuminated; the output frequency is stable, but incorrect.

RECOMMENDATIONS:

The troubleshooting procedure is the same as for the unlocked condition described in section 5.1.4 above. The same circuits are likely to be at fault, even if there is no indication of unlock; the problem may be caused by improper control or reference inputs rather than by complete circuit failure.

5.1.6: FM MALFUNCTION

Symptoms: The instrument does not frequency modulate its RF output in accordance with the operator's commands.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check FM driver (see note 22).

Check output PLL (see note 23).

Check modulation generator (see note 24).

5.1.7: AM MALFUNCTION

Symptoms: The instrument does not amplitude modulate its RF output in accordance with the operator's commands.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check leveler (see note 25).

Check level control (see note 26).

Check modulation generator (see note 27).

5.1.8: PULSE MODULATION MALFUNCTION

Symptoms: Instrument does not pulse modulate its RF output in accordance with the operator's commands.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check pulse modulator (see note 28).

Check modulation generator (see note 29).

Check delay/width generator (see note 30).

5.1.9: IEEE-488 INTERFACE MALFUNCTION

Symptoms: Instrument does not respond appropriately to commands sent via the interface, or exhibits a particular malfunction (see 5.1.1 through 5.1.8 above) only while under remote control.

RECOMMENDATIONS:

Check power supplies (see note 1).

Check GPIB address (see note 31).

Verify that commands used are appropriate to this instrument (see note 32).

Check IEEE-488 circuit (see note 33).

5.2 TROUBLESHOOTING NOTES

NOTE 1 -- POWER SUPPLIES

This is the common denominator among malfunctions of all types. Because the instrument has many regulated supplies, and they are not all used by all circuits, it is possible for the failure of a single supply to disable only a part of the system. For this reason power supply voltages should be checked whenever there is an instrument malfunction, even though the malfunction may seem too limited or specialized to have such a cause.

The power supply circuit board (A101) is located at the rear of the instrument; filter capacitors C1 through C4 are located along the left side of the instrument beside the computer boards. The individual supplies are:

Computer +5 volts. Used by the computer, TTL circuits, etc. Test point: CPU Bus (A102), J2, pins 57-60 (any card slot). Wire color: red.

RF +5 volts. Used by PLL circuits and other RF circuits. Test point: RF Bus (A103) pins 2/B (any card slot). Wire color: red.

-5.2 volts. Used by ECL-type high speed logic circuits, frequency dividers, etc. Test point: RF Bus, pins 4/D. Wire color: green.

+15 volts. Used by YIG oscillator. Test point: YIG. Wire color: blue.

+24 volts. Used to drive the cooling fan, and also the relays in the 10 dB step attenuator. Test point: PS Capacitor C3, plus terminal. Wire color: blue/orange/white.

+18 volts #1. Used by amplifiers, drivers, etc. Secondary regulators on circuit boards convert the supply to a lower voltage where necessary. Test point: RF Bus, pins 5/E. Wire color: blue/orange.

+18 volts #2. Used as heater voltage and tuning coil current source for YIG oscillator. Test point: YIG. Wire color: blue/orange.

-18 volts. Used by amplifiers, drivers, etc. Secondary regulators on circuit boards convert the supply to a lower voltage where necessary. Test point: RF Bus, pins 3/C. Wire color: violet/orange.

+35 volts. Used by the fluorescent display drivers. Test point: terminal 'C' on CPU bus. Wire color: grey.

8 VAC. Used by the fluorescent display heaters. Also tied to computer +5 volt DC supply. Test point: terminals 'A' and 'B' on CPU bus (two violet wires). AC must be measured across the terminals, not to ground.

Instruments in which option 06 (the high stability timebase) is installed have an additional voltage output, the +15 volt supply. This supply is independent of the power switch, and should be "on" whenever AC power is applied to the instrument. Test point: high stability oscillator. Wire color: blue/black.

CORRECTIVE ACTION

Check the line fuse; replace it if it is open. If the new fuse opens, check the power supply primary and secondary circuits.

If any supply output is at an incorrect voltage, remove all plug-in circuit boards. If the overload ceases, replace the boards one at a time to isolate the fault. If the overload persists, open the supply regulator output and verify regulator input and output voltages.

NOTE 2 -- THE COMPUTER

All instrument functions are controlled by the computer, and a general computer failure will lead to a general system failure. The computer is based on the Motorola 6809 microprocessor. It uses a bus architecture which corresponds on a one-to-one basis with the signals from and to the 6809 chip itself, with two exceptions: the DMA/BREQ signal into the 6809 is not used, and the three high order address lines from the 6809 are decoded (on the CPU board) into eight page-lines for the bus.

CORRECTIVE ACTION

Four circuit boards house the computer:

A1 -- This is the Display PIA board, which acts as an interface between the microprocessor and other devices, including the front panel readouts.

A2 -- This is the Memory board, which holds the ROM devices in which the instrument's operating software is stored, as well as the RAM chips used by the computer for temporary data storage.

A3 -- This is the IEEE-488 board; it includes the circuits which act as an interface between the computer and the remote control bus. The board also houses circuits through which the computer controls the instrument's digital to analog converters.

A4 -- This is the CPU board, which houses the microprocessor and some of the control logic through which it runs the instrument.

When a computer failure is suspected, the best way to troubleshoot the system is to isolate the problem to board level by substituting known good PC boards. If the problem persists with four known good boards, the problem is most likely on the computer bus board (the motherboard) into which the computer boards are plugged. Many computer problems are caused by dirt on the connections between these boards.

If the computer seems to have become "lost", it can be reset either by pressing the reset button on the CPU board (A4) or by turning the power switch off and on.

NOTE 3 -- 10 dB STEP ATTENUATOR

The programmable attenuator is capable of attenuating the RF output by as much as 110 dB; if the output is not at the desired power level, the cause may be that the attenuator is improperly set. Note that the attenuator is outside of the leveling loop, and therefore the leveling system cannot detect, or compensate for, attenuator errors.

CORRECTIVE ACTION

The programmable attenuator's internal structure includes a series of relays which add or remove lossy elements in combination (10 dB, 20 dB, 40 dB, etc.) to achieve the desired total attenuation. The relay drivers which select these increments are located on the leveling circuit board (A5). Verify that the attenuator is receiving the appropriate drive signals; if not, investigate the drivers on the leveling board and the computer logic lines which control them.

NOTE 4 -- MODULATOR

The RF path through the microwave module is divided into two or more (depending on output bandwidth) filter lines; pulse modulation is normally accomplished by turning the active path "off" at intervals. If the filter select/modulator control line for the active path is held at the "off" logic level, the RF signal will be shut down.

CORRECTIVE ACTION

The filter select/modulator control lines applied to the RF module have voltage levels of roughly +1 volt (for "off") and -1 volt (for "on"). The signals originate on the modulation generator board (A105). If inappropriate signals are received, investigate the driver circuits on that board and the computer logic lines which control them.

NOTE 5 -- YIG OSCILLATOR

All YIG oscillators require +15V and +18V supplies; the 2-8 and 6-12 GHz YIGs also require a -5V supply. In addition to the power supply requirements, the YIG oscillator must have current supplied to its tuning coil within an appropriate range in order to generate an RF output of any kind. If tuning coil current is excessive or insufficient, there will be no signal.

CORRECTIVE ACTION

The easiest way to measure coil current is to read the voltage drop across the sense resistor. This is a large, high-wattage, metal-encased resistor (usually 5 or 7 ohms, depending on the oscillator used) mounted near the YIG. One end is grounded, and the other is connected (through an NPN transistor controlled by the YIG driver board, A13) to the negative end of the YIG oscillator tuning coil. The voltage across the sense resistor, divided by its resistance, equals the coil current.

Since the tuning sensitivity of the YIG oscillator is 20 MHz/mA, the current (in Amps) for a given frequency may be found by dividing the frequency (in GHz) by 20. Current values corresponding to frequencies outside the range of the oscillator will shut the oscillator down.

If the coil current is out of range, investigate the NPN transistor and the YIG oscillator circuit (A13) which drives its base.

NOTE 6 -- LEVELER

The signal path through the RF module includes a voltage controlled attenuator circuit, or "leveler". The level control circuit board (A5) has an output which uses complementary transistors to drive the leveler pin on the outside of the module. The leveler increases attenuation as the input becomes more positive, and reduces attenuation as the input becomes more negative; sensitivity to the control voltage varies for individual instruments. The voltage swing as measured at the module's leveler pin, is (very roughly) from -14 volts to +2 volts.

CORRECTIVE ACTION

When the output level is incorrect, the leveler input voltage may be clearly inappropriate in a way which indicates the cause of the problem. If output power is too low, and the leveler at the positive rail (maximum attenuation), the level control circuit is reducing the output power by sending a bad control signal; if output power is too low and the leveler at the negative rail (minimum attenuation), the level control circuit is trying unsuccessfully to compensate for power loss occurring somewhere in the RF path (the loss could be in the RF module itself).

If power is too high, and the leveler at the positive rail (maximum attenuation), the leveler circuit within the module is faulty; if power is too high and the leveler at the negative rail (minimum attentuation), the level control circuit is increasing the output power by sending a bad control signal.

If the level control voltage is between the extremes of its range, but the output level is still incorrect, the fault is probably in the level control circuit (A5).

A failure of the leveler or other circuits in the RF module is unlikely, but can be caused by excessive reverse power applied at the instrument's RF output connnector.

NOTE 7 -- DETECTOR

The instrument's leveling system requires feedback from the RF path in order to control output power. This is provided by a negative-output diode detector, driven by a signal coupled from the RF output. The internal detector is mounted directly on the level coupler output of the RF module.

An external detector can also be used, by attaching the cable from the external detector to the external ALC input on the rear panel.

CORRECTIVE ACTION

A failure of the internal detector itself is unlikely, but it is important to verify that the detector signal is in fact being received by the level control board (A5). When there is an apparent failure of the leveling system, disconnecting the detector cable and observing the resulting changes is often a revealing experiment.

Be sure that the correct levelling mode is activated (external ALC should not be enabled unless an external detector is in use).

NOTE 8 -- LEVEL CONTROL CIRCUIT

The level control circuit board (A5) is basically a loop amplifier which must balance a variable input (feedback from the level detector) against a reference signal. The detector can be either the internal detector mounted outside the RF module, or a remote detector (in the external ALC mode). The reference signal is derived from a combination of three inputs: the leveling reference programmed by the system computer, the correction signal from the temperature compensation circuit board (A112), and the AM signal, if any, from the modulation generator board (A105). The level control circuit, using its output to drive the leveler in the RF module, adjusts output power in whichever direction will equalize the reference and variable inputs to the loop amplifier. So long as the output is between the extremes of its control range, the output is considered to be "leveled" and the indicator on the front panel will remain lit.

CORRECTIVE ACTION

If the 'LEVEL' indicator on the front panel is dark, the leveler output should be at one extreme or the other of its control range, and comparing the control signal with the result will indicate the nature of the problem (see note 6 above). If the indicator is lit, the control signal should be within its control range, and if the output power is nevertheless incorrect, it is likely that the level control circuit is receiving a bad input, is defective, or has been incorrectly calibrated.

If possible, replace the level control circuit with a known good board. Make sure that the potentiometers on the board have not been improperly adjusted (see the calibration procedure in Section 4). Check all inputs and control signals to the board, including the input from the temperature compensation board, the data lines to the digital/analog converter, the AM input, the AM control line, and the detector input. Be sure that the instrument has not been set to the wrong leveling mode (if an external detector is not being used, external ALC should be off).

An excellent way to investigate a problem in the leveling system is to break the loop, by disconnecting the detector or the leveler control line, and observe the resulting changes.

NOTE 9 -- INDIVIDUAL PLL LOCK INDICATORS

Each of the six phase lock loop circuit boards has a lock indicator, in the form of an LED which is dark only for the "locked" condition.

CORRECTIVE ACTION

Determine which PLL or PLLs are unlocked. The relevant boards are:

A6 (output PLL)
A8 (40-80 MHz PLL)
A9 (intermediate PLL, Option 03)
A10 (10-12 MHz PLL Option 03)
A11 (300 MHz PLL)
A12 (110 MHz PLL)

If two or more loops are unlocked, it is possible that one unlocked loop is disabling "subsequent" loops which use the output of the first as a reference. The hierarchy of the loops, in terms of this dependency, may be divided into two branches terminating in the reference and variable inputs to the output PLL:

REFERENCE BRANCH	VARIABLE BRANCH
A12 (110 MHz PLL)	A12 (110 MHz PLL)
--option 03 only: --A10 (10-12 MHz PLL) --A9 (intermediate PLL)	A11 (300 MHz PLL)
A8 (40-80 MHz PLL)	
A6 (output PLL)	A6 (output PLL)

NOTE 10 -- OUTPUT PHASE LOCK LOOP

This circuit is located on the A6 PC board.

CORRECTIVE ACTION

Verify appropriate inputs from the divide-by-N circuit and the divide-by-8 circuit (see A7) and control line status (FM on/off).

The output to the FM driver (A103) goes more negative to increase the YIG output frequency, more positive to decrease frequency -- be sure that the PLL output is not driving the YIG oscillator in the wrong direction.

Verify that the output signal is reaching the FM driver, and that the driver's output is reaching the YIG oscillator FM coil and is being fed back to the output amplifier of the PLL.

If possible, replace the circuit with a known good board.

NOTE 11 -- DIVIDE-BY-N

This circuit is one half of the frequency divider PC board (A7).

CORRECTIVE ACTION

Verify that the appropriate IF is being received from the 300 MHz oscillator circuit board (A104).

Verify that the circuit is being programmed with the correct divisor.

Verify that the IF is being correctly divided and that the output signal is reaching the output PLL (A6).

If possible, replace the circuit with a known good board.

NOTE 12 -- 300 MHz OSCILLATOR

This circuit board (A104) is encased in an aluminum housing mounted on the microwave deck, directly beneath the RF module.

CORRECTIVE ACTION

This circuit is mounted in an inaccessible location; the most that can normally be done to investigate it in the field is to verify that the RF input from the RF module coupler, the two phase detector inputs from the 300 MHz PLL (A11), and the IF output to the divide-by-N (A7) are all present.

NOTE 13 -- 300 MHz PLL

This circuit is located on the A11 PC board.

CORRECTIVE ACTION

Verify appropriate inputs (from the 110 MHz oscillator/multiplier, 10 MHz master reference, and feedback from the 300 MHz oscillator) and control signals (from the computer).

Verify that the phase detector outputs for controlling the VCO are present and are reaching the 300 MHz oscillator.

If possible, replace the circuit with a known good board.

NOTE 14 -- YIG DRIVER

This circuit is located on the A13 PC board.

CORRECTIVE ACTION

If this circuit is tuning the YIG oscillator to the wrong frequency, the error may be too large for the output PLL to correct. The problem sometimes occurs after incorrect adjustment of the "MIN" and "MAX" pots, in which case the output loop may be able to lock at some frequencies but not others. If the instrument develops phase lock problems after calibration of the YIG driver, try repeating the adjustment. Be sure to follow the correct calibration procedure as outlined in Section 4.

If the driver calibration is not to blame for the unlocked condition, attempts to adjust it may only aggravate the problem. Therefore, it is a good idea to determine first whether the driver output is approximately correct for the requested output frequency.

As described in note 5 above, the oscillator tuning coil has a sensitivity of 20 MHz/mA. The NPN transistor which controls the coil current is driven at its base by a control voltage from the YIG driver. Because of large variations in coil impedence it is not possible to specify a "correct" voltage. However, it should be a positive voltage increasing with frequency at a rate of roughly 650 mV/GHz. A more exact idea of the coil current can be obtained from the voltage drop accross the sense resistor (see note 5).

If the driver output seems substantially wrong, the cause could be bad control data to the digital/analog converter as well as bad calibration.

If possible, replace the circuit with a known good board.

NOTE 15 -- 110 MHz OSCILLATOR/MULTIPLIER

This circuit board (A113) is encased in an aluminum housing mounted on the underside of the microwave chassis.

CORRECTIVE ACTION

This circuit is mounted in an inaccessible location; the most that can normally be done to investigate it in the field is to verify that the tuning input is being received from the 110 MHz PLL (A12) and that the doubler and tripler outputs (220 and 330 MHz) are present and are reaching their destinations.

NOTE 16 -- 110 MHz PLL

This circuit is located on the A12 PC board.

CORRECTIVE ACTION

Verify that the 10 MHz master reference input is being received.

Verify that the 110 MHz input is being received.

If possible, replace the circuit with a known good board.

NOTE 17 -- 10 MHz MASTER REFERENCE

The internal timebase is located between the front panel and the power supply; the 10 MHz input/output circuit is located on the 110 MHz PLL circuit board (A12).

CORRECTIVE ACTION

Verify that the signals from the internal timebase, and from the external timebase (if any), are being received by the 10 MHz input/output circuit.

Verify that the 10 MHz signal from the input/output circuit is reaching the various PLL circuits which require it.

NOTE 18 -- DIVIDE-BY-8

This circuit is one-half of the frequency divider PC board (A7).

CORRECTIVE ACTION

Verify that the frequency input is being received from the 40-80 MHz PLL (A8).

Verify that the input is being divided by 8 and that the output signal is reaching the output PLL (A6).

If possible, replace the circuit with a known good board.

NOTE 19 -- 40-80 MHz PLL

This circuit is located on the A8 PC board.

CORRECTIVE ACTION

Verify that the 10 MHz input is being received from the master reference.

If option 03 is installed, verify that the 225-226 MHz input is being received from the intermediate PLL (A9). If option 03 is not installed, verify that the 220 MHz input is being received from the 110 MHz oscillator/mutliplier (A113).

Verify that the 40-80 MHz output is reaching the divide-by-8 circuit (A7).

If possible, replace the circuit with a known good board.

NOTE 20 -- INTERMEDIATE PLL

This circuit is located on the A9 PC board. It is present only in instruments with option 03.

CORRECTIVE ACTION

Verify that the 220 MHz input is being received from the 110 MHz oscillator/multiplier (A113).

Verify that the 10-12 MHz input is being received from the 10-12 MHz PLL (A10).

Verify that the 225-226 MHz output is reaching the 40-80 MHz PLL (A8).

If possible, replace the circuit with a known good board.

NOTE 21 -- 10-12 MHz PLL

This circuit is located on the A10 PC board. It is present only in instruments with option 03.

CORRECTIVE ACTION

Verify that the 220 MHz input is being received from the 110 MHz oscillator/multiplier (A113).

Verify that the 10 MHz input is being received from the master reference.

Verify that the 10-12 MHz output is reaching the intermediate PLL.

If possible, replace the circuit with a known good board.

NOTE 22 -- FM DRIVER

This circuit is located on the RF bus board, A103.

CORRECTIVE ACTION

Verify that the FM input signal is being received from the output PLL circuit (A6).

Verify that the output signal is reaching the YIG oscillator FM coil's negative terminal and is also being fed back to the output PLL. This output goes more negative to increase frequency, more positive to decrease.

NOTE 23 -- OUTPUT PHASE LOCK LOOP (FM)

This circuit is located on the A6 PC board.

CORRECTIVE ACTION

Verify that the FM input signal is being received from the modulation generator board (A105).

Verify that the FM control line line is activating the FM mode.

Verify that the FM output signal is reaching the FM driver (A103) and that the driver output is being fed back to this circuit.

If possible, replace the circuit with a known good board.

NOTE 24 -- MODULATION GENERATOR (FM)

This circuit is located on the A105 PC board.

CORRECTIVE ACTION

Verify that all control inputs are appropriate to the FM mode selected (e.g., remote or local control, internal or external FM, etc.), and that an external modulation input (if applicable) is being received.

Verify that the FM output signal is reaching the output PLL (A6).

NOTE 25 -- LEVELER (AM)

The RF module's variable attenuator, described in note 6 above, is used for amplitude modulation as well as for RF leveling.

CORRECTIVE ACTION

Verify that the control signal is being received from the level control circuit (A5). The control pin should go more positive to increase attenuation, more negative to reduce attenuation.

NOTE 26 -- LEVEL CONTROL CIRCUIT (AM)

This circuit is located on the A5 PC board.

CORRECTIVE ACTION

Verify that the AM input signal is being received from the modulation generator (A105) and that the AM mode is being selected by the control input.

Verify that the AM signal is present on the output to the leveler.

If possible, replace the circuit with a known good board.

NOTE 27 -- MODULATION GENERATOR (AM)

This circuit is located on the A105 PC board.

CORRECTIVE ACTION

Verify that all control inputs are appropriate to the AM mode selected (e.g., remote or local control, internal or external AM, etc.), and that an external modulation input (if applicable) is being received.

Verify that the AM output signal is reaching the level control board (A5).

NOTE 28 -- MODULATOR

The RF module's filter select/modulation lines, described in note 4 above, are used for pulse modulation.

CORRECTIVE ACTION

Verify that the filter select/modulation control pin which is active for the requested output frequency has positive pulses corresponding with the "off" periods of the instrument's RF output; these should be received from the modulation generator (A105).

NOTE 29 -- MODULATION GENERATOR (PULSE MODULATION)

This circuit is located on the A105 PC board.

CORRECTIVE ACTION

Verify that all control inputs are appropriate to the pulse mode selected (e.g., remote or local control, internal or external trigger, etc.), and that an external modulation input (if applicable) is being received.

Verify that there is continuity for modulation and control signals between this board and the delay/width generator board (see note 30 below).

Verify that the modulation output is reaching the appropriate pulse modulator pin on the RF module, and that the sync and video outputs are reaching the front panel connectors.

NOTE 30 -- DELAY/WIDTH GENERATOR (PULSE MODULATION)

This circuit is located on the A106 PC board, and is used in the internal and external trigger modes; it is bypassed in the external pulse mode.

CORRECTIVE ACTION

Verify that the modulation signal is being received from the modulation generator board (A105) and is being returned to that board after delay and/or width conditioning. Verify that the delay and width select lines from the modulation generator board are reaching the diode switches which activate the appropriate timing capacitors.

NOTE 31 -- GPIB ADDRESS

The DIP switches which set the address are located on the A110 PC board, which is mounted at the rear panel.

CORRECTIVE ACTION

Verify that the address assigned to the instrument by the GPIB bus controller is properly set (in the form of a 5-place binary number) by the five switches located on the rear panel. If the address is set incorrectly, the instrument will ignore all IEEE-488 commands.

NOTE 32 -- COMMANDS

Section 1 includes a full description of the syntax and commands appropriate to the operation of the Series 600 under remote control using the IEEE-488 interface bus. Be sure that any remote commands issued to the instrument conform to the guidelines set out in that description.

NOTE 33 -- IEEE-488 INTERFACE CIRCUIT

This circuit is found on the A3 PC board.

CORRECTIVE ACTION

Verify that this circuit's data and control lines have continuity to the rear panel connector and to the CPU. If possible, replace the circuit with a known good board.

5.3 Electrical Interconnections Within Model 600

Most of the instrument's circuits are housed in replaceable plug-in modules; connections between these circuits are made by means of wires, ribbon cables, and bus-board traces. This list of interconnections is provided for purposes of continuity checking.

Circuit boards A1 through A5 are inserted in the computer bus board (A102), which includes several headers (P1, P2 etc.) for ribbon connectors. PC boards A1-A5 have three edge-connectors: J1 (34 pins), J2 (60 pins), and J3 (26 pins). Even numbers designate pins on the solder side of the board, odd numbers designate pins on the component side. Boards A6 through A13 are similarly inserted in the RF bus board, A103, which includes two headers (P1 and P2) for ribbon connectors. PC boards A6-A13 have a single 44-pin edge connector (letters designate pins on the solder side of the board, numbers 1 through 22 designate pins on the component side). The computer and RF bus boards contain printed traces which provide connections between the circuits mounted on them. The instrument's other circuits are mounted independently and are interconnected by wires, coaxial cables, and ribbon cables.

A1--101CA29500, DISPLAY PIA

from:	to:	notes:
A1-J1-2	A102-P5-18	DDF 1
A1-J1-3	A102-P5-10	FSEG h
A1-J1-4	A102-P5-5	FSEG e
A1-J1-5	A102-P5-8	DDF 0
A1-J1-6	A102-P5-7	FSEG d
A1-J1-7	A102-P5-4	FSEG f
A1-J1-8	A102-P5-13	DDF 2
A1-J1-9	A102-P5-16	FSEG c
A1-J1-10	A102-P5-14	DDF 3
A1-J1-11	A102-P5-15	FSEG b
A1-J1-12	A102-P5-11	DDF 4
A1-J1-13	A102-P5-3	DDF 7
A1-J1-14	A102-P5-12	DDF 5
A1-J1-15	A102-P5-17	FSEG a
A1-J1-16	A102-P5-9	DDF 6
A1-J1-21	A102-P4-22	DDP 2
A1-J1-22	A102-P5-6	FSEG y
A1-J1-23	A102-P4-25	PSEG t
A1-J1-24	A102-P4-18	DDP 0
A1-J1-25	A102-P4-8	PSEG c
A1-J1-26	A102-P4-16	PSEG y
A1-J1-27	A102-P4-26	DDP4
A1-J1-28	A102-P4-14	PSEG f
A1-J1-29	A102-P4-4	PSEG a
A1-J1-30	A102-P4-20	DDP 1
A1-J1-31	A102-P4-6	PSEG b
A1-J1-32	A102-P4-12	PSEG e
A1-J1-33	A102-P4-24	DDP 3
A1-J1-34	A102-P4-10	PSEG d

from:	to:	notes:
A1-J2-1 THRU -4	J2-1 THRU J2-4, A2 THRU A5	(GND)
A1-J2-11 THRU -50	J2-11 THRU J2-50, A2, A3, A4	(BUS)
A1-J2-53 & -54	A102-P3-5 & 6, AND J2-53 & -54, A2 THRU A5	(-18V)
A1-J2-55 & -56	A102-P3-1 & 2, AND J2-55 & -56, A2 THRU A5	(+18V)
A1-J2-57 THRU -60	A102-P3-7 & 8 AND J2-57 THRU -60, A2 THRU A5	(+5V)
A1-J3-1	A102-P2-4	TWS D4
A1-J3-2	A102-P2-3	TWS D8
A1-J3-3	A102-P2-6	TWS D1
A1-J3-4	A102-P2-5	TWS D2
A1-J3-5	A102-P2-8	TWS STB C
A1-J3-6	A102-P2-7	TWS STB D
A1-J3-7	A102-P2-10	TWS STB A
A1-J3-8	A102-P2-9	TWS STB B
A1-J3-10	A102-P3-14	
A1-J3-11	A102-P2-11	SPARE
A1-J3-14	A102-P3-13	
A1-J3-16	A102-P3-12	
A1-J3-17	A102-P2-17	SPARE
A1-J3-18	A102-P3-11	
A1-J3-19	A102-P2-19	
A1-J3-20	A102-P4-28	(+) SIGN
A1-J3-22	A102-P1-22	FILT SEL 2
A1-J3-24	A102-P1-24	SEL/NOT 2
A1-J3-26	A102-P1-26	FILT SEL 0

A2--101CA35700, MEMORY

NOTE: Connectors J1 and J3 are absent from PC board A2

from:	to:	notes:
A2-J2-1 THRU -4	(GND)	SEE A1 J2
A2-J2-11 THRU -50	BUS	SEE A1 J2
A2-J2-53 & -54	(-18 V)	SEE A1 J2
A2-J2-55 & -56	(+18 V)	SEE A1 J2
A2-J2-57 THRU -60	(+5V)	SEE A1 J2

A3--101CA06700, IEEE PIA

from:	to:	notes:
A3-J1-1	A102-P6-2 & INTFC ADDRESS	DEVICE ADDRESS BIT A4
A3-J1-2	A102-P6-1 & INTFC ADDRESS	GND
A3-J1-3	A102-P2-4 & INTFC ADDRESS	DEVICE ADDRESS BIT A3
A3-J1-4	A102-P2-3 & INTFC ADDRESS	GND
A3-J1-5	A102-P2-6 & INTFC ADDRESS	DEVICE ADDRESS BIT A2
A3-J1-6	A102-P6-5 & INTFC ADDRESS	GND
A3-J1-7	A102-P6-8 & INTFC ADDRESS	DEVICE ADDRESS BIT A1
A3-J1-8	A102-P6-7 & INTFC ADDRESS	GND
A3-J1-9	A102-P6-10 & INTFC ADDRESS	DEVICE ADDRESS BIT A0

from:	to:	notes:
A3-J1-10	A102-P6-9 & INTFC ADDRESS	GND
A3-J1-11	A102-P6-12 & REMOTE	SHIELD PIN 12
A3-J1-12	A102-P6-11 & REMOTE	GND PIN 24
A3-J1-13	A102-P6-14 & REMOTE	ATN PIN 11
A3-J1-14	A102-P6-13 & REMOTE	GND PIN 23
A3-J1-15	A102-P6-16 & REMOTE	SRQ PIN 10
A3-J1-16	A102-P6-15 & REMOTE	GND PIN 22
A3-J1-17	A102-P6-18 & REMOTE	IFC PIN 9
A3-J1-18	A102-P6-17 & REMOTE	GND PIN 21
A3-J1-19	A102-P6-20 & REMOTE	NDAC PIN 8
A3-J1-20	A102-P6-19 & REMOTE	GND PIN 20
A3-J1-21	A102-P6-22 & REMOTE	NRFD PIN 7
A3-J1-22	A102-P6-21 & REMOTE	GND PIN 19
A3-J1-23	A102-P6-24 & REMOTE	DAV PIN 6
A3-J1-24	A102-P6-23 & REMOTE	GND PIN 18
A3-J1-25	A102-P6-26 & REMOTE	EOI PIN 5
A3-J1-26	A102-P6-25 & REMOTE	REN PIN 17
A3-J1-27	A102-P6-28 & REMOTE	D104 PIN 4
A3-J1-28	A102-P6-27 & REMOTE	D108 PIN 16
A3-J1-29	A102-P6-30 & REMOTE	D103 PIN 3
A3-J1-30	A102-P6-29 & REMOTE	D107 PIN 15
A3-J1-31	A102-P6-32 & REMOTE	D102 PIN 2
A3-J1-32	A102-P6-31 & REMOTE	D106 PIN 14
A3-J1-33	A102-P6-34 & REMOTE	D101 PIN 1
A3-J1-34	A102-P6-33 & REMOTE	D105 PIN 13
A3-J2-1 THRU -4	(GND)	SEE A1 J2
A3-J2-11 THRU -50	(BUS)	SEE A1 J2
A3-J2-53 & -54	(-18 V)	SEE A1 J2
A3-J2-55 & -56	(+18 V)	SEE A1 J2
A3-J2-57 THRU -60	(+5)	SEE A1 J2
A3-J3-3	A5-J3-3 & A102-P1-3	DAC D0
A3-J3-5	A5-J3-6 & A102-P1-6	DAC D1
A3-J3-6	A5-J3-5 & A102-P1-5	DAC D2
A3-J3-7	A5-J3-8 & A102-P1-8	DAC D3
A3-J3-8	A5-J3-7 & A102-P1-7	DAC A0
A3-J3-9	A5-J3-9 & A102-P1-10	DAC A1
A3-J3-10	A102-P1-9	DAC A2
A3-J3-11	A102-P1-12 & A7-K	DIV A
A3-J3-12	A5-J3-11, A102-P1-11, & A13-R/14	DAC WR/NOT
A3-J3-13	A102-P3-15	SAMPLER FILTER
A3-J3-14	A102-P1-13 & A7-L	DIV B
A3-J3-19	A102-P1-15	SEL/NOT 7
A3-J3-20	A102-P1-17	SEL/NOT 0
A3-J3-21	A102-P1-19	SEL/NOT 4
A3-J3-22	A5-J3-10	SEL/NOT 1
A3-J3-23	A102-P1-21	SEL/NOT 5
A3-J3-25	A102-P1-23	SEL/NOT 6
A3-J3-26	A102-P1-25	SEL/NOT 3

A4--101CA35800, CPU

NOTE: CONNECTOR J1 IS ABSENT FROM PC BOARD A4

from:	to:	notes:
A4-J2-1 THRU 4	(GND)	SEE A1 J2
A4-J2-11 THRU -50	(BUS)	SEE A1 J2
A4-J2-53 & -54	(-18V)	SEE A1 J2
A4-J2-55 & -56	(+18V)	SEE A1 J2
A4-J2-57 THRU -60	(+5V)	SEE A1 J2
A4-J3-2	A102-P1-2 & A12-6	LOCK (110 PLL)
A4-J3-3	A102-P1-4 & A8-H	LOCK (40-80 PLL)
A4-J3-4	A102-P1-1 & A10-F & A9-H	LOCK (INT + HI RES PLLS)
A4-J3-6	A102-P1-14 & A11-Y	LOCK (300 PLL)
A4-J3-14	A5-J3-13	STEP ATTEN 0
A4-J3-15	A102-P4-27	LEVEL LED
A4-J3-16	A5-J3-15	STEP ATTEN 1
A4-J3-17	A102-P3-16 & -P5-23	REM LED
A4-J3-18	A5-J3-17	STEP ATTEN 2
A4-J3-19	A102-P1-16 & A6-20	LOCK (OUTPUT PLL)
A4-J3-20	A5-J3-19	STEP ATTEN 3
A4-J3-21	A5-J3-4	LEVEL DET/NOT
A4-J3-22	A102-P5-24	LOCK LED

A5--304CA03500, LEVEL CONTROL

from:	to:	notes:
A5-J1-1 & -2	A102-1 OR A102 J4-6	STEP ATTEN: +24V (red)
A5-J1-3	A102-2 OR A102 J4-2	STEP ATTEN: 10 ON (yel)
A5-J1-5	A102-3 OR A102 J4-13	STEP ATTEN: 10 OFF (vio)
A5-J1-7	A102-4 OR A102 J4-11	STEP ATTEN: 20 OFF (blk)
A5-J1-9	A102-5 OR A102 J4-5	STEP ATTEN: 20 ON (grn)
A5-J1-11	A102-6 OR A102 J4-3	STEP ATTEN: 40 OFF #1 (ora)
A5-J1-13	A102-7 OR A102 J4-9	STEP ATTEN: 40 ON #1 (blu)
A5-J1-15	A102-8 OR A102 J4-4	STEP ATTEN: 40 OFF #2 (brn)
A5-J1-17	A102-9 OR A102 J4-10	STEP ATTEN: 40 ON #2 (wht)
A5-J1-20	A6-19	FM SIGNAL
A5-J1-22	A5-J2-18	AM SIGNAL
A5-J1-24	A102-P4-11	FM
A5-J1-27	A102-P4-3	U8 Q0
A5-J1-28	A102-P4-23	U8 DS4
A5-J1-29	A102-P4-5	U8 Q1
A5-J1-30	A102-P4-21	U8 DS3
A5-J1-31	A102-P4-7	U8 Q2
A5-J1-32	A102-P4-19	U8 DS2
A5-J1-33	A102-P4-9	U8 Q3
A5-J1-34	A102-P4-17	U8 DS1
A5-J2-1 THRU -4	(GND)	SEE A1 J2
A5-J2-6	A102-P3-4	A102 -5.2V
A5-J2-28	GND	
A5-J2-30	A102-P1-18	SEL AM
A5-J2-32	A3-J3-16 & A117-5	SEL EXT ALC

from:	to:	notes:
A5-J2-34	A117-3	EXT DET
A5-J2-36	A117-2	EXT O.S.
A5-J2-38	DETECTOR	
A5-J2-53 & -54	(-18V)	SEE A1 J2
A5-J2-55 & -56	(+18V)	SEE A1 J2
A5-J2-57 THRU -60	(+5V)	SEE A1 J2
A5-J3-1	GND	
A5-J3-2	2-8, 6-12 RF MODULE PIN 1	LEVELING, 600/2-8 OR 6-12
OR:	10-18 RF MODULE PIN 4	LEVELING, 600/10-18
A5-J3-3	A3-J3-3 & A102-P1-3	DAC D0
A5-J3-5	A3-J3-6 & A102-P1-5	DAC D2
A5-J3-4	A4-J3-21	LEVEL DET/NOT
A5-J3-6	A3-J3-5 & A102-P1-6	DAC D1
A5-J3-7	A3-J3-8 & A102-P1-7	DAC A0
A5-J3-8	A3-J3-7 & A102-P1-8	DAC D3
A5-J3-9	A3-J3-9 & A102-P1-10	DAC A1
A5-J3-11	A3-J3-12 & A102-P1-11 & A13-R/14	DAC WR/NOT
A5-J3-15	A4-J3-16	STEP ATTEN 1
A5-J3-17	A4-J3-18	STEP ATTEN 2
A5-J3-19	A4-J3-20	STEP ATTEN 3
A5-J3-24	A112 OUT	TEMP COMP OUT
A5-J3-26	A105-2	

A6 THROUGH A13--THE RF BUS

Circuit boards A6 through A13 are inserted into the RF bus board, A103. Several pairs of pins on circuit boards A6 through A13 are tied together, and are connected to the equivalent pins on most or all of the other boards. The following list specifies how the pins are held in common:

PINS:	PC BOARD SLOTS:	A103 CONNECTOR:	NOTES:
1/A & 22/Z	A6-A13	P2-9/10	DIGITAL GND
2/B	A6-A13		+5V
3/C	A6-A13	P2-5/6	-18V
4/D	A6-A13	P2-3/4	-5.2V
5/E	A6-A13	P2-1/2	+18V
11/M	A6-A13	P1-3	D0
12/N	A6-A13	P1-6	D1
13/P	A6-A13	P1-7	A0
14/R	A6 thru A12 only	P1-9	WR/NOT
16/T	A6-A13	P1-10	A1
17/U	A6-A13	P1-8	D3
18/V	A6-A13	P1-5	D2

In the following list of interconnections between boards mounted on the RF bus, the pins on PC boards A6 through A13 are listed in order, with letter-designated pins following number-designated pins. Special connectors ("J1" etc.) are shown last. Where letter/number pairs are tied together, the connection is listed under the number-designated pin; e.g., under "A6-5/E" where pins 5 and E of PC board A6 are tied together.

Additional connections involving the RF bus board itself, rather than circuits A6 through A13, are listed under A103.

A6--304CA01000, OUTPUT PLL

from:	to:	notes:
A6-2/B	A103 U1-14 & HEATSINK Q5 OUT	+5V
A6-6	A103 P1-20, & A102 P1-20	FM ON
A6-7	A103 R7	FROM FM DRIVER
A6-8	A7-H	5-10 MHZ IN (REF)
A6-9	A7-J	5-10 MHZ IN (REF)
A6-19	A5-J1-20 & A105-9	FM IN
A6-20	A103 P1-16 & A102 P1-16 & A105 P3-16 & A4 J3-19	LOCK
A6-K	A7-X	5-10 MHZ IN (VAR)
A6-L	A7-Y	5-10 MHZ IN (VAR)
A6-Y	A103 CR11/CR12	TO FM DRIVER

A7--304CA03100, DIVIDER

from:	to:	notes:
A7-2/B	A117 +5V	+5V
A7-4/D	A117-1	-5.2V
A7-H	A6-8	5-10 OUT (40-80 MHZ/8)
A7-J	A6-9	5-10 OUT (40-80 MHZ/8)
A7-K	A103 P1-12 & A102 P1-12 & A3 J3-11	DIV A
A7-L	A103 P1-13 & A102 P1-13 & A3 J3-14	DIV B
A7-X	A6-K	5-10 OUT (I.F./N)
A7-Y	A6-L	5-10 OUT (I.F./N)
A7-J1	A104-J3	I.F. IN
A7-J2	A8-J1	40-80 MHZ IN

A8, 304CA03000, 40-80 PLL

from:	to:	notes:
A8-H	A103 P1-4 & A102 P1-4 A4 J3-3	LOCK
A8-K	A12-L	10 MHZ IN
A8-L	A12-10	10 MHZ IN
A8-S	A103 U1-4	SEL6
A8-J1	A7-J2	40-80 OUT

from:	to:	notes:
A8-J2	A9-J1 [OPTION 03 ONLY]	225-226 REF IN
OR:	A113-J1 [DELETE FOR OPT. 03]	220 REF IN

A9--304CA02700, INTERMEDIATE PLL [OPTION 03 ONLY]

from:	to:	notes:
A9-19	A10-Y	
A9-22	A113 GND LUG	GND
A9-H	A10-F & A103 P1-1 & A102 P1-1 & A4 J3-4	LOCK
A9-W	A10-X	10-12 MHZ IN
A9-Y	A113-J3	220 MHZ IN
A9-J1	A8-J2	225-226 MHZ OUT

A10--304CA03400, HIGH RESOLUTION [OPTION 03 ONLY]

from:	to:	notes:
A10-F	A9-H & A103 P1-1 & A102 P1-1 & A4 J3-4	LOCK
A10-K	A12-8	10 MHZ IN
A10-L	A12-J	GND
A10-S	A103 U1-3	SEL5
A10-X	A9-W	10-12 MHZ OUT
A10-Y	A9-19	10-12 MHZ OUT
A10-J1	A113-J1	220 MHZ IN

A11--304CA02200, 300 MHz PLL

from:	to:	notes:
A11-K	A12-9	10 MHZ IN
A11-L	A12-K	GND
A11-S	A103 U1-10	SEL7
A11-W/X	A104-J2	TUNE
A11-Y	A103 P1-14 & A102 P1-14 & A4 J3-6	LOCK
A11-J1	A113-J6	284-319 MHZ OUT
A11-J2	A104-J1	330 MHZ IN

A12--304CA05600, 110 MHz PLL

from:	to:	notes:
A12-2/B	A114-2 (TCXO)	+5V; DELETE FOR OPTION 06
A12-4/D	YIG OSC -5.2V	DELETE FOR 600/10-18
A12-6	A102 P1-2 & A4 J3-2	LOCK
A12-8	A10-K	10 MHZ OUT
A12-9	A11-K	10 MHZ OUT

from:	to:	notes:
A12-10	A8-L	10 MHZ OUT
A12-21	'10 MHz IN'	REAR PANEL BNC
A12-F	A113 J5	TUNE
A12-H	A113 J4	110 MHZ IN
A12-J	A10-L	10 MHZ OUT
A12-K	A11-L	10 MHZ OUT
A12-L	A8-K	10 MHZ OUT
A12-S	A114-1 (TCXO)	DELETE FOR OPTION 06
	OR: HI STAB OSC 4	OPTION 06 ONLY
A12-W	HI STAB OSC 3	OPTION 06 ONLY
A12-X	A114-4 (TCXO)	DELETE FOR OPTION 06
A12-Y	'10 MHz OUT'	REAR PANEL BNC
A12-Z	A114-3 (TCXO GND)	DELETE FOR OPTION 06
	OR: HI STAB OSC 6	GND -- OPTION 06 ONLY

A13--304CA02400, YIG DRIVER

from:	to:	notes:
A13-2/B	A104-6	+5V
A13-3/C	A104-2	-18V
A13-4/D	A104-5 & A113-4	-5.2V
A13-5/E	A113-3 & A104-1	+18V
A13-14/R	A103 U1-9 & A103 P1-11 & A102 P-11 & A3 J3-12	DAC WR/NOT
A13-20	YIG ASSY R-sense P1	
A13-F	YIG ASSY R-sense P2	
A13-S	A103 P1-17 & A102 P1-17	SEL/NOT 0
A13-X	YIG ASSY XSTR-B	
A13-Y	YIG OSC TUNE (+)	

A101--304BA01100, POWER SUPPLY

from:	to:	notes:
A101-1	HI STAB OSC 1	+15V OPTION 06 ONLY
A101-2	HI STAB OSC 5	GND OPTION 06 ONLY
A101-3	XFMR SECONDARY	YELLOW WIRE OPTION 06
A101-4	XFMR SECONDARY	YELLOW WIRE OPTION 06
A101-5	P.S. CR2 (-)	
A101-6	A102-18	
A101-7	GND	
A101-8	A102-C	
A101-9	XFMR SECONDARY	
A101-10	XFMR SECONDARY	
A101-11	XFMR SECONDARY, GND	

A102--304BA03300, COMPUTER BUS

from:	to:	notes:
A102-1	P.S. C3 (+)	+24V
-1 OR -J4-6	ATTEN RED WIRE & A5-J1-1	
A102-2 OR -J4-2	ATTEN YEL WIRE & A5-J1-3	10 ON
A102-3 OR -J4-13	ATTEN VIO WIRE & A5-J1-5	10 OFF
A102-4 OR -J4-11	ATTEN BLK WIRE & A5-J1-7	20 OFF
A102-5 OR -J4-5	ATTEN GRN WIRE & A5-J1-9	20 ON
A102-6 OR -J4-3	ATTEN ORA WIRE & A5-J1-11	40 OFF #1
A102-7 OR -J4-9	ATTEN BLU WIRE & A5-J1-13	40 ON #1
A102-8 OR -J4-4	ATTEN BRN WIRE & A5-J1-15	40 OFF #2
A102-9 OR -J4-10	ATTEN WHT WIRE & A5-J1-17	40 ON #2
A102-A	XFMR SECONDARY	8VAC
A102-B	XFMR SECONDARY	8VAC
A102-C	A101-8	
A102-D	GND	
A102 '+5'	HEATSINK Q1 OUT	+5V
'+5'	XFMR SECONDARY	8VAC
A102 '-5.2'	HEATSINK Q2 OUT	-5.2V
'-5.2'	A5-J2-6	
A102 '-18'	A101-8	-18V
A102 '+18'	HEATSINK Q3 OUT	+18V
A102 J4	SEE A102-1 THRU -9 ABOVE	
*****************		
A102 P1 PINS 1-26	A103 P1 PINS 1-26 AND	304BC03700 (RIBBON)
*****************	A105 P3 PINS 1-26	304BC03700 (RIBBON)
A102 P1-1	A10-F & A9-H & A4 J3-4	LOCK (1 KHZ RES)
A102 P1-2	A12-6 & A4 J3-2	LOCK (110 PLL)
A102 P1-3	A3 J3-3 & A5 J3-3	DAC D0
A102 P1-4	A8-H & A4 J3-3	LOCK (40-80 PLL)
A102 P1-5	A3 J3-6 & A5 J3-5	DAC D2
A102 P1-6	A3 J3-5 & A5 J3-6	DAC D1
A102 P1-7	A3 J3-8 & A5 J3-7	DAC A0
A102 P1-8	A3 J3-7 & A5 J3-8	DAC D3
A102 P1-9	A3 J3-10	DAC A2
A102 P1-10	A3 J3-9 & A5 J3-9	DAC A1
A102 P1-11	A13-R/14 & A3 J3-12 & A5 J3-11	DAC WR/NOT
A102 P1-12	A7-K & A3 J3-11	DIV A
A102 P1-13	A7-L & A3 J3-14	DIV B
A102 P1-14	A4 J3-6	LOCK (300 PLL)
A102 P1-15	A3 J3-19	SEL/NOT 7
A102 P1-16	A6-20 & A4 J3-19	LOCK (OUTPUT PLL)
A102 P1-17	A13-S & A3 J3-20	SEL NOT/0
A102 P1-18	A5 J2-30	SEL AM
A102 P1-19	A3 J3-21	SEL/NOT 4

from:	to:	notes:
A102 P1-20	A6-6	FM ON
A102 P1-21	A3 J3-23	SEL/NOT 5
A102 P1-22	A1 J3-22	FILT SEL 2
A102 P1-23	A3 J3-25	SEL/NOT 6
A102 P1-24	A1 J3-24	SEL/NOT 2
A102 P1-25	A3 J3-26	SEL/NOT 3
A102 P1-26	A1 J3-26	FILT SEL 0
*****************		
A102 P2 PINS 1-20	A107 P1 PINS 1-20 AND	304BC04000 (RIBBON)
*****************	A109 P1 PINS 1-20	304BC04000 (RIBBON)
A102 P2-1	+5V	
A102 P2-3	A1 J3-2	TWS D8
A102 P2-4	A1 J3-1	TWS D4
A102 P2-5	A1 J3-4	TWS D2
A102 P2-6	A1 J3-3	TWS D1
A102 P2-7	A1 J3-6	TWS STB D
A102 P2-8	A1 J3-5	TWS STB C
A102 P2-9	A1 J3-8	TWS STB B
A102 P2-10	A1 J3-7	TWS STB A
A102 P2-11	A1 J3-11	SPARE
A102 P2-17	A1 J3-17	SPARE
A102 P2-19	A1 J3-19	SPARE
*****************		
A102 P3 PINS 1-16	A103 P2 PINS 1-16 AND	304BC03600 (RIBBON)
*****************	A105 P2 PINS 1-16	304BC03600 (RIBBON)
A102 P3-1	+18V	
A102 P3-2	+18V	
A102 P3-3	-5.2V	
A102 P3-4	-5.2V	
A102 P3-5	-18V	
A102 P3-6	-18V	
A102 P3-7	+5V	
A102 P3-8	+5V	
A102 P3-11	A1 J3-18	
A102 P3-12	A1 J3-16	
A102 P3-13	A1 J3-14	
A102 P3-14	A1 J3-10	
A102 P3-15	A3 J3-13	SAMPLER FILTER
A102 P3-16	A4 J3-17 & A102 P5-23	REM LED
*****************		
A102 P4 PINS 1-34	A110 P1 PINS 1-34	304BC03800 (RIBBON)
*****************		
A102 P4-3	A5 J1-27	U8 Q0
A102 P4-4	A1 J1-29	PSEG a
A102 P4-5	A5 J1-29	U8 Q1
A102 P4-6	A1 J1-31	PSEG b
A102 P4-7	A5 J1-31	U8 Q2

from:	to:	notes:
A102 P4-8	A1 J1-25	PSEG c
A102 P4-9	A5 J1-33	U8 Q3
A102 P4-10	A1 J1-34	PSEG d
A102 P4-11	A5 J1-24	FM
A102 P4-12	A1 J1-32	PSEG e
A102 P4-14	A1 J1-28	PSEG f
A102 P4-16	A1 J1-26	PSEG y
A102 P4-17	A5 J1-34	U8 DS1
A102 P4-18	A1 J1-24	DDP 0
A102 P4-19	A5 J1-32	U8 DS2
A102 P4-20	A1 J1-30	DDP 1
A102 P4-21	A5 J1-30	U8 DS3
A102 P4-22	A1 J1-21	DDP 2
A102 P4-23	A5 J1-28	U8 DS4
A102 P4-24	A1 J1-33	DDP 3
A102 P4-25	A1 J1-23	PSEG t
A102 P4-26	A1 J1-27	DDP 4
A102 P4-27	A4 J3-15	LEVEL LED
A102 P4-28	A1 J1-20	"+" SIGN
*****************		
A102 P5 PINS 1-26	A108 P1 PINS 1-26	304BC03900 (RIBBON)
*****************		
A102 P5-3	A1 J1-13	DDF 7
A102 P5-4	A1 J1-7	FSEG f
A102 P5-5	A1 J1-4	FSEG e
A102 P5-6	A1 J1-22	FSEG y
A102 P5-7	A1 J1-6	FSEG d
A102 P5-8	A1 J1-5	DDF 0
A102 P5-9	A1 J1-16	DDF 6
A102 P5-10	A1 J1-3	FSEG h
A102 P5-11	A1 J1-12	DDF 4
A102 P5-12	A1 J1-14	DDF 5
A102 P5-13	A1 J1-8	DDF 2
A102 P5-14	A1 J1-10	DDF 3
A102 P5-15	A1 J1-11	FSEG b
A102 P5-16	A1 J1-9	FSEG c
A102 P5-17	A1 J1-15	FSEG a
A102 P5-18	A1 J1-2	DDF 1
A102 P5-23	A4 J3-17 & A102 P3-16	REM LED
A102 P5-24	A4 J3-22	LOCK LED
*****************		
A102 P6 PINS 1-10	A111 P1 PINS 1-10	INTERFACE, DEVICE ADDRESS
*****************		
A102 P6-11	A3 J1-12 & REMOTE 24	INTFC GND
A102 P6-12	A3 J1-11 & REMOTE 12	INTFC SHIELD
A102 P6-13	A3 J1-14 & REMOTE 23	INTFC GND
A102 P6-14	A3 J1-13 & REMOTE 11	INTFC ATN
A102 P6-15	A3 J1-16 & REMOTE 22	INTFC GND
A102 P6-16	A3 J1-15 & REMOTE 10	INTFC SRQ

from:	to:	notes:
A102 P6-17	A3 J1-18 & REMOTE 21	INTFC GND
A102 P6-18	A3 J1-17 & REMOTE 9	INTFC IFC
A102 P6-19	A3 J1-20 & REMOTE 20	INTFC GND
A102 P6-20	A3 J1-19 & REMOTE 8	INTFC NDAC
A102 P6-21	A3 J1-22 & REMOTE 19	INTFC GND
A102 P6-22	A3 J1-21 & REMOTE 7	INTFC NRFD
A102 P6-23	A3 J1-24 & REMOTE 18	INTFC GND
A102 P6-24	A3 J1-23 & REMOTE 6	INTFC DAV
A102 P6-25	A3 J1-26 & REMOTE 17	INTFC REN
A102 P6-26	A3 J1-25 & REMOTE 5	INTFC EOI
A102 P6-27	A3 J1-28 & REMOTE 16	INTFC DIO8
A102 P6-28	A3 J1-27 & REMOTE 4	INTFC DIO4
A102 P6-29	A3 J1-30 & REMOTE 15	INTFC DIO7
A102 P6-30	A3 J1-29 & REMOTE 3	INTFC DIO3
A102 P6-31	A3 J1-32 & REMOTE 14	INTFC DIO6
A102 P6-32	A3 J1-31 & REMOTE 2	INTFC DIO2
A102 P6-33	A3 J1-34 & REMOTE 13	INTFC DIO5
A102 P6-34	A3 J1-33 & REMOTE 1	INTFC DIO1

A103--304DA02900, RF BUS (ALSO SEE A6 THROUGH A13)

from:	to:	notes:
A103 FM OUT	YIG OSC. FM COIL (-)	
*****************		
A103 P1 PINS 1-26	A102 P1 PINS 1-26 AND	304BC03700 (RIBBON)
*****************	A105 P3 PINS 1-26	304BC03700 (RIBBON)
*****************		
A103 P2 PINS 1-16	A102 P3 PINS 1-16 AND	304BC03600 (RIBBON)
*****************	A105 P2 PINS 1-16	304BC03600 (RIBBON)

A104--304CA05500, 300 MHz OSCILLATOR

from:	to:	notes:
A104-1	A13-E & A104-4	+18V
A104-2	A13-C & A104-3	-18V
A104-3	A112 '-18' & A104-2	-18V
A104-4	A112 '+18' & A104-1	+18V
A104-5	A13-4/D	-5.2V
A104-6	A13-2/B	+5V
A104-J1	A11-J2	284-319 MHZ OUT
A104-J2	A11-W	TUNE INPUT
A104-J3	A7-J1	IF OUT
A104-J4	RF INPUT	FROM RF COUPLER

A105--304CA03200, MODULATION GENERATOR

from:	to:	notes:
A105-J1	RF MODULE PIN 2	LOW FILTER SEL, 2-8, 10-18
	OR: RF MODULE PIN 4	LOW FILTER SEL, 6-12
A105-J2	RF MODULE PIN 4	MID FILTER SEL, 2-8
	OR: RF MODULE PIN 3	MID FILTER SEL, 6-12, 10-18
A105-J3	RF MODULE PIN 3	HI FILTER SEL, 2-8
A105-J6	RF MODULE PIN 5	TERMINATION SEL, 2-8
	OR: RF MODULE PIN 2	TERMINATION SEL, 6-12
	OR: RF MODULE PIN 1	TERMINATION SEL, 10-18
A105-1	'PULSE VIDEO OUT'	FRONT PANEL BNC
A105-3	'PULSE SYNC OUT'	FRONT PANEL BNC
A105-4	'PULSE EXT IN'	FRONT PANEL BNC
A105-5	RF MODULE PIN 6	FILTER SW, 2-8, 6-12
	OR: RF MODULE PIN 5	FILTER SW, 10-18
A105-6	'FM EXT IN'	FRONT PANEL BNC
A105-7	'AM EXT IN'	FRONT PANEL BNC
A105-8	'AM/FM SYNC OUT'	FRONT PANEL BNC
A105-10	A5-J2-18	
*****************		
A105 P2 PINS 1-16	A102 P3 PINS 1-16 AND	304BC03600 (RIBBON)
*****************	A103 P2 PINS 1-16	304BC03600 (RIBBON)
*****************		
A105 P3 PINS 1-26	A102 P1 PINS 1-26 AND	304BC03700 (RIBBON)
*****************	A103 P1 PINS 1-26	304BC03700 (RIBBON)

A106--304CA04400, DELAY/WIDTH GENERATOR

This board is connected directly to A105; points of connection are shown on the schematic diagram for the circuit.

A107--304BA02100, 8 POSITION LEVER SWITCH

from:	to:	notes:
*****************		
A107 P1 PINS 1-20	A102 P2 PINS 1-20 AND	304BC04000 (RIBBON)
*****************	A109 P1 PINS 1-20	304BC04000 (RIBBON)

A108--304BA02600, FREQUENCY DISPLAY

from:	to:	notes:
*****************		
A108 P1 PINS 1-26	A102 P5 PINS 1-26	304BC03900 (RIBBON)
*****************		

A109--304BA02500, 5 POSITION LEVER SWITCH

from:	to:	notes:
*****************		
A109 P1 PINS 1-20	A107 P1 PINS 1-20 AND	304BC04000 (RIBBON)
*****************	A102 P2 PINS 1-20	304BC04000 (RIBBON)

A110--304DA02300, MODULATION/POWER DISPLAY

from:	to:	notes:
*****************		
A110 P1 PINS 1-34	A102 P4 PINS 1-34	304BC03800 (RIBBON)
*****************		

A111--101BA04700, ADDRESS SWITCH

from:	to:	notes:
*****************		
A111 P1 PINS 1-10	A102 P6 PINS 1-10	IEEE-488 INTFC DEVICE ADDR
*****************		

A112--304BA04600, TEMPERATURE COMPENSATION

from:	to:	notes:
A112 OUT	A5-J3-24	TEMP COMP OUT
A112 '+18'	A104-4	+18V
A112 '-18'	A104-3	-18V

A113--304CA05700, OSCILLATOR/MULTIPLIER

from:	to:	notes:
A113-1	A113-2 & -4	-5.2V
A113-2	A113-1 & -4	-5.2V
A113-3	A13-5	+18V
A113-4	A13-4/D, A113-1 & -2	-5.2V
A113-J1	A8-J2	DELETE FOR OPTION 03
	OR: A10-J1	OPTION 03 ONLY
A113-J3	A9-Y	220 MHZ OUT
A113-J4	A12-H	110 MHZ OUT
A113-J5	A12-F	TUNE INPUT
A113-J6	A11-J1	330 MHZ OUT

A114--101BA09701, TCXO

from:	to:	notes:
A114-1	A12-S	DELETE FOR OPTION 06
A114-2	A12-2/B	+5V, DELETE FOR OPTION 06
A114-3	A12-Z	GND, DELETE FOR OPTION 06
A114-4	A12-X	DELETE FOR OPTION 06

A117--101BA36200, EXT ALC POT SW

from:	to:	notes:
A117-1	A7-4/D	-5.2V
A117-2	A5-J2-36	EXT O.S.
A117-3	A5-J2-34	EXT DET
A117-4	'EXT ALC INPUT'	REAR PANEL BNC
A117-5	A5-J2-32	SEL EXT ALC
A117 +5V	A7-2/B	+5V

PARTS LIST

Parts List for M600/2-8 SHIPPING ASY No. 304DA01400 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01500	1	58900	304DA01500	M600-TEST ASY
2	304AA10200	1	58900	304AA10200	M600 ROM SET U
3	101BA09702	1	58900	101BA09702	TCXO PCA
6	304DF01300	1	58900	304DF01300	M600 DEC. PANEL
7	304DA08700	1	58900	304DA08700	BENCHTOP CABINETIZING ASY
8	304CA08600	1	58900	304CA08600	M600 FREQ. 2-8 ASY

Parts List for M600 FREQ. 2-8 ASY No. 304CA08600   Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BF07500	1	58900	304BF07500	OSCILLATOR SHIM/2-8
3	004BA13000	1	58900	004BA13000	2-8 MODULE, 600(M180)
4	MPBO-01803	1	28480	33322H-90	0-110DB 18GHZ PGM ATTEN
5	MOYT-10208	1	24539	Y085-2217	2-8GHZ YIG XSTR OSC
6	JRAA-00200	1	98291	50-673-0159-31	SMA M TO SMA M ADAPT
7	RN55-00150	1	05905	SMA 0207 E 96	15 OHMS 1% MET FILM
8	RC20-00220	1	01121	EB-220-5	22 OHMS 5% 1/2W CARBON
9	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
10	304CA09801	1	58900	304CA09801	.085 CABLE #600A ASY
11	MDSO-00034	1	H0002	D2262-44	.01-34GHZ DETECTOR
12	304CA09903	1	58900	304CA09903	.141 CABLE #600C ASY
13	304CA09802	1	58900	304CA09802	.085 CABLE #600B ASY
14	RW25-00070	1	15915	TM25-7 OHM-1%Y	7 OHM 25W KELVIN LEAD

Parts List for M600-001 SHIPPING ASY No. 304DA01401 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01501	1	58900	304DA01501	M600-001 TEST ASY
2	304AA10200	1	58900	304AA10200	M600 ROM SET U
6	304DF01302	1	58900	304DF01302	M600-001 DEC PANEL
7	304DA08700	1	58900	304DA08700	BENCHTOP CABINETIZING ASY
8	304CA08601	1	58900	304CA08601	M600 FREQ. 6-12 RPP ASY

Parts List for M600 FREQ. 6-12 RPP ASY No. 304CA08601 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301CF00400	1	58900	301CF00400	OSCILLATOR BRACKET
2	004BA14000	1	58900	004BA14000	5-12 MODULE, 600(M181)
3	MPBO-01303	1	28480	33322G-90	0-110DB 13GHZ PGM ATTEN
4	MOYT-00513	1	24539	Y085-1266	5.4-12.5 GHz YIG OSC
6	RC20-00220	1	01121	EB-220-5	22 OHMS 5% 1/2W CARBON
8	RN55-00150	1	05905	SMA 0207 E 96	15 OHMS 1% MET FILM
9	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
10	JRAA-00200	2	98291	50-673-0159-31	SMA M TO SMA M ADAPT
11	304CA09802	1	58900	304CA09802	.085 CABLE #600B ASY
12	MDSO-00034	1	H0002	D2262-44	.01-34GHZ DETECTOR
14	304CA09904	1	58900	304CA09904	.141 CABLE #600F ASY
15	004BA23000	1	58900	004BA23000	6-12 LIMITER,M600 ASY
17	RW25-00050	1	15915	TM25-5 OHM-1%Y	5 OHM 25W KELVIN LEAD
18	GELS-26125	2	04552	LS26-1/8	LS26 ECCOSORB

Parts List for M600/6-12 SHIPPING ASY No. 304DA01403   Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01500	1	58900	304DA01500	M600-TEST ASY
2	304AA10200	1	58900	304AA10200	M600 ROM SET U
6	304DF01300	1	58900	304DF01300	M600 DEC. PANEL
7	304DA08700	1	58900	304DA08700	BENCHTOP CABINETIZING ASY
8	304CA08603	1	58900	304CA08603	M600 FREQ. 6-12 ASY

Parts List for M600 FREQ. 6-12 ASY No. 304CA08603 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301CF00400	1	58900	301CF00400	OSCILLATOR BRACKET
2	004BA14000	1	58900	004BA14000	5-12 MODULE, 600(M181)
3	MPBO-01803	1	28480	33322H-90	0-110DB 18GHZ PGM ATTEN
4	MOYT-00513	1	24539	Y085-1266	5.4-12.5 GHz YIG OSC
6	RC20-00220	1	01121	EB-220-5	22 OHMS 5% 1/2W CARBON
8	RN55-00150	1	05905	SMA 0207 E 96	15 OHMS 1% MET FILM
9	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
10	JRAA-00200	2	98291	50-673-0159-31	SMA M TO SMA M ADAPT
11	304CA09802	1	58900	304CA09802	.085 CABLE #600B ASY
12	MDSO-00034	1	H0002	D2262-44	.01-34GHZ DETECTOR
13	304CA09903	1	58900	304CA09903	.141 CABLE #600C ASY
14	RW25-00050	1	15915	TM25-5 OHM-1%Y	5 OHM 25W KELVIN LEAD

Parts List for M600/10-18 SHIPPING ASY No. 304DA01402 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01500	1	58900	304DA01500	M600-TEST ASY
2	304AA10200	1	58900	304AA10200	M600 ROM SET U
3	101BA09702	1	58900	101BA09702	TCXO PCA
6	304DF01300	1	58900	304DF01300	M600 DEC. PANEL
7	304DA08700	1	58900	304DA08700	BENCHTOP CABINETIZING ASY
8	304CA08602	1	58900	304CA08602	M600 FREQ. 10-18 ASY

Parts List for M600 FREQ. 10-18 ASY No. 304CA08602 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301CF00400	1	58900	301CF00400	OSCILLATOR BRACKET
2	304CA09901	1	58900	304CA09901	.141 CABLE #600D ASY
3	004BA15000	1	58900	004BA15000	10-18 MODULE, 600(M182)
4	MPBO-01803	1	28480	33322H-90	0-110DB 18GHZ PGM ATTEN
5	MOYT-10818	1	24539	Y085-2639	8-18 YIG OSC, 100 MW
6	RC20-00220	1	01121	EB-220-5	22 OHMS 5% 1/2W CARBON
7	RN55-00150	1	05905	SMA 0207 E 96	15 OHMS 1% MET FILM
8	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
10	JRAA-00200	1	98291	50-673-0159-31	SMA M TO SMA M ADAPT
11	304CA09903	1	58900	304CA09903	.141 CABLE #600C ASY
12	304CA09902	1	58900	304CA09902	.141 CABLE #600E ASY
13	MDSO-00034	1	H0002	D2262-44	.01-34GHZ DETECTOR
15	RW25-00050	1	15915	TM25-5 OHM-1%Y	5 OHM 25W KELVIN LEAD

Parts List for M600-TEST ASY No. 304DA01500 Rev. D

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01600	1	58900	304DA01600	M600 COMPUTER CHASSIS ASY
2	304BA04300	4	58900	304BA04300	PC SHIELD CKT SIDE ASY
3	304BF04301	2	58900	304BF04301	PC BD SHIELD FRONT
4	304BA08400	1	58900	304BA08400	CPU PC SHIELD ASY
5	304CA01800	1	58900	304CA01800	M600 REAR PANEL ASY
6	304DA01900	1	58900	304DA01900	M600 FRONT PANEL ASY
7	304DA02000	1	58900	304DA02000	MICROWAVE DECK ASY
8	304CA01700	1	58900	304CA01700	M600 HEATSINK ASY
9	301DF01500	2	58900	301DF01500	SIDE GUSSET
11	304BC03600	1	58900	304BC03600	POWER RIBBON CABLE
12	304BC03700	1	58900	304BC03700	UWAVE/PULSE RIBBON CABLE
13	304BC03800	1	58900	304BC03800	MOD/PWR DISP RIBBON CABLE
14	304BC03900	1	58900	304BC03900	FREQ DISP RIBBON CABLE
15	304BC04000	1	58900	304BC04000	TWS RIBBON CABLE
A 1	101CA29500	1	58900	101CA29500	DISPLAY PIA PCA
A 2	101CA35700	1	58900	101CA35700	MEMORY (64K) PCA
A 3	101CA06700	1	58900	101CA06700	IEEE PIA PCA
A 4	101CA35800	1	58900	101CA35800	CPU (64K) PCA
A 5	304CA03500	1	58900	304CA03500	LEVEL CONTROL PCA
A 6	304CA01001	1	58900	304CA01001	OUTPUT PLL PCA
A 7	304CA03100	1	58900	304CA03100	DIVIDER PCA
A 8	304CA03000	1	58900	304CA03000	40-80 MHZ PLL PCA
A 11	304CA02200	1	58900	304CA02200	300 MHz PLL PCA
A 12	304CA05600	1	58900	304CA05600	110 MHz REF PLL PCA
A 13	304CA02401	1	58900	304CA02401	YIG DRIVER PCA

Parts List for M600 COMPUTER CHASSIS ASY No. 304DA01600   Rev. D

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BA01100	1	58900	304BA01100	POWER SUPPLY PCA
2	304CC00201	1	58900	304CC00201	M600/M610 PWR TRANSFORMER
3	304DF00801	1	58900	304DF00801	COMPUTER CHASSIS
4	304CF00701	1	58900	304CF00701	CARD CAGE FRONT WALL
5	304BA03300	1	58900	304BA03300	COMPUTER BUS PCA
6	101CF03400	1	58900	101CF03400	CARD CAGE REAR WALL
7	CE35-08900	2	65517	EMC922AH35T	>9000 UF >35V ELECT.
8	CE15-09180	2	65517	EMC183AG15T	>18000 UF >15V ELECT.
9	DBMC-00980	2	04713	MDA980-2	MDA980-2 BRIDGE RECT.
10	HGPO-04125	10	07556	58-30-40	4.125" CARD GUIDE
11	HIGR-00437	1	06540	1155A	7/16" GROMMET
12	HIGP-00090	1	95987	WG201	FLEXIBLE GROMMET
13	HLLT-60212	5	79963	505-#6	#6 SOLDER LUG
14	HLST-A1211	11	79963	627-.196	#10 SOLDER LUG

Parts List for PC SHIELD CKT SIDE ASY No. 304BA04300 Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BF04300	1	58900	304BF04300	PC SHIELD CKT SIDE
2	HSTS-40604	4	55566	3049-B-440-A-0	4-40 X 3/8 SWAGE SPACER

Parts List for CPU PC SHIELD ASY No. 304BA08400 Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BF08400	1	58900	304BF08400	CPU PC SHIELD
2	HSTS-60404	4	06540	3047-B-632-A	6-32 X 1/4 SWAGE SPACER

Parts List for M600 REAR PANEL ASY No. 304CA01800 Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301DF01300	1	58900	301DF01300	REAR PANEL
2	101BA04700	1	58900	101BA04700	ADDRESS SWITCH PCA
3	304BA09000	1	58900	304BA09000	EXT ALC POT/SW M600 PCA
4	101CC17300	1	58900	101CC17300	IEEE INTERFACE CABLE
5	JLFF-06250	1	05245	6J4	LINE FILTER/CONNEC
6	JRDF-00001	3	02660	31-221	BNC F PANEL MOUNT
7	BHSO-05000	2	23936	5502	FAN SCREEN
8	BHGO-05000	2	82877	476042	FAN FINGER GUARD
9	FSAC-00200	1	03614	MDL-2	FUSE;2A;125V;3AG
10	HPMO-00375	2	83330	652	3/8" HOLE PLUG

Parts List for M600 FRONT PANEL ASY No. 304DA01900 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DF00600	1	58900	304DF00600	FRONT SUB PANEL
2	304DA02300	1	58900	304DA02300	MOD/PWR DISPLAY PCA
3	304CA02600	1	58900	304CA02600	FREQUENCY DISPLAY PCA
4	304BA02500	1	58900	304BA02500	5 POS LEVER SWITCH PCA
5	304CA02100	1	58900	304CA02100	8 POS LEVER SWITCH PCA
6	304DA03200	1	58900	304DA03200	MODULATION GENERATOR PCA
7	304CA04400	1	58900	304CA04400	DELAY/WIDTH GENERATOR PCA
8	JRDF-00001	6	02660	31-221	BNC F PANEL MOUNT
9	JRXA-00200	1	95077	1132-6001	N TO SMA ADAPTER
10	STPO-00202	1	09353	9201 J2 Z2Q	115VAC DPDT SWITCH
11	KBRC-50125	6	32767	1-503LP	ROUND BLACK KNOB .5D
12	KBBC-63250	6	32767	BC-128	BAR DIAL BLACK KNOB .62D

Parts List for MICROWAVE DECK ASY No. 304DA02000   Rev. C

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DF00900	1	58900	304DF00900	MICROWAVE CHASSIS
2	304CA05700	1	58900	304CA05700	OSCILLATOR/MULT PCA
3	304CA05500	1	58900	304CA05500	300 MHz OSC PCA
4	304DA02900	1	58900	304DA02900	RF BUS PCA
5	304BA04600	1	58900	304BA04600	TEMP COMP PCA
6	RW05-01000	1	54343	SP11-23 100@5%	100 OHM 5W CHASSIS MT
8	QBNP-05881	1	04713	2N5881	2N5881 15A 60V 160W NPN
9	JSSO-30003	1	06776	MD3452-G	TO3 SOCKET
10	HQIS-00030	1	55285	7403-09FR-05	TO3 INSULATOR
11	HQCP-00030	1	13103	8903VB	TO3 STYLE COVER
12	HIGP-00750	1	83330	8978	3/4" GROMMET
13	HSTH-62404	6	55566	2120-632-A	6-32 X 1 1/2 HEX SPACER
14	HLLT-60212	4	79963	505-#6	#6 SOLDER LUG

Parts List for M600 HEATSINK ASY No. 304CA01700   Rev. C

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301BF01600	2	58900	301BF01600	POWER SUPPLY HEATSINK
2	301CF00800	1	58900	301CF00800	FAN SHROUD
3	301BF00700	2	58900	301BF00700	FAN SHROUD COVER
4	BD00-05024	1	23936	MD24B2	24VDC FAN
5	JSS0-30003	4	06776	MD3452-G	T03 SOCKET
6	HIGR-00750	1	06540	1131D	3/4" GROMMET
7	HQIS-00030	4	55285	7403-09FR-05	T03 INSULATOR
8	CC50-05100	9	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
9	URK0-78180	2	04713	MC7818CK	MC7818CK 18V 1A T03 REG
10	URK0-03452	1	27014	LM345K-5.2	LM345K-5.2 3A -5.2V REG
11	URK0-03230	1	04713	LM323K	LM323K 5V 3A T03 REGULATR
12	URC0-07805	1	04713	MC7805CT	MC7805CT 1A 5V REG
13	URC0-07815	1	04713	MC7815CT	MC7815CT 1A 15V REG
14	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
15	HIGR-00375	4	06540	2170	3/8" GROMMET
16	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
17	HSCR-60404	1	06540	9224A140	#6 X 1/4 CLEAR SPACER

Parts List for M600 ROM SET U No. 304AA10200   Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	UMNO-02764	3	66148	HN4827C64-G20	HN4827C64G20 8K X8 EPROM
2	304AT10200	1	58900	304AT10200	M600 SOFTWARE U

Parts List for BENCHTOP CABINETIZING ASY No. 304DA08700 Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	301CF00901	1	58900	301CF00901	BOTTOM SUB COVER
2	301CF00900	1	58900	301CF00900	TOP SUB COVER
3	301CF01000	2	58900	301CF01000	FRONT TRIM
4	301BF01100	2	58900	301BF01100	FRONT TRIM, SIDE
5	301DF01200	2	58900	301DF01200	SIDE TRIM
6	101BF21600	1	58900	101BF21600	PC BOARD PULLER
7	101BF01000	4	58900	101BF01000	HANDLE FLANGE
8	101BF01900	2	58900	101BF01900	FOOT SUPPORT
9	301DF01400	4	08900	301DF01400	CORNER FRAME
10	HHOO-62456	2	88245	A1034-30	OVAL BLACK HANDLE
11	HHRO-31456	2	88245	A1013-30	ROUND BLACK HANDLE
12	WMPO-03006	1	16428	17506B	RT ANG IEC POWER CORD
13	HFBI-00012	1	21604	MP-40008-4	12" INSIDE MOUNT BAIL
14	HFFL-63202	2	21604	PP 40012-1	LEFT FRONT FOOT
15	HFFR-63202	2	21604	PP 40012-2	RIGHT FRONT FOOT
16	HNTU-63206	8	78553	MP40366	#6 TINNERMAN NUT
19	301CF01700	1	58900	301CF01700	TOP COVER
20	301CF01800	1	08900	301CF01800	BOTTOM COVER
21	101BA08000	1	58900	101BA08000	COMPUTER EXTENDER PCA
22	101BA08200	1	58900	101BA08200	FLOATING EXTENDER PCA
23	JLFL-01503	1	05245	85-1503	2A 120V LABEL

Parts List for COMPUTER EXTENDER PCA No. 101BA08000   Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	101BF08000	1	58900	101BF08000	COMPUTER EXTENDER PCB
2	JPP0-20013	1	31781	345-026-524-201	26 PIN PC EDGE CONN
3	JPP0-20017	1	31781	345-034-524-201	34 PIN PC EDGE CONN
4	JPP0-20030	1	31781	345-060-524-202	60 PIN PC EDGE CONN

Parts List for FLOATING EXTENDER PCA No. 101BA08200 Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	101BF08200	1	58900	101BF08200	FLOATING EXTENDER PCB
2	JPSO-20022	1	81312	HCB22SO	44 PIN PC EDGE CONN

Parts List for DISPLAY PIA ASSY No. 101CA29500   Rev. A

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	101CF29500	1	58900	101CF29500	DISPLAY PIA BD
C	1	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	9	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
IC	1	UCNO-00400	1	04713	MC14040BCP	MC14040BCP 12 BIT CTR
IC	2	UMNO-01824	1	02735	CDP1824CD	CDP1824CD 32X8 RAM
IC	3	UCNO-00280	1	04713	MC14028BCP	MC14028BCP BCD/DECIMAL
IC	4	UCNO-00290	1	04713	MC14029BCP	MC14029BCP 4 BIT CTR
IC	5	UMNO-01824	1	02735	CDP1824CD	CDP1824CD 32X8 RAM
IC	6	UCNO-00280	1	04713	MC14028BCP	MC14028BCP BCD/DECIMAL
IC	7	UGNO-06821	1	04713	MC6821P	MC6821P PIA
IC	8	UTNO-02451	1	01295	SN74LS245N	SN74LS245N 8X TRANSCEIVER
IC	9	UTNO-00170	1	01295	SN7417N	SN7417N HEX BUFFER
IC	10	UTNO-00321	1	01295	SN74LS32N	SN74LS32N QUAD OR
IC	11	UTNO-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
IC	12	101BC28409	1	58900	101BC28409	ADDRESS ROM A5-1
IC	13	UTNO-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
IC	14	UGNO-06821	1	04713	MC6821P	MC6821P PIA
IC	15	UGNO-06821	1	04713	MC6821P	MC6821P PIA
R	1	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	2	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	3	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
TP	1	ETST-06224	1	88245	1280B	TURRET TERMINAL
X	1	JSPO-10018	1	09922	DILB18P-108	18 PIN DIP SOCKET
X	2	JSPO-10018	1	09922	DILB18P-108	18 PIN DIP SOCKET
X	3	JSPO-10020	1	09922	DILB20P-108	20 PIN DIP SOCKET
X	4	JSPO-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
X	5	JSPO-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
X	6	JSPO-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET

Parts List for MEMORY (64K) PC ASSY No. 101CA35700 Rev. A

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	101CF35700	1	58900	101CF35700	MEMORY (64K) BD
	2	JSP0-10028	5	09922	DILB28P-108	28 PIN DIP SOCKET
	3	ETST-06224	1	88245	1280B	TURRET TERMINAL
C	1	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	13	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
U	6	UMN0-06264	1	61485	HM6264LP-15	HM6264LP-15 8K X 8 RAM
U	8	UTN0-00101	1	01295	SN74LS10N	SN74LS10 TRIPLE NAND
U	9	UTN0-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
U	10	UTN0-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
U	11	UTN0-02451	1	01295	SN74LS245N	SN74LS245N 8X TRANSCEIVER
U	12	UTN0-02401	1	01295	SN74LS240N	SN74LS240 8X DRIV/RECV
U	13	UTN0-00111	1	01295	SN74LS11N	74LS11 TRIPLE 3 IN AND

Parts List for IEEE PIA PC ASSY No. 101CA06700 Rev. B

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	101CF06700	1	58900	101CF06700	IEEE PIA BD
C	1	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
IC	1	UTN0-03651	1	01295	SN74LS365N	SN74LS365 HEX DRIVER
IC	2	UGN0-09914	1	01295	TMS9914NL	TMS9914NL IEEE-488
IC	3	UIN0-75162	1	01295	SN75162N	SN75162N IEEE BUFFER
IC	4	UIN0-75160	1	01295	SN75160N	SN75160N IEEE BUFFER
IC	5	UTN0-00170	1	01295	SN7417N	SN7417N HEX BUFFER
IC	6	UTN0-02451	1	01295	SN74LS245N	SN74LS245N 8X TRANSCEIVER
IC	7	UTN0-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
IC	8	101AC28401	1	58900	101AC28401	ADDRESS ROM A1
IC	9	UTN0-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
IC	10	UTN0-00321	1	01295	SN74LS32N	SN74LS32N QUAD OR
IC	11	UTN0-00001	1	01295	SN74LS00N	SN74LS00 QUAD NAND
IC	12	UTN0-01381	1	01295	SN74LS138N	SN74LS138N 3 TO 8 DEC
IC	13	UGN0-06821	1	04713	MC6821P	MC6821P PIA
R	1	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	2	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	3	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	4	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	5	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	6	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	7	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	8	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	9	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	10	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	11	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	12	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	13	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	14	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	15	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	16	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	17	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	18	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
TP	1	ETST-06224	1	88245	1280B	TURRET TERMINAL
X	1	JSP0-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
X	2	JSP0-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
X	3	JSP0-10020	1	09922	DILB20P-108	20 PIN DIP SOCKET

Parts List for CPU (64K) ASSY No. 101CA35800 Rev. B

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	101CF35800	1	58900	101CF35800	CPU (64K) BD
	2	ETST-06224	1	88245	1280B	TURRET TERMINAL
C	1	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	2	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	3	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	4	CT20-06022	1	56289	150D225X9020A2	2.2 UF 20V TANTALUM
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	13	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
R	11	RN55-21210	1	05905	SMA 0207 E 96	12.1 K OHMS 1% MET FILM
R	12	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM
R	13	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	14	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	15	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	16	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	17	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	18	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	19	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	20	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	21	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
S	1	SDPO-00801	1	71450	206-8	8 SPST DIP SWITCH
S	2	SPPO-00101	1	09353	TP11-H8AB	SPST PC MT PUSHBUTTON
U	1	UTNO-01230	1	01295	SN74123N	SN74123N DUAL ONE SHOT
U	2	UGNO-06809	1	04713	MC6809P	MC6809P MICROPROCESSOR
U	3	UTNO-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
U	4	UTNO-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
U	5	UTNO-02441	1	01295	SN74LS244N	SNL4LS244N 8X DRIV/RECV
U	6	UTNO-02451	1	01295	SN74LS245N	SN74LS245N 8X TRANSCEIVER
U	7	UTNO-02451	1	01295	SN74LS245N	SN74LS245N 8X TRANSCEIVER
U	9	UTNO-01381	1	01295	SN74LS138N	SN74LS138N 3 TO 8 DEC
U	10	UTNO-02401	1	01295	SN74LS240N	SN74LS240 8X DRIV/RECV
U	11	101AC28410	1	58900	101AC28410	ADDRESS ROM A2-1
U	12	UTNO-00170	1	01295	SN7417N	SN7417N HEX BUFFER
U	13	UTNO-00021	1	01295	SN74LS02N	SN74LS02 QUAD NOR
U	14	UGNO-06522	1	55576	SYP6522	SYP6522 VIA
X	1	JSPO-10028	1	09922	DILB28P-108	28 PIN DIP SOCKET
X	2	JSPO-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
X	3	JSPO-10020	1	09922	DILB20P-108	20 PIN DIP SOCKET
X	4	JSPO-10040	1	09922	DILB40P-108	40 PIN DIP SOCKET
Y	1	Y180-00358	1	63468	ED035	3.58MHZ FUND XTAL

Parts List for LEVEL CONTROL PCA No. 304CA03500 Rev. H

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03500	1	58900	304CF03500	LEVEL CONTROL PCB
	2	ETST-06224	3	88245	1280B	TURRET TERMINAL
C	1	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	2	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	7	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C	8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	13	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	14	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	15	CT15-R6220	1	56289	196D226X9015KA1	22UF 15V 10% RADIAL LEAD
C	16	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	17	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	18	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	20	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	21	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	22	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	23	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	24	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	25	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	26	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	27	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	28	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	29	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	30	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	31	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	32	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	33	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	34	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	35	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	36	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	37	CC50-00220	1	52763	EDPT-22-NPO-5%	22 PF CERAMIC NPO
C	38	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	39	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	40	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	41	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	42	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	43	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	45	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	47	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C	48	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE

Parts List for LEVEL CONTROL PCA No. 304CA03500 Rev. H

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
CR	4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	5	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	7	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
L	1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
Q	1	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q	2	QBPS-05771	1	27014	2N5771	2N5771 15V 850MHZ PNP
Q	3	QBPS-03645	1	27014	PN3645	PN3645 .5A 60V .6W PNP
Q	4	QBNS-03643	1	27014	PN3643	PN3643 .5A 30V .6W NPN
Q	5	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q	6	QJNS-04091	1	04713	2N4091	2N4091 300HM N CH JFET
Q	7	QJNS-04091	1	04713	2N4091	2N4091 300HM N CH JFET
Q	8	QJNS-04091	1	04713	2N4091	2N4091 300HM N CH JFET
Q	9	QJNS-04091	1	04713	2N4091	2N4091 300HM N CH JFET
R	1	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	2	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	3	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	4	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	5	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	6	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	7	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	8	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	10	RN55-13920	1	05905	SMA 0207 E 96	3.92 K OHMS 1% MET FILM
R	11	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	12	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	13	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	14	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	15	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R	16	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	17	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	18	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	19	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	20	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	21	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	22	RN55-13320	1	05905	SMA 0207 E 96	3.32 K OHMS 1% MET FILM
R	23	RAPD-11000	1	73138	89PR1K	1K POT 15T PC MNT
R	24	RN55-34750	1	05905	SMA 0207 E 96	475 K OHMS 1% MET FILM
R	25	RN55-33010	1	05905	SMA 0207 E 96	301 K OHMS 1% MET FILM
R	26	RAPD-21000	1	73138	89PR10K	10K POT 15T PC MNT
R	27	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	28	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	29	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	30	RN55-23920	1	05905	SMA 0207 E 96	39.2 K OHMS 1% MET FILM
R	31	RN55-13920	1	05905	SMA 0207 E 96	3.92 K OHMS 1% MET FILM
R	32	RN55-21240	1	05905	SMA 0207 E 96	12.4 K OHMS 1% MET FILM.
R	33	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	34	RN55-21240	1	05905	SMA 0207 E 96	12.4 K OHMS 1% MET FILM.
R	35	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R	36	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	37	RN55-21400	1	05905	SMA 0207 E 96	14 K OHMS 1% MET FILM
R	38	RN55-22000	1	05905	SMA 0207 E 96	20 K OHMS 1% MET FILM

Parts List for LEVEL CONTROL PCA No. 304CA03500 Rev. H

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 39	RN55-33010	1	05905	SMA 0207 E 96	301 K OHMS 1% MET FILM
R 40	RN55-25490	1	05905	SMA 0207 E 96	54.9 K OHMS 1% MET FILM
R 43	RAPD-21000	1	73138	89PR10K	10K POT 15T PC MNT
R 44	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 45	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 46	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 47	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R 48	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R 49	RAPD-11000	1	73138	89PR1K	1K POT 15T PC MNT
R 50	RN55-24320	1	05905	SMA 0207 E 96	43.2 K OHMS 1% MET FILM
R 51	RN55-11500	1	05905	SMA 0207 E 96	1.5 K OHMS 1% MET FILM
R 52	RAPD-22000	1	73138	89PR20K	20K POT 15T PC MNT
R 53	RN55-24220	1	05905	SMA 0207 E 96	42.2 K OHMS 1% MET FILM
R 54	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 55	RN55-25360	1	05905	SMA 0207 E 96	53.6 K OHMS 1% MET FILM
R 56	RN55-23740	1	05905	SMA 0207 E 96	37.4 K OHMS 1% MET FILM
R 57	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 58	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 59	RN55-16190	1	05905	SMA 0207 E 96	6.19 K OHMS 1% MET FILM
R 60	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 61	RAPD-31000	1	73138	89PR100K	100K POT 15T PC MNT
R 62	RN55-24320	1	05905	SMA 0207 E 96	43.2 K OHMS 1% MET FILM
R 63	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R 64	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R 65	RN55-22000	1	05905	SMA 0207 E 96	20 K OHMS 1% MET FILM
R 66	RN55-22320	1	05905	SMA 0207 E 96	23.2 K OHMS 1% MET FILM
R 67	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 68	RN55-24990	1	05905	SMA 0207 E 96	49.9 K OHMS 1% MET FILM
R 69	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 70	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 71	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 72	RN55-24990	1	05905	SMA 0207 E 96	49.9 K OHMS 1% MET FILM
R 73	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R 74	RN55-24990	1	05905	SMA 0207 E 96	49.9 K OHMS 1% MET FILM
R 75	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R 76	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R 77	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 78	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 79	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 80	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 81	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 82	RAPD-21000	1	73138	89PR10K	10K POT 15T PC MNT
R 83	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 84	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 85	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 86	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 87	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R 88	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 89	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 90	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 91	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM

Parts List for LEVEL CONTROL PCA No. 304CA03500 Rev. H

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 92	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 93	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R 94	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 95	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 96	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R 97	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 98	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 99	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
U 1	UINO-01413	1	04713	MC1413P	MC1413P X7 DRIVER .5A
U 2	UINO-01413	1	04713	MC1413P	MC1413P X7 DRIVER .5A
U 3	UENO-10125	1	04713	MC10125P	MC10125P QUAD ECL TO TTL
U 4	UONO-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 5	ULNO-05042	1	32293	IH5042CPE	IH5042CPE SPDT SWITCH
U 6	UEGO-09685	1	52648	SP9685CM	SP9685CM COMPARATOR
U 7	UONO-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 8	UCNO-04330	1	04713	MC14433P	MC14433P 3 1/2 DIG A/D
U 9	UANO-00441	1	01295	TL441CN	TL441 DUAL LOG AMP
U 10	UONO-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U 11	ULNO-02901	1	27014	LM2901N	LM2901N QUAD COMPARATOR
U 12	URPO-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
U 13	URPO-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
U 14	URPO-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
U 15	URPO-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
U 16	UONO-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 17	UONO-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 21	UANO-00100	1	13919	LOG 100JP	LOG 100JP LOG AMP
U 22	UONO-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U 23	UONO-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 24	UINO-07542	1	24355	AD7542KN	AD7542KN 12 BIT D/A
VR 1	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE
VR 2	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE
VR 3	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE

Parts List for OUTPUT PLL PCA No. 304CA01000   Rev. F

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF01000	1	58900	304CF01000	OUTPUT PLL BD
	2	ETST-06224	1	88245	1280B	TURRET TERMINAL
	3	HQH0-00010	1	05820	651-B	IC HEATSINK
C	1	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	5	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	6	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	7	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	10	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	13	CC50-05470	1	51642	500-050-601-475M	4.7UF CERAMIC Z5U
C	15	CC50-05470	1	51642	500-050-601-475M	4.7UF CERAMIC Z5U
C	16	CC50-05470	1	51642	500-050-601-475M	4.7UF CERAMIC Z5U
C	17	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	18	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	21	CC50-01150	1	51642	150-100-C0G-151J	150 PF CERAMIC NPO
C	23	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	24	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	26	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	27	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	28	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	29	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	30	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR	4	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR	6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	7	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	8	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	9	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR	10	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR	11	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	12	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	13	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	14	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
R	1	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	2	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	3	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R	4	RN55-23570	1	05905	SMA 0207 E 96	35.7 K OHMS 1% MET FILM
R	5	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R	6	RN55-23570	1	05905	SMA 0207 E 96	35.7 K OHMS 1% MET FILM
R	7	RN55-23570	1	05905	SMA 0207 E 96	35.7 K OHMS 1% MET FILM
R	8	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM

Parts List for OUTPUT PLL PCA No. 304CA01000 Rev. F

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 11	RN55-21210	1	05905	SMA 0207 E 96	12.1 K OHMS 1% MET FILM
R 12	RN55-23320	1	05905	SMA 0207 E 96	33.2 K OHMS 1% MET FILM
R 13	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 14	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 15	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 16	RN55-33010	1	05905	SMA 0207 E 96	301 K OHMS 1% MET FILM
R 17	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 18	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 19	RN55-18250	1	05905	SMA 0207 E 96	8.25 K OHMS 1% MET FILM
R 20	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 21	RN55-12740	1	05905	SMA 0207 E 96	2.74 K OHMS 1% MET FILM
R 23	RN55-31500	1	05905	SMA 0207 E 96	150 K OHMS 1% MET FILM
R 24	RN55-21210	1	05905	SMA 0207 E 96	12.1 K OHMS 1% MET FILM
R 25	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 26	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 29	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 30	RN55-18250	1	05905	SMA 0207 E 96	8.25 K OHMS 1% MET FILM
R 31	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R 32	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 33	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 34	RN55-18250	1	05905	SMA 0207 E 96	8.25 K OHMS 1% MET FILM
R 36	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 37	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 39	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 40	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 41	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 42	RAPD-25000	1	73138	89PR50K	50K POT 15T PC MNT
R 44	RN55-31500	1	05905	SMA 0207 E 96	150 K OHMS 1% MET FILM
R 45	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 46	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 47	RN55-13920	1	05905	SMA 0207 E 96	3.92 K OHMS 1% MET FILM
R 48	RC05-26800	1	01121	BB-683-5	68K; 5% 1/8W CARBON
R 49	RC05-26800	1	01121	BB-683-5	68K; 5% 1/8W CARBON
R 50	RC05-26800	1	01121	BB-683-5	68K; 5% 1/8W CARBON
R 51	RC05-26800	1	01121	BB-683-5	68K; 5% 1/8W CARBON
R 52	RN55-02740	1	05905	SMA 0207 E 96	274 OHMS 1% MET FILM
RM 1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
U 1	ULN0-05042	1	32293	IH5042CPE	IH5042CPE SPDT SWITCH
U 2	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 3	UEN0-12040	1	04713	MC12040P	MC12040P PHASE/FREQ DET
U 4	UEN0-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
U 5	UON0-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U 6	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 7	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 9	URP0-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
U 10	URP0-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
VR 3	DZAD-04734	1	04713	1N4734A	IN4734 6.2V ZENER
VR 4	DZAD-04734	1	04713	1N4734A	IN4734 6.2V ZENER

Parts List for DIVIDER PCA No. 304CA03100   Rev. D

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03100	1	58900	304CF03100	DIVIDER PCB
	2	HSCS-60304	4	06540	RAF 1532-B-6-A	#6 X 3/16SWAGE CLR SPACER
AR	1	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR	2	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
C	1	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	3	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	4	CC50-00047	1	51642	100-100-COG-479J	4.7PF CERAMIC NPO
C	5	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	6	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	7	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	8	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	9	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	12	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	13	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	14	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	15	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	16	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	17	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	18	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	19	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	20	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	21	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	22	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
J	1	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J	2	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
L	1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L	2	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L	3	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L	4	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
Q	1	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	3	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	4	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
R	1	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	2	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R	3	RN55-16810	1	05905	SMA 0207 E 96	6.81 K OHMS 1% MET FILM
R	4	RN55-13320	1	05905	SMA 0207 E 96	3.32 K OHMS 1% MET FILM
R	5	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	6	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	7	RN55-13320	1	05905	SMA 0207 E 96	3.32 K OHMS 1% MET FILM
R	8	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	9	RN55-11500	1	05905	SMA 0207 E 96	1.5 K OHMS 1% MET FILM
R	10	RN55-00681	1	05905	SMA 0207 E 96	68.1 OHMS 1% MET FILM
R	11	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R	12	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	13	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	14	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
RM	1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK

Parts List for DIVIDER PCA No. 304CA03100 Rev. D

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
RM	2	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
U	1	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U	2	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F
U	3	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F
U	4	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F
U	5	UENO-10102	1	04713	MC10102P	MC10102P QUAD NOR
U	6	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F

Parts List for 40-80 MHZ PLL PCA No. 304CA03000 Rev. H

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03000	1	58900	304CF03000	40-80 MHZ PLL PCB
	2	ETST-06224	1	88245	1280B	TURRET TERMINAL
	3	HSTS-40304	4	06540	9532B-A-0440	4-40 X 3/16 SWAGE SPACER
	4	HQH0-00010	1	05820	651-B	IC HEATSINK
	5	304CF09100	1	58900	304CF09100	TOP PC SHEILD 1.25 X 2.5
	6	304BF09200	2	58900	304BF09200	PC BD SHIELD COVER
	7	304CF09500	1	58900	304CF09500	BOTTOM PC BD SHIELD 1.25
C	1	CC50-01330	1	51642	150-100-COG-331J	330 PF CERAMIC NPO
C	2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	4	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	5	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	7	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
C	8	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
C	9	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	10	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C	12	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	16	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C	17	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C	18	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C	21	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	22	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	23	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	24	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	25	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	26	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	27	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	28	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	29	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	30	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	31	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	32	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	33	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	34	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C	35	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C	37	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	40	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	41	CC50-00390	1	51642	150-100-COG-390J	39 PF CERAMIC NPO
C	42	CC50-00560	1	51642	150-100-COG-560J	56 PF CERAMIC NPO
C	43	CC50-00390	1	51642	150-100-COG-390J	39 PF CERAMIC NPO
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
CR	4	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
J	1	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
J	2	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
L	1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L	3	LAB0-03680	1	99800	1026-12	.068 UH INDUCTOR
L	5	LAB0-04100	1	99800	1325-101	.10 UH INDUCTOR
L	6	LAB0-04100	1	99800	1325-101	.10 UH INDUCTOR
L	7	LAB0-03470	1	99800	1026-08	.047 UH INDUCTOR

Parts List for 40-80 MHZ PLL PCA No. 304CA03000 Rev. H

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
L	8	LAB0-03470	1	99800	1026-08	.047 UH INDUCTOR
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q	2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	3	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
Q	4	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
R	1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	2	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	3	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	4	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	5	RN55-18250	1	05905	SMA 0207 E 96	8.25 K OHMS 1% MET FILM
R	6	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	7	RN55-32000	1	05905	SMA 0207 E 96	200 K OHMS 1% MET FILM
R	9	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R	10	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R	11	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	12	RN55-21470	1	05905	SMA 0207 E 96	14.7 K OHMS 1% MET FILM
R	13	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	14	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM
R	15	RC05-21000	1	01121	BB-103-5	10K; 5% 1/8W CARBON
R	16	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	17	RC05-11500	1	01121	BB-152-5	1.5K; 5% 1/8W CARBON
R	18	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	19	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	20	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
R	21	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R	22	RN55-22740	1	05905	SMA 0207 E 96	27.4 K OHMS 1% MET FILM
R	23	RN55-21470	1	05905	SMA 0207 E 96	14.7 K OHMS 1% MET FILM
R	24	RN55-22740	1	05905	SMA 0207 E 96	27.4 K OHMS 1% MET FILM
R	25	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	28	RN55-00681	1	05905	SMA 0207 E 96	68.1 OHMS 1% MET FILM
R	29	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	30	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R	32	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	33	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	34	RC05-13900	1	01121	BB-392-5	3.9K; 5% 1/8W CARBON
R	35	RC05-05600	1	01121	RC05GF561-J	560 OHM 5% 1/8W CARBON
U	1	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	3	UCN0-51460	1	04713	MC145146P	MC145146P FREQ SYNTH
U	4	MMDC-00001	1	15542	ASK-1	1-600MHZ 600MHZ IF MIX
U	5	UEN0-12013	1	04713	MC12013P	MC12013 DIV 10/11 600MHZ
U	6	UEN0-10231	1	04713	MC10231P	MC10231P DUAL D F/F
U	7	URP0-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG

Parts List for INTERMEDIATE PLL PCA No. 304CA02700   Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304CF02700	1	58900	304CF02700	INTERMEDIATE PLL BD
2	ETST-06224	1	88245	1280B	TURRET TERMINAL
3	HSTS-40304	4	06540	9532B-A-0440	4-40 X 3/16 SWAGE SPACER
4	304CF09100	1	58900	304CF09100	TOP PC SHEILD 1.25 X 2.5
5	304BF09200	2	58900	304BF09200	PC BD SHIELD COVER
6	HQH0-00010	1	05820	651-B	IC HEATSINK
7	304CF09500	1	58900	304CF09500	BOTTOM PC BD SHIELD 1.25
8	HBHS-A2403	1	96906	MIL STD	10-24 X 3/16 SET SCREW
AR 2	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
C 1	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 2	CE50-07100	1	90201	TC3501D	100UF 50V ELECT.
C 3	CE50-07100	1	90201	TC3501D	100UF 50V ELECT.
C 4	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 7	CC50-01470	1	51642	150-100-COG-471	470 PF CERAMIC NPO
C 8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 12	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 13	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 14	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 15	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 16	CK50-00150	1	96733	SG91BY150JSA	15 PF NPO CHIP
C 18	CK50-00050	1	96733	SG0805BY5R0DSA	5 PF NPO CHIP
C 19	CK50-00150	1	96733	SG91BY150JSA	15 PF NPO CHIP
C 21	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 22	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 23	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 24	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 25	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 27	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 28	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 29	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 30	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 31	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C 33	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 34	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 37	CC50-00180	1	51642	150-100-COG-180J	18 PF CERAMIC NPO
C 38	CC50-00180	1	51642	150-100-COG-180J	18 PF CERAMIC NPO
C 39	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C 40	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C 42	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 43	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 44	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 45	CC50-00220	1	52763	EDPT-22-NPO-5%	22 PF CERAMIC NPO
C 46	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
CR 1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 4	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE

Parts List for INTERMEDIATE PLL PCA No. 304CA02700 Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
CR 5	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 7	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
DS 1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
J 1	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
L 1	LAD0-06270	1	72259	WEE-27	27 UH INDUCTOR
L 2	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L 3	LAD0-04680	1	72259	WEE-068	.68 uH INDUCTOR
L 5	LAB0-03470	1	99800	1026-08	.047 UH INDUCTOR
L 6	LAB0-03470	1	99800	1026-08	.047 UH INDUCTOR
L 7	LAD0-04330	1	72259	WEE-.33	.33 UH INDUCTOR
Q 1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q 2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q 3	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
Q 4	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
R 1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 2	RN55-12740	1	05905	SMA 0207 E 96	2.74 K OHMS 1% MET FILM
R 3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 4	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 5	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 6	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R 7	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 8	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 9	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 10	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 11	RN55-21210	1	05905	SMA 0207 E 96	12.1 K OHMS 1% MET FILM
R 12	RN55-25620	1	05905	SMA 0207 E 96	56.2 K OHMS 1% MET FILM
R 13	RC05-21000	1	01121	BB-103-5	10K; 5% 1/8W CARBON
R 14	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R 15	RC05-11500	1	01121	BB-152-5	1.5K; 5% 1/8W CARBON
R 16	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM
R 17	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM
R 18	RN55-34990	1	05905	SMA 0207 E 96	499 K OHMS 1% MET FILM
R 19	RN55-34990	1	05905	SMA 0207 E 96	499 K OHMS 1% MET FILM
R 20	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R 21	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R 22	RC05-00220	1	01121	BB-220-5	22 OHMS 5% 1/8W CARBON
R 23	RC05-01000	1	01121	BB-101-5	100ohms;5% 1/8W CARBON
R 26	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R 27	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R 28	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R 29	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 30	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 31	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R 32	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R 33	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM
R 34	RC05-00100	1	01121	BB-100-5	10 OHMS 5% 1/8W CARBON
R 35	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 36	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R 37	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R 38	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM

Parts List for INTERMEDIATE PLL PCA No. 304CA02700 Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 39	RC05-04700	1	01121	BB-471-5	470ohm; 5% 1/8W CARBON
R 40	RC05-13900	1	01121	BB-392-5	3.9K; 5% 1/8W CARBON
R 42	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 43	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 44	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
U 1	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 2	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U 3	UENO-12040	1	04713	MC12040P	MC12040P PHASE/FREQ DET
U 4	MMDC-00001	1	15542	ASK-1	1-600MHZ 600MHZ IF MIX
U 5	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F
U 6	UENO-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
U 7	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP

Parts List for HI RESOLUTION PCA No. 304CA03400   Rev. F

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03400	1	58900	304CF03400	HI RESOLUTION PCB
	2	HSTS-40304	4	06540	9532B-A-0440	4-40 X 3/16 SWAGE SPACER
	3	HQHO-00010	2	05820	651-B	IC HEATSINK
	4	304CF09100	1	58900	304CF09100	TOP PC SHEILD 1.25 X 2.5
	5	304BF09200	2	58900	304BF09200	PC BD SHIELD COVER
	6	304CF09500	1	58900	304CF09500	BOTTOM PC BD SHIELD 1.25
	7	ETST-06224	1	88245	1280B	TURRET TERMINAL
AR	1	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR	2	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
C	1	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	2	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	3	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	4	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	5	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	6	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C	7	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	8	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	10	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C	11	CK50-00050	1	96733	SG0805BY5R0DSA	5 PF NPO CHIP
C	12	CK50-00150	1	96733	SG91BY150JSA	15 PF NPO CHIP
C	13	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	14	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	15	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	16	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	17	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	18	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	20	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
C	21	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	22	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	24	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	27	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	28	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	29	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	30	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	31	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	32	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	33	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	34	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	35	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	37	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	38	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
CR	3	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
CR	4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
J	1	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
L	1	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
Q	1	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
Q	4	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN

Parts List for HI RESOLUTION PCA No. 304CA03400 Rev. F

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
Q	5	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
R	5	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R	6	RC05-13900	1	01121	BB-392-5	3.9K; 5% 1/8W CARBON
R	7	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	8	RC05-21000	1	01121	BB-103-5	10K; 5% 1/8W CARBON
R	9	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	10	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	11	RN55-00562	1	05905	SMA 0207 E 96	56.2 OHMS 1% MET FILM
R	13	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	15	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R	17	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R	23	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	24	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R	25	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	26	RN55-32000	1	05905	SMA 0207 E 96	200 K OHMS 1% MET FILM
R	27	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	28	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	29	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	30	RN55-22740	1	05905	SMA 0207 E 96	27.4 K OHMS 1% MET FILM
R	31	RN55-26040	1	05905	SMA 0207 E 96	60.4 K OHMS 1% MET FILM
R	32	RN55-26040	1	05905	SMA 0207 E 96	60.4 K OHMS 1% MET FILM
R	33	RN55-22740	1	05905	SMA 0207 E 96	27.4 K OHMS 1% MET FILM
R	34	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	35	RC05-11500	1	01121	BB-152-5	1.5K; 5% 1/8W CARBON
R	36	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R	37	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R	38	RN55-13920	1	05905	SMA 0207 E 96	3.92 K OHMS 1% MET FILM
R	39	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	40	RC05-00820	1	01121	BB-820-5	82 ohms;5% 1/8W CARBON
R	41	RC05-00560	1	01121	BB-560-5	56 OHMS 5% 1/8W CARBON
R	42	RC05-00560	1	01121	BB-560-5	56 OHMS 5% 1/8W CARBON
R	43	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM
R	44	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
RM	1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
U	2	UINO-03393	1	04713	MC3393P	MC3393P 40MHZ 15/16 CTR
U	4	MMDC-00001	1	15542	ASK-1	1-600MHZ 600MHZ IF MIX
U	5	UCNO-51460	1	04713	MC145146P	MC145146P FREQ SYNTH
U	7	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	8	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U	9	UENO-12011	1	04713	MC12011P	MC12011 DIV BY 8/9 600MHZ
U	10	UENO-10131	1	04713	MC10131P	MC10131P DUAL D F/F
U	11	UENO-10102	1	04713	MC10102P	MC10102P QUAD NOR

Parts List for 300 MHz PLL PCA No. 304CA02200   Rev. H

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF02200	1	58900	304CF02200	300 MHZ PLL PCB
	2	HQH0-00010	5	05820	651-B	IC HEATSINK
	4	304CF09300	1	58900	304CF09300	TOP PC SHIELD 1.5 X 1.5
	5	304BF09400	1	58900	304BF09400	PC BD SHIELD COVER
	6	HSTS-40304	4	06540	9532B-A-0440	4-40 X 3/16 SWAGE SPACER
	7	304CF09600	1	58900	304CF09600	BOTTOM PC BD SHIELD 1.5 X
	8	304BF09700	1	58900	304BF09700	BOTTOM PC BD SHEILD COVER
AR	1	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR	2	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
C	1	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	2	CC50-00680	1	51642	150-100-C0G-680J	68 PF CERAMIC NPO
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-00680	1	51642	150-100-C0G-680J	68 PF CERAMIC NPO
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	15	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	16	CF00-02470	1	56289	192P47292	.0047 UF POLY FILM
C	17	CF00-02470	1	56289	192P47292	.0047 UF POLY FILM
C	18	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	19	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	20	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	21	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	22	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	23	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	24	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	25	CC50-01100	1	51642	150-100-C0G-101J	100 PF CERAMIC NPO
C	26	CC50-01100	1	51642	150-100-C0G-101J	100 PF CERAMIC NPO
C	27	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
J	1	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
J	2	JRBM-00000	1	98291	51-045-0000	SMB M BULK MOUNT
L	1	LAB0-03820	1	99800	1026-14	.082uH INDUCTOR
L	2	LAD0-04680	1	72259	WEE-068	.68 uH INDUCTOR
R	1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	2	RC05-03300	1	01121	BB-331-5	330ohms 5% 1/8W CARBON
R	3	RC05-03300	1	01121	BB-331-5	330ohms 5% 1/8W CARBON
R	4	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	5	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON
R	6	RC05-00220	1	01121	BB-220-5	22 OHMS 5% 1/8W CARBON
R	7	RC05-06800	1	01121	BB-681-5	680ohm; 5% 1/8W CARBON
R	8	RC05-02200	1	01121	BB-221-5	220ohms;5% 1/8W CARBON
R	9	RC05-21200	1	01121	BB-123-5	12K; 5% 1/8W CARBON
R	10	RC05-25600	1	01121	BB-563-5	56K; 5% 1/8W CARBON
R	12	RC05-32700	1	01121	BB-274-5	270 K 5% 1/8W CARBON
R	13	RC05-11000	1	01121	BB-102-5	1.0K; 5% 1/8W CARBON

Parts List for 300 MHz PLL PCA No. 304CA02200 Rev. H

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 14	RC05-03300	1	01121	BB-331-5	330ohms 5% 1/8W CARBON
R 15	RC05-03300	1	01121	BB-331-5	330ohms 5% 1/8W CARBON
R 18	RC05-05600	1	01121	RC05GF561-J	560 OHM 5% 1/8W CARBON
R 19	RC05-16800	1	01121	BB-682-5	6.8K; 5% 1/8W CARBON
R 20	RC05-16800	1	01121	BB-682-5	6.8K; 5% 1/8W CARBON
R 21	RC05-05600	1	01121	RC05GF561-J	560 OHM 5% 1/8W CARBON
R 22	RC05-18200	1	01121	BB-822-5	8.2K; 5% 1/8W CARBON
R 23	RC05-18200	1	01121	BB-822-5	8.2K; 5% 1/8W CARBON
R 24	RC05-04700	1	01121	BB-471-5	470ohm; 5% 1/8W CARBON
R 25	RC05-21000	1	01121	BB-103-5	10K; 5% 1/8W CARBON
R 26	RC05-12200	1	01121	BB-222-5	2.2K; 5% 1/8W CARBON
R 27	RC05-13300	1	01121	BB-332-5	3.3K; 5% 1/8W CARBON
R 28	RC05-00470	1	01121	BB-470-5	47 OHMS 5% 1/8W CARBON
R 29	RC05-21000	1	01121	BB-103-5	10K; 5% 1/8W CARBON
R 30	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
R 31	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
R 32	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
RM 1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
RM 2	RM7S-21000	1	71450	750-81-R10K	10K OHM X 7 SIP NETWRK
RM 3	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
U 1	UEN1-10136	1	04713	MC10H136P	MC10H136P 250MHZ DIV 16
U 2	UEN0-10109	1	04713	MC10109P	MC10109P DUAL OR/NOR
U 3	UEN1-10136	1	04713	MC10H136P	MC10H136P 250MHZ DIV 16
U 4	MMDC-00001	1	15542	ASK-1	1-600MHZ 600MHZ IF MIX
U 5	ULN0-02901	1	27014	LM2901N	LM2901N QUAD COMPARATOR
U 6	ULN0-02901	1	27014	LM2901N	LM2901N QUAD COMPARATOR
U 7	UEN1-10131	1	04713	MC10H131P	MC10H131P DUAL D F/F
U 8	UEN0-12040	1	04713	MC12040P	MC12040P PHASE/FREQ DET
U 9	ULN0-00311	1	27014	LM311N	LM311N COMPARATOR
U 10	UTN0-01751	1	01295	SN74LS175N	SN74LS175 QUAD D F/F
U 11	UTN0-01751	1	01295	SN74LS175N	SN74LS175 QUAD D F/F
U 12	UTN0-00021	1	01295	SN74LS02N	SN74LS02 QUAD NOR
U 14	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 15	UEN0-10138	1	04713	MC10138P	MC10138P BI-QUINARY CTR
U 16	UON0-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U 17	URP0-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG

Parts List for 110 MHz REF PLL PCA No. 304CA05600 Rev. D

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF05600	1	58900	304CF05600	110 MHZ REF PLL BD
	2	ETST-06224	1	88245	1280B	TURRET TERMINAL
	3	HSCS-60304	4	06540	RAF 1532-B-6-A	#6 X 3/16SWAGE CLR SPACER
	4	HQHO-00010	3	05820	651-B	IC HEATSINK
C	1	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	3	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	4	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	5	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	6	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	7	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	8	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	9	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	13	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	14	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	15	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	16	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	17	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	18	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	19	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	20	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	21	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	22	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	23	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	24	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	25	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	5	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	7	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
L	1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L	2	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q	2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	3	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q	4	QBNS-00012	1	04713	MPSA12	MPSA12 20K HFE NPN
Q	5	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
R	1	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	2	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R	3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	4	RN55-32740	1	05905	SMA 0207 E 96	274 K OHMS 1% MET FILM
R	5	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	6	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM
R	7	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM

Parts List for 110 MHz REF PLL PCA No. 304CA05600 Rev. D

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
R	8	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	9	RN55-33010	1	05905	SMA 0207 E 96	301 K OHMS 1% MET FILM
R	10	RN55-25620	1	05905	SMA 0207 E 96	56.2 K OHMS 1% MET FILM
R	11	RN55-21210	1	05905	SMA 0207 E 96	12.1 K OHMS 1% MET FILM
R	12	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	13	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R	14	RN55-00825	1	05905	SMA 0207 E 96	82.5 OHMS 1% MET FILM
R	15	RN55-32740	1	05905	SMA 0207 E 96	274 K OHMS 1% MET FILM
R	16	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	17	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	18	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	19	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	20	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	21	RN55-22210	1	05905	SMA 0207 E 96	22.1 K OHMS 1% MET FILM
R	22	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	23	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R	24	RN55-21500	1	05905	SMA 0207 E 96	15 K OHMS 1% MET FILM
R	25	RN55-32740	1	05905	SMA 0207 E 96	274 K OHMS 1% MET FILM
R	26	RN55-32740	1	05905	SMA 0207 E 96	274 K OHMS 1% MET FILM
R	27	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	28	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	29	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	30	RC20-00680	1	01121	EB-680-5	68 OHMS 5% 1/2W CARBON
U	1	UON0-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	2	URP0-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
U	3	URP0-79120	1	04713	MC79L12CP	MC79L12 .1A -12V REG
U	4	UEN0-12040	1	04713	MC12040P	MC12040P PHASE/FREQ DET
U	5	UEN0-12013	1	04713	MC12013P	MC12013 DIV 10/11 600MHZ
U	6	UEN0-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
U	7	UEN0-10124	1	04713	MC10124P	MC10124P QUAD TTL TO ECL
U	8	UTN0-01322	1	01295	SN74HC132N	SN74HC132N 4X SCHMIDT NAN
U	9	URP0-78050	1	04713	MC78L05	MC78L05 .1A 5V REG

Parts List for YIG DRIVER PCA No. 304CA02400   Rev. C

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF02400	1	58900	304CF02400	YIG DRIVER PC BD
	2	ETST-06224	1	88245	1280B	TURRET TERMINAL
C	1	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	3	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	6	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	7	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	11	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	12	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	13	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	15	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	16	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	17	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	18	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	20	CC50-00470	1	52763	EDPT-47-NPO-5%	47 PF CERAMIC NPO
C	21	CC50-00470	1	52763	EDPT-47-NPO-5%	47 PF CERAMIC NPO
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
R	1	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	2	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	3	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	4	RAPD-12000	1	73138	89PR2K	2K POT 15T PC MNT
R	5	RN55-18250	1	05905	SMA 0207 E 96	8.25 K OHMS 1% MET FILM
R	6	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	7	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	8	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	9	RAPD-11000	1	73138	89PR1K	1K POT 15T PC MNT
R	10	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R	11	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	12	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R	13	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	15	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
U	1	UIN0-07542	1	24355	AD7542KN	AD7542KN 12 BIT D/A
U	2	UON0-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U	3	UON0-00027	1	24355	AD OP27GN	OP27GN LOW DRIFT OP AMP
U	5	URP0-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
U	6	URP0-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
VR	1	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE

Parts List for POWER SUPPLY PCA No. 304BA01100 Rev. C

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304BF01100	1	58900	304BF01100	POWER SUPPLY PCB
	2	ETSB-06224	11	88245	1309B	BIFURCATED TERMINAL 15/64
	3	HQHO-02200	2	13103	6106B-16	TO220 HEATSINK
	4	201BF01200	1	58900	201BF01200	CAPACITOR RETAINER
	5	HSTH-42503	1	06540	8120-SS-0440	4-40 X 1 9/16 HEX SPACER
	6	HSTS-40704	4	55566	3050-B-440-A	4-40 X 7/16 SWAGE SPACER
	7	ETSB-06216	6	88245	2000B	BIFURCATED TERMINAL 5/32
C	1	CE35-08220	1	56289	503D228F035TJ	>2200UF >35V ELECT.
C	2	CE35-08220	1	56289	503D228F035TJ	>2200UF >35V ELECT.
C	3	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	4	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	5	CE63-07220	1	56289	501D227F063PR	220 UF 63V ELECT.
C	6	CE35-08220	1	56289	503D228F035TJ	>2200UF >35V ELECT.
C	7	CE35-08220	1	56289	503D228F035TJ	>2200UF >35V ELECT.
C	8	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	9	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
CR	1	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
CR	2	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
CR	3	DBMC-00001	1	26923	CSB1	1 A DIP BRIDGE
Q	1	QBNS-00042	1	04713	MPSA42	MPSA42 300V NPN
Q	2	QBNS-00042	1	04713	MPSA42	MPSA42 300V NPN
R	1	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	2	RN55-00121	1	05905	SMA 0207 E 96	12.1 OHMS 1% MET FILM
R	3	RW03-00030	1	91637	RS-2B-3-1	3ohm 2W WIREWOUND
U	1	URCO-07918	1	04713	MC7918CT	MC7918CT -18V 1A TO220 RE
U	2	URCO-07815	1	04713	MC7815CT	MC7815CT 1A 15V REG
VR	1	DZAD-04753	1	04713	1N4753	IN4753 36 V ZENER

Parts List for COMPUTER BUS PCA No. 304BA03300 Rev. E

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03300	1	58900	304CF03300	COMPUTER BUS PCB
	2	ETSB-06216	15	88245	2000B	BIFURCATED TERMINAL 5/32
J	1	JPP0-20017	3	31781	345-034-524-201	34 PIN PC EDGE CONN
J	2	JPP0-20030	5	31781	345-060-524-202	60 PIN PC EDGE CONN
J	3	JPP0-20013	4	31781	345-026-524-201	26 PIN PC EDGE CONN
J	4	JSP0-10014	1	09922	DILB14P-108	14 PIN DIP SOCKET
P	1	JIA1-26730	1	52072	CAD26SP100230730	26 PIN STRIPLINE PLUG
P	2	JIA1-20430	1	52072	CAD20SP100230430	20 PIN STRIPLINE PLUG
P	3	JIA1-16630	1	52072	CAD16SP100430630	16 PIN STRIPLINE PLUG
P	4	JIA1-34730	1	52072	CAD34SP100230730	34 PIN STRIPLINE PLUG
P	5	JIA1-26730	1	52072	CAD26SP100230730	26 PIN STRIPLINE PLUG
P	6	JIA1-34730	1	52072	CAD34SP100230730	34 PIN STRIPLINE PLUG

Parts List for RF BUS PCA No. 304DA02900 Rev. E

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF02900	1	58900	304CF02900	RF BUS PCB
	2	JPPG-20022	8	31781	322-044-520-258	44 PIN PC GUIDE CONN
	4	ETSB-06224	7	88245	1309B	BIFURCATED TERMINAL 15/64
	5	HBPP-44005	2	96906	MIL STD	4-40 X 5/16 PAN
	6	HNKS-44004	2	96906	MS35649-***	4-40 KEP NUT
	7	105BF12100	2	58900	105BF12100	FM DRIVER HEATSINK
	8	HQIS-01260	2	55285	XXX	TO126 INSULATOR
	9	HWFN-40400	2	96906	FW-4032	#4 NYLON WASHER
C	1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	3	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	4	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	5	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	6	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	7	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	8	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	11	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
CR	12	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
L	1	LAD0-05470	1	72259	WEE-4.7	4.7 UH INDUCTOR
P	1	JIA1-26730	1	52072	CAD26SP100230730	26 PIN STRIPLINE PLUG
P	2	JIA1-16630	1	52072	CAD16SP100430630	16 PIN STRIPLINE PLUG
Q	1	QBNP-06553	1	04713	2N6552	2N6552 1A 88V 10W NPN
Q	2	QBPP-06555	1	04713	MOTO 2N6555	2N6555 1A 60V 10W PNP
Q	3	QBPS-03645	1	27014	PN3645	PN3645 .5A 60V .6W PNP
Q	4	QBNS-03643	1	27014	PN3643	PN3643 .5A 30V .6W NPN
R	1	RC07-00051	1	01121	RC07GF5R1J	5.1 OHMS 5% 1/4W CARBON
R	2	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	4	RC07-00051	1	01121	RC07GF5R1J	5.1 OHMS 5% 1/4W CARBON
R	5	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	6	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	7	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
U	1	UCN0-00010	1	04713	MC14001BCP	MC14001 QUAD NOR

Parts List for 300 MHz OSC PCA No. 304CA05500 Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304CF05500	1	58900	304CF05500	300 MHz OSC PCB
2	004BA00000	1	58900	004BA00000	SAMPLER ASSEMBLY
3	304BF05000	1	58900	304BF05000	END PLATE
4	304BF05100	1	58900	304BF05100	COMPONENT SIDE WALL S
5	304BF05200	1	58900	304BF05200	CIRCUIT SIDE SUPPORT S
6	304BF07200	1	58900	304BF07200	BASE PLATE
7	304BF07300	2	58900	304BF07300	SIDE PLATE
8	304BF07400	2	58900	304BF07400	CIRCUIT SIDE STRIP
9	304CF02800	1	58900	304CF02800	ATTENUATOR MOUNT
13	304BF04200	1	58900	304BF04200	CONNECTOR MTG. PLATE
14	304BF08800	1	58900	304BF08800	COMPONENT SIDE WALL L
15	304BF08900	1	58900	304BF08900	CIRCUIT SIDE SUPPORT L
17	JRBM-00000	3	98291	51-045-0000	SMB M BULK MOUNT
18	LFTO-83216	6	89110	859617-1	FEED-THRU FILTER 15A
AR 1	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR 2	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR 3	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR 4	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR 5	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
AR 6	MA23-00006	1	24539	MSA-0835	0-6GHZ AMP 23DB 12.5DBM
AR 7	MA23-00006	1	24539	MSA-0835	0-6GHZ AMP 23DB 12.5DBM
C 5	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 6	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 8	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 10	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 11	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 12	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 13	CK50-00050	1	96733	SG0805BY5R0DSA	5 PF NPO CHIP
C 14	CK50-00220	1	96733	SB93BY220JSA	22 PF NPO CHIP
C 15	CK50-00100	1	96733	SG91BY100JSA	10 PF NPO CHIP
C 16	CK50-00050	1	96733	SG0805BY5R0DSA	5 PF NPO CHIP
C 17	CT10-R7220	1	56289	196D227X9010TE4	220UF 10V 10% RADIAL LEAD
C 18	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 19	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 20	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 21	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 22	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 23	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 24	CT20-07100	1	56289	150D107X0020S2	100 UF 20V TANTALUM
C 25	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C 26	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 27	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 31	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C 32	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 33	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 34	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 35	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 36	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 37	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 38	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 39	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R

Parts List for 300 MHz OSC PCA No. 304CA05500   Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
C 40	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 41	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 42	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 43	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 44	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 45	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C 46	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 47	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 48	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C 49	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 50	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 51	CC50-00270	1	52763	EDPT-27-NPO-5%	27 PF CERAMIC NPO
C 52	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C 53	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 54	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C 55	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 56	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 57	CK50-00050	1	96733	SG0805BY5R0DSA	5 PF NPO CHIP
C 58	CC50-00560	1	51642	150-100-COG-560J	56 PF CERAMIC NPO
C 59	CT20-07100	1	56289	150D107X0020S2	100 UF 20V TANTALUM
CR 1	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
CR 2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 3	DAA0-03401	1	04713	MPN3401	MPN3401 PIN DIODE
CR 4	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR 5	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
L 1	LR00-00000	1	58900		HAND WOUND COIL
L 2	LR00-00000	1	58900		HAND WOUND COIL
L 3	LAD0-07470	1	72259	WEE-470	470 UH INDUCTOR
L 4	LAD0-06270	1	72259	WEE-27	27 UH INDUCTOR
L 5	LAD0-06270	1	72259	WEE-27	27 UH INDUCTOR
L 6	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L 7	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L 8	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L 9	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L 10	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
L 11	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
Q 3	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q 4	QBNS-00090	1	04713	BFR90	BFR 90 15 V 5 GHZ FT
R 1	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 3	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 7	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 8	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 9	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R 11	RN55-00562	1	05905	SMA 0207 E 96	56.2 OHMS 1% MET FILM
R 12	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 13	RN55-00825	1	05905	SMA 0207 E 96	82.5 OHMS 1% MET FILM
R 14	RN55-12430	1	05905	SMA 0207 E 96	2.43 K OHMS 1% MET FILM
R 15	RN55-16190	1	05905	SMA 0207 E 96	6.19 K OHMS 1% MET FILM
R 16	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM
R 17	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 18	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM

Parts List for 300 MHz OSC PCA No. 304CA05500 Rev. G

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 19	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 20	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 21	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 22	RN55-23740	1	05905	SMA 0207 E 96	37.4 K OHMS 1% MET FILM
R 23	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 24	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 25	RN55-00332	1	05905	SMA 0207 E 96	33.2 OHMS 1% MET FILM
R 26	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 27	RN55-00511	1	05905	SMA 0207 E 96	51.1 OHMS 1% MET FILM
U 1	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U 2	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U 3	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U 4	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U 5	URPO-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF03200	1	58900	304CF03200	MODULATION GENERATOR PCB
	2	ETSB-06224	18	88245	1309B	BIFURCATED TERMINAL 15/64
	3	304BC00400	2	58900	304BC00400	7 POS PC MT SW W/5K
	4	304AC00401	1	58900	304AC00401	7 POS PC MT SW W/5K
	5	304AC00402	1	58900	304AC00402	7 POS PC MT SW W/5K
	6	304BC00500	1	58900	304BC00500	8 POS PC MT SW W/5K
	7	304BC06200	1	58900	304BC06200	7 POS PC MT SW W/10K
C	1	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	2	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	3	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	4	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	5	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	6	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	9	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	13	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	14	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	16	CC50-00560	1	51642	150-100-COG-560J	56 PF CERAMIC NPO
C	17	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	18	CC50-00560	1	51642	150-100-COG-560J	56 PF CERAMIC NPO
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	20	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	21	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	22	CC50-01750	1	51642	200-100-NPO-751J	750 PF CERAMIC
C	23	CC50-01750	1	51642	200-100-NPO-751J	750 PF CERAMIC
C	24	CC50-02150	1	51642	200-050-NPO-152J	1500PF CERAMIC NPO
C	25	CT35-R4220	1	56289	196D224X9035HA1	.22UF 35V 10% RADIAL LEAD
C	26	CT25-R5220	1	56289	196D225X9025HA1	2.2UF 25V 10% RADIAL LEAD
C	27	CT15-R6220	1	56289	196D226X9015KA1	22UF 15V 10% RADIAL LEAD
C	28	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	29	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	30	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
C	31	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
C	32	CC50-03470	1	51642	150-100-W5R-473	.047 UF CERAMIC X7R
C	33	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	34	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	35	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	36	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	37	CC50-02150	1	51642	200-050-NPO-152J	1500PF CERAMIC NPO
C	38	CC50-01220	1	51642	150-100-COG-221	220 PF CERAMIC NPO
C	40	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C	41	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	43	CT35-R4220	1	56289	196D224X9035HA1	.22UF 35V 10% RADIAL LEAD
C	44	CC50-03680	1	51642	150-100-W5R-683	.068 UF CERAMIC X7R
C	45	CN50-03220	1	51642	400-050-NPO-223J	.022 UF CERAMIC NPO
C	46	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	47	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	48	CC50-02150	1	51642	200-050-NPO-152J	1500PF CERAMIC NPO
C	49	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
C 50	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 51	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 52	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 53	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 54	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 55	CN50-03220	1	51642	400-050-NPO-223J	.022 UF CERAMIC NPO
C 56	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 57	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 58	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C 59	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 60	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 61	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 62	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 63	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C 64	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C 65	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 66	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 67	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 68	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 69	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 70	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 71	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C 72	CC50-00750	1	51642	200-100-NPO-750J	75 PF CERAMIC NPO
C 73	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 74	CC50-00220	1	52763	EDPT-22-NPO-5%	22 PF CERAMIC NPO
C 75	CC50-00220	1	52763	EDPT-22-NPO-5%	22 PF CERAMIC NPO
C 76	CC50-00220	1	52763	EDPT-22-NPO-5%	22 PF CERAMIC NPO
CR 1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 5	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 7	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 8	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 9	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 10	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 11	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 12	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 13	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 14	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 15	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 16	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 17	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 18	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 19	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 20	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 21	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 22	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 23	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 24	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
CR 25	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 26	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 27	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 28	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 29	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 30	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 31	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 32	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 33	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 34	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
J 1	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J 2	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J 3	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J 4	JIB0-02020	1	71468	UBS4A020C4DL	20 PIN STRIPLINE SOCKET
J 5	JIB0-02020	1	71468	UBS4A020C4DL	20 PIN STRIPLINE SOCKET
J 6	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
L 1	LAD0-05150	1	72259	WEE-1.5	1.5 UH INDUCTOR
L 2	LAD0-05150	1	72259	WEE-1.5	1.5 UH INDUCTOR
L 3	LAD0-05150	1	72259	WEE-1.5	1.5 UH INDUCTOR
P 2	JIA1-16630	1	52072	CAD16SP100430630	16 PIN STRIPLINE PLUG
P 3	JIA1-26730	1	52072	CAD26SP100230730	26 PIN STRIPLINE PLUG
Q 1	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 2	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 3	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 4	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 5	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 6	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 7	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 8	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 9	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 10	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 11	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 12	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 13	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 14	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 15	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 16	QJNS-04092	1	04713	2N4092	2N4092 30OHM N CH JFET
Q 17	QJNS-04092	1	04713	2N4092	2N4092 30OHM N CH JFET
Q 18	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q 19	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
R 1	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 2	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 3	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 4	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 5	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 6	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 7	RN55-01500	1	05905	SMA 0207 E 96	150 OHMS 1% MET FILM
R 8	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 9	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER
R 10	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 11	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 12	RN55-00562	1	05905	SMA 0207 E 96	56.2 OHMS 1% MET FILM
R 13	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 14	RN55-01210	1	05905	SMA 0207 E 96	121 OHMS 1% MET FILM
R 15	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 16	RN55-01210	1	05905	SMA 0207 E 96	121 OHMS 1% MET FILM
R 17	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 18	RN55-01210	1	05905	SMA 0207 E 96	121 OHMS 1% MET FILM
R 19	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R 20	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R 21	RN55-00562	1	05905	SMA 0207 E 96	56.2 OHMS 1% MET FILM
R 22	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 23	RN55-06650	1	05905	SMA 0207 E 96	665 OHMS 1% MET FILM
R 24	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R 25	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 26	RN55-06810	1	05905	SMA 0207 E 96	681 OHMS 1% MET FILM
R 27	RN55-03010	1	05905	SMA 0207 E 96	301 OHMS 1% MET FILM
R 28	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R 31	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 32	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 35	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 36	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 37	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 38	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 39	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 40	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R 41	RN55-01820	1	05905	SMA 0207 E 96	182 OHMS 1% MET FILM
R 42	RN55-01820	1	05905	SMA 0207 E 96	182 OHMS 1% MET FILM
R 43	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R 44	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R 45	RC05-02200	1	01121	BB-221-5	220ohms;5% 1/8W CARBON
R 46	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 47	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 48	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 49	RN55-02740	1	05905	SMA 0207 E 96	274 OHMS 1% MET FILM
R 50	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 51	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 52	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 53	RN55-23010	1	05905	SMA 0207 E 96	30.1 K OHMS 1% MET FILM
R 54	RN55-23010	1	05905	SMA 0207 E 96	30.1 K OHMS 1% MET FILM
R 55	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 56	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R 57	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R 58	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 59	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 60	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 61	RAPF-31000	1	73138	66WR100K	100K 10% 20T VERT PC
R 62	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 63	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R 64	RAPF-11000	1	73138	66WR1K	1K 10% 20T VERT PC
R 65	RAPF-31000	1	73138	66WR100K	100K 10% 20T VERT PC
R 66	RN55-21870	1	05905	SMA 0207 E 96	18.7 K OHMS 1% MET FILM

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 67	RN55-22550	1	05905	SMA 0207 E 96	25.5 K OHMS 1% MET FILM
R 68	RAPF-12000	1	73138	66WR2K	2K 10% 20T VERT PC
R 69	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 70	RN55-15620	1	05905	SMA 0207 E 96	5.62 K OHMS 1% MET FILM
R 71	RN55-21150	1	05905	SMA 0207 E 96	11.5 K OHMS 1% MET FILM
R 72	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 73	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 74	RN55-28250	1	05905	SMA 0207 E 96	82.5 K OHMS 1% MET FILM
R 75	RN55-21870	1	05905	SMA 0207 E 96	18.7 K OHMS 1% MET FILM
R 76	RN55-23010	1	05905	SMA 0207 E 96	30.1 K OHMS 1% MET FILM
R 77	RAPF-11000	1	73138	66WR1K	1K 10% 20T VERT PC
R 78	RN55-14990	1	05905	SMA 0207 E 96	4.99 K OHMS 1% MET FILM
R 79	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 80	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 81	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 82	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 83	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 84	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R 85	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R 86	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 88	RN55-08250	1	05905	SMA 0207 E 96	825 OHMS 1% MET FILM
R 89	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 90	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R 91	RN55-00182	1	05905	SMA 0207 E 96	18.2 OHMS 1% MET FILM
R 92	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 93	RAPF-31000	1	73138	66WR100K	100K 10% 20T VERT PC
R 94	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 95	RN55-13320	1	05905	SMA 0207 E 96	3.32 K OHMS 1% MET FILM
R 96	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 97	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 98	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 99	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 100	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 101	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 102	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 103	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 104	RC05-02200	1	01121	BB-221-5	220ohms;5% 1/8W CARBON
R 105	RC05-02200	1	01121	BB-221-5	220ohms;5% 1/8W CARBON
R 106	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
R 107	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
R 108	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
R 109	RC05-00510	1	01121	BB510-5	51 OHMS 5% 1/8W CARBON
RM 1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
RM 2	RM7S-12200	1	71450	750-81-R2.2K	2.2KOHM X 7 SIP NETWRK
RM 3	RM7S-31000	1	71450	750-81-R100K	100 KOHM X 7 SIP NETWRK
RM 4	RM7S-31000	1	71450	750-81-R100K	100 KOHM X 7 SIP NETWRK
RM 5	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
RM 6	RM7S-31000	1	71450	750-81-R100K	100 KOHM X 7 SIP NETWRK
RM 7	RM5S-01800	1	71450	750-103-R180	5 X 180 OHM 10 LEAD SIP
RM 8	RM7S-12200	1	71450	750-81-R2.2K	2.2KOHM X 7 SIP NETWRK
RM 9	RM7S-31000	1	71450	750-81-R100K	100 KOHM X 7 SIP NETWRK

Parts List for MODULATION GENERATOR PCA No. 304DA03200 Rev. I

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
RM 10	RM7S-31000	1	71450	750-81-R100K	100 KOHM X 7 SIP NETWRK
U 1	UENO-10105	1	04713	MC10105P	MC10105P TRIPLE OR/NOR
U 2	UENO-10105	1	04713	MC10105P	MC10105P TRIPLE OR/NOR
U 3	UINO-01413	1	04713	MC1413P	MC1413P X7 DRIVER .5A
U 4	ULNO-02903	1	27014	LM2903N	LM2903N DUAL COMPARATOR
U 5	UINO-06116	1	56289	UDN-6116A-2	UDN-6116A-2 HEX DRIVER
U 6	UTNO-02372	1	04713	74HC237N	74HC237N 1 OF 8 DECODER
U 7	ULNO-02903	1	27014	LM2903N	LM2903N DUAL COMPARATOR
U 8	UENO-10105	1	04713	MC10105P	MC10105P TRIPLE OR/NOR
U 9	UINO-06116	1	56289	UDN-6116A-2	UDN-6116A-2 HEX DRIVER
U 10	UTNO-02372	1	04713	74HC237N	74HC237N 1 OF 8 DECODER
U 11	UENO-10102	1	04713	MC10102P	MC10102P QUAD NOR
U 12	ULNO-02903	1	27014	LM2903N	LM2903N DUAL COMPARATOR
U 13	UINO-01413	1	04713	MC1413P	MC1413P X7 DRIVER .5A
U 14	UINO-01413	1	04713	MC1413P	MC1413P X7 DRIVER .5A
U 15	UTNO-02372	1	04713	74HC237N	74HC237N 1 OF 8 DECODER
U 16	URPO-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
U 17	URPO-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
U 18	UGNO-08038	1	32293	ICL 8038 CC JD	ICL8038 WAVEFORM GEN.
U 19	UONO-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U 20	UGNO-08038	1	32293	ICL 8038 CC JD	ICL8038 WAVEFORM GEN.
U 21	UONO-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U 22	ULNO-05053	1	32293	IH5053CJE	IH5053 QUAD ANALOG SWITCH
U 23	ULNO-05053	1	32293	IH5053CJE	IH5053 QUAD ANALOG SWITCH
U 24	UCNO-00760	1	04713	MC14076BCP	MC14076BCP 4 BIT LATCH
U 25	UCNO-00760	1	04713	MC14076BCP	MC14076BCP 4 BIT LATCH
U 26	UCNO-00720	1	04713	MC14072BCP	MC14072BCP DUAL 4 IN OR
U 27	UCNO-00010	1	04713	MC14001BCP	MC14001 QUAD NOR
U 28	UTNO-01381	1	01295	SN74LS138N	SN74LS138N 3 TO 8 DEC
U 29	UTNO-01752	1	04713	74HC175N	74HC175N QUAD D FLIP-FLOP
U 30	UCNO-05550	1	04713	MC14555BCP	MC14555BCP DUAL 1 OF 4
U 31	UTNO-01752	1	04713	74HC175N	74HC175N QUAD D FLIP-FLOP
U 32	ULNO-05053	1	32293	IH5053CJE	IH5053 QUAD ANALOG SWITCH

Parts List for DELAY/WIDTH GENERATOR PCA No. 304CA04400 Rev. C

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BF04400	1	58900	304BF04400	DELAY/WIDTH GENERATOR BD
C 1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 3	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 4	CT10-R7220	1	56289	196D227X9010TE4	220UF 10V 10% RADIAL LEAD
C 5	CT15-R6220	1	56289	196D226X9015KA1	22UF 15V 10% RADIAL LEAD
C 6	CT25-R5220	1	56289	196D225X9025HA1	2.2UF 25V 10% RADIAL LEAD
C 7	CT35-R4220	1	56289	196D224X9035HA1	.22UF 35V 10% RADIAL LEAD
C 8	CN50-03220	1	51642	400-100-NPO-223J	.022 UF CERAMIC NPO
C 9	CC50-02150	1	51642	200-050-NPO-152J	1500PF CERAMIC NPO
C 10	CC50-01330	1	51642	150-100-COG-331J	330 PF CERAMIC NPO
C 11	CC50-00680	1	51642	150-100-COG-680J	68 PF CERAMIC NPO
C 12	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C 13	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 14	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C 15	CC50-00560	1	51642	150-100-COG-560J	56 PF CERAMIC NPO
C 16	CC50-00150	1	52763	EDPT-15-NPO-5%	15 PF CERAMIC NPO
C 17	CT10-R7220	1	56289	196D227X9010TE4	220UF 10V 10% RADIAL LEAD
C 18	CT15-R6220	1	56289	196D226X9015KA1	22UF 15V 10% RADIAL LEAD
C 19	CT25-R5220	1	56289	196D225X9025HA1	2.2UF 25V 10% RADIAL LEAD
C 20	CT35-R4220	1	56289	196D224X9035HA1	.22UF 35V 10% RADIAL LEAD
C 21	CN50-03180	1	51642	400-100-NPO-183J	.018UF CERAMIC NPO
C 22	CC50-02150	1	51642	200-050-NPO-152J	1500PF CERAMIC NPO
C 23	CC50-01750	1	51642	200-100-NPO-751J	750 PF CERAMIC
C 25	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C 26	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
CR 1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 4	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 5	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 6	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 7	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 8	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 9	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 10	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR 11	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
L 1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR
P 4	JIA1-20430	1	52072	CAD20SP100230430	20 PIN STRIPLINE PLUG
P 5	JIA1-20430	1	52072	CAD20SP100230430	20 PIN STRIPLINE PLUG
Q 1	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 2	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 3	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 4	QBPS-04258	1	27014	PN4258	PN4258 12V 700MHZ PNP
Q 5	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
Q 6	QBNS-04275	1	27014	PN4275	PN4275 .1A 15V .6W NPN
R 1	RN55-00681	1	05905	SMA 0207 E 96	68.1 OHMS 1% MET FILM
R 2	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM
R 3	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 4	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM
R 5	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM

Parts List for DELAY/WIDTH GENERATOR PCA No. 304CA04400 Rev. C

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
R 6	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 7	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
R 8	RN55-00121	1	05905	SMA 0207 E 96	12.1 OHMS 1% MET FILM
R 10	RN55-01820	1	05905	SMA 0207 E 96	182 OHMS 1% MET FILM
R 11	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R 12	RN55-00681	1	05905	SMA 0207 E 96	68.1 OHMS 1% MET FILM
R 13	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 14	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM
R 15	RN55-00100	1	05905	SMA 0207 E 96	10 OHMS 1% MET FILM
R 16	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM
R 17	RN55-00274	1	05905	SMA 0207 E 96	27.4 OHMS 1% MET FILM
R 19	RN55-00121	1	05905	SMA 0207 E 96	12.1 OHMS 1% MET FILM
R 21	RN55-04750	1	05905	SMA 0207 E 96	475 OHMS 1% MET FILM
RM 1	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
RM 2	RM5S-01800	1	71450	750-103-R180	5 X 180 OHM 10 LEAD SIP
RM 3	RM7S-05600	1	71450	750-81-R560	560 OHM X 7 SIP NETWRK
RM 4	RM5S-01800	1	71450	750-103-R180	5 X 180 OHM 10 LEAD SIP
U 1	UENO-10105	1	04713	MC10105P	MC10105P TRIPLE OR/NOR
U 2	UENO-10102	1	04713	MC10102P	MC10102P QUAD NOR

Parts List for 8 POS LEVER SWITCH PCA No. 304CA02102 Rev. A

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF02100	1	58900	304CF02100	8 POS LEVER SWITCH PCB
DA	1	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
DA	2	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
DA	3	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
DA	4	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
P	1	JIA1-20430	1	52072	CAD20SP100230430	20 PIN STRIPLINE PLUG
R	1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	2	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	4	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
S	1	101BC25401	1	58900	101BC25401	LEVER SWITCH 5 DIGIT
U	1	UCN0-05140	1	04713	MC14514BCP	MC14514 4 TO 16 DECODER

Parts List for FREQUENCY DISPLAY PCA No. 304CA02600   Rev. C

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304BF02600	1	58900	304BF02600	FREQUENCY DISPLAY PCB
2	JSP0-10018	2	09922	DILB18P-108	18 PIN DIP SOCKET
3	HSTX-44004	2	88245	A1591B	4-40 CORNR BLOCK 1/16 MTL
4	101BF05400	2	58900	101BF05400	DISPLAY MOUNT END
C 1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
DS 1	IMF0-00090	1	F0001	9LT-03	9 DIGIT FLUOR DISPLAY
DS 2	ILGR-00200	1	58361	MV5253	GREEN LED .2" DIA
DS 3	ILGR-00200	1	58361	MV5253	GREEN LED .2" DIA
P 1	JIA1-26730	1	52072	CAD26SP100230730	26 PIN STRIPLINE PLUG
Q 1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q 2	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
R 1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 2	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R 4	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R 5	RN55-01820	1	05905	SMA 0207 E 96	182 OHMS 1% MET FILM
U 1	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE
U 2	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE
W 1	WJIB-05022	1	A0003	923345-05	.5" INSULATED JUMPER

Parts List for 5 POS LEVER SWITCH PCA No. 304BA02500   Rev. B

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304BF02500	1	58900	304BF02500	5 POS LEVER SWITCH PC BD
DA	1	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
DA	2	DSA8-02719	1	07263	FSA 2719P	FSA2719P 8 DIODES DIP
P	1	JIA1-20430	1	52072	CAD20SP100230430	20 PIN STRIPLINE PLUG
S	1	101BC12702	1	58900	101BC12702	5 POS LEVER SWITCH +/-

Parts List for MOD/PWR DISPLAY PCA No. 304DA02300 Rev. D

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF02300	1	58900	304CF02300	MOD/PWR DISPLAY PB BD
	2	HSTX-44004	3	88245	A1591B	4-40 CORNR BLOCK 1/16 MTL
	3	101BF05400	4	58900	101BF05400	DISPLAY MOUNT END
	4	JSP0-10018	4	09922	DILB18P-108	18 PIN DIP SOCKET
	5	JSP0-10016	1	09922	DILB16P-108	16 PIN DIP SOCKET
	6	JSP0-10014	1	09922	DILB14P-108	14 PIN DIP SOCKET
C	1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
DS	1	IMF0-00050	1	F0001	5LT-03	5 DIGIT FLUOR DISPLAY
DS	2	IMF0-00050	1	F0001	5LT-03	5 DIGIT FLUOR DISPLAY
DS	3	ILGR-00200	1	58361	MV5253	GREEN LED .2" DIA
P	1	JIA1-34730	1	52072	CAD34SP100230730	34 PIN STRIPLINE PLUG
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
R	1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	2	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	3	RN55-12210	1	05905	SMA 0207 E 96	2.21 K OHMS 1% MET FILM
S	1	SLP0-00202	1	95146	CSS-022	DPDT PC MT SLIDE SWITCH
U	1	UCN0-00010	1	04713	MC14001BCP	MC14001 QUAD NOR
U	2	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE
U	3	UCN0-05430	1	04713	MC14543P	MC14543P BCD TO 7 SEGMENT
U	4	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE
U	5	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE
U	6	UIN0-00594	1	18364	NE594N	NE594 8X DISP DRIVE

Parts List for ADDRESS SWITCH ASSY No. 101BA04700 Rev. D

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	101BF04700	1	58900	101BF04700	ADDRESS SWITCH BD
2	SDP0-00501	1	71450	206-5	5 SPST DIP SWITCH
3	JSPR-10016	1	06776	ICN163S3T	16 PIN DIP CLIP SOCKET
4	JSPR-90016	1	06776	RC76	16 PIN RETAINER CLIP
5	HSTS-60304	2	06540	9532B-A-0632	6-32 X 3/16 SWAGE SPACER

Parts List for TEMP COMP PCA No. 304BA04600 Rev. E

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304BF04600	1	58900	304BF04600	TEMP COMP PCB
	2	ETSB-06216	8	88245	2000B	BIFURCATED TERMINAL 5/32
	3	HSCS-40203	3	55566	1531-A-4-A-7	#4 X 1/8 CLEAR SPACER
	4	ETST-06224	1	88245	1280B	TURRET TERMINAL
C	1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	2	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	3	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	4	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	5	CT25-R7100	1	90201	TDM107M025L6	100 UF 25V TANTALUM
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
J	1	JSP0-10016	1	09922	DILB16P-108	16 PIN DIP SOCKET
P	1	JHP0-10016	1	51167	16-600-10	16 PIN DIP HEADER
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q	2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
R	1	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	2	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	3	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	4	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	5	RN55-13160	1	05905	SMA 0207 E 96	3.16 K OHMS 1% MET FILM
R	6	RN55-32000	1	05905	SMA 0207 E 96	200 K OHMS 1% MET FILM
R	7	RN55-13920	1	05905	SMA 0207 E 96	3.92 K OHMS 1% MET FILM
R	8	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	9	RAPF-22000	1	73138	66WR20K	20K 10% 20T VERT PC
R	10	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	11	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	12	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	13	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	14	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	15	RN55-?????	1	05905	SMA 0207 E 96	SELECTED IN TEST
R	16	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
U	1	ULP0-00335	1	27014	LM335Z	TEMP. SENS
U	2	UON0-00074	1	01295	TL074CN	TL074CN QUAD FET OP AMP
U	3	URP0-78150	1	04713	MC78L15CP	MC78L15 .1A 15V REG
U	4	URP0-79150	1	04713	MC79L15CP	MC79L15 .1A -15V REG
VR	1	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE

Parts List for OSCILLATOR/MULT PCA No. 304CA05700 Rev. B

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF05700	1	58900	304CF05700	OSCILLATOR/MULT BD
	2	101BF04300	1	58900	101BF04300	SAMPLER IF WALL
	3	304BF06300	1	58900	304BF06300	OSCILLATOR/MULT COVER
	4	304BF06400	1	58900	304BF06400	OSCILLATOR/MULT BASE
	5	304BF06500	1	58900	304BF06500	OSCILLATOR/MULT L. SIDE
	6	304BF06600	1	58900	304BF06600	OSCILLATOR/MULT R. SIDE
	7	304BF06700	1	58900	304BF06700	OSCILLATOR/MULT END PLATE
	8	304BF06800	1	58900	304BF06800	OSCILLATOR/MULT CONN MTG
	9	LFT0-83216	4	89110	859617-1	FEED-THRU FILTER 15A
	10	JRBM-00000	6	98291	51-045-0000	SMB M BULK MOUNT
	12	101BF04601	1	58900	101BF04601	SAMPLER IF SUPPORT,NOTCHE
	13	304BF05101	1	58900	304BF05101	MODULE WALL
	14	304BF05201	1	58900	304BF05201	MODULE SUPPORT
	15	HBHS-A2403	1	96906	MIL STD	10-24 X 3/16 SET SCREW
	16	HLST-21105	1	79963	341-.093	#2 SOLDER LUG
AR	1	MA19-00001	1	24539	MSA-0135-12	0-250MHZ AMP 19DB 1.5DBM
C	1	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	2	CC50-00390	1	51642	150-100-COG-390J	39 PF CERAMIC NPO
C	3	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	4	CV00-01012	1	18736	EF12	1-12 PF VARIABLE
C	5	CC50-00120	1	51642	150-100-COG-120J	12 PF CERAMIC NPO
C	6	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
C	7	CC50-00330	1	52763	EDPT-33-NPO-5%	33 PF CERAMIC NPO
C	8	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	9	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CK50-03100	1	96733	SG133BX103KS	.01 UF X7R CHIP
C	12	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	13	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	14	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	15	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	16	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	17	CV00-02011	1	74970	187-0106-005	1.7-11 PF AIR TRIMMER
C	18	CV00-09035	1	59660	538011D 9-35	9-35 PF VARIABLE
C	19	CC50-00100	1	51642	100-100-COG-100J	10 PF CERAMIC NPO
C	20	CV00-02011	1	74970	187-0106-005	1.7-11 PF AIR TRIMMER
C	21	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	22	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	23	CV00-05018	1	59660	538011A 5.5-18	5.5-18 PF VARIABLE
C	25	CV00-05018	1	59660	538011A 5.5-18	5.5-18 PF VARIABLE
C	26	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	27	CV00-05018	1	59660	538011A 5.5-18	5.5-18 PF VARIABLE
C	28	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	29	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	30	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	31	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	33	CC50-01100	1	51642	150-100-COG-101J	100 PF CERAMIC NPO
CR	1	DSA0-02810	1	28480	5082-2810	5082-2810 SCHOT. DIODE
CR	2	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
CR	3	DVA0-00109	1	04713	MV109	MV109 6-30 PF DIODE
L	1	LAD0-05270	1	72259	WEE-2.7	2.7 UH INDUCTOR

Parts List for OSCILLATOR/MULT PCA No. 304CA05700 Rev. B

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
L	2	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L	3	LR00-00000	1	58900		HAND WOUND COIL
L	4	LR00-00000	1	58900		HAND WOUND COIL
L	5	LR00-00000	1	58900		HAND WOUND COIL
L	6	LAD0-04150	1	72259	WEE-.15	.15 UH INDUCTOR
L	7	LR00-00000	1	58900		HAND WOUND COIL
L	8	LR00-00000	1	58900		HAND WOUND COIL
Q	1	QBNS-06304	1	04713	2N6304	2N6304 15V 1400MHZ NPN
R	1	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	2	RN55-14750	1	05905	SMA 0207 E 96	4.75 K OHMS 1% MET FILM
R	3	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	4	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	5	RN55-00562	1	05905	SMA 0207 E 96	56.2 OHMS 1% MET FILM
R	6	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	7	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	8	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	9	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	10	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	11	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	12	RN55-08250	1	05905	SMA 0207 E 96	825 OHMS 1% MET FILM
R	13	RN55-08250	1	05905	SMA 0207 E 96	825 OHMS 1% MET FILM
R	14	RN55-08250	1	05905	SMA 0207 E 96	825 OHMS 1% MET FILM
R	15	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	16	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	17	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	18	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	20	RN55-03320	1	05905	SMA 0207 E 96	332 OHMS 1% MET FILM
R	21	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
U	1	UEN0-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
U	2	UEN1-10107	1	04713	MC10H107P	MC10H107P TRI OR/NOR
U	3	URP0-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
U	4	URC0-07815	1	04713	MC7815CT	MC7815CT 1A 15V REG
U	5	UEN0-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
U	6	UEN0-10216	1	04713	MC10216P	MC10216P TRIPLE RCVR
Y	1	Y180-11000	1	00809	C189-1	110MHZ 5TH OVTN XTAL
YH	1	Y18H-00150	1	12020	PCL1-43-15-60	15V HC18 XTAL OVEN

Parts List for TCXO PC ASSY No. 101BA09701 Rev. A

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	101BF09701	1	58900	101BF09701	TCXO PC BD
	2	HSTS-40204	4	06540	9531B-A-0440	4-40 X 1/8 SWAGE SPACER
	3	ETSB-06216	4	88245	2000B	BIFURCATED TERMINAL 5/32
C	1	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	2	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	3	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
IC	1	URP0-78120	1	04713	MC78L12CP	MC78L12CP .1A 12V REG
R	1	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
U	1	UTN0-01322	1	01295	SN74HC132N	SN74HC132N 4X SCHMIDT NAN
X	1	101BC18300	1	58900	101BC18300	10 MHZ TCXO SPECIFICATION

Parts List for EXT ALC POT/SW M600 PCA No. 304BA09000   Rev. C

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304BF09000	1	58900	304BF09000	EXT ALC POT/SW M600 PCB
	2	ETSB-06216	8	88245	2000B	BIFURCATED TERMINAL 5/32
	3	STW0-00102	1	09353	7101-P4-D	SPDT TOGGLE SWITCH
R	1	RAPF-15000	1	73138	66WR5K	5K 10% 20T VERT PC
R	2	RAPF-22000	1	73138	66WR20K	20K 10% 20T VERT PC
R	3	RN56-21000	1	60393	GP 1/4 TC 25	10.0 K OHMS 1% MET FILM

LIST OF MANUFACTURERS

The names and addresses of manufacturers cited in the preceding parts lists are shown on the following pages. Each manufacturer is listed under its FSCM number (Federal Supply Code for Manufacturers), as noted in the parts lists. In a few cases, no FSCM number has been assigned; these manufacturers are referenced by letter codes (e.g., 'F0001") shown at the end of the list.

FSCM	NAME & ADDRESS		ZIP CODE
00750	Air Track Mfg Corp	College Park MD	N/A
00809	Croven Crystals 500 Beech Street	Whitby, Ontario, Canada	L1N5S5
01121	Allen-Bradley Co 1201 South 2nd Street	Milwaukee, WI	53204
01295	Texas Instruments, Inc 13500 N Cntrl Expressway	Dallas, TX	75265
01963	Cherry Electrical Products 3600 Sunset Ave	Waukegan, IL	60087
02091	Wolf Co	Chambersburg, PA	N/A
02660	Bunker Ramo-Eltra Corp 2801 So 25th Ave	Broadview, IL	60153
02735	RCA Corp Route 202	Somerville, NJ	08876
04173	Houston Fearless Corp	New York,NY	N/A
04552	Grace W R and Co 869 Washington Street	Canton, MA	02021
04713	Motorola Inc 5005 E Mcdowell Rd	Phoenix, AZ	85008
05236	Jonathan Manufacturing Corp 1101 S Acacia Ave	Fullerton, CA	92631
05245	Corcom Inc 1600 Winchester Rd	Libertyville, IL	60048
05791	Lyn-Tron Inc 3150 Damon Way	Burbank CA	91505
05820	EG and G Wakefield Engineering 60 Audubon Rd	Wakefield MA	01880
05905	Jerobee Industries Inc	Redmond WA	N/A
06049	Topaz Inc 9192 Topaz Way	San Diego CA	92123
06349	Cam-Lok Div Empire Products In 10540 Chester Rd	Cincinatti OH	45215

FSCM NAME & ADDRESS ZIP CODE

FSCM	NAME & ADDRESS		ZIP CODE
06383	Panduit Corp 17301 Ridgeland	Tinley Park IL	60477
06540	Mite Corp 446 Blake St	New Haven CT	06515
06776	Robinson Nugent Inc 800 E 8th St	New Albany IN	47150
07263	Fairchild Camera & Instrument 464 Ellis St	Mountain View CA	94039
07512	Oak Materials Group Inc McCaffrey St	Hoosick Falls NY	12090
07556	Calabro Industries Inc 1372 Enterprise Dr	West Chester PA	19380
09022	Cornell-Dubilier Electric Corp 1605 Rodney French Blvd	New Bedford MA	93790
09353	C and K Components Inc 15 Riverdale Ave	Newton MA	02158
09922	Burndy Corp Richards Ave	Norwalk CT	06856
11532	Teledyne Relays 12525 Daphne Ave	Hawthorne CA	90250
11769	Elco/Dyntech Div of Elco Corp 1225 E Wakeham Ave	Santa Ana CA	92702
12020	Ovenaire Div of Electronic Tec 706 Forrest St	Charlottesville VA	22901
13103	Thermalloy Co Inc 2021 W Valley View Lane	Dallas TX	75381
13919	Burr-Brown Research Corp 6730 S Tucson Blvd	Tucson AZ	85734
14482	Watkins-Johnson Co 3333 Hillview Ave	Palo Alto CA	94304
14604	Elmwood Sensors Inc 500 Narragansett Park Dr	Pawtucket RI	02861
14831	MCI Electronics Inc	Van Nuys CA	07088
15286	RHG Electronics Laboratory Inc 161 E Industry Ct	Deer Park NY	11729

FSCM NAME & ADDRESS ZIP CODE

FSCM	NAME & ADDRESS		ZIP CODE
15542	Mini-Circuits Laboratory 2625 E 14th St	Brooklyn NY	11235
15915	Tepro of Florida Inc 2608 Enterprise Rd	Clearwater FL	33517
16179	M/A-Com Omni Spectra Inc 21 Continental Blvd	Merrimack NH	03054
16428	Cooper Belden Electronic Wire NW N St	Richmond IN	47374
16733	Cablewave Systems Inc 60 Dodge Ave	North Haven CT	06473
17217	Gore W L and Associates Inc 555 Paper Mill Rd	Newark DE	19714
17540	Alpha Industries Inc 20 Sylvan Rd	Woburn MA	01801
17856	Siliconix Inc 2201 Laurelwood Rd	Santa Clara CA	95054
18324	Signetics Corp 4130 S Market Court	Sacramento CA	95834
18364	Mag-Tool Co 940 American St	San Carlos CA	94070
18714	RCA Corp Findlay Plant 1700 Fostoria Rd	Findlay OH	45840
18736	Voltronics Corp West St	East Hanover NJ	07936
19089	Swimrite Mfg Co Inc	Van Nuys CA	N/A
19701	Mepco/Electra Inc P.O. Box 760	Mineral Wells TX	76067
20550	Engineering Mfg Co	Sheboygan WI	N/A
20944	Wiltron Co 805 E Middlefield Rd	Mountain View CA	94042
20999	Minnesota Mining and Mfg Co 3M Center	St Paul MN	55101
21604	Buckeye Stamping Co 555 Marion Rd	Columbus OH	43207

FSCM NAME & ADDRESS ZIP CODE

FSCM	NAME & ADDRESS		ZIP CODE
21847	TRW Microwave Inc 825 Stewart Dr	Sunnyvale CA	94086
23936	Pamotor 770 Airport Blvd	Burlingame CA	94010
24355	Analog Devices Inc Rt 1 Industrial Park	Norwood MA	02062
24539	Avantek Inc 3175 Bowers Ave	Santa Clara CA	95051
24995	Environmental Container System 3560 Rogue River Hwy	Grants Pass OR	97526
26923	Control Master Products Inc 1062 Shary Circle	Concord CA	94518
27014	National Semiconductor Corp 2900 Semiconductor Dr	Santa Clara CA	95051
27851	Film Microelectronics 17 A St	Burlington MA	01803
28480	Hewlett Packard Co 3000 Hanover St	Palo Alto CA	94304
29005	Storm Products Co 112 S Glasglow Ave	Inglewood CA	90301
29111	Trak Microwave Corp 735 Palomar Ave	Sunnyvale CA	94086
29990	American Technical Ceramics One Norden Lane	Huntington Station NY	11746
31433	Union Carbide Corp Hwy 276 SE	Greenville SC	29606
31703	Gudrun Frederiksen Co.	Oakland CA	N/A
31781	Edac Inc 20 Railside Rd	Don Mills Ont Can	M3A1A4
31918	ITT Schadow Inc 8081 Wallace Rd	Eden Prarie MN	55344
32293	Intersil Inc 10600 Ridgeview Ct	Cupertino CA	95014
32559	Bivar Inc 4 Thomas St	Irvine CA	92718

FSCM	NAME & ADDRESS		ZIP CODE
32767	Griffith Plastics Corp 1027 California Dr	Burlingame CA	94010
32997	Bourns Inc Trimpot Div 1200 Columbia Ave	Riverside CA	92507
33191	Drew Chemical Ltd 1 Drew Ct	Ajax Ont Can	L1S2E5
34031	Analog Devices Inc 7810 Success Rd	Greensboro NC	27409
34078	Midwest Microwave Inc 3800 Packard Rd	Ann Arbor MI	48104
34576	Rockwell International Corp 4311 Jamboree Rd	Newport Beach CA	92660
34785	Dek Inc 3480 Swenson Ave	St Charles IL	60174
50721	General Electric 11 Cabot Blvd	Mansfield MA	02048
51167	Aries Electronics Inc 62 Trenton Ave	Frenchtown NJ	08825
51284	Mos Technology Inc 950 Rittenhouse Rd	Norristown PA	19401
51642	Center Engineering Co 2820 E College Ave	State College PA	16801
51705	Icco Rally 2575 E.Bayshore Rd	Palo Alto,CA	94303
52072	Circuit Assembly Corp 18 Thomas St	Irvine CA	92714
52648	Plessey Trading Corp 1641 Kaiser Ave	Irvine CA	92714
52683	Baytron Co Inc 344 Salem St	Medford MA	02155
52763	Stettner Electronics Inc 6135 Airways Blvd	Chattanooga TN	37421
52840	Western Digital Corp 3128 Red Hill Ave	Costa Mesa CA	92626
54186	Micro Power Systems Inc 3100 Alfred St	Santa Clara CA	95050

FSCM	NAME & ADDRESS		ZIP CODE
54343	Riedel M W and Co 300 Cypress Ave	Alhambra CA	91801
54487	Micronetics Inc 36 Oak St	Norwood NJ	07648
55153	Dielectric Laboratories Inc 69 Albany St	Cazenovia NY	13035
55261	LSI Computer Systems Inc 1235 Walt Whitman Rd	Melville NY	11747
55285	Bergquist Co Inc 5300 Edina Industrial Blvd	Minneapolis MN	55435
55387	Pamtech 8030 Remmet Ave.	Canoga Park CA	91304
55566	R A F Electronic Hardware 95 Silvermine Rd	Seymour CT	06483
55576	Synertek 3001 Stender Way	Santa Clara CA	95051
56289	Sprague Electric Co 87 Marshall St	North Adams MA	01247
56563	Alatec Products 12747 Saticoy St	North Hollywood CA	91605
57793	United Microwave Products Inc 185 W 205th St	Torrance CA	90503
58202	Innowave Inc 15555 Concord Circle	Morgan Hill CA	95037
58361	General Instrument Corp 3400 Hillview Ave	Palo Alto CA	94304
58900	Giga-Tronics Inc 2495 Estand Way	Pleasant Hill CA	94523
60393	Precision Resistive Products I 655 Main St	Mediapolis IA	52637
60450	Microwave Components Inc 7 Meehan Dr	Chelmsford MA	01824
61104	Aris Engineering Corp 30 Bond St	Haverhill MA	01830
61485	Hitachi Denshi America Ltd 175 Crossways Park W	Woodbury NY	11797

FSCM NAME & ADDRESS ZIP CODE

FSCM	NAME & ADDRESS		ZIP CODE
61802	Toshiba Internatioal 13131 W Little York Rd	Houston TX	77041
62331	Krytar Inc 1292 Anvilwood Court	Sunnyvale CA	94086
63132	Time Microwave 398 Martin Ave	Santa Clara CA	95050
63468	Electro Dynamics 5625 Foxridge Dr	Shawnee Mission KS	66201
63542	Hall-Mark Electronics Corp 11333 Pagemill Rd	Dallas TX	75222
64671	Inmet Corp 7155 Jackson Rd	Ann Arbor MI	48103
65032	Rogers Corp Williams Fld & Dobson Rd	Chandler AZ	85224
65517	Ayer Engineering Co 1250 W Roger Rd	Tucson AZ	85705
66148	Fairlane Fluid/Airproducts 23435 Industrial Pk Dr	Farmington MI	48024
66466	Standard Instrumentation Inc 3322 Pennsylvania Ave	Charlston WV	25302
70903	Belden Corp 200 S Batavia Ave	Geneva IL	60134
71450	CTS Corp 905 N West Blvd	Elkhart IN	46514
71468	ITT Cannon Electric 10550 Talbert Ave	Fountain Valley CA	92708
71785	TRW Inc 1501 Morse Ave	Elk Grove Village IL	60104
72259	Nytronics Inc 475 Park Ave S	New York NY	10016
72982	Murata Erie North America Inc 645 W 11th St	Erie PA	16512
73138	Beckman Industrial Corp 2500 Harbor Ave	Fullerton CA	92634
74970	Johnson E F Co 299 10th Ave S W	Waseca MN	56093

FSCM	NAME & ADDRESS		ZIP CODE
75378	CTS Knights Inc 400 Reimann Ave	Sandwich IL	60548
75915	Tracor Littlefuse Inc 800 E Northwest HWY	Des Plains IL	60016
78553	Eaton Corp 8700 Brookpark Rd	Cleveland OH	44101
79963	Zierick Mfg Co Radio Circke	Mt Kisko NY	10549
81073	Grayhill Inc 561 Hillgrove Ave	La Grange IL	60525
81312	Winchester Electronics 400 Park Rd	Watertown CT	06795
81703	Mulberry Metal Products Inc 2199 Stanley Terrace	Union NJ	07083
81774	Carol Wire and Cable Corp 249 Roosevelt Ave	Pawtucket RI	02860
82152	Transco Products Inc 4241 Glenco Ave	Marina Del Ray CA	90295
82199	Polarad Electronics Inc 5 Delaware Dr	Lake Success NY	11042
82877	Rotron Inc 7 Hasbrouck Ln	Woodstock NY	12498
83330	Kulka Smith Inc 1913 Atlantic Ave	Manasquan NJ	08736
84084	American Iron and Machine Work	Oklahoma City OK	N/A
86797	Rogan Corp 3455 Woodhead Dr	Northbrook IL	60062
88245	Winchester Electronics 13536 Saticoy St	Van Nuys CA	91409
89110	Amp Inc 1595 S Mt Joy St	Elizabethtown PA	17022
90201	Mallory Capacitor Co 4760 Kentucky Ave	Indianapolis IN	46206
91506	Augat Inc 33 Sperry Ave	Attleboro MA	02703

FSCM	NAME & ADDRESS		ZIP CODE
91637	Dale Electronics Inc 2064 12th Ave	Columbus NE	68601
91662	Elco Corp Industrial Park	Huntington PA	16652
92194	Alpha Wire Corp 711 Lidgerwood Ave	Elizabeth NJ	07207
93459	Weinschel Engineering Co 1 Weinschel Lane	Gaithersburg MD	20877
95077	Solitron Devices Inc Cove Rd	Port Salerno FL	33492
95146	Alco Electronic Products Inc 1551 Osgood St	North Andover MA	01845
95348	Gordos Corp 250 Glenwood Ave	Bloomfield NJ	07003
95987	Weckesser Co Inc 727 W Glendale Ave	Milwaukee WI	53209
96341	Microwave Assoc Inc N.W. Iustrial Park So A	Burlington MA	01803
96733	San Fernando Electric Mfg Co 1501 First St	San Fernando CA	91341
96906	Mil Standard		N/A
98291	Sealectro Corp 40 Lindeman Dr	Trumbull CT	06611
99800	American Precision Industries 270 Quaker Rd	East Aurora NY	14052
F0001	Futaba Corp of America 555 W Victoria St	Compton CA	90220
H0002	Herotek Inc 265 J Sobrante Way	Sunnyvale CA	94086
M0004	Microplastics 9180 Gazette Ave	Chatsworth CA	91311
M0007	Mitsubishi Electronics Inc 1050 E Arques Ave	Sunnyvale CA	94086
P0004	Pacific Millimeter 189 Linbrook Dr	San Diego CA	92111

FSCM	NAME & ADDRESS		ZIP CODE
V0002	Virtech 805 G University Ave	Los Gatos CA	95030

SECTION SEVEN

DIAGRAMS

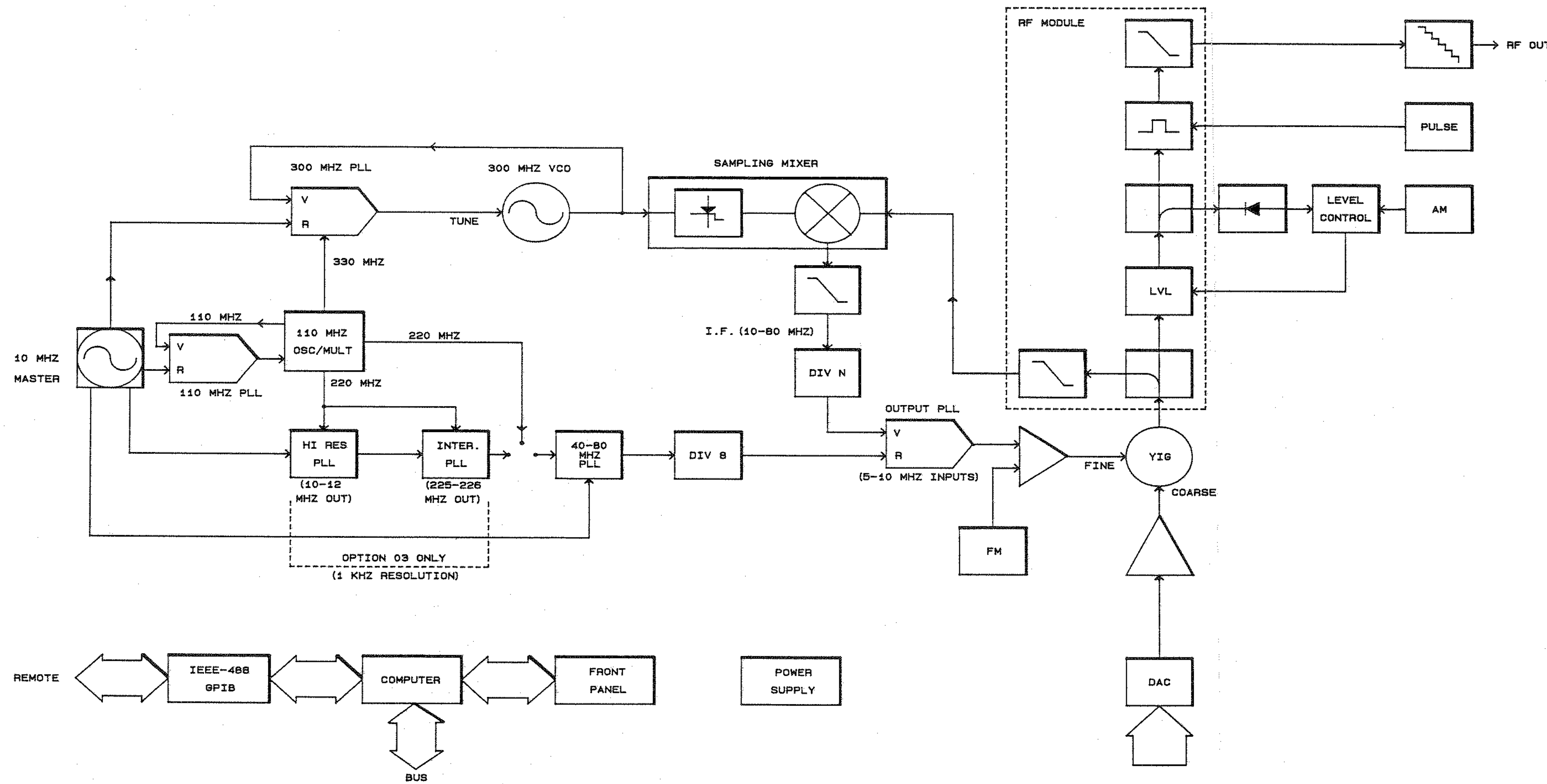
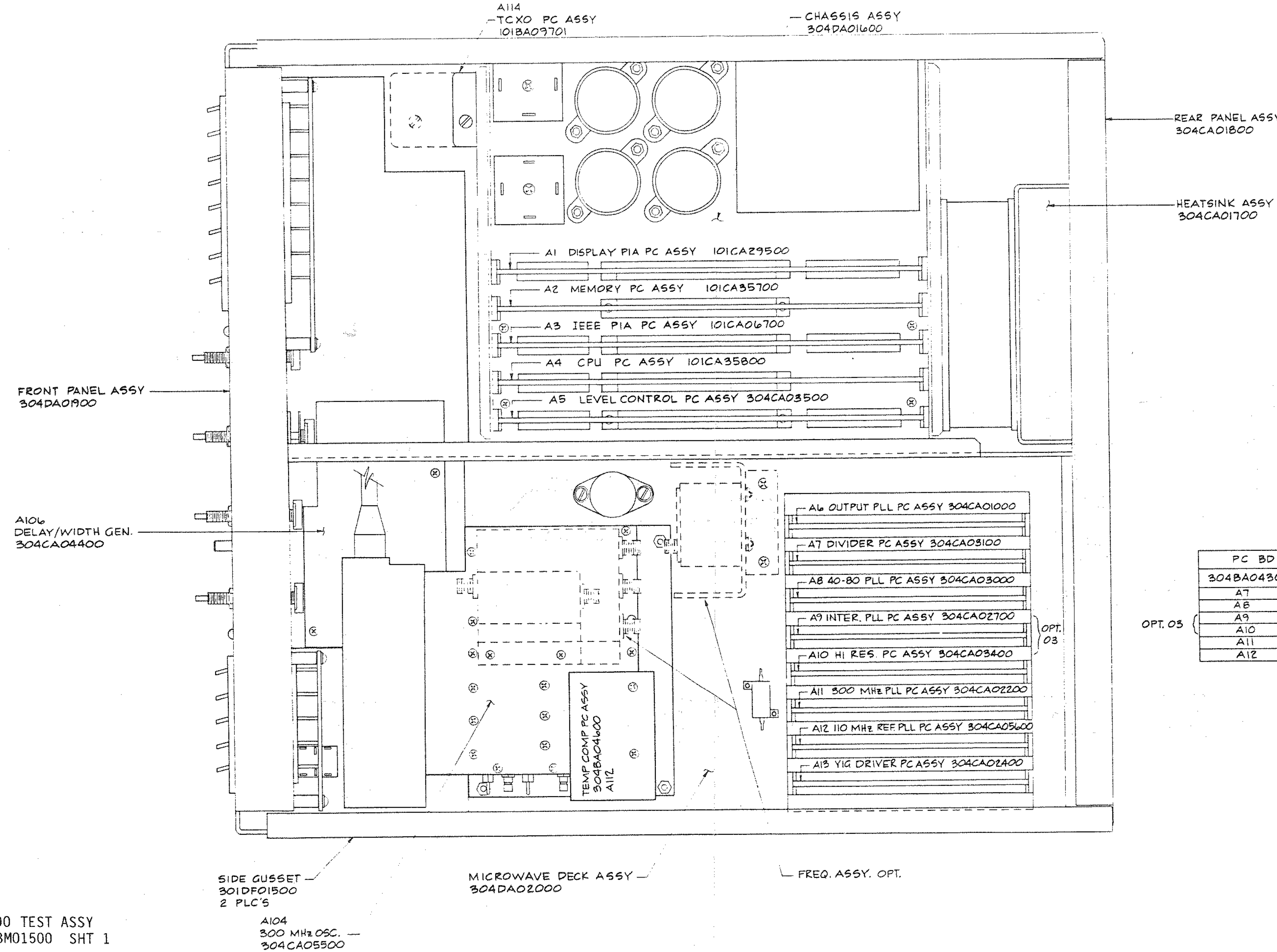


FIG: 7.1
SERIES 600 FUNCTIONAL BLOCK DIAGRAM
DWG# 304BM04800

REV A



PC BD SHIELD INSTALLATION

	304BA04300	304BA04301	304BF08400
	A7	A7	A4
	A8	A12	
OPT. 03	A9		
OPT. 03	A10		
OPT. 03	A11		
OPT. 03	A12		

FIG: 7.2
SERIES 600 TEST ASSY
DWG# 304BM01500 SHT 1

REV C

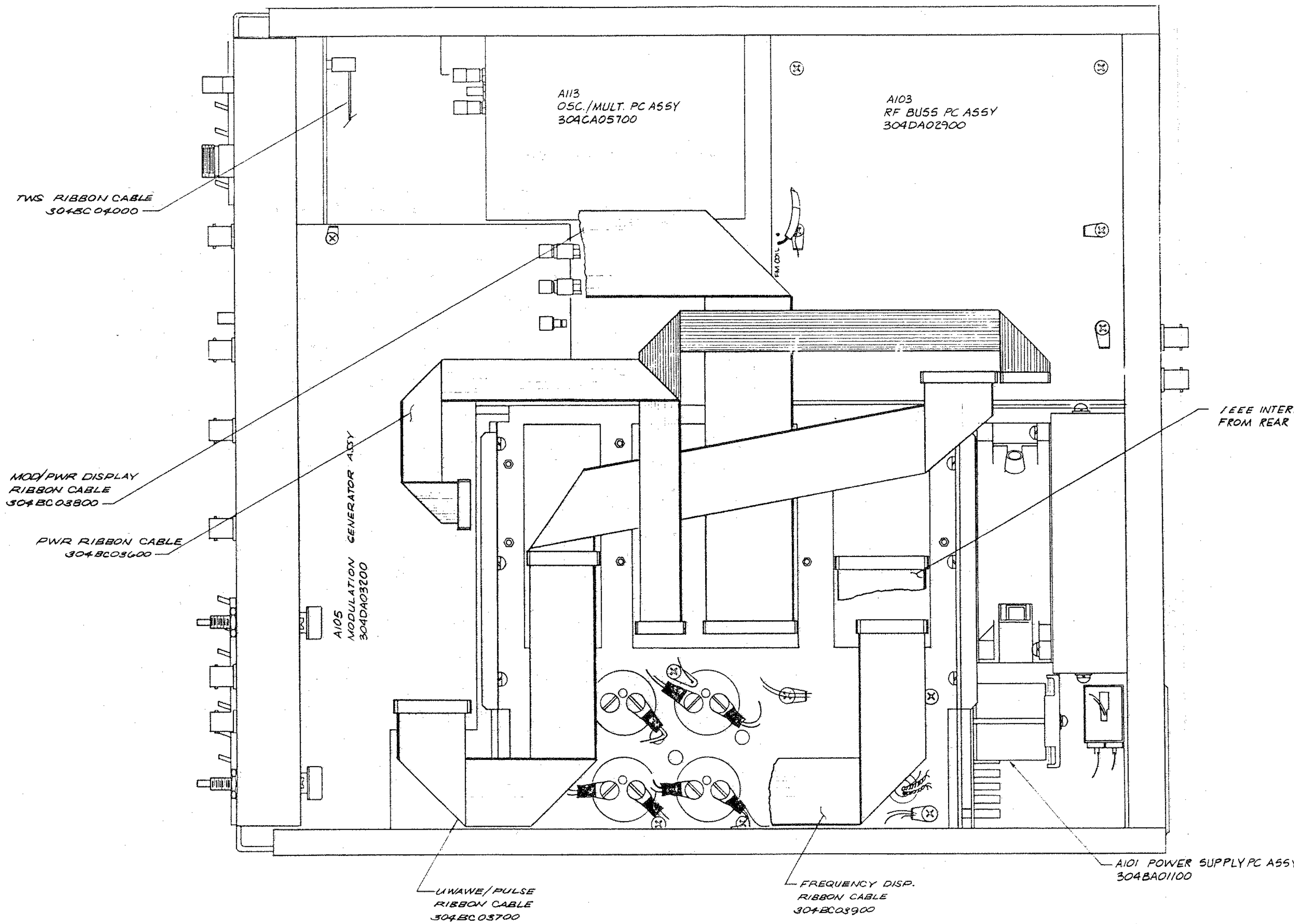
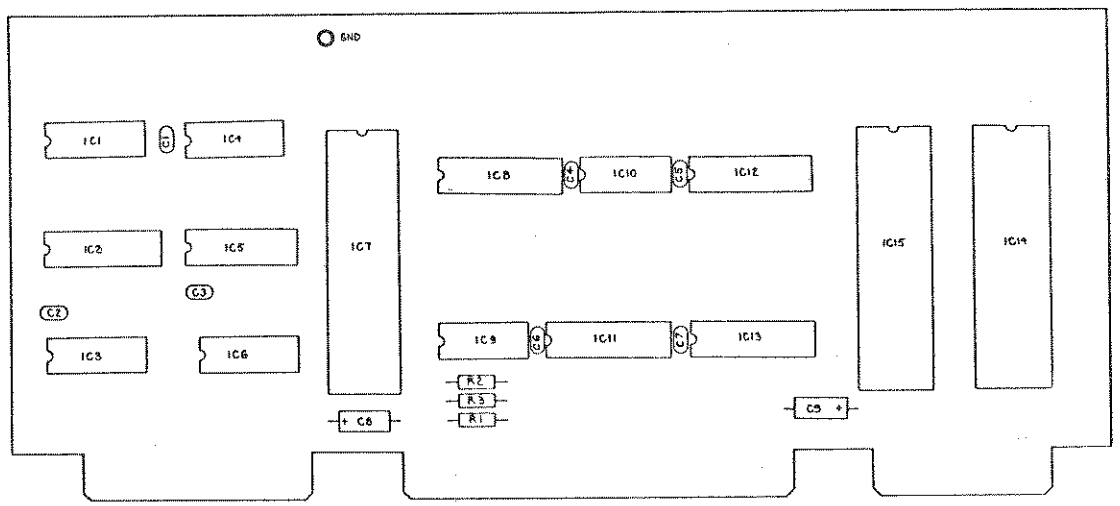


FIG: 7.3
SERIES 600 TEST ASSY
DWG# 304BM01500 SHT 2

REV C



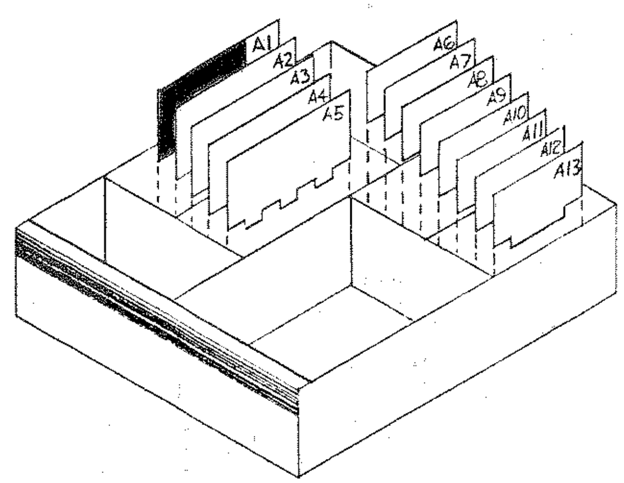


FIG: 7.A1.1
DISPLAY PIA PC ASSY (A1)
DWG# 101BM29500 SHT 1

REV A

DISPLAY PIA -- Circuit Board A1

This portion of the system computer provides the interface between the microprocessor and the front panel displays. It is also used to implement a variety of control functions.

Three peripheral interface adapters (IC4, IC7, IC15) are included in the circuit. The PIAs act as programmable ports through which information is transmitted between the computer's data bus and other devices. A bidirectional buffer (IC8) is used to interconnect the 8-bit computer data bus with these PIAs. Address and control lines from the microprocessor are buffered by IC9, IC11 and IC13 and decoded by PROM IC12; the decoding scheme results in three control lines which are applied to the chip select lines of the PIAs and to the gate of the bidirectional buffer.

The frequency and level readouts on the front panel are mulitple-digit, seven-segment fluorescent displays which must be refreshed continuously. To free the system computer from this task, an independent refresh circuit is used, in which the display data is stored by the computer in volatile memory and continuously retransmitted to the readouts. PIA IC7 programs the two RAM chips, IC2 and IC5, by using the binary counter, IC4. The counter, when in the preset mode (pin 1 high) acts as a buffer, applying its input data to the address buses of the two RAMs. The data buses and read/write controls of the RAMs are programmed by other outputs of IC7 and of IC4, another PIA. In this way, the two RAMs are filled with display data (IC2 for the level display, IC5 for the frequency display). When the display data has been set up by the computer, the counter is taken out of the preset mode and is clocked by an input from IC1, causing the RAMs to cycle through the segment data compiled for each display digit in sequence. IC6 and IC3 decode the RAM address lines into drive signals to activate the particular display digit appropriate to the segment-data being read. The RAM data lines furnish the segment data directly. Because there are fewer digits in the level readout, the level display is "doubled up" (the least significant address line is ignored and each RAM data entry appears twice) in order to give a more continuous scan.

Other outputs of PIA IC4, and PIA IC15, are used for a variety of control functions in the instrument, such as strobe and data lines for the front panel switches.

NOTE: The modulation display is not driven by this circuit. See the level control board, PC A5, which houses the modulation meter and display encoder.

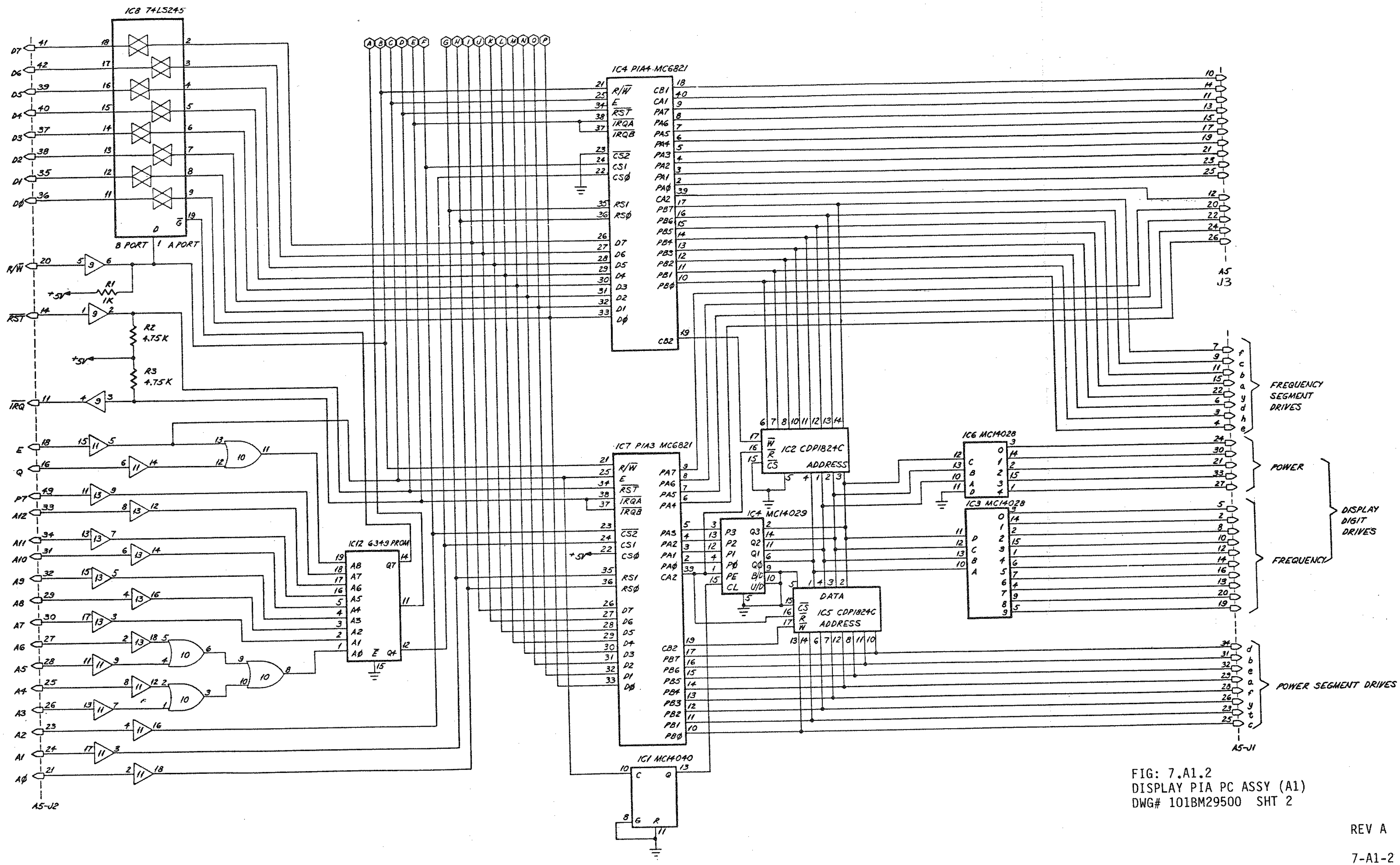
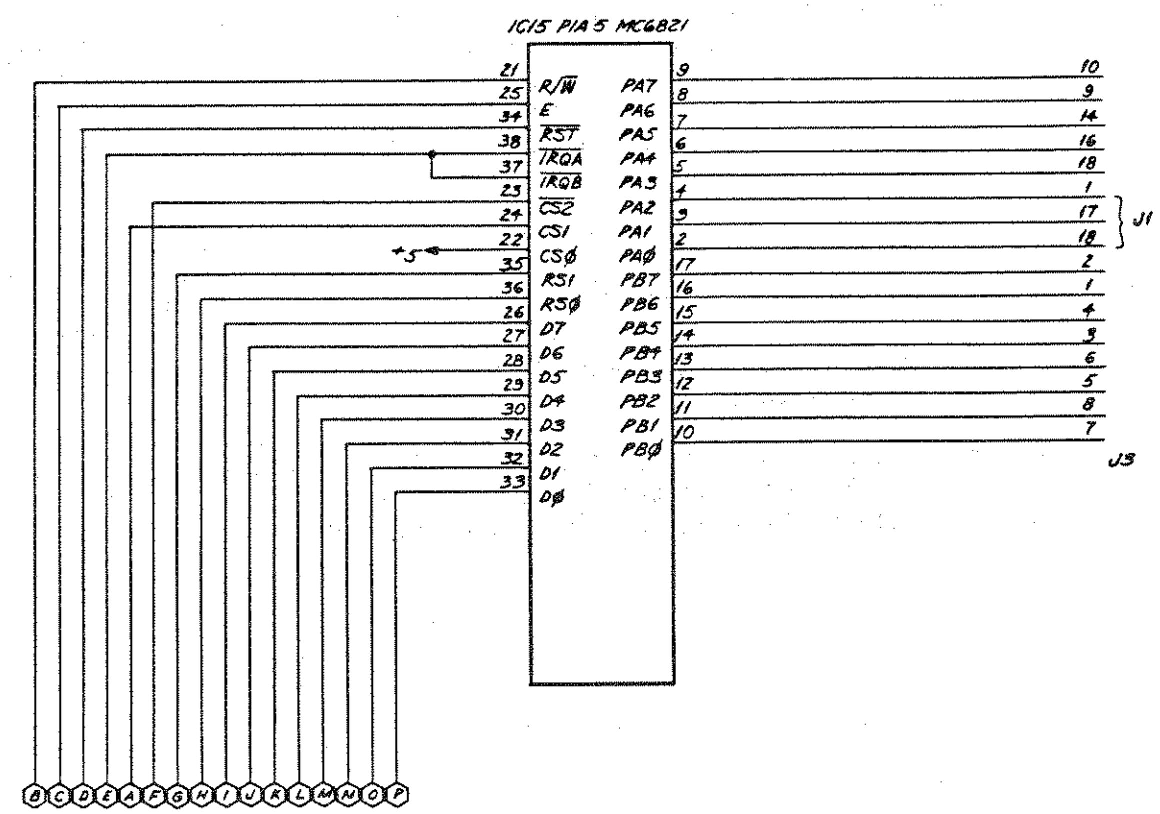
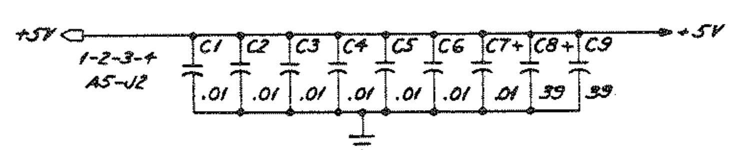


FIG: 7.A1.2
DISPLAY PIA PC ASSY (A1)
DWG# 101BM29500 SHT 2

REV A



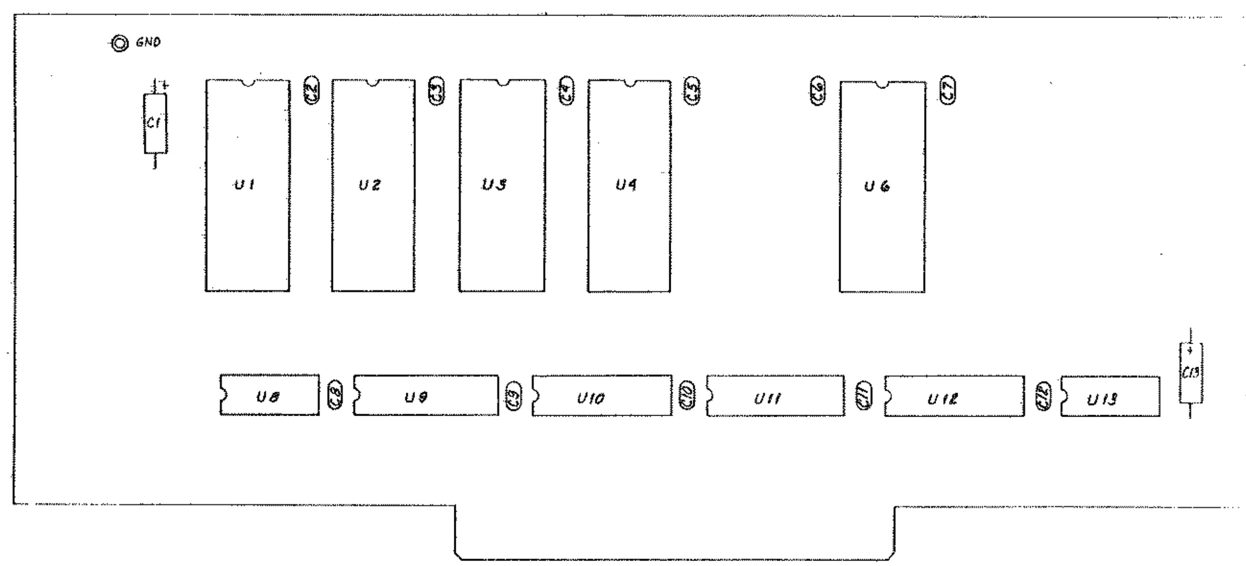


NOTES:
UNLESS NOTED OTHERWISE:
1. RESISTORS IN OHMS
2. CAPACITORS IN μF

IC#	TYPE	+5	GND
1	MC14040	16	8
2, 5	CDP1824	18	9
3, 6	MC14028	16	8
4	MC14029	16	8
7, 14, 15	6821	20	1
8	74LS245	20	10
9	7417	14	7
10	74LS32	14	7
11, 13	74LS244	20	1, 10, 19
12	6349	20	10

FIG: 7.A1.3
DISPLAY PIA PC ASSY (A1)
DWG# 101BM29500 SHT 3

REV A



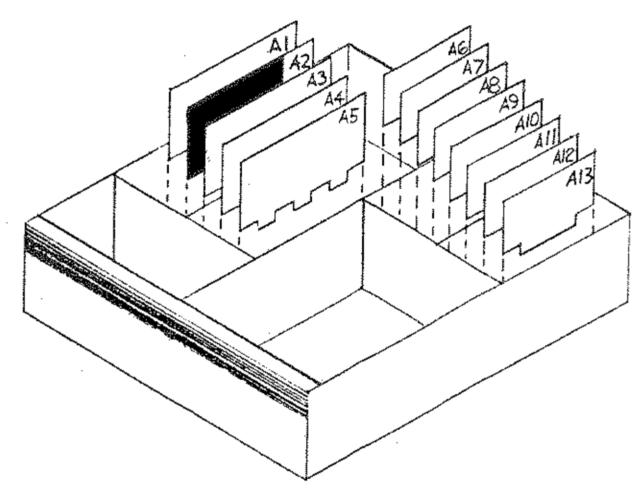


FIG: 7.A2.1
MEMORY PC ASSY (A2)
DWG# 101BM35700 SHT 1

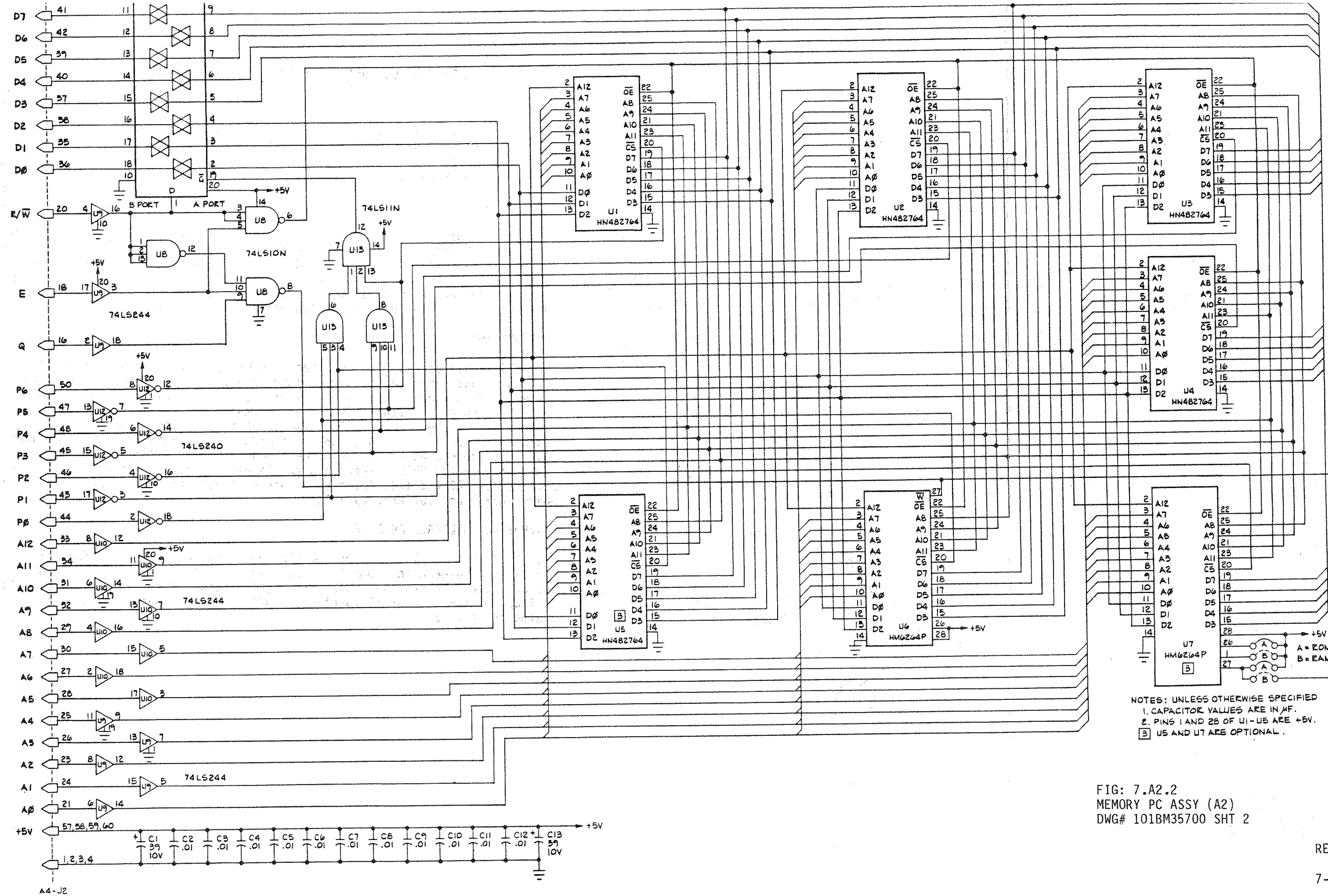
REV A

COMPUTER MEMORY -- Circuit Board A2

This circuit board can hold up to five programmable read-only memory ICs (U1 through U5), each having a capacity of 8K bytes. The PROMs hold the instrument's operational software. The amount of memory actually used is variable among individual instruments, depending on the frequency range, options, and special modifications implemented. The board also houses two RAM ICs (U6, U7), each having a capacity of 8K bytes. The remaining 8K bytes of the microprocessor's addressing capacity is taken up by the "reset" PROM on the CPU board and by input/output ports.

A bi-directional buffer (U11) interconnects the computer's 8-bit data bus with the memory devices. The computer's address bus and some control lines are buffered by U9, U10 and U12. Logic gates U8 and U13 decode some of these inputs in order to derive control signals for the memories and for the bi-directional buffer. The computer uses page lines P0 through P6 to select individual memory chips.

The address and data buses of the memory ICs are all connected in parallel; this is possible because the ICs have tri-state outputs (the outputs enter a high impedance state when the chip is de-selected).



NOTES: UNLESS OTHERWISE SPECIFIED
1. CAPACITOR VALUES ARE IN µF.
2. PINS 1 AND 28 OF U1-U5 ARE +5V.
[3] U5 AND U7 ARE OPTIONAL.

FIG: 7.A2.2
MEMORY PC ASSY (A2)
DWG# 101BM35700 SHT 2

REV A

A4-J2
U11 74LS245

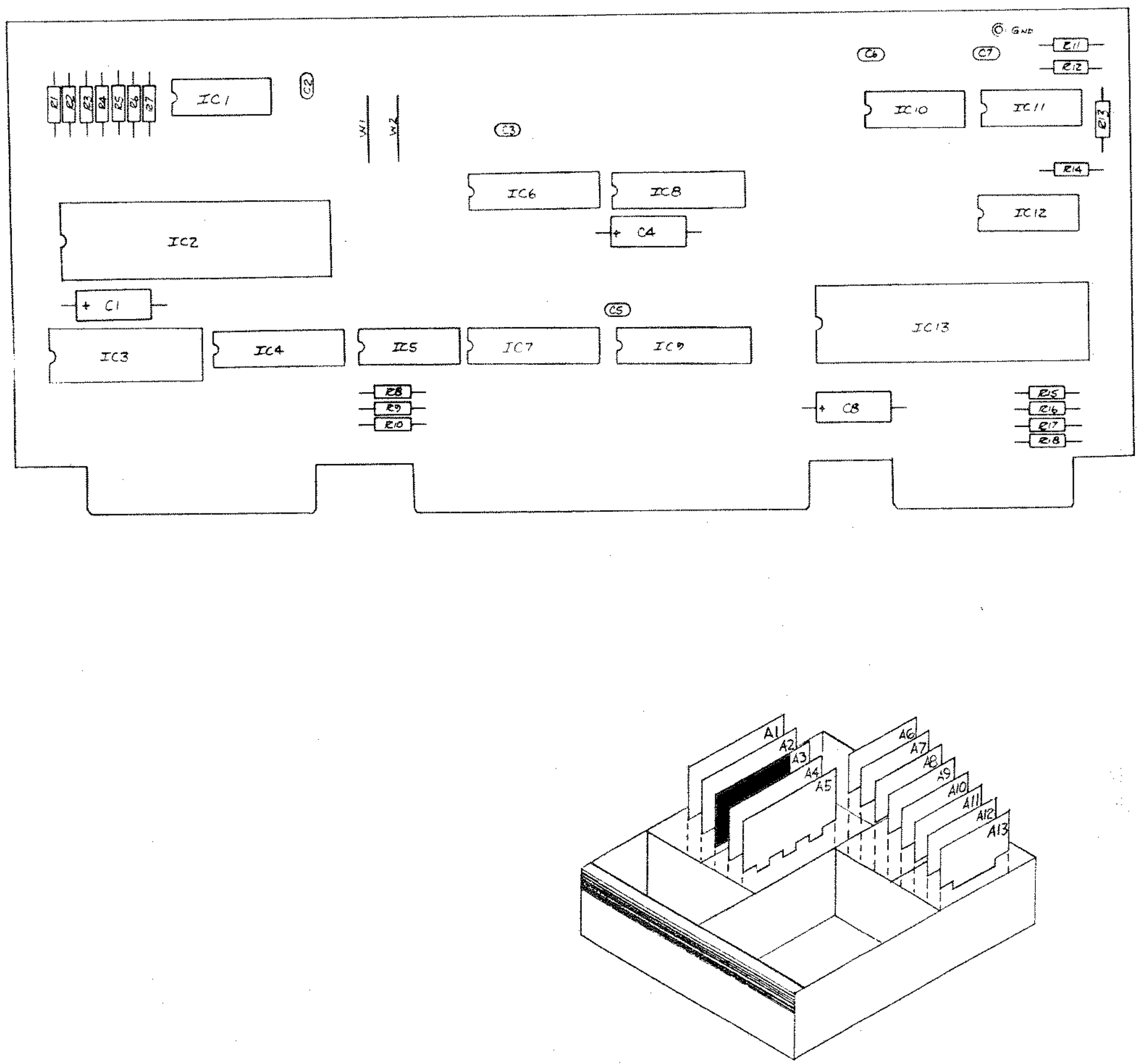


FIG: 7.A3.1
IEEE PIA PC ASSY (A3)
DWG# 101BM06700 SHT 1

REV B

IEEE-488 INTERFACE -- Circuit Board A3

GENERAL

This portion of the system computer provides communication between the microprocessor and any external controller using the IEEE-488 general purpose interface bus (GPIB). The circuit board also houses a peripheral interface adapter (PIA) which is used for a variety of instrument control functions.

COMPUTER BUS

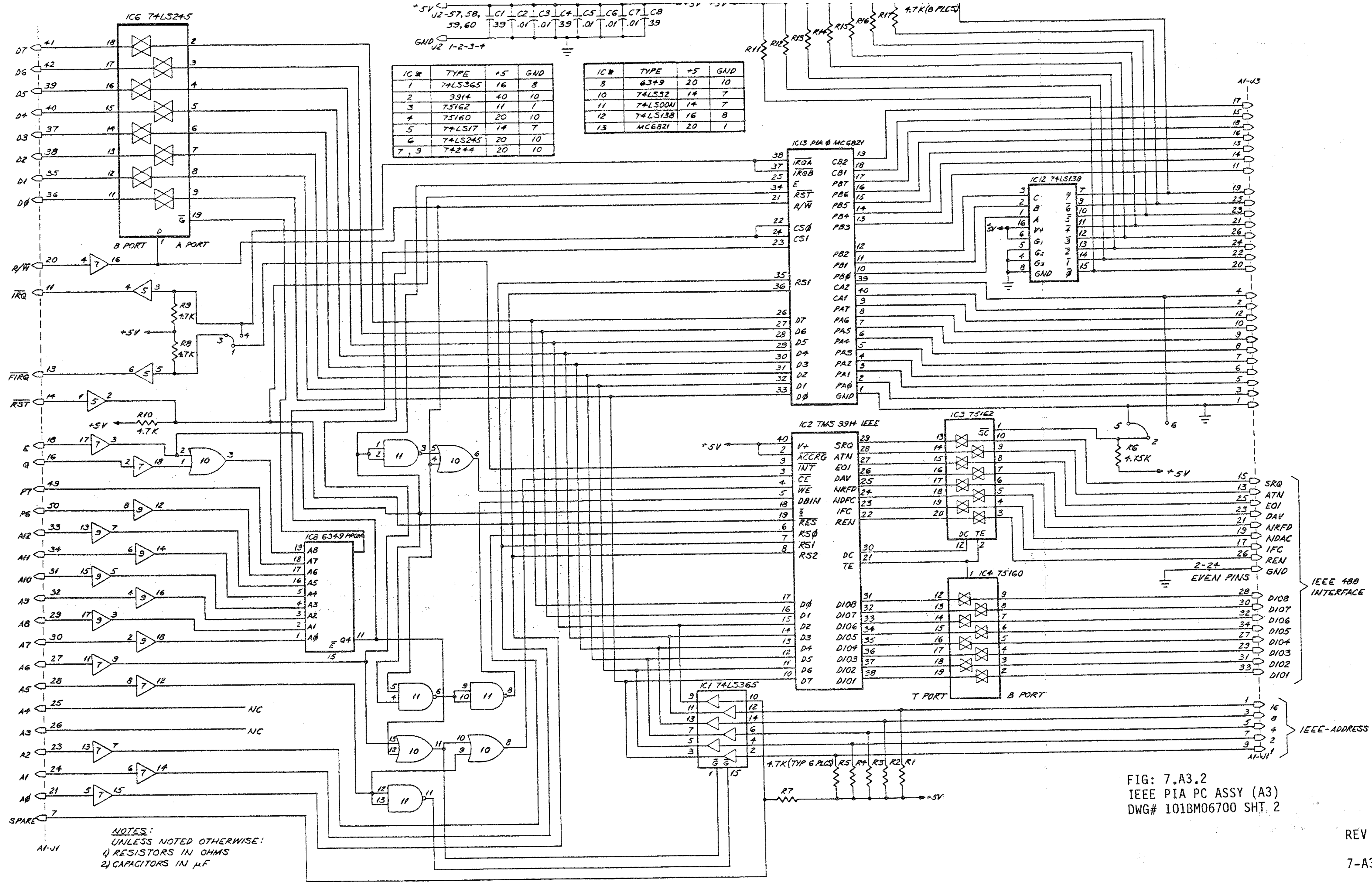
A bidirectional buffer (IC6) is used to interconnect the computer's 8-bit data bus with the PIA and GPIB devices. The computer's address bus and some control lines are buffered by IC5, IC7 and IC9, and are decoded by a high speed bipolar PROM, IC8, and by additional logic gates. The outputs of the decoder PROM are used to drive chip select lines on the PIA and GPIB devices and also to drive the data direction gate of the buffer (IC6).

IEEE-488 INTERFACE

The GPIB adapter (IC2) facilitates communication between the IEEE-488 interface bus and the system computer's data bus. It processes the general "interface" messages received from the controller, and transmits device-dependent messages (such as commands addressed specifically to this instrument) to the computer. The computer interprets these messages, using a vocabulary stored in ROM, and responds appropriately; the GPIB adapter transmits the computer's outgoing messages to the bus. The data and control lines between the GPIB adapter and the 24-pin connector on the rear panel are buffered by IC3 and IC4. The device address inputs from the IEEE Adress PC board (A111) are buffered by IC1.

PERIPHERAL INTERFACE ADAPTER

The PIA (IC13) is a programmable port through which information is transmitted between the computer's data bus and other devices. Three of its outputs are decoded by IC12 into eight control lines. The PIA is used for various instrument control functions, including the programming of digital to analog converters.



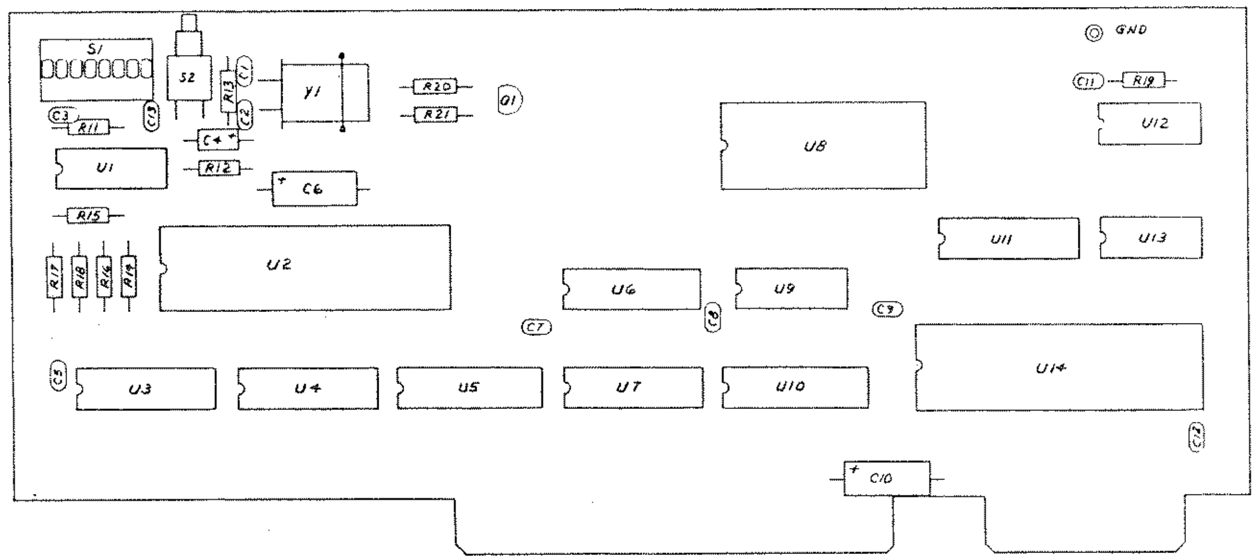
IC #	TYPE	+5	GND
1	74LS365	16	8
2	9914	40	10
3	75162	11	1
4	75160	20	10
5	74LS17	14	7
6	74LS245	20	10
7, 9	74244	20	10

IC #	TYPE	+5	GND
8	6349	20	10
10	74LS32	14	7
11	74LS00N	14	7
12	74LS138	16	8
13	MC6821	20	1

NOTES:
UNLESS NOTED OTHERWISE:
1) RESISTORS IN OHMS
2) CAPACITORS IN μF

FIG: 7.A3.2
IEEE PIA PC ASSY (A3)
DWG# 101BM06700 SHT 2

REV B



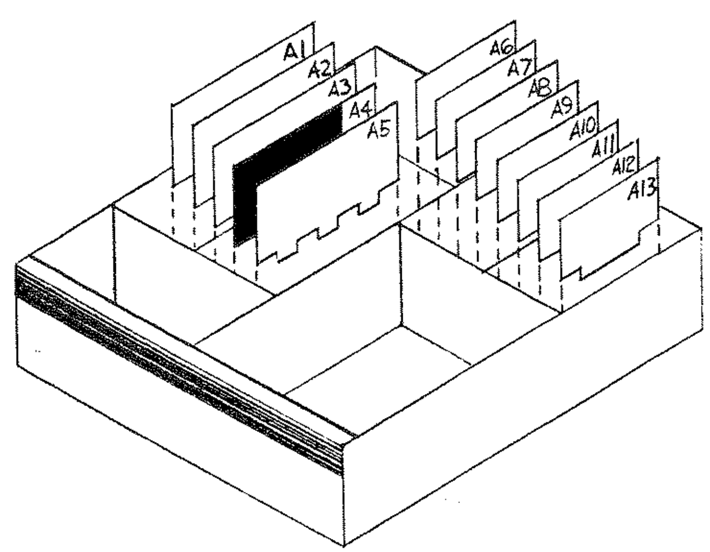


FIG: 7.A4.1
CPU PC ASSY (A4)
DWG# 101BM35800 SHT 1

REV B

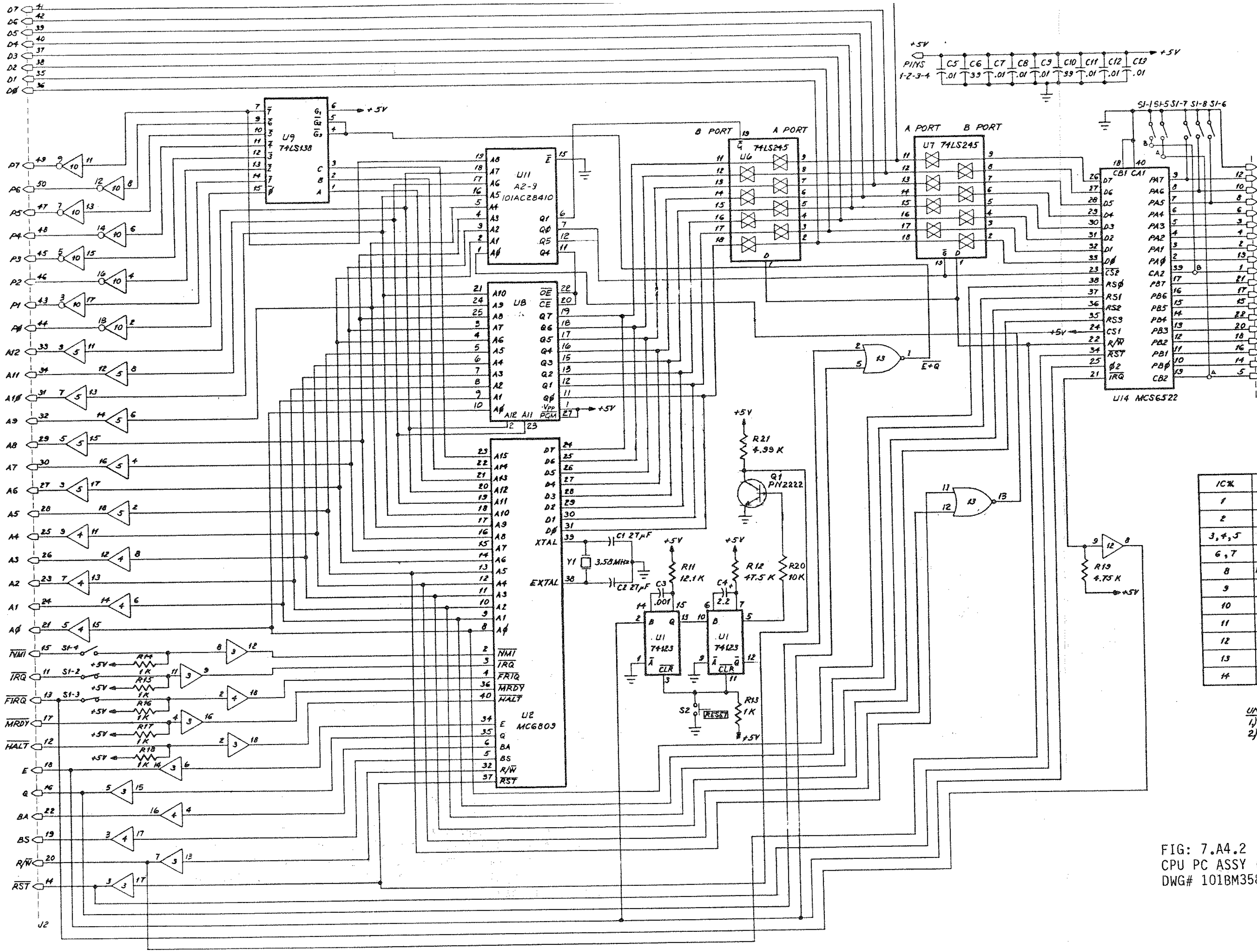
CPU -- Circuit Board A4

This portion of the computer houses the central processing unit, which is in the form of an MC6809 microprocessor (U2). Also present on the board are buffers, initialization memory and an input/output device.

The microprocessor has an 8-bit data bus and a 16-bit address bus; it has an internal clock oscillator regulated (at 3.579 MHz) by crystal Y1. The clock frequency was chosen to avoid the generation of beat frequencies between its harmonics and the various reference signals produced within the synthesizer (most of the latter are multiples of 1 MHz). Multivibrator U1 furnishes a reset "low" pulse to the microprocessor upon power-up or whenever S2 is pressed.

U8, a PROM having a capacity of 8K bytes, represents the instrument's initialization memory; it includes level characterization data and other information unique to the individual instrument in which it is installed. Output buffers U3, U4, U5, and U10 interconnect the microprocessor's address bus and control lines with the computer bus. Address decoding is aided by the 3-to-8 line decoder, U9, which converts the three high-order address lines to eight page-lines. The computer uses these page-lines to select peripheral devices on other circuit boards. Within this circuit board, device address decoding is performed by U11, a high speed bipolar PROM, whose decoded outputs drive the chip select lines and data direction select lines of the board's other IC's. The microprocessor's data bus is connected to the computer bus, and to input/output device U14, via bi-directional gates U6 and U7.

U14 is a programmable input/output device through which information is transmitted between the microprocessor data bus and other circuits. It is used for a number of instrument control and monitoring functions, such as programming the 10 dB step attenuator and polling the various PLL "lock" indicators.



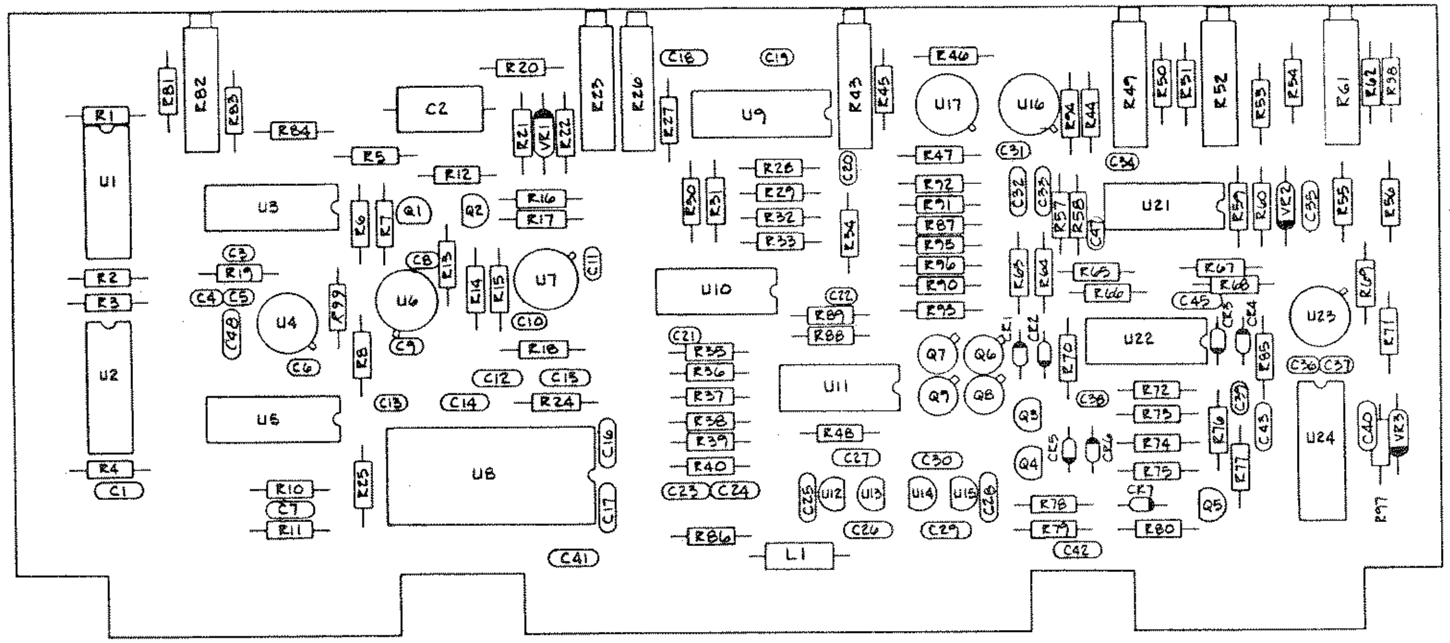
IC#	TYPE	+5	GND
1	74123	16	8
2	MC6809	7	1
3, 4, 5	74LS244	20	10
6, 7	74LS245	20	10
8	HN482764	28	14
9	74LS138	16	7
10	74LS240	20	10
11	AZ-1	20	10
12	7417	14	7
13	74LS02	14	7
14	MCS6522	20	1

UNLESS NOTED OTHERWISE:
1) RESISTORS IN OHMS.
2) CAPACITORS IN μF.

FIG: 7.A4.2
CPU PC ASSY (A4)
DWG# 101BM35800 SHT 2

REV B

7-A4-2



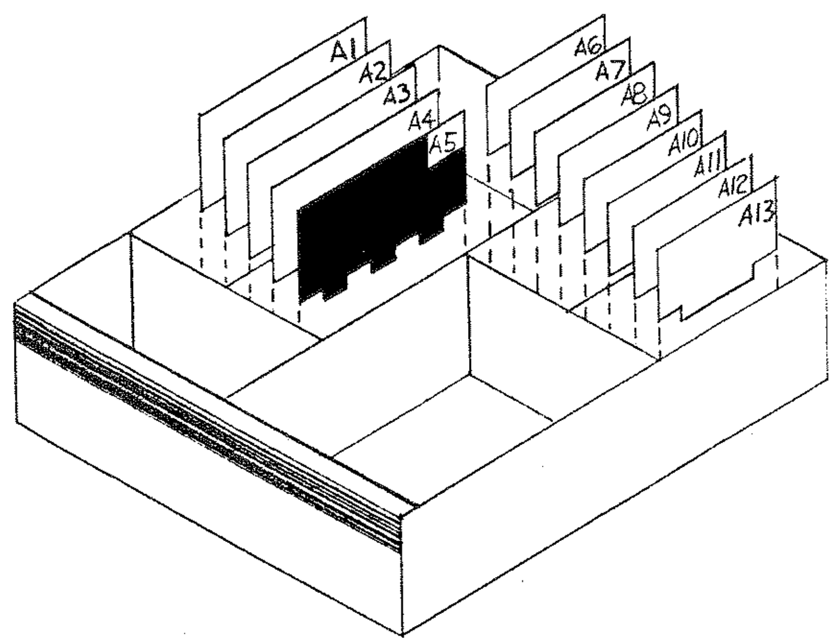


FIG: 7.A5.1
LEVEL CONTROL PC ASSY (A5)
DWG# 304BM03500 SHT 1

REV H

LEVEL CONTROL -- Circuit Board A5

This board houses the circuits which control the leveler and step attenuator, and also includes the circuit which drives the internal modulation meter display.

AUTOMATIC LEVEL CONTROL (ALC)

The ALC circuit drives the leveler, a variable attenuator circuit in the RF module, in order to make fine adjustments of output power. Feedback from a level detector in the RF path is compared with a leveling reference, and the the leveler is driven so as to equalize these two inputs.

The leveling reference is set by the computer through programming of the digital to analog converter, U24. At U22-6, the reference is combined with a correction voltage from the temperature compensation circuit (A112). During operation in the AM mode, these inputs to U22-6 are also combined with a modulation signal. The AM input is processed by logarithmic amplifier U9 (to match it to the log characteristic of the level reference and temperature compensation inputs) and furnished through FET Q9 to the summing junction at U22-6 (Q9 is turned off when AM is off). The combined leveling reference signal is processed by anti-logarithmic amplifier U21 and applied to the non-inverting input at U22-3, where it is combined with the amplified signal from the level detector (see U17, U16).

The signal at the inverting input U22-2 is amplified (U22-8) and furnished to the driver output circuit (Q3, Q4). This driver is a controlled current source for the PIN diode leveler circuit in the RF module. The polarity is positive for increased attenuation, negative for reduced attenuation. Following the leveler circuit in the RF path is a level coupler and diode detector (during operation in the external ALC mode, a remote coupler and detector are used). The detector returns a negative voltage proportional to detected RF power. The ALC circuit drives the leveler in such a way that the amplified detector signal and the leveling reference signal cancel for a zero voltage at U22-3.

When the detector and reference signals at U22-3 are in equilibrium, the amplifier output at U22-1 is zero; U22-14 turns off transistor Q5 and the 'leveled' indicator output is pulled high, illuminating the level LED on the 600's front panel. If the ALC circuit has not yet adjusted the RF output to the requested level, a significant voltage will be present at U22-1, turning Q5 on and pulling the indicator output low.

MODULATION METER

An integrated digital voltmeter circuit, U8, drives the modulation meter display on the front panel. It requires a DC voltage input (from U7-6) proportional to the amplitude of the modulation waveform. The AM and FM modulation waveforms are furnished (through analog gate U5) to U4, amplified, and applied to comparator U6. The other input to the comparator is fed back from the meter chip input at U7-6. By driving the transistor circuit (Q1, Q2), through level translator U3, the comparator builds up a charge on C2 until the DC input to the meter chip equals the peak voltage of the modulation signal.

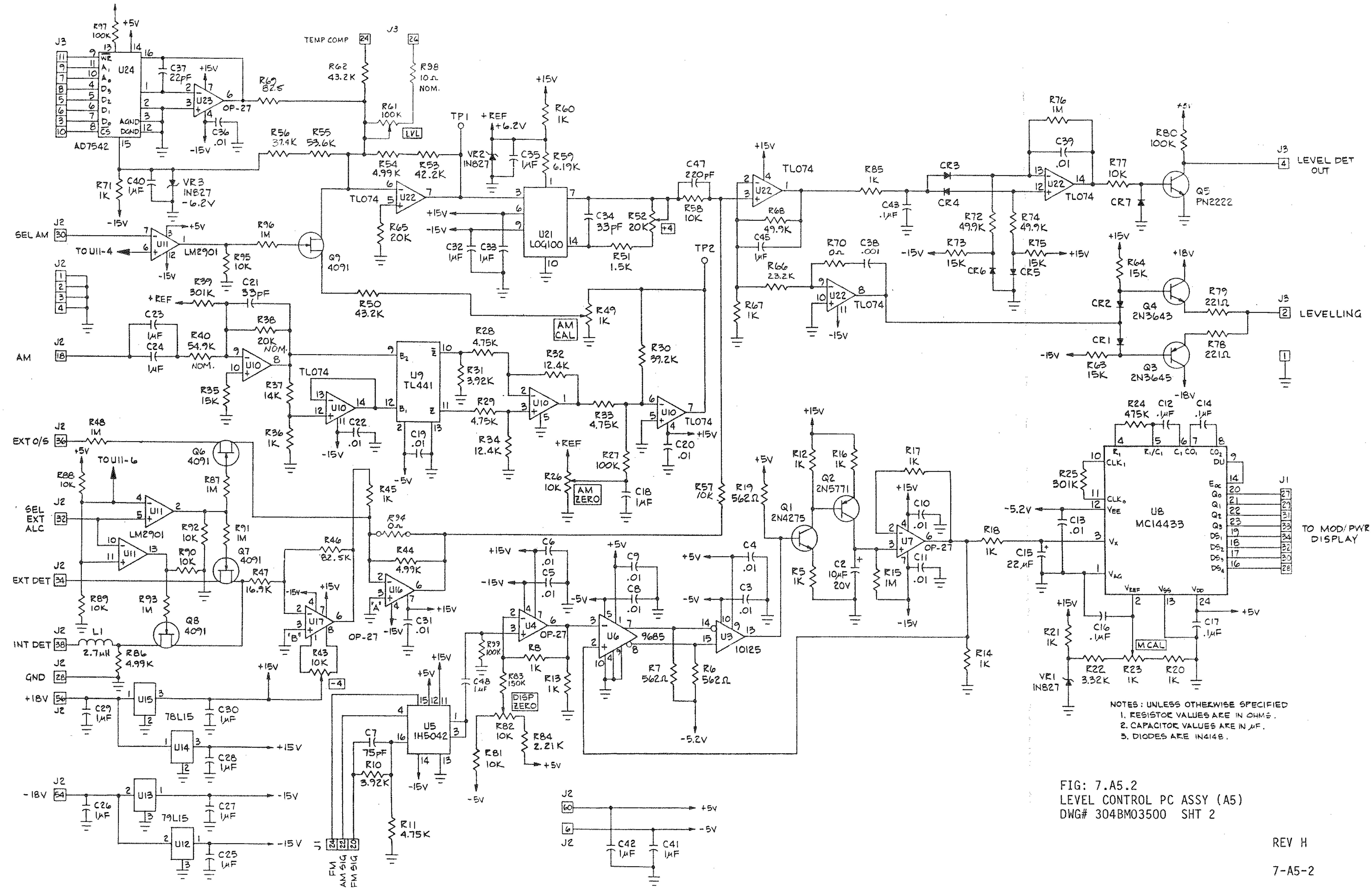


FIG: 7.A5.2
LEVEL CONTROL PC ASSY (A5)
DWG# 304BM03500 SHT 2

REV H

ATTENUATOR RELAY DRIVER

The 10 dB step attenuator is programmed by switching any or all of four fixed-attenuation segments into or out of the device's RF path. The attenuation values of the individual segments are 40 dB, 40 dB, 20 dB and 10 dB. For a setting of 110 dB, all segments are activated. The mechanical switching is enabled by relay drivers U1 and U2, which respond to TTL-level inputs and provide output levels of zero and approximately +24 volts (the unregulated supply voltage). By programming the drivers, the computer can select attenuation values between zero and 110 dB, in steps of 10 dB.

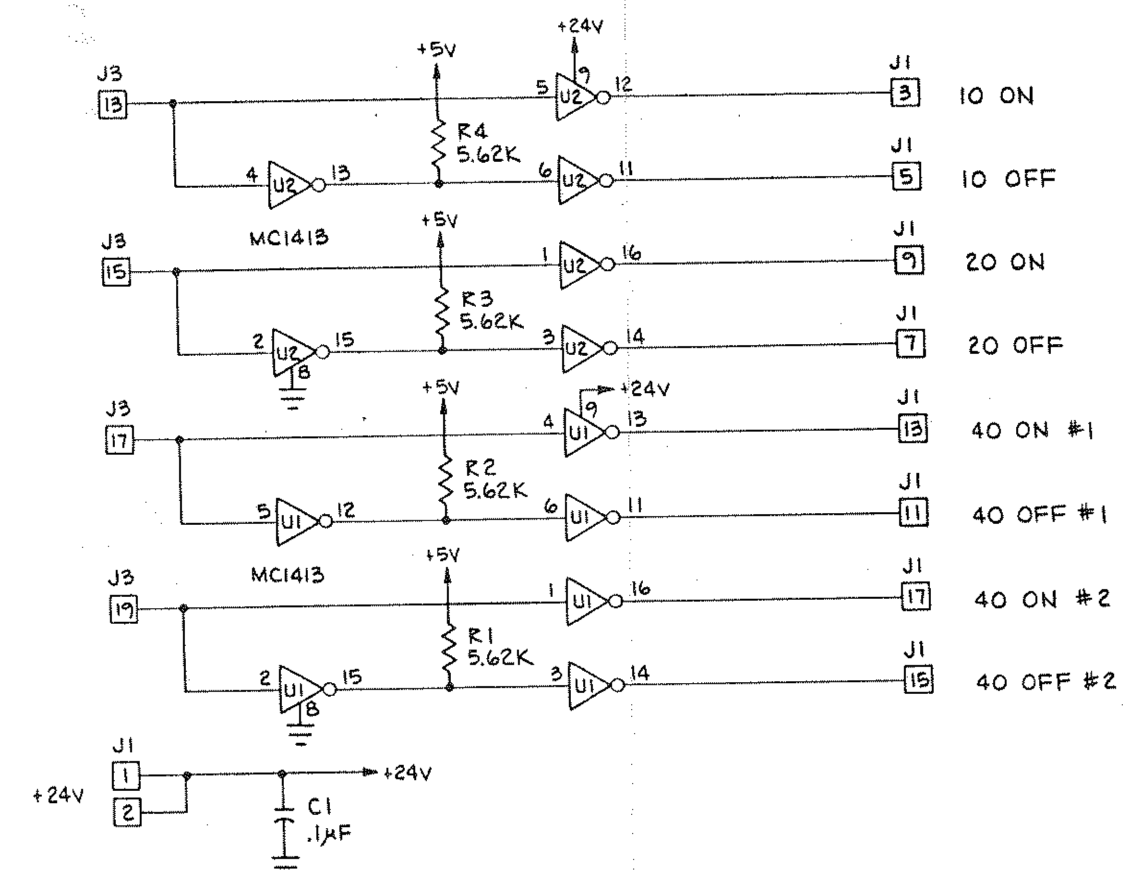


FIG: 7.A5.3
LEVEL CONTROL PC ASSY (A5)
DWG# 304BM03500 SHT 3

REV H

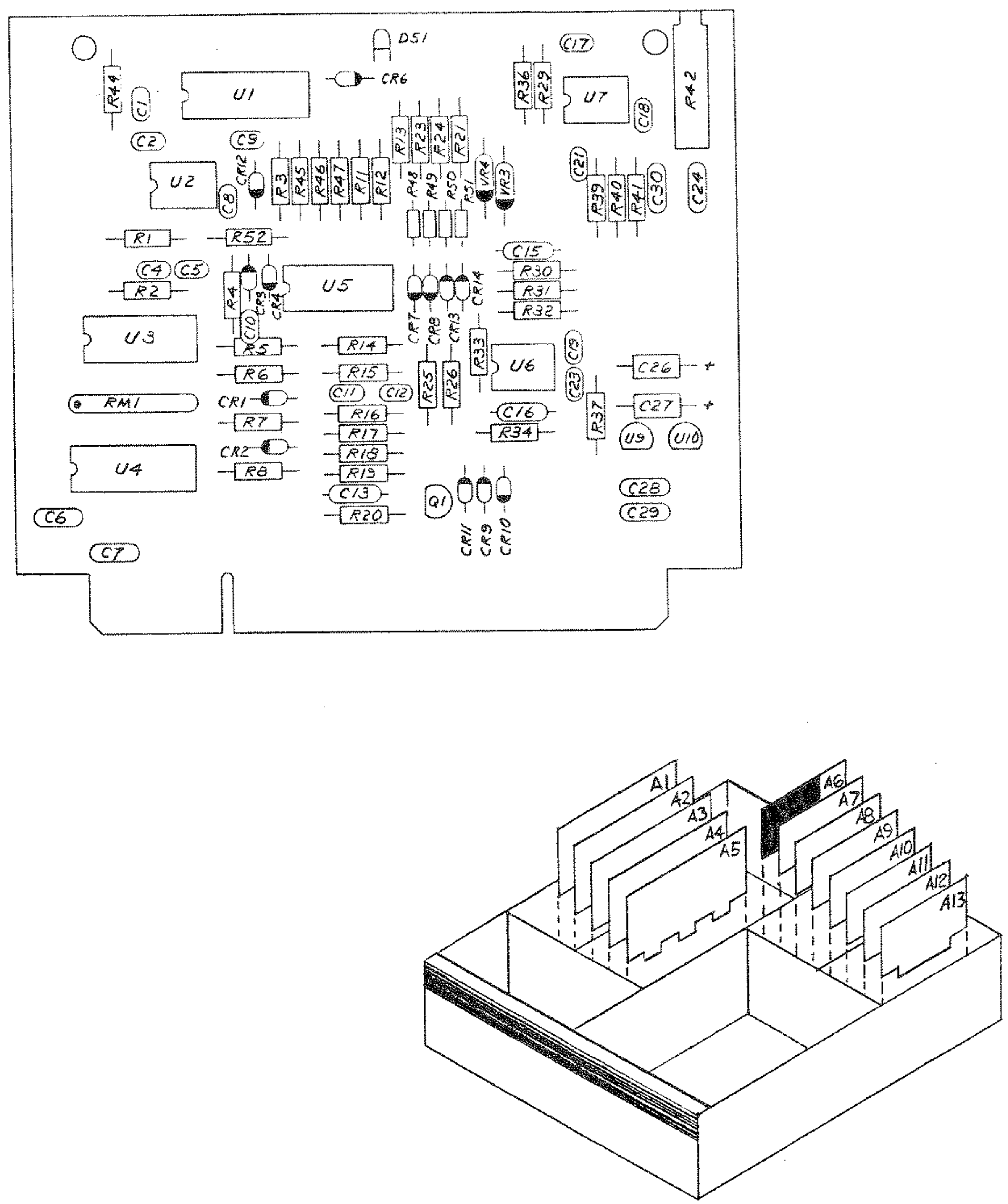


FIG: 7.A6.1
OUTPUT PLL PC ASSY (A6)
DWG# 304BM01000 SHT 1

REV F

OUTPUT PLL -- Circuit Board A6

This circuit produces a control signal for use in fine-tuning the instrument's YIG oscillator, in order to phase lock the YIG frequency to the master reference. In the FM mode, the control signal is combined with a modulation input.

The phase detector (U3) receives two input frequencies, both of which are in the 5-10 MHz range; when the loop is locked these frequencies are equal. The reference frequency input (fR) comes from the divide by 8 circuit on the divider board (A7), and the variable frequency input (fV) comes from the divide by N circuit on the same board. The phase detector produces outputs at pins 3 and 12 of U3; if the input frequencies are not in phase, wide pulses appear at one of these pins, depending on whether fV is leading or lagging. The outputs are used by the lock detector circuit (see U5-7, Q1) to determine whether the loop is locked. They are also used by one of two independent loop amplifier circuits (selected by analog gate U1) to produce the loop's control output.

The first loop amplifier circuit is used when the instrument is not in FM mode. The phase detector outputs are amplified by U5-1 and U5-14; frequency compensation networks (R8/C10, R5/C5, R3/C9) provide the rolloff needed to stabilize the loop. Diodes in the feedback loops of the amplifiers limit the amplifier outputs in order to prevent saturation during search. The output of U5-14 is applied (through the analog gate, U1) to the output amplifier, U2-1. This output is used by the FM driver (see A103) to tune the YIG oscillator's FM coil; it goes more negative to increase frequency and more positive to decrease.

The second loop amplifier circuit is used when the instrument is in the FM mode. Essentially, it duplicates the first loop amplifier (see U6-1, U6-7) but adds the input FM signal (amplified by U8-7) to the phase detector output signal. The two signals are combined by U7-1 and applied to analog gate U1.

The variable frequency input to the phase detector is derived from the sampling mixer's IF, not directly from the YIG output frequency. The sampler's IF is the product of a harmonic multiplier, and may be derived from the wrong harmonic. In that case the phase lock loop is misdirected, tuning the YIG oscillator in the wrong direction until it reaches its "+" or "-" rail. To prevent the PLL circuit from becoming stuck in this mode, a search circuit is added. This consists of amplifiers U5-8 and U2-7, which monitor the circuit output and return control voltages to the loop amplifier circuits. When the output becomes too positive (minimum frequency), U5-8 swings to its negative rail, driving the output negative (maximum frequency). When the situation is reversed, U2-7 drives the output positive (minimum frequency).

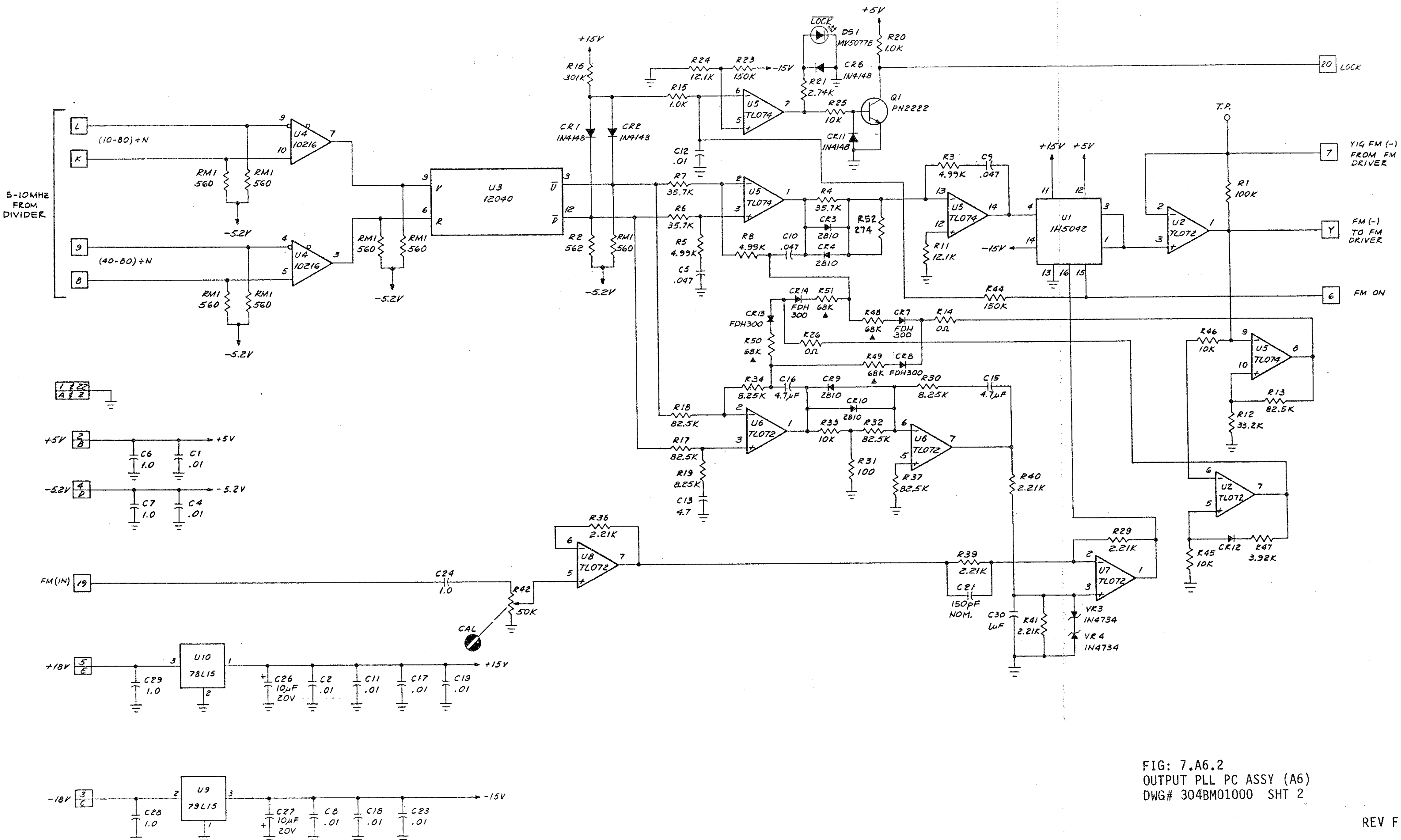
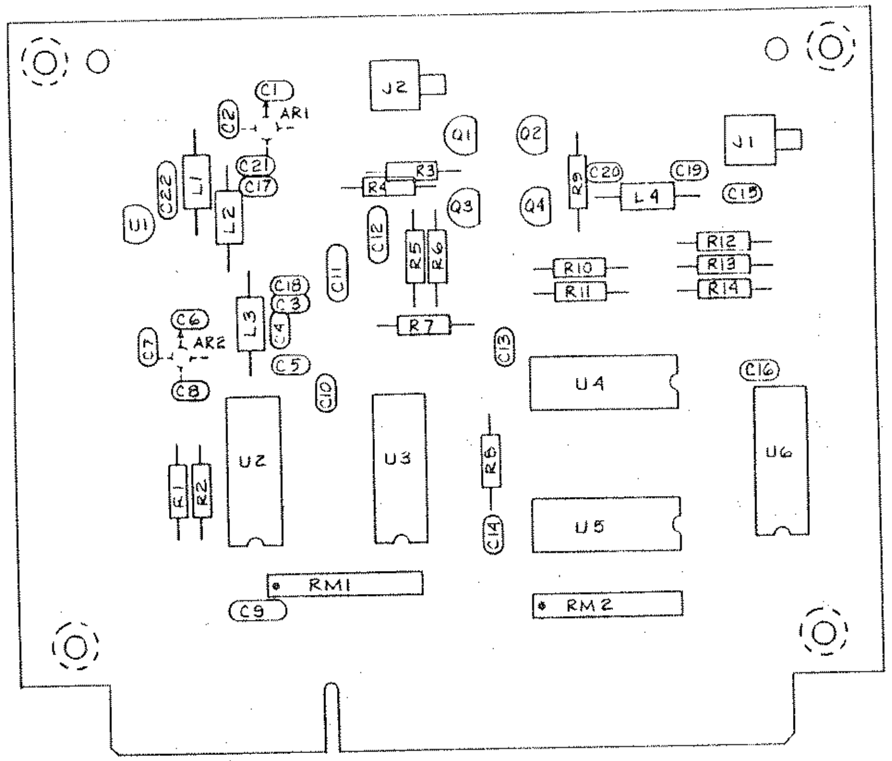
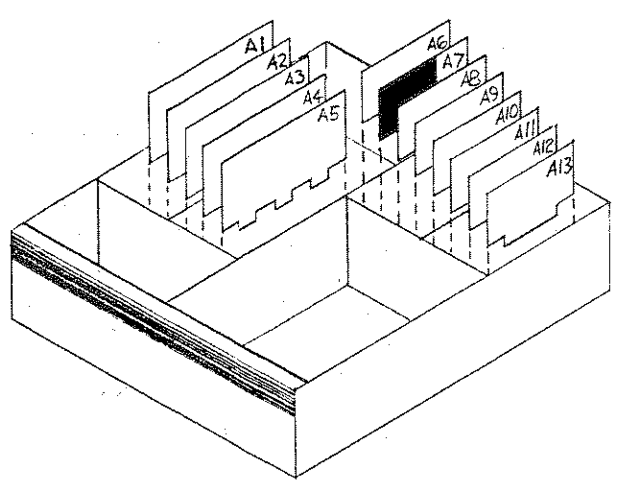


FIG: 7.A6.2
OUTPUT PLL PC ASSY (A6)
DWG# 304BM01000 SHT 2

REV F





7.A7.1
DIVIDER PC ASSY (A7)
DWG# 304BM03100 SHT 1

REV D

DIVIDER -- PC Assy A7

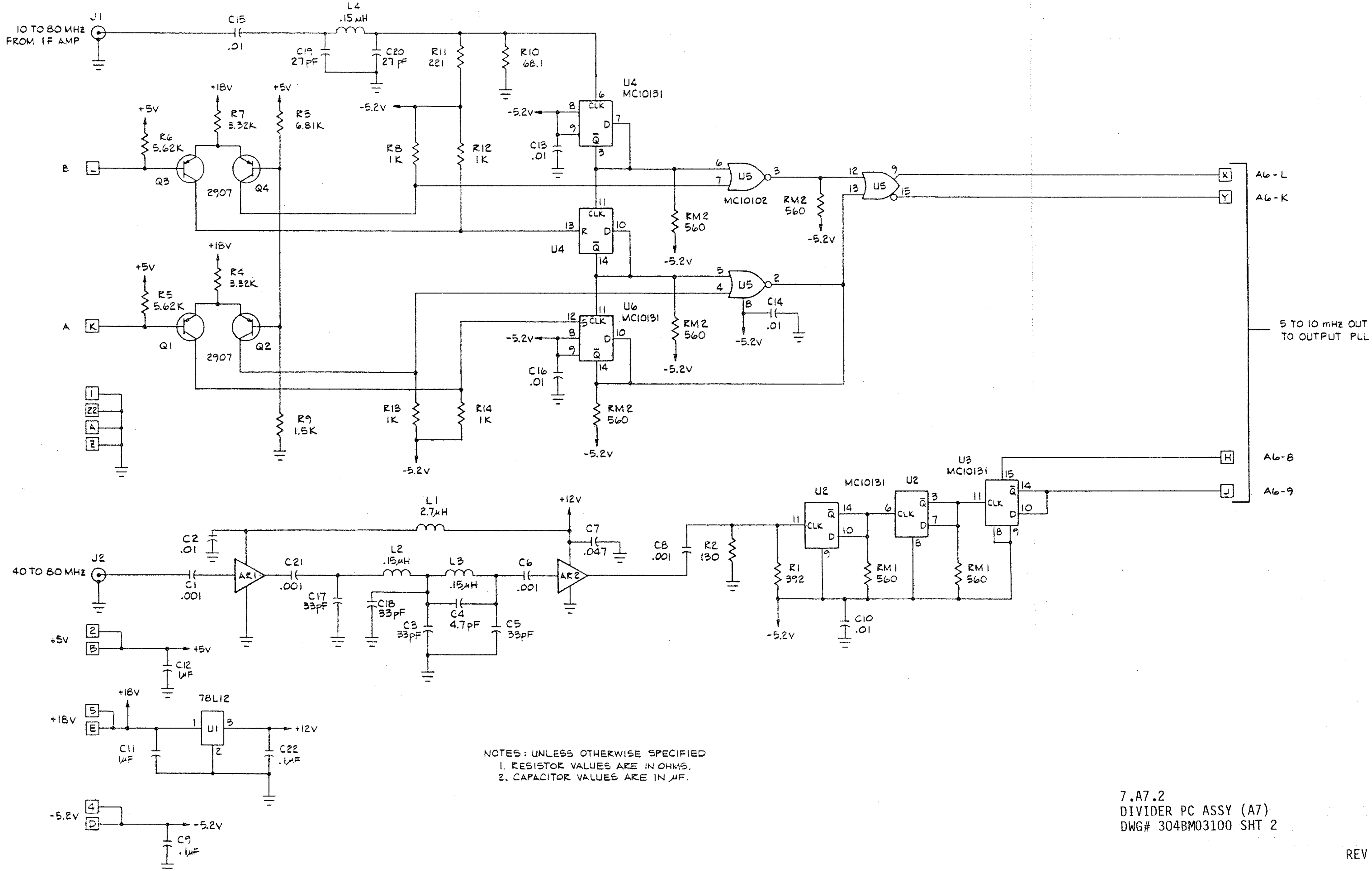
This circuit includes two frequency dividers, one fixed and one programmable, which supply paired 5-10 MHz signals to the output PLL circuit (A6).

The fixed frequency divider has a divisor of 8. It accepts an input frequency from the 40-80 MHz PLL circuit (A8). The input frequency is applied to a low-pass filter (L2/L3, etc.), and to amplifiers AR1 and AR2. The amplified 40-80 MHz signal is used to clock a series of three flip flops (U2, U3). The output of the third flip flop is the input frequency divided by 8 (in other words, it has a range of 5-10 MHz).

The programmable divider circuit can be set to divide by 2, 4, or 8. It accepts a 10-80 MHz sampler IF from the 300 MHz Oscillator board (A104). A low pass filter (L4, etc.) removes spurious high frequencies from the signal. A series of three flip flops (U4, U6) is used to provide three outputs equal to the input frequency divided by 2 (at U4-3), by 4 (at U4-14), and by 8 (at U6-14). The computer selects the appropriate divisor by means of the 'A' and 'B' control inputs. Because these inputs are at TTL logic levels, two differential amplifiers (Q1/Q2, and Q3/Q4) are used to convert them to ECL voltages. The differential outputs drive the SET and RESET inputs at U4-13 and U6-12, and also to drive the steering gates at U5-7 and U5-4. Only one of the three flip flops is allowed to contribute its output to the final buffer, U5-9.

The computer selects a divisor which will reduce the 10-80 MHz IF input to a 5-10 MHz output. The 'A' and 'B' control bits (see Q1 and Q3) are interpreted as follows:

'A'	'B'	DIVISOR
0	0	2
0	1	4
1	1	8



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN μF.

7.A7.2
DIVIDER PC ASSY (A7)
DWG# 304BM03100 SHT 2

REV D

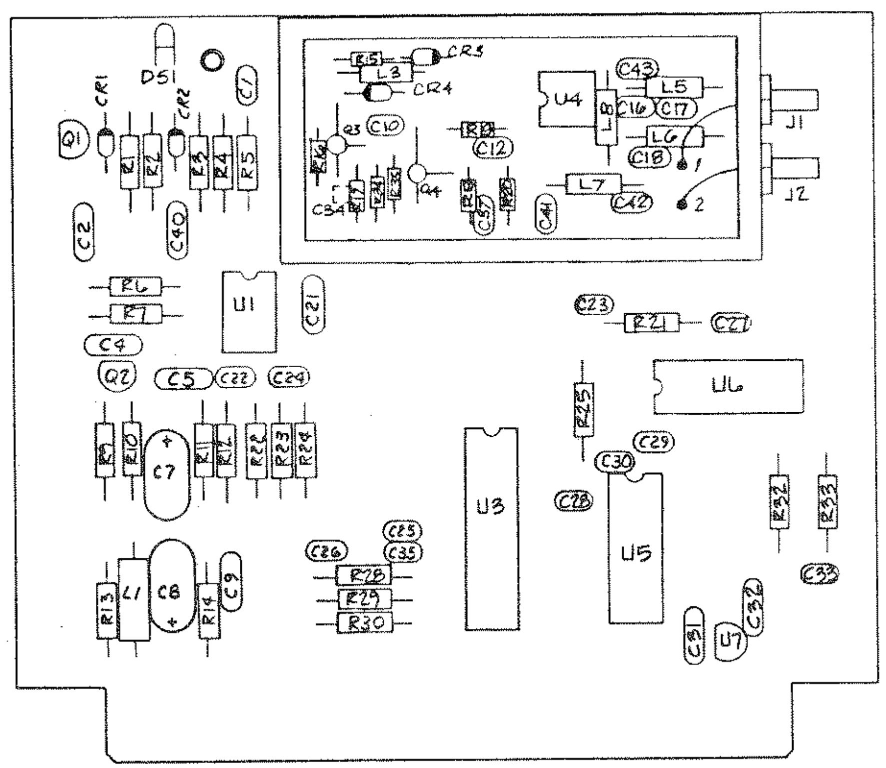
40-80 MHz PLL -- Circuit Board A8

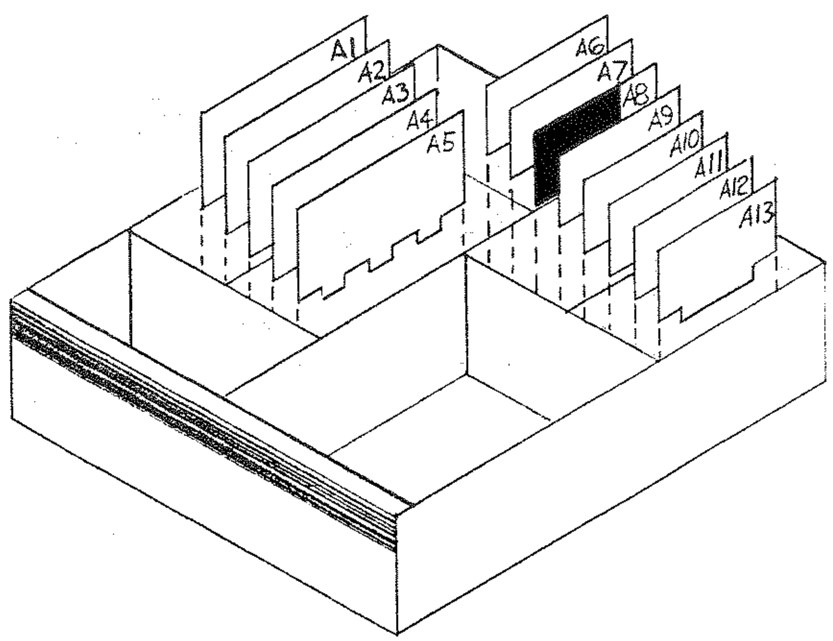
This circuit provides a programmable reference frequency to the instrument's output phase lock loop. The 40-80 MHz circuit output at J1 is an intermediate frequency produced by mixer U4; it is equal to the difference between the 225-226 MHz input (J2) and the frequency produced by the VCO (Q3). A low pass filter (L5, etc.) removes spurious high frequencies from the IF output. The VCO has a range of 145-185 MHz, and is tuned by a phase lock loop circuit.

The PLL circuit is programmed by means of the MC145146 PLL chip, U3. This IC includes three programmable frequency counters: one for dividing the 10 MHz reference input, one for dividing the variable input (feedback from the VCO), and one for controlling an external prescaler (U6/U5) on the variable input. The IC's reference input (U3-7) is taken from the 10 MHz master reference input. The reference counter is programmed to divide the 10 MHz input by 40, for a 250 kHz input to the internal phase detector. The variable counter and the external prescaler counter (U6/U5) are used in combination to divide the VCO frequency, for a 250 kHz input to the internal phase detector when the loop is locked.

The phase detector outputs at U3-17 and U3-16 provide output pulses to indicate whether the variable frequency (derived from the VCO output) is leading or lagging the reference. These pulses are converted by loop amplifier U1-7 into a tuning voltage for the VCO. By programming U3's internal counters, the computer can select a VCO frequency in 1 MHz steps between 145 and 185 MHz.

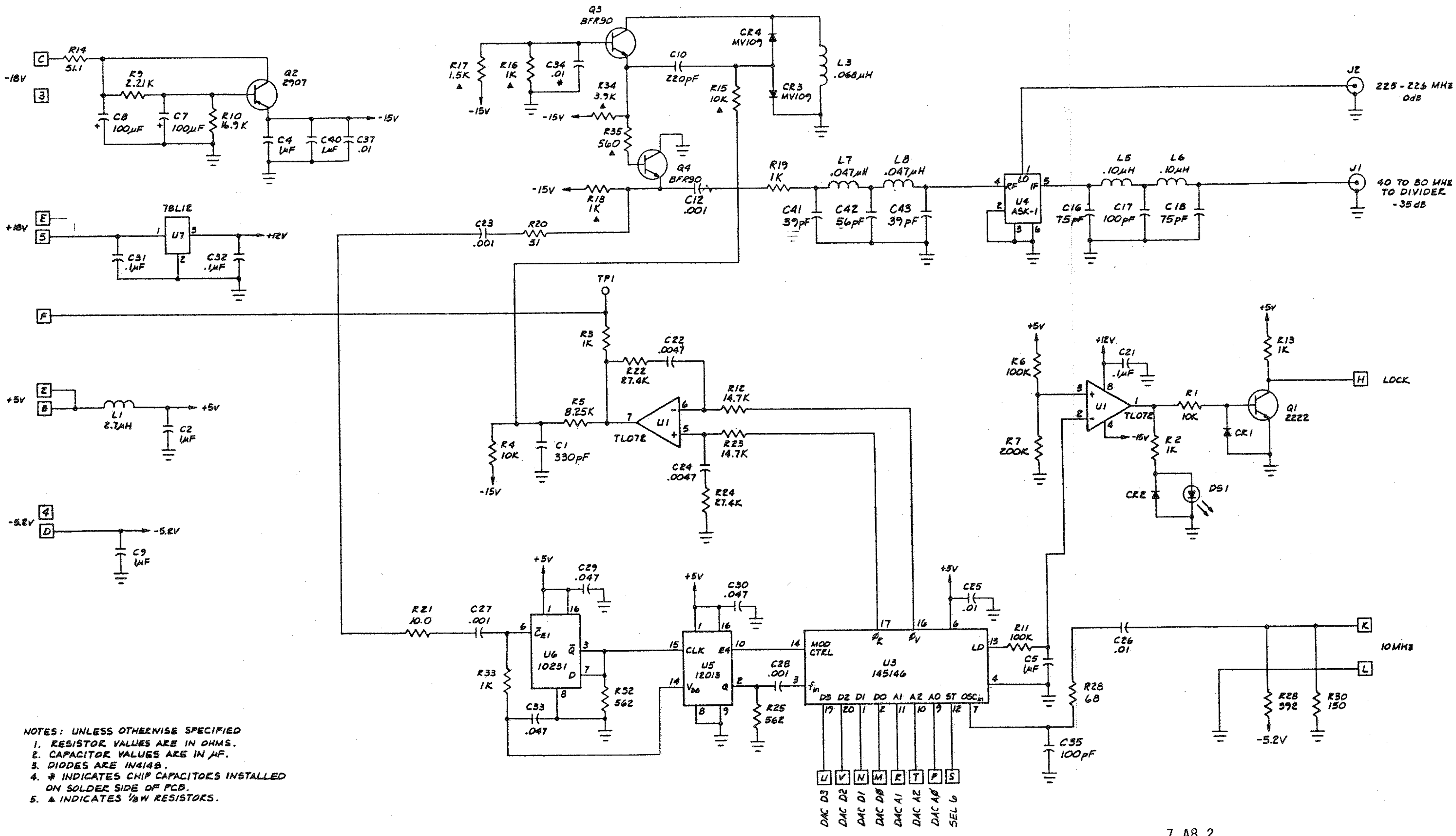
U3's internal lock detector (pin 13) drives U1-1 and Q1 so that the DS1 is illuminated and the 'lock' output at pin H is low for the unlocked condition. In the locked condition, DS1 is dark and pin H is high.





7.A8.1
40-80 MHZ PLL PC ASSY (A8)
DWG# 304BM03000 SHT 1

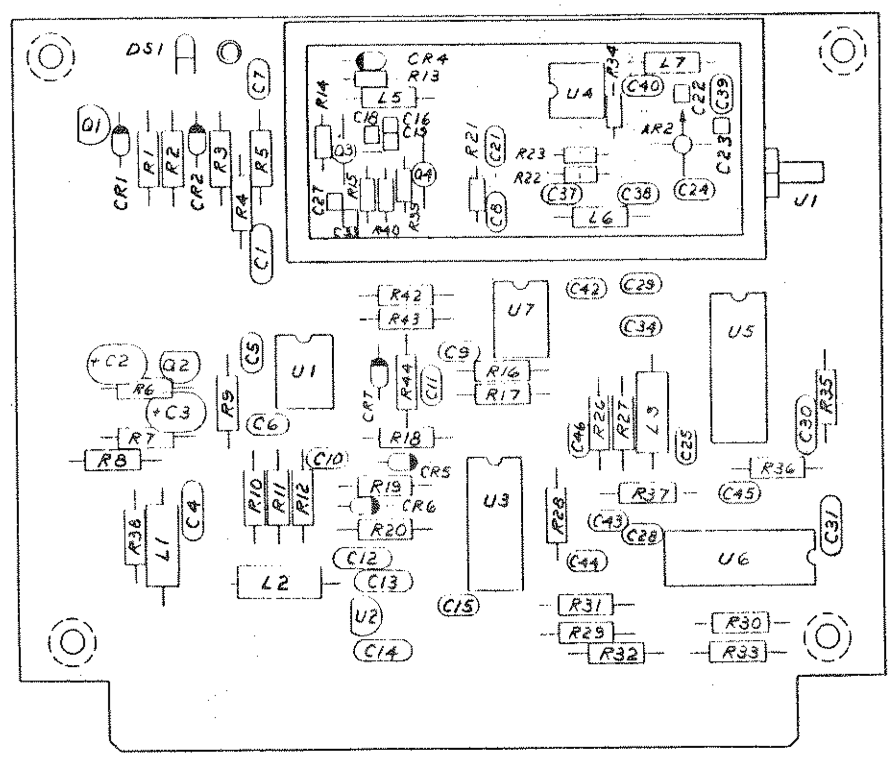
REV H



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN µF.
3. DIODES ARE IN4148.
4. # INDICATES CHIP CAPACITORS INSTALLED ON SOLDER SIDE OF PCB.
5. ▲ INDICATES 1/8W RESISTORS.

7.A8.2
40-80 MHZ PLL PC ASSY (A8)
DWG# 304BM03000 SHT 2

REV H



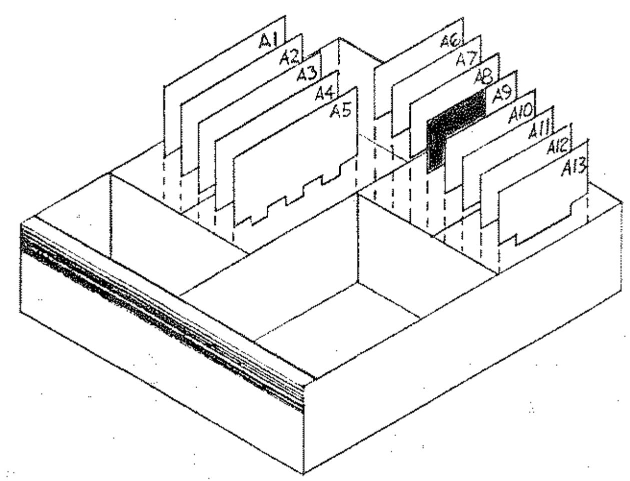


FIG: 7.A9.1
INTERMEDIATE PLL -- PC ASSY A9
DWG# 304BM02700

REV G

INTERMEDIATE PHASE LOCK LOOP -- PC board A9 (Option 03 only)

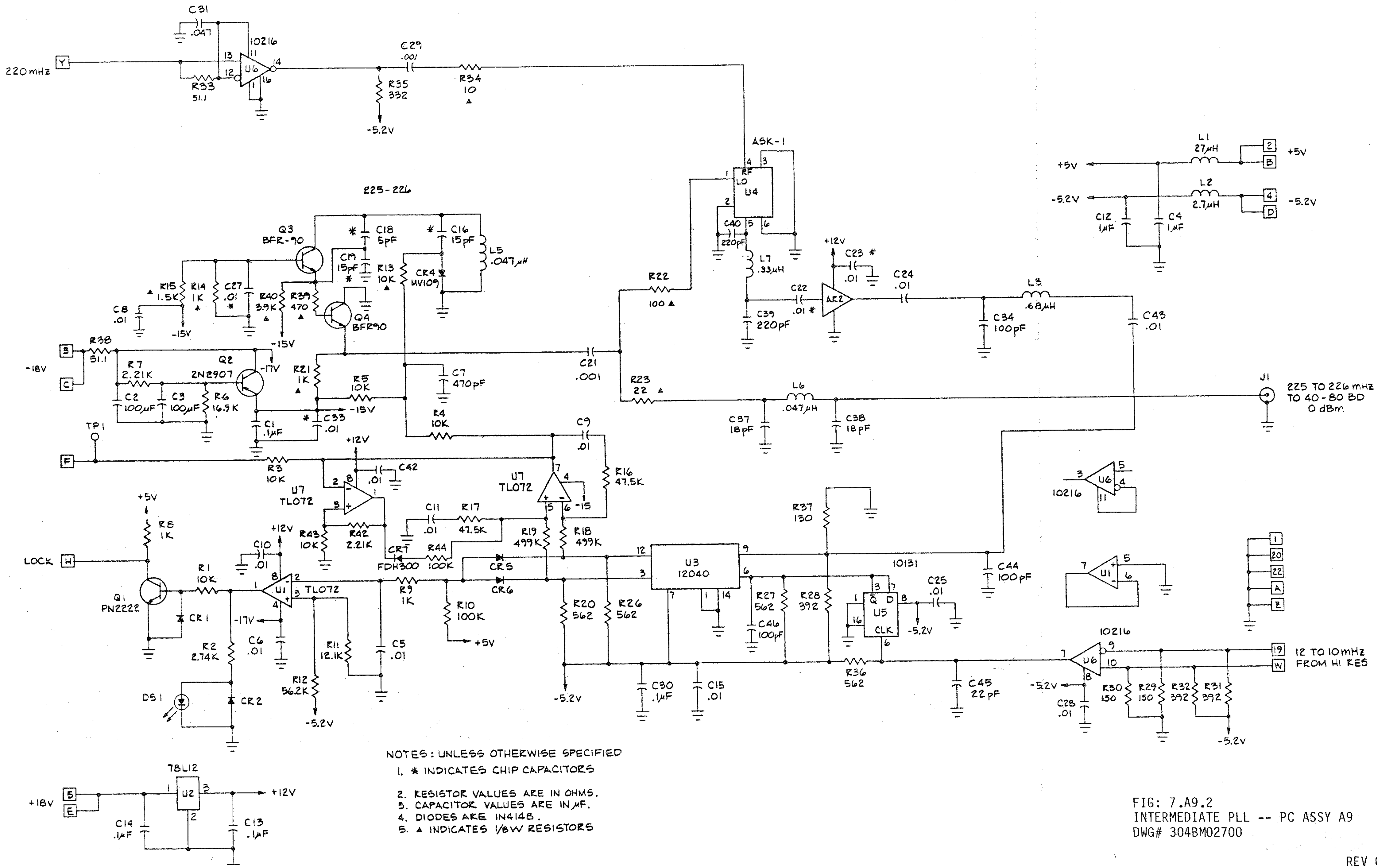
The function of this circuit is to synthesize frequencies between 225 and 226 MHz (for use by the 40-80 MHz PLL), derived from reference inputs at 220 MHz and 10-12 MHz. The main elements of the circuit are the voltage controlled oscillator (VCO), the mixer, the phase comparator, and the lock detector.

The VCO (see Q3, etc.) is designed to oscillate at 225 to 226 MHz; its output frequency is determined by the tuning voltage received from U7-7 (the tuning voltage is measurable at TP1). The VCO output is furnished (through a low pass filter which eliminates harmonics) to connector J1. The VCO is also applied to the RF mixer (see U4).

The RF mixer combines the VCO frequency with the 220 MHz reference input frequency (buffered by U6-14), producing at U4-5 an intermediate frequency (IF) output equal to the difference between them, or 5 to 6 MHz. Since the 220 MHz input is fixed, the IF is determined entirely by the VCO output. The IF output is amplified (AR2), filtered (see L3, etc.), and applied to the variable input of the phase comparator (U3-9).

The phase comparator produces pulses at one of its outputs pins (U3-3 or U3-12) depending on whether its variable input (pin 9) is leading or lagging the reference input (pin 6). The reference input is at 5-6 MHz and is derived from the 10-12 MHz input from the high resolution PLL board (pins W and 19, buffered by U6-7 and divided in half by flip flop U5). The loop amplifier (U7-7) converts U3's output pulses into a DC control voltage for the VCO. The phase comparator tunes the VCO upward or downward in order to equalize its two input frequencies; when these two frequencies are equal, the loop is "locked". The output frequency of the circuit as a whole (J1) is therefore determined by the frequency of the 10-12 MHz input.

The phase comparator's output pulses are furnished (via CR5, CR6) to the lock detector circuit (see U1-2). When the loop is unlocked (i.e., when there is a large difference between the phase comparator's inputs) the output pulses become very wide, U1-1 goes high, turns on Q1 and fault indicator DS1, and pulls the 'LOCK' output (pin H) low.

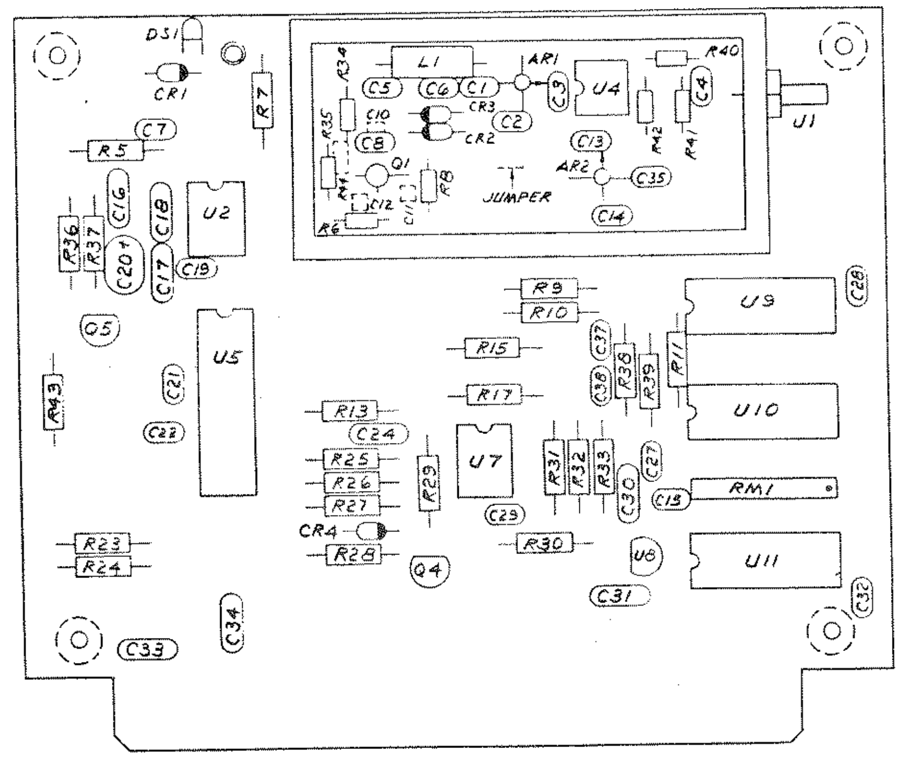


NOTES: UNLESS OTHERWISE SPECIFIED

1. ✱ INDICATES CHIP CAPACITORS
2. RESISTOR VALUES ARE IN OHMS.
3. CAPACITOR VALUES ARE IN μF.
4. DIODES ARE IN4148.
5. ▲ INDICATES 1/8W RESISTORS

FIG: 7.A9.2
INTERMEDIATE PLL -- PC ASSY A9
DWG# 304BM02700

REV G



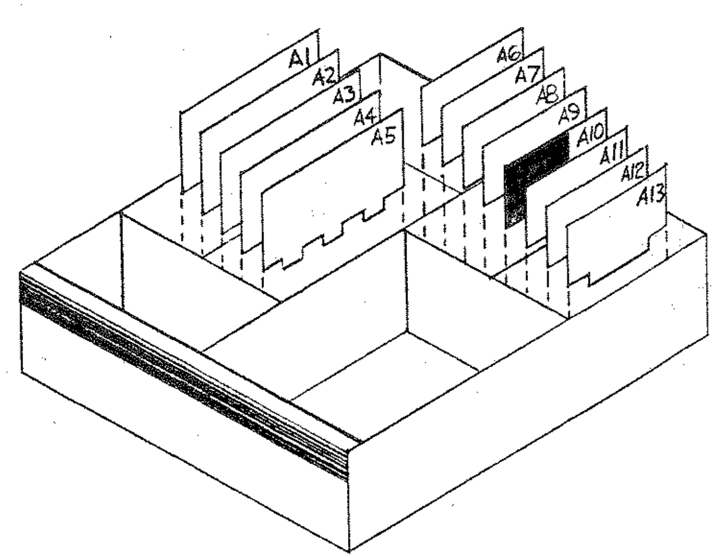


FIG: 7.A10.1
HI RESOLUTION PC ASSY (A10)
DWG# 304BM03400 SHT 1

REV F

HIGH RESOLUTION -- PC Assy A10 (Option 03 Only)

This circuit generates a reference frequency in the range of 10-12 MHz, programmable in steps of 2 kHz. A voltage controlled oscillator (Q1, etc.) produces a 250-300 MHz signal which, divided by 25 (U9, U10) yields the circuit's output frequency. A programmable synthesizer circuit tunes the VCO in order to generate a range of frequencies which are phase locked to the 10 MHz master reference. Because the VCO frequency is much higher than the master reference, it is mixed (U4) with the 220 MHz reference input to create a 30-80 MHz IF which is within the frequency range of the PLL circuit.

Synthesizer chip U5 contains three programmable counters and a phase detector. One internal counter divides the 10 MHz master reference by 200, yielding a 50 kHz reference for the phase detector. The remaining internal dividers are used in conjunction with the external prescaler divider (U2, which divides by either 15 or 16) in order to reduce the 30-80 MHz mixer IF to 50 kHz. In addition, it utilizes an external prescaler counter (U2). One of its phase detector outputs (pins 16 or 17) will produce wide pulses to indicate that the divided IF from the mixer is leading or lagging the divided master reference. The loop amplifier (U7-7) turns the phase detector output pulses into a control voltage by which the VCO is tuned. The amplifier drives the oscillator in whichever direction will reduce the phase difference between the two phase detector inputs, until the VCO is phase locked to the master reference. U5's lock detector output (pin 13) is applied to the detector circuit (U7-1, Q4 etc.); the light emitting diode (DS1) is illuminated for the unlocked condition.

A sample of the VCO frequency is mixed (by U4) with the 220 MHz reference input from A113; the resulting 30-80 MHz IF is amplified (AR1), filtered (L1 etc.) and applied to prescaler U2.

The output frequency of the VCO is tapped at L2, which is implemented as a printed trace on the circuit board. AR2 amplifies the VCO signal. The circuit consisting of U9 and U10 is a fixed frequency divider with a divisor of 25. U9 divides by either 8 or 9 (its divisor is programmed by the logic level fed back from U10-3). The two flip flops of U10 are used as a divide-by-3; U10-3 is low during one cycle out of three, programming U9 to divide by 9 for that period and by 8 the rest of the time, for a total division of the VCO frequency by 25. The 10-12 MHz quotient is buffered and complemented by U11.

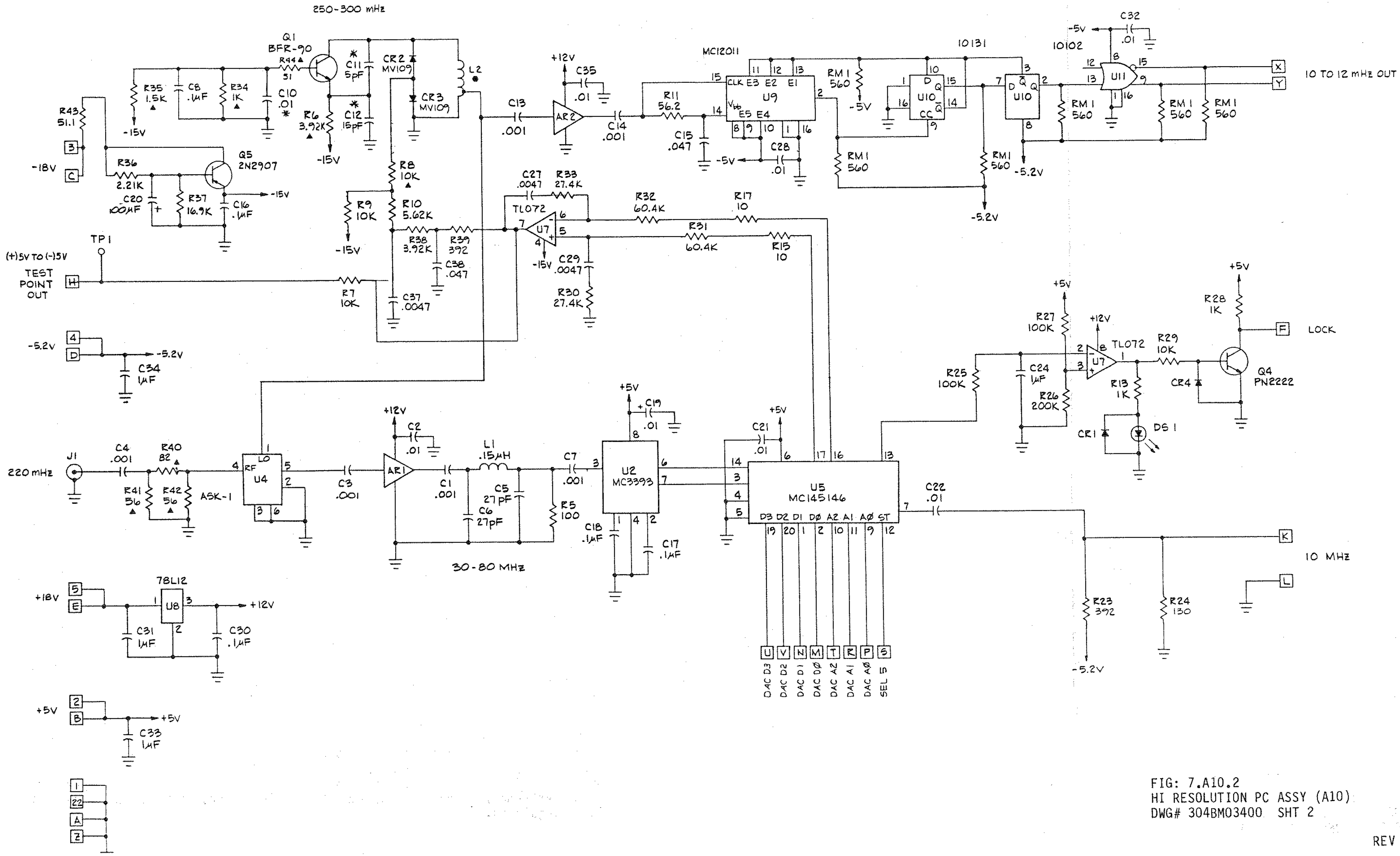
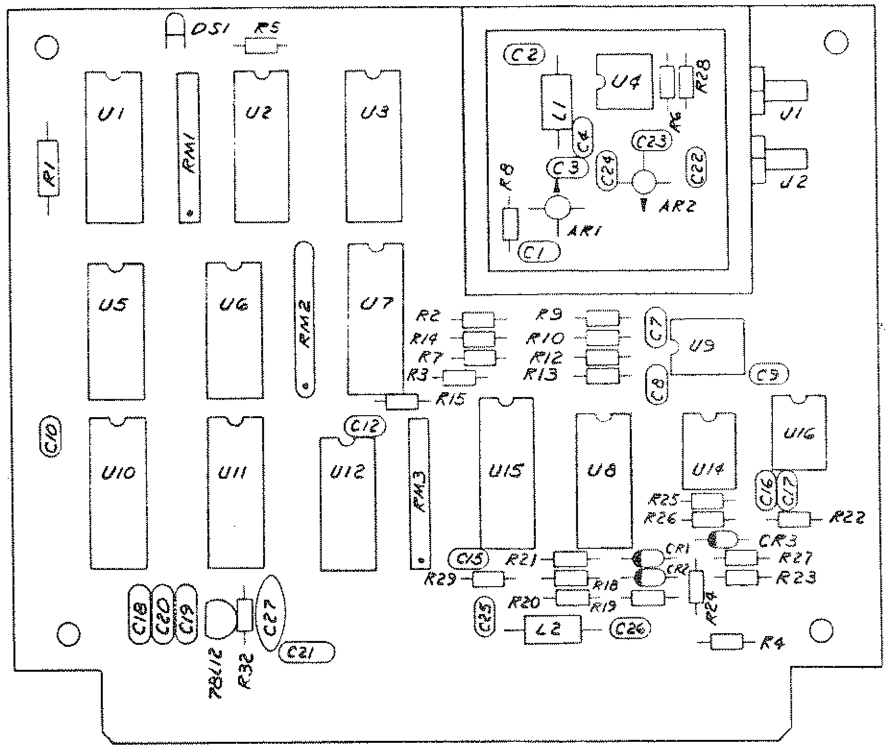
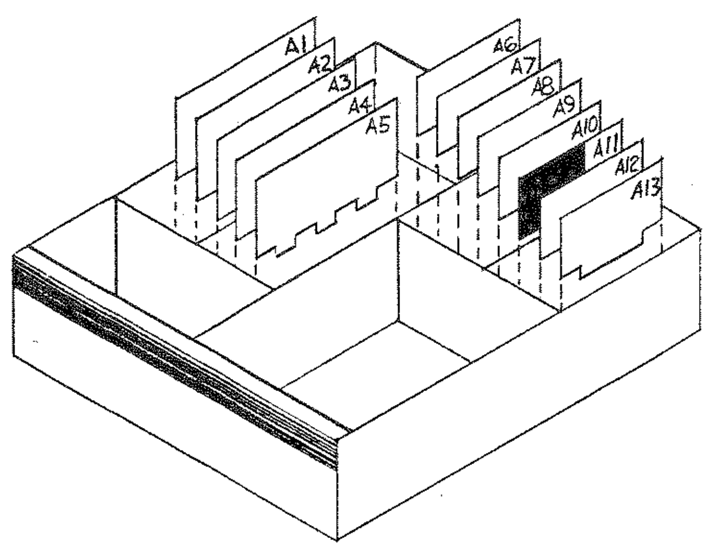


FIG: 7.A10.2
HI RESOLUTION PC ASSY (A10)
DWG# 304BM03400 SHT 2

REV F





7.A11.1
300 MHz PLL PC ASSY (A11)
DWG# 304BM02200 SHT 1

REV H

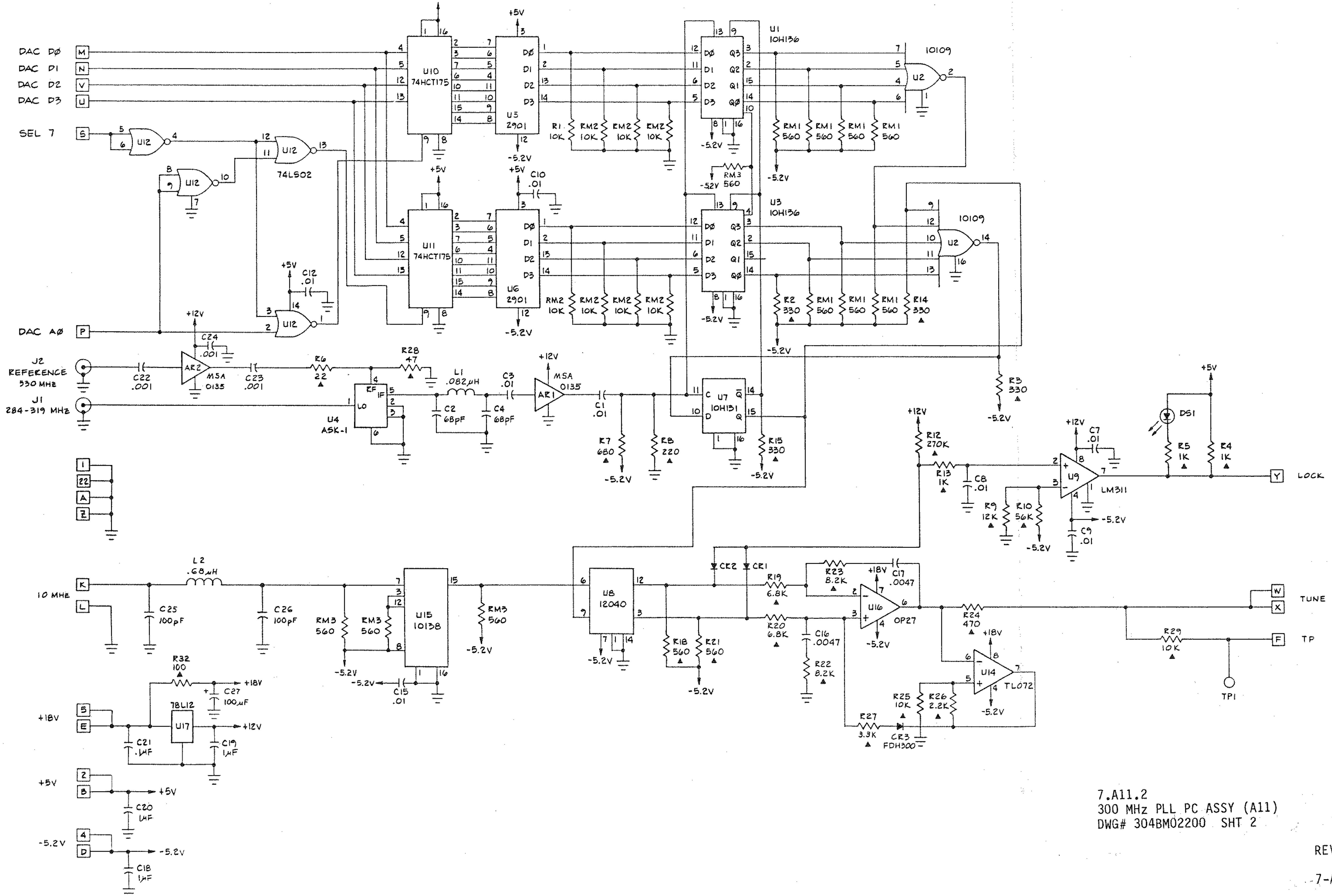
300 MHz PHASE LOCK LOOP -- Circuit Board A11

This circuit tunes the 300 MHz voltage controlled oscillator (PC board A104). The VCO can be programmed over a range of 284 to 319 MHz; the PLL circuit enables the computer to select the desired VCO frequency and phase lock the VCO to the instrument's 10 MHz timebase. The input at J1 is feedback from the VCO. Because the 284-319 MHz input frequency is too high to be counted by the digital circuits used here, the input signal is mixed (see U4) with the 330 MHz reference input (received at J2 and amplified by AR2) yielding an intermediate frequency in the range of 11-46 MHz. A low pass filter (L1 etc.) removes the mixer input frequencies. The IF is then amplified (AR1) and applied to the programmable divider.

The purpose of the programmable divider is to divide the 11-46 MHz IF down to 1 MHz. The first stage of the divider consists of latches U10 and U11; the computer selects the divisor (in the range of 11-46) by loading it as two successive four-bit words into these latches (U12 drives the chip select lines of the latches). The complementary outputs of the latches are applied to the comparators of U5 and U6; the comparator outputs translate the eight-bit divisor into ECL levels for use by the high speed ECL down-counters, U1 and U3. The counters are clocked by the amplified IF, and count down from the numbers programmed into them. U3 represents the four least significant bits, U1 the four most significant bits. Flip flop U7, also clocked by the IF, receives a high at its 'D' input (U7-10) at the end of the count and sends a high output pulse (from U7-15) to the phase comparator. The counters are reset by U7-14 and the count repeats.

The phase comparator chip, U8, requires reference and variable frequency inputs. The reference input is derived from the instrument's 10 MHz timebase. The 10 MHz input is received at pins K and L, filtered (L2 etc.) and divided by ten at U15. The 1 MHz quotient is applied to the comparator at U8-6. The variable input, received from the programmable divider circuit (see U7-15), is applied to the comparator at U8-9. The phase comparator produces wide pulses at one of its outputs (pin 3 or 12) depending on whether the variable input is leading or lagging the reference. The loop amplifier circuit (U16 etc.) converts these pulses into a DC voltage output (pins W, X) with which to tune the VCO. The polarity of tuning is: more positive to increase frequency, more negative to decrease frequency. The PLL circuit tunes the VCO in whatever direction will reduce the phase difference between the reference and variable inputs to the comparator. Filter components in the loop amplifier circuit (C16, C17, etc.) remove the phase comparator's output pulses from the tuning signal.

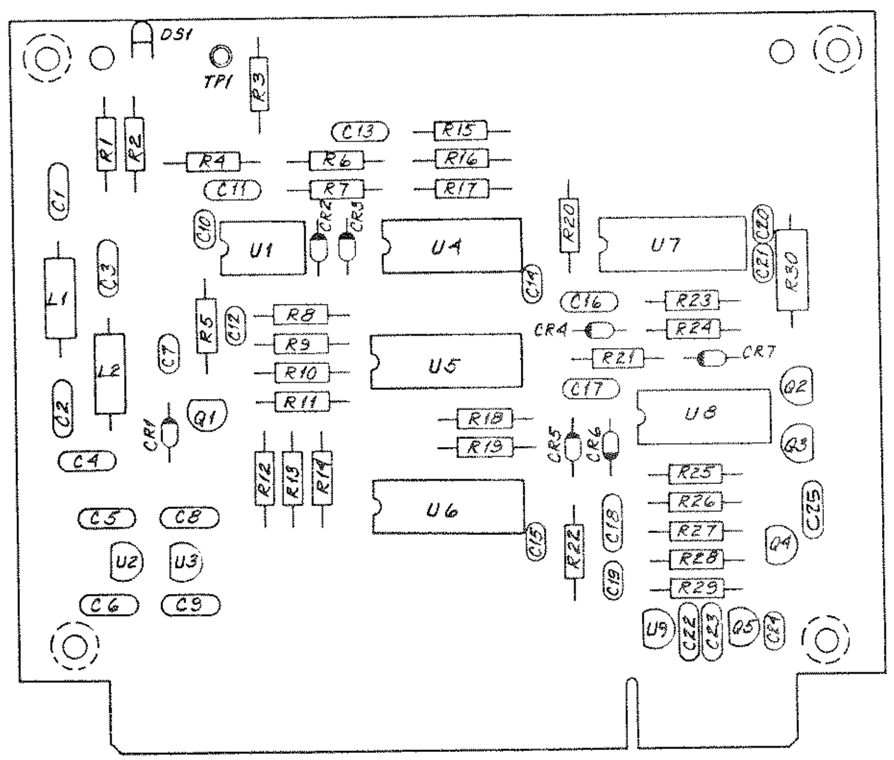
When there is a large phase difference between the reference and variable inputs to the comparator (i.e., when the loop is "unlocked"), wide low-going pulses appear at one of U8's outputs. These pulses are detected by the circuit consisting of U9 etc., and cause the 'LOCK' output at pin Y to go low and the LED (DS1) to be lit. When the loop is locked, U8's output pulses become extremely narrow and shallow, the 'LOCK' output is high, and the LED is extinguished.

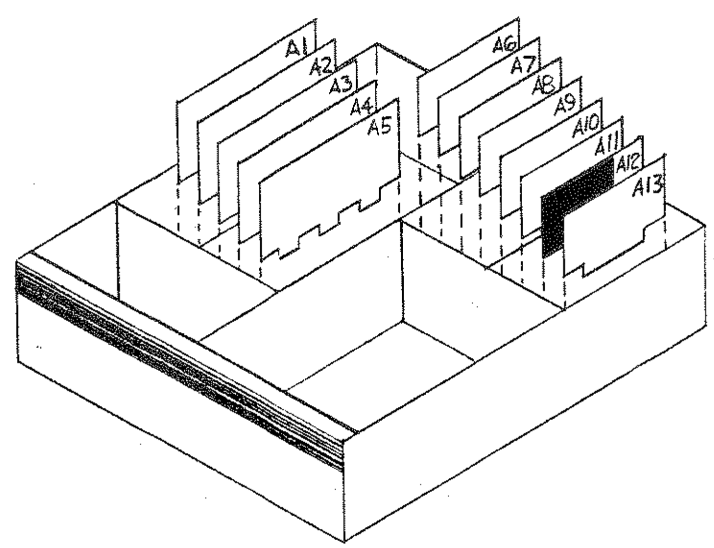


7.A11.2
300 MHz PLL PC ASSY (A11)
DWG# 304BM02200 SHT 2

REV H

7-A11-2





7.A12.1
110 MHz PLL PC ASSY (A12)
DWG# 304BM05600 SHT 1

REV D

110 MHz PHASE LOCK LOOP -- PC Board A12

The function of this circuit is to phase lock the 110 MHz VCO on the oscillator/multiplier board (A113) to the 10 MHz master reference. In addition, this circuit performs important functions related to the master reference itself.

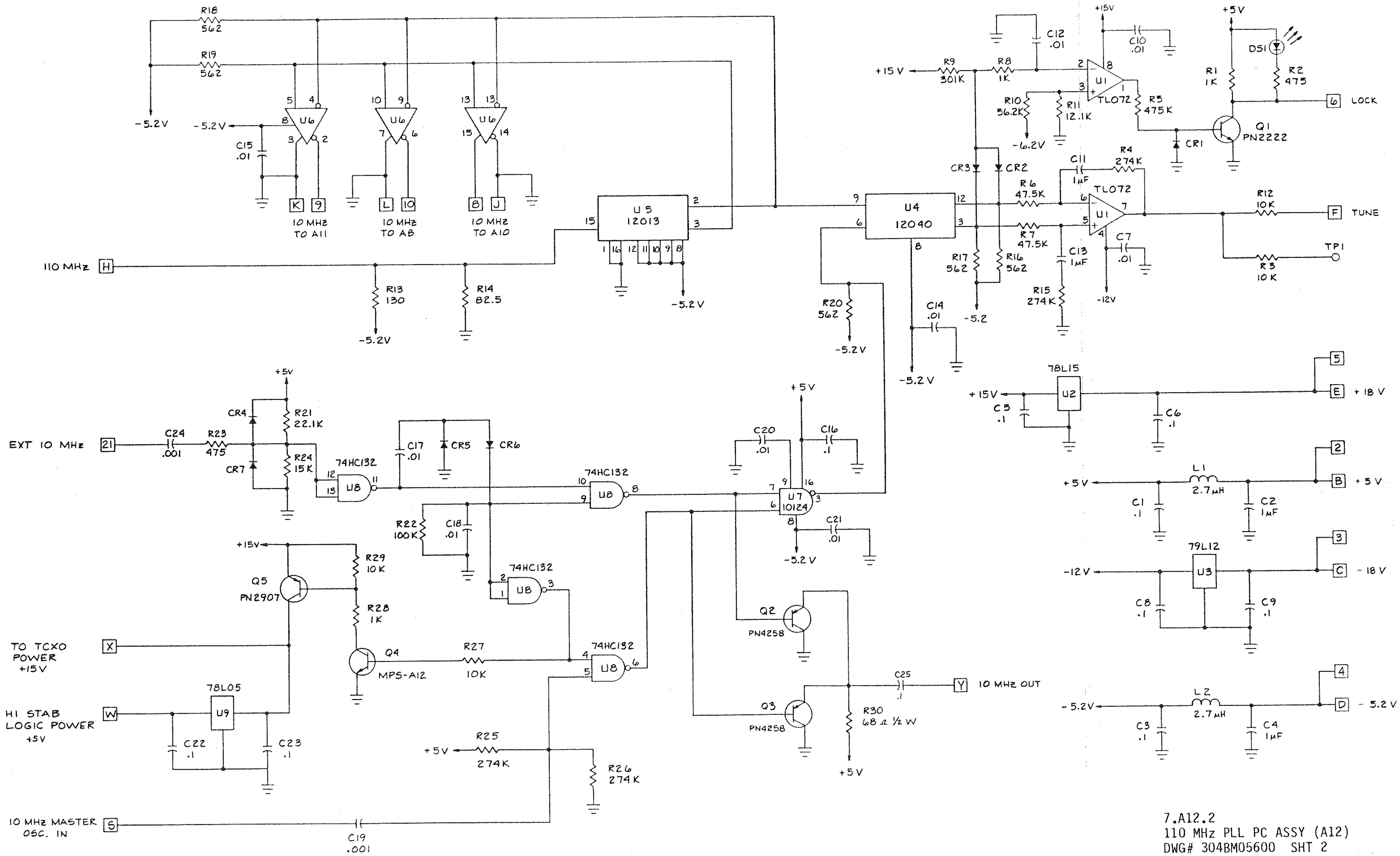
The output frequency of the 110 MHz VCO is received at pin H; U5 divides this input by 11. When the loop is locked, the input is exactly 110 MHz, and the divider's output is exactly 10 MHz. This output is applied to the variable input of the phase comparator at U4-9. The reference input to the phase comparator comes from the 10 MHz input/output circuit.

Model 600 is designed to accept an external 10 MHz timebase input, and this external input, whenever present, is automatically substituted for the internal timebase. The external 10 MHz signal is received at pin 21; the input is AC coupled (C24); U8-11 is triggered by an input of 1 Vpp or greater. When an external input is present, the signal propagates through U8-8 and TTL-ECL translator U7-3 to the reference input of the phase detector at U4-6. The external signal is also used to charge C18, so that U8-3 is held low. This low level turns off Q4 and Q5, cutting off the +15V and +5V power supplies to the internal timebase oscillator, so that it will not interfere with the active timebase. The timebase signal also propagates through Q2 to the instrument's timebase output, via pin Y.

When no external 10 MHz input is present, U8-3 is held high; Q4 and Q5 are turned on and the supply voltages are furnished to the internal timebase oscillator. The input from the internal timebase, received at pin S, propagates through U8-6 and U7-3 to the phase detector. The timebase signal also propagates through Q3 to the instrument's timebase output, via pin Y.

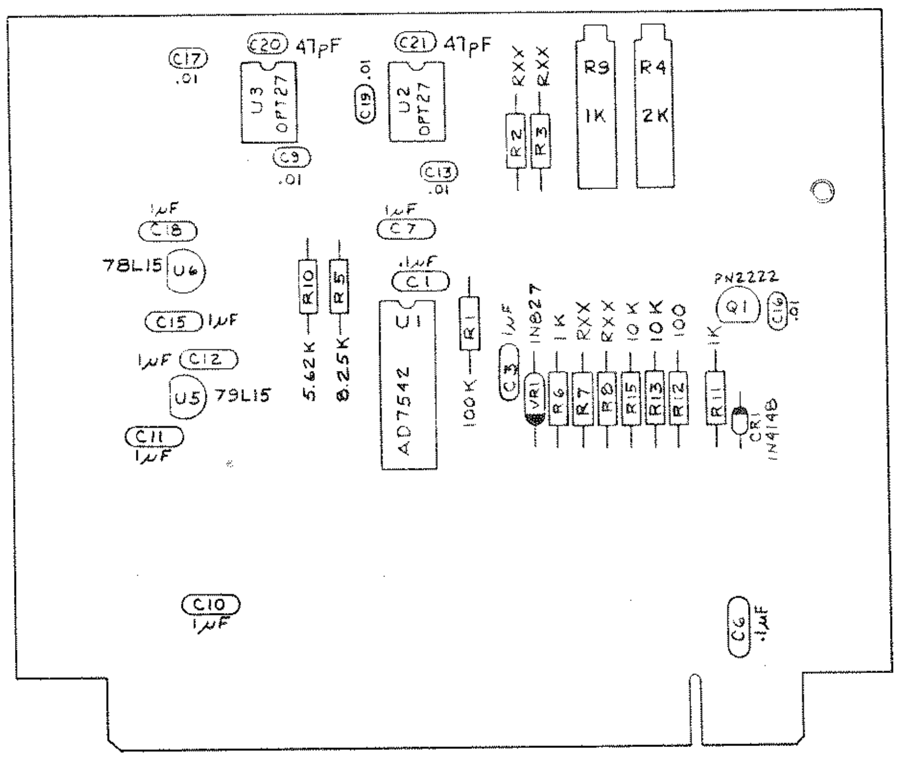
When its reference and variable inputs are not in phase, U4 produces wide pulses at one of its outputs, depending on whether the variable input is leading or lagging the reference. The pulsed outputs are filtered and amplified by U1-7 to produce a voltage output (pin F) which tunes the 110 MHz VCO.

The lock indicator circuit (U1-1, Q1) responds to the wide pulses which occur on the phase detector outputs when the loop is unlocked by turning on Q1, pulling the output low, and illuminating DS1. When the loop is locked, Q1 is off and DS1 is dark.



7.A12.2
110 MHz PLL PC ASSY (A12)
DWG# 304BM05600 SHT 2

REV D



Rxx VALUES			
	2-8	5.4-12	10-18
R2	26.7K	32.4K	18.7K
R3	1.5K	1.82K	8.25K
R7	19.6K	16.9K	10K
R8	2.21K	3.16K	2.21K

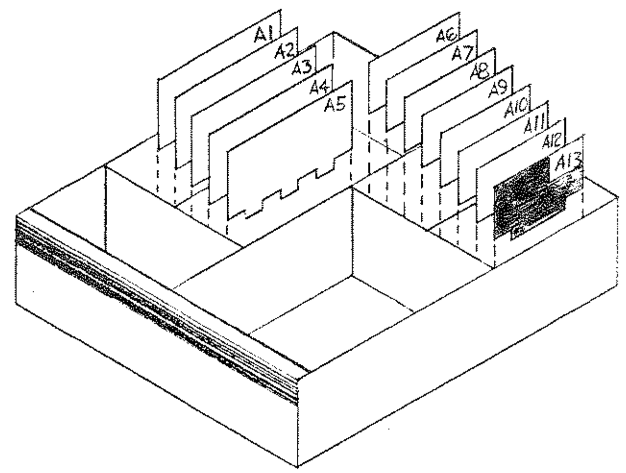


FIG: 7.A13.1
YIG DRIVER PC ASSY (A13)
DWG# 304BM02400 SHT 1

REV C

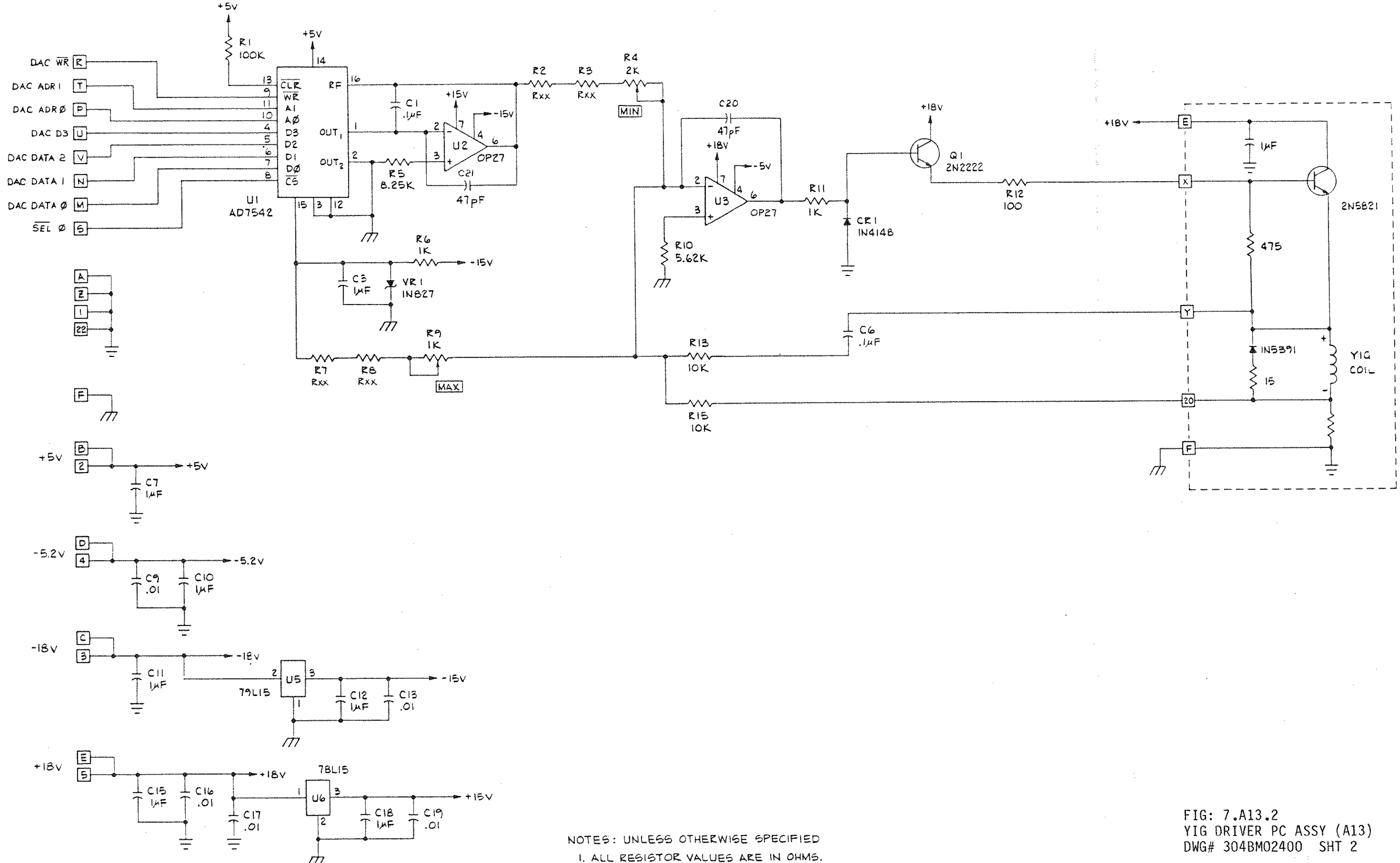
YIG DRIVER -- Circuit Board A13

This circuit is used to coarse-tune the output frequency of the instrument's YIG oscillator. The YIG frequency is determined by the current through its tuning coil; the sensitivity is 20 MHz/mA. Because the coil's impedance varies with temperature, it must be driven by a current source in order to maintain accuracy. The current source includes the +18 volt supply, the power transistor (2N5821), and the four-terminal sense resistor, all of which are located off of this circuit board; the YIG driver supplies a control signal to the base of the power transistor and receives feedback from the tuning coil.

U1 is a digital to analog converter; its analog output is proportional to the product of the digital number with which it is programmed by the system computer and the reference voltage applied to pin 15 (-6.2V). The DAC, together with inverting amplifier U2-6, produces a computer controlled voltage in the approximate range of 0 to +6 volts, with the voltage decreasing as frequency increases. Through resistors and a calibration pot, this voltage is applied to the summing junction at the inverting input of amplifier U3-6. There are two other inputs to this junction: a negative voltage from reference diode VR1 (by way of resistors and a second calibration pot), and a positive voltage fed back from the YIG oscillator tuning coil.

When the computer decreases the DAC voltage (in response to the operator's request for a higher frequency), a higher feedback voltage is required from the tuning coil in order to compensate for the change and maintain virtual ground at the summing junction. The output at U3-6 is driven more positive, increasing the current through Q1 and therefore increasing current through the power transistor, the tuning coil and the sense resistor. The positive voltage fed back from the tuning coil increases until the summing junction is restored to virtual ground, and the YIG settles on the new, higher frequency. In this way, the YIG frequency can be selected through the programming of the DAC.

The feedback path from the negative terminal of the YIG tuning coil is through R15 to the summing junction at U3-2. A parallel "AC" feedback path, from the positive terminal of the coil through C6 and R13, is provided as a filter in order to attenuate high frequency noise.



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL CAPACITOR VALUES ARE IN µF.

FIG: 7.A13.2
YIG DRIVER PC ASSY (A13)
DWG# 304BM02400 SHT 2

REV C

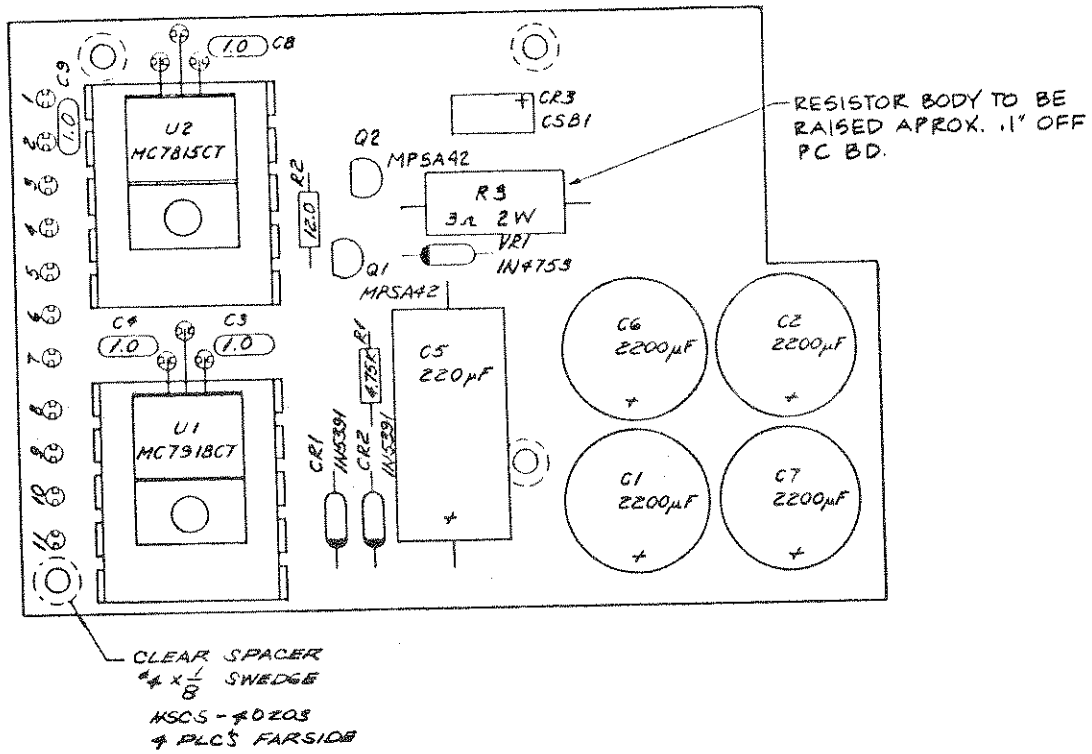


FIG: 7.A101.1
POWER SUPPLY PC ASSY (A101)
DWG# 304BM01100 SHT 1

REV C

POWER SUPPLY -- Circuit Board A101

Many of the components which make up the power supply are not located on the power supply circuit board because of their large size or cooling requirements; they are shown in this diagram for the sake of clarity. The line filter is attached to the rear panel. The transformer and the filter capacitors are mounted along the left side of the instrument, near the computer circuits. The rectifiers and voltage regulators are mounted on the heat sink at the rear of the instrument.

The transformer secondary voltages are rectified, filtered, and applied to voltage regulators to produce the instrument's power supply outputs:

Q5 provides the +5V supply used by the RF circuits.

Q1 provides the +5V supply used by the computer.

Q2 provides the -5.2V supply used by RF circuits.

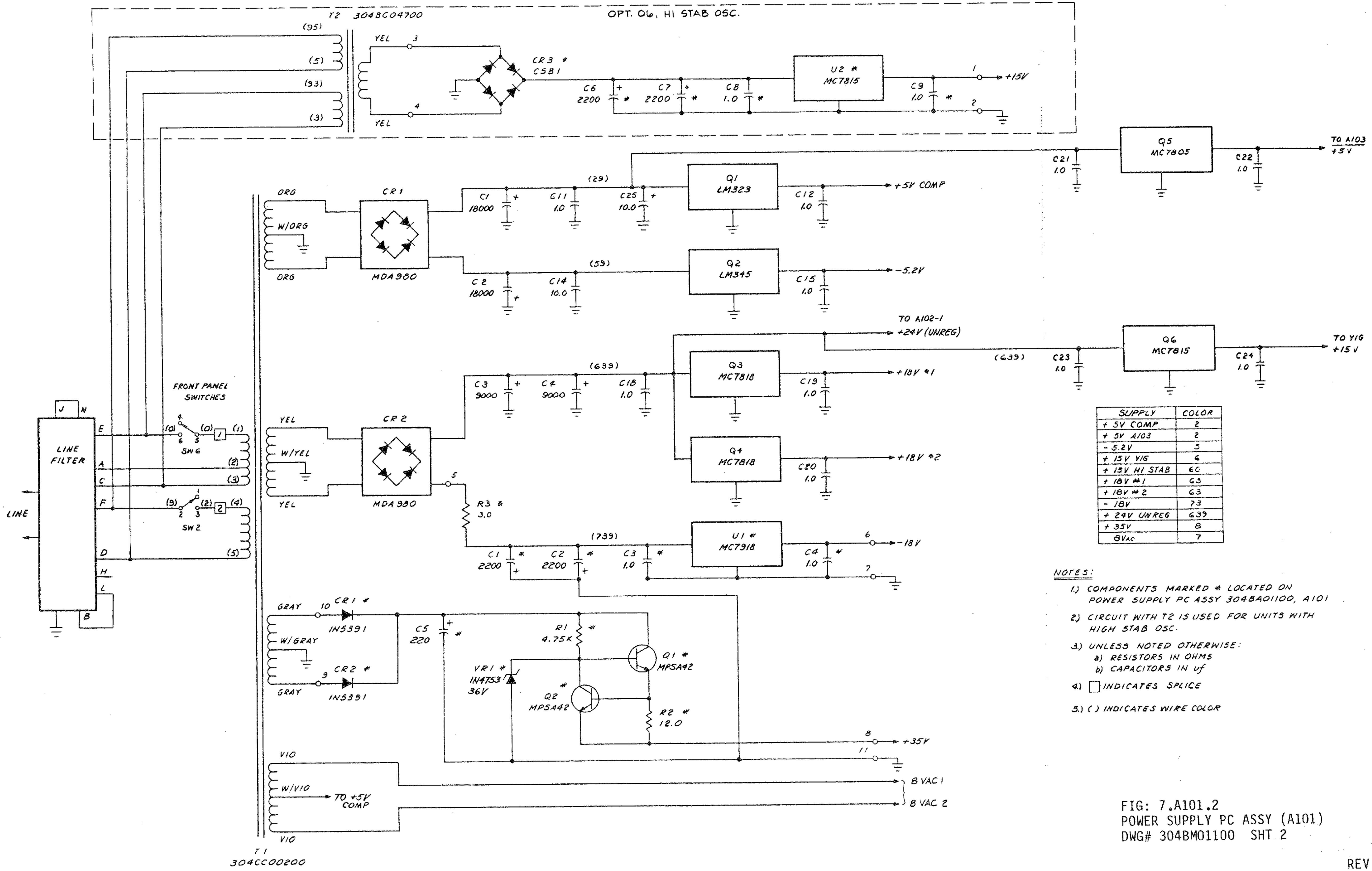
Q6 provides the +15V supply used by the YIG oscillator.

Q3 provides the +18V supply used by the RF circuits.

Q4 provides the +18V supply used by the YIG oscillator.

U1 provides the -18V supply used by the RF circuits.

UNREGULATED SUPPLIES: The +35V and 8VAC supplies are used by the fluorescent displays on the front panel. The +24V supply is used by the cooling fan and by the relays in the 10 dB step attenuator.



SUPPLY	COLOR
+ 5V COMP	2
+ 5V A103	2
- 5.2V	5
+ 15V YIG	6
+ 15V HI STAB	60
+ 18V #1	63
+ 18V #2	63
- 18V	73
+ 24V UNREG	639
+ 35V	8
8VAC	7

NOTES:

1.) COMPONENTS MARKED * LOCATED ON POWER SUPPLY PC ASSY 3048A01100, A101

2.) CIRCUIT WITH T2 IS USED FOR UNITS WITH HIGH STAB OSC.

3.) UNLESS NOTED OTHERWISE:
  a) RESISTORS IN OHMS
  b) CAPACITORS IN uf

4.) □ INDICATES SPLICE

5.) ( ) INDICATES WIRE COLOR

FIG: 7.A101.2
POWER SUPPLY PC ASSY (A101)
DWG# 304BM01100 SHT 2

REV C

RF BUS -- PC Assy A103

This bus board provides interconnections between the various RF circuit boards (A6 through A13) which are inserted into it. In addition, the bus board houses a select-line decoder (U1) used by the PLL circuits and the FM driver circuit (Q1 through Q4, etc.).

The FM driver is essentially the output stage of the output phase lock loop circuit (A6). It is a class-B amplifier providing sufficient current gain to drive the FM tuning coil of the YIG oscillator. An inductor on the output (L1) is used as a filter to eliminate frequencies above 2 MHz; this prevents high-frequency noise in the PLL circuit from contributing spurious frequency components to the RF output spectrum.

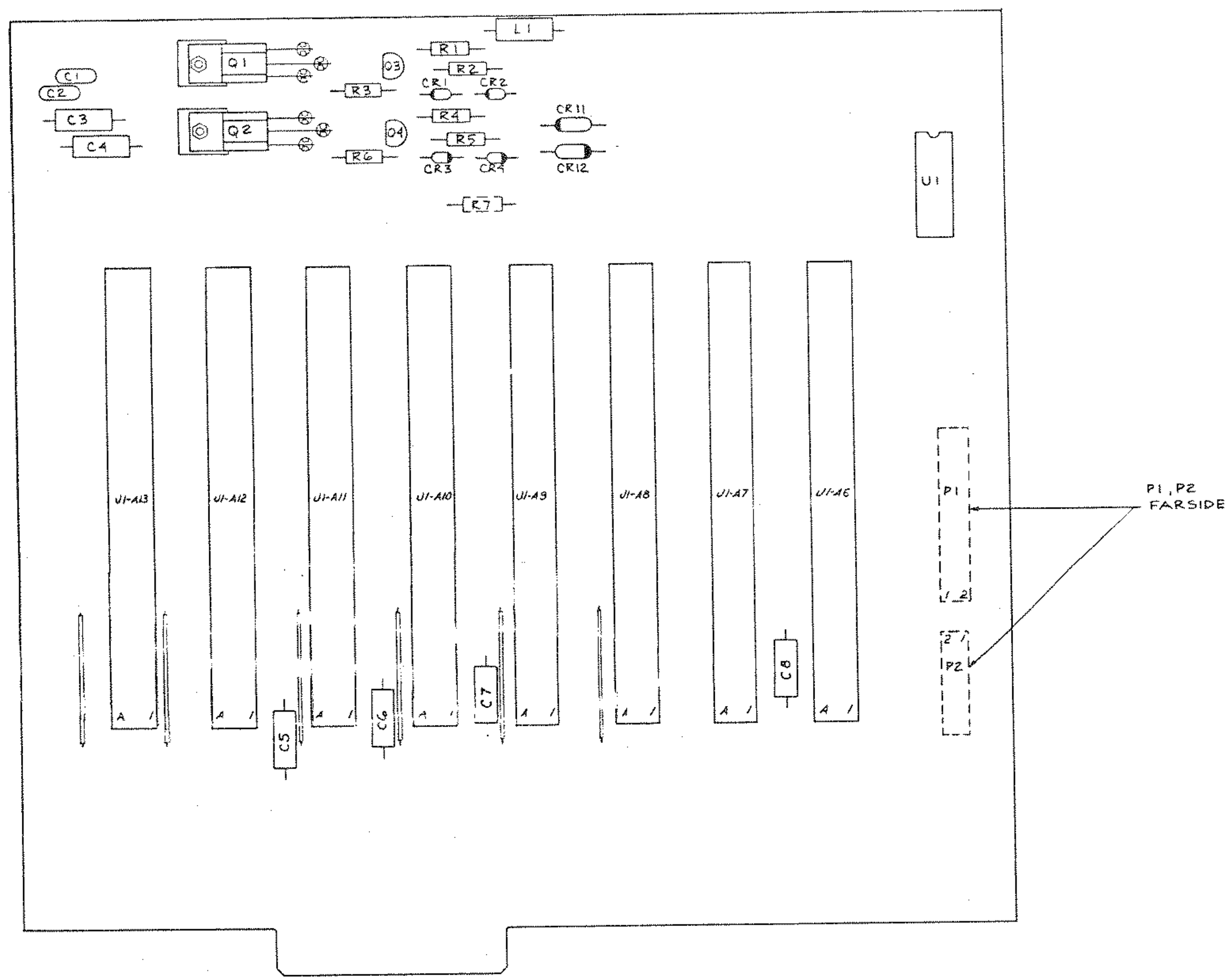
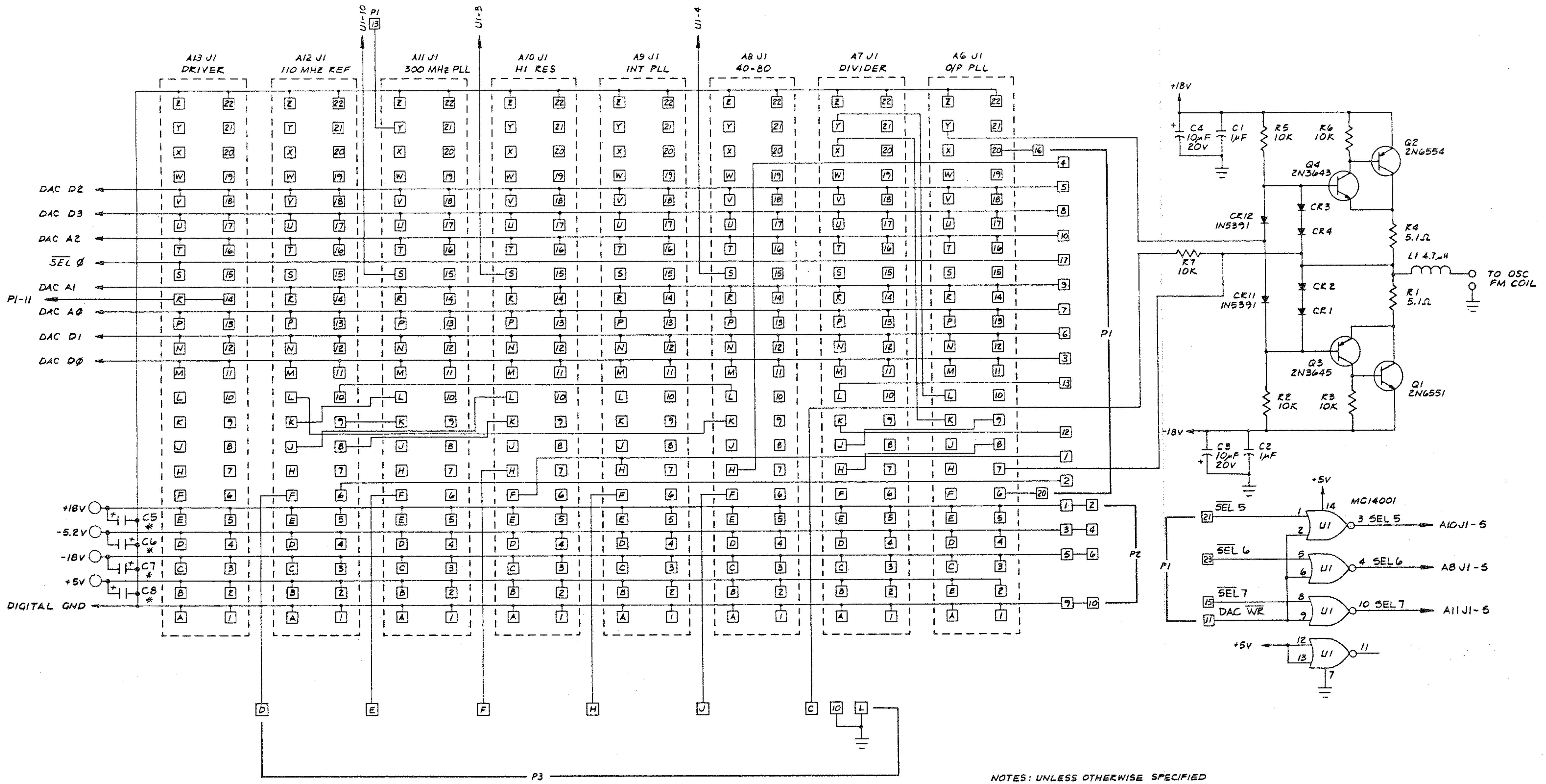


FIG: 7.A103.1
RF BUS PC ASSY (A103)
DWG# 304BM02900 SHT 1

REV E



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN µF.
3. DIODES ARE 1N4148.
4. * C5-8 ARE 10µF 20V

FIG: 7.A103.2
RF BUS PC ASSY (A103)
DWG# 304BM02900 SHT 2

REV E

7-A103-2

300 MHz OSCILLATOR/DRIVER -- Circuit Board A104

This circuit board is encased in an aluminum housing and mounted directly beneath the RF module; it is not normally accessible to service in the field.

The tuning output from the 300 MHz PLL circuit board (A11) is received at J2. A 1 MHz trap (L3, etc.) reduces the reference-frequency component contributed by the PLL's phase detector. The filtered control signal is applied to the voltage controlled oscillator (Q4). A sample of the VCO frequency is fed back to the PLL circuit (see AR2) in order to permit phase lock. The VCO operates over a range of 284 to 319 MHz.

The VCO output frequency is taken at L2; this inductor is implemented as a conductive strip in the printed circuit artwork and is tapped very close to ground in order to reduce the load on the oscillator and insure stability. The VCO frequency is amplified by AR1 and AR7 to meet the input level requirement of the sampling mixer (about 4 Vpp).

The sampling mixer is a miniature hybrid RF circuit which combines a mixer with a step-recovery diode multiplier. The multiplier (to which the VCO frequency from the driver is applied) generates numerous harmonic multiples of its input frequency. The harmonics are used as one input to the RF mixer; the other input (see J4) is a sample of the YIG oscillator frequency, obtained from a coupler in the RF module. Because one mixer input is a harmonic series, the intermediate frequency output includes numerous sum and difference frequency components.

The mixer IF must be filtered and amplified in order to isolate one IF component in the range of 10-80 MHz. The power level of the IF output is very low; AR3, AR4 and AR5 each provide about +19 dB of gain, and the final amplifier stage (AR6) provides about +33 dB of gain. Three low-pass filters (L6, L8 and L11) roll off sharply above 130 MHz to eliminate harmonics of the IF. The amplitude of the sampling mixer IF is highly variable with frequency; in order to obtain a flat frequency response, an AGC circuit is added (U2-7). Diodes CR4 and CR5 are used by the circuit as signal level detectors; a correction voltage is produced and is applied to attenuator diode CR3 in order to maintain a 1 Vpp IF output at J3.

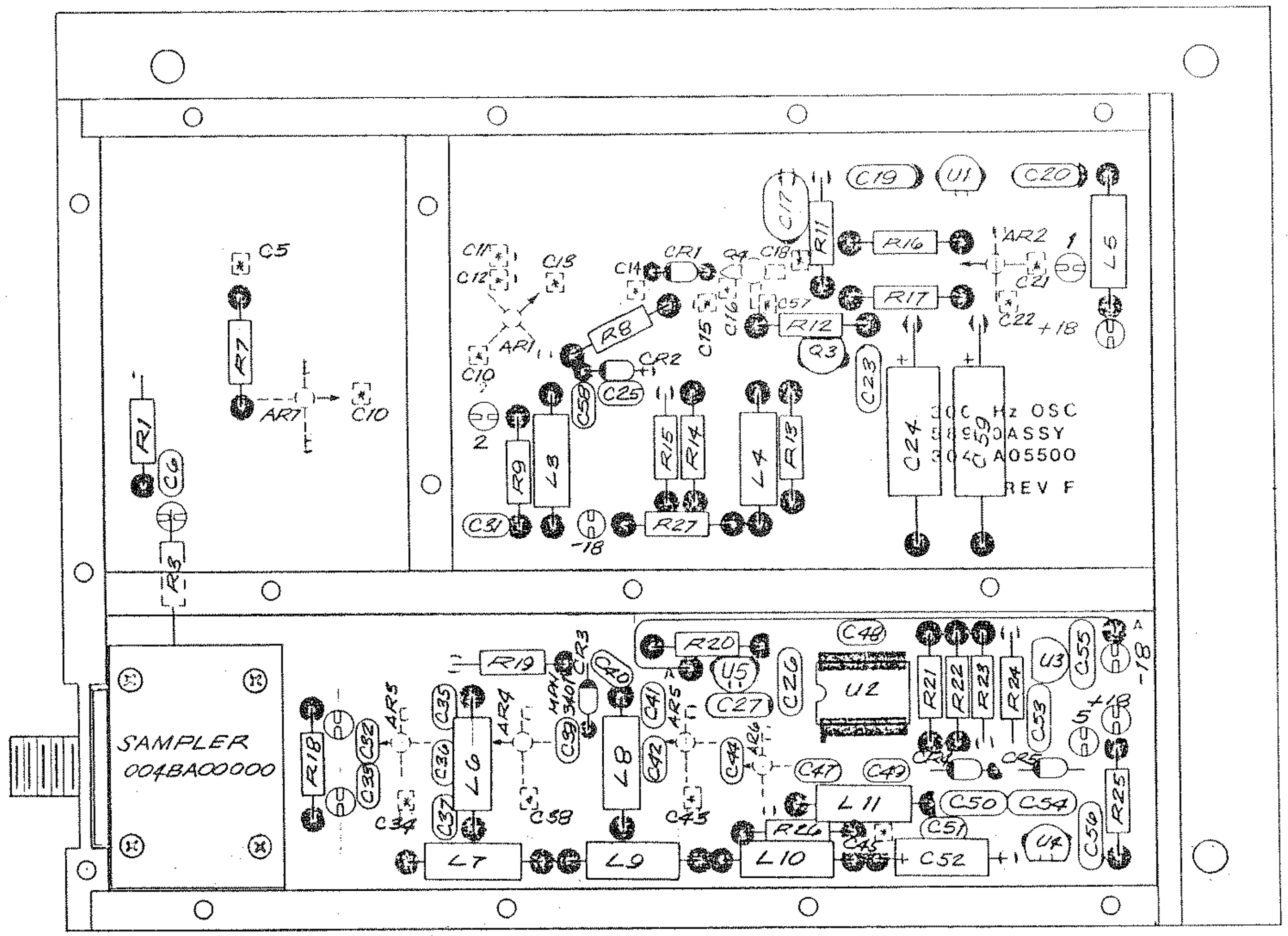


FIG: 7.A104.1
300 MHz OSC PC ASSY (A104)
DWG# 304BM05500 SHT 1

REV G

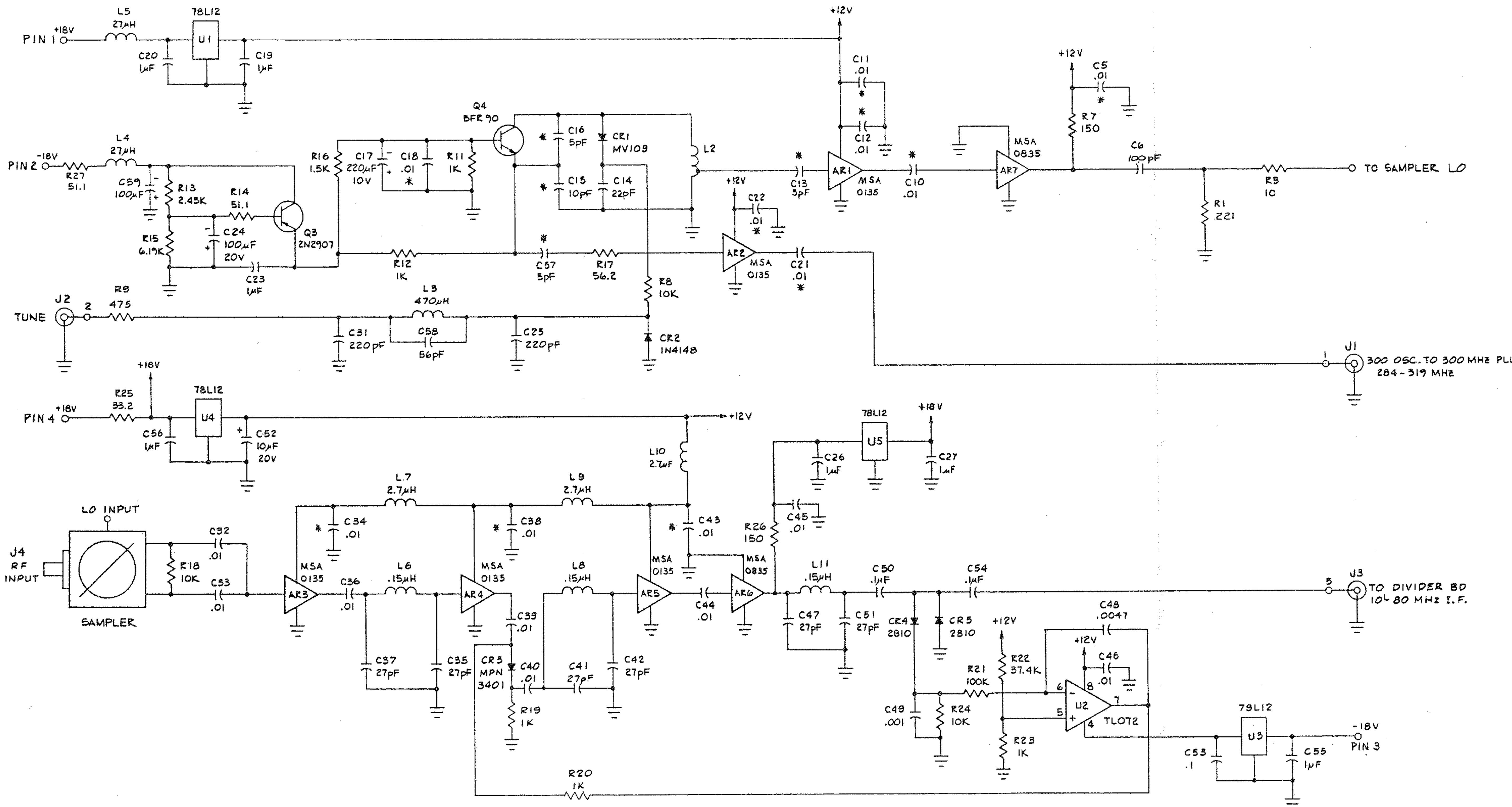


FIG: 7.A104.2
300 MHz OSC PC ASSY (A104)
DWG# 304BM05500 SHT 2

REV G

7-A104-2

Modulation Generator -- PC Assy A105

This portion of the modulation generator board is devoted to AM and FM. Function generator chips U18 and U20 produce the internal AM and FM modulating signals. U18 is used for 1 kHz fixed-rate signals (square wave for AM, triangle wave for FM). U20 generates the variable-rate signals (sine, square, or triangle); the multi-position 'AM/FM RATE' switch selects the timing capacitor for the function generator.

The FET switches in U22 and U23 provide the means of selecting the appropriate modulating signals from the function generators. The gates of U23 are tied to the multi-position 'AM SELECT' switch. (During remote control operation, computer data lines received through U25 are substituted for the switch inputs.) All AM modulating signals are combined at a single AM output (see U32-7). FM signals are similarly directed: the gates of U22 are tied to the multi-position 'FM SELECT' switch and to the computer via U24, and all FM modulating signals are combined at a single FM output (see U32-10).

The AM/FM sync output for variable rates is furnished to the front panel via terminal 8 (see U20-9). The AM modulation output is furnished to the level control circuit via terminal 10. The FM modulation output is furnished to the output phase lock loop circuit via terminal 9.

Multiple-input OR gates U26-1 and U26-13 produce logic outputs to indicate when AM or FM modes are selected; U3-16 and U3-15 use these outputs to shut down the function generators when they are not required (this prevents the generators from contributing a spurious modulation frequency to the RF output when modulation is turned off).

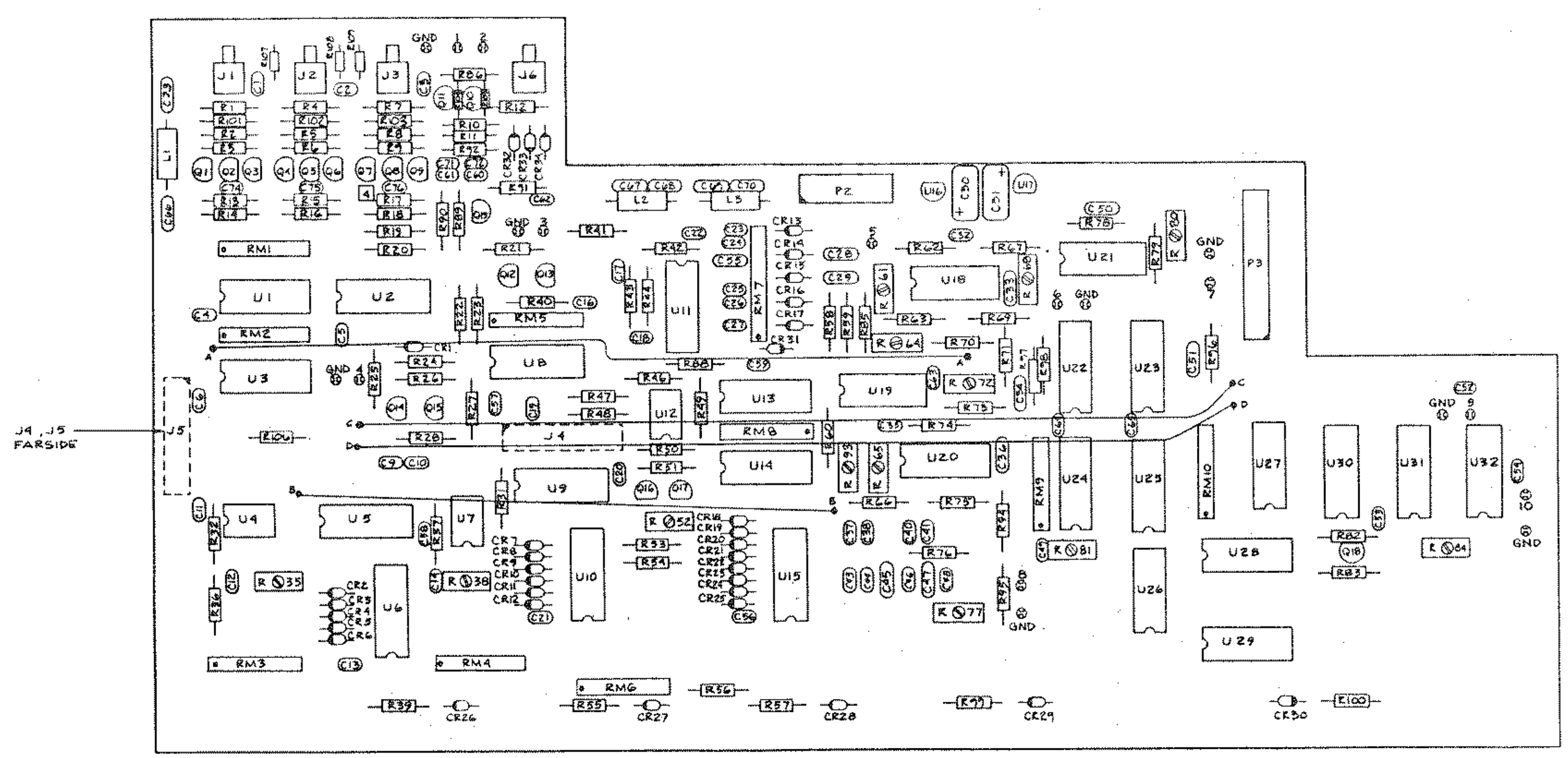


FIG: 7.A105.1
MODULATION GENERATOR PC ASSY (A105)
DWG# 304BM03200 SHT 1

REV I

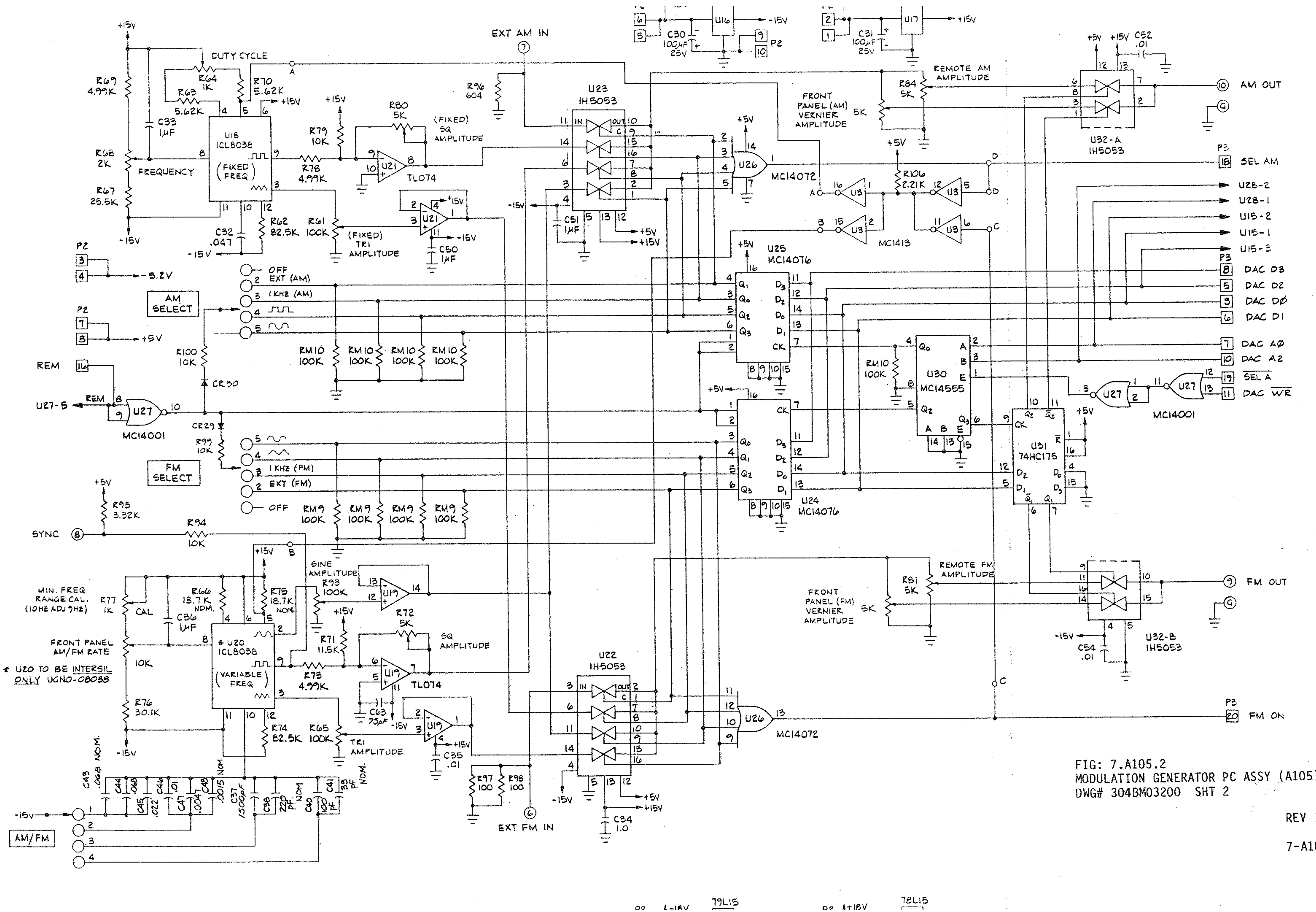


FIG: 7.A105.2
MODULATION GENERATOR PC ASSY (A105)
DWG# 304BM03200 SHT 2

REV I

7-A105-2

Modulation Generator -- PC Assy A105

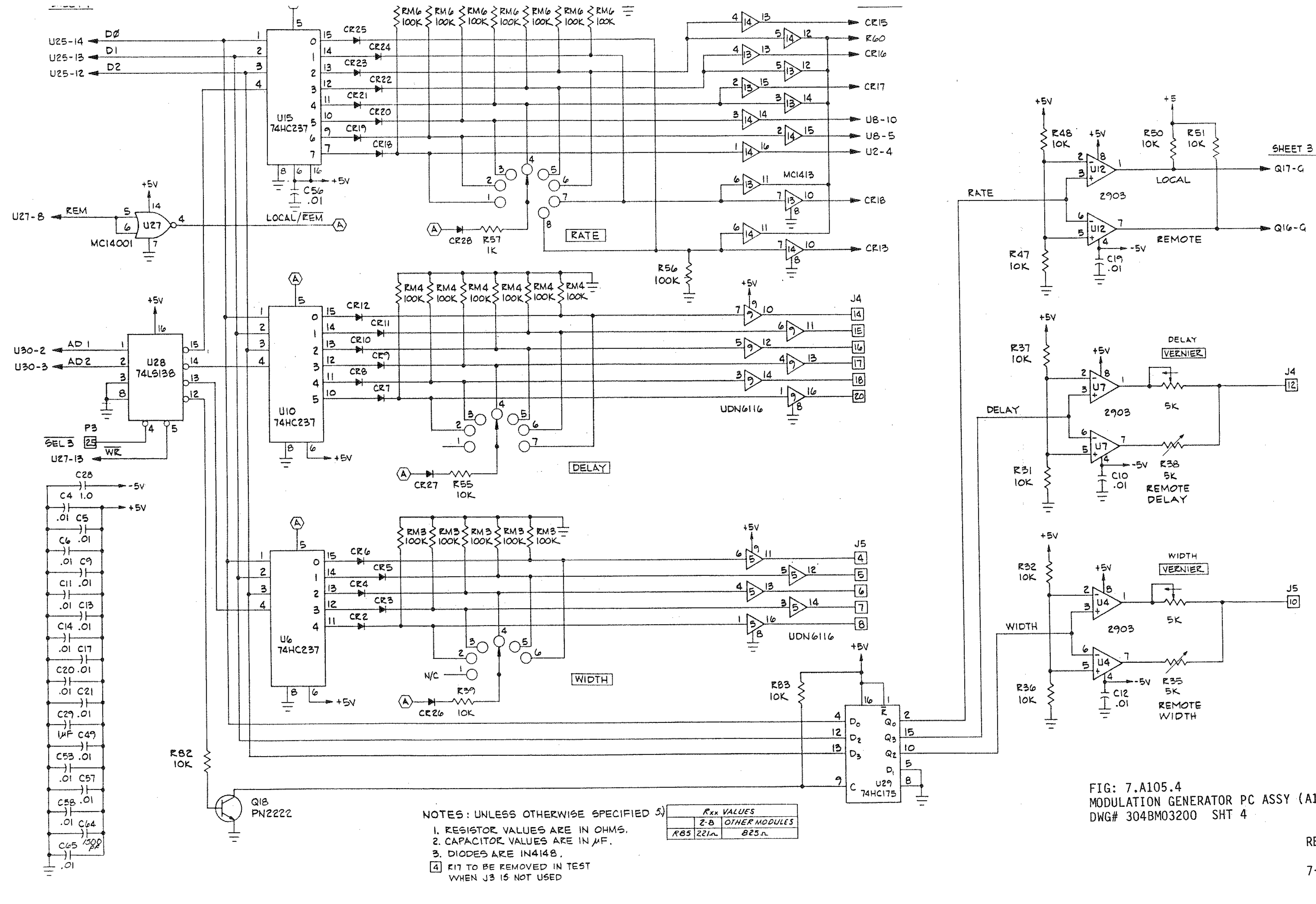
This portion of the modulation generator board includes circuits for selecting the various pulse modulation modes. The multi-position 'RATE', 'DELAY' and 'WIDTH' switches on the front panel are tied, at their common terminals, to the LOCAL/REMOTE-NOT line at U27-4, so that they are enabled only during local operation. During remote control operation, computer data lines are substituted (via U15, U10, and U6) for the switch outputs. The rate switch outputs are buffered by U13 and U14 and applied to the feedback loops of the pulse generator circuit (sheet 6).

The outputs of the 'DELAY' and 'WIDTH' switches are buffered by U9 and U5 and applied to the Delay/Width Generator PC board (A106).

U12-1 and U12-7 are used in a comparator configuration in order to distinguish local and remote pulse rate modes; the outputs drive the gates of the FETs (see sheet 6) which activate either the front panel rate vernier (local control) or the preset rate pot (remote control). Similarly, U7-1 and U7-7 distinguish local and remote pulse delay modes, activating either the front panel delay vernier (local control) or the preset delay pot (remote control). U4-1 and U4-7 distinguish local and remote pulse width control, activiating either the front panel width vernier (local control) or the preset width vernier (remote control).

FIG: 7.A105.3
MODULATION GENERATOR PC ASSY (A105)
DWG# 304BM03200 SHT 3

REV I



NOTES: UNLESS OTHERWISE SPECIFIED 5)

1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN μF.
3. DIODES ARE IN4148.

[4] E17 TO BE REMOVED IN TEST WHEN J3 IS NOT USED

	R_{xx} VALUES	
	2-8	OTHER MODULES
R85	221Ω	825Ω

FIG: 7.A105.4
MODULATION GENERATOR PC ASSY (A105)
DWG# 304BM03200 SHT 4

REV I

7-A105-4

Modulation Generator -- PC Assy A105

U11-9 functions as an oscillator in order to produce modulation pulses. Multiple feedback loops provide a choice of rate ranges. FETs Q16 and Q17 are used to activate the front panel rate vernier (local control) or the preset rate vernier (remote control). The oscillator's output is supplied (via U11-14, Q12, and Q13) to the front panel pulse sync output (the square wave produced by the oscillator is converted to pulses of approximately 50 nanosecond width by the timing circuit on the inputs of U11-14). The oscillator's square wave output is supplied (via U11-2) to the delay/width generator (A106). The oscillator output, conditioned for delay and width, is returned to this circuit board at J5-1.

Output drive circuits are needed to condition the modulation pulses so that they meet the requirements of other circuits. The RF module requires separate inputs for the 'LO' (J1), 'MID' (J2), and 'HI' (J3) frequency bands (in some instruments, depending on frequency range, the 'HI' band is not used). The logic gates of U1 combine the modulation signal with the computer's LO, MID, and HI control lines in order to direct the signal to the appropriate modulator in the RF module. The transistor circuits on the modulation outputs are designed to permit very rapid switching in accordance with the risetime specifications of the instrument. During each modulation "off" pulse, the 'TERM' output (J6) activates a 50 ohm termination circuit within the RF module in order to insure that power reflected from the opened RF path does not interfere with the operation of the level control circuit. The modulation signal is also furnished, via Q10/Q11, to the front panel 'VIDEO OUT' connector.

The RF coupler circuit located within the RF module is divided into two filter lines for harmonic suppression; U19-8 is used by the computer to activate the desired filter path.

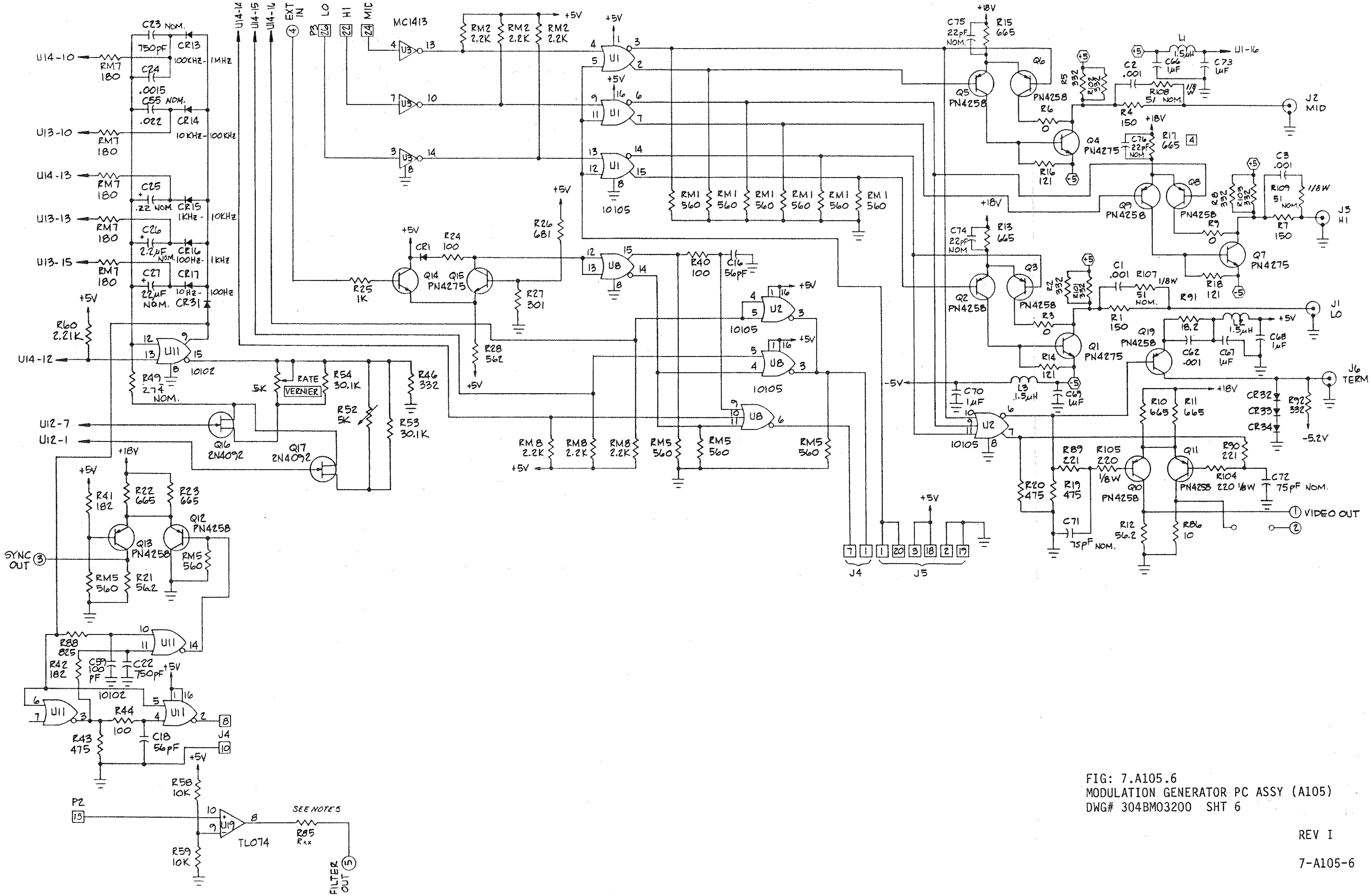


FIG: 7.A105.6
MODULATION GENERATOR PC ASSY (A105)
DWG# 304BM03200 SHT 6

REV I

7-A105-6

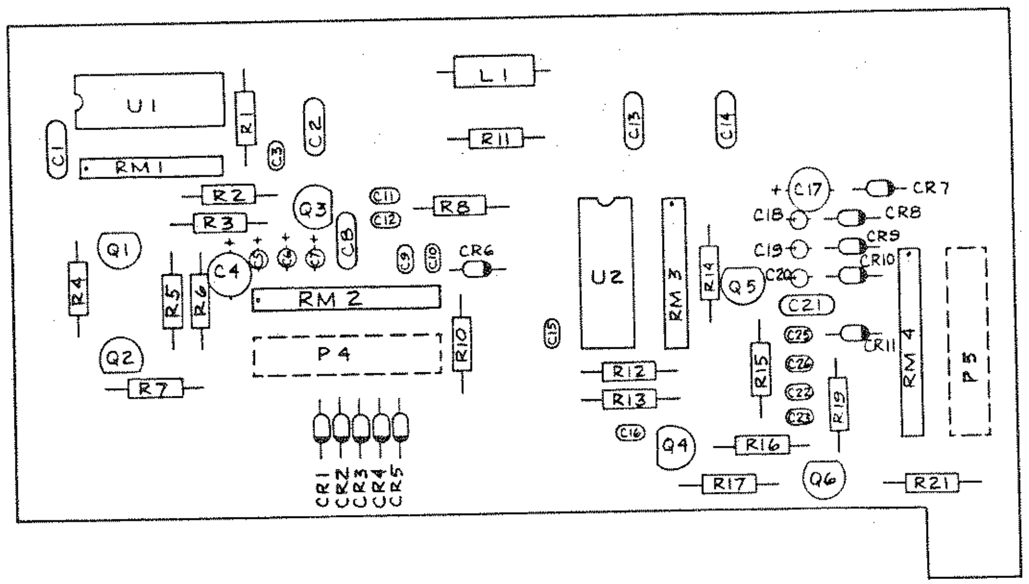


FIG: 7.A106.1
DELAY/WIDTH GENERATOR PC ASSY (A106)
DWG# 304BM04400 SHT 1

REV C

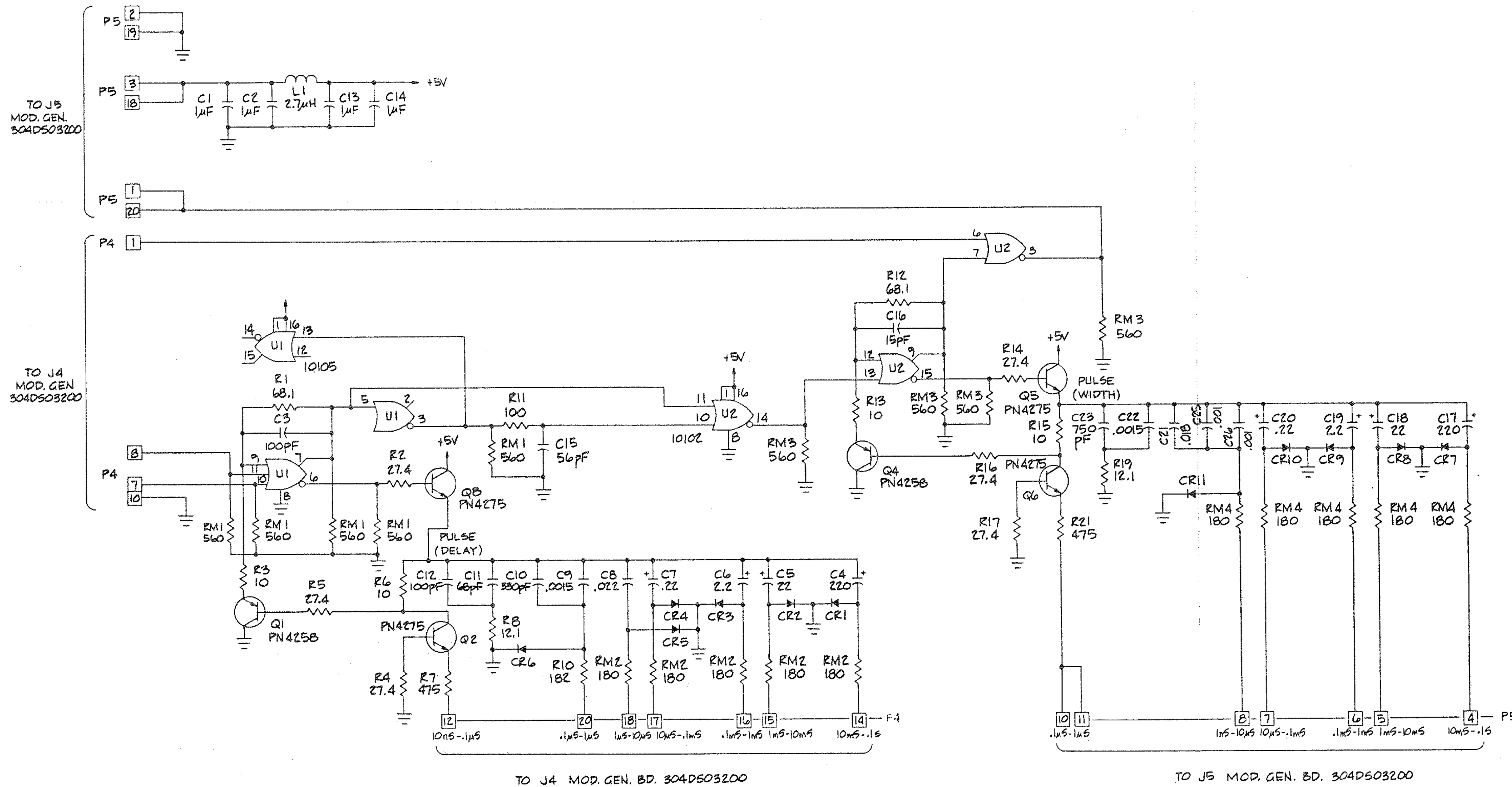
Delay/Width Generator -- PC Assy A106

The delay and width generators are two similar circuits designed to retard a pulse input. Both feature selectable time constants for different ranges.

The delay generator is centered on U1-6; the three inputs to this logic gate are the internal modulation input and the external trigger modulation input from the modulation generator PC board (A105) together with a feedback input (U1-9). Q8 is switched by the output at U1-6; an integrator circuit on the emitter produces a variable delay. Delay ranges are selected by activating particular timing capacitors. C11 and C12 are always active, and by themselves represent the 10 ns - .1 us range. Other capacitors are activated by turning on the shunt diodes connected to them. Q2, the current source for Q8, is always active and is tied to the variable delay current source output from A105. Q1 is switched at the end of the timing period, toggling the output of the gate at U1-6 and U1-7. The circuit consisting of U1-3, U2-14 etc. is a narrow pulse generator triggered by the trailing edge of variable-width pulse produced at U1-7. The narrow pulse is furnished to the width generator, becoming the leading edge of the secondary variable-width pulse produced there.

The width generator is very similar to the pulse generator. U2-15 is triggered by the narrow pulses from the delay generator as well as by a feedback input (U2-12). The various capacitors of the integrator circuit are placed between the emitter of Q5 and ground, with series diodes used to activate the appropriate capacitors. Q6 is the current source for Q5 and is tied to the variable width current source output from A105. C23 and C22 are always active and by themselves represent the .1 us - 1 us range. Other capacitors are activated as needed. Q4 switches at the end of the timing period, causing the outputs at U2-9 and U2-15 to toggle. The beginning of the pulse output to U2-7 is triggered by the beginning of the delayed pulse from the delay generator circuit (U2-14); the end of the pulse output is triggered by the end of the timing period which occurs when Q4 switches.

The delayed and width-adjusted signal is returned to A105 via U2-3; the other input to this gate is the external pulse mode input. In the external pulse mode, the delay and width generators are bypassed, and the external signal simply propagates unchanged through U2-3.



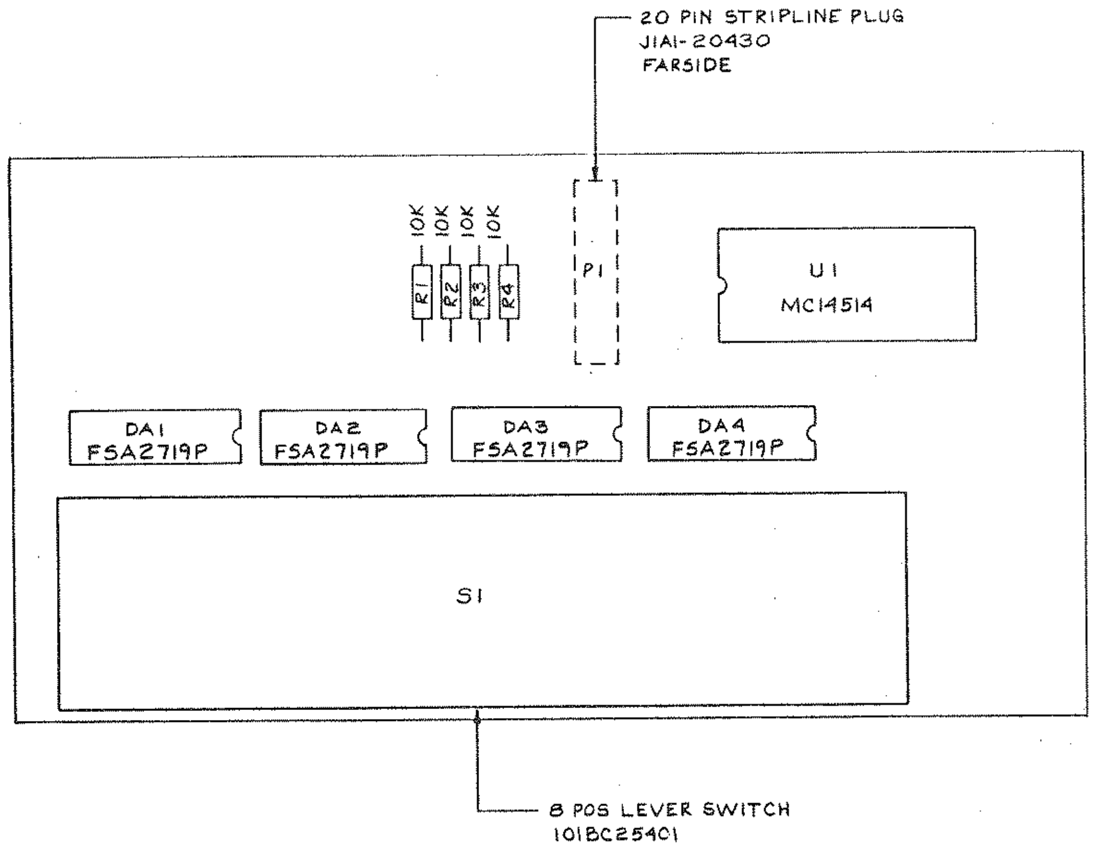
NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN µF.
3. DIODES ARE IN4148.

FIG: 7.A106.2
DELAY/WIDTH GENERATOR PC ASSY (A106)
DWG# 304BM04400 SHT 2

REV C

8-POSITION LEVER SWITCH -- PC Board A107

U1 is a 4-to-16 line decoder; it is used by the computer to strobe the front panel lever switches. The 4-bit strobe number is received (see P1-7,8,9,10) from the computer (the A1 PC board, J3) and is decoded into strobe lines. Eight of these lines are applied to S1, the 8-position lever switch on this board (it is used for frequency setting). Five other strobe lines produced by U1 are applied (see P1-13,14,15,16,18) to the 5-position lever switch on PC board A109. The position of each switch is expressed as a four-bit number on the output of S1 and is returned to the computer (see P1-3,4,5,6).



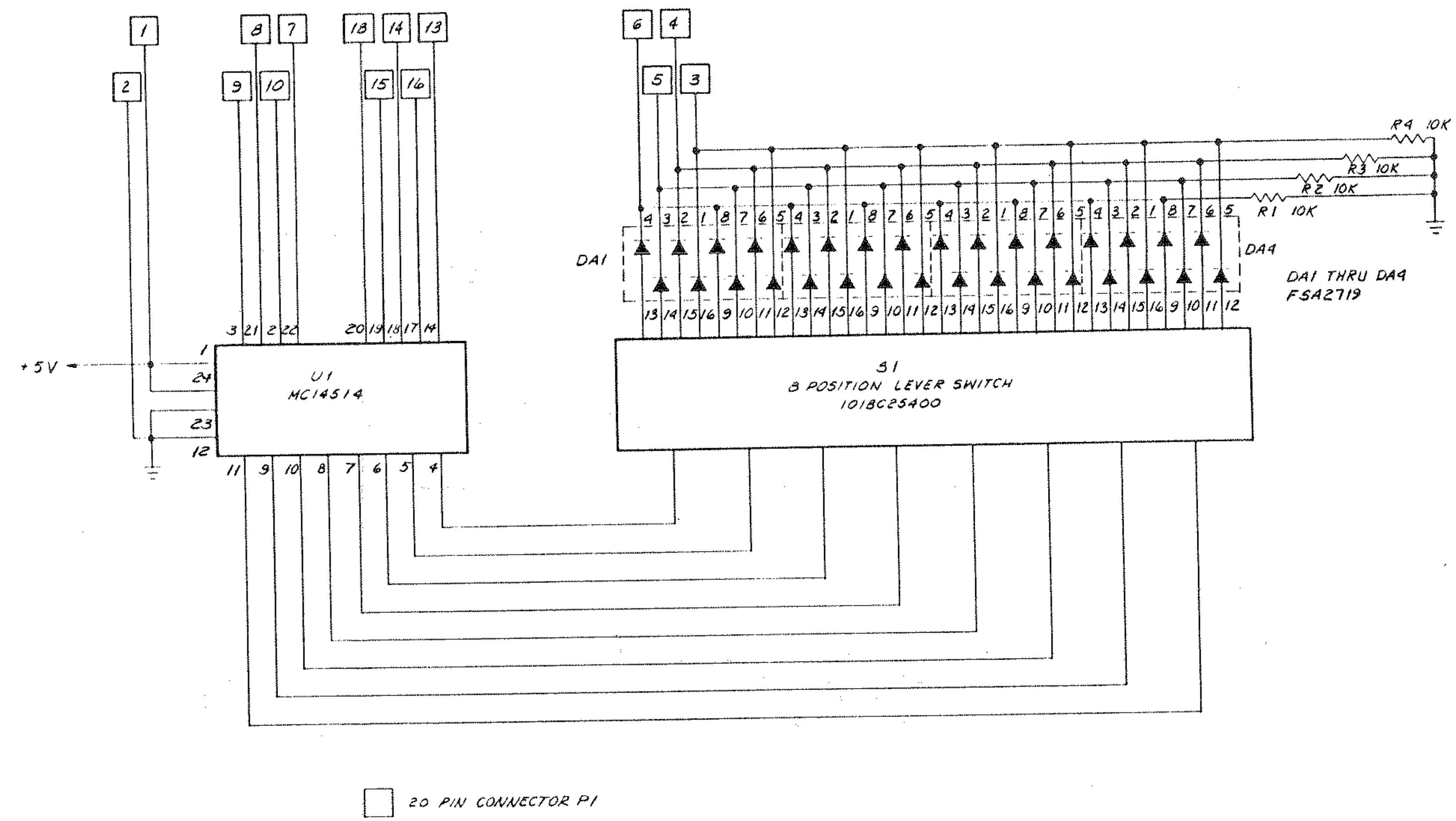
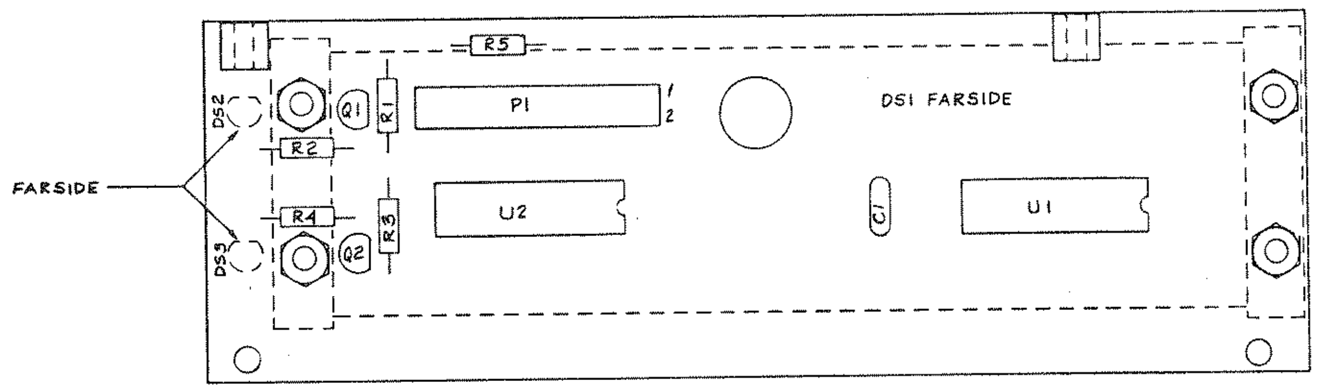


FIG: 7.A107.1
8 POSITION LEVER SWITCH (A107)
DWG# 304BM02102 SHT 1

REV A



FREQUENCY DISPLAY -- PC Board A108

This board houses the frequency display and its drivers. DS-1 is an 8-digit fluorescent display, with separate inputs for segment and digit select lines. The select lines are driven by U1 and U2, which in turn are driven by the computer (see J1 of PC board A1). In addition, the 'LOCK' and 'REMOTE' indicators, driven by inputs from J3 of PC board A4, are located on this board.

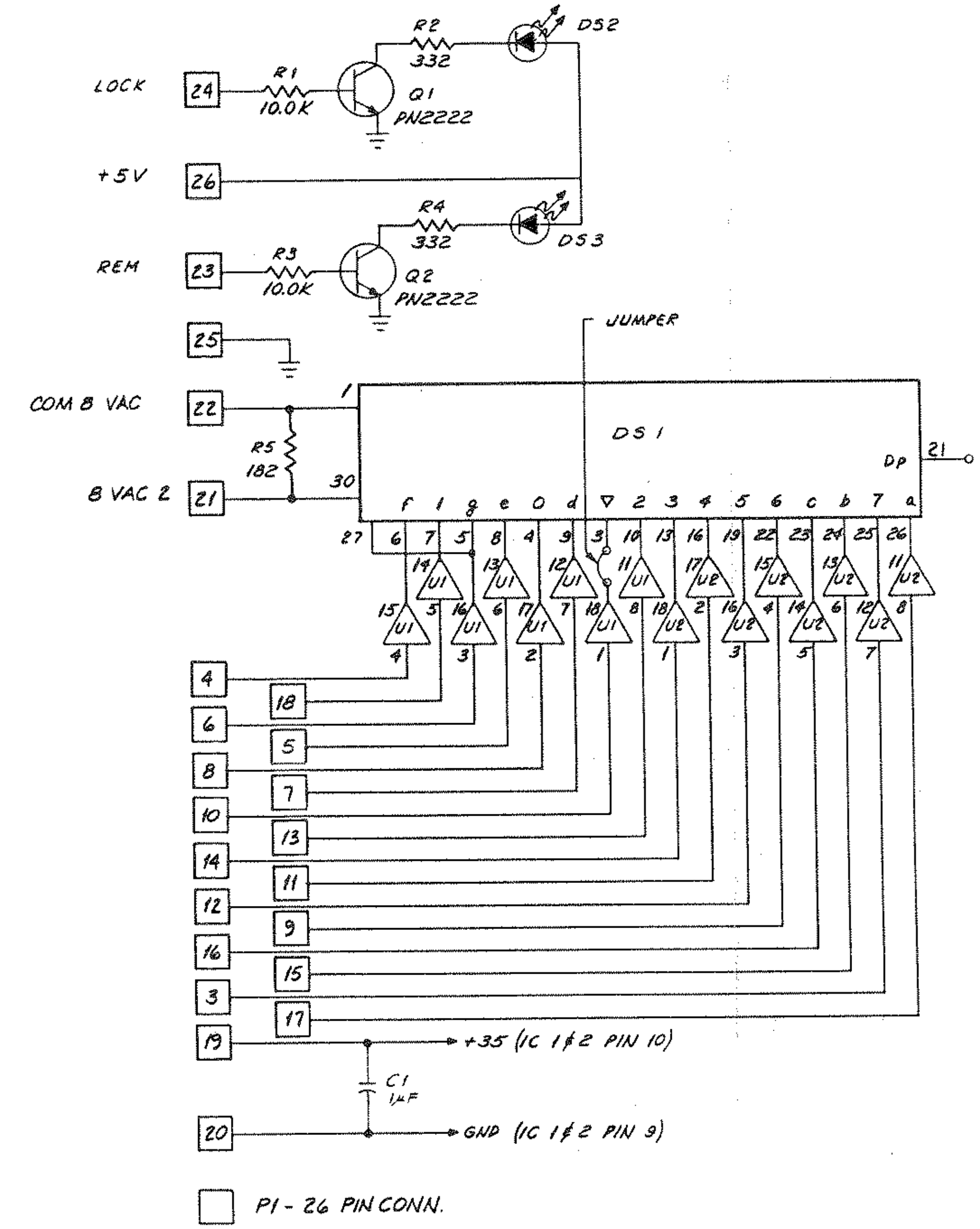
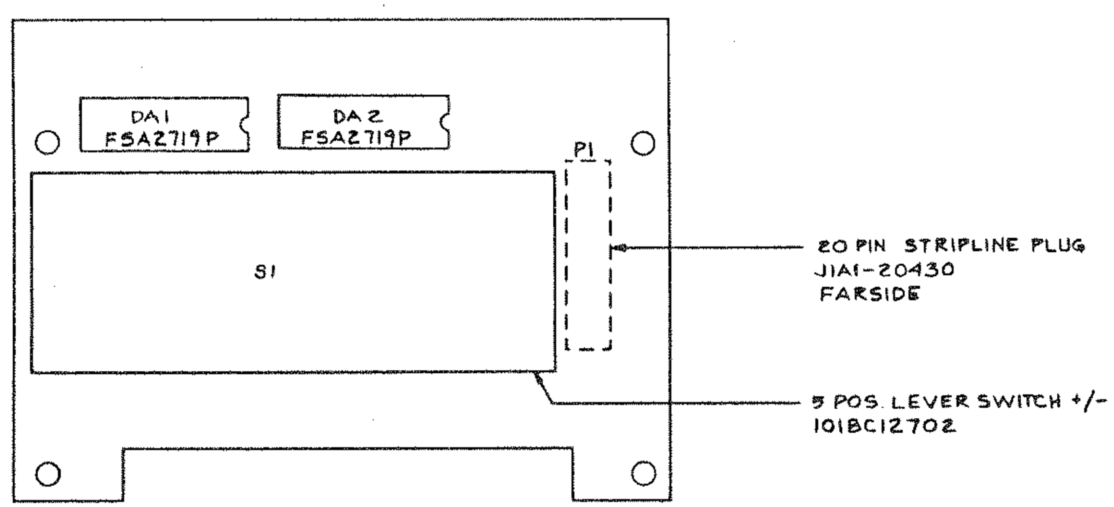


FIG: 7.A108.1
FREQUENCY DISPLAY PC ASSY (A108)
DWG# 304BM02600 SHT 1

REV C

5-POSITION LEVER SWITCH -- PC Board A109

The 5-position lever switch is used to select RF level. The five strobe lines are received from PC board A107. The position of each switch is expressed as a four-bit number which is returned to the computer (see P1-3,4,5,6).



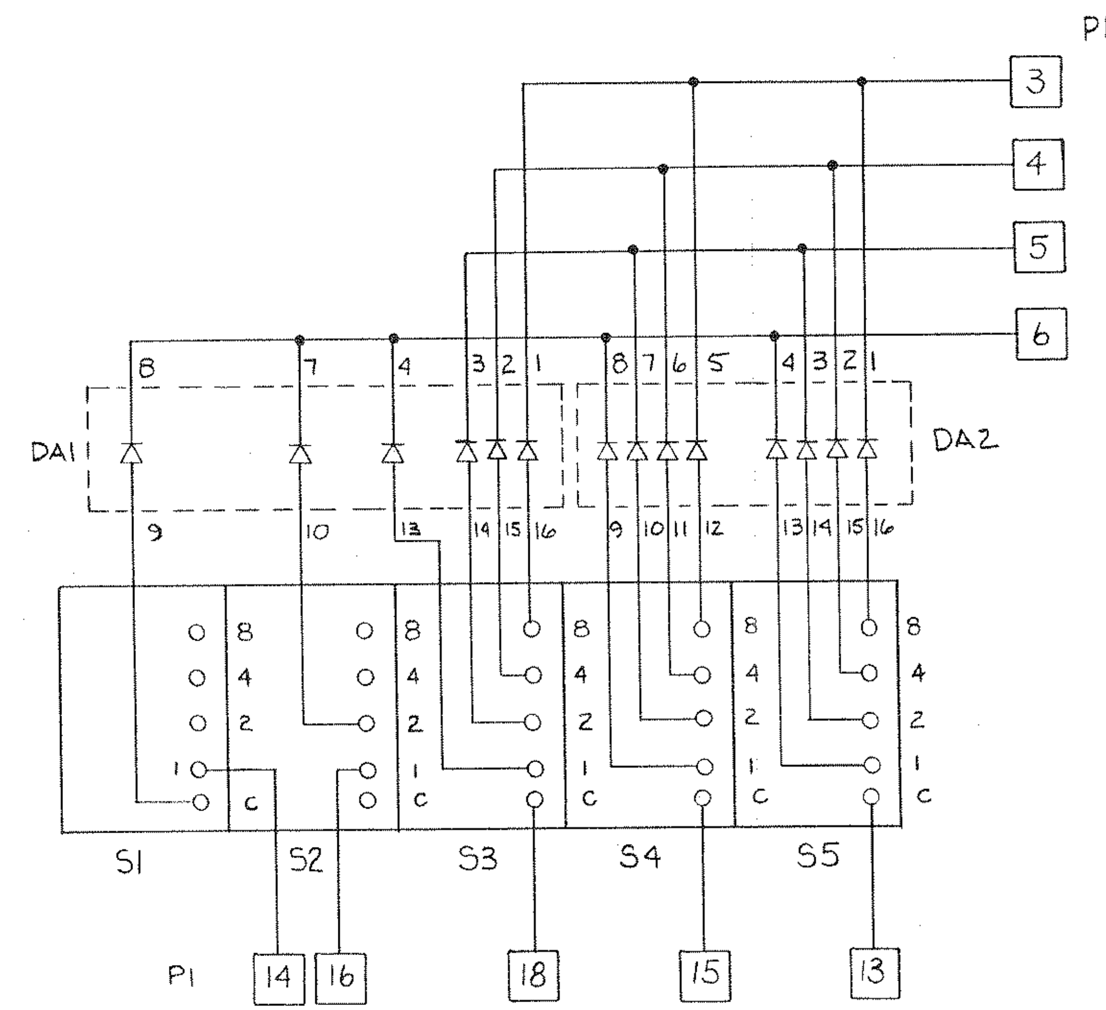
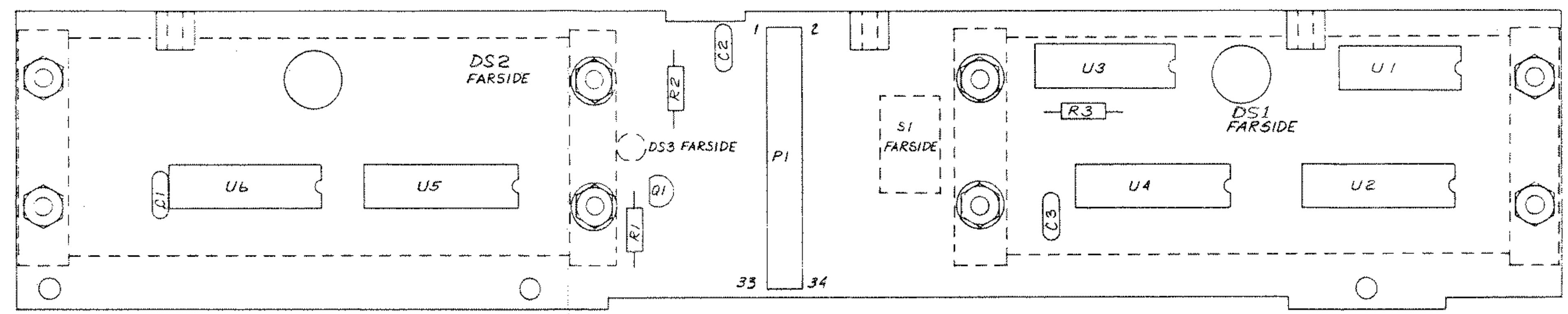


FIG: 7.A109.1
5-POSITION LEVER SWITCH (A109)
DWG# 304BM02500 SHT 1

REV B

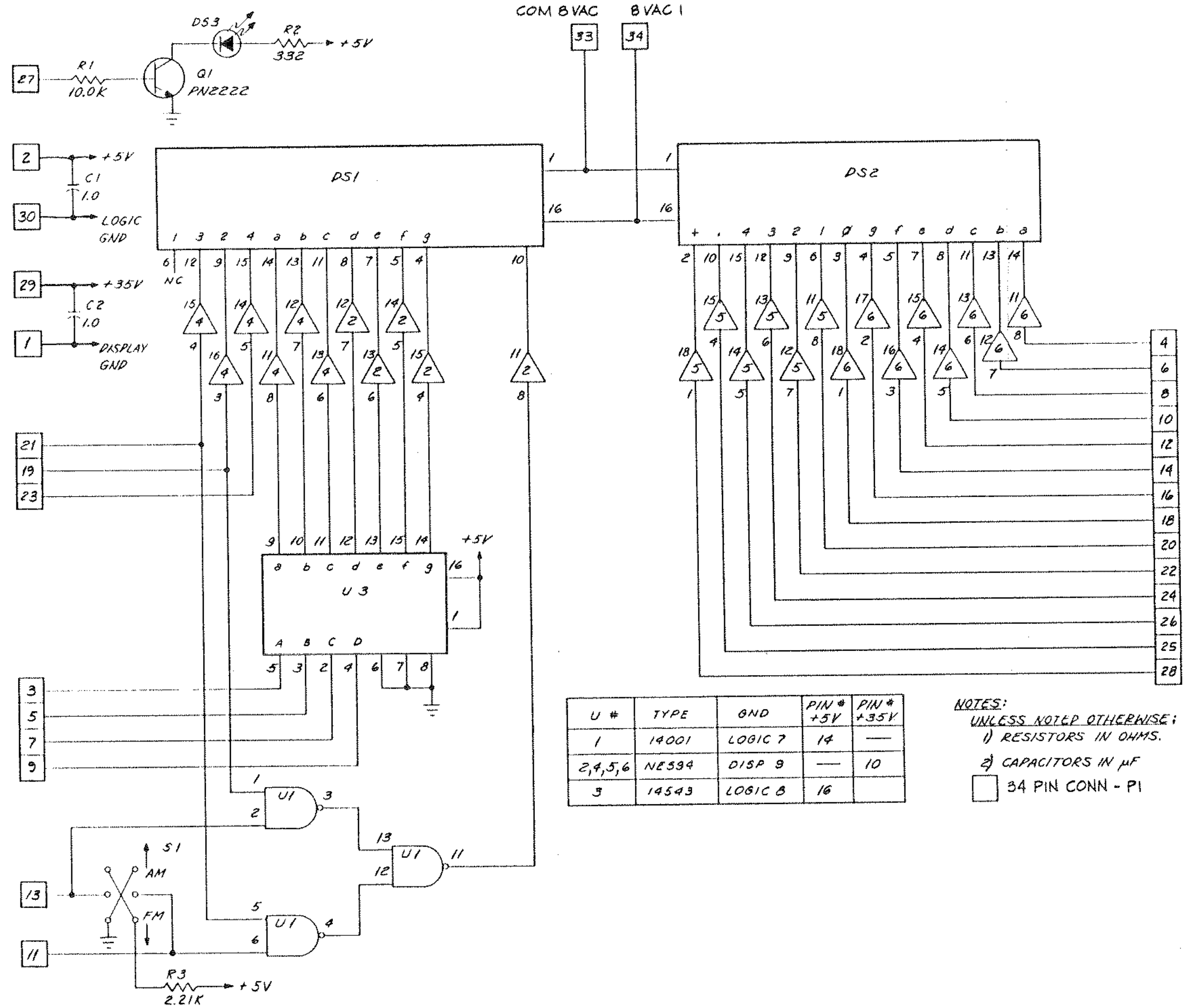


MOD/POWER DISPLAY -- PC Board A110

This board houses the fluorescent displays used by the modulation and power meters. DS2 is the power display; control lines from the computer (see J1 of PC board A1) select the appropriate digits and segments. These control inputs are buffered by display drivers U5 and U6. DS1 is the modulation display. The inputs to its display drivers come from the level control circuit (see J1 of PC board A5); the segment select lines are decoded by U3 from a BCD input produced by the level control circuit. The inputs from the modulation mode switch (S1) are decoded by U1 to determine placement of the decimal point. DS3, the 'LEVELED' indicator, is controlled by an input from the computer (see J3 of PC board A4).

FIG: 7.A110.1
MOD/POWER DISPLAY PC ASSY (A110)
DWG# 304BM02300 SHT 1

REV D

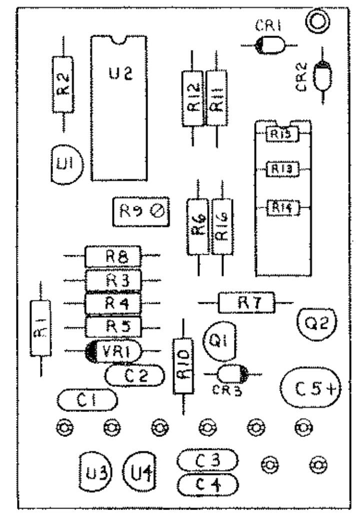


U #	TYPE	GND	PIN # +5V	PIN # +35V
1	14001	LOGIC 7	14	—
2,4,5,6	NE594	DISP 9	—	10
3	14543	LOGIC 8	16	

NOTES:
UNLESS NOTED OTHERWISE:
1) RESISTORS IN OHMS.
2) CAPACITORS IN µF
☐ 34 PIN CONN - P1

FIG: 7.A110.2
MOD/POWER DISPLAY PC ASSY (A110)
DWG# 304BM02300 SHT 2

REV D



TEMPERATURE COMPENSATION CIRCUIT -- PC Board A112

This circuit provides correction signals in response to internal temperature changes in the instrument. U1 is a temperature sensor, producing an output voltage proportional to temperature. The sensor voltage, amplified by U2-1, is furnished to two circuits. The circuit consisting of U2, Q1 and Q2 controls the speed of the instrument's cooling fan, switching to high speed when the sensor voltage indicates a temperature in excess of +40°C. The circuit consisting of U2-14, CR1, CR2, etc., provides a correction signal to the level control circuit (PC board A5). This correction signal is required because the sensitivity of the level detector changes with temperature, and this would cause a level error if not compensated. Each detector has a unique temperature response. During production testing, R13, R14, and R15 are selected and the 'ZERO' pot (R9) is adjusted to match the response curve of the instrument's particular detector. THESE VALUES SHOULD NOT BE CHANGED.

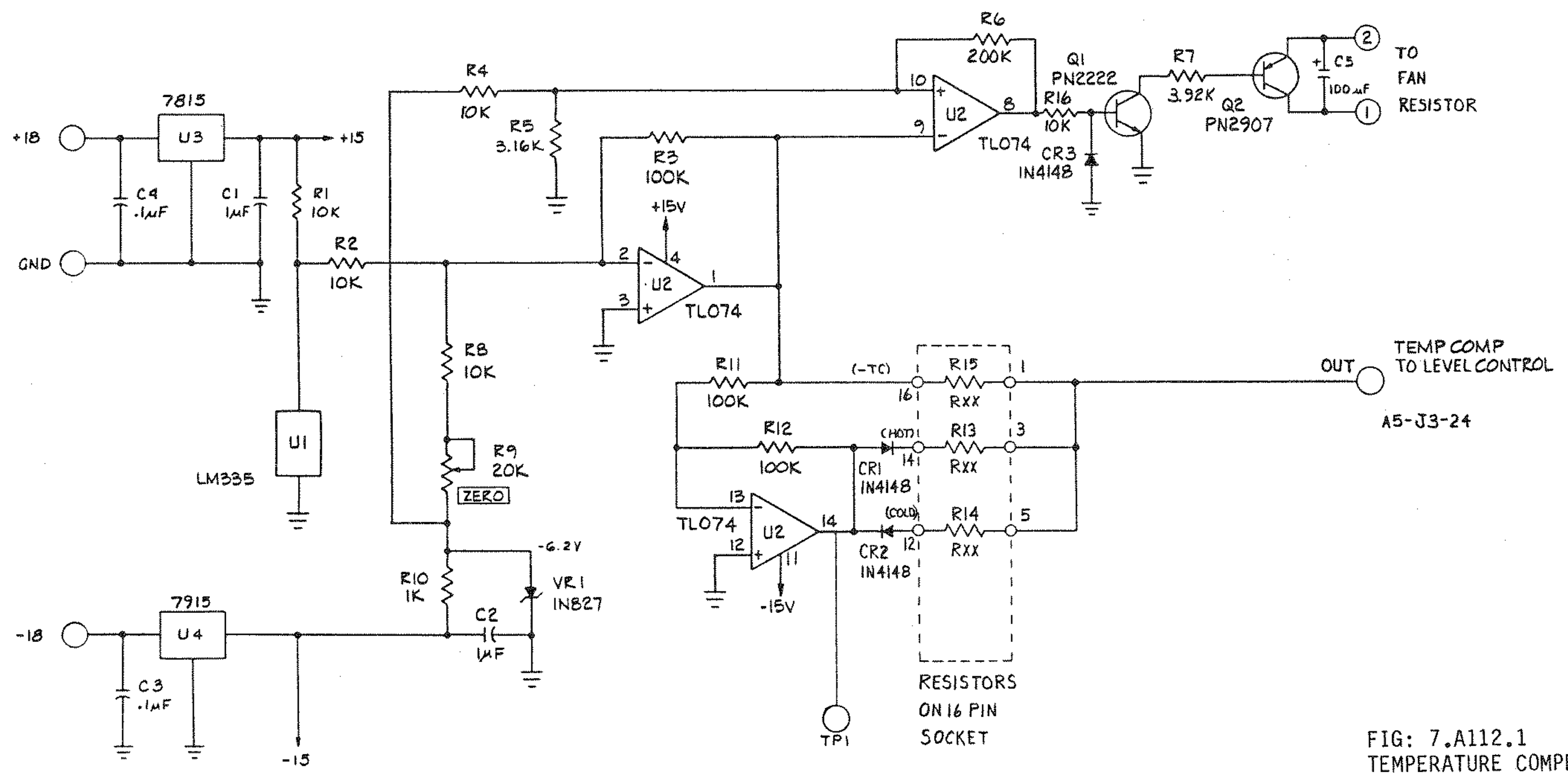


FIG: 7.A112.1
TEMPERATURE COMPENSATION PC (A112)
DWG# 304BM04600 SHT 1

REV E

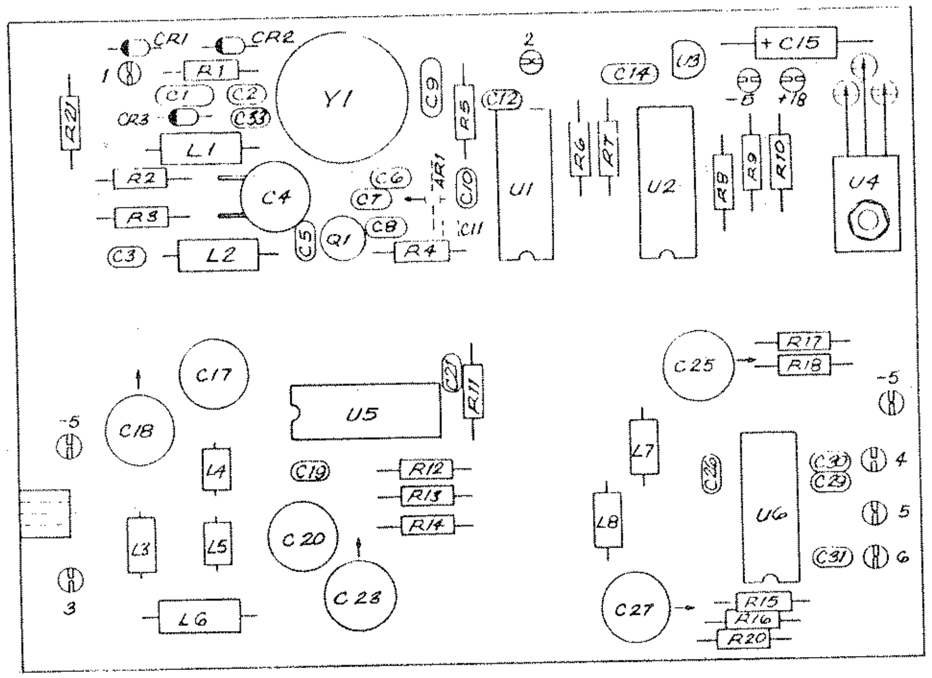


FIG: 7.A113.1
OSCILLATOR/MULTIPLIER PC ASSY (A113)
DWG# 304BM05700 SHT 1

REV B

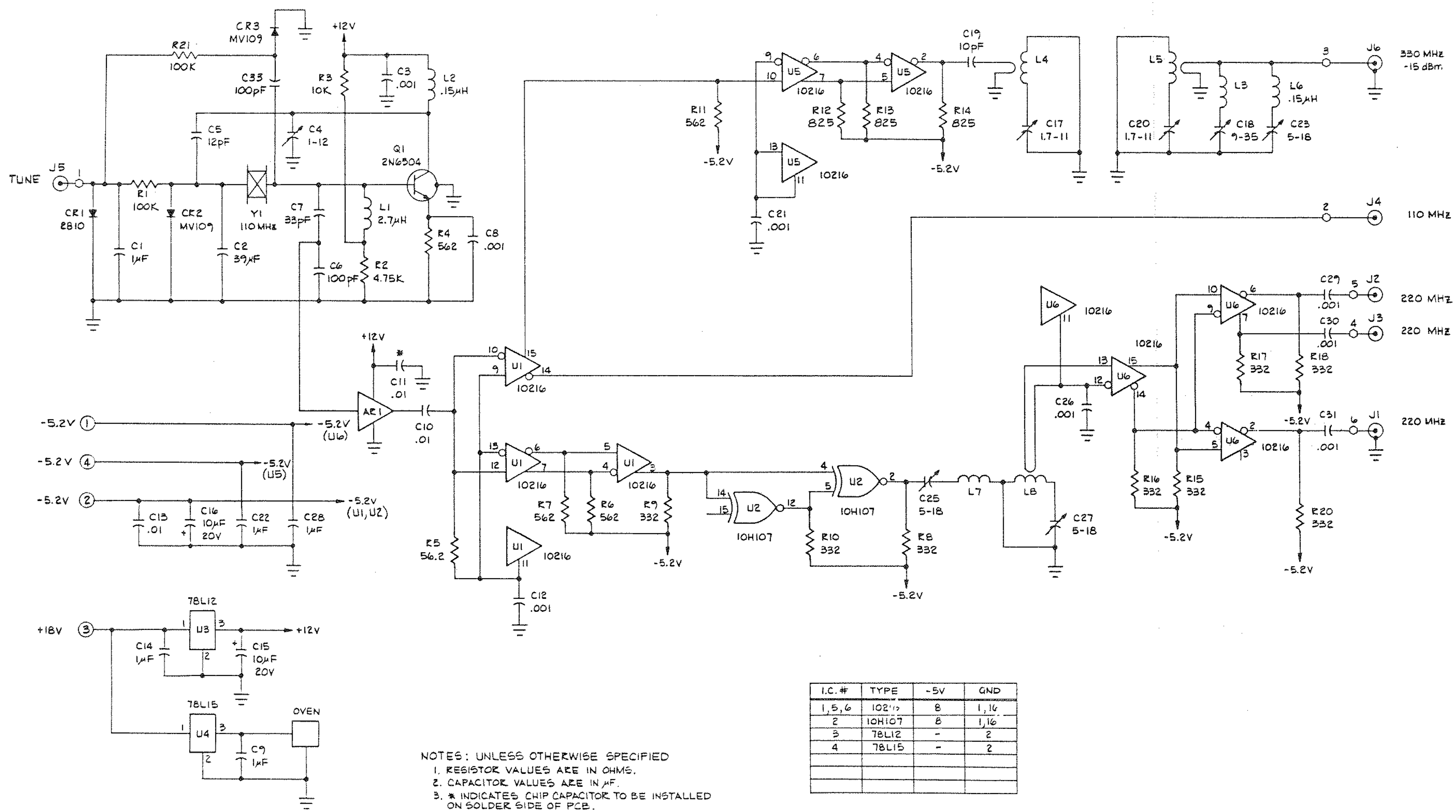
110 MHz OSCILLATOR/MULTIPLIER -- PC Assy A113

This circuit is the source for the 220 MHz and 330 MHz reference signals used by various phase lock loop circuits in the synthesizer.

The voltage controlled crystal oscillator (Q1, etc.) uses a quartz crystal resonator (Y1); a tuned circuit (L2, etc.) restricts the crystal to an oscillation mode at 110 MHz. The VCXO is fine tuned by a voltage input (J5) from the 110 MHz PLL circuit (A12). Its output signal is amplified by AR1 and buffered by line receiver U1. The buffered 110 MHz signal is fed back to the PLL (A12) at J4, and is also furnished to the frequency doubler and frequency tripler circuits.

Two exclusive-NOR gates (U2) form a frequency doubler (the output toggles on both the leading and trailing edges of the input). The resulting 220 MHz frequency is inductively coupled to a buffer stage (U6) through a band-pass filter (L7/L8, etc.). Two trimmer caps (C25 and C27) provide peaking adjustment. The output buffers (U6) provide samples of this 220 MHz signal to other circuits in the synthesizer. J1 provides a 220 MHz output to the 40-80 MHz PLL (A8), or to the High Resolution PLL (A10) for instruments with option 03. J3 provides a 220 MHz output to the Intermediate PLL (A9) for instruments with option 03. J2 is an auxiliary 220 MHz output and is not normally used.

The frequency tripler takes advantage of the large third-harmonic component present in any square wave. The line receivers of U5 produce a square 110 MHz signal which is inductively coupled through a band-pass circuit (L4/L5, etc.). C17, and C20 provide peaking adjustment. Two band-stop filters on the output (L3, L6 etc.) remove the fundamental and the second harmonic of the VCXO frequency (C18 and C23 permit fine tuning of these filters). The 330 MHz output is not buffered, because the circuit to which it is furnished (the 300 MHz PLL, A11) does not require a high power input.



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN µF.
3. * INDICATES CHIP CAPACITOR TO BE INSTALLED ON SOLDER SIDE OF PCB.

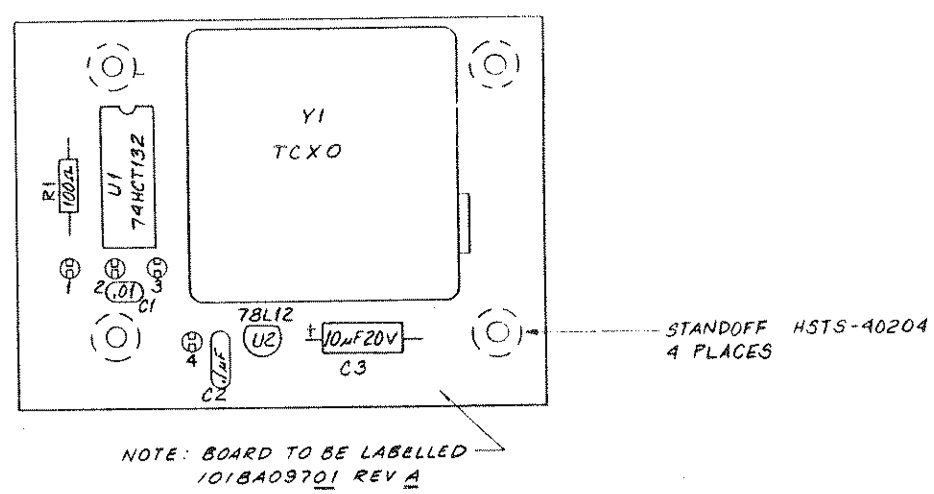
○ INTERNAL PINS
◯ EXTERNAL PINS

I.C. #	TYPE	-5V	GND
1,5,6	102½	8	1,16
2	10H107	8	1,16
3	78L12	-	2
4	78L15	-	2

FIG: 7.A113.2
OSCILLATOR/MULTIPLIER PC ASSY (A113)
DWG# 304BM05700 SHT 2

REV B

7-A113-2



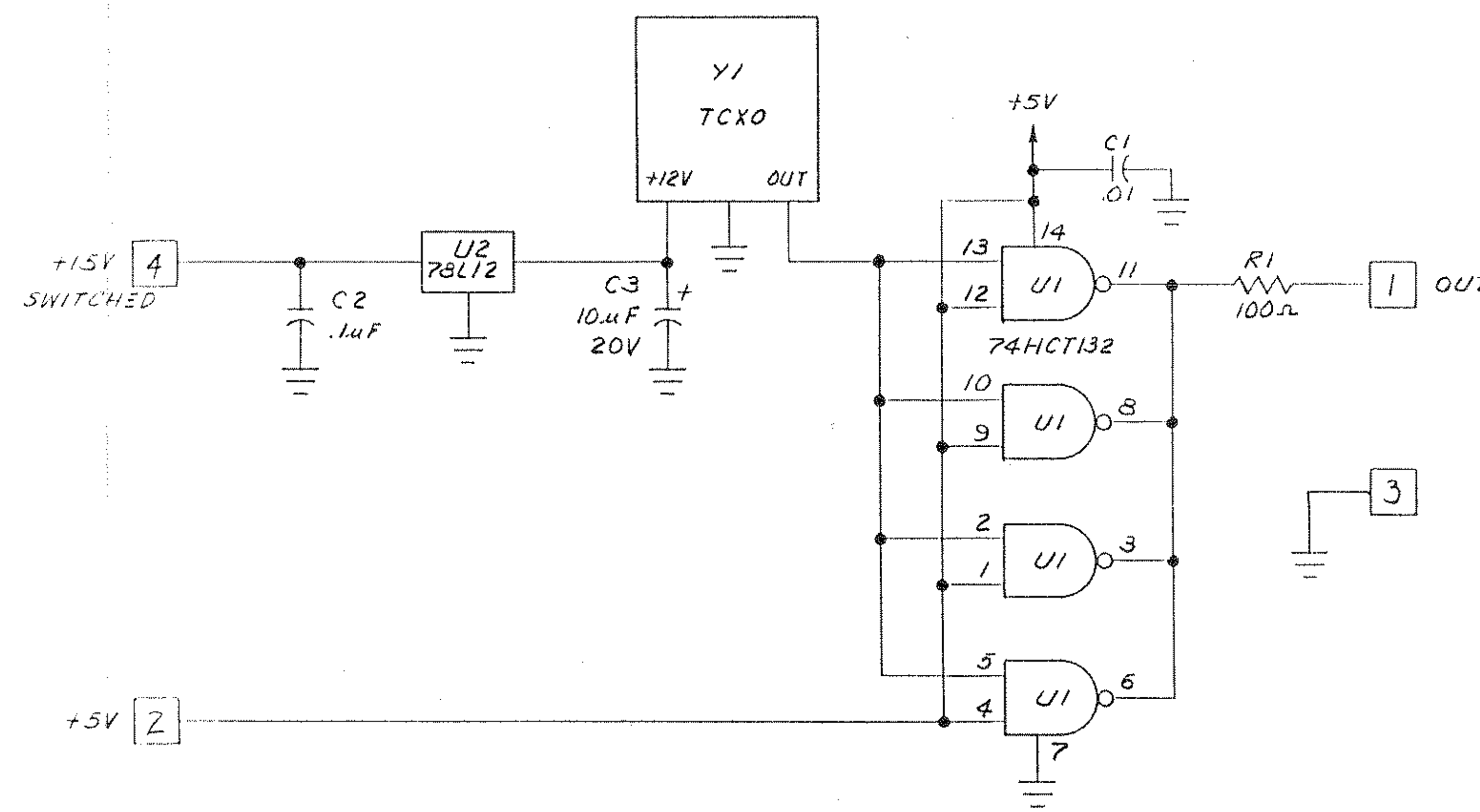
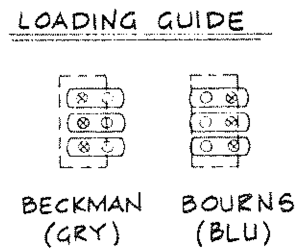
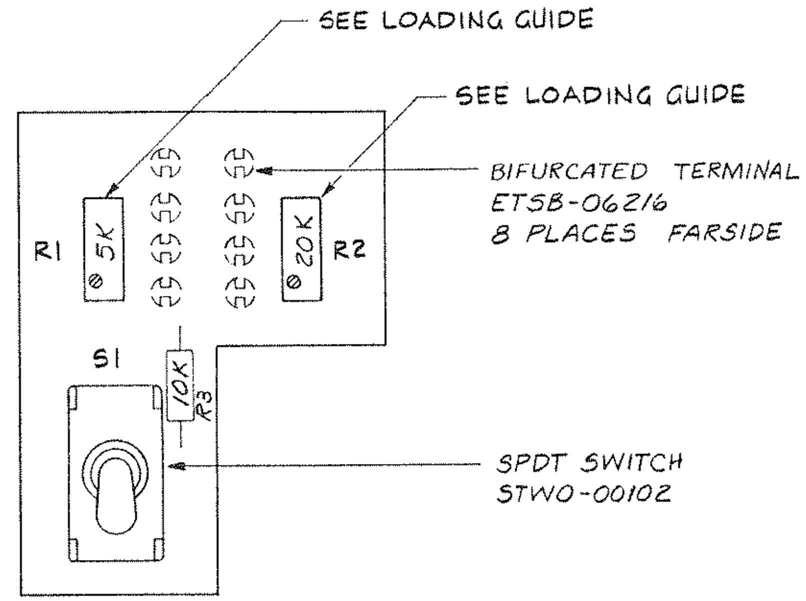
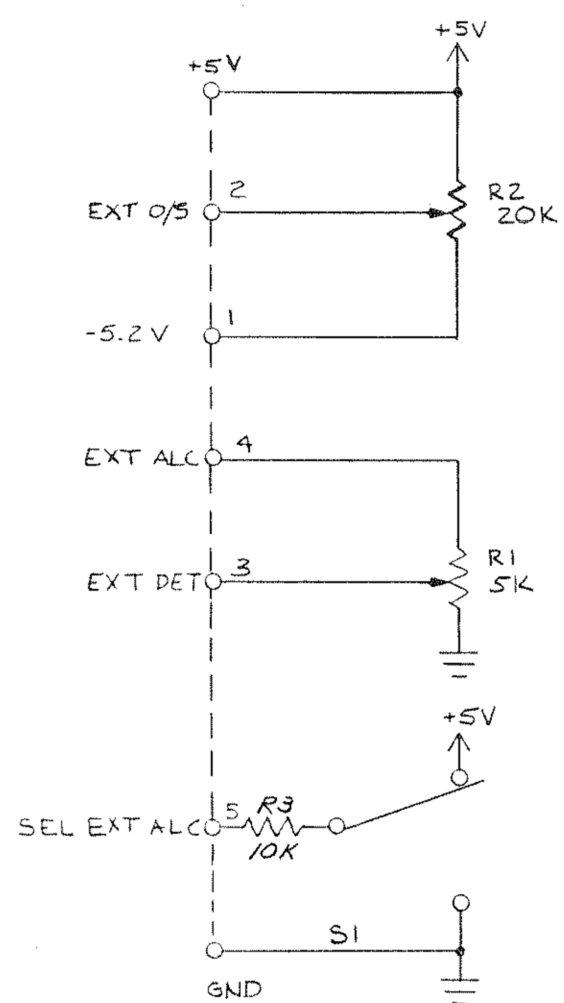


FIG: 7.A114.1
TCXO PC ASSY (A114)
DWG# 101BM09701 SHT 1

REV A







NOTES: UNLESS OTHERWISE SPECIFIED
1.) RESISTOR VALUES ARE IN OHMS

EXTERNAL ALC POT SWITCH -- Circuit Board A117

This circuit, which is mounted at the rear panel of the instrument, provides three inputs to the level control system, all of which are related to external ALC operation.

The 'ENABLE' switch (S1) is used by the operator to select or deselect the external ALC mode. It furnishes a TTL high or low to the level control circuit.

The input from the external detector is received at pin 4 (from the connector on the rear panel). The detector signal is taken from the wiper of R1 and is furnished to the level control circuit via pin 3. R1 is the 'GAIN' pot and is used to calibrate the leveling loop at the high end of its power range, in order to match the slope of the external detector's transfer curve.

R2 is the 'OFFSET' potentiometer; the voltage taken from its wiper at pin 2 is furnished to the level control circuit. The offset voltage is used to calibrate the leveling loop at the low end of its power range, in order to match the intercept point of an external detector's transfer curve.

FIG: 7.A117.1
EXT ALC POT SWITCH (A117)
DWG# 304BM09000 SHT 1

REV C

OPTIONS

Option 03: 1 kHz Resolution

When this option is installed, the output frequency resolution is 1 kHz. The 100 kHz, 10 kHz and 1 kHz digits may be set by the front panel switches or by a remote control command.

Option 03 requires the installation of two circuits: the Intermediate PLL (A9) and the High Resolution PLL (A10). These circuits are described in the manual; they are omitted from instruments without option 03.

Option 06: HIGH STABILITY TIME BASE

This option replaces the standard (10E-6/year) master reference oscillator (TCXO Assy 101BA09701) with a high stability time base (10E-9/day; part number 101CA20501).

Option 19: Reverse Power Protection

When this option is installed, a power limiter circuit is placed between the output of the step-attenuator and the RF output connector on the front panel. The limiter prevents excessive reverse power levels at the output connector from reaching the components in the instrument's RF path. An instrument with Option 19 installed will accept, without resulting damage, the following reverse power levels at the RF output connector: 5 W average power, 2 kW peak power (1 usec. pulse, .1% duty factor).

Option 22: Rear Panel RF Output

When this option is installed, the RF output connector is relocated to the instrument's rear panel.

SECTION NINE

SPECIAL CONFIGURATIONS

9.1 LOW FREQUENCY SYNTHESIS -- The Downconverter Circuit

Some instruments in the 600 series include the .01-2 GHz range, which is below the normal frequency range of YIG oscillators. In these instruments, a downconverter circuit is used to synthesize the .01-2 GHz range. The downconverter is a low frequency synthesizer which mixes the output of the instrument's YIG oscillator with the output of a local oscillator in order to produce an intermediate frequency in the desired range. The YIG and the local oscillator are both phase locked to the instrument's time base; performance specifications are not degraded in the downconverter range.

THEORY OF OPERATION

The downconverter circuit is interposed between the output of the RF module and the 10 dB step attenuator. During operation below 2 GHz, a switch in the output path diverts the RF output from the module to the downconverter; the low frequency synthesized by the downconverter is returned to the switch and furnished to the step attenuator. Most of the elements of the downconverter circuit are housed within a single module.

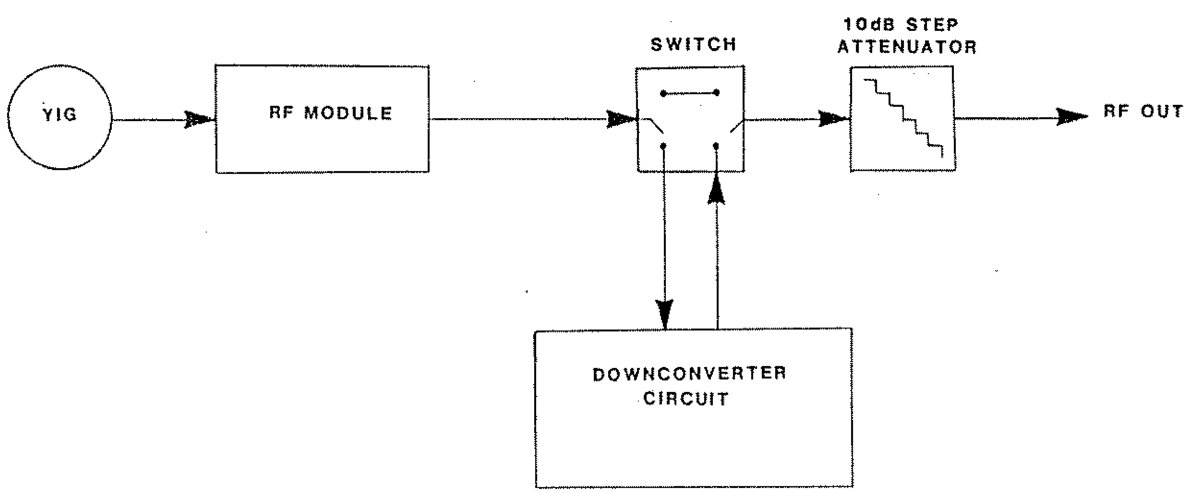


Fig. 9.1: The output path, as modified to include the downconverter.

The input from the RF module is attenuated (about -20 dB) and applied to the downconverter mixer, as the mixer's RF input. The RF input is required to be in the range of 5.931 to 7.920 GHz, and therefore the downconverter circuit can only be installed in instruments covering that range. The computer tunes the YIG oscillator appropriately for the desired RF input to the downconverter mixer. The RF is mixed with a fixed 7.930 GHz LO input. The local oscillator is phase-locked to the 10 MHz time base in order to maintain

7.930 GHz. The IF output from the mixer is equal to the difference between the RF and LO inputs (e.g., 1.000 GHz when the RF input is 6.930 GHz). The IF output is amplified (about +30 dB) and returned to the switch in the instrument's output path.

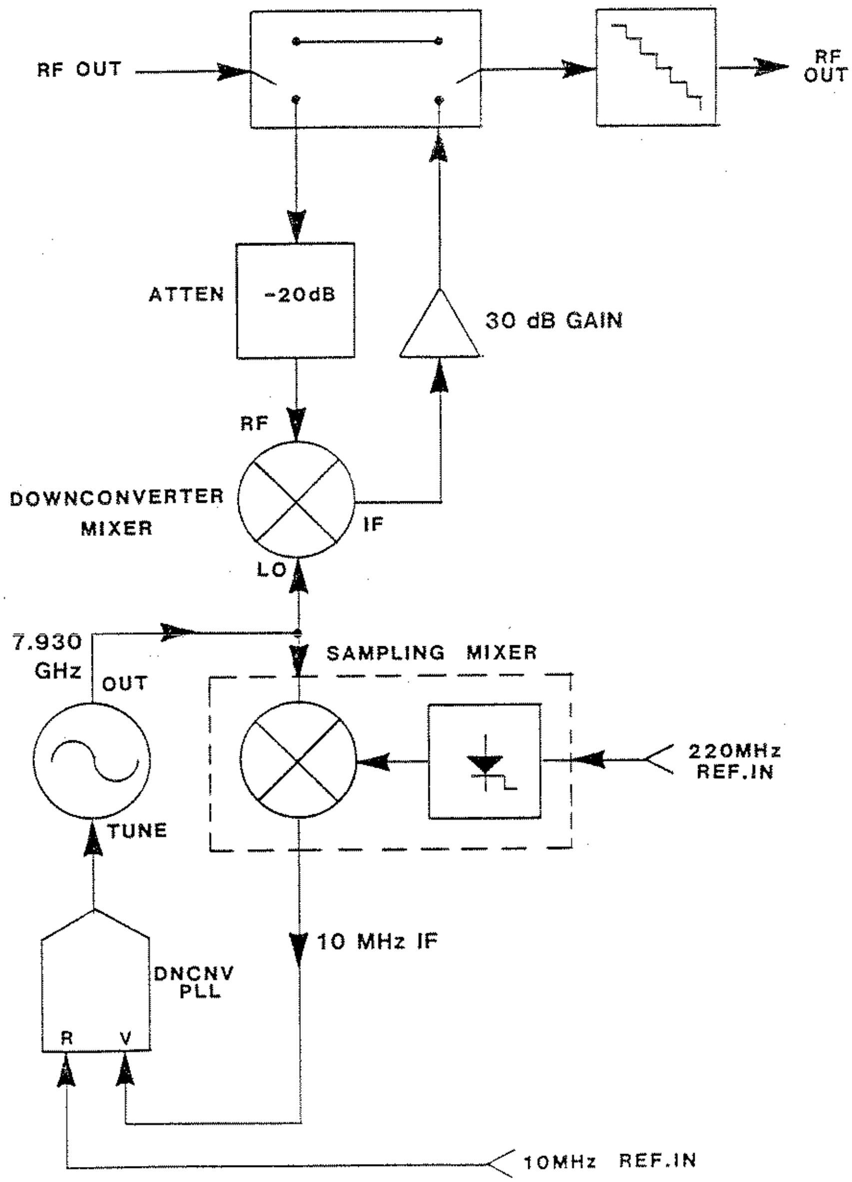


Fig. 9.2: The downconverter circuit.

The phase lock loop which controls the 7.930 GHz LO operates as follows. A sample of the LO frequency is applied to a sampling mixer (a mixer with a step-recovery diode multiplier on one input). The other input to the sampling mixer (the multiplier input) is the 220 MHz reference signal from the oscillator/multiplier circuit (PC board A113). The multiplier produces numerous harmonics of the 220 MHz reference; the 36th harmonic (7.920 GHz) combines with the 7.930 GHz LO to produce a 10 MHz intermediate frequency. This 10 MHz IF is fed back to the downconverter phase lock loop (PC board A119, which is mounted beside the downconverter module). The PLL circuit compares the 10 MHz IF to the 10 MHz timebase and fine-tunes the local oscillator in order to achieve and maintain phase lock.

Instrument functions, including level control and modulation, operate normally in the downconverter range. The frequency synthesis process is also normal, except that the YIG oscillator is tuned to a frequency equal to 7.930 GHz minus the actual output frequency.

CALIBRATION AND TESTING

The downconverter circuit includes one adjustment requiring calibration. To the calibration procedure in Section 4, add the following paragraph (as 3.4.1):

> Tie TP1 on the Downconverter PLL board (A119) to ground, disabling the loop. Set UUT for an output frequency of 1 GHz. Adjust R29 ('7.930 GHz COARSE TUNE') for a frequency counter reading of 1.000 GHz, ± 5 MHz. Remove the ground jumper from TP1.

The performance verification procedure is not altered for instruments featuring the downconverter circuit, except that test frequencies in the .01-2 GHz range are included (see Test Data Sheet).

TROUBLESHOOTING

If the downconverter circuit is included in the instrument, the following considerations apply in troubleshooting:

1. Malfunctions occurring only during operation in the .01-2 GHz range point to the downconverter circuit. Check all power supplies, including the tuning power supply to the downconverter module.

2. A loss of RF power at any frequency may indicate that the RF switch added to the output path in downconverter-equipped units is set in the wrong position. A loss of RF power in the downconverter range may indicate failure of any of several elements of the downconverter circuit, including the 7.930 GHz oscillator, the amplifier, and either of the mixers. These devices are not readily accessible to maintenance in the field, but it may be possible to establish that a required power supply or reference signal is not reaching the downconverter module.

3. If the output frequency is unlocked, or is locked on the wrong frequency, the coarse tuning adjustment on the downconverter PLL

(circuit board A119) may be out of calibration. Also, verify that there is no loss of continuity between the PLL circuit and the downconverter module.

4. Level control and modulation in the .01-2 GHz range do not differ from operation at other frequencies. Signals for modulation and level correction are applied to the RF module and YIG oscillator rather than to the downconverter module and 7.930 GHz oscillator. Frequency synthesis in the .01-2 GHz range differs from normal operation only in that the YIG oscillator is tuned to a frequency equal to 7.930 GHz minus the RF output frequency.

PARTS LISTS AND DIAGRAMS

The components added to instruments featuring the .01-2 GHz range are shown in the parts lists and drawings appended to this section:

PAGE:	DESCRIPTION:
9-5	parts lists, .01-8 shipping assembly & frequency assembly
9-6	parts list, downconverter chassis
9-7, 9-8	parts list, downconverter PLL (A119)
9-9	fig. 9.3, downconverter chassis, page one
9-10	fig. 9.4, downconverter chassis, page two
9-11	fig. 9.5, dncnv PLL (A119), assy dwg & circuit descr.
9-12	fig. 9.6, dncnv PLL (A119), schematic

Parts List for M600 /.01-8 SHIPPING ASY No. 304DA01404   Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	304DA01500	1	58900	304DA01500	M600-TEST ASY
2	304AA10200	1	58900	304AA10200	M600 ROM SET U
3	304DF01300	1	58900	304DF01300	M600 DEC. PANEL
4	304DA08700	1	58900	304DA08700	BENCHTOP CABINETIZING ASY
5	304CA08604	1	58900	304CA08604	M600 FREQ .01-8 ASY
6	304CA11900	1	58900	304CA11900	M600 DWNCONV CHASSIS ASY

Parts List for M600 FREQ .01-8 ASY No. 304CA08604   Rev. A

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	004BA13000	1	58900	004BA13000	2-8 MODULE, 600(M180)
2	MOYT-20208	1	24539	Y087-4198	2-8GHZ YIG XSTR OSC
3	MPBO-01303	1	28480	33322G-90	0-110DB 13GHZ PGM ATTEN
4	MDSO-00034	1	H0002	D2262-44	.01-34GHZ DETECTOR
5	304CA09802	1	58900	304CA09802	.085 CABLE #600B ASY
6	304CA09903	1	58900	304CA09903	.141 CABLE #600C ASY
7	304CA09801	1	58900	304CA09801	.085 CABLE #600A ASY

Parts List for M600 DWNCONV CHASSIS ASY No. 304CA11900 Rev. B

Item	Part Number	Qty	FSCM	Mfr's Part Number	Description
1	004DA25000	1	58900	004DA25000	M600 DOWNCONVERTER ASSY
2	304CA11600	1	58900	304CA11600	M600 DWNCONV. PLL PCA
3	004BA24000	1	58900	004BA24000	DOWNCONVERTER SW (M600)
4	304BA12100	1	58900	304BA12100	BUFFER MODULE PCA
5	304CA09803	1	58900	304CA09803	.085 CABLE #600G ASY
6	304CA09804	1	58900	304CA09804	.085 CABLE #600H ASY
7	304CA09805	1	58900	304CA09805	.085 CABLE #600J ASY
8	304CA09806	1	58900	304CA09806	.085 CABLE #600K ASY
9	304CA09807	1	58900	304CA09807	.085 CABLE #600L ASY
10	HIGP-00090	2	95987	WG201	FLEXIBLE GROMMET
11	304CA09808	1	58900	304CA09808	.085 CABLE #600M ASY
12	MPFS-01806	1	64671	18A-6	6DB SMA M/F PAD
13	304CF12500	1	58900	304CF12500	DOWN CONV. MOUNT
14	309BF01700	1	58900	309BF01700	D/C SWITCH MOUNT
15	HBPP-44018	4	96906	MIL STD	4-40 X 1 1/8 PAN

Parts List for M600 DWNCONV. PLL PCA No. 304CA11600   Rev. C

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
	1	304CF11600	1	58900	304CF11600	M600 DWNCONV. PLL
	2	ETSB-06216	15	88245	2000B	BIFURCATED TERMINAL 5/32
	3	ETST-06224	1	88245	1280B	TURRET TERMINAL
C	1	CT10-06390	1	56289	150D396X9010B2	39 UF 10V TANTALUM
C	2	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	3	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	4	CC50-04100	1	56289	2CZ5U104X0050C4	.1 UF CERAMIC Z5U
C	5	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	6	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	7	CT20-06100	1	56289	150D106X9020B2	10 UF 20V TANTALUM
C	8	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	9	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	10	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	11	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	12	CC50-02470	1	51642	200-100-W5R-472K	.0047 UF CERAMIC X7R
C	13	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	14	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	15	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	16	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	17	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	18	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	19	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	20	CC50-03100	1	51642	150-100-W5R-103K	.01 UF CERAMIC X7R
C	21	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	22	CC50-05100	1	56289	3CZ5U105X0050C5	1 UF CERAMIC Z5U
C	23	CC50-02100	1	52763	EDPT-1000-Y5P10%	.001 UF CERAMIC Y5P
C	24	CE63-07220	1	56289	501D227F063PR	220 UF 63V ELECT.
CR	1	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	2	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	3	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	4	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	5	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	6	DSA0-00300	1	07263	FDH300	FDH300 LOW LEAK DIODE
CR	7	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	8	DSA0-04148	1	07263	1N4148	IN4148 G.P. DIODE
CR	9	DZAD-04753	1	04713	1N4753	IN4753 36 V ZENER
CR	10	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
CR	11	DPAB-05391	1	04713	1N5391	IN5391 1.5A 35V DIODE
DS	1	ILRR-00125	1	58361	MV5077B	RED LED 1/8" DIA
J	1	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J	2	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
J	3	JRBM-00101	1	98291	51-053-0000	SMB M RTANG PC MOUNT
Q	1	QBNS-02222	1	27014	PN2222	PN2222 .5A 30V NPN
Q	2	QBPS-02907	1	27014	PN2907	PN2907 .5A 40V .6W PNP
Q	3	QBPP-05193	1	04713	2N5193	2N5193 4A 40V 40W PNP
R	1	RN55-00681	1	05905	SMA 0207 E 96	68.1 OHMS 1% MET FILM
R	2	RN55-02210	1	05905	SMA 0207 E 96	221 OHMS 1% MET FILM
R	3	RN55-01300	1	05905	SMA 0207 E 96	130 OHMS 1% MET FILM
R	4	RN55-00825	1	05905	SMA 0207 E 96	82.5 OHMS 1% MET FILM
R	5	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	6	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM

Parts List for M600 DWNCONV. PLL PCA No. 304CA11600 Rev. C

Item		Part Number	Qty	FSCM	Mfr's Part Number	Description
R	7	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	8	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	9	RN55-11820	1	05905	SMA 0207 E 96	1.82 K OHMS 1% MET FILM
R	10	RN55-11820	1	05905	SMA 0207 E 96	1.82 K OHMS 1% MET FILM
R	11	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	12	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	13	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R	14	RN55-05620	1	05905	SMA 0207 E 96	562 OHMS 1% MET FILM
R	15	RN55-21690	1	05905	SMA 0207 E 96	16.9 K OHMS 1% MET FILM
R	16	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	17	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	18	RN55-12740	1	05905	SMA 0207 E 96	2.74 K OHMS 1% MET FILM
R	19	RN55-22490	1	05905	SMA 0207 E 96	24.9 K OHMS 1% MET FILM
R	20	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	21	RN55-22490	1	05905	SMA 0207 E 96	24.9 K OHMS 1% MET FILM
R	22	RN55-24750	1	05905	SMA 0207 E 96	47.5 K OHMS 1% MET FILM
R	23	RN55-31500	1	05905	SMA 0207 E 96	150 K OHMS 1% MET FILM
R	24	RN55-31500	1	05905	SMA 0207 E 96	150 K OHMS 1% MET FILM
R	25	RN55-31000	1	05905	SMA 0207 E 96	100 K OHMS 1% MET FILM
R	26	RN55-41000	1	05905	SMA 0207 E 96	1 M OHMS 1% MET FILM
R	27	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	29	RAPF-22000	1	73138	66WR20K	20K 10% 20T VERT PC
R	30	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	31	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	32	RN55-24990	1	05905	SMA 0207 E 96	49.9 K OHMS 1% MET FILM
R	33	RN55-24020	1	05905	SMA 0207 E 96	40.2 K OHMS 1% MET FILM
R	34	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	35	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	36	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	37	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	38	RN55-03920	1	05905	SMA 0207 E 96	392 OHMS 1% MET FILM
R	39	RN55-11000	1	05905	SMA 0207 E 96	1 K OHMS 1% MET FILM
R	40	RN55-01000	1	05905	SMA 0207 E 96	100 OHMS 1% MET FILM
R	41	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
R	42	RN55-21000	1	05905	SMA 0207 E 96	10 K OHMS 1% MET FILM
U	1	UENO-12040	1	04713	MC12040P	MC12040P PHASE/FREQ DET
U	2	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	3	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	4	UONO-00072	1	01295	TL072CP	TL072CP DUAL FET OP AMP
U	5	UONO-05532	1	18324	NE5532N	DUAL;OP AMP;10MHz
U	6	UONO-05532	1	18324	NE5532N	DUAL;OP AMP;10MHz
VR	1	DRAE-00827	1	04713	1N827	IN827 6.2V REF. DIODE

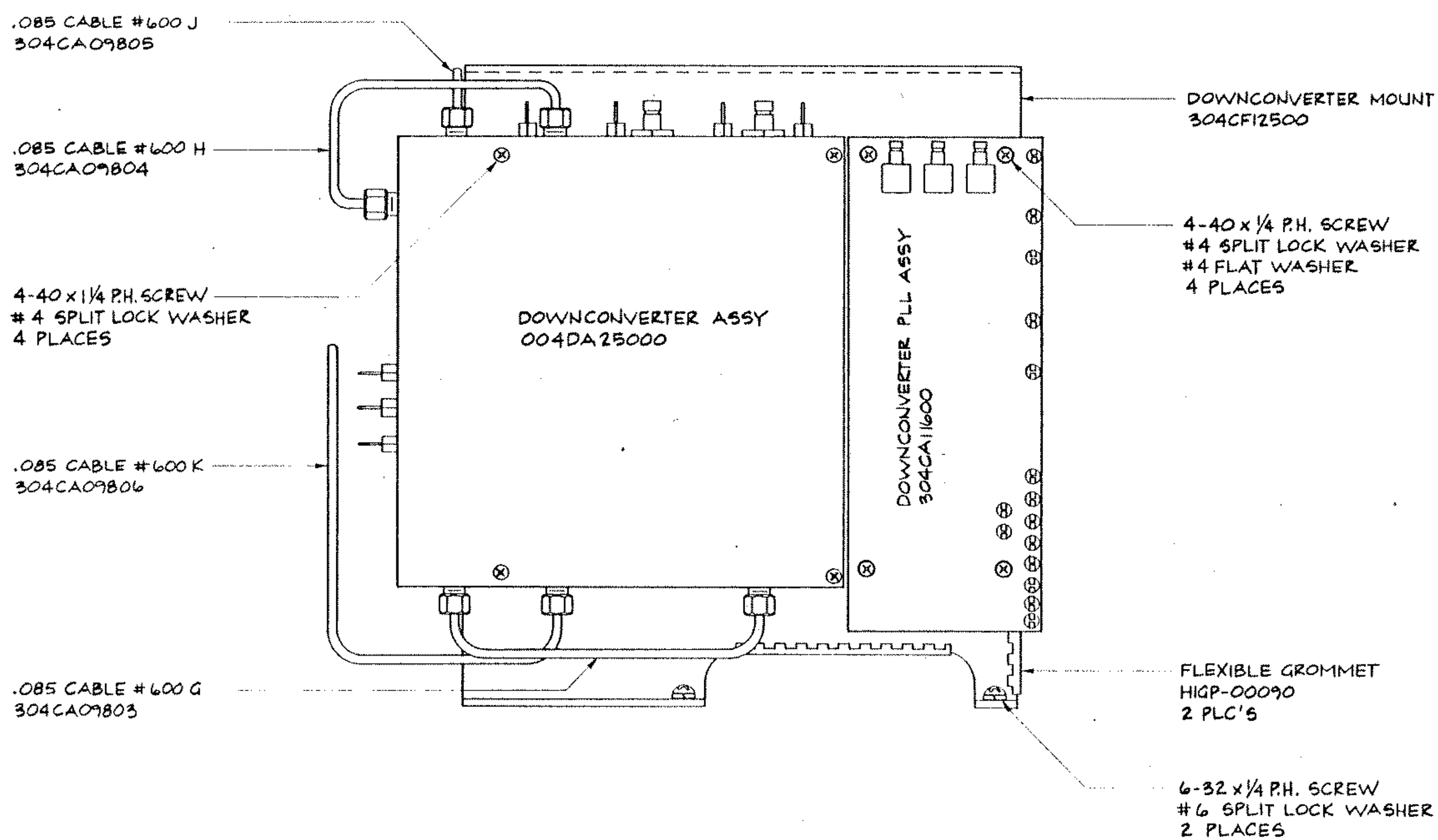


FIG: 9.3
DOWNCONVERTER CHASSIS
DWG# 304AM11900 SHT 1

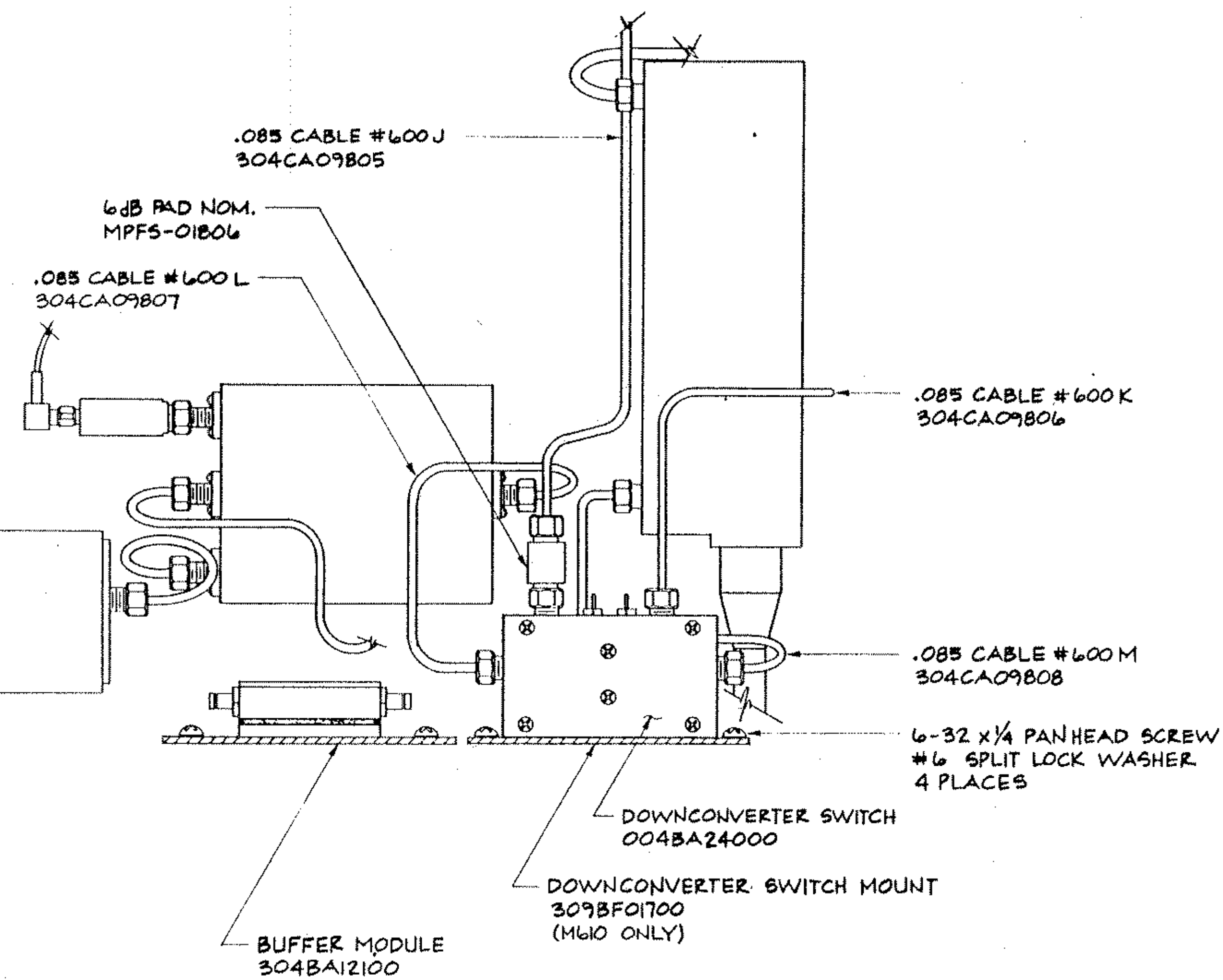


FIG: 9.4
DOWNCONVERTER CHASSIS
DWG# 304CA11900 SHT 2

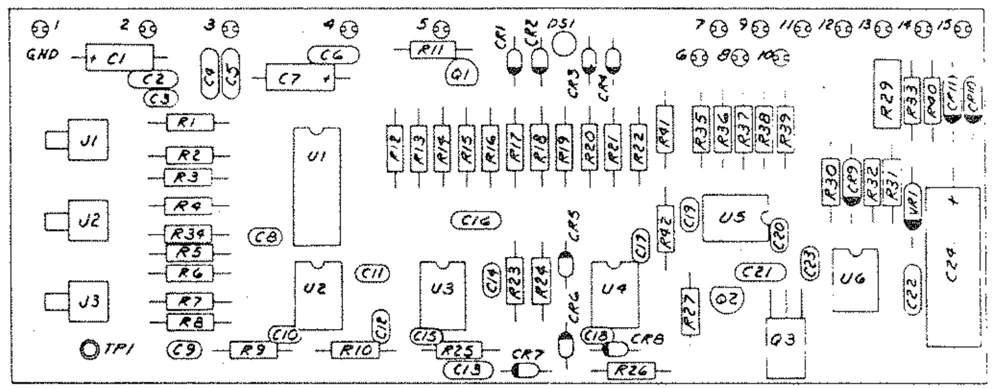


FIG: 9.A119.1
DOWNCONVERTER PLL PC ASSY (A119)
DWG# 304BM11600

REV C

DOWNCONVERTER PHASE LOCK LOOP -- PC Board A119

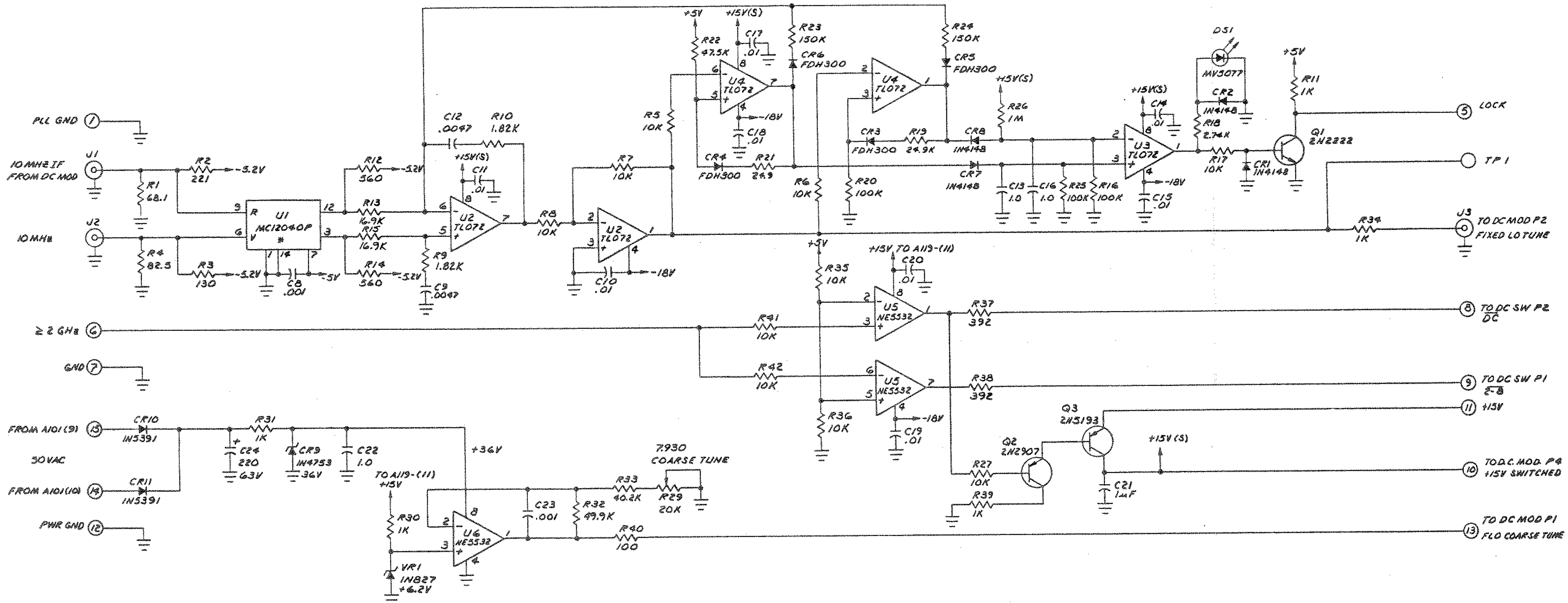
The computer controls the downconverter by means of this circuit, which supplies the necessary tuning signals and control lines.

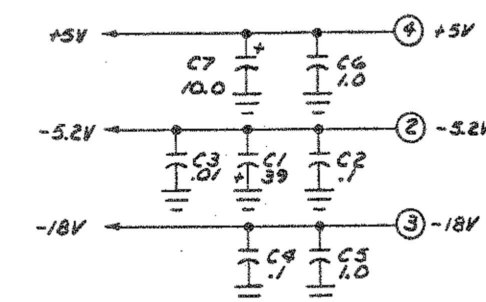
The '$\geq$ 2 GHz' logic line at pin 7 is used by inverter U5-16 to control the RF switch in the output path. In addition, the logic line (buffered by U5-15 and U5-14) controls (via Q2) the switched +15V power supply used by the downconverter module and by the PLL circuit on this board. During operation outside the .01-2 GHz band, the downconverter and its PLL circuit are disabled in order to prevent them from oscillating and contributing spurious frequencies to the RF output.

The downconverter module requires an adjustable power supply for coarse tuning of the 5.950 GHz local oscillator. The supply is nominally +26 volts, with an adjustment range of $\pm$ 4 volts. The AC inputs at pins 13 and 14 come from the transformer secondaries and are rectified by CR9; a DC output of about +36 volts is furnished to the power supply pin of U6. The gain of the amplifier is adjusted by R29 in order to vary the output at pin 12 over an approximate range to +22 to +30 volts.

The IF from the downconverter module is produced by mixing the local oscillator's output with the 27th harmonic of the 220 MHz reference (i.e., 5.940 GHz). The IF is fed back to J1 and is equal to 10 MHz when the local oscillator is correctly tuned to 5.950 GHz. The phase comparator chip (U1) compares the IF to the 10 MHz timebase (J2) and produces wide pulses at one of its outputs (pins 3 or 12) depending on whether the IF is leading or lagging the timebase. The output pulses are averaged by a low pass filter circuit (see U2-7) to produce a DC tuning voltage. The tuning voltage is furnished (via J3) to the downconverter tuning input. The phase lock loop circuit adjusts the frequency in whichever direction will reduce the phase difference between the two 10 MHz inputs, until the local oscillator stabilizes at 5.950 GHz.

Because the signal fed back from the downconverter is generated by harmonic mixing, it is possible for the PLL circuit to become stuck at either extreme of its control range by pursuing the wrong intermediate frequency. To prevent the PLL from latching up in this way, two "kicker" circuits (U4-7 and U4-1) are used. The two amplifiers are set up as a window detector. If the output tuning voltage exceeds about 11 volts in either the positive or negative directions one of the amplifer outputs will forward-bias CR6 or CR5; the voltage fed back to U2-6 will drive the control voltage back towards zero to resume the search. In addition, the lock detector circuit (U3) monitors the control voltage; when this output exceeds the $\pm$ 11 volt window, U3-1 goes high, the 'UNLOCK' LED is illuminated and the '$\overline{\text{LOCK}}$' output at pin 5 is pulled low.





NOTES: UNLESS OTHERWISE SPECIFIED
1.) CAPACITOR VALUES ARE IN µF
2.) RESISTOR VALUES ARE IN OHMS
3.) * INDICATES HEAT SINK REQUIRED

U #	TYPE	+5V	-5V	GND	+15VS	-18V	+36V
1	MC12040		7	1,14			
2	TL072				8	4	
3	TL072				8	4	
4	TL072				8	4	
5	NE5532				8	4	
6	NE5532			4			8

FIG: 9.A119.1
DOWNCONVERTER PLL PC ASSY (A119)
DWG# 304BM11600

REV C

9.2 SPECIAL CONFIGURATIONS

If the instrument is specially configured (as indicated by a three-digit number on the "Config." line of the Model/Serial/Config. sticker), a supplement describing the configuration is added to the manual, beginning on the following page. Modifications of the instrument, its circuits, and its performance characteristics are listed in that supplement.

MANUAL CHANGES