SERIES
67XXB
SWEPT FREQUENCY SYNTHESIZER

MAINTENANCE MANUAL

WILTRON

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Section 1 contains a general description of the WILTRON Series 67XXB Swept Frequency Synthesizer, its identification number, related manuals, and options. Information is included concerning level of maintenance, replaceable subassemblies and components, exchange assembly program, preventive maintenance, firmware, and schematics. Static-sensitive component handling precautions and lists of recommended test equipment and exchangeable assemblies are also included.

2 SYSTEM DESCRIPTION AND TROUBLESHOOTING

Section 2 contains system and subsystem level descriptions and maintenance troubleshooting information for all models of the Series 67XXB Swept Frequency Synthesizer. It is made up of a front section and 13 subsections, 2A thru 2M. The front section provides system level theory of operation for the synthesizer, a generic 67XXB block diagram, and system level maintenance troubleshooting. The troubleshooting portion contains a listing of hidden-key routines useful for maintenance troubleshooting and a summary listing of error codes with probable causes. A detailed table of contents for the subsections, 2A thru 2M, is also included.

2A thru 2M DETAILED SUBSYSTEM DESCRIPTIONS

The subsections 2A through 2M contain detailed information on the individual subsystems that comprise the Series 67XXB Swept Frequency Synthesizer. Each subsection contains detailed circuit descriptions, block diagrams, schematic diagrams, and parts locator diagrams for the PCBs that make up a particular subsystem.

3 DISASSEMBLY AND REPAIR PROCEDURES

Section 3 contains the procedures necessary to gain access to the major 67XXB assemblies and PCBs for troubleshooting and maintenance. All necessary diagrams are provided.

4 SPECIAL OPTIONS

Section 4 is reserved for a listing and description of any special options that are provided with your model 67XXB Swept Frequency Synthesizer.

5 PARTS LISTS

Section 5 contains parts lists for all major assemblies and printed circuit board assemblies of the Series 67XXB Swept Frequency Synthesizer (including RF microwave deck components). The parts lists for the major assemblies include photo and line art illustrations for ease of component identification.

SECTION I
GENERAL INFORMATION

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Figure 1-1. Typical Series 67XXB Swept Frequency Synthesizer

SECTION 1
GENERAL INFORMATION

1-1 SCOPE OF THE MANUAL

This manual provides general information, service data (circuit descriptions, troubleshooting data, schematics, and block diagrams) and parts lists for all models of the Series 67XXB Swept Frequency Synthesizer. The majority of the information in this manual applies to all 67XXB models. Specific model number references are made where the information presented is unique to that model only.

1-2 INTRODUCTION

Section 1 provides a general description of the synthesizer, its identification number, related manuals, and options. Information is included concerning level of maintenance, replaceable subassemblies and components, exchange assembly program, preventive maintenance, firmware, and schematics. Static-sensitive component handling precautions and lists of recommended test equipment and exchangeable assemblies are also provided.

1-3 DESCRIPTION

The Series 67XXB Swept Frequency Synthesizers (Figure 1-1) are microprocessor-controlled synthesized signal sources that generate swept and CW frequencies in one or more frequency bands between 10 MHz and 60 GHz. All models are controllable via the IEEE-488 Bus (GPIB). The series, which will expand as additional frequency ranges are added, presently consists of 30 models covering a variety of frequency and power ranges. Table 1-1 lists all models presently available, their frequency range, and their output power level.

1-4 IDENTIFICATION NUMBER

All WILTRON instruments are assigned a unique six-digit ID number, such as "405001." Each 67XXB has two ID numbers assigned – one for the basic frame and one for the RF microwave deck. The ID number for the RF microwave deck is affixed to the outside of the rear panel, while that for the basic frame is affixed to chassis floor, below the swing-out RF microwave deck. The RF microwave deck ID number, on the outside, is the primary number.

Table 1-1. 67XXB Series Swept Frequency Synthesizers

67XXB Model	Frequency (GHz)	Output Power
6709B 6709B-40	0.01 to 2.0	+10 dBm +16 dBm
6717B 6717B-20	0.01 to 8.4	+10 dBm +13 dBm
6719B	2.0 to 8.4	+13 dBm
6721B 6721B-20	2.0 to 12.4	+10 dBm +13 dBm
6722B 6722B-20	0.01 to 12.4	+10 dBm +13 dBm
6728B 6728B-40	8.0 to 12.4	+13 dBm +16 dBm
6729B 6729B-20	8.0 to 20	+10 dBm +13 dBm
6730B 6730B-40	12.4 to 20	+13 dBm +16 dBm
6736B	18.0 to 26.5	+7 dBm
6737B 6737B-20	2.0 to 20.0	+10 dBm +13 dBm
6740B	26.5 to 40.0	+10 dBm
6745B	0.01 to 18.0	+10 dBm
6747B 6747B-20	0.01 to 20.0	+10 dBm +13 dBm
6753B 6753B-10	2.0 to 26.5	+10 dBm,≤20 GHz +5 dBm,>20 GHz +10 dBm
6759B 6759B-10	0.01 to 26.5	+10 dBm,≤20 GHz +5 dBm,>20 GHz +10 dBm
6760B	12.4 to 40.0	+5 dBm
6763B	2.0 to 40.0	+10 dBm,≤20 GHz +5 dBm,>20 GHz
6769B	0.01 to 40.0	+10 dBm,≤20 GHz +5 dBm,>20 GHz
6772B	40.0 to 60.0	0 dBm

* Optional attenuators reduce rated power by 3 to 4 dB.

Please use it when ordering parts or corresponding with the WILTRON Customer Service department.

1-5 RELATED MANUALS

This is one of a three manual set that consists of an Operating Manual (OM), a Test and Calibration Manual (T&C), and a Maintenance Manual (MM).

The OM and MM provide coverage for all models in the 67XXB series. Conversely, the T&Cs contain model-dependent information. Because of this model dependency there are nineteen different T&Cs—one for each frequency model.

Operating Manual (OM). The OM provides general, installation, and operation information for all 67XXB models. The WILTRON part number for the OM is 10370-10202.

Test and Calibration Manual (T&C). The T&C supplies performance verification test procedures, calibration and adjustment procedures, and test records for a specific 67XXB model. The WILTRON part numbers for all T&Cs are listed in Table 1-2.

Maintenance Manual (MM). The WILTRON part number for the MM is 10370-10242.

Table 1-2. Test & Calibration Manual Part Numbers

67XXB Model Number(s)	Manual Part Number
6709B & 6709B-40	10370-10204
6717B & 6717B-20	10370-10206
6719B	10370-10208
6721B & 6721B-20	10370-10210
6722B & 6722B-20	10370-10212
6728B & 6728B-40	10370-10214
6729B & 6729B-20	10370-10216
6730B & 6730B-40	10370-10218
6736B	10370-10220
6737B & 6737B-20	10370-10222
6740B	10370-10224
6745B	10370-10226
6747B & 6747B-20	10370-10228
6753B & 6753B-10	10370-10230
6759B & 6759B-10	10370-10232
6760B	10370-10240
6763B	10370-10234
6769B	10370-10236
6772B	10370-10238

1-6 OPTIONS

The following standard instrument options are available.

Option 1, Rack Mount. A kit is available containing mounting brackets and chassis track slides.

Option 2A, 110 dB Step Attenuator. Each synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency of ≤20 GHz.

Option 2B, 110 dB Step Attenuator. Each synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency limit of 26.5 GHz.

Option 2C, 110 dB Step Attenuator. Each synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 4 dB. This option is available for all models having an upper frequency limit of 40 GHz.

Option 9K, K Connector. Each synthesizer comes supplied with a rear panel K Connector® RF Output instead of the type of connector that would normally be installed on the front panel. The front panel connector is deleted. Rated output power, flatness, and SWR are slightly degraded.

1-7 LEVEL OF MAINTENANCE

Maintenance of the 67XXB synthesizer consists of:

- troubleshooting the instrument to a replaceable subassembly or RF component.
- repair by replacing the failed subassembly or RF component.

The 67XXB synthesizer contains firmware that generates hidden-key routines and error codes to aid in troubleshooting instrument failures to the replaceable subassembly or RF component. Section 2- System Description and Troubleshooting contains lists of these maintenance-related hidden-key routines and error codes.

The 67XXB synthesizer may require calibration or adjustment after repair. Refer to Section 3 of the T&C manual for your specific 67XXB model for calibration/adjustment procedures.

1-8 REPLACEABLE SUBASSEMBLIES AND PARTS

Table 1-3 is a *partial* listing of replaceable subassemblies and RF components for the 67XXB series of synthesizers. It lists those replaceable subassemblies and RF components that are presently covered byh the WILTRON exchange assembly program (see paragraph 1-9).

® K Connector is a registered trademark of WILTRON Company

Section 5–Parts Lists provides a complete parts breakdown for the 67XXB series of synthesizers. It contains figures and parts lists for the main components of each major 67XXB assembly. Parts lists of all replaceable components for each PCB assembly (A1–A29) are also included.

1-9 EXCHANGE ASSEMBLY PROGRAM

WILTRON maintains an exchange assembly program for selected synthesizer subassemblies and RF components (Table 1-3). If a malfunction occurs in one of these subassemblies or RF components, the defective item can be exchanged. Upon request and typically within 24 hours, WILTRON will ship the exchange subassembly or RF component. The customer then has 30 days in which to return the defective item. All exchange subassemblies or RF components are warranted for 90 days from the date of shipment or for the balance of the original equipment warranty–whichever is longer.

For more information on this program, contact your local sales representative or call the WILTRON Customer Service department at (408) 778-2000.

1-10 PREVENTIVE MAINTENANCE

The rear panel fan on the 67XXB has a two-part air filter. The exterior filter element should be periodically checked and cleaned as needed. The interior honeycomb element should also be checked and cleaned each time the exterior element is removed.

1-11 STATIC-SENSITIVE COMPONENT HANDLING PRECAUTIONS

The 67XXB synthesizer contains components that can be damaged by static electricity. Figure 1-2 contains a list of precautions for handling static-sensitive components. If followed, these precautions will minimize the possibilities of static-shock damage to these components.

1-12 FIRMWARE

The descriptions in this manual of synthesizer circuitry operation, hidden-key routines, self test routines, and error codes are based on using version 8.03 operating firmware. If your particular instrument contains an older version of firmware, these descriptions may not accurately reflect its operation. You may wish to upgrade your synthesizer's operating firmware to the latest available version. Contact the WILTRON Customer Service department at (408) 778-2000 for assistance with firmware problems or for firmware upgrade details.

1-13 SCHEMATICS

The schematics in this manual are the most current version in use at the time of publication. They may not accurately reflect the circuitry in your particular 67XXB synthesizer. Contact the WILTRON Customer Service department at (408) 778-2000 for assistance in resolving schematic differences.

The schematic conventions used in this manual are described below.

- Signal flow is from left to right. All signals entering the PCB do so on the left of the page and those exiting the PCB do so on the right of the page.
- The arrow points of the signal flags indicate the direction of signal flow.
- The lettering in the signal flags indicate the sheet and grid coordinates of the signal destination (for outputs), or the point of signal origination (for inputs). The sheet number is designated first.
- The arrow points on the end of connector lines indicate plugs. The arrow tails on the end of connector lines indicate jacks.
- Signal lines are identified by a distinctive name, mnemonic symbol, or voltage value. The letters "H" and "L" in front of digital signal lines indicate the line's active state–H for TTL high and L for TTL low. The "(-)" symbol that follows certain analog signals lines indicates a negative value.

1-14 RECOMMENDED TEST EQUIPMENT

Table 1-4 provides a list of recommended test equipment for maintenance troubleshooting of the 67XXB synthesizer.

Contact the WILTRON Customer Service department at (408) 778-2000 for help regarding test equipment compatibility.



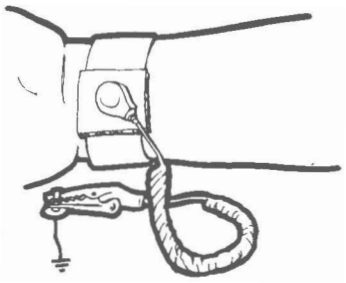
1. Do not touch exposed contacts on any static sensitive component.



2. Do not slide static sensitive components across any surface.



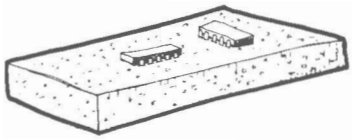
3. Do not handle static sensitive components in areas where the floor or work surface covering is capable of generatng a static charge.



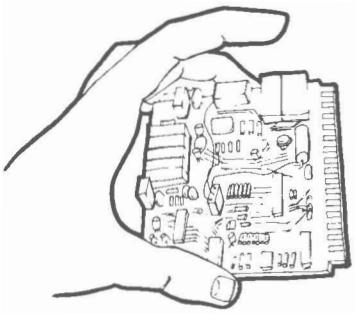
4. Wear a static-discharge wristband when working with static sensitive components.



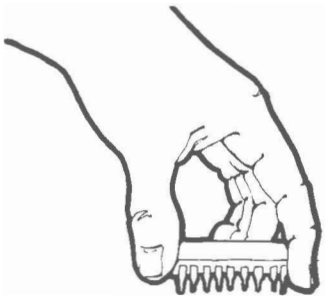
5. Label all static sensitive devices.



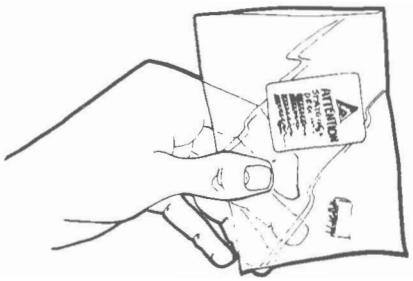
6. Keep component leads shorted together whenever possible.



7. Handle PCBs only by their edges. Do not handle by the edge connectors.



8. Lift and handle sold state devices by their bodies – never by their leads.



9. Transport and store PCBs and other static sensitive devices in static-shielded containers.

10. ADDITIONAL PRECAUTIONS:
- Keep workspaces clean and free of any objects cabable of holding or storing an electric charge.
- Connect soldering tools to an earth ground.
- Use only special anti-static suction or wick-type desoldering tools.

Figure 1-2. Static-Sensitive Component Handling Precautions

Table 1-3. Replaceable Subassemblies and RF Components

SUBASSEMBLY OR PART NAME	WILTRON PART NUMBER
Printed Circuit Board Assemblies	
A1, A2 Front Panel Assy	ND35656
A3 Coarse Loop Mixer PCB Assy	C31703-4
A4 Coarse Loop Osc. PCB Assy	D31914-3
A5 Reference Osc. PCB Assy	D31805-4
A6 Coarse Loop Divider PCB Assy	D31806-3
A7 Reference Divider PCB Assy	C31707-4
A8 Serial I/O PCB Assy	D31708-3
A9 Fine Loop Osc. PCB Assy	C31709-4
A10 Reference Buffer PCB Assy	C31710-4
A11 Fine Loop Divider PCB Assy	D31711-4
A12 YIG Phase Detector PCB Assy	D31712-4
A13 Pulse Generator PCB Assy	D31913-3
A15 ALC PCB Assy	D31915-3
A16 FM PCB Assy	D31716-5
A17 Analog Instruction PCB Assy	D31717-3
A18 YIG Driver PCB Assy	ND34071-1
A19 YIG Driver PCB Assy	ND34072
A20 YIG Driver PCB Assy	ND34073
A21 YIG Driver PCB Assy	ND34075
A22 Regulator Interface PCB Assy	ND34075
A23 Microprocessor PCB Assy	D31723-3
A24 GPIB PCB Assy	D31724-3
A25 Power Supply PCB Assy	D31925-3
A27 Auxiliary I/O PCB Assy	C31840-3
A29 Rear Panel Interface PCB Assy	D31829-3
Miscellaneous RF Components	
RF Take-off	D9970
Coupler, 20 GHz	D21450
Coupler, 26.5 GHz	D21451
Coupler, 40 GHz	D21452
Switched Filter	C31755-3
A31 Power Amplifier Assy	B31867-1
10 MHz Crystal Oscillator	C31755-3
Output Connector Assy, 20 GHz	ND34998
OutputConnector Assy, 40 GHz	ND35898
A30 Sampler/IF Amplifier Assy	C36025
Doubler Amplifier/Modulator	60-59
YIG-Tuned Oscillators	
2 to 8 GHz Oscillator, cabled	C31752-3
8 to 12.4 GHz Oscillator, cabled	C31751-3
12.4 to 20 GHz Oscillator, cabled	C31754-3
18 to 26.5 GHz Oscillator, cabled	C31753-3

SUBASSEMBLY OR PART NAME	WILTRON PART NUMBER
Control Modulators	
2 to 8 GHz Control Modulator	D19960
8 to 12.4 GHz Control Modulator	D19970
12.4 to 20 GHz Control Modulator	D19980
18 to 26.5 GHz Control Modulator	D19990
Down Converters	
Low Power Down Converter	B31996
Low Power Down Converter, cabled	D19450
High Power Down Converter	ND36035
High Power Down Converter, cabled	D19460
RF Amplifiers	
2 to 8 GHz Amplifier	B21260
2 to 8 GHz Amplifier	C21270
8 to 12.4 GHz Amplifier	ND19072
12.4 to 20 GHz Amplifier	B18730
18 to 26.5 GHz Amplifier	C20552
18 to 26.5 GHz Amplifier	C18965
PIN Switches	
SP4T, 26.5 GHz, Output PIN Switch,	A31956
cabled	D18630
SP4T, 26.5 GHz, Sampler PIN Switch,	A31957
cabled	D18360
DPDT, PIN Switch,	A31997
cabled	D22166
SP4T, 40 GHz, Output PIN Switch,	A31998
cabled	D19900
Step Attenuators	
Step Attenuator, 110 dB, 20 GHz	4422K
Step Attenuator, 110 dB, 26.5 GHz	4522K
Step Attenuator, 110 dB. 40 GHz	4622K

Table 1-4. Recommended Test Equipment for Maintenance Troubleshooting

INSTRUMENT	CRITICAL SPECIFICATION	RECOMMENDED MANUFACTURER/MODEL
Spectrum Analyzer, with Diplexer and External Mixers	*Frequency:* 0.01 to 60 GHz *Resolution:* 10 Hz	Tektronix, Model 494P, with External Mixers: WM 490K (18 to 26.5 GHz) WM 490A (26.5 to 40 GHz) WM 490U (40 to 60 GHz) Diplexer PN: 015-3085-00
Frequency Counter, with External Mixers	*Frequency:* 0.01 to 60 GHz *Input Impedance:* 50Ω *Resolution:* 1 Hz *Other:* Ext Time Base Input	EIP Microwave, Inc., Model 578A, with External Mixers: Option 91 (26.5 to 40 GHz) Option 92 (40 to 60 GHz)
Power Meter, with Power Sensors	*Power Range:* -30 to +20 dBm	Hewlett-Packard, Model 436A, with Power Sensors: HP 8484A (0.01 to 20 GHz) HP 8485A (0.01 to 26.5 GHz) HP R8486A (26.5 to 40 GHz)
Digital Voltmeter	*Resolution:* 4-1//2 digits (to 20V) *DC Accuracy:* 0.002% +2 counts *DC Input Impedance:* 10 MΩ *AC Accuracy:* 0.07% +100 counts (to 20 kHz) *AC Input Impedance:* 1 MΩ	John Fluke, Inc., Model 8840A, with Option 8840A-09 (True RMS AC)
Oscilloscope	*Bandwidth:* dc to 150 MHz *Sensitivity:* 2 mV *Horizontal Sensitivity:* 50 ns/division	Tektronix, Model 2445
Cables	*Connectors:* 50Ω BNc	Any common source

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SECTION 2
SYSTEM DESCRIPTION AND TROUBLESHOOTING

2-1 INTRODUCTION

This section provides system and subsystem level descriptions (circuit descriptions, schematics, and block diagrams) and maintenance troubleshooting information for all models of the synthesizer. The material is arranged as follows:

- System level theory of operation and block diagram
- System level maintenance troubleshooting
- Individual subsystem level circuit descriptions, block diagrams, and schematics
- RF microwave deck configuration circuit descriptions and block diagrams
- Motherboard and cable interconnections

The following paragraphs provide an overall description of the major circuit subsystems that compose the synthesizer. Paragraphs 2-2 and 2-3 contain information about the mechanical and electrical construction and the content of the synthesizer. Paragraph 2-4 is an overview of the frequency synthesis functions. It includes the Reference Loop, Coarse Loop, Fine Loop, and YIG Loop. Paragraph 2-5 is a brief description of the Automatic Leveling Control (ALC) and modulation functions. Figure 2-1 (fold-out) is an overall block diagram of a typical synthesizer, and Figure 2-3 (fold-out) is a block diagram of the ALC and pulse modulation circuits.

Paragraph 2-6 and Tables 2-2 through 2-4 provide detailed system troubleshooting information. Table 2-2 is a listing of all hidden-key routines, useful in maintenance troubleshooting. Table 2-3 provides procedures for troubleshooting faults that do not cause error codes. Table 2-4 is a summary listing of error codes with their probable causes.

Subsections 2A through 2M provide detailed data on the individual subsystems. All subsystem circuit descriptions, block diagrams, and schematics are contained within that subsection. For example, all schematics and other descriptive data bearing on the power supply subsystem are contained within paragraphs 2A-x located in Subsection 2A. This includes the one page of the A28 Motherboard schematic that contains power supply circuitry.

2-2 INSTRUMENT MECHANICAL LAYOUT

The synthesizer contains 25-28 printed circuit boards (PCBs), a front panel assembly, a rear panel assembly, and a number of microwave components/microcircuits (mounted on the RF microwave deck). The exact number of PCBs contained in the instrument varies, depending upon the number of YIG Driver PCBs included for the specific model. The layout of the instrument with covers removed is shown in Figures 5-3 and 5-4 of Section 5–Parts Lists. The figures and parts lists contained in Section 5 for the major assemblies of the synthesizer identify the main components of each assembly.

2-3 CIRCUIT SUBSYSTEMS

The synthesizer circuitry consists of various distinct subsystems that are contained on one or more printed circuit board (PCB) assemblies or in microwave components located on the RF microwave deck of the synthesizer. The RF microwave deck comprises the subsystems listed below; a brief description of each subsystem is also included. The overall instrument block diagram shown in Figure 2-1 (page 2-18) reflects this organization.

2-3.1 Power Supply (A22, A25, A26 PCBs and p/o A28 PCB)

These PCBs supply regulated voltages to the synthesizer circuits. The subsystem consists of the A25 Switching Power Supply PCB, A26 Line Filter PCB, A22 Regulator PCB, and part of the A28 Motherboard PCB. Refer to Section 2A–Power Supply for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.2 Digital Control/GPIB Interface (A8, A23, and A24 PCBs)

This circuit subsystem provides microprocessor control and General Purpose Interface Bus (GPIB) functions. The microprocessor control portion consists of the A23 Microprocessor and the A8 Serial I/O PCBs. The GPIB functions, which allow the synthesizer to interface with an external network analyzer/control-

ler, are provided by the A24 GPIB PCB. Refer to Section 2B–Digital Control for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.3 Front Panel Assembly (A1 and A2 PCBs)

This circuit subsystem interfaces the front panel LCD displays, the LEDs, the keys, and the DEC/INCR knob to the A23 Microprocessor PCB. It consists of the A1 Front Panel PCB and the A2 Front Panel Control PCB. Refer to Section 2C–Front Panel for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.4 Inputs/Outputs (A27 PCB and p/o A29 PCB)

The A27 Auxiliary I/O PCB and the A29 Rear Panel Interface PCB contain the interface circuitry for most of the front and rear panel input/output connectors, including the AUX I/O connector. Refer to Section 2D–Inputs/Outputs for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.5 Frequency Synthesis Subsystem–RF Casting (A3-A7, A9-A12, A16 PCBs and A30, A31 Assys)

This circuit subsystem provides the reference frequencies and phase lock circuits for precise control of the YIG-tuned oscillator frequencies. This subsystem is further divided into the four smaller subsystems described below.

- Reference Loop – provides the overall reference for the rest of the frequency synthesis subsystem. It consists of the 10 MHz Crystal Oscillator assembly, the A5 Reference Oscillator PCB, the A7 Reference Divider PCB, and the A10 Reference Buffer PCB. Refer to paragraph 2-4 for a functional overview and to Section 6G–Reference Loop for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.
- Coarse Loop – provides the coarse tuning frequencies for the YIG Loop. It consists of the A3 Coarse Loop Mixer PCB, the A4 Coarse Loop Oscillator PCB, and the A6 Coarse Loop Divider PCB. Refer to paragraph 2-4 for a funtional overview and to Section 2F–Coarse Loop for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.
- Fine Loop – provides the fine tuning frequencies for the YIG Loop. It consists of the A9 Fine Loop Oscillator PCB and the A11 Fine Loop Divider PCB. Refer to paragraph 2-4 for a functional overview and to Section 2G–Fine Loop for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.
- YIG Loop/FM – performs phase detection of the YIG-tuned oscillator output frequency and provides the correction voltages to fine tune and phase lock the YIG-tuned oscillator. This loop also includes circuitry for FM modulation of the YIG-tuned oscillator by external FM input signals. It consists of the A12 YIG Phase Detector PCB, the A16 FM PCB, the A30 Sampler/IF Amplifier Assy, and the A31 Power Amplifier Assy. Refer to paragraph 2-4 for a functional overview and to Section 2H–YIG Loop/FM for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.6 Analog Instruction (A17 PCB)

The A17 Analog Instruction PCB provides the analog sweep ramp and tuning voltages to coarse tune the YIG-tuned oscillators. It also contains the digital voltmeter (DVM) and power meter circuitry. The DVM interfaces with the A23 Microprocessor and the various analog circuits of the synthesizer. Refer to Section 2I–Analog Instruction for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.7 YIG Drivers (A18-A21 PCBs)

These PCBs provide the main tuning-current and bias voltages for the YIG-tuned oscillators. The actual number of these PCBs depends on the frequency coverage of the synthesizer model. Refer to Section 2J–YIG Drivers for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.8 ALC/Pulse Modulation (A13, A15 PCBs and p/o A29 PCB)

This subsystem provides level control of the RF output power, AM modulation, pulse modulation, and multiplexing of the YIG-tuned oscillator RF outputs. It consists of the A15 ALC PCB, the A13 Pulse Generator PCB, and part of the A29 Rear Panel Interface

PCB. Refer to Section 2K–ALC/Pulse for circuit descriptions, block diagrams, PCB parts locator diagrams, and schematics.

2-3.9 RF Microwave Deck

The shaded circuit elements shown in Figure 2-1 are related to the generation, modulation and control of sweep- and CW-frequency RF signals. These circuit elements include: YIG-tuned oscillators, 0.01 to 2 GHz Down Converter, Control Modulators, Switched Filter, PIN Switches, Directional Coupler/Level Detector, Frequency Doubler Amplifier/Modulator, and Step Attenuator. Refer to Section 2L–Microwave Deck for detailed descriptions of the microwave components, parts locator diagrams, and block diagrams of the various frequency band configurations.

2-3.10 Motherboard/Interconnections (A28 PCB)

The A28 Motherboard PCB and its associated cables provide the interconnections between the internal components and the assemblies throughout the synthesizer. Refer to Section 2M–Motherboard/Interconnections for a description of the A28 PCB, a parts locator diagram, schematics, and interconnection diagrams.

2-4 FREQUENCY SYNTHESIS CIRCUITS, FUNCTIONAL DESCRIPTION

The frequency synthesis circuits provide phase-lock control for the synthesizer output frequency. These circuits, comprising four loops, are distributed over 11 PCBs and two assemblies. The overall block diagram of these circuits is shown in Figure 2-2. The operation of the four loops, Reference, Coarse, Fine, and YIG, is described briefly in paragraph 2-4.1 below.

The four phase-lock loop subsystems, operating together, produce an accurately synthesized, low-noise RF output signal. The output frequency is selectable in 1 kHz increments from 10 MHz to 26.5 GHz, in 2 kHz increments from 26.5 to 40 GHz, and in 3 kHz increments from 40 to 60 GHz. The output signal is ultimately derived from a single precision 10 MHz internal reference.

YIG-tuned oscillators are used to produce the actual RF output signal. Several YIG-tuned oscillators, each tunable over a different frequency range, may be installed to give the synthesizer broad frequency coverage (Figure 2-1). Only one YIG-tuned oscillator is active at any given time. Refer to Table 2L-2 (in Section 2L) for a listing of the frequency coverage and RF microwave deck configuration of each synthesizer model.

2-4.1 Overall Operation

The YIG-tuned oscillator (Figure 2-2) generates a high-power RF output signal that has low broadband noise and low spurious content. Main tuning coil current from the YIG Driver PCB coarsely tunes the YIG-tuned oscillator to within a few megahertz of the final output frequency. The YIG phase-lock loop is then used to fine-tune the YIG-tuned oscillator to the exact output frequency and to reduce FM noise close to the carrier.

One input to the YIG-loop Sampler/IF Amplifier is a 220 to 245 MHz signal. The signal is derived from the 440 to 490 MHz coarse loop oscillator output by the Power Amplifier/Multiplier. This signal drives the step-recovery diode, which is part of the Power Amplifier/Multiplier, to produce harmonics of the coarse-loop signal (1.98 to ≈ 40 GHz). These harmonics are used by the sampler circuits of the Sampler/IF Amplifier.

The other input to the Sampler/IF Amplifier is a sample of RF output signal from the YIG-tuned oscillator. Mixing this RF output signal sample with the adjacent coarse-loop harmonic produces a low frequency difference signal which is the YIG IF signal (20-32.1 MHz).

The synthesizer's microprocessor programs the coarse-loop oscillator's output frequency so that one of its harmonics will be within 20 to 32.1 MHz of the desired YIG-tuned oscillator's output frequency. The YIG Phase Detector compares the YIG IF signal to a 20 to 32.1 MHz frequency reference signal that is derived from the 200 to 321 MHz fine-loop oscillator output. The YIG phase detector fine tunes the YIG-tuned oscillator via the YIG FM coil driver to eliminate any frequency difference between the two signals. The resulting YIG-tuned oscillator output frequency is equal to the frequency of the selected coarse-loop harmonic plus $^1/_{10}$ the frequency of the fine-loop signal.

Phase locking the synthesizer's output frequency over a broad frequency range is accomplished by programming the coarse-loop oscillator's output to various frequencies that have harmonics close to the

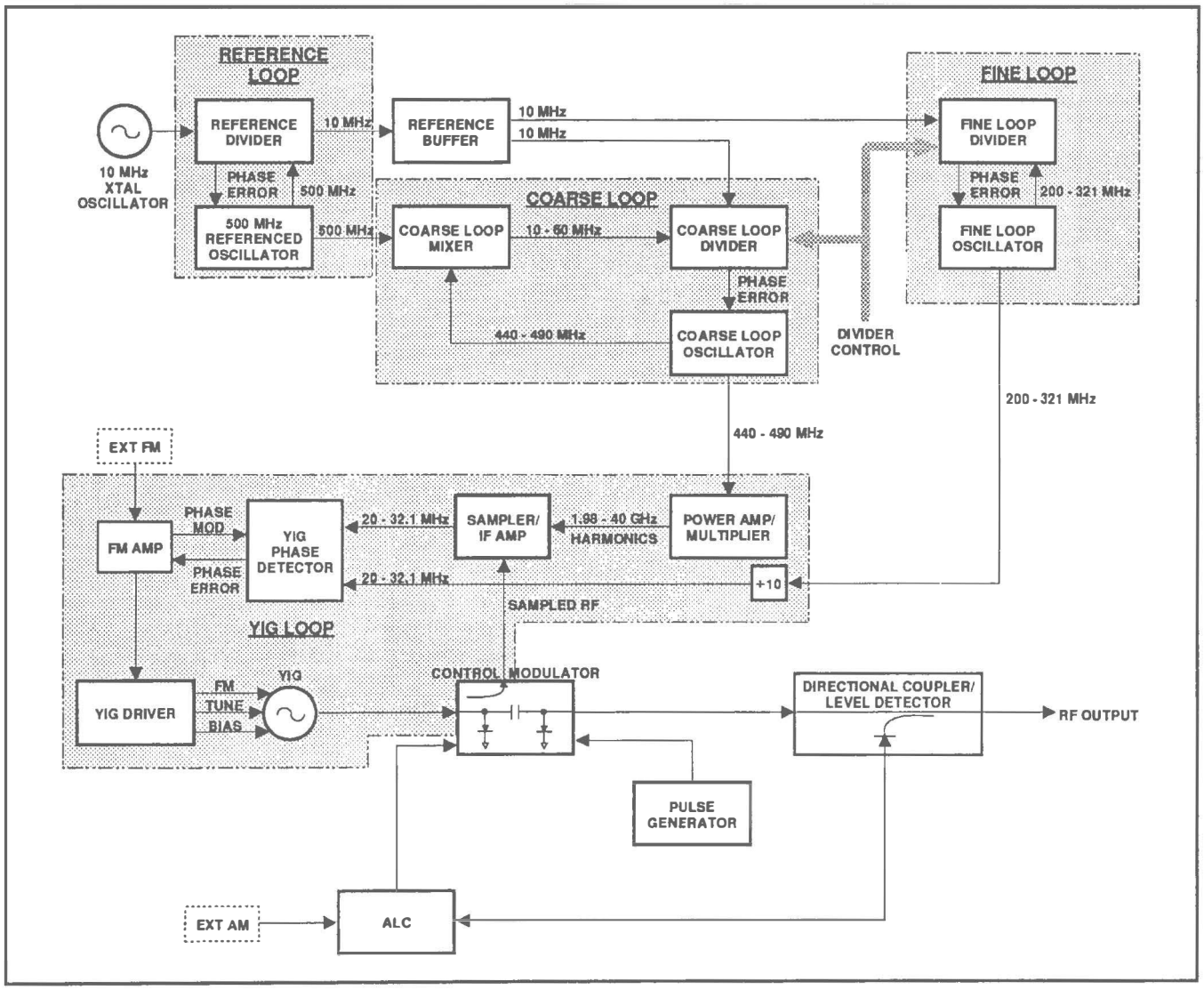


Figure 2-2. Block Diagram of Frequency Synthesis, ALC, and Modulation Circuits

desired operating frequencies. Exact frequency tuning for each desired operating frequency is accomplished by programming of the fine-loop oscillator. (In each case, the YIG-tuned oscillator is first tuned via its main tuning coil to the approximate desired operating frequency.)

The programming (tuning) range of the coarse-loop oscillator provides harmonics in the range of ≥1.98 GHz to ≈40 GHz. The harmonic signal spacing varies throughout this range from 1 MHz to 12 MHz. An example of this is shown in Table 2-1. Thus, any YIG output frequency can be downconverted to a YIG IF signal between 20 to 32.1 MHz. Since the coarse-loop output is synthesized, its frequency can be adjusted only in finite steps. The resulting harmonic steps may be as large as 12.1 MHz at high frequencies.

The YIG loop is fine tuned by varying the 20 to 32.1 MHz reference frequency signal applied

Table 2-1. Example of Coarse-Loop Tuning Range vs Harmonic Spacing

Desired YIG Freq In GHz	1/2 Coarse-Loop Freq In MHz	Harmonic Number	Harmonic Freq In GHz
2.000	220	9	1.980
2.198	242	9	2.178
2.220	220	10	2.200

to the YIG loop phase detector. This signal is derived by dividing the fine-loop oscillator signal by a factor of 10. By programming the fine-loop oscillator, this signal can be adjusted in 1 kHz increments over a 20 to 32.1 MHz range. The resolution of the fine-loop oscillator (hence the resolution of the RF output signal) is 1 kHz, which is much finer resolution than is available from the coarse-loop alone.

NOTE

Whenever the synthesizer is operating in the phase-locked mode, the frequency of the YIG IF will always equal $^1/_{10}$ the frequency of the fine-loop oscillator.

For applications requiring a resolution finer than 1 kHz, an external 20 to 32.1 MHz synthesizer can be connected at the rear panel to substitute for the internal fine-loop signal. The tuning resolution is then determined by the resolution of the external synthesizer.

The Coarse Loop and Fine Loop outputs are derived from high-stability 10 MHz and 500 MHz signals produced by the Reference Loop circuits. The 500 MHz oscillator frequency of the Reference Loop oscillator is precisely stabilized by locking it to the internal or external 10 MHz frequency standard.

2-4.2 RF Outputs 0.01 to 60 GHz

Refer to the shaded portion of Figure 2-1 for the following description. Four YIG-tuned oscillators are used to generate the fundamental RF output frequencies of 2.0 to 26.5 GHz, as follows:

- The S/C-Band YIG-tuned oscillator generates the fundamental RF output frequencies of 2.0 to 8.4 GHz (Band 1).
- The X-Band YIG-tuned oscillator generates the fundamental RF output frequencies of 8.0 to 12.4 GHz (Band 2).
- The Ku-Band YIG-tuned oscillator generates the fundamental RF output frequencies of 12.4 to 20 GHz (Band 3).
- The K-Band YIG-tuned oscillator generates the fundamental RF output frequencies of 18 to 26.5 GHz (Band 4).

All other frequencies output by the 67XXB synthesizers are derived from the fundamental frequencies generated by the S/C- and Ku-Band YIG-tuned oscillators.

RF output frequencies of 0.01 to 2.0 GHz (Band 0) are developed by downconverting the fundamental frequencies of 6.01 to 8.0 GHz, generated by the S/C Band YIG-tuned oscillator, using a 6.0 GHz local oscillator signal that is phase locked to the 500 MHz Reference Loop oscillator. Precise control of the Band 0 frequencies to 1 kHz accuracy is accomplished by phase-lock control of the 6.01 to 8.0 GHz fundamental frequencies prior to downconverting.

Frequency doubling of the fundamental frequencies of 13.25 to 20 GHz, generated by the Ku-Band YIG-tuned oscillator, is used to produce the 26.5 to 40 GHz frequency band (Band 5). Phase-lock control of the 13.25 to 20 GHz fundamental frequencies, accomplished prior to their doubling, ensures precise control of the Band 5 frequencies to 2 kHz accuracy.

RF output frequencies of 40 to 60 GHz (Band 6) are developed by tripling the fundamental frequencies of 13.33 to 20 GHz generated by the Ku-Band YIG-tuned oscillator. Precise control of the Band 6 frequencies to 3 kHz accuracy is accomplished by phase-lock control of the 13.33 to 20 GHz fundamental frequencies prior to tripling.

2-4.3 FM Modulation

FM modulation of the YIG-tuned oscillator RF output by external signals is performed by summing the external signals into the FM control path of the YIG loop. Refer to Figures 2-1 and 2-2; FM inputs from the front panel and rear panel are routed via the A28 Motherboard PCB to the FM Amplifier circuits located on the A16 FM Driver PCB. These circuits frequency modulate the YIG signal by controlling the YIG-tuned oscillator's FM coil in the same manner as for the phase lock error signal from the YIG loop phase detector circuits.

2-4.4 Sweep Mode of Operation

Analog sweeps of the YIG-tuned oscillator RF output that are less than 50 MHz wide are accomplished by summing the appropriate analog sweep ramp signals, generated by the A17 Analog PCB, into the FM control path of the YIG loop. In this mode of operation, the YIG-tuned oscillator RF output is swept about a center frequency that has been set via the appropriate YIG Driver PCB's main tuning coil circuitry. The phase-locking of the YIG loop is disabled except during frequency correction, which occurs during sweep retrace.

Broadband analog sweeps (≥50 MHz wide) of the YIG-tuned oscillator RF output are accomplished by applying appropriate sweep ramp signals generated by the A17 Analog Instruction PCB to the YIG-tuned oscillator's main tuning coil (via the appropriate A18-A21 YIG Driver PCB). The A23 Microprocessor controls the A17 PCB to produce precisely controlled *start* and *stop* frequencies. For those analog sweeps that cross over one or more YIG-tuned oscillator bands, the microprocessor controls the generation and timing of the ramp signals from the A17 PCB and the selection of the appropriate A18-A21 YIG Driver PCB(s) throughout the sweep.

2-5 ALC AND MODULATION CIRCUITS, FUNCTIONAL DESCRIPTION

The ALC and modulation circuits provide automatic level control (ALC), AM modulation and pulse modulation of the synthesizer's RF output signal. The ALC loop is comprised of circuits, located on the A15 ALC PCB and part of the A29 Rear Panel Interface PCB, that interface with the Control Modulator and Directional Coupler/Level Detector components located on the RF microwave deck (Figure 2-1). AM modulation circuits (located on the A15 ALC PCB) are included in this loop.

Pulse modulation of the synthesizer's RF output signal is provided by circuits located on the A13 Pulse Generator PCB. These circuits interface directly with the Control Modulator components located on the RF microwave deck (Figure 2-1).

The overall block diagram of the ALC and pulse modulation circuits is shown in Figure 2-3 (page 2-20). The operation of these circuits is described briefly in the paragraphs that follow.

2-5.1 ALC Loop Operation

The ALC circuitry located on the A15 PCB controls the RF power output level of the synthesizer as follows. A portion of the RF output is detected and coupled out of the Directional Coupler/Level Detector as an input to the ALC loop. The detected RF sample is routed to the A15 ALC PCB. The RF sample is compared with a *reference voltage* that represents the desired RF power output level. If the two voltages do not match, an error correction signal is fed from the A15 ALC PCB to the PIN shaper/driver circuits located on the A29 PCB. The resulting PIN driver current output causes the PIN level control diodes, located in the Control Modulator, to adjust the RF output level accordingly. Thus, the detected RF voltage will be set equal to the RF reference voltage.

NOTE

The synthesizer uses two internal level detection circuits. For frequencies <2 GHz, the level detector is part of the Down Converter and the RF sample is amplified by the A15 Band 0 Detector Preamplifier. For frequencies ≥2 GHz, the level detector is part of the main Directional Coupler and the RF sample is amplified by the A15 Band 1-4 Detector Preamplifer.

The RF level reference voltage is produced by summing a precision dc reference voltage with the output from the Range and Level DACs, which are controlled by the A23 Microprocessor. By setting the output of these DACs to the appropriate voltage, the Microprocessor adjusts the RF output power to the level selected by the user. The desired output level may be set throughout a 12 dB range (standard) using either the front panel switches or the GPIB. For those units with the 110 dB attenuator (Options 2A , 2B, and 2C) the output level range is 0–122 dB.

a. External Leveling

In the external leveling mode of operation, an external detector is used to monitor the RF power output level of the synthesizer instead of an internal level detector. The external detector RF signal is sent to the A15 ALC PCB from the front panel input via a preamplifier located on the A2 Front Panel Control PCB. The ALC controls the RF power output as previously described.

b. Power Sweep

In this mode of operation, the A23 Microprocessor controls the ALC circuitry to step the RF output signal through a range of output levels specified by the user. This feature can be used in conjunction with the sweep mode to produce a set of identical frequency sweeps, each with a different RF power output level.

c. AM Modulation

To provide AM modulation of the RF output signal, the external AM modulation signal from the front or rear panel inputs is summed with the precision dc reference voltage to produce a RF reference voltage that varies with the external modulation signal. The action of the ALC leveling loop then causes the envelope of the RF output signal to match the external modulation signal.

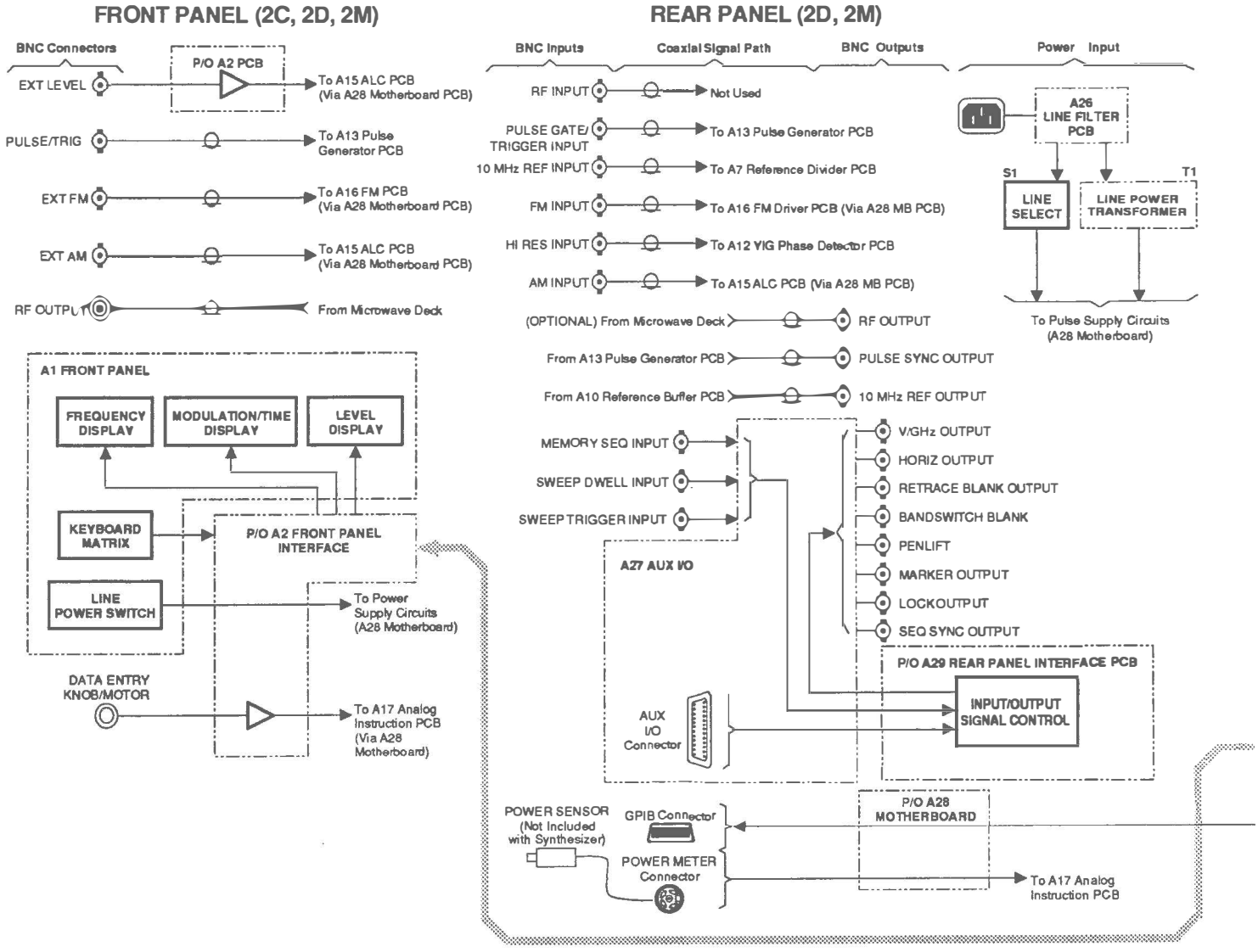
d. Pulse Modulation Operation

During pulse modulation, the ALC loop amplifier (A15 PCB) is operated as a sample/hold amplifier. This amplifier is synchronized with the modulating pulse from the A13 Pulse Generator PCB so that the ALC loop effectively operates only on the *ON* portion of the pulsed RF output waveform.

2-5.2 A13 Pulse Generator PCB Operation

The A13 PCB provides the internal pulse generating function for the synthesizer and interfaces the external pulse signal source to the pulse generation and PIN driver circuits in the external modes. The 67XXB has four pulse modes of operation:

- Internal pulse modulation mode (+ or –) – The pulse modulation waveform is generated and timed internally.
- External pulse mode – The external pulse source signal from the front or rear panel connectors is interfaced directly to the pulse modulation PIN driver circuits.
- External triggered mode – The internally generated modulating pulse waveform is triggered by the external pulse source signal.
- External gated mode– The external pulse source gates the internal pulse generator on and off.


FRONT PANEL (2C, 2D, 2M)
BNC Connectors
P/O A2 PCB
EXT LEVEL
To A15 ALC PCB (Via A28 Motherboard PCB)
PULSE/TRIG
To A13 Pulse Generator PCB
EXT FM
To A16 FM PCB (Via A28 Motherboard PCB)
EXT AM
To A15 ALC PCB (Via A28 Motherboard PCB)
RF OUTPUT
From Microwave Deck
A1 FRONT PANEL
FREQUENCY DISPLAY
MODULATION/TIME DISPLAY
LEVEL DISPLAY
KEYBOARD MATRIX
P/O A2 FRONT PANEL INTERFACE
LINE POWER SWITCH
To Power Supply Circuits (A28 Motherboard)
DATA ENTRY KNOB/MOTOR
To A17 Analog Instruction PCB (Via A28 Motherboard)
REAR PANEL (2D, 2M)
BNC Inputs
Coaxial Signal Path
BNC Outputs
Power Input
RF INPUT
Not Used
PULSE GATE/ TRIGGER INPUT
To A13 Pulse Generator PCB
10 MHz REF INPUT
To A7 Reference Divider PCB
FM INPUT
To A16 FM Driver PCB (Via A28 MB PCB)
HI RES INPUT
To A12 YIG Phase Detector PCB
AM INPUT
To A15 ALC PCB (Via A28 MB PCB)
(OPTIONAL) From Microwave Deck
RF OUTPUT
From A13 Pulse Generator PCB
PULSE SYNC OUTPUT
From A10 Reference Buffer PCB
10 MHz REF OUTPUT
A26 LINE FILTER PCB
S1
T1
LINE SELECT
LINE POWER TRANSFORMER
To Pulse Supply Circuits (A28 Motherboard)
MEMORY SEQ INPUT
SWEEP DWELL INPUT
SWEEP TRIGGER INPUT
V/GHz OUTPUT
HORIZ OUTPUT
RETRACE BLANK OUTPUT
BANDSWITCH BLANK
PENLIFT
MARKER OUTPUT
LOCK OUTPUT
SEQ SYNC OUTPUT
A27 AUX I/O
P/O A29 REAR PANEL INTERFACE PCB
AUX I/O Connector
INPUT/OUTPUT SIGNAL CONTROL
POWER SENSOR (Not Included with Synthesizer)
GPIB Connector
POWER METER Connector
P/O A28 MOTHERBOARD
To A17 Analog Instruction PCB

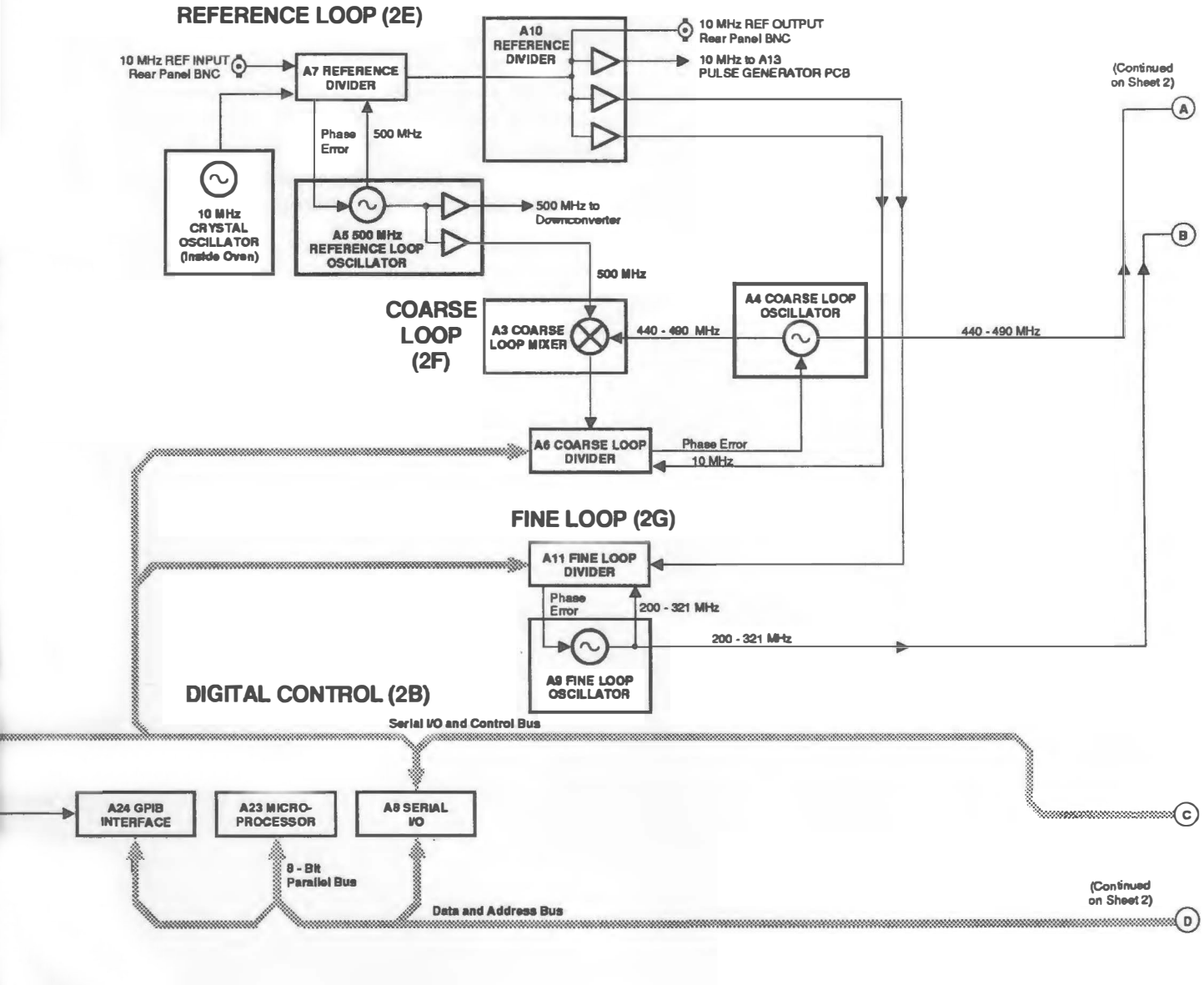
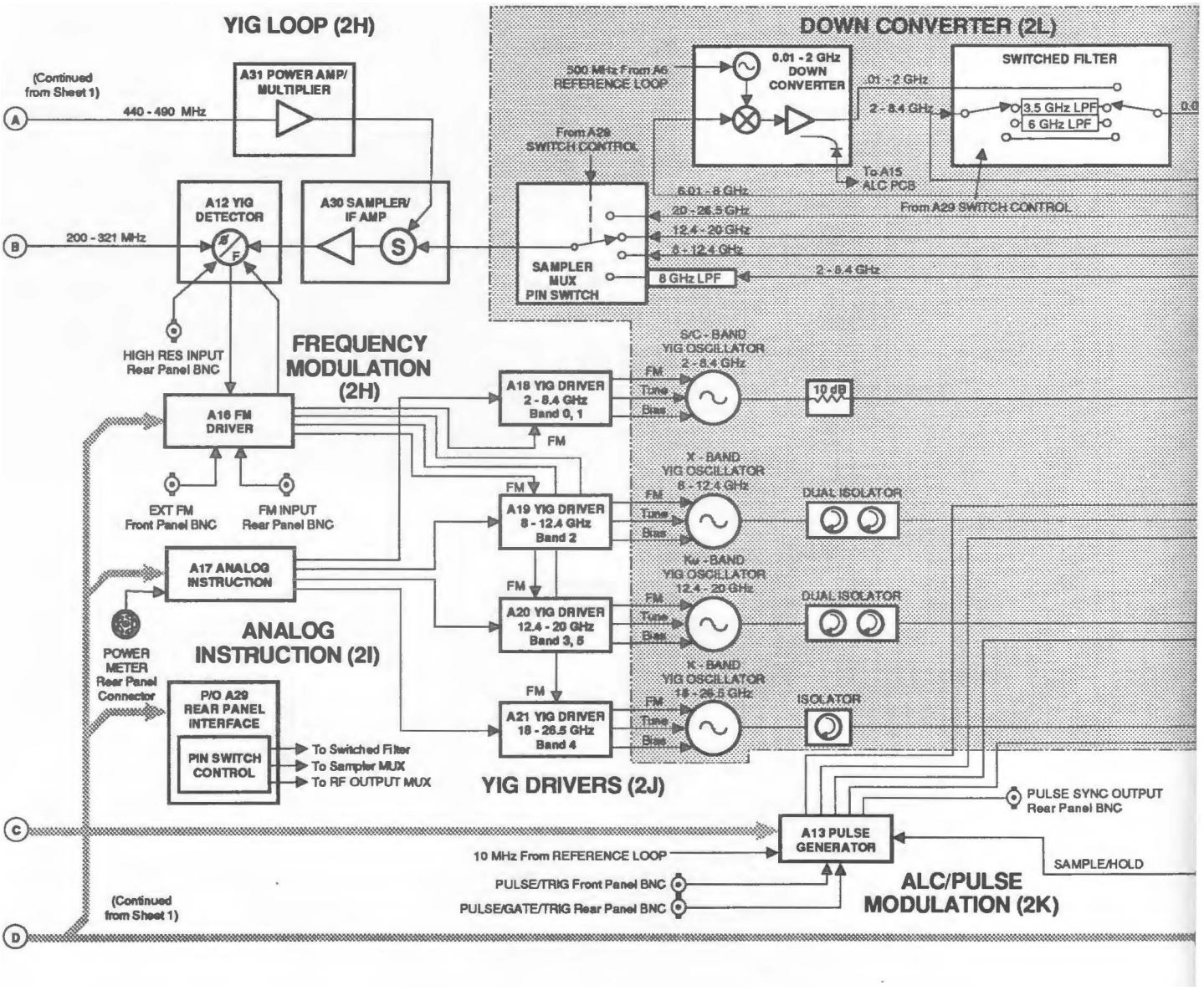


Figure 2-1. Typical 67XXB Swept Frequency Synthesizer, Block Diagram Showing Bands 0 Through 4 (Sheet 1 of 2)


YIG LOOP (2H)
DOWN CONVERTER (2L)
(Continued from Sheet 1)
A31 POWER AMP/ MULTIPLIER
440 - 490 MHz
500 MHz From A6 REFERENCE LOOP
0.01 - 2 GHz DOWN CONVERTER
SWITCHED FILTER
.01 - 2 GHz
2 - 8.4 GHz
3.5 GHz LPF
6 GHz LPF
From A29 SWITCH CONTROL
To A15 ALC PCB
A12 YIG DETECTOR
A30 SAMPLER/ IF AMP
200 - 321 MHz
0.01 - 8 GHz
20 - 26.5 GHz
12.4 - 20 GHz
8 - 12.4 GHz
SAMPLER MUX PIN SWITCH
8 GHz LPF
2 - 8.4 GHz
HIGH RES INPUT Rear Panel BNC
FREQUENCY MODULATION (2H)
S/C - BAND YIG OSCILLATOR 2 - 8.4 GHz
A18 YIG DRIVER 2 - 8.4 GHz Band 0, 1
FM
Tune
Bias
10 dB
A16 FM DRIVER
X - BAND YIG OSCILLATOR 8 - 12.4 GHz
EXT FM Front Panel BNC
FM INPUT Rear Panel BNC
A19 YIG DRIVER 8 - 12.4 GHz Band 2
DUAL ISOLATOR
Ku - BAND YIG OSCILLATOR 12.4 - 20 GHz
A17 ANALOG INSTRUCTION
A20 YIG DRIVER 12.4 - 20 GHz Band 3, 5
POWER METER Rear Panel Connector
ANALOG INSTRUCTION (2I)
K - BAND YIG OSCILLATOR 18 - 26.5 GHz
ISOLATOR
P/O A29 REAR PANEL INTERFACE
PIN SWITCH CONTROL
A21 YIG DRIVER 18 - 26.5 GHz Band 4
To Switched Filter
To Sampler MUX
To RF OUTPUT MUX
YIG DRIVERS (2J)
PULSE SYNC OUTPUT Rear Panel BNC
A13 PULSE GENERATOR
10 MHz From REFERENCE LOOP
SAMPLE/HOLD
PULSE/TRIG Front Panel BNC
PULSE/GATE/TRIG Rear Panel BNC
ALC/PULSE MODULATION (2K)
(Continued from Sheet 1)
A
B
C
D

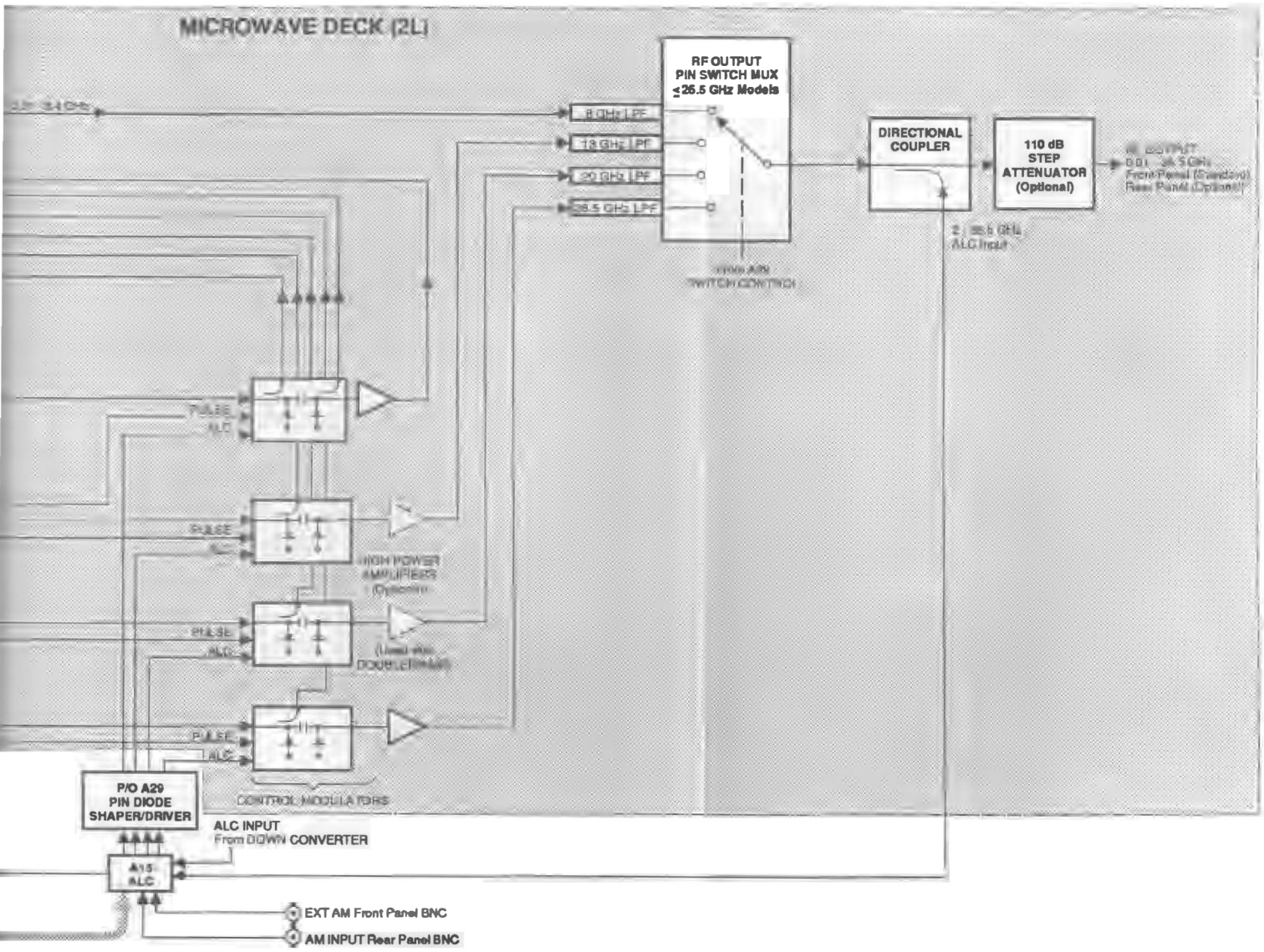
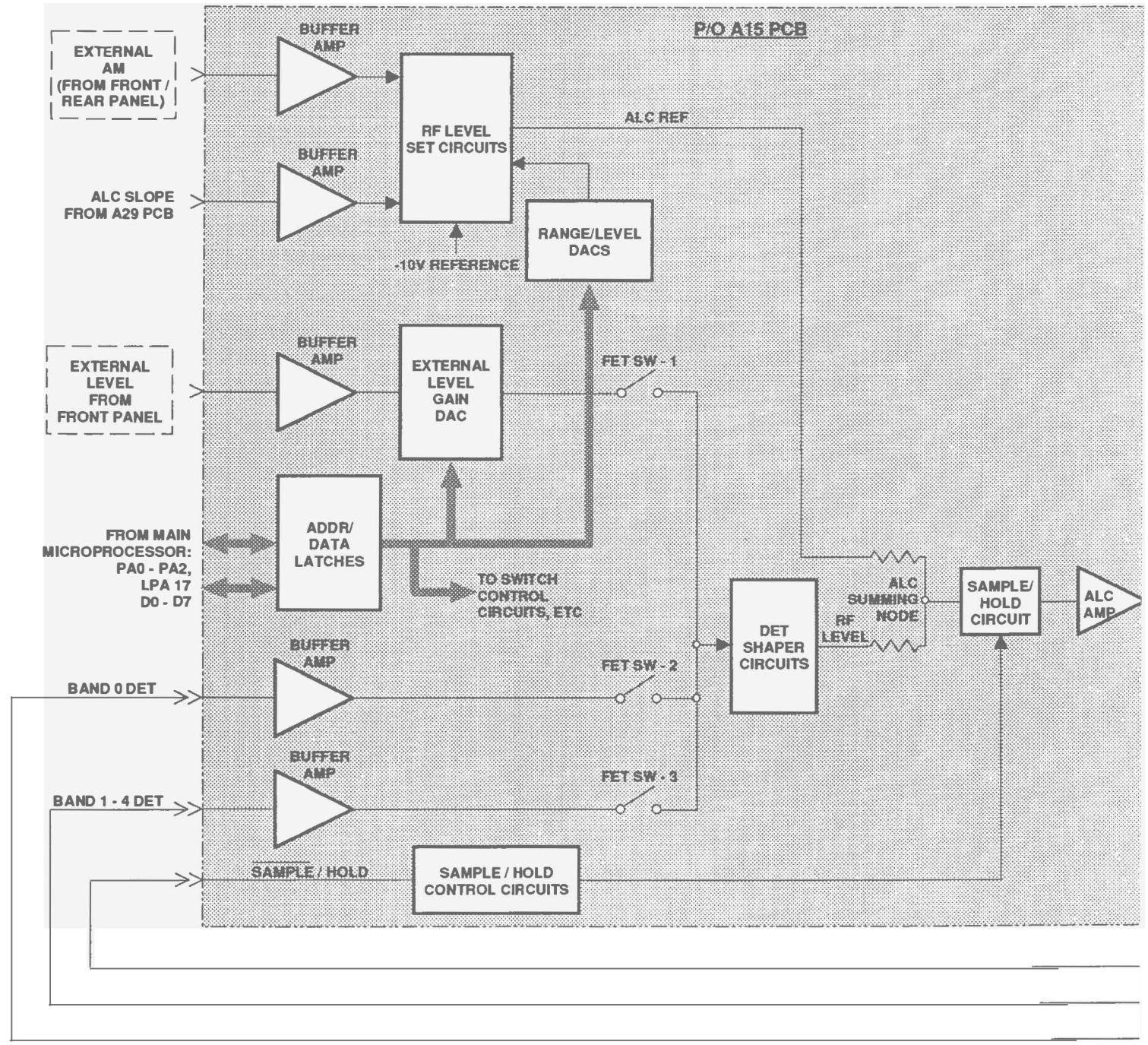


Figure 2-1. Typical 67XXB Swept Frequency Synthesizer, Block Diagram Showing Bands 0 Through 4 (Sheet 2 of 2)


P/O A15 PCB
EXTERNAL AM (FROM FRONT / REAR PANEL)
BUFFER AMP
RF LEVEL SET CIRCUITS
ALC REF
BUFFER AMP
ALC SLOPE FROM A29 PCB
RANGE/LEVEL DACS
-10V REFERENCE
EXTERNAL LEVEL FROM FRONT PANEL
BUFFER AMP
EXTERNAL LEVEL GAIN DAC
FET SW - 1
FROM MAIN MICROPROCESSOR: PA0 - PA2, LPA 17 D0 - D7
ADDR/ DATA LATCHES
TO SWITCH CONTROL CIRCUITS, ETC
ALC SUMMING NODE
RF LEVEL
DET SHAPER CIRCUITS
SAMPLE/ HOLD CIRCUIT
ALC AMP
BUFFER AMP
FET SW - 2
BAND 0 DET
BUFFER AMP
FET SW - 3
BAND 1 - 4 DET
SAMPLE / HOLD
SAMPLE / HOLD CONTROL CIRCUITS

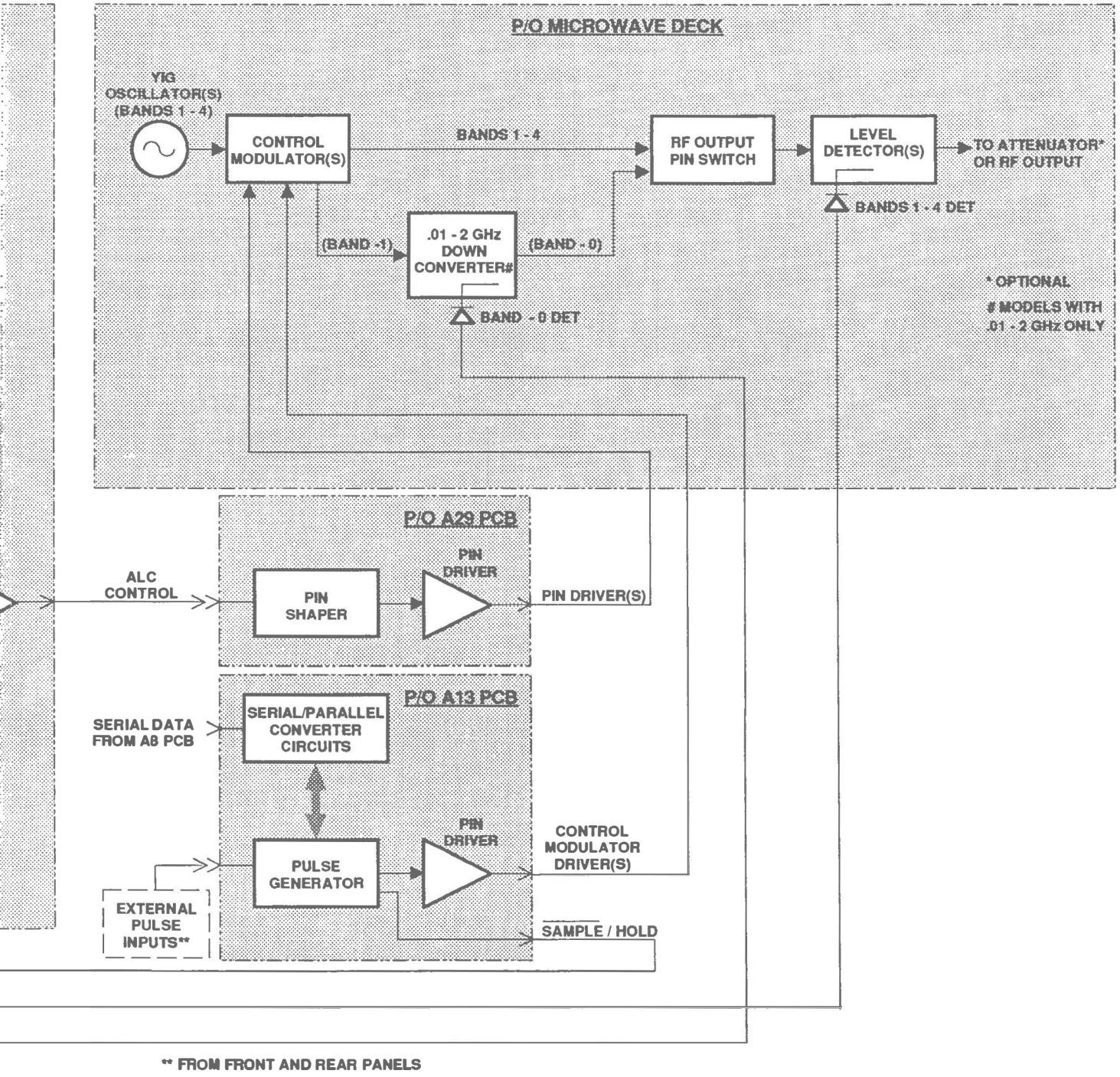


Figure 2-3 Overall Block Diagram of ALC and Modulation Circuits

2-6 SYSTEM TROUBLESHOOTING

The synthesizer contains firmware that generates hidden-key routines and error codes that aid in troubleshooting instrument failures to the replaceable subassembly level. This section provides a tabular listing of the hidden-key routines used for maintenance troubleshooting and the error codes along with their possible causes. Troubleshooting procedures for faults that do not produce error codes are also provided.

NOTE

WILTRON recommends that you upgrade your instrument's operating firmware to the latest available version. Although the error codes and hidden-key routines cited herein may have been implemented in earlier versions of firmware, newer firmware versions contain upgraded testing and calibration techniques that will maximize the performance of your instrument. Contact the WILTRON Customer Service department at (408) 778-2000 for further details.

2-6.1 HIDDEN-KEY ROUTINES

The <Shift> TRIGGER key in conjunction with a 3 digit code implements hidden-key routines. These routines are used for calibration, troubleshooting, and implementation of some synthesizer functions. Table 2-2 provides descriptions of the hidden-key routines useful in maintenance troubleshooting. Once a hidden-key routine has been activated, the keys used (except for the DATA ENTRY keypad) have different functions than are indicated by the front panel markings.

The 300- and 400-series of <Shift> TRIGGER codes enable hidden-key routines used for calibration or to check out DACs prior to calibration. Refer to Section 3 of the 67XXB Test and Calibration manual for your particular instrument model before attempting to use these codes for maintenance troubleshooting.

2-6.2 TROUBLESHOOTING FAULTS THAT DO NOT PRODUCE ERROR CODES

Since the synthesizer must run a self test to generate error codes, faults that cause the instrument to be non-operational do not produce error codes. These faults generally are failure to power up properly, unexpected shutdown, and front panel lock up. Table 2-3 provides troubleshooting procedures for these types of failures along with their most probable causes.

2-6.3 ERROR CODES

During normal operation, a self test runs automatically as part of the instrument turn-on process. If there is a failure during the self test, an error code is generated and displayed in the FREQUENCY LCD display area. This alerts the operator to the failure and aids in troubleshooting the failure to a replaceable subassembly.

In addition, a self test of specific subsystems or subassemblies may be invoked at anytime by using the appropriate hidden-key routine as described in paragraph 2-6.1 and Table 2-2.

Table 2-4 provides a summary listing of the error codes along with descriptions and probable causes. This table makes reference to the circuit descriptions, block diagrams, and schematics located in the various subsystem sections of the manual. This additional data will assist you in further isolating failures to the replaceable subassembly or RF component.

2-6.4 MASTER RESET FUNCTION

This function causes the non-volatile RAM on the A23 Microprocessor PCB to be erased and reprogrammed with default data. In addition to being used to overwrite the non-volatile RAM, the function is used to cancel the <Shift> TRIGGER 004 hidden-key function and as a troubleshooting diagnostic aid. To perform a master reset, proceed as follows:

a. With the 67XXB in STANDBY, press and hold the RF ON/RF OFF key.
b. Press the LINE STANDBY/OPERATE key to turn the instrument on. After the displays blank and the self test starts, release the RF ON/RF OFF key.

NOTE

The master reset function overwrites all information stored in the non-volatile RAM, including the nine stored front panel setups with their default values. Whenever a master reset is performed, the error code E23-10 may occur on self test.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (1 of 6)

<Shift> TRIGGER Code	Function
000	Enables the security function that turns off the FREQUENCY and MODULATION displays. It is disabled by a reset.
001	Enables the security function that turns off all of the front panel displays. It is disabled with a reset.
002	Enables the external high-resolution mode. It is turned off by a reset or <Shift> TRIGGER 003.
003	Disables the external high-resolution mode.
004	Makes the non-volatile RAM act like standard RAM on POWER OFF/ON. It is disabled with a master reset (para 2-6.4).
008	Enables the entry or display of the instrument serial number in the FREQUENCY display window.
009	Enables the display of the current operating firmware and GPIB firmware version numbers in the FREQUENCYdisplay window. Pressing the <Shift> key exits this function.
010	Enables the display of the Reference Loop frequency in the FREQUENCY display window and the tuning voltage in the LEVEL display window.
011	Enables direct control of the Fine Loop. The frequency is displayed in the FREQUENCY display window and the tuning voltage is displayed in the LEVEL display window. Changes to the Fine Loop frequency are made with DATA ENTRY keypad inputs.
012	Enables direct control of the Coarse Loop. The frequency is displayed in the FREQUENCY display window and the tuning voltage is displayed in the LEVEL display window. Changes to the Coarse Loop frequency are made with DATA ENTRY keypad inputs.
013	Provides normal RESET key operation (resets with default power and RF on). This is the default setting.
014	Suppresses the output-power level when RESET key is pressed. The level-value is not reset. Pressing LEVEL 1 or LEVEL 2 following a RESET returns output power to the value last set before the RESET key was pressed.
015	Turns off the digital level-vs-frequency correction. This is the same as sending LC0 over the GPIB. Reset removes the condition.
016	Turns on the digital level-vs-frequency correction. This is the same as sending LC1 over the GPIB. This is the default setting.
019	Executes the display test that is part of self test. The test turns on all the LEDs and all segments of the LCD displays continuously. Unit must be turned off to terminate this test.
020	Executes the Microprocessor test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
021	Executes the A17 DVM test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
022	Executes the power supply and A22 voltage regulator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
023	Executes the A8 serial I/O test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
024	Executes the A17 ramp generator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
025	Executes the A13 pulse generator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
026	Executes the A16 FM PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (2 of 6)

<Shift> TRIGGER Code	Function
027	Executes the A17 Analog Instruction PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
028	Executes the A15 ALC PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
029	Executes the A15 leveling loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
030	Executes the A15 ALC test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
031	Executes the A5 reference oscillator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
032	Executes the A9, A11 Fine Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
033	Executes the A3, A4, A6 Coarse Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
034	Executes the A12, A16 YIG Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
035	Executes the A24 GPIB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
080	Unlocks the synthesizer. Mainly used for unlocked FM mode where it is possible to get up to a 25 MHz deviation. It is disabled by reset or <Shift> TRIGGER 081.
081	Disables hidden-key routine 080. Resets the synthesizer to normal locking.
089	Enables access to hidden-key routines that have <Shift> TRIGGER codes from 300 to 599. These routines are used for calibration or to check out the DACs to be calibrated. (Refer to the 67XXB Test and Calibration manual, Section 3,Table 3-3 for a listing these hidden-key routines.)
101	Selects RF level to be on during frequency switching in the CW or step sweep modes (except bandswitch points).
102	Selects RF level to be off during frequency switching in the CW or step sweep modes only. The RF is blanked before starting a frequency change and enabled when the RF is within approximately 1 kHz of the final frequency.
103	Turns RF on during sweep retrace.
104	Turns RF off during sweep retrace. Has no effect in manual or external sweep mode when the RF is always on.
105	Selects ac coupling for the front panel EXT AM input and the rear panel AM INPUT.
106	Selects dc coupling for the front panel EXT AM input and the rear panel AM INPUT.
107	Turns RF on when a TTL-high signal is applied to the front panel PULSE/TRIG TTL input or to the rear panel PULSE/GATE/TRIG INPUT when the INTERNAL (PULSE) key is activated.
108	Turns RF on when a TTL-low signal is applied to the front panel PULSE/TRIG TTL input or to the rear panel PULSE/GATE/TRIG INPUT when the INTERNAL (PULSE) key is activated.
109	Selects a +5V output for the rear panel RETRACE BLANK OUTPUT and AUX I/O connector pin 6 and the rear panel BANDSWITCH BLANK and Aux i/O connector pin 20.
110	Selects a –5V output for the rear panel RETRACE BLANK OUTPUT and AUX I/O connector pin 6 and the rear panel BANDSWITCH BLANK and AUX I/O connector pin 20.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (3 of 6)

<Shift> TRIGGER Code	Function
115	Turns on the internally-gated pulse modulation mode of operation.
116	Turns off the internally-gated pulse modulation mode of operation.
135	Sets the ALC loop to the fixed gain (unleveled) mode. In this mode the power level is controlled by the ALC Level DAC. At +10 dBm in the LEVEL display, the DAC is set to full scale (maximum power output). At 0 dBm in the LEVEL display, the DAC is set for minimum output.
136	Returns the synthesizer back to normal leveling by the ALC loop.
300	Enables direct control of the A17 PCB Tune DAC. No calibration is performed.
301	Enables direct control of the A17 PCB Linearizer DAC. No calibration is performed.
302	Enables direct control of the A15 PCB ALC Level DAC. No calibration is performed.
303	Enables direct control of the A15 PCB ALC Level Range DAC. No calibration is performed.
305	Enables direct control of the A15 PCB External ALC Gain DAC. No calibration is performed.
306	Enables direct control and calibration of the A15 PCB %AM DAC (AM Sensitivity).
307	Enables direct control of the A16 PCB FM Sensitivity Cal DAC (FM Driver Output). No calibration is performed.
308	Enables direct control and calibration of the A16 PCB FM Attn DAC (FM Input Sensitivity).
309	Enables direct control of the A15 PCB ALC Slope DAC. No calibration is performed.
310	Enables direct control of the A17 PCB Sweep Width DAC. No calibration is performed.
312	Enables direct control of the A17 PCB Sweep Time DAC. No calibration is performed.
313	Enables direct control of the A17 PCB Marker/Switch Point DAC. No calibration is performed.
314	Enables direct control of the A29 PCB CW Horiz DAC. No calibration is performed.
315	Enables direct control of the A29 PCB V/GHz Slope DAC. No calibration is performed.
316	Enables direct control of the A29 PCB V/GHz Offset DAC. No calibration is performed.
317	Enables direct control and calibration of the A16 PCB Phase Mod Cal DAC (FM Flatness).
319	Enables direct control of the A17 PCB Linearizer DAC. No calibration is performed.
340	Calibrates the FM meter when there is no input voltage.
341	Calibrates the FM meter when there is a 1V peak (0.707 Vrms) input.
342	Calibrates the AM meter when there is no input voltage.
343	Calibrates the AM meter when there is a 1V peak (0.707 Vrms) input.
390	Zeros out the A17 PCB Linearizer DAC calibration.
391	Zeros out the frequency calibration for the C/S Band (2 to 8 GHz).
392	Zeros out the frequency calibration for the X Band (8 to 12.4 GHz).
393	Zeros out the frequency calibration for the Ku Band (12.4 to 20 GHz).
394	Zeros out the frequency calibration for the K Band (20 to 26.5 GHz).
395	Zeros out the A16 PCB FM Attn DAC (FM Input Sensitivity) calibration.
396	Zeros out the A15 PCB %AM DAC (AM Sensitivity) calibration.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (4 of 6)

<Shift> TRIGGER Code	Function
397	Generates memory checksum for the A23 PCB EEPROMs. Must be done anytime calibration of the instrument is performed to eliminate checksum errors.
398	Zeros out the AM meter calibration.
399	Zeros out the frequency calibration for the Ka Band (26.5 to 40 GHz).
400	Automatically calibrates the A16 PCB FM Sensitivity Cal DAC (FM Driver Output) for all installed frequency bands.
402	Calibrates the ALC bandwidth for each installed frequency band except for the Ka Band (26.5 to 40 GHz).
403	Automatically calibrates the analog sweep time, both the ≤1 second and >1 second ranges.
404	Automatically calibrates the A16 PCB FM Sensitivity Cal DAC (FM Driver Output) for all installed frequency bands.
405	Automatically calibrates the paths used by analog sweeps.
406	Automatically calibrates the pathes used by narrow band sweeps (analog sweeps of ≤50 MHz).
407	Calibrates the ALC slope for the <2 GHz (heterodyne band) and the ≥2 GHz frequency bands.
460	Calibrates the YIG output frequency for each band.
612	Sets the A17 DVM scale to 2. This makes the voltage range –20 to +20 Volts.
613	Disables hidden-key routine 612.
614	Sets the A17 DVM scale to 10. This makes the voltage range –100 to +100 Volts.
615	Disables hidden-key routine 614.
621	Sets A17 power meter gain = 1.
622	Sets A17 power meter gain = 10.
623	Sets A17 power meter gain = 100.
624	Sets A17 power meter gain = 1000.
625	Sets A17 power meter gain = 10000.
642	Selects +10 V reference for the A17 Tuning DAC.
643	Selects –10 V reference for the A17 Tuning DAC.
644	Set A17 Tuning gain to 4.
645	Set A17 Tuning gain to 1.
646	Set A17 gain 0 width path.
647	Set A17 gain 1 width path.
648	Set A17 gain 4 width path.
649	Disables the A17 ramp Integrator.
650	Enables the A17 ramp integrator.
651	Selects A17 sweep ramp of <1 sec.
652	Selects A17 sweep ramp of >1 sec.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (5 of 6)

<Shift> TRIGGER Code	Function
656	Clears the A17 dwell strobe.
657	Enables the A17 dwell strobe.
658	Disables the A17 dwell strobe.
659	Disable all the YIG-tuned oscillators.
660	Enable the CS band YIG-tuned oscillator.
661	Enable the X band YIG-tuned oscillator.
662	Enable the Ku band YIG-tuned oscillator.
663	Enable the K or Ka band YIG-tuned oscillator.
670	Sets A17 power meter amplifier A to gain of 1.
671	Sets A17 power meter amplifier A to gain of 10.
672	Sets A17 power meter amplifier A to gain of 100.
673	Sets A17 power meter amplifier B to gain of 1.
674	Sets A17 power meter amplifier B to gain of 10.
675	Sets A17 power meter amplifier B to gain of 100.
689	Enables access to and display of the Memory RAM.
692	Tests EEPROM U27.
693	Tests EEPROM U28.
694	Enables access to and display of EEPROM data.
695	Copies EEPROM U27 to U28.
697	Displays number of errors in EEPROM test.
699	Copies EEPROM U28 to U27.
703	Enables control of the A17 analog ramp and set it to the end.
704	Enables control of the A17 analog ramp and set it to the beginning.
730	Displays the tuning range of the Reference oscillator.
732	Displays the tuning range of the YIG Loop for the current band.
760	Checks the A17 DVM linearity.
761	Turns on the external DVM.
762	Turns on the internal DVM.
764	Activates the power meter test with fixed gain.
765	Deactivates the power meter test with fixed gain.
772	Removes the CW filter from the YIG Loop.
773	Places the CW filter in the YIG Loop.
778	Zeros out the frequency dynamic calibration.

Table 2-2. Descriptions of Hidden-Key Routines Useful in Maintenance Troubleshooting (6 of 6)

<Shift> TRIGGER Code	Function
791	Sweeps the A17 Tuning DAC in 100 step increments.
792	Sweeps the A17 Sweep Width DAC in 100 step increments.
793	Sweeps the A17 Tuning and Sweep Width DACs at the same time.
794	Sweeps the A17 Linearizer DAC.
795	Sweeps the A17 Breakpoint DAC.
796	Sweeps the A17 Sweep Time DAC.
797	Sweeps the A17 Switchpoint DAC.
798	Exercises the analog ramp in the open loop.
820	Causes a pause the external leveling calibration.
821	Stops the analog sweep at each dwell point. The microprocessor will stop the sweep just before it locks. Pressing <Shift> allows the sweep to continue to the next dwell point.
904	Disables the line/external trigger interrupt.
905	Enables the line/external trigger interrupt.
906	Disables the dwell interrupt.
907	Enables the dwell interrupt.
908	Disables the timer 2 interrupt.
909	Enables the timer 2 interrupt.
910	Disables the timer 1 interrupt.
911	Enables the timer 1 interrupt.
912	Disables the GPIB interrupt.
913	Enables the GPIB interrupt.
914	Disables the fast frequency change interrupt.
915	Enables the fast frequency change interrupt.
916	Disables the front panel interrupt.
917	Enables the front panel interrupt.
918	Disables the housekeeping interrupt.
919	Enables the housekeeping interrupt.

Table 2-3. Troubleshooting Turn On, Unusual Shutdown, and Locked Up Front Panel Problems (1 of 2)

Trouble Indication	Troubleshooting Procedure
Synthesizer does not power up, **STANDBY** light is **OFF**.	Check both line fuses on rear panel. • If the line fuses are good, check A22TP11 for +24V. • If the +24V is present, check the A28J1 connection to the front panel casting. If this connection is good, then there is an open in the cabling between the front panel casting and the A1 and A2 PCBs. • If there is no +24V present at A22TP11, disconnect A28J3 and A28J1. If the +24V appears, there is a short circuit in either the front panel casting PCBs or the 10 MHz crystal oscillator. • If the +24V does not appear, the problem is with the Rear Panel line power transformer (T1), A22VR1, or A28CR6-9.
Synthesizer does not power up, **STANDBY** light is **ON**.	When the **LINE** key is pressed, the **STANDBY** light should go off and the **OPERATE** light should illuminate. • If **STANDBY** goes off and the **OPERATE** light remains off, it indicates either that the LINE switch is defective or that there is a short circuit on the +24V line following the LINE switch. • If the **STANDBY** light goes off and the **OPERATE** light illuminates as normal, you should hear a click. This click means the A28K1 relay has energized. If A28K1 does not energize, but the fan operates, then A28K1 is defective. If the fan does not operate, the cabling from the front panel casting via A28J2 is most likely open.
Front panel LCDs and LEDs flash on and off when **LINE** is switched to **OPERATE**.	Indicates one of the A25 power supply outputs is shorted to ground. The table below shows the resistance to ground of A25 outputs with A25 installed. The cause of the short circuit may be localized to the PCB or subsystem level by removing the PCBs until the short circuit goes away. (All readings taken between ground and the connector point on a 1 KΩ scale. Ohmmeter negative lead to ground, positive lead to test point.) *Connection* / *Signal* / *Resistance to Ground* / *Action* XA25P2-1 / +5V / 60Ω / Remove: A28J1, A8, A13, A15, A16, A17, A23, A24, A28J19 XA25P2-29 / –50V / 14kΩ / Remove: A22 XA25P2-25 / –18V / 3kΩ / Remove: A22 XA25P2-23 / +22V / 143kΩ / Remove: A18, A19, A20, A21, A22, A28J19, A28Q4 XA25P2-11 / +18V / 490Ω / Remove: A22 XA25P2-15 / –18V / 38Ω / Remove: A22 XA25P2-9 / +9V / 465Ω / Remove: A6, A7, A11, A12, A22

Table 2-3. Troubleshooting Turn On, Unusual Shutdown, and Locked Up Front Panel Problems (2 of 2)

Trouble Indication	Troubleshooting Procedure
Synthesizer operates for some time, then shuts down (**OPERATE** indicator is on). After a short time, synthesizer resumes normal operation.	Indicates the 67XXB synthesizer has reached an excessive operating temperature. • If fan is still operating, clean air filter. • If fan is not operating, the trouble could be A22VR1, the fan, or the fan circuitry. Refer to Section 2A—Power Supply for circuit descriptions, block diagrams, and schematics to assist you in isolating the failure.
Front Panel Locks Up or Unable to Control Synthesizer via the Front Panel	During normal operation when the synthesizer is turned on, the front panel LCD displays and LEDs will light in a random pattern for a few seconds and then blank while self test is being performed. Upon completion of self test, the front panel will display the set-up that the synthesizer had when last powered down. If the LCD numeric displays and the indicator LEDs never change from their initial random pattern and/or if front panel control is lost, a problem in either the Digital Control subsystem or the Operator I/O subsystem is indicated. Troubleshoot as follows: During power up, monitor A28J1-3 and A28J1-4 (Mother board connector that connects to the front panel casting) with an oscilloscope. You should observe a TTL serial data signal on pin 3 and a TTL 400 kHz clock signal on pin 4 at intervals indicating that the front panel is being written to by the A8 Serial I/O. • If the data and clock signals are observed at A28J1 pins 3 and 4, then the malfunction is most likely in the Front Panel A1 and A2 PCBs. Refer to Section 2C—Front Panel for circuit descriptions, block diagrams, and schematics to assist you in isolating the failure. • If the data and clock signal are ***not*** observed at A28J1 pins 3 and 4, the problem lies within the Digital Control Subsystem. Refer to Section 2B—Digital Control for circiut descriptions, block diagrams, and schematics to assist you in isolating the failure.

Table 2-4. Summary of Error Codes with Probable Causes (1 of 10)

Error Code	Description	Remarks/Possible Problem Area
E0-0	The microprocessor is unable to perform a self-test. This can be caused by either the DVM or the ±15V(G) supplies. This is a fatal error, which means that normal operation is curtailed until the error is corrected.	Refer to Section 2A–Power Supply for circuit descriptions, block diagrams, and schematics.
E0-1	The A17 Board is missing, or +10V Reference in A17 or A15 failed.	
	Coarse Loop Tests ***NOTE*** The Reference Loop must be operating.	Refer to Section 2F–Coarse Loop for circuit descriptions, block diagrams, and schematics.
E4-10	Phase-Lock Error — This test checks the A6 PCB for phase detector output. If this test passes, then the E4-13 test is run. If this test fails, then the E4-11 and E4-12 tests are used to narrow the problem area.	A3, A4, or A6 PCBs.
E4-11	Phase-Lock Negative Error — The 10 MHz reference for the Coarse Loop Subsystem is missing.	A6 PCB Input Buffer or A10 PCB Reference Buffer.
E4-12	Phase-Lock Positive Error — The A6 Coarse Loop Divider PCB is not receiving a signal from the A3 Coarse Loop Mixer PCB.	A3 and A4 PCBs.
E4-13	VCO Tuning Voltage Error — The VCO tuning voltage is out of range indicating that the A4 Coarse Loop Oscillator needs to be recalibrated. This is ***not*** a routine calibration. Contact the WILTRON Customer Service Department at (408) 778-2000 for assistance in this calibration.	If the voltage value reveals that the sweep is at the end of its range opposite from where it should be, the probable cause is the A4 PCB Tuning Amplifier.
	Reference Loop Tests ***NOTE*** The E5-series tests take precedence over the E4-, E9-, and E12-series tests. If there is no output from the A5 PCB (via the A10 PCB) the E4-, E9-, and E12-series tests are bypassed until the A5 PCB error is corrected.	Refer to Section–2E Reference Loop for circuit descriptions, block diagrams, and schematics.
E5-0	10 MHz Crystal Oscillator Error — Test indicates whether the 10 MHz Crystal Oscillator oven is at operating temperature. If not, the E5-series tests are bypassed until the Crystal Oscillator error is corrected.	The 10 MHz Crystal Oscillator Assembly.

Table 2-4. Summary of Error Codes with Probable Causes (2 of 10)

Error Code	Description	Remarks/Possible Problem Area
E5-10	Phase-Lock Error — Test checks whether the A5 Reference Oscillator is locked. If unlocked, the E5-11 and E5-12 tests are run. If locked, they are bypassed.	
E5-11	Phase-Lock Negative Error	The A7 Reference Divider PCB.
E5-12	Phase-Lock Positive Error	The A7 Reference Divider PCB is not receiving the 500 MHz signal from the A5 PCB.
	A8 Serial I/O Test	
E8-10	Serial I/O Not Responding — Failure indicates that the A8 Serial I/O PCB is not receiving information from the front panel.	Refer to Section 2B–Digital Control for circuit descriptions, block diagrams, and schematics.
	Fine Loop Tests ***NOTE*** The Reference Loop must be operating but not locked for the following tests. If there is an E5 error code, then the E9-series tests are run. If the E9-series tests fail, only the E5 error code will be displayed.	Refer to Section 2G–Fine Loop for circuit descriptions, block diagrams, and schematics.
E9-10	Phase-Lock Error — Tests whether the A9 Fine Loop Oscillator is locked. If unlocked, the E9-11 and E9-12 tests are run. If locked, they are bypassed.	
E9-11	Phase-Lock Negative Error	The A11 Reference Divider PCB is not receiving the Fine Loop signal from the A9 PCB.
E9-12	Phase-Lock Positive Error	The 10 MHz reference signal is not being received by the A11 Reference Divider PCB.
E9-13	VCO Tuning Voltage Error — The VCO tuning voltage is out of range.	Probable cause is the A9 PCB Linearizer (Tuning Shaper) or Shaper Amplifier.

Table 2-4. Summary of Error Codes and Probable Causes (3 of 10)

Error Code	Description	Remarks/Possible Problem Area
	A12 YIG Loop Tests ***NOTE*** The E4-, E5-, and E9-series tests must have been successfully completed before these tests will be run. If any of the E4-, E5-, or E9-series tests fail, the E12-series tests are bypassed.	Refer to Section 2H–YIG Loop/FM Modulation for circuit descriptions, block diagrams, and schematics.
E12-10	Phase Lock Error — The YIG Loop will not phase lock in any band. If completed successfully, the E12-11 and E12-12 tests are bypassed. If only one oscillator is not locking, the FM-path error code for that oscillator is displayed.	A12, A16, A30 and/or A31 PCBs (Probable cause is the Sampler of the A30 Sampler/IF Amplifier PCB.)
E12-11	Phase-Lock Negative Error	The reference signal from the A9 PCB is not being received.
E12-12	Phase-Lock Positive Error	No RF is being received from the A30 Sampler/IF Amplifier PCB.
	A13 Pulse Generator test	Refer to Section 2K–ALC/Pulse Modulation for circuit descriptions, block diagrams, and schematics.
E13-10	Pulse Generator Error	A13 Pulse Generator PCB.
	A15 ALC tests	Refer to Section 2K–ALC/Pulse Modulation for circuit descriptions, block diagrams, and schematics.
E15-10	UNLEVELED-Indicator-On Error — The front panel UNLEVELED indicator is always on.	A15U41 or A15U42
E15-11	UNLEVELED-Indicator-Off Error — The front panel UNLEVELED indicator will not come on.	A15U12B, A15U41, or A15U42
E15-13	Phase Error, AM Peak Detector — The AM Peak Detector is inoperative.	A15U11B, A15U11C, A15U13B , or A15U15
E15-14	Phase Error,AM Trough Detector — Failure indicates that the AM Trough Detector is inoperative.	A15U11A, A15U11D, A15U13B, or A15U15

Table 2-4. Summary of Error Codes with Probable Causes (4 of 10)

Error Code	Description	Remarks/Possible Problem Area
E15-15	–10V Reference Error	The A15 PCB –10V reference supply is inoperative: A15VR1 or A15U14C
E15-16	+10V Ref Error	The A15 PCB +10V reference supply is inoperative: A15VR1 or A15U14A
E15-20	Unleveled Error, Full Band — The RF output is unleveled (maximum output) across the entire frequency range. (If only one band were unleveled, one of the E18- thru E21-series error codes would be shown.)	
E15-21	No RF Error, Full Band — No RF output is present across the entire frequency range. (If only one band were unleveled, one of the E18- thru E21-series error codes would be shown.)	
E15-22	Slope DAC Error	Slope DAC is inoperative: A15U8 or A15U9
E15-23	Detector Path Error, Band 0 CW	Either the Down Converter or the Band 0 Preamplifier on the A15 PCB is defective.
E15-24	Detector Path Error, Band 1-4 CW	Either the Band 1-4 Level Detector or Band 1-4 Preamplifier on the A15 PCB is defective.
E15-25	Detector Path Error, Band 0 Sample/Hold — This test is bypassed if the E15-23 test passes.	This detector path, which is used during pulse operations, is defective.
E15-26	Detector Path Error, Band 1-4 Sample/Hold — This test is bypassed if the E15-24 test passes.	This detector path, which is used during pulse operations, is defective.
E15-30	Band 0 Pulse Error — This test is bypassed if the E13-10 test passes.	Indicates that the A13 PCB pulse driver for Band 1, Band 1 Control Modulator, or A15 Sample/Hold circuit is defective.
E15-31	Band 1-4 Pulse Error — This test is bypassed if the E13-10 test passes.	The A13 PCB pulse drivers, or the A15 PCB Sample/Hold circuit is defective.
E15-40	Voltage Level reference error.	

Table 2-4. Summay of Error Codes with Probable Causes (5 of 10)

Error Code	Description	Remarks/Possible Problem Area
	A16 FM tests	Refer to Section 2H–YIG Loop/FM Modulation for circuit descriptions, block diagrams, and schematics.
E16-10	FM Ø Error	The FM peak detector on A16 is inoperative: A16U28
E16-11	Phase Mod Ø Error	The Phase Modulation Peak Detector on the A16 PCB is inoperative: A16U30
E16-12	YIG Loop Ø Error	The loop amplifier for the YIG loop is inoperative.
E16-13	Sweep Path Error, YIG FM	The 50 MHz sweep path is inoperative.
	A17 Analog Instruction Tests ***NOTE*** The error code E17-30, Ramp Generator Error, is displayed during self test when the 67XXB is connected to a Scalar Network Analyzer (SNA) and operating in the unintellegent mode. To insure this is not an actual failure, perform the self test either with the SNA connected and operating in the intellegent mode or with the SNA completely disconnected.	Refer to Section 2I–Analog Instruction for circuit descriptions, block diagrams, and schematics.
E17-10	DVM Measurement Error, 0 Volts — The DVM is inoperative. All other tests are bypassed. This is a fatal error; the instrument is inoperative.	
E17-11	DVM Measurement Error, +10 Volt Reference	The 10V reference for the A17 PCB is defective.
E17-12	DVM Measurement Error, +20 Volt Range	The 20V range of the DVM is inoperative.
E17-13	DVM Measurement Error, 100 Volt Range	The 100V range of the DVM is inoperative.
E17-20	Tune DAC 0V	The Tune DAC is not operating properly.
E17-21	Tune DAC +10V	The Tune DAC –10V reference supply or the Tune DAC itself is defective.
E17-22	DVM Error, Tune DAC –10V	The Tune DAC +10V reference supply or Tune DAC is defective.

Table 2-4. Summary of Error Codes with Probable Causes (6 of 10)

Error Code	Description	Remarks/Possible Problem Area
E17-23	DVM Error, Tune DAC Sweep	Linearity problem in the Tune DAC.
E17-24	DVM Error, Tune DAC Gain= 4	The switch for gain=4 is defective: A17U41A.
E17-30	Ramp Generator Error	The integrator for the ramp generator and its associated circuitry is not operating properly.
E17-31	Sweep Time Error, Sweep Time DAC	The DAC that controls the sweep time is out of its specified limits.
E17-32	Retrace Time Error, Sweep Time DAC	Error in retrace timing of the ramp.
E17-33	Range Error, Sweep Time Circuit	Error in the >1 second sweep-time circuitry.
E17-40	Sweep Width DAC Error, 0V	Sweep Width DAC error at maximum attenuation.
E17-41	Sweep Width DAC Error, Full-Scale, +10V	Sweep Width DAC error at full scale.
E17-42	Sweep Width DAC Error. –10V	
E17-43	Sweep Width DAC Error, 1% Steps	Sweep Width DAC linearity error.
E17-44	Sweep Width DAC Error, Gain 4	The Gain=4 switch is defective: A17U36.
E17-50	Linearizer Slope DAC Ø Error	Linearizer DAC is defective.
E17-51	Linearizer Slope DAC 100 % Error	Linearizer DAC is defective.
E17-52	Linearizer Slope DAC 0 % Error	Linearizer DAC is defective.
E17-53	Linearizer Breakpoint DAC 50% Error	Breakpoint DAC is defective.
E17-60	Power Meter Error	Power meter circuit is defective.

Table 2-4. Summary of Error Codes with Probable Cause (7 of 10)

Error Code	Description	Remarks/Possible Problem Area
	RF tests ***NOTE*** The following error codes indicate a problem on the RF microwave deck. They may not be applicable to all 67XXB models because of different RF microwave deck configurations. Refer to Table 2L-2 for the RF microwave deck configuration by model number. The first two digits of the error code indicate the number of the YIG Driver PCB (A18 thru A21) associated with the frequency band. The third digit is the frequency band number. The fourth digit is the type of test.	Refer to Section 2L–Microwave Deck for circuit descriptions, block diagrams, and schematics.
E18-01	Unleveled Error, Band 0	The Down Converter output is unleveled. The Band 1 Control Modulator or modulator drive is the most probable cause.
E18-02	No RF Error, Band 0	Either the Down Converter is defective or there is no output from the A5 Reference Oscillator PCB to the Downconverter.
E18-03	FM Path Error, Band 0	The FM driver on A18 is defective.
E18-11	Unleveled Error, Band 1	The Band 1 Control Modulator or driver is defective.
E18-12	No RF Error, Band 1	The Band 1 Control Modulator or YIG-tuned oscillator is defective.
E18-13	FM Path Error, Band 1	The FM driver on A18 is defective.
E19-21	Unleveled Error, Band 2	The Band 2 Control Modulator or driver is defective.
E19-22	No RF Error, Band 2	The Band 2 Control Modulator or YIG-tuned oscillator is defective.
E19-23	FM Path Error, Band 2	The FM driver on A19 is defective.
E20-31	Unleveled Error, Band 3	The Band 3 Control Modulator or driver is defective.
E20-32	No RF Error, Band 3	The Band 3 Control Modulator or YIG-tuned oscillator is defective.

Table 2-4. Summary of Error Codes with Probable Causes (8 of 10)

Error Code	Description	Remarks/Possible Problem Area
E20-33	FM Path Error, Band 3	The FM driver on A20 is defective.
E21-41	Unleveled Error, Band 4	The Band 4 Control Modulator or driver is defective.
E21-42	No RF Error, Band 4	The Band 4 Control Modulator or YIG-tuned oscillator is defective.
E21-43	FM Path Error, Band 4	The FM driver on A21 is defective.
E21-51	Unleveled Error, Band 5	The Frequency Doubler Amplifier/Modulator or driver is defective.
E21-52	No RF Error, Band 5	The Band 3 YIG-tuned oscillator, or the Frequency Doubler Amplifier/Modulator is defective.
E21-53	FM Path Error, Band 5	The FM driver on A20 is defective.
	Power Supply/Regulator Tests	Refer to Section 2A–Power Supply for circuit descriptions, block diagrams, and schematics.
E22-10	PS1 Error	A PS1 monitor problem which cannot be determined from the E22-21 thru -29 tests.
E22-11	PS2 Error	A PS2 monitor problem which cannot be determined from the E22-21 thru -29 tests.
E22-20	+9V LP Error	The 9V supply has no output to the 5V regulators in the phase lock circuitry.
E22-21	+24V Error	The supply is unregulated. If there is no output from this supply, the STANDBY lite will not illuminate and the instrument will not power up.
E22-22	+15V (G) Error	There is no output from this supply located on the A22 PCB.
E22-23	–18V Tuning Error	There is no output from this supply located on the A22 PCB.
E22-24	–43V Tuning Error	There is no output from this supply located on the A22 PCB.
E22-25	–15V LP Error	There is no output from this supply located on the A22 PCB.
E22-26	+15V LP Error	There is no output from this supply located on the A22 PCB.

Table 2-4. Summary of Error Codes with Probable Causes (9 0f 10)

Error Code	Description	Remarks/Possible Problem Area
E22-27	+15V FM Error	There is no output from this supply located on the A22 PCB.
E22-28	+15V (A) Error	There is no output from this supply located on the A22 PCB.
E22-29	–15V FM Error	There is no output from this supply located on the A22 PCB.
E22-30	–15V (A) Error	There is no output from this supply located on the A22 PCB.
E22-31	–15V (G) Error	There is no output from this supply located on the A22 PCB.
	Microprocessor Tests	Refer to Section 2B–Digital Control for circuit descriptions, block diagrams, and schematics.
E23-10	Non-volatile RAM for storing front panel setups has failed read-write testing. In addition, this error code may be generated by a master reset of the 67XXB which overwrites all information stored in the non-volatile RAM.	The front panel setups need to be reentered and stored in non-volatile RAM or A23U25 needs to be replaced.
E23-11	Volatile RAM #1 has failed read-write test	Replace A23U26.
E23-12	Volatile RAM #2 has failed read-write test	Replace A23U29.
E23-14	Personality PROM Check-Sum Error	Replace A23U24.
E23-15	EPROM #1 Check-Sum Error	Replace A23U22 .
E23-16	EPROM #2 Check-Sum Error	Replace A23U23.
E23-17	EEPROM Check-Sum Error	Error in the frequency, AM, and FM calibration table.
E23-18	EEPROM Check-Sum Error	Error in the AM Bandwidth calibration table.
E23-19	EEPROM Check-Sum Error	Error in the ALC calibration table.
E23-20	Stored Setups Check-Sum Error	
E23-21	I/O Error — Indicates the I/O interrupt is inoperative.	Replace A23U8.

Table 2-4. Summary of Error Codes with Probable Causes (10 of 10)

Error Code	Description	Remarks/Possible Problem Area
	A24 GPIB Tests	Refer to Section 2B–Digital Control for circuit descriptions, block diagrams, and schematics.
E24-0	GPIB no response or A24 not installed	
E24-10	Check-Sum Error in the GPIB RAM	Replace A24U11.
E24-11	Check-Sum error in the PROM	Replace A24U10.
E24-12	GPIB Interface Error	The interface processor is inoperative. Replace A24U7.
	A29 Rear Panel Interface Tests	Refer to Section 2D–Inputs/Outputs for circuit descriptions, block diagrams, and schematics
E29-10	V/GHz Offset DAC Error	The U15 V/GHz Offset DAC or Data Latches U8 or U9.
E29-11	V/GHz Slope Error	The U13 V/GHz Slope DAC or Data Latches U8 or U9.

2A–POWER SUPPLY: A22, A25, A26, AND PART OF A28 PCBS

2A-1 POWER SUPPLY ASSEMBLIES: A22, A25, AND PART OF A28 PCBs

This section contains service information for the power supply assemblies listed in Table 2A-1 below. For further information pertaining to the A28 Motherboard PCB, refer to Section 2M-Motherboard/Interconnection. Refer also to the specific troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting).

Table 2A-1. Power Supply Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2A-2	2A-1
Detailed Circuit Description	Para. 2A-3	2A-2
Block Diagram	Fig. 2A-1	2A-3
PCB LEVEL		
A22 Regulator Interface PCB		
Detailed Circuit Description	Para. 2A-3.4	2A-7
Parts Locator Diagram	Fig. 2A-5	2A-10
Schematic (Sheet 1 of 1)	Fig. 2A-6	2A-11
(Sheet 2 of 2)	"	2A-13
A25 Switching Power Supply		
Detailed Circuit Description	Para. 2A-3.3	2A-5
Block Diagram	Fig. 2A-4	2A-9
Parts Locator Diagram	Fig. 2A-7	2A-14
Schematic (Sheet 1 of 1)	Fig. 2A-8	2A-15
(Sheet 2 of 2)	"	2A-17
A26 Line Filter PCB		
Detailed Circuit Description	Para. 2A-3.1	2A-2
Parts Locator Diagram	Fig. 2A-9	2A-18
Schematic (Sheet 1 of 1)	Fig. 2A-10	2A-19
A28 Motherboard PCB		
Detailed Circuit Description	Para. 2A-3.2	2A-2
Parts Locator Diagram	Fig. 2A-11	2A-20
Schematic (partial))	Fig. 2A-12	2A-21

2A-2 POWER SUPPLY ASSEMBLIES, OVERALL DESCRIPTION

The PCBs and other assemblies that comprise the synthesizer power supply subsystem include the A22 Regulator Interface PCB, the A25 Switching Power Supply PCB, the A26 Line Filter, and parts of the A28 Motherboard PCB.

WARNING

Voltages hazardous to life are present throughout the Power Supply circuits, *even when the front panel* POWER *switch is in* STANDBY *position.*

The ac line voltage and the +24 Vdc are always present whenever the line cord is connected to the ac line voltage source. Use utmost care to avoid electrical shock when working with this unit with the covers removed.

Refer to the overall block diagram of the synthesizer power supply subsystem, Figure 2A-1. The circuits and components that comprise the power supply subsystem are located as follows:

- ***Rear Panel Assembly/A26 Line Filter*** – The rear panel assembly contains the AC Line Connector/EMI Filter, LINE SELECT switch, line fuses, and 24 V line power transformer. The A26 Line Filter PCB interfaces these components to the power supply circuits located on the A28 Motherboard PCB.
- ***Part of A28 Motherboard PCB*** – The Motherboard PCB contains the following power supply circuits: AC line rectifier/doubler, +30V supply bridge rectifier, A28K1 line-switch relay, and the dc fan driver circuits.
- A25 Switching Power Supply PCB – This PCB contains the 50 kHz switching regulator power supply that provides the +5 VD, +9V LP and +22V outputs that are routed via the A28 Motherboard throughout the synthesizer. It also supplies the ±18V, –21V and –50 V outputs to the A22 PCB that are reduced and regulated to lower voltages (Figure 2A-1).
- **A22 Regulator PCB** – This PCB contains the regulator and filter circuits for the ±15 VA, ±15V G, ±15V FM, ±15V LP, –18V, and –43V supplies. It also contains the regulator for the +24V standby power supply and the logic circuits for the two power supply status monitor lines, PS MON1 and PS MON2.

2A-3 POWER SUPPLY ASSEMBLIES, DETAILED DESCRIPTION

During this description, refer to Figure 2A-1 and to Figure 2A-12, which is a partial schematic of the A28 Motherboard PCB (Sheet 1).

2A-3.1 AC Line and +24V Standby Power Supply Circuits

AC line power (90-130 Vac or 180-260 Vac) is connected to the synthesizer via the rear panel AC Line Connector/EMI Filter. It is routed from the filter through the Main Line Fuse F1, the LINE SELECT switch S1 and the A26 Line Filter PCB to the power supply circuits located on the A28 Motherboard PCB and to the rear panel 24 V line power transformer, T1.

The A26 Line Filter PCB contains the following primary power circuit components (see Figure 2A-10):

- Line filter capacitors C1/C2,
- Surge suppression thermistors RT1/RT2,
- Transient suppression varistors RV1/RV2.

The line power transformer supplies approximately 30 Vac to the +30 Vdc bridge rectifier circuit located on the A28 Motherboard PCB. The unregulated +30 Vdc from this circuit is routed to the dc fan switching circuits and to the input of the +24V Standby Power Supply that is located on the A22 Regulator Interface PCB.

The +24 Vdc output by this regulator is *always* present whenever the synthesizer is connected to the ac line. It is routed to the 10 MHz reference oscillator oven heater and to the front panel LINE switch. When the LINE switch is depressed (OPERATE), the +24 Vdc is applied to the line switch relay (A28K1) and to transistor A28Q2 of the dc fan driver circuit.

The line-switch relay connects the ac line voltage to the line rectifier/doubler circuit located on the A28 Motherboard PCB. As determined by the rear panel LINE SELECT switch, this circuit functions either as a full-wave voltage doubler (for a 90-130 Vac line input) or as a full-wave bridge rectifier (for a 180-260 Vac line input). In both modes of operation, the output of this circuit is +165 Vdc and –165 Vdc. These voltages are filtered by A28FL1 and routed to the A25 Power Supply PCB.

2A-3.2 A28 Motherboard PCB Power Supply Circuits, Detailed Circuit Description

The power supply circuits that are located on the A28 Motherboard PCB are described below; refer to Figure 2A-12 during this description. (For further information pertaining to the A28 Motherboard PCB, refer to Section 2M–Motherboard/Interconnection.)

a. Line Rectifier

The line-switch relay, A28K1, connects the ac line voltage to the Line Rectifier circuit comprised of power diodes CR1-CR4. In the **110** position of the LINE SELECT switch, this circuit functions as a full-wave voltage doubler; in the **220** position of the LINE SELECT switch it functions as a full-wave bridge rectifier. Capacitors C3 and C4 are filter capacitors for the rectified line voltage. Filter FL1 removes any 50 kHz switching transients returned from the A25 switching power supply to prevent them from getting onto the ac power line. In both modes of operation, this circuit outputs +165 Vdc and –165 Vdc voltages that are routed to the A25 Power Supply PCB.

b. +30 V Rectifier

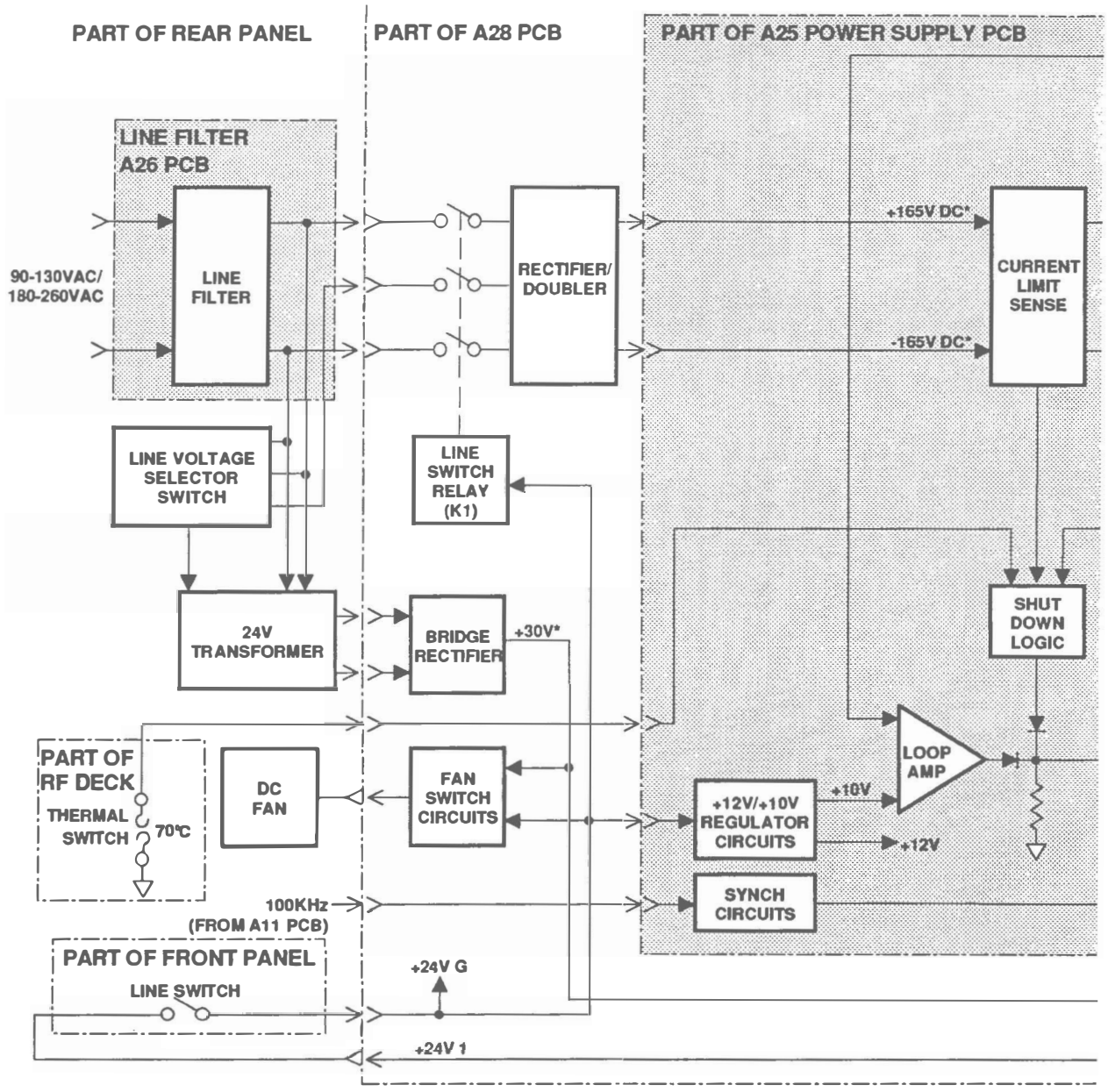
The rear panel line power transformer supplies approximately 30 Vac to power diodes CR6-CR9 that comprise the bridge rectifier circuit for the +30V power supply. The unregulated +30 Vdc output from this circuit is routed to the A22 Regulator PCB, where it is regulated to +24V (standby power supply).

c. Line Trigger Circuit

The 30 Vac is also connected to transistor switch Q4. This circuit converts the 30 Vac to TTL levels that are used by the A23 Microprocessor for synchronizing the sweep to the power line frequency.

d. Fan Driver Circuits

When the front panel LINE switch is depressed, +24 Vdc is applied to the input of Q2, which turns on driver transistor Q3. This applies the unregulated +30 Vdc to the dc fan. In the STANDBY mode, Q2 and Q3 are shut off, and no +30 Vdc power is applied to the dc fan.



* Unregulated voltage

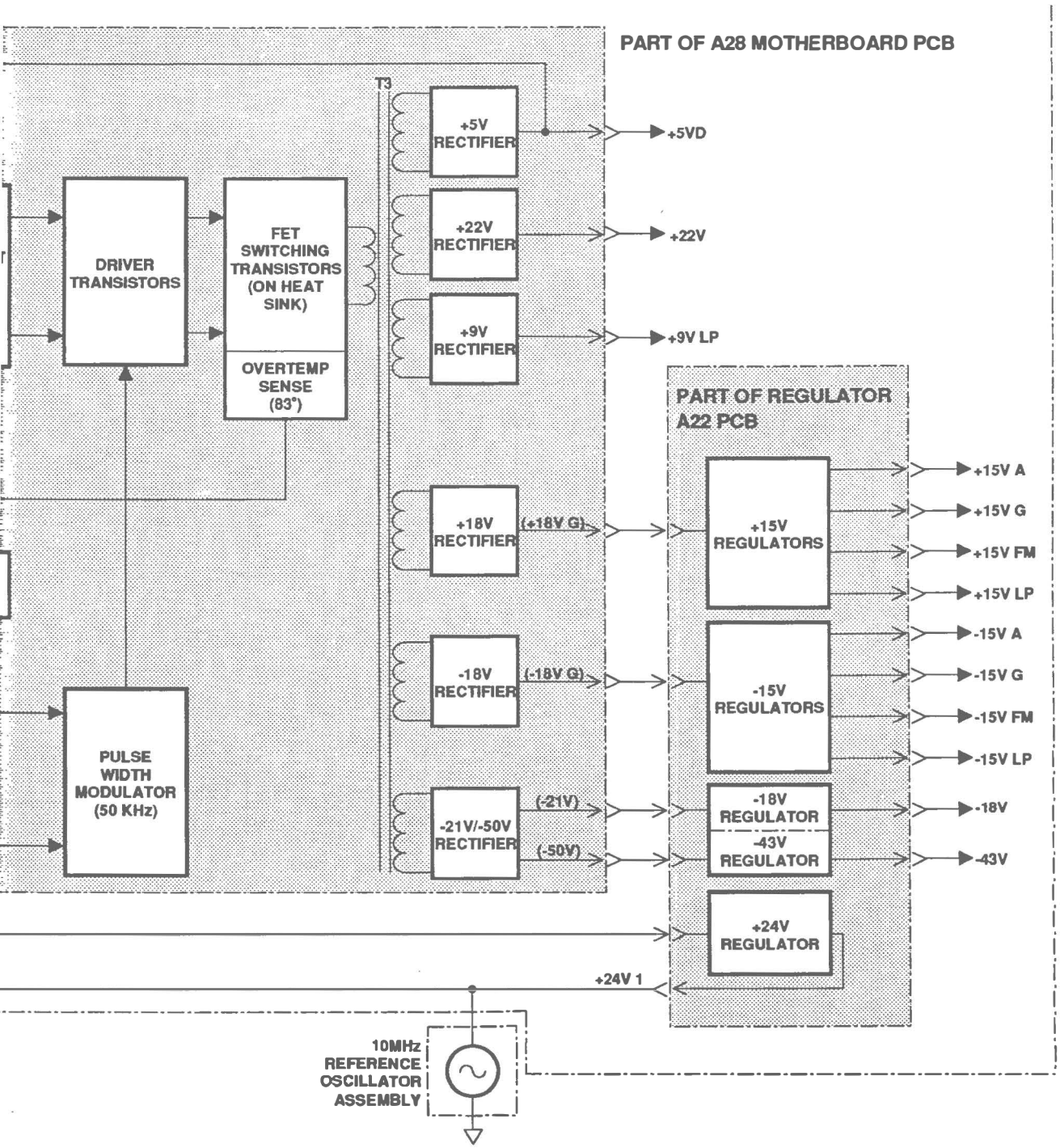


Figure 2A-1. Power Supply Overall Block Diagram

2A-3.3 A25 Switching Power Supply PCB, Detailed Circuit Description

During the following description, refer to the block diagram of the A25 Switching Power Supply PCB, Figure 2A-4. Refer also to the A25 PCB schematic diagram, Figure 2A-8.

The A25 PCB contains the following circuits:
- ±165 Vdc Input Filter
- Driver Transistors/Switching Transistors
- Pulse-width Modulator/50 kHz Generator
- Rep Rate Synchronization circuits
- Loop Control Amplifier
- Shut-Down Timer and Soft-Start Control
- Overcurrent Sense circuits
- +5V /+22v Overvoltage Sense circuits
- Over Temperature Sense circuits
- Low Voltage Rectifier/Filter circuits

a. Switching Transistor Output Circuits

Refer to Figure 2A-2; switching transistors A25Q6 and Q7 alternately switch between +165 Vdc and –165 Vdc at a 50 kHz rate. The outputs from Q6 and Q7 form the composite waveform shown in the figure. The peak-to-peak value of this waveform is directly proportional to the peak value of the input ac line voltage. The primary winding of transformer T3 couples this waveform to the five secondary windings, as shown in Figure 2A-4.

The reduced voltages in the secondary windings of T3 are proportional to the value of the ac line voltage input *and* to the duty cycle of the output waveform generated by the pulse width modulator circuit (explained below). This signal is the input to the driver transistors, Q4/Q5 that control switching transistors Q6/Q7. The voltages from these windings are rectified and passed through inductors that function as integrators/filters.

b. Pulse Width Modulator Circuit (PWM)

The PWM integrated circuit, U4 controls the on/off ratio of the switching transistors. It develops a train of pulses with a duty cycle that varies between 25% and 40% (Figure 2A-2). This duty cycle is determined by the amplitude of the control voltage applied to the Vc input of U4 (pin 3).

During normal operation, the amplitude of the control voltage is determined by the output of the Loop Control Amplifier, U3. During instrument power up, it is controlled by the Soft Start circuit; during abnormal conditions, it is controlled by the output of the shut down timer, U5.

c. Rep Rate Synchronization Circuit

The 100 kHz reference signal from the A11 Fine Loop Divider PCB and the PWM oscillator signal from U4 (pin 5) are fed through the signal conditioning comparators U6B and U6A. The outputs of U6B and U6A are then fed to the **R** and **V** inputs of the phase/frequency detector integrated circuit, U7.

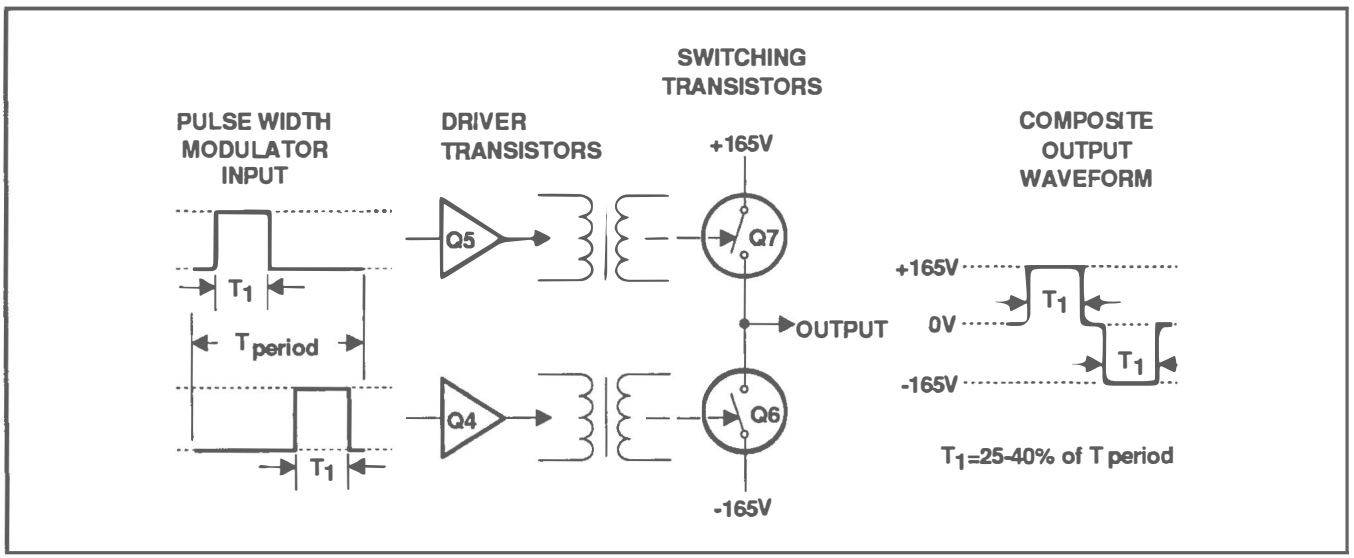


Figure 2A-2. Switching Transistors and Drivers

The UF and DF outputs of U7 are combined at the junction of R90, R91, and R85. When the PWM oscillator frequency is too high, the signal consists primarily of a series of positive-going pulses. When it is too low, it consists primarily of a series of negative-going pulses. The combined UF/DF output signal is integrated and then fed to the frequency determining network of U4. This causes the PWM oscillator frequency to shift in the direction required to achieve phase lock.

The U2 output of U7 is fed to the input of the lock detector timer, U8, via the filter comprised of R93 and C67. When the PWM oscillator is phase locked with the reference signal, the signal at this point is a static high. When not in phase lock, the negative-going pulses, output by U7, cause U8 to drive the L PS LOCK MON output high (i.e., unlocked). This status line goes to the DVM circuits located on the A17 Analog Instruction PCB.

d. Loop Control Amplifier

The +5V D and +5V SENSE COMP outputs from the +5V rectifier/filter circuit form a composite input to the Loop Control Amplifier, U3. (The +5V SENSE COMP signal contains the high frequency components of the feedback information.) The other input to U3 is a +5V reference voltage derived from the +10V output of VR2. The output of U3 is the 0 to 12V control signal (**Vc**) to U4. The action of U3 causes U4 to output the correct duty cycle that maintains the +5V D output at precisely +5V.

e. Shut Down Timer/Soft Start Circuits

These circuits shut down the switching power supply when overvoltage, overcurrent, or overtemperature conditions occur. They also cause the rectified outputs from the switching power supply to come on line at their minimum voltage levels (soft start).

Overcurrent conditions in the switching power supply circuits are sensed by photo-couplers, U1 and U2. Zener diode CR8 is used to sense any overvoltage condition on the +5 VD output (via Q3). Any overvoltage condition on the +22V output is sensed by zener diodes CR2 and CR19 (via Q12). Any overtemperature condition of the FET switching transistors is sensed by the circuit comprised of thermistor RT1, and transistors Q1 and Q2. This circuit switches state when an overtemperature condition occurs.

The inputs to the Shut Down Timer, U5, are the common collector outputs of U1, U2, Q3 and Q12, which are part of the overvoltage and overcurrent sense circuits described above. The heat sensing switch, located on the microwave deck, is also connected to this line. If an overvoltage, overcurrent, or overtemperature condition is sensed, this line goes low and causes U5 to generate a pulse having a pulse width of approximately 1 second.

The leading edge of the pulse from U5 causes the **Vc** pin of Q4 to go to +12V and the INH pin to go low. This causes Q4 to turn off, which shuts down the FET switching transistors. The lagging edge of the one second pulse causes the INH pin of Q4 to return high, which causes the switching power supply to soft-start.

If the overvoltage, overcurrent, or overtemperature condition that started the above cycle is still present, U5 generates another pulse and again causes the supply to shut down. This cycling operation continues until the overvoltage or overcurrent condition is corrected or the unit is put in the (LINE) STANDBY condition.

The input to the soft start circuit is +12 Vdc from the +12V regulator, VR1. At the instant the LINE switch is depressed, +12V is applied to the **Vc** pin of Q4 through C23 (via R51 and CR12, refer to Figure 2A-8, sheet 1). With the **Vc** pin at +12V, the duty cycle of the PWM output pulse train is at its minimum, thus causing the rectified outputs of the switching power supply to be at their minimum levels. As C23 charges, the subsequently decreasing voltage at the **Vc** pin causes the duty cycle of the output pulse train to increase. This, in turn, causes the +5 VD supply output voltage to rise until it is regulated in the normal manner by the action of the loop control amplifier.

f. Rectifier/Filter Circuits

A typical A25 PCB rectifier/filter circuit is shown in Figure 2A-3. The output voltage from the T3 winding is rectified and passed through a double inductor/capacitor filter network. Refer to Sheet 2 of Figure 2A-8; the +22V and +9V LP rectifier/filter circuits are the same as shown in Figure 2A-3. The +18 VG/–18 VG and –50V/–21V circuits are variations of this circuit and function in the same manner.

The +5 VD full-wave rectifier circuit uses hot carrier diodes CR17 and CR18 as rectifiers (Zener diode CR16 is used to provide reverse bias protection for these diodes). The dc output from this circuit is obtained via the filter network comprised of L1, L4, and C32-C34. The +5V SENSE COMP output from this circuit contains the high frequency components of the feedback information that are fed to the input of the loop control amplifier.

The value of the voltage that is output from inductor, L4, is regulated by the control loop amplifier by varying the PWM duty cycle (time T1 shown in Figure 2A-3). This output is regulated precisely to +5V, which also maintains the other rectifier outputs at their nominal value.

Table 2A-2 lists the dc output voltages produced by the A25 PCB, along with the distribution of these voltages. As explained below, all of these voltages (except the +5V D and +22V) are also routed to the A22 Regulator Interface PCB power supply monitor circuits.

Table 2A-2. A25 PCB Output Voltages Distribution

OUPUT	DISTRIBUTION
+5V D	To All Digital Circuits
+22V	To A18–A21, and A29 PCBs
+18V G/–18V G	To A22 PCB Regulator Circuits
–50V/–21V	To A22 PCB Regulator Circuits
+9V LP	To A6, A7, and A10–A12 PCBs.

2A-3.4 A22 Regulator Interface PCB, Detailed Circuit Description

Refer to Figure 2A-6, sheets 1 and 2, during the following description.

a. +24V Power Supply

The unregulated +30 Vdc from the A28 Motherboard is connected to the input of the three-terminal regulator integrated circuit, VR1. The output voltage of this circuit is set by the ratio of resistors R1 and R2. Capacitor C2 is used to reduce the noise output of this circuit. The +24V output from VR1 is routed via the Motherboard to the 10 MHz Reference Oscillator oven heater and to the A28K1 LINE-switch relay. It is also used to derive the tuning voltage for the Reference Oscillator circuits on the A5 PCB. The output of this supply is designated as *+24 V1*; after the LINE-switch, it is designated as *+24 VG*.

b. –18V Power Supply

Integrated circuit VR2 is a precision voltage regulator that supplies the –10V reference voltage for both the –18V and –43V power supplies. It is

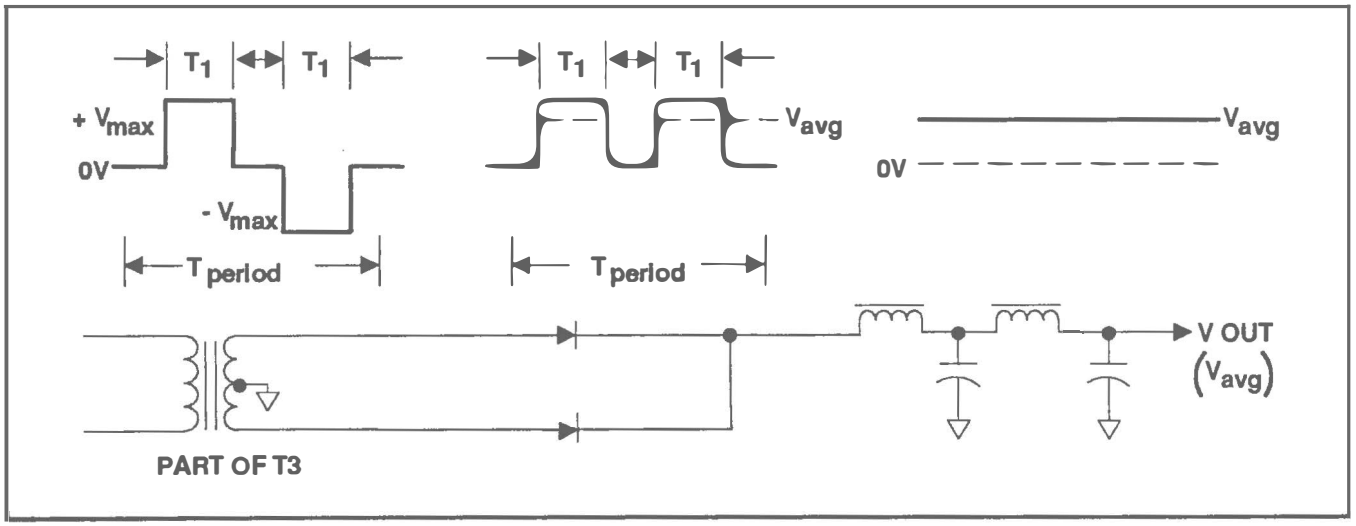


Figure 2A-3. Typical A25 PCB Rectifier/Filter Circuit

configured as a negative series regulator, with the –10V output at the GND terminal.

Operational amplifier U1B is the control amplifier for the –18V supply. The ratio of resistors R12 and R13 sets the output voltage of this supply at –18V. Transistor Q3 functions as a level shifter that drives Q1, which is the series pass transistor for the –18V supply (Q3 is required to prevent the output of U1B from approaching –18V).

Transistor Q2, in conjunction with R6 and R7, provides current limiting for this circuit. Transistor Q8 provides foldback limiting. During current limiting conditions, if the output voltage goes above approximately –12V, Q8 conducts. This causes Q2 to conduct, thus reducing the current through Q1. Under short circuit conditions, the current limit of the –18V supply is approximately 300 mA.

c. –43V Power Supply

Voltage regulator VR2 also supplies the –10 V reference for the –43V supply. Except for the voltage output and current limiting levels, the operation of the –43V supply is identical to that of the –18V supply. This circuit is current limited by R17 and Q4. The foldback limiting (Q7) functions at approximately –29.4V; under short circuit conditions, the output current is limited to approximately 200 mA.

NOTE:

Both the VR2 voltage reference circuit and –18V supply must be operating correctly for the –43V supply to function normally. This prevents overloading of the –43V supply by the A18-A21 YIG Driver PCBs in case of a failure of either of these circuits.

The –18V and –43V power supplies provide current for the YIG tuning current driver circuits located on the A18 through A21 YIG Driver PCBs. During most modes of operation, the –18V supply supplies the current for these circuits. Additional current is supplied by the –43V supply during fast analog sweeps or step sweep operation (refer to Section 2J—YIG Drivers).

d. +15V and –15V Supplies

The +18V G and –18V G voltages from the A25 PCB are reduced and regulated by VR3–VR10 to produce the ±15V A, ±15V G, ±15V LP, and ±15V FM power supply outputs. Regulators VR3–VR10 are fixed output integrated circuit types; see Figure 2A-6, Sheets 1 and 2. These circuits have built-in current limiting and current foldback that limit the output current to approximately 1.5A.

e. Power Supply Monitor Circuit

All of the power supply voltages, except the +5V and +22V, are summed by operational amplifiers U2A and U2B to produce the PS MON1 and PS MON2 outputs. These outputs are approximately 0V when all of the power supply voltages are at their nominal levels. If one of the power supplies has no output, the effective weighting value of the input resistor associated with that power supply will yield a distinctive operational amplifier output.

The PS MON1 and PS MON2 outputs are routed to DVM circuits located on the A17 Analog Instruction PCB. During instrument self test, the A23 Microprocessor PCB causes the DVM circuits to monitor these status lines to determine the status of the power supply circuits.

f. +22V Power Supply Test Point

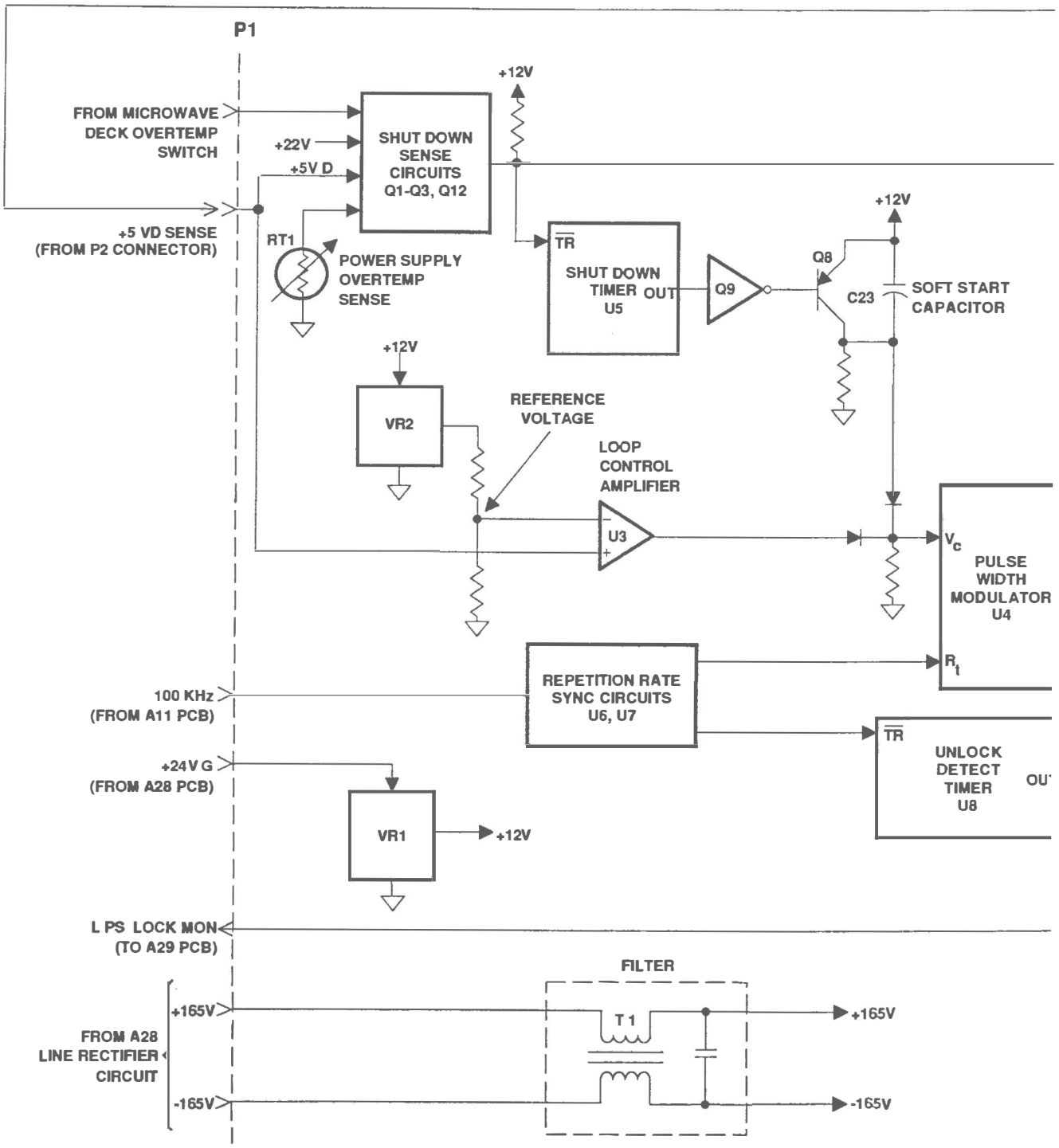
The +22V from the A25 PCB is routed onto the A22 PCB only to provide a convenient test point. This unregulated supply is used as the source for the bias regulators on the A18 through A21 YIG Driver PCBs. It also supplies power to the (optional) step attenuator driver on the A29 Rear Panel Interface PCB.

2A-4 POWER SUPPLY ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the power supply assemblies and probable causes of the failures.

2A-5 POWER SUPPLY ASSEMBLIES, SERVICE SHEETS

Table 2A-1, on the first page of this section, references the block diagrams, schematic diagrams, and parts locator diagrams for the A22, A25, A26, and A28 PCBs.


P1
FROM MICROWAVE DECK OVERTEMP SWITCH
+5 VD SENSE (FROM P2 CONNECTOR)
+22V
+5V D
SHUT DOWN SENSE CIRCUITS Q1-Q3, Q12
+12V
RT1
POWER SUPPLY OVERTEMP SENSE
TR
SHUT DOWN TIMER U5
OUT
Q9
Q8
C23
SOFT START CAPACITOR
+12V
VR2
REFERENCE VOLTAGE
LOOP CONTROL AMPLIFIER
U3
Vc
PULSE WIDTH MODULATOR U4
Rt
100 KHz (FROM A11 PCB)
REPETITION RATE SYNC CIRCUITS U6, U7
TR
UNLOCK DETECT TIMER U8
OUT
+24V G (FROM A28 PCB)
VR1
+12V
L PS LOCK MON (TO A29 PCB)
FILTER
+165V
FROM A28 LINE RECTIFIER CIRCUIT
-165V
T1
+165V
-165V

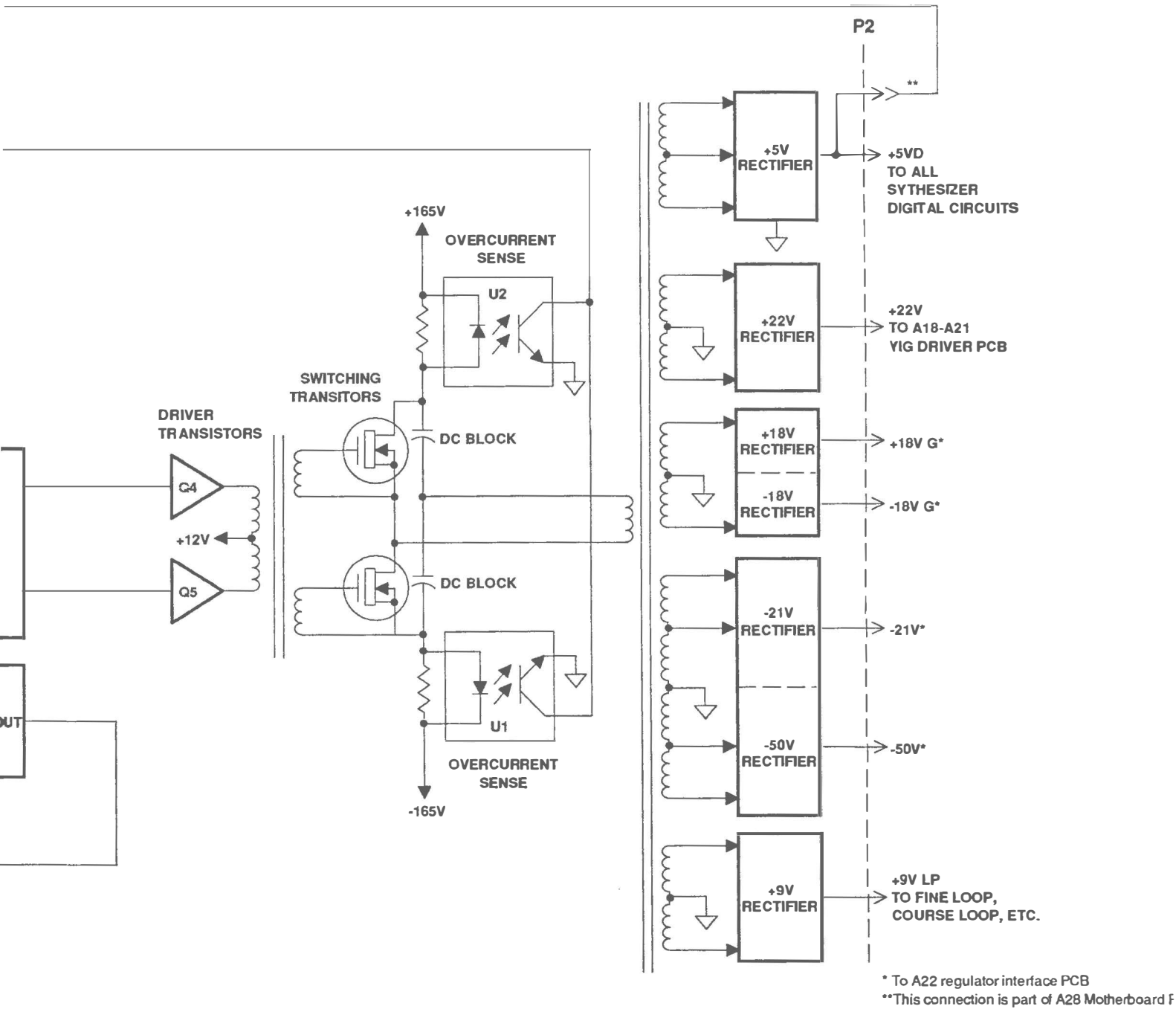
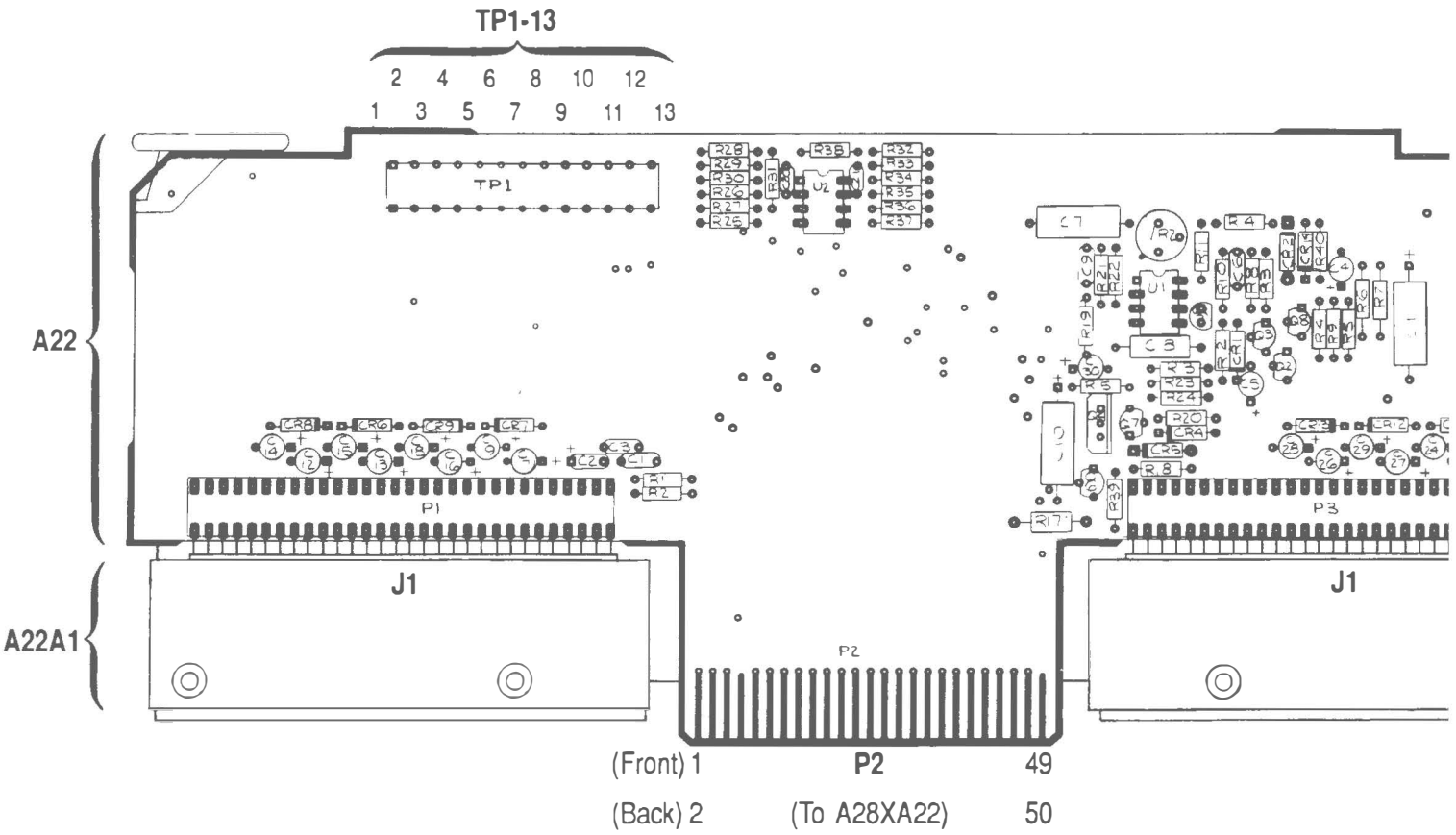
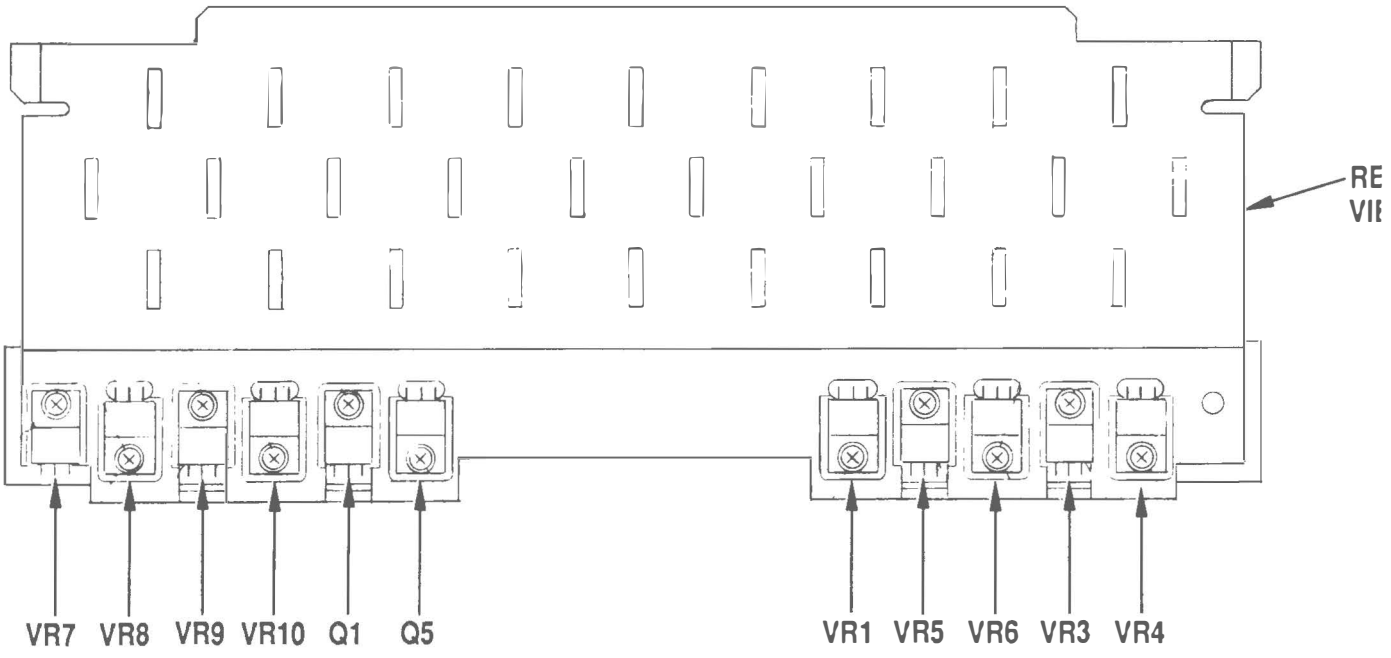
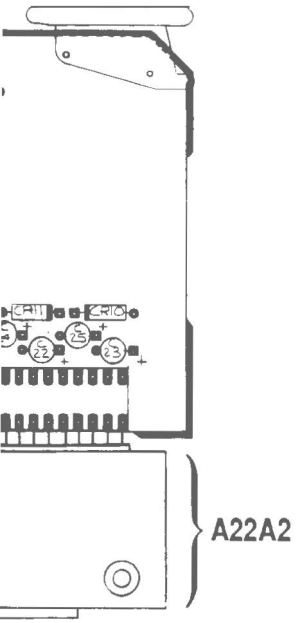


Figure 2A-4. Overall Block Diagram of A25 Switching Power Supply PCB


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
A22
A22A1
TP1
P1
P2
P3
J1
J1
(Front) 1
P2
49
(Back) 2
(To A28XA22)
50

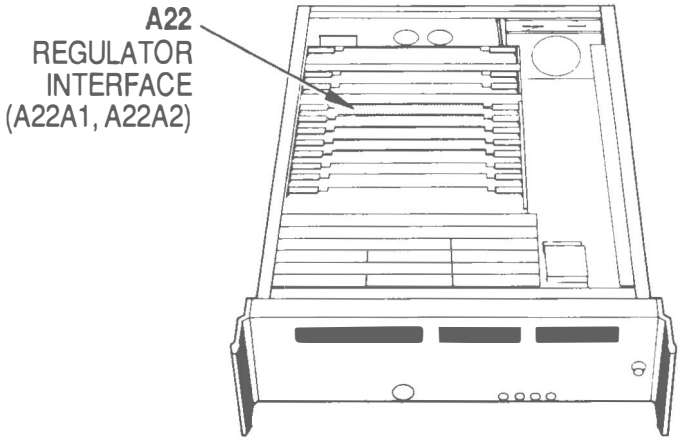

VR7
VR8
VR9
VR10
Q1
Q5
VR1
VR5
VR6
VR3
VR4



TEST POINTS

TP1	GND G
TP2	+22V
TP3	–15VFM
TP4	+15VFM
TP5	–15VG
TP6	+15VG
TP7	–15VA
TP8	+15VA
TP9	–15VLP
TP10	+15VLP
TP11	+24V1
TP12	–18V
TP13	–43V

All measurements are made with reference to GND G at TP1.



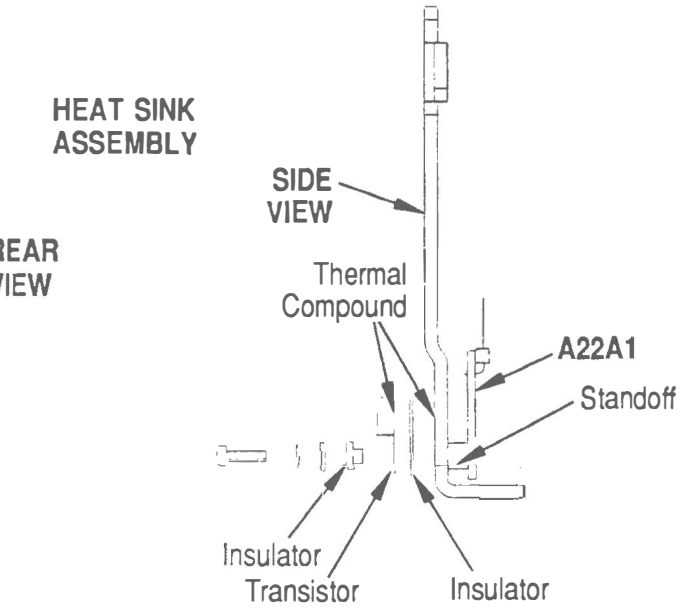
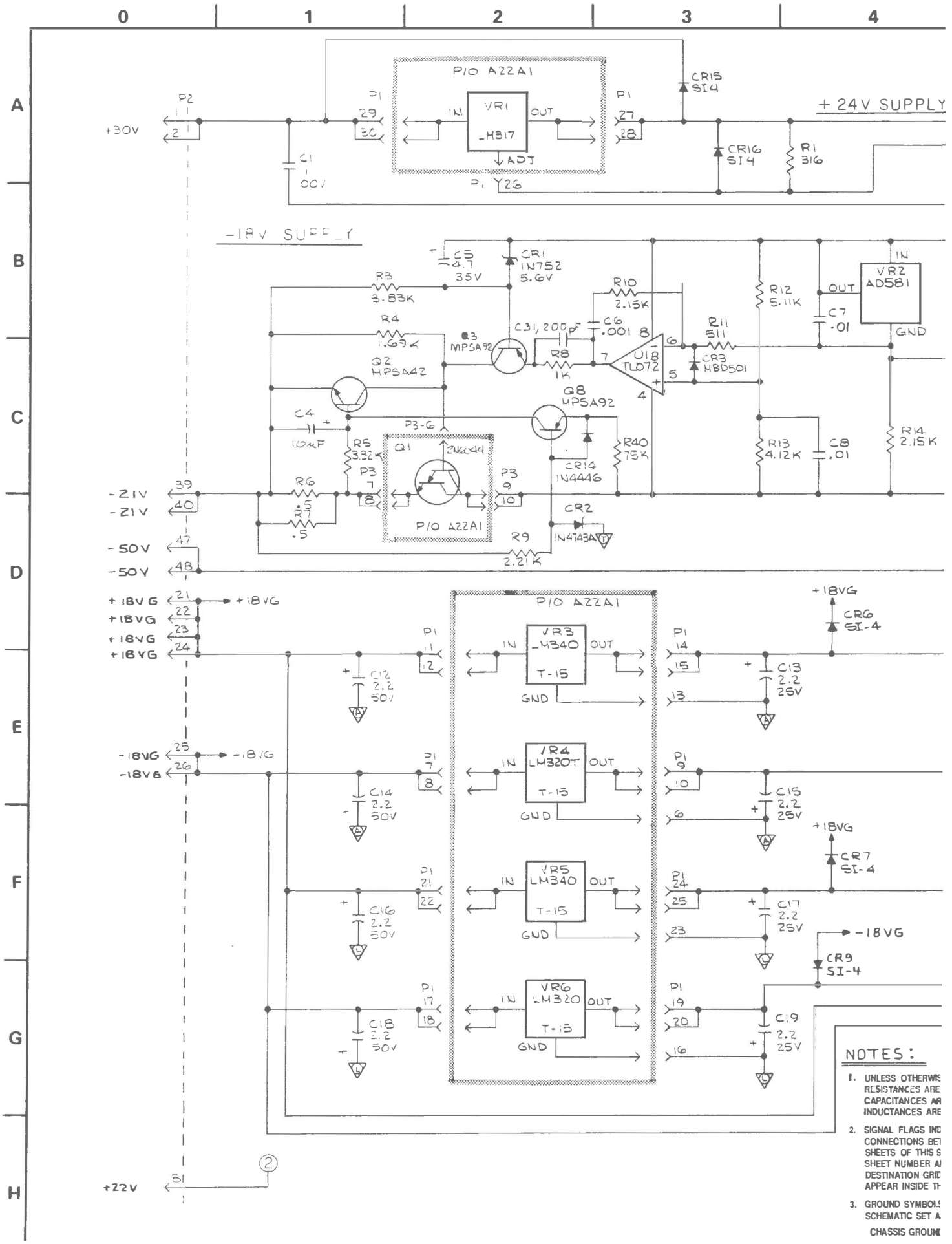
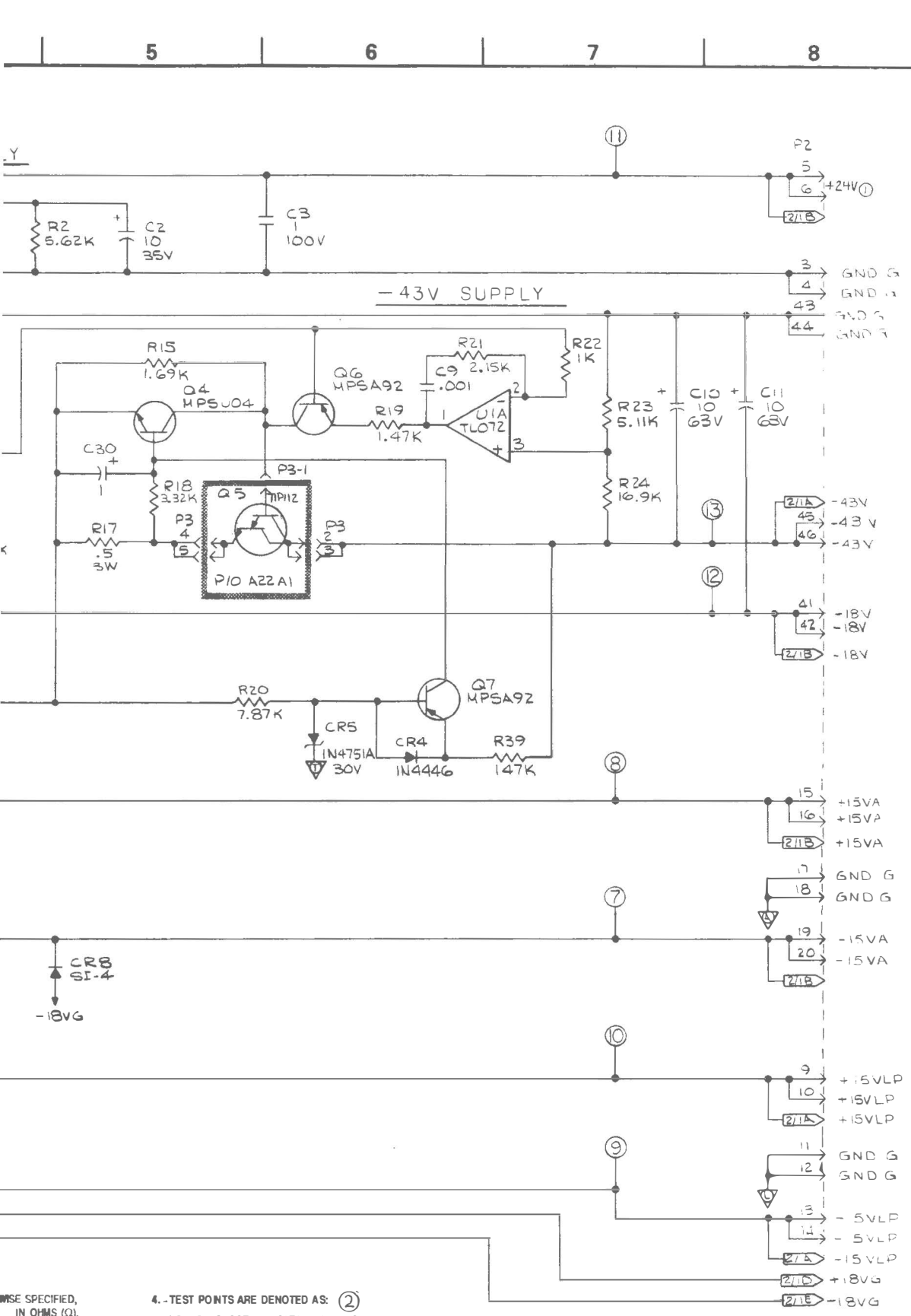


Figure 2A-5. A22 Regulator Interface PCB Parts Locator Diagram
6700-D-31722-3 (Rev. L)


0
1
2
3
4
A
B
C
D
E
F
G
H
+24V SUPPLY
P/O A22A1
VR1
LM317
ADJ
IN
OUT
+30V
C1
100/
CR15
SI4
CR16
SI4
R1
316
-18V SUPPLY
CR1
IN752
5.6V
C5
4.7
35V
R3
3.83K
R4
1.69K
Q3
MPSA92
C31, 200pF
C6
.001
R10
2.15K
R12
5.11K
R11
511
CR3
MBD501
VR2
AD581
C7
.01
GND
R8
1K
U18
TL072
Q2
MPSA42
Q8
MPSA92
C4
10uF
P3-G
Q1
2N6744
R5
3.32K
R6
.5
R7
.5
P3
CR14
IN4446
R40
75K
R13
4.12K
C8
.01
R14
2.15K
CR2
IN4743A
R9
2.21K
-21V
-50V
+18VG
-18VG
+22V
VR3
LM340
T-15
VR4
LM320T
VR5
LM340
VR6
LM320
C12
2.2
50V
C13
2.2
25V
C14
2.2
50V
C15
2.2
25V
C16
2.2
50V
C17
2.2
25V
C18
2.2
50V
C19
2.2
25V
CR6
SI-4
CR7
SI-4
CR9
SI-4
NOTES:
1. UNLESS OTHERWIS
RESISTANCES ARE
CAPACITANCES AR
INDUCTANCES ARE
2. SIGNAL FLAGS IND
CONNECTIONS BE
SHEETS OF THIS S
SHEET NUMBER AI
DESTINATION GRID
APPEAR INSIDE TH
3. GROUND SYMBOLS
SCHEMATIC SET A
CHASSIS GROUN
ISOLATED GROUN



WISE SPECIFIED, IN OHMS (Ω), ARE IN MICROFARADS (μF), IN MICROHENRIES (μH).

INDICATE MATCHING BETWEEN MULTIPLE SCHEMATIC. THE AND SOURCE OR COORDINATES THE FLAG: 2/B3

USED ON THIS ASSEMBLY ARE DENOTED AS:

GND:

GROUNDS:

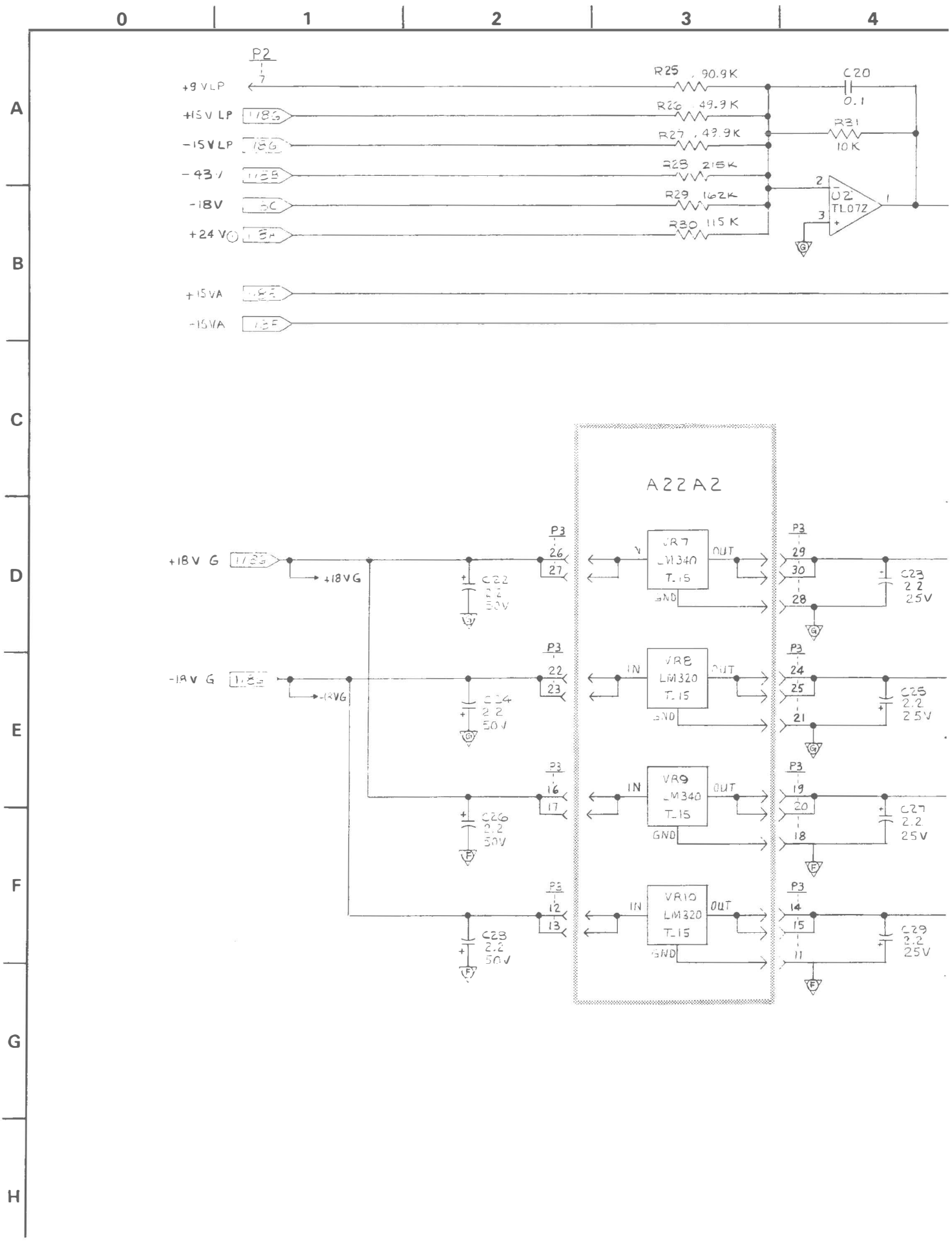
4. TEST POINTS ARE DENOTED AS: (2)
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. SUBASSEMBLY BORDERS ARE DENOTED AS:
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

CR3, U1, U2, VR2

LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C31	NONE
CR14	
Q8	
R40	
TP13	
U2	

Figure 2A-6. A22 Regulator Interface PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31722-3 (Rev. H)


0
1
2
3
4
A
B
C
D
E
F
G
H
P2
+9VLP
+15V LP
-15V LP
-43V
-18V
+24V
+15VA
-15VA
R25 90.9K
R26 49.9K
R27 49.9K
R28 215K
R29 162K
R30 115K
C20 0.1
R31 10K
U2 TL072
A22A2
+18V G
-18V G
+18VG
-18VG
C22 2.2 50V
C24 2.2 50V
C26 2.2 50V
C28 2.2 50V
VR7 LM340 T-15
VR8 LM320 T-15
VR9 LM340 T-15
VR10 LM320 T-15
IN
OUT
GND
C23 2.2 25V
C25 2.2 25V
C27 2.2 25V
C29 2.2 25V

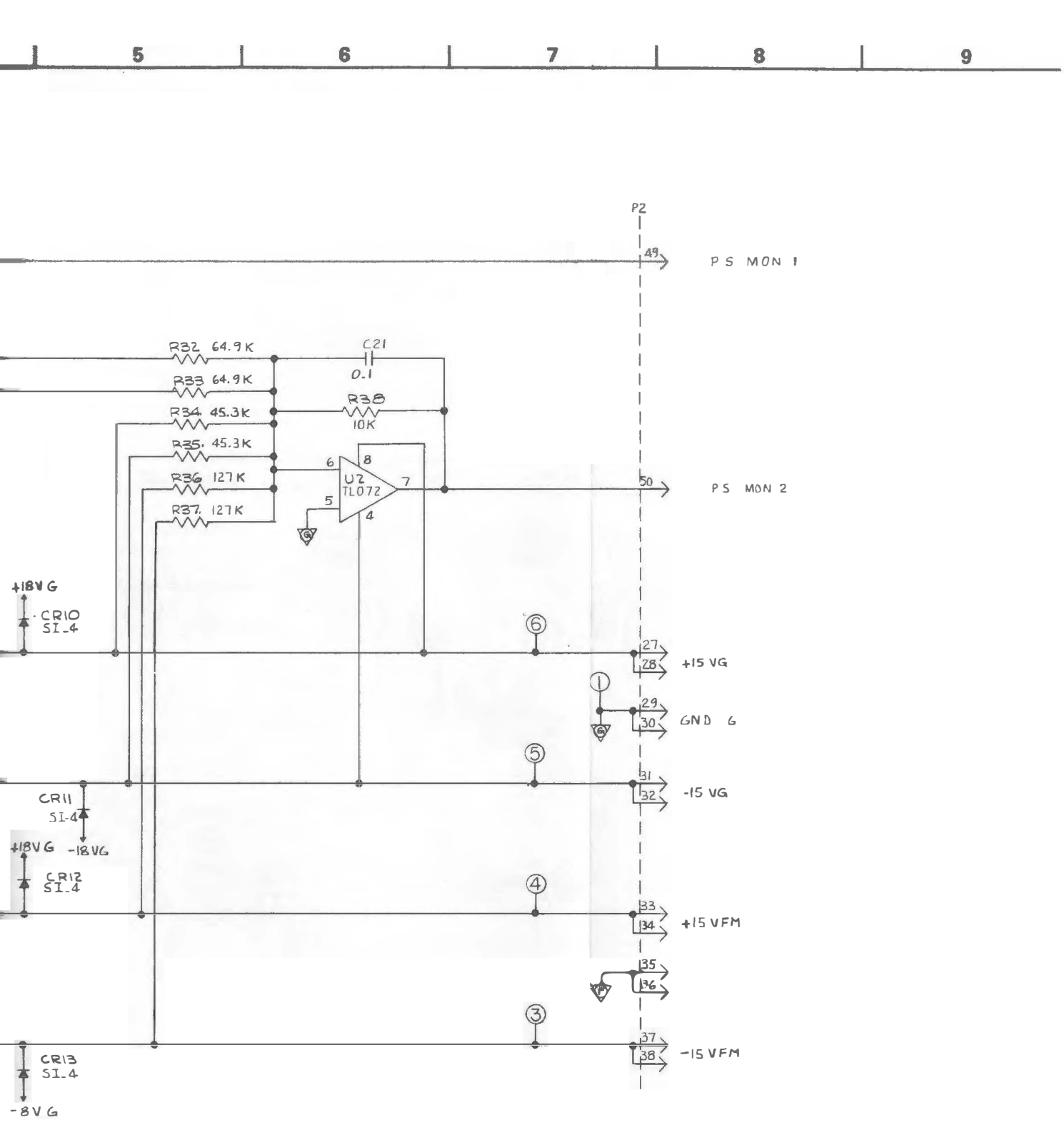
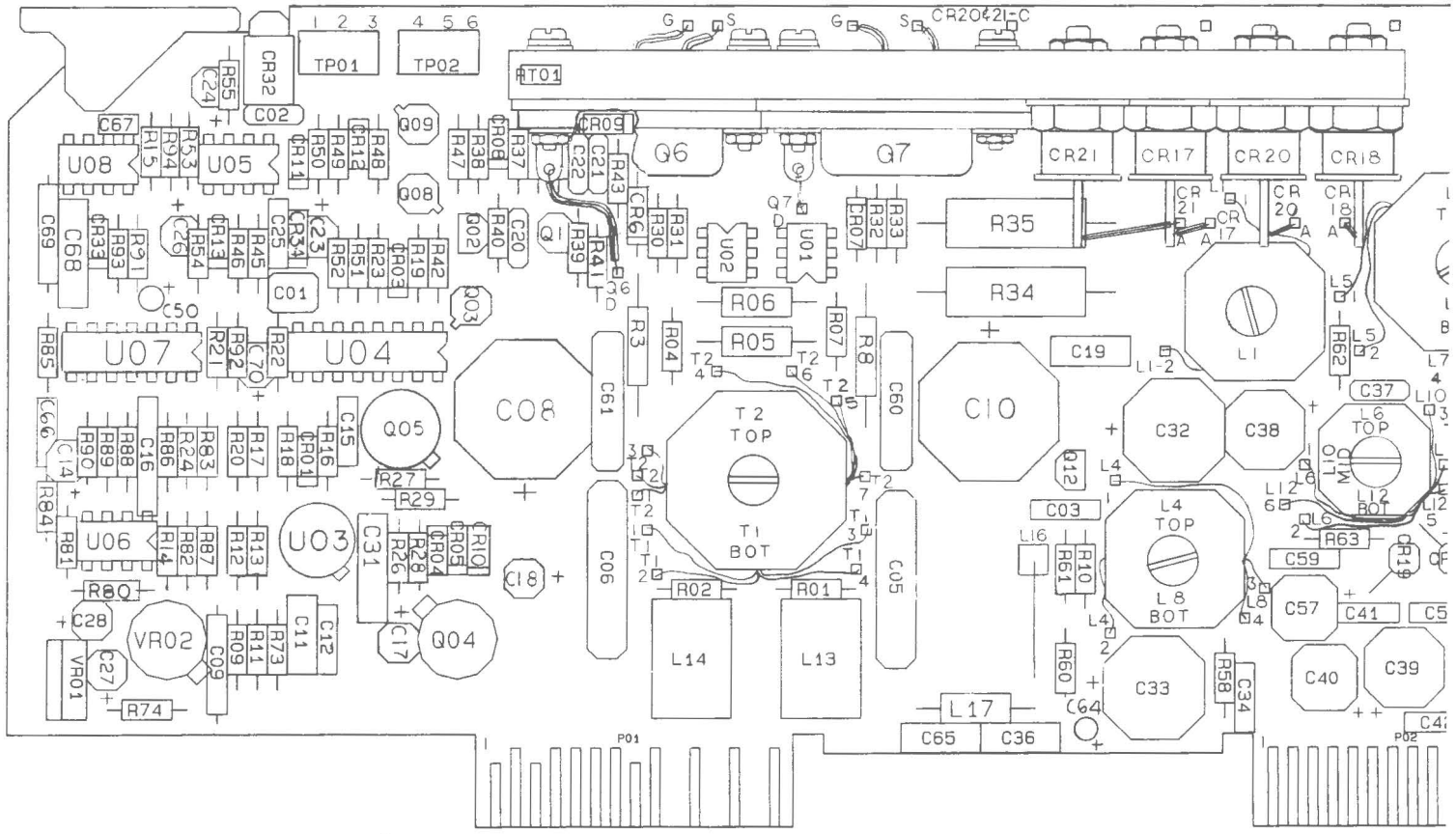


Figure 2A-6. A22 Regulator Interface PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31722-3 (Rev. H)

TEST POINTS

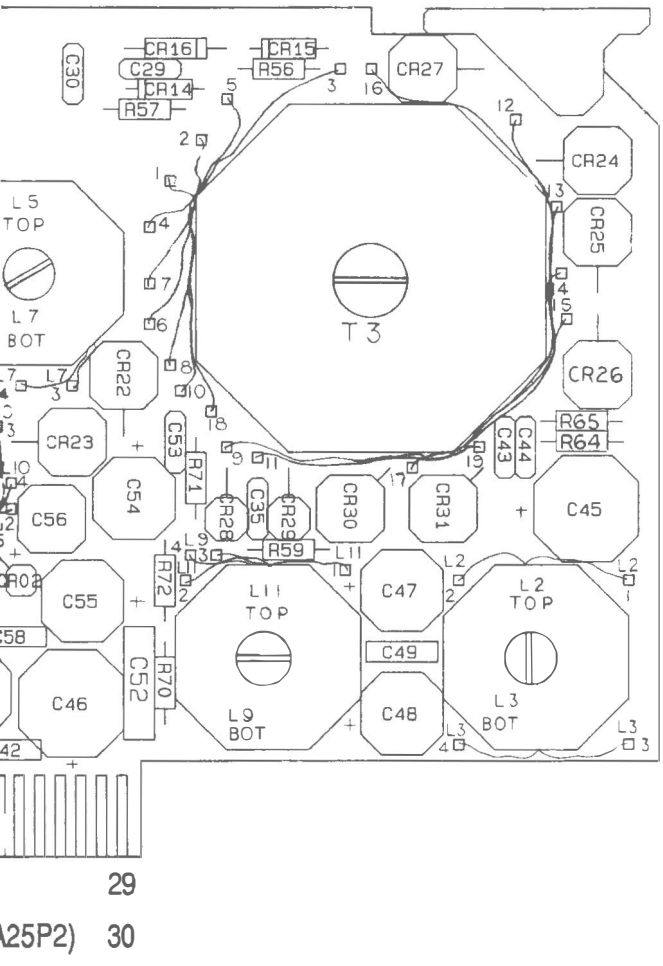
TP1 GND G
TP2 +5VD
TP3 U6, PIN 1 (OSC SIG)
TP4 PRIMARY DRIVE
TP5 PRIMARY +165V
TP6 PRIMARY –165V

TP1-6



(Front) 1 **P1** 29
(Back) 2 (To A28XA25P1) 30

(Front) 1 **P2**
(Back) 2 (To A28XA



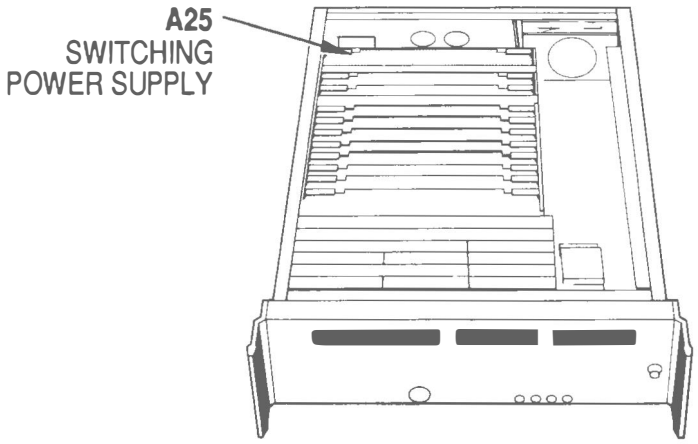
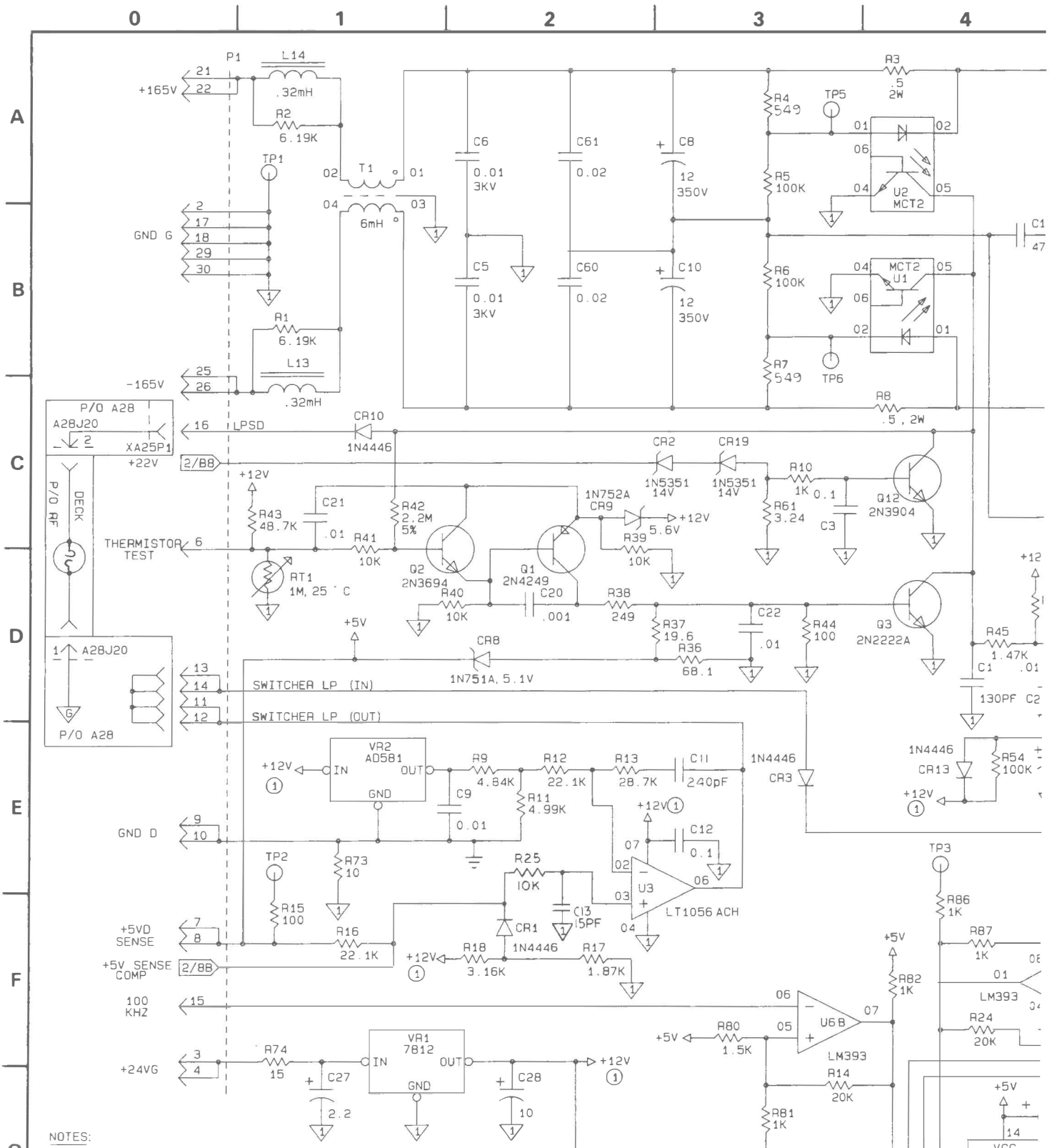


Figure 2A-7. A25 Switching Power Supply PCB Parts Locator Diagram
6700-D-31725-3 (Rev. J)


0
1
2
3
4
A
B
C
D
E
F
G
H
P1
L14
.32mH
+165V
21
22
R2
6.19K
TP1
T1
02
01
04
03
6mH
GND G
2
17
18
29
30
C6
0.01
3KV
C5
0.01
3KV
C61
0.02
C60
0.02
C8
12
350V
C10
12
350V
R4
549
R5
100K
R6
100K
R7
549
TP5
TP6
R3
.5
2W
U2
MCT2
U1
MCT2
R8
.5, 2W
C1
47
R1
6.19K
L13
.32mH
-165V
25
26
P/O A28
A28J20
XA25P1
+22V
16
LPSD
CR10
1N4446
2/B8
CR2
1N5351
14V
CR19
1N5351
14V
R10
1K
C3
0.1
R61
3.24
Q12
2N3904
+12V
R43
48.7K
C21
.01
R42
2.2M
5%
R41
10K
THERMISTOR
TEST
6
RT1
1M, 25 ° C
Q2
2N3694
Q1
2N4249
1N752A
CR9
5.6V
R39
10K
R40
10K
C20
.001
R38
249
R37
19.6
R36
68.1
CR8
1N751A, 5.1V
+5V
C22
.01
R44
100
Q3
2N2222A
R45
1.47K
C1
.01
130PF
C2
P/O RF
DECK
P/O A28
A28J20
13
14
11
12
SWITCHER LP (IN)
SWITCHER LP (OUT)
VR2
AD581
IN
OUT
GND
R9
4.84K
R12
22.1K
R13
28.7K
C11
240pF
1N4446
CR3
C9
0.01
R11
4.99K
+12V
C12
0.1
GND D
9
10
TP2
R73
10
R15
100
R25
10K
C13
15PF
U3
LT1056 ACH
CR1
1N4446
R18
3.16K
R17
1.87K
R16
22.1K
+5VD
SENSE
7
8
+5V SENSE
COMP
2/B8
100
KHZ
15
TP3
R86
1K
R87
1K
R82
1K
LM393
R24
20K
R80
1.5K
U6B
LM393
R14
20K
R81
1K
+24VG
3
4
R74
15
VR1
7812
C27
2.2
C28
10
1N4446
CR13
R54
100K
130PF
C2
VCC
U7
GND
MC4
NOTES:
A25 SWITCHING POWER SUPPLY SCHEMATIC NOTES:
UNLESS OTHERWISE SPECIFIED,
RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN
MICROFARADS, AND INDUCTANCES ARE IN MICROHENRIES
2/B9 MATCHING CONNECTIONS FOR SIGNAL FLAGS ARE
LOCATED BY SHEET NUMBER AND GRID COORDINATE
DENOTES TEST POINT
DENOTES +5V RETURN
DENOTES ANALOG GROUND 1
-V(1) DENOTES RELATIVE VOLTAGES
DENOTES ANALOG GROUND 2
-V(2) DENOTES RELATIVE VOLTAGES
DENOTES OFF BOARD SUBASSEMBLY
STATIC SENSITIVE COMPONENTS USED IN THIS
ASSEMBLY INCLUDE: R9, 11, U4, 5, Q6, 7, VR1, 2
REF DESIGNATIONS
LAST USED
NOT USED
U8
Q12
CR34
C70
R94
P2
T3
L17
TP6
VR2
RT1
Q6, Q7, Q10, Q11
CR17, 18, 20, 21
C4, C7,
C51, 62, 63
R26
R67, 68, 69, 75
R76, 77, 78, 79
L15

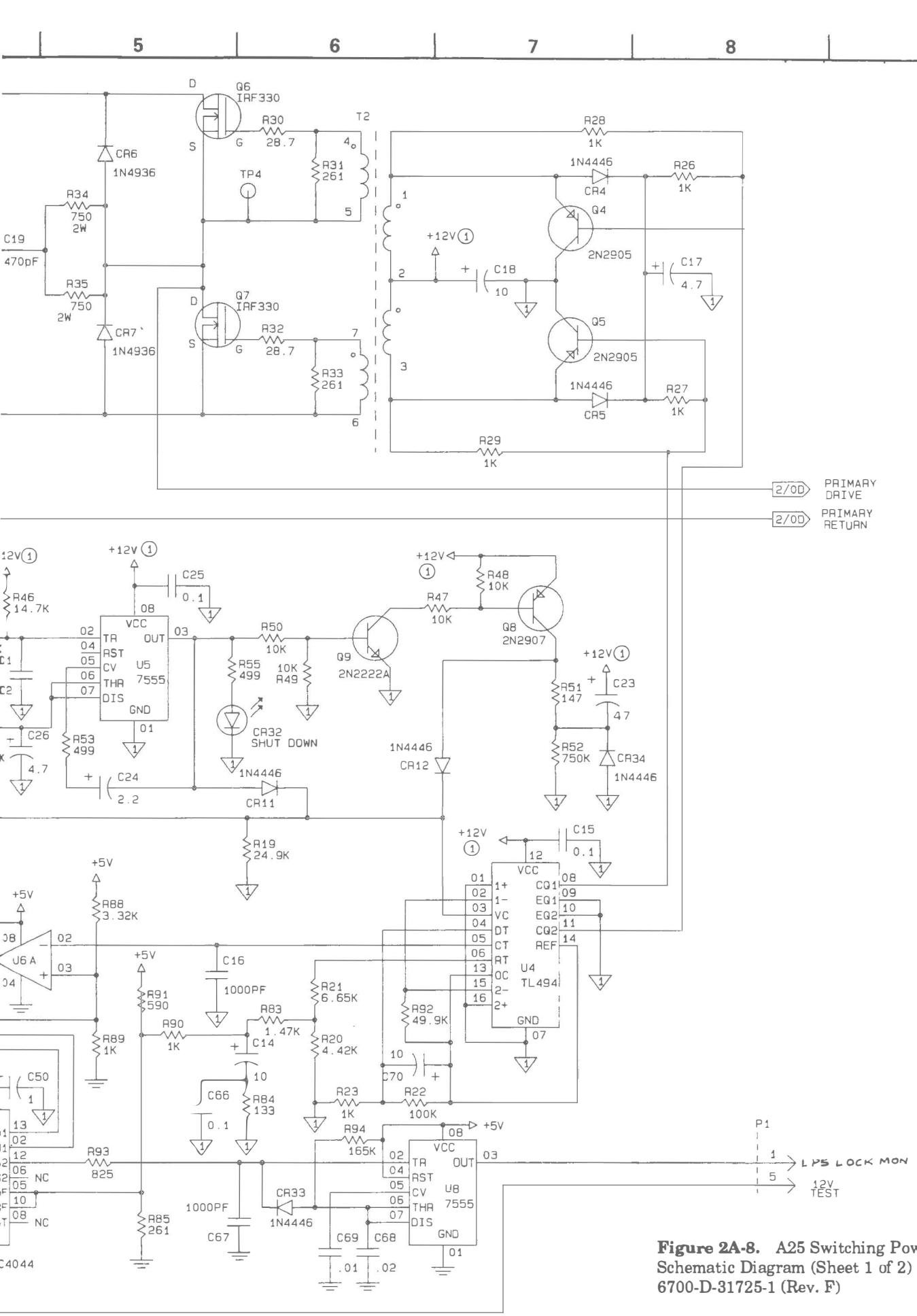
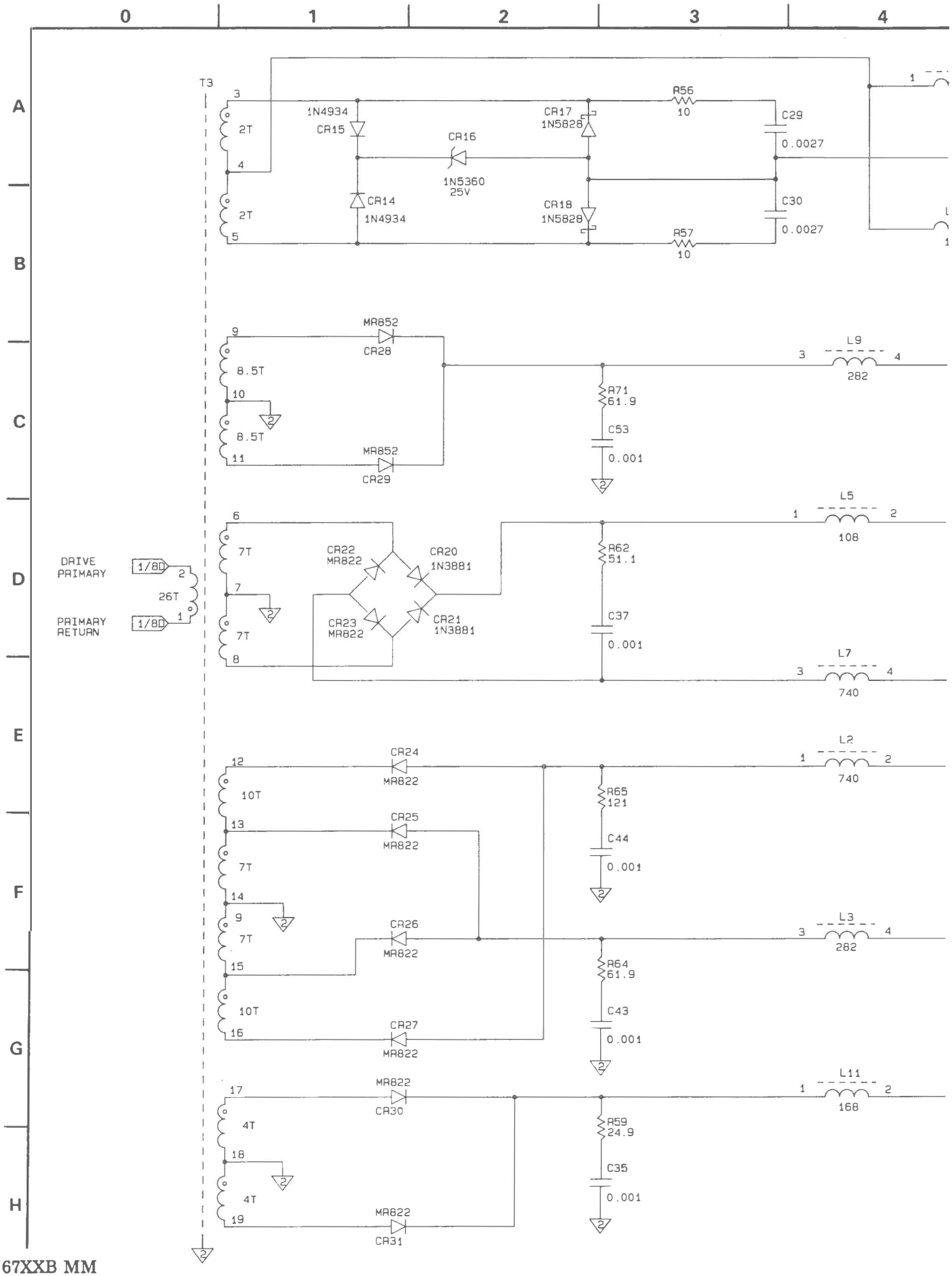


Figure 2A-8. A25 Switching Power Supply PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31725-1 (Rev. F)


0
1
2
3
4
A
B
C
D
E
F
G
H
T3
3
2T
4
2T
5
1N4934
CR15
CR14
1N4934
CR16
1N5360
25V
CR17
1N5828
CR18
1N5828
R56
10
R57
10
C29
0.0027
C30
0.0027
1
9
8.5T
10
8.5T
11
MR852
CR28
MR852
CR29
R71
61.9
C53
0.001
L9
3
4
282
6
7T
7
7T
8
CR22
MR822
CR20
1N3881
CR23
MR822
CR21
1N3881
R62
51.1
C37
0.001
L5
1
2
108
L7
3
4
740
DRIVE
PRIMARY
1/8D
2
26T
PRIMARY
RETURN
1/8D
1
12
10T
13
7T
14
9
7T
15
10T
16
CR24
MR822
CR25
MR822
CR26
MR822
CR27
MR822
R65
121
C44
0.001
R64
61.9
C43
0.001
L2
1
2
740
L3
3
4
282
17
4T
18
4T
19
MR822
CR30
MR822
CR31
R59
24.9
C35
0.001
L11
1
2
168
2

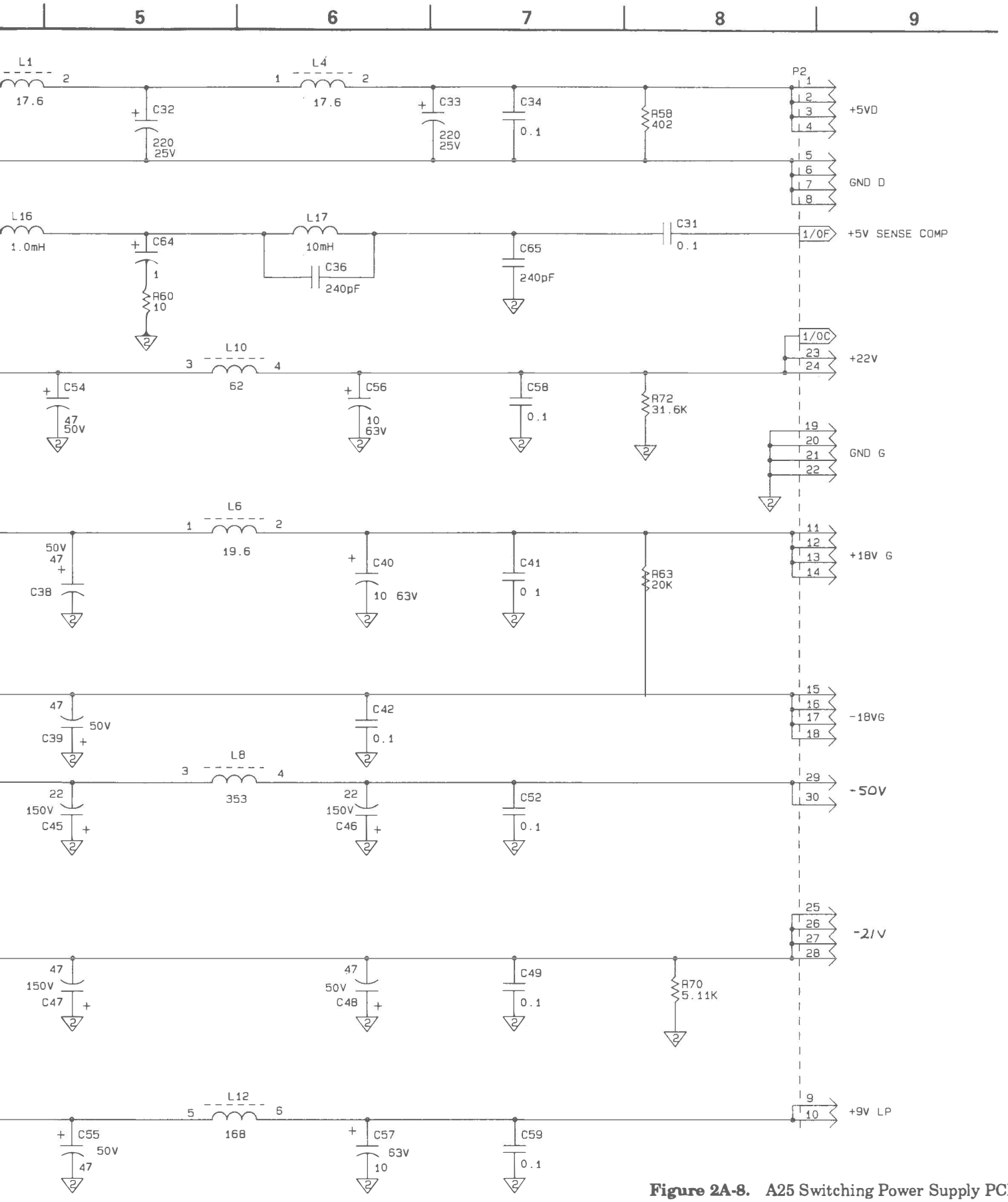


Figure 2A-8. A25 Switching Power Supply PCB Schematic Diagram (Sheet 2 of 2)
6700-D-31725-1 (Rev. F)

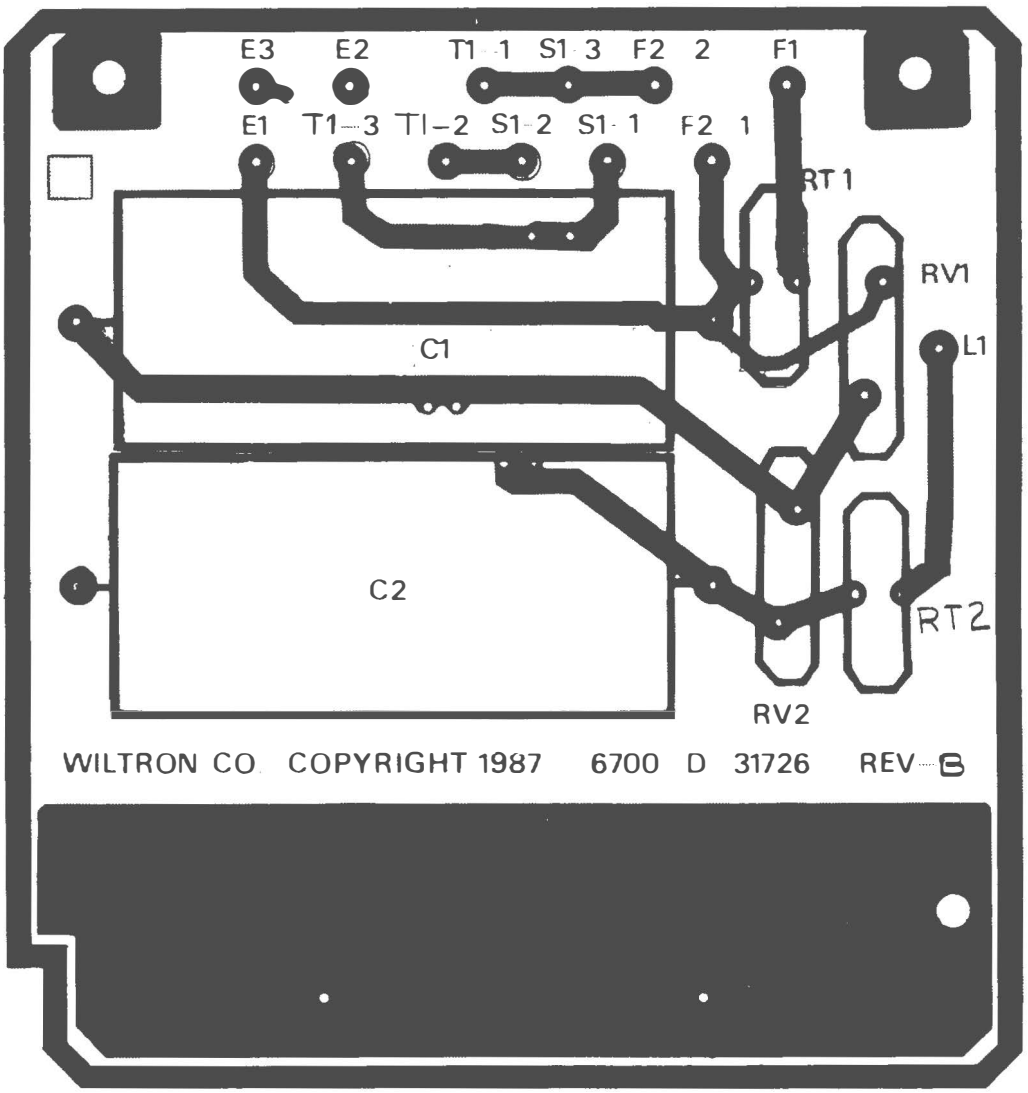
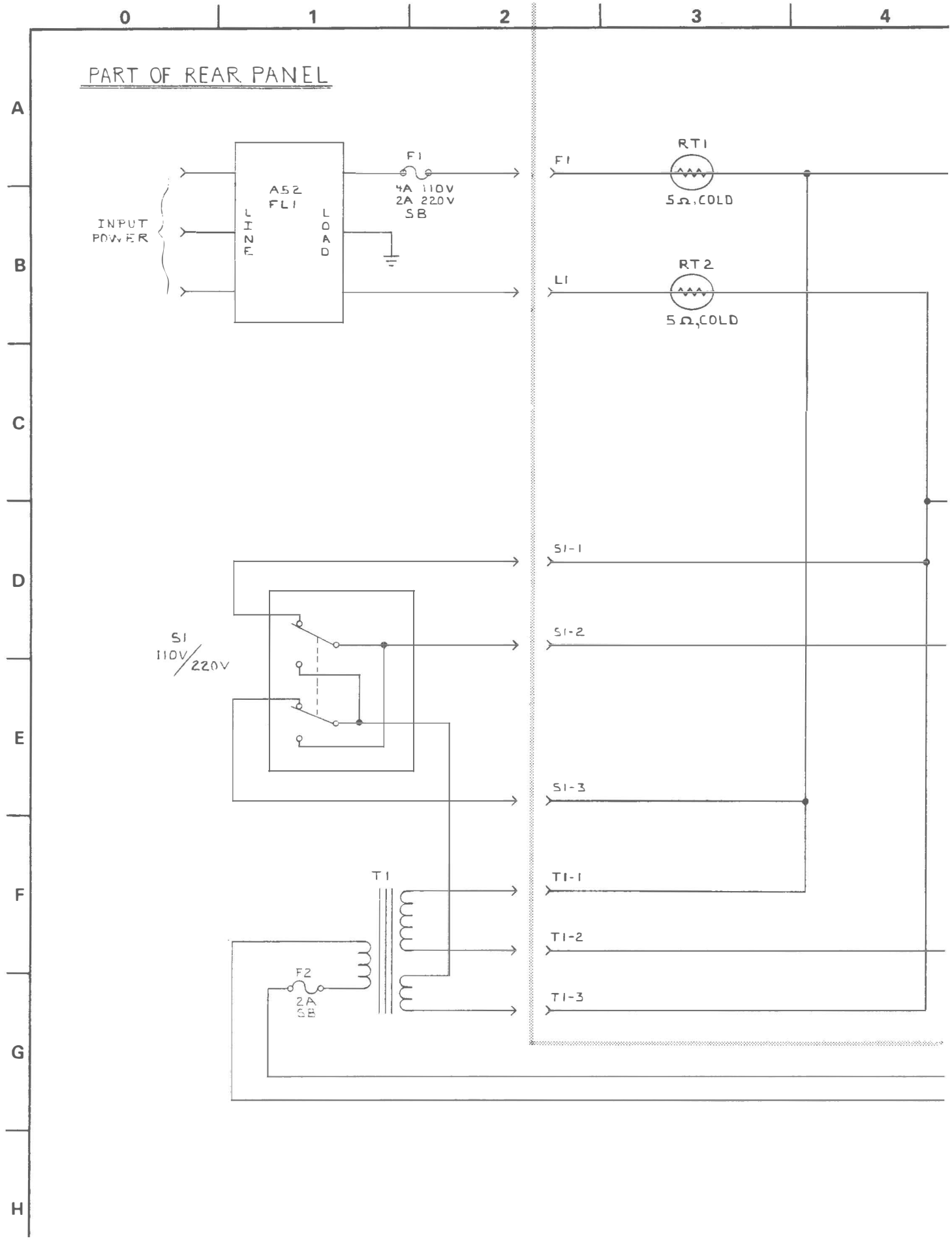


Figure 2A-9. A26 Line Filter PCB
Parts Locator Diagram
6700-D-31726-2 (Rev. C)


0
1
2
3
4
A
B
C
D
E
F
G
H
PART OF REAR PANEL
INPUT POWER
A52
FL1
LINE
LOAD
F1
4A 110V
2A 220V
SB
F1
RT1
5Ω,COLD
L1
RT2
5Ω,COLD
S1-1
S1-2
S1-3
S1
110V/220V
T1
T1-1
T1-2
T1-3
F2
2A
SB

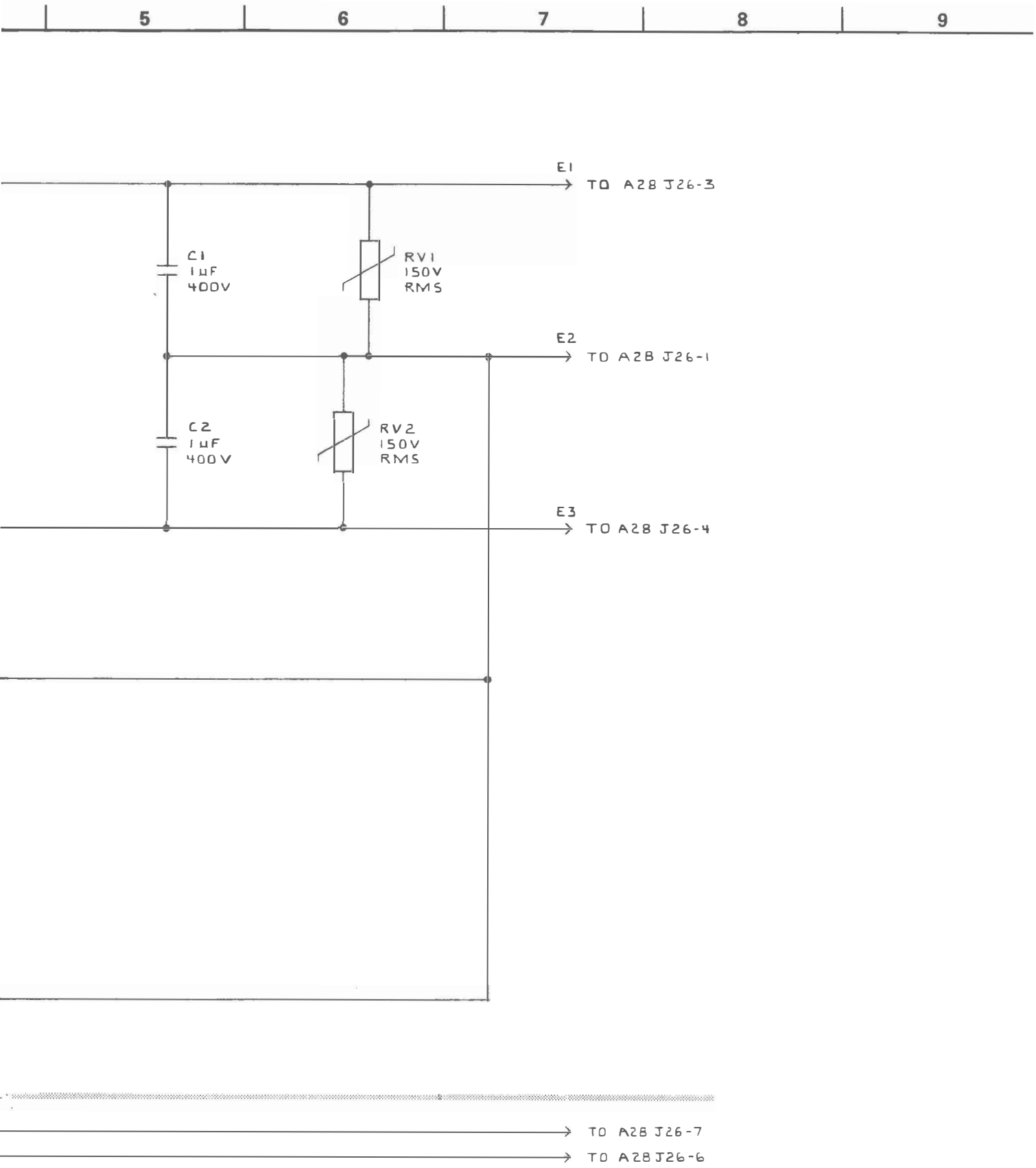
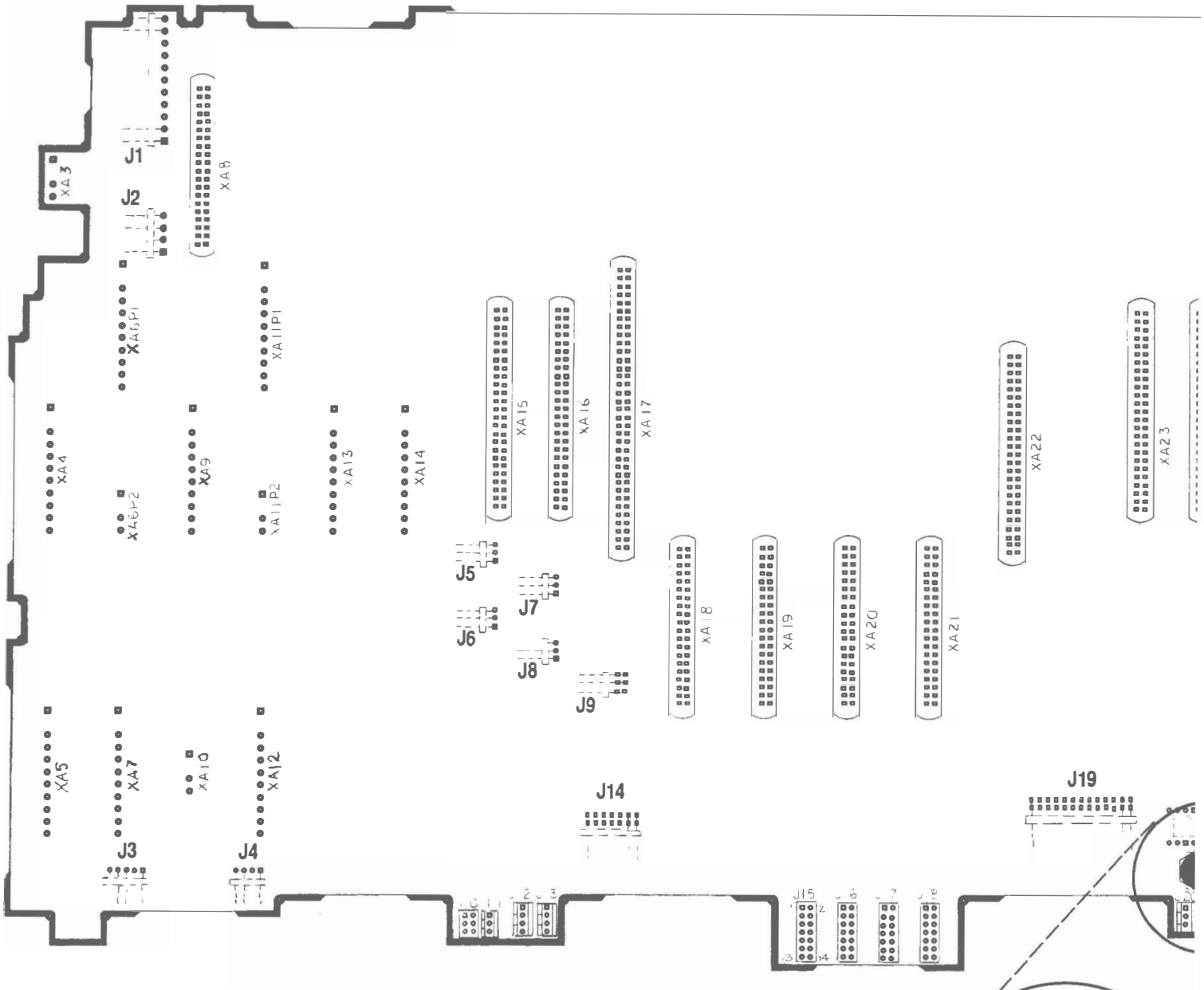


Figure 2A-10. A26 Line Filter PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31726-2 (Rev. B)

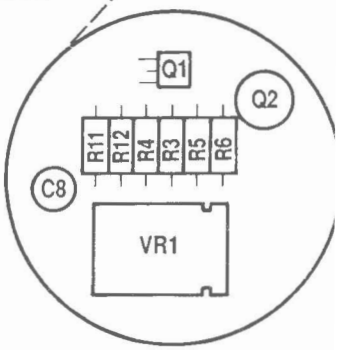
A28 MOTHERBOARD
(As viewed from *top* of instrument)

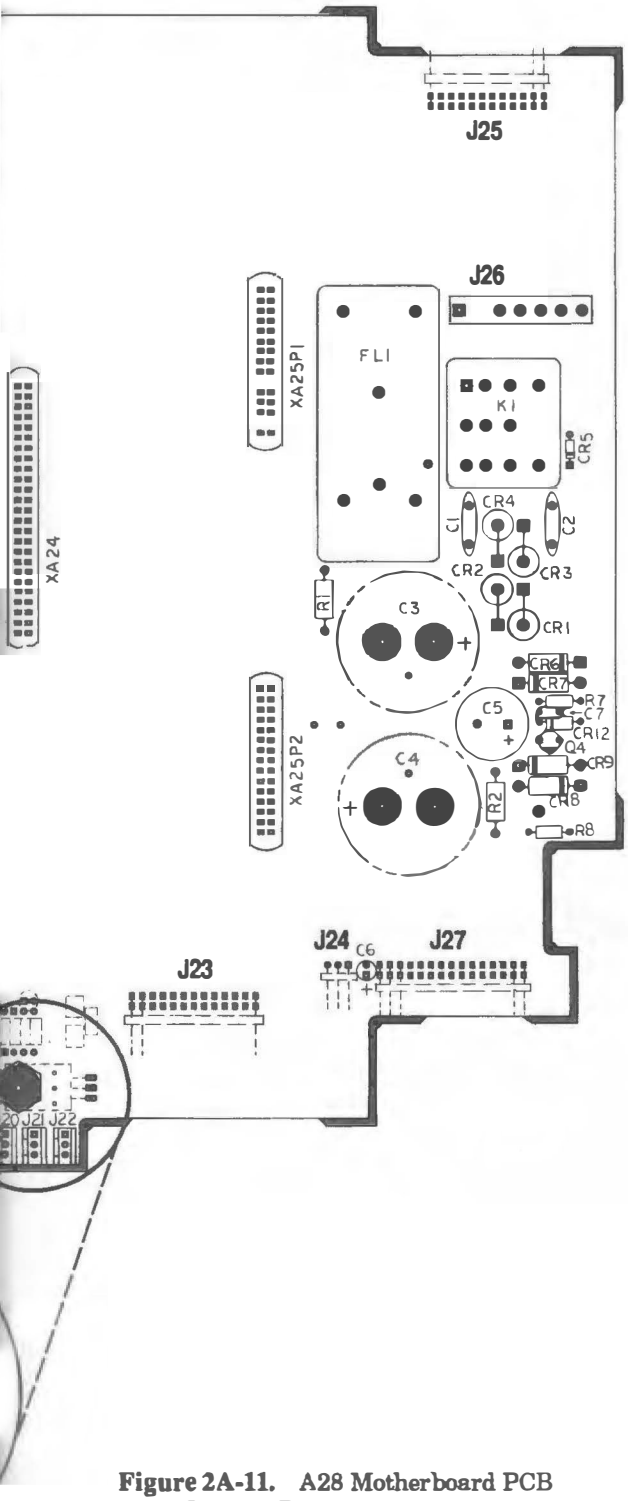


NOTES:

1. Filtercons are designated as:
   ●●●●●●●●● ■
   Each signal path connection has (typically) 1500 pF capacitance between it and chassis ground.
2. J1-9, J14, J19, J23-25, and J27 are mounted on the bottom side of the A28 PCB.

Fan Power Supply Components
(As viewed from *bottom* of instrument)





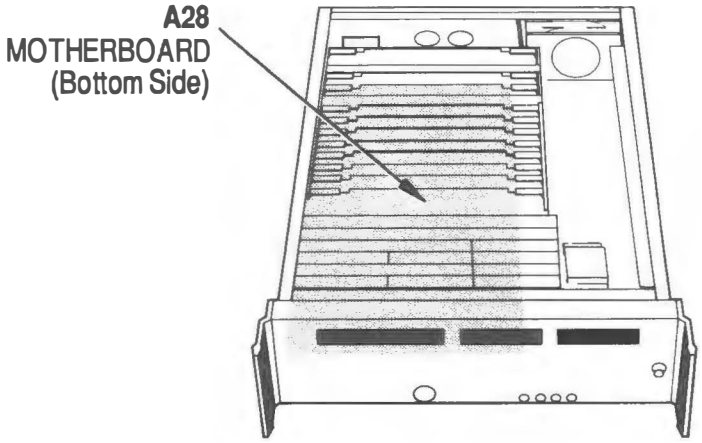
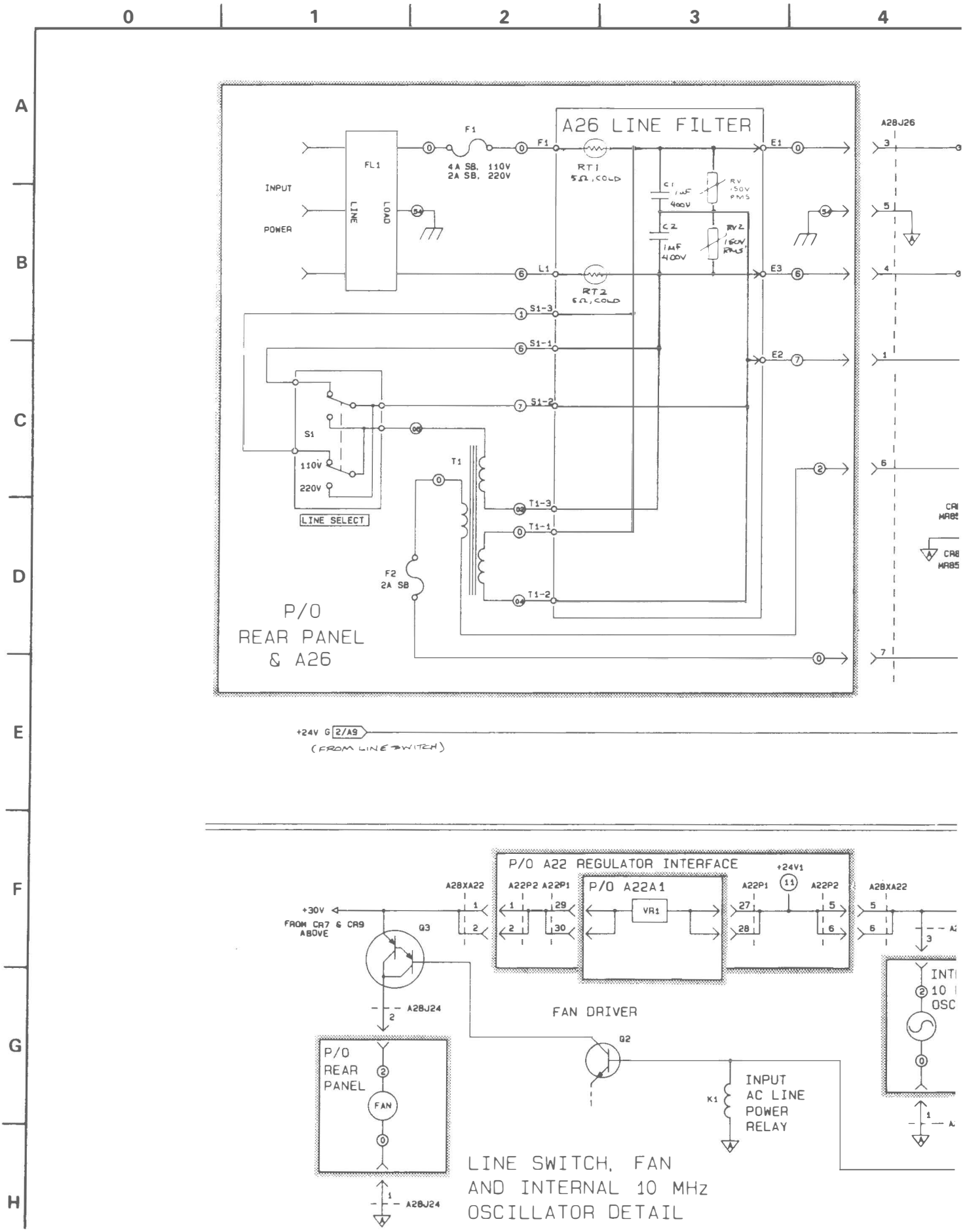


Figure 2A-11. A28 Motherboard PCB Parts Locator Diagram 6700-D-31828-3 (Rev. F)


A26 LINE FILTER
INPUT POWER
FL1
LINE
LOAD
F1
4A SB, 110V
2A SB, 220V
RT1
5Ω, COLD
C1
1μF
400V
RV1
150V RMS
C2
1μF
400V
RV2
150V RMS
RT2
5Ω, COLD
S1-3
S1-1
S1-2
S1
110V
220V
LINE SELECT
T1
T1-3
T1-1
T1-2
F2
2A SB
P/O
REAR PANEL
& A26
A28J26
+24V G 2/A9
(FROM LINE SWITCH)
P/O A22 REGULATOR INTERFACE
P/O A22A1
VR1
A28XA22
A22P2 A22P1
A22P1
A22P2
+24V1
+30V
FROM CR7 & CR9 ABOVE
Q3
Q2
A28J24
P/O
REAR
PANEL
FAN
FAN DRIVER
K1
INPUT
AC LINE
POWER
RELAY
LINE SWITCH, FAN
AND INTERNAL 10 MHz
OSCILLATOR DETAIL

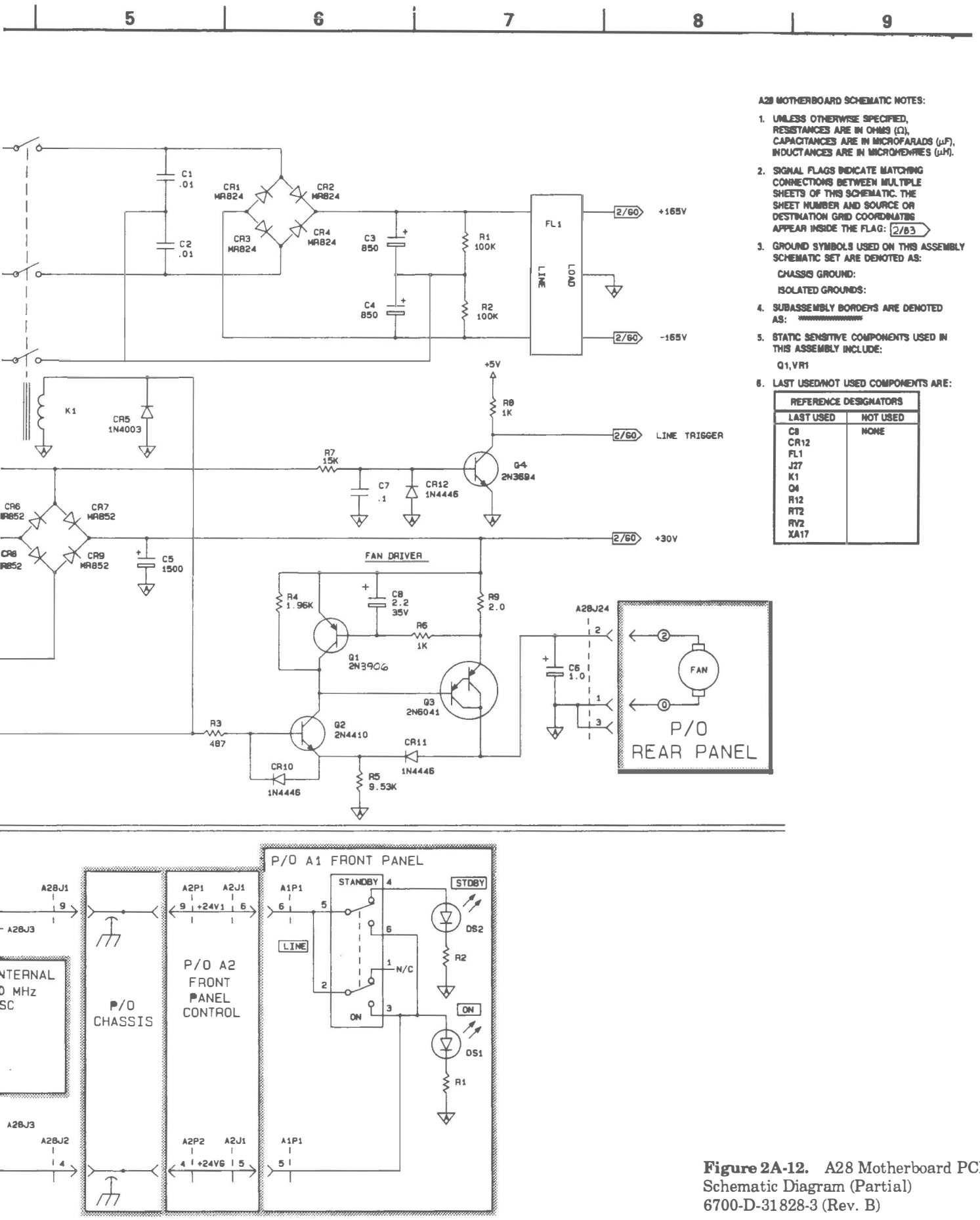


Figure 2A-12. A28 Motherboard PCB Schematic Diagram (Partial) 6700-D-31828-3 (Rev. B)

2B–DIGITAL CONTROL A8, A23, and A24 PCBs

2B-1 DIGITAL CONTROL ASSEMBLIES: A23, A24, AND A8 PCBs

This section contains service information for the digital control assemblies listed in Table 2B-1 below. Refer also to the specific troubleshooting information for these PCBs that is located in the beginning of this section (Section 2–System Description and Troubleshooting).

Table 2B-1. Digital Control Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2B-2	2B-1
Block Diagram	Fig. 2B-1	2B-3
PCB LEVEL		
A8 Digital Control PCB		
General Circuit Description	Para. 2B-2	2B-1
Detailed Circuit Description	Para. 2B-5	2B-8
Block Diagram	Fig. 2B-4	2B-11
Parts Locator Diagram	Fig. 2B-5	2B-12
Schematic (Sheet 1 of 1)	Fig. 2B-6	2B-13
A23 Microprocessor PCB		
General Circuit Description	Para. 2B-2	2B-1
Detailed Circuit Description	Para. 2B-3	2B-2
Block Diagram	Fig. 2B-2	2B-5
Parts Locator Diagram	Fig. 2B-7	2B-14
Schematic (Sheet 1 of 2)	Fig. 2B-8	2B-15
(Sheet 2 of 2)	"	2B-17
A24 GPIB PCB		
General Circuit Description	Para. 2B-2	2B-1
Detailed Circuit Description	Para. 2B-4	2B-4
Block Diagram	Fig. 2B-3	2B-7
Parts Locator Diagram	Fig. 2B-9	2B-18
Schematic (Sheet 1 of 1)	Fig. 2B-10	2B-19

2B-2 DIGITAL CONTROL ASSEMBLIES, OVERALL DESCRIPTION

The digital control assemblies consist of the A23 Microprocessor PCB, the A24 GPIB PCB, and the A8 Serial I/O PCB (see Figure 2B-1). These PCB assemblies control the synthesizer either locally via the front panel or remotely over the IEEE-488 General Purpose Interface Bus (GPIB).

2B-2.1 A23 Microprocessor PCB, General Description

The 8088 microprocessor on the A23 Microprocessor PCB is the main controller for the synthesizer. It controls all of the main synthesizer functions, either directly or indirectly. The microprocessor on the A24 PCB, and other control circuits located throughout the synthesizer, control specific functions that are under the overall control of the A23 PCB main microprocessor.

As shown in Figure 2B-1, the A23 PCB directly controls the A8, A15, A16, A17, A24 and A29 PCBs using an 8-bit data bus and a 3-bit PCB address bus. In addition, there is one (or more) dedicated address lines from the A23 PCB to each of these PCBs (LPA10, LPA11 and LPA12-LPA22).

2B-2.2 A8 Serial I/O PCB, General Description

The A23 PCB indirectly controls the A2, A6, A11 and A13 PCBs via the A8 Serial I/O PCB. The A23 PCB controls these PCBs by first sending suitable address and command data to the A8 PCB. It then sends the command/data information for the target PCB to the A8 PCB (in parallel format). The A8 PCB converts the information into a serial data string and sends it to the target PCB.

The A8 PCB also converts serial data from the A2 Front Panel Control PCB, the A7 Reference Divider PCB and the optional A14 PCB and sends it to the A23 PCB main microprocessor. All information from the front panel keys and controls is sent to the A23 PCB in this manner.

2B-2.3 A24 GPIB PCB, General Description

The A24 GPIB PCB provides communication between the A23 main microprocessor and the synthesizer GPIB interface. It decodes command and data information from the IEEE-488 (GPIB) bus and

sends interrupts and data to the A23 Microprocessor PCB, as required. It also transmits data from the A23 PCB to the GPIB bus under control of the (A23) main microprocessor.

The A23 PCB communicates with the A24 PCB in the normal manner via the (parallel) main microprocessor data bus. For quick response to external GPIB commands, the A24 GPIB PCB interfaces with the A23 PCB using interrupts. When a (external) GPIB controller sends a command to the synthesizer, the A24 PCB decodes the command and sends an interrupt to the main microprocessor. This interrupt has the highest priority of all main processor interrupts. When it is received, the main microprocessor processes the command from the GPIB and performs the required task.

2B-3 A23 MICROPROCESSOR PCB, DETAILED DESCRIPTION

Refer to the A23 PCB block diagram (Figure 2B-2) and to the A23 PCB schematic diagram (Figure 2B-6) during the following description.

2B-3.1 Microprocessor Circuits

The synthesizer main microprocessor, A23U9 is an 8088 16-bit microprocessor that operates at a 5 MHz clock rate. Clock chip U1, in conjunction with the 15 MHz crystal Y1, generates the 5 MHz clock signal for U9. Timer U32 provides the power-up reset function for the microprocessor circuit. Flip-flops U2A and U2B generate two wait states (total ≈ 400 ns) whenever U9 addresses circuits located on any other PCB.

Both address and data information are multiplexed on the U9 microprocessor bus. Buffer latches U10 and U11 store address information from the microprocessor bus. The U10/U11 outputs, in conjunction with the AD9 and A10-A15 outputs of U9, produce the 19-bit internal address bus. This bus is used to address all memory locations and other controller functions on the A23 PCB. (It also contains the information to address all of the other PCBs—see below.)

NOTE

Switch SW1 must be in the NORM position for normal operation of the synthesizer. (Placing SW1 in the SERV position will cause U9 to become inoperative.)

2B-3.2 A23 PCB Memory

The A23 PCB memory is structured as follows.

- 136 Kbyte of EPROM that is used to store the main operating program of the synthesizer (i.e., synthesizer firmware).
- 16 Kbyte of EEPROM (expandable to 64 K) that is used to store calibration data. This EEPROM is electrically erasable and is programmed by the main microprocessor during calibration. The reprogramming is enabled by jumper P2 (see note below).
- 8 Kbyte of non-volatile RAM that is used to store front panel setups in the power-off condition. The battery for this RAM is part of the integrated circuit structure of these chips and requires no external charging circuitry.
- 16 Kbyte of general purpose scratch-pad RAM.

NOTE

Jumper P2 must be in the NORMAL position for normal operation. (Jumper P2 is placed in the CAL position to allow data to be written into the EEPROMs during calibration of the synthesizer; refer to the 67XXB Test and Calibration Manual for more information.)

2B-3.3 PCB Address Bus Circuits

These circuits address all of the circuit functions throughout the synthesizer. As shown in Figure 2B-2, the internal address bus goes to the U14 port latch. The Q_0-Q_3 outputs of U14 are the PCB address bus lines, **PA0–PA3**. (Note: **PA3** is not presently used.) The Q_4-Q_7 outputs are decoded by U18 and U19 to produce the dedicated address lines **L PA10**, **L PA11** and **L PA12-L PA22**. These dedicated address lines are used in conjunction with the PCB address lines **PA0–PA2** to select specific circuit functions located on the A8, A15, A16, A17, A24 and A29 PCBs.

2B-3.4 Main Microprocessor Data Bus

Data from the memory circuits are placed onto the 8-bit *internal* data bus, ID BUS, under control of the main microprocessor. This bus goes to various A23 controller circuits and to buffer-latch U16. The outputs of U16 are the **D0-D7** lines of the (external) main microprocessor bus that transfers data to/from the A8, A15, A16, A17, A24 and A29 PCBs.

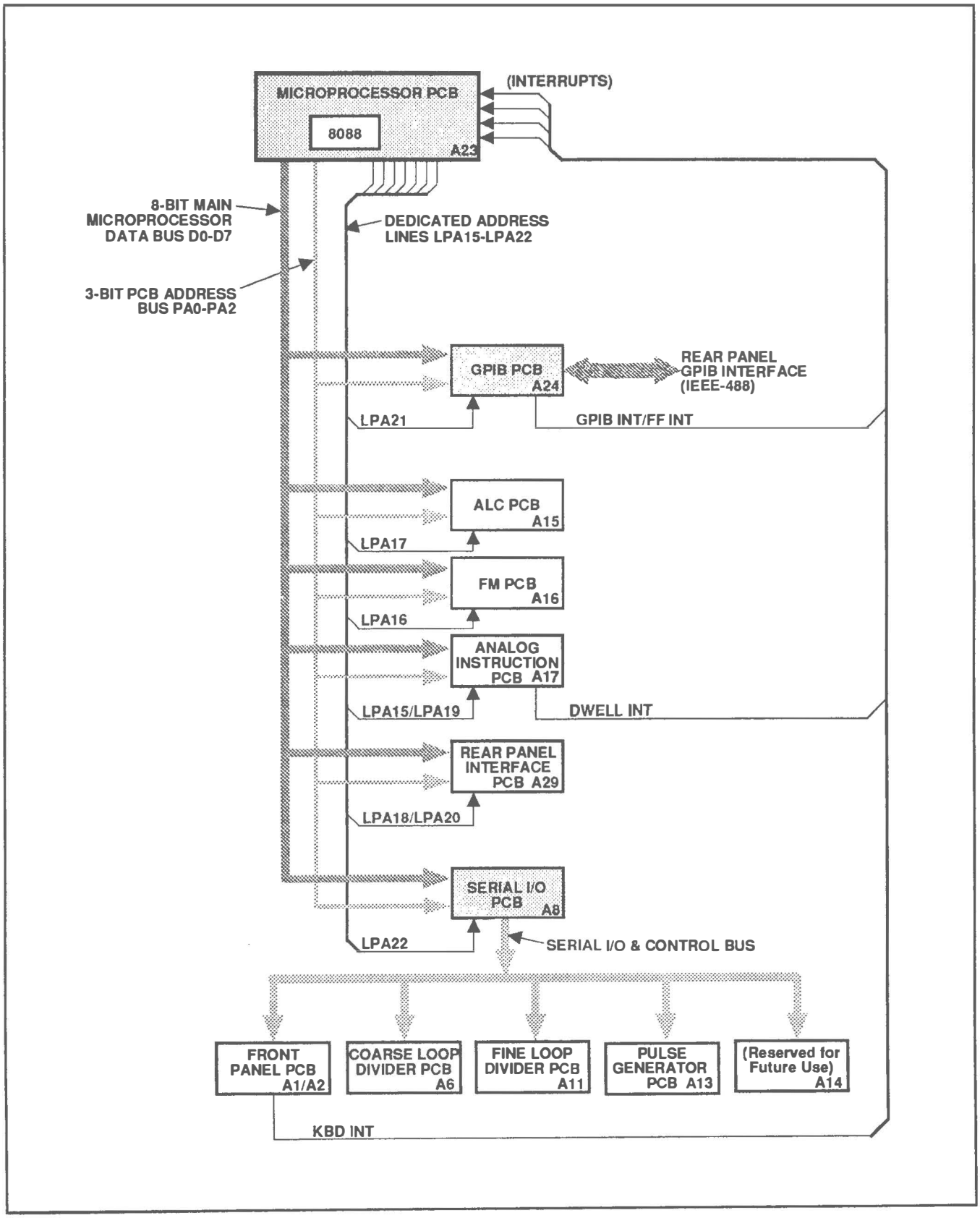


Figure 2B-1. Overall Block Diagram of 67XXB Digital Control Subsystem

Data from the A24 GPIB PCB, the A8 Serial I/O PCB, or the DVM circuits on the A17 PCB are sent to the A23 PCB via the main microprocessor data bus. This data is received by tri-state buffer U17 and transferred to U9 via the internal data bus.

The inputs to tri-state buffer U15 form a start up instruction for the main microprocessor. When the synthesizer is turned on, this instruction is transferred via U15, U17 and jumper block J1 to the U9 microprocessor bus.

2B-3.5 Interrupt Control and Timing Circuits

The interrupt controller integrated circuit (U8) processes the interrupt signals from the **DWELL INT**, **GPIB INT**, **LFF INT** and **KBD INT** inputs and generates interrupts to U9, as required. These interrupt signals are handled on a priority basis. The **L FF INT** interrupt from the A24 GPIB PCB has top priority; the **KBD INT** interrupt from the A2 Front Panel Control has the lowest priority.

The **L FF INT** (Low Fast Frequency) interrupt from the A24 PCB occurs when a fast frequency stepping command is received from the GPIB interface. (The fast frequency stepping function is initialized by storing up to 512 frequencies in RAM memory.) Each time a group execute trigger (GET) command is received from the GPIB, the A24 PCB sends an L FF interrupt to the A23 PCB. The microprocessor then commands the synthesizer circuits to go to the next frequency stored in memory. This reduces the time required for the GPIB microprocessor to process the frequency commands and request service from the main microprocessor.

A **DWELL INT** interrupt is generated by the A17 Analog Instruction PCB during analog sweep operations. This interrupt tells the microprocessor that a (sweep) dwell has occurred and that it must now perform either a bandswitch, retrace, or beginning-of-new-sweep operation.

The **LINE TRIG** input from the A28 Motherboard power circuits and the **EXT TRIG** input from the rear panel BNC connector are multiplexed by the U3 priority encoder chip to produce a single interrupt signal. This interrupt occurs when the synthesizer is in sweep mode and set for line trigger or external trigger operation.

The U6 counter and U7 timer circuits provide timing signals for wait periods controlled by U9. These wait periods are used to trigger events (such as the microprocessor housekeeping routine) and to provide time for the phase-lock loops to achieve lock. During these waits, the microprocessor does other (non-related) tasks. At the end of a wait period, U7 sends an interrupt to the microprocessor via U8; the microprocessor then services the next (related) task.

NOTE

The microprocessor housekeeping routine normally occurs every 50 ms. During this routine, the microprocessor checks for phase lock on each of the loops and monitors such items as AM and FM status and the power meter input.

2B-4 A24 GPIB PCB, DETAILED DESCRIPTION

During the following description, refer to the the A24 PCB block diagram (Figure 2B-3) and to the A24 PCB schematic diagram (Figure 2B-10).

The A24 GPIB PCB controller consists of an 8085 microprocessor (U1) and associated ROM and RAM. These circuits perform all the necessary software operations to interface the IEEE-488 (GPIB) instrument bus to the A23 PCB main microprocessor. The A24 PCB also contains a GPIB controller integrated circuit (U7) that performs the actual GPIB interfacing and control operations under overall control of microprocessor U1.

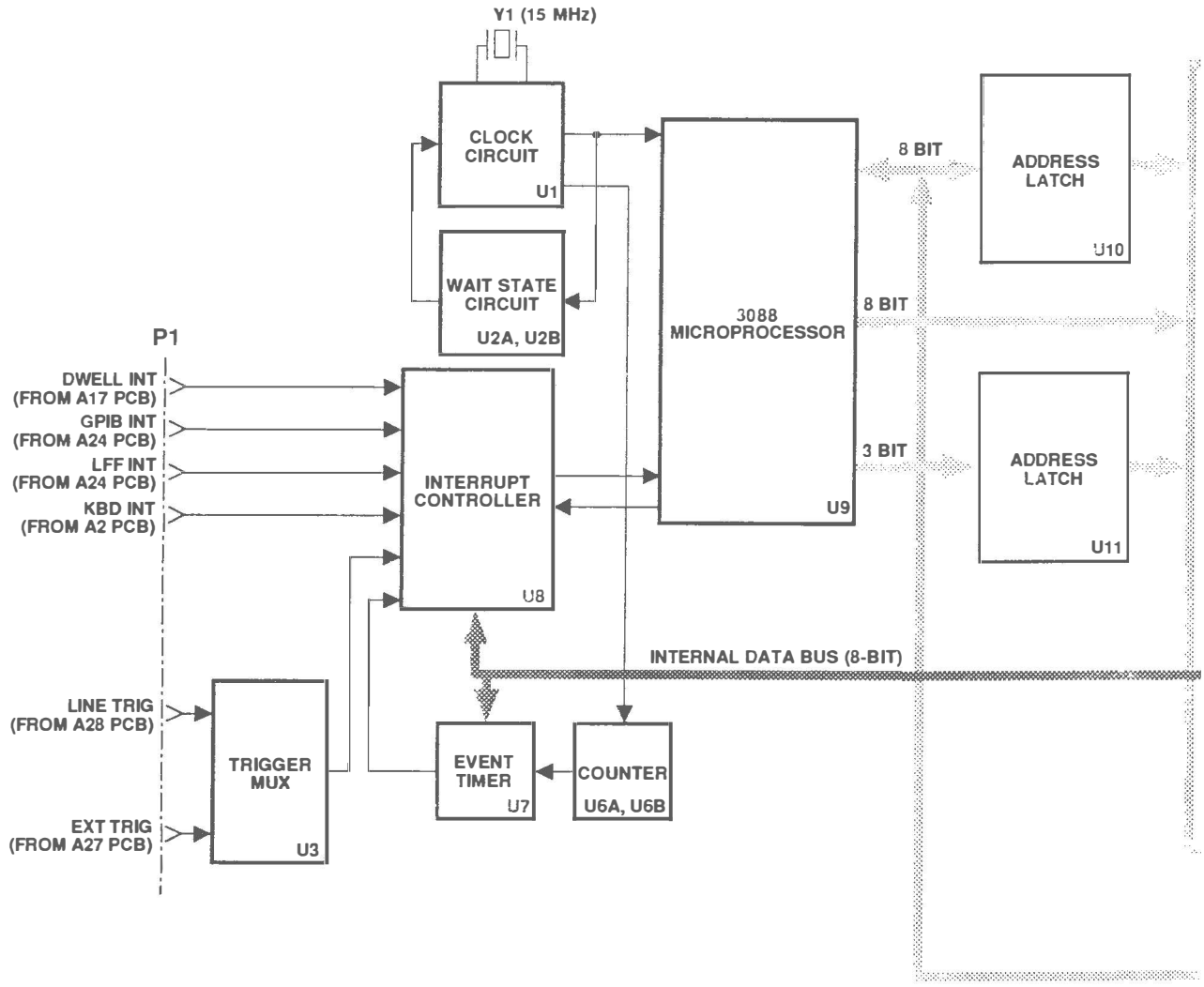
Microprocessor U1 implements the following GPIB subset functions: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, and C5. Also, the front panel GPIB status LEDs (remote, SRQ, listen, talk, etc.) are controlled by the A23 PCB main microprocessor from information supplied by U1.

2B-4.1 A24 Microprocessor Circuits

Microprocessor U1 is an 8-bit 8085 microprocessor that operates at a 6 MHz clock rate. The internal clock generator circuits of U1 are controlled by the 6 MHz crystal, Y1.

NOTE

Switch SW1 must be in the NORM position for normal operation. (Switching SW1 to the SERV position causes U1 to perform special test functions.)


Y1 (15 MHz)
CLOCK CIRCUIT
U1
WAIT STATE CIRCUIT
U2A, U2B
3088 MICROPROCESSOR
U9
8 BIT
ADDRESS LATCH
U10
8 BIT
3 BIT
ADDRESS LATCH
U11
P1
DWELL INT (FROM A17 PCB)
GPIB INT (FROM A24 PCB)
LFF INT (FROM A24 PCB)
KBD INT (FROM A2 PCB)
INTERRUPT CONTROLLER
U8
INTERNAL DATA BUS (8-BIT)
LINE TRIG (FROM A28 PCB)
EXT TRIG (FROM A27 PCB)
TRIGGER MUX
U3
EVENT TIMER
U7
COUNTER
U6A, U6B

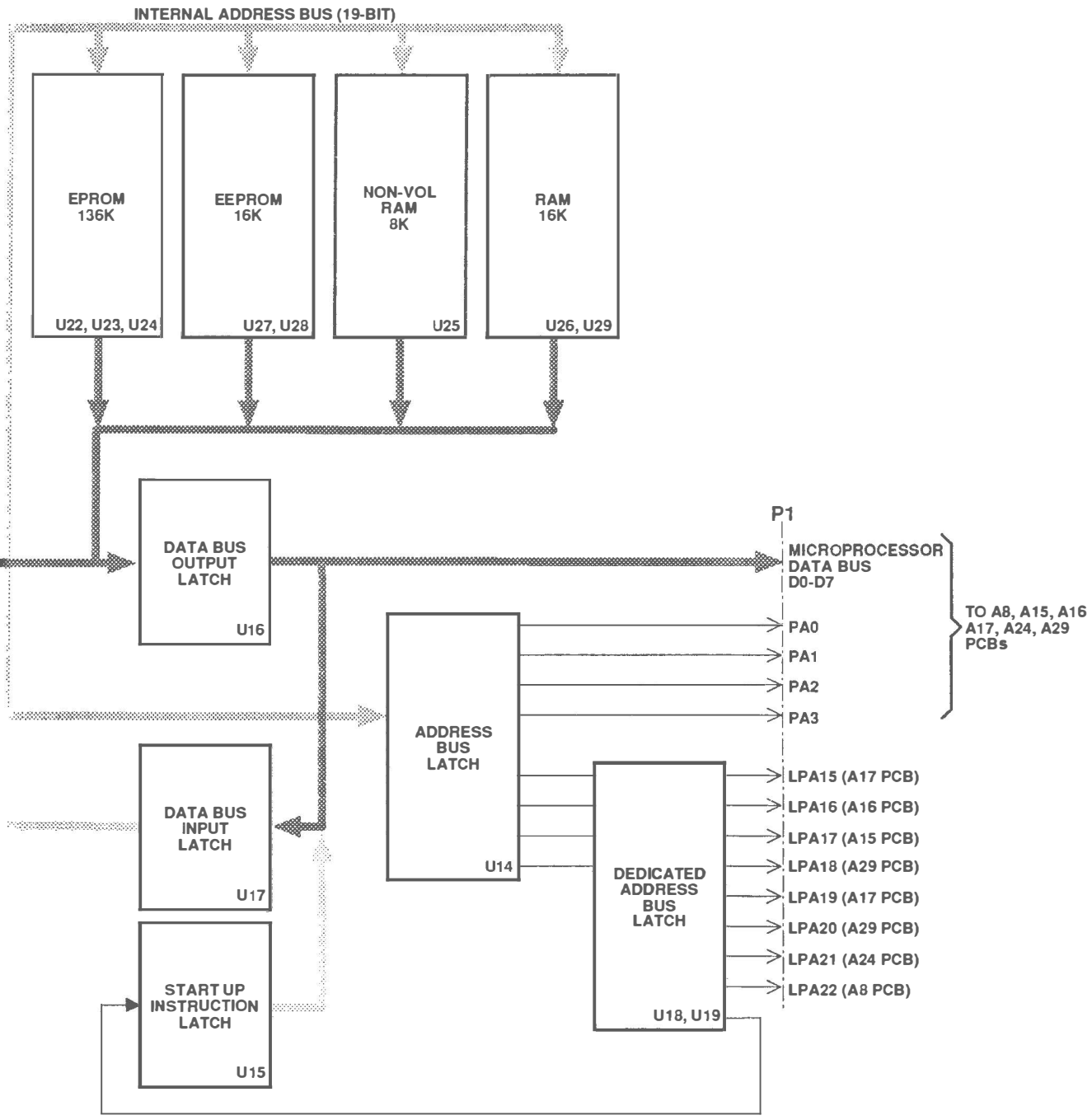


Figure 2B-2. Block Diagram of A23 Microprocessor PCB

The GPIB control programs for U1 are located in EPROM U10. The 8K RAM chip, U11, is used as an input/output buffer and as Ua general scratch-pad memory by U1. Latch U8 separates the address information from the multiplexed microprocessor data-address bus lines, **AD0-AD7**. The outputs of U8, along with microprocessor address lines **A8-A1**, form the 16-bit internal address bus.

2B-4.2 Address Decode Circuit

The circuit functions on the A24 PCB are addressed by the A23 PCB main microprocessor via the PCB address bus lines **PA0-PA1** and the dedicated address line, **L PA21**. When enabled by **L PA21,** the address decoder, U4A, decodes the PCB address lines. Only one output from U4A is active at any time. These output signals are used by the main microprocessor to select and control various A24 PCB circuit functions.

2B-4.3 Dedicated GPIB Controller and Interface Circuits

Integrated circuit U7, is a dedicated microprocessor/controller for the GPIB. This device controls the data transfer to/from the GPIB via bus transceivers U5 and U6. The bus transfer rate is approximately 15 Kbytes/second.

The interface between U1 and U7 is via interrupts. Controller U7 receives commands from the GPIB and sends them to a part of RAM (U11) that is used as a buffer. Microprocessor U1 then decodes these commands and sends command/data information to another part of RAM that is used as an output buffer. This data is then sent, via the programmable interface, U12, and the bus transceiver, U16, to the main microprocessor data bus lines (**D0-D7**).

NOTE

Jumper P3 must be in the NORMAL position for normal operation. (Jumper P3 is placed in the CAL position to allow certain GPIB commands to be used during calibration.)

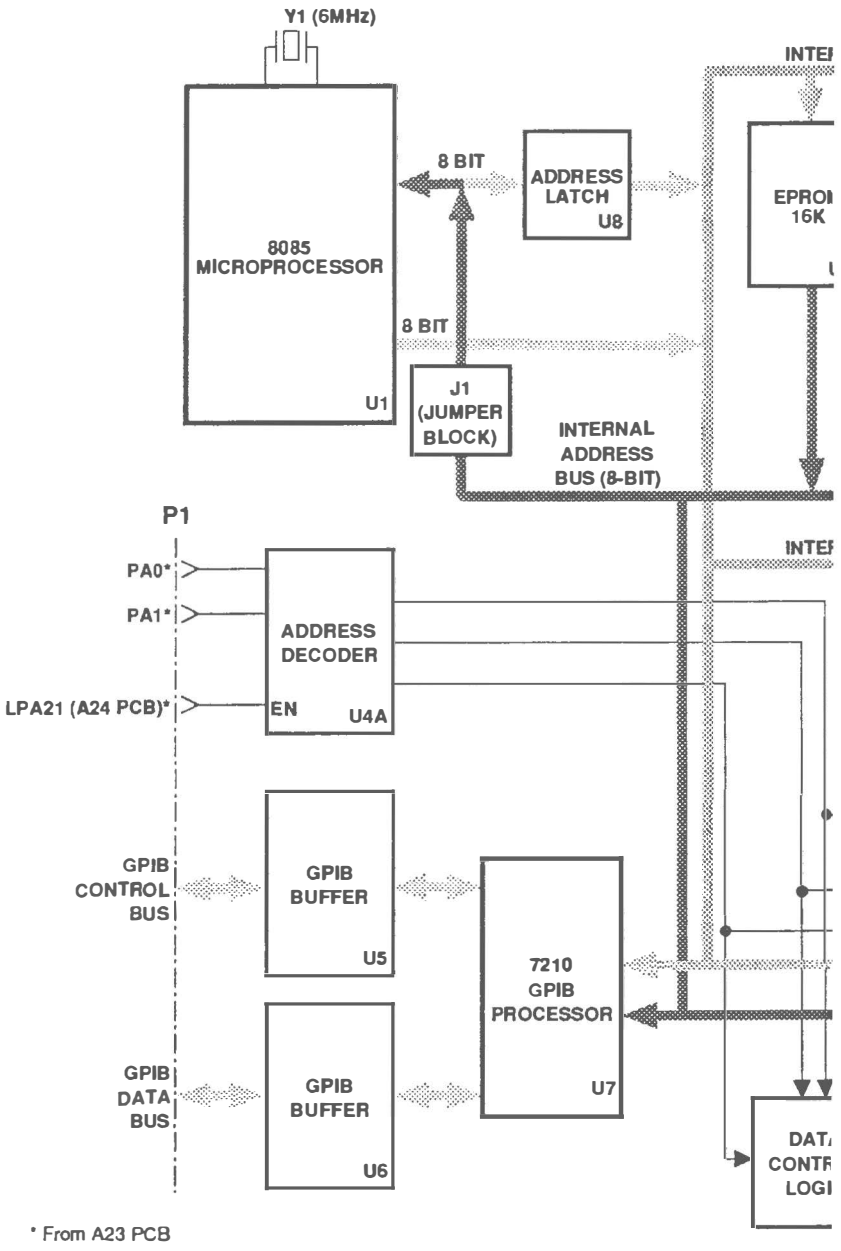
2B-4.4 Data Transfer Functions

The output of U12, pin 7 (via inverter U2C) is the **GPIB INT** (interrupt) signal. This signal and the PCB address bus decoder, U4A, control the transfer of data between U1 and the A23 (main) Microprocessor PCB.

During fast frequency stepping operations (via the GPIB), **L FF INT** interrupts are generated by the A24 PCB. Refer to the description contained in paragraph 2B-3.5, above. The **L FF INT** interrupts are generated by the logic circuits consisting of U3A, U3B, U4B, U9, U13B, and U17C/U17D.

When the synthesizer is turned on, the A23 PCB main microprocessor commands the A24 PCB to perform a self test. Microprocessor U1 performs a self test of the GPIB circuits and stores the results in a buffer in RAM (U11). When the main microprocessor has completed its self test routines, it retrieves this information via the main microprocessor data bus.

Programmable interface chip U14 functions as a parallel peripheral driver/receiver. It is intended for future use. The L TEST input line is also not presently used.


Y1 (6MHz)
8085
MICROPROCESSOR
U1
8 BIT
ADDRESS
LATCH
U8
8 BIT
J1
(JUMPER
BLOCK)
INTERNAL
ADDRESS
BUS (8-BIT)
P1
PA0*
PA1*
LPA21 (A24 PCB)*
ADDRESS
DECODER
EN
U4A
GPIB
CONTROL
BUS
GPIB
BUFFER
U5
GPIB
DATA
BUS
GPIB
BUFFER
U6
7210
GPIB
PROCESSOR
U7
* From A23 PCB

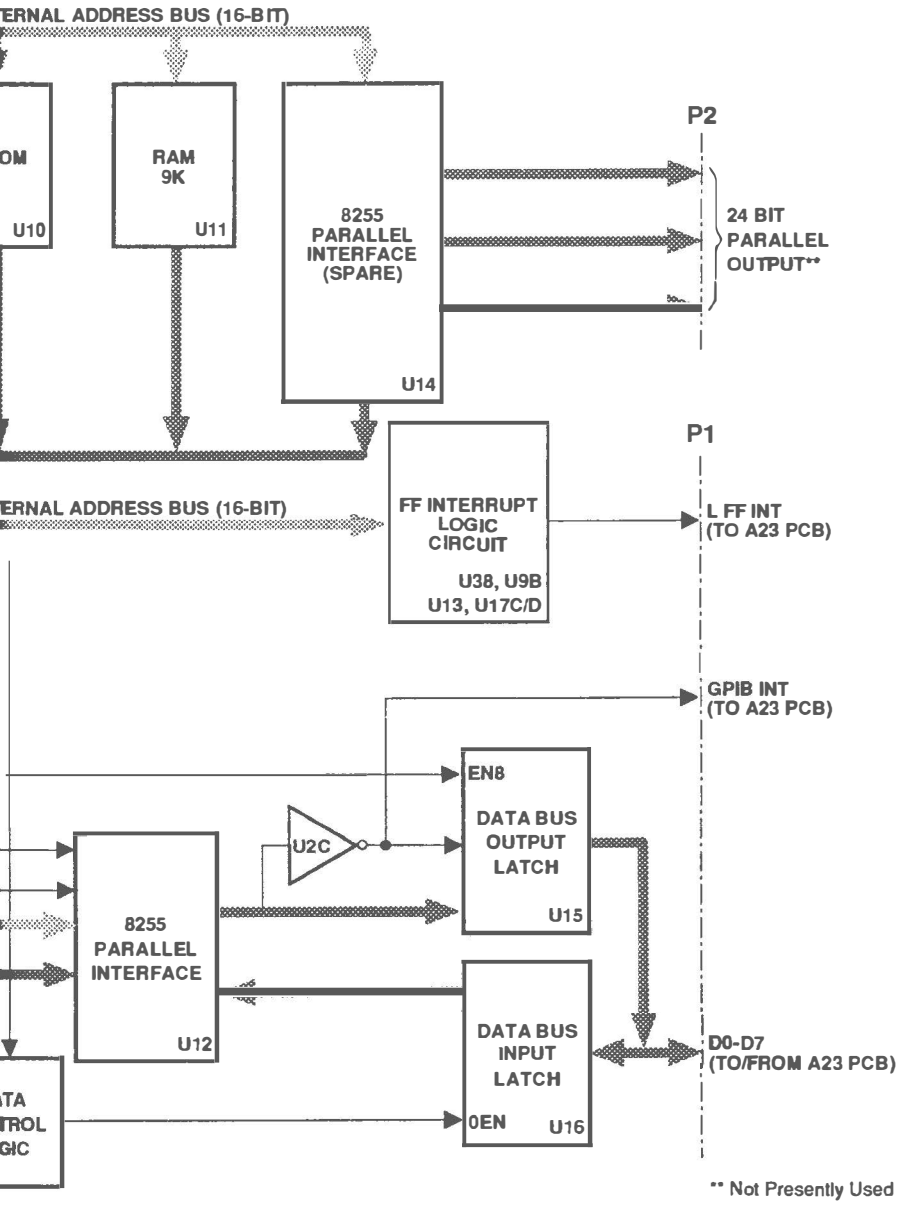


Figure 2B-3. Block Diagram of A24 GPIB PCB

2B-5 A8 SERIAL I/O PCB, DETAILED CIRCUIT DESCRIPTION

During the following description, refer to the A8 Serial I/O PCB block diagram (Figure 2B-4) and to the A8 PCB schematic diagram (Figure 2B-6).

The A8 PCB converts the 8-bit parallel data from the A23 PCB main microprocessor into a 16-bit serial format. It then transmits the resultant serial data strings to either the A2, A6, A11, or A13 PCB, as determined by prior commands issued by the A23 PCB. Note that there is a separate serial data bus from the A8 PCB to each of these PCBs (Figure 2B-4). The A8 PCB also receives serial data from the A2, A7 and A14 PCBs and converts it into a parallel data format. This data is sent to the A23 PCB via the main microprocessor data bus.

2B-5.1 Microprocessor Interface and Control Circuits

The circuit functions on the A8 PCB are addressed by the A23 PCB main microprocessor via the PCB address bus lines, **PA0-PA2**, and the dedicated address line, **L PA22**. When enabled by **L PA22,** the 3-to-8 decoder, U1, decodes the PCB address lines. Only one U1 output is active at any time. The output signals from U1 consist of negative going strobes with a duration of approximately 800 ns. These strobe signals are used to latch data into the control latches and shift registers, and to control the clock/timer circuits.

The main microprocessor data bus lines, **D0-D7,** go to U5 (and to U9, and U11). Latch U5 controls the multiplexer circuits so that the serial data, clock, and strobe outputs are steered to the correct serial data bus for the PCB selected.

Tri-state gate U3A monitors the Q output of U4B, which is in the high state whenever the A8 PCB is processing data. When enabled by the strobe from U1, U3A passes the state of this output to the **D0** line of the main microprocessor data bus. This line is monitored by the main microprocessor to determine if the serial I/O data circuits are busy.

2B-5.2 Clock/Timer Circuits

These circuits generate the following clock/strobe signals:

- The *external* clock that is sent to the A2, A6, A11, A13 (and A14) PCBs.
- The *internal* clock that is used to shift the data through the shift registers.
- The strobe signal that is sent either to the A2 Front Panel Control PCB or to the A14 PCB (not presently used).

Integrated circuit U7 is a multivibrator that operates at a frequency of approximately 600 kHz (as determined by R6, R7, and C9). This circuit is gated on/off by the state of flip flop U4B, which is controlled by the main microprocessor via the strobe from U1. The output of U7 is divided by two and by sixteen by counter U8A. The divide-by-two output (Q_A) is the (external) clock signal that goes to the clock multiplexer circuit, U12. This signal is inverted by U2C and is the internal clock signal that goes to the shift registers.

The divide-by-sixteen output of U8A (Q_D) goes to U8B where it is again divided by a factor of four. The output of U8B is inverted by U2D and is the strobe signal that goes to the strobe multiplexer circuit, U10A. This signal is also used to reset flip-flop U4B after 32 clock cycles have occurred.

2B-5.3 Shift Registers

Write-only shift register U11 and read/write shift register U9 send serial data to the selected PCB via the multiplexer circuits. (Serial data is sent in 16-bit segments; therefore, two shift registers are required.) Serial data from the A2, A7 and A14 PCBs is received by U10B and goes to the SIN input of U11. This data is shifted by U11 into U9. The resultant (8-bit) parallel data is sent to the A23 PCB via the main microprocessor bus. All shift operations are controlled by the signal from the clock/timer circuits that is applied to the CLK inputs of U9 and U11.

Data from the main microprocessor data bus lines, **D0-D7,** is loaded into U9 and U11 by the strobe signals from U1. This requires two load operations because the main microprocessor must put a new 8-bit word on the data bus after each load. On the rising edge of each clock signal, the data in each register is shifted 1 bit toward the Q_H output of U9.

2B-5.4 Multiplexers

Analog multiplexers U6, U12 and U10A steer the serial data from shift register U9, and the clock and strobe signals from the clock/timer circuits to the serial data bus of the PCB selected by the main

microprocessor. Each of the five serial data buses include DATA, CLOCK, and RETURN lines. The serial data bus to the A2 Front Panel Control PCB also includes the FP STRB line. The serial data bus to the A13 Pulse Generator PCB includes a second clock line, PLS TRG CLK. The lines that are included in each serial data bus are shown in Figure 2B-4. Only one serial data bus is active at any time.

NOTE:

The serial data bus lines from the A8 PCB to the A28XA14 connector (labeled CNTR or FC) are not presently used.

a. Serial Data Multiplexer Circuit

The serial data from the Q_H output of U9 goes to the D input of analog multiplexer integrated circuit U6. To transmit data to a specific PCB, the main microprocessor first loads address information for the selected PCB into multiplexer control latch U5. This causes U6 to connect the serial data to the serial data bus for the selected PCB.

Note that the serial data bus select information from U5 is fed in parallel to multiplexers U6, U12 and U10A. Therefore, only the DATA and CLOCK lines (and the strobe line—if used) for the selected serial data bus are active).

b. Clock Signal Multiplexer Circuit

The clock signal from the Q_A output of U8A goes to the D input of analog multiplexer integrated circuit U12. The serial data bus select information from U5 causes U12 to connect the clock signal to the serial data bus for the selected PCB.

c. Strobe Multiplexer Circuit

The 16-bit serial data word sent to the A2 Front Panel Control PCB contains an 8-bit data byte followed by an 8-bit strobe address byte. The strobe signal sent on the FP STRB line to the A2 PCB is used to enable the circuits that decode the strobe address byte.

The strobe signal from U2D goes to the D input of analog multiplexer integrated circuit U10A. When programmed by the main microprocessor, the serial data bus select information from U5 causes U10A to connect the strobe signal to the FP STRB line or to the START FC line.

d. Ground Return Multiplexer

All of the serial data and clock signals from the A8 PCB go to destinations which have chassis-mounted filtercons as an interconnection device. Filtercons are π-filter networks that are used to reduce crosstalk between the circuits in the RF casting, and to reduce overall signal radiation from the synthesizer. They are also used in the signal and power supply lines of the phase lock and front panel circuits. For further information, refer to Section 2M—Motherboard/Interconnections.

Filtercons have approximately 1500 pF of capacitance to ground. Driving this capacitance with the serial data and clock (TTL) signals causes high frequency ground currents that affect other circuits connected to the ground system and also cause undesirable signal radiation.

Transformers T1-T4 couple the high frequency components of the TTL signals to a separate multiplexer circuit consisting of FET switches Q2 thru Q6. The inverted high frequency components from the secondary windings of T1-T4 are coupled back into the grounding system to oppose the currents caused by the filtercons. This reduces the overall ground current effects and improves the Electro-Magnetic Compatibility (EMC) performance.

The FET switches connect the secondary windings of T1-T4 to the RETURN line of the selected serial data bus. These switches are controlled by the Q_4-Q_8 outputs of data latch U5.

2B-5.5 FLD12 Data Latch

Flip-flop U4A is used as a 1-bit data latch that controls the **FLD12** line of the Fine Loop serial data bus (the fine loop dividers require 17 bits of information). The **D0** line of the main microprocessor data bus is connected to the D input of U4A. The data on this line is clocked into U4A by a separate strobe from U1. The **FLD12** line is set high by the main microprocessor only when the frequency of the fine loop is programmed beyond 300 MHz.

2B-5.6 Serial Data Input

When any key is pressed on the front panel, the A2 PCB sends a KBD INT interrupt to the A23

Microprocessor PCB. Upon servicing the interrupt, the main microprocessor programs the A8 PCB as follows.

- The U10B serial data input multiplexer is programmed to switch the FP DATA line to the SIN input of U11.
- The clock multiplexer, U12, is programmed to route the serial data clock to the A2 PCB.
- The clock control flip-flop U4A is triggered to shift the data from the A2 PCB into U11 (and U9).

After the data has been shifted into U9, the main microprocessor interprets and processes the (keystroke) data from the main microprocessor data bus lines (**D0-D7**).

Whenever an external 10 MHz reference signal is connected to the rear panel 10 MHz REF INPUT BNC connector, the A7 Reference Divider PCB sets the EXT REF DET status line high. The main microprocessor reads the state of this line during the housekeeping routine by programming the A8 Serial I/O PCB as follows.

- The U10B serial data input multiplexer is programmed to switch the EXT REF DET line to the SIN input of U11.
- The Clock control flip-flop U4A is triggered to shift the single bit of data from the A2 PCB into U11 (and U9).

After the data has been shifted into U9, the main microprocessor interprets and processes the data word from the main microprocessor data bus.

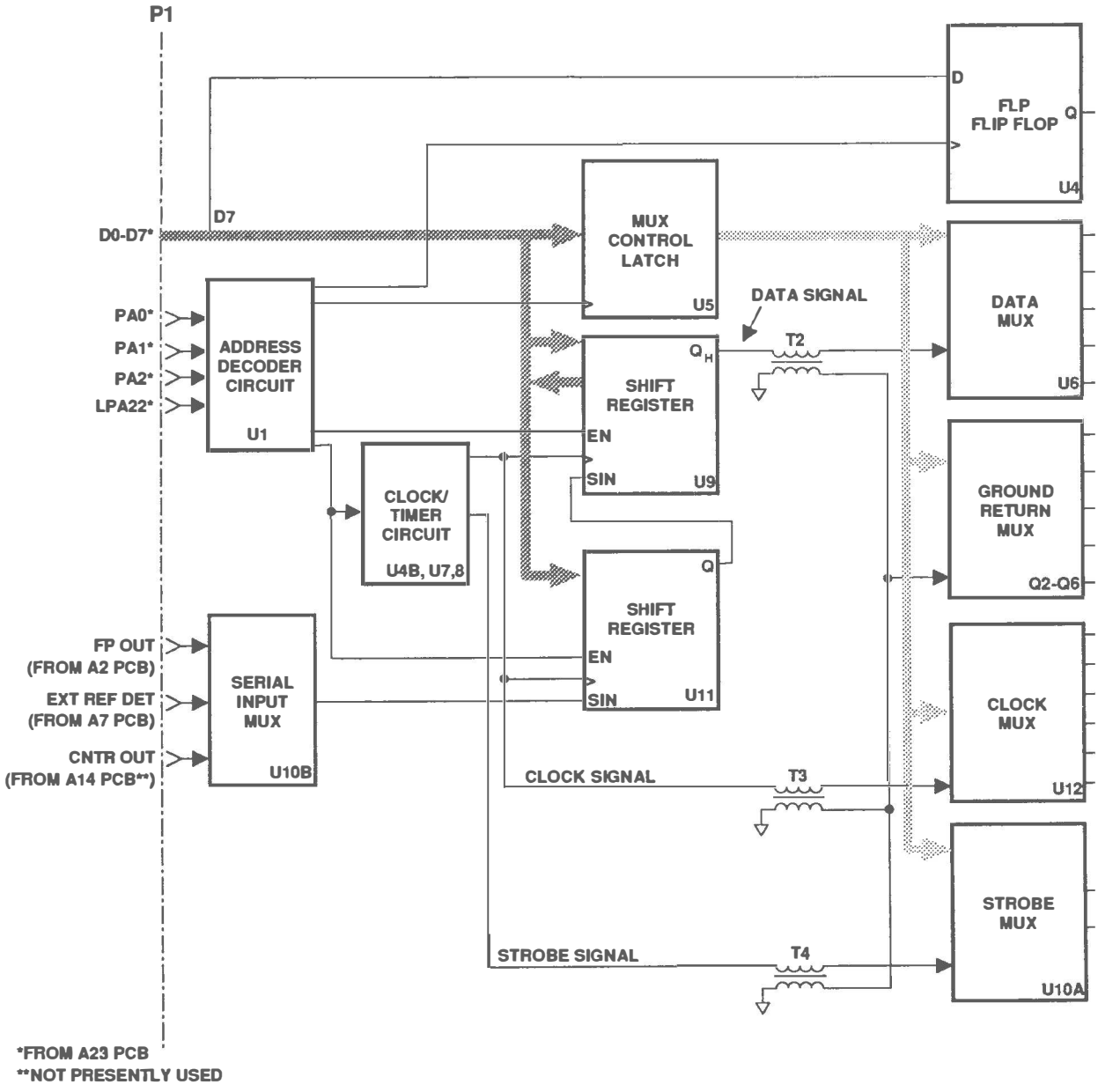
NOTE:
The CNTR OUT line (from the A14 PCB) is not presently used.

2B-6 DIGITAL CONTROL ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the digital control assemblies and probable causes of the failures.

2B-7 DIGITAL CONTROL ASSEMBLIES, SERVICE SHEETS

Table 2B-1, on the first page of this section, references the block diagrams, schematics, and parts locator diagrams for the A8, A23, and A24 PCBs.


P1
D
FLP
FLIP FLOP
Q
U4
D7
D0-D7*
MUX
CONTROL
LATCH
U5
DATA SIGNAL
DATA
MUX
U6
PA0*
PA1*
PA2*
LPA22*
ADDRESS
DECODER
CIRCUIT
U1
Q H
SHIFT
REGISTER
EN
SIN
U9
T2
CLOCK/
TIMER
CIRCUIT
U4B, U7,8
GROUND
RETURN
MUX
Q2-Q6
Q
SHIFT
REGISTER
EN
SIN
U11
FP OUT
(FROM A2 PCB)
EXT REF DET
(FROM A7 PCB)
CNTR OUT
(FROM A14 PCB**)
SERIAL
INPUT
MUX
U10B
CLOCK
MUX
U12
CLOCK SIGNAL
T3
STROBE
MUX
U10A
STROBE SIGNAL
T4
*FROM A23 PCB
**NOT PRESENTLY USED

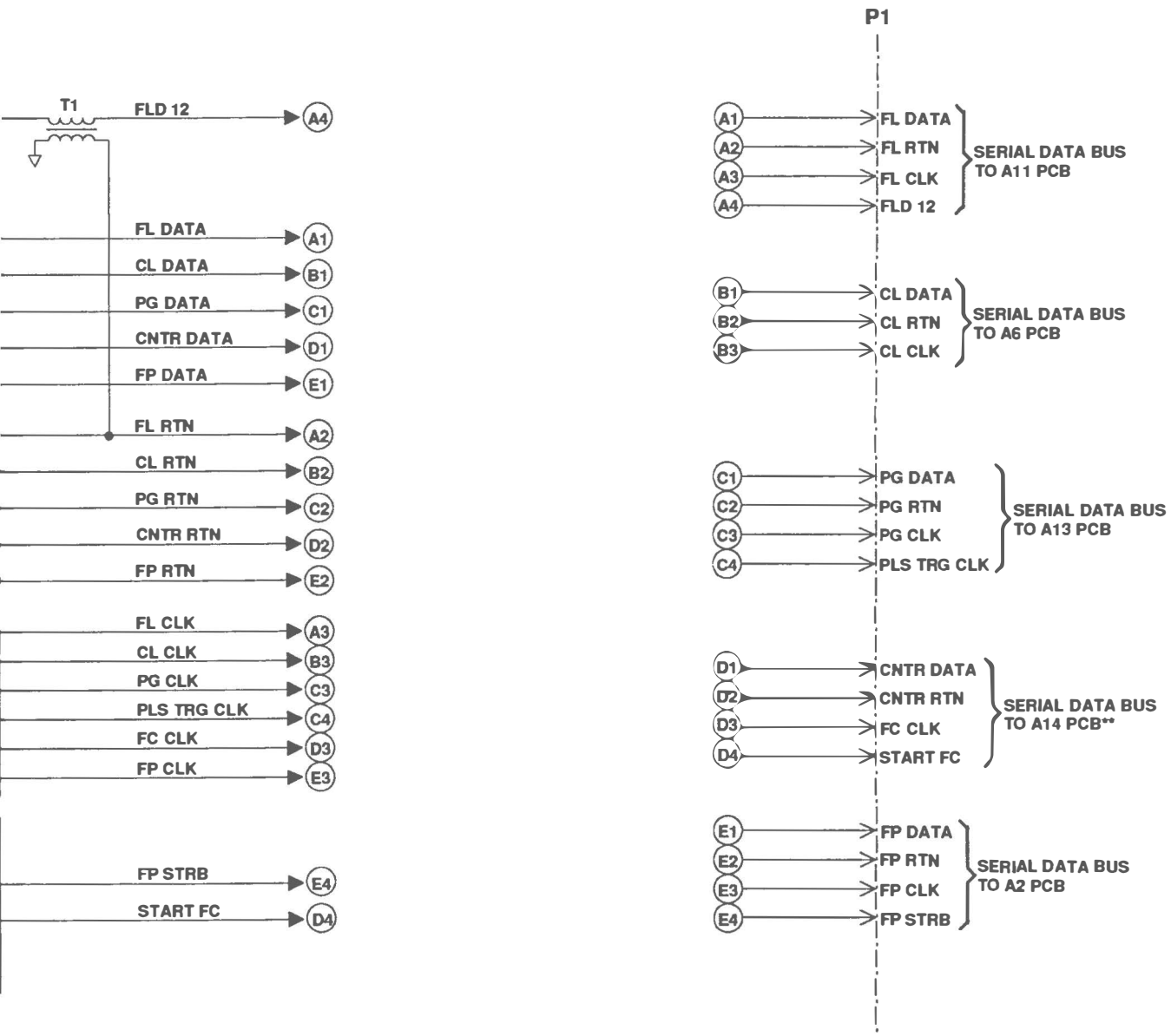
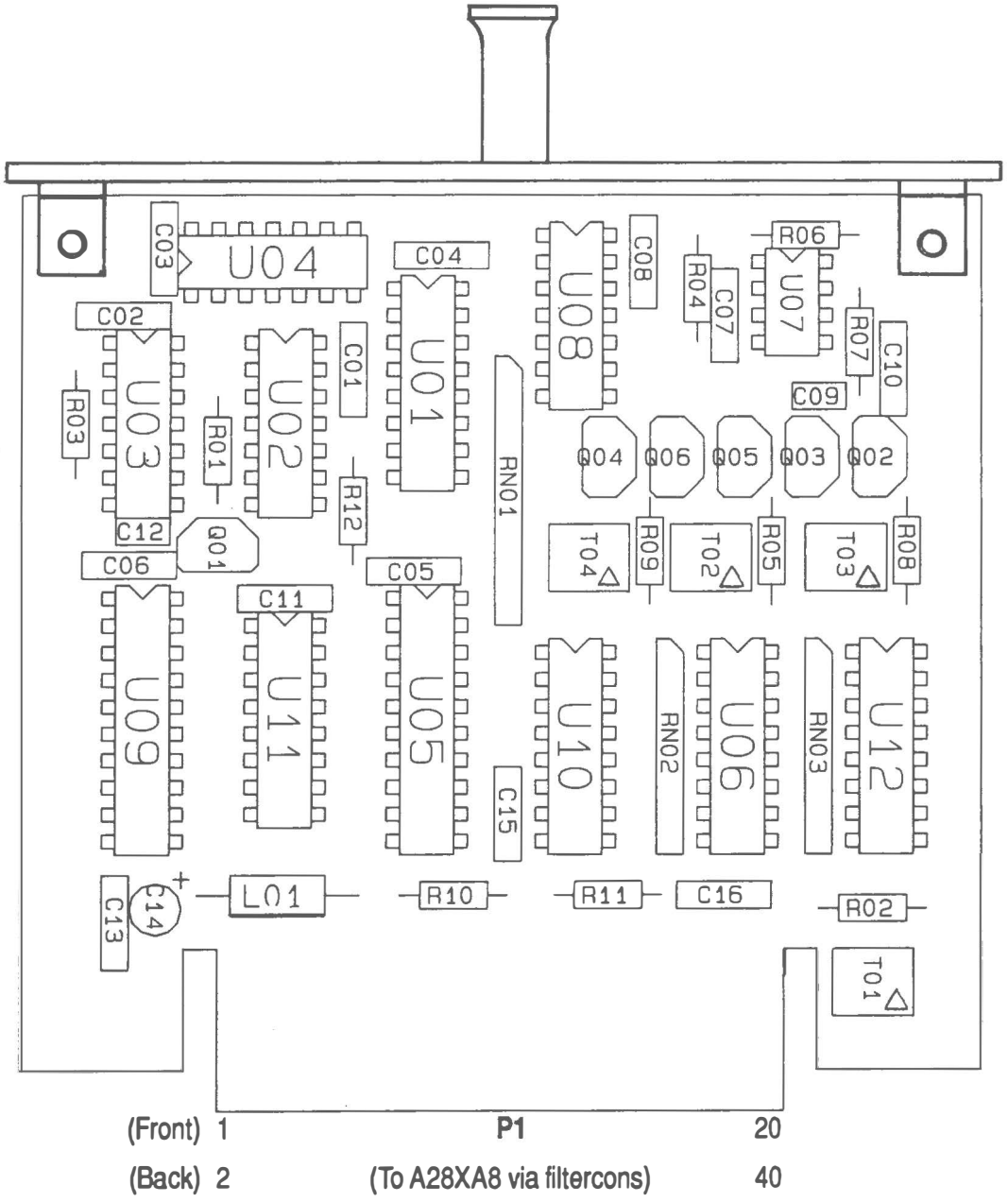


Figure 2B-4. Block Diagram of A8 Serial I/O PCB



NOTE:
Leading zeros on component number references may be disregarded.

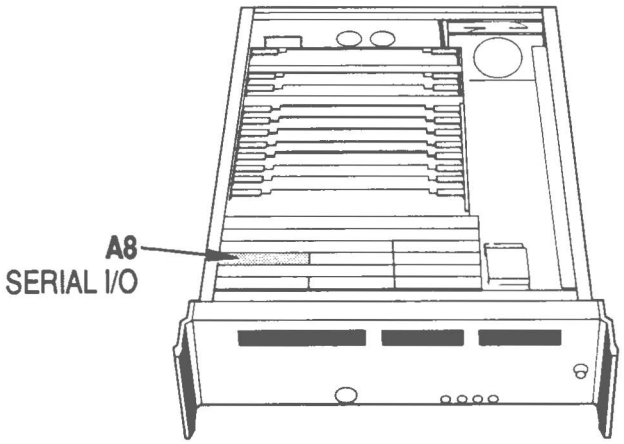
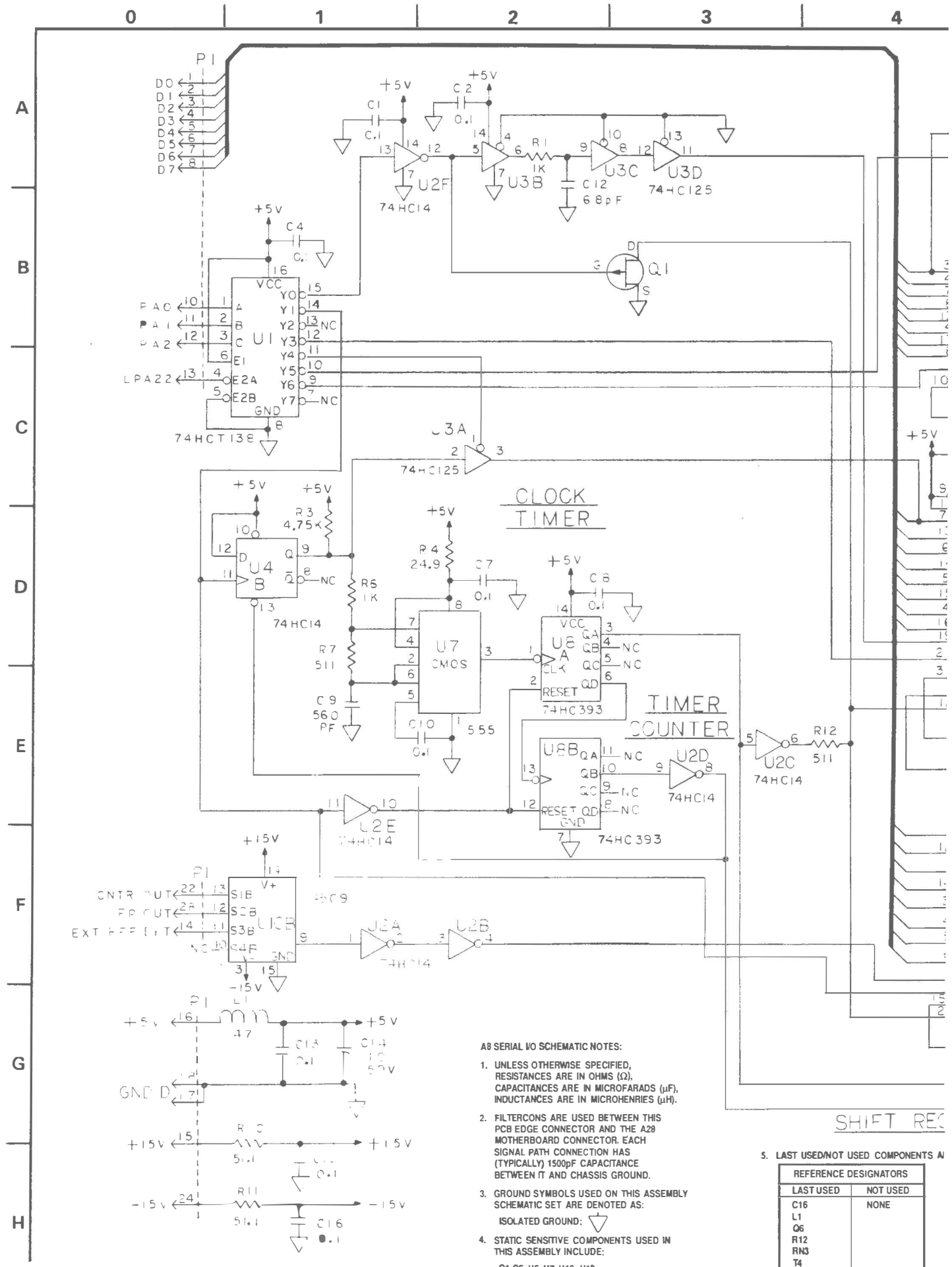


Figure 2B-5. A8 Serial I/O PCB Parts Locator Diagram 6700-D-31708-3 (Rev. C)



A8 SERIAL I/O SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUND: ▽
4. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   Q1-Q6, U6, U7, U10, U12
5. LAST USED/NOT USED COMPONENTS AI

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C16	NONE
L1	
Q6	
R12	
RN3	
T4	
U12	

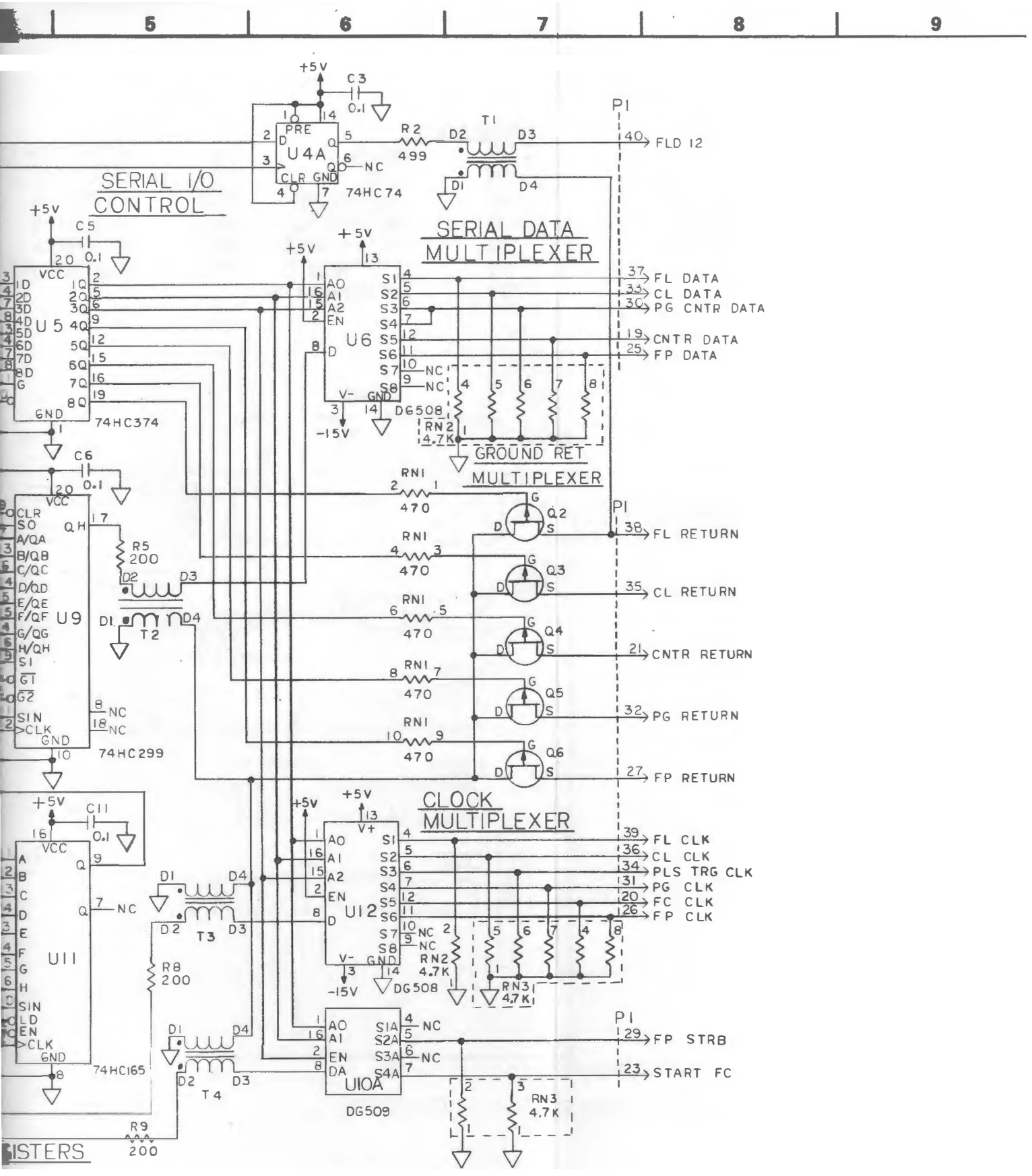
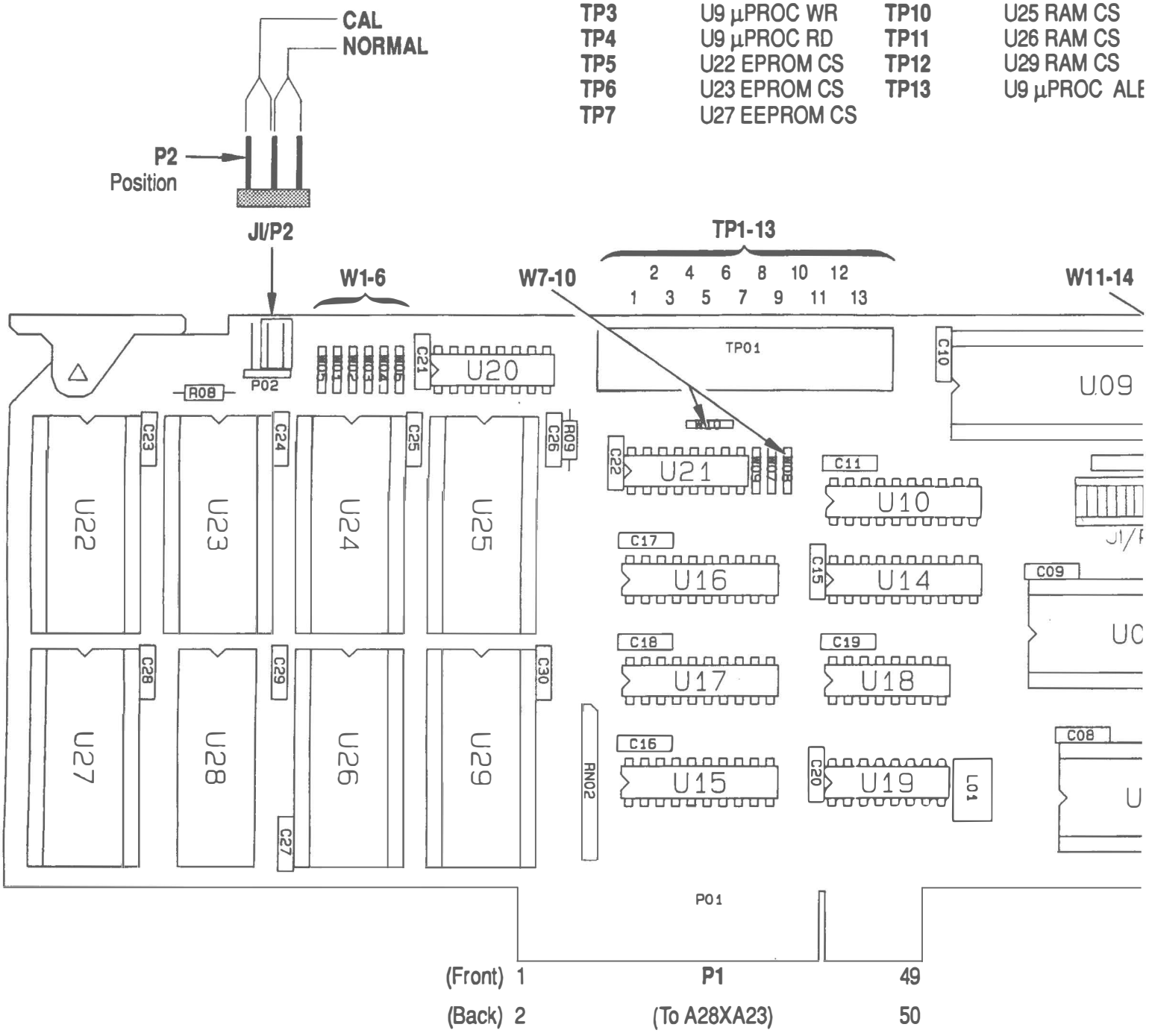


Figure 2B-6. A8 Serial I/O PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31708-3 (Rev. D)

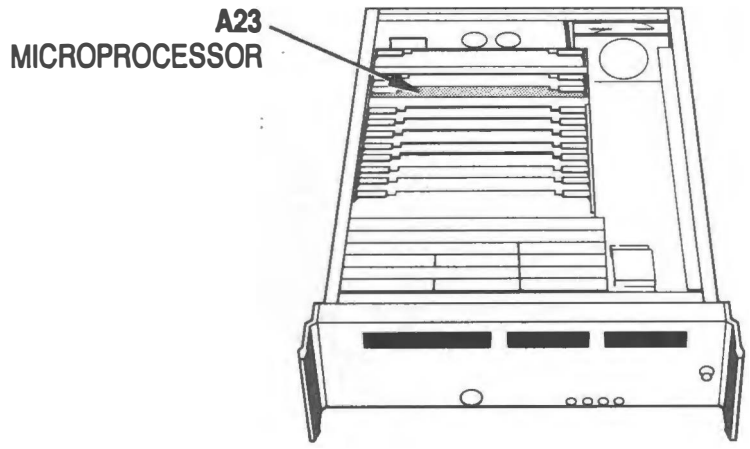
TEST POINTS

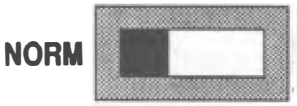
TP1	GND G	**TP8**	U28 EEPROM C
TP2	+5VD	**TP9**	U24 EPROM CS
TP3	U9 µPROC WR	**TP10**	U25 RAM CS
TP4	U9 µPROC RD	**TP11**	U26 RAM CS
TP5	U22 EPROM CS	**TP12**	U29 RAM CS
TP6	U23 EPROM CS	**TP13**	U9 µPROC ALE
TP7	U27 EEPROM CS		



NOTE:
Leading zeros on component number references may be disregarded.

CS





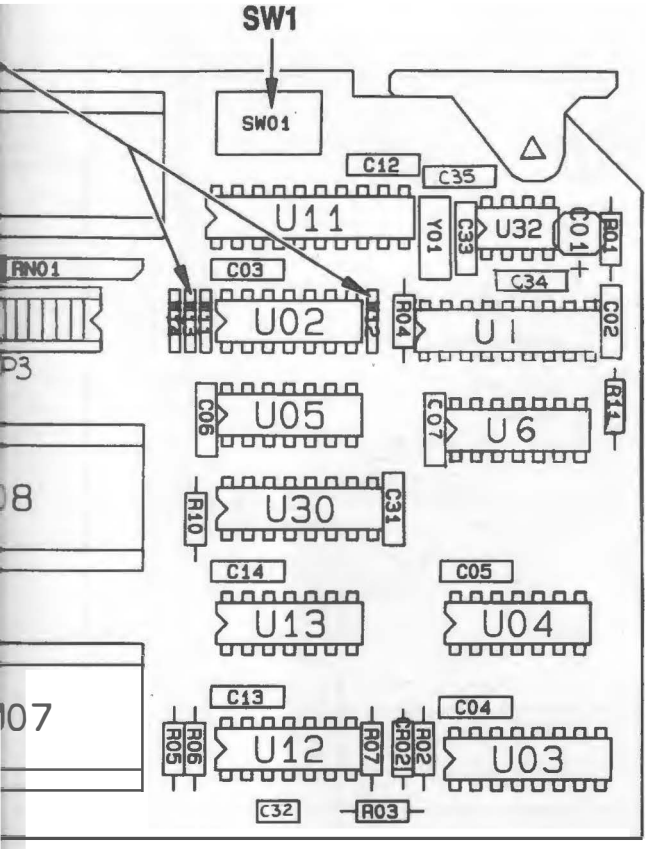
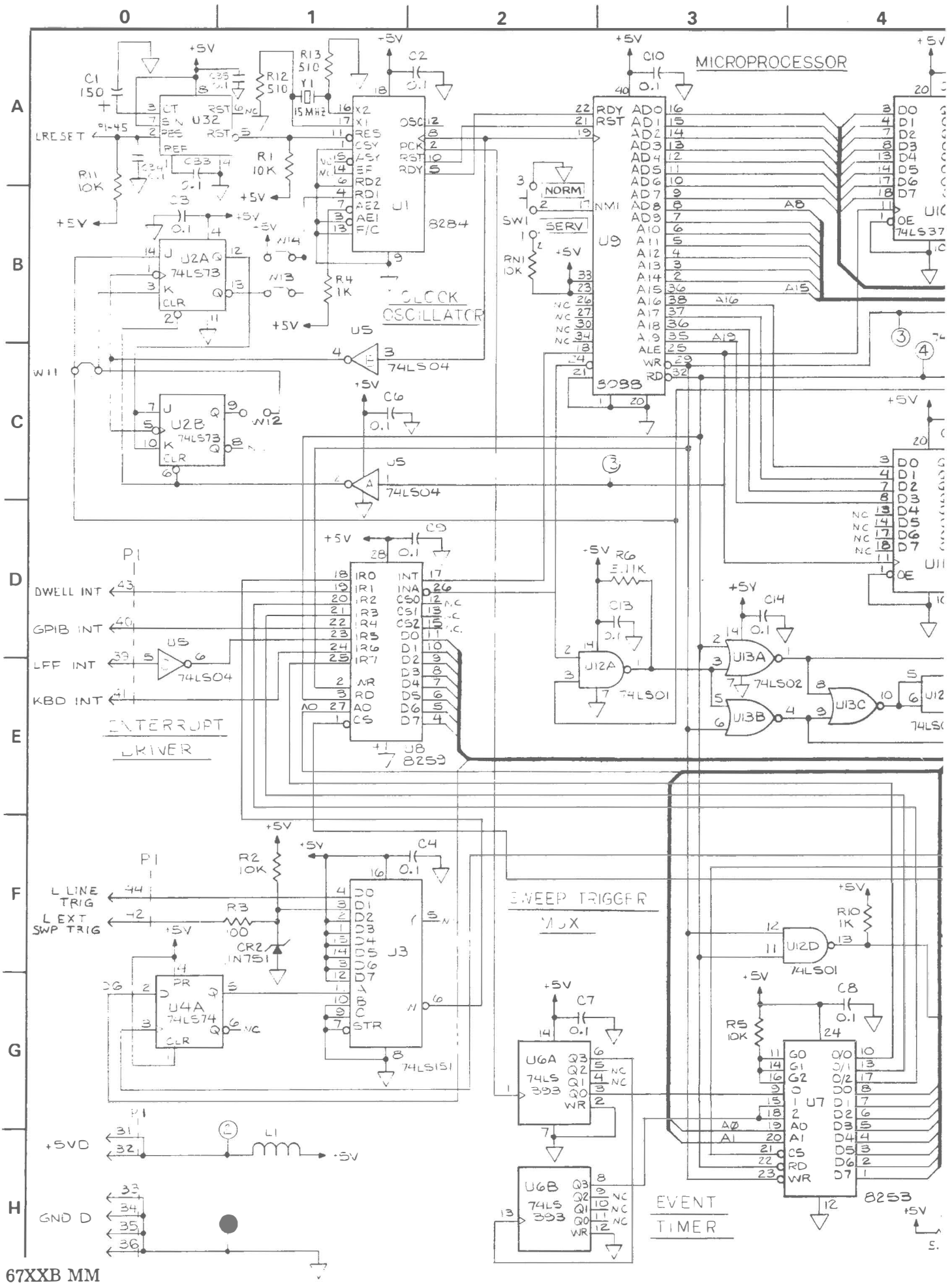


Figure 2B-7. A23 Microprocessor PCB Parts Locator Diagram 6700-D-31723-3 (Rev. T)


MICROPROCESSOR
CLOCK OSCILLATOR
INTERRUPT DRIVER
SWEEP TRIGGER MUX
EVENT TIMER
8284
8088
8259
8253
74LS373
74LS04
74LS02
74LS01
74LS393
74LS151
74LS374
74LS37
+5V
GND D
+5VD
DWELL INT
GPIB INT
LFF INT
KBD INT
L LINE TRIG
L EXT SWP TRIG
LRESET
NORM
SERV

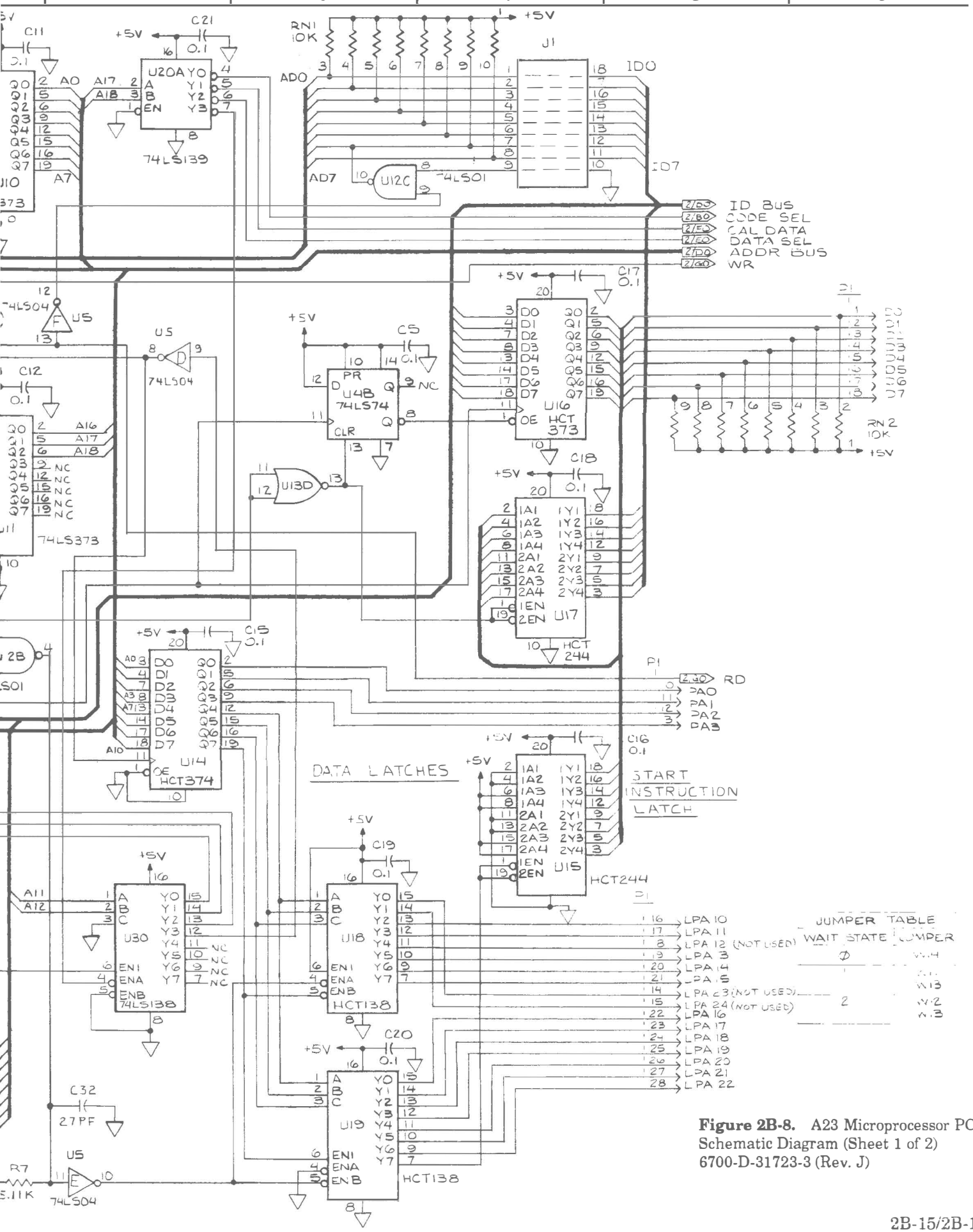
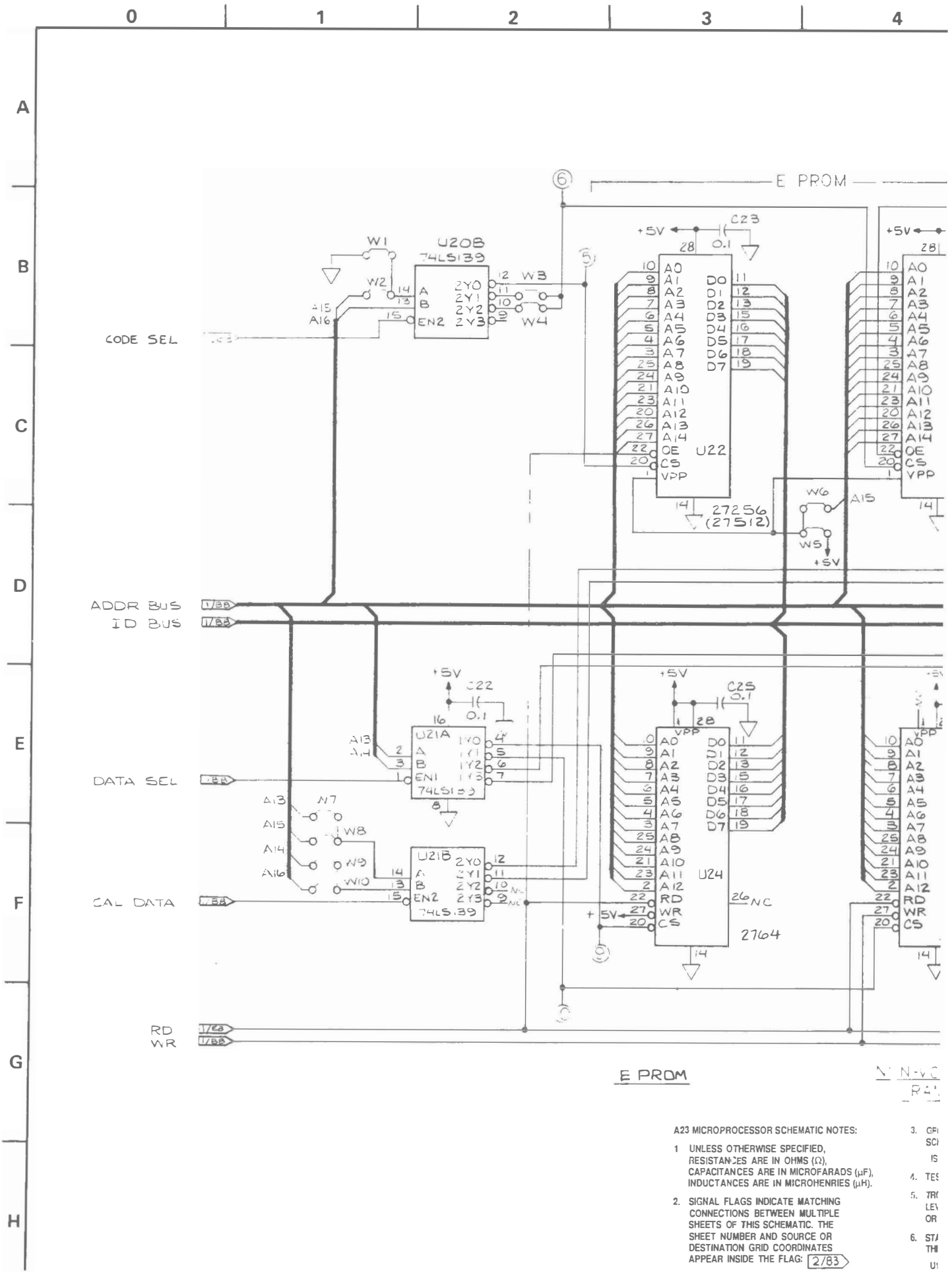
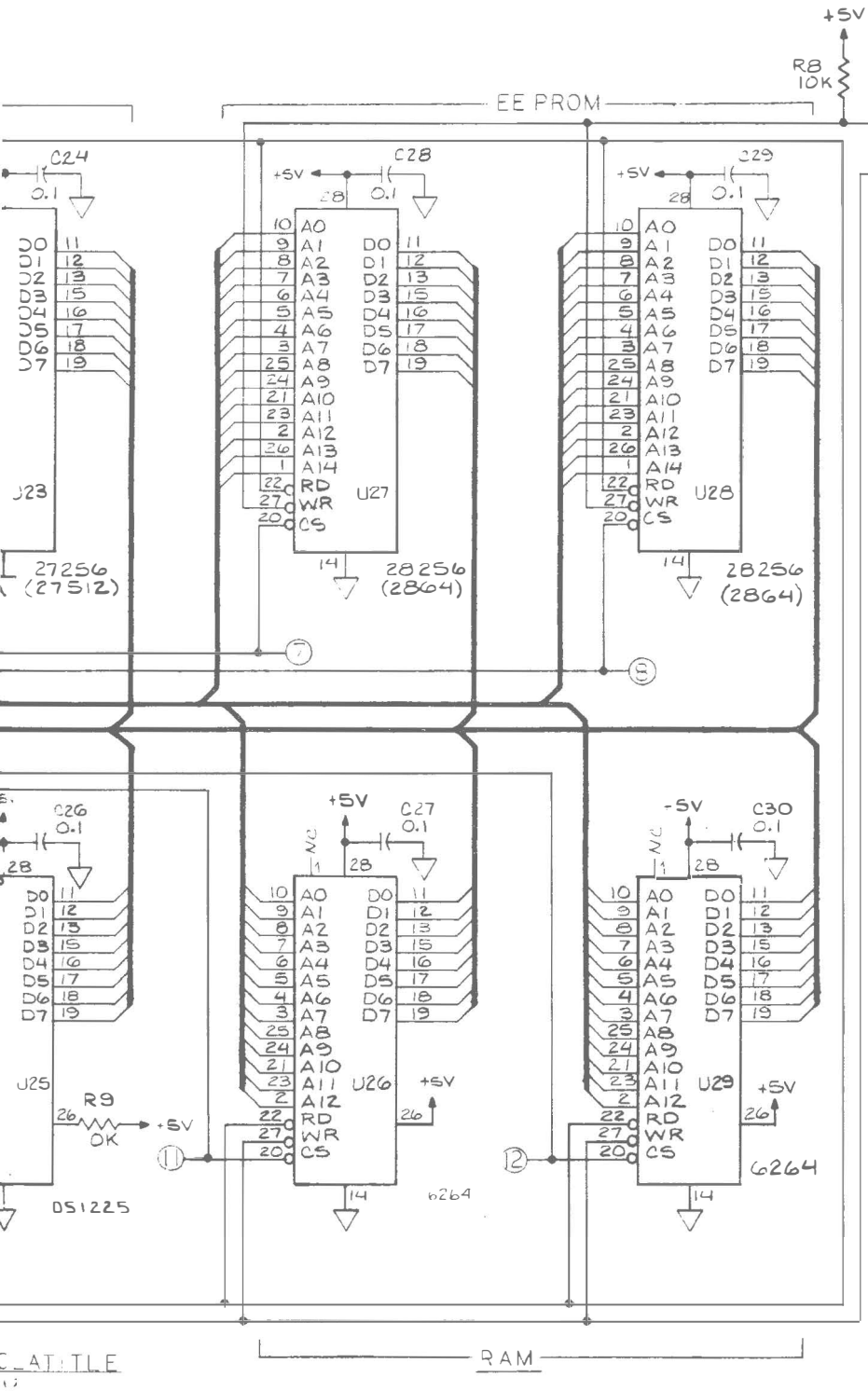


Figure 2B-8. A23 Microprocessor PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31723-3 (Rev. J)



A23 MICROPROCESSOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/83



JUMPER TABLE	
IC USED	JUMPERS
27256	W2 W3 W5
27512	W1 W4 W6
28256	W8 W10
2864	W7 W9

FOUND SYMBOLS USED ON THIS ASSEMBLY CHEMATIC SET ARE DENOTED AS:

ISOLATED GROUNDS:

EST POINTS ARE DENOTED AS: (2)

ROUBLESHOOTING VOLTAGE AND POWER EVELS INDICATED IN BOXES ARE TYPICAL R NOMINAL LEVELS.

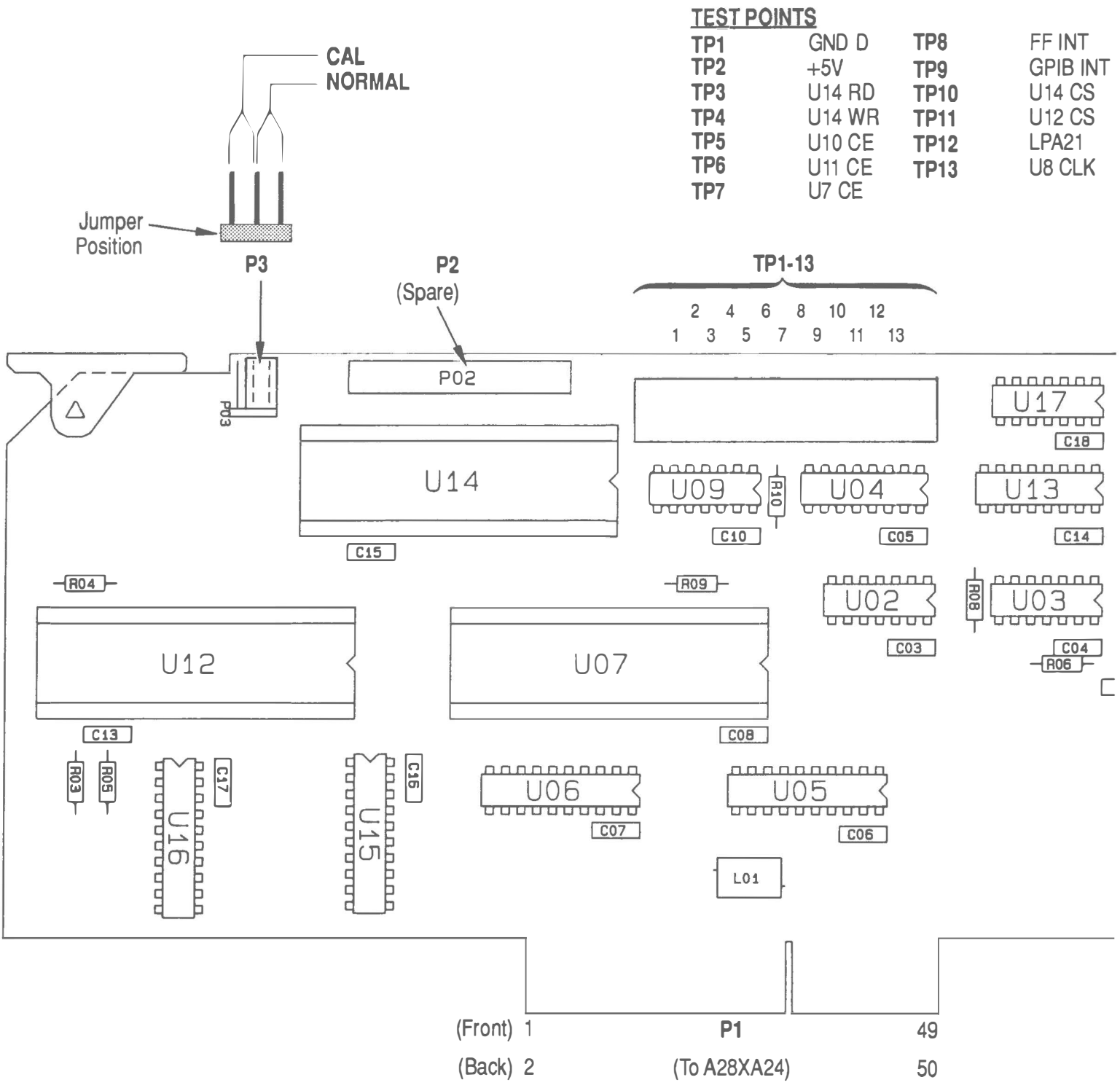
TATIC SENSITIVE COMPONENTS USED IN HIS ASSEMBLY INCLUDE:

U1-U13, U20, U21, U24-U27, U29, U30, Y1

7, LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C35	CR1
CR2	P1
J1	U31
L1	W1
P3	W4
R11	W6
RN2	W8
U32	W10
W13	W11
Y1	

Figure 2B-8. A23 Microprocessor PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31723-3 (Rev. J)



NOTE:
Leading zeros on component number references may be disregarded.

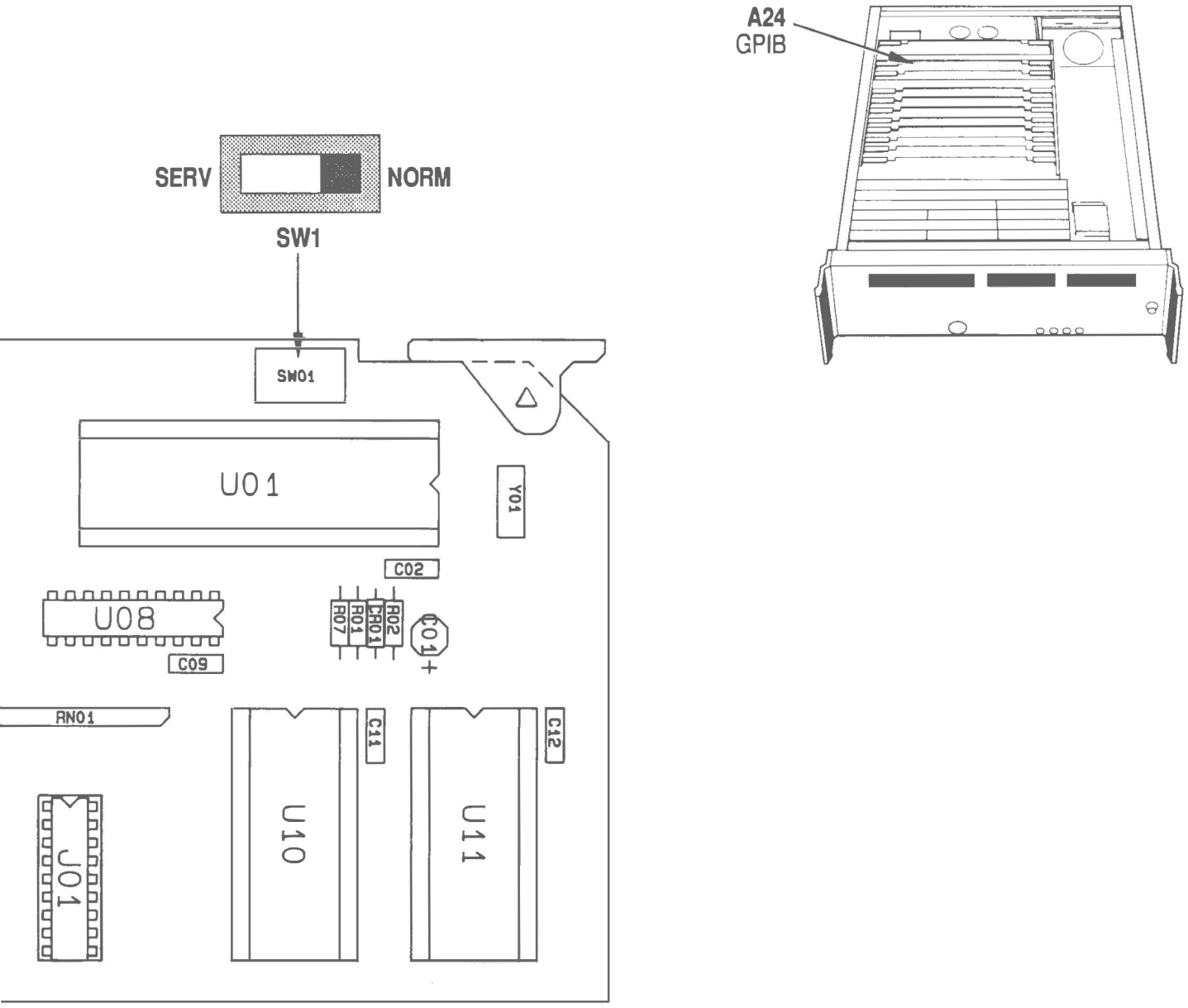
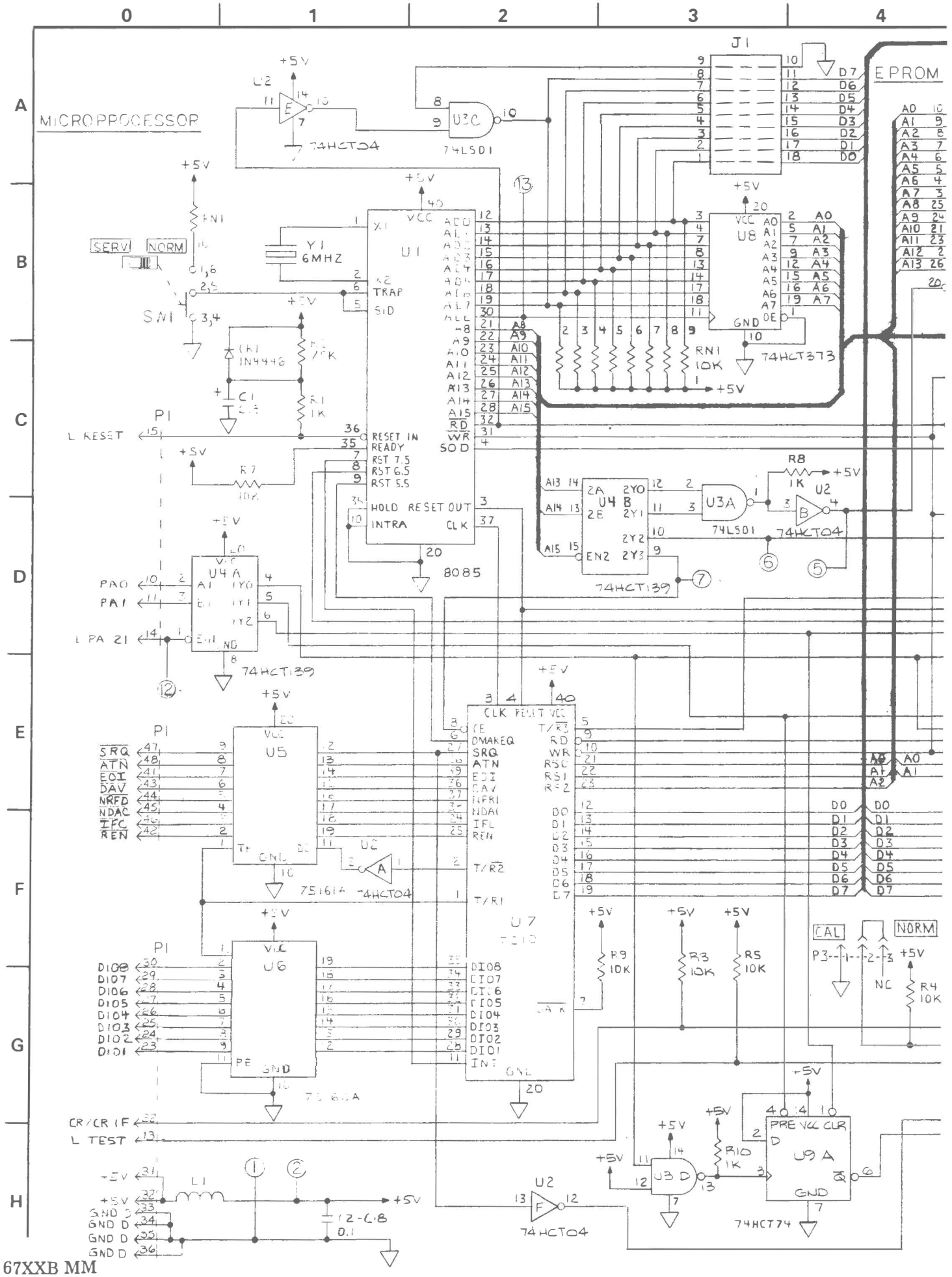
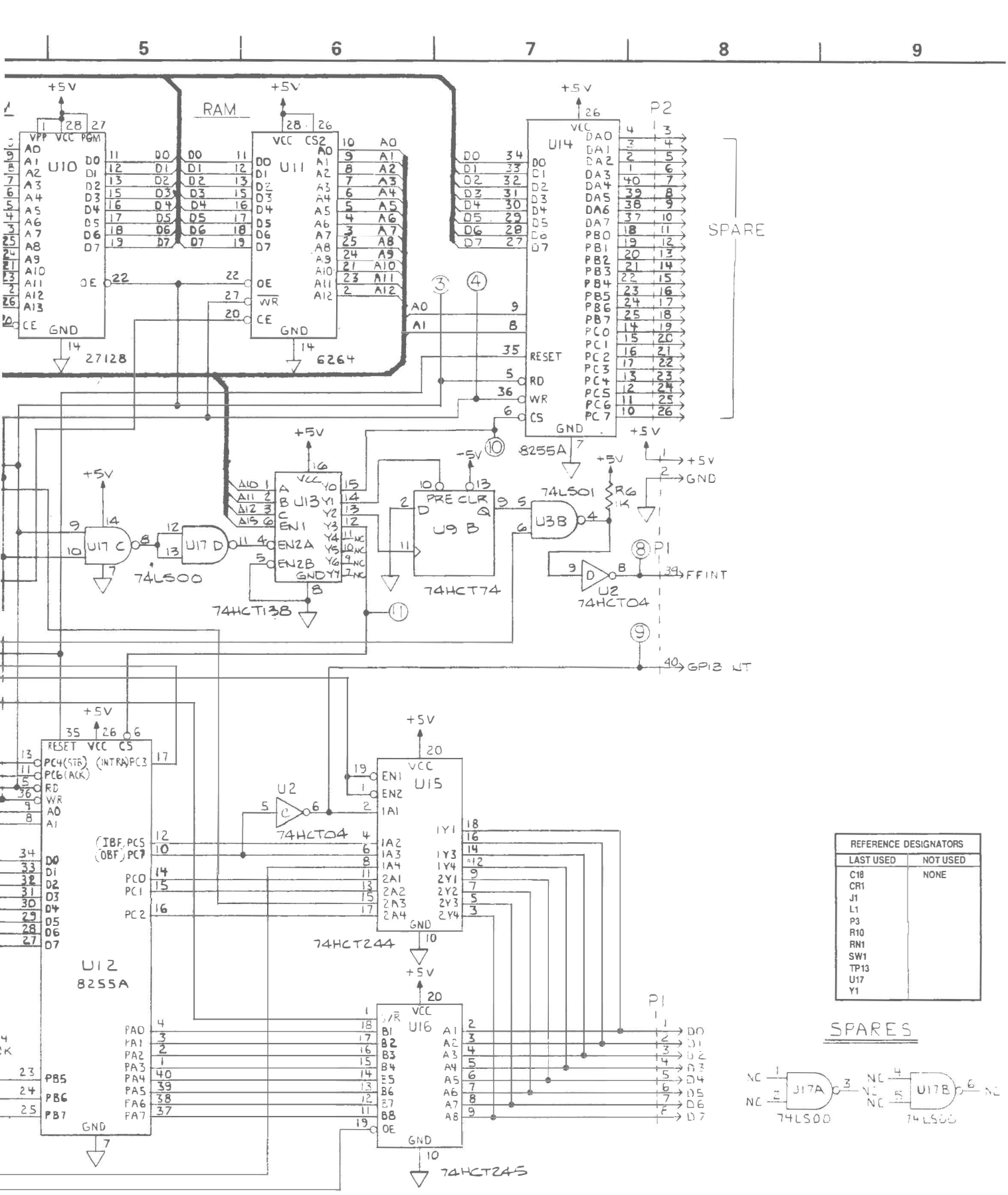


Figure 2B-9. A24 GPIB PCB
Parts Locator Diagram
6700-D-31724-3 (Rev. E)


MICROPROCESSOR
EPROM
8085
74HCT373
74LS01
74HCT04
74HCT139
7516IA
74HCT74
SERVI
NORM
SW1
Y1
6MHZ
CR1
IN4446
C1
2.2
R1
1K
R2
1K
R7
10K
R8
1K
RN1
10K
R9
10K
R3
10K
R5
10K
R4
10K
R10
1K
CAL
NORM
NC
L1
L RESET
L TEST
CR/CR IF
PA0
PA1
PA 2I
SRQ
ATN
EOI
DAV
NRFD
NDAC
IFC
REN
DIO8
DIO7
DIO6
DIO5
DIO4
DIO3
DIO2
DIO1
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
D0
D1
D2
D3
D4
D5
D6
D7
RD
WR
SOD
SID
TRAP
RESET IN
READY
RST 7.5
RST 6.5
RST 5.5
HOLD
RESET OUT
INTR
INTA
CLK
U1
U2
U3A
U3C
U3D
U4A
U4B
U5
U6
U7
U8
U9A
J1
P1
P3
+5V
GND



REFERENCE DESIGNATORS	
LAST USED	NOT USED
C18	NONE
CR1	
J1	
L1	
P3	
R10	
RN1	
SW1	
TP13	
U17	
Y1	

NOTES:

A24 GPIB SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUNDS:
3. TEST POINTS ARE DENOTED AS: (2)
4. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   U1, U3, U5-U7, U10-U12, U17, Y1

Figure 2B-10 A24 GPIB PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31724-3 (Rev. C)

2C–FRONT PANEL: A1 and A2 PCBs

2C-1 FRONT PANEL ASSEMBLIES: A1 AND A2 PCBS

This section contains service information for the A1 and A2 front panel PCB assemblies; see Table 2C-1 below. Refer also to the specific troubleshooting information in the beginning of this section (Section 2–System Description and Troubleshooting).

Table 2C-1. Front Panel Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2C-1	2C-1
Block Diagram	Fig. 2C-1	2C-7
PCB LEVEL		
A1 Front Panel PCB		
General Circuit Description	Para. 2C-2.1	2C-1
Detailed Circuit Description	Para. 2C-3	2C-2
Block Diagram	Fig. 2C-1	2C-7
Parts Locator Diagram	Fig. 2C-2	2C-8
Schematic (Sheet 1 of 4)	Fig. 2C-3	2C-9
(Sheet 2 of 4)	"	2C-10
(Sheet 3 of 4)	"	2C-11
(Sheet 4 of 4)	"	2C-13
A2 Front Panel PCB		
General Circuit Description	Para. 2C-2.2	2C-2
Detailed Circuit Description	Para. 2C-4	2C-4
Block Diagram	Fig. 2C-1	2C-7
Parts Locator Diagram	Fig. 2C-4	2C-14
Schematic (Sheet 1 of 3)	Fig. 2C-5	2C-15
(Sheet 2 of 3)	"	2C-16
(Sheet 3 of 3)	"	2C-17

2C-2 FRONT PANEL ASSEMBLIES, OVERALL DESCRIPTION

The A1 Front Panel and A2 Front Panel Control PCBs are part of the Front Panel Assembly. These PCBs are mounted within the front panel casting and are isolated from the internal synthesizer circuits. This prevents the internal RF sources and microprocessor bus signals from interfering with sensitive external equipment. Refer to the front panel assembly photographs in Section 5–Parts Lists.

The A1 and A2 PCBs make up the front panel subsystem that sends the operator input commands to the A23 Microprocessor PCB. (The main microprocessor located on the A23 PCB controls the overall operation of the synthesizer.) This subsystem also displays operating parameters and status information via the front panel displays and indicators (Figure 2C-1). The subsystem is described in paragraphs 2C-2.1 through 2C-4 below.

2C-2.1 A1 Front Panel PCB, General Description

The A1 PCB contains the displays, indicators, and controls listed below. These components are mounted on the front surface of the A1 PCB and protrude through the front panel (and front panel overlay).

- Three multi-digit liquid crystal displays (LCD's): FREQUENCY, MODULATION/TIME, and LEVEL – indicate the main operational parameters of the internal synthesizer circuits. They are controlled by the A23 PCB main microprocessor via driver circuits on the A1 and A2 PCBs.
- Forty nine LED indicators. Indicate the status of the operational functions controlled by the front panel keys. All but two of these LEDs are controlled by the A1 PCB driver circuits.
- Fifty one control keys. Allow the operator to control the operation of the synthesizer. The digital keycodes for these keys are generated by circuits on the A2 PCB and sent to the A23 Microprocessor PCB.
- LINE (power) switch. Controls the +24V that operates the line switch relay (A28K1) on the A28 Motherboard PCB. This switch also controls the associated STANDBY and OPERATE LEDs.
- SINGLE SWEEP push button. Initiates a single sweep in the EXT sweep trigger mode. It operates in the same manner as any of the control keys.

The operation and functions of these displays and controls are described in the 67XXB Swept Frequency Synthesizer Operation Manual.

The three liquid crystal displays are refreshed with a 150 Hz (approximate) backplane signal. Other than this signal, the A1/A2 front panel circuits are normally in a static state. They become active only when the main microprocessor writes to an LCD display or a LED data latch, or when a front panel key is pressed by the operator.

2C-2.2 A2 Front Panel Control PCB, General Description

The A2 PCB contains the data interface and control circuit groups described below.

a. Serial/Parallel Data Conversion Circuits

These circuits convert the serial data information received from the A8 Serial I/O PCB into parallel format. (The A23 Microprocessor PCB sends latch address and display data information to the front panel subsystem via the A8 PCB.) The outputs of these circuits consist of an internal 8-bit parallel data bus (**D0-D7**) and control (strobe) signals. The strobe signals latch data into the crystal display driver and LED driver latches on the A1 and A2 PCBs.

b. Crystal Display Message Latches

The non-numeric information displayed by the three crystal displays (function names, units, and decimal points) are controlled by driver circuits located on the A2 PCB. All of the numeric information for these displays is controlled by driver circuits on the A1 PCB.

c. Keyboard Encode and Parallel/Serial Conversion Circuits

The 51 front panel keys make up a keyboard matrix. Whenever the operator presses a particular key, the keyboard encode circuits convert the **x** and **y** coordinates for that key into a 7-bit (parallel) *keycode* signal. These circuits also generate a KBD INT interrupt signal to the A23 PCB. When the A23 PCB services this interrupt (via the A8 PCB), the parallel keycode data is converted into serial format and sent to the A23 PCB (via the A8 PCB).

d. Knob Motor and EXT ALC Amplifier Circuits

The front panel DECREASE/INCREASE knob is used by the operator to modify operational data parameters that have been previously entered. This knob turns a motor that is used as a dc generator. The output of the motor is a dc voltage proportional to the speed and direction in which it is turned.

The A2 PCB contains the amplifier for the signal generated by the knob motor. The output of this amplifier goes to the DVM circuits on the A17 Analog Instruction PCB.

The A2 PCB also contains the preamplifier circuit for the signal from the front panel EXT LEVEL BNC connector. The output of this amplifier goes to the A15 ALC PCB.

2C-3 A1 FRONT PANEL PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the Front Panel Assembly block diagram (Figure 2C-1) and to the A1 PCB schematic (Figure 2C-3) during the following description.

2C-3.1 Line Switch and Power on Circuits

Whenever the synthesizer is connected to a source of line voltage, +24V is present on one side of the LINE switch, S46. This voltage (designated as **+24V1**) is produced by the A22 Regulator Interface PCB.

- With the LINE switch in the STANDBY position, +24V1 goes only to the STANDBY LED, DS2.
- When the LINE switch is depressed (OPERATE position) it connects the +24V to the line switch relay, A28K1, on the A28 Motherboard PCB. This relay applies line voltage to the rectifiers located on the A28 Motherboard PCB. The +24V from the LINE switch (designated as **+24VG**) is also connected to the A5 Reference Oscillator PCB, the A25 Power Supply PCB, the A29 Rear Panel Interface PCB, and the OPERATE LED, DS1.

2C-3.2 Front Panel Keys

The 51 front panel keys constitute an 8-bit by 8-bit switch matrix. Each key of the matrix is a DPST momentary type switch (Figure 2C-3, sheet 1). When a key is pressed, the **x** and **y** coordinate lines that

are associated with that key are connected to ground.

The **x** coordinate lines (**X0-X7**), and **y** coordinate lines, (**Y0-Y7**), go to the keyboard encode circuits on the A2 PCB (described below). The output of the encode circuits is converted to serial data format and then sent to the A23 Microprocessor PCB via the A8 Serial I/O PCB.

The SINGLE SWEEP push button (S54) is connected to the **X6** and **Y1** coordinate lines of the switch matrix by diodes CR1 and CR2, respectively. This circuit performs the same function as the DPST function key switches described above. The **x** and **y** coordinates for this switch are processed in the same manner described above.

2C-3.3 LED Driver Circuits

Latches U1-U6 drive 46 of the 49 front panel LED indicators (Figure 2C-3, sheet 2). Data from the serial/parallel conversion circuits located on the A2 PCB is sent to these latches via the internal 8-bit bus (**D0-D7**). This data is strobed into each latch by a dedicated control strobe. These strobes are generated by the strobe decode circuits located on the A2 PCB. (The LED drive data is generated by the A23 PCB and sent to the A2 PCB via the A8 PCB.)

NOTE:

The Q7 output of U1 controls the A2U26 analog relay, that is part of the knob amplifier on the A2 PCB. (This output does not drive an LED indicator.) Relay A2U26 is controlled by the A23 Microprocessor PCB and is used to configure the amplifier input during the zeroing processes.

The driver circuit for the RF UNLVLD LED consists of transistor Q1 and resistors R8-R10. This circuit is controlled by the **L RF UNLVLD** signal from the A15 ALC PCB (which is routed through the A2 PCB).

2C-3.4 Liquid Crystal Displays and Display Driver Circuits

The three front panel Liquid Crystal Displays (LCDs) display numeric digits and alphanumeric characters that indicate the operational parameters and status of the synthesizer. These displays are mounted on the front surface of the A1 PCB and protrude through the front panel. Integrated circuits U7-U10 and U12 are the LCD drivers that control the numeric digits of the three displays.

The LCD drivers latch and decode the information from the internal 8-bit bus (**D0-D7**) that comes from the A2 Front Panel Control PCB. Each device is capable of controlling up to four 7-segment display digits. Data lines **D0-D3** contain the BCD code of the character (0-9) to be displayed, and lines **D4/D5** contain the address of the LCD digit.

LCD drivers U7-U9 control the nine digits of the FREQUENCY display (Figure 2C-3, sheet 3). LCD driver U10 controls the MODULATION/TIME display and U12 controls the LEVEL display. Each of these displays contain four digits (Figure 2C-3, sheet 4). In addition to these driver circuits, the driver latches on the A2 PCB control the non-numeric message characters of the three LCD displays (these circuits are described in the following paragraphs).

The OSC input (pin 36) of U10 is unconnected, which enables the internal 19 kHz oscillator. The OSC inputs of drivers U7-U9 and U12 are grounded, which disables the internal oscillators of these devices. The internal oscillator signal of U10 is internally divided by 128 to produce the **BP** signal at pin 5, which is the backplane drive signal required by the LCDs. This signal is a 0 to 5V square wave with an approximate frequency of 150 Hz.

The BP signal from U10 goes directly to the backplane of the MODULATION/TIME display and to the input of buffer amplifier U11A, which drives buffer amplifiers U11B-U11F. The combined outputs of U11B-U11F is the BP signal line that is the backplane drive signal for the FREQUENCY and LEVEL displays. This signal also goes to the display message driver latches located on the A2 PCB.

2C-4 A2 FRONT PANEL CONTROL PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the Front Panel Assembly block diagram (Figure 2C-1) and to the A2 PCB schematic (Figure 2C-5) during the following description.

2C-4.1 Serial Data Conversion Circuits

The A8 Serial I/O PCB sends 16-bit word serial data to the A2 Front Panel Control PCB via the data signal **FP DATA**, the clock signal **FP CLK**, and the data strobe signal **FP STRB**. These signals go to the

inputs of Schmitt-trigger inverters U30A, U30C and U30F, respectively. These Schmitt-trigger devices improve the rise time of these signals, which is degraded by the filtercons (filter connectors) which are part of the front panel casting A2 PCB connector assembly.

The serial clock signal, **FP CLK,** shifts the 16-bit words of the **FP DATA** signal into shift registers U1 and U2. At the end of the data word, the **FP STRB** signal goes low and enables one of the three 3-to-8 decoders (U3, U7, or U8) that has been selected (partially enabled) by the Q_D and Q_E outputs of U2. The selected decoder decodes the Q_A, Q_B and Q_C outputs of U2 to produce a single negative-going control strobe that goes to a particular display driver or display driver latch.

2C-4.2 Internal Parallel Data Bus

The data from the Q_A-Q_H outputs of shift register U1 is distributed to all the display drivers/latches on the A1/A2 PCBs via the parallel data bus lines (**D0-D7**). The control strobe signal produced by the strobe decoder circuits latches this data into the target display driver/latch circuit.

2C-4.3 Keyboard Encoder, Interrupt and Output Circuits

When a front panel key is pressed by the operator, the 8-line to 3-line encoders, U6 and U9, produce a six-bit parallel data word (keycode) for the selected switch. This data word represents the x and y coordinates of the selected switch within the front panel switch matrix. When a valid keycode signal is produced by U6 and U9, gate U5A triggers flip-flop U11 to produce an interrupt (**KBD INT**) that goes to the A23 Microprocessor PCB.

Upon receiving the **KBD INT** interrupt, the A23 Microprocessor PCB completes the current task and then services this interrupt as follows:

- A data word is sent via the A8 Serial I/O PCB that generates a control strobe from the Y_3 output of decoder A2U7. This control strobe loads the keycode data into output shift register U10.
- Another dataword is sent to the A8 PCB that sends a train of **FP CLK** signals to the A2 PCB. This clock train causes U10 to output the keycode data onto the **FRONT PANEL OUT** line.
- The A8 PCB receives the keycode data and sends it to the A23 PCB.
- The main microprocessor checks the keycode data and sends another instruction to the A8 PCB that instructs U10 to load the keycode data a second time. The main microprocessor reads the second set of keycode data; if the keycode is valid, and if it is the same as the keycode read during the first data transaction, the processor executes the routines for the specified keycode.

2C-4.4 Display Message Data Latches

Refer to Figure 2C-3, sheets 3 and 4. Integrated circuits U12-U25 are LCD display drivers that control the non-numeric (message) segments of the three front panel displays. Each driver circuit controls four display elements. These driver circuits are configured to operate in pairs; two drivers are connected to each of the seven control strobe lines for the message displays. One driver of each pair receives the data from the upper 4 bits of the internal data bus (**D0-D3**) and the other receives the lower 4 bits (**D4-D7**). Transition of the strobe line signal from low to high loads the data into the latches. A particular display segment is selected by a high input to the associated latch. Only one (or none) of the four outputs of each active driver will be selected at one time.

The LCD display backplane drive signal (**BP**) from the A1 PCB goes to the DF input of drivers U12-U25. The output signal from the selected output of each active driver circuit is a square wave signal that is *180 degrees out of phase* with the **BP** signal. This causes the selected display element to light. The unselected outputs have a square wave signal that is *in phase* with the **BP** signal.

2C-4.5 Knob Amplifier

The front panel DECREASE/INCREASE knob turns a motor that is used as a dc generator. This motor produces a dc voltage with a polarity determined by the direction of rotation and is proportional in magnitude to the speed of rotation.

The dc voltage from the knob motor is connected directly to the A2 PCB via cable J5. This signal goes to the input of the Knob Amplifier, U27. Diodes CR1 and CR2 limit the output of the motor to approximately ±10.7V to prevent damage to the amplifier input switching circuits (analog switch U26).

Amplifier U27 has a gain of ×10. Diodes CR9 and CR10 limit the output of this amplifier to approximately ±8V. The output of U27 goes to the DVM circuits on the A17 Analog Instruction PCB via the **KNOB MON** signal line. The output limiting provided by diodes CR9 and CR10 prevents overloading of the A17 PCB DVM circuits.

As part of the housekeeping routine that it performs every 50 ms, the main microprocessor reads the **KNOB MON** signal voltage via the DVM circuits. The value read is used to determine the necessary amount, and polarity, of change required for the operational parameter currently open. (This is usually the last parameter entered by the operator.)

Since the Knob Amplifier is dc coupled and of relatively high gain, it is necessary for the main microprocessor to periodically measure the dc offset of this amplifier. During the knob amplifier zeroing procedure, the **KNOB AMP ZERO** control line is set high. This causes analog switch U26 to disconnect the knob motor signal and to short the input of U27. The main microprocessor reads the residual **KNOB MON** signal voltage via the DVM circuits and stores this measurement value for use as the residual error correction voltage.

When the microprocessor reads a voltage resulting from movement of the knob, it subtracts the residual error correction value to determine the actual measurement value. This is especially important when the knob is turned very slowly, as the signal voltage produced is extremely small. This technique allows the DECREASE/INCREASE knob to be used over a wide range of rotational speeds.

2C-4.6 External Level Detector Preamplifier

The external ALC amplifier on the A2 PCB boosts the external ALC signal to the proper level for use by the A15 ALC PCB. An external detector or power meter is often used instead of the internal detector circuits of the synthesizer. This is done to eliminate uncertainties caused by long cables or the insertion of an additional amplifier in the RF output path of the synthesizer.

The **EXT LVL DET INPUT** signal line and **EXT LVL DET REF** line from the front panel EXT LEVEL BNC connector are connected directly to the A2 PCB via cable J6. Diodes CR4-CR7 limit the input signals on these two lines to approximately ±5.7V. Resistor R8 is the load for the external detector.

Operational amplifier U28 is a unity gain, non-inverting buffer for the detector input signal line; U29 is a differential amplifier/receiver that has a gain of ×5. The output of this amplifier goes to the external ALC input circuits on the A15 ALC PCB via the FP ALC INPUT and FP ALC REF signal lines.

Potentiometer R15 is used to adjust the input offset of U29 to zero. This adjustment is performed during the calibration of the ALC circuits. For information regarding this adjustment, refer to the 67XXB Test and Calibration Manual.

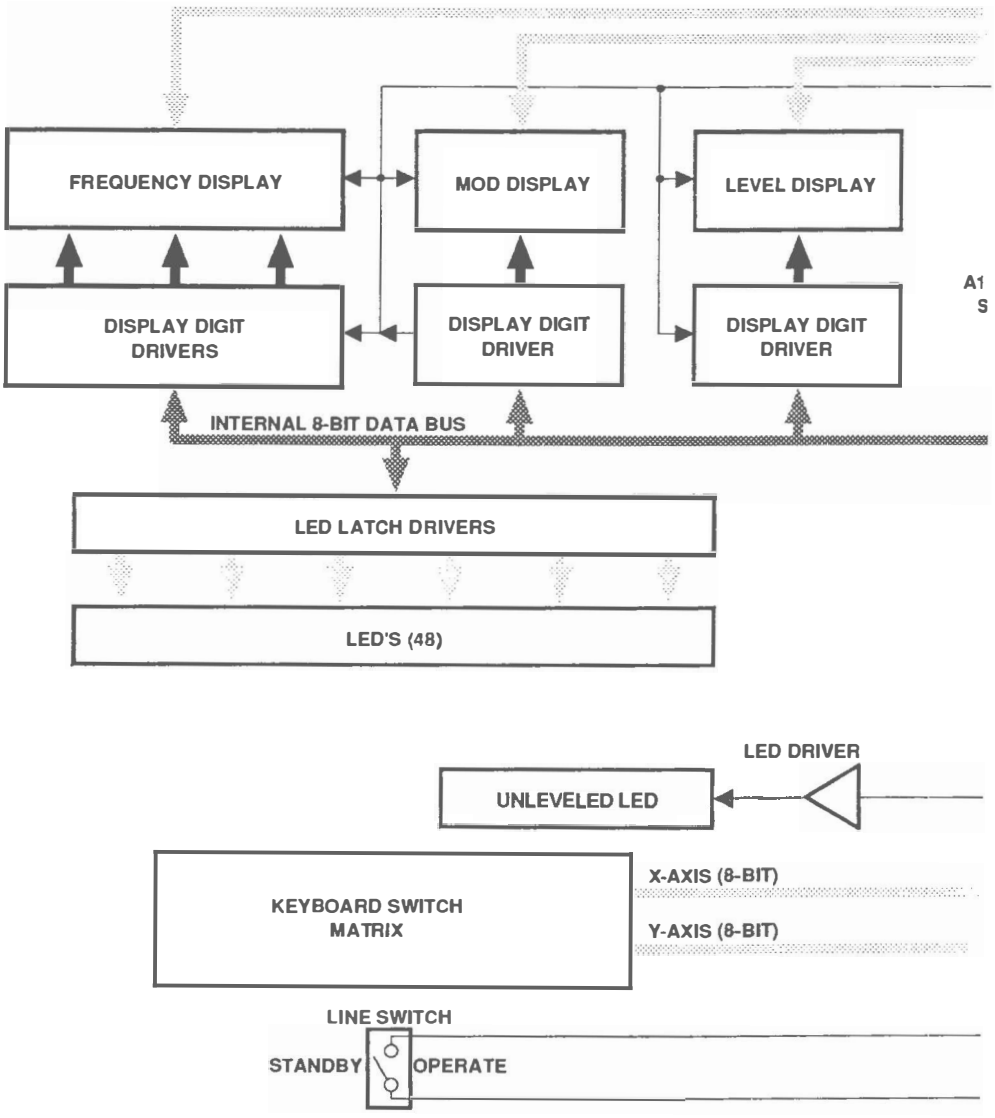
2C-5 FRONT PANEL ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides some common front panel trouble indications and procedures for locating the failed assembly.

2C-6 FRONT PANEL ASSEMBLIES, SERVICE SHEETS

Table 2C-1, on the first page of this section, references the block diagrams, schematics, and parts locator diagrams for the A1 and A2 PCBs.

PART OF A1 FRONT PANEL



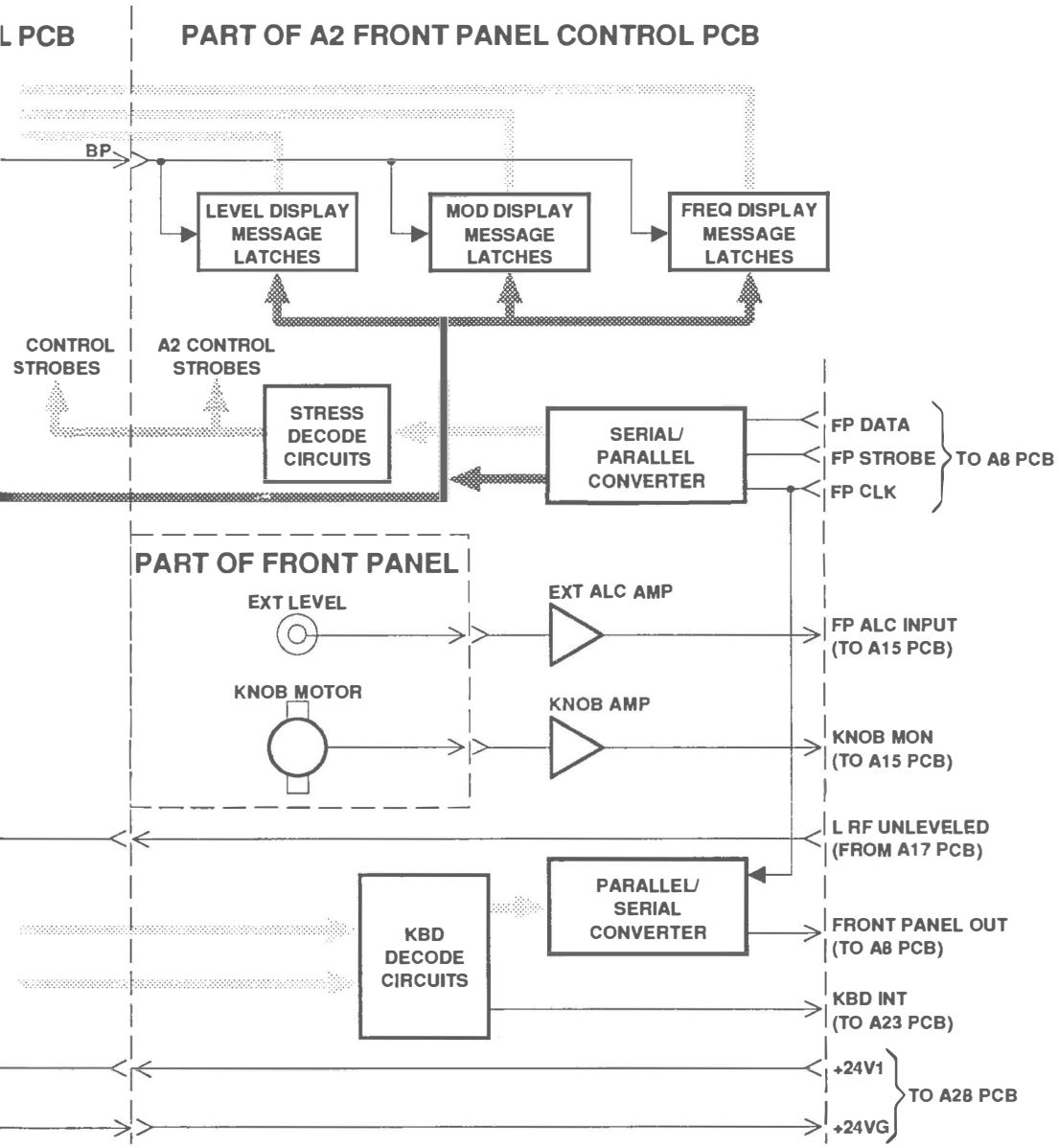
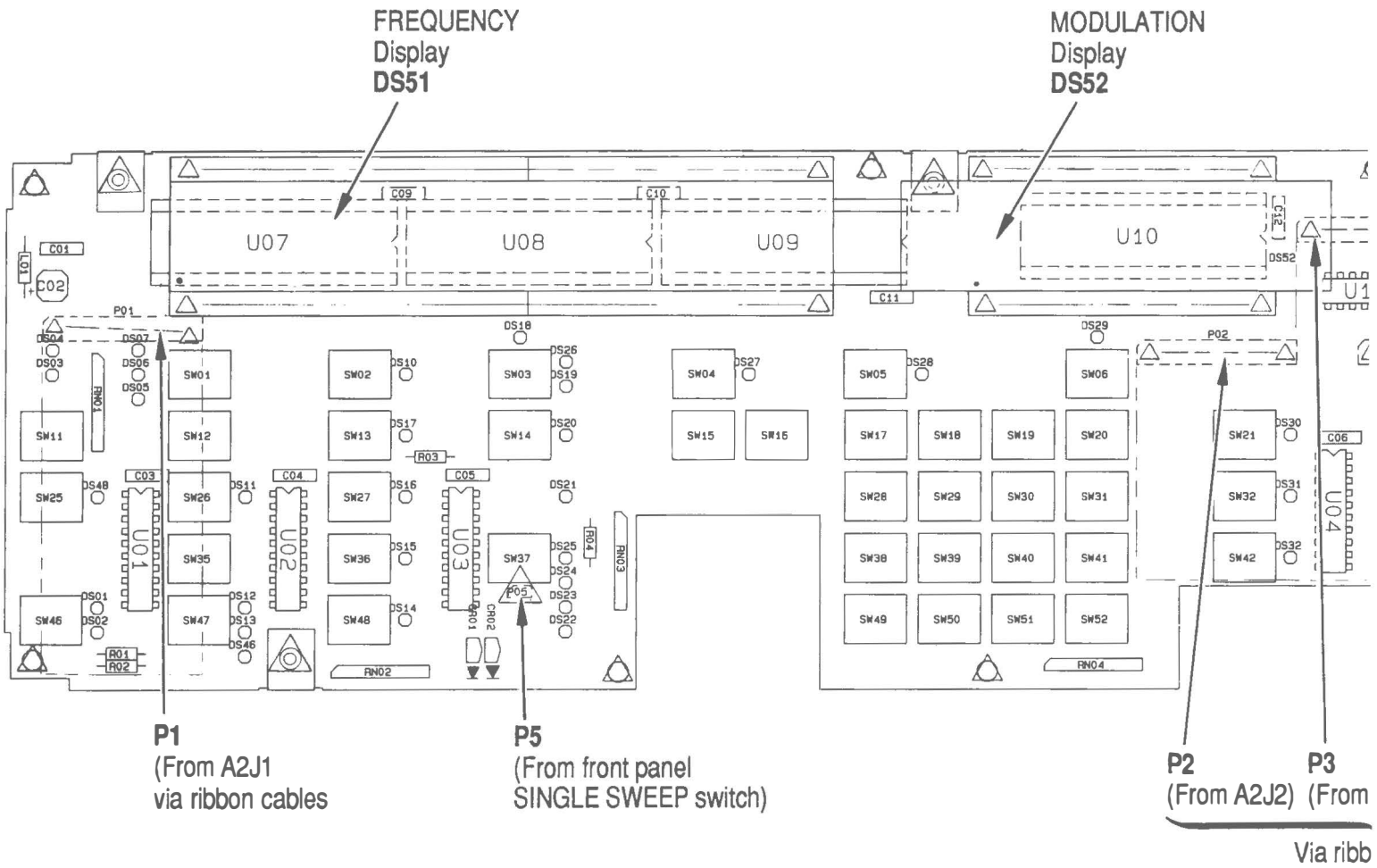


Figure 2C-1. Block Diagram of Front Panel Assembly



NOTE:
Leading zeros on component number references may be disregarded.

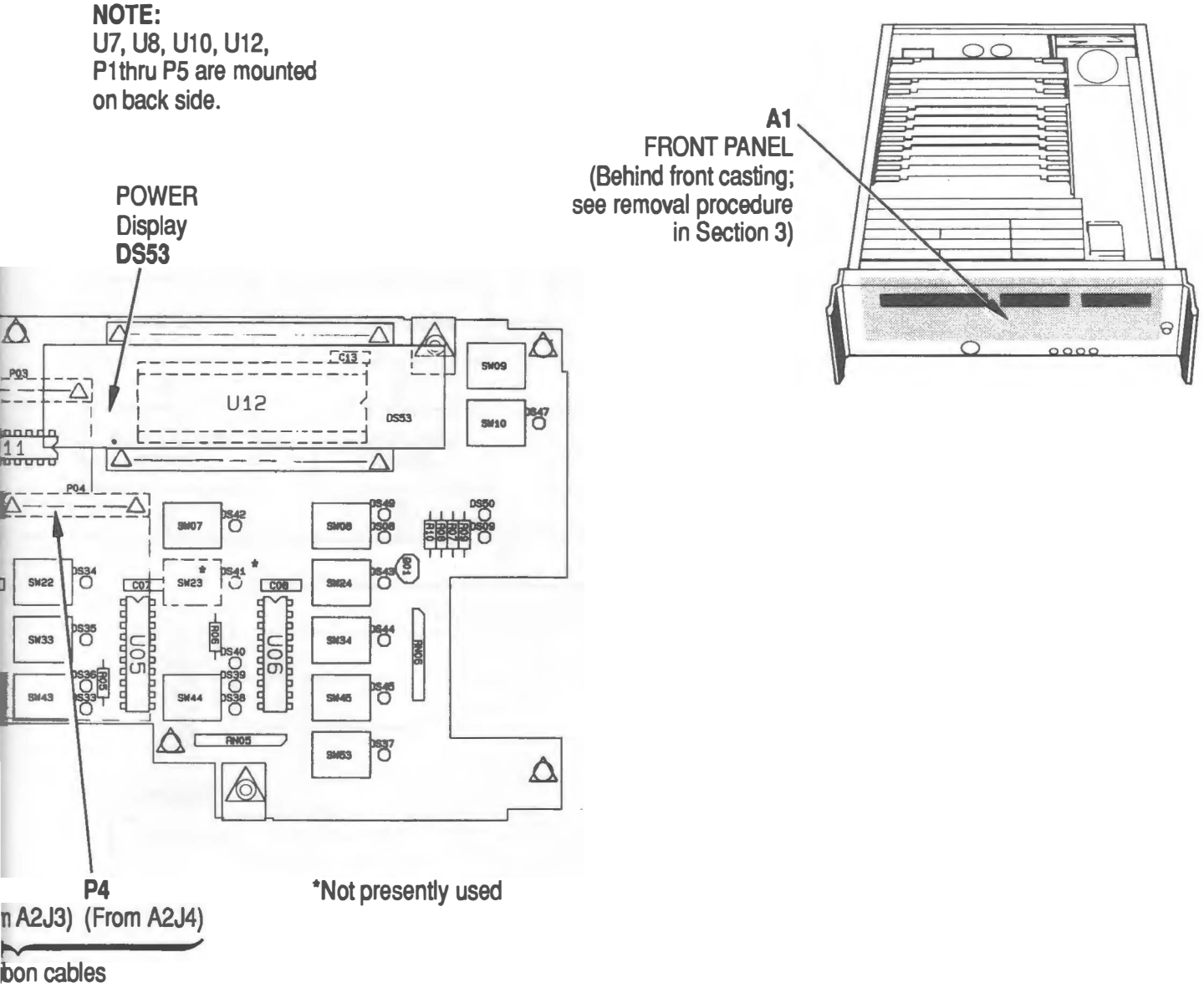
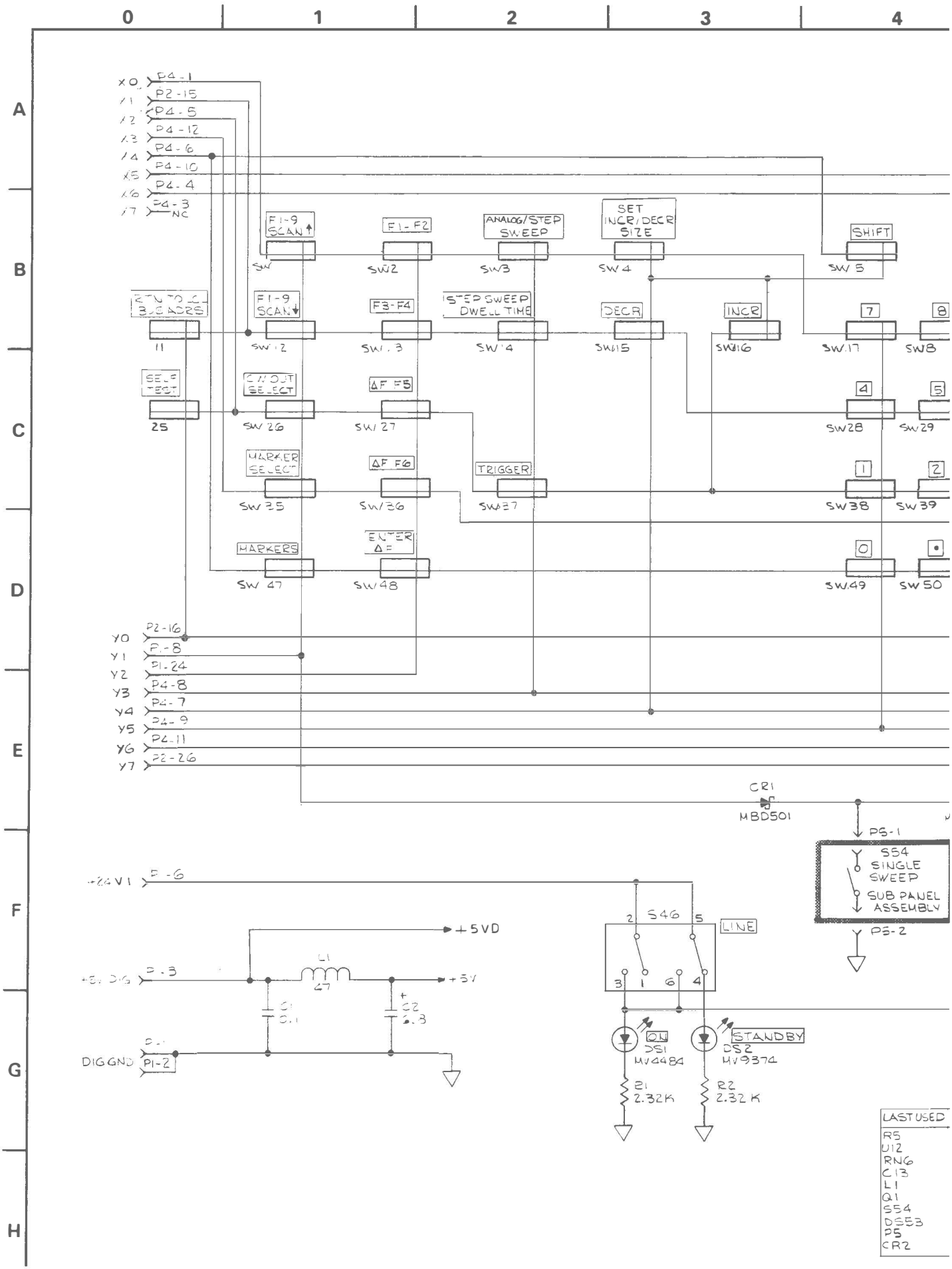
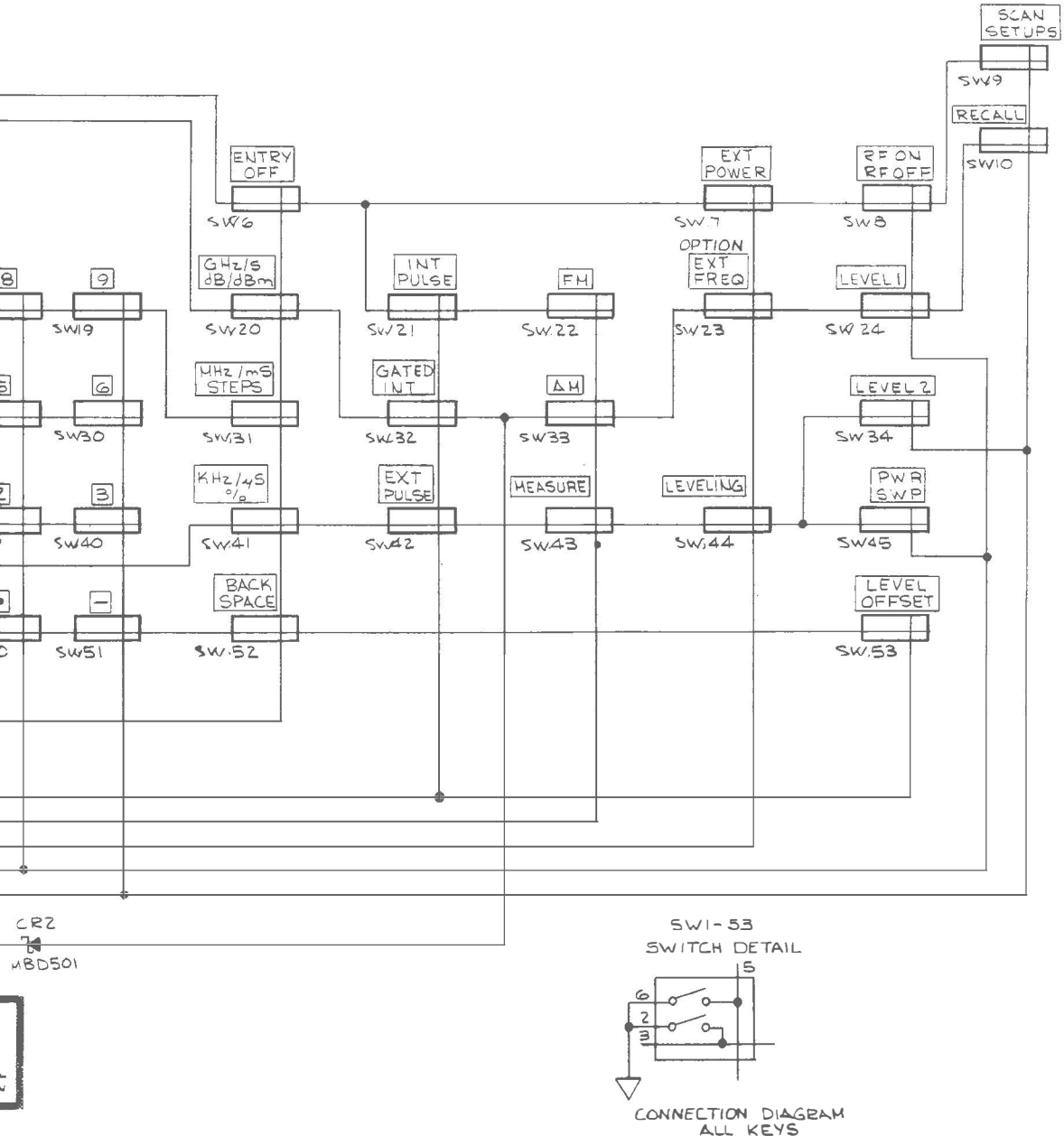


Figure 2C-2. A1 Front Panel PCB Parts Locator Diagram
6700-D-31701-3 (Rev. P)

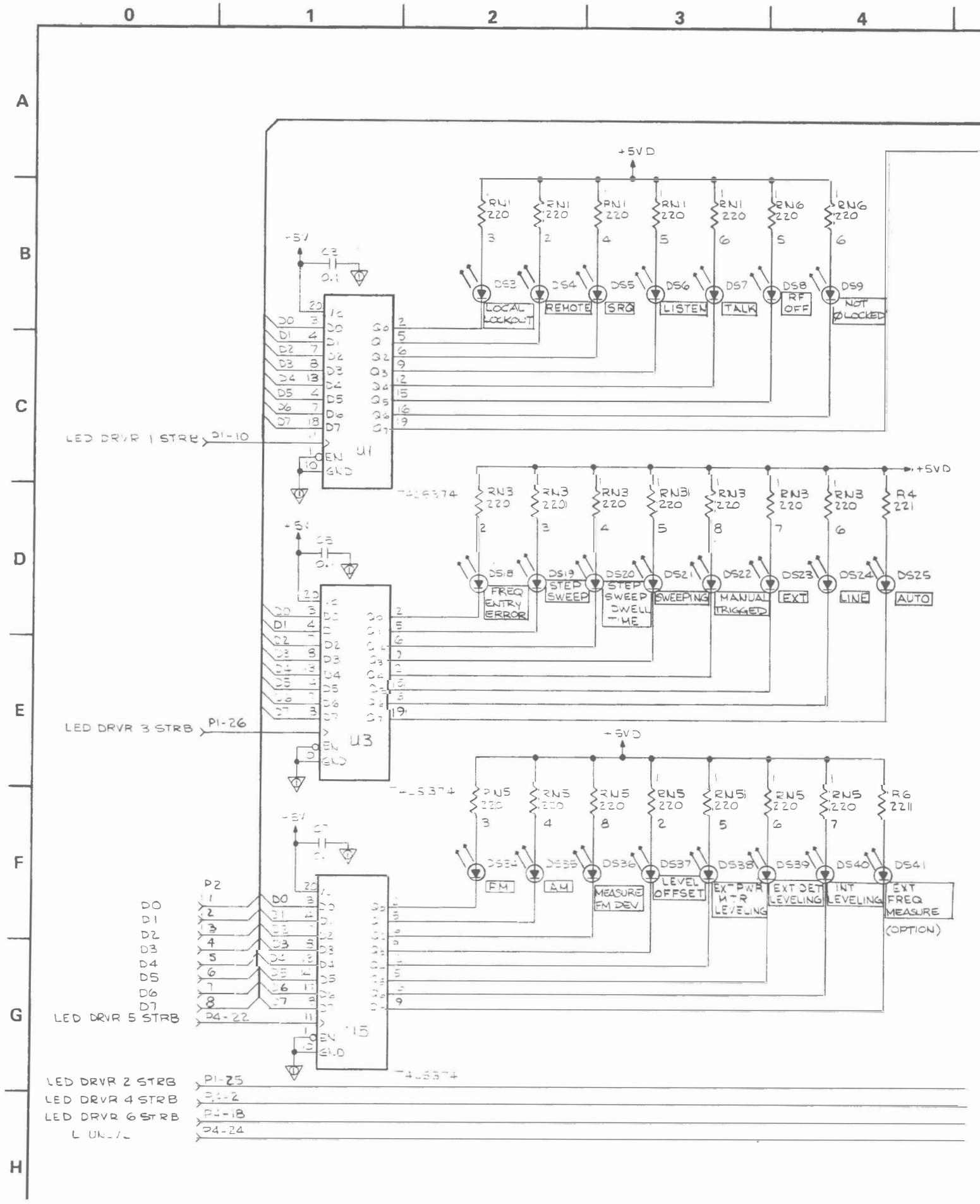

0
1
2
3
4
A
B
C
D
E
F
G
H
X0
X1
X2
X3
X4
X5
X6
X7
P4-1
P2-15
P4-5
P4-12
P4-6
P4-10
P4-4
P4-3
NC
F1-9 SCAN
F1-F2
ANALOG/STEP SWEEP
SET INCR/DECR SIZE
SHIFT
SW1
SW2
SW3
SW4
SW5
RTN TO C BOARDS
F1-9 SCAN
F3-F4
STEP SWEEP DWELL TIME
DECR
INCR
7
8
11
SW12
SW13
SW14
SW15
SW16
SW17
SW8
SELF TEST
CNDJT SELECT
ΔF F5
4
5
25
SW26
SW27
SW28
SW29
MARKER SELECT
ΔF F6
TRIGGER
1
2
SW25
SW36
SW37
SW38
SW39
MARKERS
ENTER ΔF
0
SW47
SW48
SW49
SW50
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
P2-16
P1-8
P1-24
P4-8
P4-7
P4-9
P2-11
P2-26
CR1
MBD501
P5-1
S54
SINGLE SWEEP
SUB PANEL ASSEMBLY
P5-2
+24V1
P5-6
+5VD
+5V DIG
P5-3
L1
47
+5V
C1
0.1
C2
4.3
DIGGND
P5-1
P1-2
S46
2
5
LINE
3
1
6
4
ON
DS1
MV4484
STANDBY
DS2
MV9374
R1
2.32K
R2
2.32K
LAST USED
R5
U12
RN6
C13
L1
Q1
S54
DS53
P5
CR2



NOTES:

1. UNLESS OTHERWISE SPECIFIED,
   RESISTANCES ARE IN OHMS.
   CAPACITANCES ARE IN MICROFARADS.
   INDUCTANCES ARE IN MICROHENRIES.
2. <2/10> MATCHING CONNECTIONS FOR SIGNAL FLAGS ARE LOCATED BY SHEET NUMBER AND GRID COORDINATE.
3. ⏚ DENOTES +5V RETURN.
4. ▭ DENOTES PANEL CONTROL MOUNTING

Figure 2C-3. A1 Front Panel PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31701-3 (Rev. C)


0
1
2
3
4
A
B
C
D
E
F
G
H
+5VD
+5V
C3
0.1
U1
74LS374
RN1 220
RN1 220
RN1 220
RN1 220
RN1 220
RN6 220
RN6 220
DS3 LOCAL LOCKOUT
DS4 REMOTE
DS5 SRQ
DS6 LISTEN
DS7 TALK
DS8 RF OFF
DS9 NOT LOCKED
LED DRVR 1 STRB
P1-10
D0
D1
D2
D3
D4
D5
D6
D7
EN
GND
+5VD
C8
0.1
U3
74LS374
RN3 220
RN3 220Ω
RN3 220
RN3 220
RN3 220
RN3 220
RN3 220
R4 221
DS18 FREQ ENTRY ERROR
DS19 STEP SWEEP
DS20 STEP SWEEP DWELL TIME
DS21 SWEEPING
DS22 MANUAL TRIGGER
DS23 EXT
DS24 LINE
DS25 AUTO
LED DRVR 3 STRB
P1-26
+5VD
C7
0.1
U5
74LS374
RN5 220
RN5 220
RN5 220
RN5 220
RN5 220
RN5 220
RN5 220
R6 221
DS34 FM
DS35 AM
DS36 MEASURE FM DEV
DS37 LEVEL OFFSET
DS38 EXT PWR MTR LEVELING
DS39 EXT DET LEVELING
DS40 INT LEVELING
DS41 EXT FREQ MEASURE (OPTION)
P2
D0
D1
D2
D3
D4
D5
D6
D7
LED DRVR 5 STRB
P4-22
LED DRVR 2 STRB
P1-25
LED DRVR 4 STRB
P4-2
LED DRVR 6 STRB
P4-18
P4-24

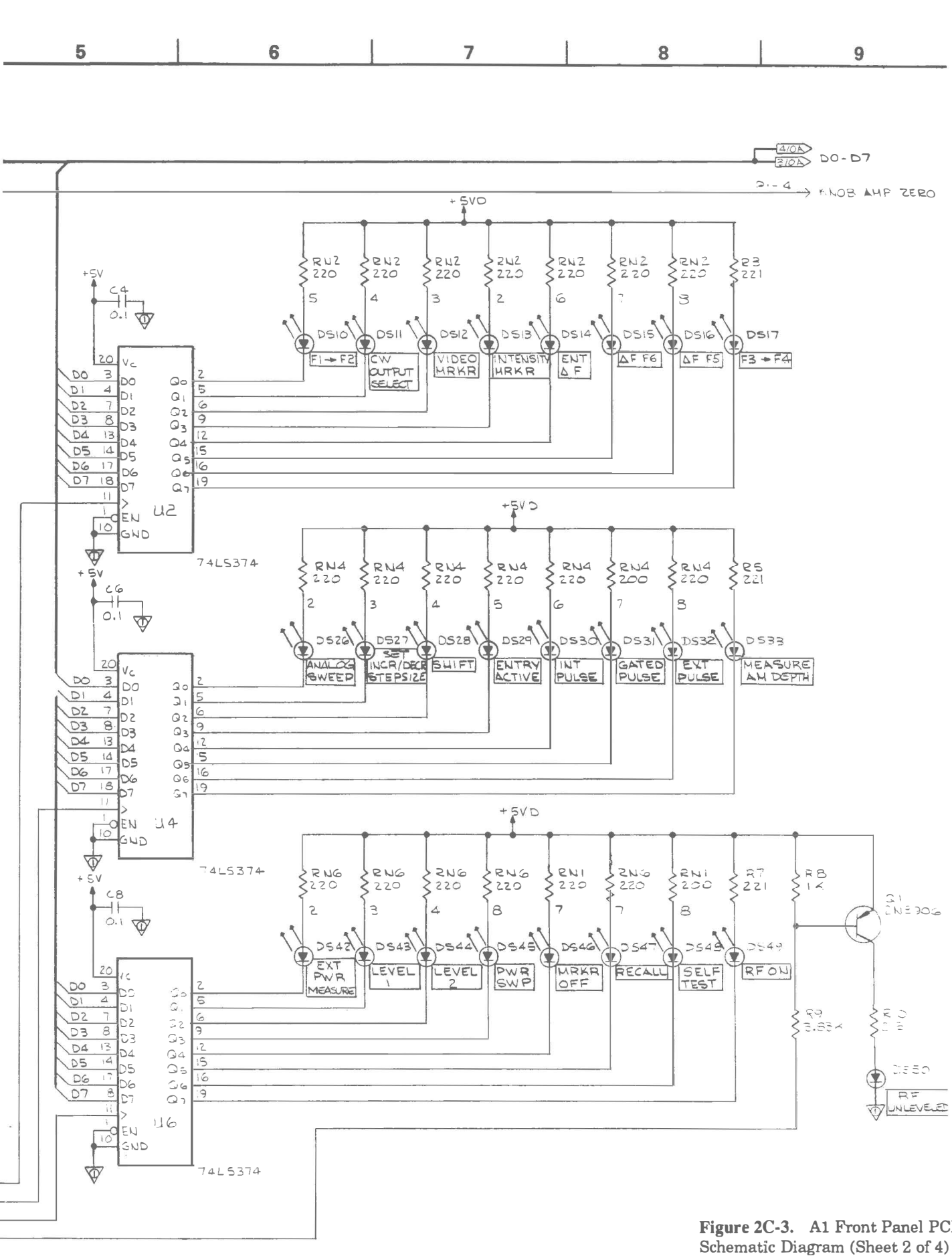
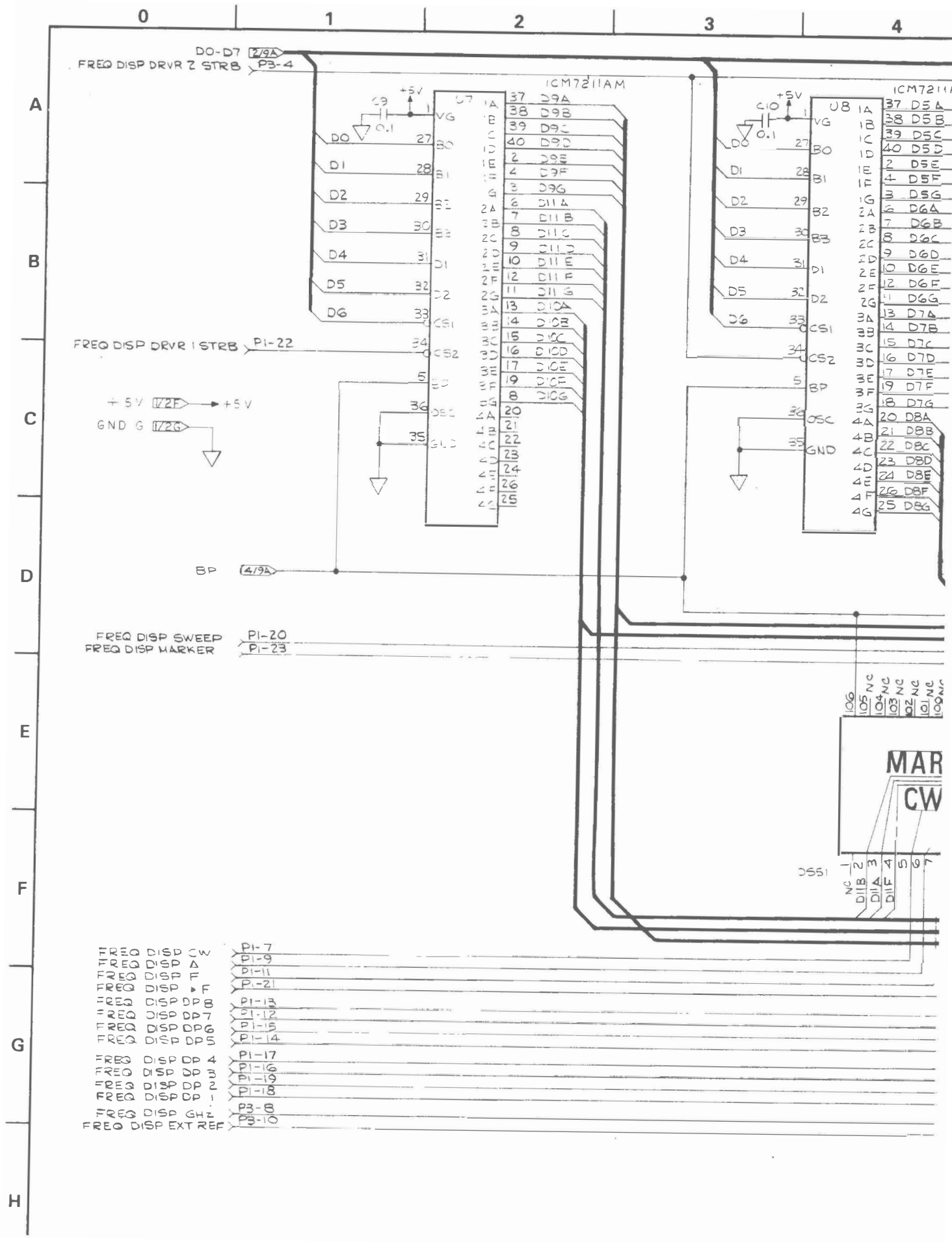


Figure 2C-3. A1 Front Panel PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31701-3 (Rev. C)


0
1
2
3
4
A
B
C
D
E
F
G
H
DO-D7
FREQ DISP DRVR Z STRB
P3-4
ICM7211AM
U7
U8
+5V
C9
C10
0.1
VG
BO
B1
B2
B3
D1
D2
CS1
CS2
BP
OSC
GND
D0
D1
D2
D3
D4
D5
D6
FREQ DISP DRVR I STRB
P1-22
+5V
GND G
BP
FREQ DISP SWEEP
FREQ DISP MARKER
P1-20
P1-23
DS1
FREQ DISP CW
FREQ DISP A
FREQ DISP F
FREQ DISP ▸F
FREQ DISP DP8
FREQ DISP DP7
FREQ DISP DP6
FREQ DISP DP5
FREQ DISP DP 4
FREQ DISP DP 3
FREQ DISP DP 2
FREQ DISP DP 1
FREQ DISP GHz
FREQ DISP EXT REF
P1-7
P1-9
P1-11
P1-21
P1-13
P1-12
P1-15
P1-14
P1-17
P1-16
P1-19
P1-18
P3-8
P3-10

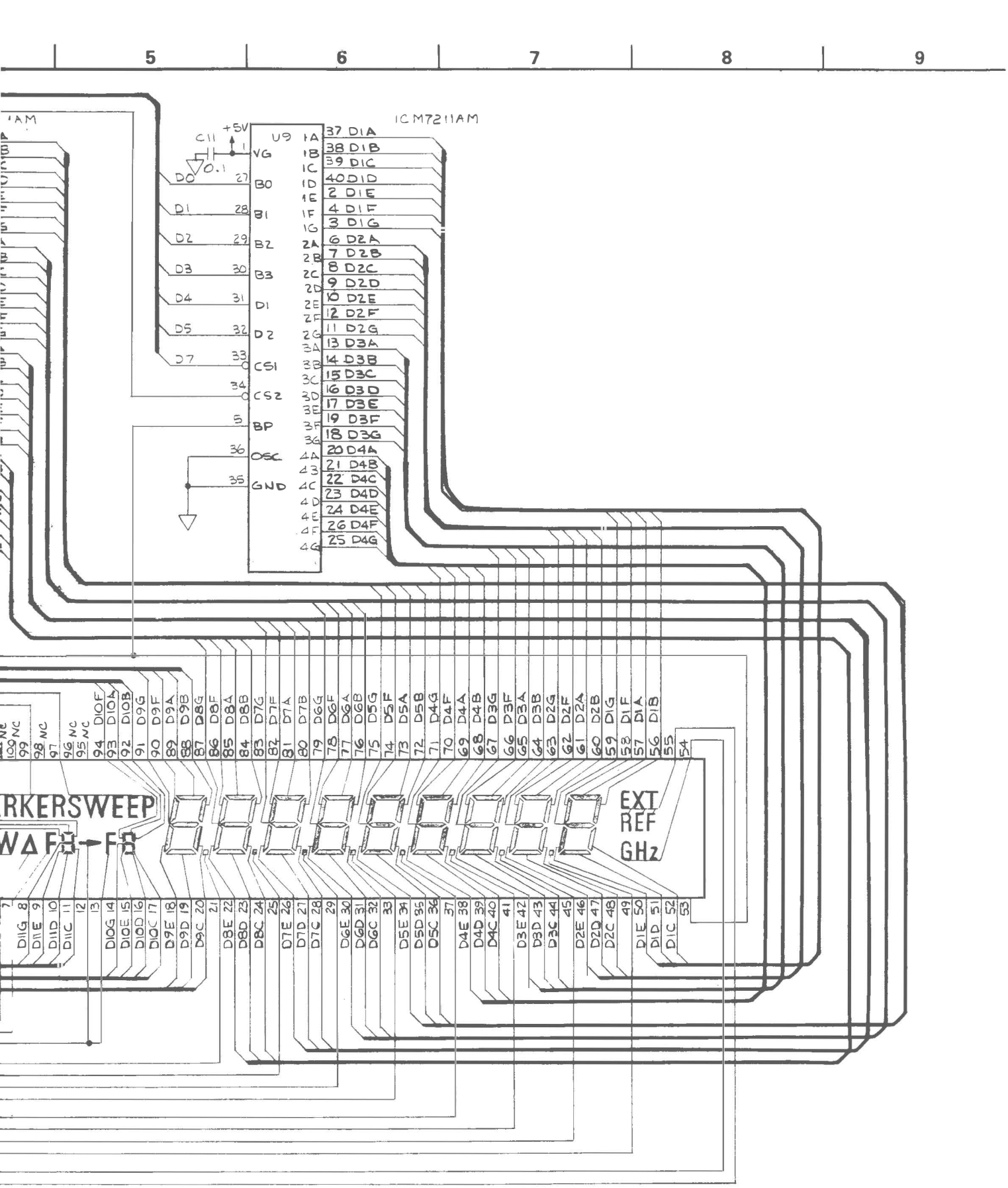
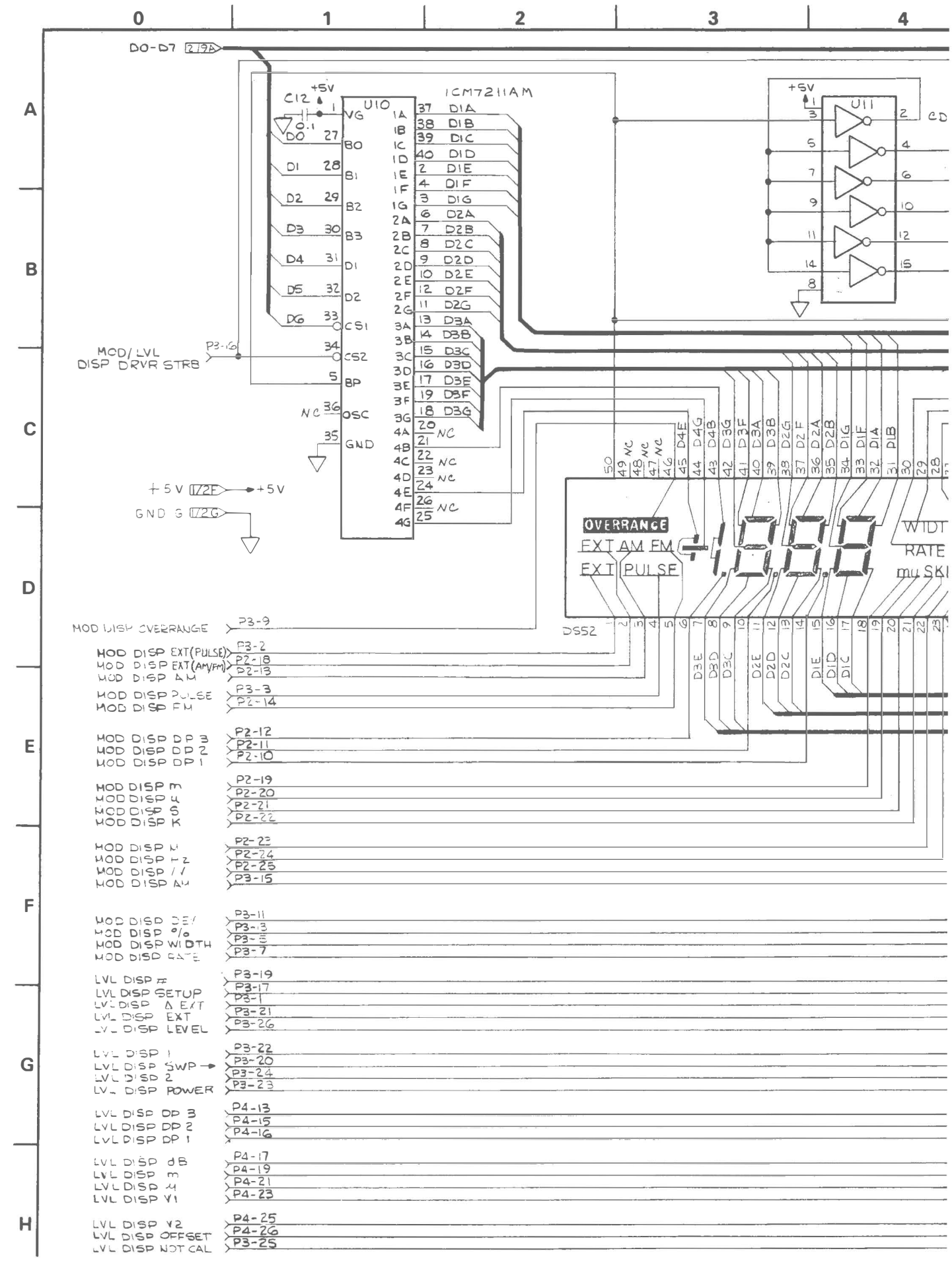


Figure 2C-3. A1 Front Panel PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31701-3 (Rev. C)


0
1
2
3
4
A
B
C
D
E
F
G
H
D0-D7
U10
ICM7211AM
+5V
C12
0.1
MOD/LVL DISP DRVR STRB
P3-16
+5V
GND
OVERRANGE
EXT AM FM
EXT PULSE
DS52
MOD DISP OVERRANGE P3-9
MOD DISP EXT(PULSE) P3-2
MOD DISP EXT(AM/FM) P2-18
MOD DISP AM P2-13
MOD DISP PULSE P3-3
MOD DISP FM P2-14
MOD DISP DP 3 P2-12
MOD DISP DP 2 P2-11
MOD DISP DP 1 P2-10
MOD DISP m P2-19
MOD DISP µ P2-20
MOD DISP S P2-21
MOD DISP K P2-22
MOD DISP M P2-23
MOD DISP Hz P2-24
MOD DISP / / P2-25
MOD DISP AM P3-15
MOD DISP DEV P3-11
MOD DISP %/o P3-13
MOD DISP WIDTH P3-5
MOD DISP RATE P3-7
LVL DISP # P3-19
LVL DISP SETUP P3-17
LVL DISP Δ EXT P3-1
LVL DISP EXT P3-21
LVL DISP LEVEL P3-26
LVL DISP 1 P3-22
LVL DISP SWP P3-20
LVL DISP 2 P3-24
LVL DISP POWER P3-23
LVL DISP DP 3 P4-13
LVL DISP DP 2 P4-15
LVL DISP DP 1 P4-16
LVL DISP dB P4-17
LVL DISP m P4-19
LVL DISP µ P4-21
LVL DISP V1 P4-23
LVL DISP V2 P4-25
LVL DISP OFFSET P4-26
LVL DISP NOT CAL P3-25

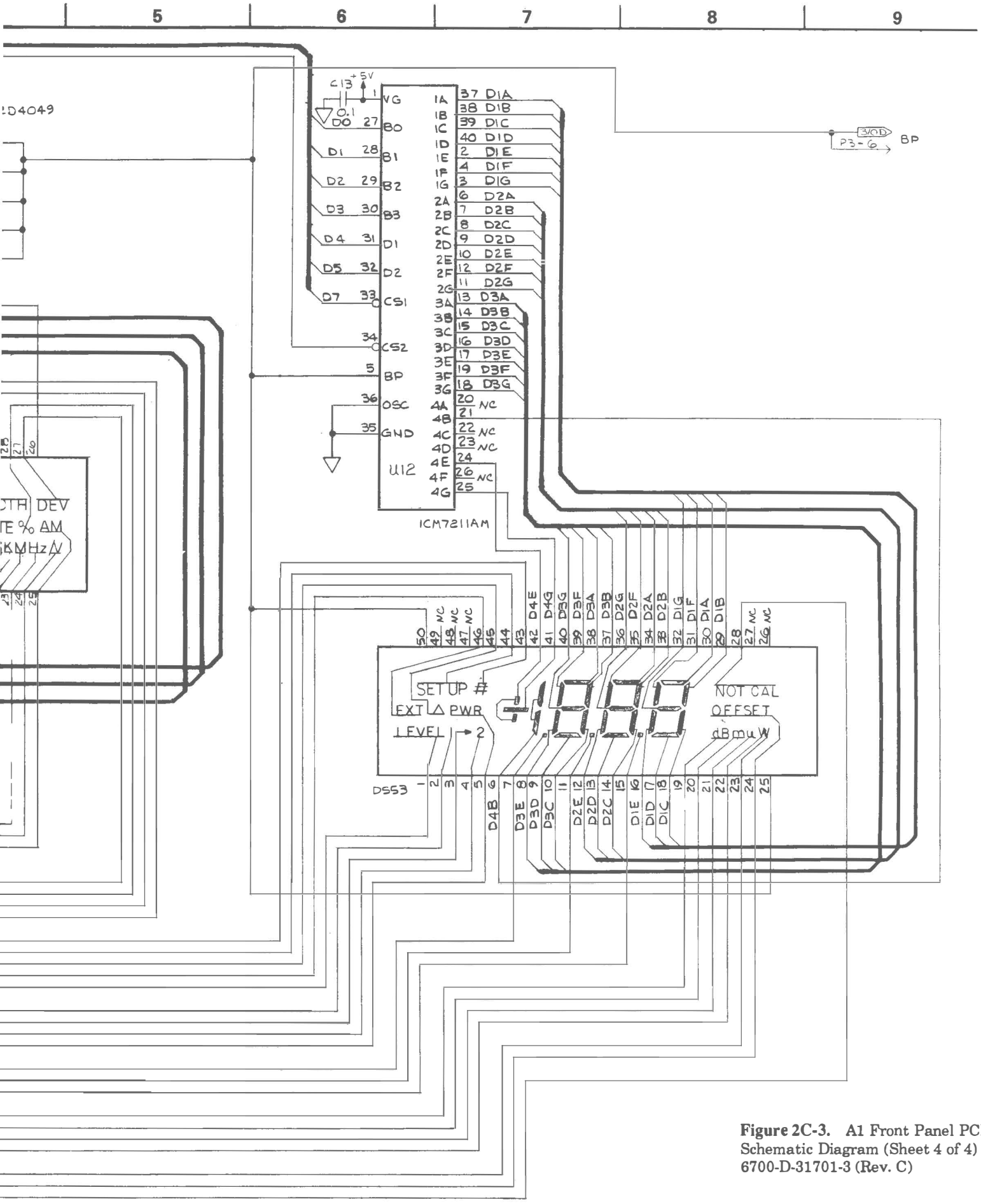
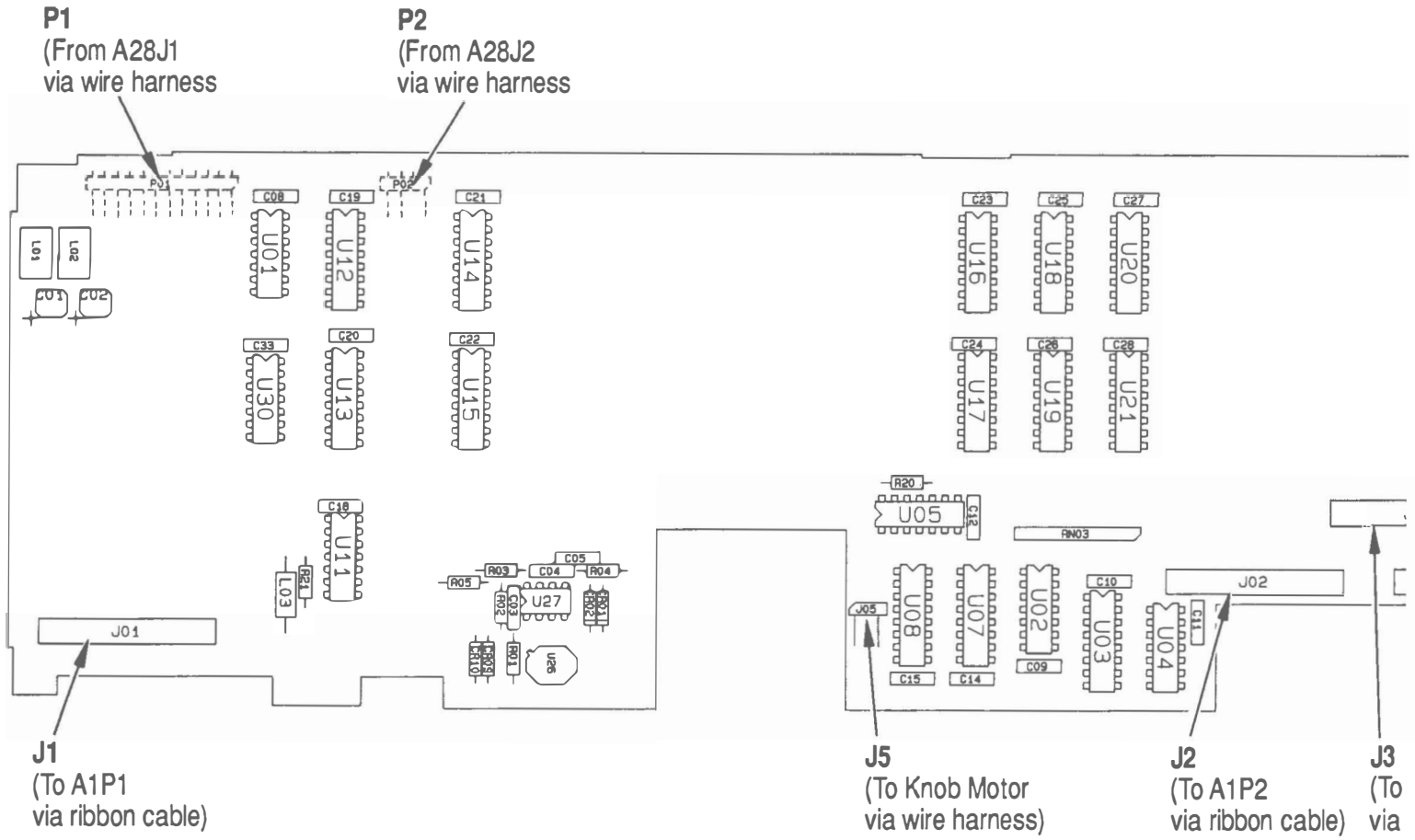


Figure 2C-3. A1 Front Panel PCB Schematic Diagram (Sheet 4 of 4) 6700-D-31701-3 (Rev. C)



NOTE:
Leading zeros on component number references may be disregarded.

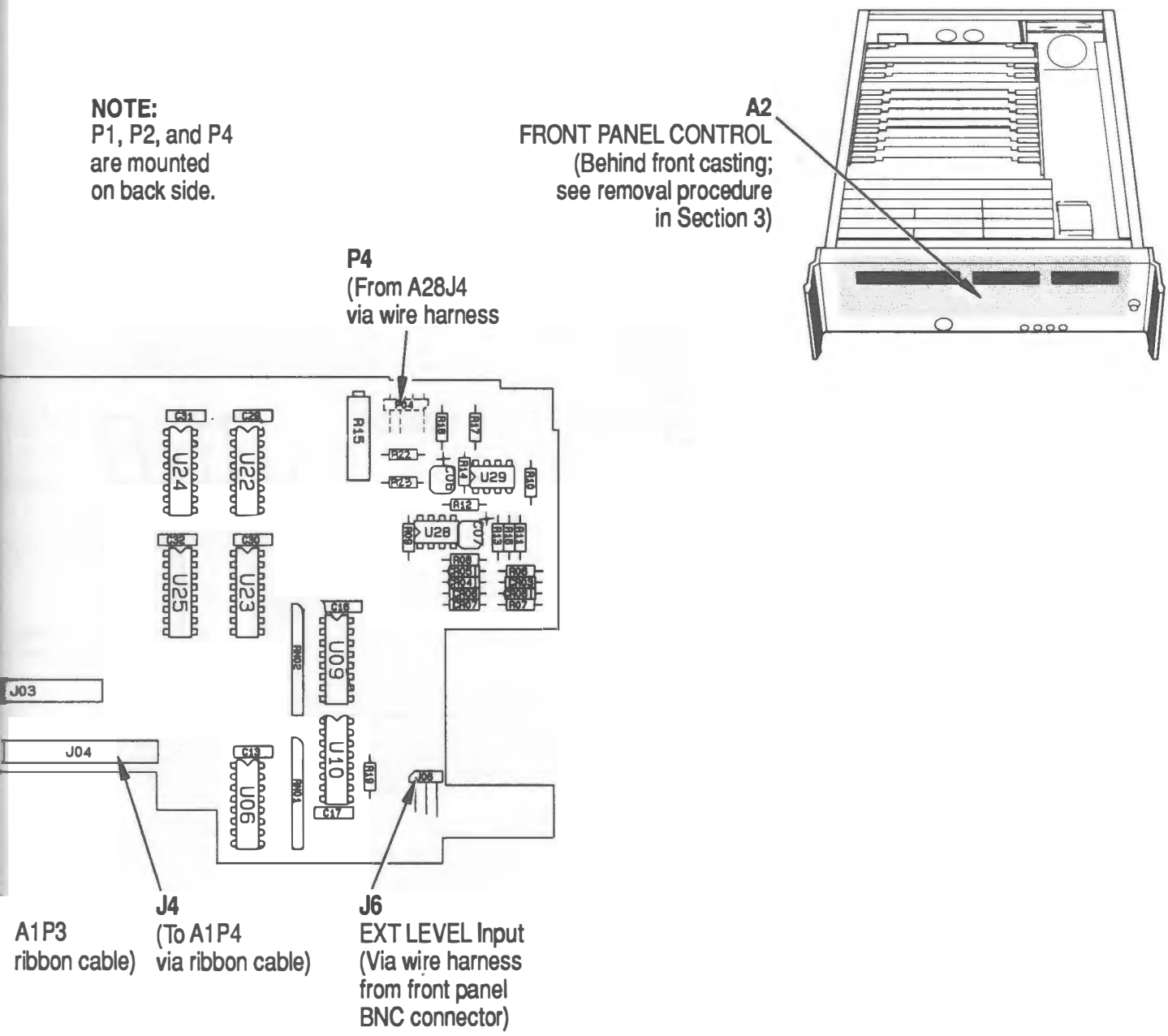
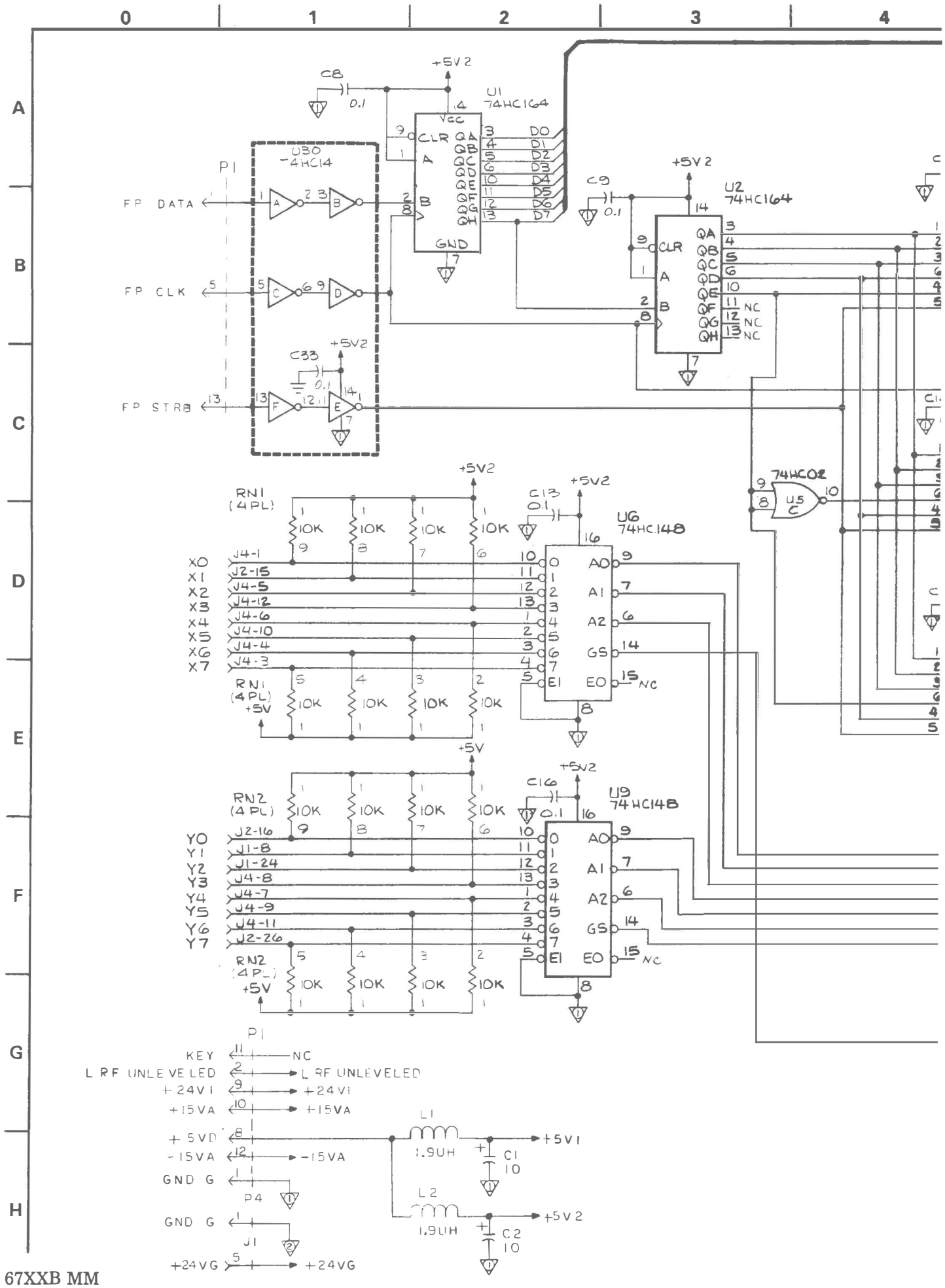


Figure 2C-4. A2 Front Panel Control PCB Parts Locator Diagram
6700-D-31702-3 (Rev. M)


0
1
2
3
4
A
B
C
D
E
F
G
H
+5V2
C8
0.1
U1
74HC164
Vcc
CLR
QA
QB
QC
QD
QE
QF
QG
QH
GND
DO
D1
D2
D3
D4
D5
D6
D7
U30
74HC14
P1
FP DATA
FP CLK
FP STRB
C33
C9
U2
74HC164
NC
74HC02
U5
RN1
(4PL)
10K
+5V
C13
U6
74HC148
AO
A1
A2
GS
EO
EI
X0
X1
X2
X3
X4
X5
X6
X7
J4-1
J2-15
J4-5
J4-12
J4-6
J4-10
J4-4
J4-3
RN2
(4PL)
C16
U9
74HC148
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
J2-16
J1-8
J1-24
J4-8
J4-7
J4-9
J4-11
J2-26
KEY
L RF UNLEVELED
+24V1
+15VA
+5VD
-15VA
GND G
P4
J1
+24VG
L1
1.9UH
C1
10
+5V1
L2
1.9UH
C2
10

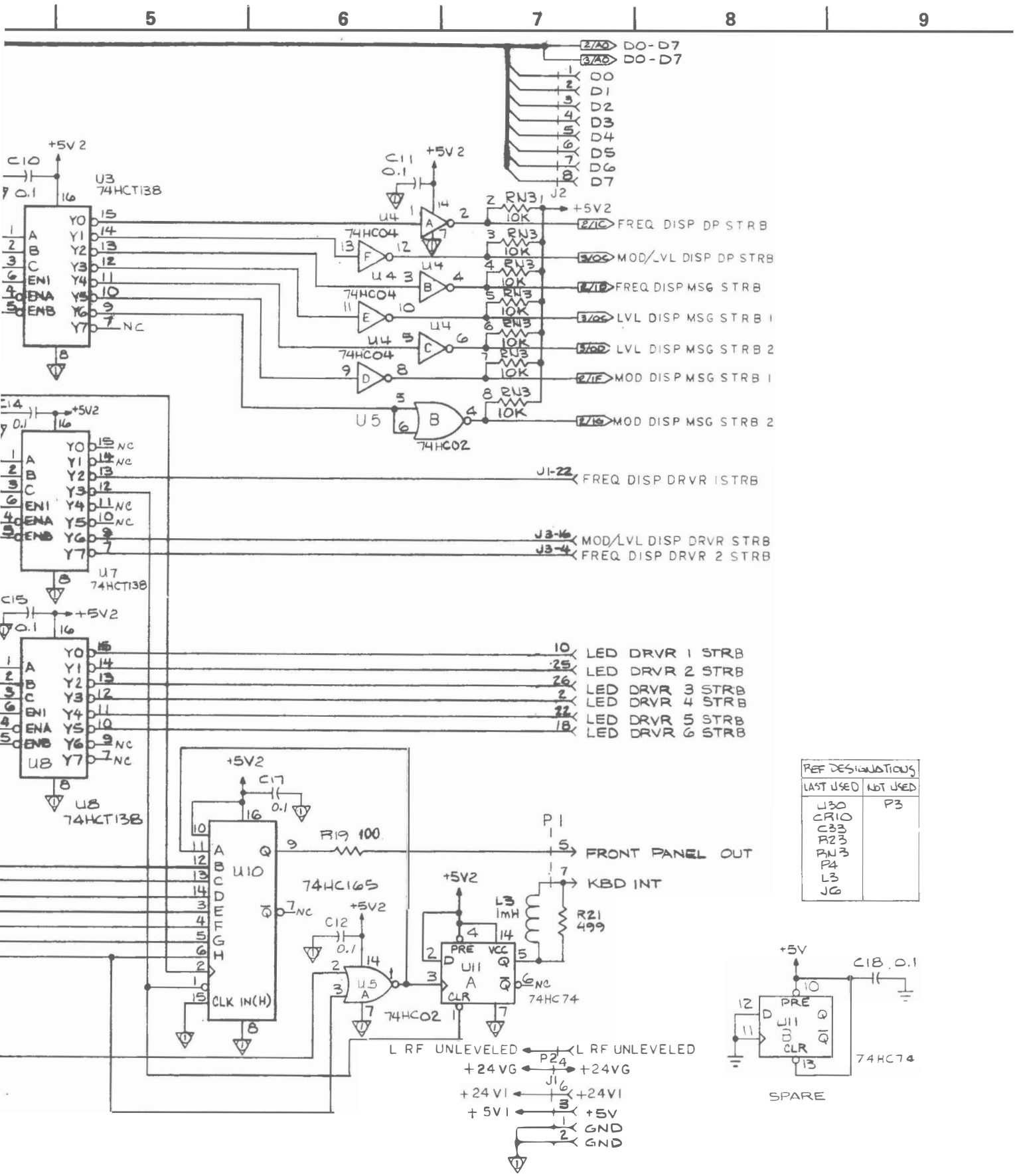
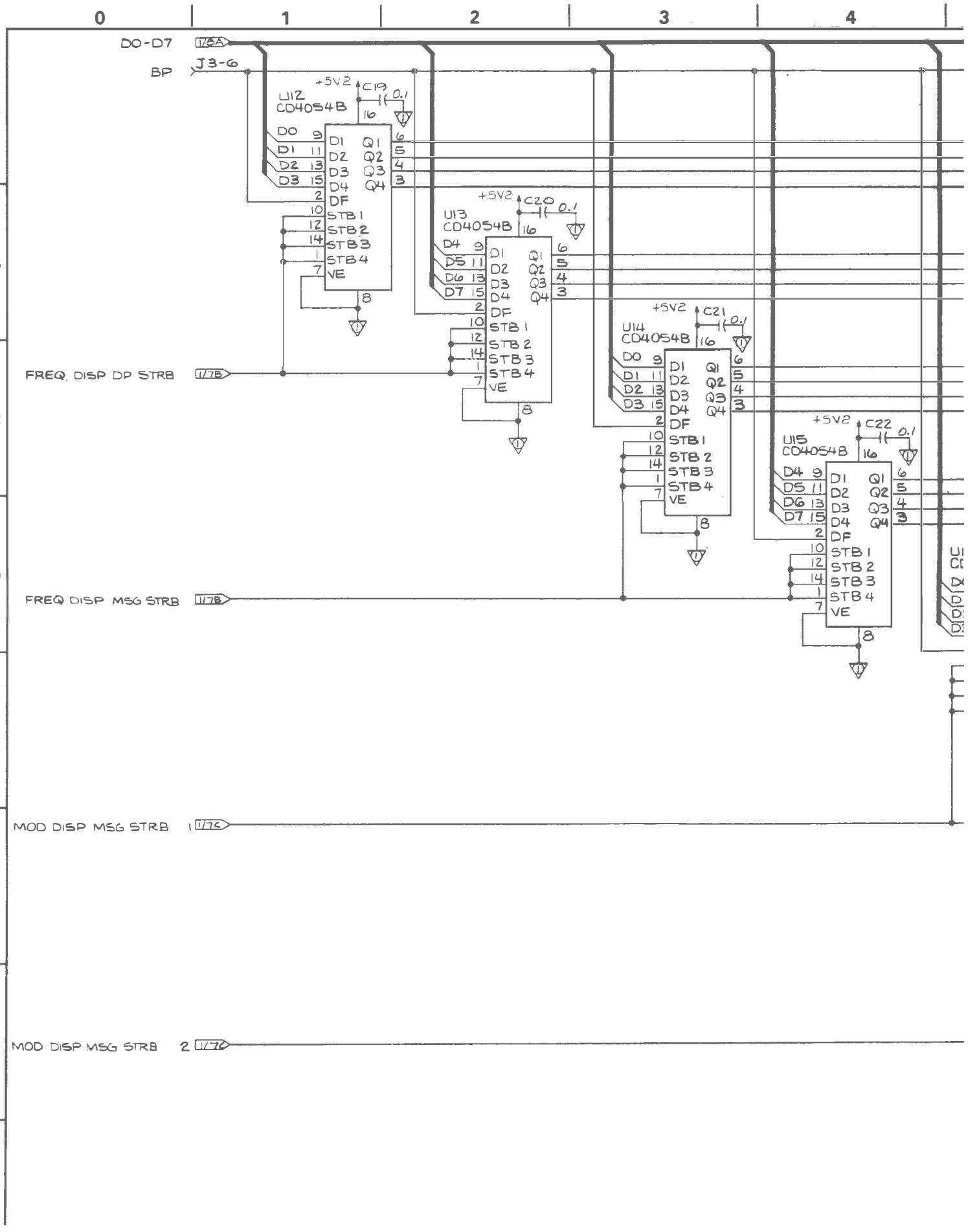


Figure 2C-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 1 of 3) 6700-D-31702-3 (Rev. H)


0
1
2
3
4
A
B
C
D
E
F
G
H
D0-D7
1/5A
BP
J3-6
U12
CD4054B
U13
CD4054B
U14
CD4054B
U15
CD4054B
+5V2
C19
C20
C21
C22
0.1
D0
D1
D2
D3
D4
D5
D6
D7
DF
STB1
STB2
STB3
STB4
VE
Q1
Q2
Q3
Q4
FREQ. DISP DP STRB
1/7B
FREQ DISP MSG STRB
1/7B
MOD DISP MSG STRB 1
1/7C
MOD DISP MSG STRB 2
1/7C

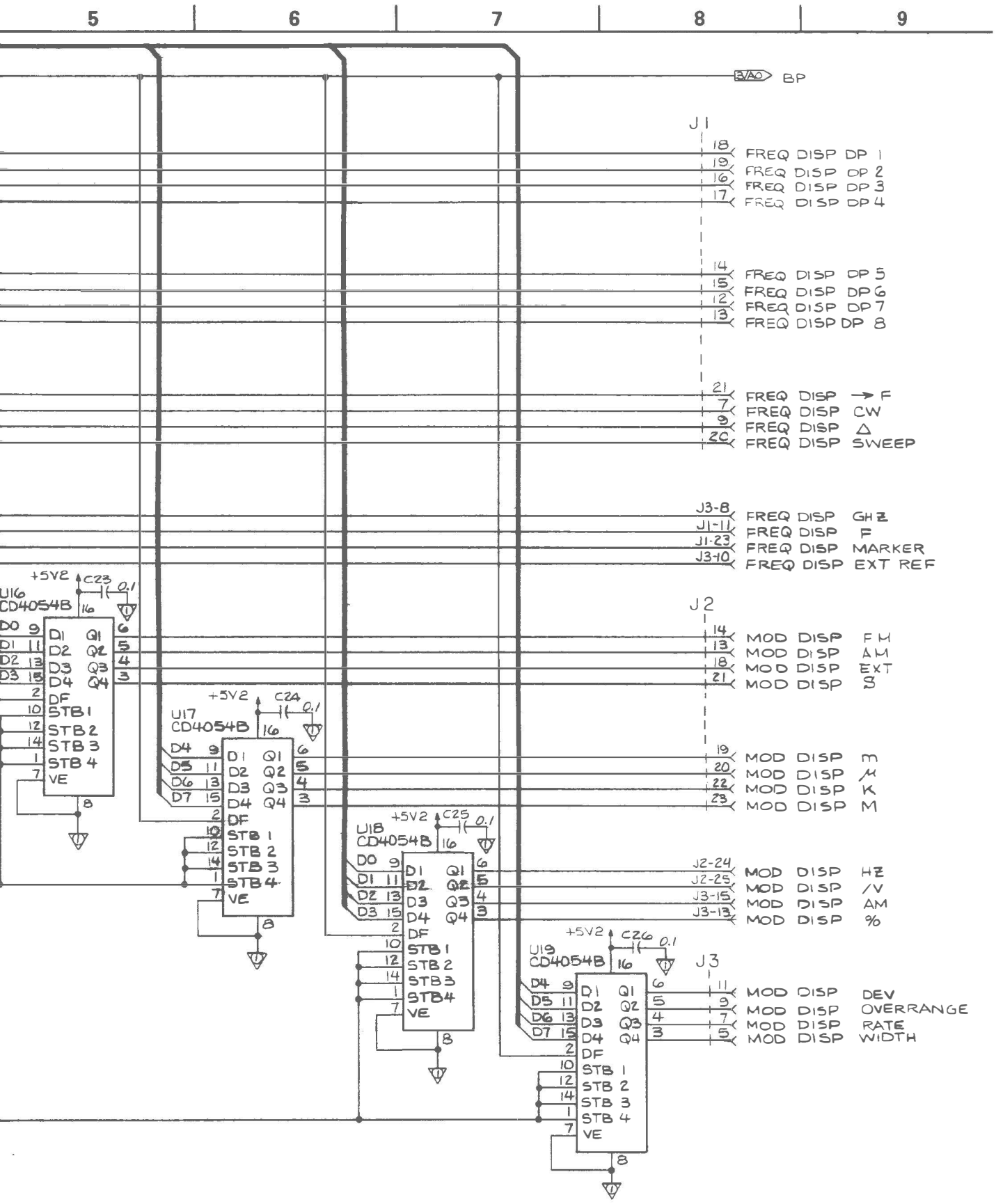
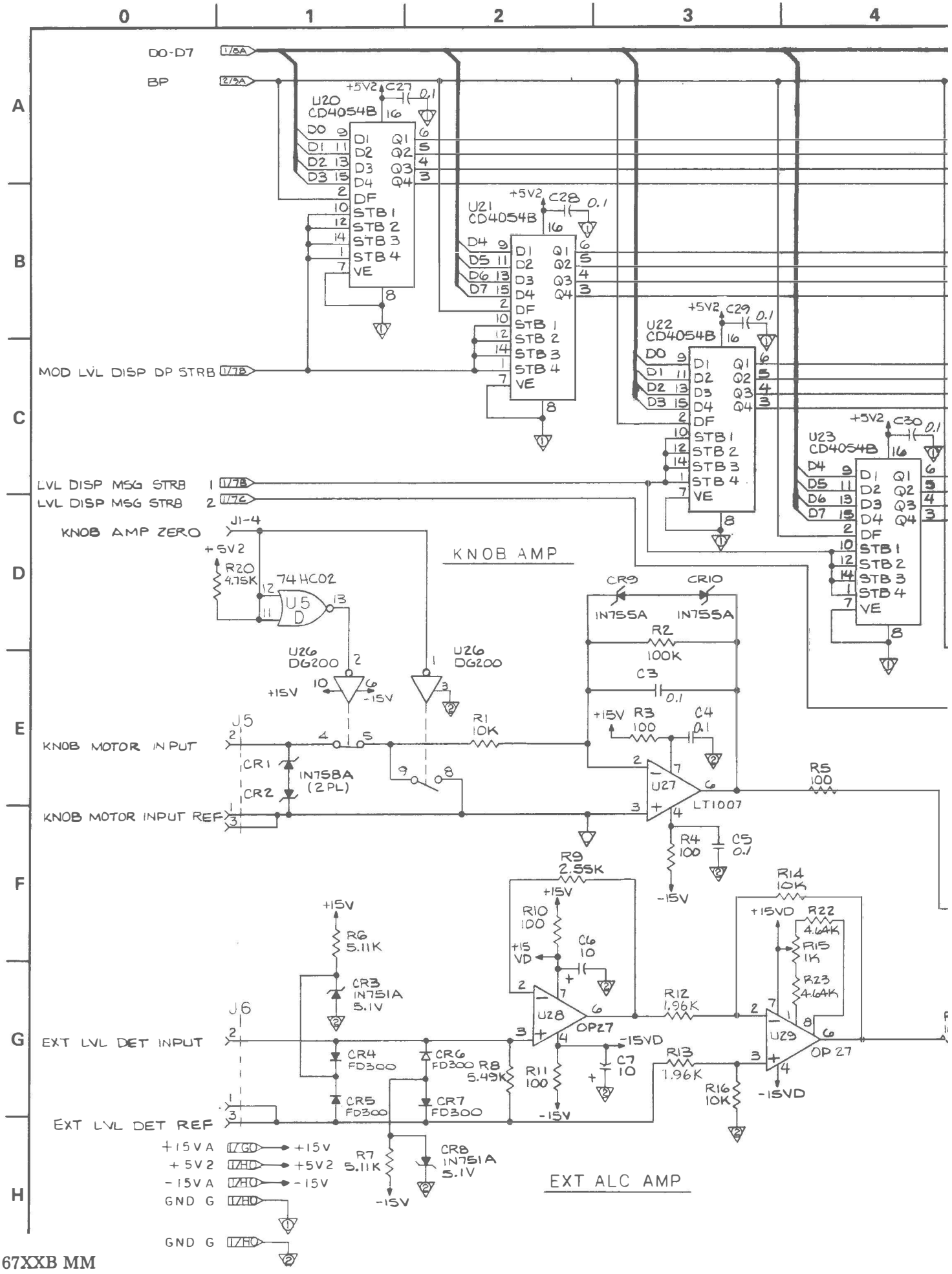


Figure 2C-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 2 of 3) 6700-D-31702-3 (Rev. H)


0
1
2
3
4
A
B
C
D
E
F
G
H
D0-D7
BP
MOD LVL DISP DP STRB
LVL DISP MSG STRB 1
LVL DISP MSG STRB 2
KNOB AMP ZERO
KNOB MOTOR INPUT
KNOB MOTOR INPUT REF
EXT LVL DET INPUT
EXT LVL DET REF
+15VA
+5V2
-15VA
GND G
GND G
U20 CD4054B
U21 CD4054B
U22 CD4054B
U23 CD4054B
DO D1 D2 D3 D4 DF STB 1 STB 2 STB 3 STB 4 VE
Q1 Q2 Q3 Q4
+5V2
C27 0.1
C28 0.1
C29 0.1
C30 0.1
J1-4
R20 4.75K
74 HC02
U5 D
U26 DG200
+15V
-15V
KNOB AMP
CR9 IN755A
CR10 IN755A
R2 100K
C3 0.1
R3 100
C4 0.1
R1 10K
J5
CR1 IN758A (2 PL)
CR2
U27 LT1007
R5 100
R4 100
C5 0.1
R9 2.55K
R10 100
+15 VD
C6 10
R14 10K
+15VD
R22 4.64K
R15 1K
R23 4.64K
R6 5.11K
CR3 IN751A 5.1V
J6
U28 OP27
R12 1.96K
U29 OP 27
-15VD
CR4 FD300
CR5 FD300
CR6 FD300
CR7 FD300
R8 5.49K
R11 100
C7 10
R13 1.96K
R16 10K
R7 5.11K
CR8 IN751A 5.1V
EXT ALC AMP

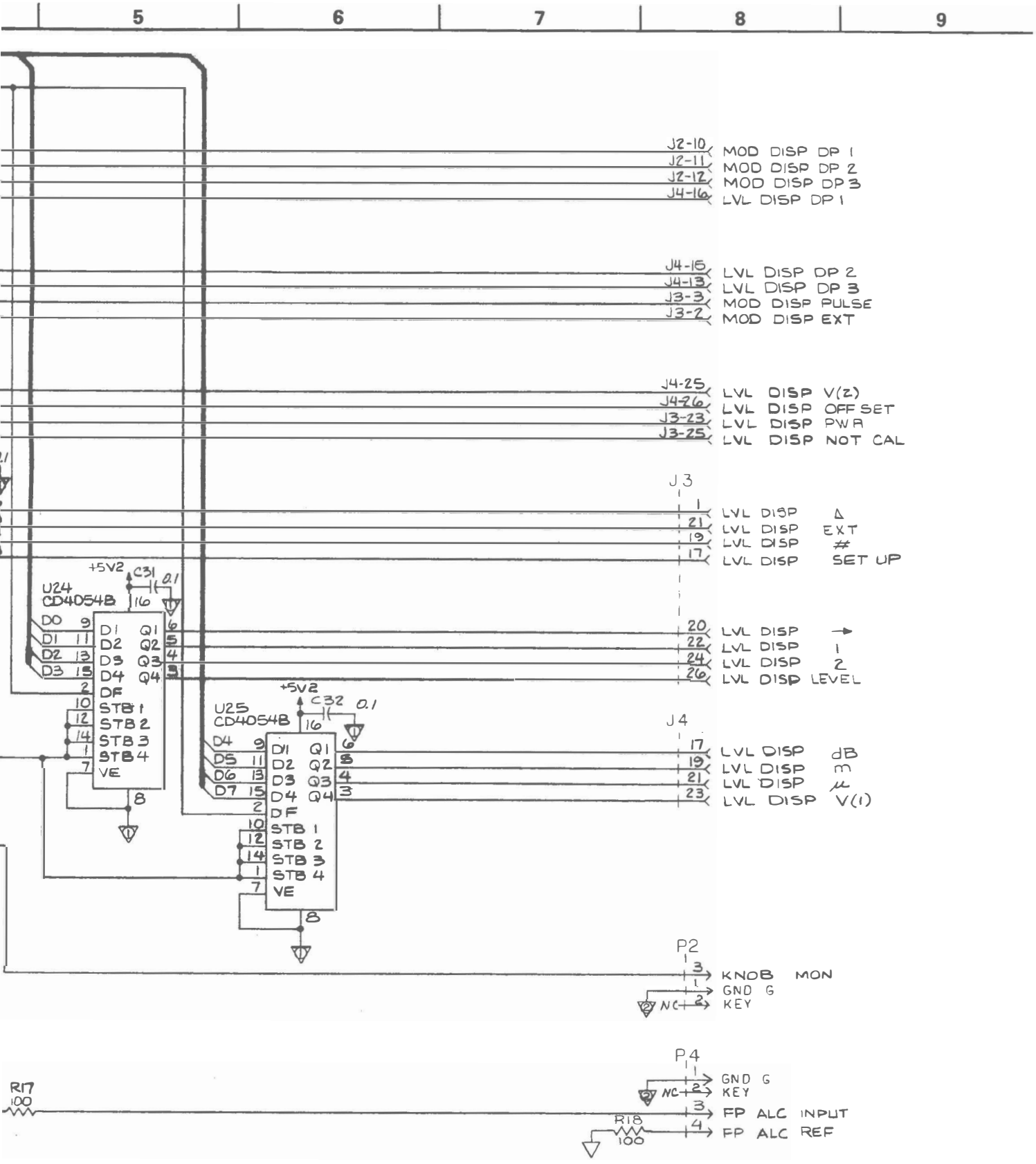


Figure 2C-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 3 of 3) 6700-D-31702-3 (Rev. H)

2D–INPUTS/OUTPUTS A27 AND P/O A29 PCBs

2D-1 INPUTS/OUTPUTS ASSEMBLIES: A27 AND A29 PCBs

This section contains service information for the Input/Output interface circuits located on the A29 Rear Panel Interface and A27 Auxiliary I/O PCBs. Refer to Table 2D-1 below. Refer also to the specific troubleshooting information for these PCBs that is located in the beginning of this section (Section 2–System Description and Troubleshooting).

For information pertaining to the rear panel input/output signal lines not routed through—or processed by—the A27/A29 PCBs, refer to Section 2M–Motherboard/Interconnections. For information pertaining to the front panel input signal lines, refer to Section 2M and to Section 2C–Front Panel.

Table 2D-1. Inputs/Outputs Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2D-2	2D-1
Block Diagram	Fig. 2D-1	2D-3
PCB LEVEL		
A27 Auxiliary I/O PCB		
General Circuit Description	Para. 2D-2.1	2D-1
Detailed Circuit Description	Para. 2D-3	2D-2
Parts Locator Diagram	Fig. 2D-3	2D-6
Schematic (Sheet 1 of 1)	Fig. 2D-4	2D-7
A29 Rear Panel Interface		
General Circuit Description	Para. 2D-2.1	2D-1
Detailed Circuit Description	Para. 2D-4	2D-2
Block Diagram	Fig. 2D-2	2D-5
Parts Locator Diagram	Fig. 2D-5	2D-8
Schematic (Sheet 1 of 5)	Fig. 2D-6	2D-9
Schematic (Sheet 2 of 5)	"	2D-10
Schematic (Sheet 3 of 5)	"	2D-11
Schematic (Sheet 4 of 5)	"	2D-12
Schematic (Sheet 5 of 5)	"	2D-13

2D-2 INPUTS/OUTPUTS ASSEMBLIES, OVERALL DESCRIPTION

Refer to the overall block diagram of the Inputs/Outputs interface circuits shown in Figure 2D-1. As shown in the diagram, the circuitry contained on the A29 and A27 PCBs process the input and output signals that go to the rear panel AUXILIARY I/O and BNC connectors. Generally, these are signals that interface the 67XXB with another instrument, such as a network analyzer. The switching and processing of many of the 67XXB I/O interface circuits—either on the A29 PCB or elsewhere—are under control of the A23 Microprocessor PCB.

a. A27 Auxiliary I/O PCB

The A27 Aux I/O PCB routes most of the I/O interface signals to/from the internal PCB assemblies of the 67XXB to the appropriate rear panel connectors. Additionally, relay A27K1 generates the drive signal that is routed to the rear panel PEN LIFT BNC connector. This signal is used to interface with data plotters.

The rear panel AUXILIARY I/O connector is an integral part of the A27 PCB. The signals contained in this connector are used to interface to a WILTRON 560 series Scalar Network Analyzer. Many of the signals in this connector also parallel those that are routed to associated rear panel BNC connectors by the A27 PCB.

b. A29 Rear Panel Interface PCB

The circuits located on the A29 Rear Panel Interface PCB perform the following functions:

- Generate the HORIZ OUTPUT, V/GHz, and ALC SLOPE signals. Under control of the A23 Microprocessor PCB, the A29 PCB DAC circuits generate these signals using the 0-10V analog ramp and +10V reference signals from the A17 Analog Instruction PCB.
- Provide latching and buffering circuits for various instrument interface signals, which include retrace/ band switch blanking, penlift control, lock output, sequential sync, and markers output signals.
- Generate drive and control signals for the microwave deck components as follows: attenuator control, sampler switch drive, RF output band switch drive, switched filter drive, down converter selection, and modulator drive.

2D-3 A27 AUXILIARY I/O PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the A27 PCB schematic, Figure 2D-4, during the following description.

All of the input/output signals that are routed to/from the rear panel by the A27 PCB are routed to the A27 PCB via the A28 Motherboard. Edge connector P1 connects the A27 PCB to the motherboard. The A27 PCB then routes the I/O signals to the appropriate rear panel BNC connectors and/or to the AUXILIARY I/O connector.

NOTE:

The A27 PCB has no interaction with, or control of, the signal inputs from the *front panel* BNC connectors or the input/output lines that are routed, via the A28 Motherboard and coaxial cables, to the rear panel. Refer to Section 2M–Motherboard/Interconnections for information pertaining to these signal lines.

Connector J1 is a 14-pin DIL connector that connects via a ribbon cable to 11 of the rear panel BNC connectors (see Figure 2D-4). The AUXILIARY I/O connector, J2, is a 25-pin D-type connector. This connector extends through, and mounts to, the rear panel.

Relay K1 provides the switch closure for the rear panel PEN LIFT BNC connector signal. It is controlled by the PEN LIFT RELAY DRIVE signal from the A29 Rear Panel Interface PCB to provide normally open or normally closed operation during sweep retrace. This mode of operation is set by the A23 Microprocessor PCB in response to instructions entered via the front panel keys or by GPIB commands. (Refer to the 67XXB Swept Frequency Synthesizer Operating Manual.)

2D-4 A29 REAR PANEL INTERFACE PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the overall block diagram of the A29 PCB (Figure 2D-2) and to the A29 PCB schematic (Figure 2D-6) during the following description.

2D-4.1 Digital Control Circuits

Decoder chips U6 and U7 decode the PA0–PA2, LPA18 and LPA20 address lines from the A23 Microprocessor PCB. The outputs of these devices are strobe pulses that load data from the microprocessor data bus lines, D0–D7, into the various control latches and DACs throughout the A29 PCB. This data controls the operation of the I/O interface and microwave component drive circuits located on this PCB.

2D-4.2 Microprocessor Interface Circuits

These circuits interface input signals from the rear panel BNC connectors and status inputs from the A15/A25 PCBs and the 10 MHz Reference Oscillator Assembly to the microprocessor data bus. Refer to sheet 1 of Figure 2D-6. Tri-state buffer, U1, connects the following signals to the microprocessor data bus when strobed by the Y6 output of U6:

- L MEM SEQ IN and L SWEEP DWELL IN signals that are input from the associated rear panel BNC connectors (via the A27 PCB),
- L RF UNLVLD from the A15 PCB (via U2B/U2C),
- L XTAL OVEN from the 10 MHz Reference Oscillator Assembly,
- L PS LOCK MON from the A25 PCB.

The A23 Microprocessor PCB reads the state of the U1 outputs associated with these signals approximately every 50 ms. It then initiates appropriate action, as required.

NAND gates U2B and U2C comprise a latch that senses the state of the L RF UNLVLD signal. When the output of U2C goes high, the A23 Microprocessor reads the associated U1 output and determines that an unleveled condition has occurred. It then sends the proper signals to U6 to reset U2B/U2C. (This operation is used during the automatic ALC loop gain calibration that is initiated via the front panel EXT GAIN CAL key.)

When the L MEM SEQ IN signal from the rear panel goes low, the change in state is sensed by the A23 Microprocessor PCB via U1. It then sequences from the current front panel setup to the next setup that is stored in memory.

The L SWEEP DWELL IN signal from the rear panel is sensed in the same manner. When the synthesizer is in the sweep mode and this signal goes low, the A23 Microprocessor PCB causes the sweep to dwell (stop and wait). The duration of the dwell signal is monitored by the A23 microprocessor to sense the length of the sweep dwell. (The L SWEEP DWELL IN signal also goes to the A17 Analog Instruction PCB sweep ramp control circuits.)

2D-4.3 External Instrument Interface Circuits

The Q_0 and Q_1 outputs of data latch U4 are used to generate the RETRACE BLANK and BAND-SWITCH BLANK signals. Operational amplifiers U5A and U5B invert these U4 outputs to provide negative polarity versions of the retrace and bandswitch blanking signals. Integrated circuit switch U36 is controlled by the Q_2 output of U4 to select either the positive or negative versions of both signals. The state of this signal is set by the A23 Microprocessor PCB in response to instructions entered via the front panel keys or by GPIB commands. The outputs of U36 are routed to the rear panel RETRACE BLANK OUTPUT and BAND-SWITCH BLANK OUTPUT BNC connectors via the A27 PCB.

The Q_4 output of U4 drives Q19 to produce the PEN-LIFT RELAY DRIVE signal. The Q_3 and Q_5 outputs of U4 are used as the LOCK OUTPUT and MARKER outputs, respectively. These signals are routed to the rear panel PEN LIFT, LOCK OUTPUT and MARKER OUTPUT BNC connectors via the A27 PCB.

The Q_5, Q_6 and Q_7 outputs of U4 are used in conjunction with operational amplifier U5C to produce the SEQ SYNC signal. During retrace and band switch blanking, the Q_7 output of U4 goes high. This causes the output U5C to go to a TTL high level (≈+5V).

For sweep markers that were selected via the front panel keys as MARKER SELECT, INTENSITY, the marker output signal from U4, Q5 drives the output of U5C to –5V during the positive portion of the marker signal. For sweep markers that were selected as MARKER SELECT, VIDEO (i.e., enhanced markers), the Q6 output of U4 also goes high during those particular marker periods. This drives the output of U5C to –10V during the positive portion of the marker signal. The SEQ SYNC signal is routed to the rear panel SEQ SYNC OUTPUT BNC connector via the A27 PCB.

The Q_0 and Q_1 outputs of data latch U8 are used as the L ALT 1 and L ALT 2 outputs, respectively. These signals are routed to the A27 PCB and distributed to the rear panel AUX I/O connector as the L ALTER-

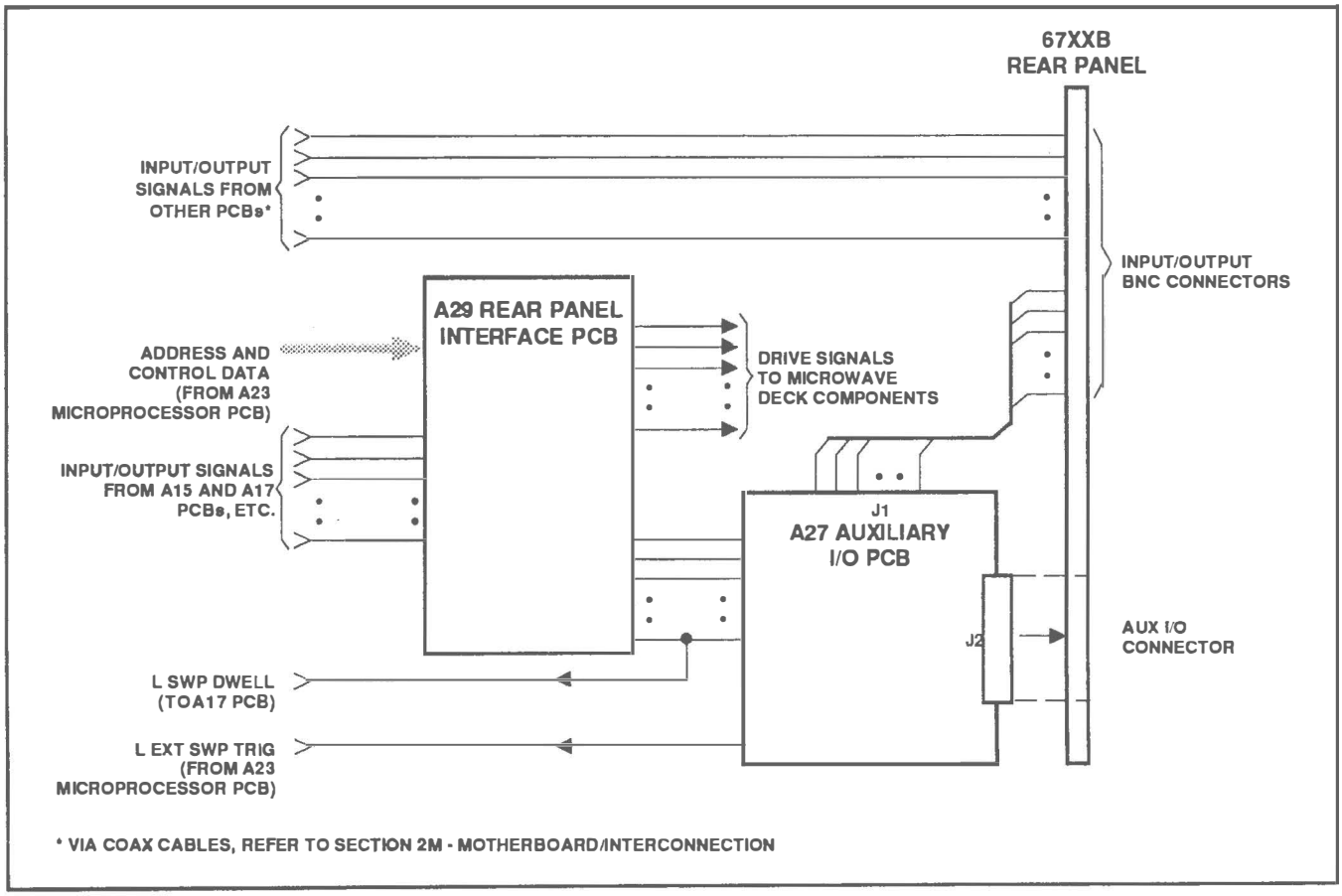


Figure 2D-1. Rear Panel Inputs/Ouputs Block Diagram

NATE 1 and L ALTERNATE EN signals. These signals are used with the WILTRON 560 series network analyzers in the alternate sweep mode of operation.

2D-4.4 10V Horiz Output Signal Circuits

The data for DAC U10 is first latched onto control latch U8 and data latch U9. This data is then strobed into the internal latches of U10. During the CW or step sweep modes of operation, the output of DAC U10 (via U11A) is switched to the input of buffer amplifier U11B by analog switch U12A. In the analog sweep mode, the ramp signal from the A17 Analog Instruction PCB is switched to the input of U11B by analog switch U12D. The output of U11B is the signal that is routed to the rear panel HORIZ OUT BNC connector via the A17 PCB.

2D-4.5 Step Attenuator and Relay Drivers

The step attenuator driver circuits are used only for those units equipped with Options 2A, 2B or 2C. Refer to sheet 3 of Figure 2D-6. Data latch U8 controls the driver circuits for the microwave deck step attenuator and spare relays.

The data that control these circuits are latched from the data bus into U8. The dual open collector line drivers, U20–U23, are used to drive the step attenuator actuator coils. Inverters U17C–U17F invert the signals to one input of each of the dual drivers. This configuration provides opposite drive signals to the *ATTN* and *THRU* coils of each attenuator section. The output transistor of the dual drivers are protected by the diodes on each output.

Optional relay drivers U19 and U35 operate in the same manner as described above. The outputs of U19/U35 drive current driver transistors Q1, Q2, Q13 and Q14, which drive the (optional function) relays. The driver transistors are protected by the diodes on each output.

2D-4.6 PIN Switch Drivers

Refer to sheet 4 of Figure 2D-6. Data latches U24 and U31 control the PIN switch drivers for the 4-pole main RF output multiplexing switch, the 4-pole sampler multiplexing switch, and the switched filter, all of which are mounted on the microwave deck.

Each of the drivers is identical except for the resistors determining the output current to the PIN switch; therefore, only one driver circuit is described. Refer to the PIN drive circuit for the 2–8 GHz pole of the main RF output multiplex switch that is comprised of analog switch U26A and driver transistors Q6 and U30B.

When the Q_0 output of U31 is high, the contacts of U26A are open and the switch driver is in the off mode. In this condition, U30B is saturated. The current through R52 determines the current to the 2 to 8 GHz pole of the main RF output multiplexing switch and turns it off. Transistor Q6 is turned off.

When the Q_0 output of U31 goes low, the contacts of U26A close. Transistor Q6 is turned on and supplies current through R56 to the PIN switch, turning it on. Transistor U30B is biased off.

2D-4.7 ALC Loop I/O Interface Circuits

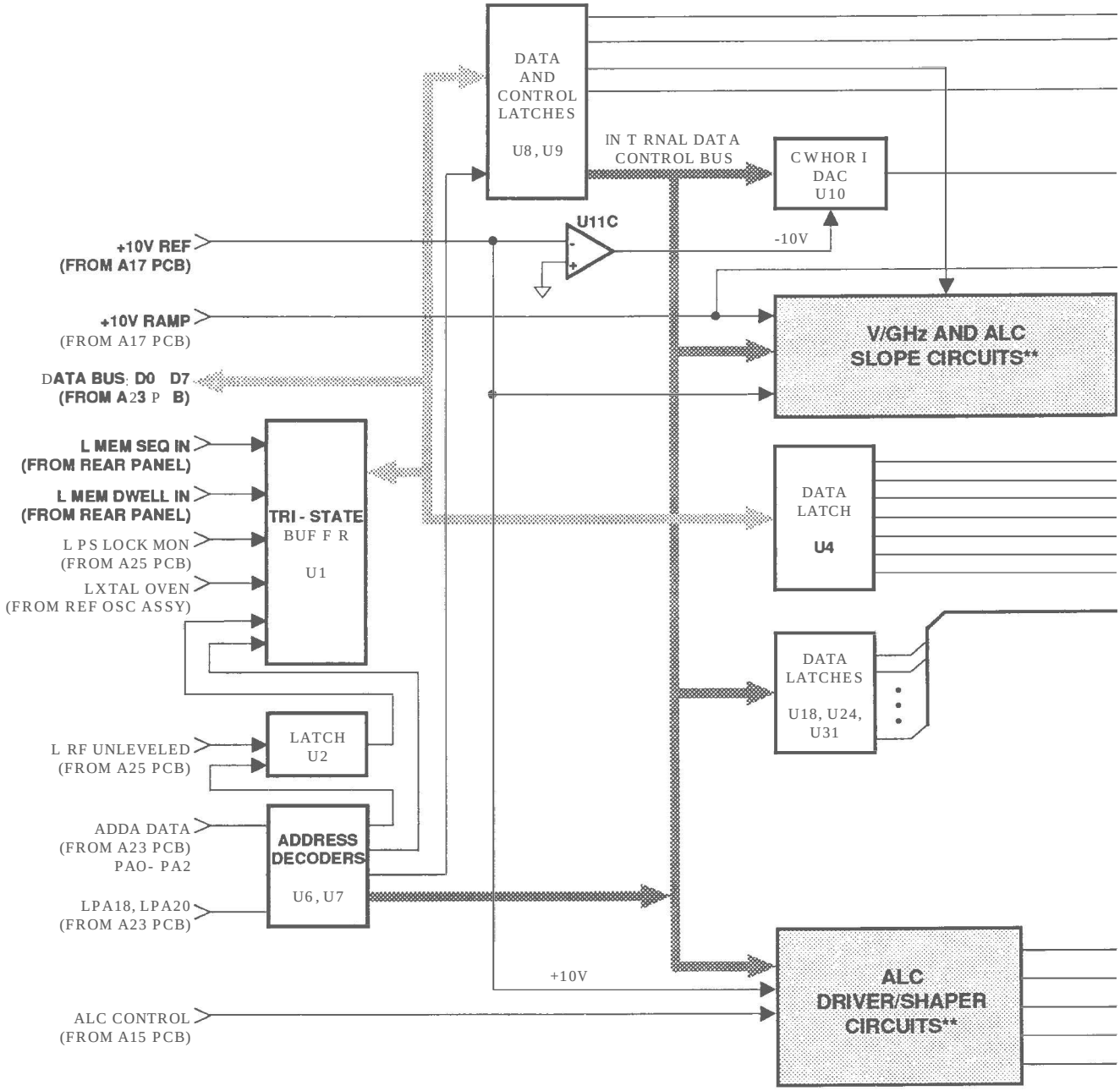
The ALC Loop circuits located on the A29 PCB are described in Section 2K–ALC / Pulse Modulation. These circuits are shown as shaded areas in Figure 2D-2. The set of schematic diagrams contained in Figure 2D-6 includes these circuits (this is done in order to maintain the continuity of the A29 PCB service information presented in this manual). Note that the ALC loop circuitry is electrically separate from that of the other A29 PCB I/O interface and microwave drive circuitry. Each of these circuit groups has separate power supply and ground references.

2D-5 INPUTS/OUTPUTS ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the input/output assemblies and probable causes of the failures.

2D-6 INPUTS/OUTPUTS ASSEMBLIES, SERVICE SHEETS

Table 2D-1, on the first page of this section, presents the arrangements of the block diagrams, schematics, and parts locator diagrams for the A27 and A29 PCBs.


DATA AND CONTROL LATCHES
U8, U9
INTERNAL DATA CONTROL BUS
CW HORI DAC U10
U11C
-10V
+10V REF (FROM A17 PCB)
+10V RAMP (FROM A17 PCB)
DATA BUS; D0 D7 (FROM A23 P B)
V/GHz AND ALC SLOPE CIRCUITS**
L MEM SEQ IN (FROM REAR PANEL)
L MEM DWELL IN (FROM REAR PANEL)
LOCK MON (FROM A25 PCB)
LXTAL OVEN (FROM REF OSC ASSY)
TRI-STATE BUFFER U1
DATA LATCH U4
DATA LATCHES U18, U24, U31
LATCH U2
L RF UNLEVELED (FROM A25 PCB)
ADDA DATA (FROM A23 PCB) PA0- PA2
LPA18, LPA20 (FROM A23 PCB)
ADDRESS DECODERS U6, U7
+10V
ALC CONTROL (FROM A15 PCB)
ALC DRIVER/SHAPER CIRCUITS**

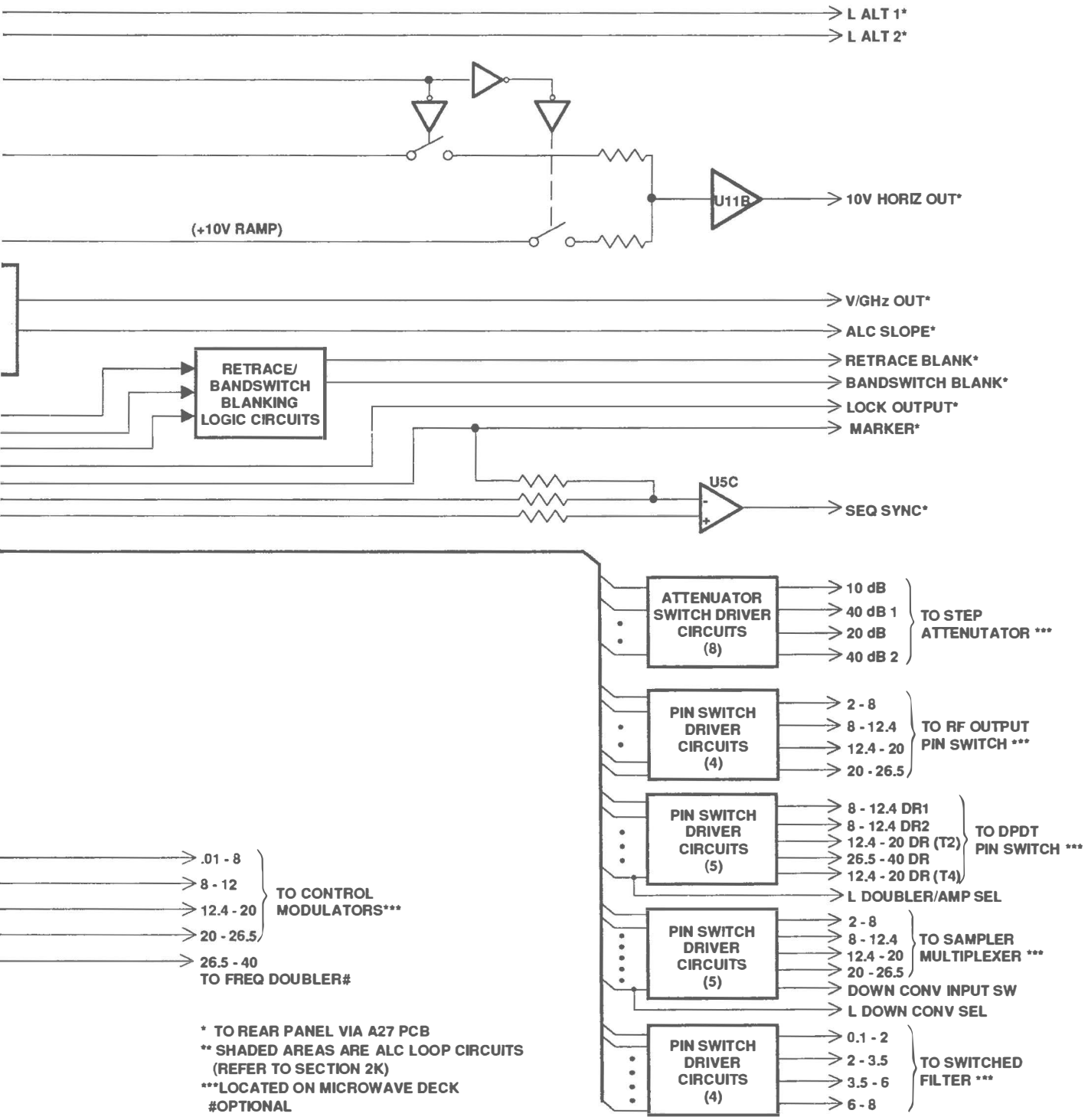
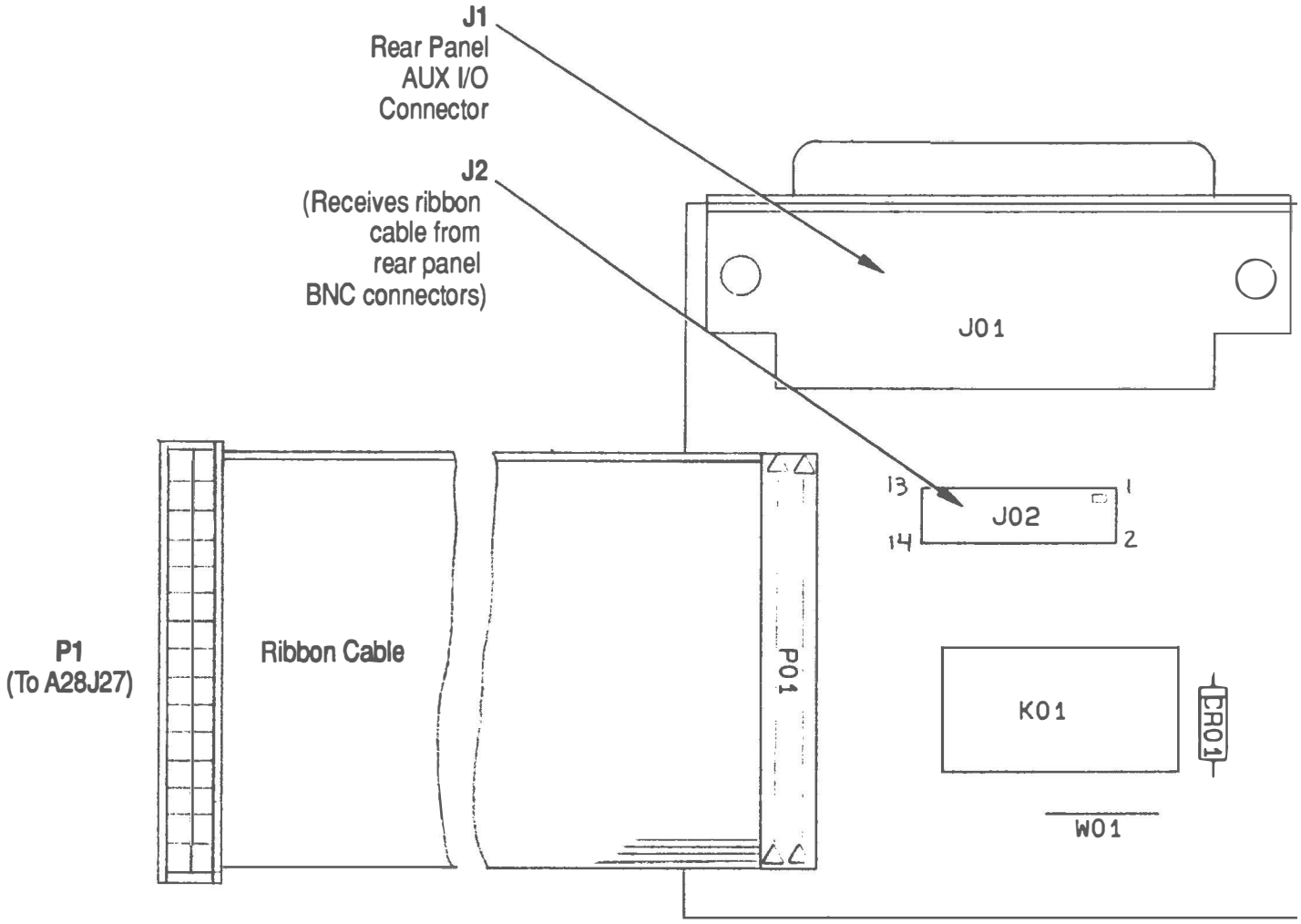


Figure 2D-2. Block Diagram of A29 Rear Panel Interface PCB


J1
Rear Panel
AUX I/O
Connector
J2
(Receives ribbon
cable from
rear panel
BNC connectors)
J01
13
1
J02
14
2
P1
(To A28J27)
Ribbon Cable
P01
K01
CR01
W01

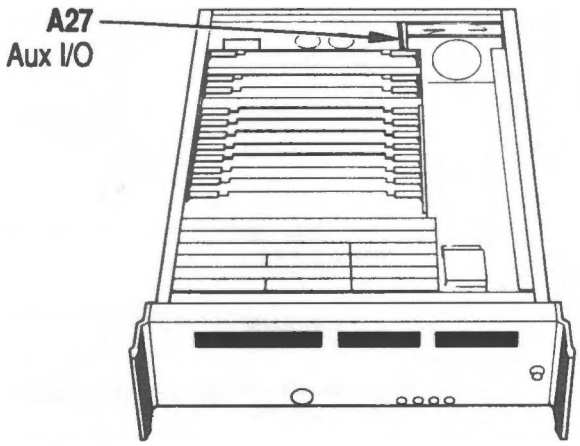
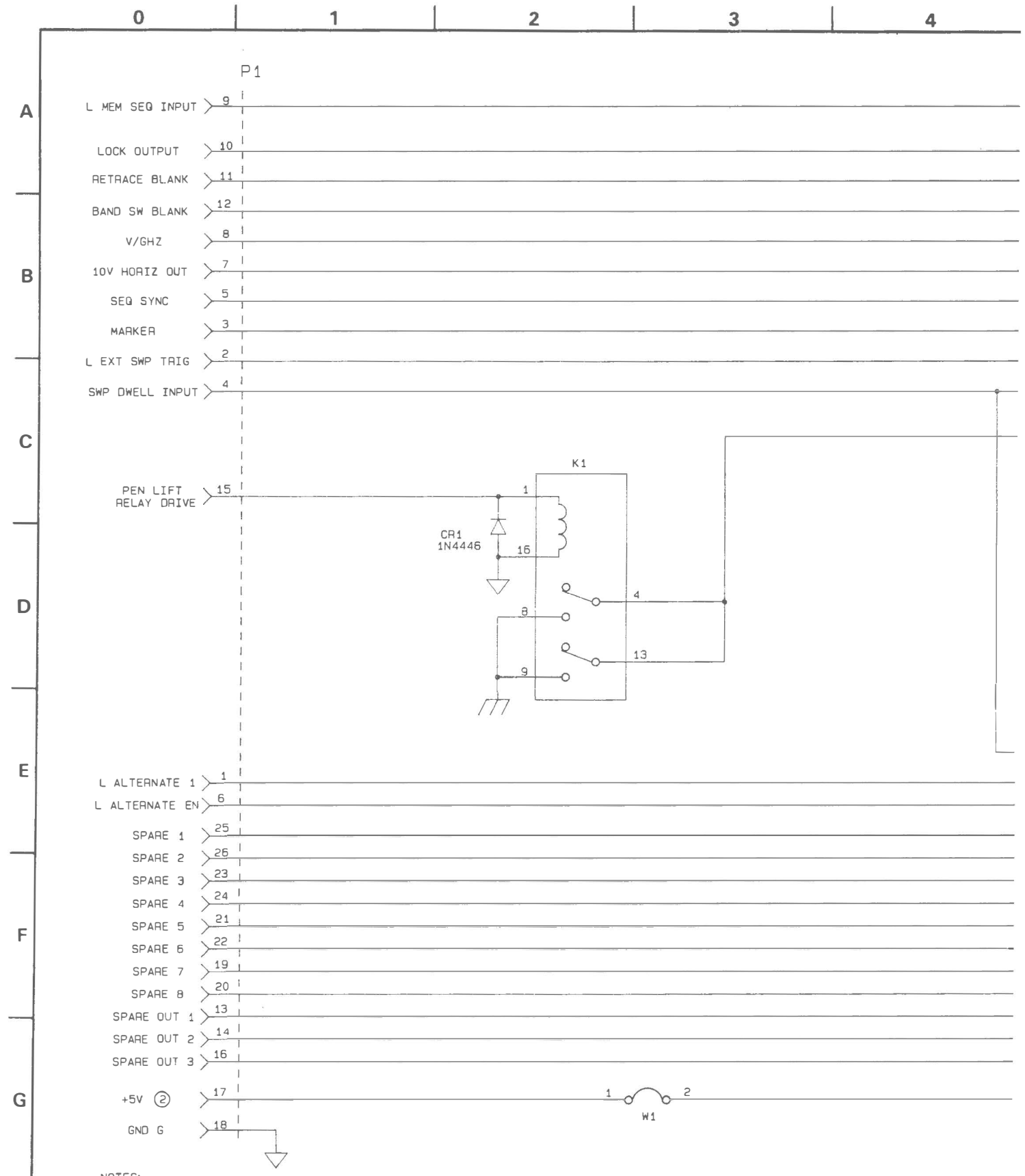


Figure 2D-3. A27 Aux I/O PCB
Parts Locator Diagram
6700-C-31840-3 (Rev. B)



NOTES:

UNLESS OTHERWISE SPECIFIED,

RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN MICROFARADS, AND INDUCTANCES ARE IN MICROHENRIES

DENOTES ANALOG GROUND

DENOTES CHASSIS GROUND

REF DESIGNATIONS	
LAST USED	NOT USED
CR1	
K1	
W1	
J2	
P1	

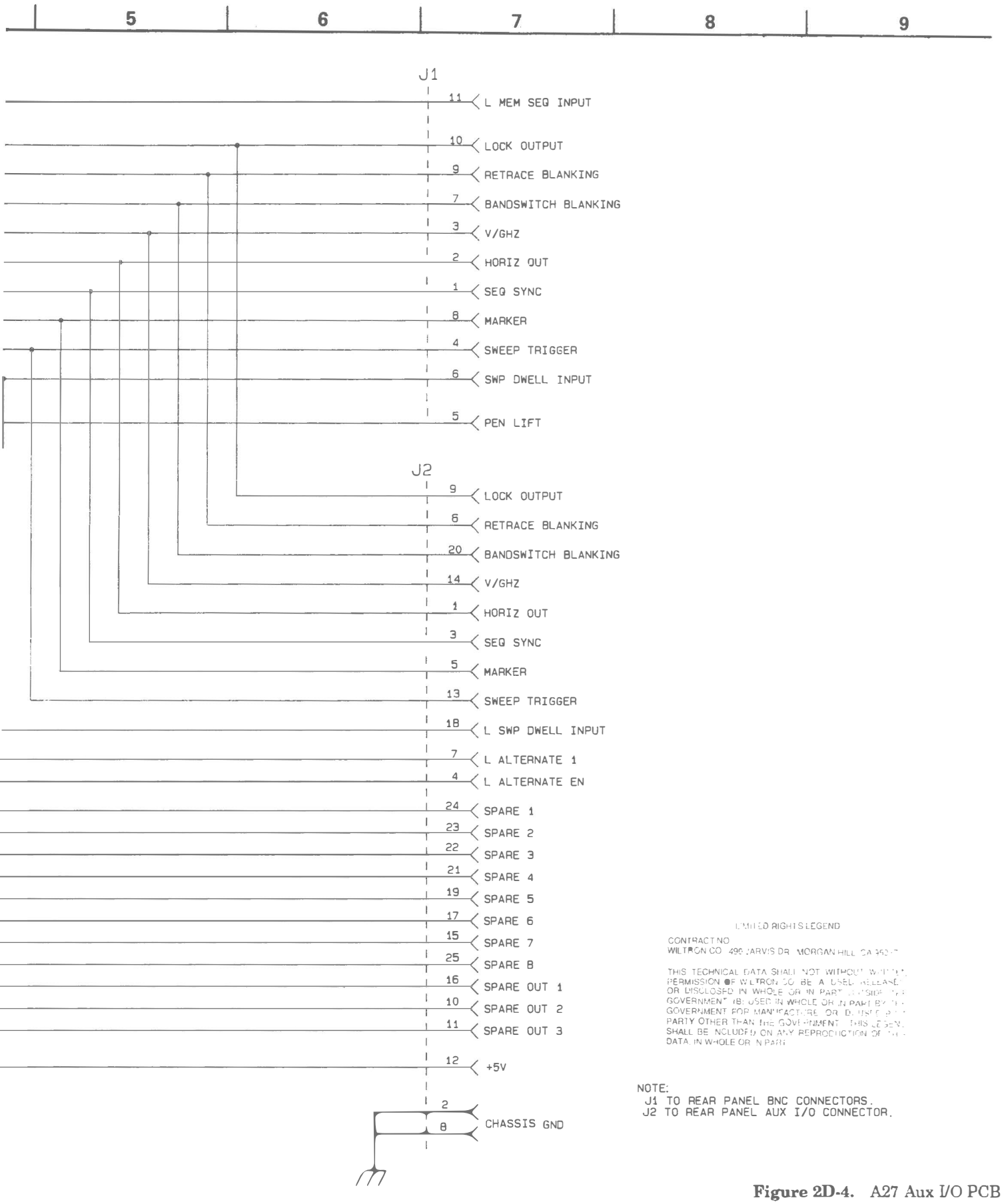
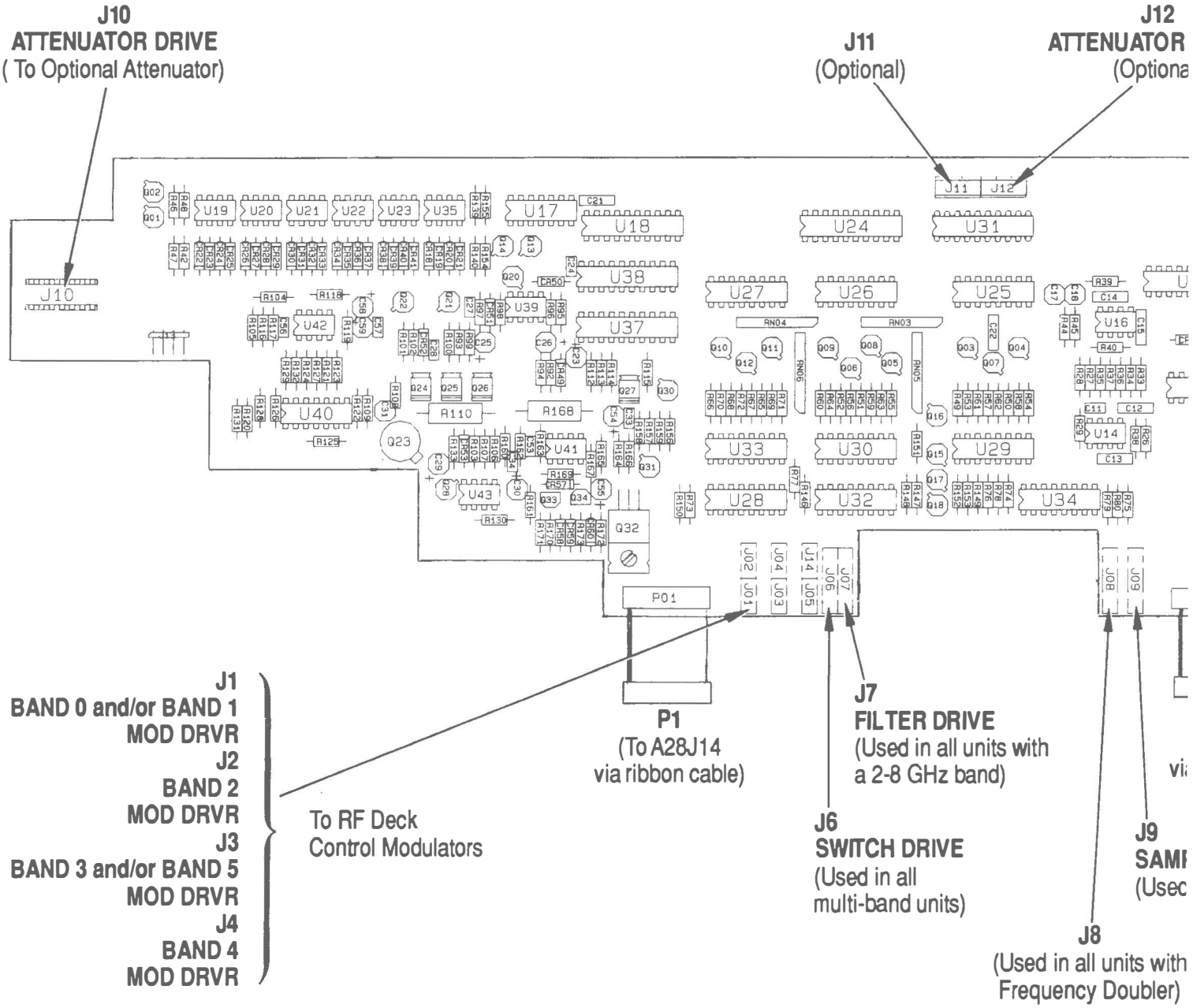
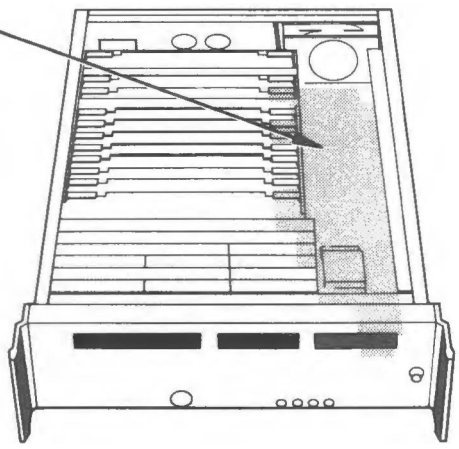


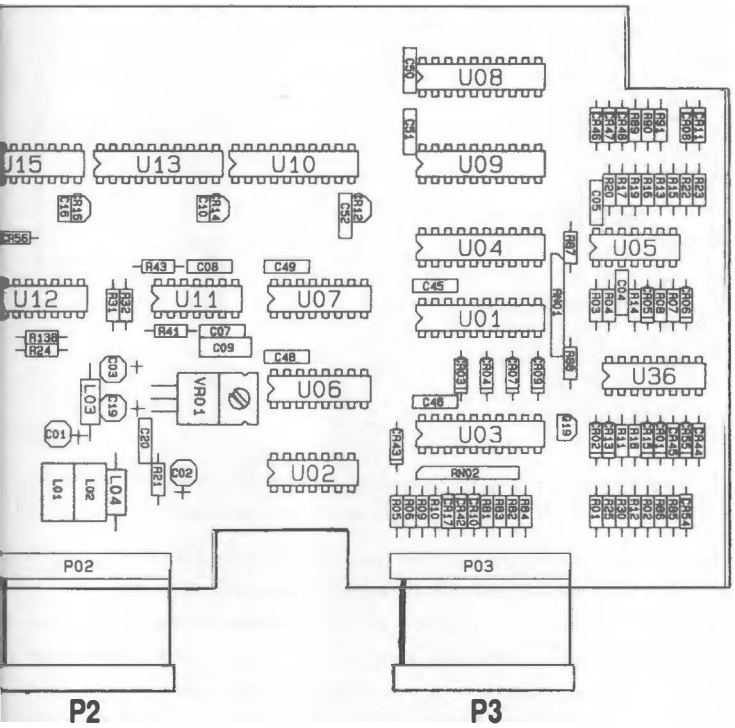
Figure 2D-4. A27 Aux I/O PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31840-3 (Rev. A)

A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)





R DRIVER
al)

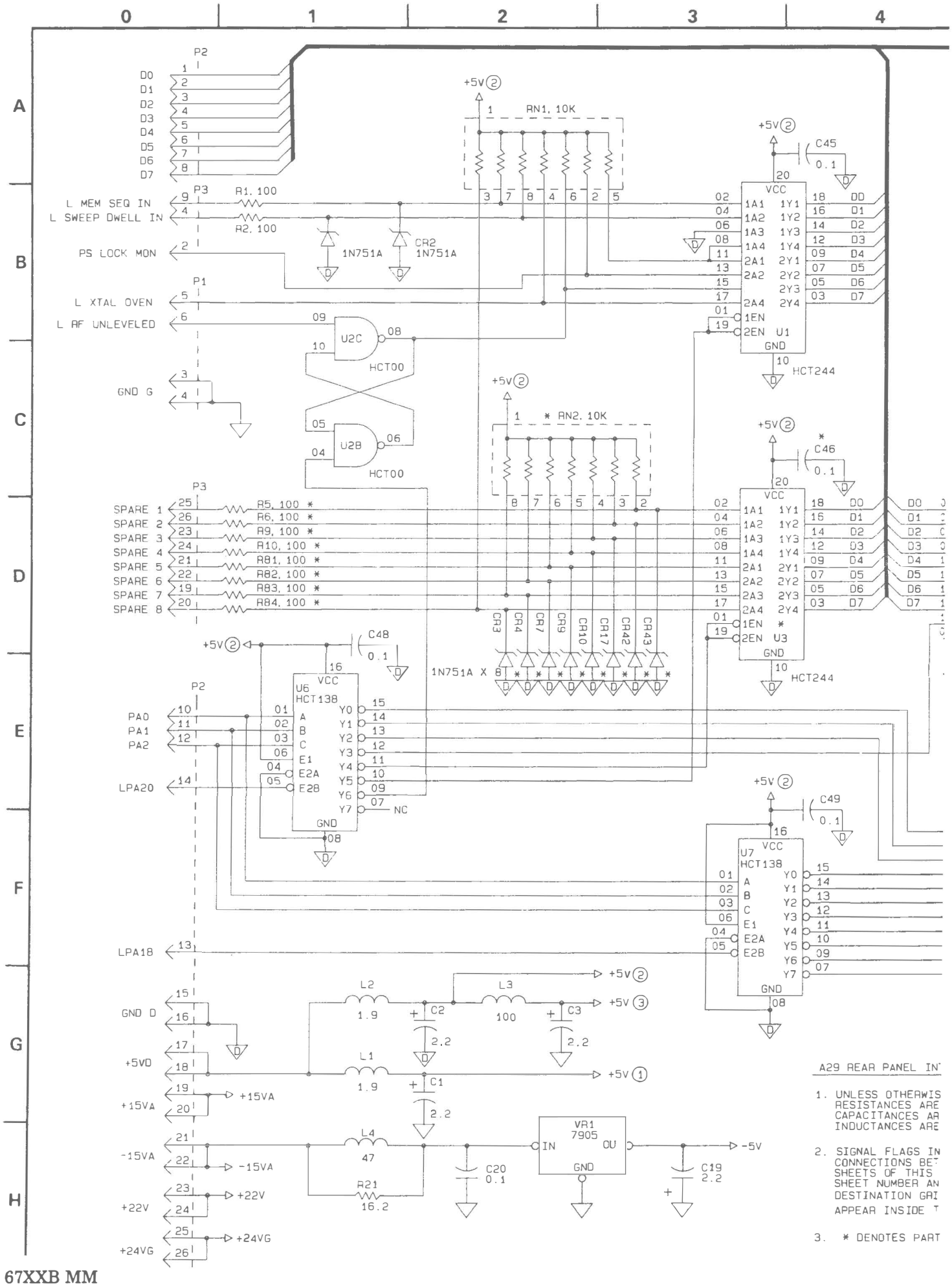


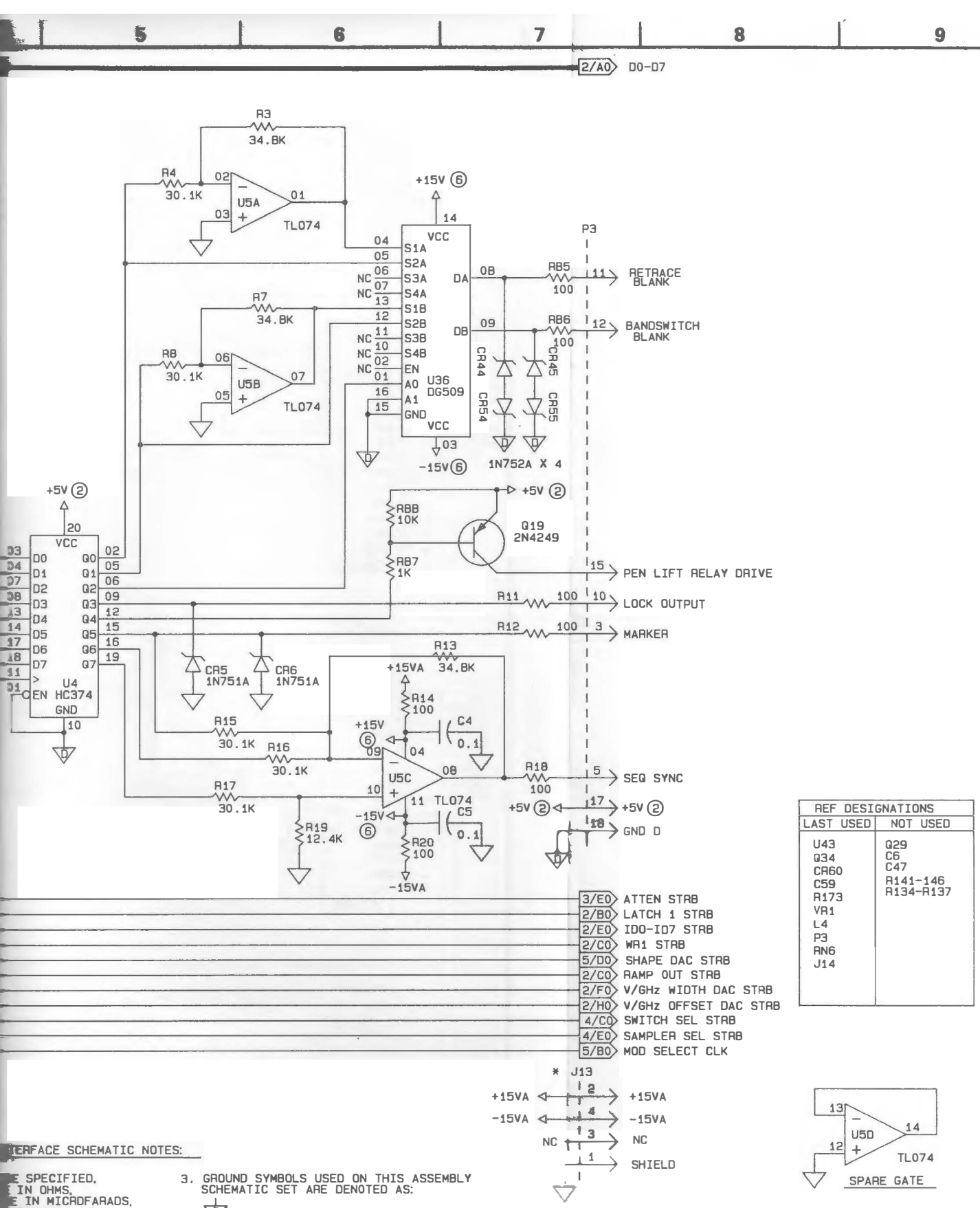
P2
(To A28J19
ia ribbon cable)

P3
(To A28J23
via ribbon cable)

IPLER SWITCH DRIVE
in all multi-band units)

Figure 2D-5. A29 Rear Panel Interface PCB Parts Locator Diagram
6700-D-31829-3 (Rev. K)


0
1
2
3
4
A
B
C
D
E
F
G
H
P2
D0
D1
D2
D3
D4
D5
D6
D7
P3
L MEM SEQ IN
L SWEEP DWELL IN
PS LOCK MON
P1
L XTAL OVEN
L RF UNLEVELED
GND G
R1, 100
R2, 100
1N751A
CR2
1N751A
+5V②
RN1, 10K
C45
0.1
VCC
HCT244
U2C
U2B
HCT00
RN2, 10K
C46
SPARE 1
SPARE 2
SPARE 3
SPARE 4
SPARE 5
SPARE 6
SPARE 7
SPARE 8
R5, 100 *
R6, 100 *
R9, 100 *
R10, 100 *
R81, 100 *
R82, 100 *
R83, 100 *
R84, 100 *
CR3
CR4
CR7
CR9
CR10
CR17
CR42
CR43
1N751A X 8
C48
U6
HCT138
PA0
PA1
PA2
LPA20
C49
U7
LPA18
GND D
+5VD
+15VA
-15VA
+22V
+24VG
L2
L3
L1
L4
1.9
100
47
C1
C2
C3
C20
C19
2.2
0.1
R21
16.2
VR1
7905
IN
OU
GND
-5V
+5V③
+5V①
A29 REAR PANEL IN
1. UNLESS OTHERWIS
RESISTANCES ARE
CAPACITANCES AR
INDUCTANCES ARE
2. SIGNAL FLAGS IN
CONNECTIONS BE
SHEETS OF THIS
SHEET NUMBER AN
DESTINATION GAI
APPEAR INSIDE T
3. * DENOTES PART



TERFACE SCHEMATIC NOTES:

E SPECIFIED,
IN OHMS,
E IN MICROFARADS,
E IN MICROHENRIES.

DICATE MATCHING
MEEN MULTIPLE
SCHEMATIC. THE
O SOURCE DA
IO COORDINATES
THE FLAG: 2/B3

TS NOT INSTALLED

3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

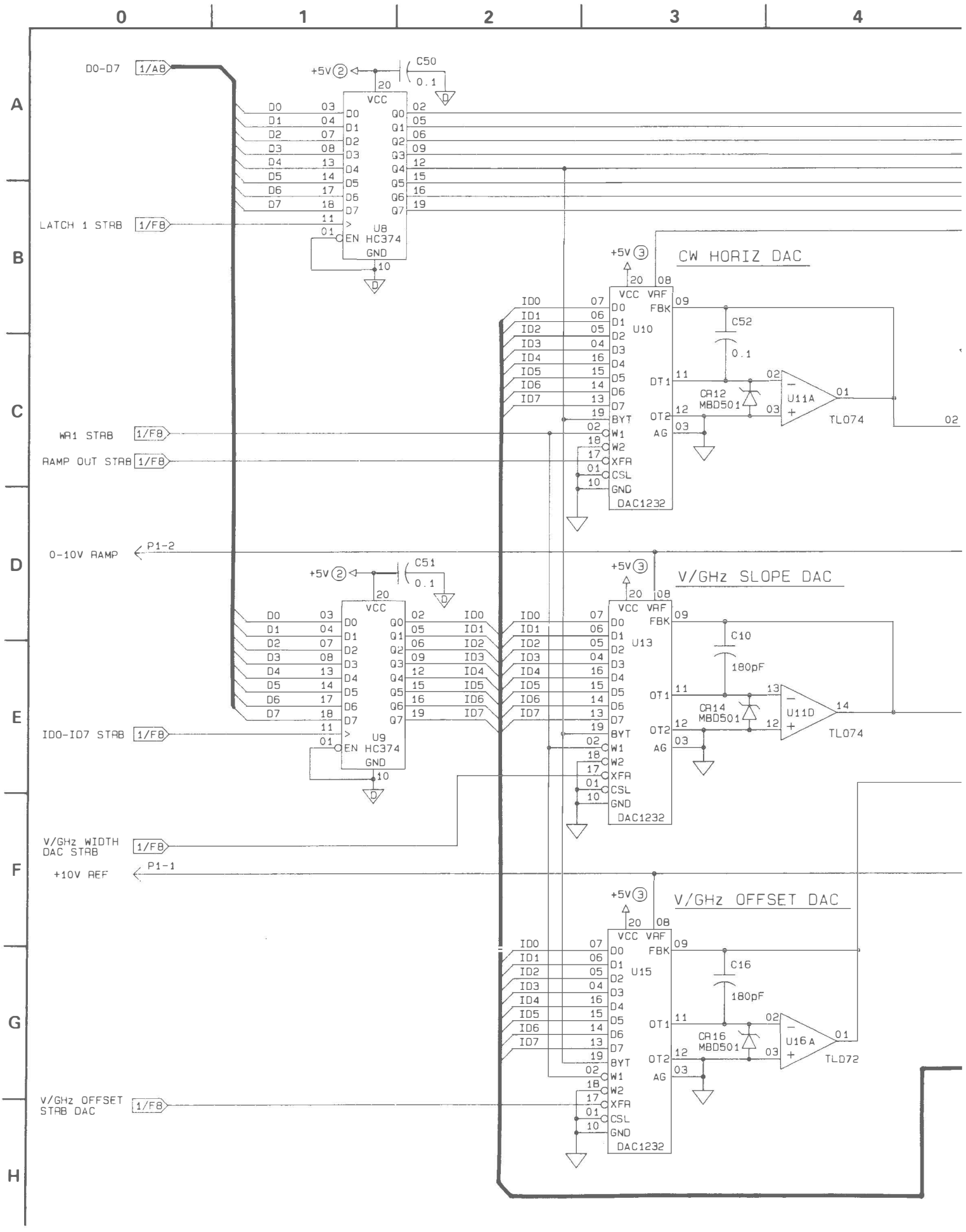
DENOTES DIGITAL GROUND

DENOTES ANALOG GROUND

4. SUBASSEMBLY BORDERS ARE NOTED AS:

5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
CR12, CR14, CR16, U5, U10-U16, U19-U23, U25-U27, U39, U41, U48

Figure 2D-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 1 of 5) 6700-D-31829-3 (Rev. J)


0
1
2
3
4
A
B
C
D
E
F
G
H
D0-D7
1/A8
+5V
C50
0.1
U8
HC374
LATCH 1 STRB
1/F8
CW HORIZ DAC
U10
DAC1232
C52
CR12
MBD501
U11A
TL074
WR1 STRB
RAMP OUT STRB
0-10V RAMP
P1-2
C51
U9
ID0-ID7 STRB
V/GHz SLOPE DAC
U13
C10
180pF
CR14
U11D
V/GHz WIDTH
DAC STRB
+10V REF
P1-1
V/GHz OFFSET DAC
U15
C16
CR16
U16A
TL072
V/GHz OFFSET
STRB DAC

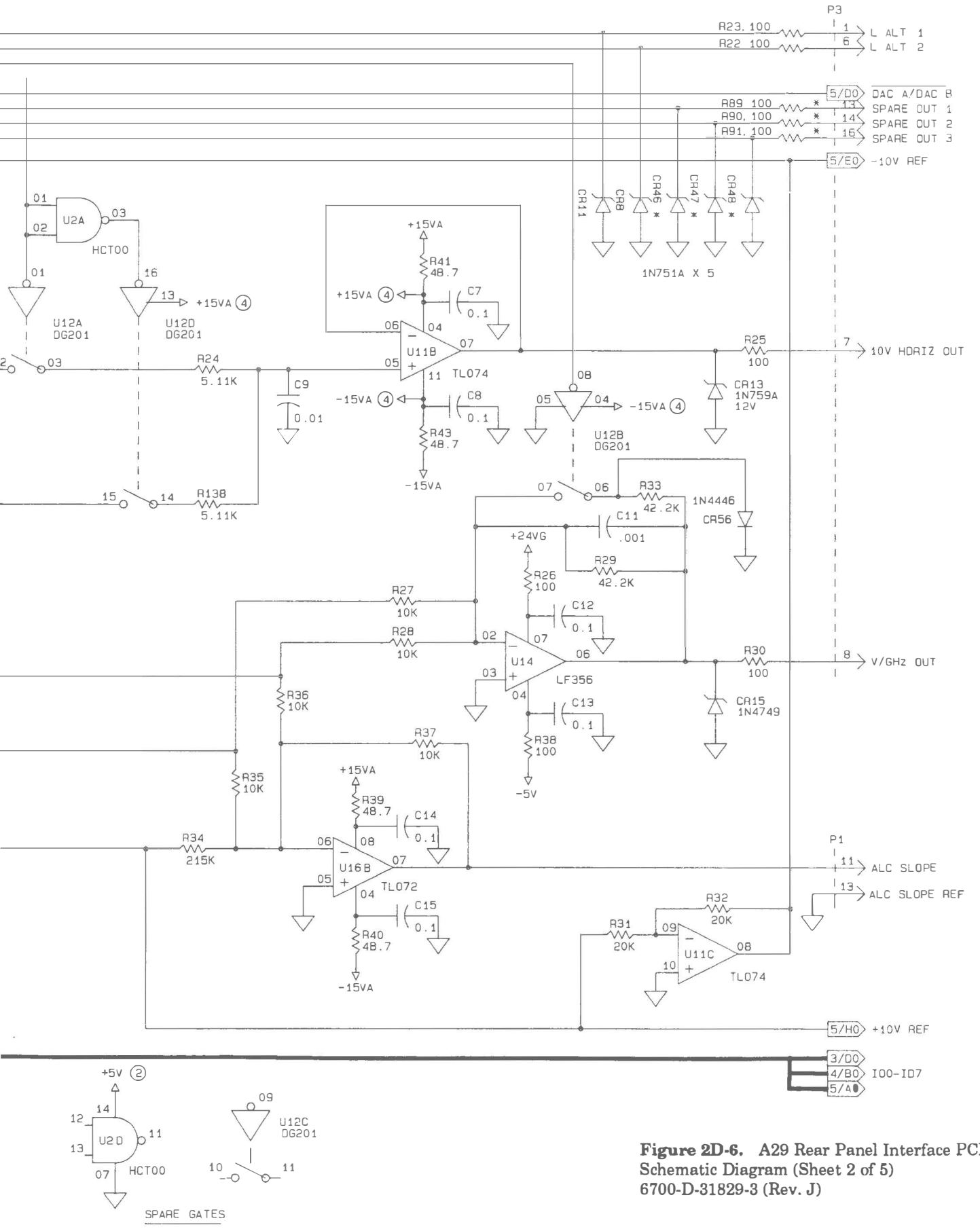
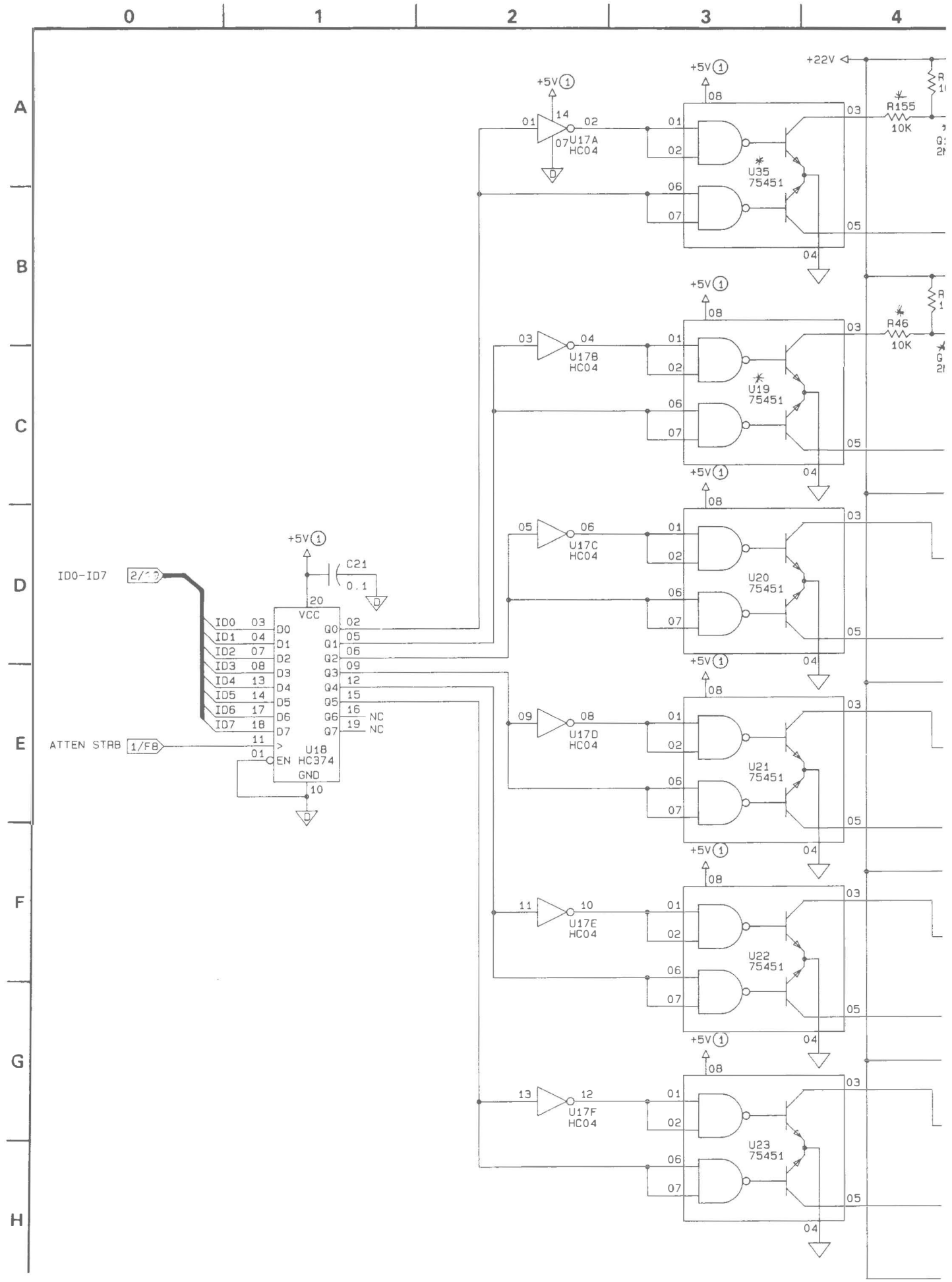


Figure 2D-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 2 of 5) 6700-D-31829-3 (Rev. J)


0
1
2
3
4
A
B
C
D
E
F
G
H
+5V
+22V
U17A HC04
U17B HC04
U17C HC04
U17D HC04
U17E HC04
U17F HC04
U35 75451
U19 75451
U20 75451
U21 75451
U22 75451
U23 75451
R155 10K
R46 10K
C21 0.1
ID0-ID7
ATTEN STRB
1/FB
U18 HC374
VCC
GND
EN
NC

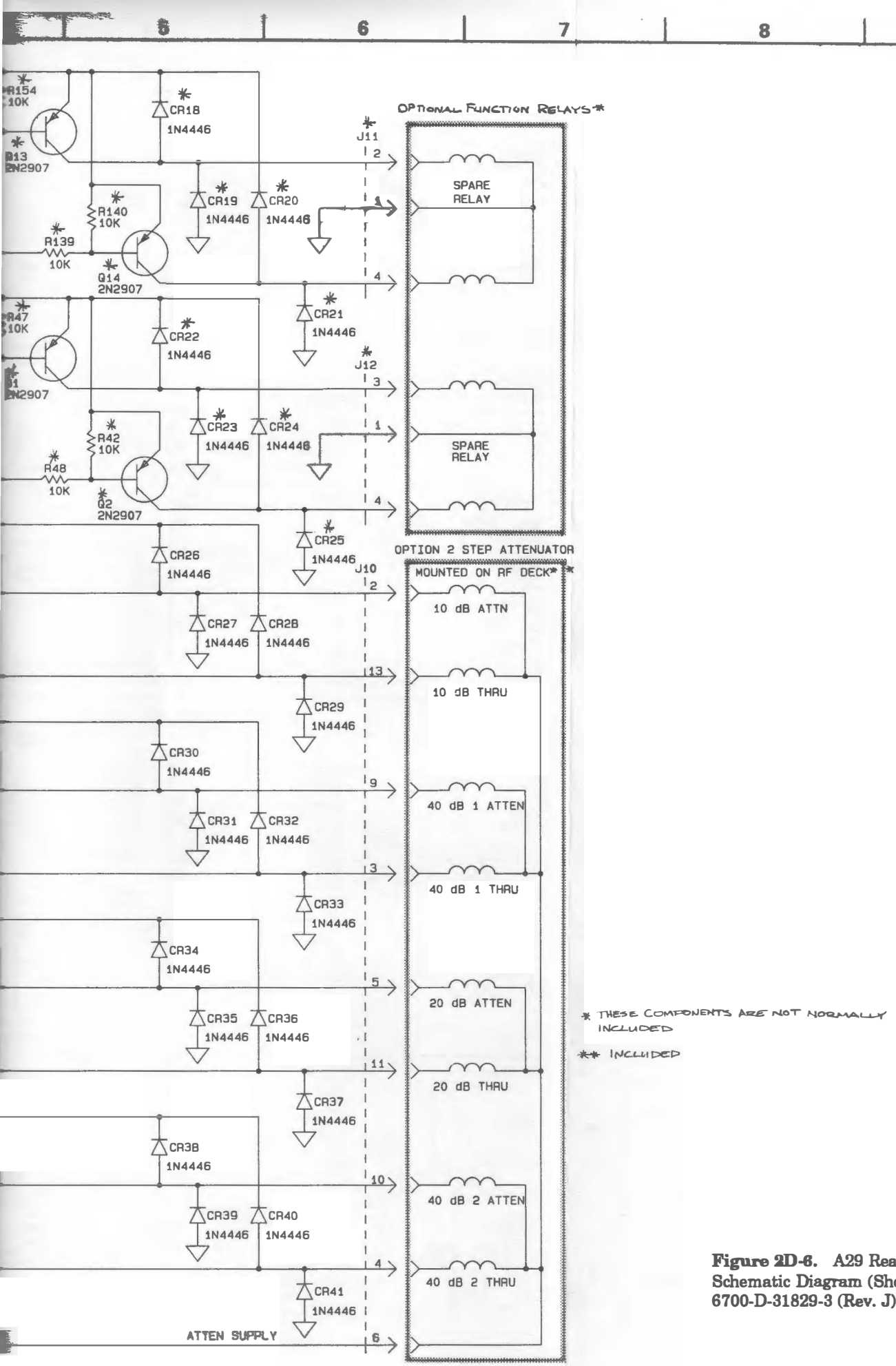
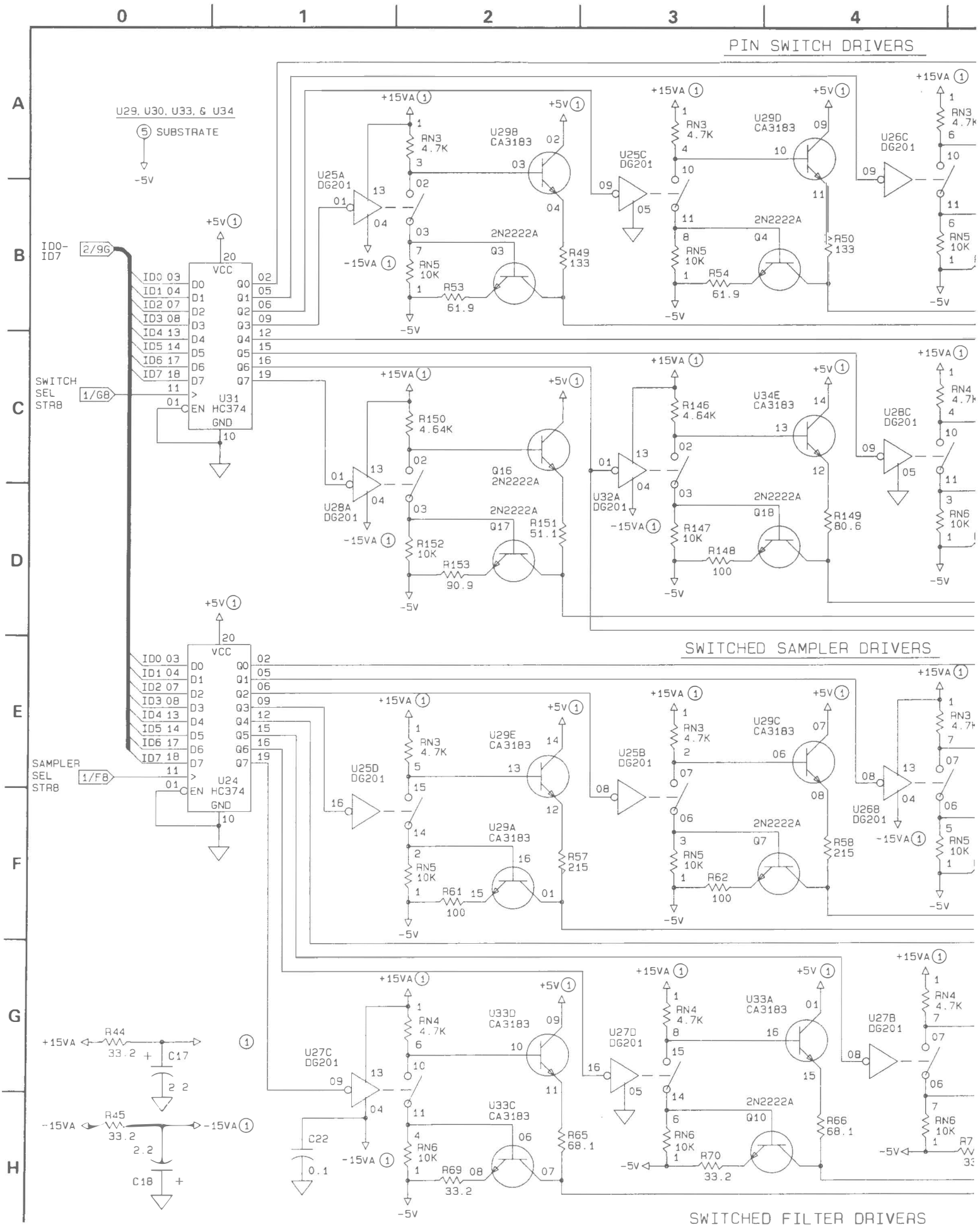


Figure 2D-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 3 of 5) 6700-D-31829-3 (Rev. J)


PIN SWITCH DRIVERS
SWITCHED SAMPLER DRIVERS
SWITCHED FILTER DRIVERS
U29, U30, U33, & U34
5 SUBSTRATE
-5V
ID0-ID7
2/9G
SWITCH SEL STR8
1/G8
SAMPLER SEL STR8
1/F8
U31 HC374
U24 HC374
VCC
GND
+5V
+15VA
-15VA
U25A DG201
U25B DG201
U25C DG201
U25D DG201
U26C DG201
U27B DG201
U27C DG201
U27D DG201
U28A DG201
U28B DG201
U28C DG201
U32A DG201
U29B CA3183
U29C CA3183
U29D CA3183
U29E CA3183
U33A CA3183
U33C CA3183
U33D CA3183
U34E CA3183
2N2222A
RN3 4.7K
RN4 4.7K
RN5 10K
RN6 10K
R44 33.2
R45 33.2
C17 2.2
C18 2.2
C22 0.1

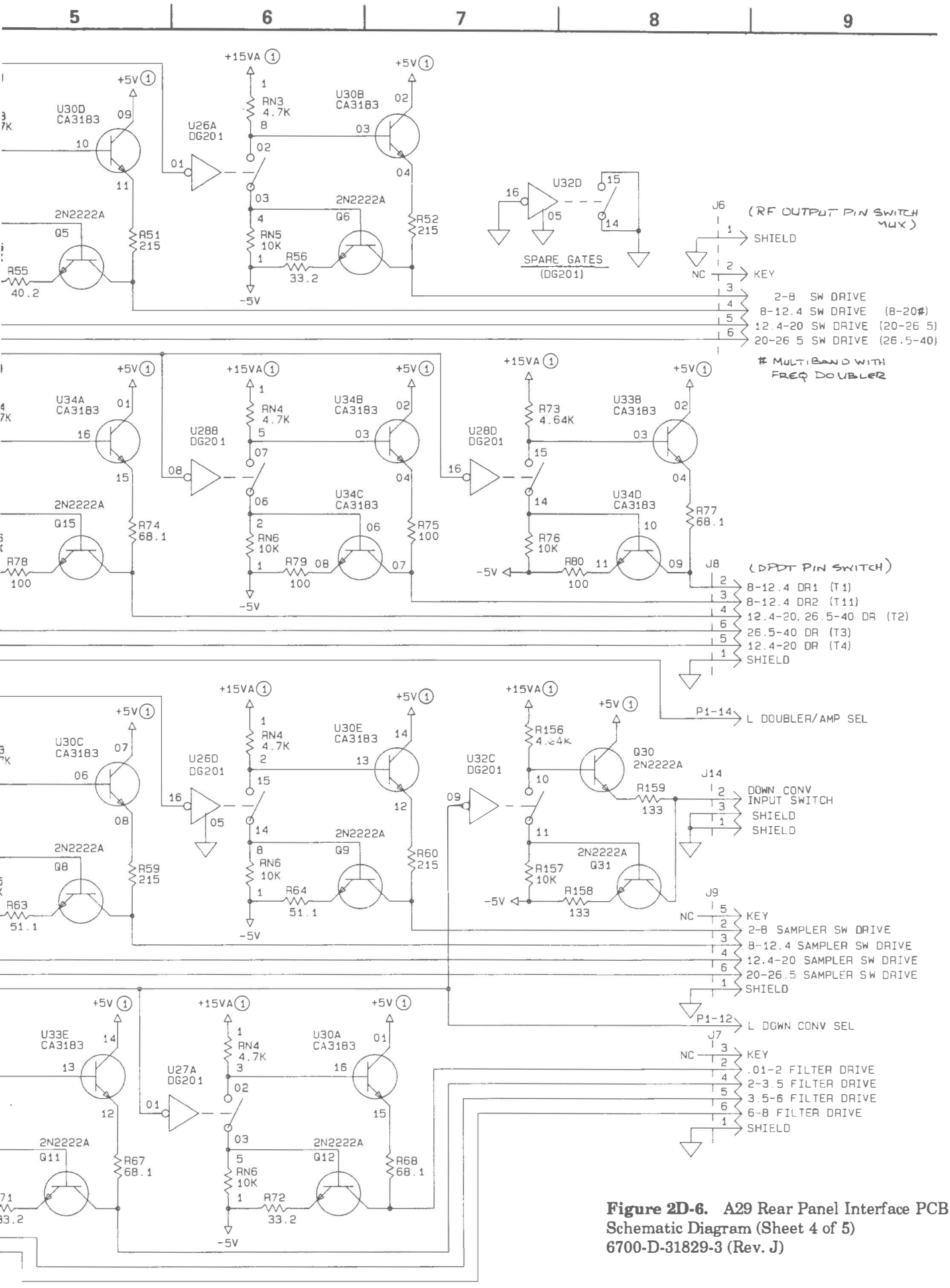
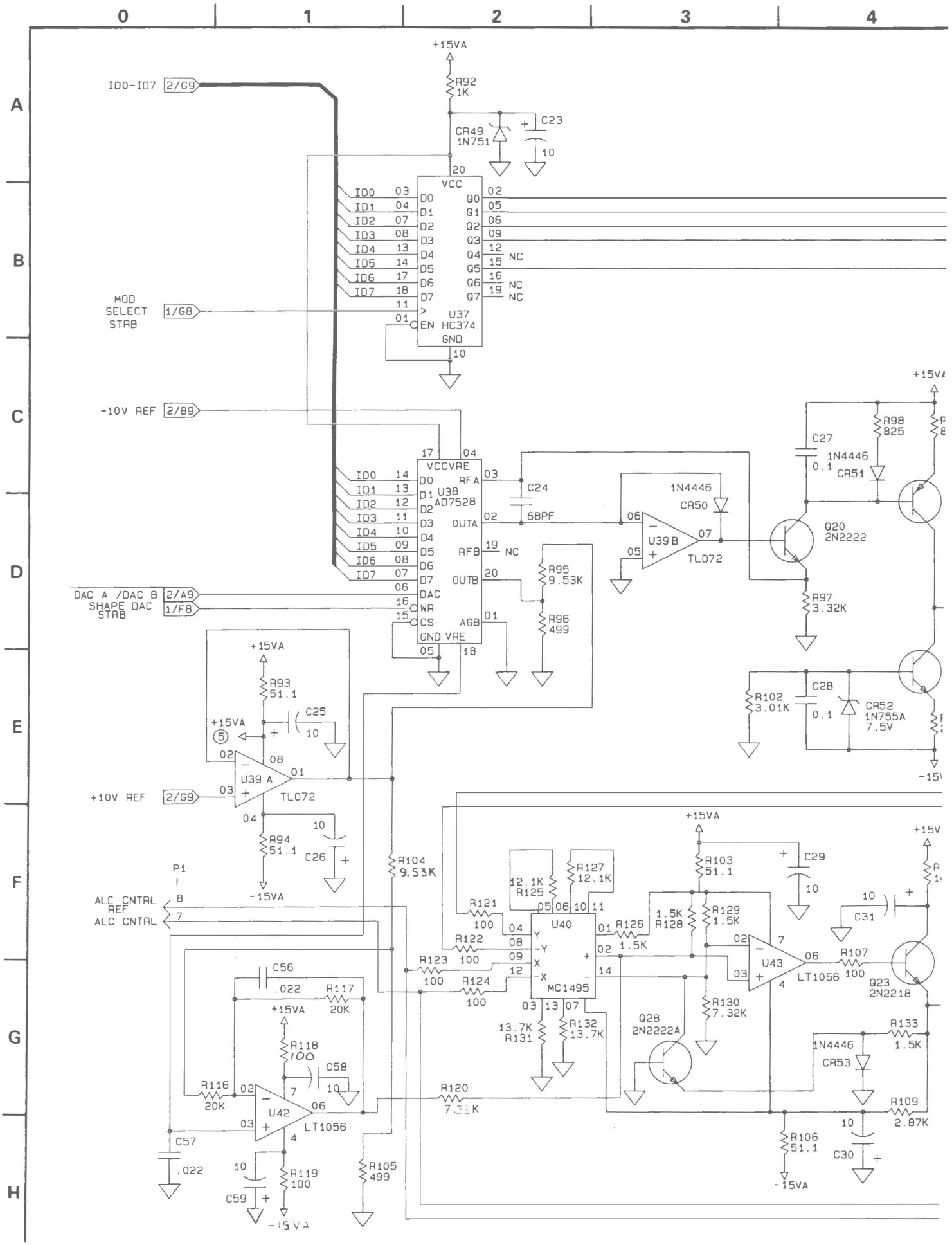


Figure 2D-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 4 of 5) 6700-D-31829-3 (Rev. J)


0
1
2
3
4
A
B
C
D
E
F
G
H
+15VA
R92
1K
CR49
1N751
C23
10
ID0-ID7
2/G9
VCC
U37
HC374
GND
MOD
SELECT
STRB
1/G8
-10V REF
2/B9
U38
AD7528
VCCVRE
GND VRE
C24
68PF
R95
9.53K
R96
499
DAC A /DAC B
SHAPE DAC
STRB
2/A9
1/F8
U39 A
U39 B
TL072
1N4446
CR50
C27
0.1
CR51
R98
825
Q20
2N2222
R97
3.32K
R102
3.01K
C28
CR52
1N755A
7.5V
R93
51.1
C25
R94
51.1
C26
R104
9.53K
P1
ALC CNTRL
REF
ALC CNTRL
U40
MC1495
R121
R122
R123
R124
R125
R126
R127
R128
R129
R130
R131
R132
R103
C29
U43
LT1056
R107
C31
Q23
2N2218
Q28
2N2222A
R133
1.5K
CR53
R109
2.87K
R106
51.1
C30
C56
.022
R117
20K
R118
100
C58
R116
20K
U42
LT1056
C57
.022
R119
100
C59
R105
499
R120
7.32K

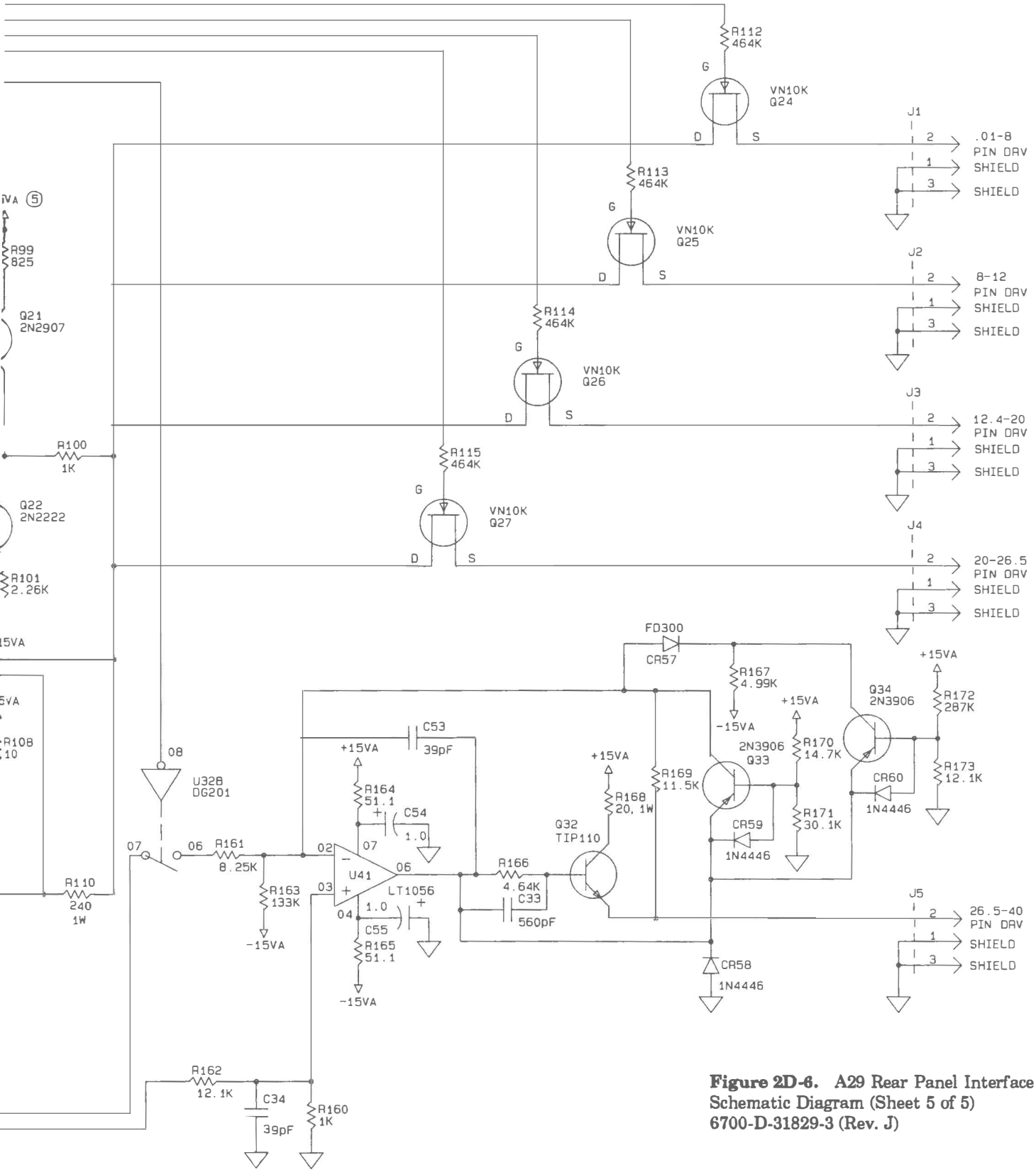


Figure 2D-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 5 of 5) 6700-D-31829-3 (Rev. J)

2E–REFERENCE LOOP: A5, A7, A10 PCBs AND CRYSTAL OSCILLATOR

2E-1 REFERENCE LOOP ASSEMBLIES: A5, A7, A10 PCBs and Crystal Oscillator

This section contains service information for the reference loop assemblies listed in Table 2E-1 below. Refer also to the specific troubleshooting information for the reference loop in the error code table that is located in the front portion of Section 2-System Description and Troubleshooting.

Table 2E-1. Reference Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2E-2	2E-1
Block Diagram	Fig. 2E-1	2E-5
Troubleshooting	Para. 2E-6	2E-4
PCB LEVEL		
A5 Reference Oscillator PCB		
Detailed Circuit Description	Para. 2E-3	2E-2
Parts Locator Diagram	Fig. 2E-2	2E-6
Schematic (Sheet 1 of 1)	Fig. 2E-3	2E-7
A7 Reference Divider PCB		
Detailed Circuit Description	Para. 2E-4	2E-2
Parts Locator Diagram	Fig. 2E-4	2E-8
Schematic (Sheet 1 of 1)	Fig. 2E-5	2E-9
A10 Reference Buffer PCB		
Detailed Circuit Description	Para. 2E-5	2E-4
Parts Locator Diagram	Fig. 2E-6	2E-10
Schematic (Sheet 1 of 1)	Fig. 2E-7	2E-11

2E-2 REFERENCE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the block diagram in Figure 2E-1 for the following discussion. The Reference Loop is comprised of the 10 MHz Crystal Oscillator Assembly, the A5 Reference Oscillator PCB, the A7 Reference Divider PCB, and the A10 Reference Buffer PCB.

The function of the Reference Loop is to translate the frequency accuracy and stability of the 10 MHz reference signal (from the internal crystal reference or an external synthesized source) to the Coarse Loop, the Fine Loop, the 0.01 to 2 GHz Down Converter, and the Pulse Generator.

The A5 Reference Oscillator PCB contains a voltage-controlled, surface-acoustical-wave (SAW) oscillator that generates an output frequency of 500 MHz. This 500 MHz signal is buffered and fed to the A3 Coarse Loop Mixer PCB, the A7 Reference Divider PCB, and the 0.01 to 2 GHz Down Converter. The 500 MHz signal applied to the A7 Reference Divider PCB is divided by 10 and then divided by 5. (The 50 MHz resulting from the divide by 10 is also buffered and applied to an output reserved for future use.) The 10 MHz resulting from the divide-by-5 is applied to the A7 PCB's phase/frequency detector and to a buffer amplifier which drives the A10 Reference Buffer PCB.

The synthesizer's internal 10 MHz crystal oscillator reference and the external 10 MHz reference (when used) are input through buffer amplifiers to the Reference Select Logic on the A7 PCB. The control logic detects the presence of an external 10 MHz reference and automatically switches it in as an input to the Phase/Frequency Detector. When an external 10 MHz reference is used, the control logic also supplies a signal to turn off the internal 10 MHz crystal oscillator and to tell the A23 Microprocessor PCB to illuminate the EXT REF message on the synthesizer's front panel FREQUENCY display.

The phase/frequency detector compares the 10 MHz signal, from the A7 PCB's dividers, with the 10 MHz signal, from the internal or external reference, and outputs a + or – phase error to the A5 PCB. The phase error is applied to the loop amplifier that controls the frequency of the 500 MHz SAW oscillator. This compensates for any drift of the SAW oscillator due to time and temperature.

The output of the phase/frequency detector is zero when the Reference Loop oscillator is phase locked. This output is also monitored by the A23 Microprocessor PCB (via the DVM circuits on the A17 Analog Instruction PCB) to detect an unlocked condition. An unlocked Reference Loop is shown (1) as an error code (E5-10, E5-11 or E5-12) during self test, and (2) by the illumination of the NOT Ø-LOCKED LED on the synthesizer's front panel.

NOTE

There are several reasons for the NOT Ø-LOCKED LED to be illuminated. If it is illuminated when it should not be; i.e., in the CW or Stepped Sweep modes of operation, an instrument self test will indicate the area causing the unlocked condition.

In addition to the phase lock monitor, the output of the loop amplifier is monitored by the A23 Microprocessor PCB via the DVM circuits on the A17 Analog Instruction PCB. This voltage may be displayed on the synthesizer's front panel LEVEL DISPAY as a aid in troubleshooting.

2E-3 A5 REFERENCE OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A5 PCB schematic diagram in Figure 2E-3 for the following discussion.

2E-3.1 Loop Amplifier

The reference loop phase error signal from the A7 Reference Divider PCB is input at A5P1, pin 6, and then goes to the unity gain differential amplifier, U1. From the U1 output, the error signal goes to the input of the Loop Amplifier, U2. The network comprised of R11 and C3 sets the basic reference loop bandwidth to approximately 30 kHz. The output of U2 is the tuning control voltage for the Reference Loop Oscillator.

The output of the loop amplifier, U2, is clamped to ensure that the reference loop oscillator, Y1, will not generate frequencies outside of the desired operating frequency of 500 MHz. The circuit comprised of Q1, CR1, CR4, R8, R12, and R13 clamps the most "negative" output of U2 to +2V. The output range of U2 is approximately +2V to +12V.

The output of U2 is also coupled to pin 5 of connector A5P1 via the voltage divider/isolation network R16 and R17. This is the RL TUNE signal that goes to the DVM circuits located on the A17 Analog Instruction PCB for monitoring by the A23 Microprocessor.

NOTE

Pressing <Shift> TRIGGER 010 displays the RL TUNE voltage in the synthesizer's front panel LEVEL display window and the Reference Loop frequency in the FREQUENCY display window. This may be useful in troubleshooting reference loop problems.

2E-3.2 Reference Loop Oscillator

The voltage-controlled SAW oscillator, Y1, is tuned by the output of U2 to generate 500 MHz. The tuning voltage range of +2V to +12V compensates for any drift of the SAW oscillator output frequency due to time and temperature. The output of Y1 is fed in parallel to buffer amplifiers U3, U4, and U5.

2E-3.3 Buffer Amplifiers

Buffer amplifiers U3, U4, and U5 isolate the RF output connectors A5J1, A5J2, and A5J3 and buffer the output of Y1. These amplifiers are all configured the same, however, their biases are slightly different to provide the necessary output signal levels.

The output of U4 is coupled to A5J1 by C19. This 500 MHz signal, at approximately 0 dBm, goes to the A7 Reference Divider PCB. The output of U3 is coupled to A5J2 by C18. This 500 MHz signal, at approximately 8 dBm, goes to the A3 Coarse Loop Mixer PCB. The output of U5 is coupled to A5J3 by C20. This 500 MHz signal, at approximately 5.5 dBm, goes to the 0.01 to 2 GHz Down Converter located on the RF microwave deck.

The +10V supply for Y1 comes from on-board regulator VR1. This regulator helps isolate the SAW oscillator from the normal +15 VLP power supply noise. The circuitry of Q2, Q3, and Q4 filters the input voltages (+15 VLP, -15 VLP, and +24 VG) received from the A22 Regulator PCB, providing approximately 20 dB rejection of noise and ripple from the power supplies.

2E-4 A7 REFERENCE DIVIDER, DETAILED CIRCUIT DESCRIPTION

Refer to the A7 PCB schematic diagram in Figure 2E-5 for the following discussion.

2E-4.1 500 MHz Input

The 500 MHz output from A5J1 goes to an impedance matching network (R1, R2, and R3). From there it is input to buffer amplifier Q1 and is coupled out by C3 to U1, a divide-by-10 integrated circuit. The 50 MHz TTL output of U1 goes to the divide-by-5 circuits, U3 and U4, and buffer amplifier Q7. Q7 isolates the RF connector A7J2, reserved for future use.

2E-4.2 Divide-by-Five

U3, U4, and part of U2 comprise a divide-by-five circuit that drops the frequency from 50 MHz to 10 MHz and outputs it to the U6 phase/frequency detector circuit. The output of the divide-by-five circuit also goes to buffer amplifier Q3. The output of Q3 is coupled to RF connector A7J3 via C27. This 10 MHz signal, at approximately –2 dBm, goes to the A10 Reference Buffer PCB. The rest of the synthesizer uses this 10 MHz signal for reference.

NOTE

This 10 MHz signal comes from the 500 MHz reference loop oscillator, not from the internal 10 MHz crystal oscillator. When the reference loop oscillator is unlocked, the 10 MHz reference for the synthesizer is off frequency by the same percentage as the reference loop oscillator is from 500 MHz. When the unlocked reference loop oscillator is 50 kHz high, the 10 MHz at A5J3 is 10 kHz high (50 kHz/50). Although the Reference Loop is unlocked, the Coarse, Fine, and YIG Loops still lock, but at a corresponding frequency offset.

2E-4.3 Internal 10 MHz Input Circuit

The 10 MHz signal, from the internal crystal oscillator, is input via RF connector A7J5 to buffer amplifier/squaring circuit Q8 where it is converted from a sine wave to a TTL level square wave. CR7 acts as a switch for the bias current of Q8, which is furnished by R13. CR8 prevents saturation of Q8. The output of Q8 goes to NAND gate U5D. Normally, U5-12 functions at a TTL high, so U5D inverts the 10 MHz input. From U5-11, the 10 MHz output goes to U5-4, which also has a TTL high on pin 5. The 10 MHz output at U5-6 is input to U6.

2E-4.4 External 10 MHz Input Circuit

If a 10 MHz signal is present at A7J4, it is input to buffer amplifier/squaring circuit Q4 where it is converted to a TTL-level square wave and output to U5-10. The output of Q4 also goes to CR5 and CR6, a full-wave rectifier. The rectifier dc output turns on Q5, pulling the collector to ground. This ground signal to U5-12 disables U5D, causing its output at pin 11 to go to a TTL high. U2C inverts the ground signal from Q5 and applies a TTL high to U5-9 causing U5C to invert the 10 MHz input. From U5-8, the 10 MHz goes to U5-5 which also has a TTL high on pin 4. The 10 MHz output at pin U5-6 is input to U6.

The TTL high from U2C also goes to connector A7P1, pin 3, then to the A8 Serial I/O PCB via the A28 Motherboard PCB. The A23 Microprocessor PCB reads the signal during normal housekeeping routines, then instructs the front panel to activate the EXT REF annunciator on the FREQUENCY display via the A8 Serial I/O and A2 Front Panel Control PCBs. The signal from U2C also turns on Q6. Since the collector of Q6 connects to the internal 10 MHz crystal oscillator via the A28 Motherboard PCB, the line is pulled to ground, shutting off the internal 10 MHz oscillator. This prevents spurious responses.

2E-4.5 Phase/Frequency Detector

U5A and U6 compose a "D" flip-flop phase/frequency detector. When the 10 MHz signals at U6-1 and U6-13 are in phase, the rising edges transfer the +5V on pins 3 and 11 to output pins 5 and 9. Since pins 1 and 2 of U5A go high at the same time, U5A-3 goes low and clears U6A and U6B, setting their Q output low again. This causes a pulse of approximately 20 ns (due to the propagation delay of U5A and U6) at pins 5 and 9 of U6.

When the 10 MHz clock at U6-1 is delayed by 90 degrees (25 ns at 10 MHz), U5A-1 goes high 25 ns after U5A-2. This results in a pulse of approximately 45 ns at U6-9 and a pulse of 20 ns at U6-5. When the 10 MHz clock at U6-1 is ahead by 90 degrees, U6-5 has the 45 ns pulse and U6-9 has the 20 ns pulse.

R23-C19 and R25-C20 integrate the outputs of U6, which go to the differential receiver U7. If one of the outputs of U6 has a wider pulse than the other, the dc voltage resulting from the integration of that

pulse will be higher than the dc voltage resulting from the narrow pulse. U7 amplifies this dc voltage difference (the reference loop phase error) and outputs it to A7P1, pin 6. The error signal then goes to the A5 Reference Oscillator PCB as the input to the loop amplifier. Because the phase lock loop corrects the frequency until there is zero phase difference, the output from U7 is 0V when the Reference Loop is phase locked. When the loop is unlocked, the phase detector has maximum output and the output from U7 is approximately ±12V.

The U7 output is also coupled to pin 5 of connector A7P1 via the decoupling network R37, C22, and R39. This is the RL MON signal that goes to the DVM circuits located on the A17 Analog Instruction PCB. The A23 Microprocessor monitors this signal via the A17 PCB DVM circuit to determine if the Reference Loop is locked.

The +5V supply for this PCB comes from the on-board regulator VR1. This regulator helps isolate the Reference Divider from both the 50 kHz switching signals and the normal noise and ripple on the +9 VLP unregulated supply from the A25 Switching Power Supply PCB.

2E-5 A10 REFERENCE BUFFER, DETAILED CIRCUIT DESCRIPTION

Refer to the A10 schematic diagram in Figure 2E-7 for the following discussion.

2E-5.1 Input

The 10 MHz signal input at RF connector A10J4 comes from the A7 Reference Divider PCB. It is buffered by Q1 and then applied to the four output buffer amplifier circuits. The buffer amplifier circuits going to RF connectors A10J1, A10J2, and A10J3 are identical. The buffer amplifier circuit for RF connector A10J5 (rear panel output) provides additional isolation and protection from any signal applied to the A10J5 output. This high isolation prevents destination circuit signals from going to the other circuits. For example, any 200 to 321 MHz signal that comes from the A11 Fine Loop Divider PCB and goes back into A10J1 will be attenuated by 40 dB at the A10J2 and A10J3 outputs. This prevents interaction of circuits requiring the 10 MHz reference signal and decreases the possibility of spurious responses.

2E-5.2 Buffer Amplifiers

Q1 is configured as an emitter follower and biased by R3 and R4 for a collector current of approximately 5 mA. R7, R8, R9, and R10 split the output signal from Q1 into four paths.

Emitter follower Q2 receives its bias from the emitter of Q1. Its collector current is approximately 3 ma. The output signal, which is coupled by C7 to amplifier Q6, is amplified approximately three times to overcome the losses from the splitter and emitter followers. The amplified signal, whose peak amplitude is ≈0.2V, is coupled to A10J1 by C9. The 10 MHz signal, at approximately –2 dBm, goes to the A11 Fine Loop Divider PCB. The other two buffer amplifiers (consisting of Q3, Q4, Q7, and Q8) operate the same as the first buffer amplifier. The 10 MHz signals at A10J2 and A10J3 go to the A6 Coarse Loop Divider PCB and the A13 Pulse Generator PCB respectively.

Emitter follower Q5 applies its output signal to a voltage divider consisting of L3, Q9, R38, Q11, and L4. The divider sets the collector current for Q10 and Q12 at approximately 10 mA. Q9 and Q11 provide temperature compensation for Q10 and Q12. CR1 and CR2 prevent Q10 and Q12 from becoming saturated. CR3 and CR4 prevent damage to Q10 and Q12 by clamping any signal inadvertently applied to the A10J5 output. R39 provides the 50 ohm source impedance for the A10J5 output and current limits any signal applied to A10J5.

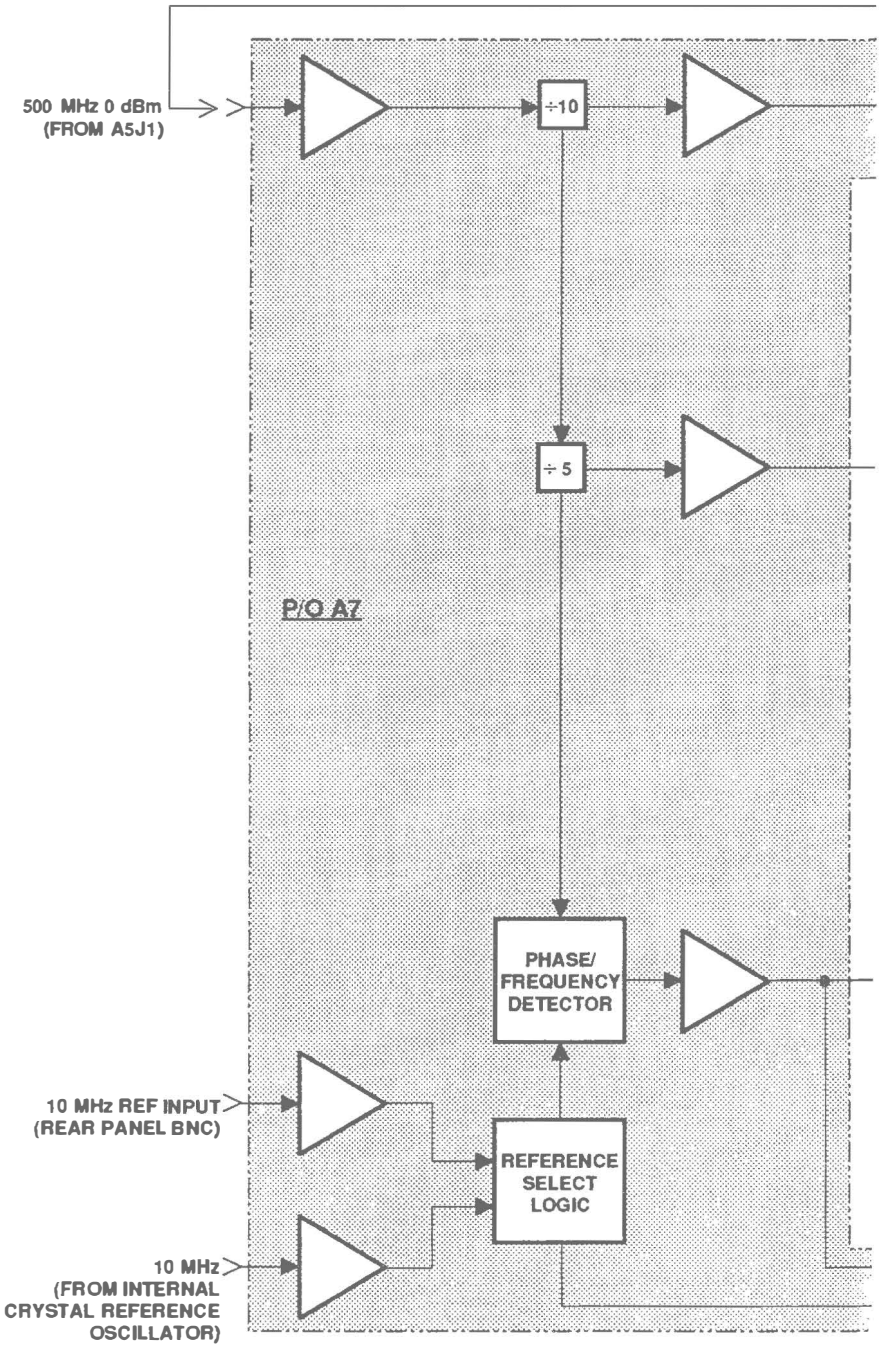
On-board regulator VR1 provides the +5V power for the PCB. It receives its voltage from the A25 Switching Power Supply +9VLP unregulated supply.

2E-6 REFERENCE LOOP ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2-System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the reference loop subsystem and probable causes of the failures.

2E-7 REFERENCE LOOP ASSEMBLIES, SERVICE SHEETS

Table 2E-1 (page 2E-1) presents the arrangements of the block diagrams, schematics, and parts locator diagrams for the A5, A7 and A10 PCBs.


500 MHz 0 dBm
(FROM A5J1)
÷10
÷ 5
P/O A7
PHASE/
FREQUENCY
DETECTOR
10 MHz REF INPUT
(REAR PANEL BNC)
REFERENCE
SELECT
LOGIC
10 MHz
(FROM INTERNAL
CRYSTAL REFERENCE
OSCILLATOR)

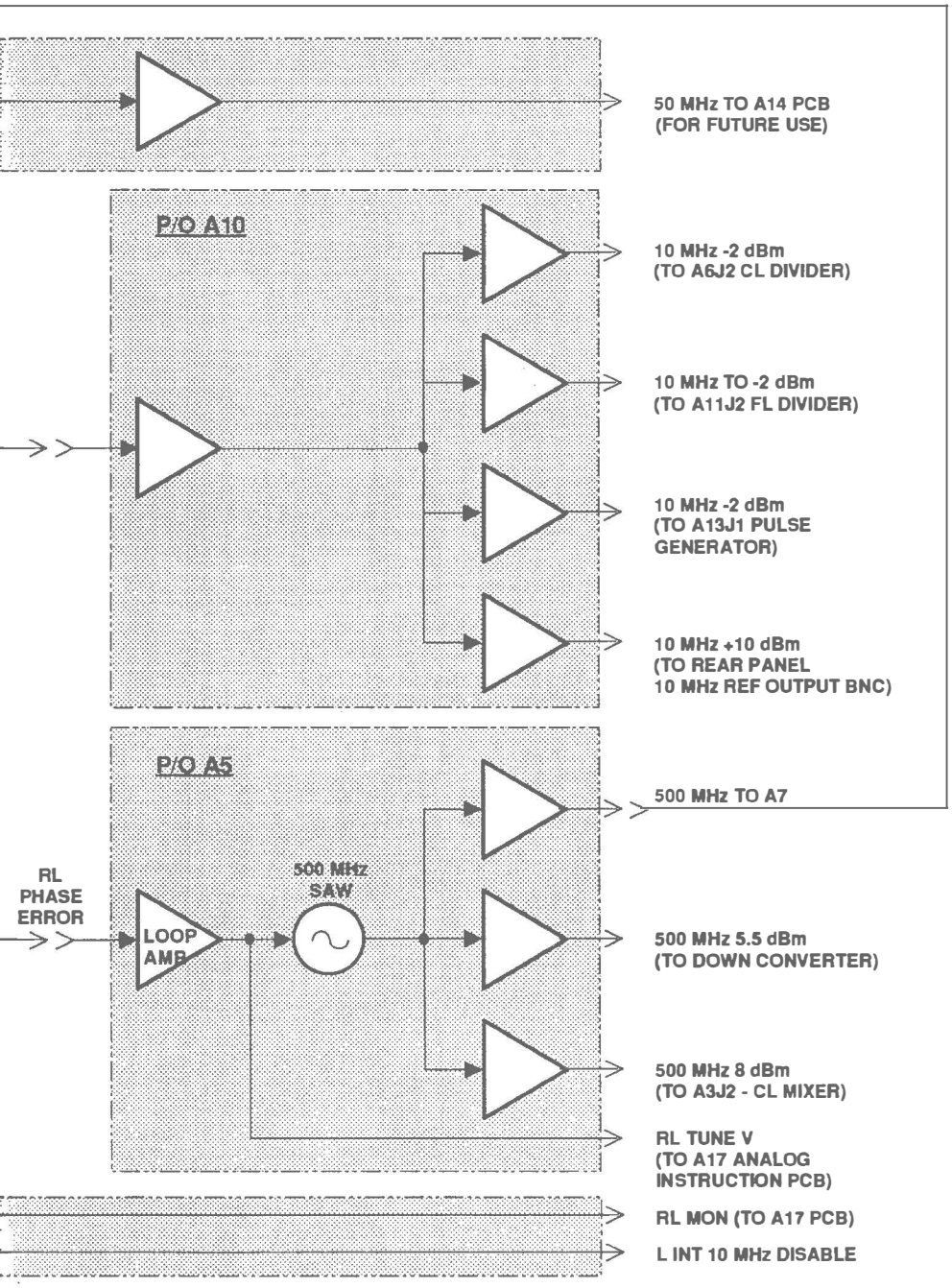
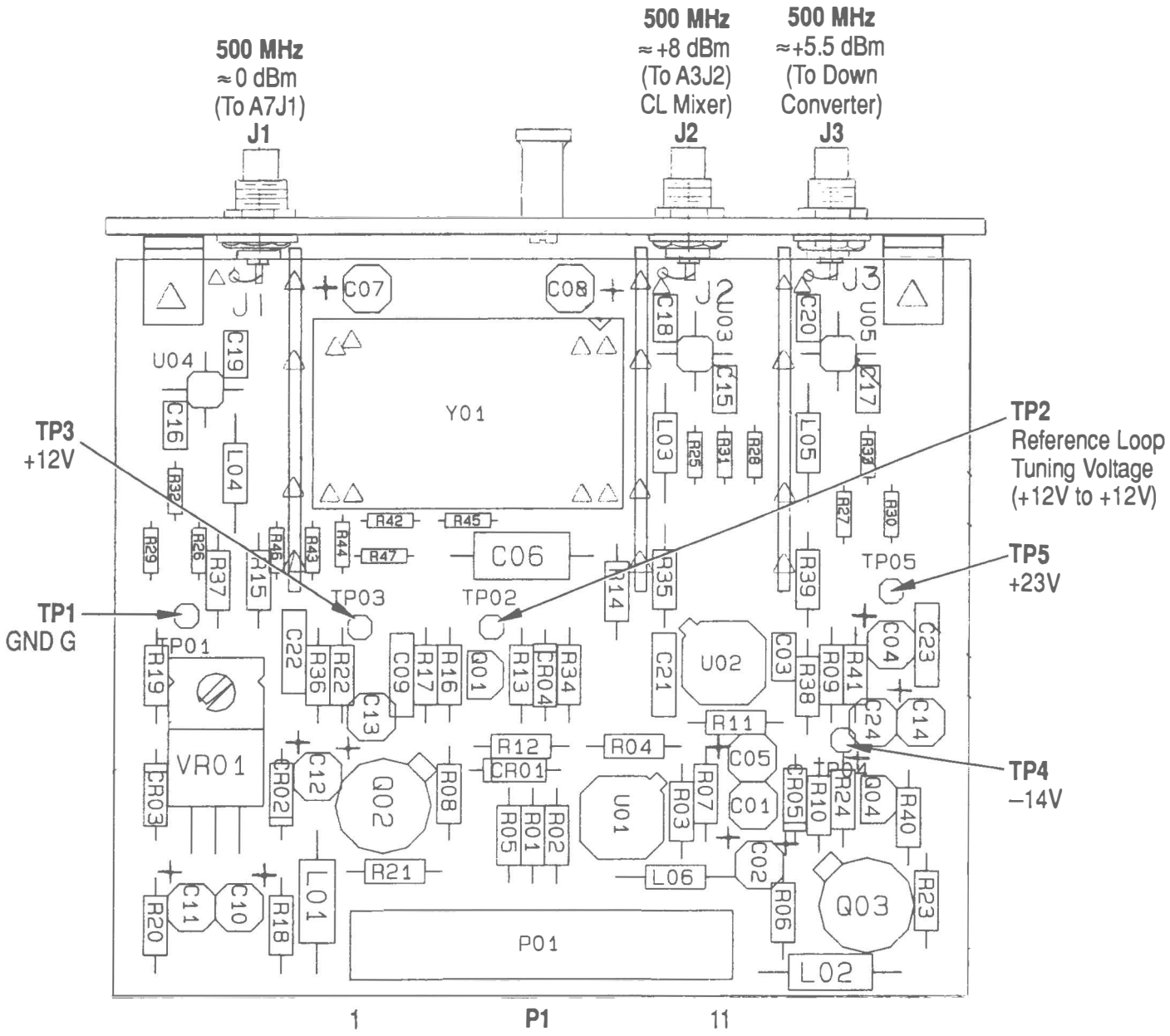


Figure 2E-1. Reference Loop Block Diagram


500 MHz
≈ 0 dBm
(To A7J1)
J1
500 MHz
≈ +8 dBm
(To A3J2)
CL Mixer)
J2
500 MHz
≈ +5.5 dBm
(To Down
Converter)
J3
TP3
+12V
TP1
GND G
TP2
Reference Loop
Tuning Voltage
(+12V to +12V)
TP5
+23V
TP4
–14V
Y01
C06
VR01
Q02
Q03
U01
U02
P01
1
P1
11
(To A28XA5 via filtercons)

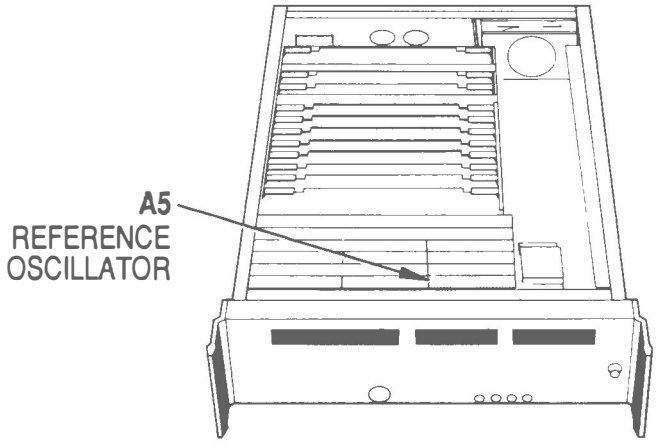
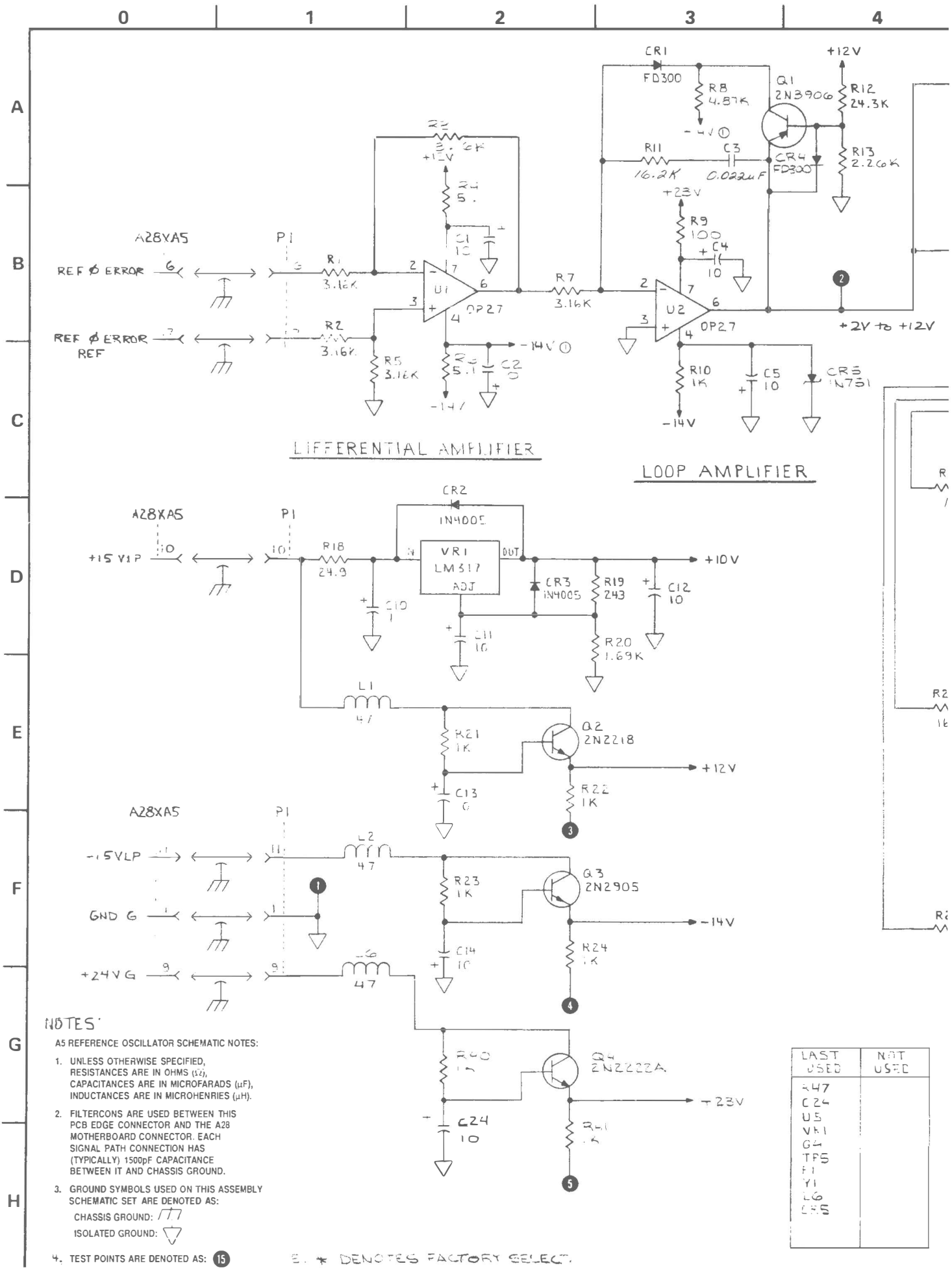


Figure 2E-2. A5 Reference Oscillator PCB Parts Locator Diagram
6700-D-31805-3 (Rev. D)


0
1
2
3
4
A
B
C
D
E
F
G
H
CR1
FD300
+12V
R8
4.87K
Q1
2N3906
R12
24.3K
-4V ①
R11
16.2K
C3
0.022uF
CR4
FD300
R13
2.26K
+23V
R9
100
C4
10
R22
3.16K
+12V
R4
5.
C1
10
A28XA5
P1
REF Ø ERROR
6
R1
3.16K
U1
OP27
R7
3.16K
U2
OP27
+2V to +12V
REF Ø ERROR REF
7
R2
3.16K
R5
3.16K
R6
5.1
C2
0
-14V ①
-14V
R10
1K
C5
10
CR5
IN751
-14V
DIFFERENTIAL AMPLIFIER
LOOP AMPLIFIER
CR2
IN4005
A28XA5
P1
+15V1P
10
R18
24.9
VR1
LM317
ADJ
IN
OUT
+10V
C10
1
CR3
IN4005
R19
243
C12
10
C11
10
R20
1.69K
L1
47
R21
1K
Q2
2N2218
+12V
C13
R22
1K
A28XA5
P1
-15V1P
11
L2
47
R23
1K
Q3
2N2905
-14V
GND G
1
C14
10
R24
1K
+24V G
9
L6
47
R40
1K
Q4
2N2222A
+23V
C24
10
R41
1K
NOTES:
A5 REFERENCE OSCILLATOR SCHEMATIC NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
CHASSIS GROUND:
ISOLATED GROUND:
4. TEST POINTS ARE DENOTED AS: 15
E. * DENOTES FACTORY SELECT.
LAST USED
R47
C24
U5
VR1
G4
TP5
F1
Y1
L6
D5
NOT USED

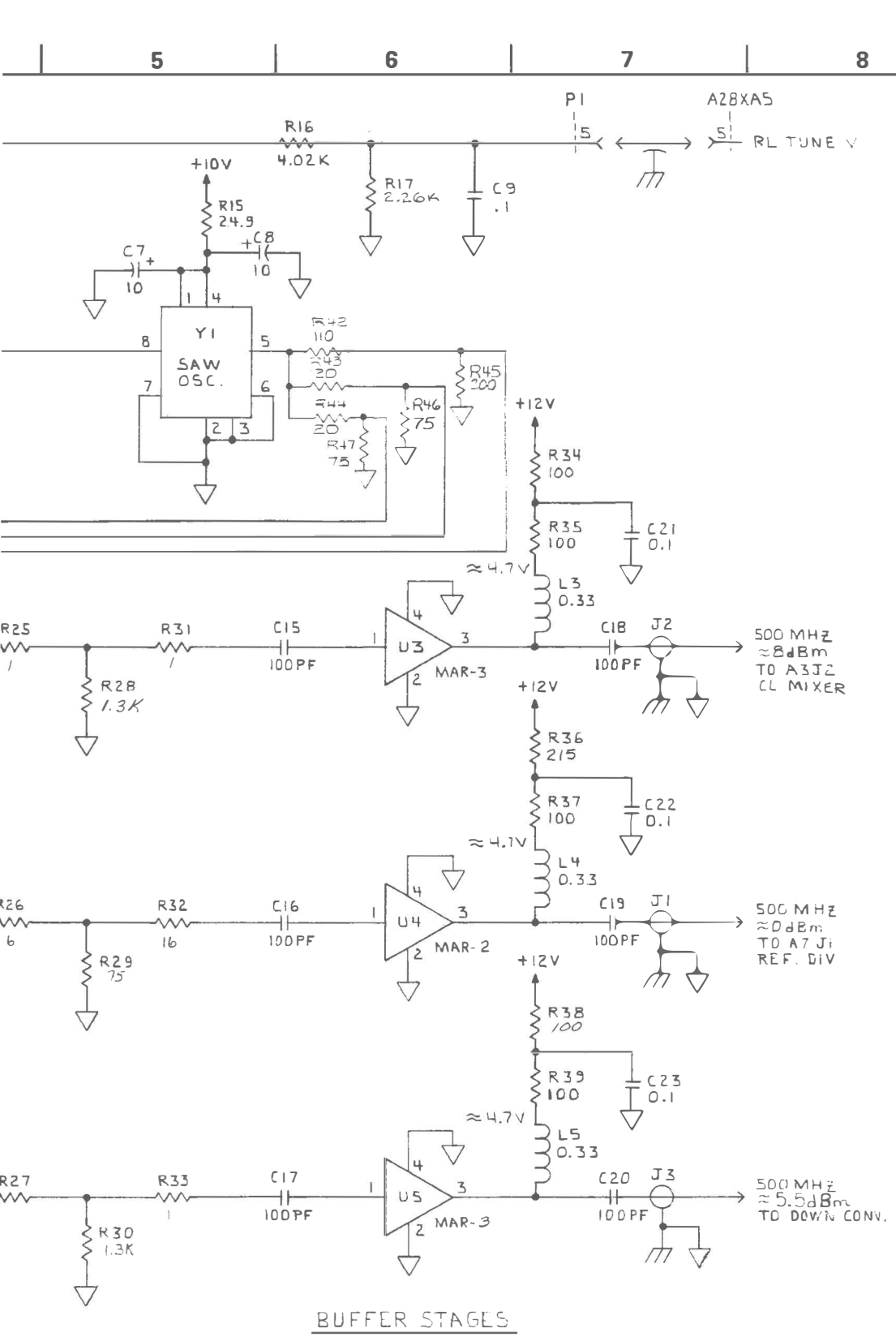
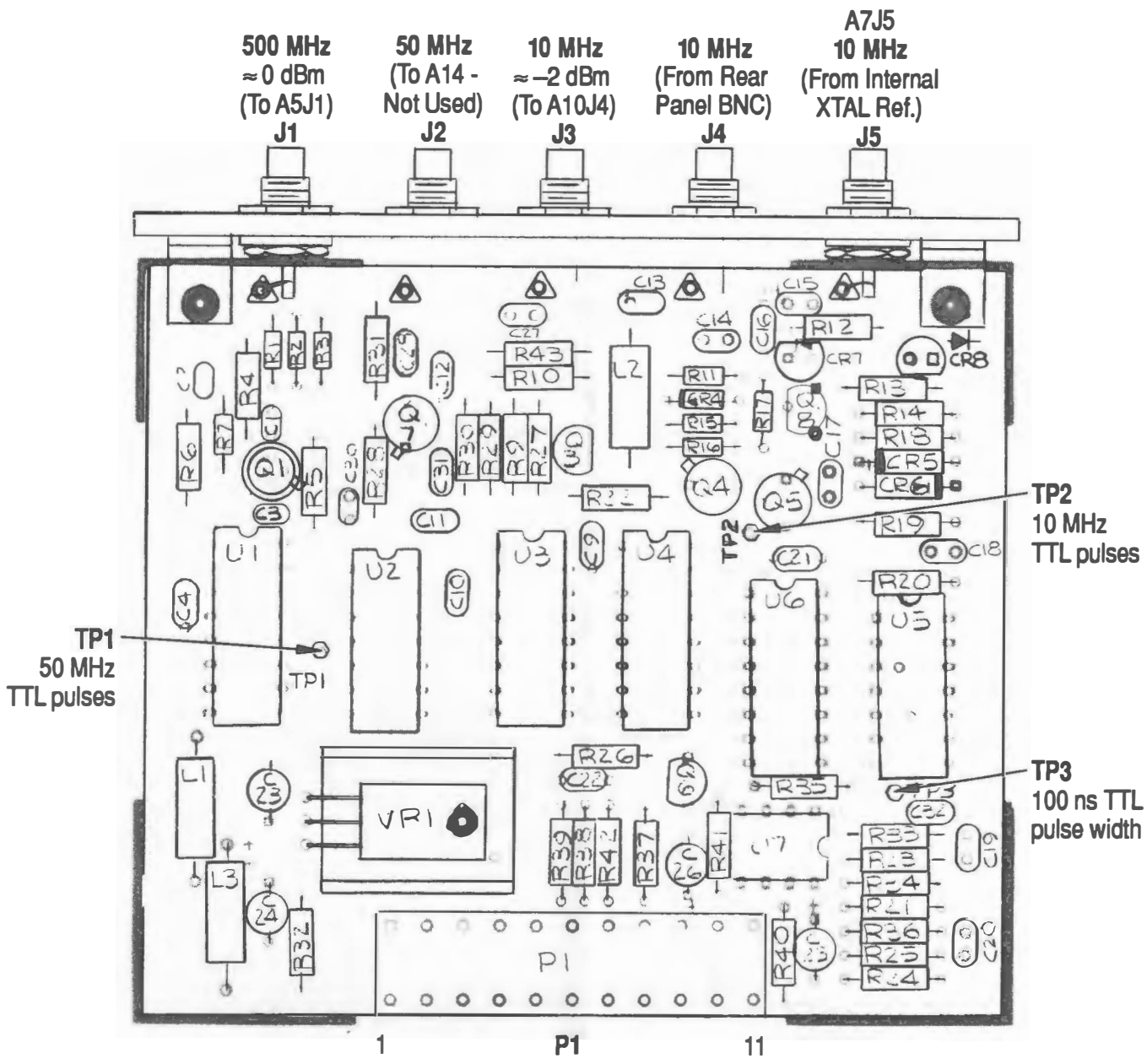


Figure 2E-3. A5 Reference Oscillator PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31805-4 (Rev. B)


500 MHz
≈0 dBm
(To A5J1)
J1
50 MHz
(To A14 -
Not Used)
J2
10 MHz
≈–2 dBm
(To A10J4)
J3
10 MHz
(From Rear
Panel BNC)
J4
A7J5
10 MHz
(From Internal
XTAL Ref.)
J5
TP1
50 MHz
TTL pulses
TP2
10 MHz
TTL pulses
TP3
100 ns TTL
pulse width
1
P1
11
(To A28XA7 via filtercons)

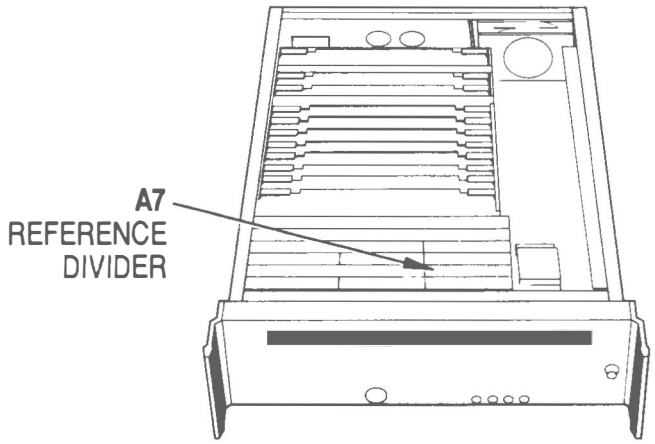
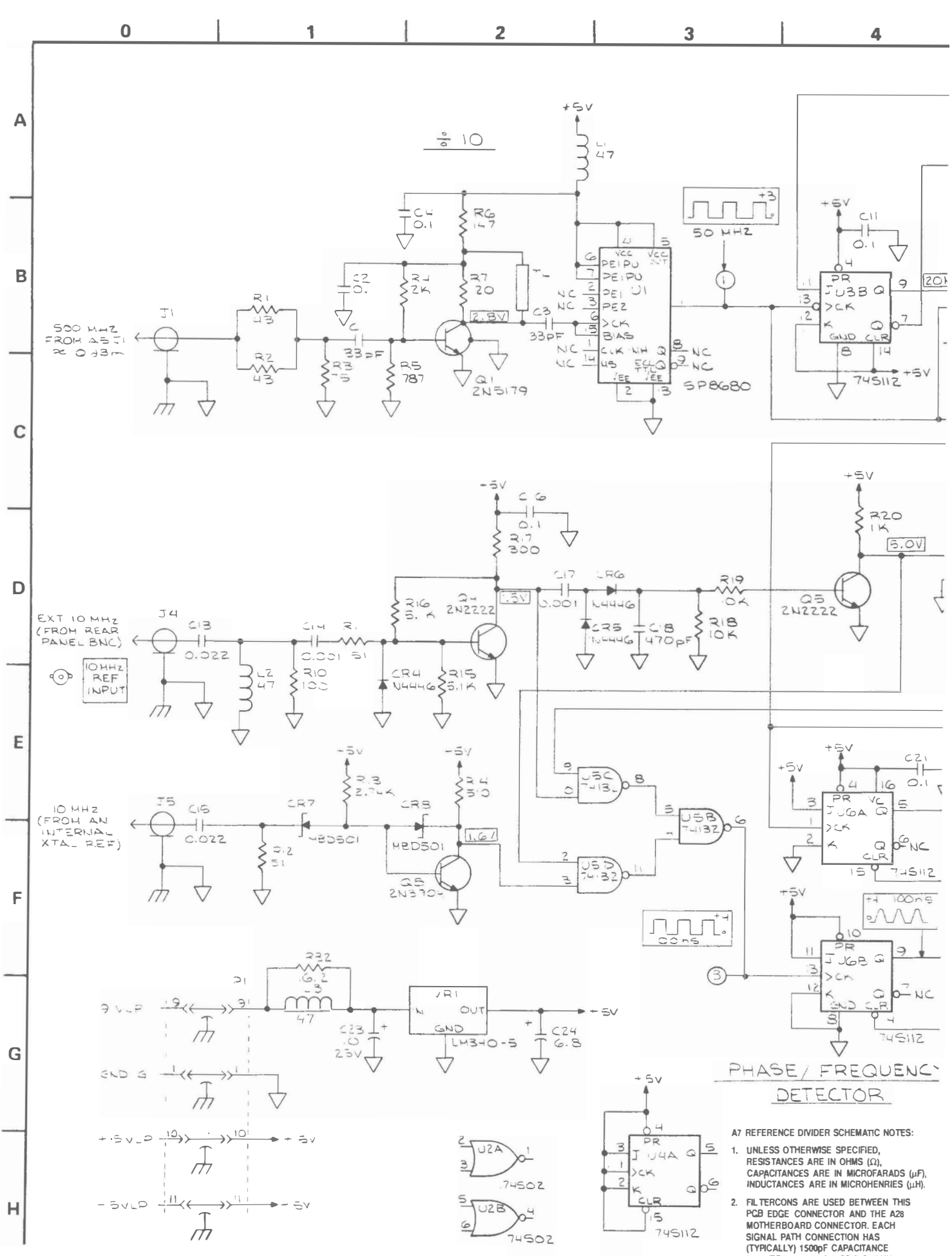
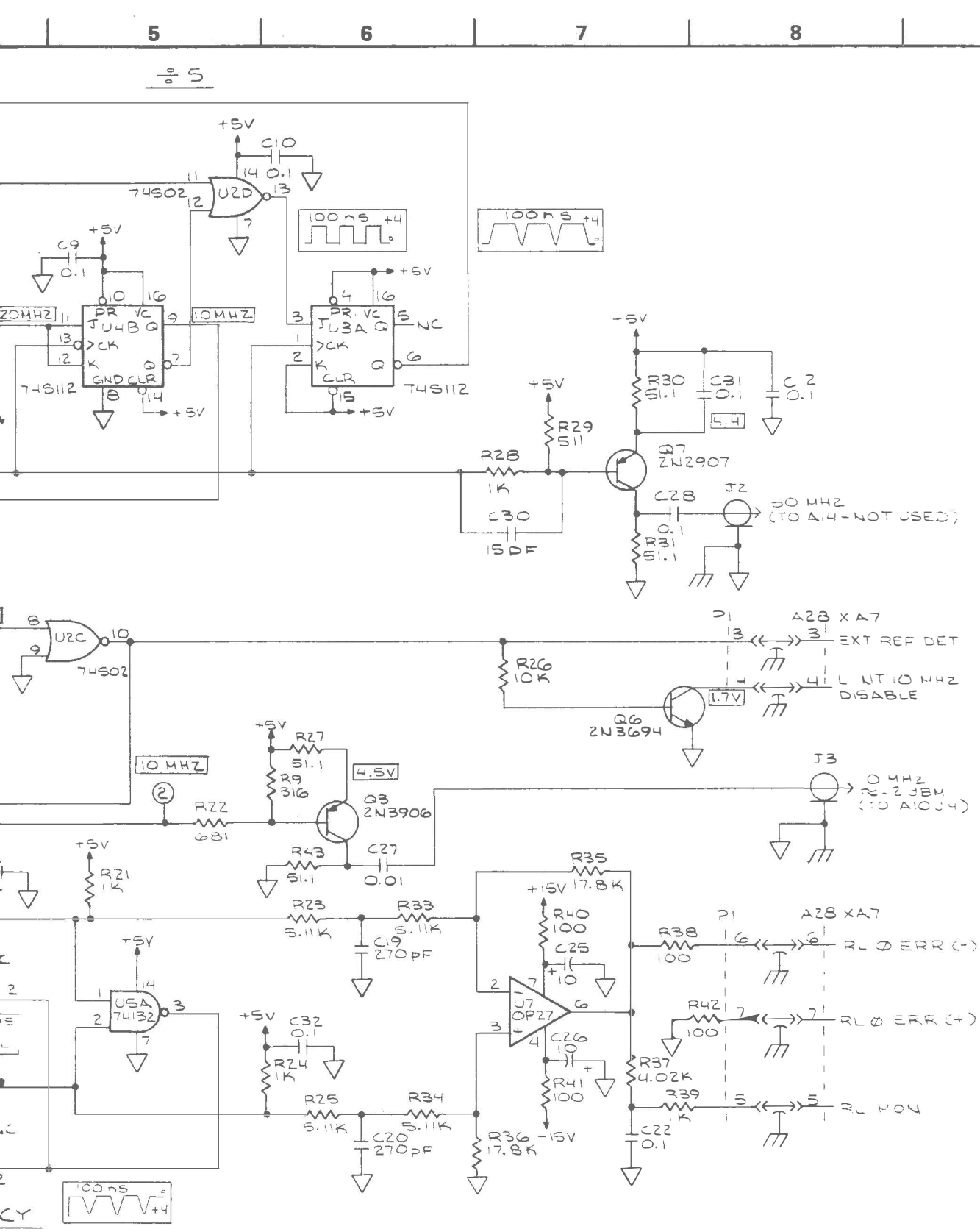


Figure 2E-4. A7 Reference Divider PCB Parts Locator Diagram
6700-D-31707-3 (Rev. G)



A7 REFERENCE DIVIDER SCHEMATIC NOTES:

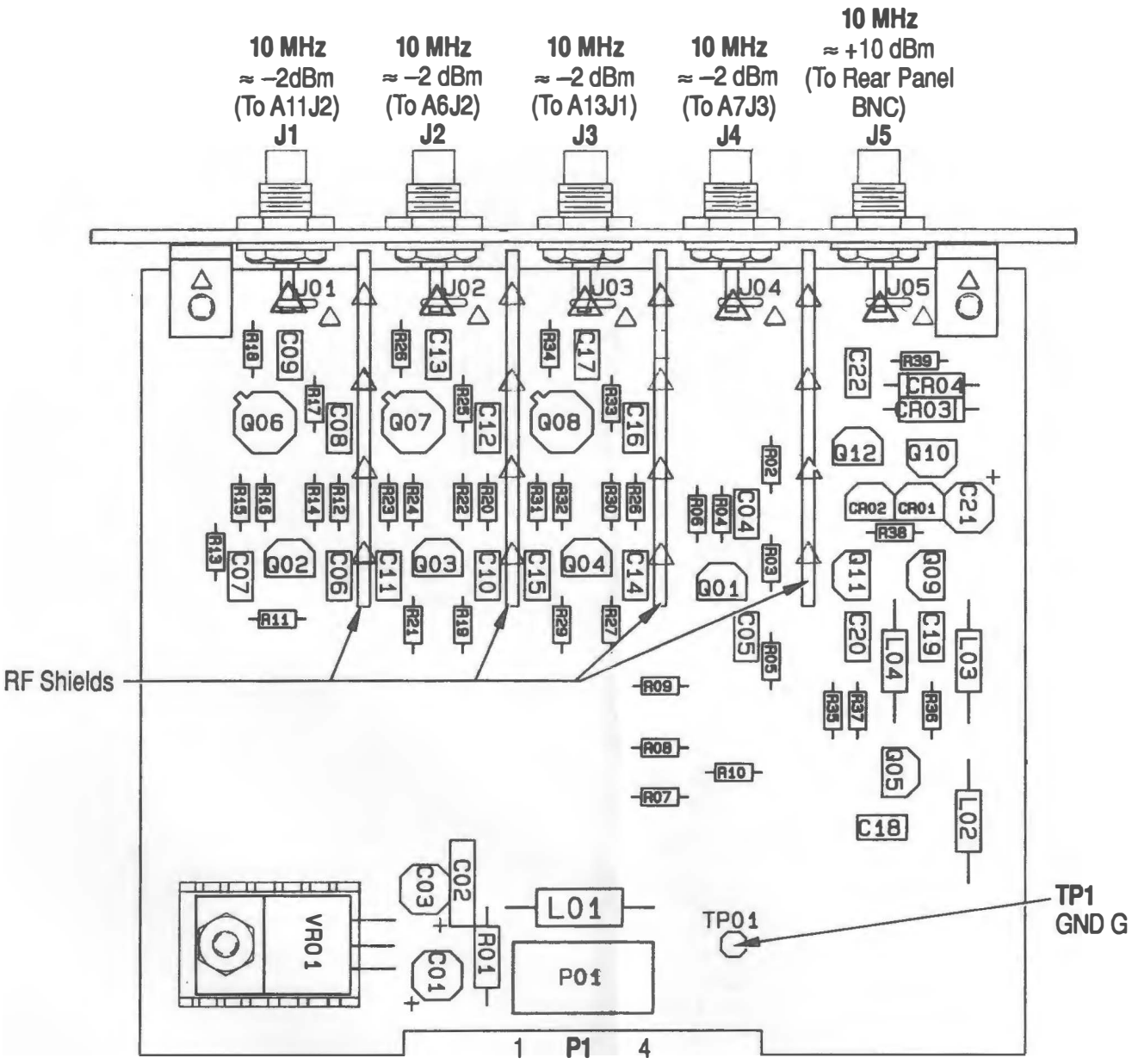
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.



3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUND:
4. TEST POINTS ARE DENOTED AS: (2)
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR7, CR8, Q1, U2-U4, U6, U7, VR1
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C32	C5-8
CR8	C29
L3	CR1-3
P1	Q2
Q8	R8
R43	
TP3	
U7	
VR1	

Figure 2E-5. A7 Reference Divider PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31707-3 (Rev. F)



NOTE:
Leading zeros on component number references may be disregarded.

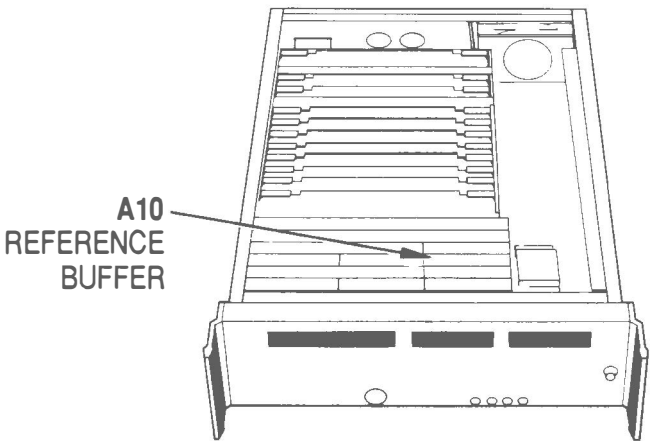
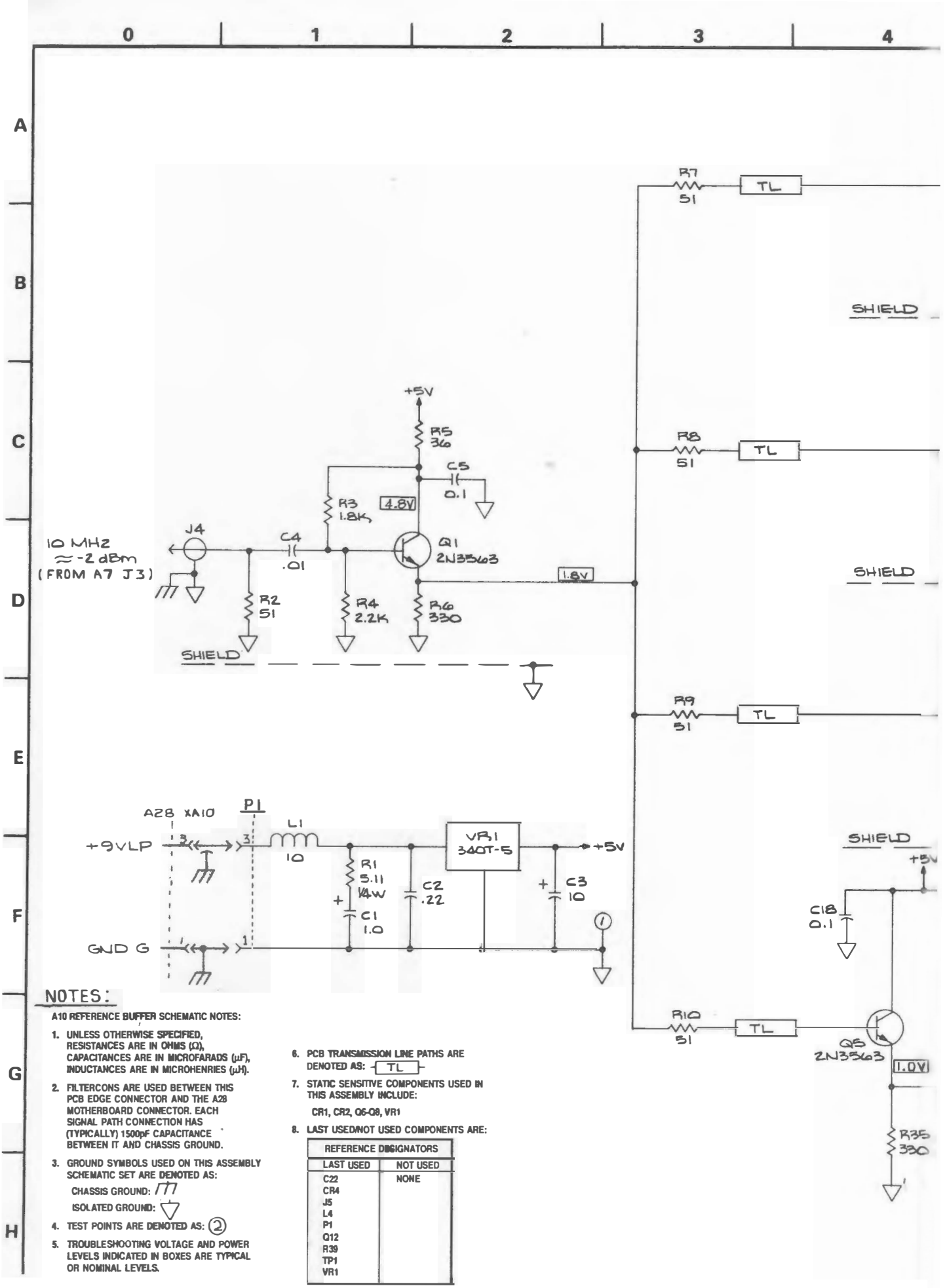


Figure 2E-6. A10 Reference Buffer PCB Parts Locator Diagram
6700-D-31710-3 (Rev. L)



NOTES:

A10 REFERENCE BUFFER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUND:
4. TEST POINTS ARE DENOTED AS: (2)
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: TL
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR1, CR2, Q6-Q8, VR1
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C22	NONE
CR4	
J5	
L4	
P1	
Q12	
R39	
TP1	
VR1	

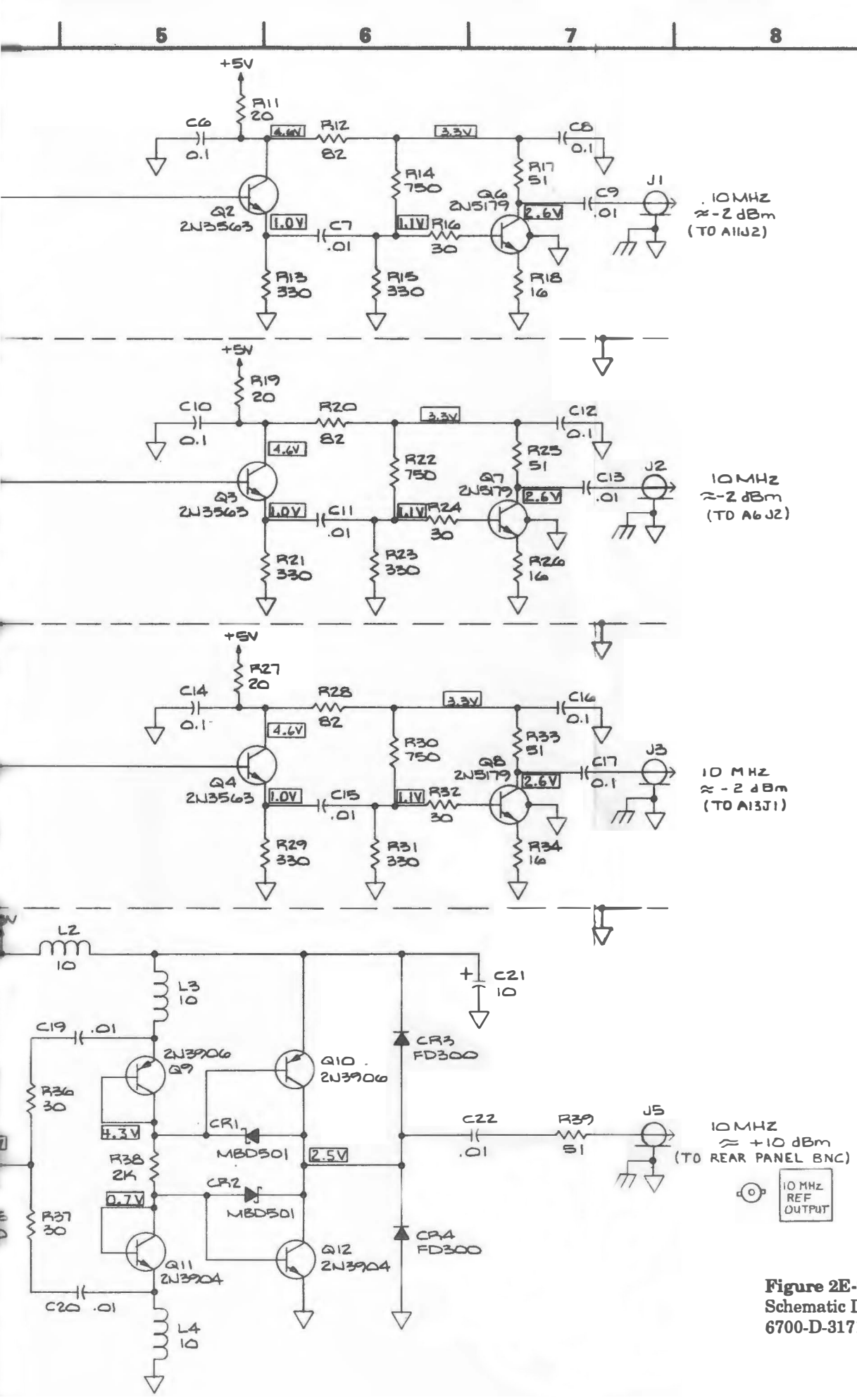


Figure 2E-7. A10 Reference Buffer PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31710-3 (Rev. E)

2F–COARSE LOOP A3, A4, AND A6 PCBs

2F-1 COARSE LOOP ASSEMBLIES: A3, A4, AND A6 PCBs

This section contains service information for the Coarse Loop frequency synthesizer circuits located on the A3 Coarse Loop Mixer PCB, A4 Coarse Loop Oscillator PCB, and A6 Coarse Loop Divider PCB. Refer to Table 2F-1 below. Refer also to the specific troubleshooting information for these PCBs that is located in the beginning of this section (Section 2–System Description and Troubleshooting.)

Table 2F-1. Coarse Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2F-2	2F-1
Block Diagram	Fig. 2F-1	2F-3
Troubleshooting	Para 2F-6	2F-9
PCB LEVEL		
A3 Coarse Loop Mixer PCB		
Detailed Circuit Description	Para. 2F-3	2F-2
Parts Locator Diagram	Fig. 2F-3	2F-10
Schematic (Sheet 1 of 1)	Fig. 2F-4	2F-11
A4 Coarse Loop Oscillator		
Detailed Circuit Description	Para. 2F-4	2F-2
Parts Locator Diagram	Fig. 2F-5	2F-12
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A6 Coarse Loop Divider PCB		
Detailed Circuit Description	Para. 2F-5	2F-5
Block Diagram	Fig. 2F-2	2F-9
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2F-2 COARSE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the overall block diagram of the Coarse Loop circuits shown in Figure 2F-1. The Coarse Loop is comprised of the A3 Coarse Loop Mixer PCB, the A4 Coarse Loop Oscillator PCB, and the A6 Coarse Loop Divider PCB.

The primary function of the Coarse Loop (CL) is to provide the coarse tuning frequency that is used by the YIG Loop circuits. The A4 Coarse Loop Oscillator PCB contains a voltage-controlled oscillator (VCO) comprised of a varactor-diode integrated circuit that generates an output frequency of 440-490 MHz. This Coarse Loop Oscillator (CLO) signal is buffered and fed to the A3 Coarse Loop Mixer PCB, where it is mixed with a fixed 500 MHz reference signal from the A5 Reference Oscillator PCB to produce the 10-60 MHz Coarse Loop IF signal. This IF signal is passed through a 80 MHz low pass filter and then goes to a limiter/ amplifier that prevents amplitude modulated noise from being translated into frequency modulated phase noise errors in the following A6 PCB circuits.

The amplified and limited CL IF signal is then divided by the A6 PCB divider circuits—either by integer division—or by fractional division—if required. The output of these circuits is a 2 MHz signal that contains the frequency and phase information of the CLO signal. This signal is fed to the A6 phase/frequency detector circuits.

The A6 PCB integer divider circuits provide only 2 MHz frequency division steps of the C.L. IF signal (which represents a 2 MHz resolution of the CLO signal). At high YIG oscillator frequencies, Coarse loop division steps finer than 2 MHz are needed. The A6 fractional divide circuits provide this capability.

The phase/frequency detector circuits compare the 2 MHz divided signal from the counter circuits with a 2 MHz reference signal that is derived from the 10 MHz signal from the A10 Reference Buffer PCB. The phase/frequency error signal produced by these circuits is filtered and then used to tune the CLO on the A4 PCB.

All A6 PCB counter functions are controlled by the serial data input from the A8 Serial I/O PCB. This control data is generated by the A23 Microprocessor, using information derived from the DVM circuits located on the A17 Analog Instruction PCB.

2F-3 A3 COARSE LOOP MIXER, DETAILED CIRCUIT DESCRIPTION

Refer to the schematic of the A3 PCB, Figure 2F-4, during the following description.

2F-3.1 Local Oscillator (LO) Input

The 500 MHz LO signal from the A5 Reference Oscillator PCB is input to A3J2 at an approximate level of +7 dBm. The LO signal goes through a 6 dB attenuator consisting of R11, R12, and R13. From the attenuator, the signal goes to amplifier Q2 where it is amplified back to a +7 dBm level. This attenuation/amplification process isolates the signal, thus preventing it from reflecting back into the A5 Reference Oscillator PCB. Capacitor C9 couples the signal from the collector of Q2 to the input of the double balanced mixer, U1.

2F-3.2 440-490 MHz RF Input

The 440-490 MHz coarse loop signal from the output of the A4 Coarse Loop Oscillator PCB (A4J2) is input to A3J3 at an approximate +3 dBm level. Resistors R1, R2, and R3 attenuate the signal by 16 dB, which provides isolation to prevent the 500 MHz reference oscillator signal and the IF signal from the mixer from reflecting back into the A4 coarse loop oscillator circuit.

The signal from the 16 dB attenuator is amplified by Q1 and and goes to the 6 dB attenuator composed of R9 and R10. The signal level at the output of this attenuator is approximately –17 dBm. This signal is fed to one input of mixer U1, where it is mixed with the 500 MHz LO signal from the A5 Reference Loop Oscillator PCB. The resulting 60 to 104 MHz IF signal at the output of U1 has a level of approximately –26 dBm.

2F-3.3 Limiter/Amplifier

From the mixer, the IF signal goes to the 80 MHz low pass filter consisting of L2, L3, C10, C11, and C12. Resistor R18 provides the proper termination for the mixer and low pass filter. At this point, the IF signal level is approximately –33 dBm.

The signal goes to amplifier Q3, which provides a gain of approximately 20 dB. The output of Q3 is coupled by C15 to Q4 and Q5 which are arranged as an ac-coupled differential amplifier (ac-coupled by C16). This amplifier has a small signal gain of approximately 12 dB. For input signals > –6 dBm, Q4 and Q5 have a gain of about 6 dB. This limiting action prevents any AM component on the IF signal from causing an FM component in the phase detector output signal (which would degrade the phase noise performance of the oscillator).

The output of Q5 goes to the input of emitter follower Q6. The output of U6 is coupled to connector A3J1 by R34 and C21. (Resistor R34 provides the 50 Ohm source match for this output, and C21 blocks the dc component on the Q6 emitter.) This signal goes to connector A6J1 of the A6 Coarse Loop Divider PCB.

2F-4 A4 COARSE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A4 PCB schematic in Figure 2F-6 during the following description.

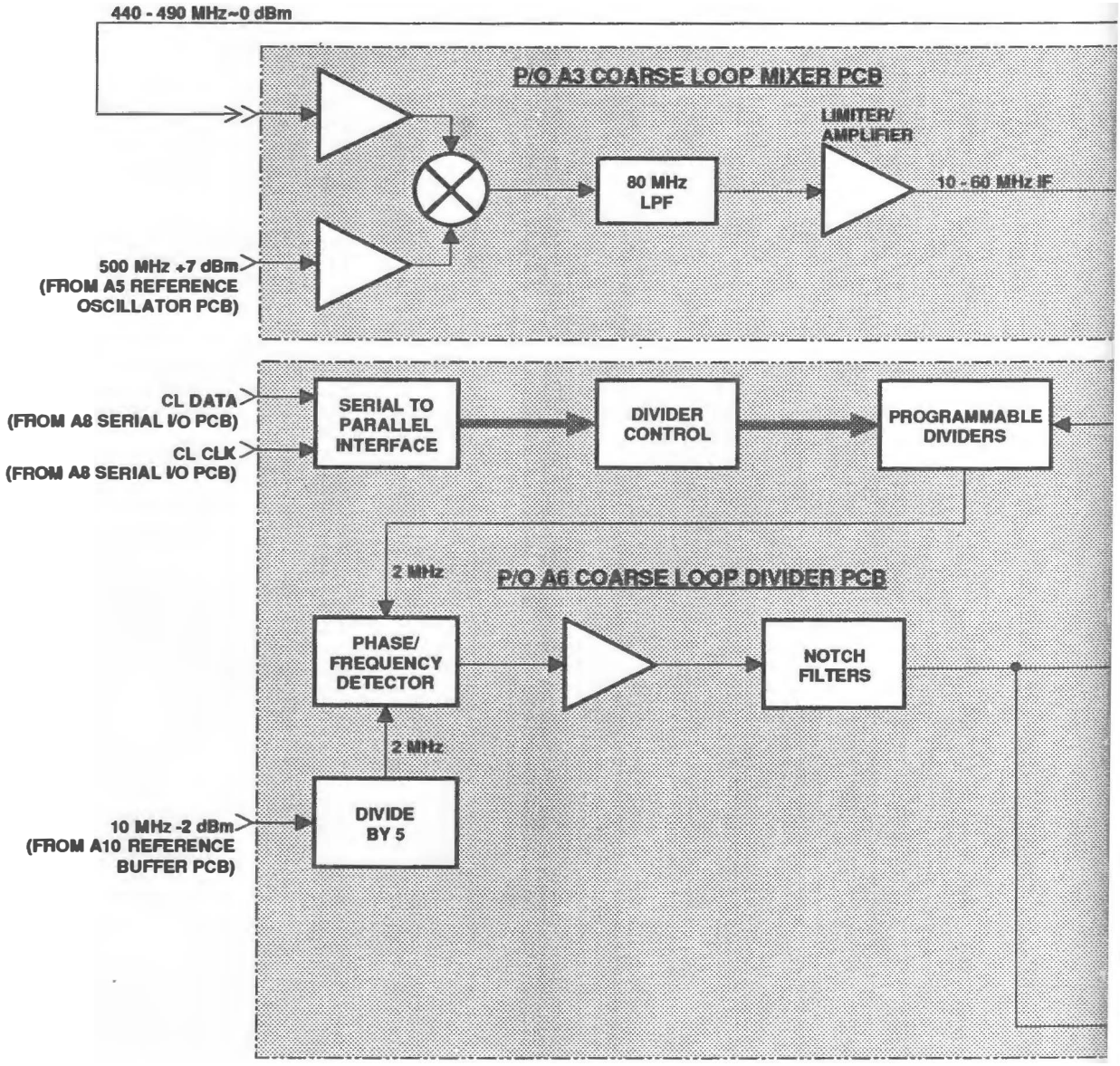
2F-4.1 Input Amplifier

The coarse loop phase detector error signal from the A11 Coarse Loop Divider PCB is input at A4P1, pin 7, and then goes to the input of the unity gain differential receiver, U1A. The output of U1A goes to the four-element low pass filter consisting of L1, L2, C3, and C4. This low pass filter reduces the 2 MHz power level of the error signal to bring the 2 MHz sidebands on the VCO output within acceptable limits. In order to keep the sidebands out of the final RF output signal, they must be at least –109 dBc. The filter also reduces the 600 kHz, 800 kHz, and 1 MHz fractional division sidebands to –41 dBc, –28 dBc, and –89 dBc, respectively.

2F-4.2 Loop Amplifier

From the low pass filter, the signal goes to the input of Loop Amplifier, U1B. The network comprised of R26 and C21 sets the basic coarse loop bandwidth to approximately 5 kHz. The output of U1B is the tuning control voltage for the Coarse Loop Oscillator, Y1.

The circuit comprised of FET Q4, R10, and R12-R14 is used to adjust the coarse loop gain as a function of the coarse loop operating frequency. This is done in order to normalize to coarse loop bandwidth throughout the range of operation of the A6 Coarse Loop Divider PCB. As the output of loop amplifier U1B goes more negative, the conductance of Q4 increases, which increases the gain of U1B. Variable


440 - 490 MHz~0 dBm
P/O A3 COARSE LOOP MIXER PCB
LIMITER/
AMPLIFIER
80 MHz
LPF
10 - 60 MHz IF
500 MHz +7 dBm
(FROM A5 REFERENCE
OSCILLATOR PCB)
CL DATA
(FROM A8 SERIAL I/O PCB)
CL CLK
(FROM A8 SERIAL I/O PCB)
SERIAL TO
PARALLEL
INTERFACE
DIVIDER
CONTROL
PROGRAMMABLE
DIVIDERS
2 MHz
P/O A6 COARSE LOOP DIVIDER PCB
PHASE/
FREQUENCY
DETECTOR
NOTCH
FILTERS
2 MHz
10 MHz -2 dBm
(FROM A10 REFERENCE
BUFFER PCB)
DIVIDE
BY 5

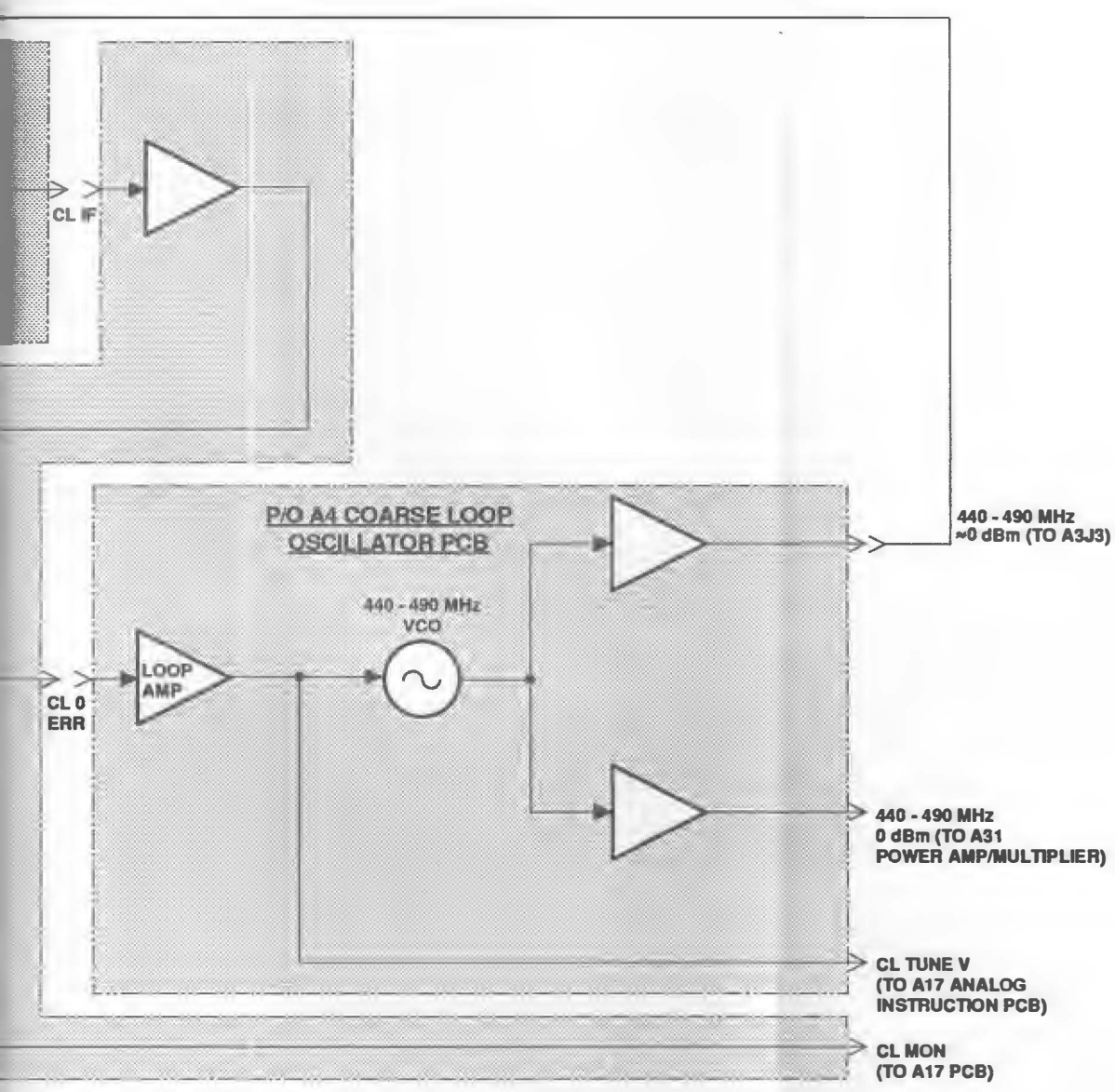


Figure 2F-1. Block Diagram of Coarse Loop Circuits

resistor R14 is used to adjust the operating point of this circuit.

NOTE:
Variable resistor R14 is adjusted during initial calibration at WILTRON. No attempt should be made to adjust R14 without proper equipment. Contact WILTRON Customer Service Department at (408) 778-2000 for further information.

The output of loop amplifier U1B is clamped so that the coarse loop oscillator, Y1, will not produce frequencies outside of the desired operating range. (The clamping limits described below are for the -4 configuration of the A4 PCB.)

The circuit comprised of Q5, CR1, CR2, and R18-R20 clamps the most "positive" output of U1B so that the lowest coarse loop oscillator frequency is above approximately 420 MHz. The circuit comprised of Q6, Q7, CR3, R42-R47, and C45 clamps the most negative output of U1B so that the highest coarse loop oscillator frequency is below approximately 500 MHz. Variable resistor R47 is used to adjust the operating point of this circuit.

Whenever the A4 Coarse Loop Oscillator PCB is replaced, the operation and adjustment of these circuits should be verified before using the synthesizer. For further information regarding performance verification and/or adjustment procedures for these circuits, contact WILTRON Customer Service Department at (408) 778-2000.

The output of U1B is also coupled to pin 5 of connector A4P1 via the voltage divider/isolation network comprised of R15-R17. This is the CL TUNE signal that goes to the DVM circuits located on the A17 Analog Instruction PCB (for monitoring by the A23 Microprocessor).

NOTE:
Pressing <Shift> TRIGGER 012 displays the CL TUNE signal voltage on the front panel LEVEL display for troubleshooting and calibration.

2F-4.3 Coarse Loop Oscillator Circuit

The varactor-diode oscillator integrated circuit, Y1, is tuned through a frequency range of 440-490 MHz by the output of U1B; see Table 2F-2. The output of Y1 is fed in parallel to buffer amplifiers U2 and U3.

Table 2F-2. Y1 Tune Control Voltage Range

Tune Voltage	Output Frequency
≈ –10.3V	440 MHz
≈ –11.9V	465 MHz
≈ –13.6V	490 MHz

2F-4.4 Buffer Amplifiers

Buffer amplifiers U2/U3 isolate the two RF OUTPUT connectors, A4J1 and A4J2 and buffer the output of Y1. These amplifiers also provide an approximate 12 dB gain that sets the output signal level to approximately 0 dBM at both connectors.

The output of U2 is coupled to A4J1 via C17. This signal is the Coarse Loop signal that goes to the A31 Power Amplifier/Multiplier module located on the microwave deck. The output of U3 is coupled to A4J2 via C18. This signal is the Coarse Loop signal that goes to the A3 Coarse Loop Mixer PCB.

2F-5 A6 COARSE LOOP DIVIDER PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the block diagram of the A6 PCB, Figure 2F-2 (page 2F-9). Refer also to the schematic diagram of the A6 PCB, Figure 2F-8.

2F-5.1 Serial Input Control

Shift registers U2 and U5 control all A6 PCB counter functions using control data from the A8 Serial I/O PCB. Schmitt trigger gates U1A–U1D improve the rise and fall times of the data clock and data signals that are input from the A8 PCB. The data signals require two clock pulses per data bit to be transferred into the shift registers. Since U2 and U5 are in series, it requires 32 clock cycles each time the A23 Microprocessor sends data to the A6 Coarse Loop Divider PCB.

Once the data transfer is complete, the outputs of shift registers U2 and U5 remain stable until the A23 microprocessor sends new data. Each time the frequency of the coarse loop oscillator is changed, U2 and U5 receive new data to program the counters.

2F-5.2 Coarse Loop IF Input

The 10 to 60 MHz IF signal from the A3 Coarse Loop Divider PCB is input at connector A6J1 with a level of approximately –2 dBm. The IF signal is ter-

minated by R12 and coupled via C11 to amplifier Q1, which has a gain of approximately two. The output of Q1 drives buffer gate U8B that produces an ECL-compatible clock signal that drives the coarse loop divider counters (U4/U7) and the divide-by-two flip-flop, U9A.

2F-5.3 Course Loop Counter Chain Operation

The coarse loop counter chain is implemented as a N+1 counter circuit. In the integer count mode of operation, these circuits divide the CL IF signal by whole integer ratios only. In the fractional division mode, the count ratios include fractional (decimal) components, as described below.

a. Integer Division Mode of Operation

The main coarse loop counter circuits are comprised of presetable up/down hexadecimal counters U4/U7 and J-K flip-flop, U9A. Counters U4/U7 are controlled by the Q outputs of shift register U2 as modified by the 4-bit adder integrated circuits, U3 and U6. In the integer count mode of operation, these circuits divide the CL IF signal by integer ratios of 5 to 30. Refer to Table 2F-3 which lists example A6 division ratios and the corresponding CLO and CL IF signal frequencies. As can be seen from the table, each integer division step corresponds to a 2 MHz step in the CLO and CL IF signal frequencies.

Table 2F-3. Example A6 PCB Division Ratios vs CLO Frequencies

A6 Division Ratio	CLO IF Freq (MHz)	CLO Freq (MHz)
5	10	490
6	12	488
7	14	486
•		
•		
28	56	444
29	58	442
30	60	440

b. Fractional Division Mode of Operation

At higher RF output frequencies, the 2 MHz CLO division steps are insufficient to provide adequate frequency resolution. To tune the YIG oscillator to an RF output frequency of approximately 20 GHz, the A31 Power Amplifier Assembly divides the coarse loop oscillator signal frequency (490 MHz) by two and effectively multiplies it by 82. This results in a harmonic comb signal output with a harmonic signal spacing of 82 MHz (in the vicinity of 20 GHz). This is inadequate, since harmonic comb signals must have a spacing of ≤20 MHz (minimumFine Loop Frequency divided by 10) near the desired YIG tune frequency. To solve this problem, fractional division of the C.L. IF signal is performed by the A6 counter circuits. This technique results in a coarse loop resolution of 200 kHz. Note that 200 KHz divided by two and multiplied by 82 results in a 8.2 MHz harmonic comb spacing in the vicinity of 20 GHz. This is well within the 12 MHz tuning range (20 to 32MHz) of the fine loop oscillator/counter circuits.

The mode of operation of counters U4/U7 is modified by the fractional division count control circuits to produce division ratios that contain fractional components. These circuits are comprised of:

- Rate-multiplier integrated circuit U10,
- Waveform control and synchronization circuit comprised of Flip-flops U11A/U11B,
- Bi-phase clock generation circuit comprised of U20D, Q7 and Q8,
- Shift register U5, which controls U10.

When active, these circuits cause the main coarse loop counters (U4/U7) to count by a factor of N+1 instead of N for the percentage of time determined by the number programmed into U10. For example, a divide ratio of 10.3 is obtained as follows:

1. Counters U4/U7 are programmed to divide the CL IF signal by a factor of 10.
2. U10 is preset to 3.
3. U4/U7 divide by 10 for 70% of the time and by 11 for the remaining 30%. This results in a total count during one period of the 2 MHz clock of [(7 X 10)+(3 X 11)] = 103. This corresponds to a count ratio of 103/10 = 10.3.

In the example above, the CL IF signal frequency would be 10.3 X 2 MHz = 20.6 MHz, which corresponds to a CLO signal frequency of 479.4 MHz. If U10 had been programmed to 1 instead of 3, the division ratio would have been 10.1 and the resultant CLO frequency would have been 479.8 MHz. Note that by loading different counts into U10, any 200 kHz step can be obtained between the integer division steps.

2F-5.4 10 MHz Reference Input

The 10 MHz signal from the A10 Reference Oscillator module is input at connector A6J2 with a level of approximately –2 dBm. The signal goes to termination resistor R68 and to the emitter of transistor Q5, which is configured as a temperature-compensating diode for transistor Q5. Amplifier Q5 converts the 10 MHz signal to TTL levels. Diode CR6 improves the 10 MHz input signal rise time by preventing Q6 from becoming saturated. The output of Q6 goes to U16, which is a presetable counter that is configured to divide-by-5. The output of U16 is the 2 MHz TTL-level signal that is the reference frequency input to the phase detector circuits.

2F-5.5 Phase/Frequency Detector

The A6 phase/frequency detector circuits comprised of J-K flip-flops U14A /U14B, operational amplifier U16, diodes CR2–CR5, and associated filter components. Flip-flops U14A and U14B operate in the same manner as the phase/frequency detector circuits located on the A7 Reference Divider PCB (refer to the circuit description for these circuits located in Section 2E–Reference Loop). However, the A6 phase detector circuits operate at 2 MHz (i.e., the Coarse Loop reference frequency) instead of 10 MHz.

When the loop is phase locked, the Q outputs of U14A and U14B consists of narrow (≈ 20 ns) pulses at a 2 MHz rate. These pulses are *almost* identical , as explained below. These outputs are connected to the steering diode switches CR2-CR5.

Diodes CR2-CR5 are controlled by the Q outputs of U14A and U14B. They switch the decoupled +15V from R35 into the phase detector integrator filter networks comprised of R36-C24 and R37-C27. these filters integrate the 2 MHz pulses into a resultant dc voltage that is applied to the inputs of U16. Resistors R38 and R39 provide the bias voltage to CR3 and CR5 for proper switching action and C28 and C31 provide additional filtering of the 2 MHz signal component.

When the Q output of U14A is low, CR2 conducts and CR3 shuts off. When the Q output is high, CR2 shuts off and CR3 conducts the current from R33 and R35 into the R36-C24 filter network. Diodes CR4/CR5, resistors R34/R35, and filter R37-C27 work in a similar manner for the Q output of U14B. The charges on C24 and C27 sums with the currents through R36/R38 and R37/R39 to produce a resultant dc voltage at the input of U16. The output of U16 is the (unfiltered) coarse loop phase error signal.

At zero phase difference, the output sensitivity (output pulse width versus phase difference) of the D-type flip-flop phase detector circuit decreases. When the phase detector operates in this region, this decrease affects the loop gain and loop bandwidth. This can cause loop instability and poor phase noise performance of the loop. (This point of the phase detector is also called the dead zone).

To reduce the dead zone, the A6 phase detector circuits are designed to function in an offset mode of operation. The pulse width of the two input signals to flip-flops U14A and U14B are unequal: the 10 MHz reference signal from U6 has a pulse width of approximately 40 ns, and the F DIV signal from the coarse loop divider circuits (U7) has a pulse width of approximately 20 ns. Also, resistor R38 is smaller than R39.

During phased locked operation, the loop amplifier on the A4 Coarse Loop Oscillator PCB forces the output of U16 to be 0V when the loop is phase locked. To counteract the extra current through R38, the pulse output at U14B is therefore *slightly* wider than that at U14A (this phase lock offset is approximately 5 degrees).

2F-5.6 Notch Filters

The phase information contained on the output of U16 goes to the notch filters before being routed to the loop amplifier on the A4 Coarse Loop Oscillator PCB. When the divider is set for fractional division, there is a 200 kHz component and its related harmonics on the output of U16. If unfiltered, these 200 kHz components and related harmonics cause 200, 400, 600, and 800 kHz sidebands on the A4 Coarse Loop Oscillator output. These sideband signal components multiply, along with signal components from the Coarse Loop Oscillator signal, and show up in the final RF output signal. The notch filter circuits reduce these levels so they are typically better than –70 dBc in the final RF output.

The A6 Coarse Loop Divider PCB contains three notch filters; two 200 kHz filters and one 400 kHz filter. The 400 kHz low pass filter, which is located on the A4 Coarse Loop Oscillator PCB, reduces the other harmonically related signals.

The first 200 KHz notch filter is comprised of U17B/U17A and associated components. This circuit reduces the 200 KHz signal components of the coarse loop phase error signal (thus reducing the amount of these components that appear in the final RF output signal). The output of this filter goes to the input of the 400 KHz notch filter.

The 400 KHz notch filter is comprised of U18B/U18A and associated components. This circuit reduces the 400 KHz signal components of the coarse loop phase error signal. The output of this circuit goes to the input of the second 200 KHz notch filter comprised of U19B/U19A and associated components. This circuit is identical in operation to the first 200 KHz notch filter.

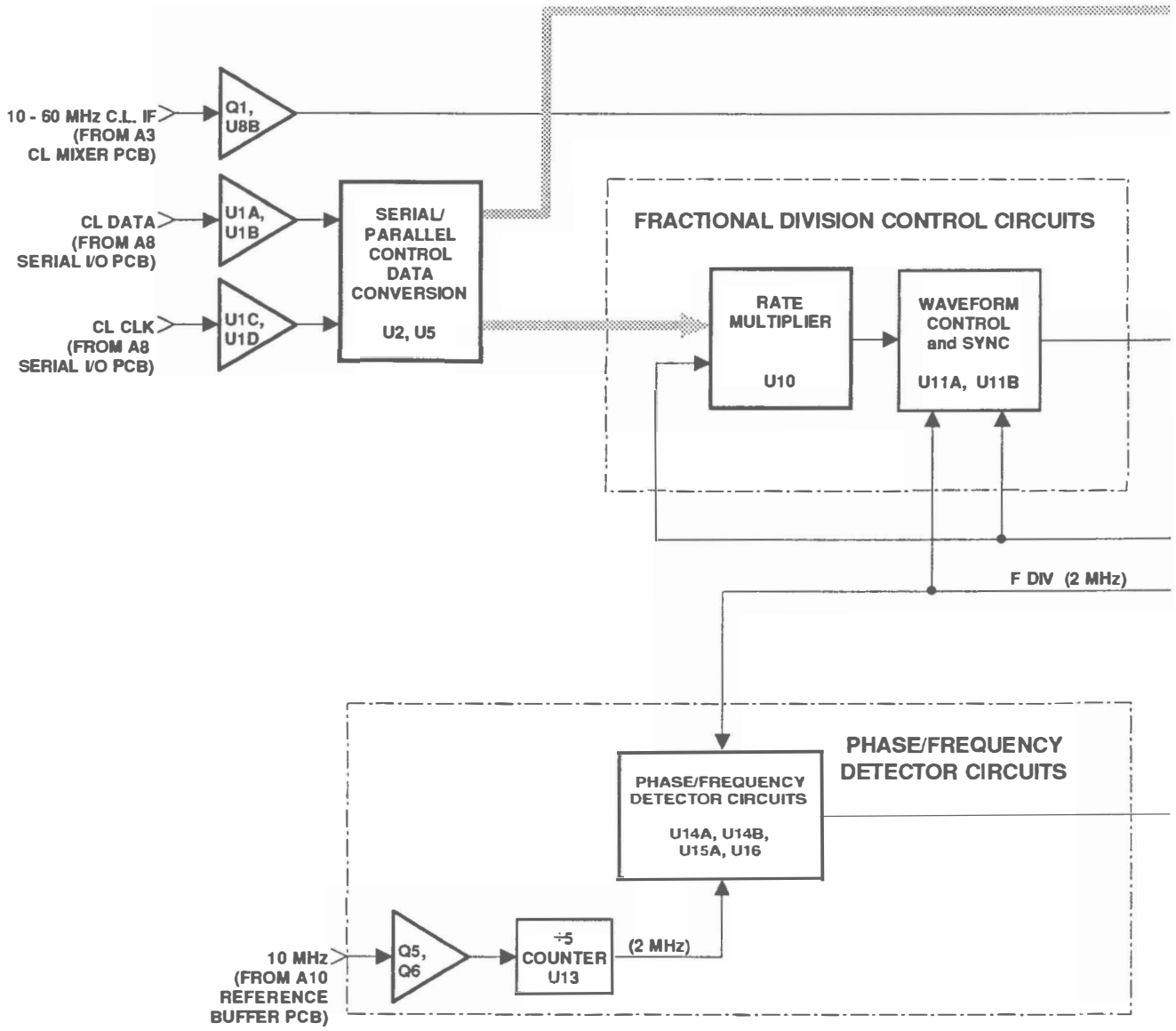
The output of U19B is the filtered coarse loop error signal, CL 0 ERR, that go to the A4 Coarse Loop Oscillator PCB. The output of U19B is also fed through isolation network comprised of R63/R64 and C50 to become the CL MON signal to the A17 Analog Instruction DVM circuit. The A23 Microprocessor monitors this point via the A17 PCB DVM circuits to determine if the Coarse Loop is phase locked or not.

2F-6 COARSE LOOP ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the coarse loop subsystem and probable causes of the failures.

2F-7 COARSE LOOP ASSEMBLIES, SERVICE SHEETS

Table 2F-1 on the first page of this section the location of the block diagrams, schematics, and parts locator diagrams for the A3, A4 and A6 PCBs.


10 - 60 MHz C.L. IF
(FROM A3
CL MIXER PCB)
Q1,
U8B
CL DATA
(FROM A8
SERIAL I/O PCB)
U1A,
U1B
CL CLK
(FROM A8
SERIAL I/O PCB)
U1C,
U1D
SERIAL/
PARALLEL
CONTROL
DATA
CONVERSION
U2, U5
FRACTIONAL DIVISION CONTROL CIRCUITS
RATE
MULTIPLIER
U10
WAVEFORM
CONTROL
and SYNC
U11A, U11B
F DIV (2 MHz)
PHASE/FREQUENCY
DETECTOR CIRCUITS
PHASE/FREQUENCY
DETECTOR CIRCUITS
U14A, U14B,
U15A, U16
10 MHz
(FROM A10
REFERENCE
BUFFER PCB)
Q5,
Q6
÷5
COUNTER
U13
(2 MHz)

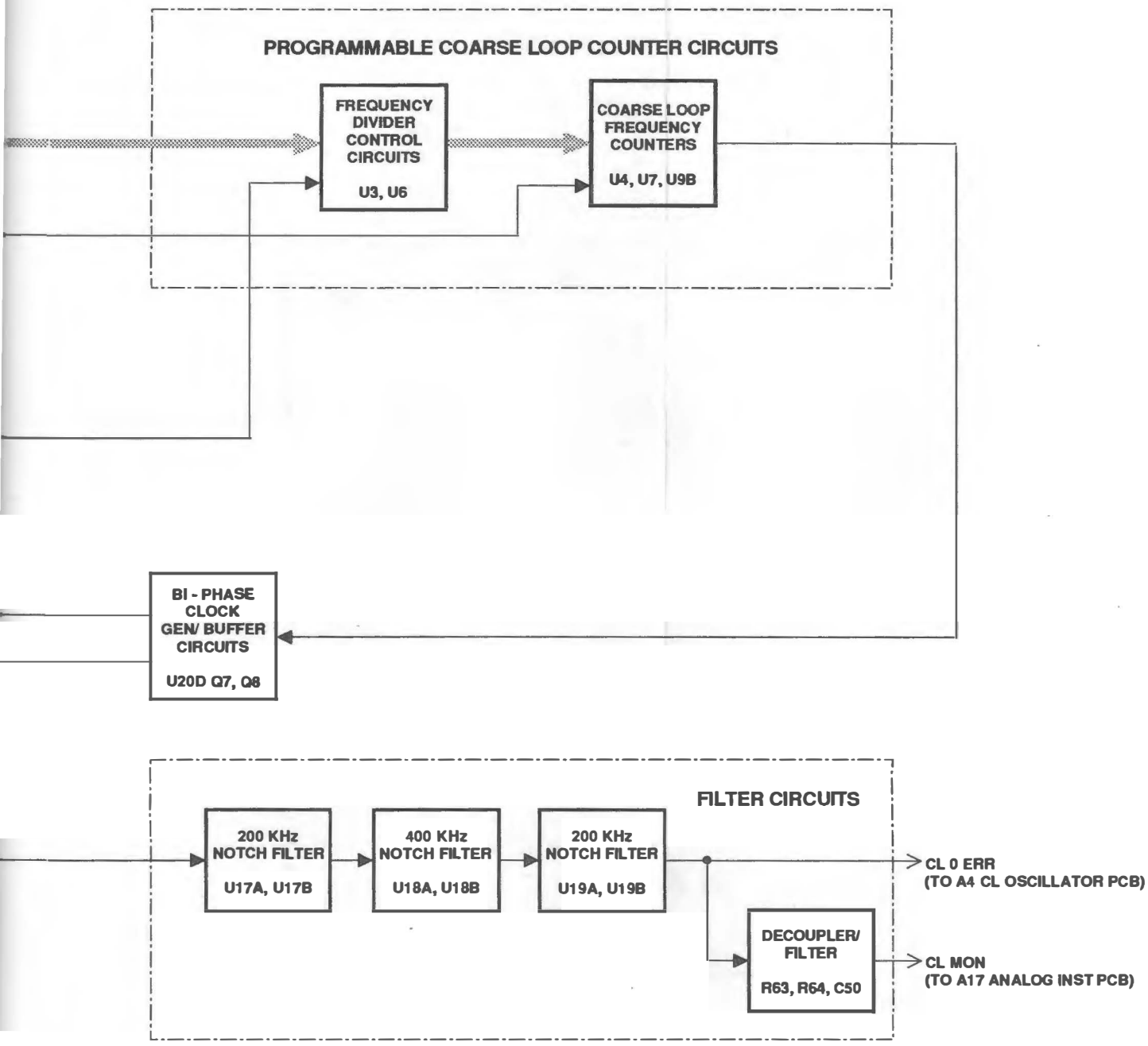
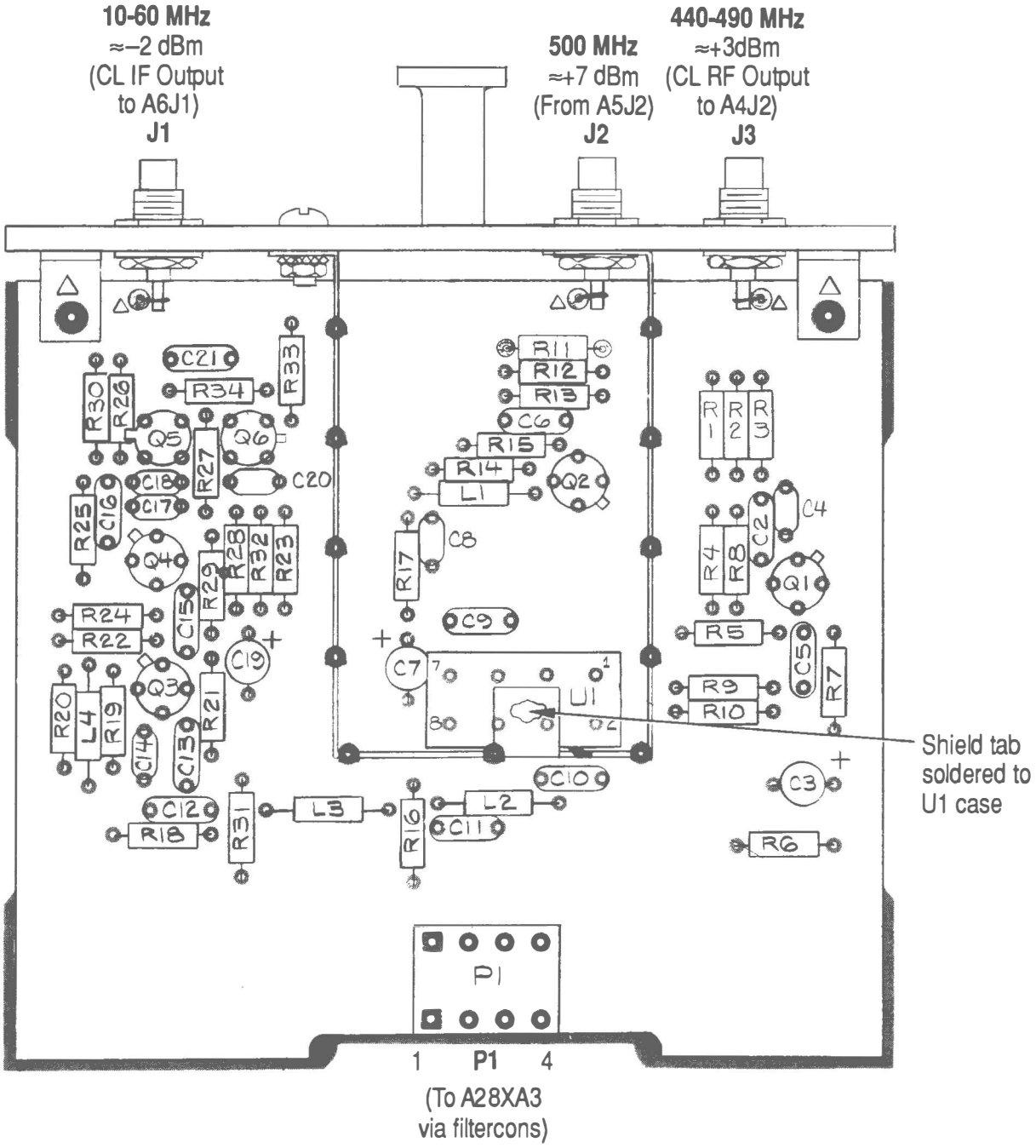


Figure 2F-2. Block Diagram of A6 Coarse Loop Divider PCB


10-60 MHz
≈–2 dBm
(CL IF Output
to A6J1)
J1
500 MHz
≈+7 dBm
(From A5J2)
J2
440-490 MHz
≈+3dBm
(CL RF Output
to A4J2)
J3
C21
R33
R34
R30
R26
Q5
Q6
R27
C18
C17
C20
R25
C16
Q4
R28
R32
R23
R29
C15
R24
R22
C19
Q3
R20
L4
R19
C14
C13
R21
C12
R18
R31
L3
R16
L2
C11
C10
R11
R12
R13
C6
R15
R14
L1
Q2
C8
R17
C9
C7
U1
R1
R2
R3
C4
C2
R4
R8
Q1
R5
C5
R7
R9
R10
C3
R6
Shield tab
soldered to
U1 case
P1
1
P1
4
(To A28XA3
via filtercons)

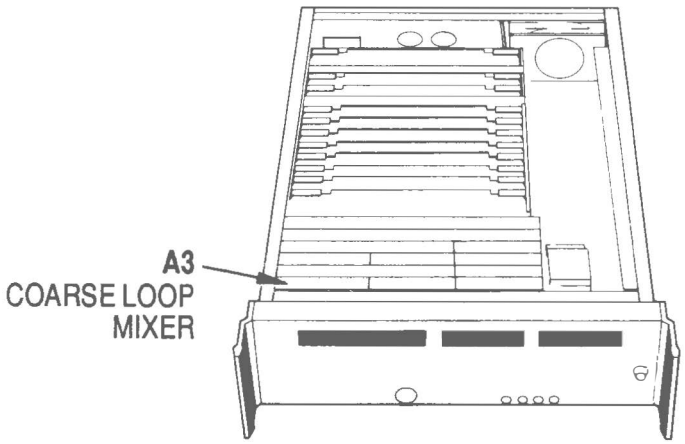
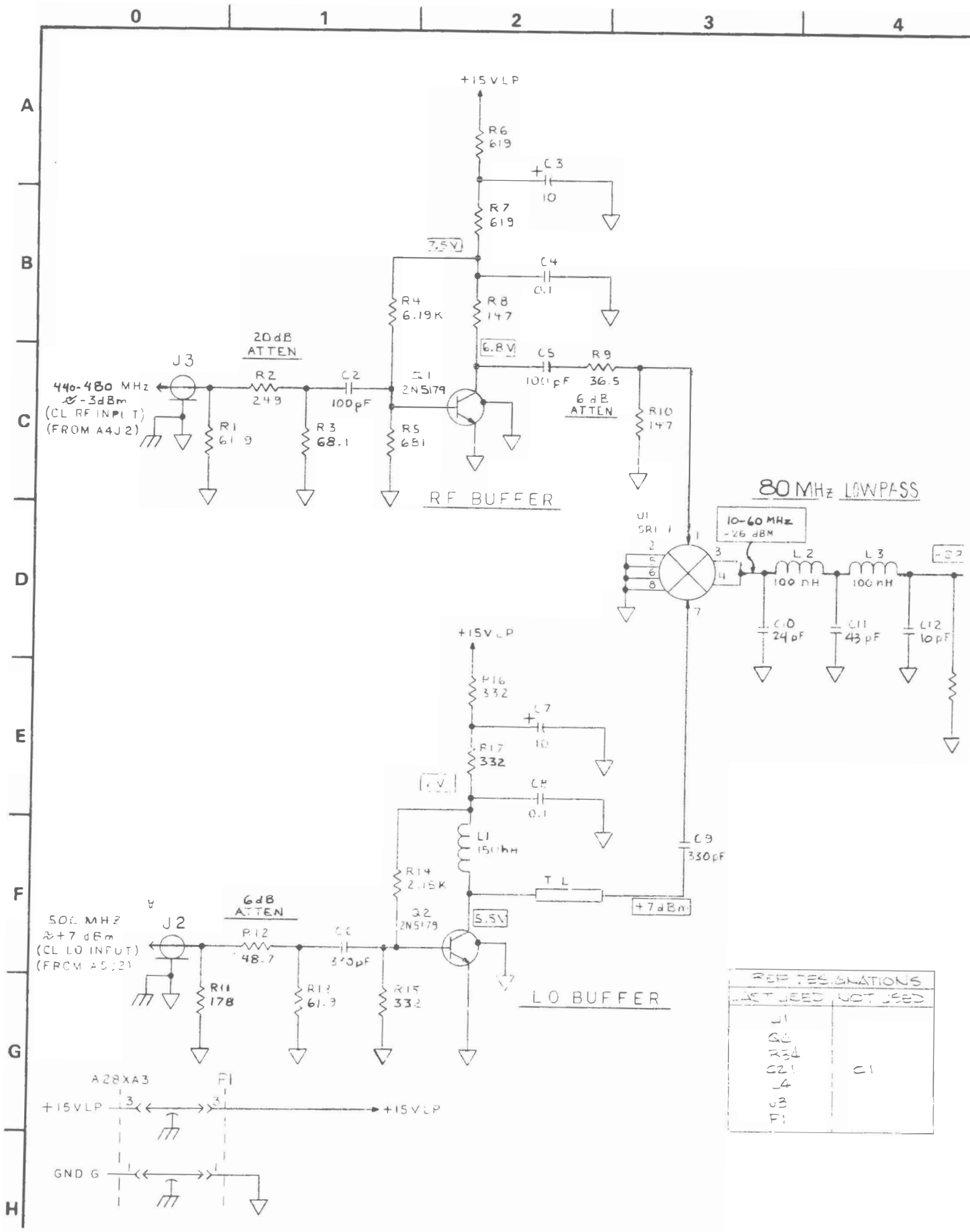


Figure 2F-3. A3 Coarse Loop Mixer PCB Parts Locator Diagram
6700-D-31703-3 & -4 (Rev. E)


0
1
2
3
4
A
B
C
D
E
F
G
H
+15VLP
R6 619
C3 10
R7 619
7.5V
C4 0.1
R4 6.19K
R8 147
6.8V
C5 100pF
R9 36.5
6dB ATTEN
R10 147
20dB ATTEN
J3
440-480 MHz
≈-3dBm
(CL RF INPUT)
(FROM A4J2)
R2 249
C2 100pF
Q1 2N5179
R1 61.9
R3 68.1
R5 681
RF BUFFER
80 MHz LOWPASS
U1 SRA-1
10-60 MHz
-26 dBM
L2 100 nH
L3 100 nH
C10 24 pF
C11 43 pF
C12 10 pF
+15VLP
R16 332
C7 10
R17 332
7V
C8 0.1
L1 150nH
C9 330pF
R14 2.15K
T L
+7dBm
6dB ATTEN
J2
50 MHz
≈+7 dBm
(CL LO INPUT)
(FROM A5J2)
R12 48.7
C6 330pF
Q2 2N5179
5.5V
R11 178
R13 61.9
R15 332
LO BUFFER
A28XA3
P1
+15VLP
GND G
REF DESIGNATIONS
LAST USED
NOT USED
J1
C6
R34
C21
J4
U3
P1
C1

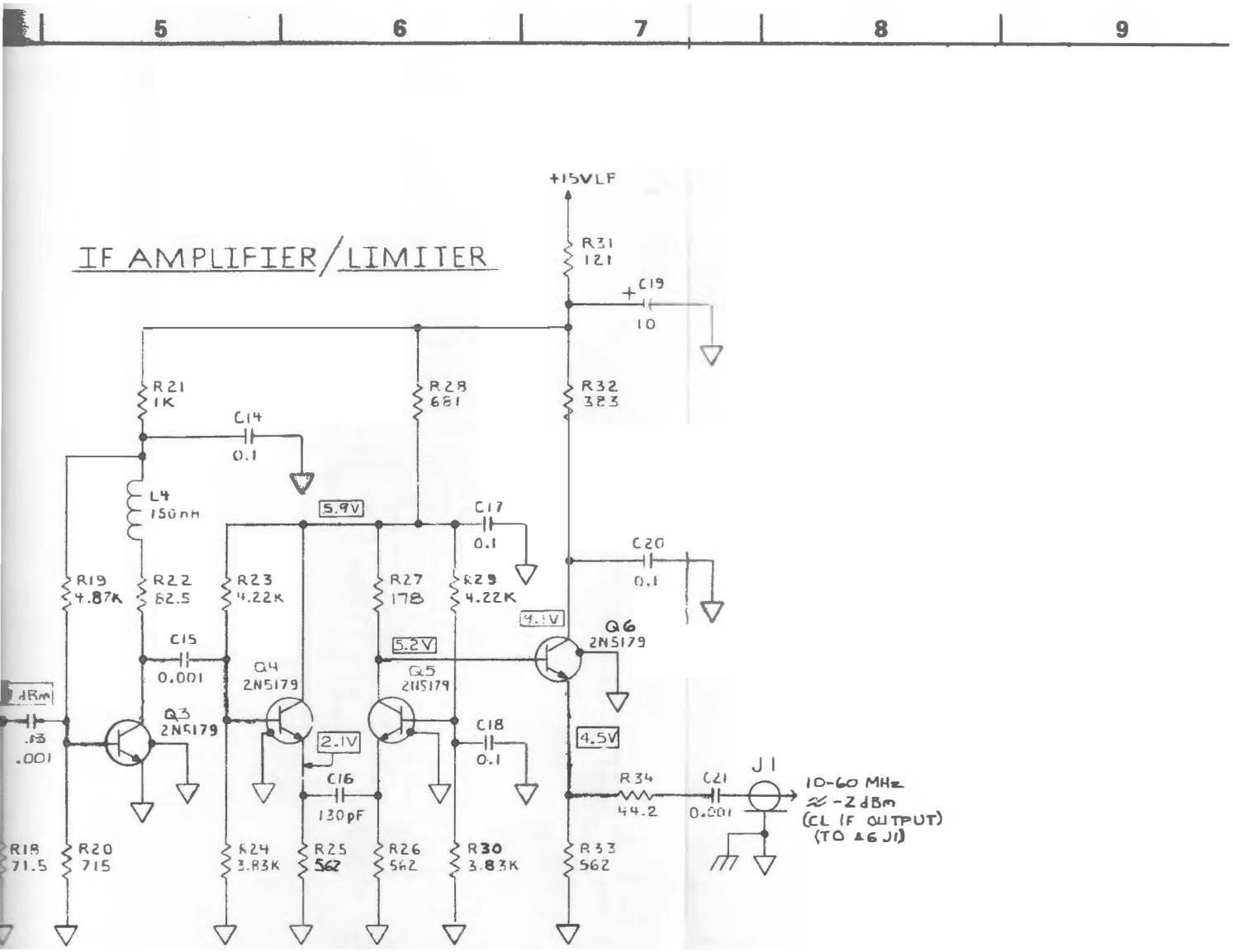
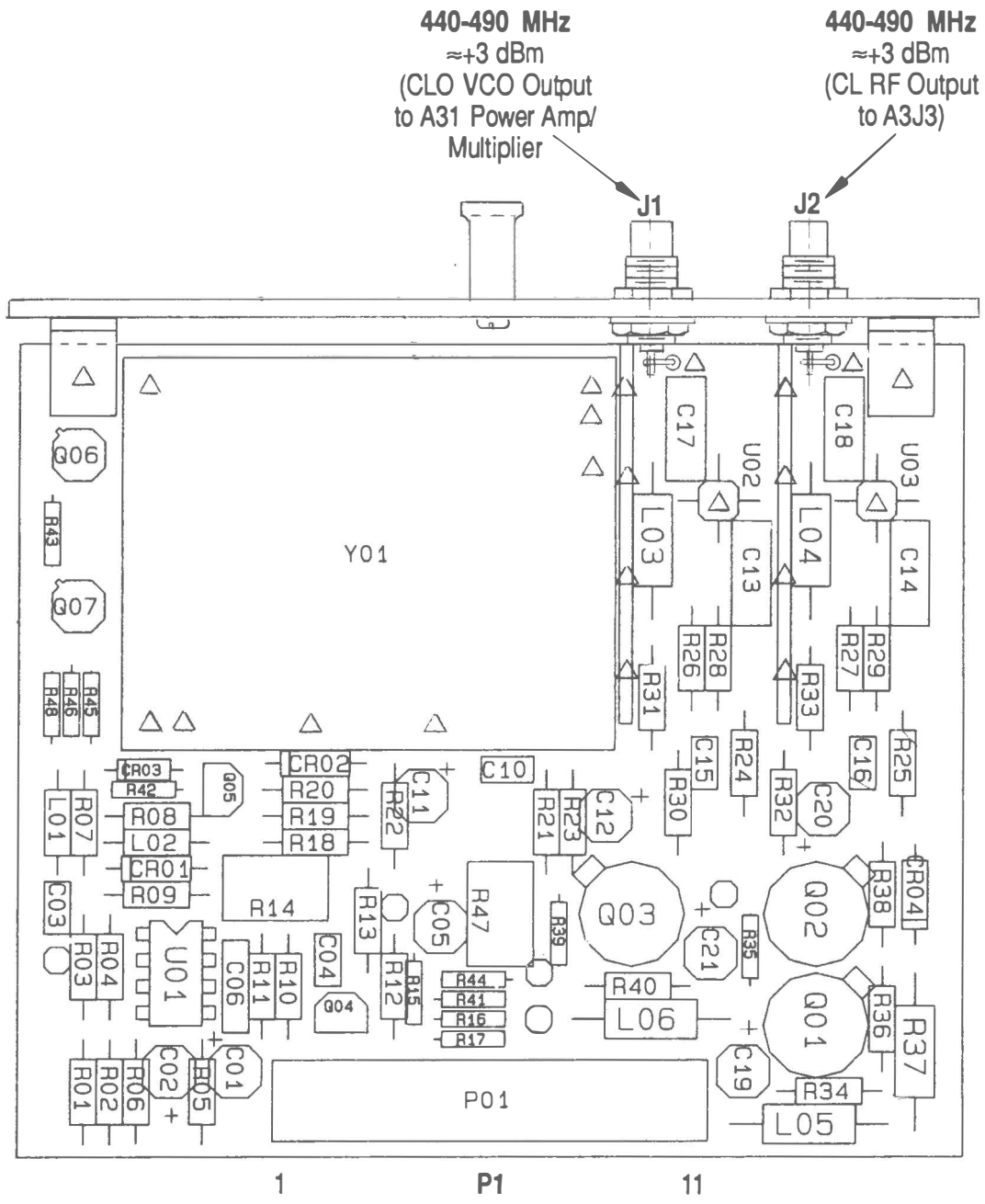


Figure 2F-4. A3 Coarse Loop Mixer PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31703-3 & -4 (Rev. C)



(To A28XA4 via filtercons)

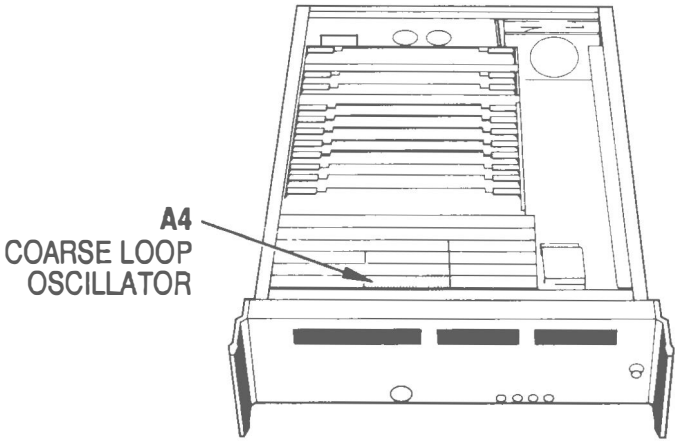
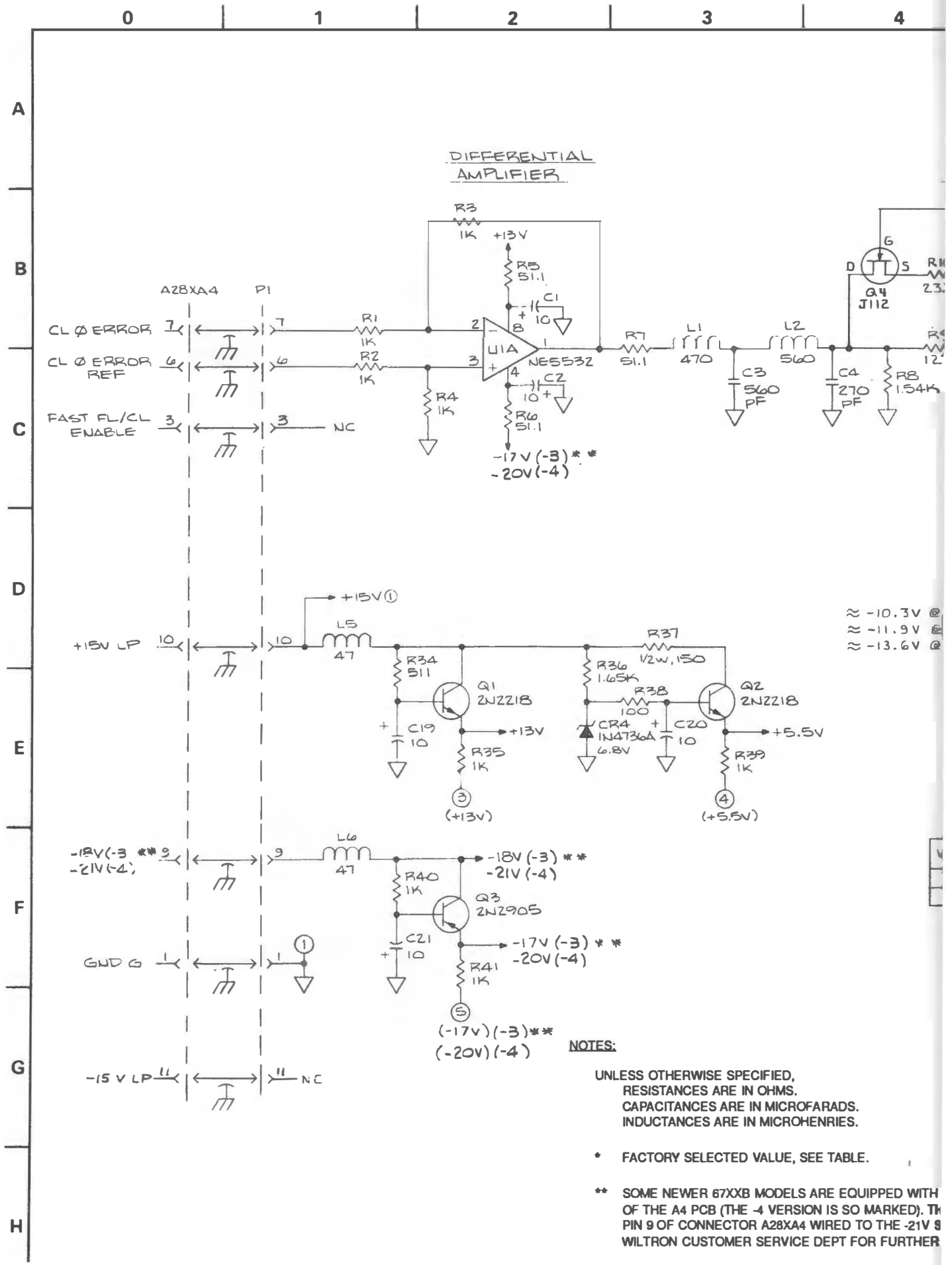


Figure 2F-5. A4 Coarse Loop Oscillator PCB Parts Locator Diagram
6700-D-31914-3 & -4 (Rev. H)

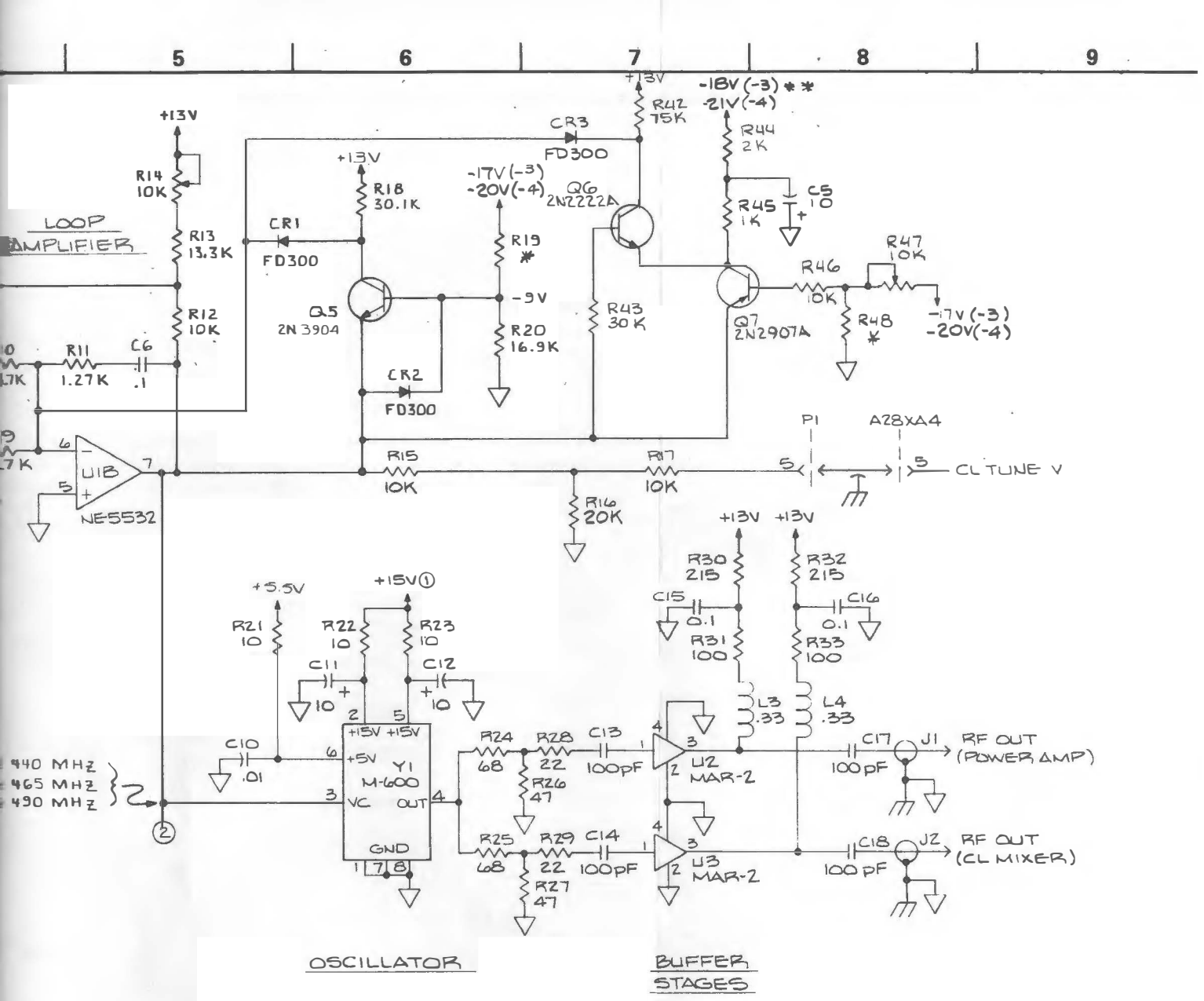


NOTES:

UNLESS OTHERWISE SPECIFIED,
RESISTANCES ARE IN OHMS.
CAPACITANCES ARE IN MICROFARADS.
INDUCTANCES ARE IN MICROHENRIES.

* FACTORY SELECTED VALUE, SEE TABLE.

** SOME NEWER 67XXB MODELS ARE EQUIPPED WITH
OF THE A4 PCB (THE -4 VERSION IS SO MARKED). TH
PIN 9 OF CONNECTOR A28XA4 WIRED TO THE -21V S
WILTRON CUSTOMER SERVICE DEPT FOR FURTHER

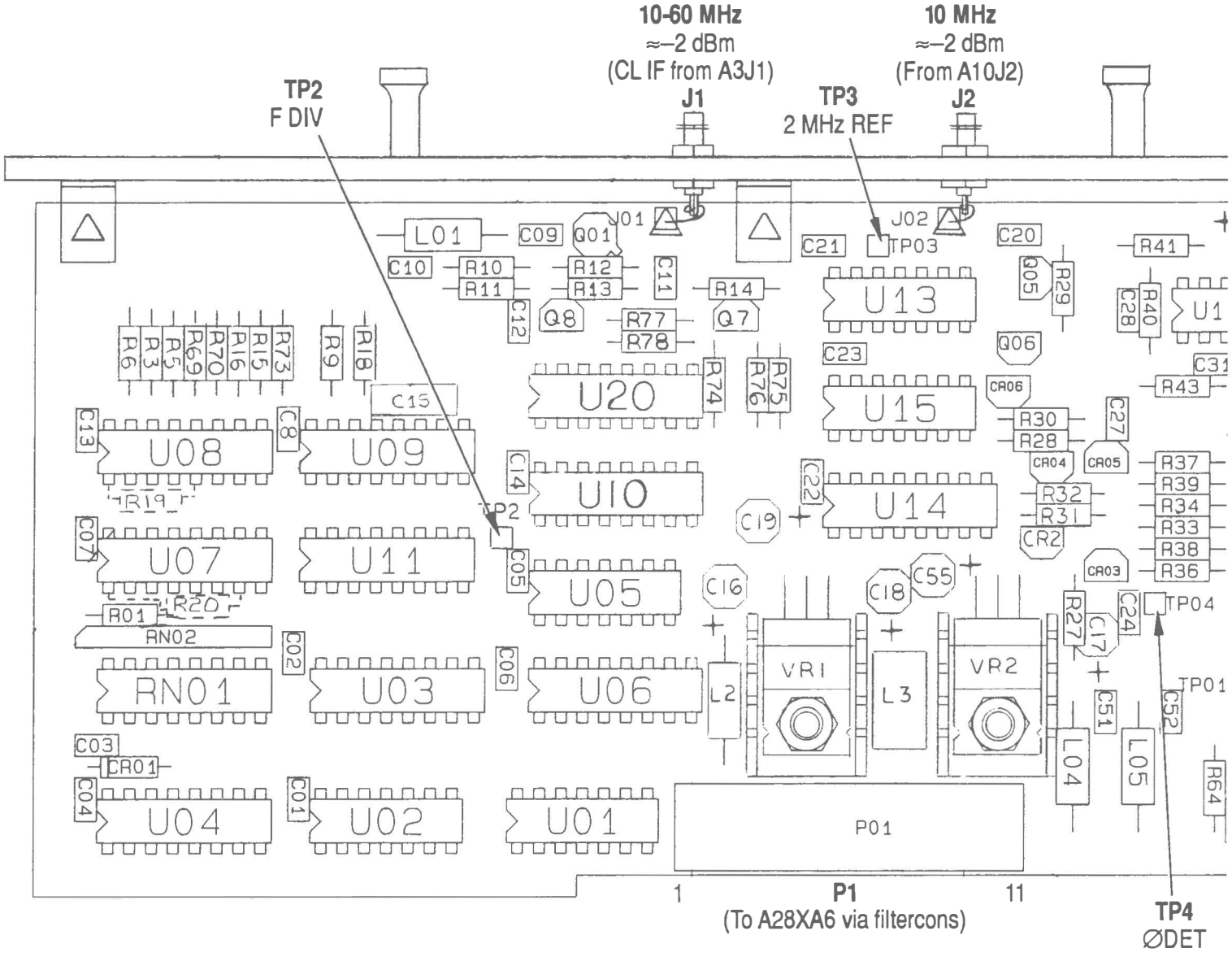


VERSION	R19 FACTORY SELECT	R48
-3	15.4K	33K
-4	19.1K	20K

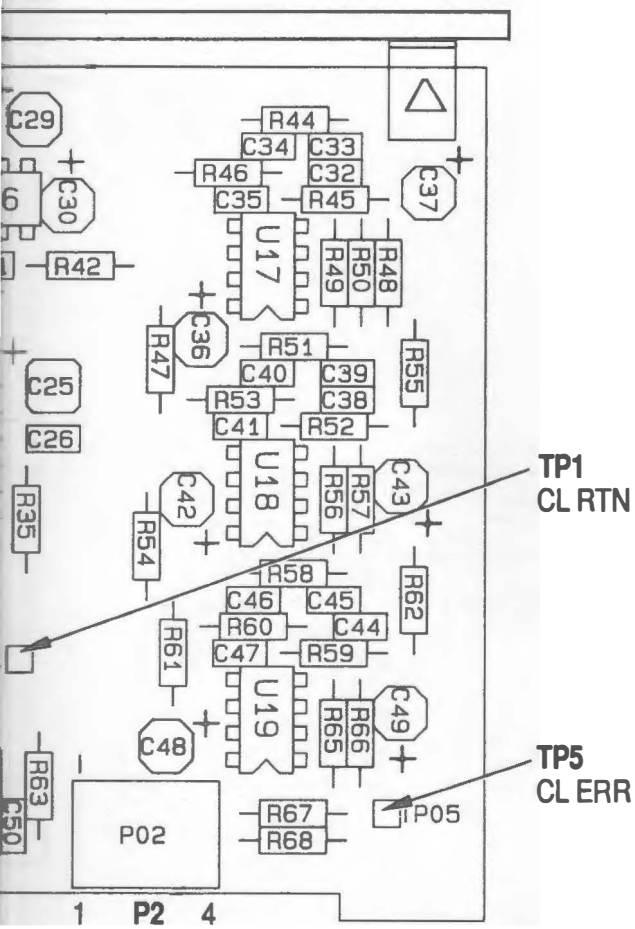
REF DESIGNATIONS	
LAST USED	NOT USED
U3	C7, C9
Q7	
CR4	
L6	
Y1	
R48	
C21	
TP5	

THE -4 VERSION
HESE UNITS HAVE
SUPPLY, CONTACT
INFORMATION.

2F-6. A4 Coarse Loop Oscillator PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31914-3 & -4 (Rev. F)



NOTE:
Leading zeros on component number references may be disregarded.



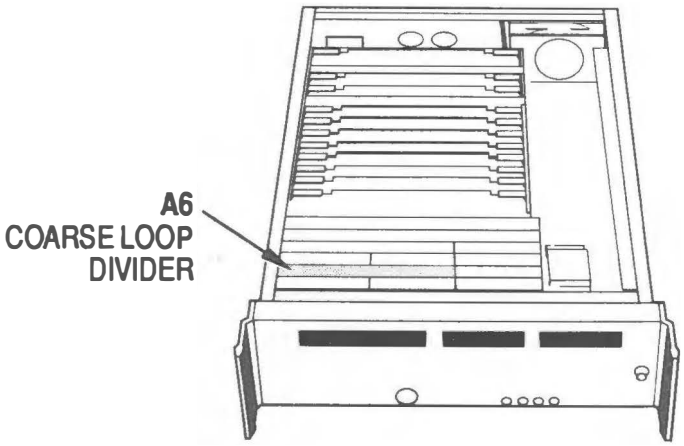
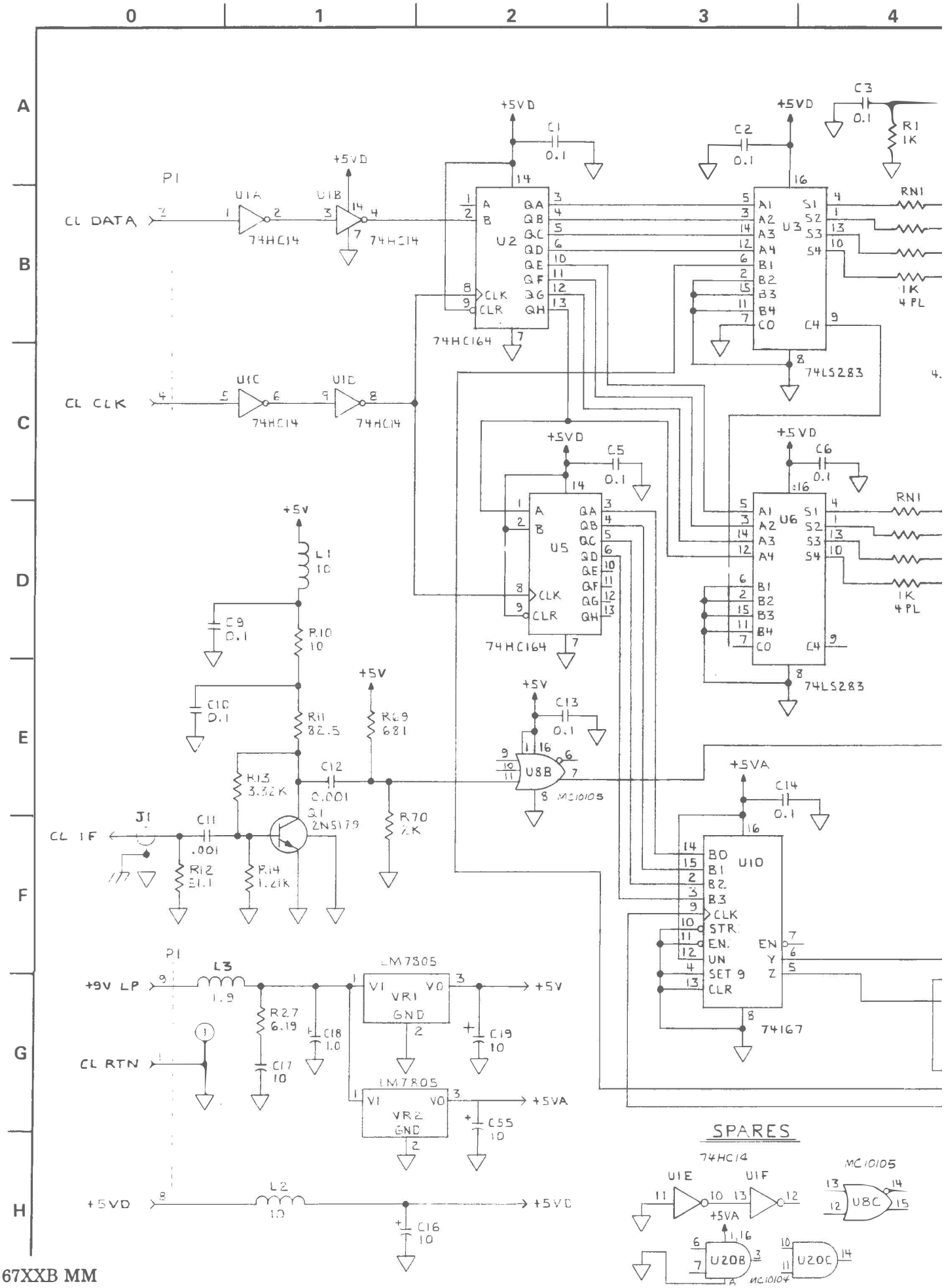
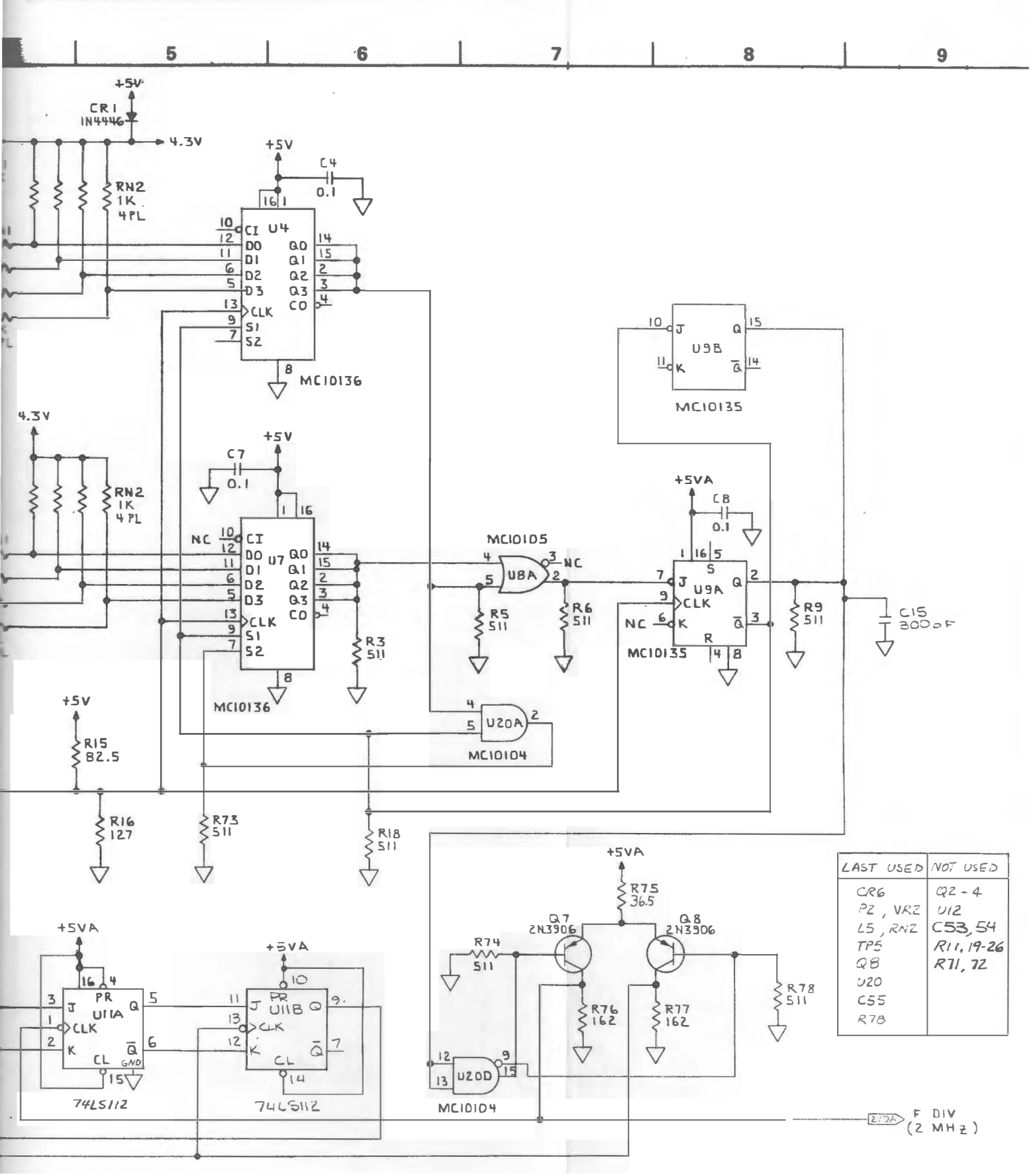


Figure 2F-7. A6 Coarse Loop Divider PCB Parts Locator Diagram
6700-D-31806-3 (Rev. G)


0
1
2
3
4
A
B
C
D
E
F
G
H
P1
CL DATA
CL CLK
CL IF
CL RTN
+9V LP
+5VD
+5V
+5VA
U1A
U1B
U1C
U1D
74HC14
U2
74HC164
U3
74LS283
RN1
1K
4 PL
C1
C2
C3
0.1
R1
1K
U5
U6
C5
C6
C9
C10
C11
C12
C13
C14
L1
10
R10
10
R11
82.5
R69
681
R13
3.32K
R12
81.1
R14
1.21K
R70
2K
J1
.001
0.001
Q1
2N5179
U8B
MC10105
U10
74167
L3
1.9
R27
6.19
C17
10
C18
1.0
C19
10
LM7805
VR1
VR2
GND
C55
L2
C16
SPARES
U1E
U1F
U8C
U20B
U20C
MC10104

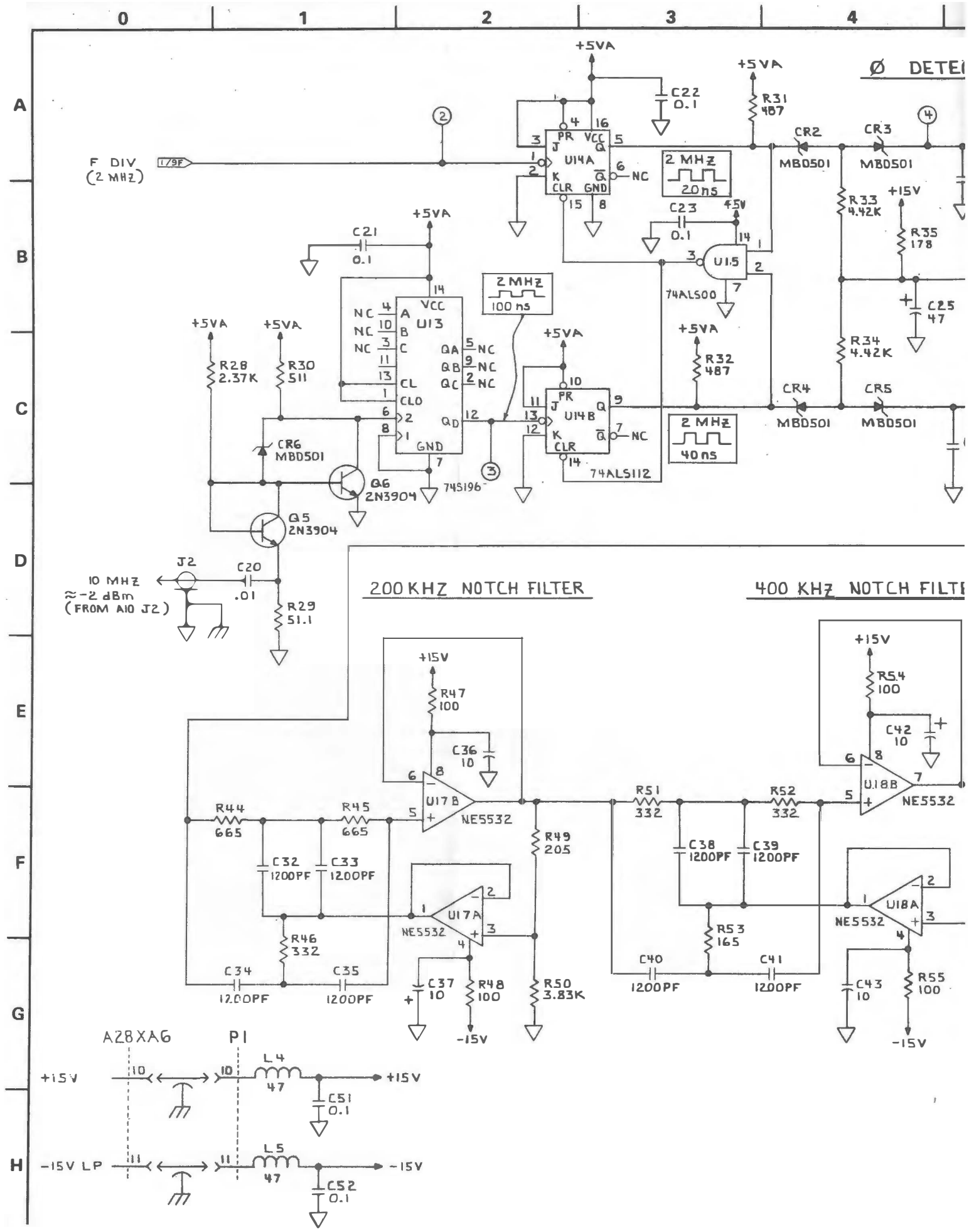


LAST USED	NOT USED
CR6	Q2 - 4
P2, VR2	U12
L5, RN2	C53, 54
TP5	R11, 19-26
Q8	R71, 72
U20	
C55	
R78	

NOTES:

1. UNLESS OTHERWISE SPECIFIED,
   RESISTANCES ARE IN OHMS.
   CAPACITANCES ARE IN MICROFARADS.
   INDUCTANCES ARE IN MICROHENRIES.
2. <2.8.1> MATCHING CONNECTIONS FOR SIGNAL FLAGS ARE LOCATED BY SHEET NUMBER AND GRID COORDINATE.

Figure 2F-8. A6 Coarse Loop Divider PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31806-3 (Rev. E)


Ø DETE
F DIV (2 MHZ)
1/9F
+5VA
C22 0.1
R31 487
CR2 MBD501
CR3 MBD501
U14A
2 MHZ 20ns
R33 4.42K
+15V
R35 178
C23 0.1
U15
74ALS00
C25 47
C21 0.1
U13
74S196
2 MHZ 100 ns
R28 2.37K
R30 511
R32 487
R34 4.42K
CR4 MBD501
CR5 MBD501
U14B
74ALS112
2 MHZ 40 ns
CR6 MBD501
Q6 2N3904
Q5 2N3904
J2
10 MHZ ≈-2 dBm (FROM A10 J2)
C20 .01
R29 51.1
200 KHZ NOTCH FILTER
400 KHZ NOTCH FILTE
R47 100
C36 10
U17B NE5532
R44 665
R45 665
C32 1200PF
C33 1200PF
R46 332
C34 1200PF
C35 1200PF
U17A NE5532
C37 10
R48 100
R49 205
R50 3.83K
-15V
R54 100
C42 10
U18B NE5532
R51 332
R52 332
C38 1200PF
C39 1200PF
R53 165
C40 1200PF
C41 1200PF
U18A NE5532
C43 10
R55 100
A28XA6
P1
L4 47
C51 0.1
L5 47
C52 0.1
-15V LP

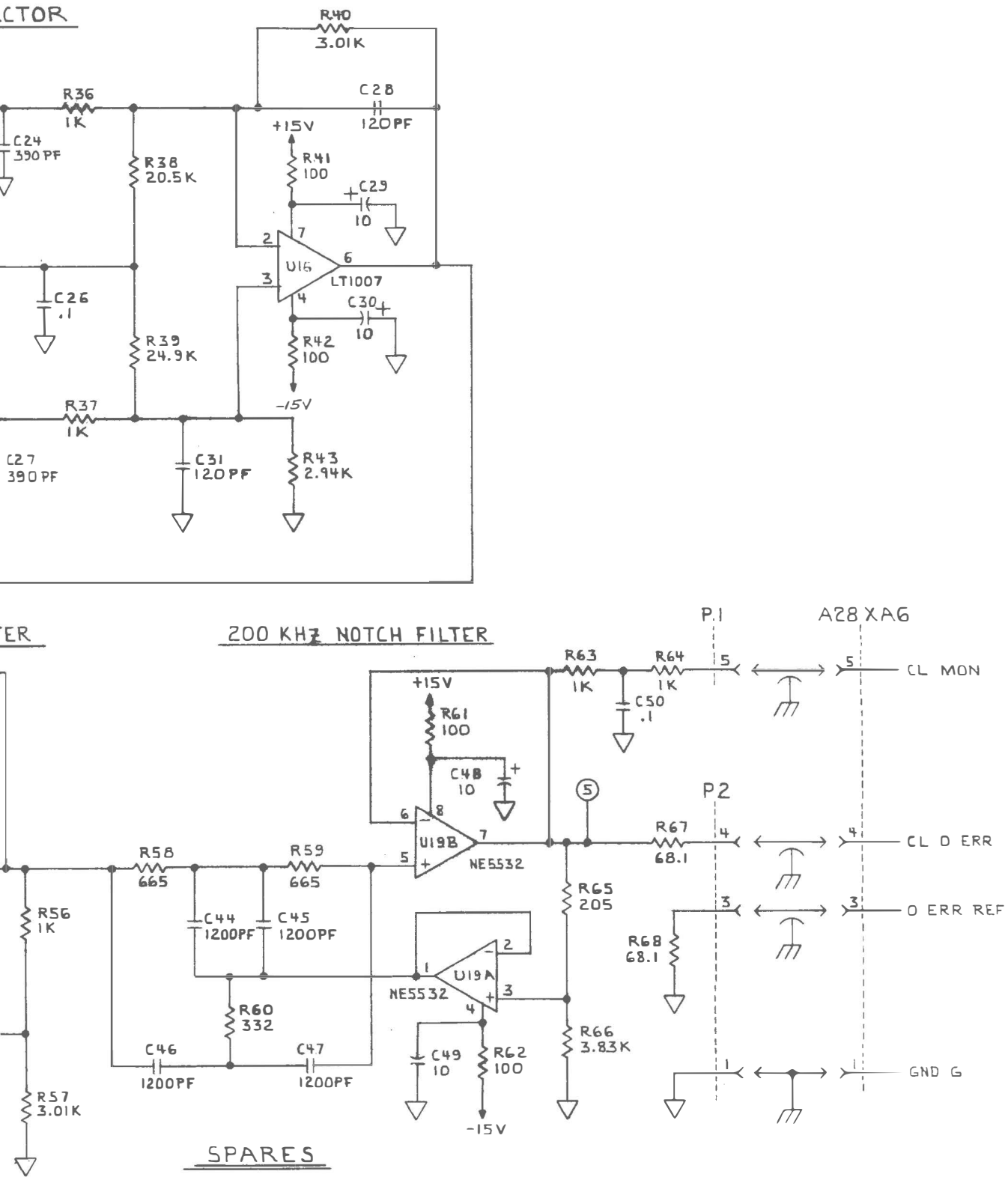


Figure 2F-8. A6 Coarse Loop Divider PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31806-3 (Rev. E)

2G–FINE LOOP: A9 AND A11 PCBs

2G-1 FINE LOOP ASSEMBLIES: A9 AND A11 PCBs

This section contains service information for the fine loop assemblies listed in Table 2G-1 below. Refer also to the specific troubleshooting information for the fine loop in the error code table in the front portion of Section 2-System Description and Troubleshooting.

Table 2G-1. Fine Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2G-2	2G-1
Block Diagram	Fig. 2G-1	2G-5
Troubleshooting	Para. 2G-5	2G-4
PCB LEVEL		
A9 Fine Loop Oscillator PCB		
Detailed Circuit Description	Para. 2G-3	6I-2
Parts Locator Diagram	Fig. 2G-2	6I-6
Schematic (Sheet 1 of 1)	Fig. 2G-3	6I-7
A11 Fine Loop Divider PCB		
Detailed Circuit Description	Para. 2G-4	2G-3
Parts Locator Diagram	Fig. 2G-4	2G-8
Schematic (Sheet 1 of 2)	Fig. 2G-5	2G-9
(Sheet 2 of 2)	"	2G-10

2G-2 FINE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the block diagram (Figure 2G-1) for the following discussion. The fine loop comprises the A9 Fine Loop Oscillator PCB and the A11 Fine Loop Divider PCB.

The function of the fine loop is to provide the fine tuning reference frequencies for the YIG Loop. The A9 Fine Loop Oscillator PCB contains a voltage-controlled oscillator (VCO) that generates an output frequency of 200 to 321 MHz. This fine loop oscillator signal is buffered and fed to the following places.

- A12 YIG Phase Detector PCB, where it is used as the reference signal for the phase/frequency detector of the YIG Loop.
- A11 Fine Loop Divider PCB, where it is compared to a reference frequency by a phase/frequency detector resulting in a phase error signal that accurately controls the fine loop oscillator.

In addition to the 200 to 321 MHz signal received from the A9 Fine Loop Oscillator PCB, the A11 Fine Loop Divider PCB receives a 10 MHz reference signal from the A10 Reference Buffer PCB and serial data and clock signals from the A8 Serial I/O PCB.

As indicated on the block diagram, the 10 MHz reference signal is divided by 100 to obtain a 100 kHz reference signal that is applied to the phase/frequency detector and output to the A25 Switching Power Supply PCB. The serial data and clock signals from the A8 Serial I/O PCB originate in the A23 Microprocessor PCB. This data programs an appropriate divide number into the A11 PCB to arrive at a 100 kHz signal input to the phase/frequency detector. There, it is compared to the 100 kHz reference signal and a + or – phase error is output. The phase error signal is sent to the A9 PCB via notch filters which eliminate any high frequency components. The phase error signal is amplified by the loop amplifier, shaped by the linearizer circuit to compensate for the nonlinear tuning characteristics of the VCO's varactor diodes, and applied as tuning voltage to the fine loop oscillator.

The output of the phase/frequency detector is monitored by the A23 Microprocessor PCB (via the DVM circuits on the A17 Analog Instruction PCB) to detect an unlocked conditon. The output of the loop amplifier is also monitored by the A23 Microproces-

sor PCB via the A17 PCB's DVM circuits. This voltage may be displayed on the synthesizer's front panel LEVEL display as an aid in troubleshooting.

A 20 to 32.1 MHz signal from an external synthesizer or other signal source may be used in place of the fine loop oscillator's signal when finer frequency resolution is needed. The A9 Fine Loop Oscillator PCB receives a TTL-level signal that disables the VCO to reduce the possibility of spurious responses being generated.

2G-3 A9 FINE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A9 PCB schematic (Figure 6I-3) for the following discussion.

2G-3.1 Loop Amplifier

The phase error signal, FL Ø ERR, at A9P1-6 is input to the loop amplifier, U1B via the unity gain differential receiver, U1A. When J3 is between pins 1 and 2 (*the normal position*), U1B has no dc feedback and the ac feedback is via C7 and C31. This provides a loop bandwidth of approximately 2 kHz. With J3 between pins 2 and 3, the loop amplifier becomes a unity gain inverting amplifier to allow testing of the VCO without the phase-lock loop. The output of the loop amplifier goes to the shaping amplifier, U3, and to A9P1-5 via the voltage divider/isolation network (R13, R14 and R16). FL TUNE, the voltage from the divider R13 and R16, is monitored by the A23 Microprocessor PCB via the A17 PCB DVM circuit for troubleshooting purposes.

NOTE

Pressing <Shift> TRIGGER 011 allows independent control of the fine loop VCO via the A11 Fine Loop Divider PCB. The FREQUENCY display shows the frequency of the oscillator. the LEVEL display shows the tuning voltage.

2G-3.2 Linearizer

The tuning shaper, U2, and its associated circuits, controls the gain of the shaping amplifier, U3, by shaping the tuning voltage. Shaping compensates for the non-linear tuning characteristics of the tuning varactor diodes, CR11 and CR12. This results in a more constant loop-gain and bandwidth-with-frequency change.

Reference voltages for the shaping diodes, CR5-CR10 are supplied by U2A and U2B; diode emitter voltage is determined by the U2A and U2B output resistors. As the input voltage at U3 pin 3 rises above approximately 2V, CR10 starts conducting and puts R31 in the circuit. The gain of U3 then goes from unity gain to approximately 1.25. When the input on U3 pin 3 reaches approximately 2.9V, CR9 starts conducting. This adds the parallel value of R28 and R29 in parallel with R31, which increases the gain of U3. This continues with each successive breakpoint until CR5 conducts. When CR5 conducts, the gain of U3 is at its maximum. The output of U3, the tuning voltage, is applied to the VCO tuning varactor diodes, CR11 and CR12.

2G-3.3 Voltage-Controlled Oscillator

The fine loop VCO consists of Q1, a low noise FET, and a resonant circuit made up of the varactor diodes, CR11 and CR12, in conjunction with the printed circuit transmission lines. The VCO is tuned through the frequency range of 200 to 321 MHz by the tuning voltage output of U3. The ALC amplifier, U4, controls the output power of the oscillator by controlling the collector current of Q1. The output of Q1 is applied to the Q2 buffer amplifier, which reduces loading on the resonator circuit. This increases the Q (quality) of the oscillator, resulting in reduced phase noise. Q2's output is sent to the two output buffer amplifier circuits and to rectifier diode, CR14. CR14 is the rectifier diode for the ALC loop of the VCO.

When an external source is used to get finer frequency resolution than is available with the synthesizer's fine loop, the signal, L HI RES EN, at A9P1-4 goes to a TTL low. This forces the output of U4 to its maximum positive value, cutting off the Q1 oscillator. This reduces the possibility of spurious responses due to the mixing of the signals from the synthesizer's fine loop and the external source in the A12 YIG Phase Detector PCB.

2G-3.4 Output Amplifiers

The two output buffer amplifier circuits isolate the output signals from each other and from the VCO itself. Q3 provides some gain and Q4 provides a low output impedance. R43 provides the 50 Ohm output impedance for J1 while R59 does the same for J2. The Q5 and Q6 amplifiers operate in the same manner as Q3 and Q4.

2G-4 A11 FINE LOOP DIVIDER, DETAILED CIRCUIT DESCRIPTION

Refer to the A11 PCB schematic (Figure 6I-5) for the following discussion.

2G-4.1 10 MHz Input Circuit

The 10 MHz reference signal input at A10J1, shown on sheet 2 of the schematic set, is received from the A10 Reference Buffer PCB. It goes to Q3 via Q2, which provides temperature compensation. Q3 converts the signal to TTL levels to drive U19, a dual bi-quinary divider. U19 divides the 10 MHz reference signal by 100 producing a 100 kHz TTL output at U19-3. This 100 kHz signal is applied to U20-1 as the reference signal input to the phase/frequency detector.

The 100 kHz signal also goes to U10 where it is buffered and sent to the A25 Switching Power Supply PCB via A11P1-7. EMI filtering is provided by R10 and the chassis-mounted filtercon at A11P1-7. The A25 Switching Power Supply PCB is injection locked to 100 kHz to ensure that its 50 kHz switching rate does not zero beat with the reference frequencies in the synthesizer's phase-lock loops.

2G-4.2 200-321 MHz Fine Loop Input

The 200-321 MHz signal input at A11J1, shown on sheet 1 of the schematic set, comes from the A9 Fine Loop Oscillator PCB. It is amplified by Q1 and sent to U14, a dual-modulus 10/11 divider. Dual flip-flop, U13 provides the PE1 and PE2 inputs that control the state of U14. When PE1 and PE2 inputs are both low, Q14 divides by 11, and when either input is high, Q14 divides by 10. The divided-signal output of U14 is inverted by U15 and then sent to counters U8 and U12, and flip-flops U9 and U13.

2G-4.3 Serial Input Circuits

FL DATA and FL CLK, the serial data and clock signals from the A8 Serial I/O PCB, are input at A11P1 pins 3 and 4 and then sent to shift registers U2 and U6 via U1, a Schmitt trigger buffer. The clock signal shifts the serial data input, which is 16 bits long, into the registers. Once data is shifted into the shift registers, the parallel outputs of the registers hold the data until new data is shifted in. The parallel data output of U2 and U6 sets the count of the counters and fractional division control circuits.

FLD 12, also from the A8 PCB, is the only A11 PCB control signal that is not sent serially. It is normally low and goes to a TTL high only at Fine Loop oscillator frequencies of 300 MHz or greater.

2G-4.4 Counter Circuits

The divide-by-10/11 counter circuits are programmed to arrive at a 100 kHz signal to be input to the phase/frequency detector.

Decade counter U3 determines the count for the 10 MHz decade and U8 does the same for the 1 MHz decade. U5 counts by either two or three, depending on the condition of the FLD 12 input control. U12 determines the number of output cycles of U14 when U14 is in the divide-by-11 state instead of the divide-by-10 state. U12 operates in both the 100 kHz decade steps and the 10 kHz fractional division steps. U7, in combination with U11, provides the counts for fractional division used to obtain the 10 kHz resolution of the fine loop.

U12 is normally programmed for a count of two at a fine loop frequency of 200 MHz, causing U14 to remain in a divide-by-10 state for each 100 kHz cycle. If the count is incremented to three, U14 divides by 11 for each 100 kHz cycle, resulting in 2001 input cycles for each 100 kHz cycle and a fine loop frequency of 200.1 MHz. Increasing the U12 count to four results in 2002 input cycles to U14 for each 100 kHz cycle and a fine loop frequency of 200.2 MHz. By incrementing the count of U12, the entire 100 kHz decade can be obtained.

U11 is programmed for a count that is one higher than the required count of U12. When the input to U11-7 goes low, the output of U11 reprograms the U12 counter to provide an increase of one count. Rate multiplier U7 controls the input to U11-7. If U7 is programmed to provide one output pulse for every ten input pulses at 100 kHz, it outputs a low to U11-7, causing U11 to increase the U12 count by one for every tenth 100 kHz pulse. This causes U14 to divide by 11 for one out of every ten 100 kHz cycles, resulting in 20,001 input cycles for every ten 100 kHz cycles and a fine loop frequency of 200.01 MHz. Increasing the count of U7 increments the fine loop frequency in 10 kHz steps.

At 200 MHz, U8 provides 20 output pulses for every 200 input pulses from U14, U3 provides two output pulses for every 20 input pulses from U8, and U5

provides one output pulse for every two output pulses from U3. If U8 is programmed to load a count of one at every 100 kHz cycle, the input to U14 increases to 201 MHz to provide 100 kHz at U9-5. If U3 is programmed to load a count of one for each 100 kHz cycle, U8 must provide an additional 10 counts. This requires the input to U14 to increase to 210 MHz. By loading different counts into U3 and U8, the entire frequency range (from 200 to 300 MHz) can be covered in 1 MHz steps.

At 300 MHz, the FLD 12 line goes to a TTL high. This causes U5 to output one pulse for every three input pulses which is essentially the 100 MHz decade. The *only* difference in the programming for the Fine Loop counters, at 200 and 300 MHz, is the **FLD 12** line. The input data to U3, U8, U12 and U7 is the same at 200 and 300 MHz. Incrementing in 10 kHz, 100 kHz, 1 MHz and 10 MHz steps is identical to when the frequency is at 200 MHz.

The 100 kHz signal at U4-6 is output via flip-flop U9 to the phase/frequency detector to be compared with the divided 10 MHz reference frequency. U9 provides 2 clock cycles of delay and determines the 100 ns pulse width for the 100 kHz signal. The output signal at U9-6 reloads the counters for the next 100 kHz cycle, loads two counts into the U12 counter, and sets U13-5 low and U13-9 high.

2G-4.5 Phase/Frequency Detector

The fine loop phase/frequency detector, U20 operates the same as the reference loop phase/frequency detector on the A7 Reference Divider PCB (refer to Section 2E-Reference Loop for a detailed circuit description). However, the fine loop phase/frequency detector operates at 100 kHz instead of 10 MHz.

The outputs of U20 are sent via the integrator filter networks, R13-C26 and R14-C27, to the differential receiver, U21. The output of U21 is the (unfiltered) fine loop phase error signal. R20 provides a dc offset voltage for U21 which results in the phase/frequency detector operating in an offset mode. This prevents the phase/frequency detector from operating in the dead zone and drastically affecting the loop dynamics. When the Fine Loop is phase-locked, the loop amplifier on the A9 Fine Loop Oscillator PCB forces the output of U21 to be 0V. This causes the output pulse on U20-9 to be wider than at U20-5, thereby canceling the approximately three degrees of offset provided by R20. Test point 4 at R17 allows an ac signal to be injected for testing of the notch filters or for exercising the phase-lock loop.

2G-4.6 Notch Filters

The fine loop phase information at the output of U21 goes through the notch filters before being sent to the A9 Fine Loop Oscillator PCB. When the divider is set for fractional division, there is a 10 kHz component and its related harmonics on the output of U21. If left unfiltered, this causes 10, 20, 30, and 40 kHz sidebands on the fine loop oscillator output signal and shows up in the final RF output signal. The notch filter circuits reduce these sideband levels.

The A11 Fine Loop Divider PCB contains five active twin-T notch filters. There are two each for 10 kHz, since this is the highest amplitude and can cause the most spurious responses. There is one each for 20 kHz, 30 kHz and 40 kHz. These filters have a 40 dB (typical) rejection at their notch frequency.

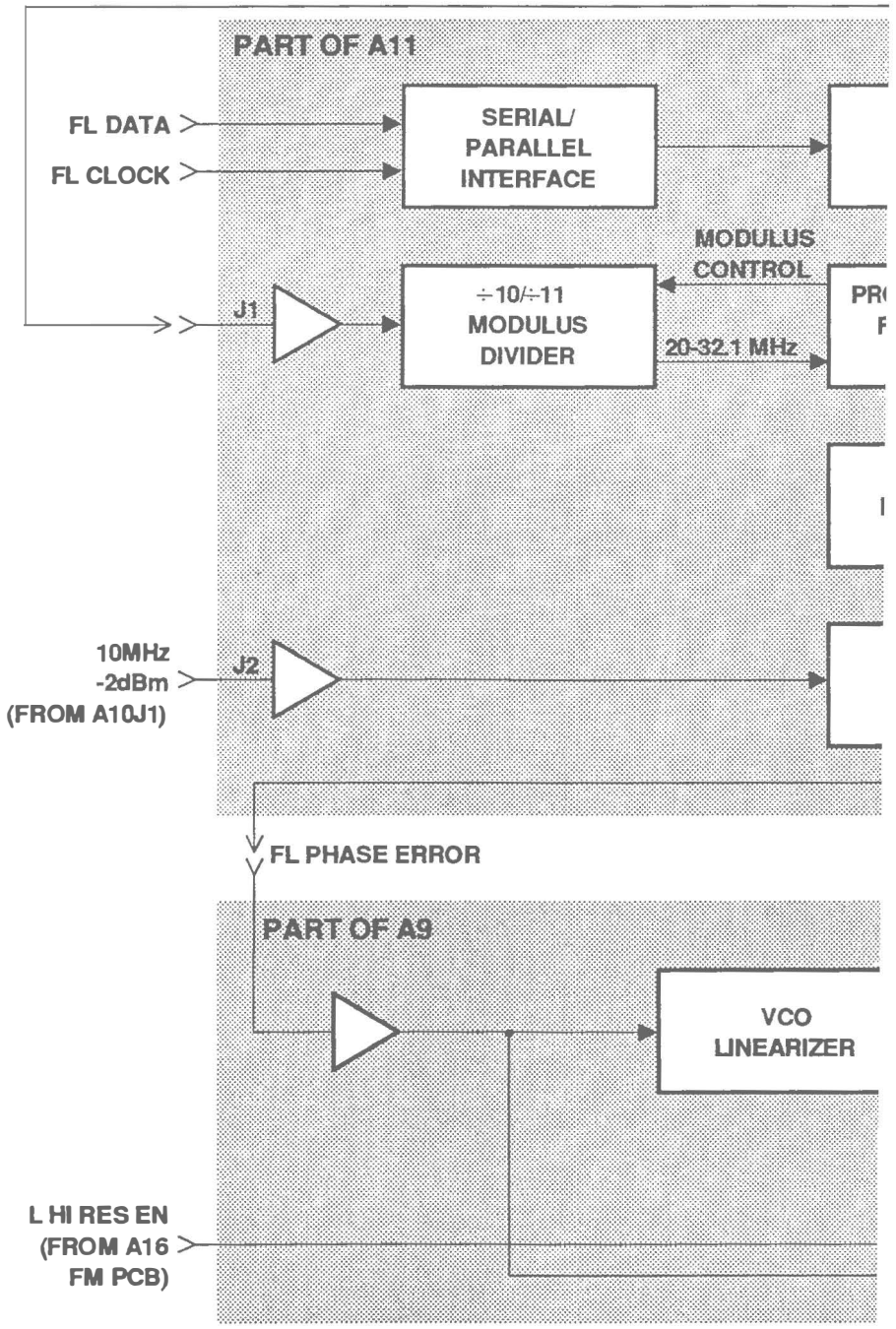
The output of U26 is the (filtered) fine loop phase error signal, FL Ø ERR, that is sent via A11P1-3 to the A9 Fine Loop Oscillator PCB to control the fine loop oscillator's frequency. The output of U26 is also sent via the filtering and isolation network (R46, C48, and R47) and connector A11P1-6 as the signal FL MON to the A17 Analog Instruction PCB's DVM circuit. The A23 Microprocessor monitors this signal via the A17 PCB's DVM to determine if the fine loop is phase-locked. When the fine loop is phase-locked, this voltage is very close to 0V.

2G-5 FINE LOOP ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the front portion of Section 2-System Description and Troubleshooting. This information provides a list of error codes that may be displayed as a result of failures in the fine loop subsystem and probable causes of the failures.

2G-6 FINE LOOP ASSEMBLIES, SERVICE SHEETS

Table 2G-1 (page 2G-1) presents the arrangements of the block diagrams, schematics, and parts locator diagrams for the A9 and A11 PCBs.


PART OF A11
FL DATA
FL CLOCK
SERIAL/
PARALLEL
INTERFACE
MODULUS
CONTROL
J1
÷10/÷11
MODULUS
DIVIDER
20-32.1 MHz
10MHz
-2dBm
(FROM A10J1)
J2
FL PHASE ERROR
PART OF A9
VCO
LINEARIZER
L HI RES EN
(FROM A16
FM PCB)

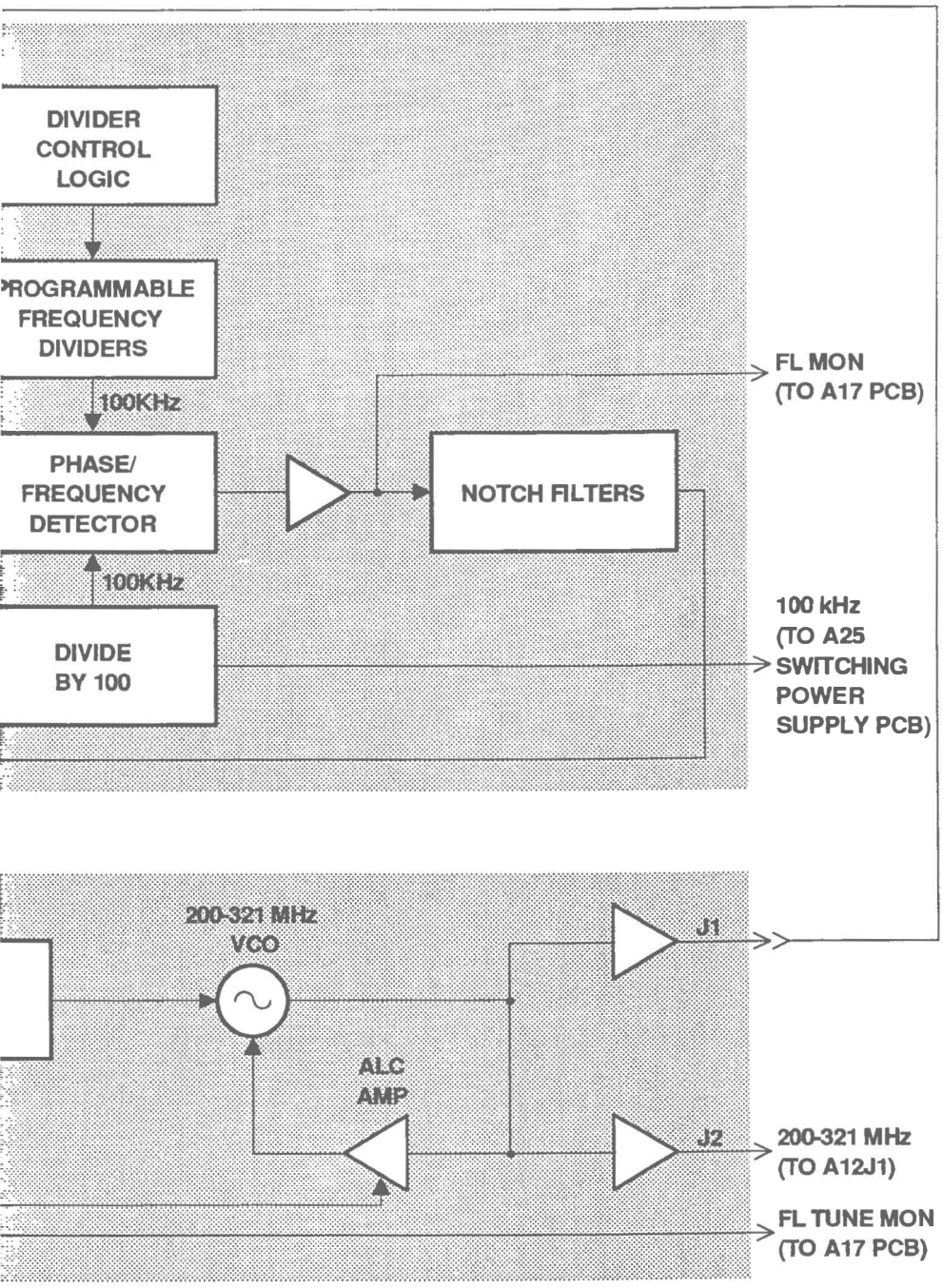
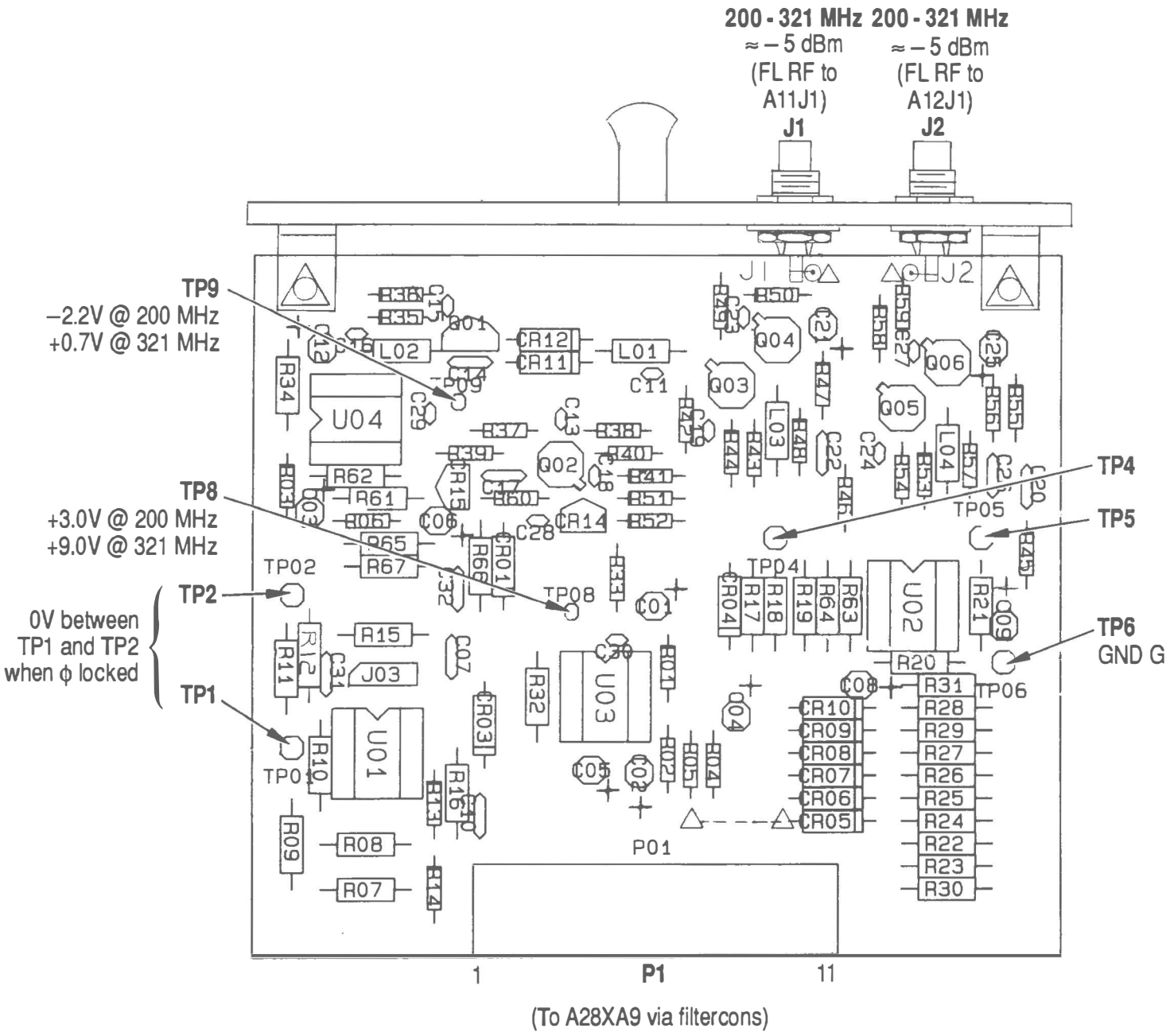


Figure 2G-2. Fine Loop Block Diagram


200 - 321 MHz
≈ – 5 dBm
(FL RF to
A11J1)
J1
200 - 321 MHz
≈ – 5 dBm
(FL RF to
A12J1)
J2
TP9
–2.2V @ 200 MHz
+0.7V @ 321 MHz
TP8
+3.0V @ 200 MHz
+9.0V @ 321 MHz
TP2
0V between
TP1 and TP2
when ϕ locked
TP1
TP4
TP5
TP6
GND G
U04
U01
U02
U03
P01
1
P1
11
(To A28XA9 via filtercons)

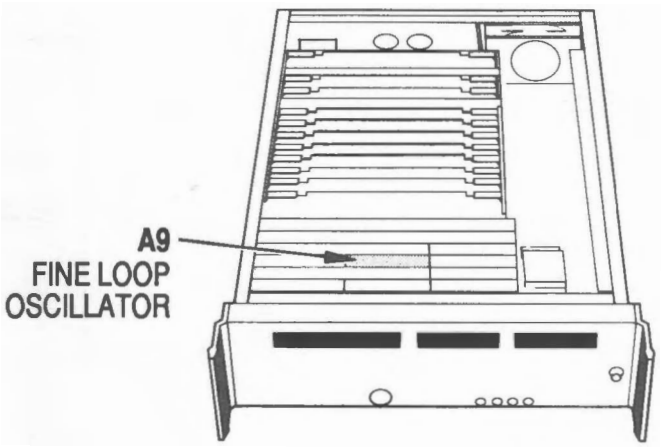
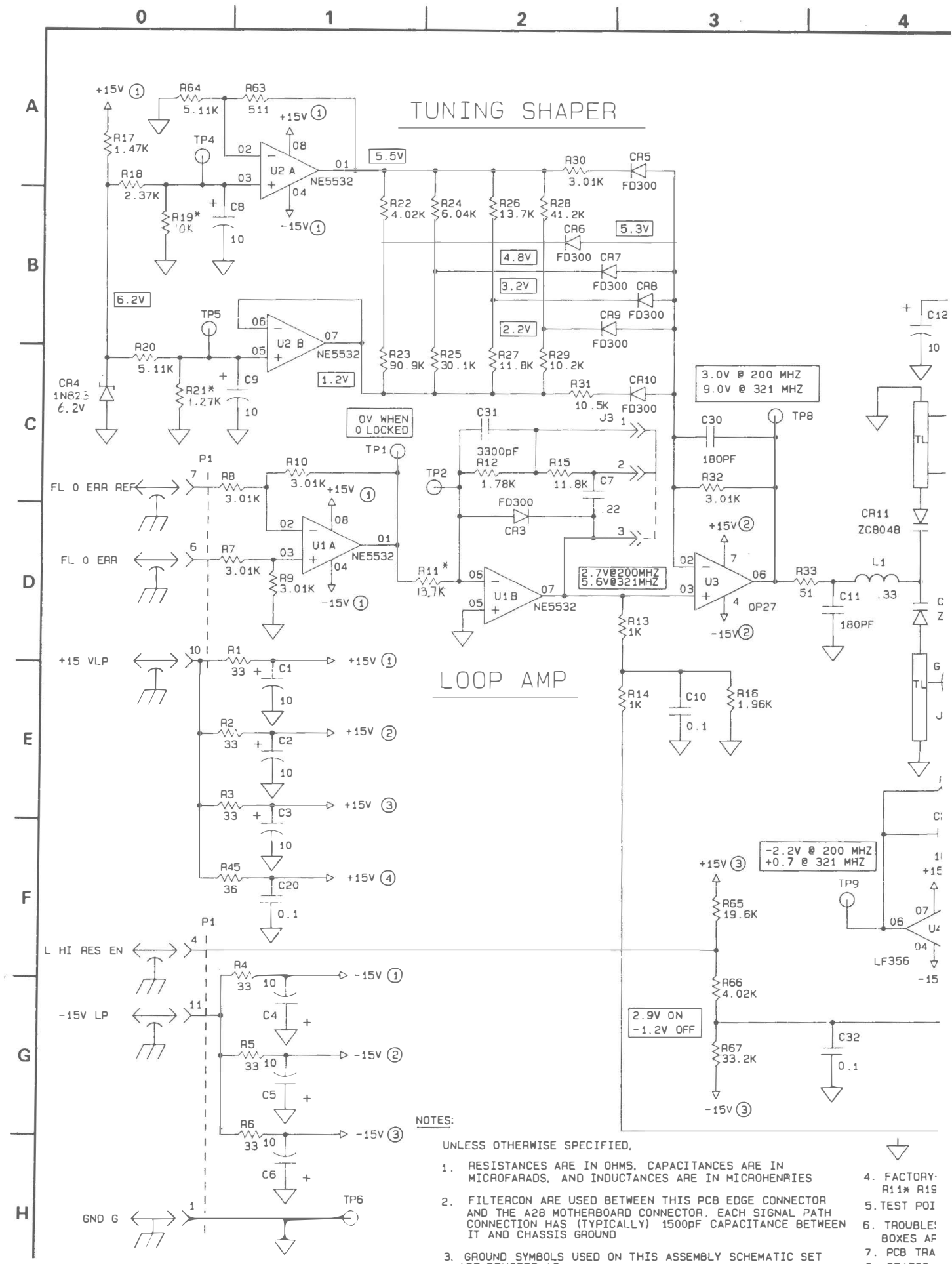


Figure 2G-3. A9 Fine Loop Oscillator PCB Parts Locator Diagram
6700-D-31709-3 (Rev. K)



NOTES:

UNLESS OTHERWISE SPECIFIED,

1. RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN MICROFARADS, AND INDUCTANCES ARE IN MICROHENRIES
2. FILTERCON ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS CHASSIS GROUND
4. FACTORY- R11* R19
5. TEST POI
6. TROUBLE BOXES AR
7. PCB TRA
8. STATIC INCLUDE:

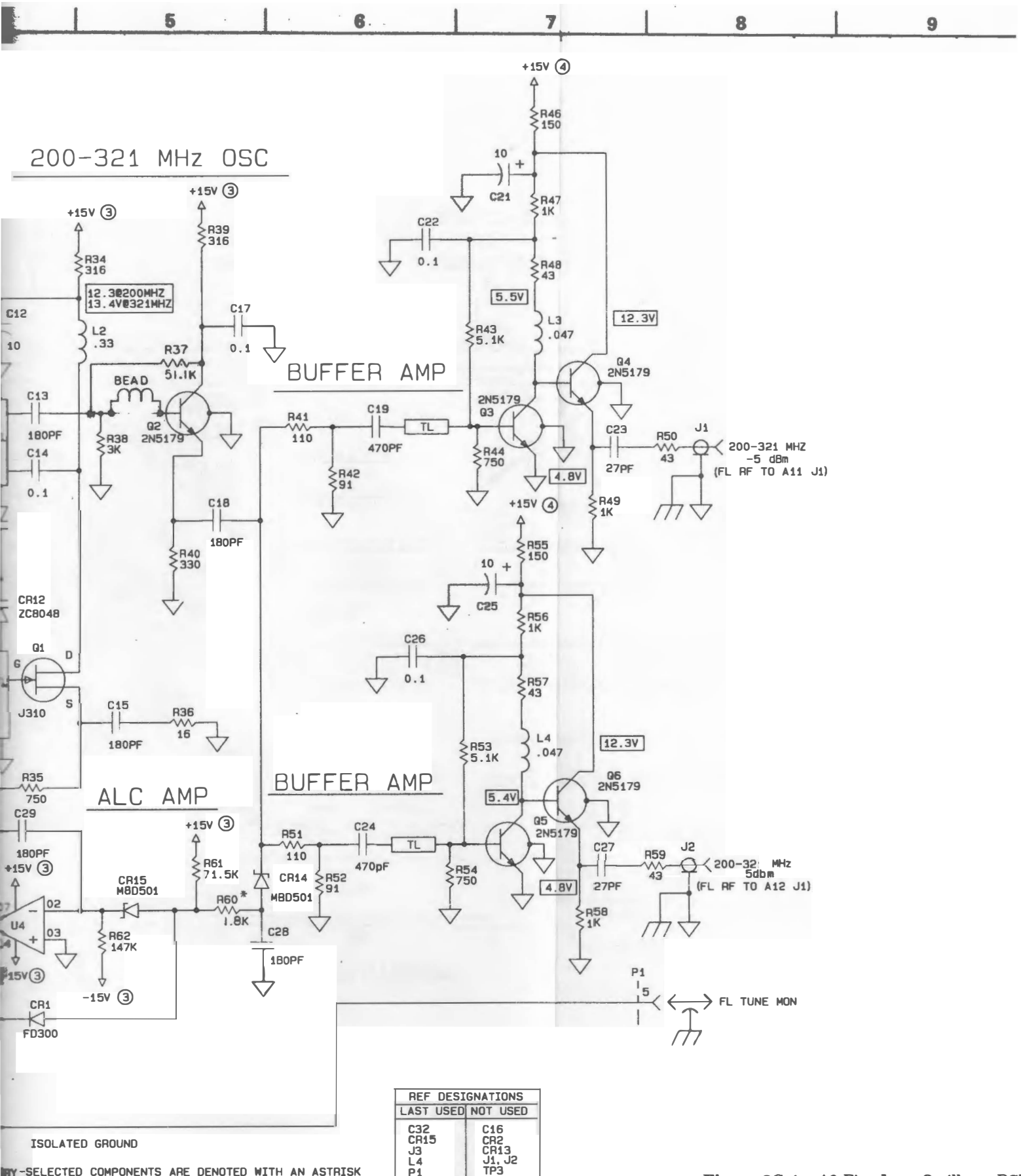
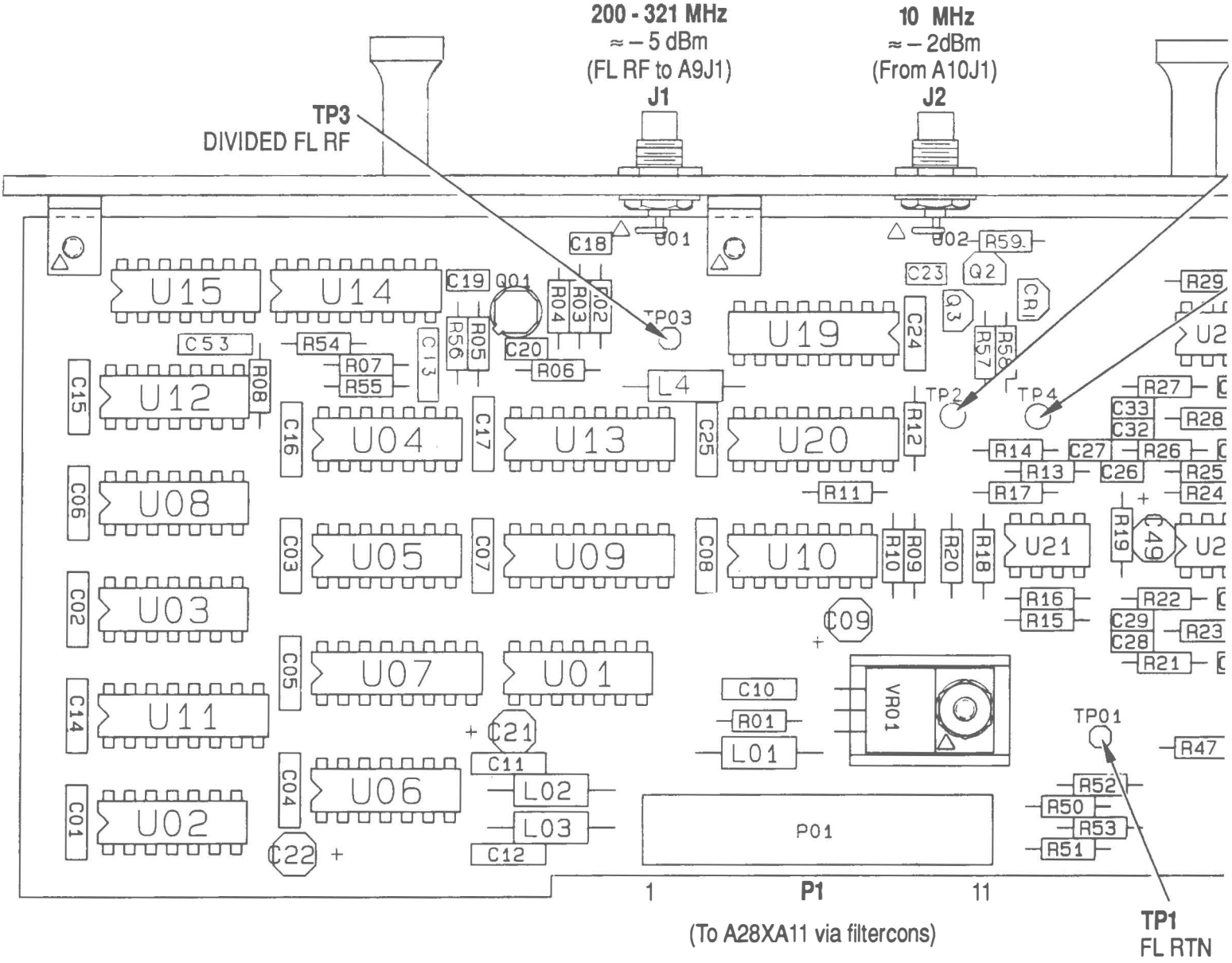
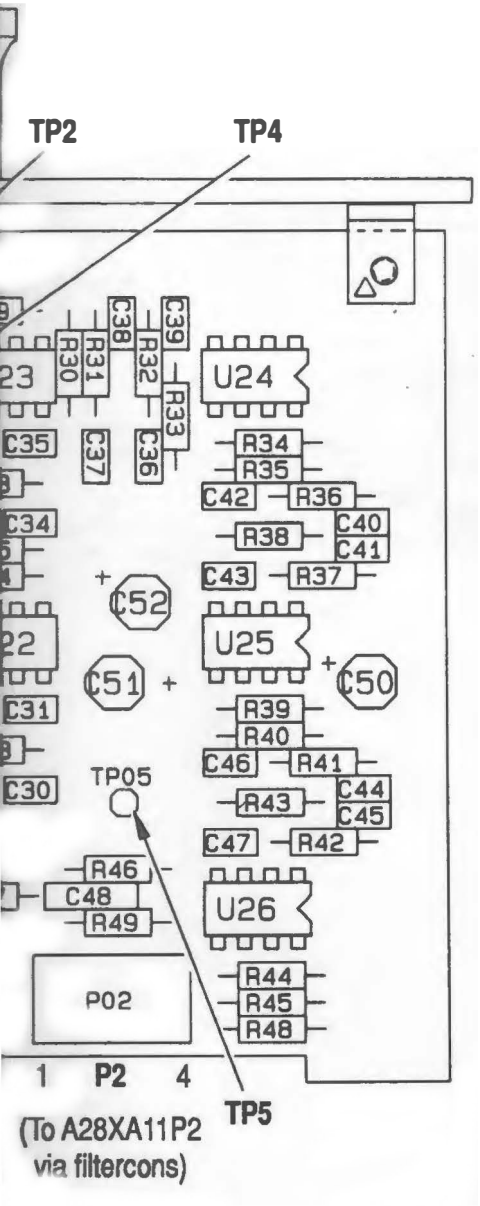


Figure 2G-4. A9 Fine Loop Oscillator PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31709-3 (Rev. L)



NOTE:
Leading zeros on component number references may be disregarded.



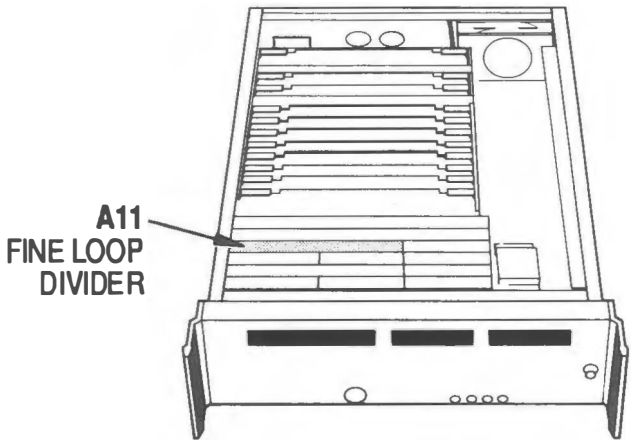
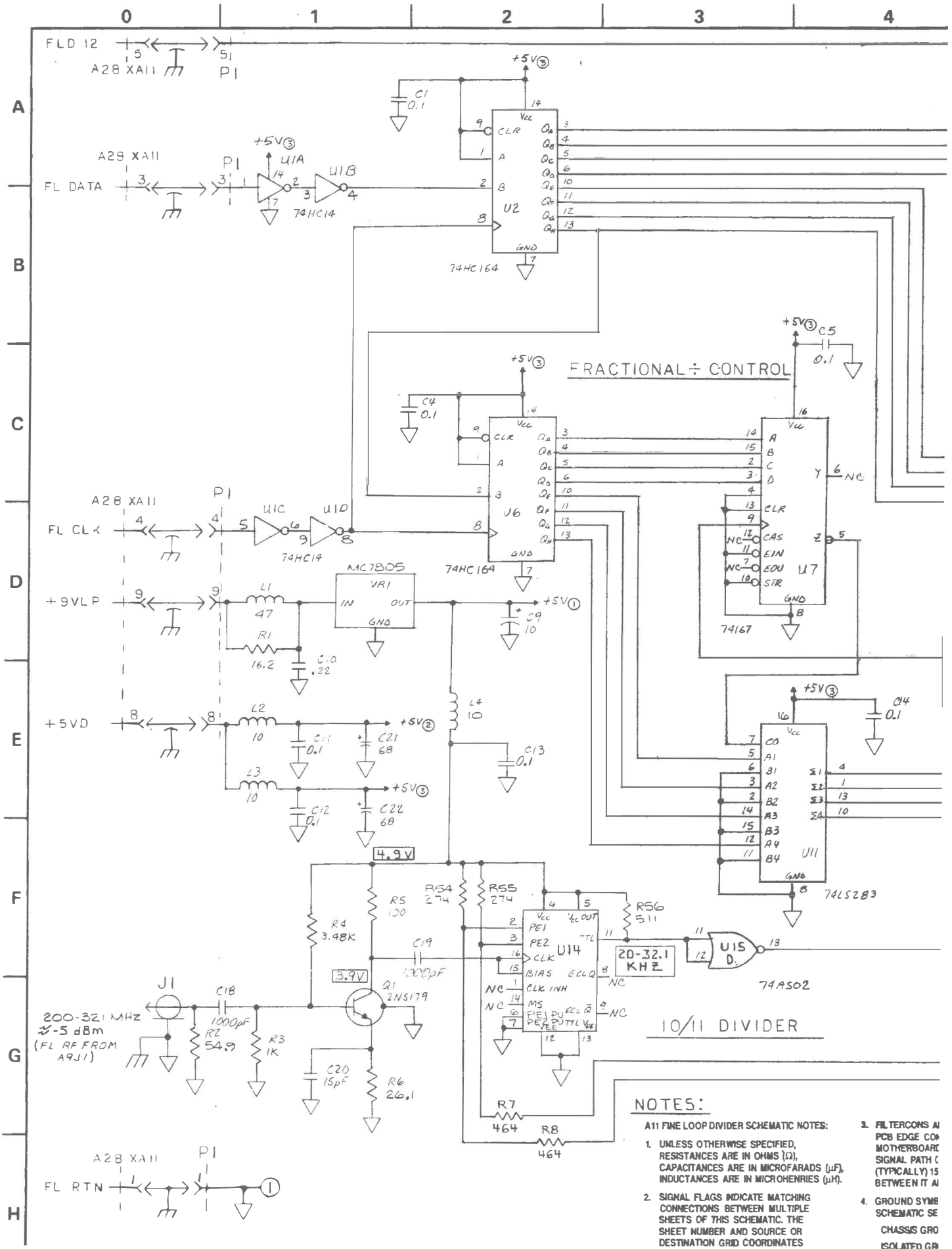
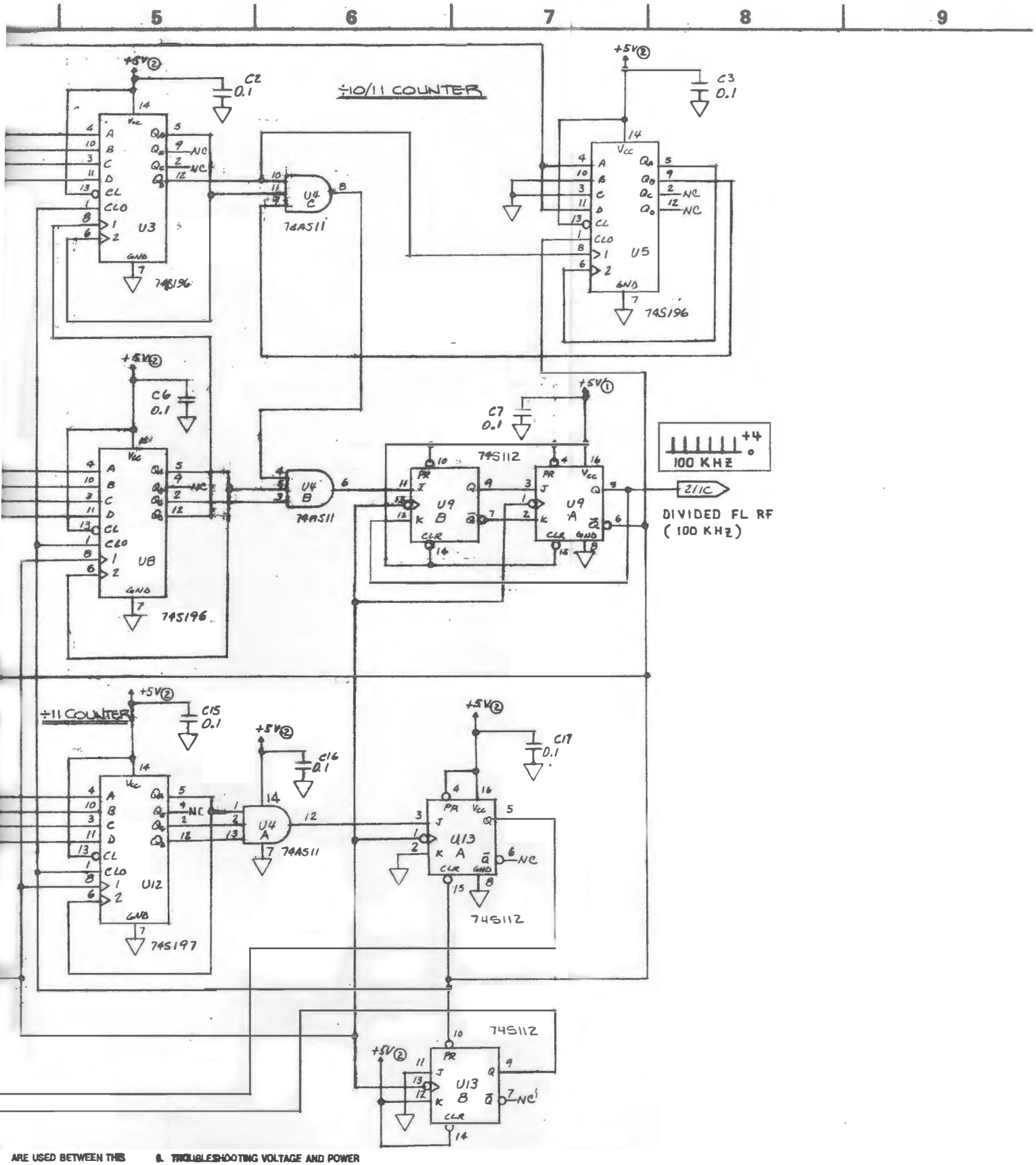


Figure 2G-5. A11 Fine Loop Divider PCB Parts Locator Diagram
6700-D-31711-3 (Rev. K)


FRACTIONAL ÷ CONTROL
10/11 DIVIDER
NOTES:
A11 FINE LOOP DIVIDER SCHEMATIC NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. FILTERCONS AI PCB EDGE CO MOTHERBOARI SIGNAL PATH ((TYPICALLY) 15 BETWEEN IT AI
4. GROUND SYMB SCHEMATIC SE
CHASSIS GRO
ISOLATED GR
5. TEST POINTS I

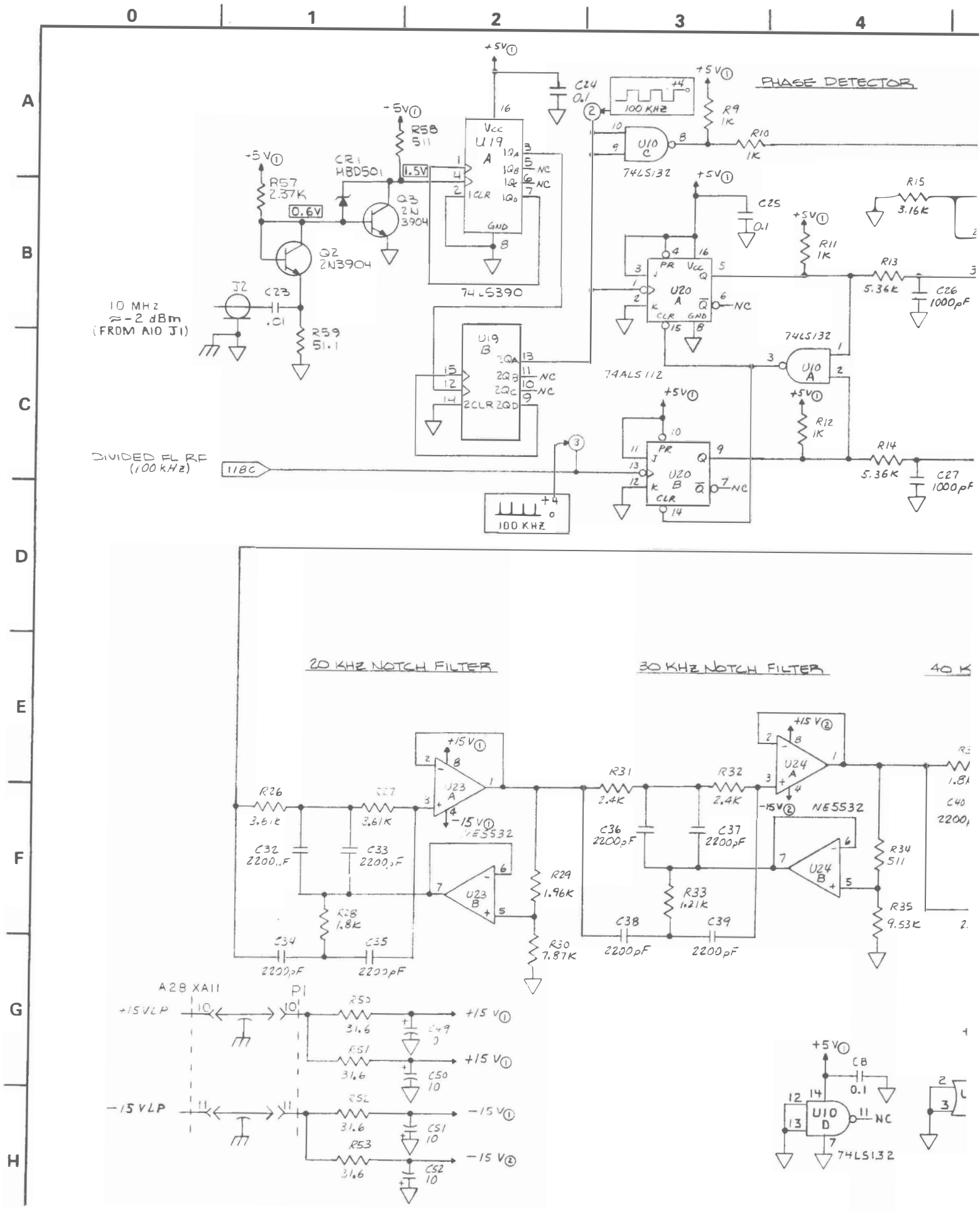


ARE USED BETWEEN THIS CONNECTOR AND THE A28 BOARD CONNECTOR. EACH CONNECTION HAS 1500pF CAPACITANCE TO CHASSIS GROUND.

SYMBOLS USED ON THIS ASSEMBLY SET ARE DENOTED AS:
GROUND:
GROUNDS:
ARE DENOTED AS: (2)

6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
CR1, Q1, U3, U5, U7-U13, U19, VR1

Figure 2G-6. A11 Fine Loop Divider PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31711-3 (Rev. H)


PHASE DETECTOR
20 KHZ NOTCH FILTER
30 KHZ NOTCH FILTER
40 K
10 MHz
≈-2 dBm
(FROM A10 J1)
DIVIDED EL RF
(100 kHz)
118C
74LS390
74ALS112
74LS132
NE5532
100 KHZ
A28 XA11
P1
+15VLP
-15VLP
74LS132

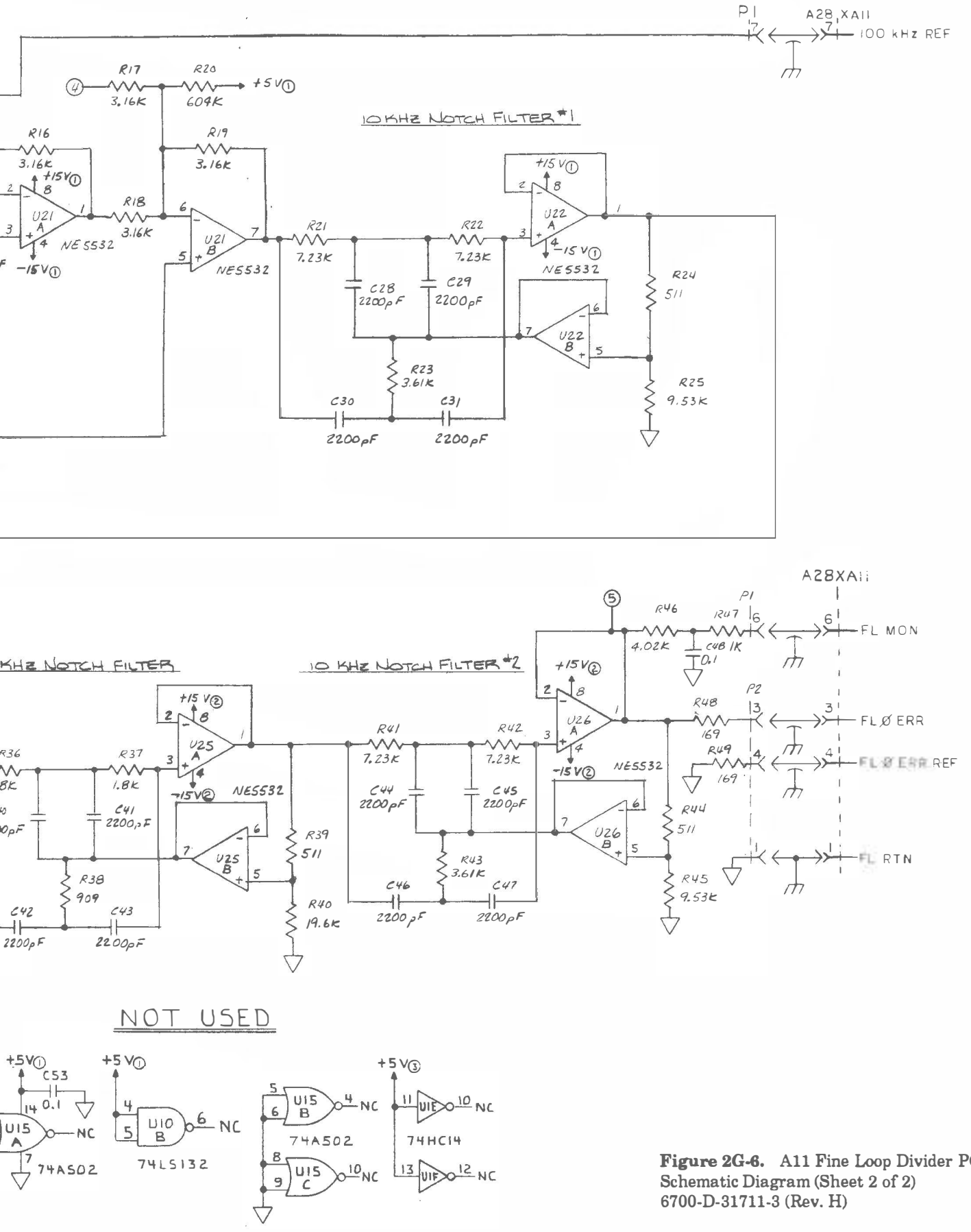


Figure 2G-6. A11 Fine Loop Divider PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31711-3 (Rev. H)

2H–YIG LOOP/ FM MODULATION SUBSYSTEM: A12 AND A16 PCBs

2H-1 INTRODUCTION

This section contains service information for the YIG Loop and FM Modulation circuits located on the A12 and A16 PCBs and also on the A30 Sampler/IF Amp Assembly and the A31 Multiplier/Power Amp Assembly; see Table 2H-1 below. For information pertaining to the A18–A21 YIG Driver PCBs, refer to Section 2J–YIG Driver. Refer also to the specific troubleshooting information for the A12 and A16 PCBs in the error code table located in the front portion of Section 2-System Description and Troubleshooting.

Table 2H-1. YIG Loop / FM Modulation Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2H-1.1	2H-1
Block Diagram	Fig. 2H-1	2H-9
PCB LEVEL		
A12 YIG Phase Detector PCB		
Detailed Circuit Description	Para. 2H-2	2H-3
Block Diagram	Fig. 2H-1	2H-9
Parts Locator Diagram	Fig. 2H-3	2H-12
Schematic Diagram	Fig. 2H-4	2H-13
A16 FM PCB		
Detailed Circuit Description	Para. 2H-3	2H-4
Block Diagram	Fig. 2H-2	2H-11
Parts Locator Diagram	Fig. 2H-5	2H-14
Schematic (Sheet 1 of 4)	Fig. 2H-6	2H-15
(Sheet 2 of 4)	"	2H-16
(Sheet 3 of 4)	"	2H-17
(Sheet 4 of 4)	"	2H-18
A30 Sampler/ IF Amp Assembly		
Detailed Circuit Description	Para. 2H-5	2H-7
Parts Locator Diagram	Fig. 2H-7	2H-19
Schematic Diagram	Fig. 2H-9	2H-21
A31 Multiplier/ Power Amp Assembly		
Detailed Circuit Description	Para. 2H-4	2H-7
Parts Locator Diagram	Fig. 2H-8	2H-20
Schematic Diagram	Fig. 2H-10	2H-22

2H-1.1 YIG Loop/FM Subsystem Overall Functional Description

The YIG phase-lock loop portion of this subsystem is used to fine-tune the YIG-tuned oscillator to the exact output frequency entered by using the front panel keys or via the GPIB. It also reduces FM noise close to the carrier. The FM portion of the subsystem provides the synthesizer with frequency modulation capability in both phase-locked and unlocked modes of operation.

a. YIG Loop Functions

Refer to the overall YIG loop functional block diagram, Figure 2H-1. One input to the A30 Sampler/IF Amplifier is a 220-245 MHz harmonic comb signal which is derived from the 440-490 MHz output of the coarse loop oscillator by the A31 Power/Amp Multiplier assembly. This signal drives the step-recovery diode (also part of the A31 assembly) that produces harmonics from 1.98 to ≈ 40 GHz. This harmonic comb is fed to the input of the A30 Sampler/IF Amplifier assembly.

The other input to the Sampler/IF Amplifier is a sample of RF power from the YIG-tuned oscillator output. Sampling the oscillator's output signal at the rate of the adjacent coarse-loop harmonic produces a low frequency difference signal which is the YIG IF signal (20-32.1 MHz).

The A23 Microprocessor programs the coarse-loop output frequency so that one of its harmonics will be within 20-32.1 MHz of the desired YIG operating frequency. The YIG Phase Detector compares the YIG IF signal to a 20-32.1 MHz frequency reference signal that is derived from the 200-321 MHz output of the fine-loop oscillator. The YIG phase detector fine tunes the YIG via the YIG FM coil driver to eliminate any frequency difference between the two signals.

Phase-locking the YIG-tuned oscillator over a broad frequency range is accomplished by programming the coarse loop to various frequencies that have harmonics close to the desired operating frequencies. Exact frequency tuning for each desired operating frequency is accomplished by programming of the fine-loop oscillator. (In each case, the YIG-tuned oscillator is first tuned via its main tuning coil to the approximate desired operating frequency.)

The programming (tuning) range of the coarse-loop oscillator provides harmonic signals in the range of 1.98 to ≈ 40 GHz. The harmonic signal spacing varies throughout this range from 1 MHz to 12 MHz. Thus, any YIG-tuned oscillator output frequency can be down converted to a YIG IF signal between 20-32.1 MHz. Since the coarse-loop output is synthesized, its frequency can be adjusted only in finite steps. The resulting harmonic steps may be as large as 12.1 MHz at high frequencies.

The YIG loop is fine tuned by varying the 20-32.1 MHz reference frequency signal applied to the YIG loop phase detector. This signal is derived by dividing the fine-loop oscillator signal by a factor of 10. By programming the fine-loop oscillator, this signal can be adjusted in 1 kHz increments over a 20-32.1 MHz range. The resolution of the fine-loop oscillator (hence the resolution of the RF output signal) is 1 kHz, which is much finer resolution than is available from the coarse-loop alone.

NOTE

Whenever the synthesizer is operating in the phase-locked mode, the frequency of the YIG IF will always equal $^1/_{10}$ the frequency of the fine-loop oscillator.

For applications requiring resolution finer than 1 kHz, an external 20-32.1 MHz synthesizer can be connected at the rear panel to substitute for the internal fine-loop signal. The tuning resolution is then determined by the resolution of the external synthesizer.

b. FM Modulation Functions

In addition to the YIG loop's frequency phase-lock control circuitry, the YIG loop contains the FM modulation circuitry that allows the user to frequency modulate the RF output waveform. A portion of this circuitry is also used for the narrow band sweep function (i.e., sweeps ≤50 MHz).

The external FM signals from the front and rear panel connectors are routed to input buffer amplifiers and combined. The output of the input amplifier chain is fed to the input of the filter networks.

In the phase-locked mode of operation, the FM circuits are configured to operate as follows:

- The FM modulation signal is filtered, as DC FM operation is not possible in this mode. The filter selection in this mode is normally under control of the A23 Microprocessor.
- The FM Integrator circuit is not bypassed in this mode; therefore, the FM modulation signal from the amplifier/filter circuits is integrated. This circuit also amplifies the FM modulation signal by a factor approximately equal to the YIG loop gain factor and with the same response characteristics (i.e., high gain at low frequencies, decreasing gain as the modulating frequency increases).
- The output of the integrator circuit is fed into the A12 PCB's YIG phase-lock circuit to cancel the correction error signal that is caused by the frequency modulation of the RF output signal. Without this function, modulation frequencies below the YIG loop bandwidth (approximately 10 kHz) would be removed by the YIG phase-lock loop circuitry.
- The attenuated FM modulation signal is combined with the YIG frequency error signal at the input of the FM Deviation Limiter circuit. The combined signal output from this circuit then goes to the FM amplifier in the normal manner (see below).

In the unlocked mode of operation, the FM circuits are configured to operate as follows:

- The FM modulation signal is not filtered (i.e., DC FM operation is selected).
- The FM Integrator circuit is bypassed in this mode; therefore, the FM modulation signal from the amplifier/filter circuits is not integrated.

In both FM operating modes, the output of the amplifier/filter circuits (U4) goes to the input of the FM attenuator circuit and the input of the FM peak detector circuit. The output from the FM attenuator circuit goes to the FM limiter, FM sensitivity circuits, and FM output amplifier.

The FM output from the A16 PCB is routed to the A18–A21 YIG driver PCB(s). The FM amplifier of the YIG driver board selected by the A23 Microprocessor drives the FM coil of the YIG-tuned oscillator assembly.

The field produced by the YIG-tuned oscillator's FM coil interacts with the magnetic field that results from the current flow through the YIG-tuned oscillator's main tuning coil. The modulation of this magnetic field changes the frequency of the YIG-tuned oscillator at the rate of the modulating frequency. Maximum deviation in the unlocked mode is ±25 MHz.

For narrow band analog sweeps (<50 MHz), the ramp voltage from the A17 PCB goes to the Sweep Amp. The Sweep Amp applies the ramp through S3 to the FM Amp on the A18–A21 YIG Driver PCBs. This improves the residual FM characteristics during narrow band sweeps.

2H-2 A12 YIG PHASE DETECTOR PCB CIRCUIT DESCRIPTION

The circuits located on the A12 PCB provide the frequency/phase locking functions for the YIG loop. Refer to Figure 2H-1, and to the A12 PCB schematic diagram, Figure 2H-4.

2H-2.1 Sampler/IF Amplifier Input Circuit

The 20-32.1 MHz IF signal from the A30 Sampler/IF is input at connector A12J4 (the signal level at this connector is approximately 0 dBm). Resistors R6 and R7 comprise a resistive pad that attenuates and isolates the A12J3 test connector. This test point can be monitored by an oscilloscope, network analyzer, or spectrum analyzer to monitor what is happening inside the YIG loop. The signal level at A12J3 is approximately 12 dB down from the level at A12J4. The signal at A12J4 goes to transistor Q7, which has a gain of approximately 10 dB; the output from Q7 goes to Q8 which converts the signal to TTL levels. From the collector of Q8, the signal goes to U3 which divides the signal by 10 and applies it to U4, which is the phase/frequency detector for the YIG loop.

2H-2.2 200-321 MHz Fine Loop Oscillator Input and Divider Circuits

The output signal from the A9 Fine Loop Oscillator PCB is input at A12J1 (signal level ≈ –5 dBm). It is coupled by C3 to X5 amplifier, Q1. The output of Q1 is coupled to the ECL input of U1, which is a dual modulus divider configured to divide by 10 at all times. The TTL output of U1 goes to U5A, which is a NAND gate that is used as a switch. When the L HIGH RES EN signal from the A16 PCB is high, U5A-2 and U5B-5 will be high and the 20-32.1 MHz signal from U1 goes to U2, which is another divide-by-10 counter. The 2-3.21 MHz TTL signal from U2 is the frequency reference signal that is connected to one input of the YIG phase/frequency detector circuit comprised of U4A and U4B.

2H-2.3 Phase/Frequency Detector Circuit

This circuit compares the 2-3.21 MHz output signal from the A30 Sampler/IF Amplifier signal with the 2-3.21 MHz output signal from U2, which is derived from the Fine-Loop Oscillator signal. This circuit is a "D" flip-flop phase detector circuit comprised of U4A , U4B and U5C.

Whenever the input signal at pin 13 of U4 leads the input signal at pin 1, the waveform at the Q2 output (pin 9) will be of longer duration than that at the Q1 output (pin 5). Conversely, whenever the signal at pin 1 lags that at pin 5, the waveform duration at Q2 will be of shorter duration. When both input signals are in phase, both Q output signals will be approximately equal (≈20 ns).

Resistors R25/R28 and capacitor C20 along with R27/R29 and C21 comprise RC filters that integrate the output waveforms of U4 Q1 and Q2 respectively. These filters also reduce the 2-3.21 MHz phase detector reference frequency sidebands. The outputs of the filters go to the inputs of differential receiver, U6. The output of U6 is the YIG phase error signal. If R30 were not in the circuit, the output of U6 would be 0V when the YIG loop was locked. However, R30 provides a phase offset of about 30 degrees to prevent the phase detector from operating in its dead zone. This is especially important during phase modulation.

Differential receiver U6 has a X4 gain. The output of U6 is the YL Ø ERR signal that is routed to the A16 FM board via the A28 Mother Board. Under locked conditions, The voltage at this point will be 0V. When the YIG loop is unlocked, the voltage will be +12V or –12V.

Resistors R45/R46 and capacitor C10, filter the YIG error signal and provide isolation for the U6 output. The output of this filter is the YL MON signal that is routed to the A17 Analog Instruction PCB's DVM circuit. The A23 Microprocessor monitors this signal via the DVM to determine if the YIG Loop is phase-locked.

The Ø MOD and Ø MOD REF phase modulation signals from the A16 FM board are filtered by the RC filter networks comprised of R39, C26, R40 and R38, C27, and R41. These filtered signals are combined with the YIG phase error signal that are input to the phase detector, U6. During the FM modulation mode of operation, these signals change the offset of the phase detector at the FM modulation rate. This cancels the error signal generated by the phase detector circuits in response to the FM modulation. Without this canceling effect, the phase-lock loop would remove any FM modulation applied to the RF output signal that is within the 10 kHz YIG loop bandwidth.

2H-2.4 External 20-32.1 MHz Synthesizer Input

The 20-32.1 MHz external signal from the rear panel HIGH RES INPUT connector is input at A12J2. This signal is fed to the input amplifier comprised of Q4 and Q5. The output of Q5 goes to one input of gate U5D. Whenever the L HIGH RES EN signal is set to the low state by the A23 Microprocessor, the gating circuits comprised of U5A, U5B and U5D pass the 20-32.1 MHz external signal to the input of U2 to be used as the YIG IF reference frequency input to the phase/frequency detector circuits. This control line also disables the Fine Loop oscillator (A9 PCB). During normal operation, the L HIGH RES EN signal is in the high state and the U1 output signal (i.e., the divided A9 Fine-Loop Oscillator signal) will be passed to the input of U2.

When an external synthesizer or other signal source is used replace the internal Fine Loop Oscillator signal, the characteristics of the YIG RF output signal will be dependent on the characteristics of the external signal source. If the phase noise of the external synthesizer is equal to or better than the divided Fine Loop signal, then the phase noise of the RF output signal will not be degraded. The RF output signal will also have the same frequency stability and tuning resolution characteristics of the external source.

Normally, this mode of operation is used only with a GPIB controller, as the frequency of the external source must be calculated for each desired synthesizer output frequency. This is easily done using a GPIB controller, as this can be implemented by a simple program. There are also "hidden key" functions to enable this input from the front panel for troubleshooting purposes. These codes are listed in Table 2-2 located in the front portion of Section 2-System Description and Troubleshooting.

2H-3 A16 FM PCB CIRCUIT DESCRIPTION

The circuitry contained on the A16 FM PCB provides the following functions: YIG frequency/phase locking, FM modulation, and narrow band sweep operations. Refer to the overall block diagram of the A16 PCB, Figure 2H-2, and to the A16 PCB schematic diagram, Figure 2H-6.

2H-3.1 Digital Control

All of the functions of the A16 PCB are controlled by the A23 Microprocessor. The U5 Address Decoder decodes the PA0-PA2 lines and generates strobes that latch instructions and data into the latches and DACs that control the various A16 and A12 PCB functions. Decoder U5 is enabled by the low-active L PA 16 dedicated address line from the A23 Microprocessor; this line is the unique address line for the A16 PCB.

Data Latch U6 buffers the A23 Microprocessor data bus lines from the internal A16 data bus. YIG Loop Control Latch U9 provides control for various YIG Loop functions located on the A16 and U12 PCBs. The FM Control Latch, U7, provides control for the FM attenuator DAC and the various analog switches used in the FM circuits..

2H-3.2 A16 YIG Phase-Lock Circuits

The phase-lock error signal from the A12 YIG Phase Detector goes to buffer amplifier U19B. The U27 False Lock Detector prevents a false lock on signals that result whenever the IF output of the Sampler/IF Amplifier goes through a zero beat. From U19B, the error signal goes to notch filters, which remove the fractional-division sidebands that result from the fine/coarse loop oscillator divider circuits. During the time that phase-lock is being acquired, switch U22C closes to bypass these filters and give a faster locking time. After phase-lock is acquired, U22C opens to insert the notch filters. The error signal then goes to loop amplifier U23. In unlocked modes, analog switch U18B closes to keep the U23 output signal from going to the supply rails.

From U23 the error signal goes through analog switch U18C to the FM Deviation Limiter, U24; this circuit limits the deviation of the FM system to ap-

proximately ±40 MHz, which prevents saturation of the circuits following U24. This improves response time and eliminates overdrive conditions.

From U24, the error signal goes to output amplifier U25 and to the U20 FM Sensitivity Cal DAC. The Cal DAC can adjust the sensitivity approximately ±10%. There are variations in YIG-tuned oscillator sensitivities, and component variation in the FM driver circuits; the Cal DAC provides a means to compensate for these variations. The Cal DAC data for each YIG-tuned oscillator driver is stored in EEPROM on the A23 PCB. At the bandswitch points, this data sets the DAC so that each YIG driver has the same sensitivity. This provides for a more constant loop gain. It is also a requirement for a calibrated FM and sweep width.

2H-3.3 FM Input Amplifiers and Filters

The external FM modulation signals from the front and rear panel connectors go to the input buffer amplifiers U1A and U1B, respectively. Diodes CR1-CR4 and resistors R2 and R5 provide overdrive protection for U1A and U1B. Resistors R1 and R6 provide the terminations for the two external FM modulation signal inputs.

The outputs of U1A and U1B go to the input of differential receiver amplifier U2, which sums the two external modulation signal inputs. The output of U2 is applied to the inputs of the two filter networks and to analog switch U3A.

In the unlocked FM mode of operation, the A23 Microprocessor selects the DC FM path (U3A closed) and extends the FM deviation range from dc to 25 MHz/V.

In the phase-lock mode of operation, the phase detector does not have the range to allow DC FM operation, and analog switch U3B is opened. At FM deviations up to 300 kHz/V, U3B is closed and the FM modulation signal goes through the 30 Hz HPF (high-pass filter) comprised of C6, R106 and R13 . At deviations between 300 kHz/V and 5 MHz/V, it goes through the 1 kHz HPF comprised of C4, C5, R11, and R12. The microprocessor selects these filters based on the deviation range selected by the operator.

From the selected filter, the FM signal goes to buffer amplifier U4, which provides a constant impedance to the filter circuits. It is inverting or non-inverting, depending on the position of W5-W8 jumpers.

Jumpers W5-W8 provide a means of changing the polarity of the modulation signal. Normally, a negative going modulation signal causes the RF output frequency to increase. By removing W5 and W6 and installing W7 and W8, the frequency will increase with a positive input. From U4, the FM signal goes to U28 FM peak detector and U10 FM Attenuator DAC.

2H-3.4 FM Attenuator Circuits

These circuits include DAC U10, buffer amplifier U11, and two 20 dB attenuators comprised of resistors R24-R27 and analog switches U12A-U12D. Whenever the user enters a FM Sensitivity value via the front panel (or GPIB), the A23 Microprocessor sets the DAC/attenuators accordingly. The attenuator circuits provide a resolution control of approximately 0.02 dB throughout a 90 dB dynamic range.

The two 20 dB attenuators are used to provide high values of attenuation, therefore allowing the DAC to be used only for low attenuation values. This avoids AC feedthrough of the DAC at high frequencies.

Buffer amplifier U13B provides a high impedance load to the attenuators. With U10 DAC set for 0 dB attenuation and the 20 dB attenuators in the 0 dB attenuation state, the signal at the output of U13B will be 5V peak for a 1V peak input signal. At 10 kHz peak deviation, this signal will be about 50 µV peak for a 1V peak input signal.

From U13B, the FM signal goes to the input of the FM integrator and to analog switch U18D for application to the input of the FM Deviation Limiter.

2H-3.5 FM Integrator Circuits

The FM integrator circuits generate a signal that is fed into to the A12 PCB's YIG phase-lock circuits to cancel the correction error signal that is caused by the frequency modulation of the RF output signal. Without this function, modulation frequencies below the YIG loop bandwidth (approximately 10 kHz) would be removed by the YIG phase-lock loop circuitry.

The FM integrator circuits amplify the FM modulation signal by a factor approximately equal to the YIG phase-lock loop gain factor and with the same response characteristics. This signal is inverted and fed back to the A12 PCB.

The signal from the FM attenuator goes to amplifier U13A, which has a decreasing gain with increasing frequency characteristic. From U13, the signal goes to amplifier, U15. The input circuit of U15 includes the limiting network comprised of CR13, CR14 and R33. This circuit provides overdrive protection in the event of sudden level changes, such as connecting and disconnecting the FM modulation signal source.

From U15, the signal goes to the input of the Phase Modulation Sensitivity DAC, U20A. The outputs of U15 and U20A are summed by R37 and R29 at the input of U16. This provides adjustment of the frequency response of the signal generated by the FM integrator so it can be matched to that of the phase-lock loop. The Phase Modulation Sensitivity DAC is adjusted during the FM flatness calibration procedure.

Amplifier U16 also has a decreasing gain with increasing frequency characteristic. From U16, the FM signal goes to amplifier U17, which is also overdrive protected by CR15–CR18. From U17, the FM signal goes to the phase modulation metering circuits and to A12 YIG phase detector.

2H-3.6 False Lock Detector

The YIG phase error signal from the A12 PCB goes to differential receiver, U19B. From U19B, the error signal goes to the input of the notch filter circuits. Analog switch, U22A, is a bypass for the notch filters; when closed, it routes the error signal directly to the input of the YIG Loop Amplifier (U23).

The YIG phase error signal will contain high frequency signals whenever a change in the YIG frequency causes a zero beat with the harmonic comb signal from the A31 Power Amplifier. Because of the very high gain of the A30 Sampler/IF Amplifier, any noise at the zero beat will be amplified. It is possible for the YIG loop circuits to sense these signals as a coherent IF signal and to falsely lock at that point.

The output of U19B is amplified by U27B and only high frequency components of the signal are coupled by C32 to the doubling rectifiers, CR27 and CR28. These high frequency components of the signal are rectified by CR27 and CR28 and go to comparator, U27A. When U27A switches states, a DC level is fed back to U19B via CR26 which forces the YIG-tuned oscillator to a higher frequency. Resistors R80 and R77 set the comparison voltage of U27A to approximately 1 volt; R79 is a positive feedback path that provides hysteresis for this circuit.

2H-3.7 Notch Filter Circuits

Operational amplifiers U32A and U32B are configured as a notch filter with a center frequency of 200 kHz (this is the frequency of the main fractional division sidebands generated by the A6 Coarse Loop Divider). Operational amplifiers U33A and U33B comprise a 100 kHz notch filter that reduce any 100 kHz sidebands caused by the switching power supply and 100 kHz reference frequency signals generated by the A11 Fine Loop Divider. Operational amplifiers U34A and U34B comprise a 50 kHz notch filter that filter out any sidebands that are also caused by the 50 kHz switching frequency of the power supply.

When changing the YIG-tuned oscillator's frequency output in large increments, the notch filters are bypassed via analog switch U22A to provide a faster lock time; when lock is obtained, U22A is opened. The switching of U22A is controlled by the A23 Microprocessor. When U22A is closed, the output of U34 is swamped by the low output impedance of U19, and the signal from U19B is fed to the input of the YIG loop amplifier.

2H-3.8 YIG Loop Amplifier

Operational amplifier U23 is the YIG loop amplifier. When the YIG loop is phase-locked, it has a loop bandwidth of approximately 10 kHz. When the notch filters are bypassed by analog switch U22A, the loop bandwidth is approximately 50 kHz. When the YIG loop is unlocked (during switching in step sweep, or in analog sweep mode) analog switch U18B is closed to prevent the output of U23 from limiting at ±15V. This provides faster locking when the YIG is within the capture range of the phase detector.

Whenever the loop is unlocked, analog switch U18C is opened, which disconnects the output of U23. This prevents the YIG FM coil from receiving an erroneous phase error voltage. When closed, U18C connects the phase error signal from U23 to the input of the FM Deviation Limiter amplifier, U24.

The processed phase error signal at the output of U23 is connected to the divider/filter network comprised of R74, R72 and C34. The YL TUNE MON signal is picked off at the junction of R74/R72. This signal goes to the A17 Analog Instruction PCB's DVM circuit. The A23 Microprocessor monitors this signal via the DVM to determine if the YIG loop is phase locked, and also when performing various A17 Tune DAC adjustments. The amplitude of this monitor signal is approximately 5 MHz/V.

2H-3.9 FM Deviation Limiter

This circuit prevents over driving of the FM amplifiers located on the A18-A21 YIG driver PCBs. It limits the maximum FM modulation deviation to approximately 30 MHz.

The FM Deviation Limiter circuit is comprised of Amplifier U24 and associated components. Diode CR25 is a 6.8V zener diode. With no input to U24, there is approximately +3.4V on the cathode, and –3.4V on the anode. As the output of U24 reaches +4V, CR22 starts conducting, which starts to limit the signal. Diode CR23 functions in the same manner for negative-going signals. Diodes CR21 and CR24 limit the maximum signal swing to approximately ±8V.

There are three inputs to the FM deviation limiter circuit:

- The YIG phase error signal from U23, which is the processed output signal from the YIG loop phase detector circuit located on the A12 PCB. This signal is connected to the limiter circuit by analog switch U18C.
- The FM modulation signal from the FM Sensitivity DAC. This signal is connected to the limiter circuit by analog switch U18D.
- The 10V ramp signal from the A17 Analog Instruction PCB, which is used to generate analog (narrow band) sweep widths ≤50 MHz. This signal is buffered by differential receiver amplifier U19. This signal is connected to the limiter circuit by analog switch U18A.

2H-3.10 FM Sensitivity Circuit

This circuit, which is comprised of U20B and operational amplifier U21 functions as a variable attenuator. It is used to adjust the FM modulation sensitivity to compensate for the slight variation in sensitivity of the YIG-tuned oscillators and the FM amplifier circuits on the A18-A21 YIG driver PCBs.

The output of U24 goes to the input of the FM Sensitivity DAC, U20B. The outputs of U24 and U20B are summed by R68 and R70 at the input of U25. This provides an adjustment range of the FM sensitivity of approximately 16%, with a 0.12% adjustment resolution . The FM signal at the output of U25 has a nominal 4 MHz/Volt sensitivity

2H-4 A31 MULTIPLIER/POWER AMPLIFIER ASSEMBLY CIRCUIT DESCRIPTION

Refer to the schematic diagram of the A31 Multiplier/Power Amplifier assembly, Figure 2H-10. The 440-490 MHz –2 dBm signal from the A4 Coarse Loop Oscillator is input at A31, J1. Transistor Q1 is a X5 amplifier that shifts the signal to the ECL levels required by U1. Integrated circuit U1 is a divide-by-two circuit that outputs a 220-245 MHz signal. Resistor R4 and capacitor C4 comprise an input biasing network for U1.

The output of U1 goes to the attenuator/impedance matching network consisting of R6, R5, R8, and C8. Transistors Q2 and Q3 comprise a preamplifier that drives the power amplifier, Q4. The power level at the input to Q4 is approximately +27 dBm. The collector of Q4 is impedance matched to the step-recovery diode module by TL8, TL9, C24 and C20. (The step-recovery diode is part of the J2 output connector assembly.).

The step recovery diode produces a very sharp impulse signal that contains harmonic signals in the range of 1.98 GHz to approximately 40 GHz. This signal is used to switch the sampling diodes in the sampler module portion of the A30 Sampler/IF Amplifier assembly.

2H-5 A30 SAMPLER/IF AMPLIFIER ASSEMBLY CIRCUIT DESCRIPTION

2H-5.1 Sampler Circuits

Refer to the schematic diagram of the A30 Sampler/IF Amplifier assembly, Figure 2H-9. The sampler module of the A30 assembly contains a high speed diode switch circuit. A sample of the YIG RF input signal is one input to the sampler module. A very sharp impulse waveform from the step-recovery diode module (which is part of the A31 Multiplier/Power Amplifier Assembly) is the other input. This impulse waveform turns on the sampling diodes, which sample the RF input signal for a very short period of time.

When the RF output frequency is tuned to an exact multiple of the Coarse Loop signal that drives the step recovery diode *plus* 20 MHz, the resulting output from the sampler will be a 20 MHz sinewave that carries the FM information from the RF output signal. The sampler output signal is fed to the (A30) IF amplifier circuits for amplification and limiting to remove any residual AM information it may contain.

2H-5.2 IF Preamplifier

Resistor R1 provides a DC return for the sampler diodes and C1 and C2 couple the IF signal to the IF preamplifier. Since the output impedance of the sampler is very high, Q1 FET amplifier presents a high input impedance to the sampler to prevent excessive loading. The output from the source of Q1 goes to emitter follower Q2. Resistors R9 and capacitor C6 increase the high frequency gain of this stage to compensate for the loss in output of the sampler with increasing frequency. The overall gain of the Q1-Q2 gain stage is about X1.

The signal from Q2 goes to amplifier stages Q3 and Q4 which have an overall voltage gain of approximately 24 dB. The signal from Q4 goes to Q5, which drives the 72 MHz Low Pass Filter.

2H-5.3 72 MHz Low Pass Filter

Inductors L1-L4 and C18-C22 comprise a 72 MHz low pass filter. This filter removes any signals caused by intermodulation products of the sampler, which are produced when harmonics of the RF signal mix with harmonics of the comb signal and produce image frequency signals.

2H-5.4 Limiter Circuit

The signal from the low pass filter goes to emitter follower Q6. The output from Q6 goes to Q7, which has an output of approximately 0.2V peak. Whenever the output of Q7 exceeds this value, CR1 and CR2 will start conducting and provide degenerative feedback that will limit the output of Q7. The signal from Q7 goes to the input of the limiter stages comprised of Q8 and Q9, which are identical to Q7 and Q8.

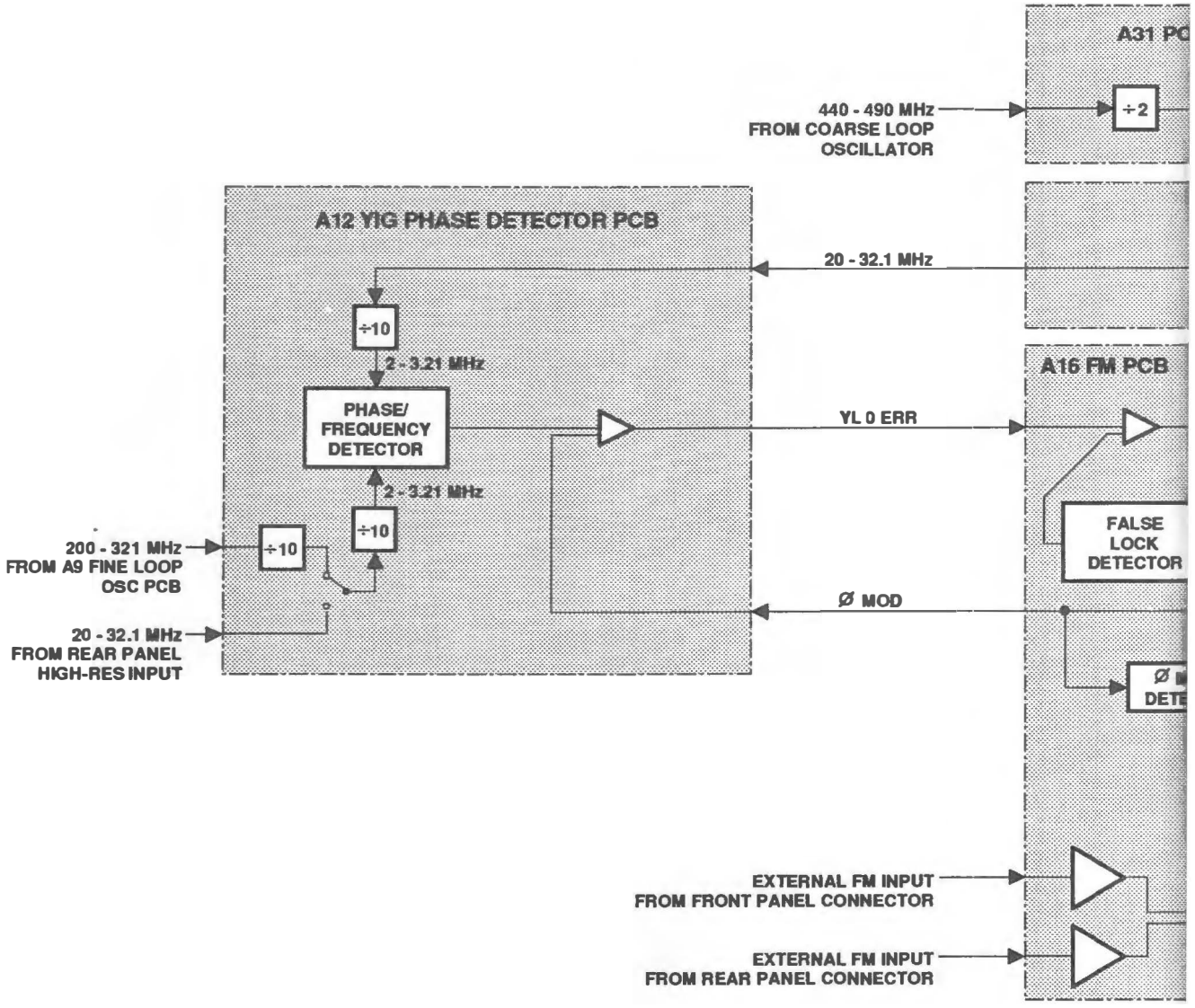
Emitter follower Q10 drives the output connector, A30J5. Capacitor C36 couples the output signal from the emitter of Q10 to R52 which provides the 50 ohm output impedance for A30J5.

2H-6 YIG LOOP ASSEMBLIES, TROUBLESHOOTING

Refer to the troubleshooting information located in the front portion of Section 2-System Description and Troubleshooting. This information provides a list of error codes that may be displayed as a result of failures in the A12 YIG Phase Detector PCB and the A16 FM PCB and probable causes of the failures.

2H-7 YIG LOOP ASSEMBLIES SERVICE SHEETS

Table 2H-1, on the first page of this section, lists the block diagrams, schematic diagrams, and parts locator diagrams for the A12 and A16 PCBs that are contained in this section. It also lists the schematic diagrams and parts locator drawings for the A30 Multiplier/Power Amplifier and A31 Sampler/IF Amplifier assemblies.


A31 PC
440 - 490 MHz
FROM COARSE LOOP
OSCILLATOR
÷2
A12 YIG PHASE DETECTOR PCB
20 - 32.1 MHz
÷10
2 - 3.21 MHz
PHASE/
FREQUENCY
DETECTOR
2 - 3.21 MHz
÷10
200 - 321 MHz
FROM A9 FINE LOOP
OSC PCB
÷10
20 - 32.1 MHz
FROM REAR PANEL
HIGH-RES INPUT
A16 FM PCB
YL 0 ERR
FALSE
LOCK
DETECTOR
Ø MOD
EXTERNAL FM INPUT
FROM FRONT PANEL CONNECTOR
EXTERNAL FM INPUT
FROM REAR PANEL CONNECTOR

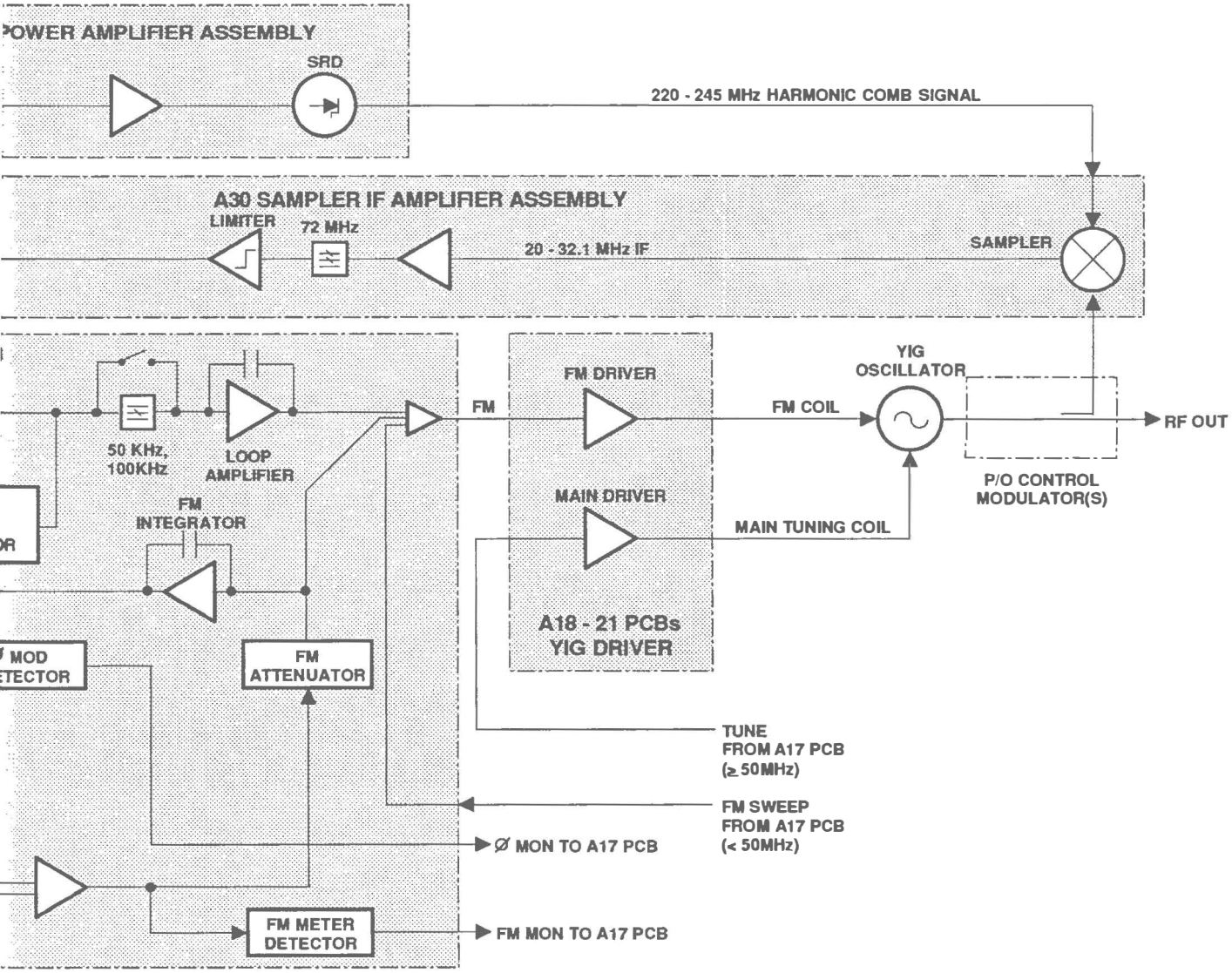
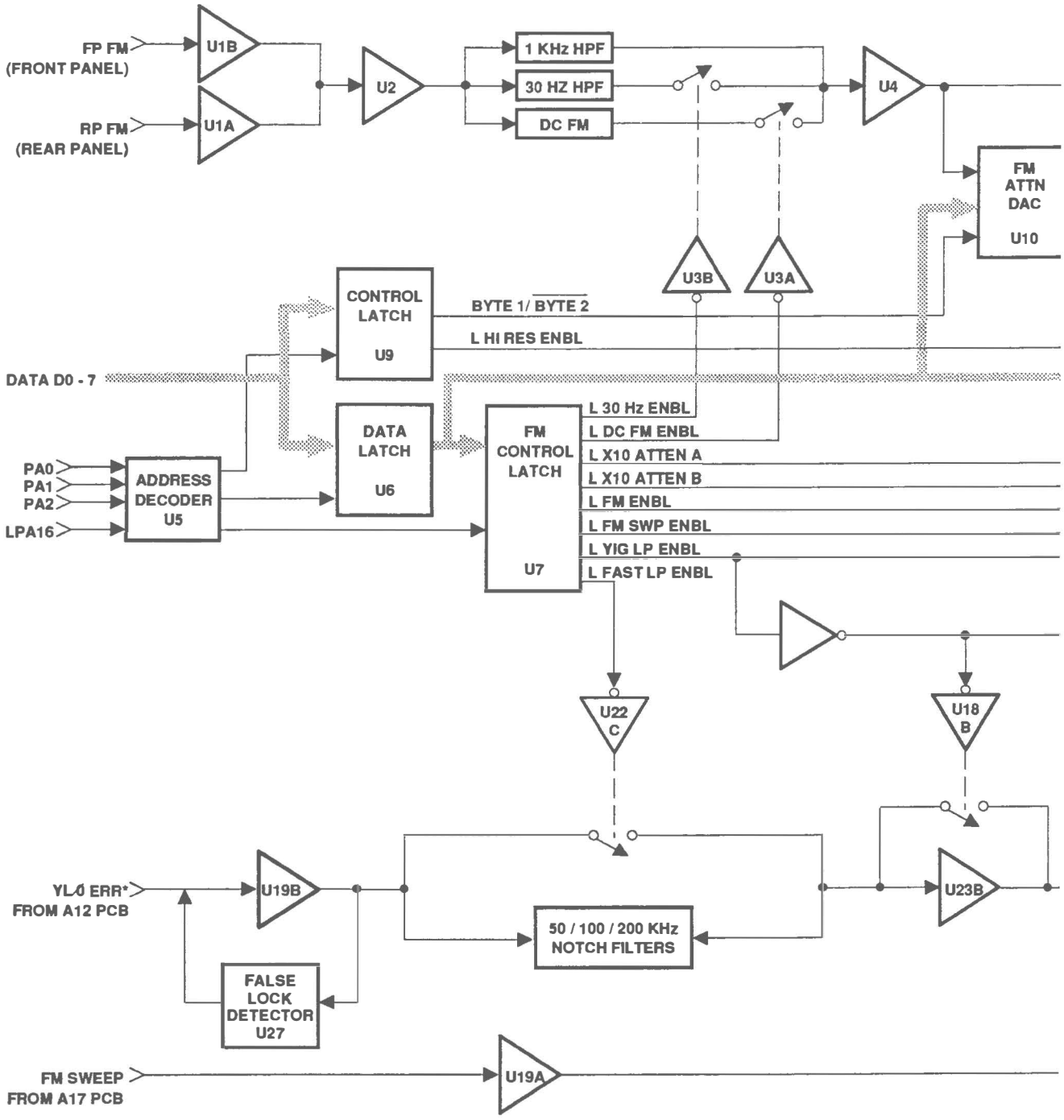


Figure 2H-1. Overall Block Diagram of YIG Loop/FM Modulation Subsystem



* YIG PHASE ERROR

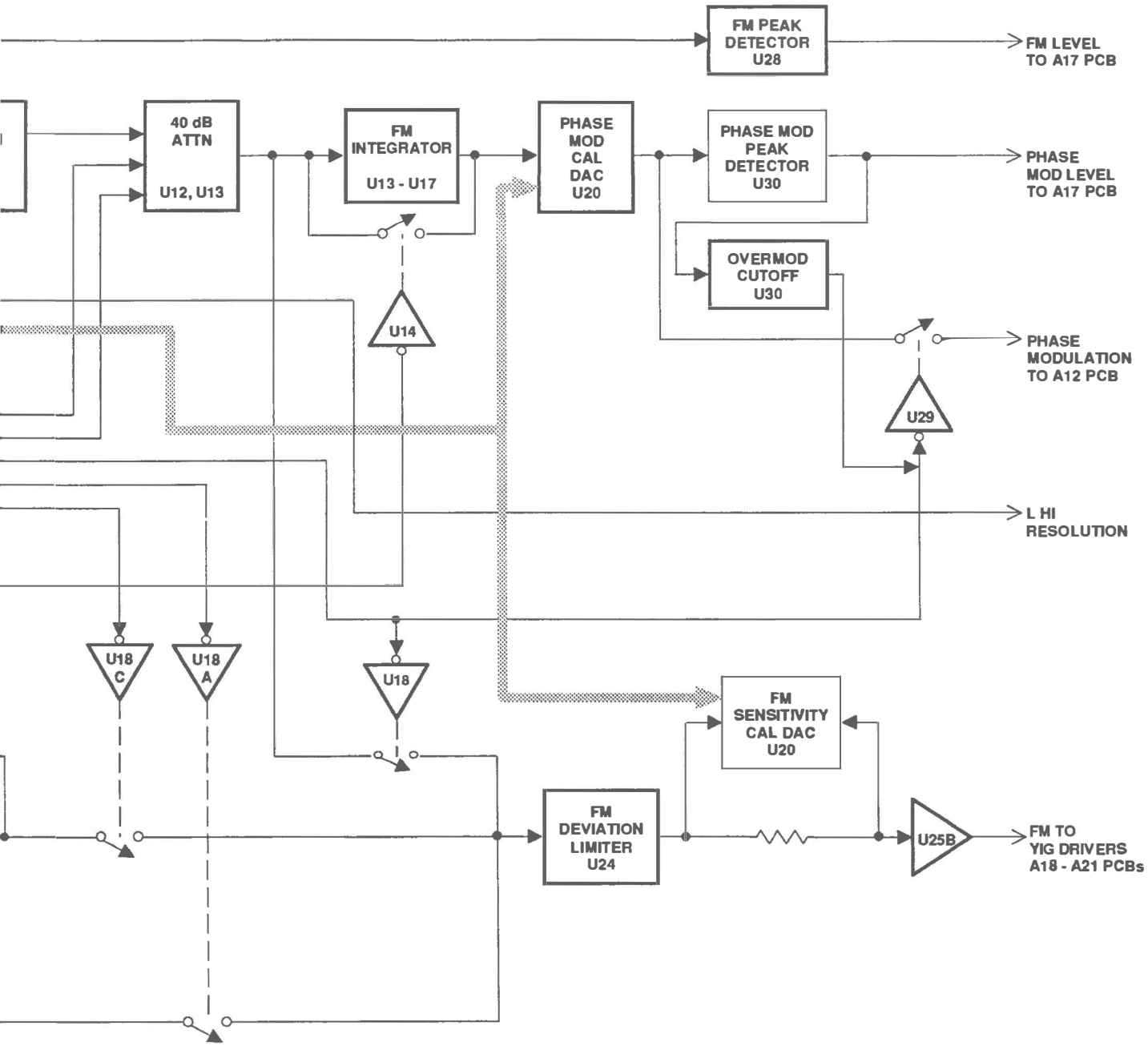
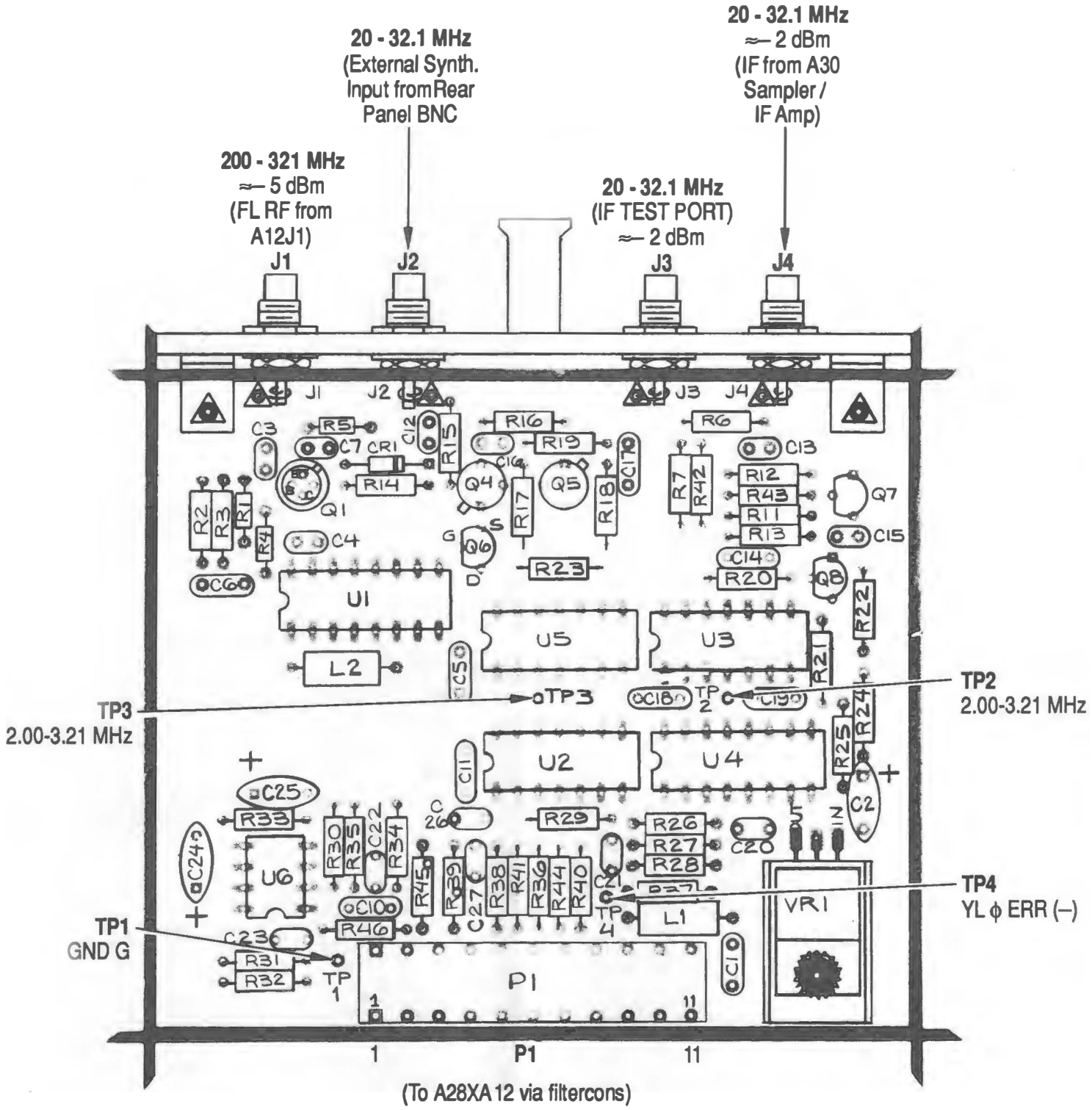


Figure 2H-2. A16 FM PCB Overall Block Diagram


20 - 32.1 MHz
(External Synth.
Input from Rear
Panel BNC
20 - 32.1 MHz
≈— 2 dBm
(IF from A30
Sampler /
IF Amp)
200 - 321 MHz
≈— 5 dBm
(FL RF from
A12J1)
20 - 32.1 MHz
(IF TEST PORT)
≈— 2 dBm
J1
J2
J3
J4
TP3
2.00-3.21 MHz
TP2
2.00-3.21 MHz
TP4
YL ϕ ERR (–)
TP1
GND G
1
P1
11
(To A28XA12 via filtercons)

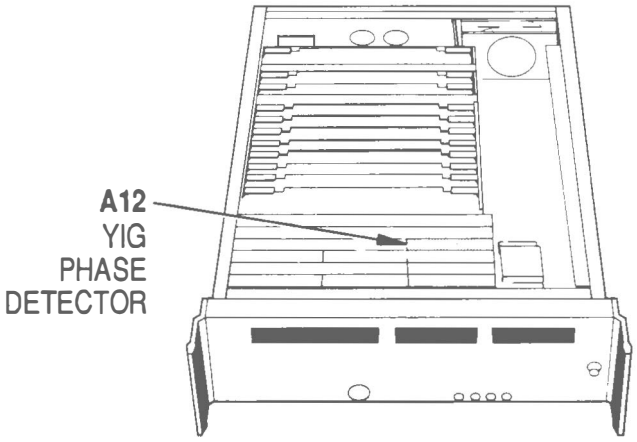
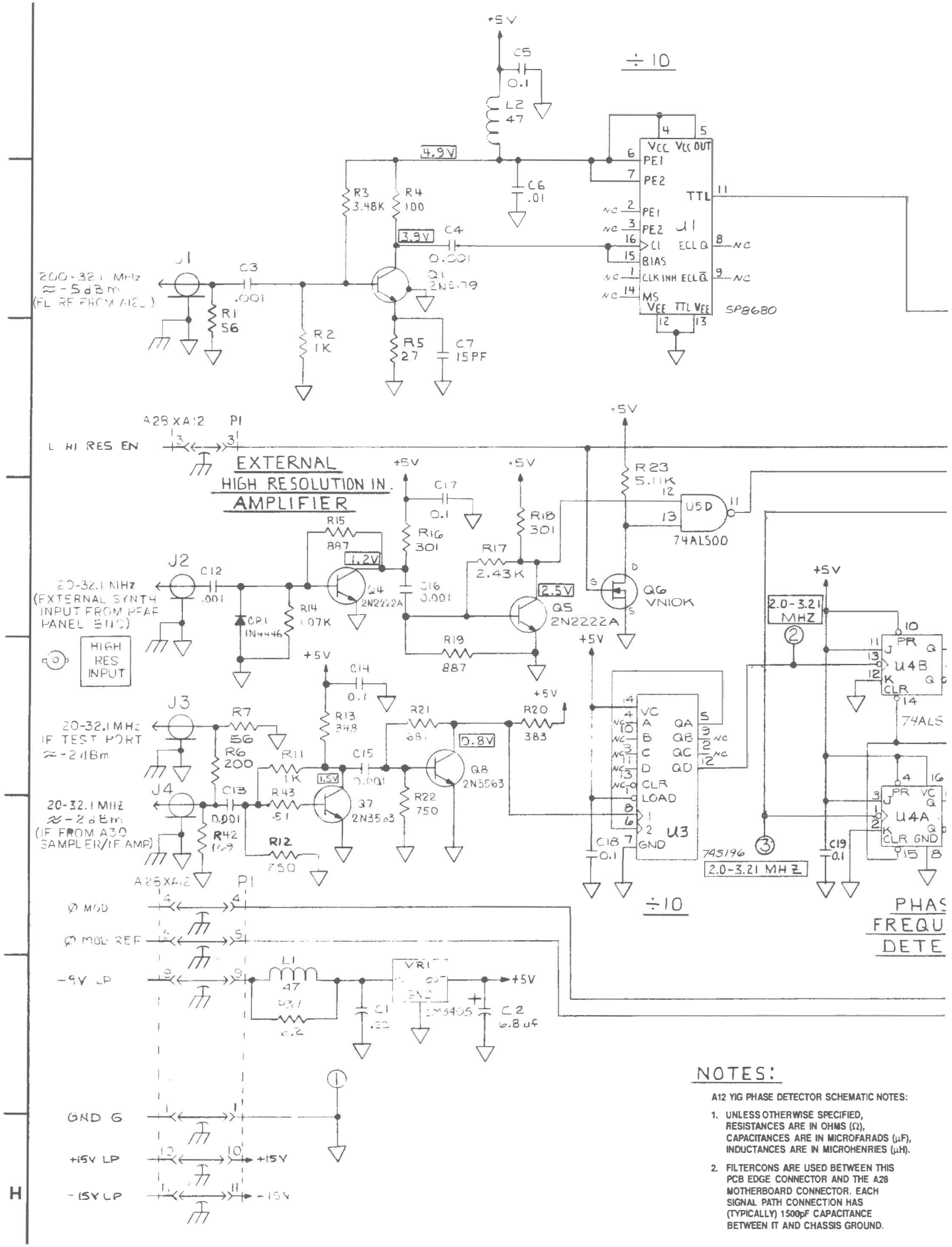


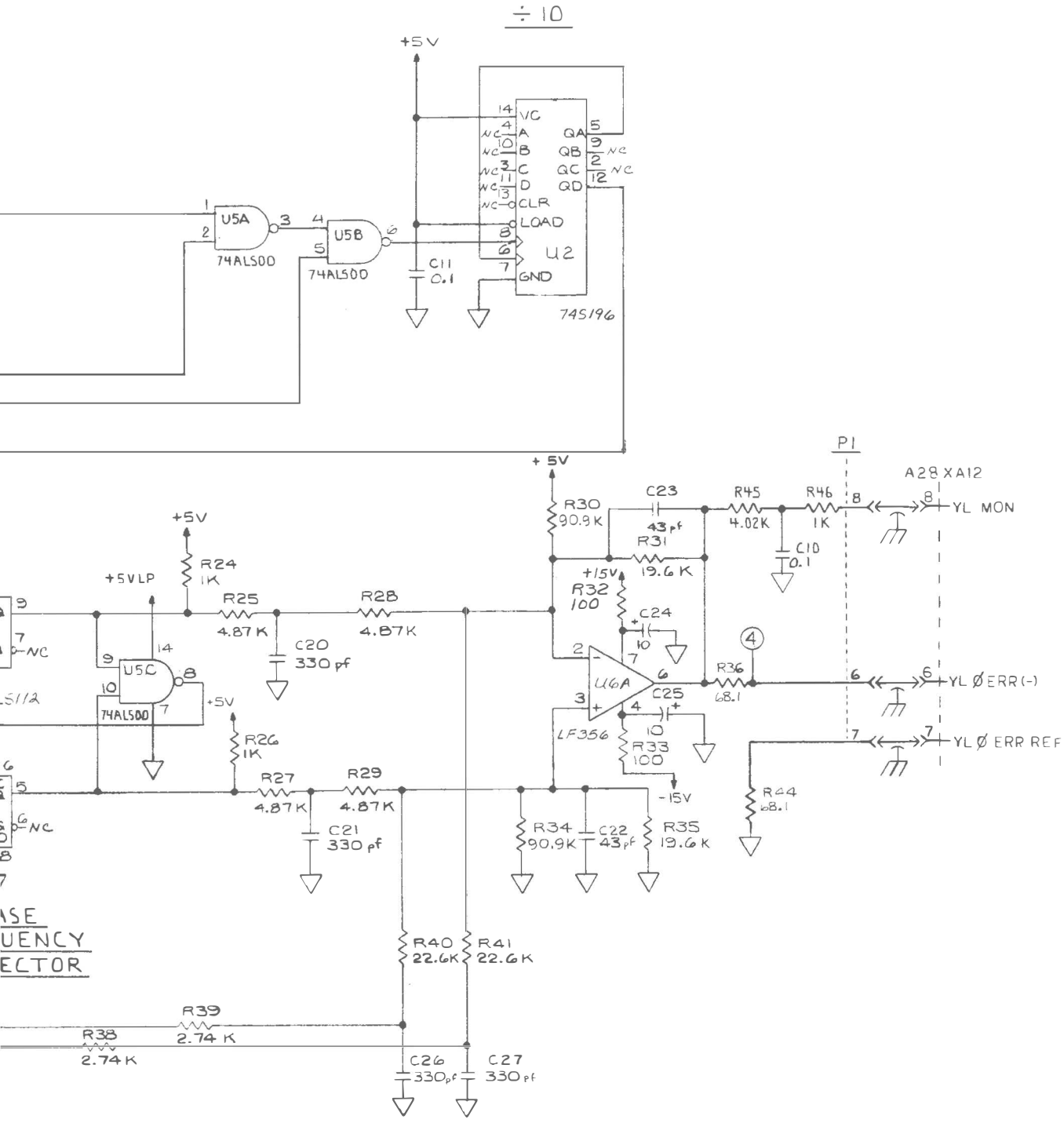
Figure 2H-3. A12 YIG Phase Detector PCB Parts Locator Diagram
6700-D-31712-3 (Rev. F)



NOTES:

A12 YIG PHASE DETECTOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.



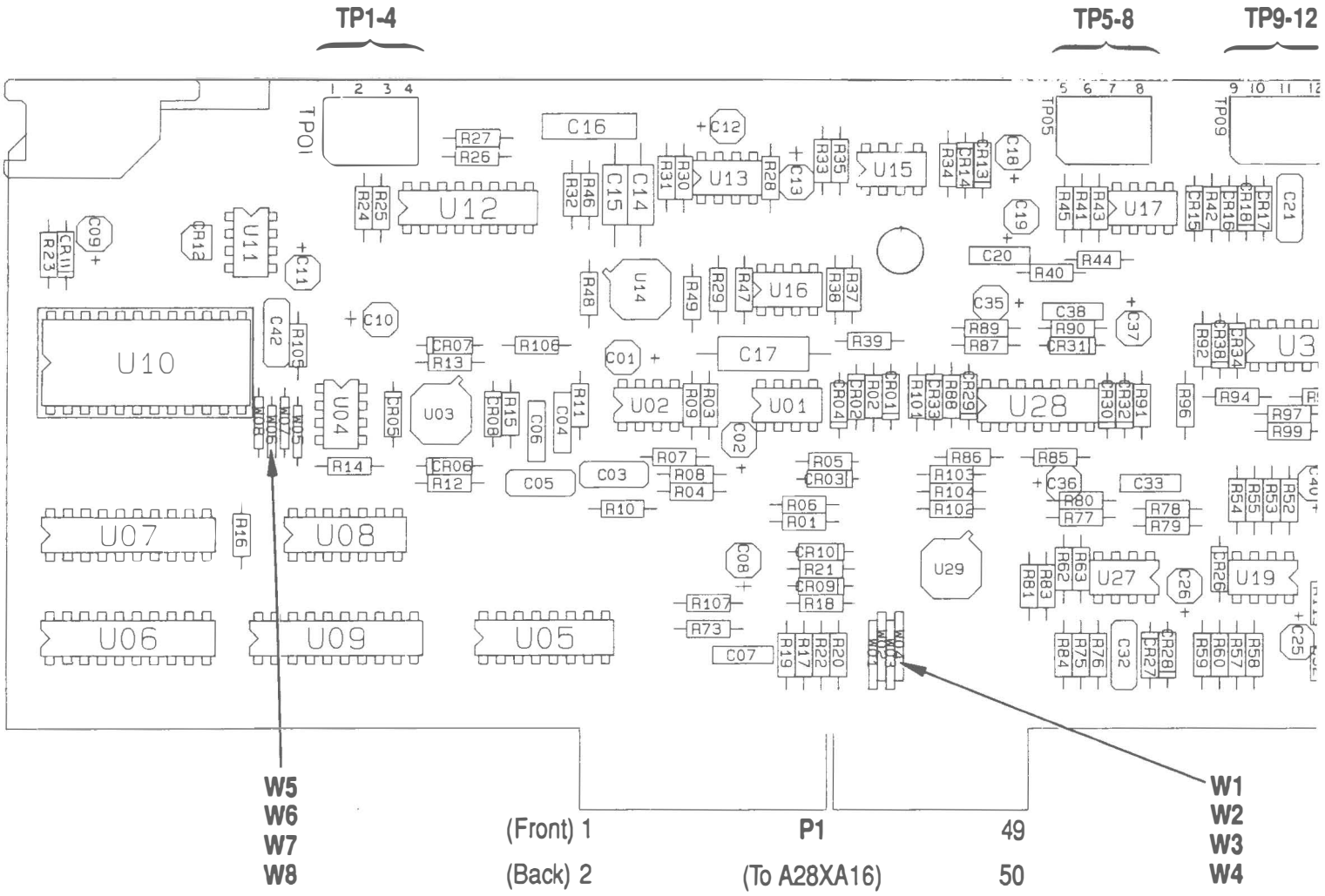
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUND:
4. TEST POINTS ARE DENOTED AS: (2)
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   Q1, Q6, U2, U3, U5, U6, VR1

Figure 2H-4. A12 YIG Phase Detector PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31712-3 (Rev. E)

TEST POINTS

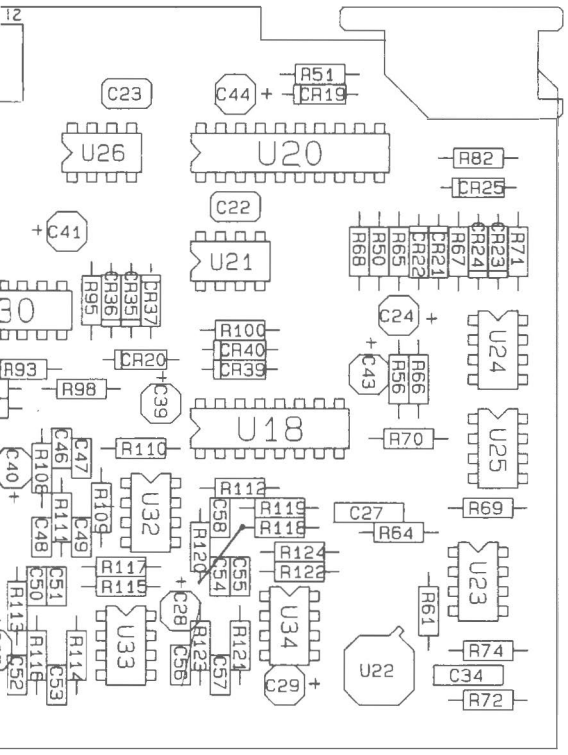
TP1	GND G	**TP7**	ϕ MOD
TP2	FM	**TP8**	Not Use
TP3	FM ATTEN DAC OUT	**TP9**	GND G
TP4	ATTEN FM	**TP10**	FM SEN
TP5	GND G	**TP11**	FM DEV
TP6	FALSE LOCK DET OUT	**TP12**	FM (+)

All test point measurements are made with reference to GND G (TP1 or TP9).



)
ed
G
NS DAC OUT
V LIMITER OUT
)

2



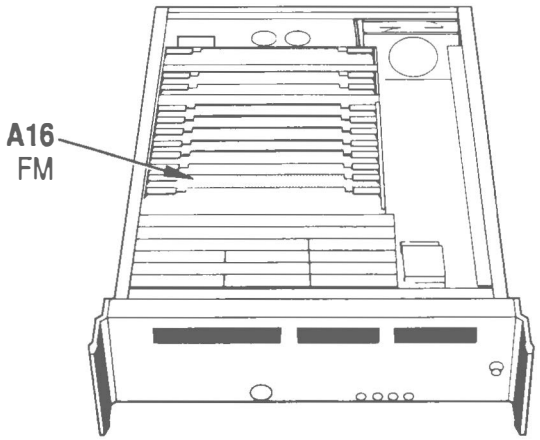
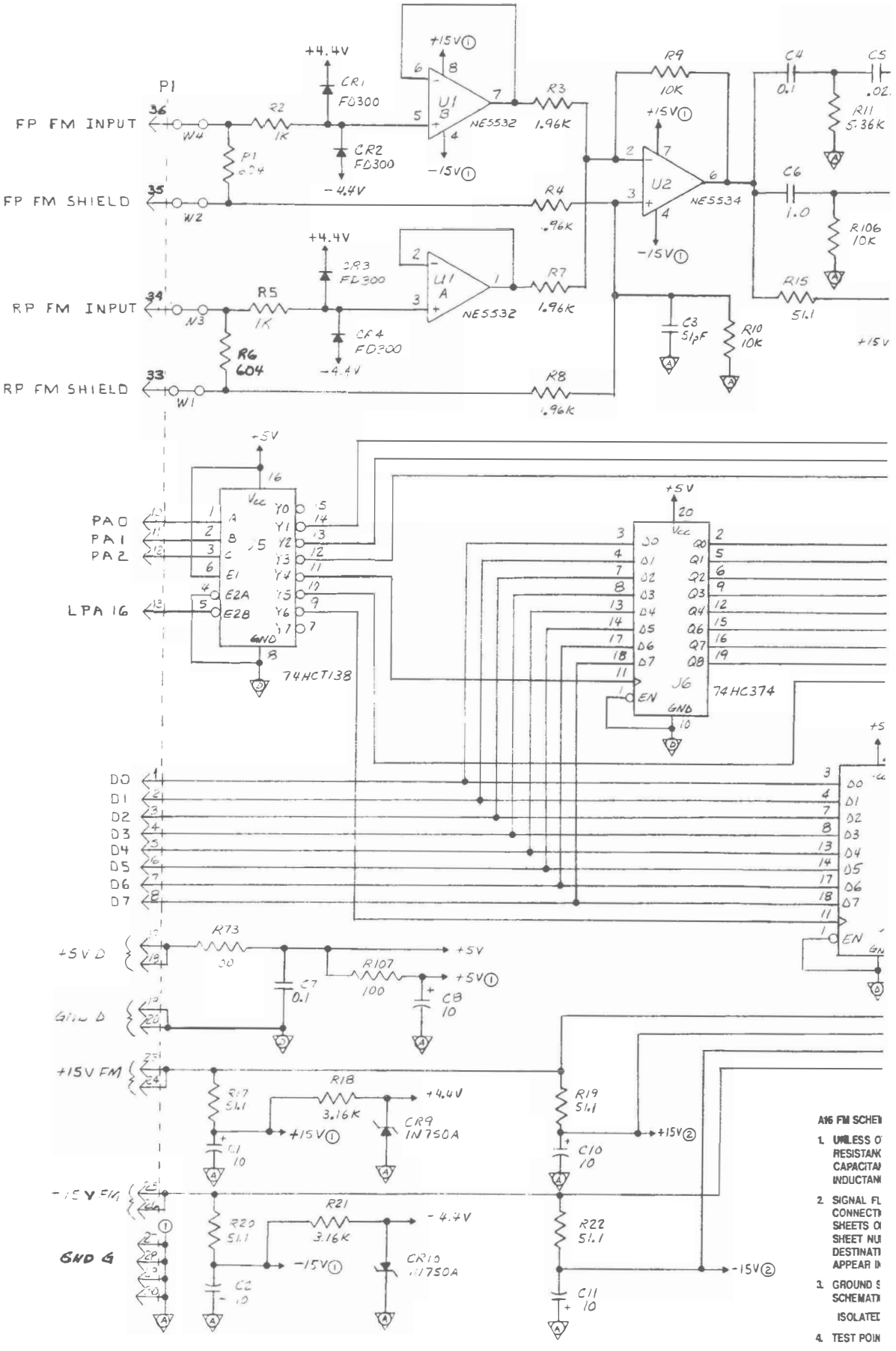
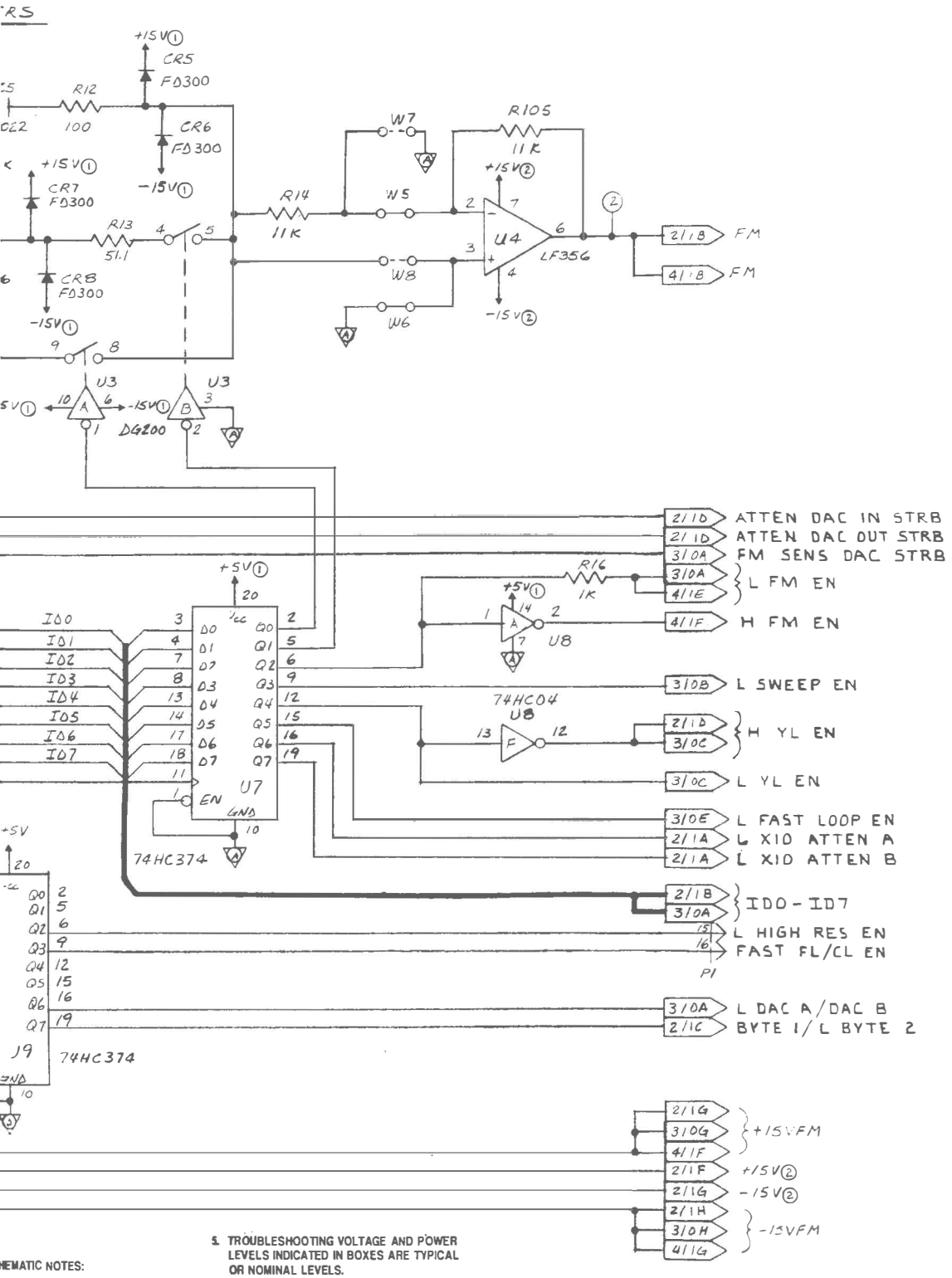


Figure 2H-5. A16 FM PCB Parts Locator Diagram 6700-D-31716-3 (Rev. J)


FM INPUT BUFFER & FILTER
FP FM INPUT
FP FM SHIELD
RP FM INPUT
RP FM SHIELD
P1
W4
W2
W3
W1
R1 1K
R2 1K
R3 1.96K
R4 1.96K
R5 1K
R6 604
R7 1.96K
R8 1.96K
R9 10K
R10 10K
R11 5.36K
R15 51.1
R106 10K
C3 51pF
C4 0.1
C5 .02
C6 1.0
CR1 FD300
CR2 FD300
CR3 FD300
CR4 FD300
+4.4V
-4.4V
+15V①
-15V①
U1 A NE5532
U1 B NE5532
U2 NE5534
+15V
PA0
PA1
PA2
LPA 1G
74HCT138
74HC374
D0
D1
D2
D3
D4
D5
D6
D7
+5V D
GND D
+15V FM
-15V FM
GND G
R73 50
C7 0.1
R107 100
C8 10
R17 51.1
R18 3.16K
CR9 IN750A
C1 10
R19 51.1
C10 10
+15V②
R20 51.1
R21 3.16K
CR10 IN750A
C2 10
R22 51.1
C11 10
-15V②
A16 FM SCHE
1. UNLESS O
RESISTANC
CAPACITAN
INDUCTANC
2. SIGNAL FL
CONNECTI
SHEETS O
SHEET NU
DESTINATI
APPEAR IN
3. GROUND S
SCHEMATI
ISOLATEI
4. TEST POIN



SCHEMATIC NOTES:

UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).

FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE FIRST NUMBER AND SOURCE OR DESTINATION GRID COORDINATES ARE INSIDE THE FLAG: 2/B3

GRAPHIC SYMBOLS USED ON THIS ASSEMBLY CONFORM TO ANSI Y32.2-1975 STANDARD SET ARE DENOTED AS:

CHASSIS GROUND: (A) (D)

TEST POINTS ARE DENOTED AS: (2)

5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.

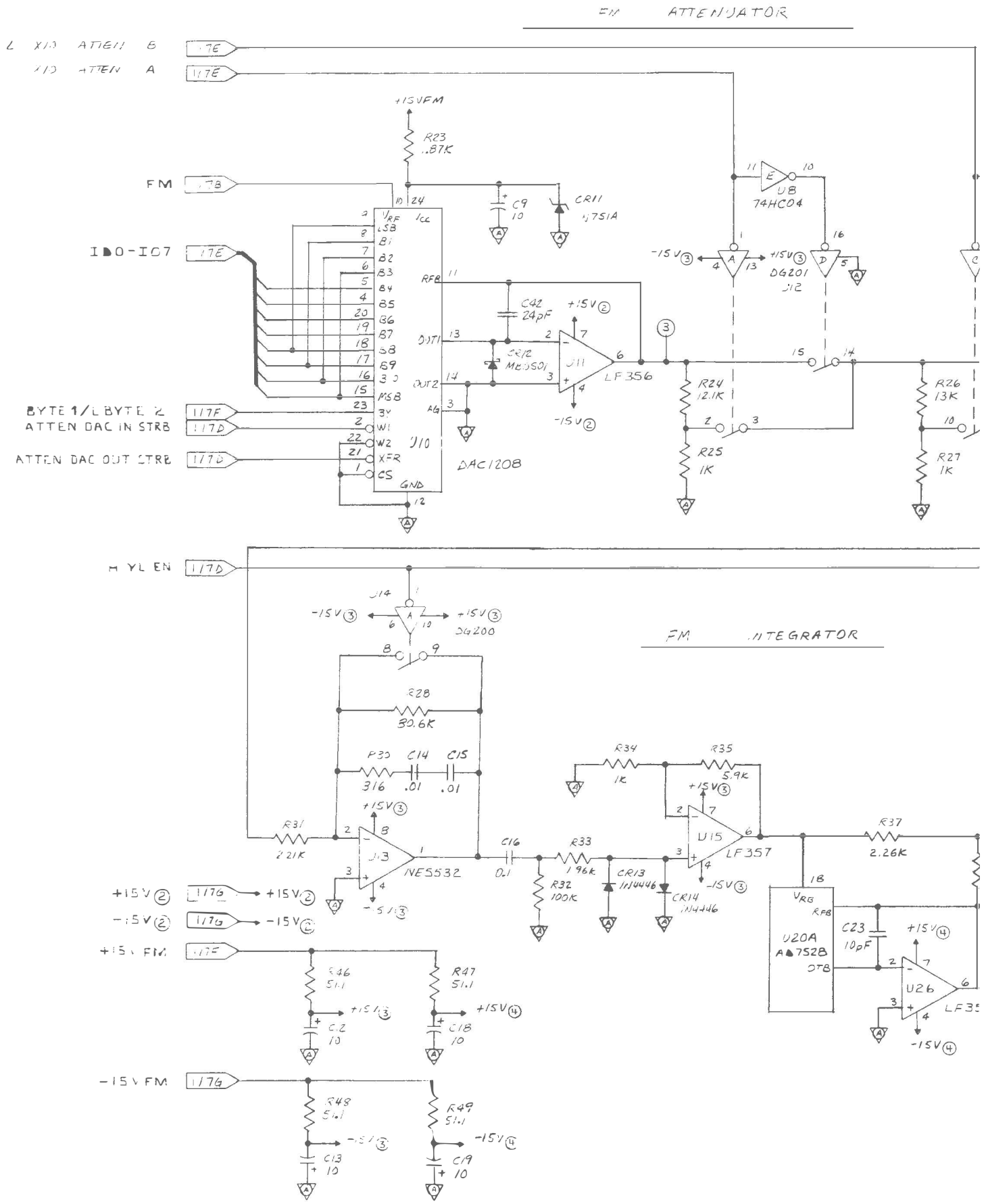
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

CR12, U1-U5, U10-U19, U21-U30, U32-U34

7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C58	C30
CR40	C31
R124	C45
TP12	R36
U34	U8B
W9	U8C
	U22B

Figure 2H-6. A16 FM PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31716-3 (Rev. J)


FM ATTENUATOR
L XID ATTEN B
XID ATTEN A
+15VFM
R23
.887K
FM
I80-I07
BYTE 1/L BYTE 2
ATTEN DAC IN STRB
ATTEN DAC OUT STRB
C9
10
CR11
1N751A
U8
74HC04
-15V
+15V
DG201
U12
C42
24pF
CR12
MBD501
U11
LF356
R24
12.1K
R25
1K
R26
13K
R27
1K
U10
DAC1208
VREF
LSB
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
MSB
WR1
WR2
XFER
CS
GND
IOUT1
IOUT2
RFB
AGND
VCC
FM INTEGRATOR
R28
80.6K
R30
316
C14
.01
C15
.01
R31
2.21K
U13
INE5532
C16
0.1
R33
1.96K
R34
1K
R35
5.9K
U15
LF357
R37
2.26K
R32
100K
CR13
1N4446
CR14
1N4446
U20A
AD7528
OUTB
C23
10pF
U26
LF35
R46
51.1
R47
51.1
C12
10
C18
10
R48
51.1
R49
51.1
C13
10
C19
10

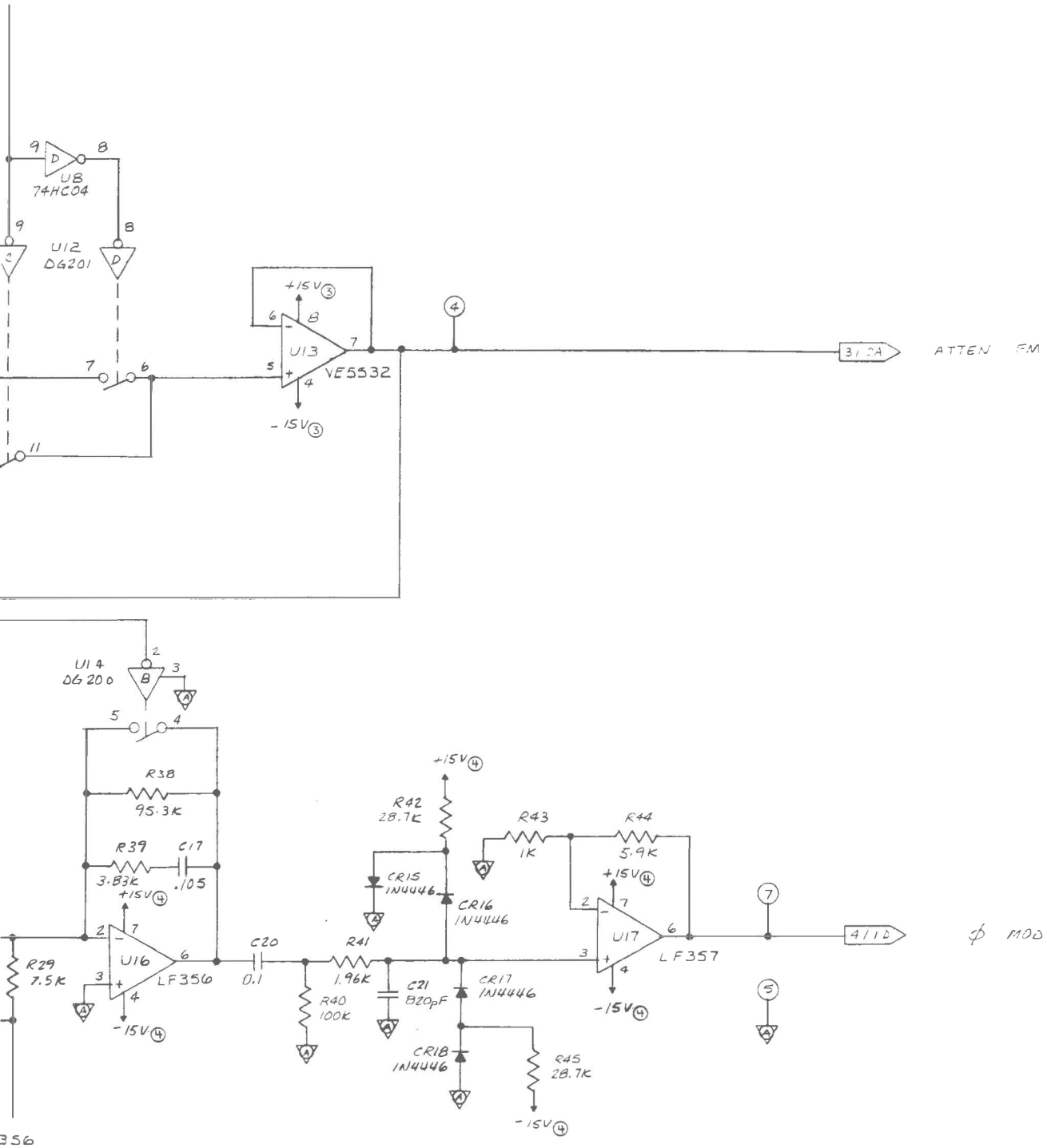
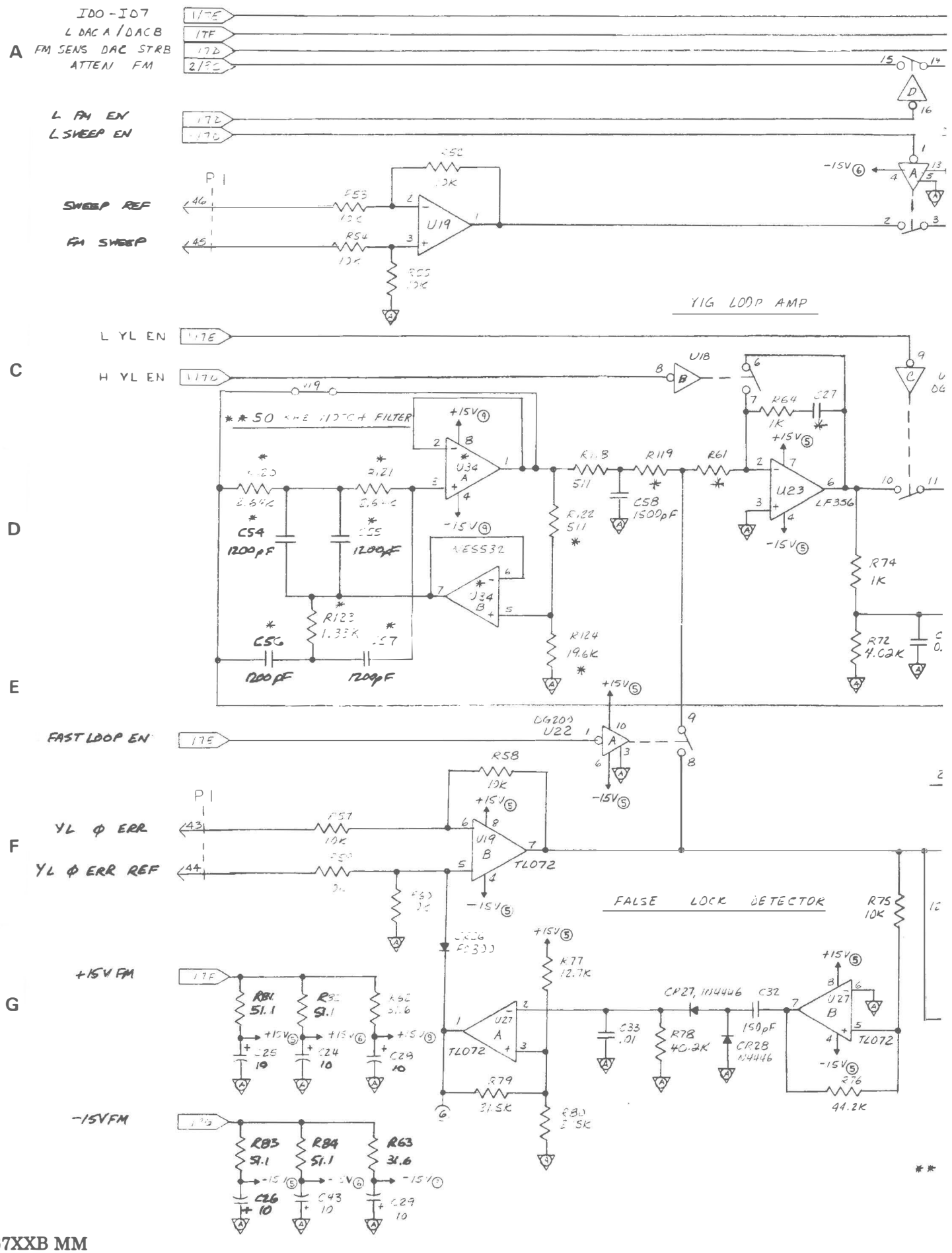
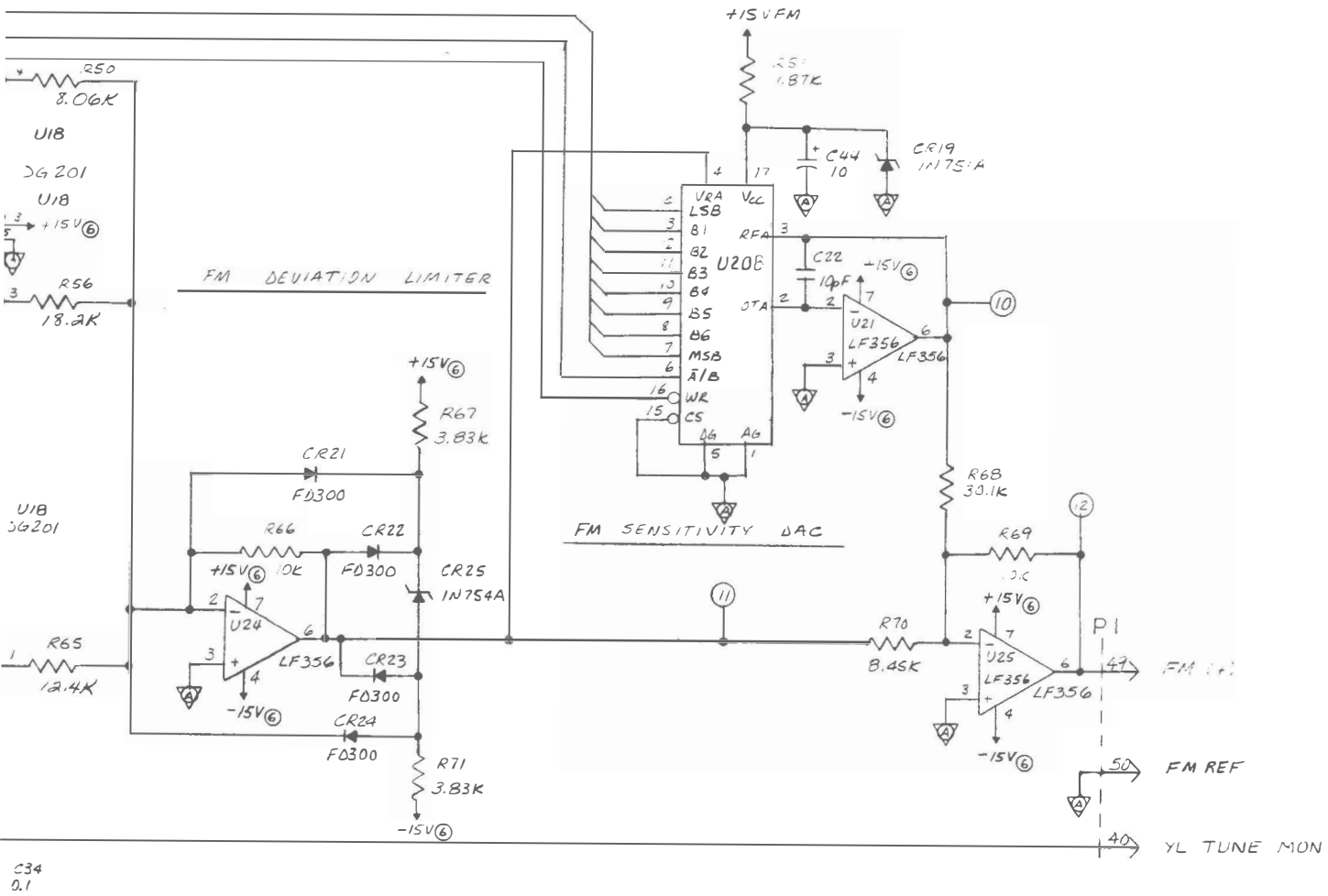
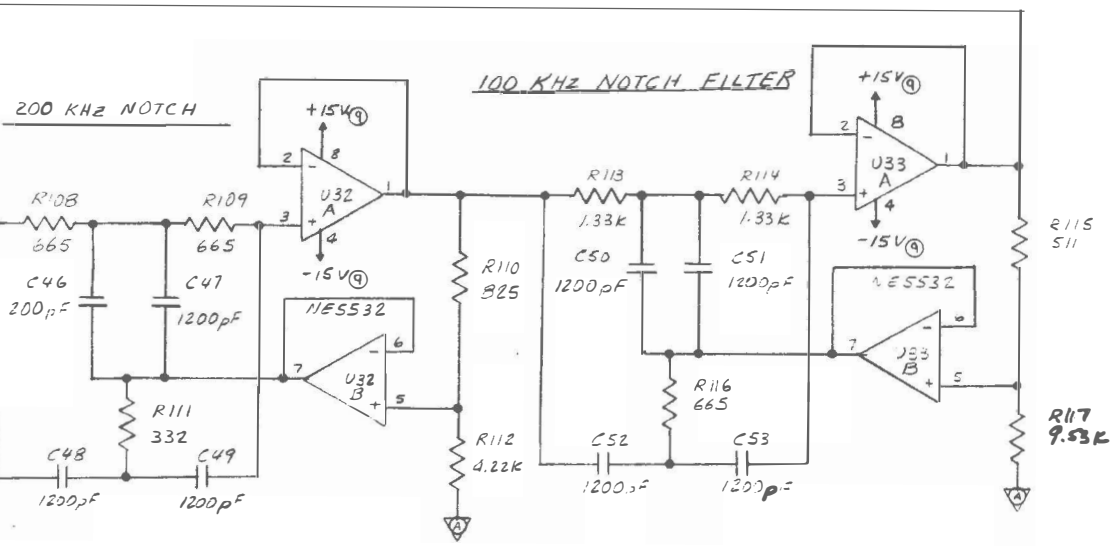


Figure 2H-6. A16 FM PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31716-3 (Rev. J)


0
1
A
C
D
E
F
G
ID0 - ID7
L DAC A / DAC B
FM SENS DAC STRB
ATTEN FM
L FM EN
L SWEEP EN
SWEEP REF
FM SWEEP
P1
U19
R52
10K
R53
10K
R54
10K
R55
10K
-15V
YIG LOOP AMP
L YL EN
H YL EN
U18
U19
** 50 MHz NOTCH FILTER
+15V
U34 A
R120
2.64K
R121
2.64K
C54
1200pF
C55
1200pF
R123
1.33K
C56
1200pF
C57
1200pF
NE5532
U34 B
R118
511
R119
R61
C58
1500pF
R122
511
R124
19.6K
U23
LF356
R64
1K
C27
R74
1K
R72
4.02K
DG201
U22
FAST LOOP EN
R58
10K
YL Φ ERR
YL Φ ERR REF
R57
10K
R59
10K
R60
10K
TL072
FALSE LOCK DETECTOR
R75
10K
+15V FM
-15V FM
R81
51.1
R82
51.1
R83
31.6
C25
10
C24
10
C28
10
R84
51.1
R85
51.1
R63
31.6
C26
10
C43
10
C29
10
R77
12.7K
R78
40.2K
R79
31.5K
R80
1.5K
C33
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C32
150pF
CR27, IN4446
CR28
IN4446
U27 A
U27 B
R76
44.2K

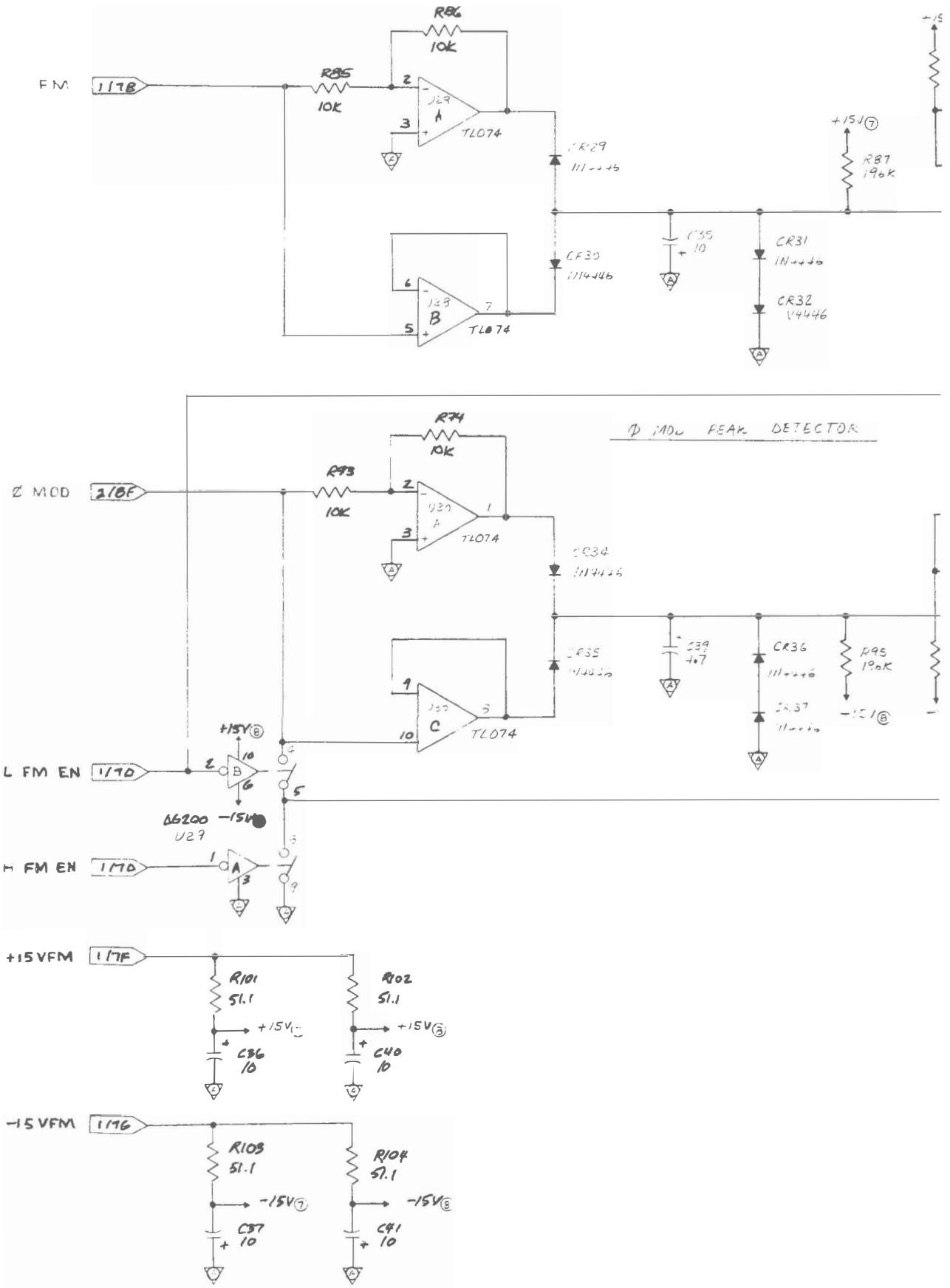




D31716-X	R119	R61	C27	W9	R120-124, C54-57, U34
-3, FOR 6700A	41.2K	10K	0.1	NOT USED	USED
-5, FOR 6700B	25.5K	25.5K	0.047	USED	NOT USED

▶ THE 50KHz NOTCH FILTER IS BYPASSED ON THE 6700B ONLY.

Figure 2H-6. A16 FM PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31716-3 (Rev. J)


FM PEAK DET
FM
117B
R86
10K
R85
10K
U29
A
TLO74
CR29
CR30
CR31
CR32
C35
10
+15V
R87
196K
U29
B
TLO74
Z MOD
218F
R74
10K
R73
10K
U30
A
TLO74
CR34
CR35
C39
4.7
CR36
CR37
R95
196K
U30
C
TLO74
+15V
L FM EN
117D
H FM EN
117D
DG200
U29
-15V
+15VFM
117F
R101
51.1
R102
51.1
C36
10
C40
10
-15VFM
117G
R103
51.1
R104
51.1
C37
10
C41
10

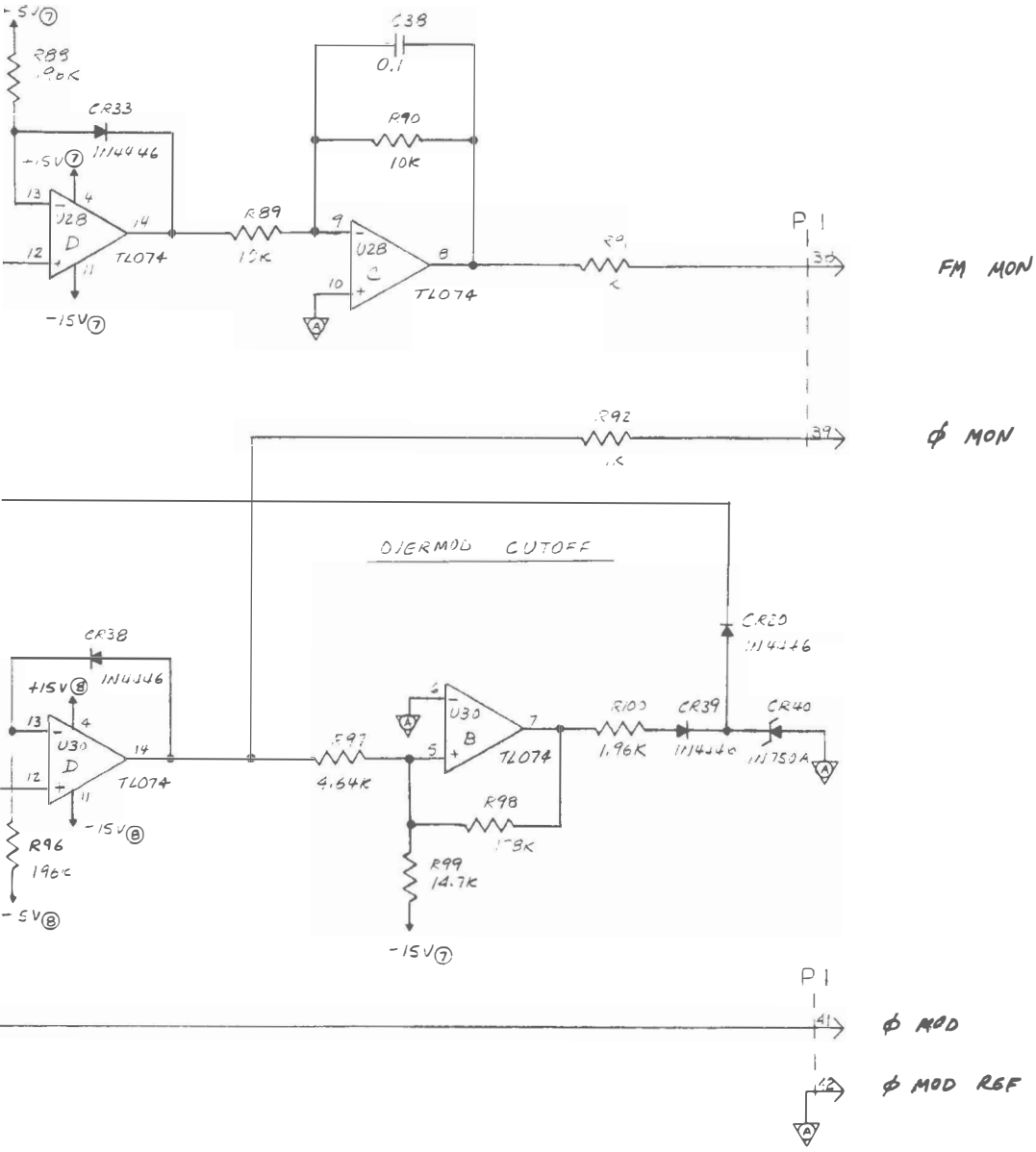
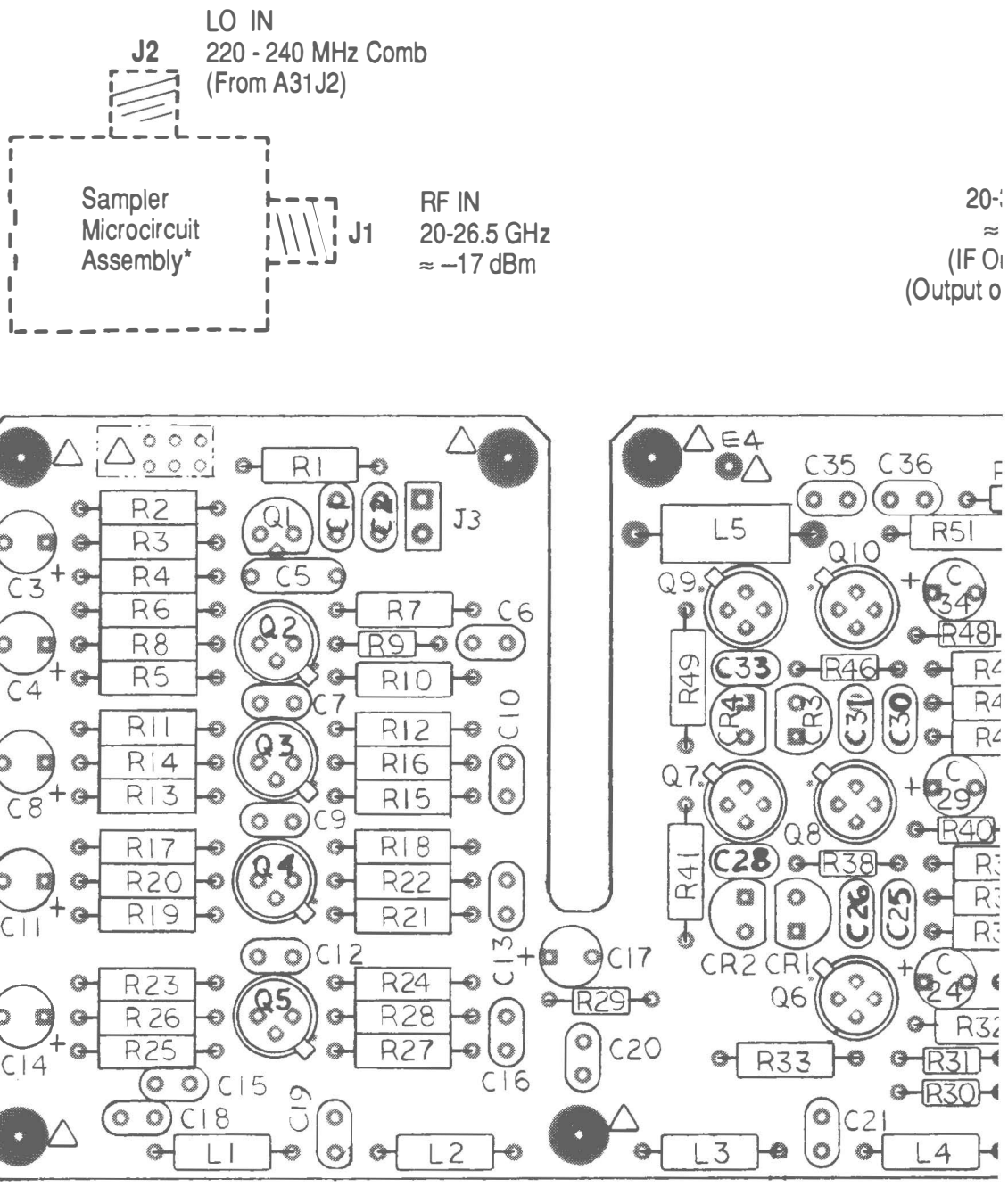


Figure 2H-6. A16 FM PCB Schematic Diagram (Sheet 4 of 4) 6700-D-31716-3 (Rev. J)



* Part of A30 Sampler / IF
Ampliifier PCB Assembly

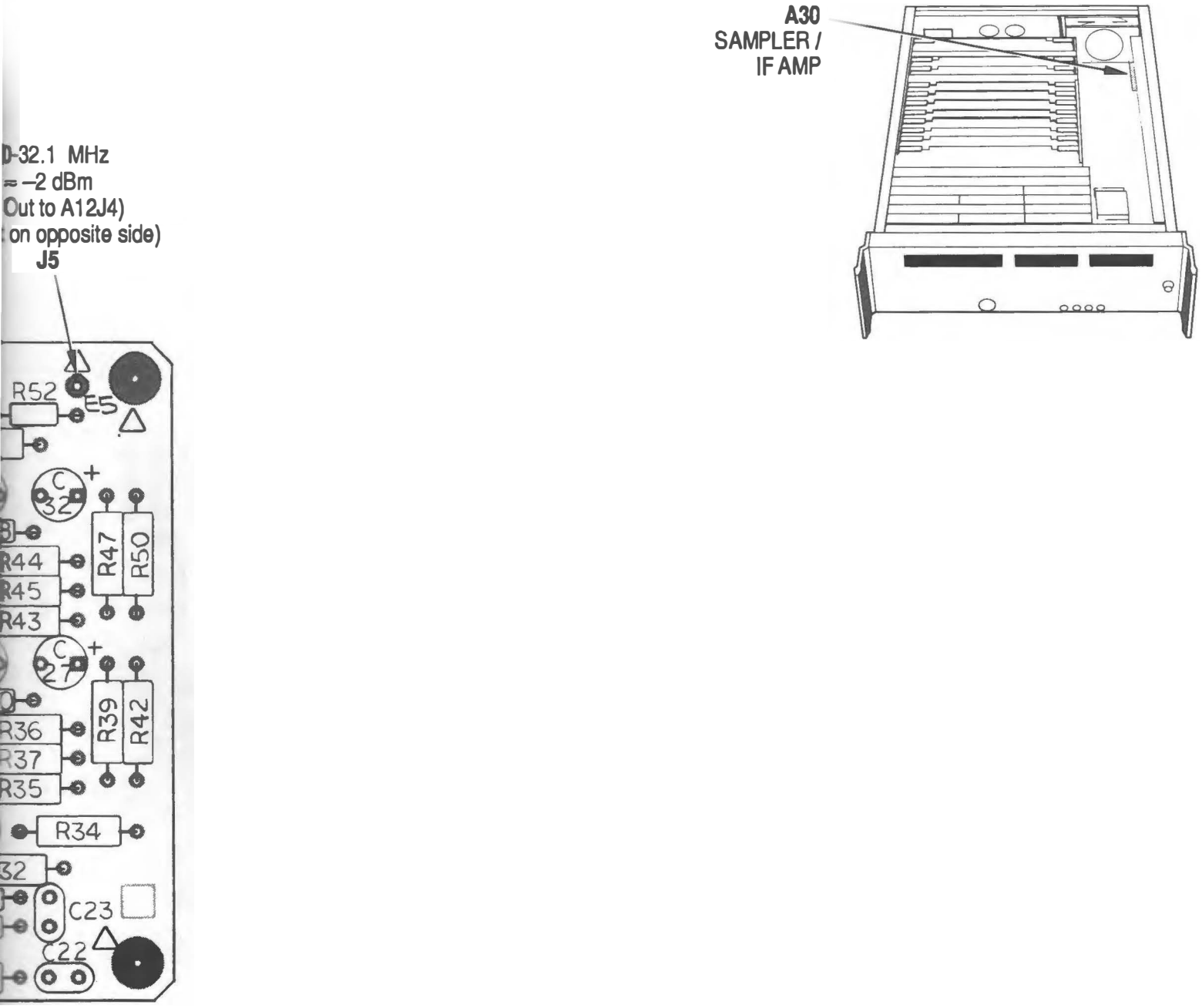
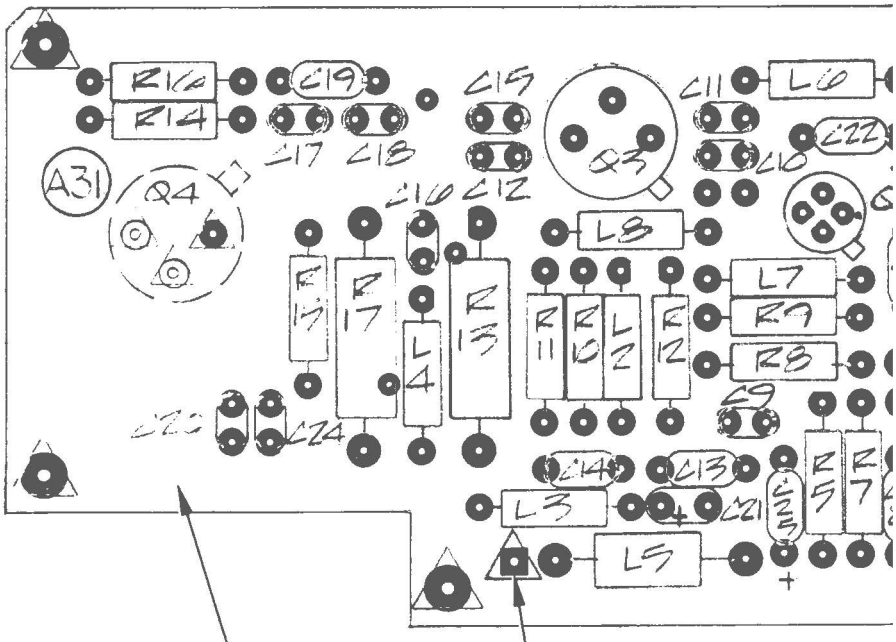
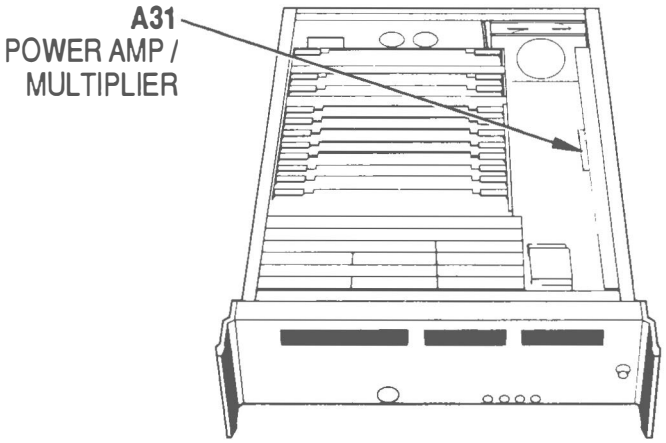


Figure 2H-7. A30 Sampler/IF Amplifier PCB Parts Locator Diagram
6700-C-31730-3 (Rev. E)


R16
R14
C19
C17
C18
C15
C16
C12
A31
Q4
Q3
C11
L6
C22
C10
L8
L7
R7
R8
R17
R17
L4
R13
R11
R10
L2
R12
C9
C20
C24
C14
C13
L3
C21
C23
L5
R5
R7
J1
440 - 490 MHz
≈ –3 dBm
(CL VTO from A4J1)
The step-recovery diode
microcircuit connects at this
point (part of connector assembly)



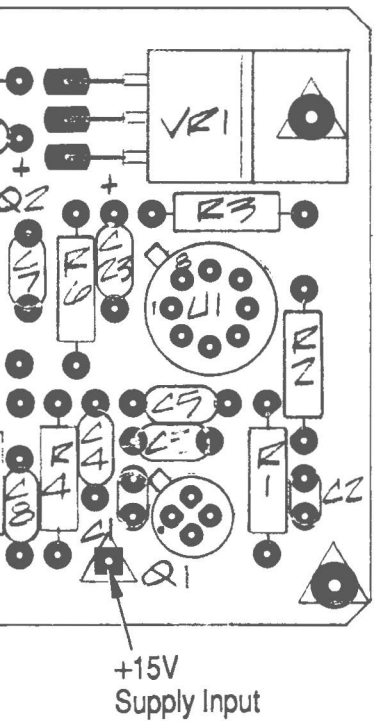
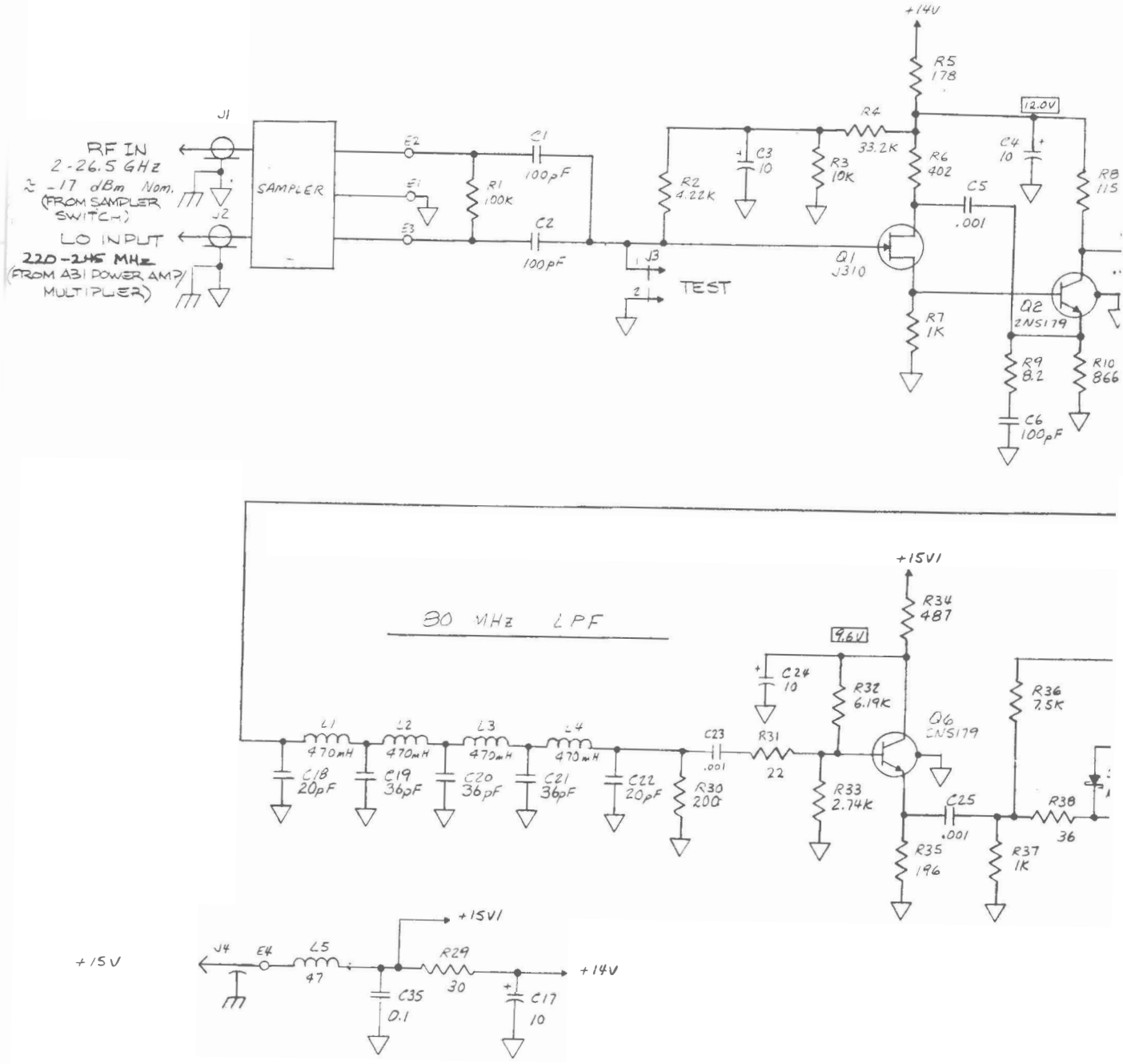
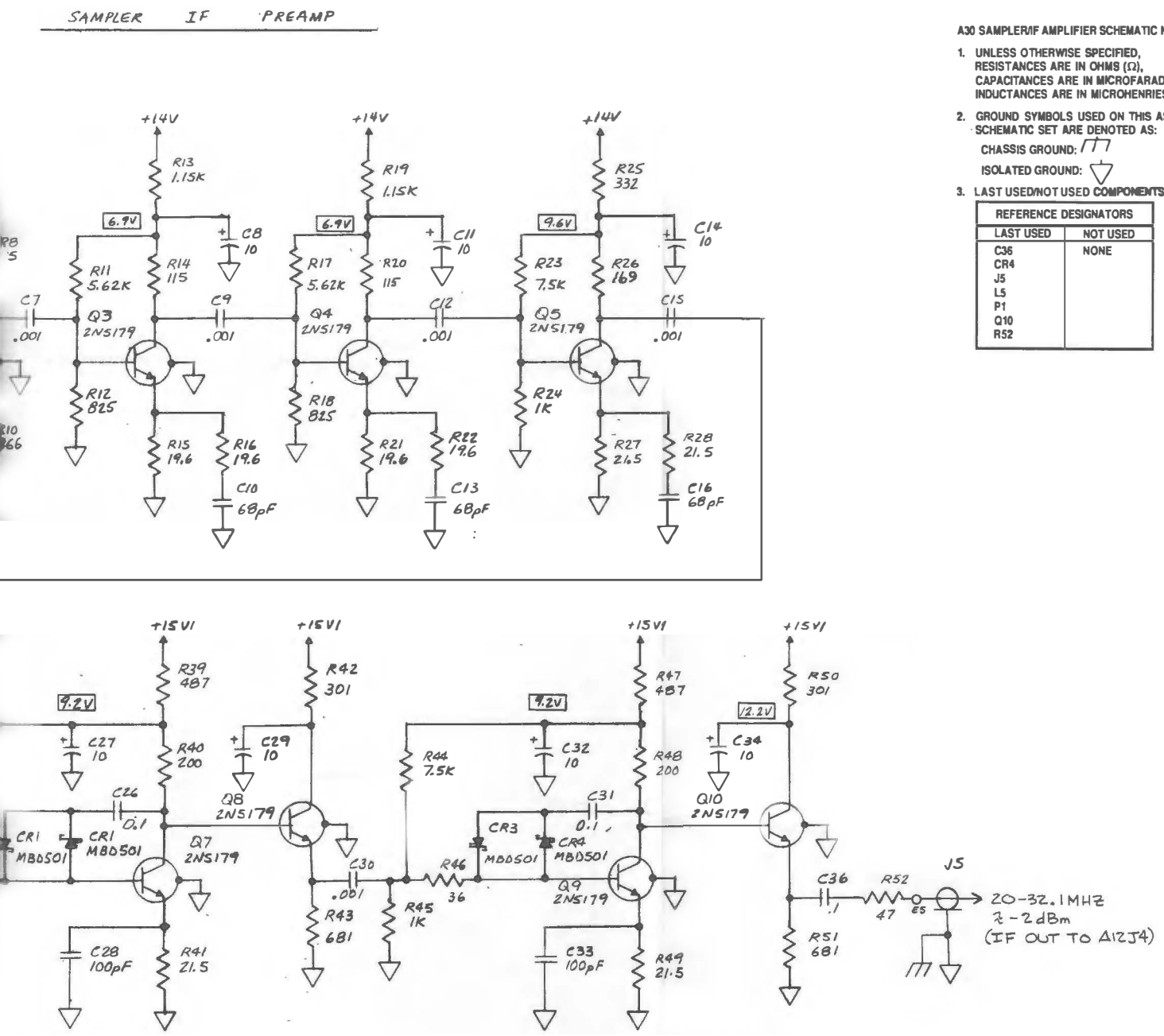


Figure 2H-8. A31 Power Amp/Multiplier PCB Parts Locator Diagram
6700-C-18664 (Rev. I)


RF IN
2-26.5 GHz
~ -17 dBm Nom.
(FROM SAMPLER SWITCH)
LO INPUT
220-245 MHz
(FROM A31 POWER AMP/ MULTIPLIER)
J1
J2
SAMPLER
E2
E1
E3
R1 100K
C1 100pF
C2 100pF
J3
TEST
R2 4.22K
C3 10
R3 10K
R4 33.2K
+14V
R5 178
R6 402
12.0V
C4 10
C5 .001
Q1 J310
Q2 2N5179
R7 1K
R9 8.2
R10 866
C6 100pF
30 MHz LPF
+15V1
R34 487
9.6V
C24 10
R32 6.19K
L1 470mH
L2 470mH
L3 470mH
L4 470mH
C18 20pF
C19 36pF
C20 36pF
C21 36pF
C22 20pF
C23 .001
R30 200
R31 22
R33 2.74K
Q6 CNS179
R36 7.5K
C25 .001
R35 196
R37 1K
R38 36
+15V
J4
E4
L5 47
R29 30
+14V
C35 0.1
C17 10

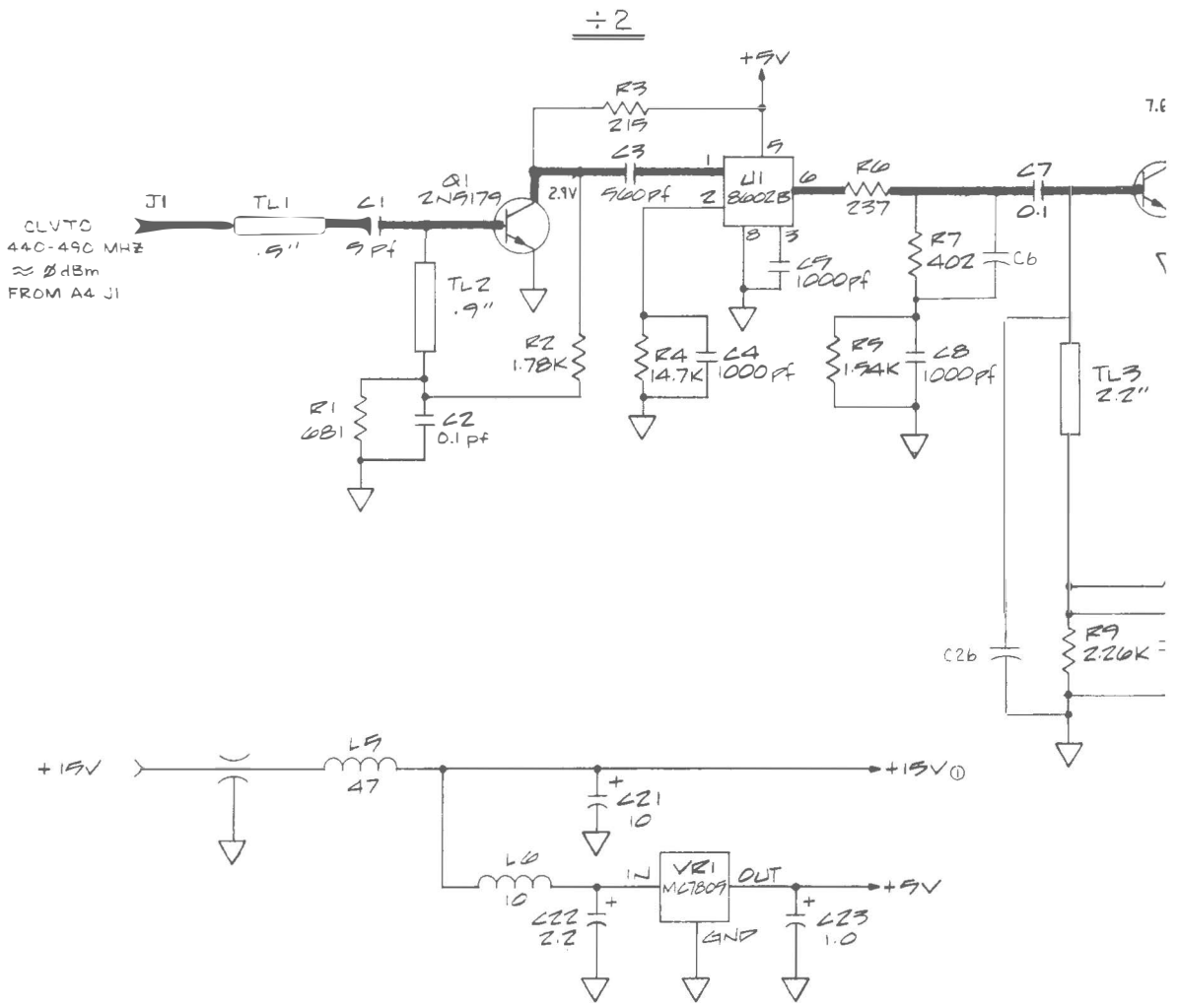


A30 SAMPLER/IF AMPLIFIER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUND:
3. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C36	NONE
CR4	
J5	
L5	
P1	
Q10	
R52	

Figure 2H-9. A30 Sampler/IF Amplifier PCB Schematic Diagram (Sheet 1 of 1) 6700-C-31730-3 (Rev. D)



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN MICROFARADS. INDUCTANCES ARE IN MICROHENRIES.
2. ▽ DENOTES ANALOG GROUND
3. ━━ DENOTES PRIMARY SIGNAL PATH.
4. TL DENOTES TRANSMISSION LINE.

LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C26	NONE
J2	
Q3	
R17	
U1	
VR1	

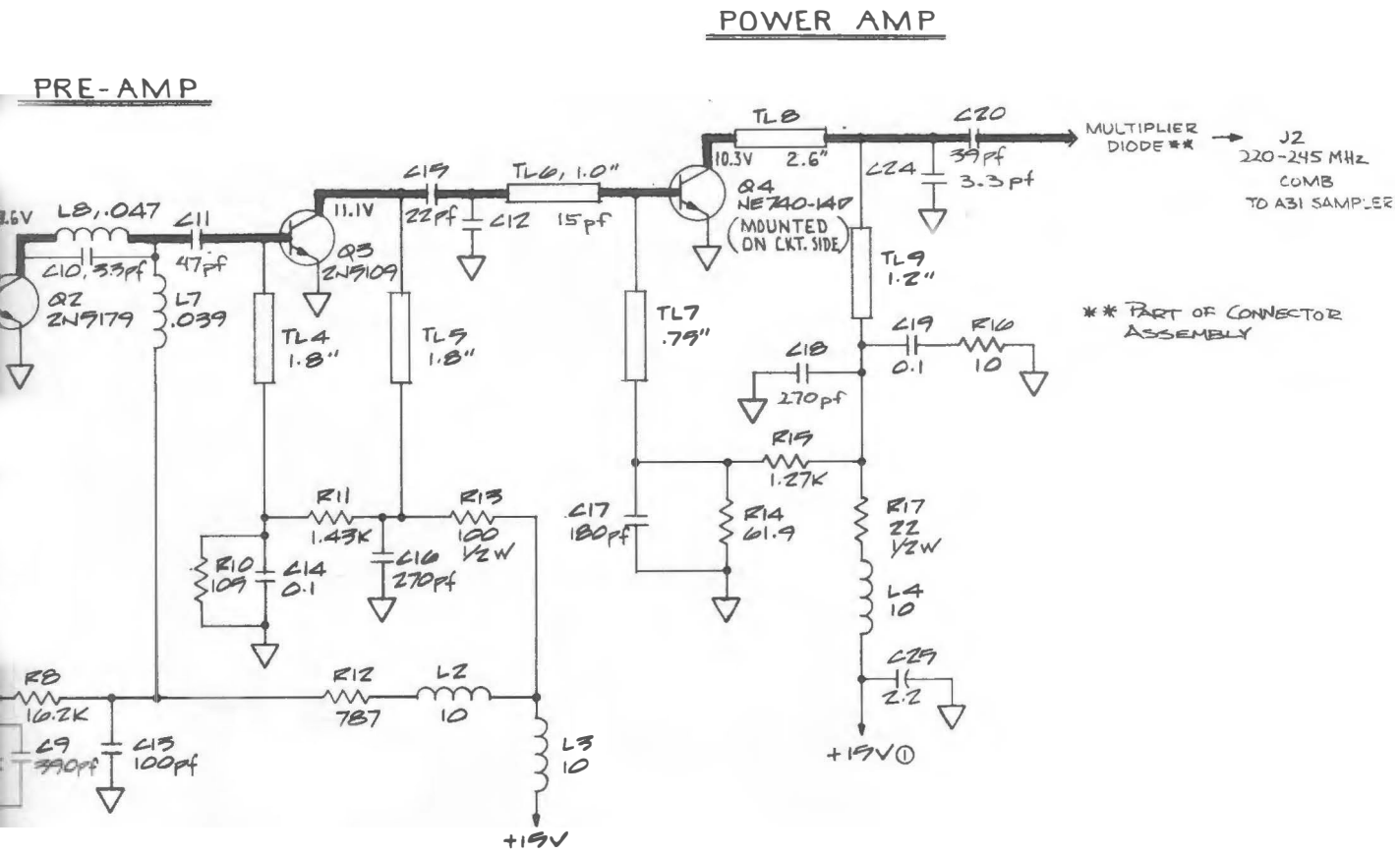


Figure 2H-10. A31 Power Amp/Multiplier PCB Schematic Diagram (Sheet 1 of 1)
6700-C-18664 (Rev. E)

2I–ANALOG INSTRUCTION: A17 PCB

2I-1 ANALOG INSTRUCTION ASSEMBLY: A17 PCB

This section contains service information for the analog instruction assembly listed in Table 2I-1 below. Refer also to the specific troubleshooting information for the A17 Analog Instruction PCB in the error code table located in the front portion of Section 2-System Description and Troubleshooting.

Table 2I-1. Analog Instruction Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2I-2	2I-1
Block Diagram	Fig. 2I-3	2I-11
Troubleshooting	Para. 2I-4	2I-10
PCB LEVEL		
A17 Analog Instruction PCB		
Detailed Circuit Description	Para. 2I-3	2I-2
Parts Locator Diagram	Fig. 2I-4	2I-12
Schematic (Sheet 1 of 4)	Fig. 2I-5	2I-13
(Sheet 2 of 4)	"	2I-14
(Sheet 3 of 4)	"	2I-15
(Sheet 4 of 4)	"	2I-16

2I-2 ANALOG INSTRUCTION ASSEMBLY, OVERALL DESCRIPTION

Refer to the block diagram in Figure 2I-3 for the following discussion. The Analog Instruction assembly consists solely of the A17 Analog Instruction PCB.

The A17 PCB controls the analog operations of the synthesizer. Although analog, the A17 PCB is controlled entirely by the A23 Microprocessor PCB. The use of high-precision analog-to-digital converters (ADCs), digital-to-analog converters (DACs), and operational amplifiers (Op Amps), eliminates the need for hardware adjustments normally required for correct operation.

The functional groupings that make up the A17 Analog Instruction PCB are as follows:

- **Microprocessor Bus Interface and Internal Data Bus** – Separate control lines and an internal data bus provide noise immunity and isolation for the sensitive ramp generator and frequency instruction portions of the A17 PCB.
- **Ramp Generator** – Provides the analog sweep ramp. Additionally, it establishes bandswitch points (for multiple band units) and marker placement.
- **±10V Reference Supplies** – Provides the reference voltages for the A17 ramp generator, frequency instruction, DVM, and power meter circuits. Also, it provides +10V reference voltage to the YIG Driver PCBs and to the A29 Rear Panel Interface PCB.
- **Frequency Instruction** – Has two modes: CW and sweep. In the CW mode, a dc voltage goes to the appropriate YIG driver to coarse tune the YIG-tuned oscillator for phase-lock operation. In the sweep mode, this circuit adjusts the amplitude of the ramp from the ramp generator circuit. It sums this ramp with the dc CW tune voltage to provide a sweep voltage to the appropriate YIG driver.
- **Digital Voltmeter (DVM)** – Does the following:
  (1) Monitors the phase lock condition of all phase-lock loops.
  (2) Measures the AM and FM deviation levels when the RF output is modulated.
  (3) Monitors other points during self-test and calibration routines.

(4) Interfaces between the A23 Microprocessor PCB and various analog circuits.

- **Power Meter –** Used with a WILTRON 560 series detector (or equivalent), allows measurement of an external RF source—or of the RF output of the synthesizer.

2I-3 A17 ANALOG INSTRUCTION, DETAILED CIRCUIT DESCRIPTION

Refer to the A17 PCB block diagram (Figure 2I-3) and the A17 PCB schematic diagram (Figure 2I-5) during the following discussion.

2I-3.1 Microprocessor Bus Interface and Internal Data Bus

On sheet 1 of the schematic set is the A23 Microprocessor PCB's data bus, D0-D7. The data bus is connected directly to the data latches, U1, U2, U16, and U40 and the analog-to-digital converter, U3. The A23 Microprocessor PCB's address bus, PA0-PA2, and dedicated address lines, LPA 15 and LPA 19, are connected directly to address decoders, U14 and U17.

The 3-to-8 decoders, U14 and U17, decode the PA0-PA2 address information. The LPA 15 signal enables U14; the LPA 19 signal enables U17. The decoders output strobe pulses to the latches and DACs having their own built-in latches to latch in the data from the data bus. Decoder U14 addresses the DVM, power meter, and band select latches (U1, U16, and U40) and the analog-to-digital converter (U3). Decoder U17 addresses the ramp integrator and frequency instruction latches (U2, U8, and U11) and DACs (U18, U24, U34, U38, and U42).

Latches U1 and U16 are 8-bit, D-type flip-flops with a clear function. The clear, or master reset (MR), is tied through RN1 to +5V and through C10 to ground. At power on, the MR is at 0V which sets the output of U1 and U16 to a low state. After approximately 10 ms, U1 and U16 may then be written to by the A23 Microprocessor PCB. This prevents the YIG Driver select lines from going to a low state and turning on all the YIG-tuned oscillators at the same time during power on. It also disables U3, the analog-to-digital converter, from accessing the A23 Microprocessor PCB data bus at the critical power-on condition.

The DVM and MUX control latch, U1, controls the analog multiplexers U7, U9, and U13 and the DVM's analog-to-digital converter (ADC), U3. The power meter control latch, U40, is an 8-bit, edge-triggered latch with the outputs enabled at all times by the ground at pin 1. The outputs change only on the low-to-high transition of the strobe applied to pin 11. The YIG driver select latch, U16, selects the YIG-tuned oscillator to which the frequency instruction's voltages are to be applied. This latch also supplies two signals to the YIG Driver PCBs; L RF OFF, which turns off the YIG-tuned oscillator and CW FILTER, which switches a filter capacitor across the YIG-tuned oscillator's main tuning coil for CW operation and narrow band sweeps. In addition, U16 provides the range select signals for the DVM circuit.

Latch U2 is for the internal data bus, ID0-ID7. It is an 8-bit, D-type transparent latch with tri-state outputs. As long as the enable input on pin 11 is high, the outputs follow the inputs. The internal data bus, ID0-ID7, provides isolation of the A23 Microprocessor PCB's data bus, D0-D7, from the sensitive DACs in the ramp generator and frequency instruction circuits. The internal data bus is connected to 8-bit latches U8 and U11 and DACs U18, U24, U34, U38, and U42.

There are two 12-bit DACs (U18 and U24) and two 16-bit DACs (U34 and U38). The 4 and 8 extra bits are obtained with the U8 latch. The least significant 4 bits (in the case of the 12-bit DACs) or least significant byte (in the case of the 16-bit DACs) is first loaded into U8 by latch U2. Then, the next 8 bits are put on the internal data bus by U2. The appropriate DAC is then strobed to latch the 12 or 16 data bits into the internal latches of the DAC. This parallel loading of the 12 or 16 bits eliminates the glitching of the DACs that would occur by loading the first byte and then the second byte into the DAC itself.

The ramp control latch is U11. Both the U8 and U11 latches are referenced to T ground and receive their +5V power from the R57, C30, and Zener diode CR11 supply circuit. This further isolates the ramp generator and frequency instruction circuits from the A23 Microprocessor PCB data bus and the 5V digital power supply.

2I-3.2 Ramp Generator

The Ramp Generator circuit consists of the Sweep Time DAC, the Ramp Integrator, the Marker-Switch Point DAC, the Marker-Switch Point Comparator, the Ramp Control Logic circuitry, and part of the Ramp Control Latch. The circuits, shown on sheet 2 of the schematic set, are described in the following subgroups:

- Ramp Integrator
- Marker-Switch Point DAC
- Marker-Switch Point Comparator
- Ramp Control Logic

a. Ramp Integrator

The Ramp Integrator consists of a 12-bit DAC (U18), a dual-operational amplifier (U19), a quad-analog switch (U20), and their associated components. The DAC, U18 receives digital sweep time information and outputs a voltage representing this sweep time via U19A. The range of the output voltage is 0V to +10V. A typical U19A output at a 30 ms sweep speed is approximately +8V. At a sweep speed of 999 ms, this voltage approaches 0V. When applied through a resistor, this voltage determines the charge rate of the integrator capacitor.

The output of U19A goes to pin 3 of analog switch U20A. This switch is closed for a forward ramp and open during a retrace or dwell. From pin 2 of U20A, the voltage is applied to the input of U19B through either R20 or R20 in series with R21, depending upon the front panel sweep time setting. R21 is in series with R20 for sweep speed ranges of from greater than 1 second to 99 seconds. At sweep speeds less than or equal to 1 second, R21 is shorted out by pins 10 and 11 of analog switch U20C. During retrace of the ramp, a current through R19 and pins 6 and 7 of U20B from –10V is summed in at the junction of R20 and R21. The A23 Microprocessor PCB, in conjunction with the Ramp Control Logic, determines the closing of U20B for the retrace-to-discharge time. From the junction of R21 and pin 10 of U20C, the U19A output voltage/R19 current goes to the input of U19B. The U19B output charges the integrator capacitor C14. Since U19B has a typical gain of 200,000, this produces a very linear ramp.

When the Ramp Generator is not being used, switch U20D pins 14 and 15 are closed, shunting C14 with R22. This prevents the output of U19B from going to the supply rails when not being used.

The sweep ramp output of the Ramp Integrator goes to U26, pin 2 as an input to the Marker-Switch Point Comparator. It is also buffered and amplified by U21, then applied to the Frequency Instruction circuits as a –10V to +10V ΔF sweep ramp. In addition, it is buffered and inverted by U22, then sent as a 0V to +10V ramp to the rear panel HORIZ OUTPUT BNC connector via the A29 Rear Panel Interface PCB.

b. Marker-Switch Point DAC

Also shown on sheet 2 of the schematic set are U24, a 12-bit DAC, and U25, an operational amplifer, which comprise the Marker-Switch Point DAC circuit. The DAC, U24, receives digital information concerning a marker point, a bandswitch point (for multiband units), or the top or bottom of the sweep ramp. It outputs a voltage representing this information via U19A. The amplifier, U25, has a resistor, R32, in its feedback path that calibrates its output to be within typically 3 mV at full scale. The U25 output, which has a range of 0V to –10V, goes to the Marker-Switch Point Comparator inputs, U26 pin 3 and U27 pin 3.

c. Marker-Switch Point Comparator

The Marker-Switch Point Comparator, in conjunction with the Marker-Switch Point DAC, provides a logic signal to the Ramp Control Logic which starts the dwell. Dwell occurs at the top and bottom of the ramp, at each bandswitch point (for multiband units), and at each selected marker.

The Marker-Switch Point Comparator consists of an operational amplifier (U26), a voltage comparator (U27), and their associated components. The amplifer, U26, provides precise comparison between the 0V to –10V ramp output from the Ramp Integrator and the voltage from the Marker-Switch Point DAC. The swing of U26's output voltage from its pin 3 input voltage is limited to from +0.6V to –0.6V by CR4 and CR5. The output of U26 goes to U27 pin 2 where it is compared with the voltage from the Marker-Switch Point DAC at U27 pin 3. As the voltage input at U27 pin 2 becomes more positive than the voltage at U27 pin 3, the output of U27 is pulled to a TTL high by RN1. This logic signal goes to the Ramp Control Logic to start the dwell.

d. Ramp Control Logic

The Ramp Control Logic circuitry determines when the ramp is in the sweep, retrace, or dwell mode. The circuitry consists of a hex inverter (U4), quad NAND gates (U5 and U23), a quad exclusive-OR gate (U6), and associated components. The signal from U27 or L SWP DWELL from the rear panel BNC connector determines the start of each dwell. All other control signals and timing are determined by the A23 Microprocessor PCB. L DWELL EN enables the dwell signal from U27, CLR DWELL STRB terminates the dwell, and RETRACE determines if the ramp is sweeping or retracing.

The following is a description of the ramp control logic and the A23 Microprocessor PCB actions during a sweep ramp cycle.

During retrace (ramp discharge), the output of U27 is at a TTL high, RETRACE is high, L DWELL EN is low, and the Marker-Switch Point DAC output is set to 0V. As the ramp reaches 0V, the output at U27 switches to a TTL low. This transition causes the outputs at U6 pin 8 and U5 pin 11 to go low. The output of U5 is inverted by U4E and sent to the A23 Microprocessor PCB as the interrupt signal, DWELL INT. The output of U5 also goes to U23 pin 2. From U23 pin 3 it is inverted by U4C and applied to U23 pin 4 and U23 pin 9. Since RETRACE is true, there is no change in the output at U23 pin 6 (switch U20A remains open), but the output at U23 pin 8, which was low, is now high. This opens analog switch U20B, supplying integrator current for the retrace. The output of the integrator is now at 0V and remains there for the duration of the bottom-of-the-ramp dwell.

The following is a description of the events during a dwell. Approximately 100 µs after the dwell starts, the A23 Microprocessor PCB acknowledges the dwell interrupt by setting L DWELL EN high. Since U6 is an exclusive-OR gate with open-collector outputs, the high L DWELL EN signal causes U6 pin 6 to go low (the condition that it was in prior to dwell start). During the approximately 20 ms of the dwell, the A23 Microprocessor PCB phase-locks the RF at the new frequency and adds any correction value that was calculated during retrace. It then turns the RF on via the A15 ALC PCB and changes the state of the blanking and sequential sync signals on the A29 Rear Panel Interface PCB.

At the end of the dwell, the A23 Microprocessor PCB sets the Marker-Switch Point DAC to the value for the next dwell. This value depends on the synthesizer model, sweep width, and marker settings. The CLR DWELL STRB is then applied to U5 pin 12, changing the state of flip-flop U5. Since the RETRACE signal at U4 pin 9 is low, the U5 output is routed via U23A, U4C, and U23B to the analog switch, U20A. The switch closes and the ramp starts toward –10V. At this time, the L DWELL EN signal is also set low to enable the next dwell from comparator, U27. When the ramp reaches the next dwell, the events of the dwell just described repeat.

If the next dwell is a bandswitch dwell, the A23 Microprocessor PCB locks the YIG-tuned oscillator that was sweeping and determines the error, if any. It then turns it off. After so doing, it:

- Turns on the next YIG-tuned oscillator.
- Phase-locks it, and determines the frequency error, if any.
- Sets the Marker-Switch Point DAC for the next dwell point.
- Clears the dwell and sends the ramp toward –10V.

If the next dwell is for a frequency marker within the sweep range, the YIG-tuned oscillator's frequency is not phase-locked as at other dwell points. If the VIDEO marker is selected, there is a 5V pulse from the A29 Rear Panel Interface PCB applied to the rear panel MARKER OUTPUT BNC connector.

During the top-of-the-ramp dwell prior to retrace (ramp discharge), the ramp holds at –10V for approximately 20 ms. The A23 Microprocessor PCB phase-locks the RF signal, determines the frequency error, and stores this error-value for later use. When this is accomplished, the A23 Microprocessor:

- Turns off the YIG-tuned oscillator.
- Sets the blanking and sequential sync signals on the A29 Rear Panel Interface PCB.
- Turns off the A15 ALC PCB.

At the end of the top of the ramp dwell, the A23 Microprocessor PCB sets the Marker-Switch Point DAC to 0V (the value of the next dwell) and sends a CLR DWELL STRB to U5 pin 12. This changes the state of flip-flop U5. Since the RETRACE signal to U4 pin 9 is high, the output of U5 is routed via U23A, U4C, and U23C to the analog switch, U20B.

The switch closes and the ramp starts toward 0V (retrace). The L DWELL EN signal is also set low to enable the next dwell from comparator, U27. During the ramp discharge (retrace) of approximately 30 ms, the A23 Microprocessor PCB calculates the errors for the correction of the frequency on the next setup and prepares the phase-lock loops to lock at the bottom of the sweep.

2I-3.3 ±10V Reference Supplies

Refer to sheet 2 of the schematic set during the following discussion. There are four reference voltage supplies on the A17 PCB:

- +10V REF T
- –10V REF T
- +10V REF 2
- –10V REF 2

The ±10V REF T supplies provide the reference voltages for the ramp generator and frequency instruction circuits. They also supply +10V REF T reference voltage to the A18-A21 YIG Driver PCBs and a +10V REF reference voltage to the A29 Rear Panel Interface PCB. The ±10V REF 2 supplies produce reference voltages for the DVM and the power meter circuits.

Voltage regulator U30 is a precision 10V regulator used as a reference for U31. The amplifier, U31A, buffers and filters the precision regulator output for the 10V REF T reference voltage supply. The amplifier, U31B, inverts the +10V and filters it for the –10V REF T reference voltage supply.

The ±10V REF 2 reference voltage supplies, consisting of the U28 and U29 circuits, operate in an identical manner to the ±10V REF T reference voltage supplies.

2I-3.4 Frequency Instruction

The Frequency Instruction circuit provides the analog tuning voltages for the A18-A21 YIG Driver PCBs in both the CW and sweep modes. The Frequency Instruction circuit consists of the Tune DAC, Sweep Width DAC, and Linearizer DAC circuitry. The circuits, shown on sheet 3 of the schematic set, are described in the following subgroups:

- Tune DAC
- Sweep Width DAC
- Analog Sweep Correction
- Linearizer DAC

a. Tune DAC

The Tune DAC circuit consists of a 16-bit DAC (U34), an operational amplifier (U35), and their associated components. The DAC, U34, receives digital tuning information from the A23 Microprocessor and outputs a tuning voltage via U35. The DAC reference voltage input, at pin 13, is supplied with either the +10V REF T or –10V REF T supply through the analog switches, U33A and U33B, and the isolation amplifier, U53. The output voltage from U35 is inverted from this input reference voltage.

In CW mode, switch U33A is closed. Therefore, the output of U35 is in the range of 0 to +10V. This output goes to the input of amplifier U37 via switch U41B and resistor R51. This is a unity gain inverting path, so the output of U37 goes from 0 to –10V. The analog switches, U41B and U33C, provide temperature drift compensation. The output of U37 is the analog tuning voltage that is applied to the YIG Driver PCBs. To allow for circuit tolerances, the actual voltage applied to the YIG Driver PCBs is approximately –1V at the low end and –9V at the high end of the YIG-tuned oscillator's tuning range. This –1V to –9V may vary as much as 10%, depending on the YIG-tuned oscillator and its driver. However, a particular YIG driver/YIG-tuned oscillator for a frequency band will be the same whether it is used in a single- or multiple-band synthesizer.

In the broadband sweep modes, it is necessary for the DAC, U34, to offset a very high ΔF ramp voltage. At this time, switch U41A closes and puts R52 in parallel with R51. This results in a gain of four for amplifier U37.

The actual tuning voltages for each YIG Driver PCB are stored as a DAC word in the synthesizer's nonvolatile memory at the time of frequency calibration. These calibration voltages are used in all of the A23 Microprocessor PCB calculations for analog sweep, stepped sweep, and CW frequencies.

b. Sweep Width DAC

The Sweep Width DAC circuit consists of a 16-bit DAC (U38), an operational amplifier (U39), and their associated components. The DAC U38 receives digital sweep width information from the A23

Microprocessor PCB and outputs a ΔF ramp voltage via U39. The DAC reference input, at pin 13, is a –10V-to-+10V ΔF ramp from the Ramp Generator circuit. The output ΔF ramp voltage from U39 is inverted from this input reference voltage. It goes to analog switch U36A. Switch U36A provides a gain of one while U36A together with switch U36B provide a gain of four. This ΔF ramp voltage is then summed with the Tune DAC output voltage by the summing amplifier U37.

When sweeping a single YIG-tuned oscillator, the Sweep Width DAC attenuates the 20V peak-to-peak ramp down to the 8V peak-to-peak swing required for the YIG driver. Since this attenuated ramp goes from –4V to +4V, the Tune DAC sums a –5V offset with the attenuated ΔF ramp, providing the necessary –1V to –9V tuning range for the YIG-tuned oscillator.

When broadband analog sweeps are selected—such as 2 to 20 GHz—the slope of the ΔF ramp is insufficient to cover the frequency range of each of the YIG-tuned oscillators. In this case, the gain of the summing amplifier, U37, is switched to provide a gain of four for both the ΔF ramp voltage and the Tune DAC voltage. This allows the Sweep Width DAC to still attenuate the ΔF ramp from the Ramp Generator circuit.

Figure 2I-1 shows the relationship of the ΔF ramp, Sweep Width DAC attenuation settings, and Tune DAC voltage required for a typical broadband sweep.

The ΔF ramp from U39 is also applied to connector A17P1 pin 63 which goes to the A16 FM PCB. During narrow band analog sweeps (sweep widths of ≤50 MHz), the ramp is applied to the FM coil of the YIG-tuned oscillator instead of to the main tuning coil. Under this condition, both analog switches,

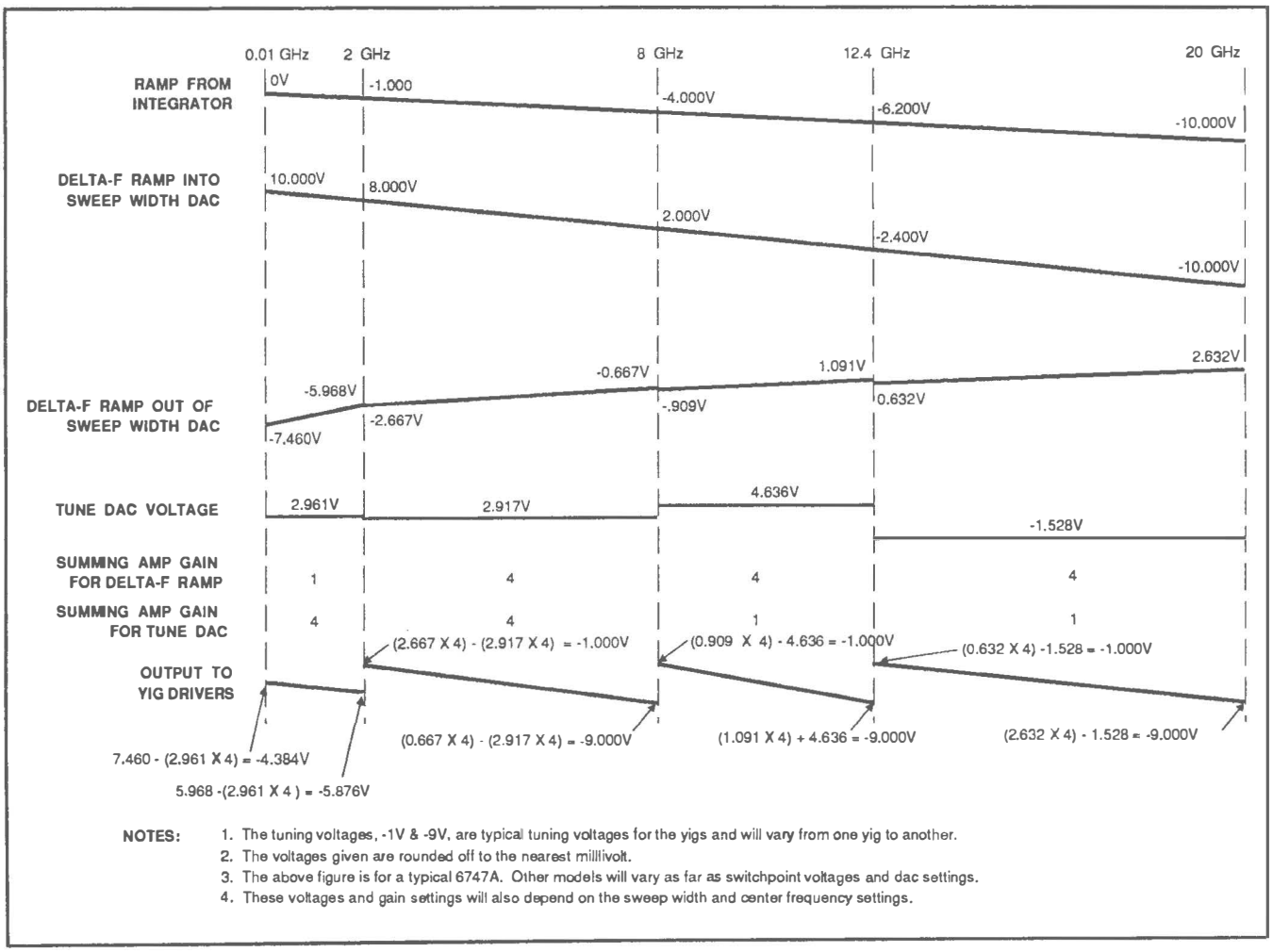


Figure 2I-1. Frequency Instruction Circuit Voltage Relationships

U36A and U36B, are open and an analog switch on the A16 PCB is closed. The Tune DAC sets the voltage for the center frequency of the narrow band sweep and the CW filter (located across the main tuning coil) is enabled. This reduces residual FM and provides improved resolution during narrow band analog sweeps.

c. Analog Sweep Correction

In analog sweep, the frequencies on both sides of each band switch point, and at the top and bottom of the sweep, are phase-locked. The phase-lock error voltage is read and, on the next sweep, the Tune DAC and the Sweep Width DAC are adjusted by the A23 Microprocessor PCB for improved accuracy. During sweeps ≤50 MHz, the center frequency of the sweep is phase-locked and corrected. This is accomplished at the top of the sweep by opening the analog switch on the A16 FM PCB to remove the ΔF ramp from the FM coil.

At a point where the synthesizer phase-locks during a sweep, as indicated previously, the A23 Microproccessor PCB sets the appropriate DACs to get the frequency requested. The frequency is phase-locked and the error voltage, which is approximately 1 volt/MHz, is measured. During retrace of the sweep, the A23 Microprocessor PCB calculates the new DAC setting to correct these errors. During the next sweep, the errors are corrected and the accuracy is checked. The accuracy is continuously checked during each sweep so that any temperature drift or drift with time will automatically be corrected.

d. Linearizer DAC

YIG-tuned oscillators have a linear frequency output with a linear tuning current input. However, they do have some nonlinearities on the order of 0.05%; typically at the top third of the band. Any nonlinearity can lead to significant errors (≈13 MHz @ 20-26 GHz) in analog sweep between the two phase-locked end points. The Linearizer DAC cicuit, shown on sheet 3 of the schematic set, reduces the frequency errors caused by nonlinearity of the YIG-tuned oscillator. Figure 2I-2 shows a typical YIG frequency versus tuning current curve as graph "A". Graph "B" shows the same curve after correction by the Linearizer DAC circuit.

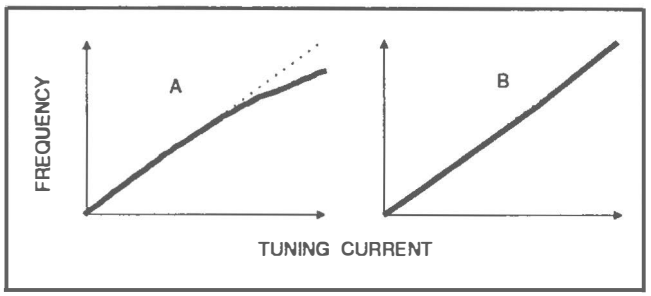


Figure 2I-2. Frequency Versus Tuning Current

The Linearizer DAC circuit consists of a dual 8-bit DAC (U42), a quad-operational amplifier (U32), a transistor (Q1), and their associated components. The DAC, U42, receives digital linearity information from the A23 Microprocessor PCB and outputs voltages based on this input via U32. Side B of U42 uses –10V REF T as a reference voltage (U42 pin 18) and is used to set the breakpoint of the linearizer. The output of U32C is summed with the tune output voltage from U37 at the base of Q1. When the output of U37 goes higher than the breakpoint voltage, the input to U42 pin4 (U42 side A reference voltage) starts following the sweep. The output of U42 at pin 2 is inverted by U32B and goes through R68 to the input of U32D.

If side A of U42 is set to half of full scale, then the output of U32B is half of the reference input at U42 pin 4 and of opposite polarity. The output of Q1 is also tied to R61 which is twice the value of R68. Since the currents through R61 and R68 are equal and opposite, the output of U32D is 0V. If side A of U42 is set to some other value, then these currents are not equal and opposite and their difference is amplified by U32D. The polarity of the output is determined by the direction of the setting of side A away from the halfway point of full scale. The magnitude of the output is determined by the settings of both side A and side B of U42, with the maximum output being with side B set to 0V and side A set to no output or to full scale output.

The output of U32D is summed through R56 with the Tune DAC and Sweep Width DAC voltages. This adds to or subtracts from the normal tune output voltage of U37 to provide the correction for YIG-tuned oscillator linearity.

Linearity calibration is done automatically by the A23 Microprocessor PCB during the frequency calibration of each YIG-tuned oscillator. In multiband models, the values loaded into the Linearizer

Table 2I-2. DVM Channels and Their Functions

Multiplexed Inputs	Inputs (to DVM)	Measurement/Monitor Functions
	Reference Loop	Measures the phase lock condition of the reference loop from A7.
	Coarse Loop	Measures the phase lock condition of the coarse loop from A6.
	Fine Loop	Measures the phase lock condition of the fine loop from A11.
	Knob	Measures the dc voltage from the A2 PCB DECREASE/INCREASE knob circuit. (The control in located on the front panel.)
	YIG Loop	Measures the phase lock condition of the YIG loop from A12.
	FM Ø	Measures the FM Ø modulation level from A16.
	PS1 PS2	Monitors the status of the regulated power supplies on the A22 Regulator PCB.
(From the A15 PCB) Band 0 Det Therm Band 1-4 Det Therm 10V Reference AM Peak AM Through Detector Shaper ALC Reference	 ALC1 ALC2	 Measures the thermistor voltages of the leveling detectors for temperature compensation. Measures the reference supplies for self test. Measures the AM level for display on the front panel MODULATION/TIME display. Measures the detector shaper and ALC reference for use in calibration and test.
	Pulse	Used for self test of the A13 Pulse Generator PCB.
	DVM	Connected to analog ground. Used to zero the DVM.
	Fine Loop Tune	Measures the tuning voltage of the fine loop oscillator from A9.
	Coarse Loop Tune	Measures the tuning voltage of the coarse loop oscillator from A4.
	Reference Loop Tune	Measures the tuning voltage of the reference loop oscillator from A5.
	YIG Loop Tune	Measures the YIG loop phase lock error from A12. Used in Analog Sweep mode.
	Power Meter	Measures the output of the A17 PCB's power meter circuit (Series 560 detector) for display on the front panel LEVEL display.
	Detector Thermistor	Measures the thermistor voltage of the power meter head (Series 560 detector) for temperature compensation.
	Power Meter Offset	Measures the calibration offset voltage of the power meter head (Series 560 detector).
	+10V T	Measures the A17 PCB's reference voltage for self test purposes.
	Tune	Measures the A17 PCB's Tune DAC output that goes to the YIG drivers.
	Down Converter Loop	Measures the phase lock condition of the oscillator loop from the Down Converter.
	FM	Measures the FM deviation from A16 for display on the front panel MODULATION/TIME display.

DAC changes at each bandswitch point. This automatically compensates for the YIG-tuned oscillator linearity in both the CW and sweep modes.

2I-3.5 Digital Voltmeter (DVM)

The DVM circuit consists of a 12-bit analog-to-digital converter (ADC), a 24-channel analog multiplexer (MUX), and a sample/hold network. It has a +10V to –10V basic range and two auto ranges of ±20V and ±100V.

As shown on sheet 1 of the schematic set, the various analog inputs to the DVM are applied through the 8-to-1 multiplexers U7, U9, and U13. The A23 Microprocessor addresses these MUXs via the DVM and MUX control latch, U1, to select which channel is to be measured. Table 2I-2 lists the DVM input channels and their basic functions.

The output voltage from the selected MUX channel goes to the input of U10, the sample and hold integrated circuit. Whenever an analog-to-digital conversion is *not* taking place, the analog signal input to U10 charges C8 and is output via U10 pin 5 as the analog input to U3, the analog-to-digital converter. During the convert mode (analog-to-digital conversion) of U3, the STS line (U3 pin 28) goes high, is inverted by U4B, and is applied to U10 pin 8. This places U10 in the HOLD mode so that the input to U3 will be stable during its conversion, even though the input to U10 may be changing.

U3 is an analog-to-digital converter (ADC) connected directly to the A23 Microprocessor bus. It has a built-in DAC that is compared with the input analog signal at pin 14. Using a successive approximation algorithum in its built-in microprocessor, it adjusts the DAC until its output equals the analog input. It then creates the digital word to be read by the A23 Microprocessor PCB. The A23 Microprocessor PCB accesses the DVM at least once every 50 ms as a function of its housekeeping routines. Additionally, when certain operations are in progress — such as during phase-locking — the microprocessor accesses the DVM more frequently.

The operation of U3 ADC is controlled by the control signals AO (U3 pin 4), R/C (U3 pin 5), and CE (U3 pin 6). AO and R/C are set by the A23 Microprocessor PCB via latch U1; CE is set by U14 which is also controlled by the A23 Microprocessor PCB. The control signal R/C determines if U3 is to do a conversion or make conversion data available to the A23 Microprocessor PCB (read). The control signal, CE, enables U3 operation for the requested convert or read operation. The control signal, AO, determines if an 8-bit or 12-bit conversion is to be made. To improve accuracy, +10V REF 2 is applied to REF1 (U3 pin 10) rather than using the internal reference of the ADC itself. This voltage is also applied to B/P OFF (U3 pin 12) to allow the DVM to have a full-scale operating range of +10V to –10V.

Switch U15 provides an additional two ranges for the DVM. When switch U15A is closed, the range of the DVM is +20V to –20V for all inputs except U13 pin 4, which is +100V to –100V. When switches U15A and U15B are both closed, the range of the DVM is +100V to –100V.

The U13 pin 4 input is tied to TP2 through R15. This provides an internal DVM for general test and troubleshooting purposes. It has a range of +100V to –100V and is auto-ranging for maximum resolution.

2I-3.6 Power Meter

The power meter circuit, shown on sheet 4 of the schematic set, consists of a chopper amplifier, a programmable gain amplifier, a synchronous detector, and buffer amplifiers for temperature compensation and offset calibration of the detector head. The chopper/synchronous detector system minimizes dc offset and drift errors at low signal levels. The front panel LEVEL display, which is the indicator for the power meter, is enabled when the EXT PWR MTR key is pressed. If there is no detector physically connected to the rear panel, or if there is no RF power applied to the detector, the display indicates LLL.

a. Input Chopper Amplifier

PWR HEAD DET, the dc voltage from the detector, is input to the power meter circuit at A17P1 pin 67. It goes to the inputs of U47 via the contacts of the quad-analog switch, U46 . When L SAMPLE 1 is true, the detector voltage is applied to U47 pin 5 and when L SAMPLE 2 is true, it is applied to U47 pin 3. The outputs of U47 are sent to the inputs of U48. The amplifiers, U47 and U48A, are arranged as an instrumentation amplifier. The amplifier, U48A, follows the input from U47B and inverts the input from U47A, resulting in a square wave output at U48A pin 7. This chopping is done at a 10 Hz rate, control-

led by the A23 Microprocessor PCB during housekeeping.

b. Programmable Gain Amplifier

The programmable gain amplifier consists of amplifiers U48B and U51A, each with a gain of from 1 to 100. The resultant overall gain of the programmable gain amplifier ranges from 10,000, at low detector input signal levels, to 1 at high input signal levels. The A23 Microprocessor PCB uses the range select analog switches to set the overall gain of the amplifier. The 10 Hz square wave output from U48A is applied to U48B and amplified. It is then ac coupled to U51A, where it is again amplified and ac coupled out to the U50A and U50B analog switches.

c. Synchronous Detector

The synchronous detector converts the amplified 10 Hz square wave back to a dc voltage appropriate for the A17 PCB's DVM circuit. When L SAMPLE 1 is true, the amplified detector voltage is negative and is routed through U51B to the inverting input of U52B. When L SAMPLE 2 is true, the amplified detector voltage is positive and is routed through U52A to the non-inverting input of U52B. In both cases, V DET, the output of U52B, is positive. V DET is applied to the A17 PCB's DVM through analog multiplexer U13. The A23 Microprocessor PCB reads the detector output from the DVM and converts it to a logarithmic (dB) scale for output to the front panel LEVEL display.

d. Temperature Compensation and Offset Amplifiers

Amplifiers U45B and U45C are connected in a bridge configuration. The detector thermistor is connected to the input of U45B via connector A17P1 pin 65. The detector thermistor is 1 MΩ at 25°C. At this time, the bridge is balanced resulting in a 0V output from U45B. As the temperature of the thermistor increases or decreases, the output of U45B goes positive or negative. This voltage change, V Th, is sent to the A17 PCB's DVM through analog multiplexer U13. The A23 Microprocessor PCB reads this voltage change and corrects the power reading on the front panel LEVEL display.

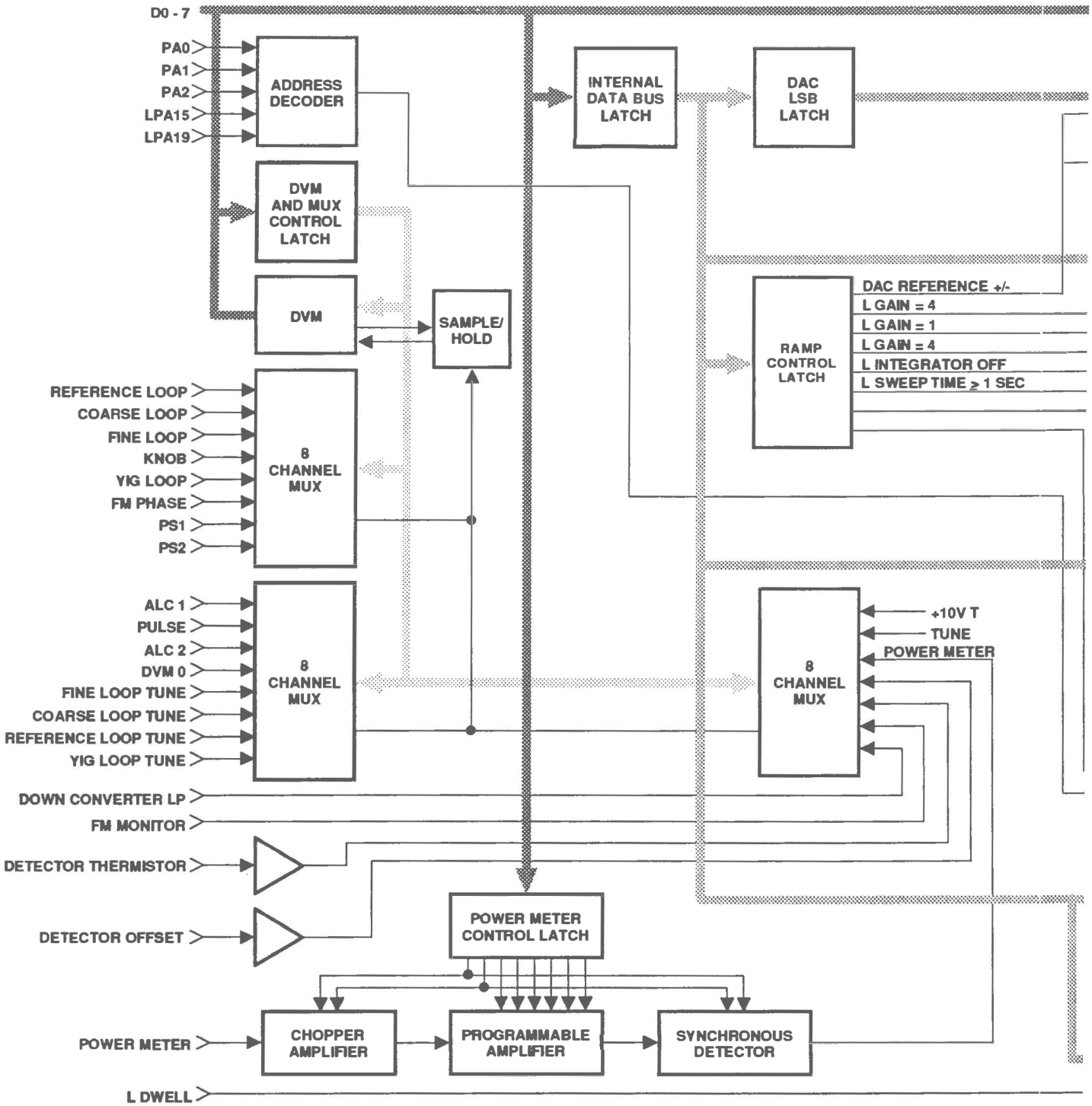
The detector also has a 1 MΩ nominal resistance connected to the input of U45C via connector A17P1 pin 70. The actual value of the resistor is determined during calibration of the detector head itself. The output of U45C changes with the calibration resistor value. This voltage change, V dBm, is sent to the A17 PCB's DVM through U13 and is read by the A23 Microprocessor PCB. It is used so that, for a given power, the front panel LEVEL display is the same for any compatible detector head.

2I-4 ANALOG INSTRUCTION ASSEMBLY, TROUBLESHOOTING

Refer to the troubleshooting information in the front portion of Section 2-System Description and Troubleshooting. This information provides a list of error codes that may be displayed as a result of failures in the analog instruction subsystem and probable causes of the failures.

2I-5 ANALOG INSTRUCTION ASSEMBLY, SERVICE SHEETS

Table 2I-1, on the first page of this section, presents the arrangements of the block diagram, schematics, and parts locater diagram for the A17 Analog Instruction PCB.


D0 - 7
PA0
PA1
PA2
LPA15
LPA19
ADDRESS DECODER
INTERNAL DATA BUS LATCH
DAC LSB LATCH
DVM AND MUX CONTROL LATCH
DVM
SAMPLE/ HOLD
RAMP CONTROL LATCH
DAC REFERENCE +/-
L GAIN = 4
L GAIN = 1
L GAIN = 4
L INTEGRATOR OFF
L SWEEP TIME ≥ 1 SEC
REFERENCE LOOP
COARSE LOOP
FINE LOOP
KNOB
YIG LOOP
FM PHASE
PS1
PS2
8 CHANNEL MUX
ALC 1
PULSE
ALC 2
DVM 0
FINE LOOP TUNE
COARSE LOOP TUNE
REFERENCE LOOP TUNE
YIG LOOP TUNE
8 CHANNEL MUX
+10V T
TUNE
POWER METER
DOWN CONVERTER LP
FM MONITOR
DETECTOR THERMISTOR
DETECTOR OFFSET
POWER METER CONTROL LATCH
POWER METER
CHOPPER AMPLIFIER
PROGRAMMABLE AMPLIFIER
SYNCHRONOUS DETECTOR
L DWELL

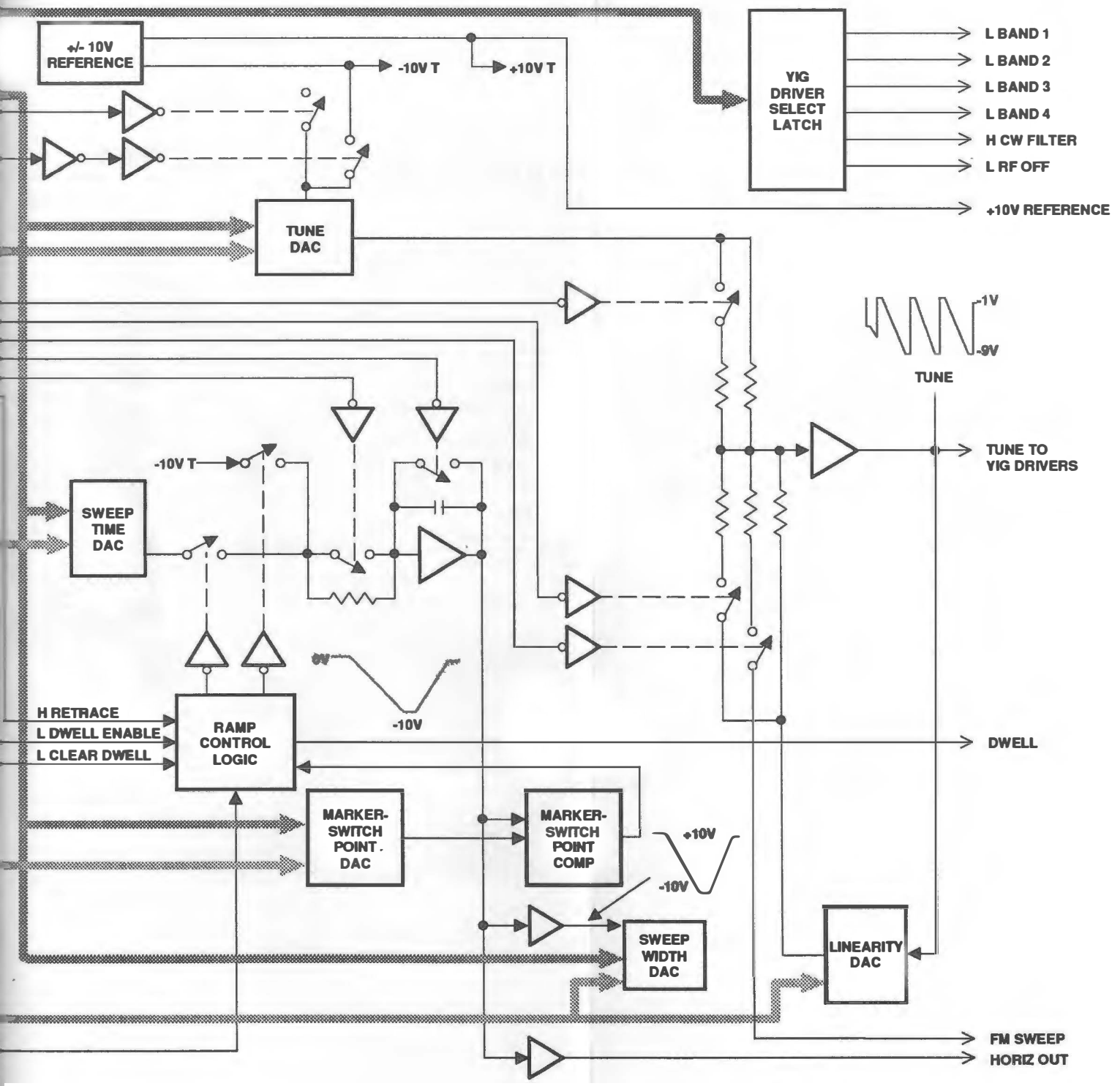
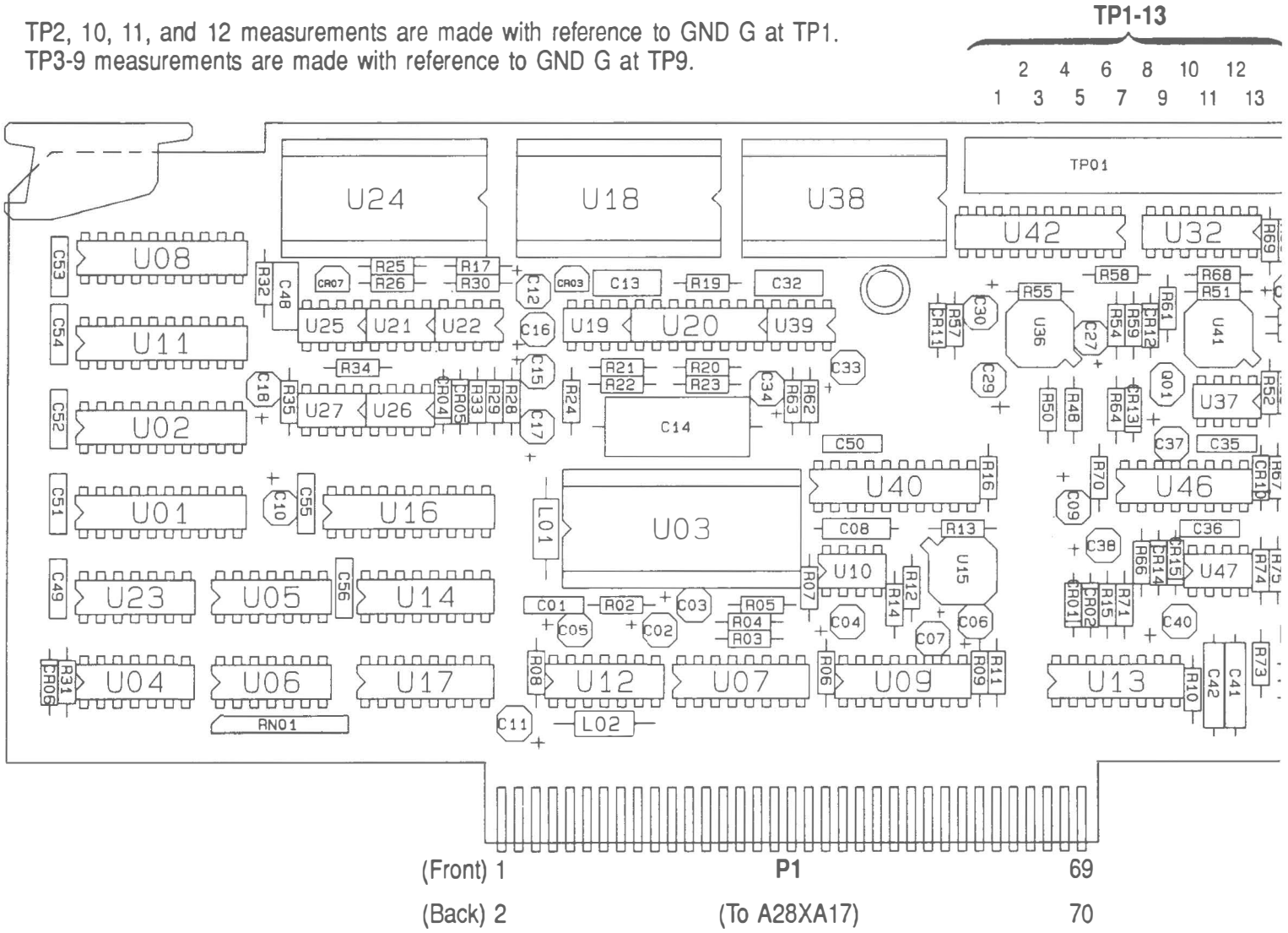


Figure 2I-3. A17 Analog Instruction PCB Block Diagram

TEST POINTS

TP1	GND G	**TP8**	FM SWP
TP2	DVM EXT INPUT	**TP9**	GND G
TP3	20V ΔF	**TP10**	V DET
TP4	TUNE DAC OUT	**TP11**	V TH
TP5	TUNE	**TP12**	V dBm
TP6	SWITCH POINT DET OUT	**TP13**	Not Used
TP7	LINEARIZER DAC OUT		

TP2, 10, 11, and 12 measurements are made with reference to GND G at TP1.
TP3-9 measurements are made with reference to GND G at TP9.



NOTE:
Leading zeros on component number references may be disregarded.

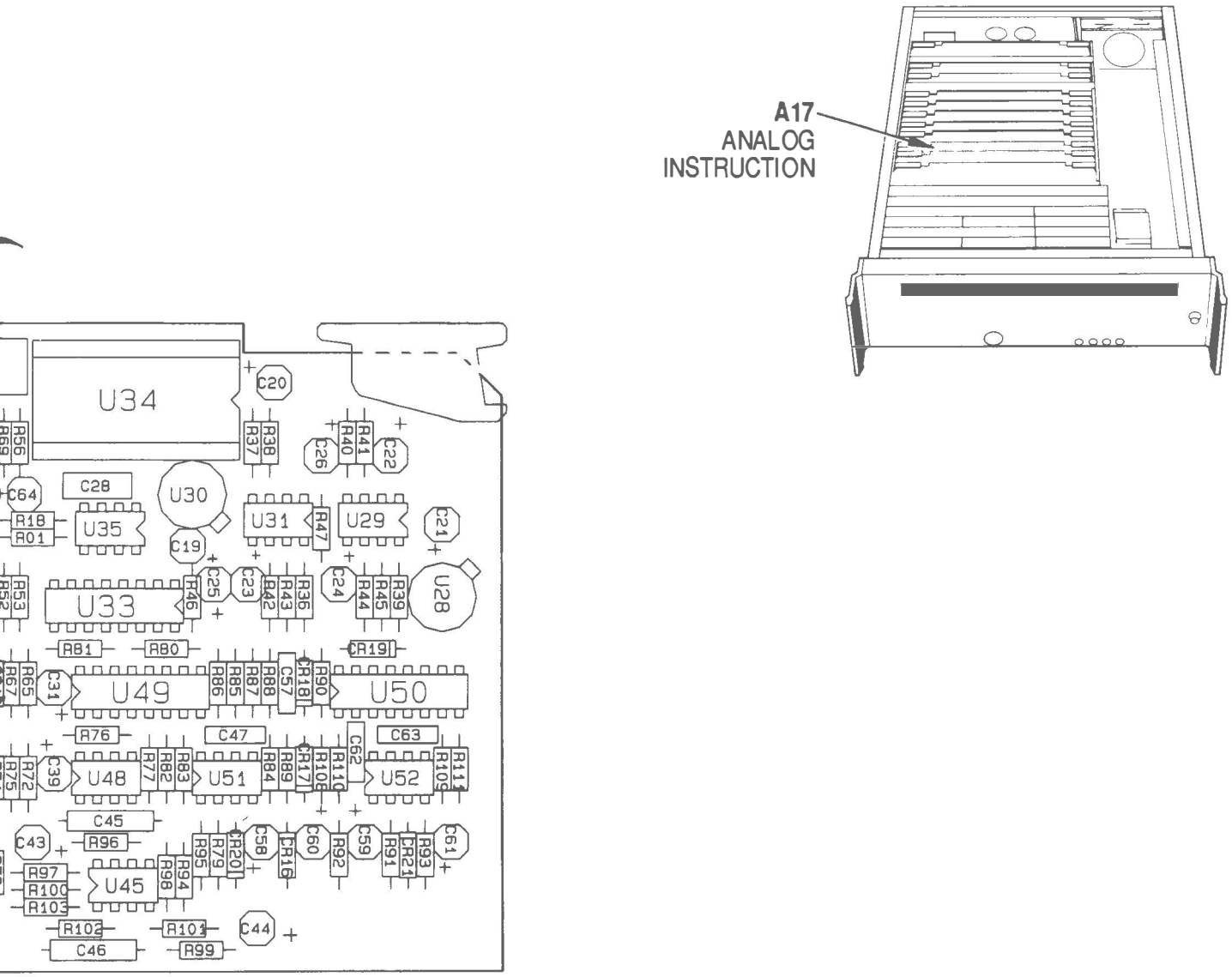
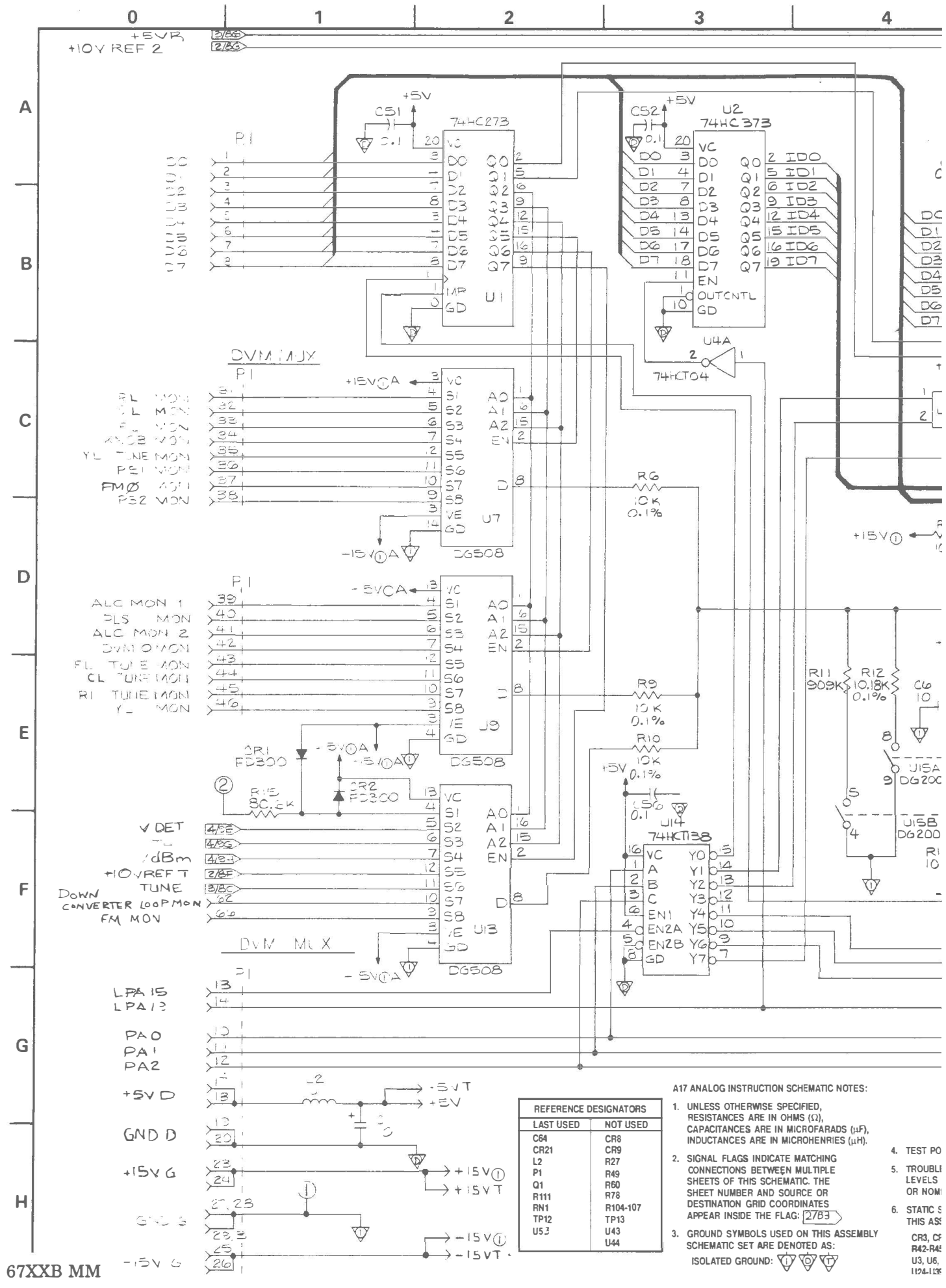


Figure 2I-4. A17 Analog Instruction PCB Parts Locator Diagram
6700-D-31717-3 (Rev. N)


+5VR
+10V REF 2
+5V
C51
74HC273
U1
C52
U2
74HC373
U4A
74HCT04
DVM MUX
P1
DG508
U7
U9
U13
U14
74HCT138
RG
10K
0.1%
R9
R10
R11
90.9K
R12
10.18K
0.1%
C6
10
+15V①
-15V①A
-5VCA
+5VCA
-5V①A
+5V①A
CR1
FD300
CR2
FD300
R15
80.6K
V DET
dBm
+10VREF T
TUNE
DOWN CONVERTER LOOP MON
FM MON
LPA15
LPA12
PA0
PA1
PA2
+5V D
GND D
+15V G
GND G
-15V G
-5VT
+5V
+15V①
+15VT
-15V①
-15VT
L2
REFERENCE DESIGNATORS
LAST USED
NOT USED
C64
CR21
L2
P1
Q1
R111
RN1
TP12
U53
CR8
CR9
R27
R49
R60
R78
R104-107
TP13
U43
U44
A17 ANALOG INSTRUCTION SCHEMATIC NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 27B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
ISOLATED GROUND:
4. TEST PO
5. TROUBL LEVELS OR NOM
6. STATIC S THIS AS
CR3, CR R42-R4 U3, U6, 1124-113

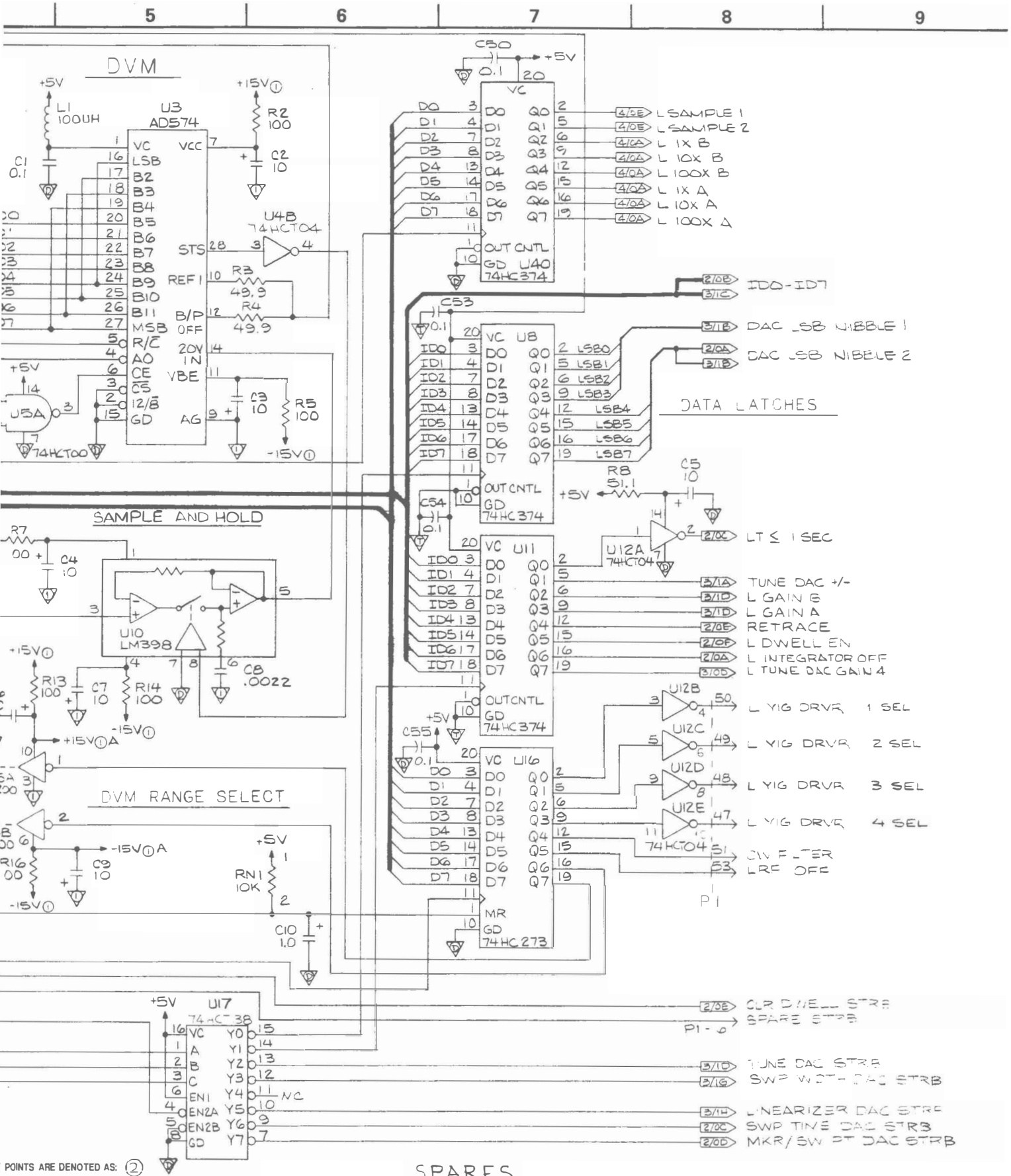
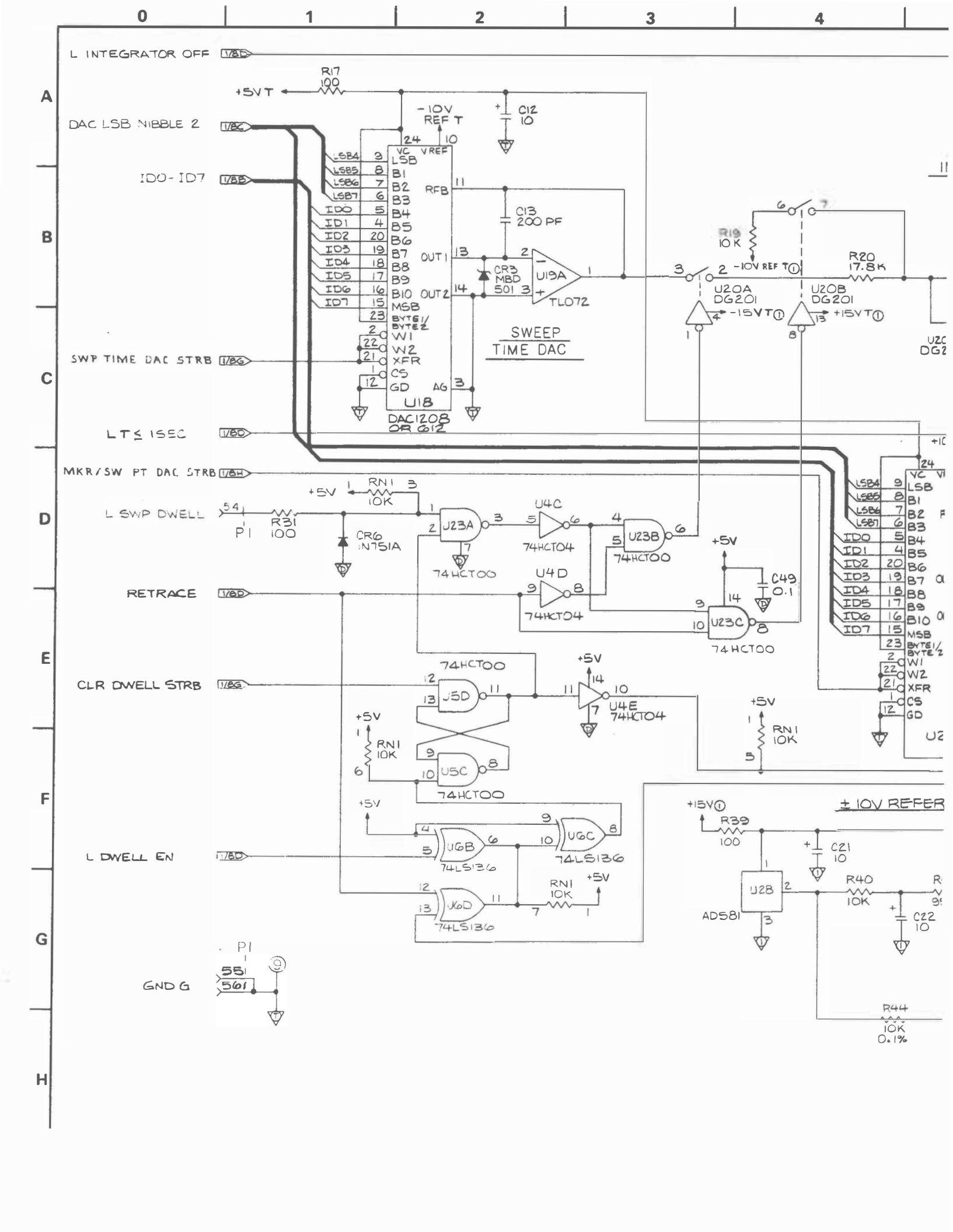


Figure 2I-5. A17 Analog Instruction PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31717-3 (Rev. K)


L INTEGRATOR OFF
DAC LSB NIBBLE 2
ID0-ID7
SWP TIME DAC STRB
LT≤ 1SEC
MKR/SW PT DAC STRB
L SWP DWELL
RETRACE
CLR DWELL STRB
L DWELL EN
GND G
+5VT
R17 100
-10V REF T
C12 10
C13 200 PF
CR3 MBD 501
U19A TLO72
SWEEP TIME DAC
U18 DAC1208 OR 612
R19 10K
R20 17.8K
U20A DG201
U20B DG201
-15VT
+15VT
RN1 10K
R31 100
CR6 1N751A
U23A
U23B
U23C
74HCT00
U4C
U4D
U4E
74HCT04
C49 0.1
U5C
U5D
U6B
U6C
U6D
74LS136
P1
55
561
± 10V REFER
R39 100
C21 10
U28 AD581
R40 10K
C22 10
R44 10K 0.1%

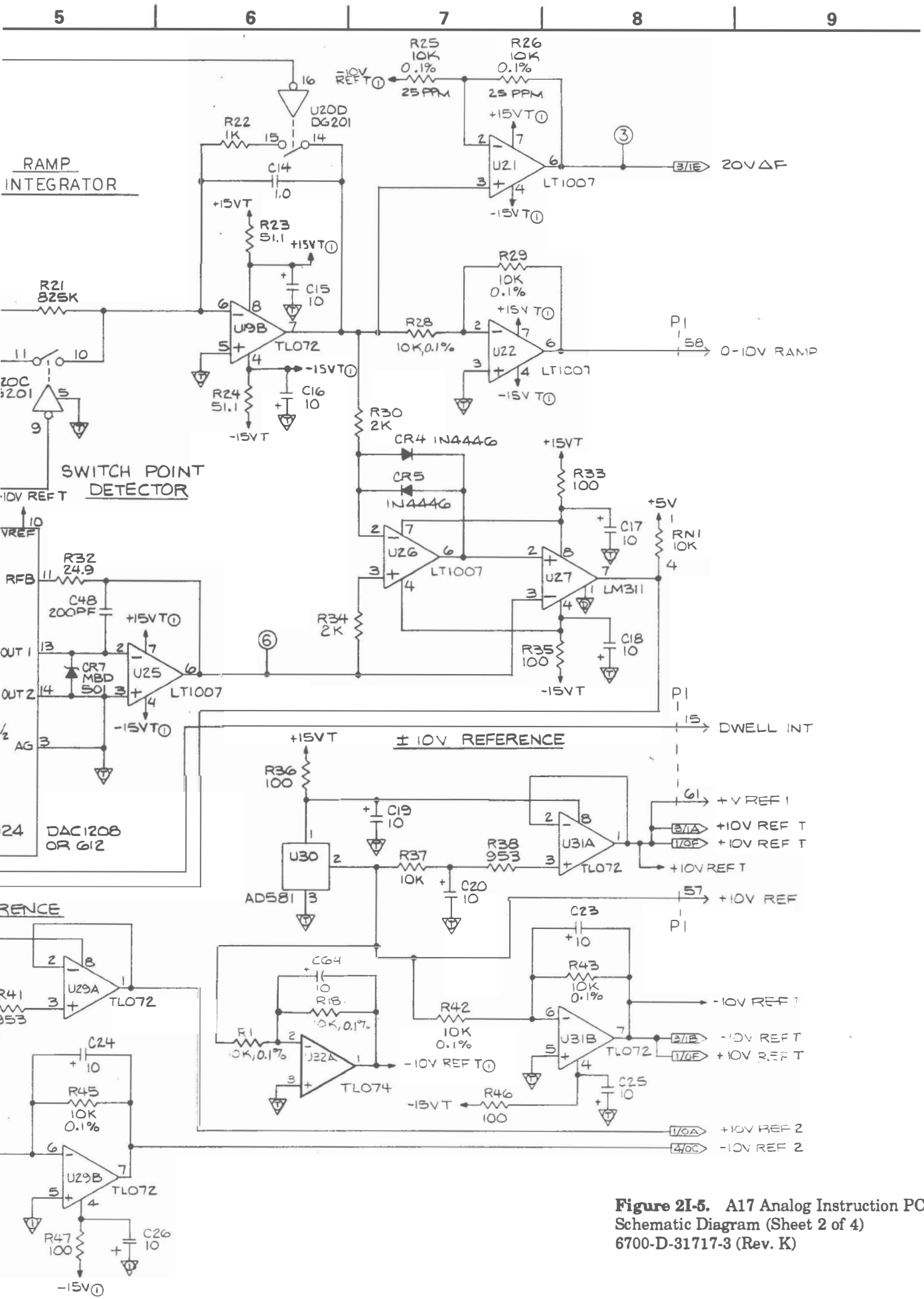
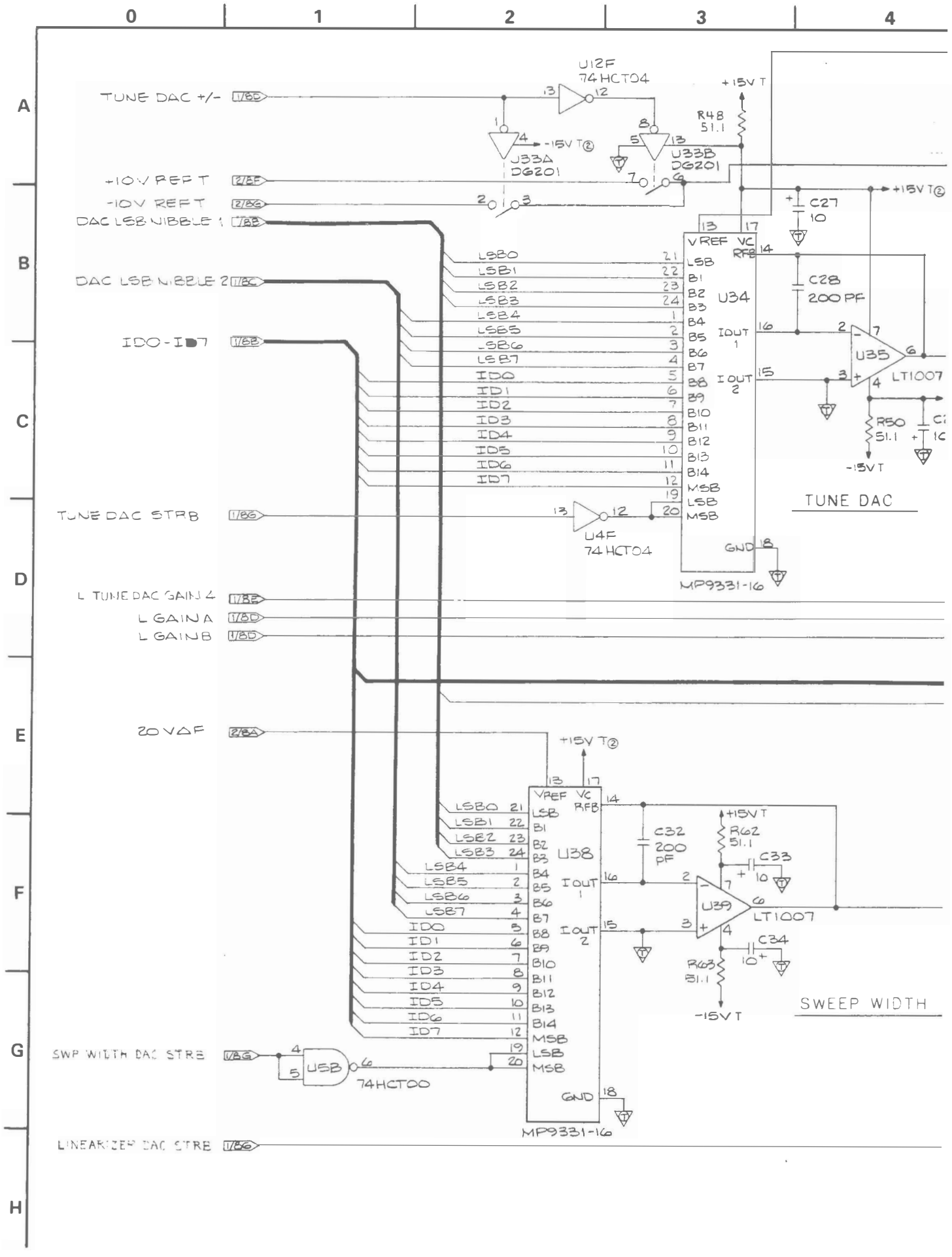


Figure 2I-5. A17 Analog Instruction PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31717-3 (Rev. K)


0
1
2
3
4
A
B
C
D
E
F
G
H
TUNE DAC +/-
+10V REF T
-10V REF T
DAC LSB NIBBLE 1
DAC LSB NIBBLE 2
ID0-ID7
TUNE DAC STRB
L TUNE DAC GAIN 4
L GAIN A
L GAIN B
20VAF
SWP WIDTH DAC STRB
LINEARIZER DAC STRB
U12F
74HCT04
U33A
DG201
U33B
DG201
+15V T
-15V T
R48
51.1
C27
10
C28
200 PF
U34
MP9331-16
U35
LT1007
R50
51.1
TUNE DAC
U4F
74HCT04
U38
MP9331-16
C32
200
PF
R62
51.1
C33
10
U39
LT1007
C34
10
R63
51.1
SWEEP WIDTH
U5B
74HCT00

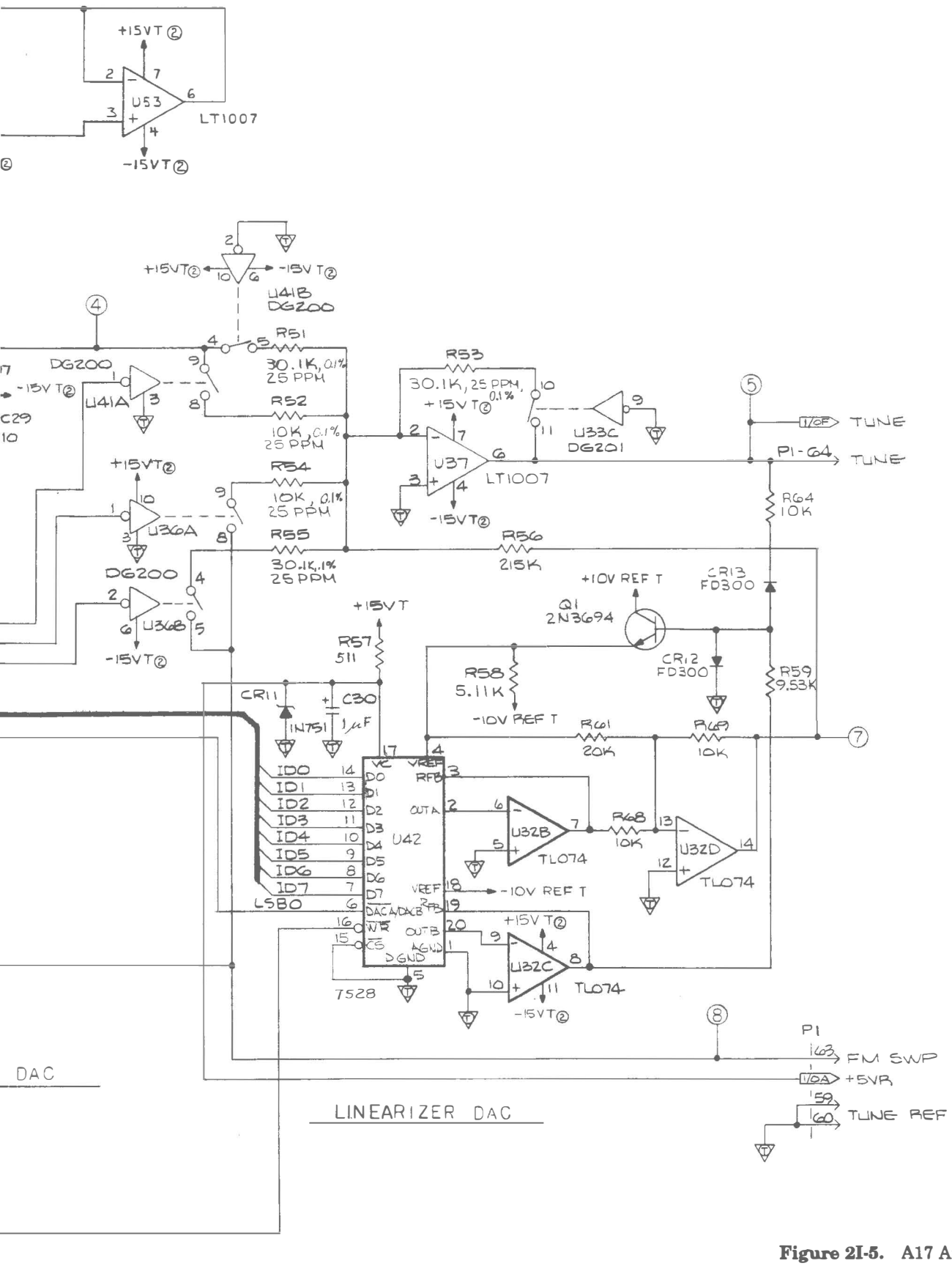
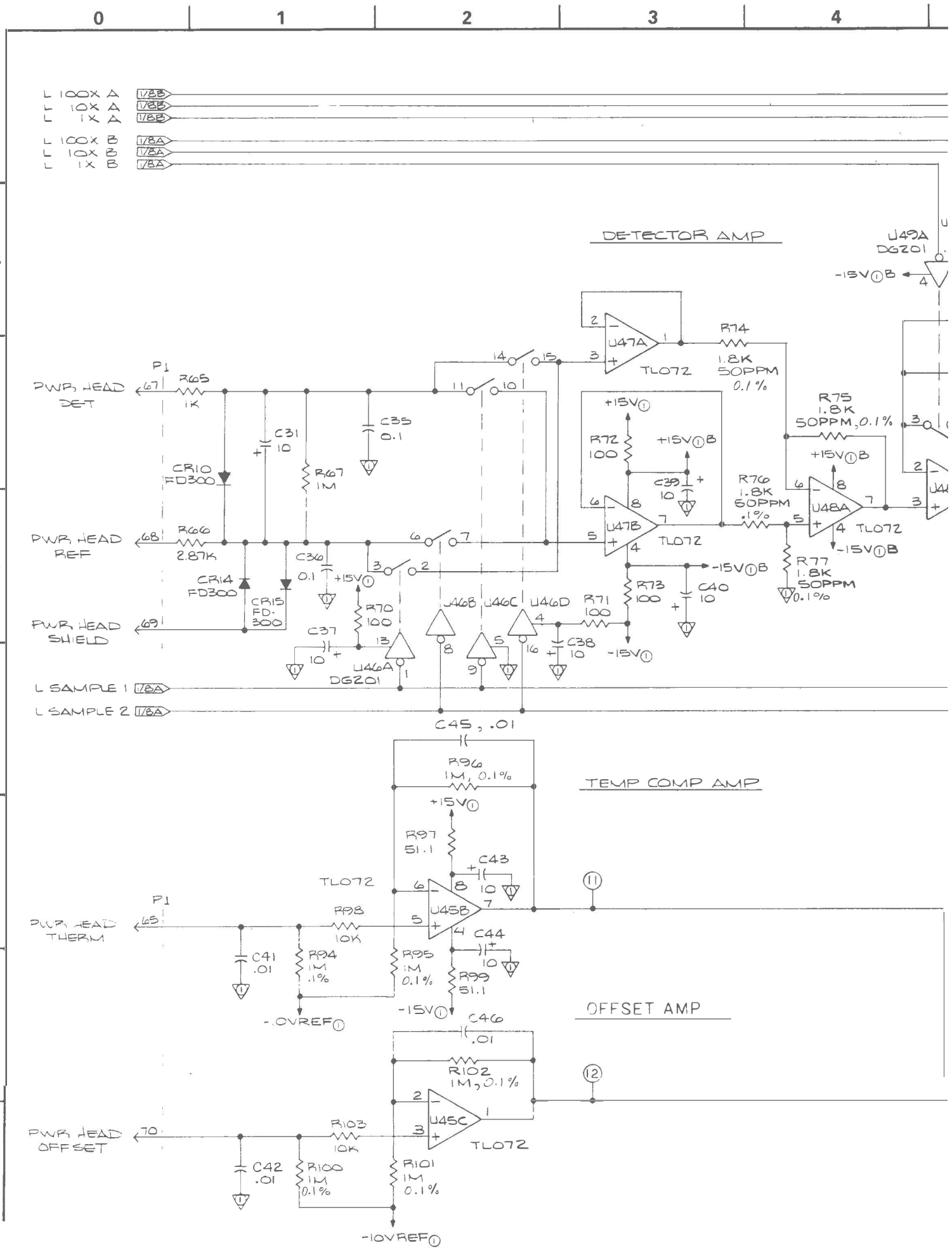


Figure 2I-5. A17 Analog Instruction PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31717-3 (Rev. K)


L 100X A
L 10X A
L 1X A
L 100X B
L 10X B
L 1X B
DETECTOR AMP
U49A DG201
-15V B
P1
PWR HEAD DET
67
R65 1K
C31 10
C35 0.1
CR10 FD300
R67 1M
U47A
TL072
R74 1.8K 50PPM 0.1%
R75 1.8K 50PPM, 0.1%
+15V
R72 100
+15V B
C39 10
R76 1.8K 50PPM .1%
U48A
TL072
-15V B
R77 1.8K 50PPM 0.1%
PWR HEAD REF
68
R66 2.87K
U47B
TL072
C36 0.1
+15V
CR14 FD300
CR15 FD-300
R73 100
C40 10
-15V B
PWR HEAD SHIELD
69
R70 100
C37 10
U46A DG201
U46B
U46C
U46D
R71 100
C38 10
-15V
L SAMPLE 1
L SAMPLE 2
C45, .01
R96 1M, 0.1%
TEMP COMP AMP
+15V
R97 51.1
C43 10
TL072
U45B
P1
PWR HEAD THERM
65
R98 10K
C41 .01
R94 1M .1%
R95 1M 0.1%
C44 10
R99 51.1
-15V
-.OVREF
OFFSET AMP
C46 .01
R102 1M, 0.1%
U45C
TL072
PWR HEAD OFFSET
70
R103 10K
C42 .01
R100 1M 0.1%
R101 1M 0.1%
-10VREF

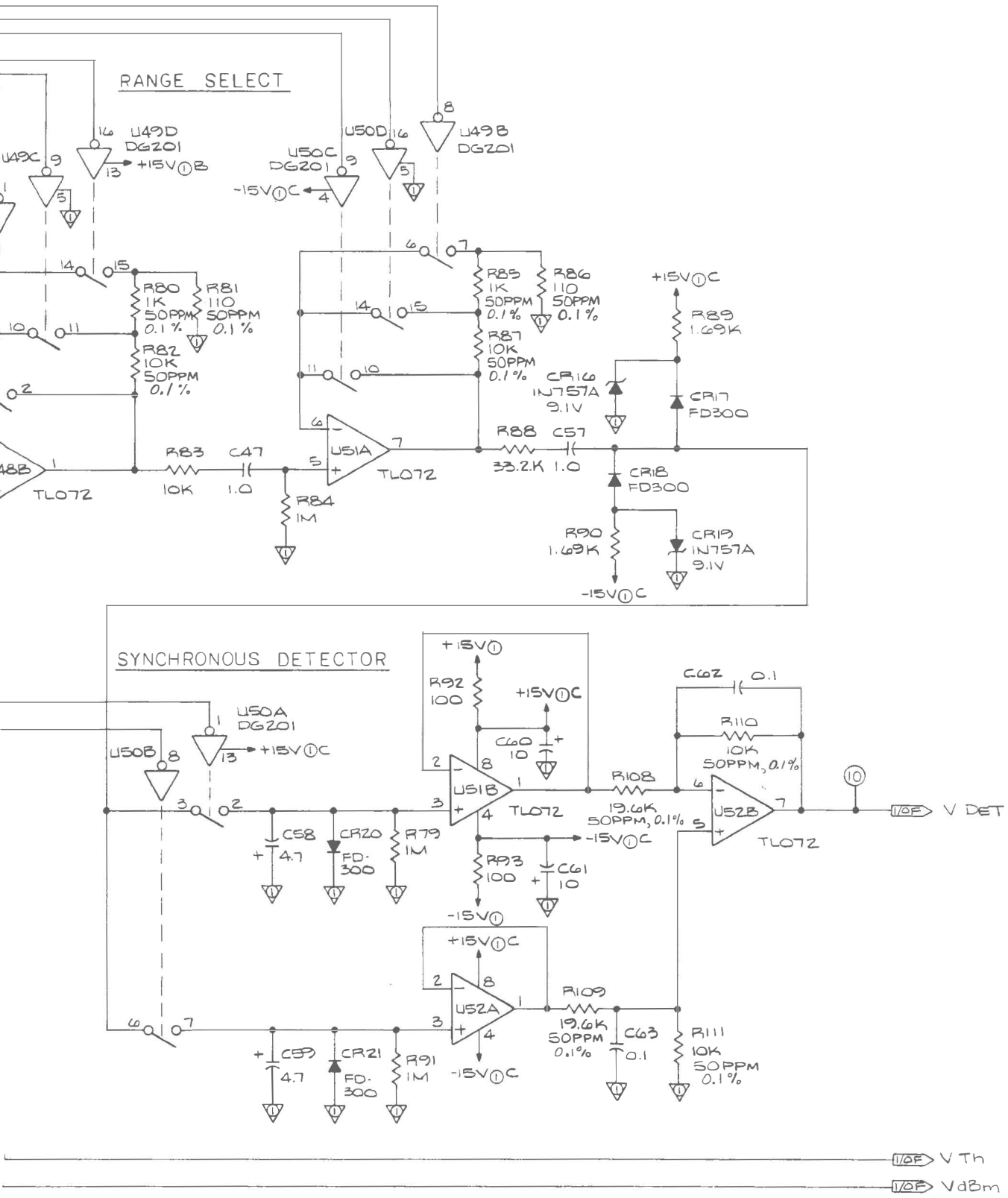


Figure 2I-5. A17 Analog Instruction PCB Schematic Diagram (Sheet 4 of 4) 6700-D-31717-3 (Rev. K)

2J–YIG DRIVER SUBSYSTEM: A18-A21 PCBs

2J-1 INTRODUCTION

This section contains service information for the A18-A21 YIG driver PCBs; see Table 2J-1 below. For information pertaining to the YIG Loop/FM Modulation subsystem, refer to Section 2H–YIG Loop/FM. Refer also to the specific troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting).

Table 2J-1. YIG Drivers Service Information

Documentation	Reference	Page
A18–A21 PCBs:		
Overall Description	Para. 2J-1.1	2J-1
Detailed Circuit Description	Para. 2J-2	2J-1
Block Diagram	Fig. 2J-1	2J-5
Parts Locator Diagram	Fig. 2J-2	2J-6
Schematic (Sheet 1 of 3)	Fig. 2J-3	2J-7
" (Sheet 2 of 3)	" "	2J-8
" (Sheet 3 of 3)	" "	2J-9

2J-1.1 YIG Driver PCB Versions

The A18-A21YIG Driver PCBs contain the main tuning coil driver, FM coil driver, and bias supply circuits for each YIG tuned oscillator assembly. These PCBs are identical in circuit layout and configuration and differ only in the values and quantities of some components. These differences are shown on the parts locator and schematic diagrams for these PCBs (Figures 2J-2 and 2J-3).

Each type of YIG Driver PCB is used for a particular frequency band. Table 2J-2 lists the YIG Driver PCBs associated with the frequency bands covered by the various models of synthesizers. For each model, only those YIG driver PCB(s) that are appropriate for the frequency band(s) covered by that particular model are installed. Refer to Section 1 for information pertaining to specific frequency coverage of each model.

2J-2 YIG DRIVER PCBs, CIRCUIT DESCRIPTION

The following paragraphs describe the circuitry contained on the A18-A21 YIG Driver PCBs. Refer to the block diagram (Figure 2J-1) and the schematic (Figure 2J-3) during the following circuit description.

2J-2.1 A18–A21 YIG Driver PCB Addressing

The A23 Microprocessor PCB selects a specific YIG Driver PCB for each frequency band by setting the appropriate L YIG DRVR SEL output from the A17 Analog Instruction PCB to the low state. Table 2J-2 lists the L YIG DRVR SEL output associated with each frequency band and YIG driver PCB type. Each of these outputs is routed separately from the A17 PCB to pin P2-11 of the associated A18–A21 PCB.

Table 2J-2. YIG Driver PCB Usage

Freq Range	Selected YIG Driver PCB	A17 PCB Driver Select Line
.01 – 2 GHZ	A18 PCB	L YIG DRVR SEL 1
2 – 8 GHz	A18 PCB	L YIG DRVR SEL 1
8 – 12 GHz	A19 PCB	L YIG DRVR SEL 2
12 – 18 GHz	A20 PCB	L YIG DRVR SEL 3
18 – 26.5 GHz	A21 PCB	L YIG DRVR SEL 4
>26.5 GHz	A20 PCB	L YIG DRVR SEL 3

2J-2.2 FM Coil Driver Circuits

These transistors provide the drive current for the FM coil of the associated YIG tuned oscillator assembly. The FM signal output by the A16 FM PCB is routed to the input of the differential receiver amplifier, U1. The output of U1 is fed to the input of filter/amplifier U3 via analog switch U2B. This switch is closed whenever the L YIG DRVR SEL input is in the low state.

Filter/amplifier U3 improves the YIG loop frequency response and drives the FM coil driver amplifier that is composed of transistors Q1 and Q2. Resistor R7 senses the output current through the FM coil; this signal is fed back to the input of U3 by resistor R9.

The feedback signal developed across R7 also goes to buffer amplifier U4A. The output of U4A goes to the input of the main tuning coil control amplifier (U6)

whenever the H CW FILTER control line is in the high state. This feedback signal cancels the magnetic coupling between the FM coil and the main tuning coil. This produces a linear sweep for sweep widths ≤50 MHz.

2J-2.3 Main Tuning Coil Driver Circuits

The TUNE output of the A17 Analog Instruction PCB is either a dc voltage that represents the tuning current needed for the selected YIG oscillator (CW mode) or a 0 to –10V ramp signal (sweep mode). This signal is input to the differential receiver amplifier U4C. The output of U4C goes to the input of control amplifier U6 via analog switch U5C. Switch U5C is closed whenever the L YIG DRVR SEL input is in the low state.

During 0.01 to 2 GHz operation, the A23 Microprocessor PCB sets the L DOWN CONV SELECT control line from the A17 PCB to the low state. This closes analog switches U2A and U5B. Switch U5B connects R91 in parallel with R45. This shifts the YIG oscillator frequency to 6.01 GHz, which is the YIG operating frequency for the low end of the band (i.e., 6.01 GHz – 6.00 GHz = .01 GHz).

The +V REF reference voltage from the A17 PCB is input to differential receiver U4D. The output of U4D (+10V) is used as a reference for all of the control drive signals developed by the YIG Driver PCB.

The TUNE signal from U4C and the +10V reference signal from U4D are summed at the input of control amplifier U6. The output of U6 goes to the input of driver amplifier Q4, which drives the main tuning coil drive amplifier composed of Q5 and Q7. This amplifier furnishes the main tuning coil current for the associated YIG oscillator assembly. Resistor R29 senses the current through the main tuning coil; this signal is fed back to the input of U6 by resistor R28.

During fast sweeps—or stepping operations in the GPIB mode—more main tuning coil driver voltage is required to speed up the current change in the main tuning coil. The voltage switch circuit composed of Q6, Q8 and Q9 furnishes –43V to the main tuning coil drive amplifier on demand. LED CR22 is used in this circuit as a 1.2 V Zener diode. This switch operates whenever the voltage drive signal to the coil goes below approximately –12.5V.

When operating in the CW mode, or with sweep widths less than 50 MHz, control line H CW FILTER is set to the high state. This opens analog switch U5A and closes switch U5D, connecting the filter network comprised of R36 and C23/24 into the feedback path of control amplifier U6. It also connects the feedback path from the output of Q5 (and the FM feedback signal from U4A) to the input of U6. The feedback filter network reduces the overall bandwidth of the main tuning coil driver amplifier from approximately 6 kHz to 30 Hz. This reduced bandwidth improves the residual FM performance in the CW and narrow band sweep modes.

During fast broadband sweeps, analog switch U5A is closed and U5D is open. This disconnects the feedback paths from the input of control amplifier U6, which provides wider driver circuit bandwidth. The switching of the H CW FILTER control line is controlled by the A23 Microprocessor PCB and is completely automatic.

2J-2.4 Bias Supply Driver Circuits.

Integrated switch U7 provides the switching logic for the YIG bias supply driver circuits. The A18 PCB also includes driver circuits for the –5V YIG bias supply and for the Frequency Downconverter assembly. The A20 PCB YIG also includes driver circuits for the Frequency Doubler assembly.

Switch U7 is controlled by the L RF OFF and L BAND SEL lines from the A17 PCB. When L RF OFF is high and L BAND SEL is low, +10V from the output of U4B is connected via U7 to the input of U8A. This causes driver transistor Q11 to supply +15V bias to the YIG oscillator assembly. This also causes U9 to turn on the –5V YIG bias driver, Q13 (A18 only).

Switch U7 also connects +10V to the input of U8B, which turns on driver transistor Q12. This driver circuit supplies +15V to the A31 Multiplier/Power Amplifier assembly. This circuit is identical to the driver circuits of the YIG bias supplies.

When the RF OUTPUT is turned off via the front panel or a frequency is selected in another band, U7 connects 0V to the inputs of the bias supply driver circuits. This turns the driver circuits off, thereby turning off the associated YIG oscillator.

The A18 PCB also contains a driver circuit that supplies +15V to the Frequency Downconverter as-

sembly. When the synthesizer is operating in the 0.01 to 2 GHz band, the A23 Microprocessor PCB sets control line L DOWN CONV SEL low (via the A29 Rear Panel Interface PCB). This causes analog switch U2A to connect +10V to the input of U10. The output of U10 turns on driver transistor Q16, which supplies +15V to the frequency downconverter assembly.

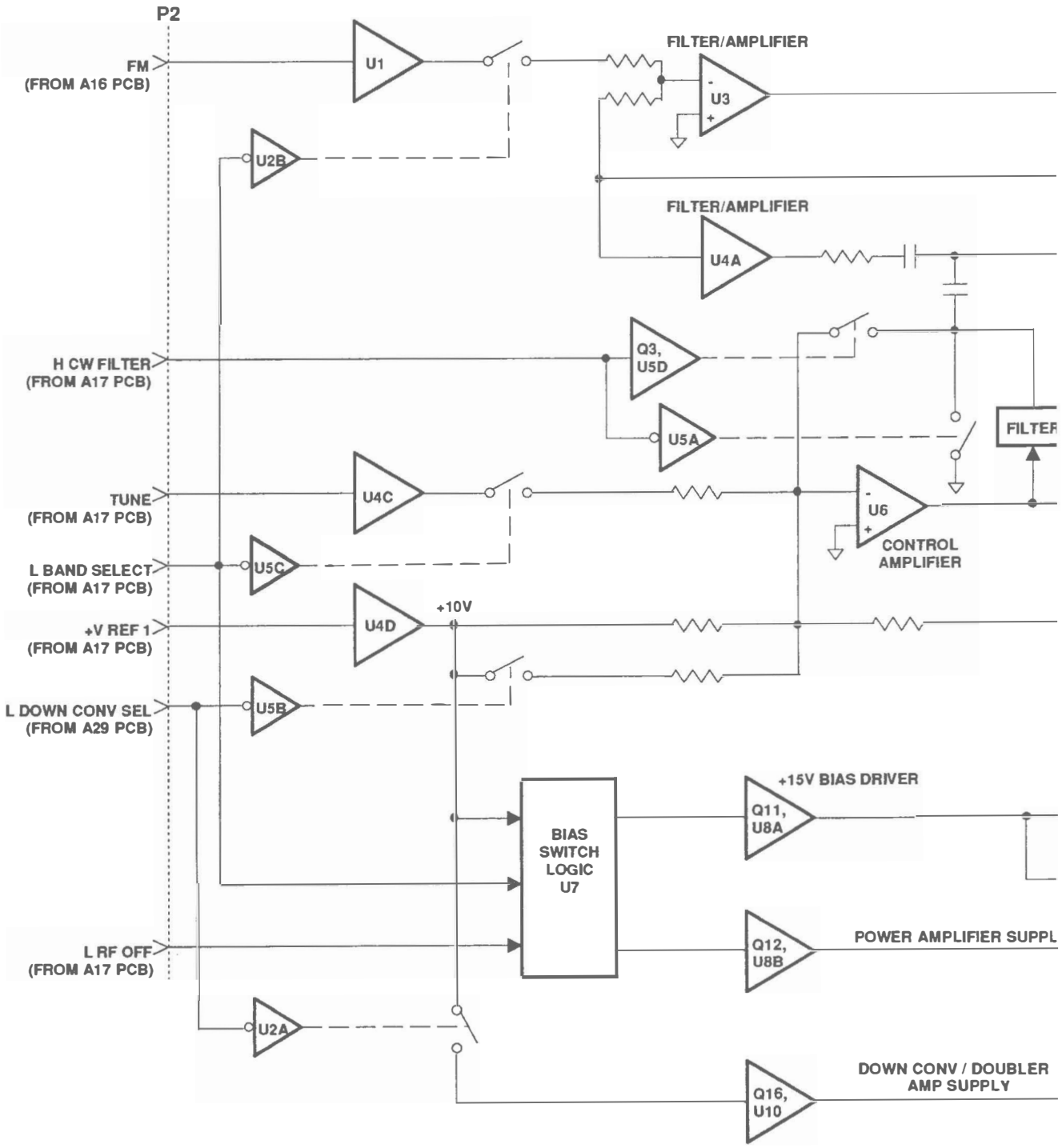
The A20 YIG Driver PCB uses this same circuit (with a different value for R85) to output +12V to the Frequency Doubler (26.5 GHz to 40 GHz) or Frequency Tripler (40 GHz to 60 GHz) assemblies. Refer to Section 2L–RF Microwave Deck for further information pertaining to these assemblies.

2J-3 YIG DRIVER PCBs TROUBLESHOOTING

Refer to the troubleshooting information located in the beginning of this section (Section 2–System Description and Troubleshooting). This information provides a list of error codes that may be displayed as a result of failures in the RF microwave deck associated with the YIG Driver PCBs, A18-A21, and probable causes of the failures.

2J-4 YIG DRIVER PCBs SERVICE SHEETS

Table 2J-1, at the front of this section, lists the block diagrams, schematic diagrams, and parts locator diagrams for the A18–A21 PCBs that are contained in this section.


P2
FM
(FROM A16 PCB)
U1
FILTER/AMPLIFIER
U3
U2B
FILTER/AMPLIFIER
U4A
H CW FILTER
(FROM A17 PCB)
Q3,
U5D
U5A
FILTER
TUNE
(FROM A17 PCB)
U4C
U6
CONTROL
AMPLIFIER
L BAND SELECT
(FROM A17 PCB)
U5C
+10V
+V REF 1
(FROM A17 PCB)
U4D
L DOWN CONV SEL
(FROM A29 PCB)
U5B
+15V BIAS DRIVER
BIAS
SWITCH
LOGIC
U7
Q11,
U8A
L RF OFF
(FROM A17 PCB)
Q12,
U8B
POWER AMPLIFIER SUPPL
U2A
DOWN CONV / DOUBLER
AMP SUPPLY
Q16,
U10

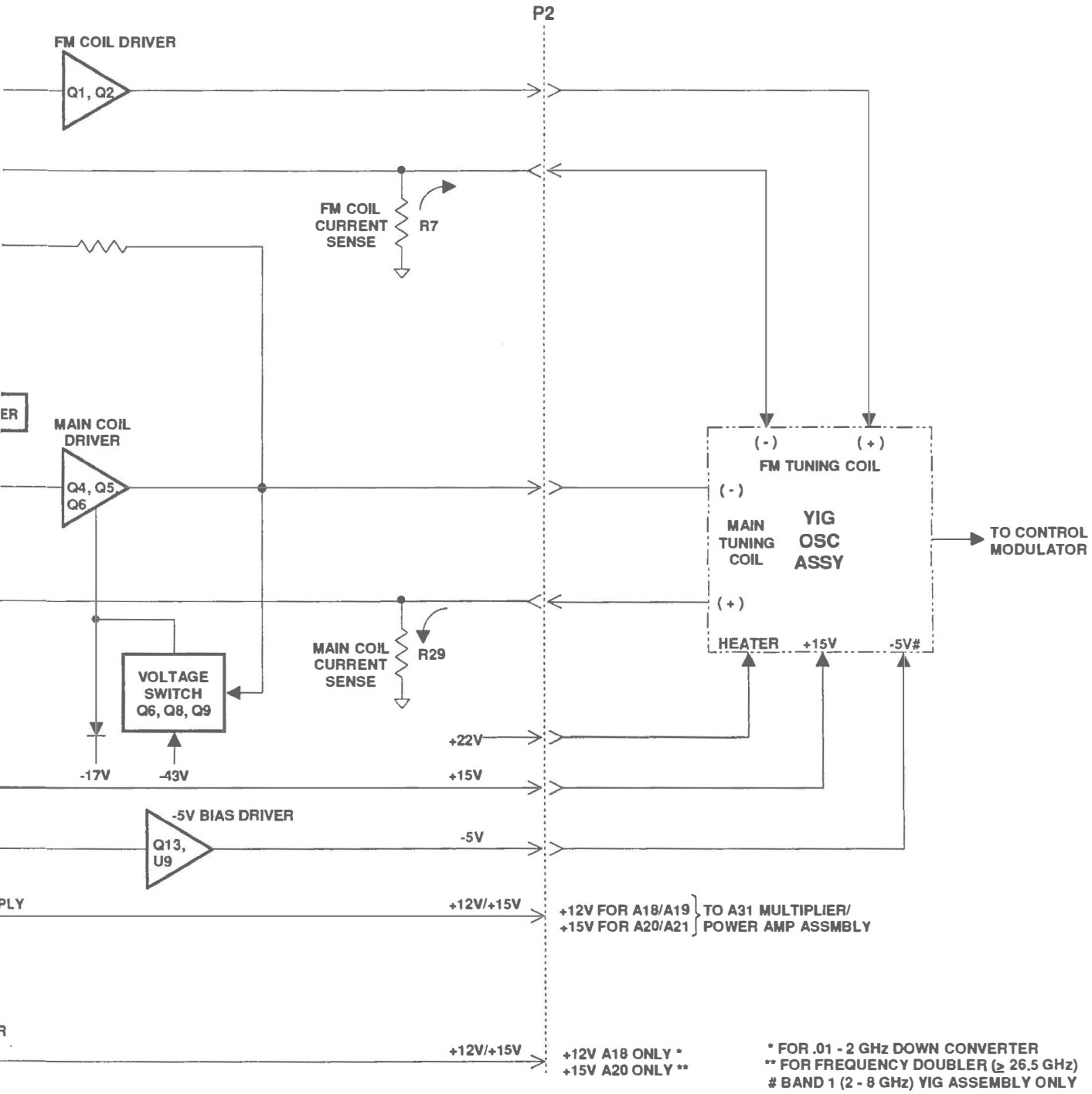
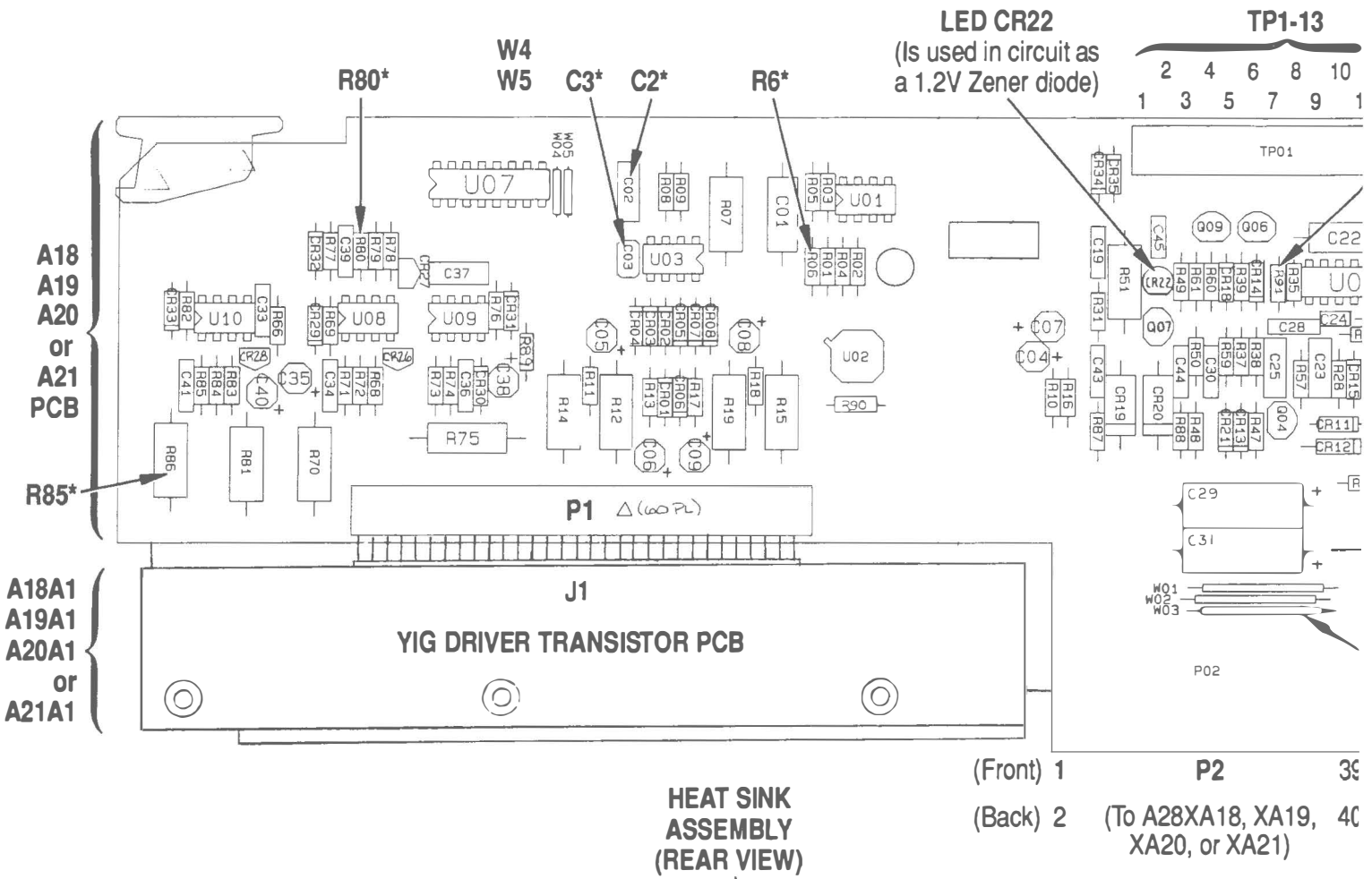
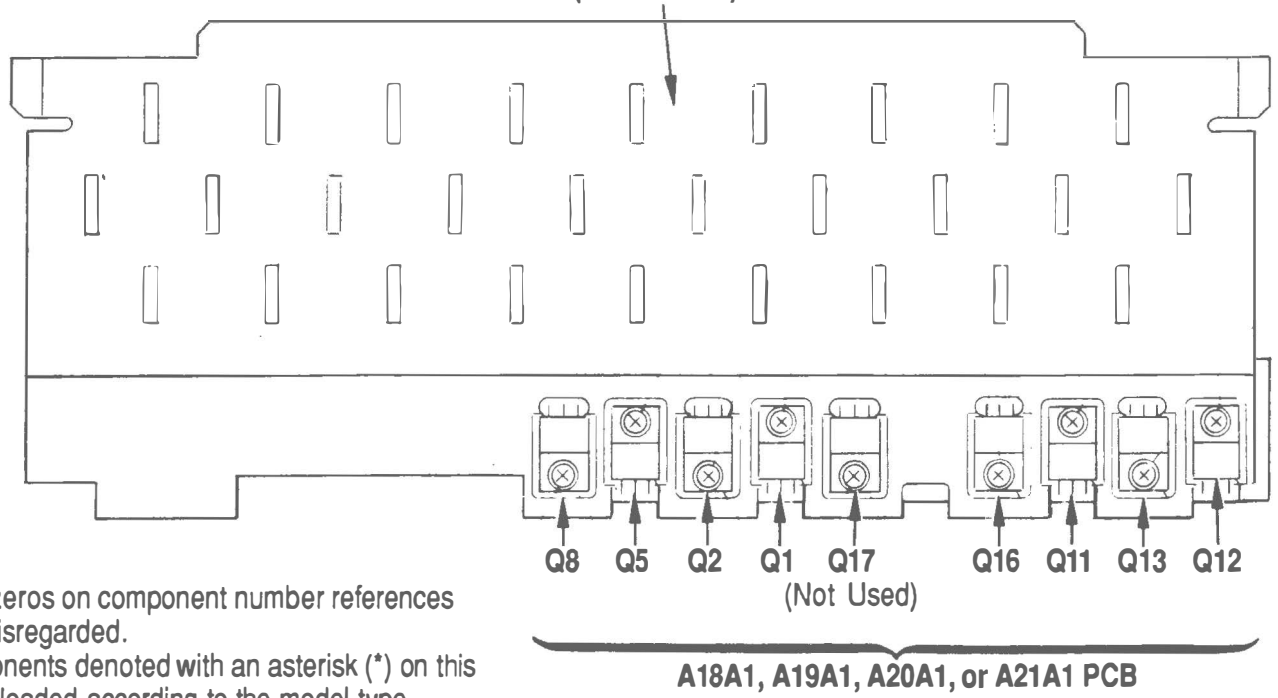


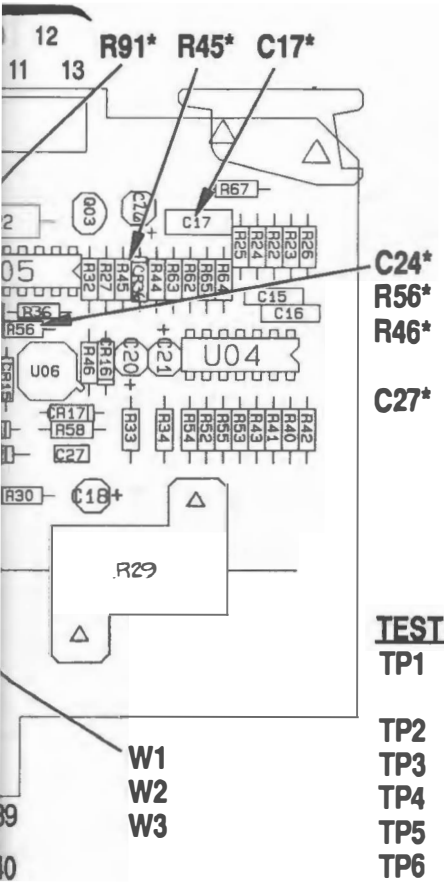
Figure 2J-1. Overall Block Diagram of A18–A21 YIG Driver PCBs

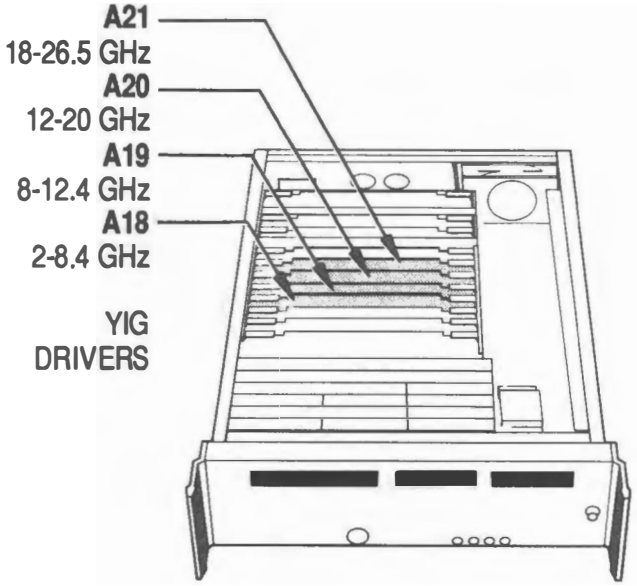




NOTES:

1. Leading zeros on component number references may be disregarded.
2. All components denoted with an asterisk (*) on this page are loaded according to the model type frequency range; see the tables on each schematic sheet for the appropriate values.



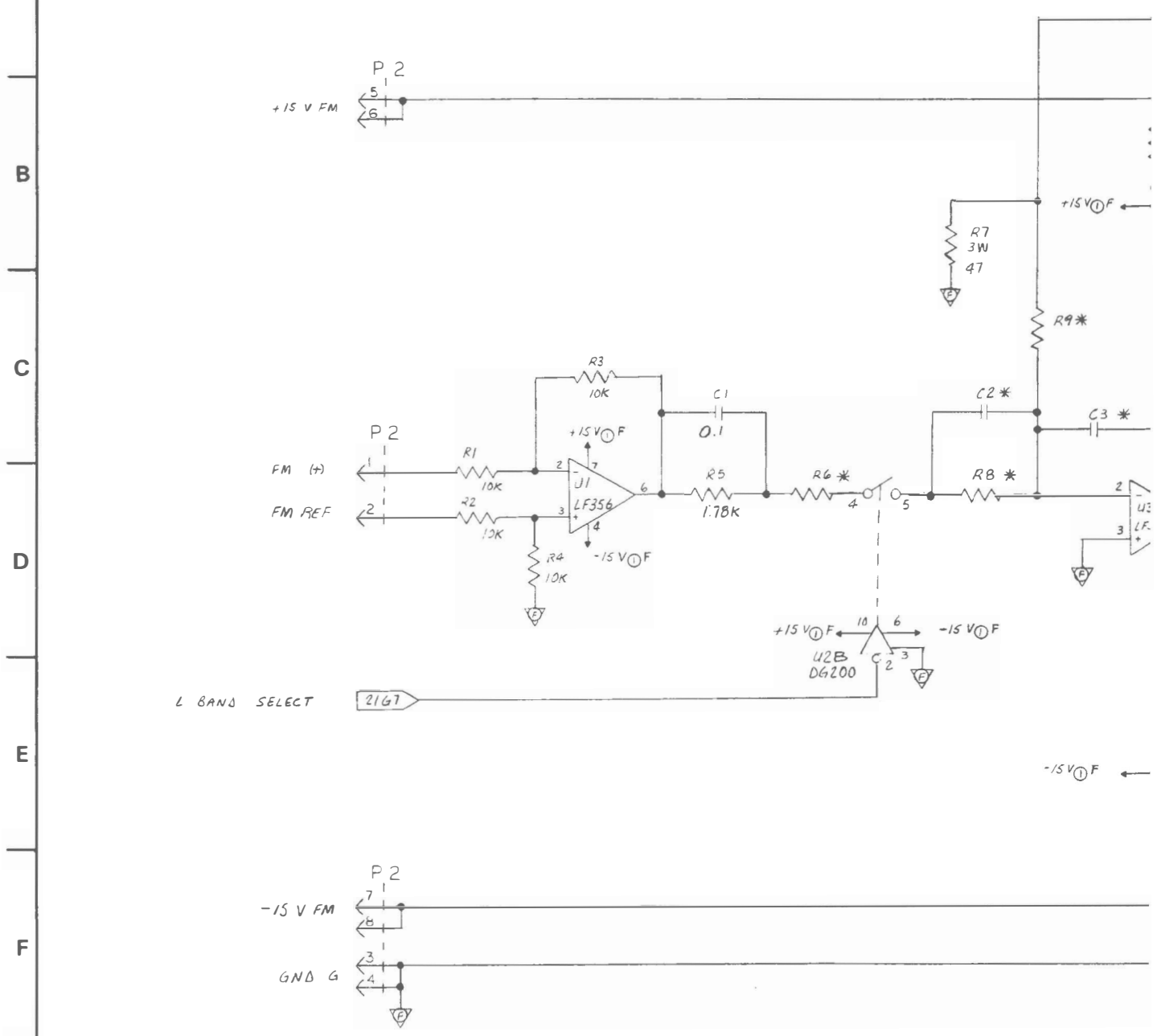


TEST POINTS

TP1	FM COIL CIRCUITS GND (GND F)
TP2	FM COIL (+)
TP3	FM COIL (–)
TP4	MAIN COIL (+)
TP5	MAIN COIL (–)
TP6	MAIN COIL CIRCUITS GROUND (GND M)
TP7	+22V HEATER
TP8	+12V/+15V AMP BIAS
TP9	+15V DOWN CONV/ +12V DOUBLER AMP
TP10	–5V BIAS
TP11	BIAS SENSE (RF DECK GROUND)
TP12	+15V BIAS
TP13	Not Used

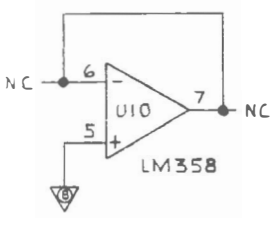
TP2 and TP3 measurements are made with reference to FM COIL CIRCUITS GROUND (GND F) at TP1.
TP4 and TP5 measurements are made with reference to MAIN COIL CIRCUITS GROUND (GND M) at TP6.
TP7-12 measurements are made with reference to BIAS SENSE (RF DECK GROUND) at TP11.

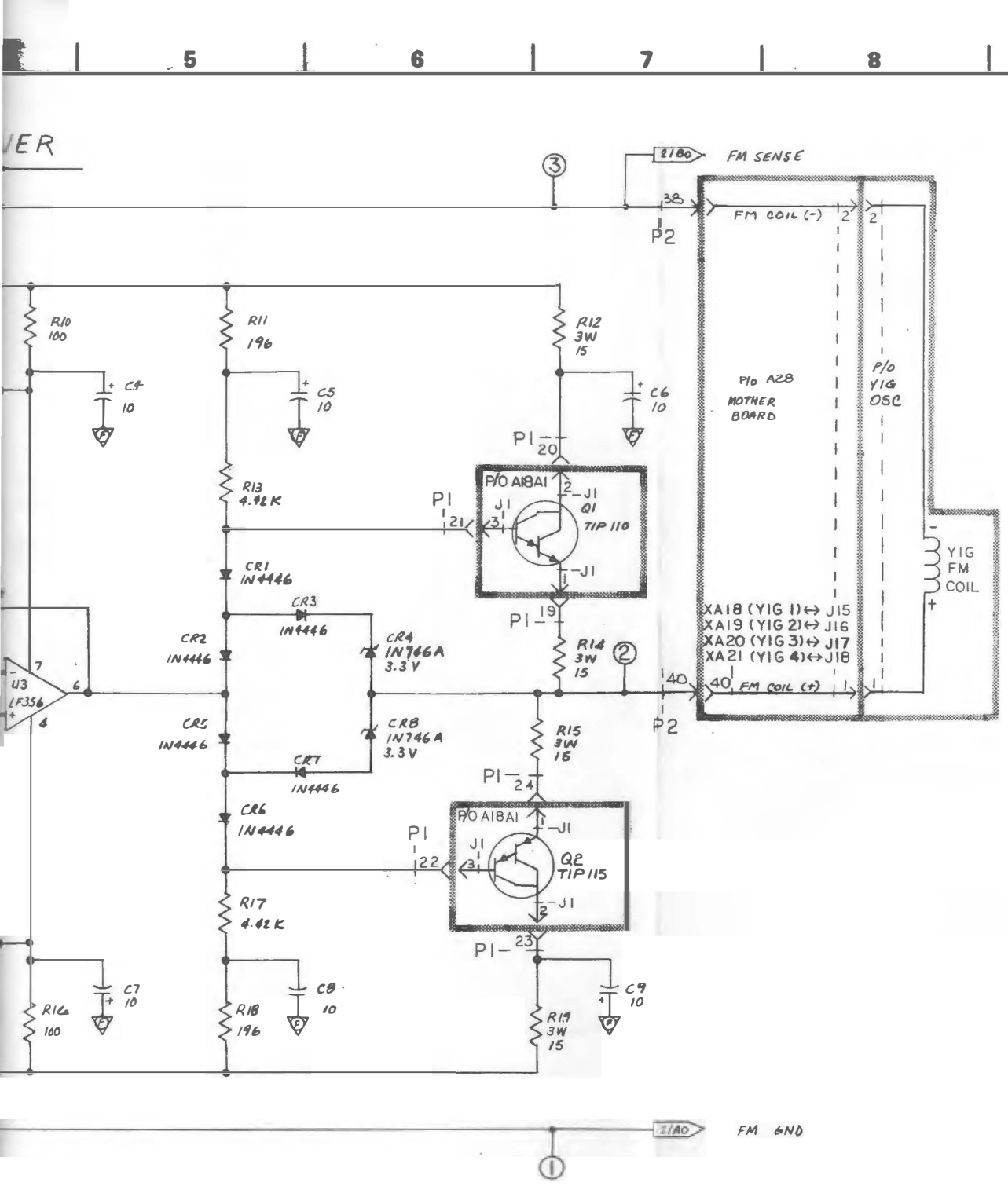
Figure 2J-2. A18–21 YIG Driver PCB Parts Locator Diagram 6700-D-31718-4 thru -9 (Rev. V)



			COMPONENT VALUES				
ASSY	DES	FREQ RANGE	R6*	R8*	R9*	C2*	C3
-4	A18	2-8 GHz	12.7K	1.87K	12.4K	1000pF	10p
-5	A19	8-12.4 GHz	12.1K	2.74K	12.4K	680pF	10p
-6	A20	12.4-20 GHz	12.7K	1.87K	8.25K	1000pF	15p
-7	A21	20-26.5 GHz	12.7K	1.87K	10.2K	1000pF	15p
-8	A21	18-26.5 GHz	12.7K	1.87K	10.2K	1000pF	15p
-9	A18	2-8 GHz	12.7K	1.87K	12.4K	1000pF	10p

SPARE



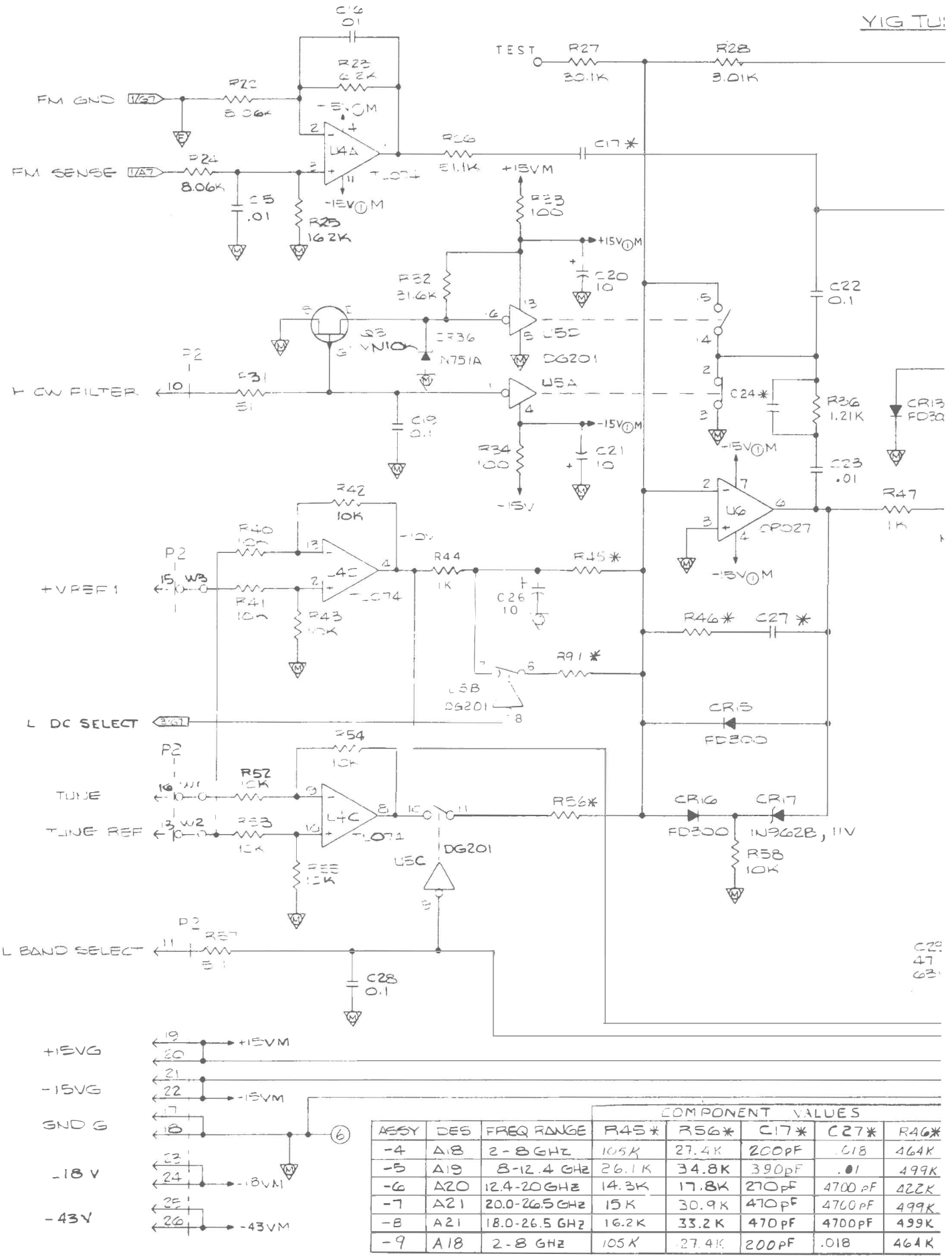


A18 YIG DRIVER SCHEMATIC NOTES:

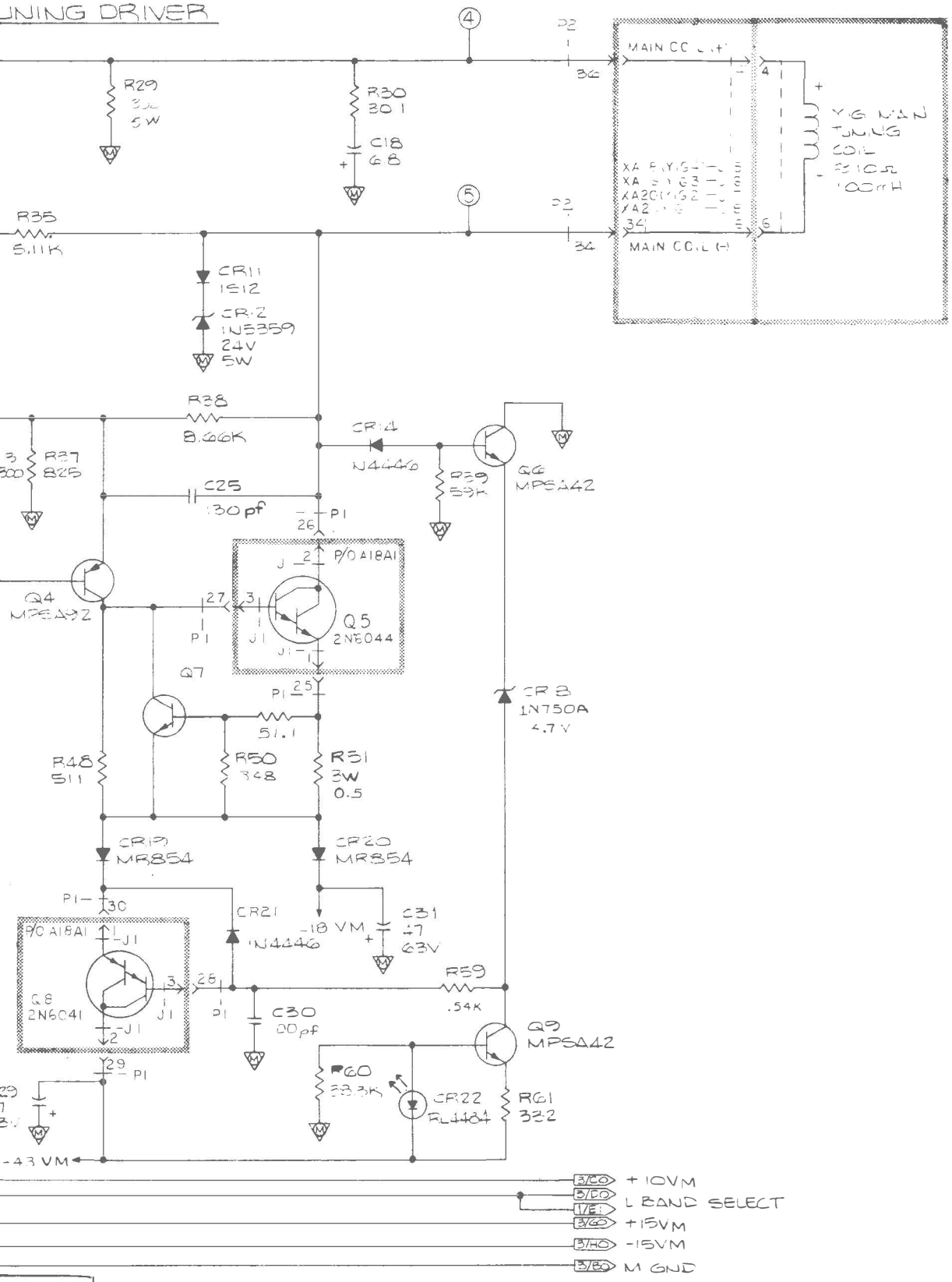
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUNDS: (E) (F) (M)
4. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:
   C2*, C3*, C17*, C24*, C27*, R6*, R8*, R9*, R46*, R56*, R80*,
5. TEST POINTS ARE DENOTED AS: (2)
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. SUBASSEMBLY BORDERS ARE DENOTED AS:
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR26, CR27, R28, R62-65, Q3, U1-U7
9. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C44	(See factory-selected resistor tables.)
CR36	
P1	
Q9	
R88	C42
TP1	
U10	
W5	

Figure 2J-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 1 of 3) 6700-D-31718-4 thru -9 (Rev. P)

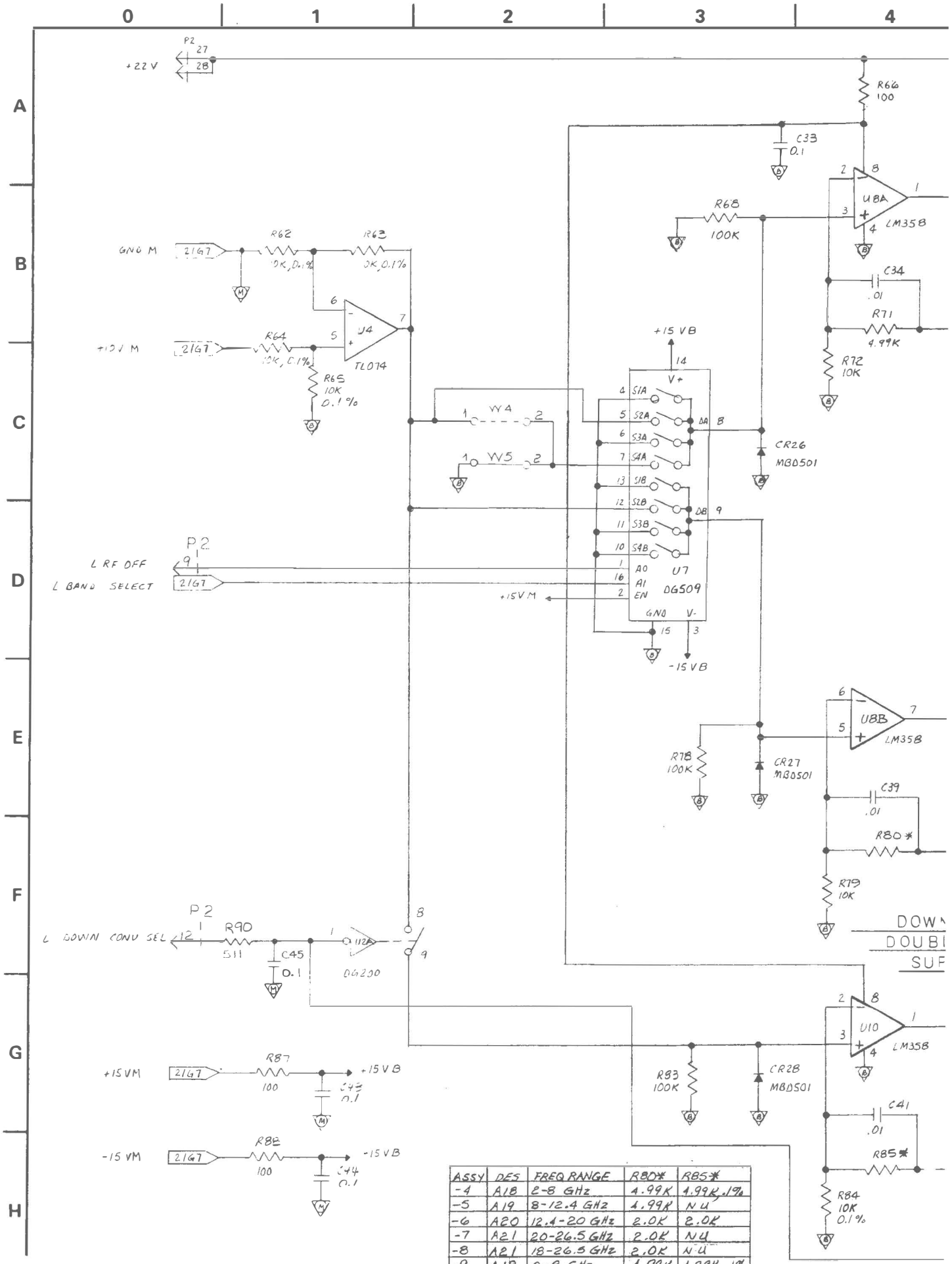


			COMPONENT VALUES				
ASSY	DES	FREQ RANGE	R45 *	R56 *	C17 *	C27 *	R46 *
-4	A18	2 - 8 GHz	105K	27.4K	200pF	.018	464K
-5	A19	8-12.4 GHz	26.1K	34.8K	390pF	.01	499K
-6	A20	12.4-20GHz	14.3K	17.8K	270pF	4700 pF	422K
-7	A21	20.0-26.5 GHz	15K	30.9K	470pF	4760 pF	499K
-8	A21	18.0-26.5 GHz	16.2K	33.2K	470pF	4700pF	499K
-9	A18	2-8 GHz	105K	27.4K	200pF	.018	464K



	C24*	R91
	39pf	NU
K	39pf	NU
	39pf	NU
	68pf	NU
	68pf	NU
	39pF	105K

Figure 2J-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 2 of 3) 6700-D-31718-4 thru -9 (Rev. P)



ASSY	DES	FREQ RANGE	R80*	R85*
-4	A18	2-8 GHz	4.99K	4.99K, .1%
-5	A19	8-12.4 GHz	1.99K	N U
-6	A20	12.4-20 GHz	2.0K	2.0K
-7	A21	20-26.5 GHz	2.0K	N U
-8	A21	18-26.5 GHz	2.0K	N U
-9	A18	2-8 GHz	4.99K	4.99K, .1%

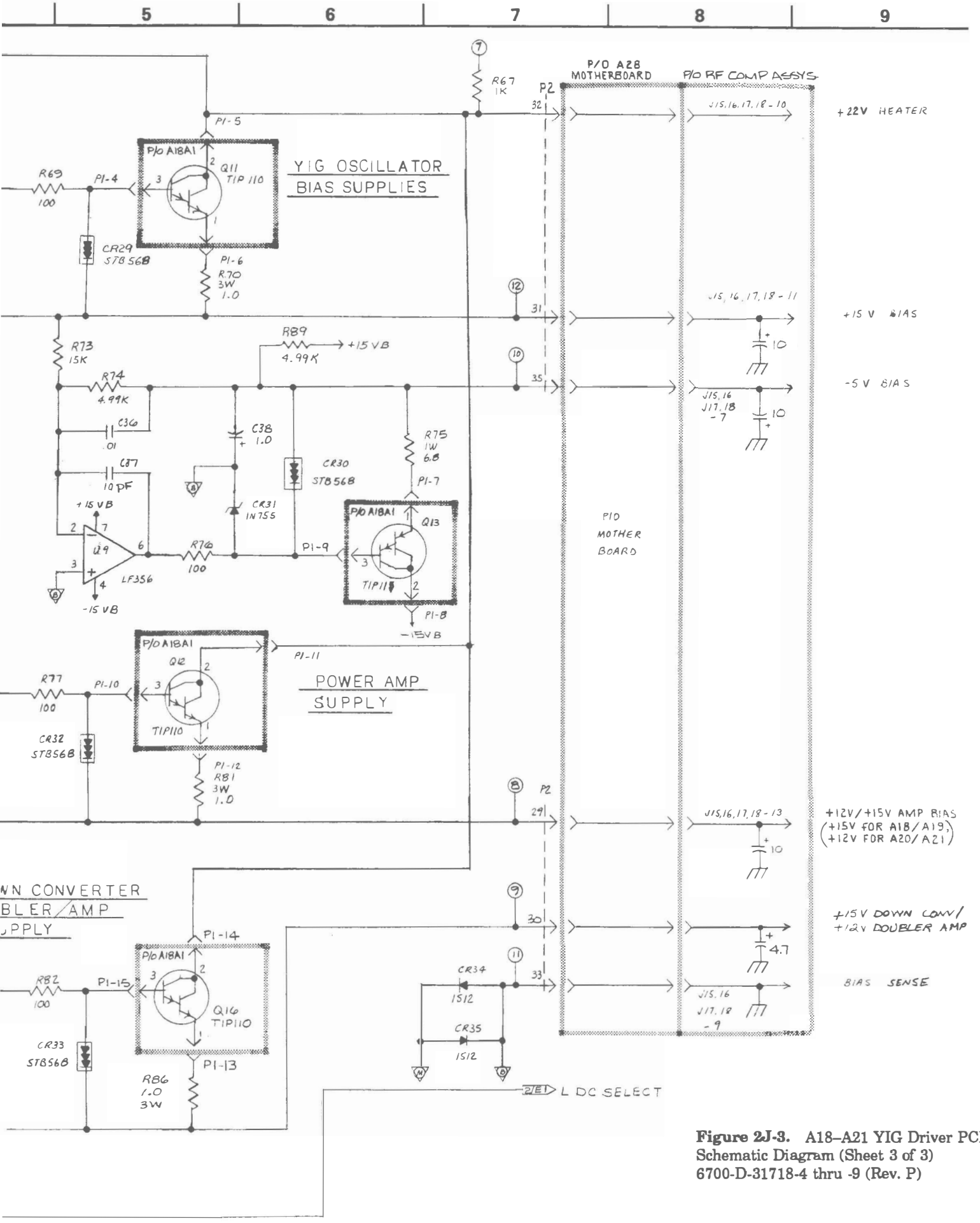


Figure 2J-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 3 of 3) 6700-D-31718-4 thru -9 (Rev. P)

2K–ALC/PULSE MODULATION SUBSYSTEM: A15, A13, AND A29 PCBS

2K-1 ALC (AUTOMATIC LEVEL CONTROL) AND PULSE MODULATION PCBS AND ASSEMBLIES

This section contains service information for the ALC loop and Pulse Modulation circuits located on the A15, A13, and A29 PCBs. This information is listed in Table 2K-1 below. Refer also to Section 2L–RF Microwave Deck and to the specific troubleshooting information located at the beginning of this section (Section 2–System Description and Troubleshooting). Note that the parts locator diagram and partial schematic diagrams for the A29 Rear Panel Interface PCB are located in this section. Refer to Section 2–Inputs/ Outputs for complete schematics for this PCB.

Table 2k-1. ALC Loop/Pulse Modulation Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2K-1.1	2K-1
Block Diagram	Fig. 2K-1	2K-3
PCB LEVEL		
A13 PULSE GEN PCB		
Detailed Circuit Description	Para. 2K-3	2K-8
Block Diagram	Fig. 2K-3	2K-11
Parts Locator Diagram	Fig. 2K-5	2K-14
Schematic (Sheet 1 of 4)	Fig. 2K-6	2K-15
(Sheet 2 of 4)	"	2K-16
(Sheet 3 of 4)	"	2K-17
(Sheet 4 of 4)	"	2K-19
A15 ALC PCB		
Detailed Circuit Description	Para. 2K-2	2K-2
Block Diagram	Fig. 2K-2	2K-5
Parts Locator Diagram	Fig. 2K-7	2K-20
Schematic (Sheet 1 of 5)	Fig. 2K-8	2K-21
(Sheet 2 of 5)	"	2K-22
(Sheet 3 of 5)	"	2K-23
(Sheet 4 of 5)	"	2K-24
(Sheet 5 of 5)	"	2K-25
P/O A29 REAR PANEL INTERFACE PCB		
Detailed Circuit Description	Para. 2K-4	2K-10
Block Diagram	Fig. 2K-4	2K-13
Parts Locator Diagram	Fig 2K-9	2K-26
Schematic Diagram (partial)		
(Sheet 2 of 5)	Fig 2K-10	2K-27
(Sheet 5 of 5)	Fig 2K-11	2K-28

2K-1.1 Overview of ALC Loop Operation

The ALC loop controls the RF output power level through a feedback system. It also provides amplitude modulation capabilities and control of the RF during pulse operation. Most of the major ALC circuits are located on the A15 PCB. Other circuits and components of the ALC loop are located on the A29 Rear Panel Interface PCB and on the microwave deck. Refer to the overall block diagram of these circuits (Figure 2K-1).

All major circuits of the ALC loop are controlled by the synthesizer main microprocessor. When a RF output power level is selected by the operator, the main microprocessor sets the ALC level reference voltage (on the A15 PCB) to a value equal to the desired RF output voltage. The ALC reference voltage is compared to a sample of the RF output from the Level Detector and an error signal is developed if they are not equal.

The ALC error signal is amplified and processed by the ALC control circuits and then fed to the PIN driver circuits located on the A29 PCB. The output of these circuits causes the PIN diodes that are part of the Control Modulators to change the level of the RF signal accordingly. (The Control Modulators are located on the RF deck.) This process causes the RF output voltage to be set to the desired output level (i.e., equal to the ALC reference voltage).

During amplitude modulation (AM), the signal from the external AM source is summed with the internal ALC reference voltage. The action of the ALC loop causes the RF output to change with the ALC reference voltage. This causes the RF envelope to duplicate the AM signal.

In internal or external pulse modulation modes, the output signal from the A13 Pulse Generator PCB drives the Control Modulator(s). This produces a pulse-modulated RF output waveform.

2K-2 A15 ALC PCB FUNCTIONAL DESCRIPTION

The major ALC circuits are located on the A15 PCB; these circuits are discussed in the following paragraphs. Refer to the overall block diagram of the A15 PCB (Figure 2K-2), and to the schematic diagram (Figure 2K-8).

2K-2.1 Microprocessor Control

The ALC internal data bus is buffered from the main processor data bus by latch U1. Whenever the ALC PCB is addressed via the L PA17 line, the data on the microprocessor bus is transferred by U1 to the internal data bus. The L PA17 line also enables the ALC/PM address decoder (U2), which decodes address lines PA0–PA2. The decoder circuit then strobes the addressed ALC/Pulse Generator data latch(es) or DACs. This loads the instructions/data from the data bus into the addressed device.

2K-2.2 ALC Reference Voltage

The ALC loop reference voltage is the –10 volt output from the reference supply circuits (VR1/U14A). Operational Amplifier U8D sums this voltage with the ALC SLOPE signal from the A29 PCB and with the output of the AM modulation circuits from the %AM DAC.

The output of U8D goes to the 12-Bit Level DAC, U17. The output of U17 goes to the input of 8-Bit ALC Range DAC, U19A. The combination of these two DACs provides a 1 million-bit resolution over the typical 20 dB control range of the level loop. The main microprocessor sets the output voltage level from the ALC DAC circuits equal to that of the desired RF output signal.

2K-2.3 External AM Circuits

The external AM input signals from the front and rear panel connectors go to Input Amplifiers U6A and U6D. The outputs of U6A/U6D are summed by amplifier U6B. The output of U6B is connected to the AM Peak Detector, the AM Trough Detector, and the %AM DAC circuits.

The main microprocessor adjusts the output of the %AM DAC, U9B to provide the necessary modulation signal voltage required for the %AM level selected. (The operator selects the desired %AM level by using the front panel keys or via the GPIB.)

The output of U9B is summed with the ALC reference voltage (and the ALC SLOPE signal) before being applied to the ALC Level and range DACs. This maintains a constant-percentage AM signal with a changing reference-level voltage.

NOTE:

If the external AM input signal is 1 volt peak, then the actual %AM equals the %AM level selected. If the input signal is not 1 volt peak, then the modulation percentage is something other than the %AM level selected.

Operational amplifiers U11A and U11D are the *AM Peak* and *AM Trough* Detectors. These circuits provide dc output voltages proportional to the amplitude modulation of the signal. The output signals from these circuits goes to the U15 Analog MUX (multiplexer) circuit. This circuit selects various ALC signals for measurement by the digital voltmeter circuits located on the A17 Analog Instruction PCB.

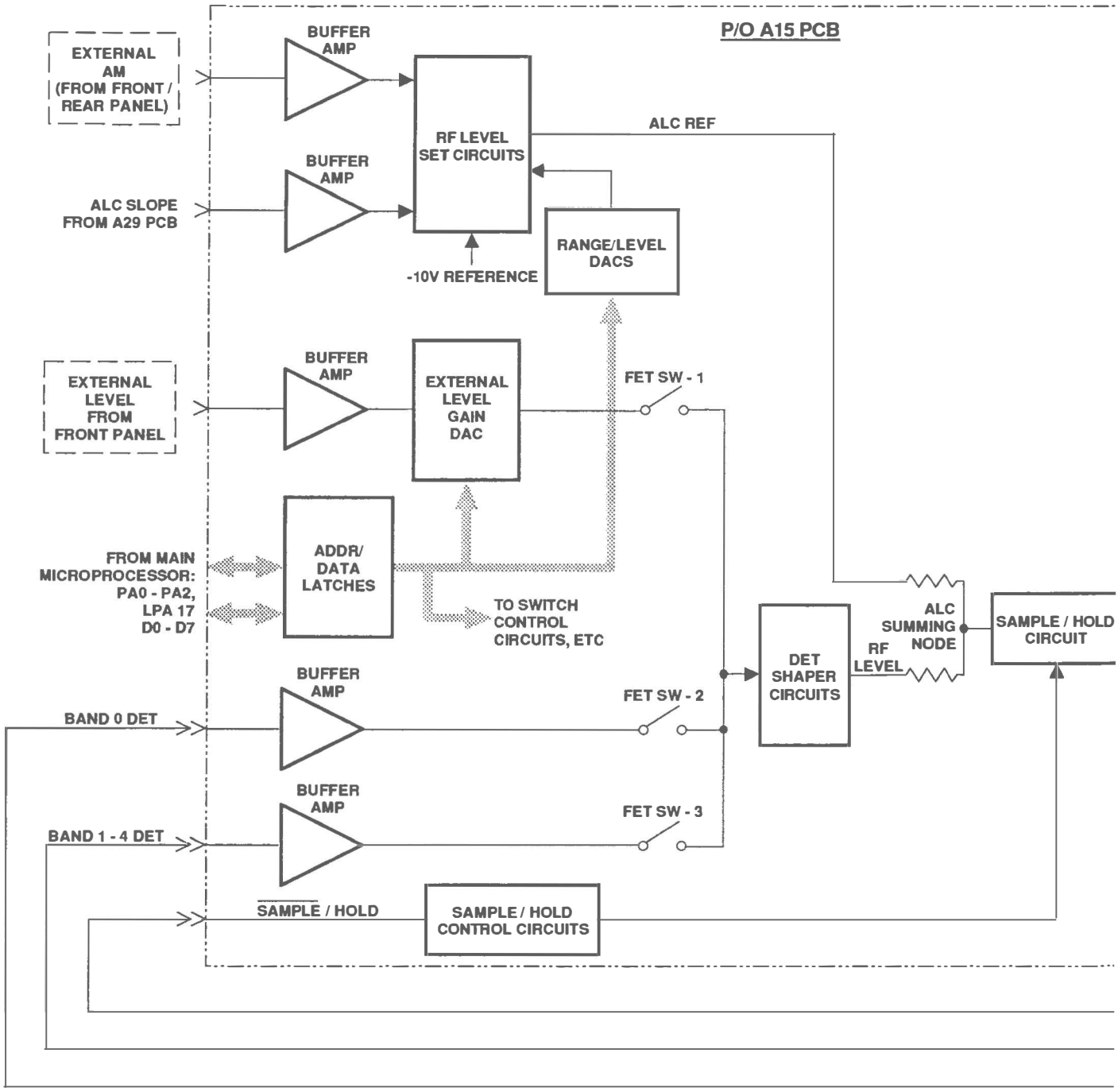
The actual percentage of amplitude modulation can be measured and displayed using the front panel AM MEASURE function. When this function is selected, the main microprocessor instructs the A17 digital voltmeter to measure the voltages from the ALC peak and trough detectors. It then calculates the actual percentage of AM using the peak and trough measurements.

2K-2.4 ALC Slope Circuits

This circuit compensates for an increasing or decreasing output power-vs-frequency characteristic of the microwave circuits. This correction is usually for a decreasing-output vs increasing-frequency characteristic caused by the level detectors (and optional step attenuator).

The V/GHz circuits on the A29 PCB provide an ALC Slope correction that has a linear voltage change for a linear change in frequency. The output of these circuits is the ALC SLOPE signal that goes to the unity gain buffer amplifier, U8A (on the A15 PCB).

The output from U8A is fed to the ALC Range DAC, U9B. The data for setting this DAC is stored in the EEPROM on the A23 PCB. This data is stored into the EEPROM by the main microprocessor during calibration of the synthesizer.


P/O A15 PCB
EXTERNAL AM (FROM FRONT / REAR PANEL)
BUFFER AMP
RF LEVEL SET CIRCUITS
ALC REF
BUFFER AMP
ALC SLOPE FROM A29 PCB
RANGE/LEVEL DACS
-10V REFERENCE
EXTERNAL LEVEL FROM FRONT PANEL
BUFFER AMP
EXTERNAL LEVEL GAIN DAC
FET SW - 1
FROM MAIN MICROPROCESSOR: PA0 - PA2, LPA 17 D0 - D7
ADDR/ DATA LATCHES
TO SWITCH CONTROL CIRCUITS, ETC
DET SHAPER CIRCUITS
ALC SUMMING NODE
RF LEVEL
SAMPLE / HOLD CIRCUIT
BUFFER AMP
FET SW - 2
BAND 0 DET
BUFFER AMP
FET SW - 3
BAND 1 - 4 DET
SAMPLE / HOLD
SAMPLE / HOLD CONTROL CIRCUITS

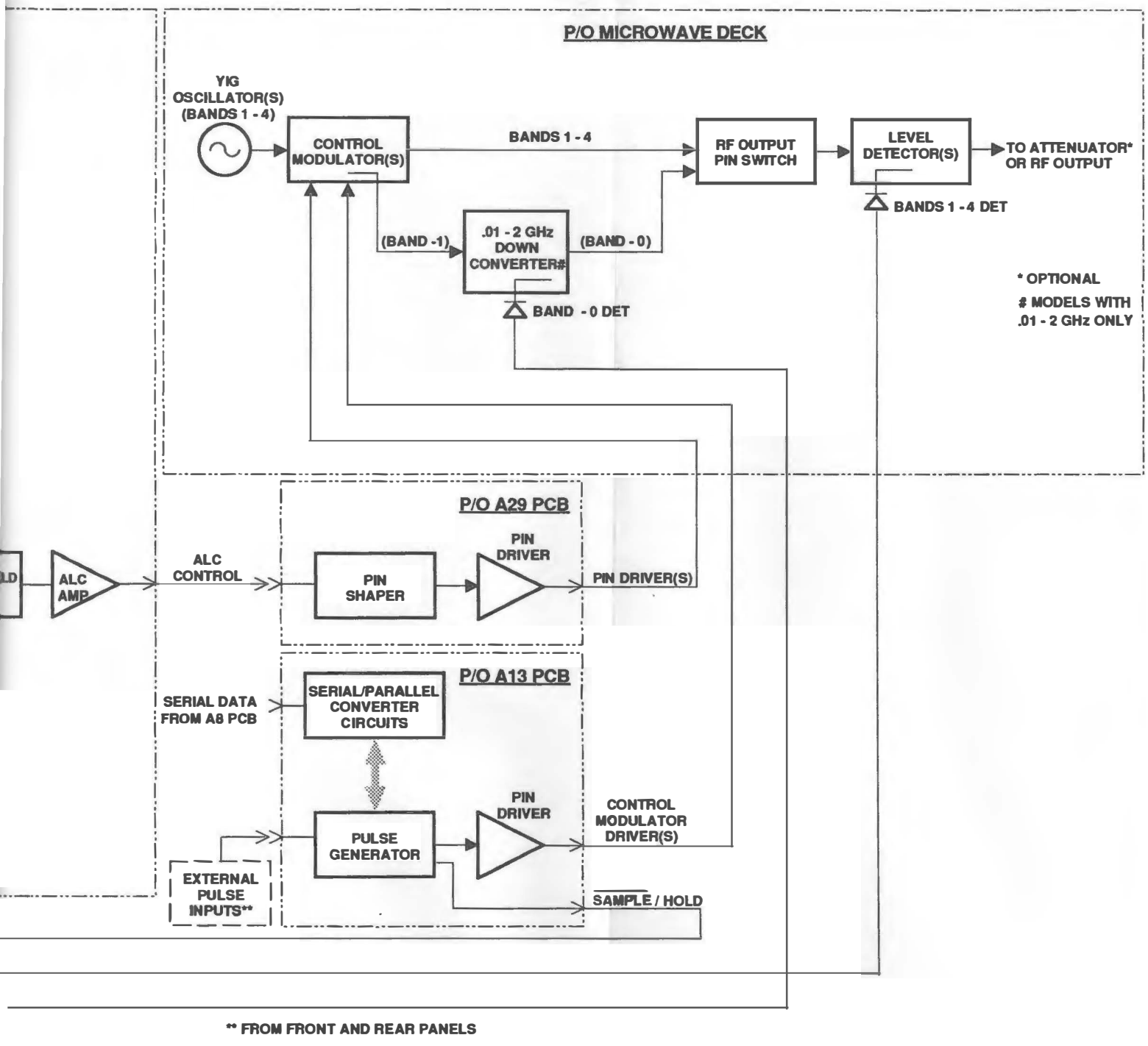


Figure 2K-1. Overall Block Diagram of the ALC Power Level Control Subsystem

The EEPROM data includes ALC slope range settings for the CW and stepped-sweep modes. Also included are two additional settings for the ALC Range DAC that are used only in the analog sweep mode. One is for ≤2 GHz, and the other is for >2 GHz.

2K-2.5 Detector Preamplifiers

There are two sets of detector preamplifier circuits, Band 0 Det and Band 1-4 Det.

- Band 0 Det preamplifier. Consists of transistors Q1–Q8 and operational amplifiers U25/U26. These circuits amplify the level detector output of the frequency down converter. The down converter is used for Band 0 only (output frequencies ≤2 GHz).
- Band 1–4 Det preamplifier. Consists of transistors Q9–Q16 and operational amplifiers U27/U28. These circuits amplify the output of the main Directional Coupler/Level Detector. This coupler is used for bands 1 thru 4 (output frequencies >2 GHz—refer to Section 2L).

The detector preamplifier circuits amplify the low-level-detector voltage by a factor of five. They also transform the 2 kΩ detector diode output impedance to less than 50Ω. Each preamplifier is composed of a low-frequency and a high-frequency amplifier section. The high-frequency amplifier section has a very high gain at high frequencies. (This compensates for the detector diode output capacitance and the capacitance of the interconnecting cable.)

The band 0 preamplifier circuits include relay K1 that is used to short-out R59. This eliminates RF feedthrough from the Level detector(s) during certain operating modes. The RELAY DRIVER control line from data latch U4 is used to drive K1. The status of K1 during the various operation modes is listed in Table 2K-2.

2K-2.6 External ALC Level Circuits

In the external level mode, an external detector is used to monitor the RF output of the synthesizer. (The external detector goes to the front panel EXT LEVEL connector.) The signal from the EXT LEVEL connector goes to the ×5 preamplifier located on the A2 Front Panel Control PCB.

Table 2K-2. Relay K1 Operation

FUNCTION	K1 STATUS
CW (no AM or Pulse modulation)	CLOSED
STEP / ANALOG SWEEP	CLOSED
AM	CLOSED
PULSE, or PULSE w/AM	OPEN
EXT DET ALC (w/AM or w/o AM)	OPEN
EXT PWR MTR ALC	OPEN
EXT DET ALC w/PULSE	OPEN

The output of the A2 PCB preamplifier goes to the input of the A15 PCB External ALC Amplifiers, U21 and U29. Analog switches U20A and U20B are controlled by the main microprocessor to select between U29 (which is a ×1 differential receiver amplifier), and U21 (which has a gain of approximately five).

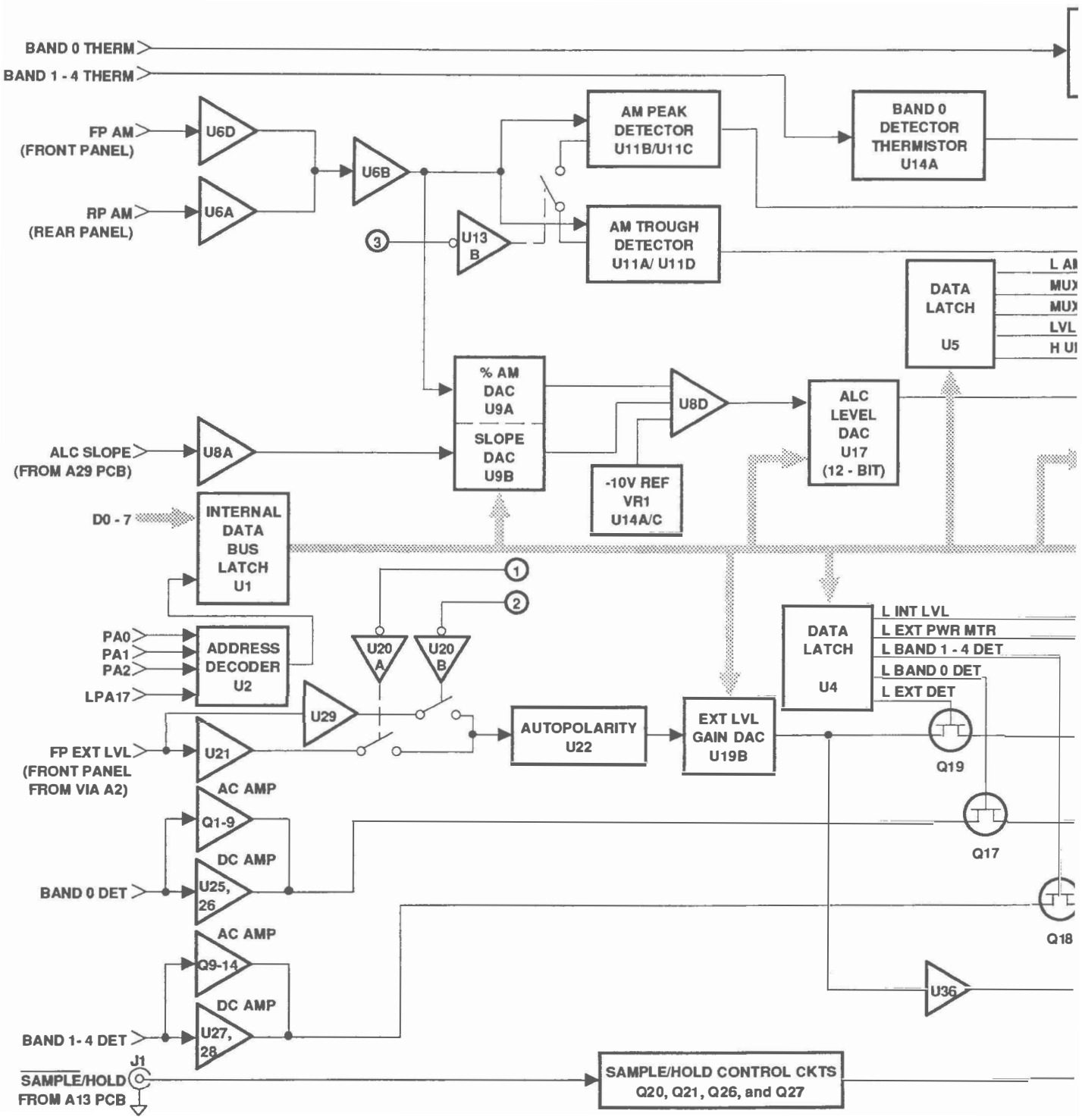
Switch U20B is closed and U20A is open whenever a power meter (or similar device) having a relative high output is used for external leveling. For other detectors, U20A is closed and U20B is open, thus selecting amplifier U21.

NOTE:

A power meter usually has a typical output of approximately 1 volt, which is much higher than that of a directional detector. During the external ALC gain calibration procedure (described below), the gain calibration comparator circuits sense this higher voltage. This causes the microprocessor to select U29 to lower the circuit gain.

The output of U21/U29 goes to the Autopolarity Detector, U22. This circuit senses the polarity of the external level detector signal and switches it so that the signal polarity to the input of the External Level Gain DAC (U19B) is always negative. The output of U19B goes to the switching circuit consisting of FET switches Q17, Q18, and Q19. This circuit selects the input to the Detector Shaper Circuits (U30, etc.).

The output of U19B also goes to the input of buffer amplifier U36. When an external detector is used, FET switch Q19 is opened. The output of U36 is connected via FET switches Q32 and Q34, to the input of the ALC Comparator circuit.


BAND 0 THERM
BAND 1 - 4 THERM
FP AM (FRONT PANEL)
RP AM (REAR PANEL)
U6D
U6A
U6B
AM PEAK DETECTOR U11B/U11C
AM TROUGH DETECTOR U11A/ U11D
U13 B
BAND 0 DETECTOR THERMISTOR U14A
DATA LATCH U5
% AM DAC U9A
SLOPE DAC U9B
U8D
ALC LEVEL DAC U17 (12 - BIT)
ALC SLOPE (FROM A29 PCB)
U8A
-10V REF VR1 U14A/C
D0 - 7
INTERNAL DATA BUS LATCH U1
PA0
PA1
PA2
LPA17
ADDRESS DECODER U2
U20 A
U20 B
DATA LATCH U4
L INT LVL
L EXT PWR MTR
L BAND 1 - 4 DET
L BAND 0 DET
L EXT DET
U29
FP EXT LVL (FRONT PANEL FROM VIA A2)
U21
AUTOPOLARITY U22
EXT LVL GAIN DAC U19B
Q19
AC AMP
Q1-9
DC AMP
U25, 26
BAND 0 DET
Q17
AC AMP
Q9-14
DC AMP
U27, 28
BAND 1- 4 DET
Q18
U36
J1
SAMPLE/HOLD FROM A13 PCB
SAMPLE/HOLD CONTROL CKTS Q20, Q21, Q26, and Q27

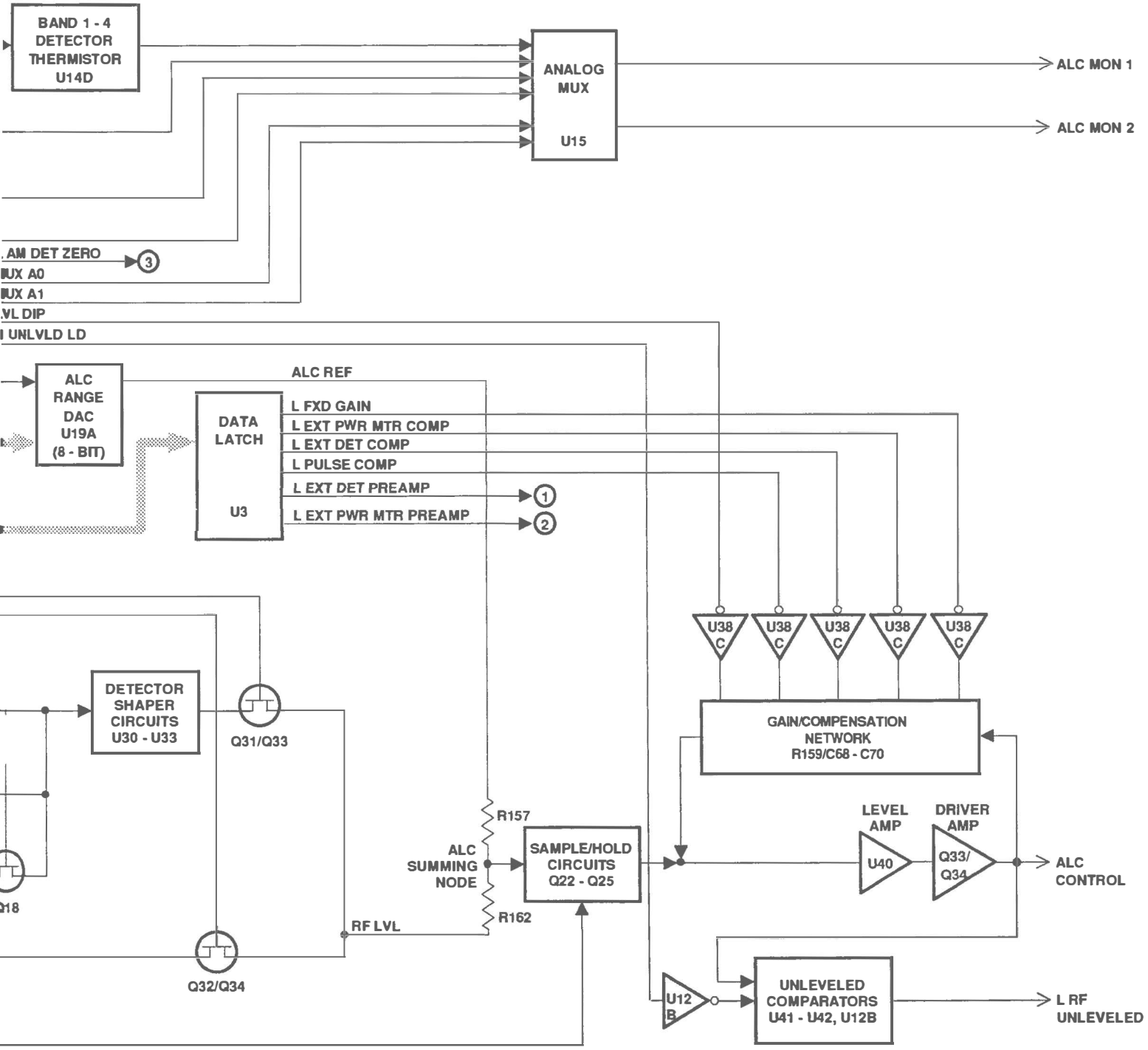


Figure 2K-2. Overall Block Diagram of the A15 ALC PCB

2K-2.7 External ALC Gain Calibration

The input voltage at the EXT LEVEL input connector varies over a large range. The main microprocessor software includes a procedure for adjusting the external detector signal voltage to a level usable by the ALC loop. This calibration procedure is invoked from the front panel and is performed by the synthesizer main microprocessor. To initiate the calibration procedure, either EXT DETECTOR or EXT POWER MTR must first be selected by using the LEVELING key. When the EXT GAIN CAL key is pressed, the following occurs (EXT DETECTOR selected):

1. The output of the appropriate *internal* detector (Band 1-4 or Band 0) is switched to the input of the Detector Shaper circuits (U32) and the RF output is leveled in the normal manner.
2. The output of the Detector Shaper circuit (DET SHAPER MONITOR) is read by the main microprocessor via the voltmeter circuits located on the A17 PCB.
3. The ×1 External ALC amplifier is selected (U29) and the External ALC Range DAC is programmed for minimum gain (high attenuation).
4. The output of the ALC Range DAC (U19B) is switched to the input to the Detector Shaper circuit. The main microprocessor steps the bits of the ALC Range DAC until the External ALC signal value is equal to the value of the internal detector signal that was read initially.

This completes the calibration of the External ALC signal path gain. This procedure guarantees that the RF power level sensed at the input of the external level detector is set equal to the power for which the synthesizer is set in the INT leveling mode.

The External ALC gain calibration for use with a power meter is performed in the same manner as that described above, with the following differences:

- To initiate the calibration procedure, EXT POWER MTR is selected via the LEVELING key.
- After the initial measurement of the internal detector level, the output of the ALC Range DAC is *not* switched to the input of the Detector Shaper circuit.
- The Ext ALC signal (output of DAC) U19B) is measured via buffer amplifier U36 and the EXT PWR MTR MON signal line. The signal value measured on this line is compared with the initial measurement of the internal detector signal as described above.

2K-2.8 Detector Shaper Circuit

The percentage of amplitude modulation of a RF signal is the ratio of the modulating voltage vs the RF carrier *voltage*. The detector diodes that are part of the microwave deck Level Detectors are square-law devices. (The output voltage of these devices is a function of the input *power*.) To maintain a constant %AM with changing RF power levels (and prevent the introduction of AM distortion), a linear-voltage-output versus RF-*voltage*-input response is necessary.

The selected detector signal goes to the input of the Detector Shaper circuits. These circuits compensate for the square-law characteristic of the diodes in the Level Detectors. The output signal produced by these circuits has the correct linear-voltage-output versus RF-*voltage*-input characteristic.

The outputs of the detector preamplifiers go to the switching circuit consisting of FET switches Q17, Q18, and Q19. These switches select either one of the two Detector Preamplifier outputs, or the output from the ALC Range DAC as the input to the Detector Shaper circuits.

The Detector Shaper circuits consist of operational amplifiers U31/U32 and FETs U30A/U30B. The circuit composed of FET U30B, potentiometer R203 and operational amplifier U31B provides temperature compensation for FET U30A. The circuit composed of potentiometer R197 and U31B is used to adjust the AM linearity of the ALC loop. The output of this circuit is switched to one input of the ALC Comparator circuit via FET switches Q31 and Q33.

2K-2.9 ALC Comparator and Sample/Hold Circuits

a. ALC Comparator Circuit

When the RF output of the synthesizer is leveled, the ALC level reference voltage from the ALC Range DAC (U19A) and the output from the Detector Shaper circuits are of opposite polarity (the ALC reference voltage has twice the magnitude). These voltages are summed by R157 and R162. The difference voltage at the junction of these two resistors is the ALC loop error voltage (this node is referred to as the ALC

Summing Node). The ALC loop error voltage is zero when the ALC loop is balanced.

b. **Sample/Hold Circuits**

The ALC loop error voltage is the input to the Sample /Hold circuits. The ALC sample/hold circuit is composed of FET switches Q23 and Q24, along with FETs Q22 and Q25. FETs Q22 and Q25 are used as coupling diodes. The gate-to-drain capacitance of Q24 is the holding capacitor for this circuit. These circuits are used in the sample/hold mode only during the pulse modulation modes. In all other modes, Q24 is on and Q23 is off.

The operation of this circuit during the sample/hold mode is as follows.

- During the *ON* portion of the RF output pulse, the gate-to-drain capacitance of Q24 is charged to the value of the ALC error voltage. This voltage is the input to the ALC Level Amplifier (U40).
- During the *OFF* condition of the pulse, Q24 is off and Q23 is on. This effectively shorts the drain of Q24 to ground. The voltage level stored on the gate-to-drain capacitance of Q24 is the input to U40. This action prevents the ALC loop from shifting the output level during the *OFF* portion of the modulation pulse waveform (which would cause distortion of the RF output pulse waveform).

The drive signals for the sample/hold circuit are generated by the Sample/Hold Switch circuits composed of transistors Q20, Q21, Q26 and Q27. Transistors Q20 and Q21 function as a flip-flop that is driven by the $\overline{\text{SAMPLE}}$/HOLD signal from connector J1. This signal is generated by the timing circuits located on the A13 Pulse Generator PCB. Transistors Q26 and Q27 produce the correct drive signals for the sampling circuits. These circuits are enabled on/off by the H S/H EN control line (via gate U12A).

The sample/hold switching circuits generate switching transients (video spikes) that can show up in the output of the sample/hold circuit. Variable Capacitor C72 and capacitor C67 cancel out these video spikes.

2K-2.10 ALC Level Amplifier

The first stage of the ALC level amplifier is operational amplifier U40, which drives output transistors Q28 and Q29. The output of these transistors is the ALC CNTRL signal that goes to the PIN diode current driver circuits located on the A29 Rear Panel Interface PCB.

The output of Q28 and Q29 is fed back through the gain setting and frequency compensation networks to the input of U40 (sheet 5 of Figure 2K-8). The overall ALC loop bandwidth is determined by the characteristics of the following: selected detector preamplifier, shaper circuits, ALC level amplifier gain/frequency compensation networks, and the A29 PCB PIN shaper circuits. In a non-pulse mode, the loop bandwidth is typically 100 kHz. In the pulse mode, the bandwidth is approximately 20 kHz. (This bandwidth also depends on the pulse width and repetition frequency of the pulse modulation signal.) When externally leveled with a power meter, the loop bandwidth is approximately 0.7 Hz. This narrow bandwidth compensates for the slow response of a power meter.

2K-2.11 Unleveled Logic Circuits

In normal operation, comparators U41 and U42 sense the ALC CNTRL output of the ALC Level Amplifier. If the RF output is too high, or does not reach the power level selected, then the ALC CNTRL signal goes outside of its normal –8V to 0V operating range. When this occurs, either U41 or U42 pulls the L UNLEVELED line low,. This does the following:

- Turns on the front panel UNLEVELED indicator LED.
- Signals the main microprocessor (via the A29 PCB) that the ALC loop is no longer controlling the RF output level.

2K-2.12 Detector Thermistor Circuits

The internal Level Detector(s) each have a built-in thermistor. It is used in conjunction with the A15 Thermistor Sense Circuits to sense the ambient temperature of the microwave deck components.

NOTE:

Only those units that are equipped with a frequency down converter have two level detectors.

The A15 Thermistor Sense Circuits are composed of operational amplifiers U14B and U14D. These circuits translate the resistances of the level detector thermistors into voltage values that represent the temperature of the respective level detectors.

The voltage values output by these circuits are monitored by the A17 PCB DVM circuits via the Analog MUX circuit (U15). As the ambient temperature changes, the main microprocessor compensates for any changes in the level detector diode output levels. This provides a very stable RF-output-vs-temperature characteristic.

2K-3 A13 PULSE GENERATOR PCB CIRCUIT DESCRIPTION

The A13 PCB provides the internal pulse generating function for the synthesizer. It also interfaces the external pulse signal source to the pulse generation and PIN driver circuits in the external modes. There are four pulse modulation modes.

- Internal pulse modulation mode (+ or –). The pulse modulation waveform is generated and timed internally.
- External pulse mode. The external pulse source signal from the front or rear panel connectors is interfaced directly to the pulse modulation PIN driver circuits.
- External triggered mode. An internally generated modulating pulse waveform is triggered by the external pulse source signal.
- External gated mode. An external pulse source signal gates the internal pulse generator on and off.

The internal pulse generation and external pulse source interface circuitry of the A13 PCB is contained in four major circuit groups.

- 10-Hz-to-1-MHz programmable pulse generator.
- Source/Mode select control circuits.
- Current driver circuits for the pulse modulation PIN diodes located in the control modulators.
- Microprocessor data interface circuits

The paragraphs that follow describe these circuit groups. Refer to the A13 simplified block diagram (Figure 2K-3) and to the A13 PCB schematic (Figure 2K-6).

2K-3.1 Pulse Generator Circuits

a. Clock Circuits

The 10 MHz reference signal from the A10 Reference Divider PCB goes to the A13 pulse generator clock divider circuits. They consist of U4, U5, and U6. The 10 MHz signal is divided into clock signals PRF CLK and PW CLK. These signals clock the Pulse Rep Frequency Counter and Pulse Width Counter circuits, respectively. The proper clock frequency for the desired pulse repetition frequency and pulse width is selected by the Pulse Clock Select multiplexer (U8/U15), under control of the synthesizer main microprocessor.

The Pulse Rep Frequency Counter (U11–U13) produces a Pulse Rep Freq clock signal (DIVIDED PRF CLK) that goes to the Pulse Source Select circuit. This integrated circuit switch (U24) gates the trigger signals to the pulse generation circuits according to the selected mode (under control of the synthesizer main microprocessor).

b. Pulse Generation Circuits

In the *internal pulse modulation* mode, the DIVIDED PRF CLK signal is routed via U24 to the Pulse Start FF, U27A. When clocked by the PRF CLK signal, U27A is set, which then sets the Pulse FF (U28A).

The output from the Pulse FF triggers the Pulse Width Counter (U17–U20) to start the count down of the pulse width. At the end of the count, the Pulse Stop FF (U27B) is set, which resets the Pulse FF and reloads the Pulse Width Counter in preparation for the next pulse.

At the end of the pulse repetition rate period, the output of the Pulse Rep Frequency Counter changes state. This action triggers the Pulse Start FF again and the process repeats.

NOTE:

The pulse width must always be programmed to be less than the period of the pulse repetition rate.

In the *external triggered* mode, the external pulse source signal is synchronized with the internal pulse generator clock circuits by flip-flop U38A. The leading edge of the synchronized external pulse waveform (i.e., the output of U38A) triggers the Gating Edge Flip-flop, U25B, to initiate the generation of the modulation pulse waveform. The waveform pulse width is determined by the pulse width counter circuits in the normal manner.

In the *delayed* triggered mode, the desired trigger delay is entered via the front panel DELAY key. The Hold-Off Delay Flip-Flop (U38B), in conjunction with the PRF counter circuits, generate the desired delay between the leading edge of the external pulse source waveform and the start of the modulating pulse. In this mode, Pulse Start Flip-flop U27A is triggered to start the generation of the modulating pulse waveform (Figure 2K-6).

In the *external gated* mode, the DIVIDED PRF CLK signal to the Pulse Source Select circuit is gated on and off by the external pulse source waveform by U2B and U14B.

NOTE:

For proper operation, the period of the external pulse source signal must be greater than the sum of the pulse repetition rate period and pulse width of the internal pulse waveform. The pulse width of the external pulse source must also exceed that of the internal pulse.

If the period of the external pulse source signal is greater than a multiple of the internal pulse period, the modulation waveform will contain multiple pulses. This technique may be used to obtain pulse-burst modulation of the RF output signal.

In the *external triggered* mode, the external pulse signal sets the Gating Edge FF (U25A), which then sets—and is immediately reset by—the Gate Edge Clear FF, U25B. This action sets the Pulse FF; the generation of the remainder of the pulse is as described above.

The output of the Pulse FF is routed via buffer gate U26A to the rear panel PULSE SYNC OUTPUT connector. This output is also routed to the input of the Pulse Resolution generator circuits.

The Pulse Resolution Generator circuits, composed of U28B, U29 and U30, function as a delay line with three outputs that are delayed by 25, 50, and 75 nanoseconds. The selection of these outputs, OR'ed together with the output of the Pulse FF, provide 25 ns pulse width resolution for all internally generated pulses from 25 ns to 100 us pulse width.

2K-3.2 Source/Mode Select Control Circuits

In the *internal pulse modulation* mode, the pulse source select circuit (U24) connects the DIVIDED PRF CLK signal to the pulse generator circuits. Also, the mode select circuit (U31) connects the output of the Pulse FF to the input to the pulse PIN driver circuits (via the 100 & 25 ns Pulse Resolution circuits).

In the *external pulse* mode, the mode select circuit (U31) connects the external pulse source signal (from the front/rear panel input connectors) to the input of the pulse modulation PIN driver circuits. The RF output signal is thus modulated with the external source waveform.

In the *external triggered* mode, the external pulse source signal is synchronized with the internal pulse generator clock circuits by flip-flop U38A . This synchronized external pulse waveform is selected by U24 to trigger the Gating Edge Flip-flop, U25B, to initiate the generation of the modulation pulse waveform.

In the *external gated* mode, the external pulse source signal gates the DIVIDED PRF CLK signal thus controlling the operation of the pulse generator circuits (see above).

In all modes, the output of U31 is routed to the A15 ALC PCB as the L SAMPLE/HOLD signal. This signal synchronizes the ALC leveling loop to the pulse-*ON* portion of the pulse modulation waveform.

The output of U31 is also the input to the Leading Edge Delay and Trailing Edge Delay circuits composed of U3C, U32B, and Q25. The output of these circuits is routed to the A15 ALC PCB as the L SAMPLE/HOLD signal.

2K-3.3 Pulse Modulation PIN Drivers

The output of U31 also goes to the Pulse Mux circuit composed of gates U35A–U35D. These gates route the pulse modulation signal to the proper PIN driver circuit for the band selected. The PIN drivers are high-speed high-current driver circuits that control the pulse PIN diodes located in the control modulators. These circuits are composed as listed below.

- Band 1: Q3–Q7, and U36A, B and F
- Band 2: Q8–Q12, and U36C, D and E
- Band 3: Q13–Q17, and U37A, B and F
- Band 4: Q18–Q22, and U37C, D and E

2K-3.4 A13 PCB Processor Interface Circuits

The synthesizer main microprocessor controls the pulse generator to produce pulse modulation of the RF output signal per the commands received from either the front panel or via the GPIB. It interfaces with the A13 pulse generator through the A8 Serial I/O PCB. On the A15 PCB, serial-parallel interface circuits U10/U16 and U33/U34, convert the serial data received from the A8 Serial I/O PCB into parallel data that is stored in control latches.

The serial data is clocked into the A13 PCB by two clocks from the A8 PCB: the Pulse Generator Clock, and the Pulse Trigger Clock. The instructions and data for the pulse generator circuits are clocked into U10 and U16 via the Pulse Generator Clock; this data is used to set the pulse frequency and pulse width. The instructions/data that are clocked into U33 and U34 by the Pulse Trigger Clock are used to select the operating mode and the appropriate pulse modulation PIN driver circuit.

2K-4 A29 REAR PANEL INTERFACE PCB CIRCUITS DESCRIPTION

The following circuit description applies only to the portion of the A29 PCB that is part of the ALC power level control subsystem. Refer to the block diagram for these A29 circuits (Figure 2K-4) on the facing page. The parts locator diagram and schematic diagrams for these circuits are located in Figures 2K-9 thru 2K-11. A complete set of schematic diagrams for the A29 PCB are located in Section 2D–Inputs/Outputs.

2K-4.1 V/GHZ DAC Circuits

The data for V/GHZ DACs, U13 and U15 are latched onto control latches U8 and U9. The data is then strobed from these latches into the internal latches of the DACs, as appropriate.

The 0-10V ramp signal from the A17 PCB is input to the V/GHz Slope DAC, U13. The output of U13 (via U11D) is combined with the output to the V/GHz Offset DAC U15 (via U16A) by operational amplifier U14 to produce the V/GHz signal. This signal is routed to the rear panel V/GHz connector (via the A27 I/O PCB).

The outputs of DACs U13 and U15 are also combined with the +10V REF voltage from the A17 PCB by operational amplifier U16B. The output of U16B is the ALC SLOPE control signal for the A15 ALC PCB.

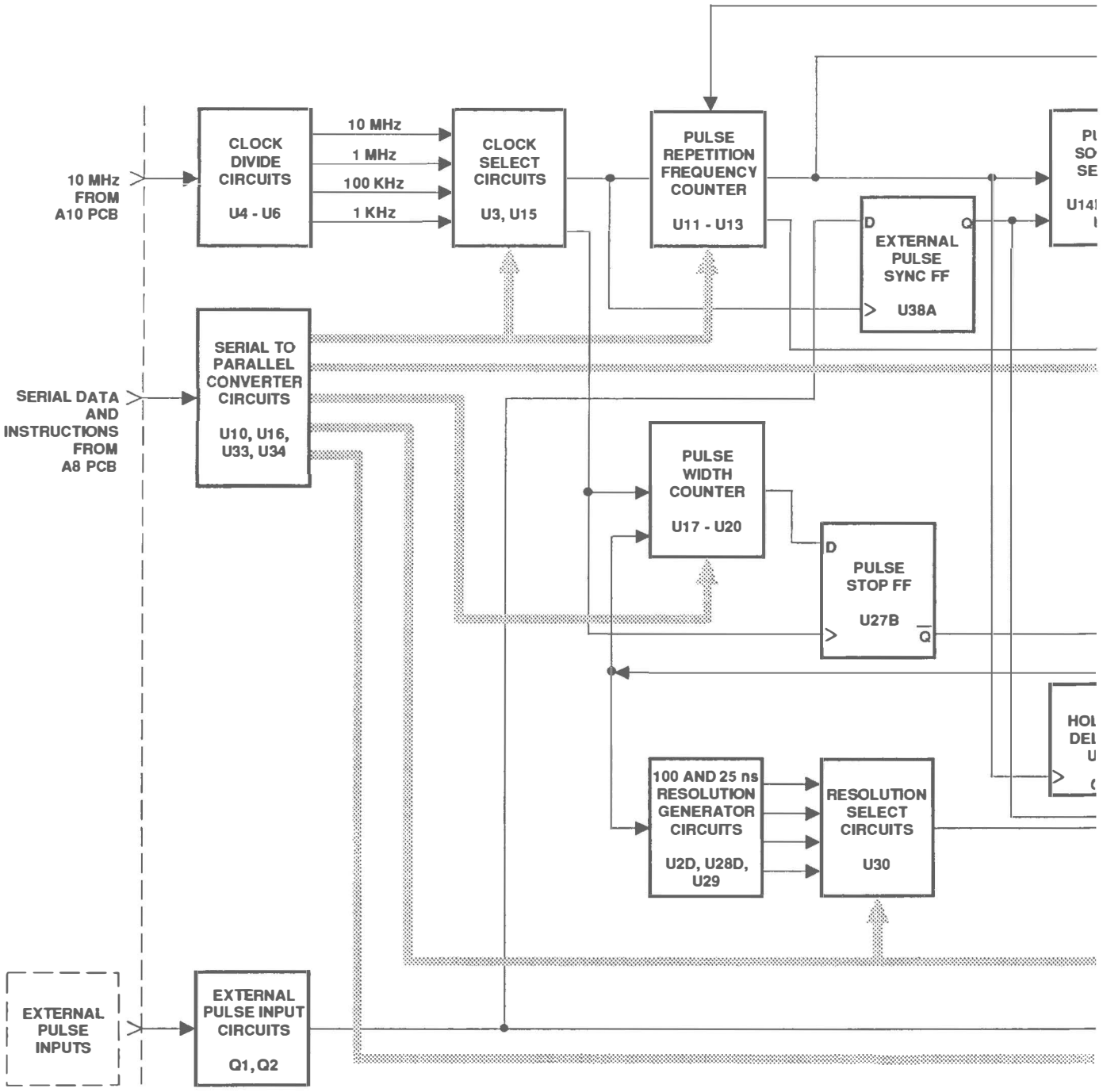
The output of DAC U15 provides the sweep-width and detector characteristic offsets for the V/GHz and ALC SLOPE signals. The offset signal from buffer amplifier U16A is summed into the ramp signal from buffer amplifier U11D in the analog sweep mode; it is also summed into the dc level signal during CW or stepped sweep modes.

Analog switch U12B sets the gain of operational amplifier U14 for either a 1V/GHz or a 0.5V/GHz output. This switch is controlled by the A23 Microprocessor PCB.

2K-4.2 ALC Control Signal Drive Circuits

Refer to Figure 2K-4 and to sheet 5 of the A29 PCB schematic diagram (Figure 2K-11). The Control Modulator PIN driver circuits, located on the A29 PCB, are described below. All of these circuits operate under the control of the A23 Microprocessor PCB.

- PIN Shaper/Driver Circuit— The ALC CNTRL signal from the A15 PCB is input to the circuit composed of DAC U38B, analog multiplier chip U40, operational amplifiers U42/U43, and transistors Q23/Q28. The gain of this circuit is nonlinear to compensate for the characteristics of the Control Modulator PIN diodes (i.e., it has a gain characteristic that decreases logarithmically with increasing input signal amplitude).


10 MHz FROM A10 PCB
CLOCK DIVIDE CIRCUITS U4 - U6
10 MHz
1 MHz
100 KHz
1 KHz
CLOCK SELECT CIRCUITS U3, U15
PULSE REPETITION FREQUENCY COUNTER U11 - U13
D
Q
EXTERNAL PULSE SYNC FF U38A
SERIAL DATA AND INSTRUCTIONS FROM A8 PCB
SERIAL TO PARALLEL CONVERTER CIRCUITS U10, U16, U33, U34
PULSE WIDTH COUNTER U17 - U20
D
PULSE STOP FF U27B
Q
100 AND 25 ns RESOLUTION GENERATOR CIRCUITS U2D, U28D, U29
RESOLUTION SELECT CIRCUITS U30
EXTERNAL PULSE INPUTS
EXTERNAL PULSE INPUT CIRCUITS Q1, Q2

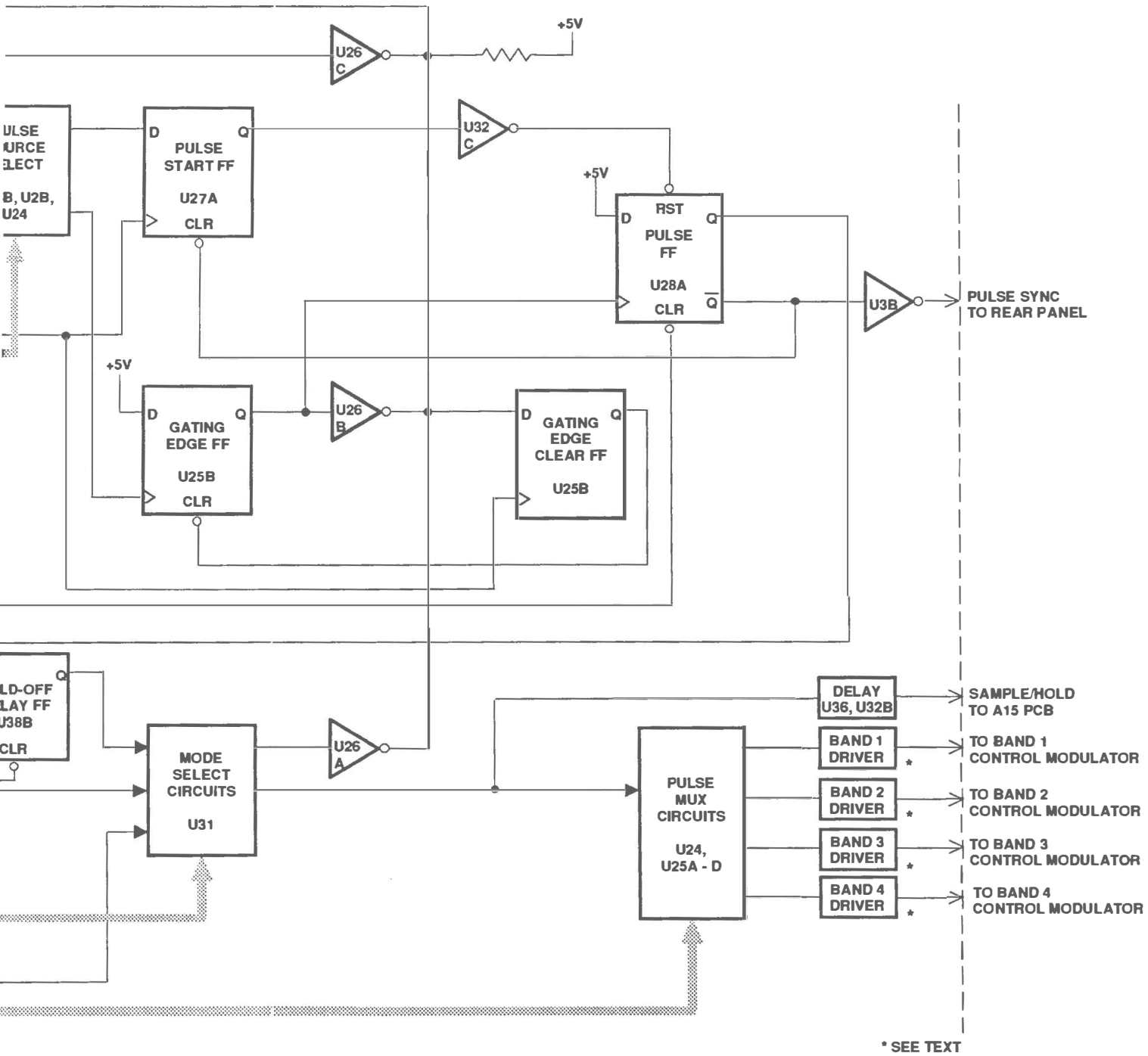


Figure 2K-3. Overall Block Diagram of the A13 Pulse Generator PCB

- Offset Current Source Circuit— This circuit is composed of DAC U38A, U39B and transistors Q20–Q22. It is used to adjust the operating point of the overall PIN Driver circuit to produce the correct RF output levels throughout the output level range of the synthesizer.
- PIN Driver MUX Switch Circuit— The combined output of the PIN Shaper/Driver and Offset Current Source circuits is routed to FET switches Q24–Q27. Control latch U37 selects the appropriate FET switch as follows:
  Q24: Bands 0 and 1 (.01–8 GHz)
  Q25: Band 2 (8–12 GHz)
  Q25: Band 3 (12.4–20 GHz)
  Q25: Band 2 (20–26.5 GHz)
- Frequency Doubler PIN Driver Circuit– This circuit is composed of operational amplifier U41, driver transistor Q32 and voltage limiters Q33/Q34. This circuit amplifies the ALC CNTL drive signal and provides a linear output to drive the PIN modulator diodes located in the Frequency Doubler/Amplifier/Modulator module on the Microwave Deck. The voltage limiters clamp the output to protect the modulator. For further information, refer to Section 2L–RF Microwave Deck. (Note: only certain models are equipped with a Frequency Doubler module.)

2K-5 ALC LOOP RF MICROWAVE DECK COMPONENTS

The following paragraphs briefly describe the microwave components that are part of—or interface with—the ALC loop. Depending on the model configuration, some of the components described may not be present. For further information pertaining to these components, refer to Section 2L–RF Microwave Deck.

2K-5.1 Control Modulators

The control modulators provide variable attenuation to control the RF power output of the YIG-tuned oscillators. They also detect a portion of the RF input from the YIG-tuned oscillators and couple it to the YIG Loop phase-lock circuitry (this RF sample is detected prior to modulation).

The ALC CNTRL driver current from the A29 Rear Panel Interface PCB is applied to the level control PIN diodes (these PIN diodes also provide AM modulation of the RF output signal). The pulse modulation drive current from the A13 Pulse Generator PCB is applied to the Pulse modulation PIN diodes. These PIN diodes provide the level control and modulation functions of the control modulators.

2K-5.2 Switched Filter Module

The switched filter is installed in models containing a 2 to 8 GHz YIG-tuned oscillator. This module provides rejection of the harmonics generated by the 2 to 8 GHz oscillator. It also rejects harmonic signals generated by the 0.01 to 2 GHz down converter.

2K-5.3 Main Mux Switch

The Main Mux switch multiplexes the various control modulator outputs into a common output port. This switch is not installed in units having only one oscillator.

2K-5.4 Directional Coupler

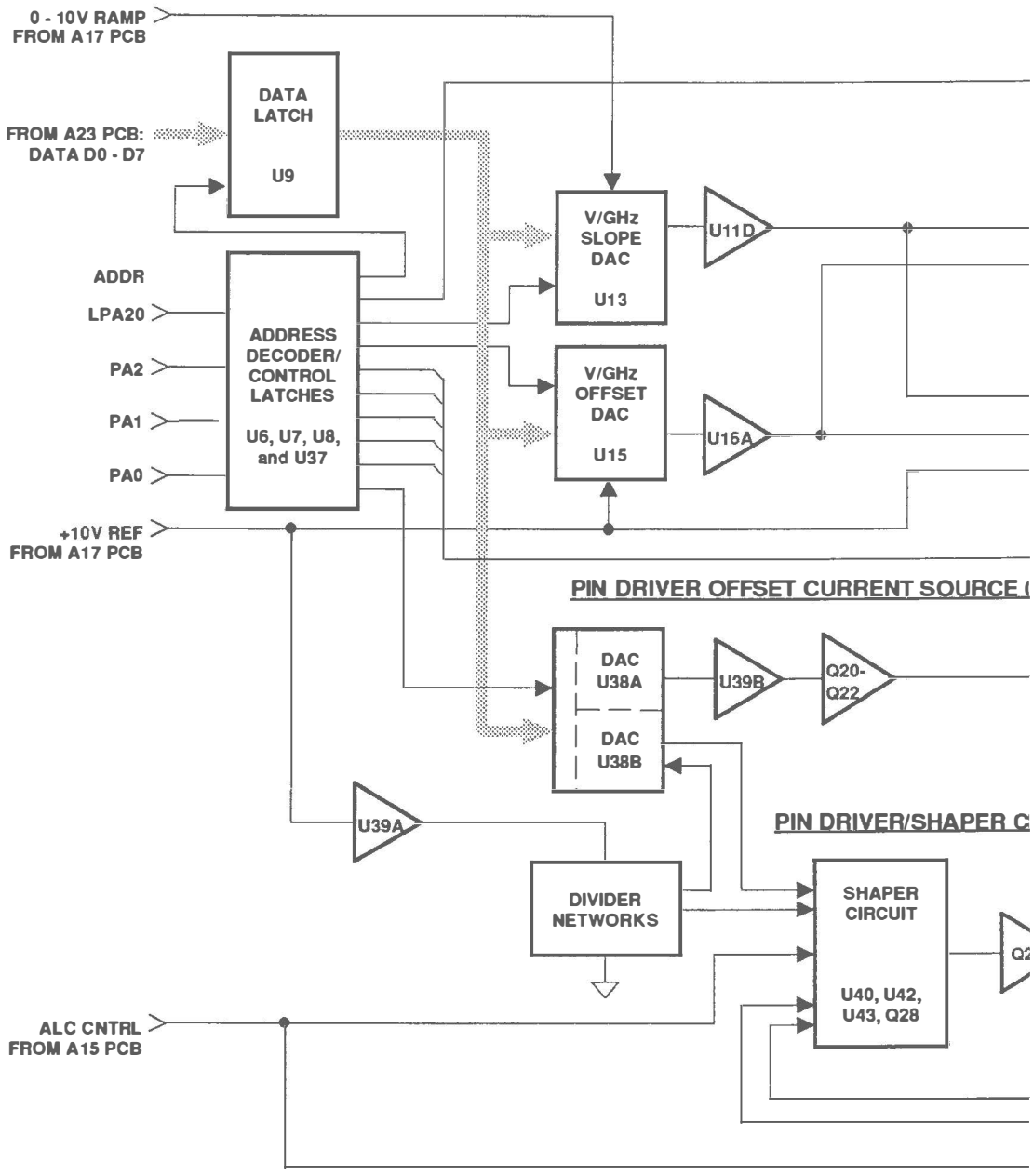
The Directional Coupler transfers the modulated RF signals to the synthesizer's RF OUTPUT. A portion of the RF output is detected, coupled out, and routed to the A15 ALC PCB for use in internal power leveling. For further information, refer to Section 2L–RF Microwave Deck.

2K-6 ALC / PULSE MODULATION SUBSYSTEM SCHEMATICS

Figures 2K-5 thru 2K-8 provide schematics and parts locator diagrams for the A13 and A15 PCBs. Figure 2K-4 is the block diagram of the A29 PCB circuits that are part of—or interface with—the ALC loop. A parts locator diagram and schematic diagrams for these circuits are located in Figures 2K-9 thru 2K-11. Schematic diagrams for the complete A29 PCB are located in Section 2D–Inputs/Outputs.

2K-7 ALC/PULSE MODULATION SUBSYSTEM TROUBLESHOOTING

Refer to the troubleshooting information located in the front portion of Section 2–System Description and Troubleshooting. This information provides a list of error codes that may be displayed as a result of failures in the ALC/Pulse Modulation subsystem cicuitry located on the A13, A15 and A29 PCBs and probable causes of the failures. Refer also to Section 2L–RF Microwave Deck for information pertaining to the microwave components located on the RF microwave deck.


0 - 10V RAMP
FROM A17 PCB
FROM A23 PCB:
DATA D0 - D7
DATA
LATCH
U9
ADDR
LPA20
PA2
PA1
PA0
ADDRESS
DECODER/
CONTROL
LATCHES
U6, U7, U8,
and U37
+10V REF
FROM A17 PCB
V/GHz
SLOPE
DAC
U13
U11D
V/GHz
OFFSET
DAC
U15
U16A
PIN DRIVER OFFSET CURRENT SOURCE
DAC
U38A
DAC
U38B
U39B
Q20-
Q22
U39A
PIN DRIVER/SHAPER C
DIVIDER
NETWORKS
SHAPER
CIRCUIT
U40, U42,
U43, Q28
ALC CNTRL
FROM A15 PCB

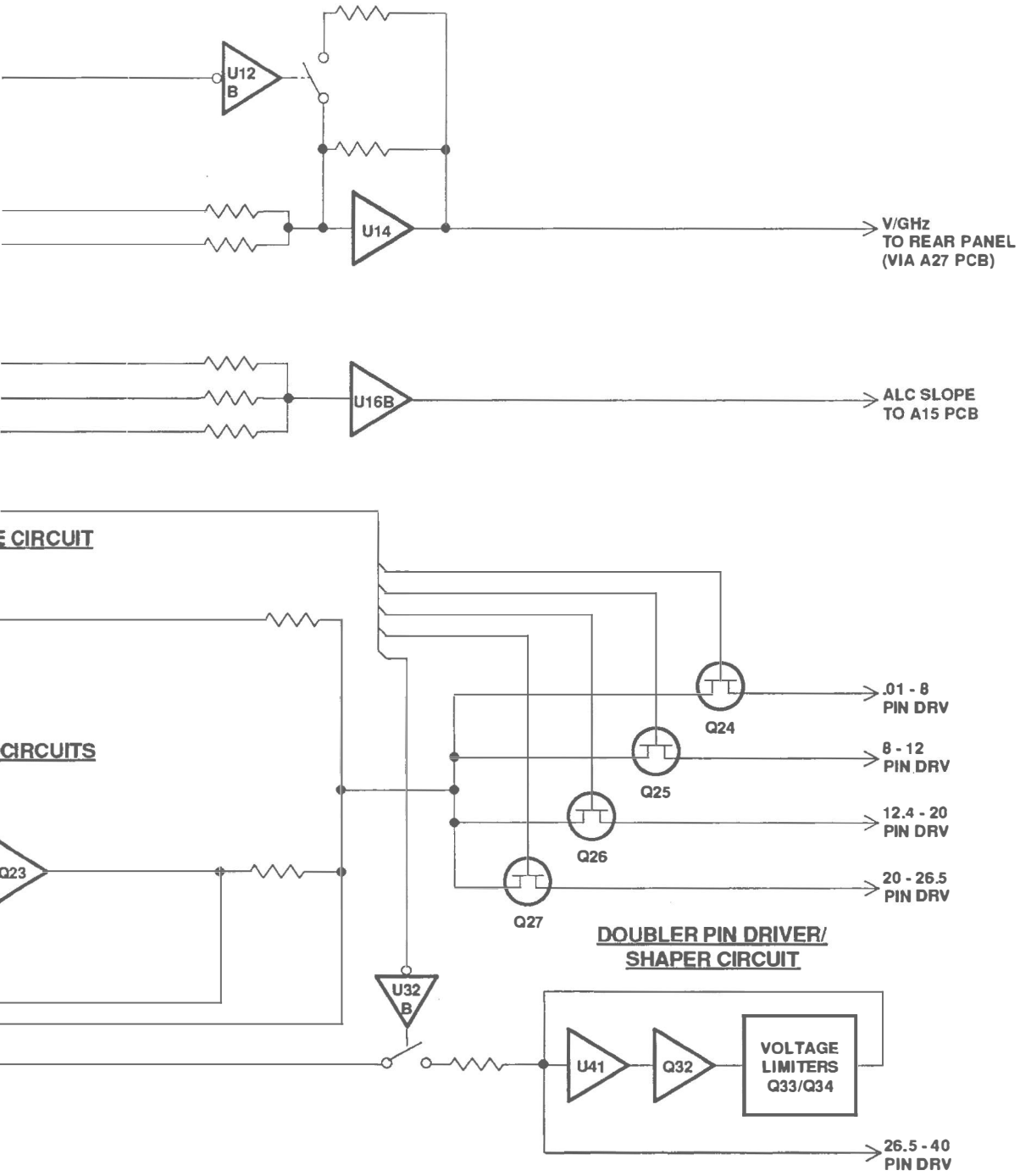
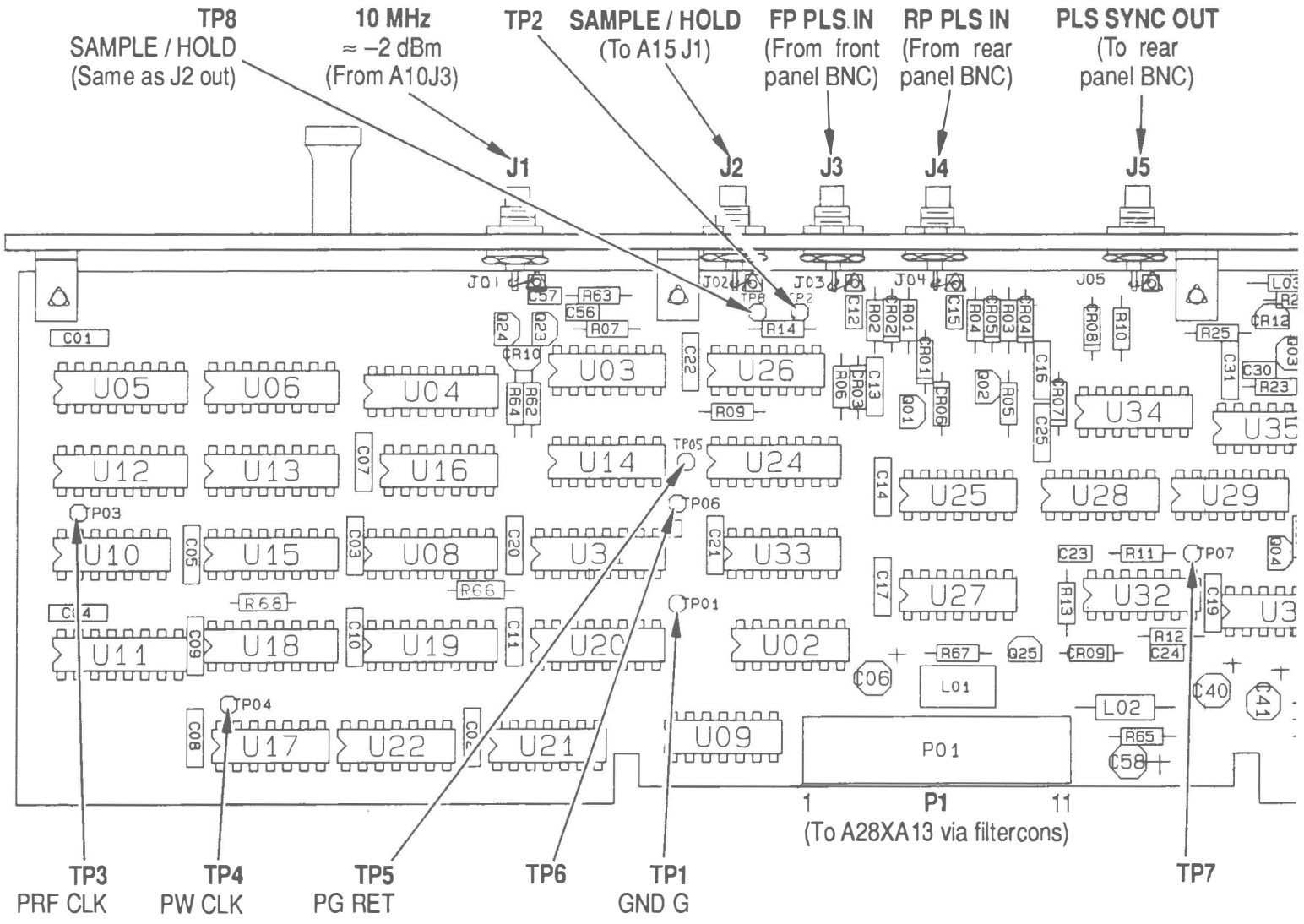


Figure 2K-4. Block Diagram of ALC Loop Circuitry Located on A29 Rear Panel Interface PCB


TP8
SAMPLE / HOLD
(Same as J2 out)
10 MHz
≈ –2 dBm
(From A10J3)
TP2
SAMPLE / HOLD
(To A15 J1)
FP PLS IN
(From front
panel BNC)
RP PLS IN
(From rear
panel BNC)
PLS SYNC OUT
(To rear
panel BNC)
J1
J2
J3
J4
J5
P1
1
11
(To A28XA13 via filtercons)
TP3
PRF CLK
TP4
PW CLK
TP5
PG RET
TP6
TP1
GND G
TP7

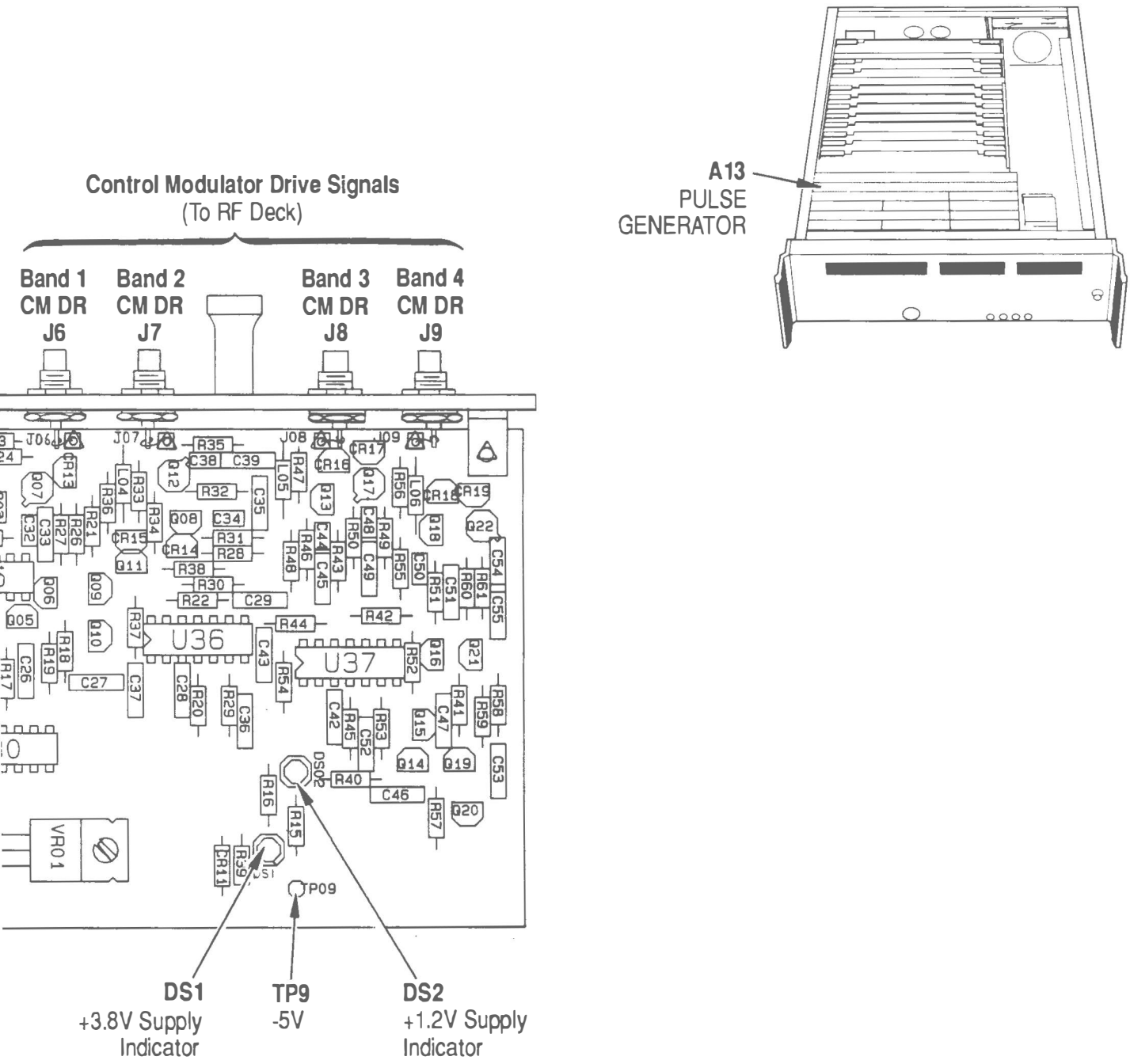
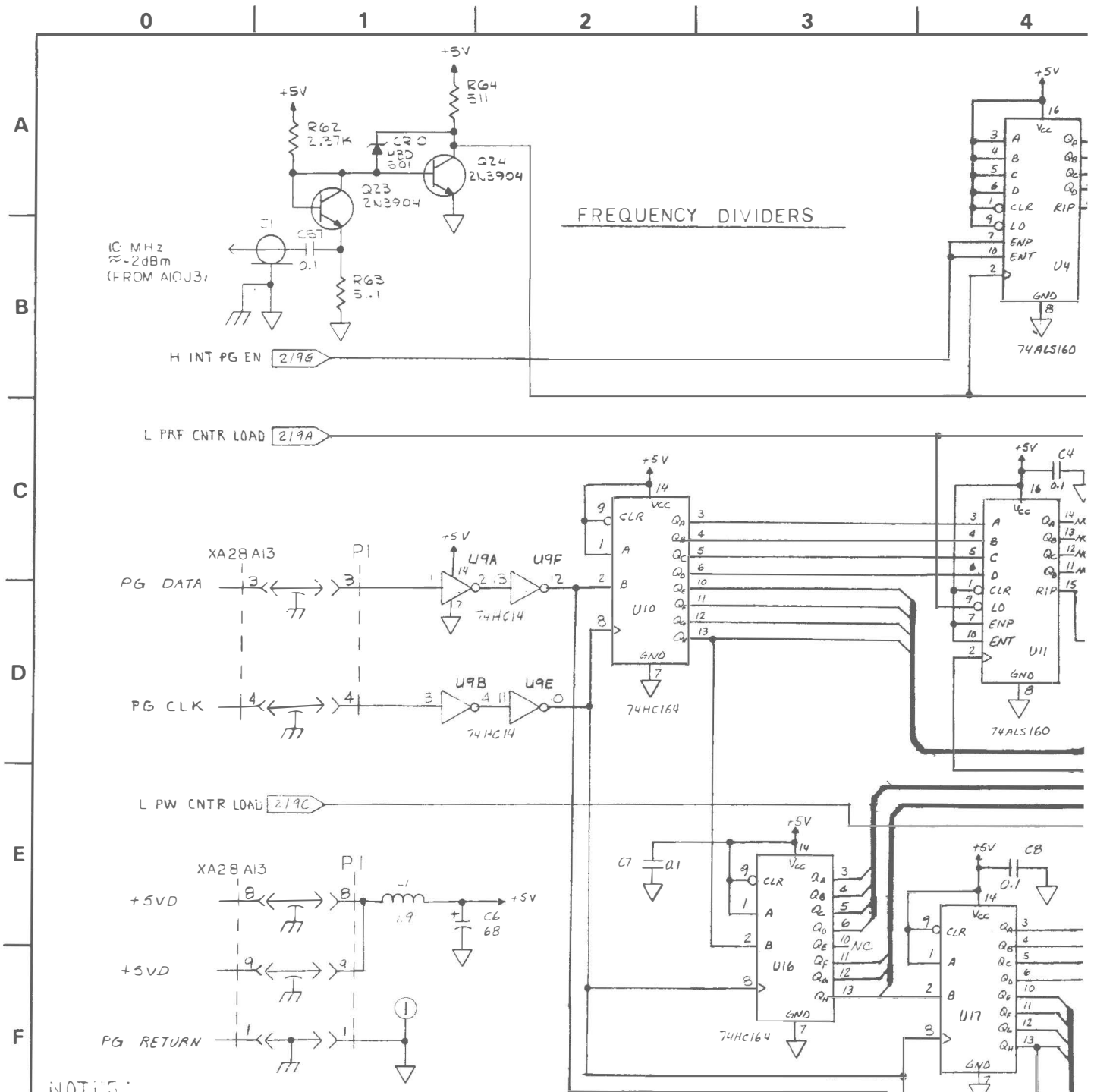


Figure 2K-5. A13 Pulse Generator PCB Parts Locator Diagram
6700-D-31913-3 (Rev. B)



NOTES:

A13 PULSE GENERATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
4. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
5. TEST POINTS ARE DENOTED AS: (2)
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR10, CR12-CR19, Q7, Q12, Q17, Q22, U3, U4, U24, U29-U32, U35-U37
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C58	C18
CR19	R8
DS2	U1
J9	U7
L6	U23
P1	
Q25	
R68	
TP9	
U38	
VR1	

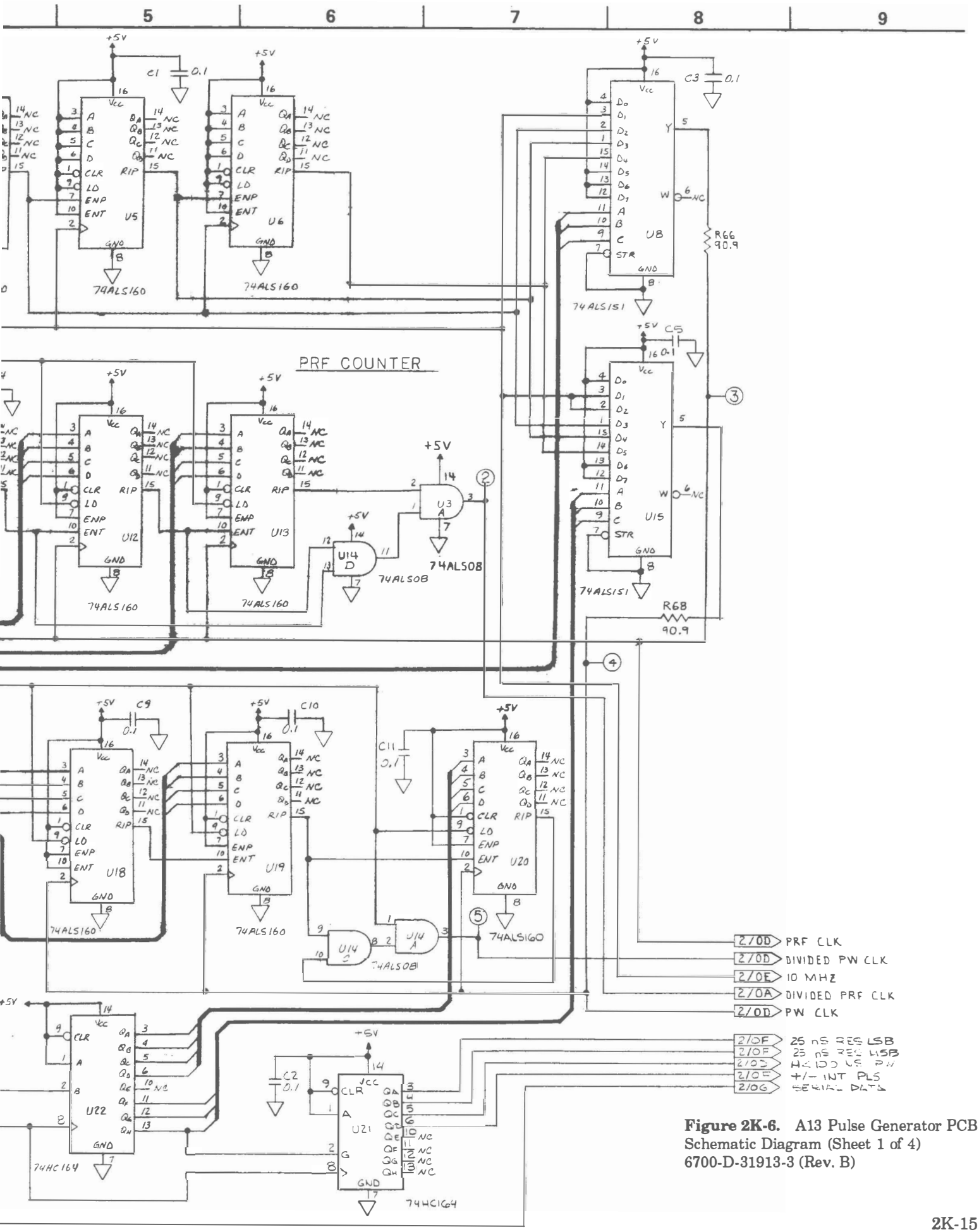
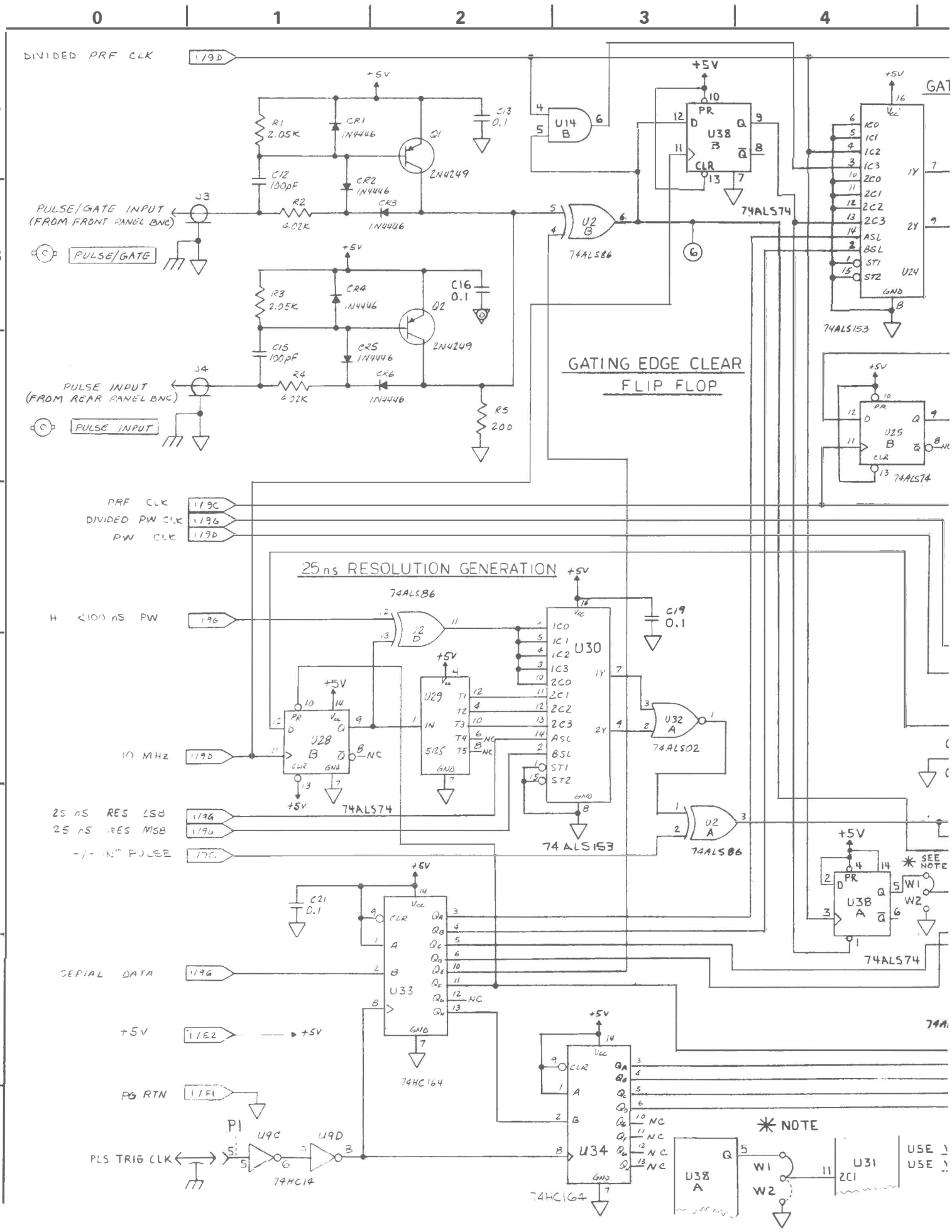


Figure 2K-6. A13 Pulse Generator PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31913-3 (Rev. B)


0
1
2
3
4
A
B
C
D
E
F
G
H
DIVIDED PRF CLK
1/9D
+5V
R1
2.05K
CR1
IN4446
C13
0.1
Q1
2N4249
C12
100pF
CR2
IN4446
R2
4.02K
CR3
IN4446
J3
PULSE/GATE INPUT
(FROM FRONT PANEL BNC)
PULSE/GATE
R3
2.05K
CR4
IN4446
C16
0.1
Q2
2N4249
C15
100pF
CR5
IN4446
J4
PULSE INPUT
(FROM REAR PANEL BNC)
R4
4.02K
CR6
IN4446
R5
200
PULSE INPUT
U14
B
U2
B
74ALS86
U38
B
74ALS74
GATING EDGE CLEAR
FLIP FLOP
U24
74ALS153
U25
B
74ALS74
PRF CLK
1/9C
DIVIDED PW CLK
1/9G
PW CLK
1/9D
25 ns RESOLUTION GENERATION
74ALS86
H <100 nS PW
1/9G
10 MHz
1/9D
U28
B
74ALS74
U29
5125
U30
C19
0.1
74ALS153
U32
A
74ALS02
U2
A
74ALS86
25 nS RES LSB
1/9G
25 nS RES MSB
1/9a
+/- 'N' PULSE
1/2C
C21
0.1
U33
74HC164
SERIAL DATA
1/9G
+5V
1/E2
PG RTN
1/F1
P1
PLS TRIG CLK
U9C
U9D
74HC14
U34
74HC164
NOTE
U38
A
W1
W2
U31
2CI
USE
SEE NOTE

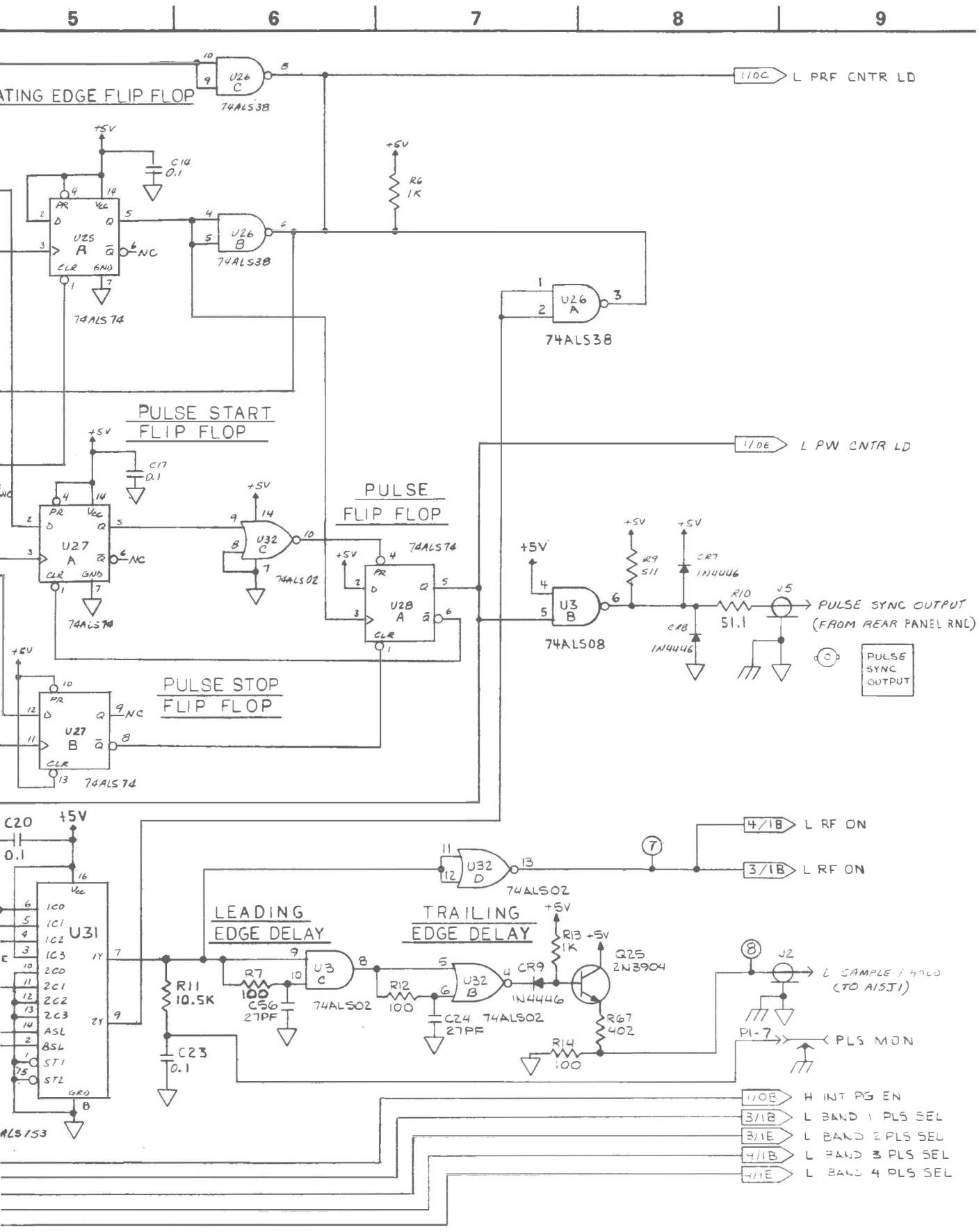
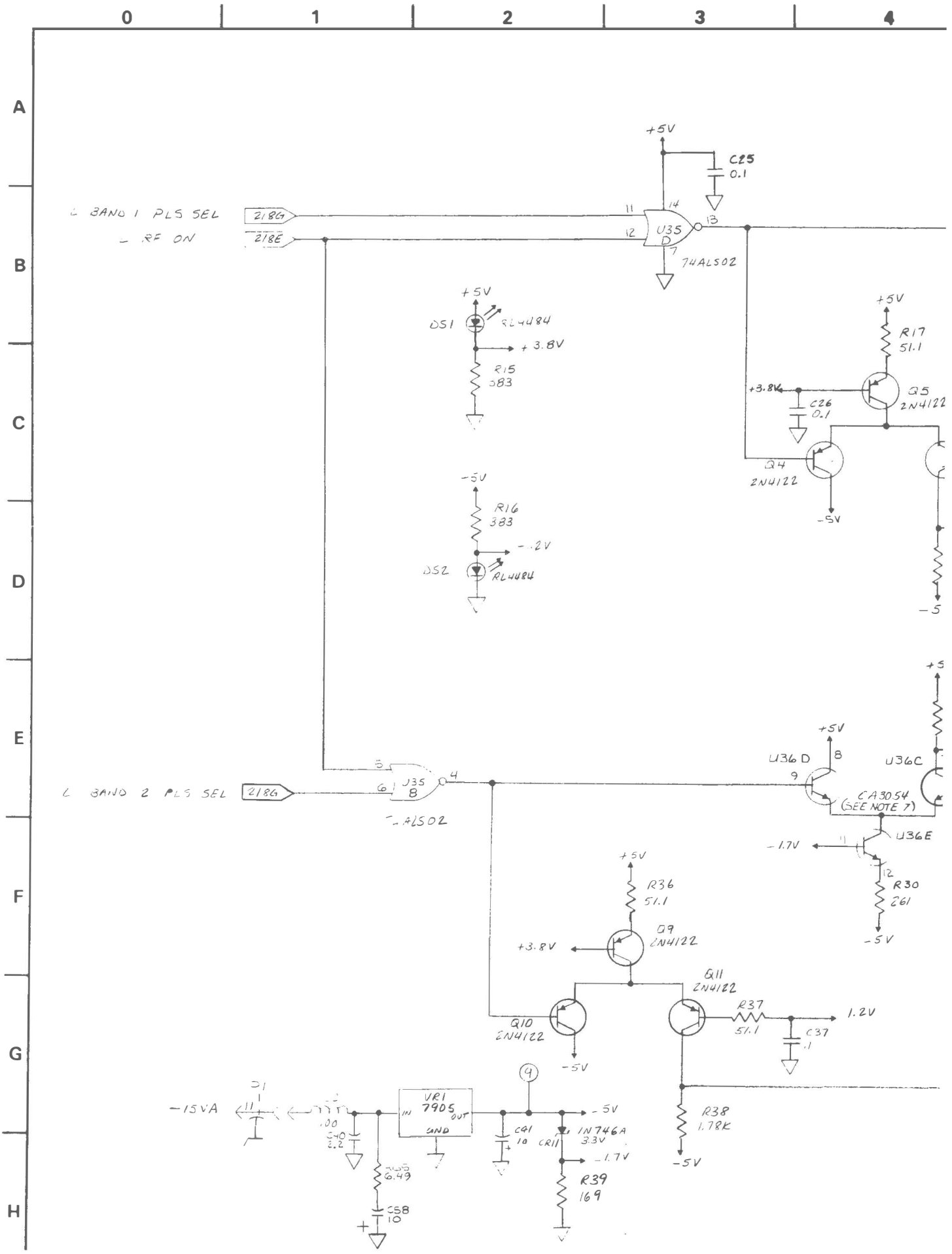


Figure 2K-6. A13 Pulse Generator PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31913-3 (Rev. B)


0
1
2
3
4
A
B
C
D
E
F
G
H
L BAND 1 PLS SEL
218G
~ RF ON
218E
U35 D
74ALS02
C25 0.1
+5V
DS1
RL4484
+3.8V
R15 383
-5V
R16 383
-.2V
DS2
R17 51.1
Q5 2N4122
C26 0.1
Q4 2N4122
L BAND 2 PLS SEL
U35 B
U36 D
U36C
CA3054 (SEE NOTE 7)
U36E
-1.7V
R36 51.1
Q9 2N4122
R30 261
Q11 2N4122
Q10 2N4122
R37 51.1
1.2V
C37 .1
-15VA
D1
VR1 7905
IN
OUT
GND
C41 10
IN746A 3.3V
CR11
R38 1.78K
R39 169
C58 10

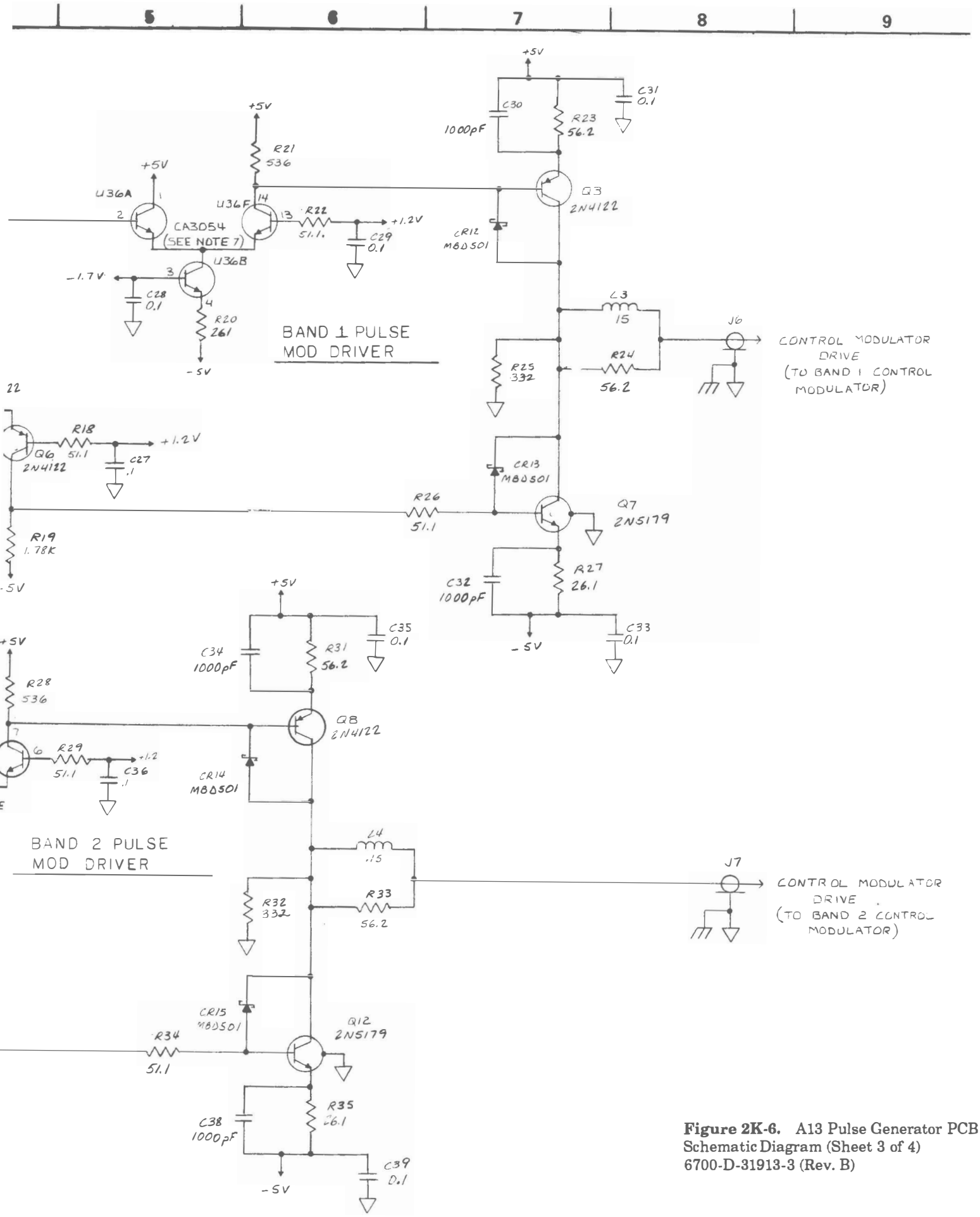
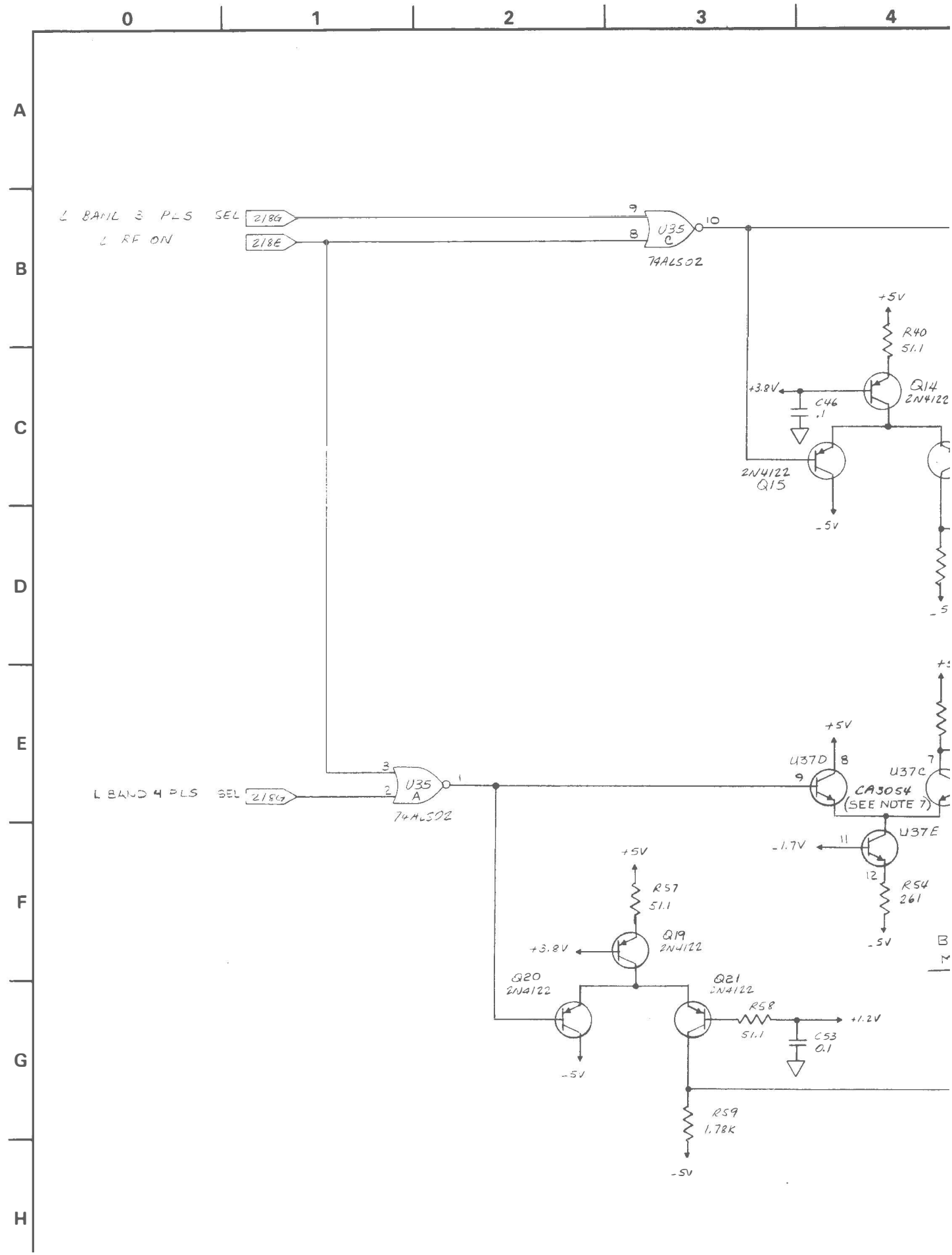


Figure 2K-6. A13 Pulse Generator PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31913-3 (Rev. B)


0
1
2
3
4
A
B
C
D
E
F
G
H
L BAND 3 PLS SEL
L RF ON
2/8G
2/8E
U35 C
74ALS02
+5V
R40
51.1
+3.8V
Q14
2N4122
C46
.1
2N4122
Q15
-5V
L BAND 4 PLS SEL
2/8G
U35 A
74ALS02
U37D
U37C
CA3054
(SEE NOTE 7)
U37E
-1.7V
R57
51.1
Q19
2N4122
+3.8V
Q20
2N4122
Q21
2N4122
R58
51.1
+1.2V
C53
0.1
R59
1.78K
R54
261

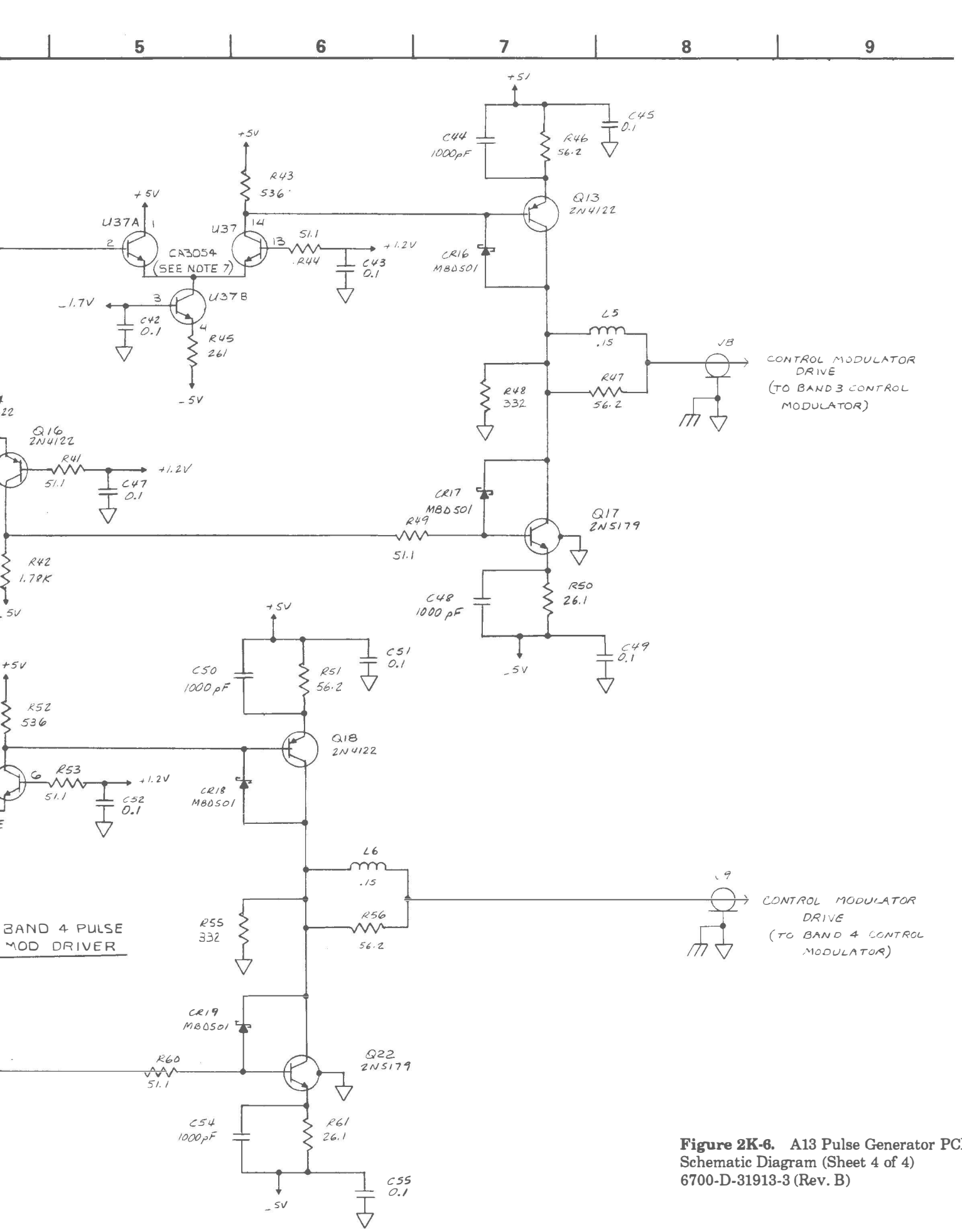
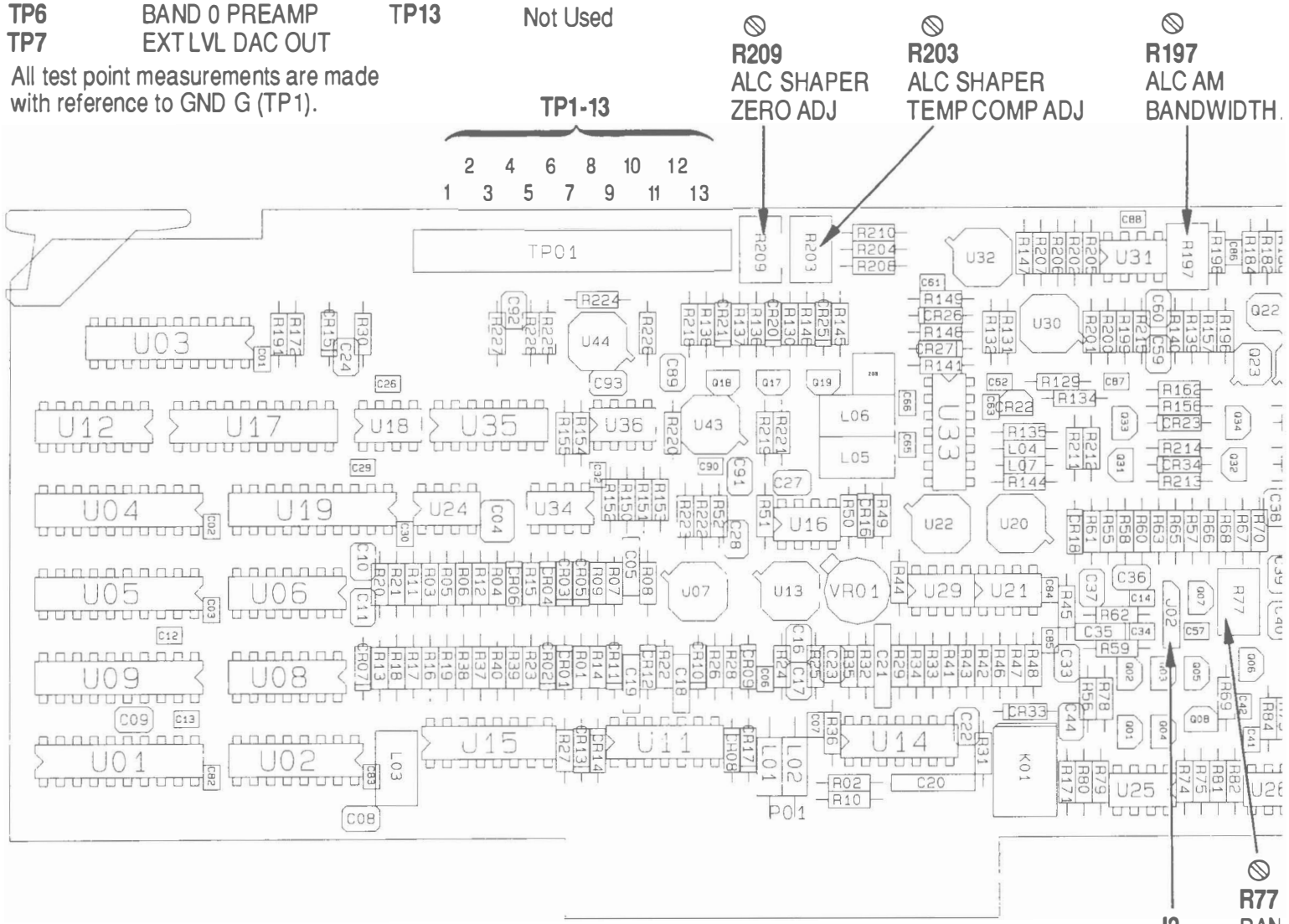


Figure 2K-6. A13 Pulse Generator PCB Schematic Diagram (Sheet 4 of 4) 6700-D-31913-3 (Rev. B)

TEST POINTS

TP1	GND G	**TP8**	DET SHAPER INPUT
TP2	BUFFERED AM INPUT	**TP9**	DET SHAPER INPUT
TP3	ALC COMBINED LVL	**TP10**	RF LVL
TP4	ALC REF	**TP11**	ALC CNTRL
TP5	BAND 1-4 PREAMP	**TP12**	L RF UNLVLD
TP6	BAND 0 PREAMP	**TP13**	Not Used
TP7	EXT LVL DAC OUT		

All test point measurements are made with reference to GND G (TP1).



NOTE:
Leading zeros on component number references may be disregarded.

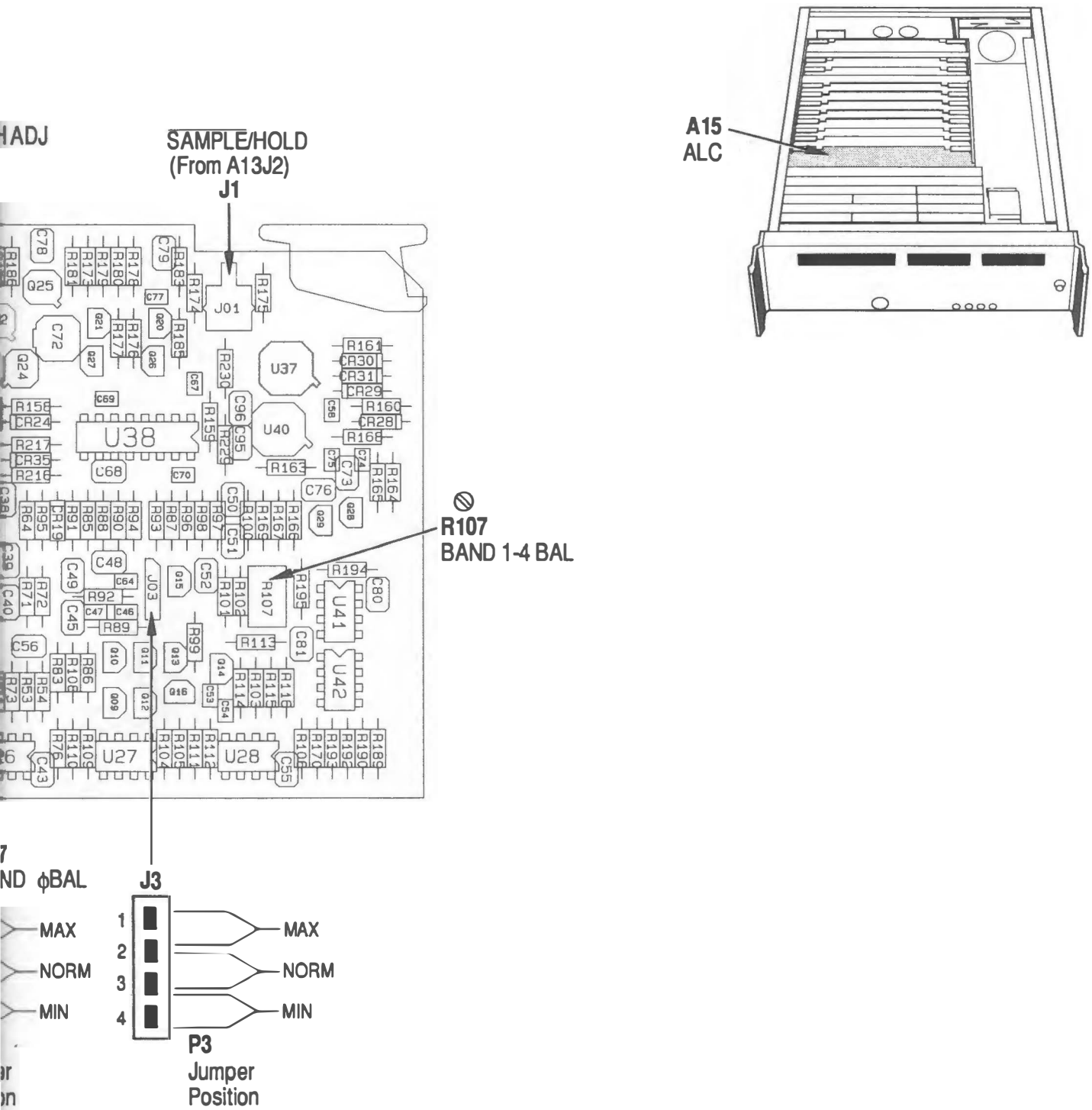
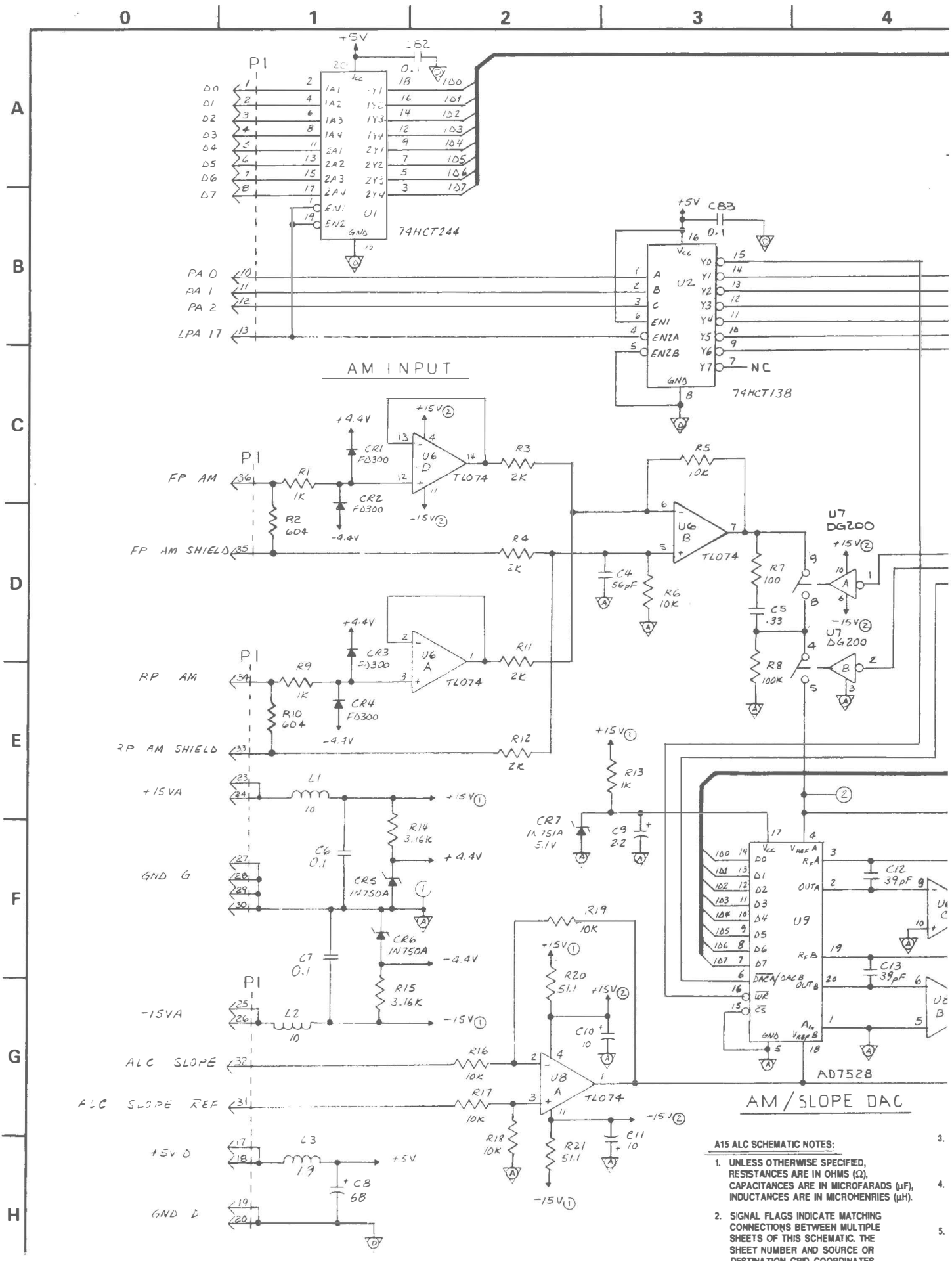
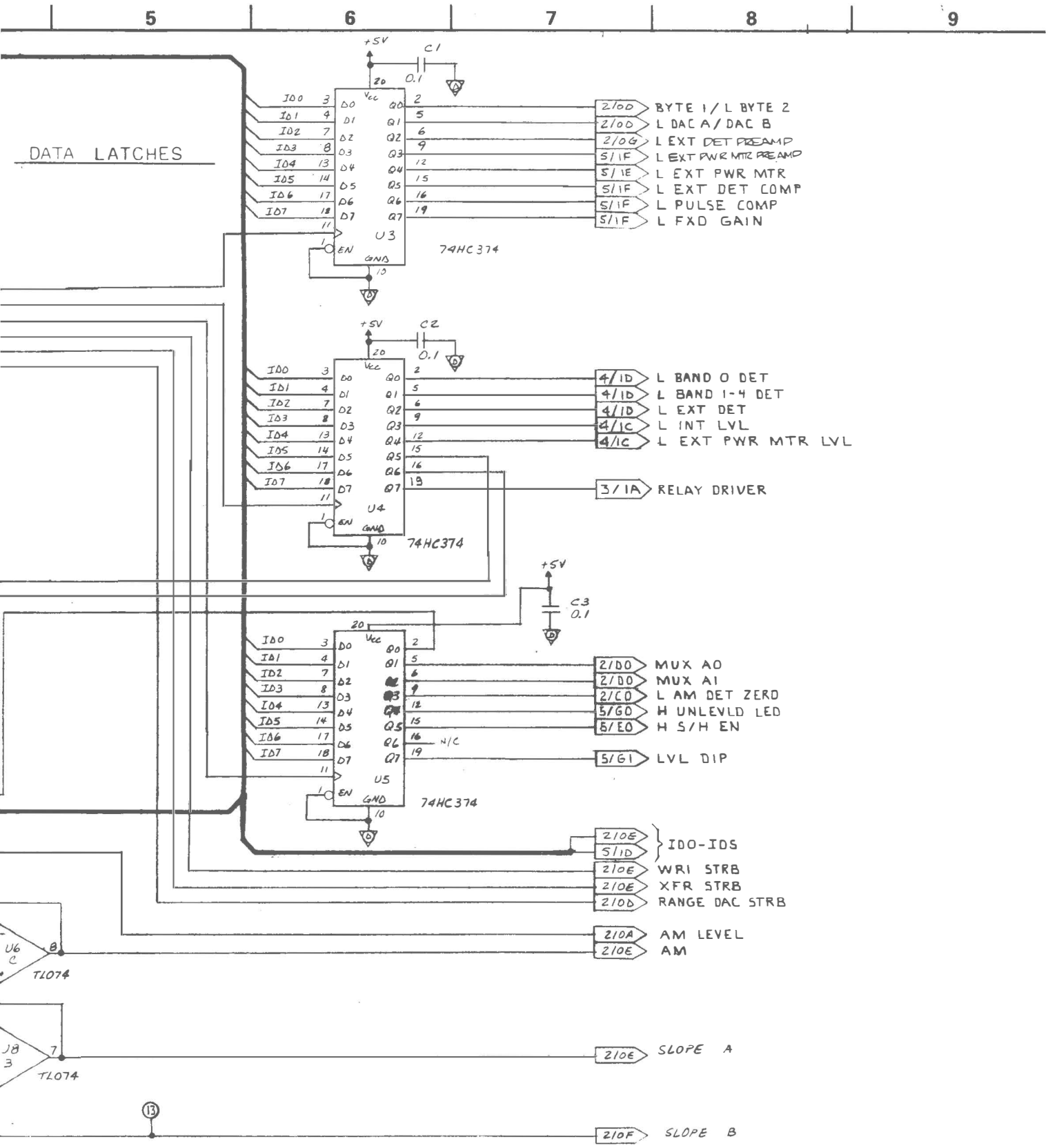


Figure 2K-7. A15 ALC PCB Parts Locator Diagram 6700-D-31915-3 (Rev. K)



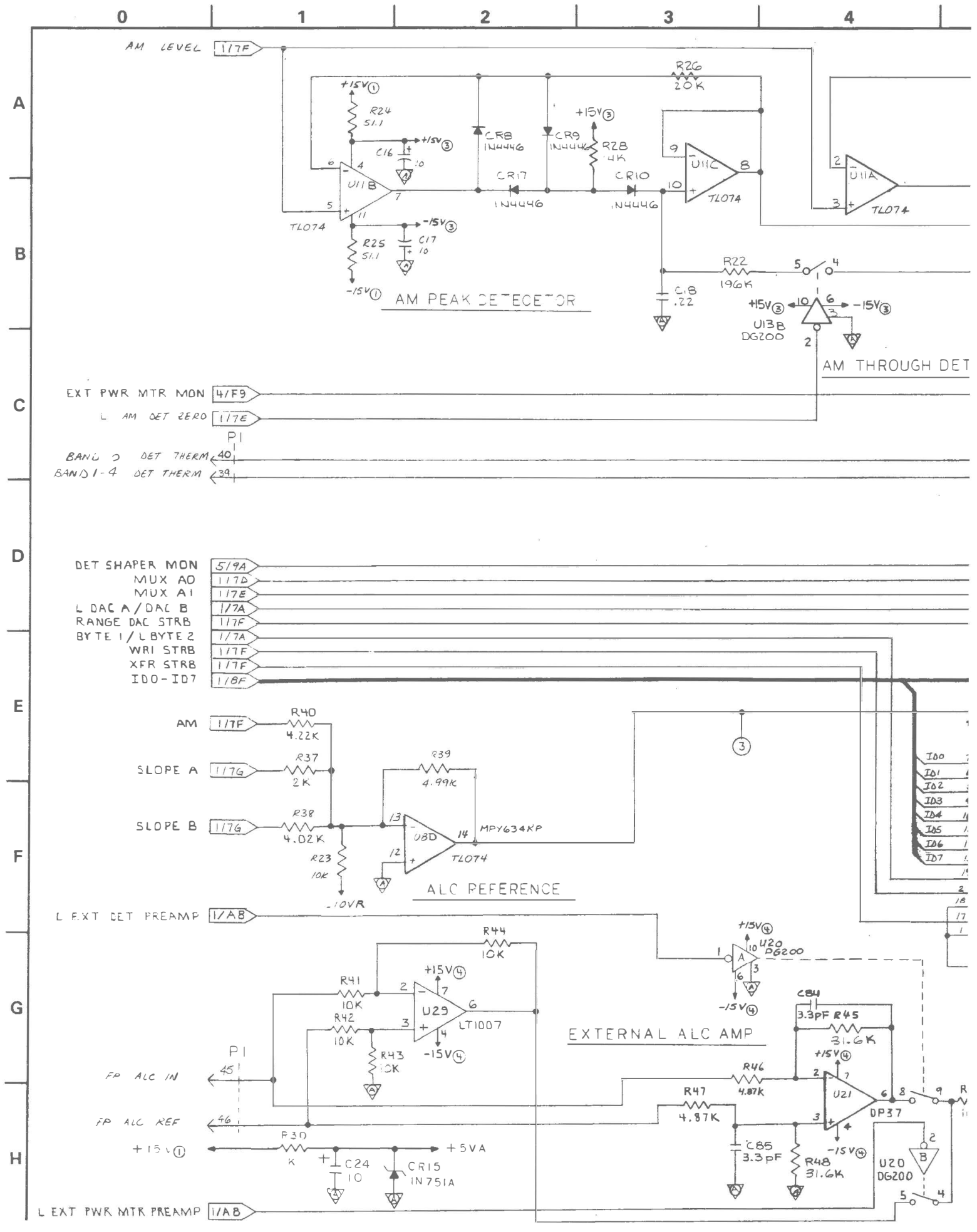
A15 ALC SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3



3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUND: (A) (C) (D)
4. ADJUSTABLE COMPONENTS ARE DENOTED WITH AN ASTERISK:
   R77 R107 R115 R158
5. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK
   C14*, C15*, C34*, C35*, R59*
6. TEST POINTS ARE DENOTED AS: (2)
7. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   R127, R128, U6-U8, U11, U13-U15, U17, U18, U20-U22, U24, U26, U28, U29, U32-U39, U41-U44, U46, VR1
9. CA3183 SUBSTRATE U45 PIN 5

Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 1 of 5) 6700-D-31915-3 (Rev. K)


AM LEVEL 1/7F
R24 51.1
+15V①
C16 .10
CR8 1N4446
CR9 1N4446
+15V③
R28 4K
R26 20K
CR17 1N4446
CR10 1N4446
U11B
U11C
TL074
U11A
TL074
-15V③
R25 51.1
C17 10
-15V①
AM PEAK DETECETOR
R22 196K
C18 .22
+15V③
U13B DG200
-15V③
AM THROUGH DET
EXT PWR MTR MON 4/F9
L AM DET ZERO 1/7E
P1
BAND 5 DET THERM 40
BAND 1-4 DET THERM 39
DET SHAPER MON 5/9A
MUX A0 1/7D
MUX A1 1/7E
L DAC A/DAC B 1/7A
RANGE DAC STRB 1/7F
BYTE 1/L BYTE 2 1/7A
WRI STRB 1/7F
XFR STRB 1/7F
ID0-ID7 1/8F
AM 1/7F
R40 4.22K
SLOPE A 1/7G
R37 2K
R39 4.99K
SLOPE B 1/7G
R38 4.02K
R23 10K
-10VR
U8D
MPY634KP
TL074
ALC REFERENCE
L EXT DET PREAMP 1/A8
R44 10K
R41 10K
R42 10K
R43 10K
U29
LT1007
+15V④
-15V④
U20 DG200
C84 3.3pF
R45 31.6K
EXTERNAL ALC AMP
P1
FP ALC IN 45
FP ALC REF 46
+15V①
R30 K
C24 10
CR15 IN751A
+5VA
R46 4.87K
R47 4.87K
U21
DP37
C85 3.3pF
R48 31.6K
U20 DG200
L EXT PWR MTR PREAMP 1/A8

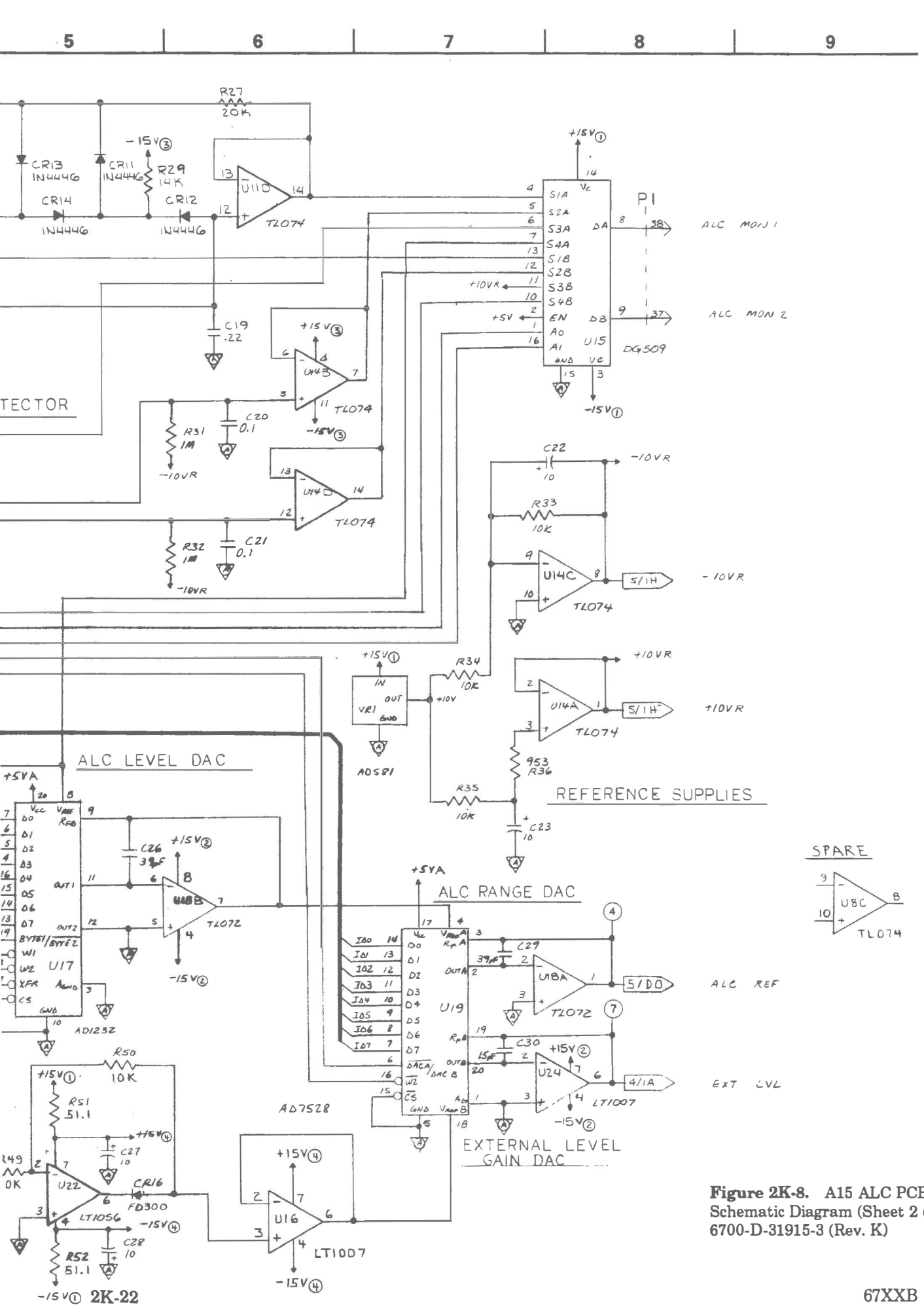
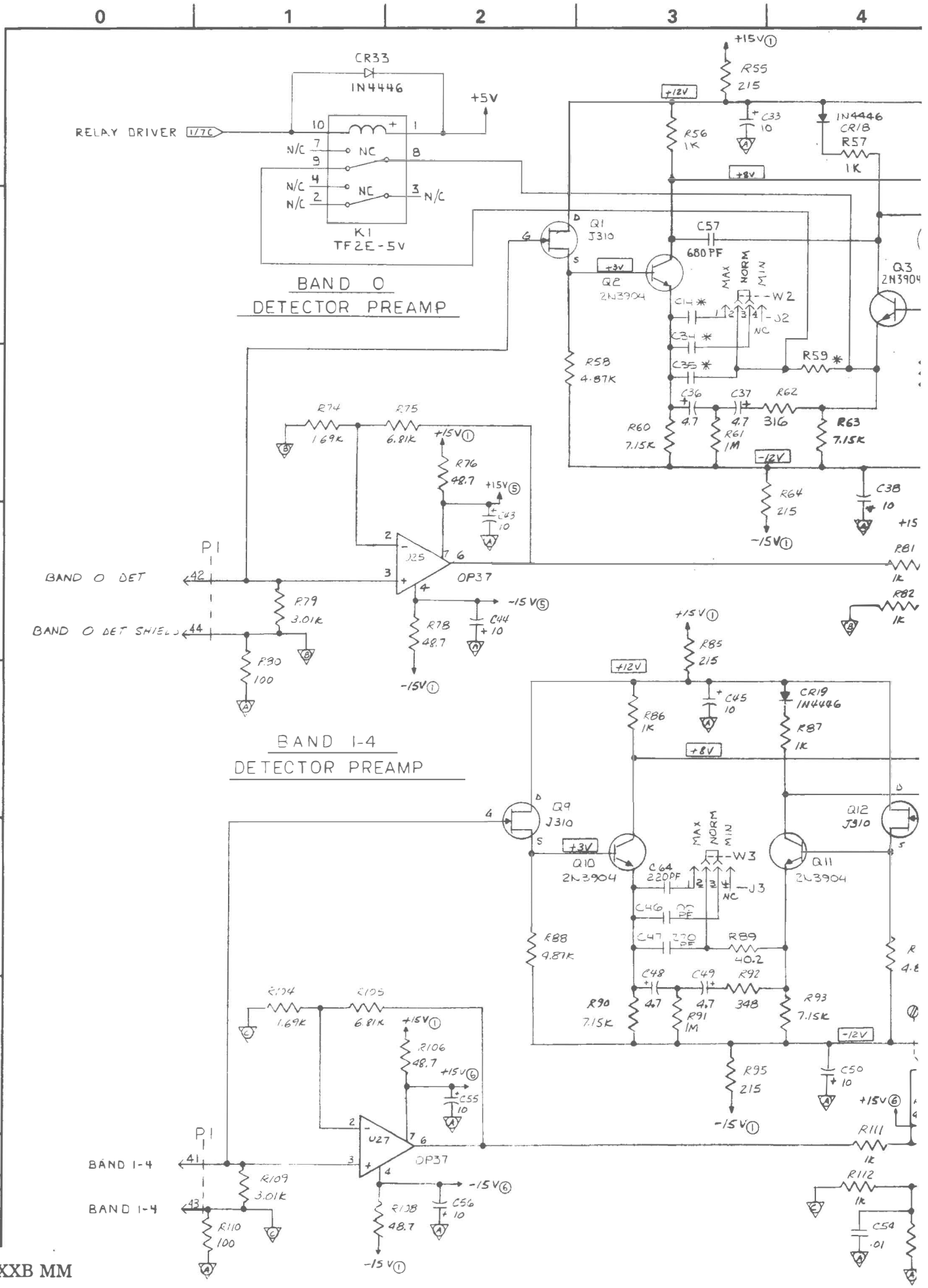
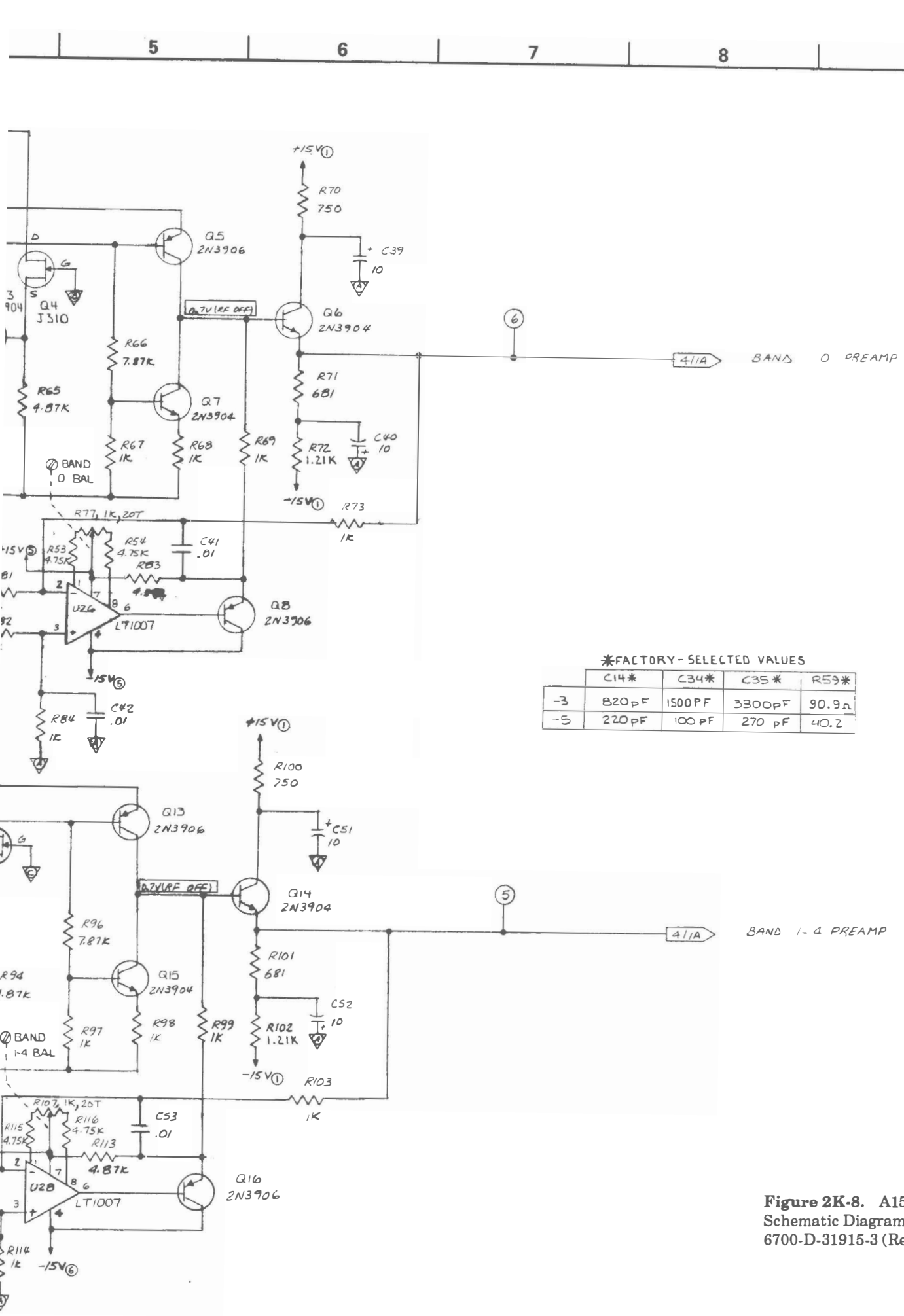


Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 2 of 5) 6700-D-31915-3 (Rev. K)

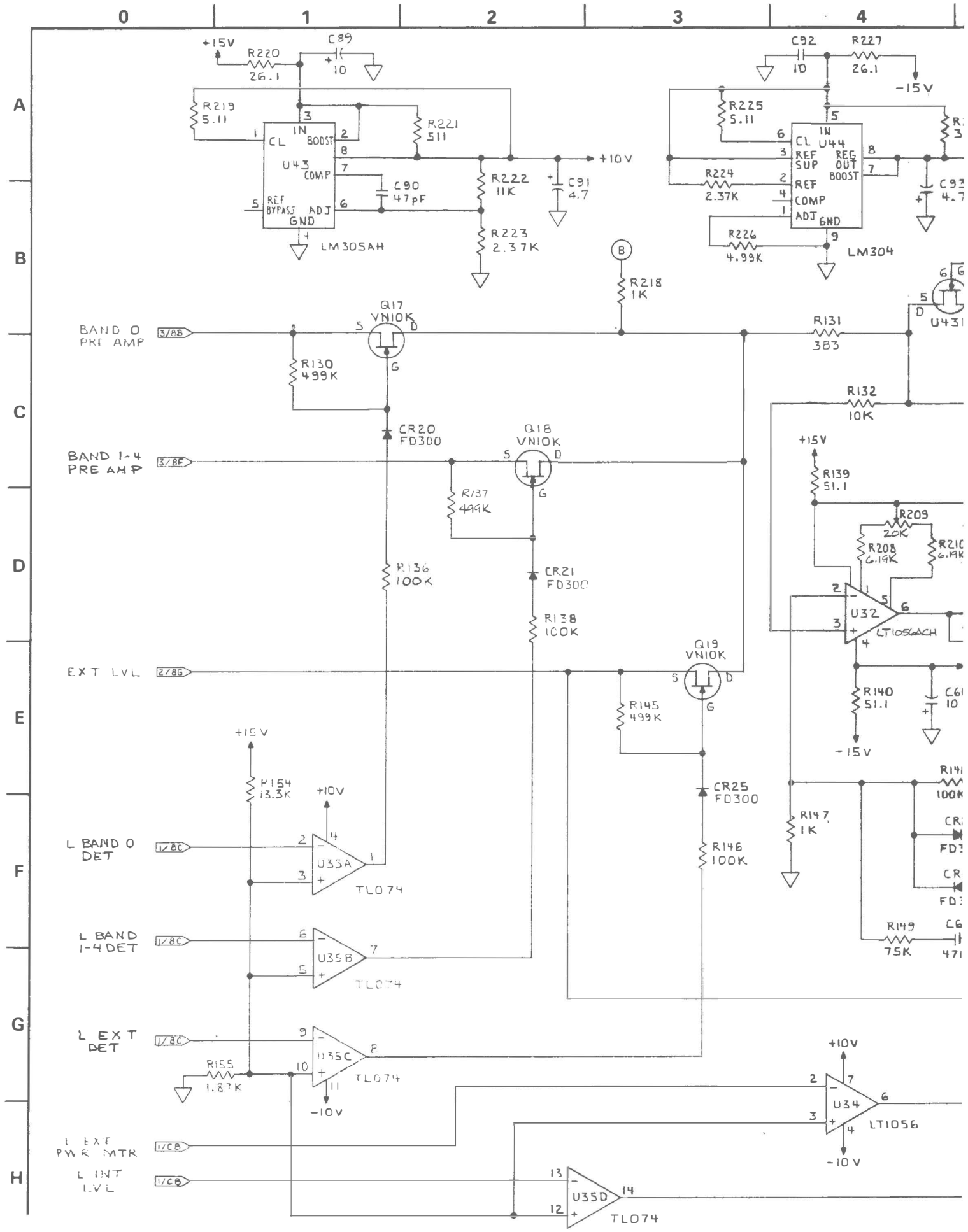

0
1
2
3
4
A
B
C
D
E
F
G
H
CR33
IN4446
+5V
RELAY DRIVER
1/7C
10
1
N/C
7
NC
8
9
N/C
4
NC
3
N/C
N/C
2
K1
TF2E-5V
BAND 0
DETECTOR PREAMP
+15V①
R55
215
+12V
R56
1K
C33
10
IN4446
CR18
R57
1K
+8V
Q1
J310
C57
680PF
+3V
Q2
2N3904
MAX
NORM
MIN
-W2
-J2
NC
C34
C35
R59
Q3
2N3904
R58
4.87K
C36
4.7
C37
4.7
R62
316
R60
7.15K
R61
1M
R63
7.15K
-12V
R64
215
-15V①
C38
10
+15
R74
1.69K
R75
6.81K
R76
48.7
+15V⑤
C43
10
P1
BAND 0 DET
42
BAND 0 DET SHIELD
44
R79
3.01K
R80
100
U25
OP37
R78
48.7
-15V⑤
C44
10
-15V①
R81
1K
R82
1K
BAND 1-4
DETECTOR PREAMP
+15V①
R85
215
+12V
R86
1K
C45
10
CR19
IN4446
R87
1K
+8V
Q9
J310
Q10
2N3904
MAX
NORM
MIN
-W3
-J3
NC
C64
220PF
C46
C47
220 PF
R88
9.81K
R89
40.2
C48
4.7
C49
4.7
R92
348
R90
7.15K
R91
1M
R93
7.15K
Q12
J310
Q11
2N3904
-12V
R95
215
-15V①
C50
10
+15V⑥
R111
1K
R112
1K
C54
.01
R104
1.69K
R105
6.81K
+15V①
R106
48.7
+15V⑥
C55
10
P1
BAND 1-4
41
BAND 1-4
43
R109
3.01K
R110
100
U27
OP37
R108
48.7
-15V⑥
C56
10
-15V①



✱FACTORY-SELECTED VALUES

	C14✱	C34✱	C35✱	R59✱
-3	820pF	1500PF	3300pF	90.9Ω
-5	220pF	100 pF	270 pF	40.2

Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 3 of 5) 6700-D-31915-3 (Rev. K)


0
1
2
3
4
A
B
C
D
E
F
G
H
+15V
R220
26.1
C89
10
R219
5.11
U43
IN
CL
BOOST
COMP
REF BYPASS
ADJ
GND
LM305AH
R221
511
R222
11K
C90
47pF
C91
4.7
R223
2.37K
+10V
C92
10
R227
26.1
-15V
R225
5.11
U44
IN
CL
REF SUP
REG OUT
BOOST
REF
COMP
ADJ
GND
LM304
R224
2.37K
R226
4.99K
R218
1K
BAND 0 PRE AMP
3/B8
Q17
VN10K
R130
499K
R131
383
R132
10K
CR20
FD300
BAND 1-4 PRE AMP
3/BF
Q18
VN10K
R137
499K
R136
100K
CR21
FD300
R138
100K
EXT LVL
2/B6
Q19
VN10K
R145
499K
CR25
FD300
R146
100K
R147
1K
R139
51.1
R209
20K
R208
6.19K
U32
LT1056ACH
R140
51.1
-15V
R154
13.3K
L BAND 0 DET
1/B6
U35A
TL074
L BAND 1-4 DET
1/B6
U35B
TL074
L EXT DET
1/B6
U35C
TL074
R155
1.87K
-10V
L EXT PWR MTR
1/C8
L INT LVL
1/C8
U35D
TL074
U34
LT1056
+10V
-10V

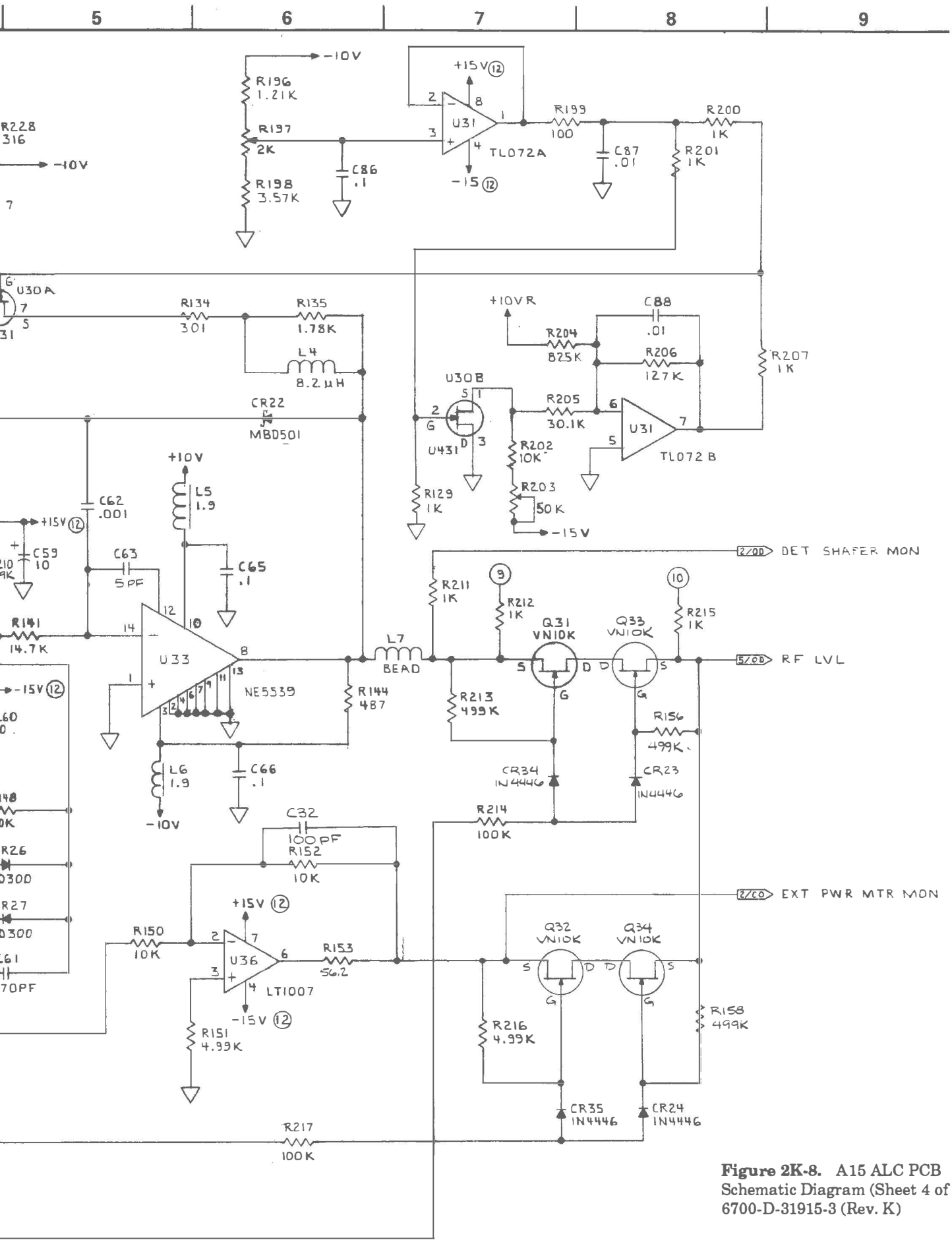
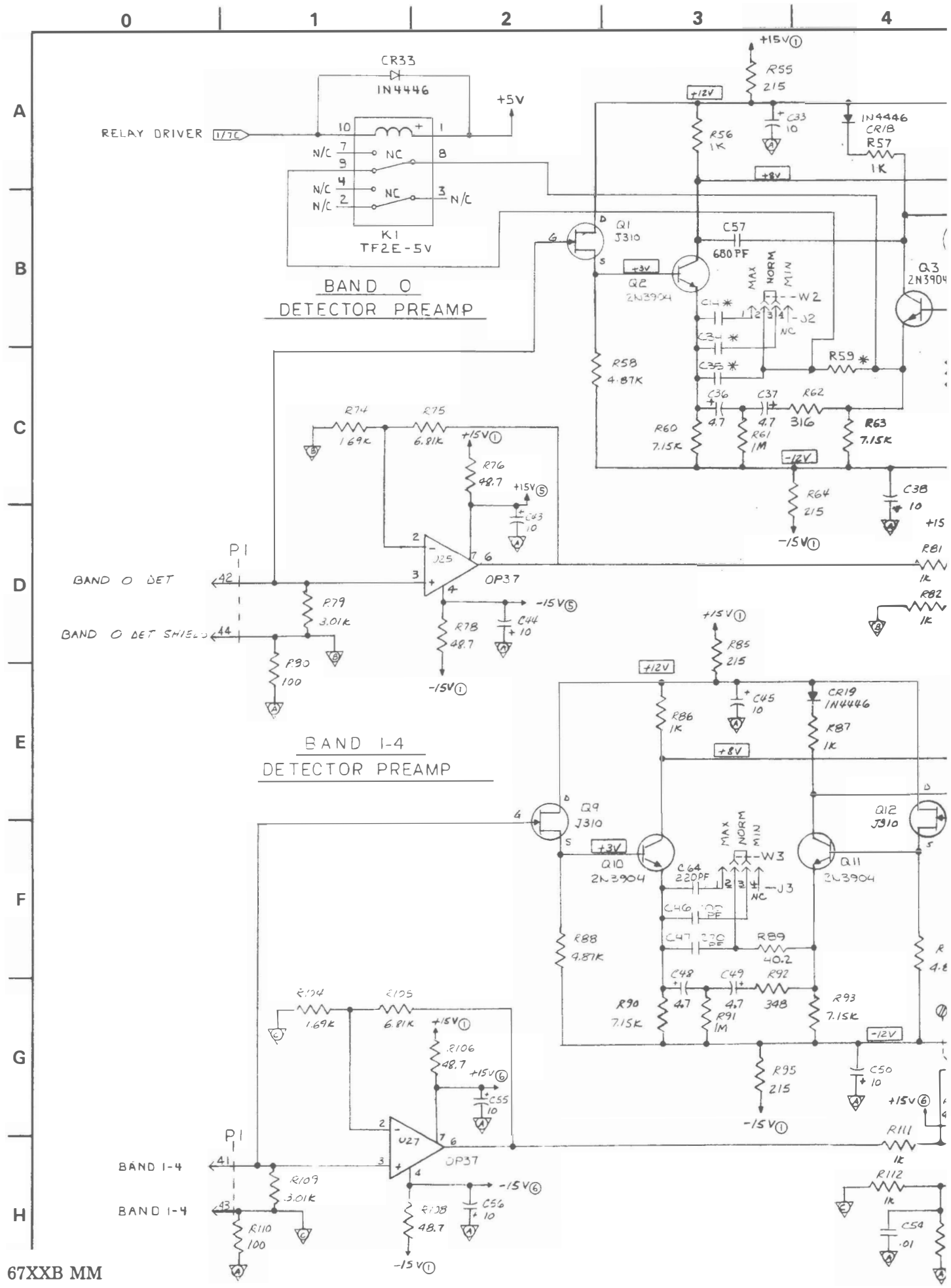
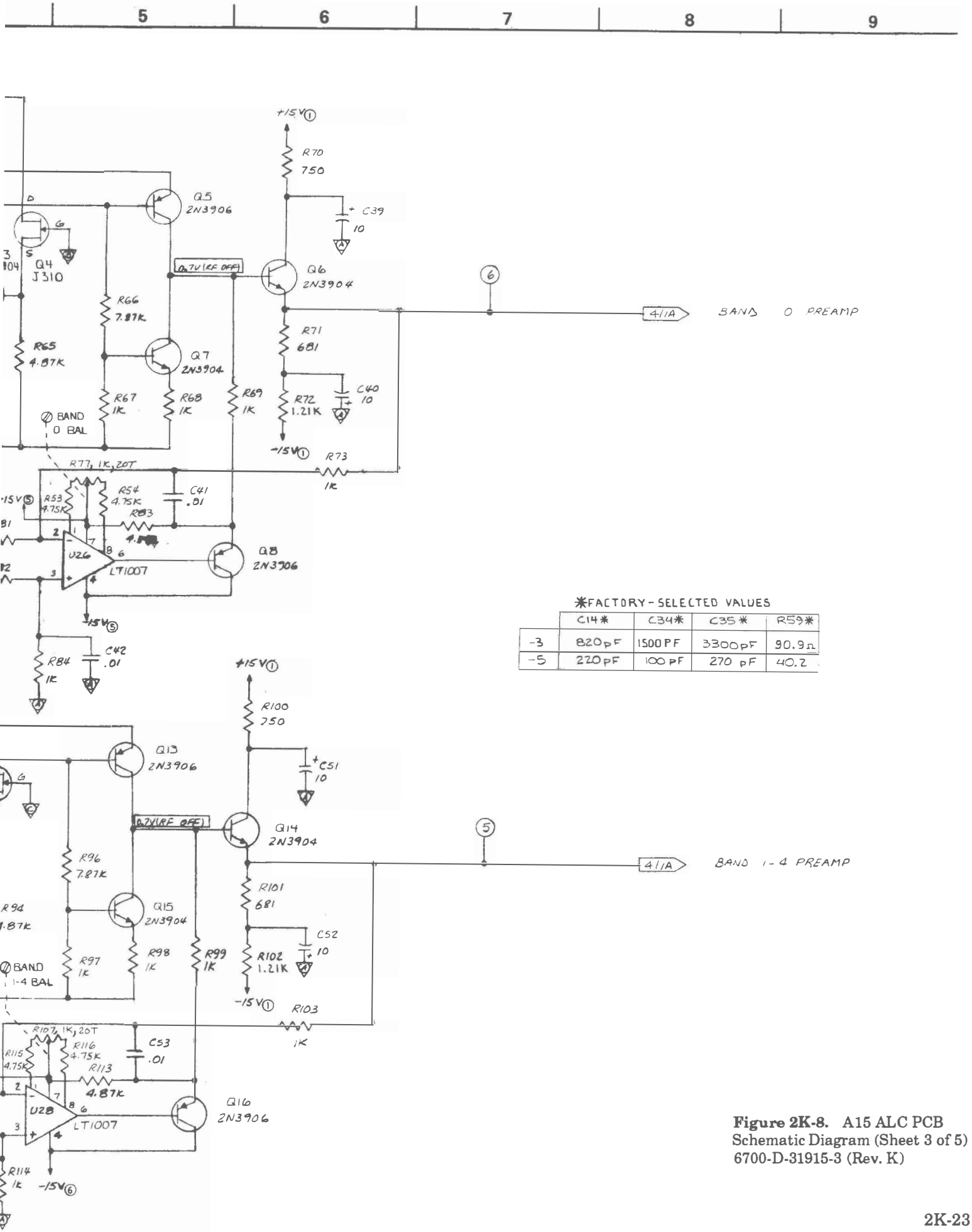


Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 4 of 5) 6700-D-31915-3 (Rev. K)

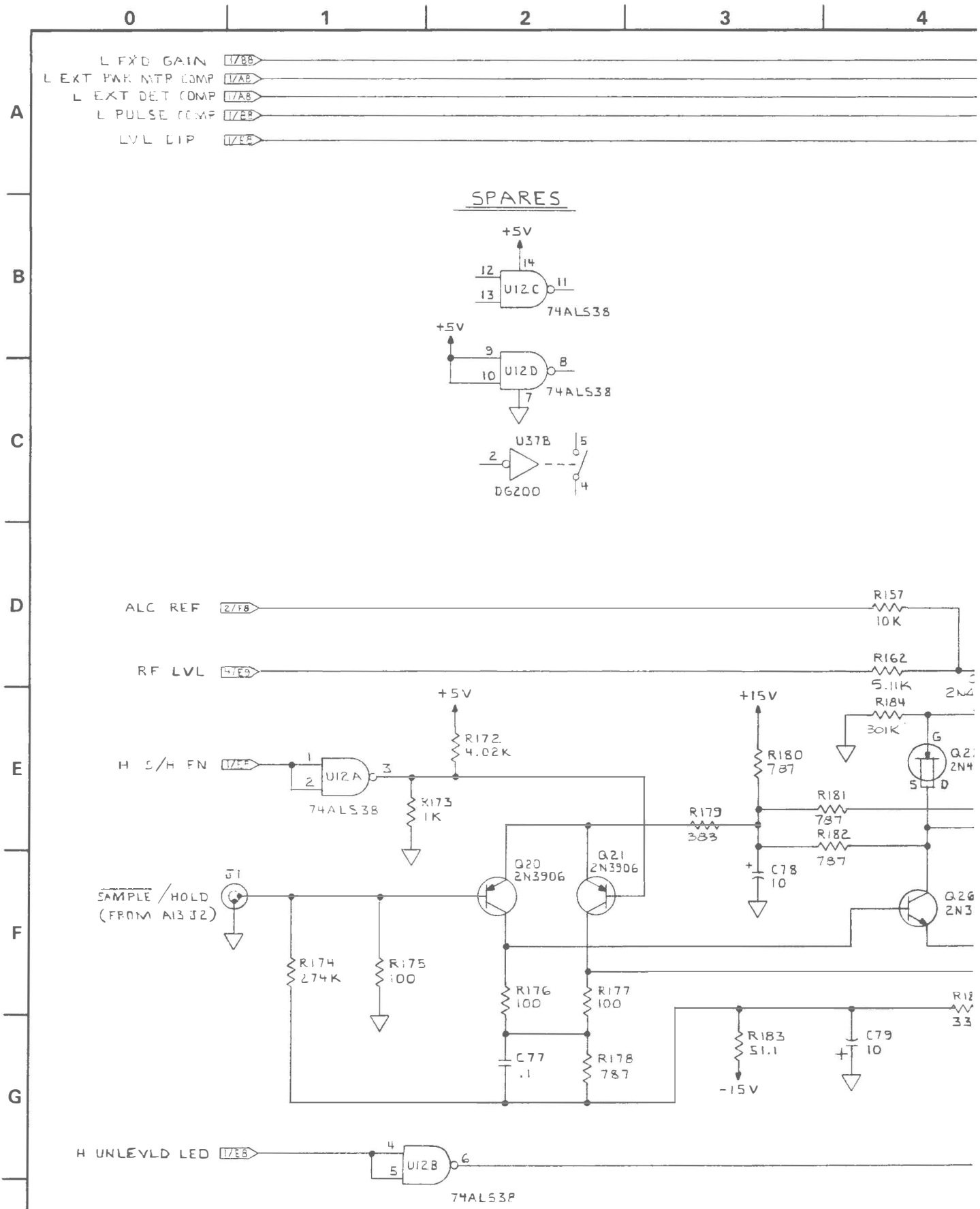

CR33
IN4446
+5V
RELAY DRIVER
K1
TF2E-5V
BAND 0
DETECTOR PREAMP
+15V
-15V
+12V
+8V
+3V
-12V
Q1
J310
Q2
2N3904
Q3
2N3904
R55
215
R56
1K
R57
1K
IN4446
CR18
C33
10
C57
680 PF
MAX
NORM
MIN
-W2
-J2
NC
C34
C35
R59
R58
4.87K
C36
4.7
C37
4.7
R62
316
R60
7.15K
R61
1M
R63
7.15K
R64
215
C38
10
R74
1.69K
R75
6.81K
R76
48.7
C43
10
P1
BAND 0 DET
BAND 0 DET SHIELD
42
44
R79
3.01K
R80
100
U25
OP37
R78
48.7
C44
10
R81
1K
R82
1K
BAND 1-4
DETECTOR PREAMP
Q9
J310
Q10
2N3904
Q11
2N3904
Q12
J310
R85
215
R86
1K
C45
10
CR19
IN4446
R87
1K
C64
220PF
-W3
-J3
C46
C47
220 PF
R88
4.87K
R89
40.2
C48
4.7
C49
4.7
R92
348
R90
7.15K
R91
1M
R93
7.15K
R95
215
C50
10
R111
1K
R112
1K
C54
.01
R104
1.69K
R105
6.81K
R106
48.7
C55
10
U27
OP37
P1
BAND 1-4
41
43
R109
3.01K
R110
100
R108
48.7
C56
10



*FACTORY-SELECTED VALUES

	C14*	C34*	C35*	R59*
-3	820pF	1500PF	3300pF	90.9Ω
-5	220pF	100pF	270 pF	40.2

Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 3 of 5) 6700-D-31915-3 (Rev. K)


0
1
2
3
4
A
B
C
D
E
F
G
H
L FXD GAIN
L EXT PWR MTR COMP
L EXT DET COMP
L PULSE COMP
LVL DIP
SPARES
+5V
U12C
74ALS38
U12D
74ALS38
U37B
DG200
ALC REF
RF LVL
H S/H EN
U12A
74ALS38
R172
4.02K
R173
1K
R157
10K
R162
5.11K
R184
301K
R180
787
R181
787
R182
787
R179
383
C78
10
Q20
2N3906
Q21
2N3906
J1
SAMPLE / HOLD
(FROM A13 J2)
R174
274K
R175
100
R176
100
R177
100
C77
.1
R178
787
R183
51.1
C79
10
-15V
H UNLEVLD LED
U12B
74ALS38

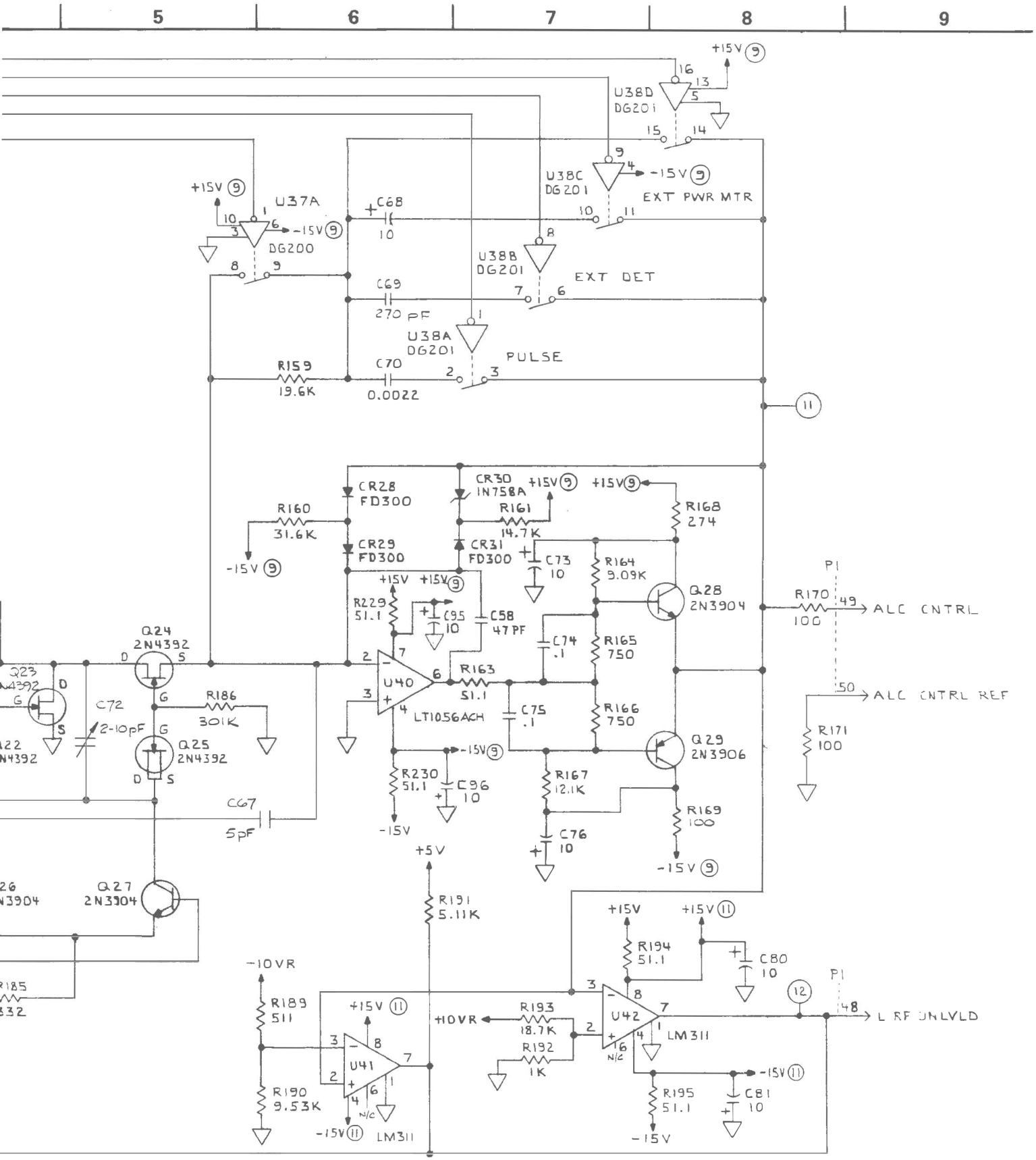
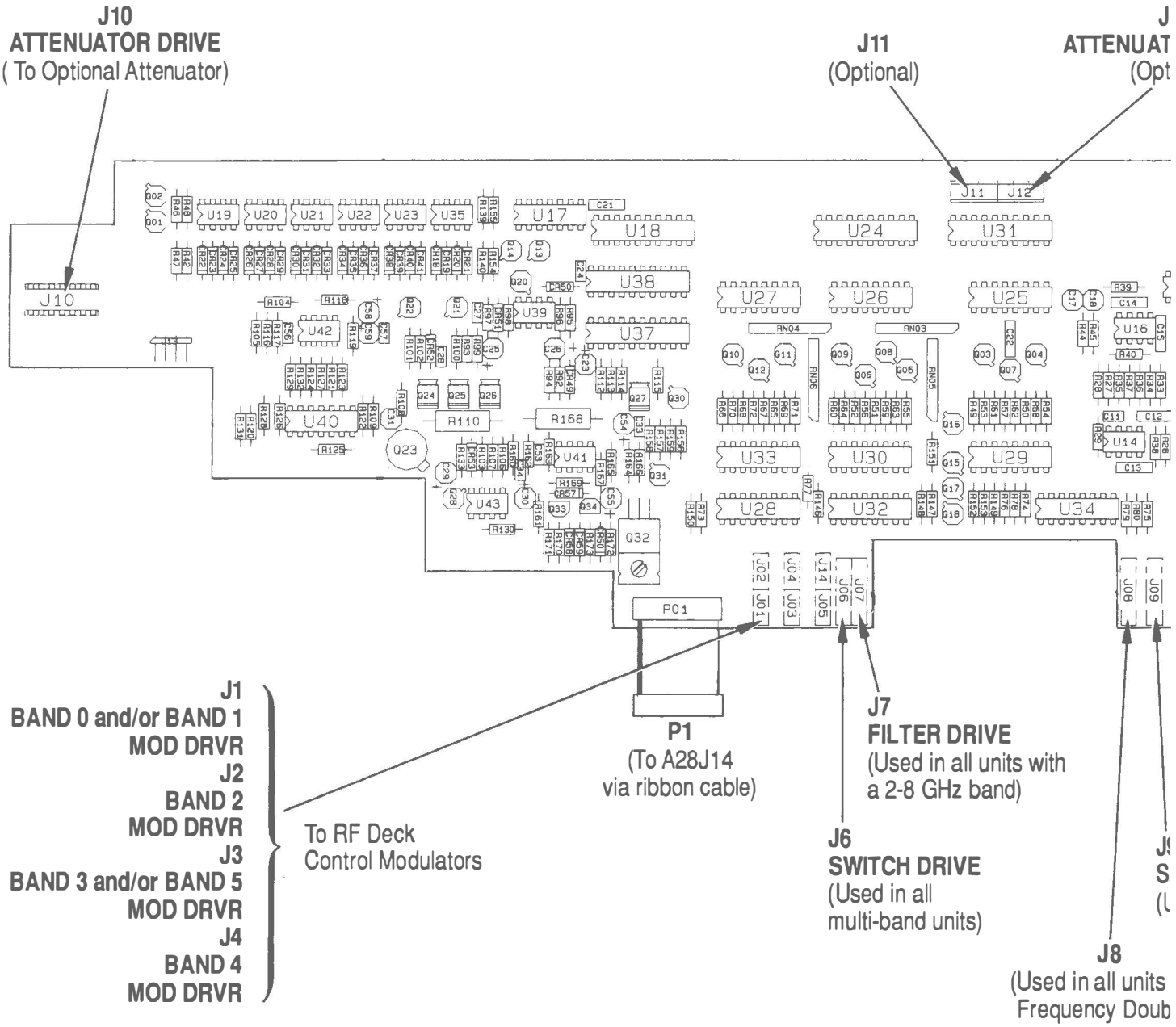
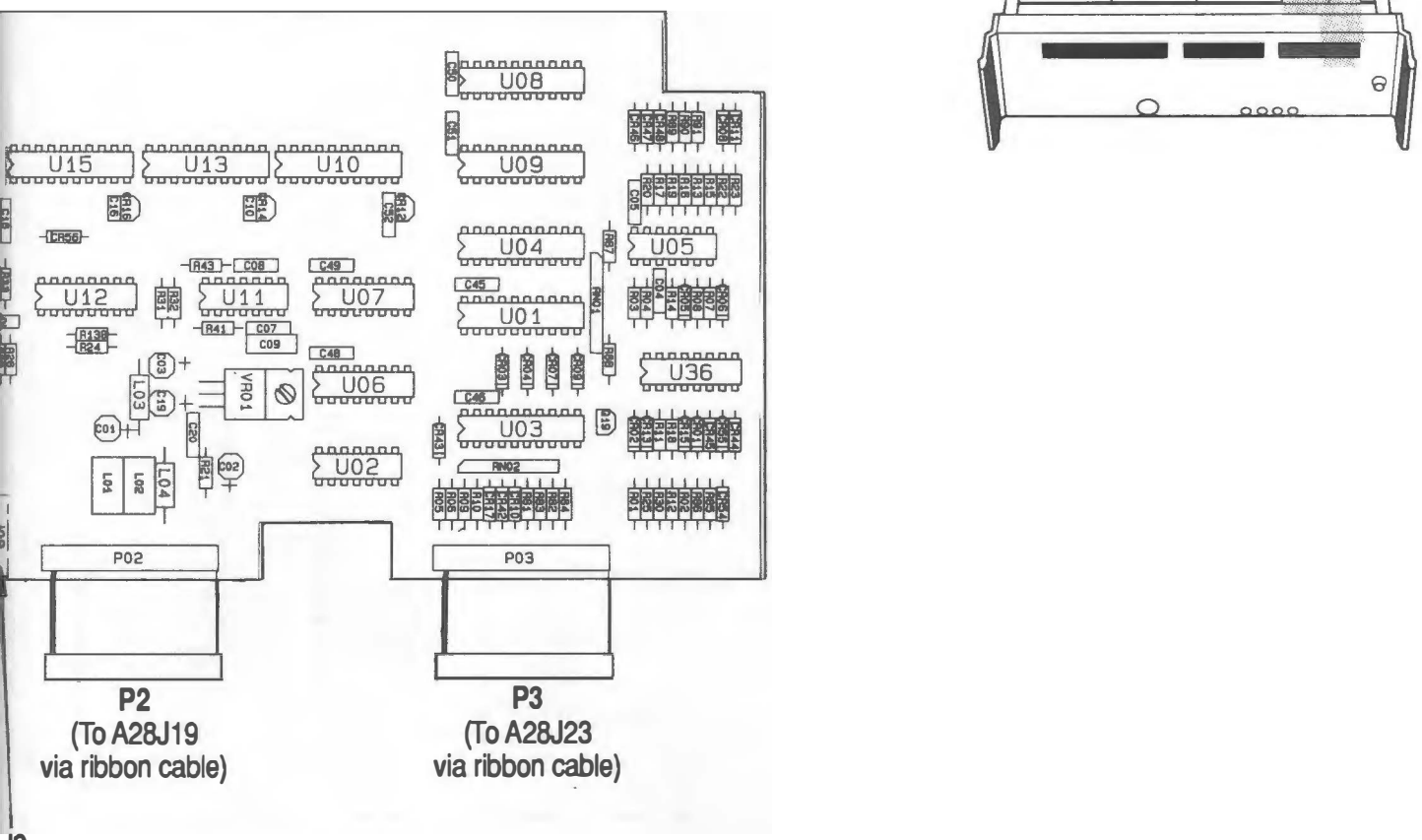


Figure 2K-8. A15 ALC PCB Schematic Diagram (Sheet 5 of 5) 6700-D-31915-3 (Rev. K)

A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)



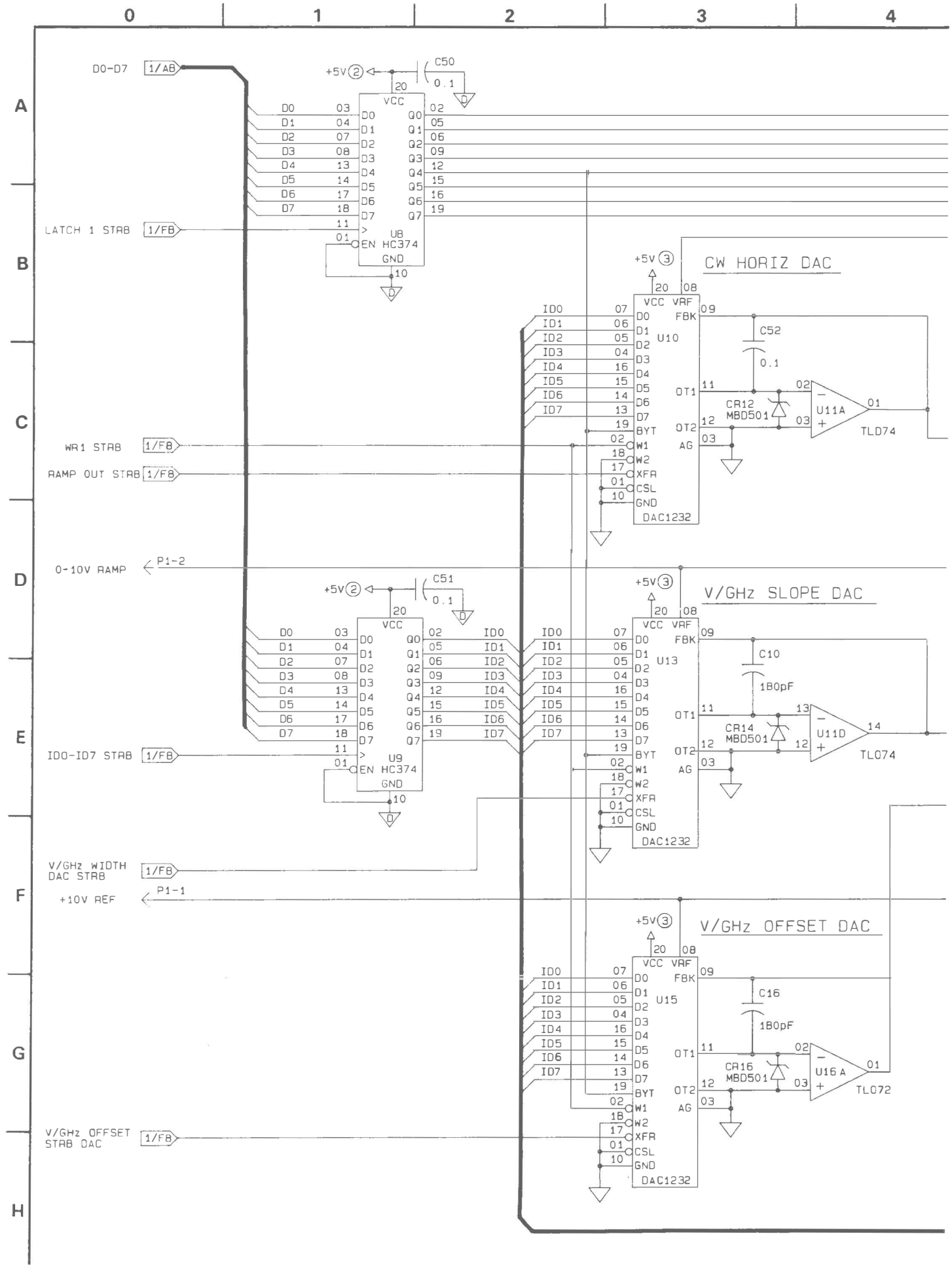
J12
ATOR DRIVER
ptional)



J9
SAMPLER SWITCH DRIVE
(Used in all multi-band units)

s with
ubler)

Figure 2K-9. A29 Rear Panel Interface PCB Parts Locator Diagram 6700-D-31829-3 (Rev. K)


0
1
2
3
4
A
B
C
D
E
F
G
H
D0-D7
1/AB
+5V
C50
0.1
VCC
D0
D1
D2
D3
D4
D5
D6
D7
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
LATCH 1 STRB
1/F8
UB
HC374
EN
GND
CW HORIZ DAC
U10
VCC
VRF
FBK
OT1
OT2
AG
BYT
W1
W2
XFR
CSL
GND
DAC1232
C52
CR12
MBD501
U11A
TLD74
WR1 STRB
RAMP OUT STRB
0-10V RAMP
P1-2
C51
U9
ID0-ID7 STRB
V/GHz SLOPE DAC
U13
C10
180pF
CR14
U11D
TL074
V/GHz WIDTH
DAC STRB
+10V REF
P1-1
V/GHz OFFSET DAC
U15
C16
CR16
U16A
TL072
V/GHz OFFSET
STRB DAC

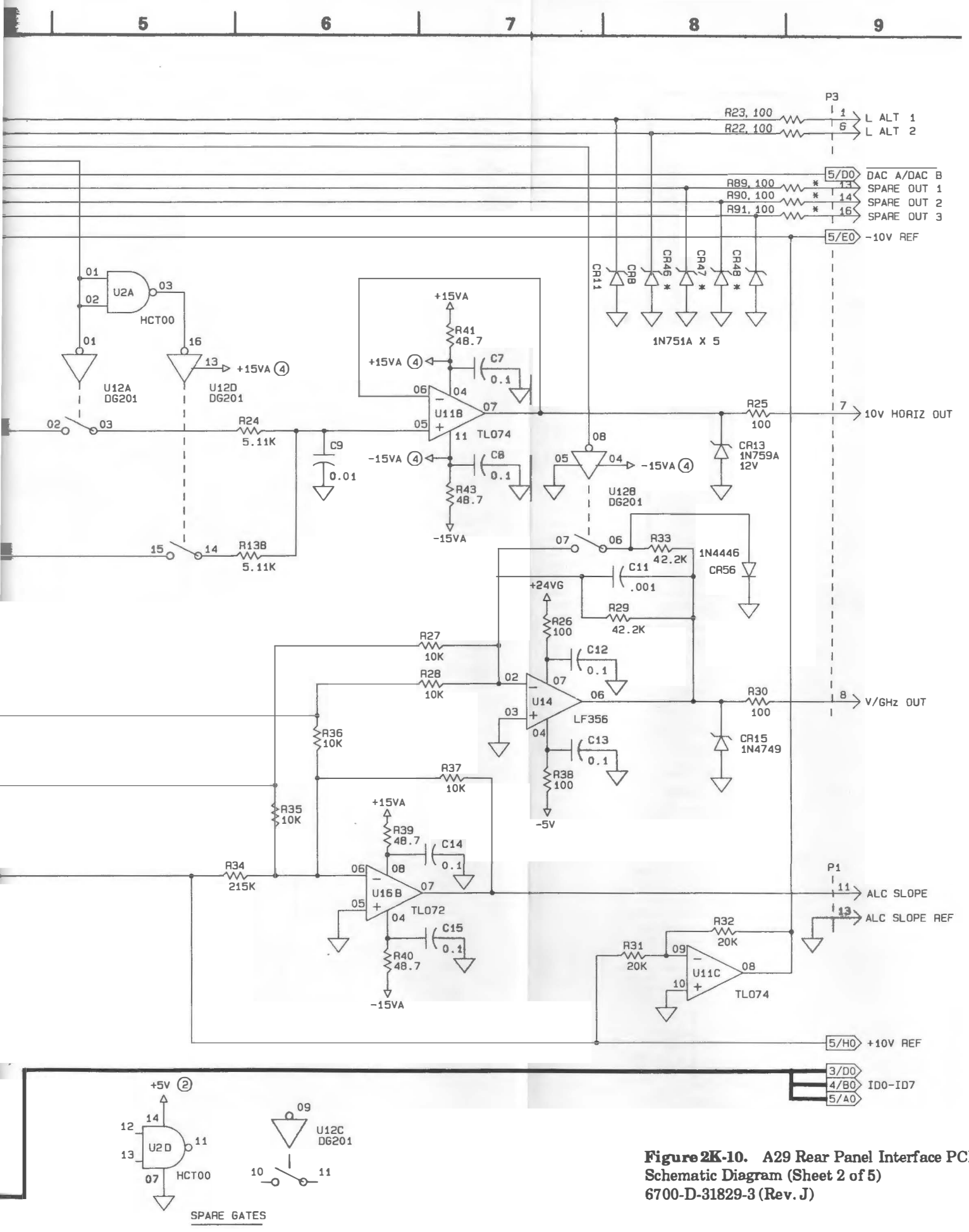
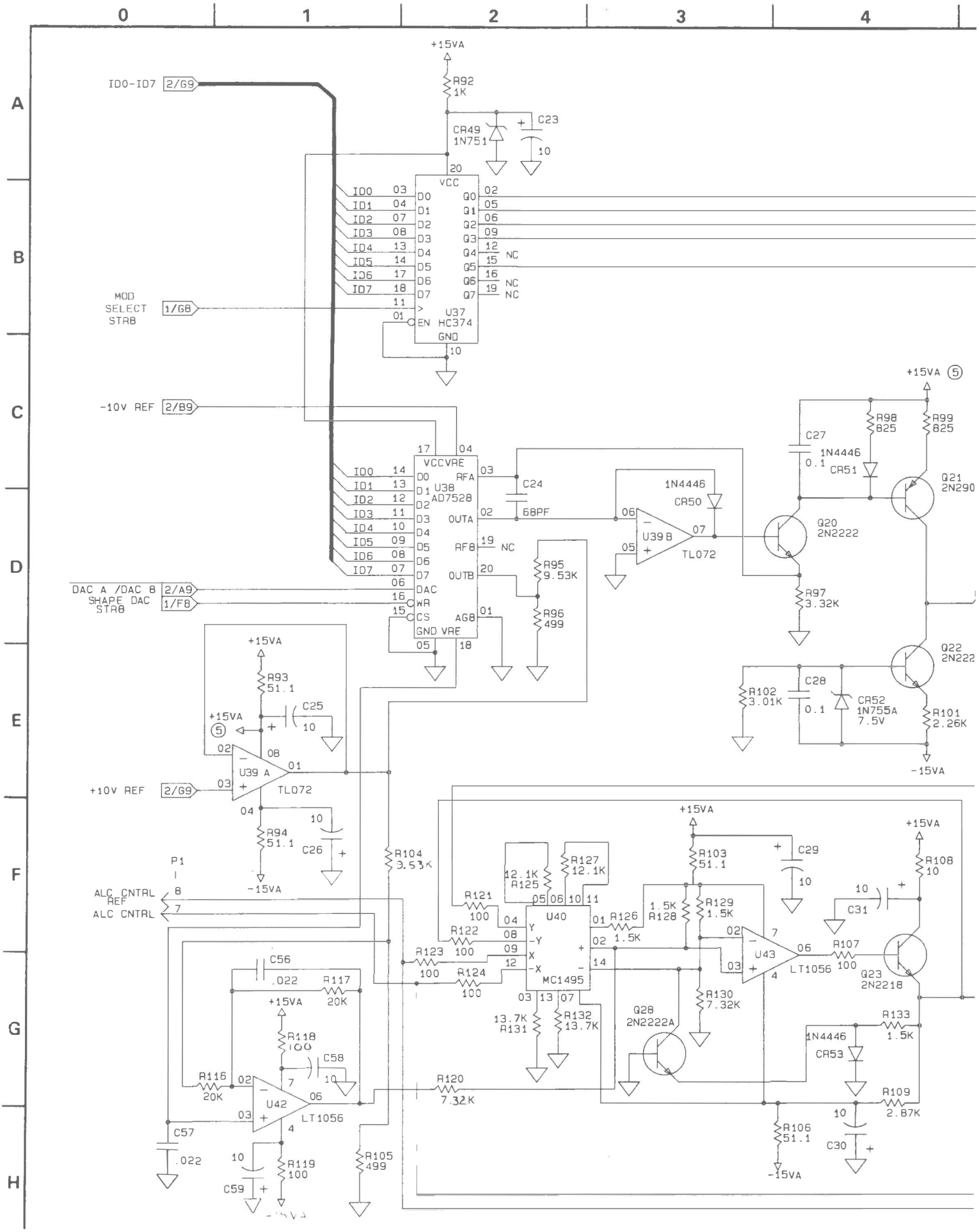


Figure 2K-10. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 2 of 5) 6700-D-31829-3 (Rev. J)


0
1
2
3
4
A
B
C
D
E
F
G
H
+15VA
R92
1K
CR49
1N751
C23
10
ID0-ID7 2/G9
VCC
ID0 03
ID1 04
ID2 07
ID3 08
ID4 13
ID5 14
ID6 17
ID7 18
D0
D1
D2
D3
D4
D5
D6
D7
Q0 02
Q1 05
Q2 06
Q3 09
Q4 12
Q5 15
Q6 16
Q7 19
NC
NC
NC
MOD SELECT STRB 1/G8
11
01
EN
U37
HC374
GND 10
-10V REF 2/B9
17
04
VCC
VRE
D0
D1
D2
D3
D4
D5
D6
D7
DAC
WR
CS
GND
RFA
OUTA
RFB
OUTB
AGB
VRE
U38
AD7528
03
02
19
20
01
18
05
16
15
C24
68PF
NC
R95
9.53K
R96
499
DAC A /DAC B SHAPE DAC STRB 2/A9 1/F8
+15VA
R93
51.1
C25
10
+15VA (5)
02
08
01
U39 A
TL072
03
04
+10V REF 2/G9
10
C26
R94
51.1
-15VA
P1
ALC CNTRL REF 8
ALC CNTRL 7
R104
3.53K
1N4446
CR50
U39 B
TL072
06
07
05
+15VA (5)
R98
825
R99
825
C27
0.1
1N4446
CR51
Q21
2N2907
Q20
2N2222
R97
3.32K
Q22
2N2222
R102
3.01K
C28
0.1
CR52
1N755A
7.5V
R101
2.26K
-15VA
+15VA
R103
51.1
C29
10
+15VA
R108
10
10
C31
Q23
2N2218
R107
100
U43
LT1056
02
03
7
06
4
R130
7.32K
R133
1.5K
1N4446
CR53
R109
2.87K
10
C30
R106
51.1
-15VA
12.1K
R125
R127
12.1K
R121
100
R122
100
R123
100
R124
100
U40
MC1495
Y
-Y
X
-X
01
02
04
08
09
12
03
13
07
14
R126
1.5K
1.5K
R128
R129
1.5K
13.7K
R131
R132
13.7K
Q28
2N2222A
C56
.022
R117
20K
+15VA
R118
100
C58
10
R116
20K
U42
LT1056
02
03
06
7
4
C57
.022
10
C59
R119
100
R120
7.32K
R105
499

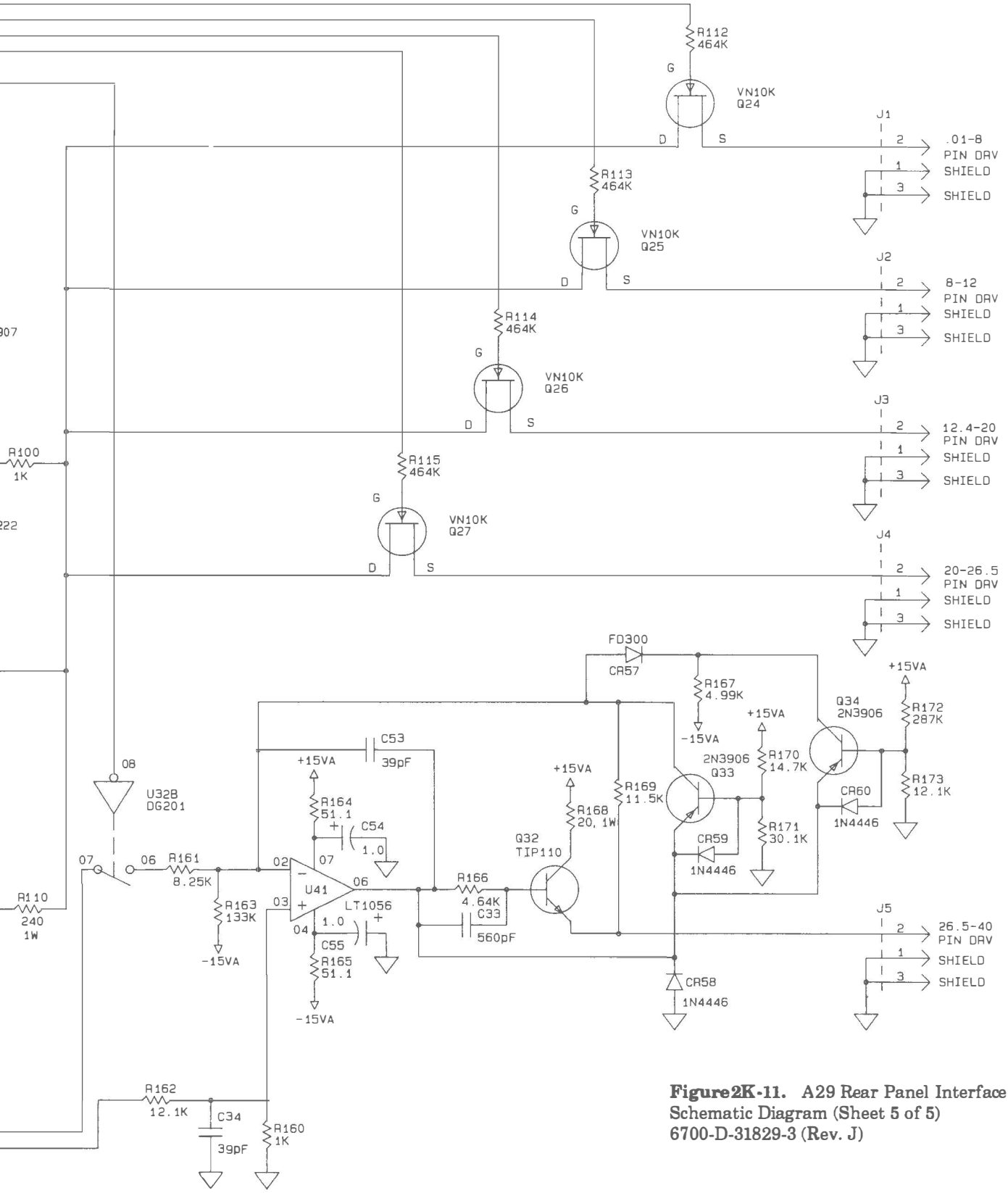


Figure2K-11. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 5 of 5) 6700-D-31829-3 (Rev. J)

2L–RF MICROWAVE DECK

2L-1 RF MICROWAVE DECK ASSEMBLY

This section contains service information for the RF microwave deck assembly and its component frequency bands listed in Table 2L-1 below. Refer also to the specific troubleshooting information in the error code table in the front portion of Section 2-System Description and Troubleshooting.

Reference is made, throughout the following description to various inputs, outputs, and loops involving related circuits and PCBs. You may wish to refer to other sections of this manual for more detail as follows:

- Section 2E–Reference Loop
- Section 2F–Coarse Loop
- Section 2G–Fine Loop
- Section 2H–YIG Loop/FM Subsystem
- Section 2I–Analog Instruction
- Section 2K –Automatic Level Control/ Pulse Modulation

Table 2L-1. Microwave Deck Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2L-2	2L-1
Block Diagram	Fig. 2L-2	2L-9
Parts Locator Diagram	Fig. 2L-3	2L-10
FREQUENCY BANDS		
Frequency Bands 2 thru 4		
Circuit Description	Para. 2L-3	2L-3
Frequency Bands 0 and 1		
Circuit Description	Para. 2L-4	2L-4
Frequency Band 5		
Circuit Description	Para. 2L-5	2L-5
Frequency Band 6		
Circuit Description	Para. 2L-6	2L-6
Block Diagram	Fig. 2L-1	2L-6

2L-2 RF MICROWAVE DECK ASSEMBLY, OVERALL DESCRIPTION

Refer to the block diagram in Figure 2L-2 for the following description.

The primary purpose of the RF microwave deck assembly is to generate sweep- and CW- frequency RF signals and route these signals to the RF OUTPUT connector. It is capable of generating RF signals in the frequency range of 0.01 to 60 GHz. The frequency range of 0.01 to 60 GHz is divided into 7 discrete bands. They are defined as follows:

- Band 0 – 0.01 to 2 GHz (Heterodyne Band)
- Band 1 – 2 to 8.4 GHz (S/C Band)
- Band 2 – 8 to 12.4 GHz (X Band)
- Band 3 – 12.4 to 20 GHz (Ku Band)
- Band 4 – 18 to 26.5 GHz (K Band)
- Band 5 – 26.5 to 40 GHz (Ka Band)
- Band 6 – 40 to 60 GHz (U Band)

The configuration of the RF microwave deck varies according to the particular synthesizer model. There are single-band and multi-band models. Table 2L-2 lists the RF microwave deck configuration by model number. Additionally, some models have a high-power version, so designated by a –10, –20, or –40 after the model number. These models require high-power versions of the standard RF components and/or the addition of RF amplifiers.

The various models produce RF output in frequency bands 0 to 6 as follows:

- Band 0 (0.01 to 2 GHz) – RF output is produced by downconverting the RF output of the Band 1 YIG-tuned oscillator.
- Bands 1 thru 4 (2 to 26.5 GHz) – RF output is generated by the four YIG-tuned oscillators.
- Band 5 (26.5 to 40 GHz) – RF output is produced by doubling the output of the Band 3 YIG-tuned oscillator.
- Band 6 (40 to 60 GHz) – RF output is produced by tripling the output of the Band 3 YIG-tuned oscillator.

During the sweep mode in multiband models, frequency bandswitching occurs at specific switch points. The bandswitch points occur at 2.0 GHz, 8.0 GHz, 12.4 GHz, 18.0 GHz, and 26.5 GHz. At each bandswitch point, the YIG-tuned oscillator that was being swept is phase-locked to determine the frequency error, if any, and then turned off. The

Table 2L-2. RF Microwave Deck Configuration by Model Number

Model Number	Frequency Band(s) Installed						
	Band 0 0.01–2 GHz	Band 1 2–8.4 GHz	Band 2 8–12.4 GHz	Band 3 12.4–20 GHz	Band 4 18–26.5 GHz	Band 5 26.5–40 GHz	Band 6 40–60 GHz
6709B/6709B-40	■						
6717B/6717B-20	■	■					
6719B		■					
6721B/6721B-20		■	■				
6722B/6722B-20	■	■	■				
6728B/6728B-40			■				
6729B/6729B-20			■	■			
6730B/6730B-40				■			
6736B/6736B-10					■		
6737B/6737B-20		■	■	■			
6740B						■	
6745B	■	■	■	■			
6747B/6747B-20	■	■	■	■			
6753B/6753B-10		■	■	■	■		
6759B/6759B-10	■	■	■	■	■		
6760B				■	■	■	
6763B		■	■	■	■	■	
6769B	■	■	■	■	■	■	
6772B							■

YIG-tuned oscillator for the next frequency band to be swept is then turned on and phase-locked.

The RF components common to all frequency bands and found in all models are described in the following paragraphs. The RF components peculiar to specific frequency bands and/or are found only in certain models described in later paragraphs as part of the description of that particular frequency band.

Common RF components that make up the RF microwave deck are:

- YIG-tuned Oscillators – The YIG-tuned oscillators generate high-power RF output signals that have low broadband noise and low spurious content. The oscillators are driven by the FM and main tuning coil currents and bias voltage from the YIG Driver PCBs. During the CW mode, the main tuning coil current tunes the oscillator to within a few megahertz of the final output frequency. The phase-lock circuitry of the YIG Loop then fine adjusts the oscillator's FM tuning coil current to make the output frequency exact and to reduce FM noise close to the carrier. In the sweep mode, the main tuning coil current tunes the oscillator through the swept frequency range. Phase-locking to fine adjust the oscillator's output frequency is only done at the bottom and top of the sweep ramp or on both sides of each band switch point. FM is also obtained by introducing an externally applied control voltage into the oscillator's FM tuning coil control path.
- Isolators – The isolators prevent the reflection of RF energy back into the YIG-tuned oscillators, which can cause frequency pulling. They pass forward wave RF energy with only 0.5 to 1 dB of attenuation; however, they attenuate reflected RF energy by 17 to 20 dB. Dual isolators attenuate reflected RF energy by up to 40 dB.
- Control Modulators – The control modulators provide variable attenuation to control the RF power output of the YIG-tuned oscillators. A portion of the RF input to the modulators is coupled out prior to modulation for use by the YIG Loop phase-lock circuitry. The level modulation driver current input is received from the A29 Rear Panel

Interface PCB where it is developed from the ALC control signal. Pulse modulation current is received from the A13 Pulse Generator PCB. The control modulators output modulated RF signals.

- Amplifiers – The RF amplifiers are used to increase the power output of the generated RF frequencies. The average power gain from a typical RF amplifier is 6 dB.
- PIN Switches – the PIN switches are current controlled variable attenuators that switch between available RF signals so that only one RF output signal at a time is coupled to the RF Output or Sampler circuitry. The PIN switches receive their drive current from the A29 PCB's PIN switch drivers. The PIN switches are not installed in single-band units having only one oscillator.
- Filters – The filters provide bandpass filtering of the RF signals to reduce harmonic emissions.
- Directional Coupler – The directional coupler transfers the modulated RF signals to the synthesizer's RF OUTPUT. A portion of the RF output is detected and coupled out for use in internal power leveling. The detected RF sample, along with a resistance representing the coupler's temperature, is routed to the A15 ALC PCB.
- Step Attenuators – The optional step attenuators provide up to 110 dB of attenuation for the RF output. Step attenuator drive current is received from the A29 Rear Panel Interface PCB.

2L-3 FREQUENCY BANDS 2 THRU 4, CIRCUIT DESCRIPTION

Since the RF microwave deck frequency bands 2 (8 to 12.4 GHz), 3 (12.4 to 20 GHz), and 4 (18 to 26.5 GHz) are very similar in operation, the following circuit description covers all three. Refer to the block diagram in Figure 2L-2 during the following description.

When operating the synthesizer in the CW or sweep modes, selection of a frequency or a band of frequencies to be swept within the range of 8 to 26.5 GHz causes the RF microwave deck frequency bands 2, 3, or 4 to generate the requested RF signals as follows.

2L-3.1 Frequency Control and FM Modulation

The appropriate YIG Driver PCB receives a dc tuning voltage (in CW mode) or a tuning ramp sweep voltage (in sweep mode) along with a +10V reference voltage from the A17 Analog Instruction PCB. The YIG driver uses these inputs to produce the main tuning coil current to drive the YIG-tuned oscillator. In sweep mode, this current tunes the oscillator through the selected swept frequency range. During CW mode, the main tuning coil current tunes the oscillator to within a few megahertz of the final output frequency.

The YIG-tuned oscillator's output RF signal is sent through an isolator to the control modulator. Before modulation, part of the RF input is coupled out to the Sampler MUX PIN Switch as an input to the YIG phase-lock loop. In the YIG phase-lock loop, the sampled RF is combined with a harmonic frequency derived from the coarse loop to produce a YIG IF signal. The YIG IF signal is then compared with a reference frequency derived from the fine loop. During CW mode, any detected phase differences are processed by the FM Driver PCB and sent as input to the YIG driver to fine adjust the YIG-tuned oscillator's FM tuning coil current and obtain an exact frequency output. During sweep mode for frequency sweeps of >50 MHz, phase-locking to fine tune the output frequency is only done at the bottom and top of the sweep ramp or on both sides of each bandswitch point. During sweep mode for frequency sweeps of ≤50 MHz, phase-locking to fine tune the output frequency is done at the center frequency of the sweep. In addition, frequency modulation of the output RF signal and YIG-tuned oscillator frequency sweeps of ≤50 MHz are accomplished by summing the appropriate signals into the FM control path of the YIG loop.

2L-3.2 Power Level Control and Amplitude Modulation (AM)

In addition to the RF signal from the YIG-tuned oscillator, the control modulator has two other inputs — the ALC input and the pulse input. The ALC input provides driver current to the PIN diodes that control the power level of the RF output signals from the YIG-tuned oscillator. This level control modulator driver current is received from the A29 PCB, where it is derived from the A15 PCB's ALC control signal input. The PIN diodes controlling the power level act as variable resistors. They have zero

ohms resistance at full drive current, reflecting all the RF back towards the YIG-tuned oscillator. Amplitude modulation of the RF output signal is accomplished by varying the ALC input driver current with the external modulation signal.

2L-3.3 Pulse Modulation

The pulse input provides driver current to the PIN diodes which control pulse modulation of the RF output signal. The pulse modulation driver current is received from the A13 Pulse Generator PCB. The PIN diodes controlling pulse modulation act as switches rather than variable resistors — they are either full-on or full-off. The level modulator PIN diodes are isolated from the pulse modulation PIN diodes by a "T" filter consisting of two capacitors and an inductor. This prevents the high-speed video pulses for the pulse modulation PIN diodes from modulating the level control modulator PIN diodes.

2L-3.4 Output Control

The modulated RF output signal is sent through a low-pass filter to the Main RF MUX PIN Switch. The low-pass filter provides bandpass filtering of the RF signal to reduce harmonic emissions. The Main RF MUX PIN Switch multiplexes the various control modulator outputs into a common output port. Drive current for the switch is received from the PIN switch drivers located on the A29 PCB. The switch input ports supporting frequency bands 2 through 4 (8 to 26.5 GHz) have additional high-pass filtering for the video pulses from the control modulator. The Main RF MUX PIN Switch is not installed in units having only one oscillator; a separate video filter is installed in these units.

2L-3.5 Power Level Detection/ALC Loop

The modulated RF signal output from the Main RF MUX PIN Switch is sent to the Directional Coupler for transfer to the RF OUTPUT connector. A portion of the RF output is detected and coupled out as an input to the ALC loop. The detected RF sample is routed to the A15 ALC PCB. In the ALC loop, the RF sample is compared with a reference voltage that represents the desired RF power output level. If the two voltages do not match, an error correction signal is fed from the A15 PCB to the PIN modulator driver circuit on the A29 PCB. The resulting modulator driver current to the control modulator causes the level control modulator diodes to adjust the RF power level output.

The directional coupler also has a built-in thermistor which outputs a resistance representing the coupler's temperature. This resistance is converted to a voltage by the A15 PCB and monitored by the A17 PCB's DVM circuit. As the ambient temperature changes, the A23 Microprocessor compensates for the output level to provide a stable RF-output-vs-temperature.

2L-4 FREQUENCY BANDS 0 AND 1, CIRCUIT DESCRIPTION

Since the RF microwave deck frequency band 0 (0.01 to 2 GHz) and band 1 (2 to 8.4 GHz) RF signals are generated using the same YIG-tuned oscillator, their circuit descriptions are combined. Refer to the block diagram in Figure 2L-2 for the following description.

Selecting a frequency or band of frequencies to be swept within the range of frequency band 1 causes the YIG-tuned oscillator to generate 2 to 8.4 GHz RF signals. Selecting a frequency or band of frequencies to be swept within the range of frequency band 0 causes the YIG-tuned oscillator to generate 6.01 to 8.0 GHz RF signals. The 6.01 to 8.0 GHz RF signals are then down converted to produce 0.01 to 2 GHz RF signals.

The YIG-tuned oscillator's output RF signal is sent through a 10 dB attenuator to the control modulator. This control modulator operates the same as the other control modulators; the only difference is that it has an additional RF output for the down converter. Refer to paragraphs 2L-3.1, 2L-3.2, and 2L-3.3 for descriptions of frequency and power level control and AM, FM, and pulse modulation operation.

2L-4.1 Down Converter

The 0.01 to 2 GHz Down Converter contains a 6 GHz voltage-controlled oscillator (VCO) that is phase-locked to the 500 MHz reference oscillator through a sampling phase detector. The 6 GHz VCO's phase-lock condition is monitored by the A23 Microprocessor via the A17 PCB DVM circuit. The 6 GHz VCO is on at all times; however, the down converter amplifier is powered on by the A18 YIG Driver PCB only when the 0.01 to 2 GHz band is selected. Additionally, when frequency band 0 is not selected, a PIN switch at the down converter RF input is activated. This prevents the 6 GHz VCO signal from leaking back through the control modulator and showing up as a spur in the 3.5 to

the switch is received from the PIN switch driver on the A29 PCB.

During frequency band 0 operation, the modulated 6.01 to 8.0 GHz RF signal output from the control modulator is sent to the 0.01 to 2 GHz Down Converter. The modulated 6.01 to 8.0 GHz RF signal is then mixed with the 6.0 GHz VCO signal resulting in a modulated 0.01 to 2 GHz RF signal. The resultant RF signal is sent through a 2 GHz Low-Pass Filter, then amplified and output to the Switched Filter. A portion of the RF output is detected and coupled out as an input to the ALC loop. Refer to paragraph 2L-3.5 for a description of power level detection and ALC loop operation.

2L-4.2 Switched Filter

The switched filter provides rejection of the harmonics generated by the 2 to 8.4 GHz YIG-tuned oscillator and multiplexing of the 0.01 to 2 GHz RF signal from the down converter. Drive current for the switched filter is received from the PIN switch filter drivers located on the A29 PCB.

The modulated 2 to 8.4 GHz RF signal from the control modulator is sent through an RF amplifier to the switched filter. The switched filter's 2 to 8.4 GHz RF input provides high-pass filtering for the video pulses from the control modulator. The modulated RF signal has three filtering paths; the 3.5 GHz filter path, the 6 GHz filter path, and the 8 GHz filter path (the actual 8 GHz Low-Pass Filter is located external to the switched filter). Since the down converter already provides filtering of the 0.01 to 2 GHz RF signal, the signal is multiplexed through to the switched filter output.

2L-4.3 RF Output

The modulated 0.01 to 8.4 GHz RF signal is sent through an 8 GHz low-pass filter to the Main RF MUX PIN Switch. The Low-Pass Filter provides bandpass filtering of the RF signal to reduce harmonic emissions. The Main RF MUX PIN Switch multiplexes the various control modulator outputs into a common output port. Drive current for the switch is provided by the PIN switch drivers located on the A29 PCB. The Main RF MUX PIN Switch is not installed in units having only one oscillator.

The modulated RF signal output from the Main RF MUX PIN Switch is sent to the Directional Coupler for transfer to the synthesizer's RF OUTPUT connector. When operating in the frequency range of 2 to 8.4 GHz, the portion of the RF output detected and coupled out to the A15 ALC PCB provides an input to the ALC loop. Refer to paragraph 2L-3.5 for a description of power level detection and ALC loop operation.

2L-5 FREQUENCY BAND 5, CIRCUIT DESCRIPTION

Frequency band 5 (26.5 to 40 GHz) RF signals are produced by frequency doubling the band 3 (12.4 to 20 GHz) YIG-tuned oscillator's RF signal output. Refer to the block diagram in Figure 2L-2 during the following description.

Selection of a frequency or band of frequencies to be swept within the frequency range of 26.5 to 40 GHz causes the band 3 YIG-tuned oscillator to generate 13.25 to 20 GHz RF signals. Since RF frequency control and FM and pulse modulation of the RF signal are exactly the same as described for frequency band 3 in paragraph 2L-3, they will not be covered here. Power level control and amplitude modulation of the RF signal takes place in the Frequency Doubler/Amplifier/Modulator. The description of the RF signal development starts with the modulated 13.25 to 20 GHz RF signal at the output of the control modulator.

2L-5.1 DPDT PIN Switch

The modulated RF signal is sent through an RF amplifier to the DPDT PIN Switch. The DPDT PIN switch multiplexes the band 2 (8 to 12.4 GHz) and band 3 (12.4 to 20 GHz) control modulator outputs into two output ports — an 8 to 20 GHz port and a 13.25 to 20 GHz port. Drive current for the switch is provided by the PIN switch drivers located on the A29 PCB. The modulated 8 to 20 GHz RF signal is sent to the Main RF MUX PIN Switch through a 20 GHz low-pass filter. The modulated 13.25 to 20 GHz RF signal is sent to the frequency Doubler/Amplifier/Modulator by way of a 6 dB attenuator. The DPDT PIN Switch is not installed in units having only one oscillator.

2L-5.2 Frequency Doubler/Amplifier/ Modulator

During the frequency band 5 operation, the modulated 13.25 to 20 GHz RF signal output from the control modulator is sent via the DPDT PIN Switch to the Frequency Doubler/Amplifier/Modulator. The

to the Frequency Doubler/Amplifier/Modulator. The Frequency Doubler/Amplifier/Modulator is powered on by the A20 YIG Driver PCB. The modulated RF signal is doubled in frequency to 26.5 to 40 GHz. The doubled RF signal is then amplified and sent to the modulator. Power level control and AM modulation of the 26.5 to 40 GHz RF signal is accomplished in the modulator. Refer to paragraph 2L-3.2 for a description of power level control and amplitude modulation. The modulated RF signal output from the frequency Doubler/Amplifier/Modulator is sent through a 40 GHz Low-Pass Filter to the Main RF MUX PIN Switch.

2L-5.3 RF Output

In multi-band units containing frequency band 5, the Main RF MUX PIN Switch's four input ports are 0.01 to 8 GHz, 8 to 20 GHz, 20 to 26.5 GHz, and 26.5 to 40 GHz. Refer to paragraph 2L-3.4 for a description of switch operation. The Main RF MUX PIN Switch is not installed in units having only a single oscillator.

The modulated RF signal output from the Main RF MUX PIN Switch is sent to the directional coupler for transfer to the synthesizer's RF OUTPUT. As in the other frequency bands, a portion of the RF output is detected and coupled out as input to the ALC loop.

2L-6 FREQUENCY BAND 6, CIRCUIT DESCRIPTION

Frequency band 6 (40 to 60 GHz) RF signals are produced by frequency tripling the band 3 (12.4 to 20 GHz) YIG-tuned oscillator's RF signal output. Refer to the block diagram (Figure 2L-1) during the following description.

NOTE:
Modulated RF output in the frequency range of 40 to 60 GHz is only available from the single band synthesizer, model 6772B.

Selection of a frequency or band of frequencies to be swept within the frequency range of 40 to 60 GHz causes the band 3 YIG-tuned oscillator to generate 13.33 to 20 GHz RF signals. Since the control of the RF frequency and power level and the modulation of the RF signal are exactly the same as described for frequency band 3 in paragraph 2L-3, they will not be covered here. The description of the RF signal development will start with the modulated 13.33 to 20 GHz RF signal at the output of the control modulator.

The modulated RF signal is sent through an RF amplifier to the frequency tripler. The frequency tripler is powered on by the A20 YIG Driver PCB. The modulated RF signal is tripled in frequency to

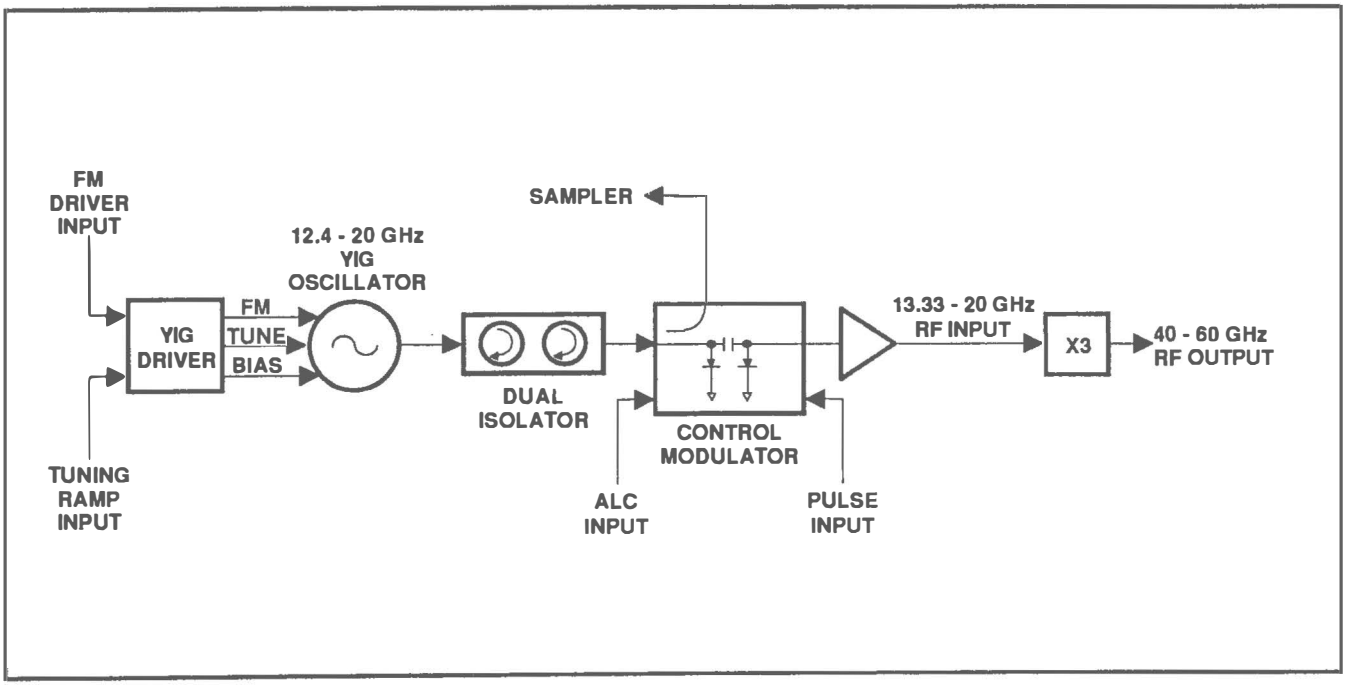


Figure 2L-1. Typical RF Microwave Deck Frequency Band 6 Block Diagram

40 to 60 GHz. The modulated RF signal output from the frequency tripler is sent via the WR-19 waveguide to the RF OUTPUT connector. The frequency tripler and RF OUTPUT connectors are both WR-19 waveguides (UG-383/U flange).

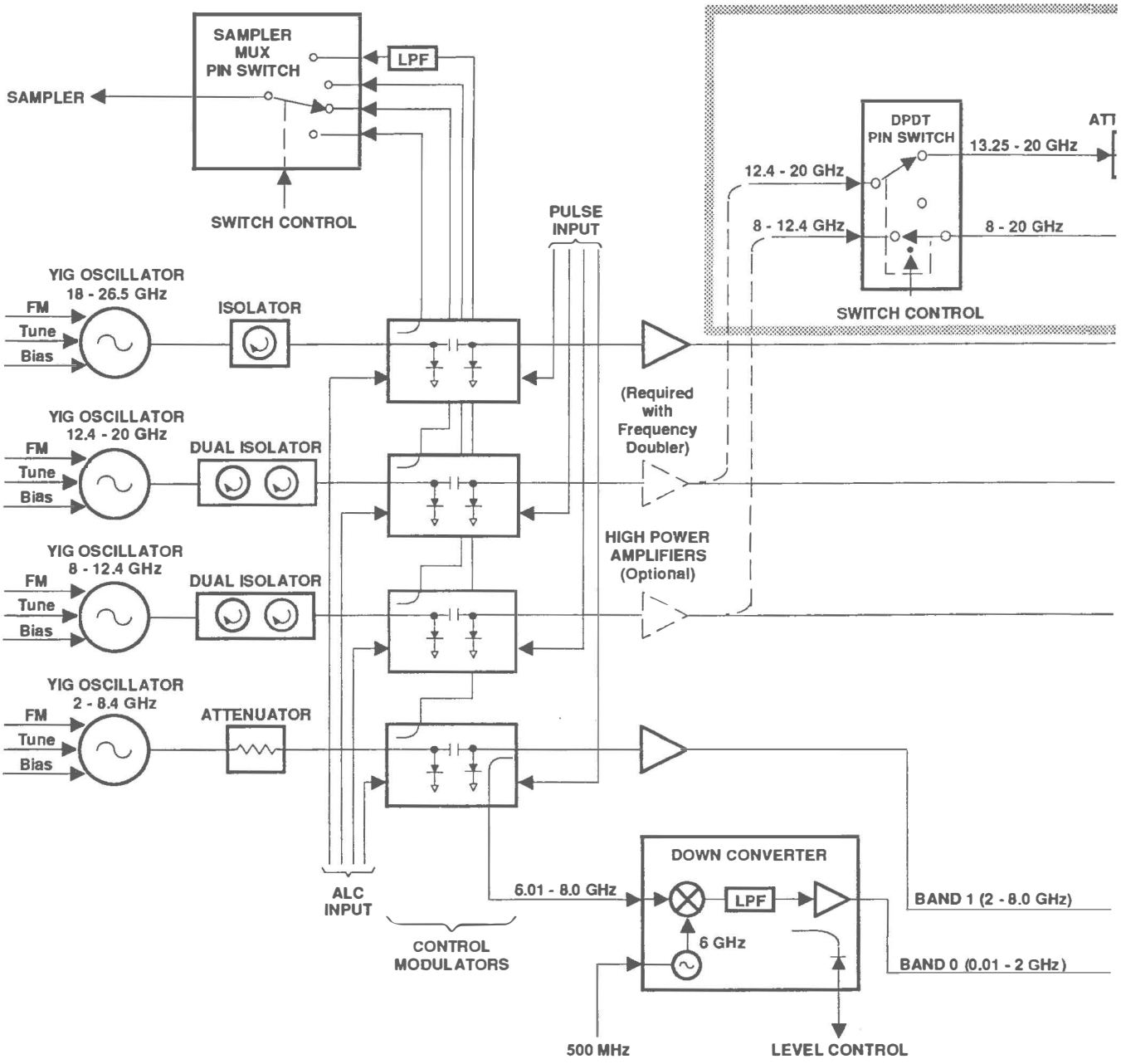
An external power level detector must be used with the model 6772B synthesizer to obtain an RF sample for the ALC loop. Refer to Section 2K-ALC/Pulse Modulation for a description of external ALC leveling.

2L-7 RF MICROWAVE DECK ASSEMBLY, TROUBLESHOOTING

Refer to the troubleshooting information located in the front portion of Section 2-System Description and Troubleshooting. This information provides a list of error codes that may be displayed as a result of failures of components on the RF microwave deck assembly and probable causes of the failures.

2L-8 RF MICROWAVE DECK ASSEMBLY, SERVICE SHEETS

Table 2L-1 on the first page of this section presents the arrangement of the block diagrams and a parts locator diagram for the RF microwave deck assembly and its components.


SAMPLER MUX PIN SWITCH
LPF
SAMPLER
SWITCH CONTROL
PULSE INPUT
DPDT PIN SWITCH
12.4 - 20 GHz
8 - 12.4 GHz
13.25 - 20 GHz
8 - 20 GHz
SWITCH CONTROL
YIG OSCILLATOR 18 - 26.5 GHz
FM
Tune
Bias
ISOLATOR
YIG OSCILLATOR 12.4 - 20 GHz
DUAL ISOLATOR
YIG OSCILLATOR 8 - 12.4 GHz
DUAL ISOLATOR
YIG OSCILLATOR 2 - 8.4 GHz
ATTENUATOR
(Required with Frequency Doubler)
HIGH POWER AMPLIFIERS (Optional)
ALC INPUT
CONTROL MODULATORS
DOWN CONVERTER
6.01 - 8.0 GHz
LPF
6 GHz
BAND 1 (2 - 8.0 GHz)
BAND 0 (0.01 - 2 GHz)
500 MHz
LEVEL CONTROL

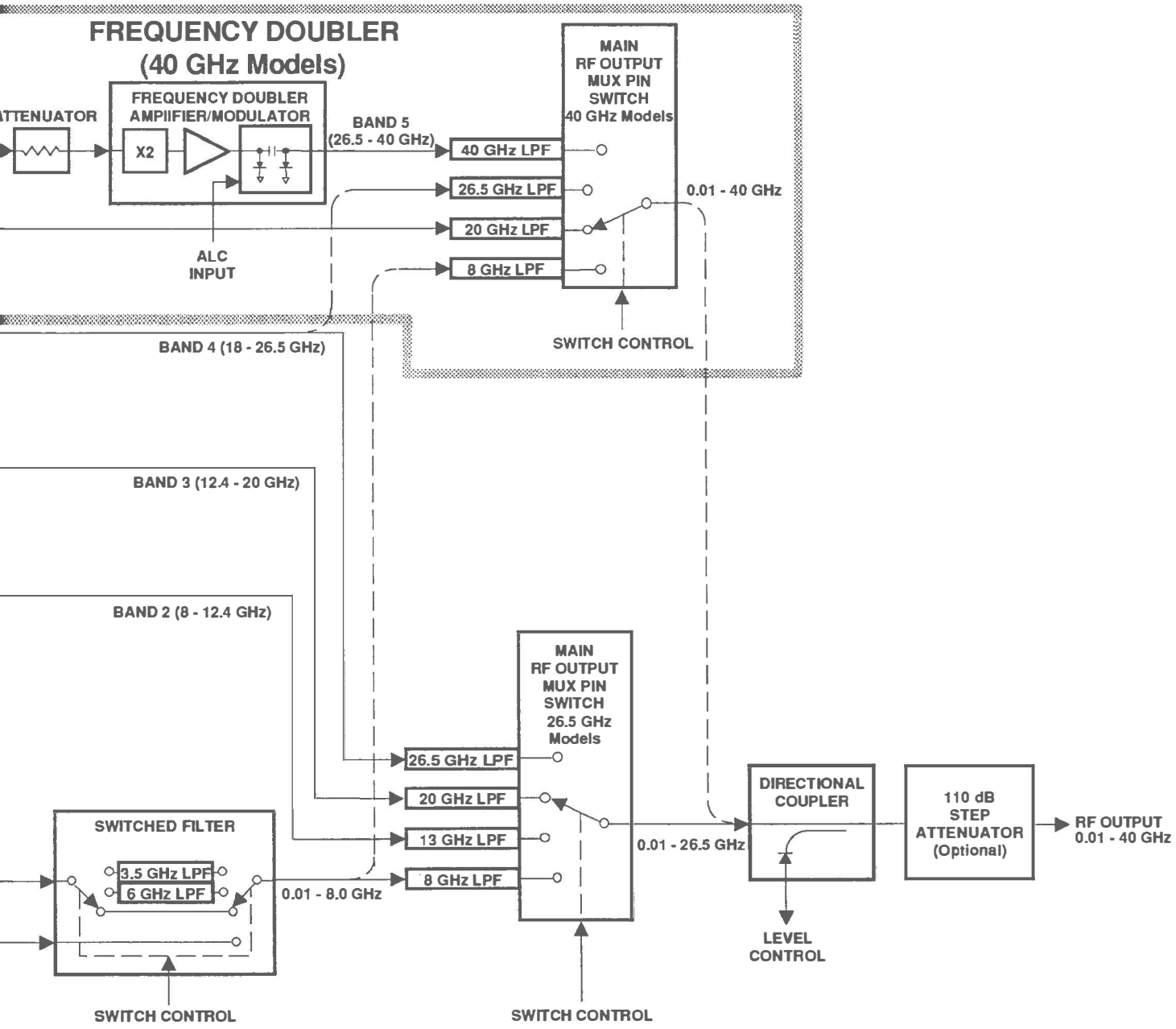
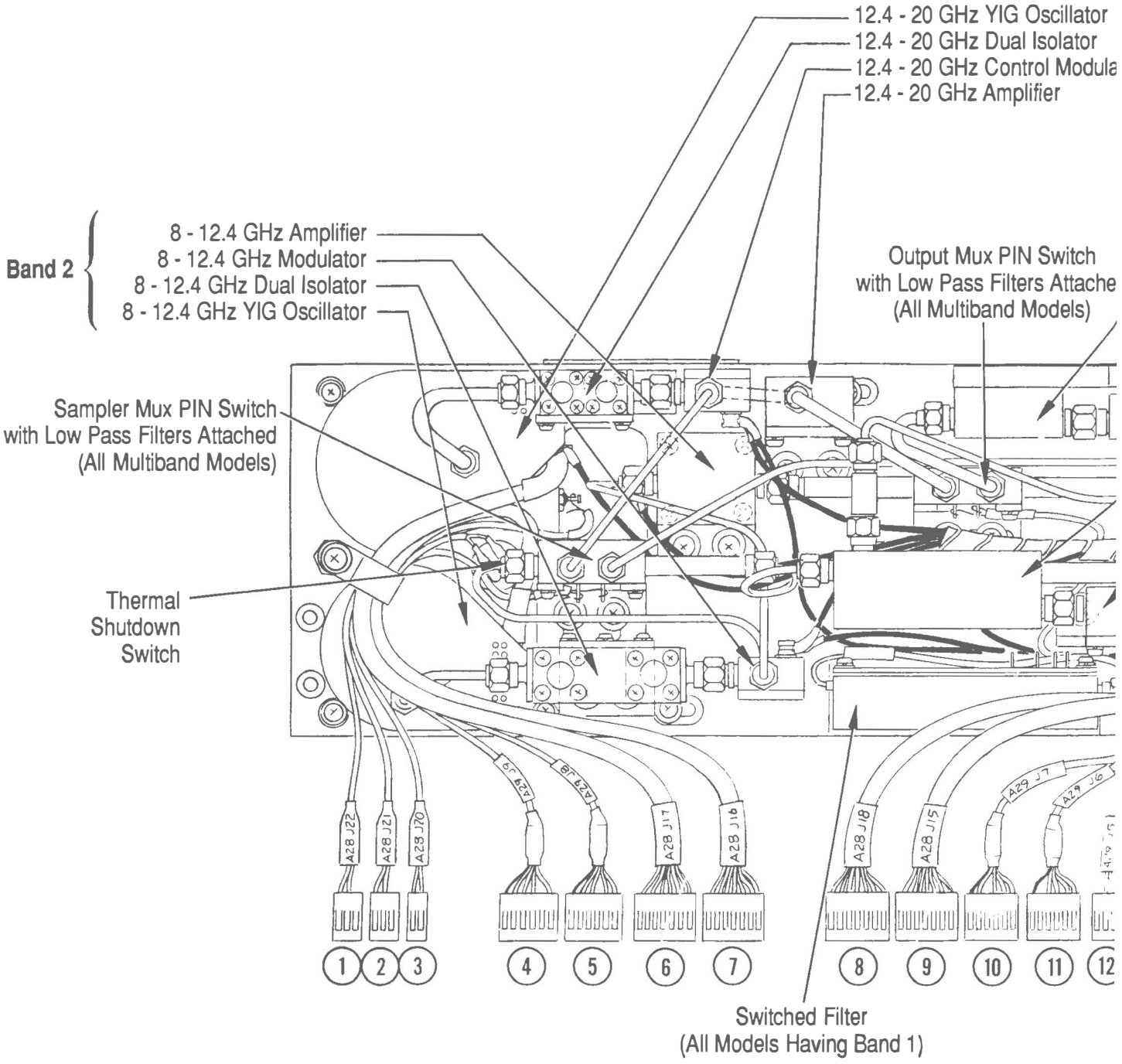


Figure 2L-2. RF Microwave Deck Block Diagram

Table 2L-3. RF Microwave Deck Connections

Diagram Number	From/To Connection	Purpose
1	A28J22 to A31 Power Amplifier/Multiplier PCB	+15V LP Power
2	A28J21 to A30 Sampler/IF Amplifier PCB	+15V LP Power
3	A28J20 to Microwave Deck Thermal Shutdown Switch	Thermal Shutdown
4	A29J9 to SamplerMux PIN Switch	PIN Switch Drive
5	A29J8 to DPDT Mux PIN Switch	PIN Switch Drive
6	A28J17 to Frequency Band 3 YIG-tuned Oscillator	Bias Voltage and Tuning Current
7	A28J16 to Frequency Band 2 YIG-tuned Oscillator	Bias Voltage and Tuning Current
8	A28J18 to Frequency Band 4 YIG-tuned Oscillator	Bias Voltage and Tuning Current
9	A28J15 to Frequency Band 1 YIG-tunedOscillator	Bias Voltage and Tuning Current
10	A29J7 to the 0.01 to 8 GHz Switched Filter	Switch Drive
11	A29J6 to Main RF Mux PIN Switch	PIN Switch Drive
12	A29J5 to Frequency Douibler/Amplifier/Modulator	Modulator Drive
13	A29J4 to Frequency Band 4 Control Modulator	Modulator Drive
14	A29J3 to Frequency Band 3 Control Modulator	Modulator Drive
15	A29J2 to Frequency Band 2 Control Modulator	Modulator Drive
16	A29J1 to Frequency Band 1 Control Modulator	Modulator Drive
17	A29J14 to Down Converter Input Switch	PIN Switch Drive
18	A28J13 to the Down Converter	Level and Thermal Detector Voltage to A15 ALC PCB
19	A28J12 to the Directional Coupler	Level and Thermal Detector Voltage to A15 ALC PCB
20	A28J11 to Frequency Doubler/Amplifier/Modulator	+12V Power
21	A28J10 to the Down Converter	±15V G and +15V Power and 6 GHz Loop Monitor
22	A13J6 to Frequency Band 1 Control Modulator	Pulse Modulation Drive
23	A13J7 to Frequency Band 2 Control Modulator	Pulse Modulation Drive
24	A13J8 to Frequency Band 3 Control Modulator	Pulse Modulation Drive
25	A13J9 to Frequency Band 4 Control Modulator	Pulse Modulation Drive
26	A12J4 to A30 Sampler/IF Amplifier PCB	20 to 32.1 MHz IF from A30 PCB
27	A4J1 to A31 Power Amplifier/Multiplier PCB	440 to 490 MHz from A4 PCB
28	A5J3 to Down Converter	500 MHz from Reference Loop

Figure 2L-3. Typical RF Microwave Deck Parts Locator Diagram (Sheet 1 of 3; Connector Listing)


12.4 - 20 GHz YIG Oscillator
12.4 - 20 GHz Dual Isolator
12.4 - 20 GHz Control Modula
12.4 - 20 GHz Amplifier
Band 2
8 - 12.4 GHz Amplifier
8 - 12.4 GHz Modulator
8 - 12.4 GHz Dual Isolator
8 - 12.4 GHz YIG Oscillator
Output Mux PIN Switch
with Low Pass Filters Attache
(All Multiband Models)
Sampler Mux PIN Switch
with Low Pass Filters Attached
(All Multiband Models)
Thermal
Shutdown
Switch
A28 J22
A28 J21
A28 J20
A28 J17
A28 J16
A28 J18
A28 J15
1
2
3
4
5
6
7
8
9
10
11
12
Switched Filter
(All Models Having Band 1)

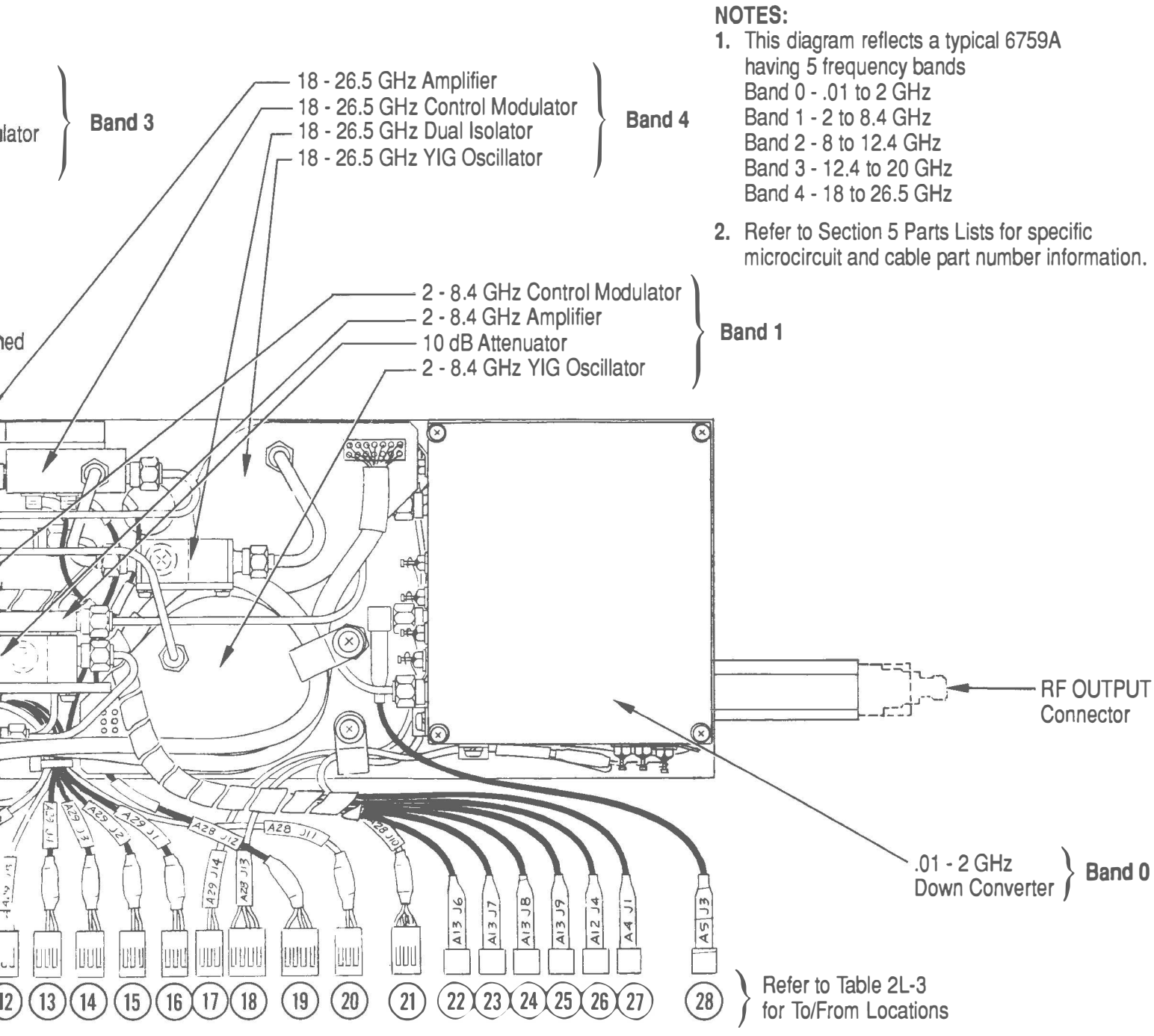
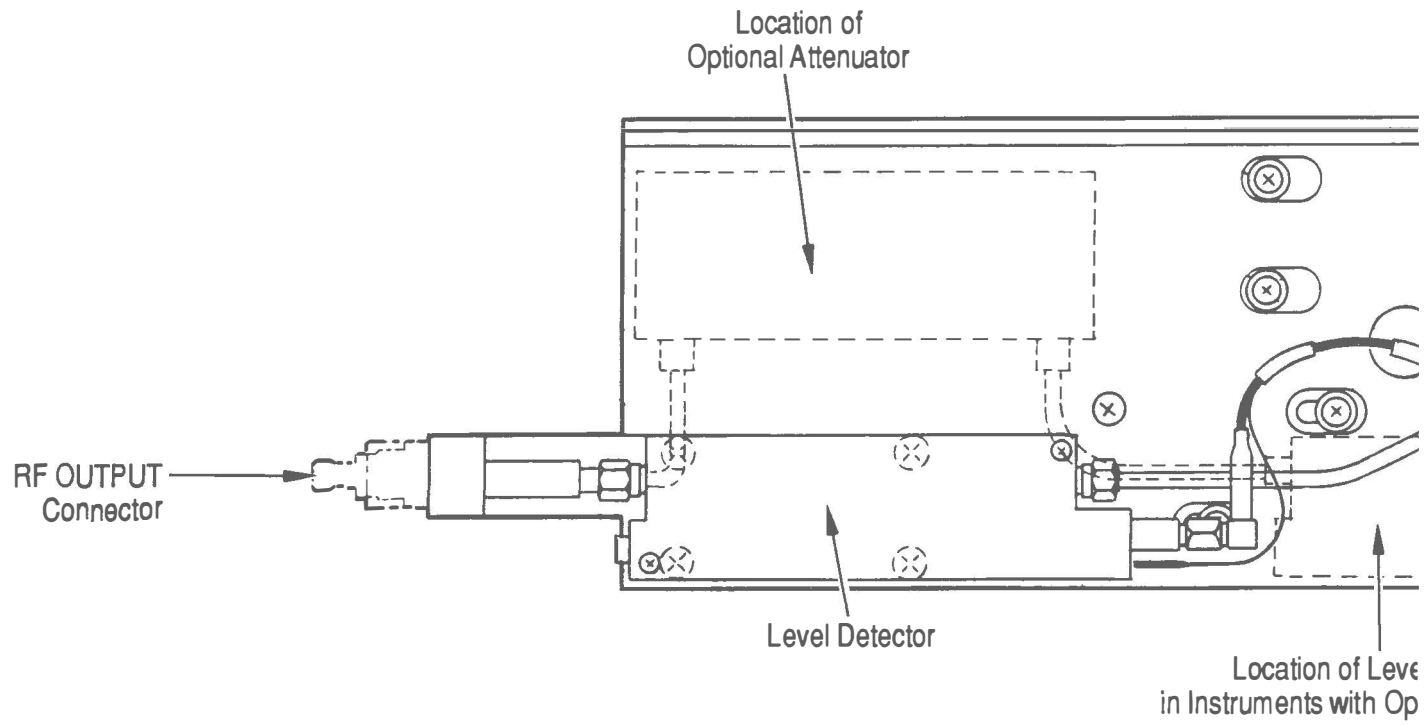


Figure 2L-3. Typical RF Microwave Deck Parts Locator Diagram
(Sheet 2 of 3; Top View)


Location of
Optional Attenuator
RF OUTPUT
Connector
Level Detector
Location of Leve
in Instruments with Op

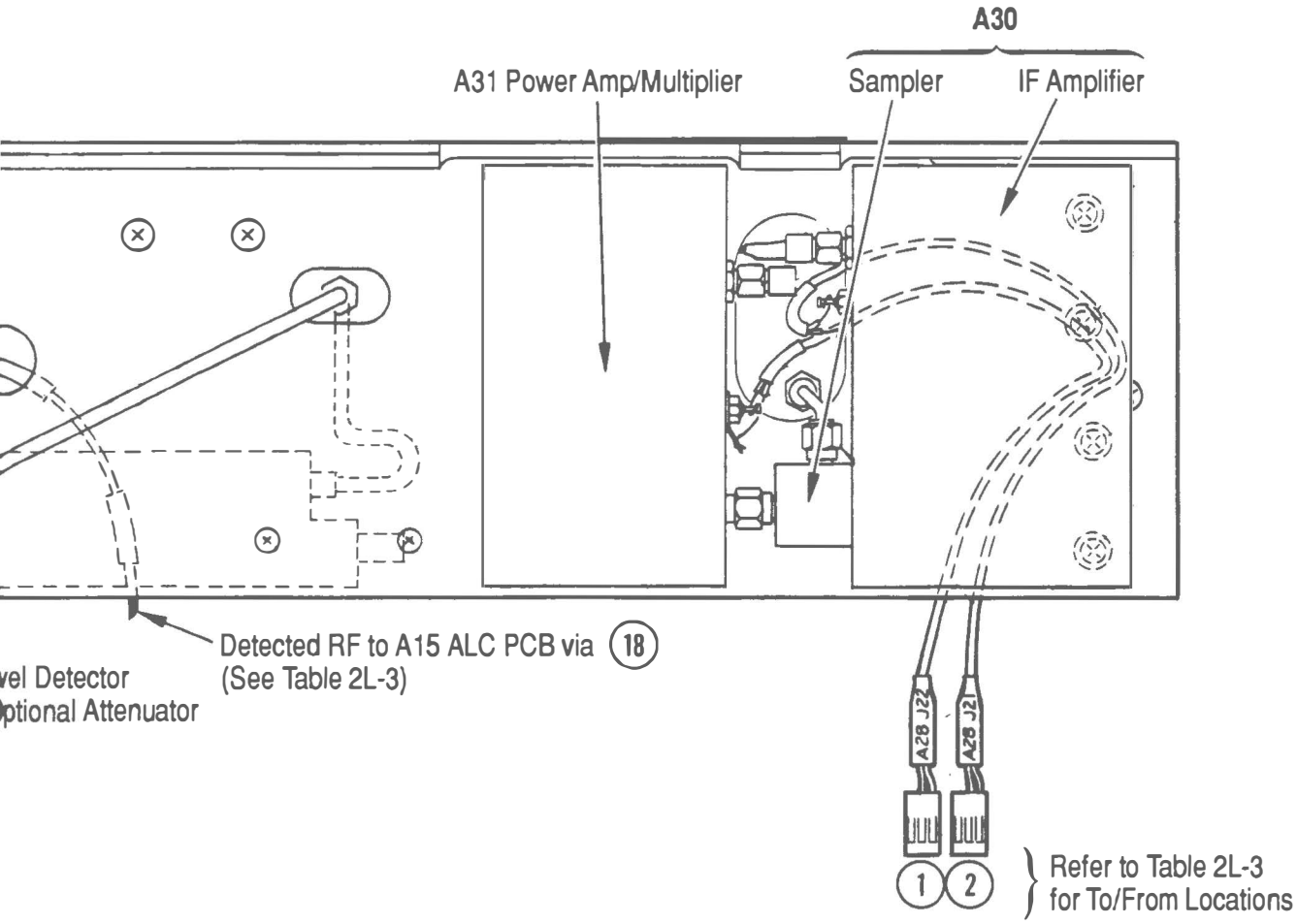


Figure 2L-3. Typical RF Microwave Deck Parts Locator Diagram
(Sheet 3 of 3; Bottom View)

2M–MOTHERBOARD/INTERCONNECTIONS A28 PCB, INTERCONNECTION CABLES

2M-1 INTRODUCTION

This section contains identification and service information for the inter-assembly RF, control signal and power distribution paths of the synthesizer. An overview of this section is listed in Table 2M-1 (below). Refer also to the referenced information in Section 2A–Power Supply and the general reference information in Section 2–System Description and Troubleshooting.

Table 2M-1. Motherboard/Interconnection Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 2M-2	2M-1
Detailed Circuit Description*	Para. 2A-3	2A-2
Block Diagram*	Fig. 2A-1	2A-3
* Power Supply Circuits		
PCB LEVEL		
A28 Motherboard PCB:		
Parts Locator Diagram	Fig. 2M-5	2M-6
Connector Cross-Reference	Tbl. 2M-2	2M-8
Schematic (Sheet 1 of 2)	Fig. 2M-6	2M-7
(Sheet 2 of 2)	"	2M-9

2M-2 OVERALL DESCRIPTION

An overall interconnect block diagram for the synthesizer is shown in Figure 2M-2. Note that the PCBs contained in the synthesizer are located/grouped in the following locations.

- RF Casting PCBs
- Microwave Deck Control PCBs
- A22 Power Regulator PCB
- Digital Control PCBs
- A25 Power Supply PCB
- Front Panel
- Rear Panel

As shown in Figure 2M-2, the following interconnection methods are used.

- Motherboard Signal Paths
- Motherboard to PCB via Filtercons
- Wire Harness and Ribbon Cables
- Coaxial Cables

A fifth method—rigid coaxial cable—is used to interconnect the components located on the microwave deck. Refer to Section 2L.

2M-3 A28 MOTHERBOARD PCB AND CABLE INTERCONNECTS

The following paragraphs describe the functions of the A28 Motherboard and the wire-harness/ribbon cable and coaxial cable interconnects of the synthesizer. The power supply circuits located on the A28 Motherboard PCB are described in detail in Section 2A–Power Supply.

2M-3.1 Motherboard/Interconnect Circuits Description

The A28 Motherboard PCB is an interconnect subsystem that contains connectors and signal pathways that link the various circuit subsystems of the synthesizer. All PCBs are either mounted directly onto the board or cabled to remote A28 PCB connectors. Shown on sheet 2 of the A28 Motherboard PCB schematic set (Figure 2M-6), are the connectors and signal pathways. Table 2M-2 provides location cross-references for all of the connectors shown in Figure 2M-6.

Shown on sheet 1 of the schematic set is the distribution of the primary ac power from the rear panel via the A26 Line Filter PCB to the A28 Motherboard PCB. The bridge rectifiers for the +30V and ±165V unregulated dc supplies are located on the Motherboard. The Motherboard also contains the LINE switch relay, K1, and the fan driver (switching) circuits for the synthesizer's dc fan. The schematic diagram and parts locator diagram for the A26 Line Filter are located in Section 2A–Power Supply.

WARNING

Voltages hazardous to life are present throughout the Power Supply circuits, *even when the front panel LINE switch is in STANDBY position.*

The ac line voltage and the +24 Vdc are always present whenever the line cord is connected to the ac line voltage source. Use utmost care to avoid electrical shock anytime maintenance procedures are performed.

Refer to the summary diagram located at the bottom of sheet 1 of the A28 PCB schematic set. This simplified schematic diagram shows the connection of the +30V unregulated dc to the +24V regulator circuit located on the A22 PCB. It also shows the distribution of the +24V regulated dc to the 10 MHz Reference Oscillator assembly, the LINE switch, the LINE switch relay, and the dc fan driver circuits.

An overall block diagram and detailed descriptions of the operation of all synthesizer power supply circuits, including those located on the A28 Motherboard PCB, are contained in Section 2A-Power Supply.

2M-3.2 Filtercons

Filtercons are pi-filter circuit elements that are used to connect all control signal and power supply circuit paths from the A28 Motherboard PCB to the A3-A13 PCBs, located in the RF Casting, and the A1/A2 PCBs, mounted on the front panel casting. The locations of the A3-A13 filtercons are shown in Figure 2M-5 (page 2M-6). A typical filtercon application is shown in Figure 2M-1.

2M-3.3 Wiring Harnesses/Ribbon Cables

Figure 2M-3 is a diagram of the synthesizer's wire harness and ribbon cable interconnections. Most RF Microwave Deck control signals are routed from the A15-A21 PCB control circuits via Motherboard circuit paths/connectors through wiring harnesses to the RF Microwave Deck components. The remainder of these control signals originate on the A29 Rear Panel Interface PCB and are routed to the RF Microwave Deck components in a similar manner.

Many of the synthesizer's front and rear panel input/output signals are routed through wiring harnesses and ribbon cables to connectors on the Motherboard where they are distributed to the various PCB circuits via Motherboard circuit paths. Most signals that interface with A29 PCB circuits are also routed via Motherboard circuit paths/connectors and ribbon cables to the A29 PCB.

2M-3.4 RF Casting Coaxial Cables

Figure 2M-4 shows the coaxial cable interconnections that are used to distribute RF signals between the RF Casting PCBs, the RF Microwave Deck components, and the synthesizer's front/rear panel RF and pulse connections.

2M-3.5 RF Microwave Deck Interconnections

The interconnections of the RF Microwave Deck components are fully documented in Section 2L. Figure 2L-2, the parts locator diagram, shows the semi-rigid coaxial interconnections between the RF Microwave Deck components. In addition, it shows the various wiring harnesses, ribbon cables, and coaxial cables connecting the RF Microwave Deck components to the A28 PCB, the A29 PCB, and the PCBs located in the RF Casting.

2M-4 A28 MOTHERBOARD PCB TROUBLESHOOTING

Refer to Section 2–System Description and Troubleshooting for information pertaining to troubleshooting of the power supply circuits located on the A28 Motherboard PCB. This information provides a list of error codes that may be displayed as a result of power supply failures and probable causes of the failures. Refer also to Section 2A–Power Supply.

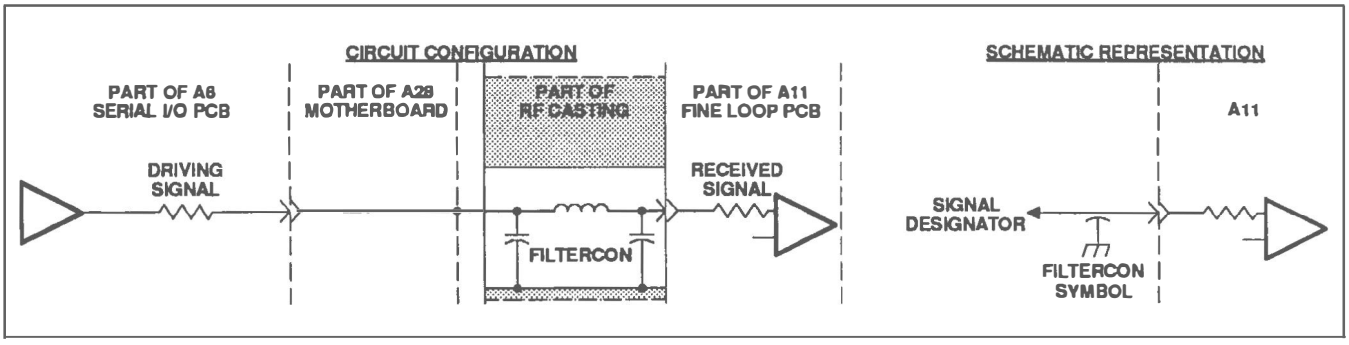
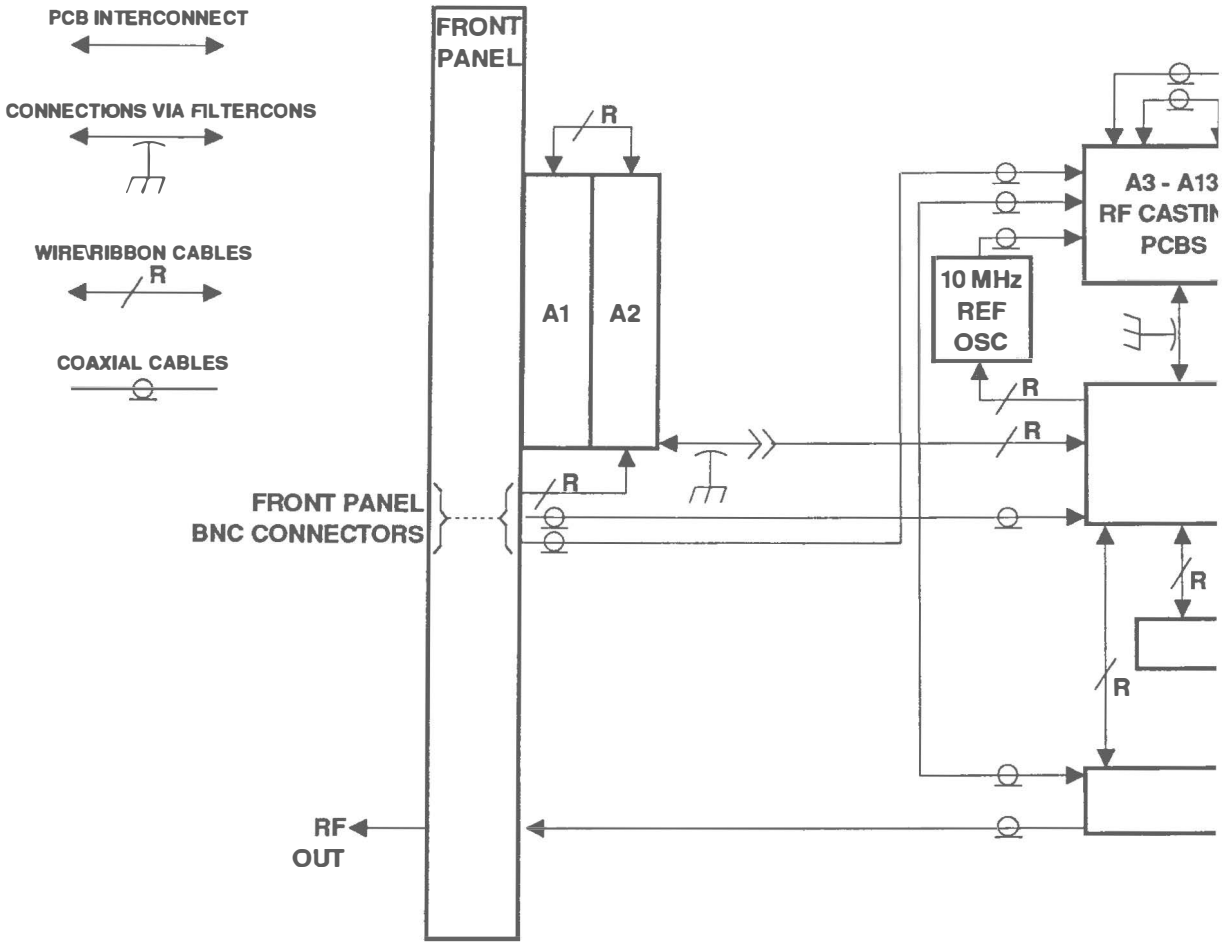


Figure 2M-1. Typical Filtercon Connection Between Motherboard Circuit Path and PCB Input


PCB INTERCONNECT
CONNECTIONS VIA FILTERCONS
WIRE\RIBBON CABLES
R
COAXIAL CABLES
FRONT PANEL
R
A1
A2
10 MHz REF OSC
A3 - A13 RF CASTI PCBS
R
R
FRONT PANEL BNC CONNECTORS
R
R
R
RF OUT

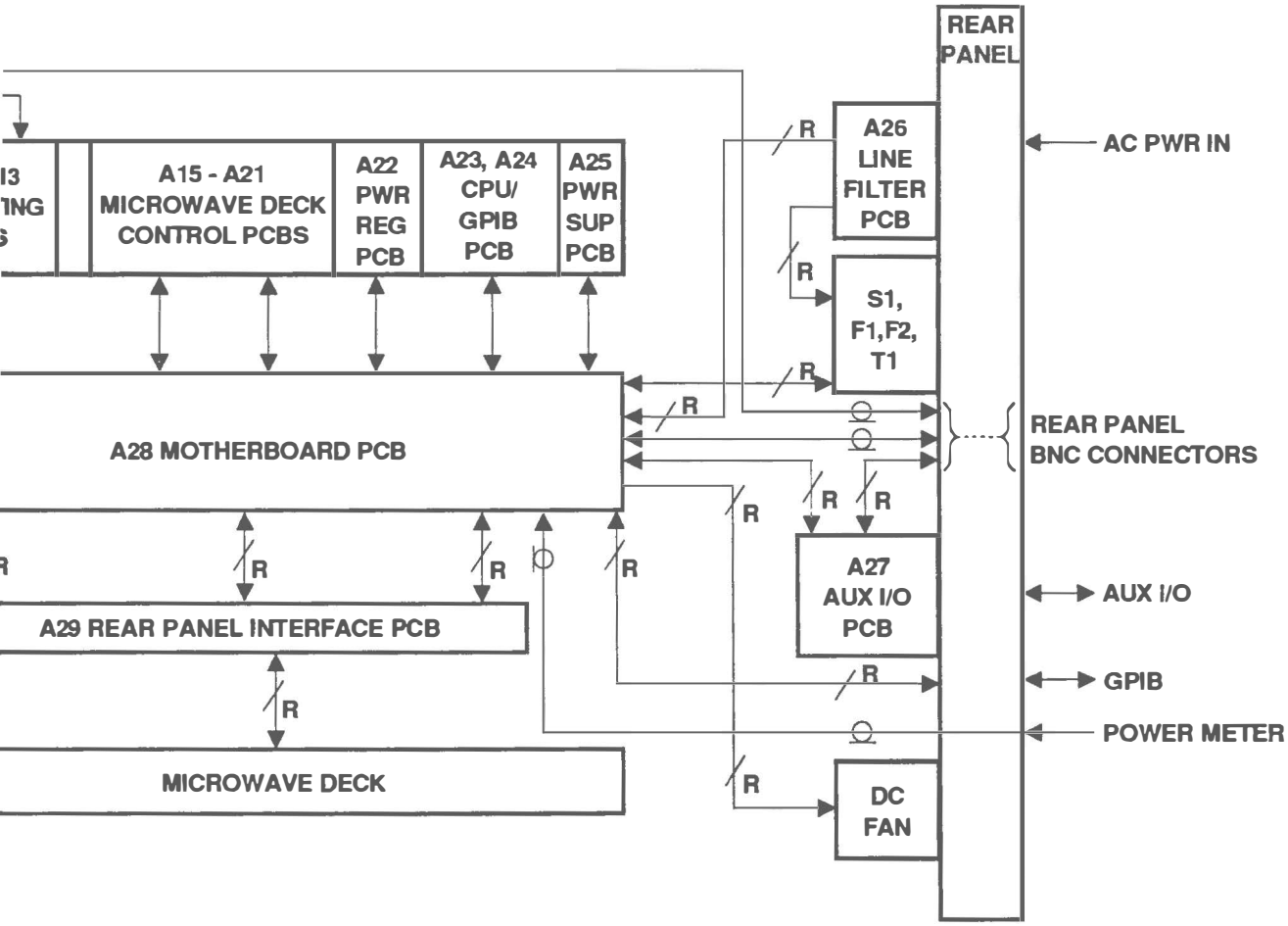
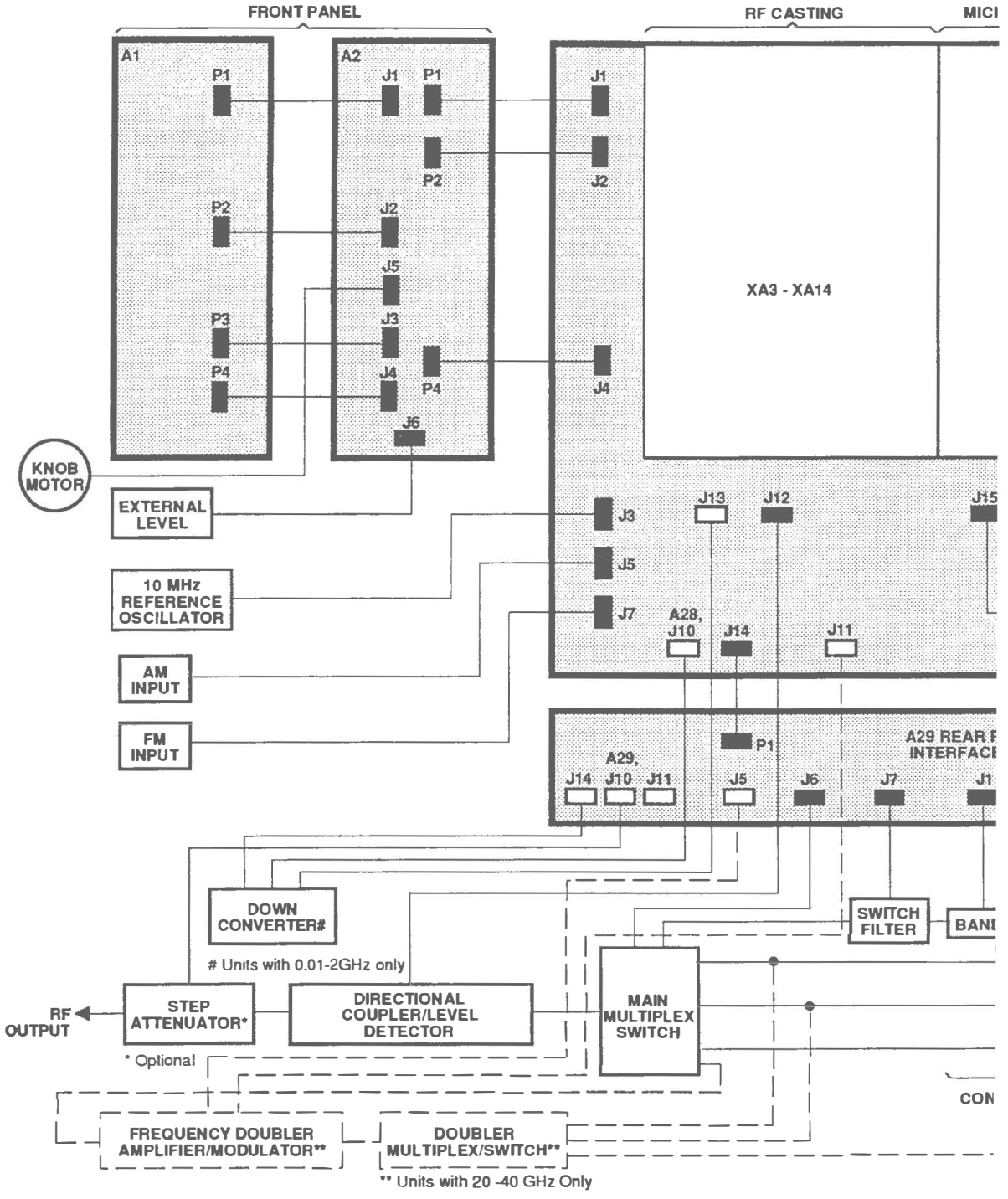


Figure 2M-2. Conceptual Block Diagram of 67XXB Interconnects


FRONT PANEL
RF CASTING
A1
A2
P1
J1
P1
P2
J1
J2
P2
J2
P3
J5
J3
P4
J4
P4
J4
J6
XA3 - XA14
KNOB MOTOR
EXTERNAL LEVEL
10 MHz REFERENCE OSCILLATOR
AM INPUT
FM INPUT
J3
J5
J7
J13
J12
A28, J10
J14
J11
P1
A29, J14 J10 J11
J5
J6
J7
A29 REAR INTERFACE
DOWN CONVERTER#
Units with 0.01-2GHz only
SWITCH FILTER
RF OUTPUT
STEP ATTENUATOR*
DIRECTIONAL COUPLER/LEVEL DETECTOR
MAIN MULTIPLEX SWITCH
* Optional
FREQUENCY DOUBLER AMPLIFIER/MODULATOR**
DOUBLER MULTIPLEX/SWITCH**
** Units with 20 -40 GHz Only

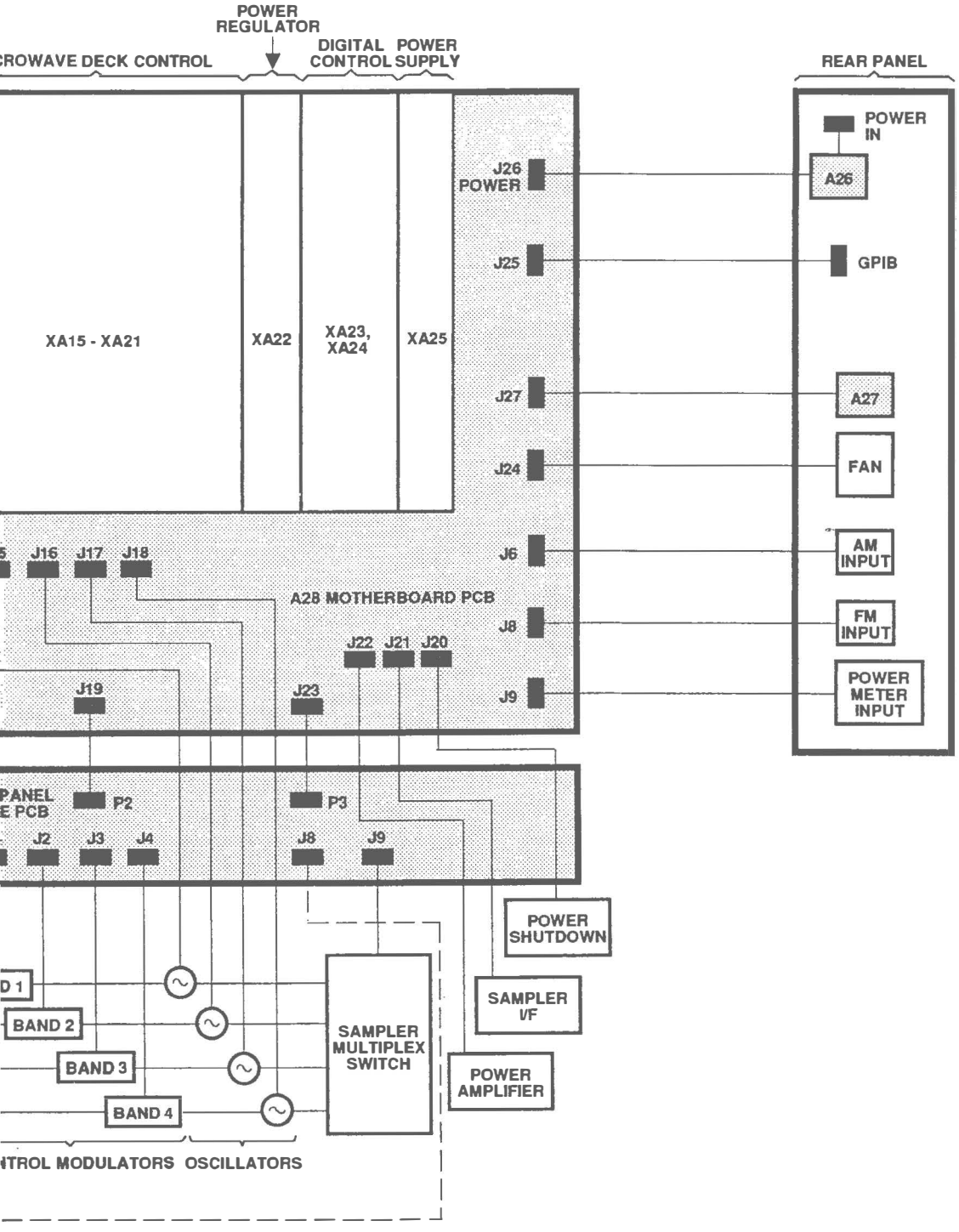
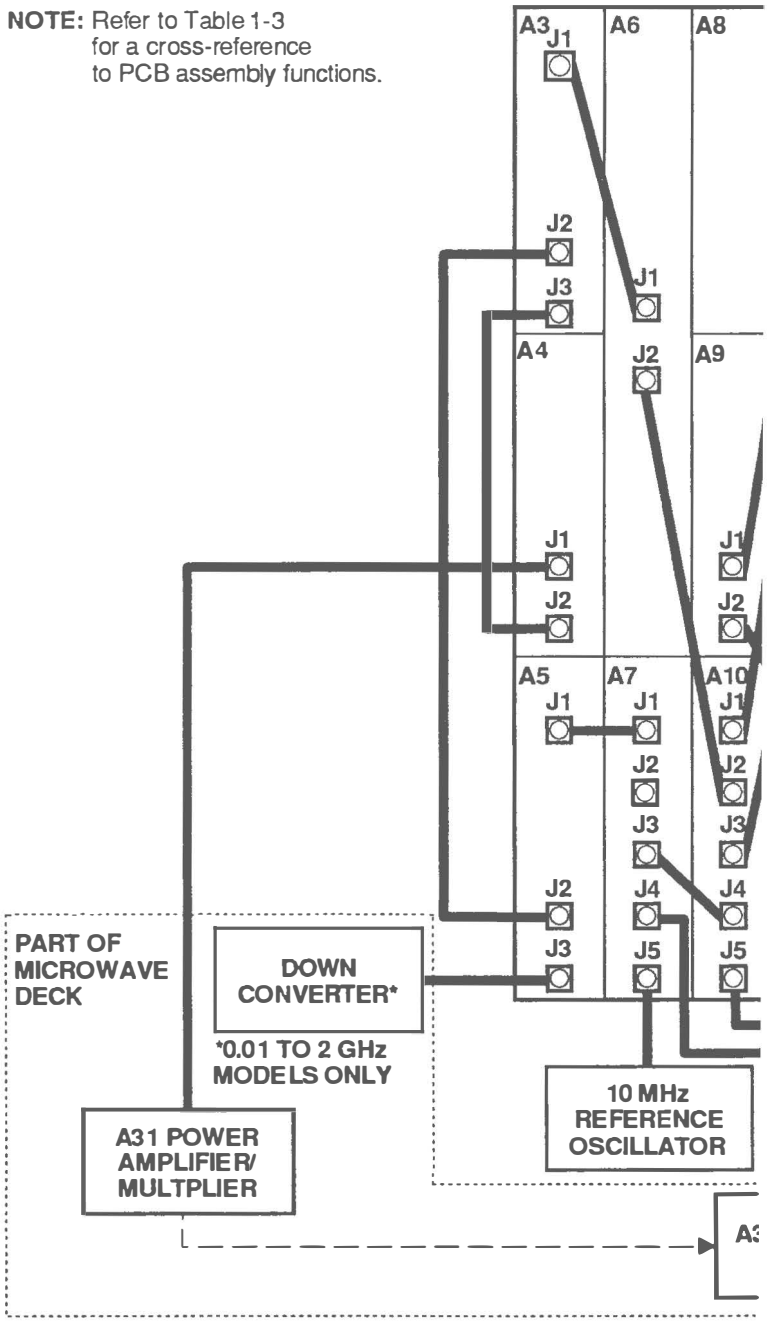


Figure 2M-3. 67XXB Synthesizer Wire/Ribbon Cable Interconnect Diagram

NOTE: Refer to Table 1-3 for a cross-reference to PCB assembly functions.



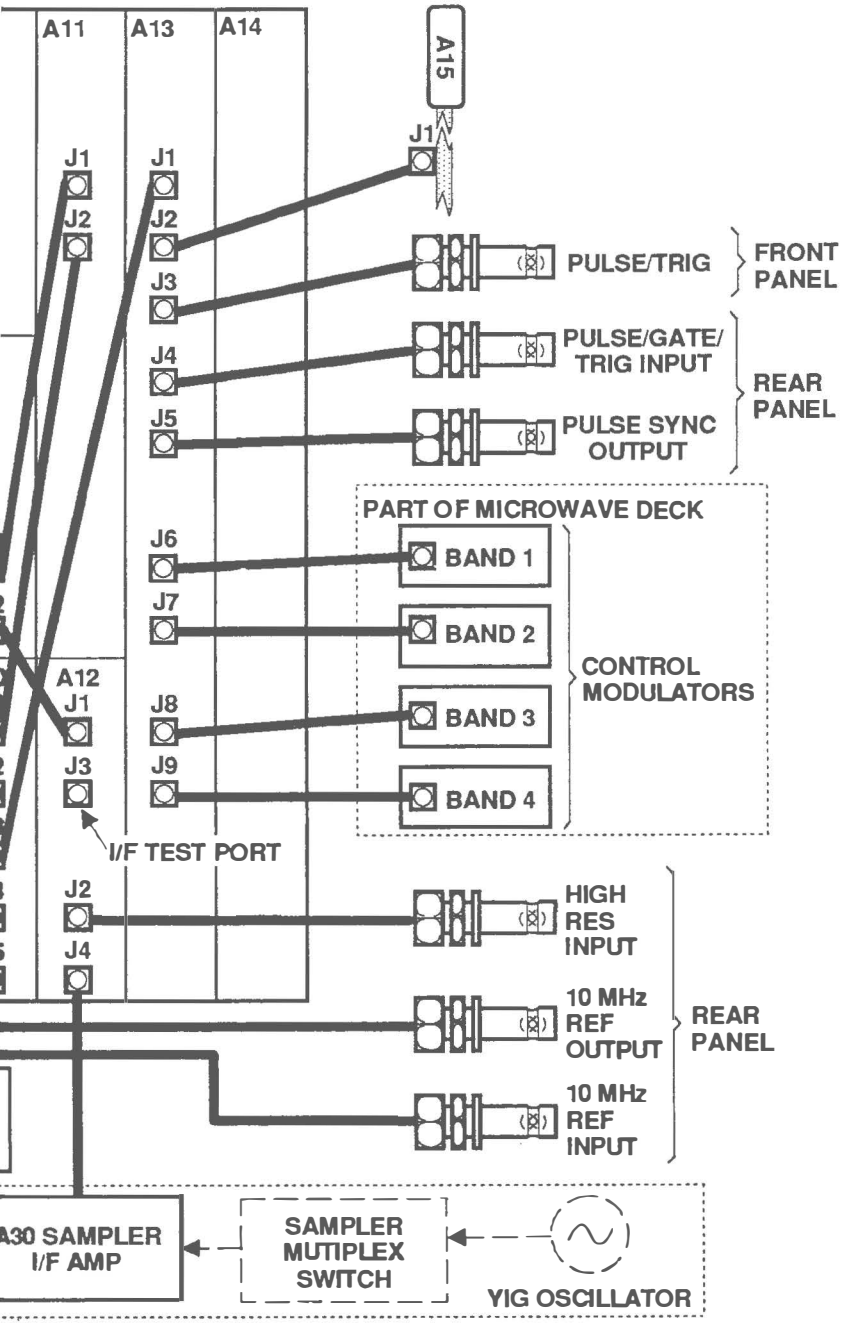
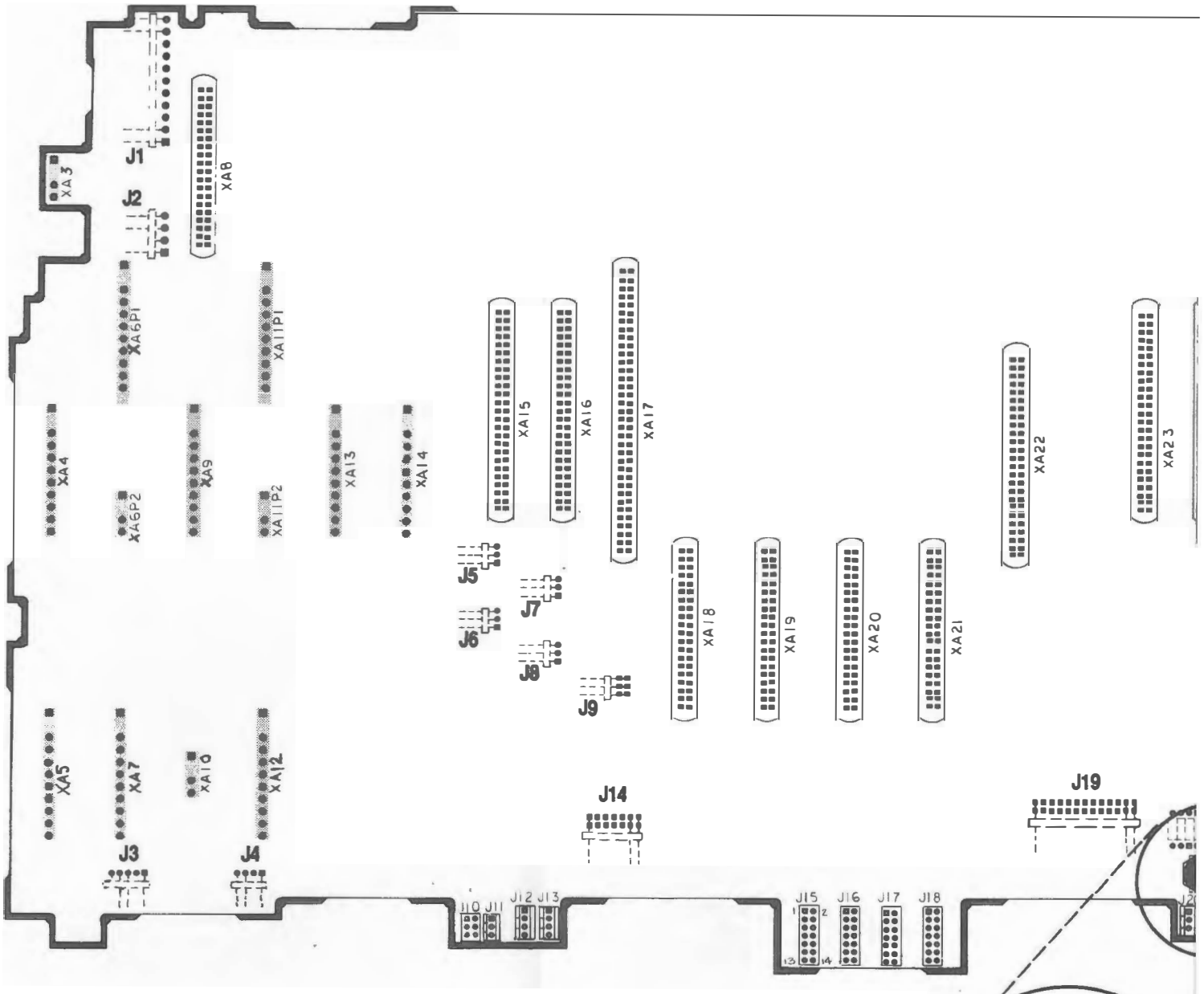
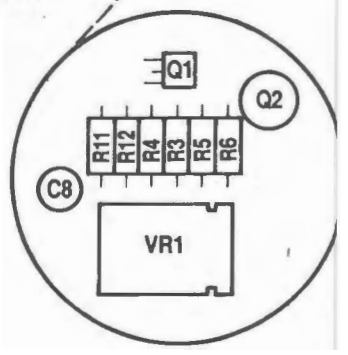


Figure 2M-4. RF Casting Coaxial Cable Interconnection Diagram

A28 MOTHERBOARD
(As viewed from *top* of instrument)



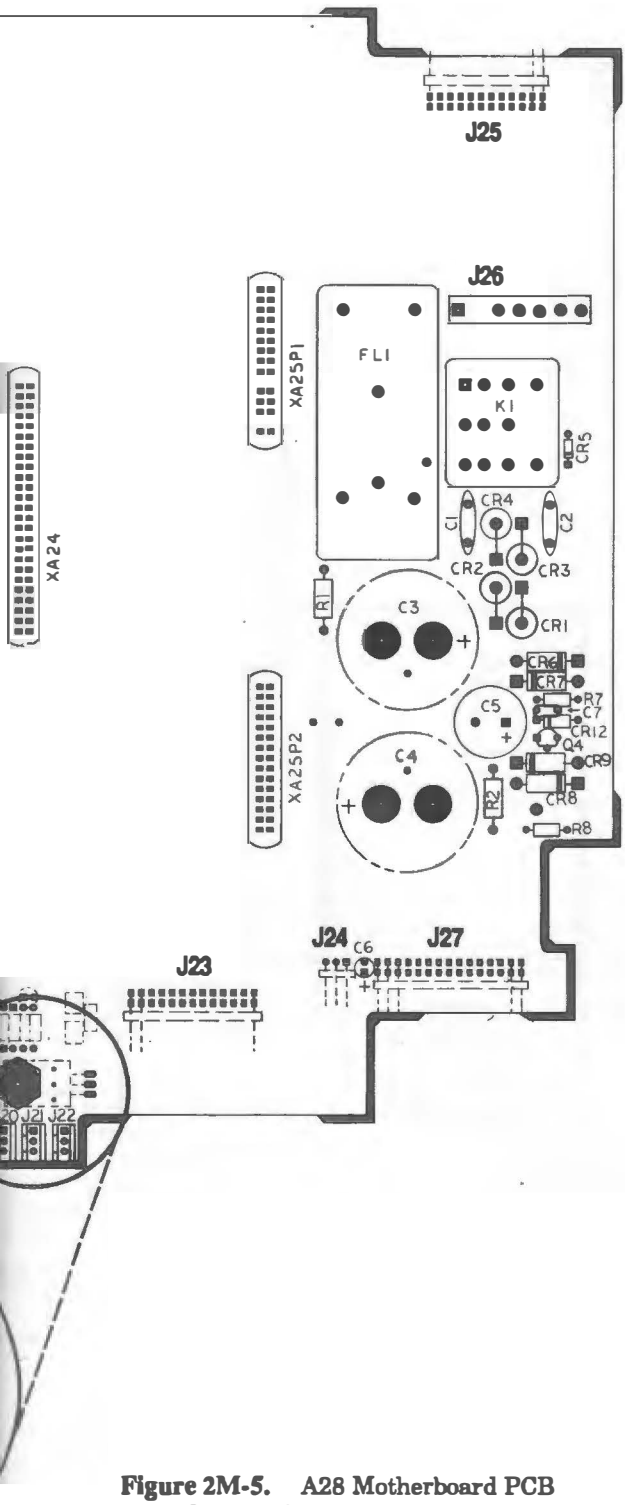
Fan Power Supply Components
(As viewed from *bottom* of instrument)



NOTES:

1. Filtercons are designated as:

   Each signal path connection has (typically) 1500 pF capacitance sbetween it and chassis ground.
2. J1-9, J14, J19, J23-25, and J27 are mounted on the bottom side of the A28 PCB.



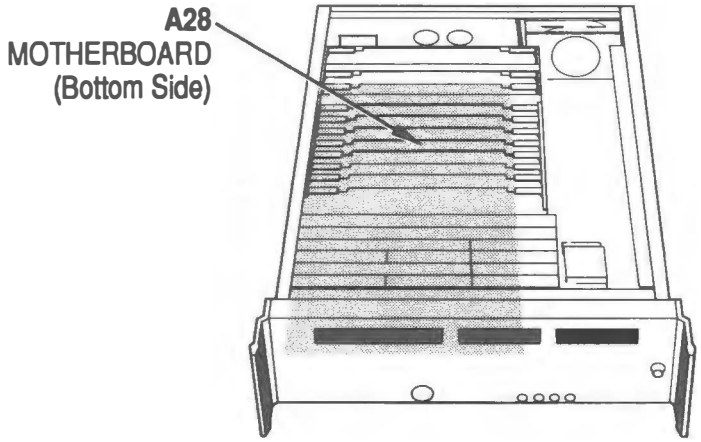
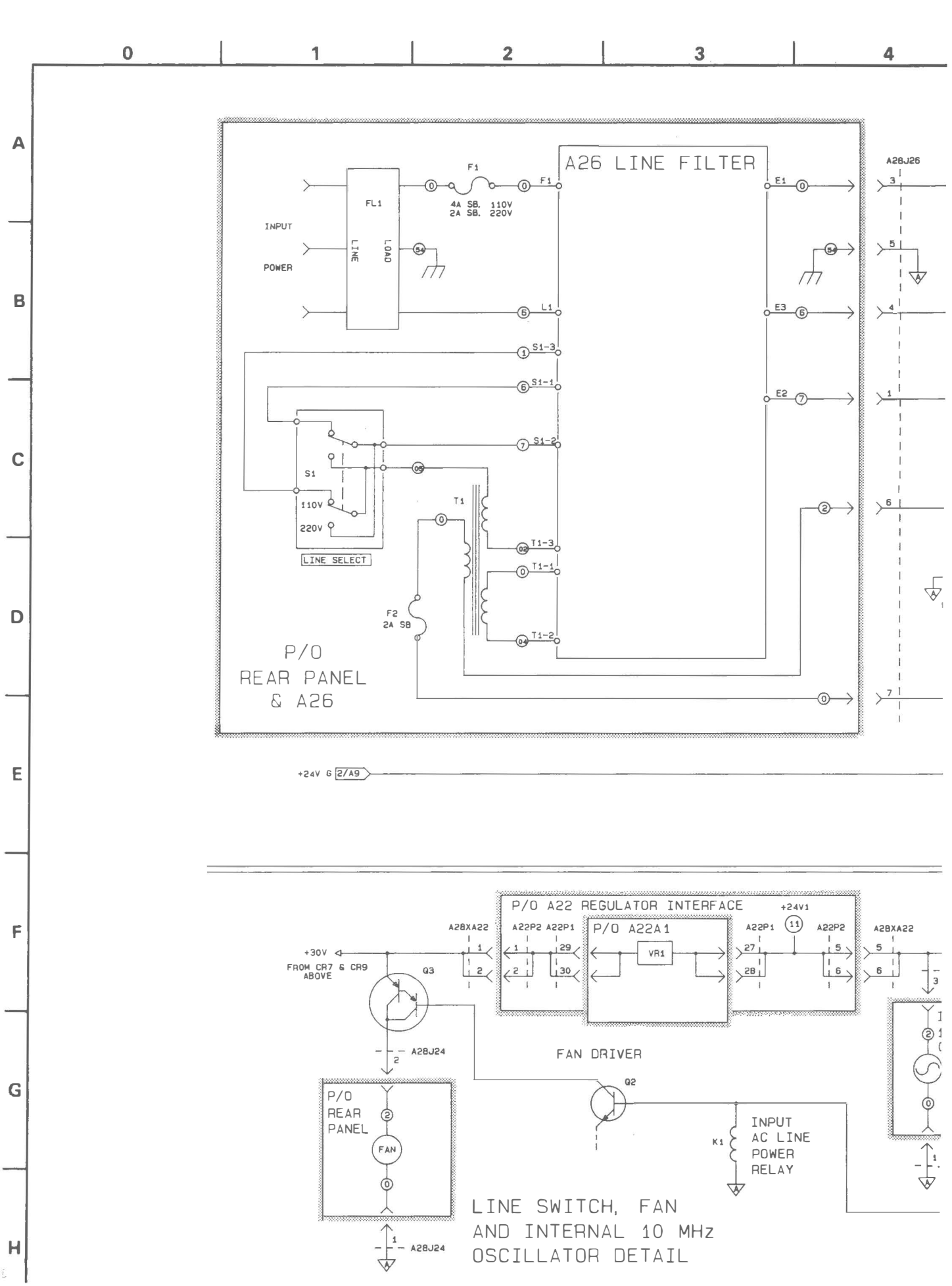


Figure 2M-5. A28 Motherboard PCB Parts Locator Diagram 6700-D-31828-3 (Rev. F)


A26 LINE FILTER
FL1
INPUT
POWER
LINE
LOAD
F1
4A SB, 110V
2A SB, 220V
L1
S1-3
S1-1
S1-2
S1
110V
220V
LINE SELECT
T1
T1-3
T1-1
T1-2
F2
2A SB
E1
E3
E2
A28J26
P/O
REAR PANEL
& A26
+24V G 2/A9
P/O A22 REGULATOR INTERFACE
P/O A22A1
A28XA22
A22P2 A22P1
A22P1 A22P2
+24V1
VR1
+30V
FROM CR7 & CR9 ABOVE
Q3
Q2
A28J24
P/O REAR PANEL
FAN
FAN DRIVER
K1
INPUT AC LINE POWER RELAY
LINE SWITCH, FAN AND INTERNAL 10 MHz OSCILLATOR DETAIL

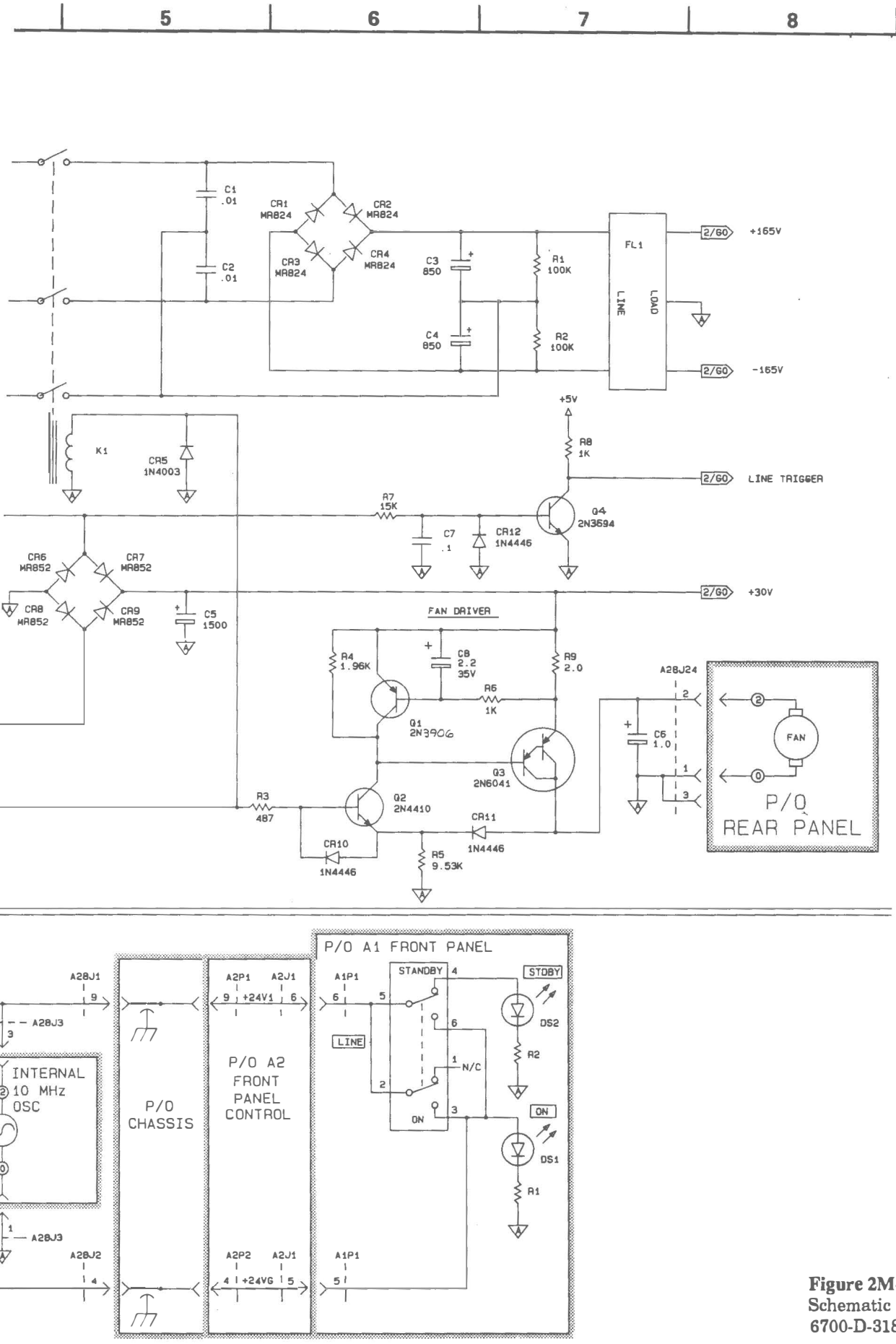
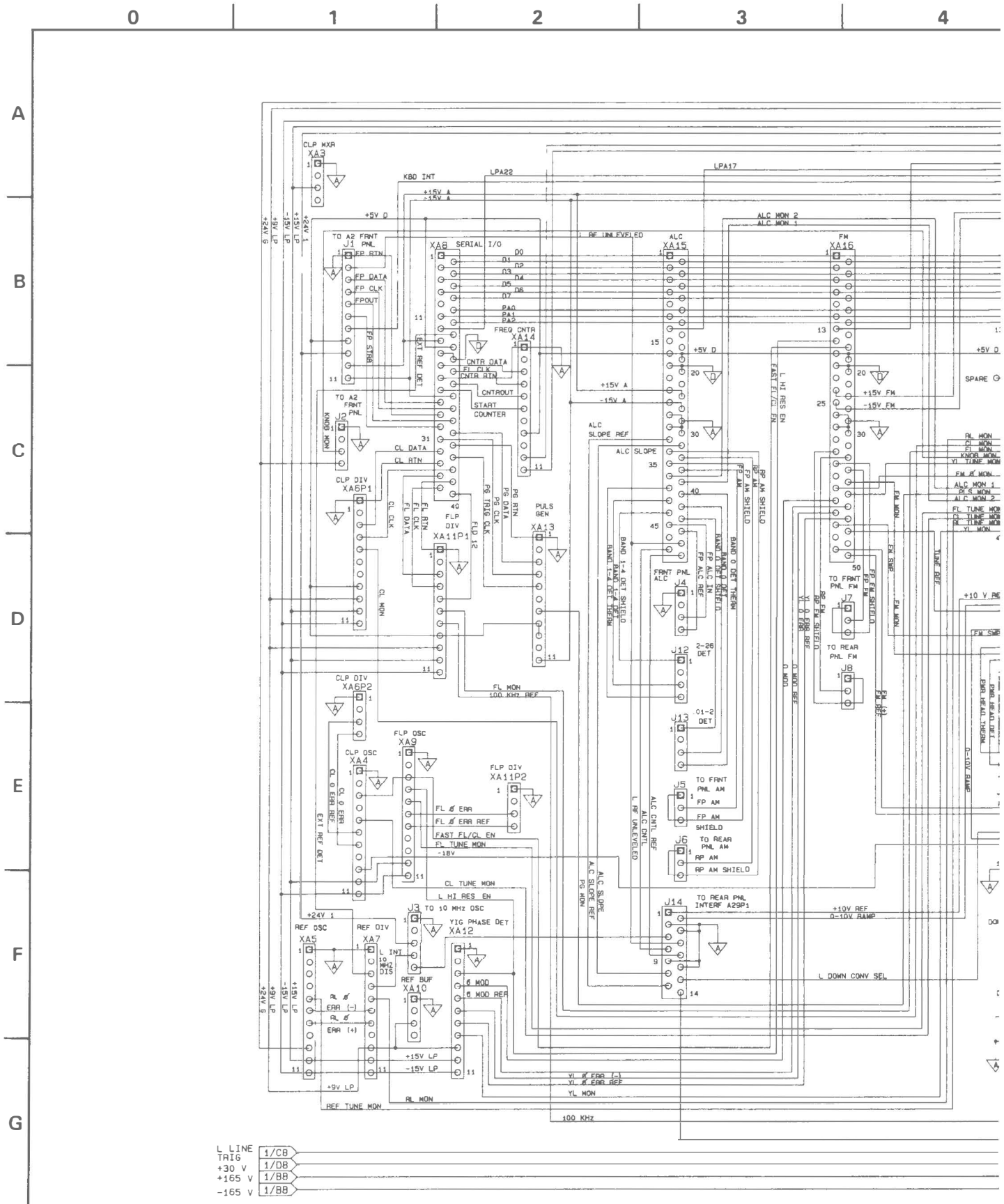


Figure 2M-6. A28 Motherboard PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31828-3 (Rev. B)

Table 2M-2. Connector Location Cross-Reference for A28 Motherboard Schematic Diagram

Connector	Location*		Connector	Location*
A28XA03	A,1		A28J01	B,1
A28XA04	E,1		A28J02	C,1
A28XA05	F,1		A28J03	F,1
A28XA06	C,1		A28J04	D,3
A28XA06,P2	E,1		A28J05	E,3
A28XA07,P1	F,1		A28J06	F,3
A28XA08	B,1		A28J07	D,4
A28XA09	E,4		A28J08	E,4
A28XA10	G,1		A28J09	E,4
A28XA11,P1	D,1		A28J10	G,4
A28XA11,P2	E,2		A28J11	B,8
A28XA12	F,1		A28J12	D,3
A28XA13	D,2		A28J13	E,3
A28XA14	B,2		A28J14	F,3
A28XA15	B,2		A28J15	G,5
A28XA16	B,3		A28J16	G,6
A28XA17	B,4		A28J17	G,6
A28XA18	E,5		A28J18	G,7
A28XA19	E,6		A28J19	B,7
A28XA20	E,6		A28J20	D,8
A28XA21	E,7		A28J21	B,8
A28XA22	E,8		A28J22	C,8
A28XA23	B,6		A28J23	C,7
A28XA24	B,6		A28J24	D,7 (Sheet 1 of schematic)
A28XA25,P1	D,8		A28J25	B,7
A28XA25,	E,8		A28J26	A,4 (Sheet 1 of schematic)
			A28J27	C,8

* Sheet 2 of schematic, unless otherwise noted.


0
1
2
3
4
A
B
C
D
E
F
G
H
CLP MXR XA3
KBD INT
LPA22
LPA17
+5V D
+15V A
-15V A
TO A2 FRNT PNL J1
FP RTN
FP DATA
FP CLK
FPOUT
FP STRB
SERIAL I/O XA8
D0
D1
D2
D3
D4
D5
D6
D7
PA0
PA1
PA2
EXT REF DET
FREQ CNTR XA14
CNTR DATA
CNTR CLK
CNTR RTN
CNTROUT
START COUNTER
TO A2 FRNT PNL J2
KNOB MON
CL DATA
CL RTN
CLP DIV XA6P1
CL CLK
CL MON
FLP DIV XA11P1
FL DATA
FL CLK
FL RTN
FLD 12
PG TRIG CLK
PG CLK
PG RTN
PULS GEN XA13
CLP DIV XA6P2
FL MON
100 KHz REF
FLP OSC XA9
CLP OSC XA4
CL Ø ERR
CL Ø ERR REF
EXT REF DET
FLP DIV XA11P2
FL Ø ERR
FL Ø ERR REF
FAST FL/CL EN
FL TUNE MON
-18V
CL TUNE MON
L HI RES EN
J3 TO 10 MHz OSC
YIG PHASE DET XA12
REF OSC XA5
REF DIV XA7
L INT
10 MHz DIS
REF BUF XA10
Ø MOD
Ø MOD REF
RL Ø ERR (-)
RL Ø ERR (+)
+24V 1
+24V G
+9V LP
-15V LP
+15V LP
REF TUNE MON
RL MON
YL Ø ERR (-)
YL Ø ERR REF
YL MON
100 KHz
ALC XA15
RF UNLEVELED
ALC SLOPE REF
ALC SLOPE
ALC CNTL
ALC CNTL REF
L RF UNLEVELED
FRNT PNL ALC J4
BAND 0 DET
BAND 0 DET SHIELD
BAND 1-4 DET
BAND 1-4 DET SHIELD
FP ALC AM
FP ALC REF
2-26 DET J12
01-2 DET J13
TO FRNT PNL AM J5
FP AM
FP AM SHIELD
TO REAR PNL AM J6
RP AM
RP AM SHIELD
TO REAR PNL INTERF A29P1 J14
L DOWN CONV SEL
FM XA16
ALC MON 2
ALC MON 1
+15V FM
-15V FM
SPARE G
L HI RES EN
FAST FL/CL EN
TO FRNT PNL FM J7
FP FM
FP FM SHIELD
TO REAR PNL FM J8
RP FM
RP FM SHIELD
FM MON
TUNE REF
+10 V REF
0-10V RAMP
RL MON
CL MON
FL MON
KNOB MON
YL TUNE MON
FM Ø MON
ALC MON 1
PULS MON
ALC MON 2
FL TUNE MON
CL TUNE MON
RL TUNE MON
YL MON
L LINE TRIG 1/C8
+30 V 1/D8
+165 V 1/B8
-165 V 1/B8

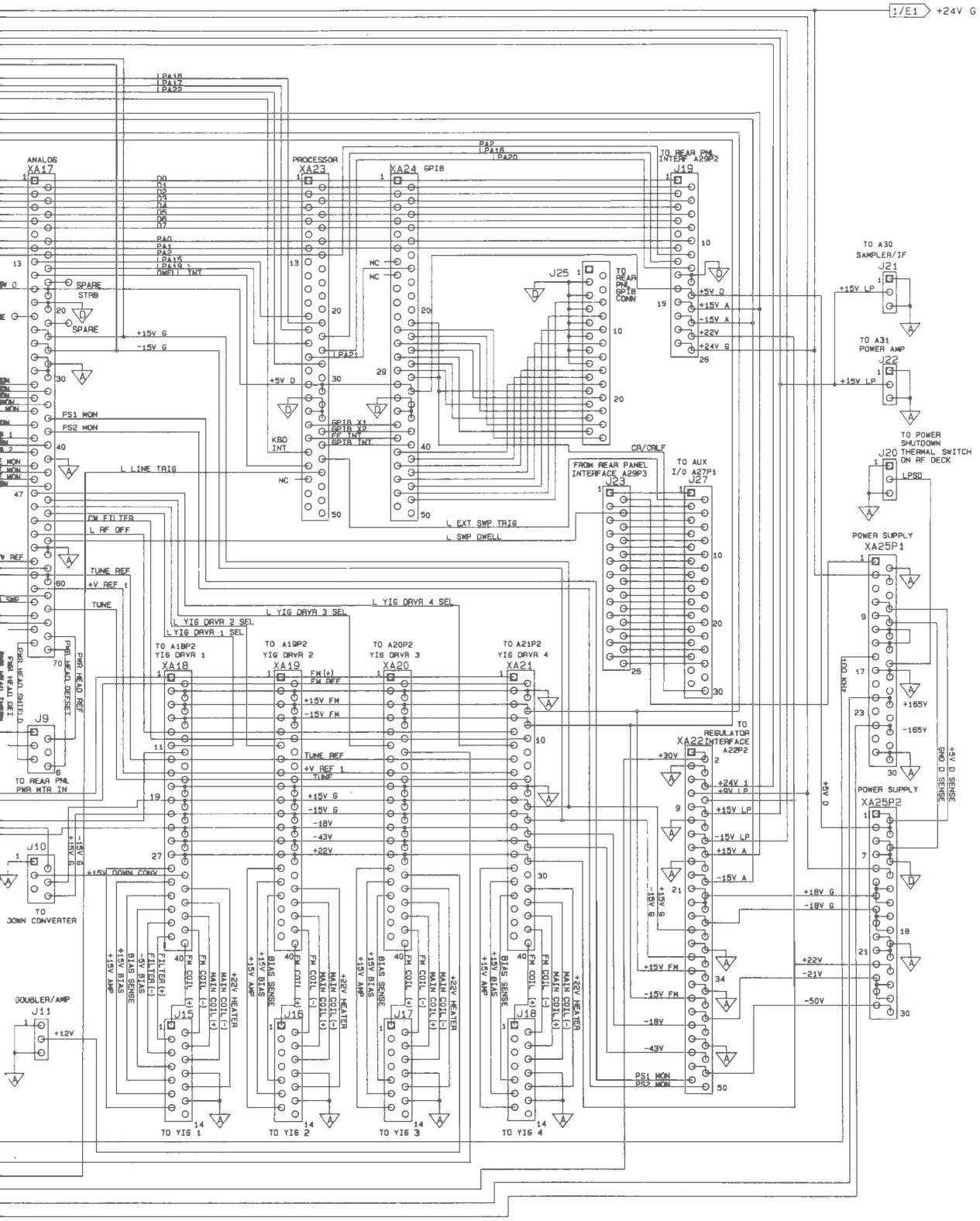


Figure 2M-6. A28 Motherboard PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31828-3 (Rev. B)

SECTION 3
DISASSEMBLY AND REPAIR PROCEDURES

CONTENTS

Paragraph	Title	Page
3-1	INTRODUCTION	3-3
3-2	DISASSEMBLY PROCEDURES	3-3
3-2.1	Removing the Cover	3-3
3-2.2	Removing the Front Panel	3-3
3-2.3	Removing the Rear Panel	3-6
3-2.4	Lowering the RF Microwave Deck	3-6

SECTION 3
DISASSEMBLY AND REPAIR

3-1 INTRODUCTION

The disassembly procedures show how to gain access to major instrument parts for troubleshooting or maintenance.

WARNING

Hazardous voltages are present inside the instrument when ac line power is connected. Turn off the instrument and remove the line cord before removing any covers or panels. Repair procedures should only be performed by service personnel who are fully aware of the potential hazards.

3-2 DISASSEMBLY PROCEDURES

3-2.1 Removing the Cover

1. Turn off the power. Disconnect all external cables.
2. Place the synthesizer on its handles so that the rear panel faces up (Figure 3-1).
3. Remove the four feet.
4. Remove the cover.

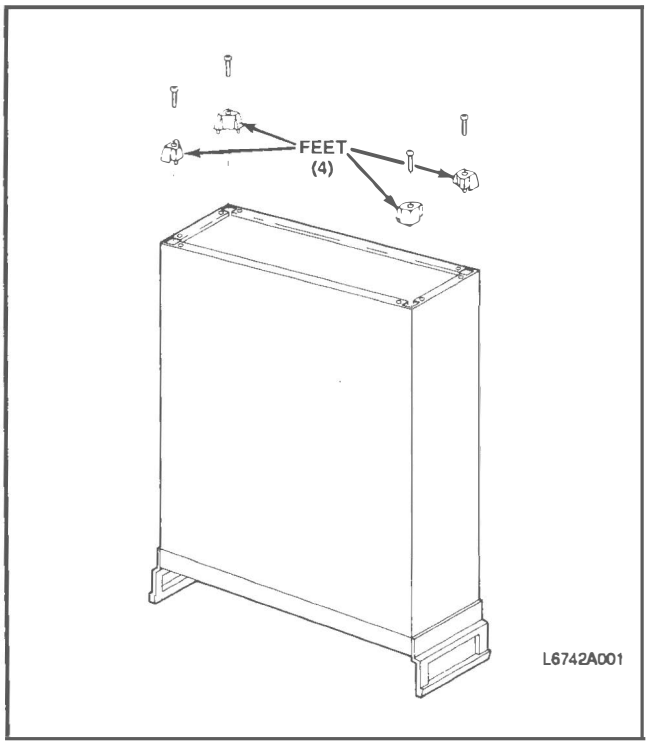


Figure 3-1. Removing the Cover

3-2.2 Removing the Front Panel

This procedure is divided into two parts: removing the front panel assembly and removing the entire front panel casting.

a. Removing the Front Panel Assembly

1. Remove the cover as described in paragraph 3-2.1.
2. Remove the five mounting screws – three top, two bottom (Figure 3-2).
3. Pull the front panel assembly away from the casting.
4. Unplug the three ribbon cables from the back of the front panel assembly.

NOTE:

If the assembly fits tightly and is difficult to pull out, push the assembly out from the inside of the instrument. Two holes are provided in the back of the front panel casting (Figure 3-2). Carefully poke an insulated tool through each hole to gently force the panel assembly free.

REASSEMBLY HINT:

- Apply even pressure on the four corners of the assembly as it is pushed back into place.

CAUTION

Do not push directly on the LCD Displays which are mounted into the front panel assembly; they may break.

b. Removing the Front Panel Casting

1. Remove the cover as described in paragraph 3-2.1.
2. Unplug the A13J3 cable and push it through the grommet on the chassis (Figure 3-3).
3. Turn the synthesizer on its top.
4. Lift the cable shield from its mounting pins just enough to remove A28J5 and A28J7 (Figure 3-4).
5. Unplug the following cables from the motherboard: A28J4, A28J5, and A28J7.

NOTE:

Remember the orientation of the J1 and J2 cables; they are not keyed. WILTRON uses the following pin/color convention for the first four pins:

Pin 1 – Tan
Pin 2 – Red
Pin 3 – Orange
Pin 4 – Yellow

6. Remove the two clamps from the A13J3 cable.
7. Remove the mounting screw at the center of the front panel casting.
8. Remove the eight screws that secure the front panel casting to the side rails.

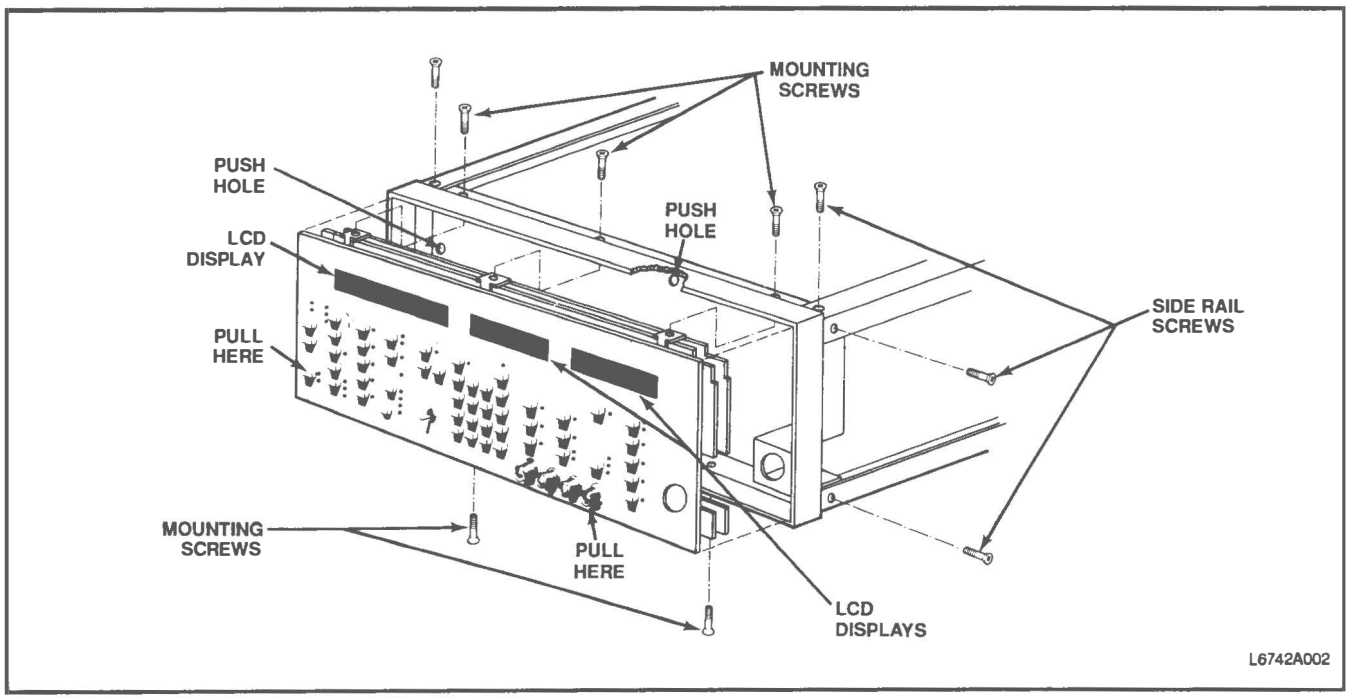


Figure 3-2. Front Panel Assembly and Casting

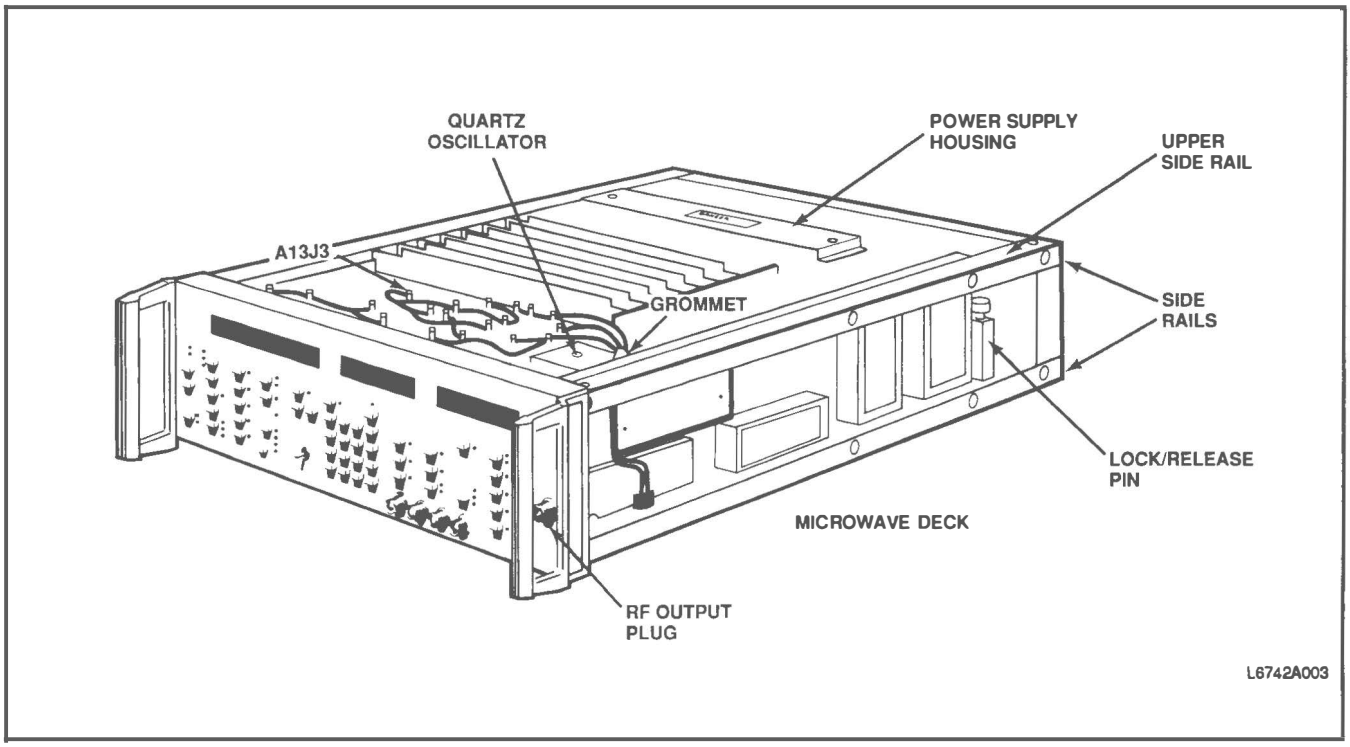


Figure 3-3. Top and Side Views

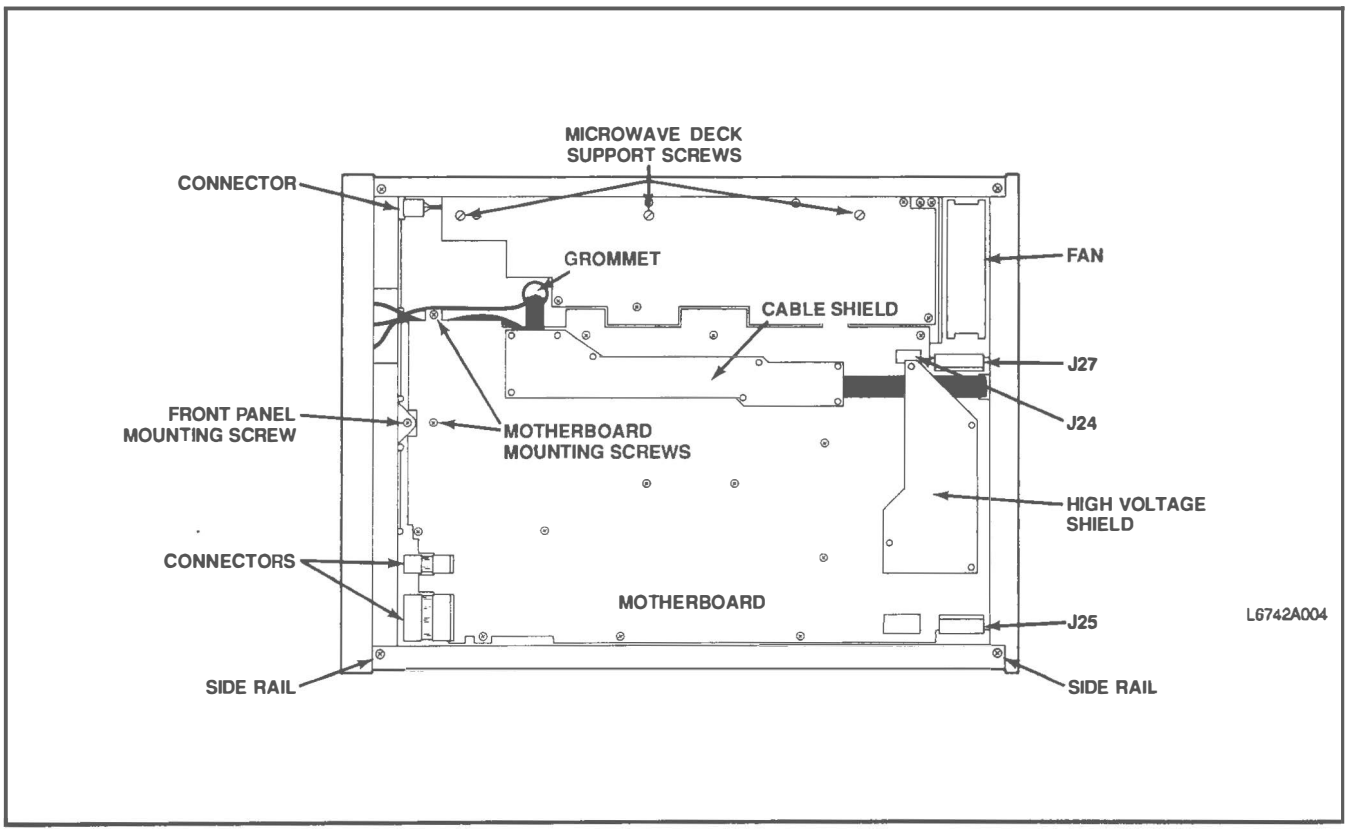


Figure 3-4. Bottom View

9. Remove the front mounting screw from the quartz oscillator housing (Figure 3-3).

CAUTION

Before sliding the front panel away from the chassis, loosen the captive nuts on the A29 PCB (Figure 3-4).

10. Slide the front panel forward.

NOTE:

If the front panel is held too tightly by the side rails, loosen the screws along the top rails.

CAUTION

When replacing the front panel, protect the cables so they are not pinched or cut. Also, protect the RF OUTPUT connector.

3-2.3 Removing the Rear Panel

This procedure is divided into two parts: opening the rear panel to access internal components and removing the rear panel casting for replacement or maintenance.

a. Opening the Rear Panel

1. Remove the cover as described in paragraph 3-2.1.
2. Turn the synthesizer over so that the bottom is accessible.
3. Unplug the cables from J25, J27, and the A28J24 fan cable (Figure 3-4).
4. Turn the synthesizer over again to make the top accessible.
5. Remove the two nuts from the back of the power supply housing.
6. Remove the eight screws that secure the rear panel to the side rails.
7. Slide the rear panel out of the side rails.

CAUTION

Take care to protect the cables that are still connected between the rear panel and the motherboard.

8. Remove the cable from J26 (on the top of the motherboard – not visible in Figure 3-4).

The rear panel is now sufficiently disassembled to allow troubleshooting and maintenance.

b. Removing the Rear Panel Casting

To completely disassemble the rear panel, perform the following steps and then follow the instructions in paragraph 3-2.3a.

1. Remove the cover as described in paragraph 3-2.1.
2. From the top of the synthesizer, remove the cables from A13J4, A13J5, A12J2, A10J5, and A7J4.
3. Pass these cables through the grommet, to the bottom of the motherboard (Figure 3-5).
4. Turn the synthesizer over so that the bottom is accessible.
5. Remove the cable and the high voltage shields.
6. Unplug the A28J6, A28J8, and A28J9 cables from the motherboard.
7. Follow the instructions in paragraph 3-2.3a to complete the disassembly of the rear panel.

NOTE:

This technique is also useful when replacing a single cable or a BNC from the rear panel.

REASSEMBLY HINT:

- When sliding the rear panel into the side rails, align the mounting bracket onto the two bolts from the power supply housing.

3-2.4 Lowering the RF Microwave Deck

The RF microwave deck is behind the front panel RF OUTPUT connector on the right side of the synthesizer. The deck may be rotated to the side to expose its components for troubleshooting and repair. The deck is supported at the front by the front casting and at the rear by a pillow block. Three screws, accessible through the A29 Rear Panel Interface PCB at the bottom of the synthesizer, secure the bottom of the RF microwave deck. The rear support pillow block has a lock/release pin that must be lifted before rotating the deck to the side.

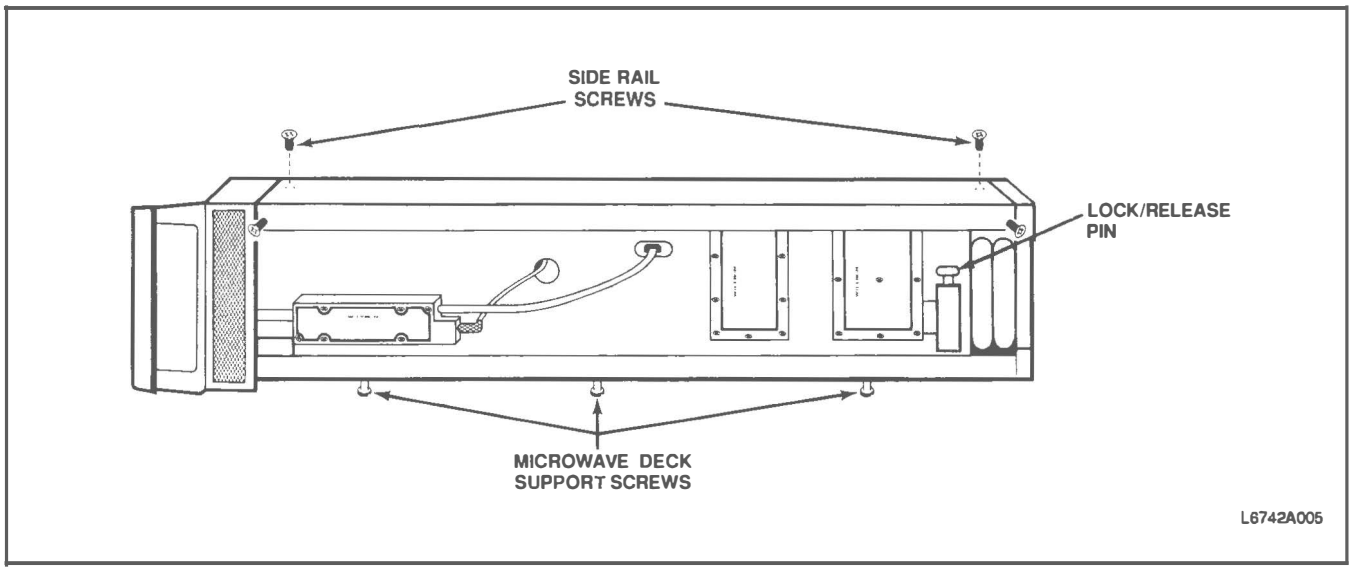


Figure 3-5. Lowering the Microwave Deck

1. Remove the cover as described in paragraph 3-2.1.
2. Remove the screws that secure the upper side rail to the front and rear panels (Figure 3-4).
3. Loosen the three support screws.
4. Lift the lock/release pin.
5. Turn the RF microwave deck out from the top until the release pin clicks into place, locking the deck in the lowered position.

REASSEMBLY HINTS:

- Lift the release pin to raise the deck back into the upright position.
- Ensure that the A28J16 and A28J17 cables are positioned over the nearby semi-rigid cables.
- Raise the RF microwave deck until the release pin clicks into place, locking the deck into the upright position.
- Tighten the support screws underneath the motherboard and the side rails.

SECTION 4
SPECIAL OPTIONS

CONTENTS

Paragraph	Title	Page
---	SPECIAL OPTIONS	4-1/4-2

This section is reserved for a listing
and description of any special options
that are fitted to your synthesizer.

SECTION V
PARTS LISTS

CONTENTS

Paragraph	Description	Page
5-1	INTRODUCTION	5-3
5-2	PARTS-ORDERING INFORMATION	5-3
5-3	VENDOR INFORMATION	5-3
5-4	ABBREVIATIONS	5-3
5-5	ORGANIZATION OF PARTS LISTS	5-3

Table 5-1. Vendor and Vendor FSCM Number Cross-Reference List

VENDOR	FSCM NO.	VENDOR	FSCM NO.
Airco	N/L	Intersil	32293
Allen-Bradley	01121	Kemet	N/L
Alpha	23365	Lenox-Fugel	24759
Amp	00779	Linear Technology	N/L
Analog Devices	24355	Lumex	N/L
Arco	N/L	MEPCO	19701
Aromat	61529	Micropower	N/L
Augat	91506	Mini Circuits	N/L
Beckman	60771	Monsanto	N/L
Belden	70903	MOT	N/L
Bell	N/L	Motorola	50012
Berg	N/L	Murata/Erie	72982
Berg-Du Pont	N/L	Nichicon	N/L
Bourns	08116	NSC	N/L
Burr-Brown	13919	Omron	N/L
Cal-R	92114	Panasonic	N/L
Cambion	N/L	Plessy	N/L
Central Labs	N/L	Precision Monolithic	N/L
Centre Engineering	51642	RCA	N/L
CDI	57518	RF Monolithic, Inc.	N/L
Chicago Switch	N/L	RMC	N/L
Circuit Assembly	52072	Samtec	55322
Corcom	N/L	Semtech	14099
Cornell-Dubilier	N/L	Signetics	N/L
Corning	N/L	Siliconix	17865
Crystek Crystal	N/L	Solid State Devices	N/L
Dallas Semiconductor	N/L	Sprague	N/L
Delevan	N/L	Squires	60386
Electrocube	14752	Supertex, Inc.	N/L
Electromotive	72915	Sussco (ARCO)	N/L
Elmenco	N/L	Teka Products	N/L
Erie	72982	Texas Instruments	01295
Ferroxcube	N/L	TRW	N/L
FSC	N/L	Ultex	N/L
Fujitsu	61271	Vermont Precision	55710
G.E.	N/L	Verospeed	N/L
Hamlin Inc.	27011	West Coast Magnetics	12042
Hitachi	N/L	Western Thermistor	N/L
IMB	27556	Winchester	81312
Intel	34649	Xicor	N/L
		3M	N/L

SECTION V
PARTS LISTS

5-1 INTRODUCTION

This section provides parts lists for the 67XXB Series Swept Frequency Synthesizers. The parts lists are divided into four groups:

- Printed circuit board (PCB) parts (Tables 5-4 thru 5-30)
- Options and accessories (Tables 5-31 thru 5-35)
- Major assembly parts (Figures 5-1 thru 5-7)
- Microwave deck components (Table 5-36)

5-2 PARTS-ORDERING INFORMATION

Parts may be ordered from your local WILTRON representative or directly from the factory.

WILTRON Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809

Telephone: 408-778-2000
TWX: 285227 WILTRON MH
FAX: 408-778-0239

When ordering, give complete information including the model and serial number of the instrument, the full part description, the WILTRON part number, and the quantity required.

5-3 VENDOR INFORMATION

Table 5-1 on the facing page provides a cross-reference list of vendors and their associated FSCM number. Vendors without FSCM numbers are marked with an "N/L" (No Listing).

5-4 ABBREVIATIONS

Common abbreviations used in the parts list descriptions are defined in Table 5-2.

5-5 ORGANIZATION OF PARTS LISTS

Table 5-3 is an index of the parts lists for all major assembly groups, PCBs, options/accessories, and microwave deck components of the 67XXB series synthesizers.

All PCBs listed in Table 5-3 are replaceable assemblies. The microwave deck components that are replaceable are listed in Table 5-36.

Table 5-2. Common Abbreviations Used in the Parts List

Abbreviation	Description	Abbreviation	Description
A	Ampere, Assembly	N	Not Assigned
B	Fan	P	Pin, Plug
C	Capacitor	PCB	Printed Circuit Board
CC	Carbon Composition	Q	Transistor
CER	Ceramic	R	Resistor
CR	Diode	RN	Resistor Network
DS	Display Indicator	S	Switch
E	Miscellaneous Electrical Part	SI	Silicon
F	Female	SW	Switch
FF	Flip Flop	T	Transformer
FXD	Fixed	TANT	Tantalum
HDR	Header	TP	Test Point
J	Jack	U	Integrated Circuit, Micro- (10^{-6})
K	Kilo (10^3), Relay	UF	Micro Farad (μF)
L	Inductor	UH	Micro Henry (μH)
LCD	Liquid Crystal Display	V	Volt
LED	Light Emitting Diode	VR	Voltage Regulator
M	Male, Meg- (10^6)	W	Watt, Wire Jumper
MF	Metal Film	Y	Crystal
MH	Milli Henry (mH)		

Table 5-3. Organization of Parts Lists

Table/Figure	PCB Assembly Name	Wiltron Part Number	Page
	Printed Circuit Boards (PCBs)		
Table 5-4	A1 Front Panel	6700-D-31701-3 (Rev. C)	5-5
Table 5-5	A2 Front Panel Control	6700-D-31702-3 (Rev. H)	5-9
Table 5-6	A3 Coarse Loop Mixer	6700-C-31703-4 (Rev. C)	5-12
Table 5-7	A4 Coarse Loop Oscillator	6700-D-31914-3 (Rev. D)	5-14
Table 5-8	A5 Reference Oscillator	6700-D-31805-3 (Rev. F)	5-17
Table 5-9	A6 Coarse Loop Divider	6700-D-31806-3 (Rev. F)	5-20
Table 5-10	A7 Reference Divider	6700-C-31707-3 (Rev. F)	5-24
Table 5-11	A8 Serial I/O	6700-D-31708-3 (Rev. D)	5-27
Table 5-12	A9 Fine Loop Oscillator	6700-C-31709-4 (Rev. E)	5-28
Table 5-13	A10 Reference Buffer	6700-C-31710-4 (Rev. E)	5-32
Table 5-14	A11 Fine Loop Divider	6700-D-31711-4 (Rev. G)	5-35
Table 5-15	A12 YIG Phase Detector	6700-D-31712-4 (Rev. E)	5-39
Table 5-16	A13 Pulse Generator	6700-D-31913-3 (Rev. K)	5-41
Table 5-17	A15 ALC	6700-D-31915-3 (Rev. M)	5-47
Table 5-18	A16 FM	6700-D-31716-5 (Rev. G)	5-58
Table 5-19	A17 Analog Instruction	6700-D-31717-3 (Rev. H)	5-65
Table 5-20	A18 2-8.4 GHz YIG Driver	6700-D-31718-9 (Rev. B)	5-71
Table 5-21	A19 8-12.4 GHz YIG Driver	6700-D-31718-5 (Rev. B)	5-76
Table 5-22	A20 12-20 GHz YIG Driver	6700-D-31718-6 (Rev. B)	5-81
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Table 5-4. A1 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-37	12	CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C2	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C3	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-4	2	DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR2	10-4		DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
DS1	15-32	44	LED,YELLOW	SSL-LX20465YD	LUMEX
DS2	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS3	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS4	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS5	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS6	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS7	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS8	15-31	4	LED,RED	SSL-LX20465RD	LUMEX
DS9	15-31		LED,RED	SSL-LX20465RD	LUMEX
DS10	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS11	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS12	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS13	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS14	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS15	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS16	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS17	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS18	15-31		LED,RED	SSL-LX20465RD	LUMEX
DS19	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS20	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS21	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS22	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS23	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS24	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS25	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS26	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX

Table 5-4. A1 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
DS27	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS28	15-33	1	LED,GREEN	SSL-LX20465GD	LUMEX
DS29	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS30	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS31	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS32	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS33	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS34	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS35	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS36	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS37	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS38	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS39	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS40	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS41	999-NU		NOT USED		
DS42	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS43	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS44	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS45	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS46	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS47	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS48	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS49	15-32		LED,YELLOW	SSL-LX20465YD	LUMEX
DS50	15-31		LED,RED	SSL-LX20465RD	LUMEX
DS51	B30539-4	1	DISPLAY,LCD,7SEG,FREQ DISPLAY	5.429	UCE
DS52	B30537-4	1	DISPLAY,LCD,7SEG,MODULATON	5.423-05-18	UCE
DS53	B30538-4	1	DISPLAY,LCD,7SEG,LEVEL DISPLAY		
L1	310-53	1	INDUCTOR,FXD,47.0µH,5%	1537-60	
P1	803-30	4	RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P2	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P3	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P4	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P5	551-420	1	CONNECTOR,HEADER	65521-102	BERG
Q1	20-2N3906	1	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
R1	110-2.32K-1	2	RESISTOR,FXD,MF, 2.32KΩ,1%,0.25W		
R2	110-2.32K-1		RESISTOR,FXD,MF, 2.32KΩ,1%,0.25W		
R3	110-221-1	5	RESISTOR,FXD,MF,, 221,1%,0.25W		
R4	110-221-1		RESISTOR,FXD,MF,, 221,1%,0.25W		
R5	110-221-1		RESISTOR,FXD,MF,, 221,1%,0.25W		
R6	110-221-1		RESISTOR,FXD,MF,, 221,1%,0.25W		
R7	110-221-1		RESISTOR,FXD,MF,, 221,1%,0.25W		

Table 5-4. A1 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R8	110-1K-1	1	RESISTOR,FXD,MF,, 1KΩ,1%,0.25W		
R9	110-3.83K-1	1	RESISTOR,FXD,MF, 3.83KΩ,1%,0.25W		
R10	110-215-1	1	RESISTOR,FXD,MF,, 215,1%,0.25W		
RN1	123-14	6	RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN2	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN3	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN4	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN5	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN6	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
SW1	430-131	51	SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW2	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW3	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW4	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW5	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW6	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW7	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW8	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW9	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW10	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW11	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW12	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW13	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW14	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW15	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW16	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW17	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW18	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW19	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW20	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW21	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW22	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW23	999-NU	2	NOT USED		
SW24	430-1		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW25	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW26	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW27	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW28	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW29	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW30	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW31	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW32	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS

Table 5-4. A1 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
SW33	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW34	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW35	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW36	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW37	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW38	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW39	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW40	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW41	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW42	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW43	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW44	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW45	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW46	430-159	1	SWITCH,PUSH BUTTON	K40352AA	CENTRALAB
SW47	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW48	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW49	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW50	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW51	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW52	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
SW53	430-131		SWITCH,PUSH BUTTON	K40142AA	CENTRALABS
U1	54-41	6	74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U2	54-41		74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U3	54-41		74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U4	54-41		74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U5	54-41		74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U6	54-41		74LS374,OCTAL,D FLIP FLOP	DM74LS374N	NSC
U7	54-341	5	FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U8	54-341		FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U9	54-341		FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U10	54-341		FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U11	54-340	1	HEX BUFFER/CONVERTER	CD4049AE	RCA
U12	54-341		FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL

Table 5-5. A2 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-42	4	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-37	29	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C19	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C24	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C30	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C31	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C32	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C33	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N758A	2	DIODE,ZENER,1N758A	1N758A	MOTOROLA
CR2	10-1N758A		DIODE,ZENER,1N758A	1N758A	MOTOROLA
CR3	10-1N751A	2	DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR4	10-FD300	4	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR5	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR6	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR7	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR8	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR9	10-1N755A	2	DIODE,ZENER,1N755A	1N755A	MOTOROLA

Table 5-4. A2 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR10	10-1N755A		DIODE,ZENER,1N755A	1N755A	MOTOROLA
J1	553-216	4	SOCKET,RIBBON CABLE HEADER	SAMTEC	
J2	553-216		SOCKET,RIBBON CABLE HEADER	SAMTEC	
J3	553-216		SOCKET,RIBBON CABLE HEADER	SAMTEC	
J4	553-216		SOCKET,RIBBON CABLE HEADER	SAMTEC	
J5	551-206	2	CONNECTOR,HDR,PC MNT	65521-103	BERG
J6	551-206		CONNECTOR,HDR,PC MNT	65521-103	BERG
L1	310-89	2	INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
L2	310-89		INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
L3	310-98	1	INDUCTOR,FXD,1 MHZ,10%	1537-744	DELEVAN
P1	551-645	1	CONNECTOR,HEADER	68015-112	BERG
P2	551-552	2	CONNECTOR HEADER	68016-104	BERG
P4	551-552		CONNECTOR HEADER	68016-104	BERG
R1	110-10K-1	3	RESISTOR,FXD,MF,10KΩ,1%,0.25W		
R2	110-100K-1	1	RESISTOR,FXD,MF,100KΩ,1%,0.25W		
R3	110-100-1	8	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R4	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R5	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R6	110-5.11K-1	2	RESISTOR,FXD,MF,5.11KΩ,1%,0.25W		
R7	110-5.11K-1		RESISTOR,FXD,MF,5.11KΩ,1%,0.25W		
R8	110-5.49K-1	1	RESISTOR,FXD,MF, 5.49KΩ,1%,0.25W		
R9	110-2.55K-1	1	RESISTOR,FXD,MF, 2.55KΩ,1%,0.25W		
R10	110-100-1		RESISTOR,FXD,MF, 100,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-100-1		RESISTOR,FXD,MF, 100,1%,0.25W	SMA-4 OR C4	CORNING
R12	110-1.96K-1	2	RESISTOR,FXD,MF, 1.96KΩ,1%,0.25W		
R13	110-1.96K-1		RESISTOR,FXD,MF, 1.96KΩ,1%,0.25W		
R14	110-10K-1		RESISTOR,FXD,MF, 10KΩ,1%,0.25W		
R15	157-1K	1	RESISTOR,TRIM,CER,1KΩ,10%,20TW		
R16	110-10K-1		RESISTOR,FXD,MF, 10KΩ,1%,0.25W		
R17	110-100-1		RESISTOR,FXD,MF, 100,1%,0.25W	SMA-4 OR C4	CORNING
R18	110-100-1		RESISTOR,FXD,MF, 100,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-100-1		RESISTOR,FXD,MF, 100,1%,0.25W	SMA-4 OR C4	CORNING
R20	110-4.75K-1	1	RESISTOR,FXD,MF, 4.75KΩ,1%,0.25W		
R21	110-499-1	1	RESISTOR,FXD,MF,, 499,1%,0.25W		
R22	110-4.64K-1	2	RESISTOR,FXD,MF, 4.64KΩ,1%,0.25W		
R23	110-4.64K-1		RESISTOR,FXD,MF, 4.64KΩ,1%,0.25W		
RN1	123-9	3	RESISTOR,NETWORK,MF,9X10KΩ,2%	410A103	ALLEN-BRADLEY
RN2	123-9		RESISTOR,NETWORK,MF,9X10KΩ,2%	410A103	ALLEN-BRADLEY
RN3	123-9		RESISTOR,NETWORK,MF,9X10KΩ,2%	410A103	ALLEN-BRADLEY
U1	54-518	2	CMOS,74HC164	SN74HC164N	T.I.
U2	54-518		CMOS,74HC164	SN74HC164N	T.I..

Table 5-4. A2 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U3	54-528	3	CMOS,74HCT138	SN74HCT138N	T.I.
U4	54-510	1	CMOS	SN74HC04N	T.I.
U5	54-508	1	CMOS,QUAD	SN74HC02N	T.I.
U6	54-515	2	CMOS,SN74HC148N,SINGLE	SN74HC148N	T.I.
U7	54-528		CMOS,74HCT138	SN74HCT138N	T.I.
U8	54-528		CMOS,74HCT138	SN74HCT138N	T.I.
U9	54-515		CMOS,SN74HC148N,SINGLE	SN74HC148N	T.I.
U10	54-519	1	CMOS,74HC165	SN74HC165N	T.I.
U11	54-513	1	CMOS,74HC74,DUAL D-TYPE	SN74HC74N	T.I.
U12	54-339	14	CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U13	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U14	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U15	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U16	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U17	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U18	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U19	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U20	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U21	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U22	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U23	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U24	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U25	54-339		CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U26	50-DG200BA	1	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U27	54-503	1	OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U28	54-376	2	OP-AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U29	54-376		OP-AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U30	54-512	1	CMOS	SN74HC14N	T.I.

Table 5-6. A3 PCB Parts List (1 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C2	220-100	2	CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C3	250-42	3	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C4	230-37	6	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	220-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C6	220-330	2	CAPACITOR,FXD,MICA,330PF,5%,50V	CD15FD331JO3	CORNELL DUBILIER
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	220-330		CAPACITOR,FXD,MICA,330PF,5%,50V	CD15FD331JO3	CORNELL DUBILIER
C10	220-51	1	CAPACITOR,FXD,MICA,51PF,5%,500V	CD15ED510J03	CORNELL DUBILIER
C11	220-24	1	CAPACITOR,FXD,MICA,24PF,5%,500V	CD15ED240JO3	CORNELL DUBILIER
C12	220-91	1	CAPACITOR,FXD,MICA,91PF,5%,500V	DM15-910 J	
C13	230-11	3	CAPACITOR,FXD,CER,0.01µF	TCP-R01	ARCO/SOSHIN
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-11		CAPACITOR,FXD,CER,0.01µF	TCP-R01	ARCO/SOSHIN
C16	220-470	1	CAPACITOR,FXD,MICA,470PF,5%,50V		
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C19	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C20	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	230-11		CAPACITOR,FXD,CER,0.01µF	TCP-R01	ARCO/SOSHIN
L1	310-57	2	INDUCTOR,FXD,0.15µH,10%	1025-00	
L2	310-82	2	INDUCTOR,FIXED,0.10µH,10%	551-5172-09	CAMBION
L3	310-82		INDUCTOR,FIXED,0.10µH,10%	551-5172-09	CAMBION
L4	310-57		INDUCTOR,FXD,0.15µH,10%	1025-00	
P1	551-539	1	CONNECTOR,SOCKET	BERG	
Q1	20-2N5179	6	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q2	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q3	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q4	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q5	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q6	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
R1	110-68.1-1	1	RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R2	110-147-1	3	RESISTOR,FXD,MF,147Ω,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-78.7-1	1	RESISTOR,FXD,MF,78.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R4	110-6.19K-1	1	RESISTOR,FXD,MF,6.19KΩ,1%,0.25W		
R5	110-681-1	2	RESISTOR,FXD,MF,681Ω,1%,0.25W		
R6	110-619-1	2	RESISTOR,FXD,MF,619Ω,1%,0.25W		
R7	110-619-1		RESISTOR,FXD,MF,619Ω,1%,0.25W		
R8	110-147-1		RESISTOR,FXD,MF,147Ω,1%,0.25W	SMA-4 OR C4	CORNING
R9	110-36.5-1	1	RESISTOR,FXD,MF,36.5Ω		
R10	110-147-1		RESISTOR,FXD,MF,147Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-6. A3 PCB Parts List (2 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R11	110-178-1	2	RESISTOR,FXD,MF,178Ω,1%,0.25W	SMA4 OR C4	CORNING
R12	110-48.7-1	1	RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-61.9-1	1	RESISTOR,FXD,MF,61.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-2.15K-1	1	RESISTOR,FXD,MF, 2.15 KΩ,1%,0.25W		
R15	110-332-1	3	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R16	110-332-1		RESISTOR,FXD,MF,332Ω,1%,0.25W		
R17	110-332-1		RESISTOR,FXD,MF,332Ω,1%,0.25W		
R18	110-71.5-1	1	RESISTOR,FXD,MF,71.5Ω,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-4.87K-1	1	RESISTOR,FXD,MF, 4.87 KΩ,1%,0.25W		
R20	110-715-1	1	RESISTOR,FXD,MF,715Ω,1%,0.25W		
R21	110-1K-1	1	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R22	110-82.5-1	1	RESISTOR,FXD,MF,82.5Ω,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-4.22K-1	2	RESISTOR,FXD,MF,4.22 KΩ,1%,0.25W		
R24	110-3.83K-1	2	RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R25	110-562-1	3	RESISTOR,FXD,MF,562Ω,1%,0.25W		
R26	110-562-1		RESISTOR,FXD,MF,562Ω,1%,0.25W		
R27	110-178-1		RESISTOR,FXD,MF,178Ω,1%,0.25W	SMA4 OR C4	CORNING
R28	110-681-1		RESISTOR,FXD,MF,681Ω,1%,0.25W		
R29	110-4.22K-1		RESISTOR,FXD,MF,4.22 KΩ,1%,0.25W		
R30	110-3.83K-1		RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R31	110-121-1	1	RESISTOR,FXD,MF,121Ω,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-383-1	1	RESISTOR,FXD,MF,383Ω,1%,0.25W		
R33	110-562-1		RESISTOR,FXD,MF,562Ω,1%,0.25W		
R34	110-44.2-1	1	RESISTOR,MF,44.2Ω,1%,0.25W		
U1	60-26	1	MIXER,DOUBLE BALANCE	SRA-1	MINI CIRCUITS
J1-J3	513-34	3	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-7. A4 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-42	8	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-61	1	CAPACITOR,FXD,560pF	CENTRE ENG	
C4	230-58	1	CAPACITOR,FXD,,270pF,5%	200-100-NPO-271J	CENTRE ENG
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	230-37	1	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-47	3	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C11	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C13	220-100	4	CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C14	220-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C15	230-47		CAPACITOR,FXD,.01uF,10%	200-100-X7R-103K	CENTRE ENG
C16	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C17	220-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C18	220-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C19	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C20	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-FD300	3	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR2	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR3	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR4	10-1N4736A	1	DIODE,ZENER,1N4736A	1N4736A	FSC
L1	310-109	1	INDUCTOR,FXD,470µH		DELEVAN
L2	310-110	1	INDUCTOR,FXD,560µH		DELEVAN
L3	310-36	2	INDUCTOR,FXD,0.33µH,20%	1025-8	
L4	310-36		INDUCTOR,FXD,0.33µH,20%	1025-8	
L5	310-53	2	INDUCTOR,FXD,47.0µH,5%	1537-80	
L6	310-53		INDUCTOR,FXD,47.0µH,5%	1537-80	
P1	551-538	1	CONNECTOR,SOCKET		BERG
Q1	20-2N2218	2	TRANSISTOR,NPN,2N2218	2N2218	NATIONAL
Q2	20-2N2218		TRANSISTOR,NPN,2N2218	2N2218	NATIONAL
Q3	20-2N2905	1	TRANSISTOR,PNP,2N2905	2N2905	MOTOROLA
Q4	20-17	1	TRANSISTOR,FET,J112	J-112-18	SILICONIX
Q5	20-2N3904	1	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q6	20-2N2222A	1	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q7	20-2N2907A	1	TRANSISTOR,PNP,2N2907A	2N2907A	MOTOROLA
R1	110-1K-1	5	RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R2	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R3	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R4	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R5	110-51.1-1	3	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-7. A4 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R6	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R7	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R8	110-1.54K-1	1	RESISTOR,FXD,MF,1.54KΩ,1%,0.25W		
R9	110-127K-1	1	RESISTOR,FXD,MF,127KΩ,1%,0.25W		
R10	110-23.7K-1	1	RESISTOR,FXD,MF,23.7KΩ,1%,0.25W		
R11	110-1.27K-1	1	RESISTOR,FXD,MF,1.27KΩ,1%,0.25W		
R12	110-10K-1	1	RESISTOR,FXD,MF,10KΩ,1%,0.25W		
R13	110-13.3K-1	1	RESISTOR,FXD,MF,13.3KΩ,1%,0.25W		
R14	157-10K-A	2	RESISTOR,TRIM,CER,10KΩ,10%		BECKMAN
R15	109-1K-5		RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R16	109-2K-5	2	RESISTOR,FXD,MF,2KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R17	109-1K-5	6	RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R18	110-30.1K-1	1	RESISTOR,FXD,MF,30.1KΩ,1%,0.25W		
R19	110-15.4K-1	1	RESISTOR,FXD,MF,15.4KΩ,1%,0.25W		
R20	110-16.9K-1	1	RESISTOR,FXD,MF,16.9KΩ,1%,0.25W		
R21	110-10-1	3	RESISTOR,FXD,MF,10Ω,1%,0.25W	SMA-4 OR C4	CORNING
R22	110-10-1		RESISTOR,FXD,MF,10Ω,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-10-1		RESISTOR,FXD,MF,10Ω,1%,0.25W	SMA-4 OR C4	CORNING
R24	101-68-5	2	RESISTOR,FXD,CC,68Ω,5%,0.25W	RC07GF680J	ALLEN BRADLEY
R25	101-68-5		RESISTOR,FXD,CC,68Ω,5%,0.25W	RC07GF680J	ALLEN BRADLEY
R26	101-47-5	2	RESISTOR,FXD,CC,47Ω,5%,0.25W	RC07GF470J	ALLEN BRADLEY
R27	101-47-5		RESISTOR,FXD,CC,47Ω,5%,0.25W	RC07GF470J	ALLEN BRADLEY
R28	101-22-5	2	RESISTOR,FXD,CC,22Ω,5%,0.25W	RC07GF220J	ALLEN BRADLEY
R29	101-22-5		RESISTOR,FXD,CC,22Ω,5%,0.25W	RC07GF220J	ALLEN BRADLEY
R30	110-215-1	2	RESISTOR,FXD,MF,215Ω,1%,0.25W		
R31	101-100-5	2	RESISTOR,FXD,CC,100Ω,5%,0.25W	RC07GF101J	ALLEN BRADLEY
R32	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R33	101-100-5		RESISTOR,FXD,CC,100Ω,5%,0.25W	RC07GF101J	ALLEN BRADLEY
R34	110-511-1	1	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R35	109-1K-5		RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R36	110-1.65K-1	1	RESISTOR,FXD,MF,1.65KΩ,1%,0.25W		
R37	102-150-5	1	RESISTOR,FXD,CC,150Ω,5%,0.5W	RC20GF151J	ALLEN BRADLEY
R38	110-100-1	1	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R39	109-1K-5		RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R40	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R41	109-1K-5		RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R42	109-75K-5	1	RESISTOR,FXD,MF,75KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R43	109-30K-5	1	RESISTOR,FXD,MF,30KΩ,5%,0.125W	CORNING	
R44	109-2K-5		RESISTOR,FXD,MF,2KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R45	109-1K-5		RESISTOR,FXD,MF,1KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R46	109-10K-5	1	RESISTOR,FXD,MF,10KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING

Table 5-7. A4 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R47	157-10K-A		RESISTOR,TRIM,CER,10KΩ,10%		BECKMAN
R48	109-33K-5	1	RESISTOR,FXD,MF,33KΩ,5%,0.125W	CT3 SERIES+VALUE	CORNING
TP1	702-17	5	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	50-30	1	OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U2	60-52	2	AMPLIFIER,2GHz,12dB,+3dBm	MSA-0204	AVANTEK
U3	60-52		AMPLIFIER,2GHz,12dB,+3dBm	MSA-0204	AVANTEK
Y1	60-53	1	OSCILLATOR,VCO,315-552 MHZ	M600D001	Z-COMMUNICATION
J1,J2	513-34	2	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-8. A5 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-42	11	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-65	1	CAPACITOR,FXD,1500pF,±5%		CENTRE ENG
C4	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	227-51	1	CAPACITOR,FXD,PEST,0.0022µF,10V	ZA2B222K	IMB
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	230-37	4	CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	250-19	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C11	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C13	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C14	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	230-55	6	CAPACITOR,FXD,,100pF ±5%		CENTRE ENG
C16	230-55		CAPACITOR,FXD,,100pF±5%		CENTRE ENG
C17	230-55		CAPACITOR,FXD,,100pF ±5%		CENTRE ENG
C18	230-55		CAPACITOR,FXD,,100pF ±5%		CENTRE ENG
C19	230-55		CAPACITOR,FXD,,100pF ±5%		CENTRE ENG
C20	230-55		CAPACITOR,FXD,,100pF ±5%		CENTRE ENG
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C24	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-FD300	2	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR2	10-SI6	2	DIODE,RECTIFIER,1N4005		
CR3	10-SI6		DIODE,RECTIFIER,1N4005		
CR4	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR5	10-1N751A	1	DIODE,ZENER,1 N751A	1N751A	MOTOROLA
L1	310-53	3	INDUCTOR,FXD,47.0µH,5%	1537-60	
L2	310-53		INDUCTOR,FXD,47.0µH,5%	1537-60	
L3	310-36	3	INDUCTOR,FXD,0.33µH,20%	1025-8	
L4	310-36		INDUCTOR,FXD,0.33µH,20%	1025-8	
L5	310-36		INDUCTOR,FXD,0.33µH,20%	1025-8	
L6	310-53		INDUCTOR,FXD,47.0µH,5%	1537-60	
P1	551-538	1	CONNECTOR,SOCKET		BERG
Q1	20-2N3906	1	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q2	20-2N2218	1	TRANSISTOR,NPN,2N2218	2N2218	NATIONAL
Q3	20-2N2905	1	TRANSISTOR,PNP,2N2905	2N2905	MOTOROLA
Q4	20-2N2222A	1	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
R1	110-3.16K-1	5	RESISTOR,FXD,MF,3.16Ω1%,0.25W		

Table 5-8. A5 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R2	110-3.16K-1		RESISTOR,FXD,MF,3.16Ω1%,0.25W		
R3	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ1%,0.25W		
R4	110-51.1-1	2	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R5	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R6	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R7	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R8	110-4.87K-1	1	RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R9	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R10	110-1K-1	7	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R11	110-110K-1	1	RESISTOR,FXD,MF,110 KΩ,1%,0.25W		
R12	110-24.3K-1	1	RESISTOR,FXD,MF,24.3 KΩ,1%,0.25W		
R13	110-2.26K-1	2	RESISTOR,FXD,MF,2.26 KΩ,1%,0.25W		
R14	110-100-1	6	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R15	110-24.9-1	2	RESISTOR,MF,24.9Ω,1%,0.25W		
R16	110-4.02K-1	1	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25		
R17	110-2.26K-1		RESISTOR,FXD,MF, 2.26 KΩ,1%,0.25		
R18	110-24.9-1		RESISTOR,MF,1%,24.9Ω,0.25W		
R19	110-243-1	1	RESISTOR,FXD,MF,243Ω,1%,0.25W		
R20	110-1.69K-1	1	RESISTOR,FXD,MF,1.69 KΩ1%,0.25W		
R21	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R22	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R23	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R24	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R25	109-1-5	2	RESISTOR,FXD,MF,1Ω,5%,0.125W		CORNING
R26	109-20-5	2	RESISTOR,FXD,MF,20Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R27	109-24-5	2	RESISTOR,FXD,MF,24Ω,5%,0.125W	CCF-50	DALE RESISTOR
R28	109-1.3K-5	1	RESISTOR,FXD,MF,1.3 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R29	109-51-5	1	RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R30	109-43-5	1	RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R31	109-1-5		RESISTOR,FXD,MF,1Ω,5%,0.125W	CORNING	
R32	109-20-5		RESISTOR,FXD,MF,20Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R33	109-24-5		RESISTOR,FXD,MF,24Ω,5%,0.125W	CCF-50	DALE RESISTOR
R34	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R36	110-215-1	2	RESISTOR,FXD,MF,215Ω,1%,0.25W		
R37	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R38	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R39	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R40	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R41	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R42	109-120-5	3	RESISTOR,FXD,MF,120Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING

Table 5-8. A5 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R43	109-120-5		RESISTOR,FXD,MF,120Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R44	109-120-5		RESISTOR,FXD,MF,120Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R45	109-75-5	3	RESISTOR,FXD,MF,75Ω,1%,0.12W	DALE RESISTOR	
R46	109-75-5		RESISTOR,FXD,MF,75,1%,0.12W	DALE RESISTOR	
R47	109-75-5		RESISTOR,FXD,MF,75Ω,1%,0.12W	DALE RESISTOR	
TP1	702-17	5	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL, EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-376	2	OP AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U2	54-376		OP AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U3	60-54	1	AMPLIFIER,2 GHz,12 dB,+8 dBm		MINI CIRCUITS
U4	60-52	2	AMPLIFIER,2 GHz,12 dB,+3 dBm		AVANTEK
U5	60-52		AMPLIFIER,2 GHz,12 dB,+3 dBm		AVANTEK
VR1	54-333	1	VOLTAGE REGULATOR,LM317	LM317T	NSC
Y1	60-55	1	OSCILLATOR,SAW,500 MHZ	H01148	RF MONOLITHICS
J1-J3	513-34	3	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-9. A6 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-39	19	CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C2	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C4	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C5	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C6	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C8	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C9	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C10	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C11	230-64	2	CAPACITOR,FXD,1000pF,5%		CENTRE ENG
C12	230-64		CAPACITOR,FXD,1000pF,5%		CENTRE ENG
C13	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C14	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C15	220-300	1	CAPACITOR,FXD,MICA,300PF,5%,50V		
C16	250-42	12	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C17	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C18	250-19	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C19	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C20	230-47	1	CAPACITOR,FXD,01µF,10%	200-100-X7R-103K	CENTRE ENG
C21	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C22	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C23	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C24	230-59	2	CAPACITOR,FXD,390pF,5%		CENTRE ENG
C25	250-107	1	CAPACITOR,FXD,ALUM,47µF	476RAR035A	ILLINOIS CAPACITOR
C26	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C27	230-59		CAPACITOR,FXD,390pF,5%		CENTRE ENG
C28	230-56	2	CAPACITOR,FXD,120pF,5%		CENTRE ENG
C29	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C30	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C31	230-56		CAPACITOR,FXD,120pF,5%		CENTRE ENG
C32	230-76	12	CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C33	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C34	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C35	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C36	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C37	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C38	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C39	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C40	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C41	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG

Table 5-9. A6 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C42	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C43	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C44	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C45	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C46	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C47	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C48	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C49	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C50	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C51	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C52	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C55	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-4	5	DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR3	10-4		DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR4	10-4		DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR5	10-4		DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR6	10-4		DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
L1	310-43	2	INDUCTOR,FXD,10.0µH,10%	1537-36	
L2	310-43		INDUCTOR,FXD,10.0µH,10%	1537-36	
L3	310-89	1	INDUCTOR,FIXED,1.9uH @ 50 MHZ		FERROXCUBE
L4	310-53	2	INDUCTOR,FXD,47.0µH,5%	1537-60	
L5	310-53		INDUCTOR,FXD,47.0µH,5%	1537-60	
P1	551-538	1	CONNECTOR,SOCKET		BERG
P2	551-539	1	CONNECTOR,SOCKET		BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q5	20-2N3904	2	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q6	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q7	20-2N3906	2	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q8	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
R1	110-1K-1	6	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R3	110-511-1	9	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R5	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R6	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R9	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R10	110-10-1	1	RESISTOR,FXD,MF,10Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-82.5-1	2	RESISTOR,FXD,MF,82.5Ω,1%,0.25W	SMA-4 OR C4	CORNING
R12	110-51.1-1	2	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-3.32K-1	1	RESISTOR,FXD,MF,3.32KΩ,1%,0.25W		
R14	110-1.21K-1	1	RESISTOR,FXD,MF,1.21KΩ,1%,0.25W		
R15	110-82.5-1		RESISTOR,FXD,MF,82.5Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-9. A6 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R16	110-127-1	1	RESISTOR,FXD,MF,127Ω,,1%,0.25W	SMA 4 OR C4	CORNING
R18	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R27	110-6.19-1	1	RESISTOR,FXD,MF,6.19Ω,1%,0.25W		
R28	110-2.37K-1	1	RESISTOR,FXD,MF,2.37KΩ,1%,0.25W		
R29	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R30	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R31	110-487-1	2	RESISTOR,FXD,MF,487Ω,1%,0.25W		
R32	110-487-1		RESISTOR,FXD,MF,487Ω,1%,0.25W		
R33	110-4.42K-1	2	RESISTOR,FXD,MF,4.42KΩ,1%,0.25W		
R34	110-4.42K-1		RESISTOR,FXD,MF,4.42KΩ,1%,0.25W		
R35	110-178-1	1	RESISTOR,FXD,MF,178Ω,1%,0.25W	SMA4 OR C4	CORNING
R36	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R37	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R38	110-20.5K-1	1	RESISTOR,FXD,MF,20.5KΩ,1%,0.25W		
R39	110-24.9K-1	1	RESISTOR,FXD,MF,24.9KΩ,1%,0.25W		
R40	110-3.01K-1	2	RESISTOR,FXD,MF,3.01KΩ,1%,0.25W		
R41	110-100-1	8	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R42	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R43	110-2.94K-1	1	RESISTOR,FXD,MF,2.94KΩ,1%,0.25W		
R44	113-665-0.5	4	RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R45	113-665-0.5		RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R46	113-332-0.5	4	RESISTOR,FXD,MF,332Ω,0.5%,0.125W		
R47	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R48	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R49	110-205-1	2	RESISTOR,FXD,MF,205Ω,1%,0.25W		
R50	110-3.83K-1	2	RESISTOR,FXD,MF,3.83KΩ,1%,0.25W		
R51	113-332-0.5		RESISTOR,FXD,MF,332Ω,0.5%,0.125W		
R52	113-332-0.5		RESISTOR,FXD,MF,332Ω,0.5%,0.125W		
R53	113-165-0.5	1	RESISTOR,FXD,MF,165Ω,0.5%,0.125W		
R54	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R55	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R56	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R57	110-3.01K-1		RESISTOR,FXD,MF,3.01KΩ,1%,0.25W		
R58	113-665-0.5		RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R59	113-665-0.5		RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R60	113-332-0.5		RESISTOR,FXD,MF,332Ω,0.5%,0.125W		
R61	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R62	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R64	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R65	110-205-1		RESISTOR,FXD,MF,205Ω,1%,0.25W		

Table 5-9. A6 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R66	110-3.83K-1		RESISTOR,FXD,MF,3.83KΩ,1%,0.25W		
R67	110-68.1-1	2	RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R68	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R69	110-681-1	1	RESISTOR,FXD,MF,681Ω,1%,0.25W		
R70	110-2K-1	1	RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R73	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R74	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R75	110-36.5-1	1	RESISTOR,FXD,MF,36.5Ω,1%,0.25W		
R76	110-162-1	2	RESISTOR,FXD,MF,162Ω,1%,0.25W	SMA-4 OR C4	CORNING
R77	110-162-1		RESISTOR,FXD,MF,162Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
RN1	123-32	1	RESISTOR NETWORK,8 X 1 KΩ,2%	316B102	ALLEN BRADLEY
RN2	123-43	1	RESISTOR,NETWORK,MF,8 X 1 KΩ,2%		MURATA-ERIE
TP1	702-17	5	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-512	1	CMOS,HEX,SN74HC14N	SN74HC14N	T.I.
U2	54-518	2	CMOS,74HC164,8 BIT SERIAL	SN74HC164N	T.I.
U3	54-349	2	TTL,74LS283,SINGLE	SN74LS283N	T.I.
U4	54-199	2	ECL,10136,4 BIT UP/DOWN	MC10136P	MOTOROLA
U5	54-518		CMOS,74HC164,8 BIT SERIAL	SN74HC164N	T.I.
U6	54-349		TTL,74LS283,SINGLE	SN74LS283N	T.I.
U7	54-199		ECL,10136,,4 BIT UP/DOWN	MC10136P	MOTOROLA
U8	54-429	1	ECL,10105,TRIPLE	MC10105P	MOTOROLA
U9	54-323	1	ECL,10135,DUAL	MC10135P	MOTOROLA
U10	54-74167	1	TTL,74167	SN74167N	T.I.
U11	54-74LS112	2	TTL,74LS112,DUAL,JK FLIP FLOP	74LS112PC	FSC
U13	54-361	1	TTL,74S196	SN74S196N	T.I.
U14	54-74LS112		TTL,74LS112,DUAL,JK FLIP FLOP	74LS112PC	FSC
U15	54-390	1	TTL,74ALS00A,QUAD	SN74ALS00AN	T.I.
U16	54-503	1	OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U17	50-30	3	OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U18	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U19	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U20	54-829	1	ECL,QUAD AND GATE	MC10104P	MOTOROLA
VR1	54-MC7805CP	2	VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
VR2	54-MC7805CP		VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
J1,J2	513-34	2	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-10. A7 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-67	2	CAPACITOR,FXD,CER,33pf,5%,100V	150-100-NPO-330J	CENTRE ENG
C2	230-39	1	CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-67		CAPACITOR,FXD,CER,33pf,5%,100V	150-100-NPO-330J	CENTRE ENG
C4	230-37	11	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-49	2	CAPACITOR,FXD,022uµF,100V	200-100-X7R-223K	CENTRE ENG
C14	230-64	2	CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C15	230-49		CAPACITOR,FXD,022µF,100V	200-100-X7R-223K	CENTRE ENG
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C18	230-60	1	CAPACITOR,FXD,470pF,5%	200-100-NPO-471J	CENTRE ENG
C19	230-58	2	CAPACITOR,FXD,270pF,5%	200-100-NPO-271J	CENTRE ENG
C20	230-58		CAPACITOR,FXD,270pF,5%	200-100-NPO-271J	CENTRE ENG
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	250-42	3	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C24	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-47	1	CAPACITOR,FXD,01µF,10%	200-100-X7R-103K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C30	230-52	1	CAPACITOR,FDX,15pF,5%	150-100-NPO-150J	CENTRE ENG
C31	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C32	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR4	10-1N4446	3	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR8	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
P1	551-538	1	CONNECTOR,SOCKET	66947-011	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q3	20-2N3906	1	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q4	20-2N2222A	2	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q6	20-2N3694	1	TRANSISTOR,NPN,2N3694	MPS3694-18	MOTOROLA
Q7	20-2N2907A	1	TRANSISTOR,PNP,2N2907A	2N2907A	MOTOROLA
Q8	20-2N3904	1	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
R1	109-43-5	2	RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR

Table 5-10. A7 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R2	109-43-5		RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R3	109-75-5	1	RESISTOR,FXD,MF,75Ω,1%,0.12W	CMF-50	DALE RESISTOR
R4	110-2K-1	1	RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R5	110-787-1	1	RESISTOR,FXD,MF,787Ω,1%,0.25W		
R6	110-147-1	1	RESISTOR,FXD,MF,147Ω,1%,0.25W	SMA-4 OR C4	CORNING
R7	109-120-5	1	RESISTOR,FXD,MF,120Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R9	110-316-1	1	RESISTOR,FXD,MF,316Ω,1%,0.25W		
R10	110-100-1	5	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	109-51-5	1	RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R12	110-51.1-1	5	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-2.74K-1	1	RESISTOR,FXD,MF,2.74 KΩ,1%,0.25W		
R14	110-511-1	2	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R15	109-5.1K-5	2	RESISTOR,FXD,MF,5.1 KΩ,5%,0.12W		CORNING
R16	109-5.1K-5		RESISTOR,FXD,MF,5.1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R17	109-300-5	1	RESISTOR,FXD,MF,300Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R18	110-10K-1	3	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R19	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R20	110-1K-1	4	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R21	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R22	110-681-1	1	RESISTOR,FXD,MF,681Ω,1%,0.25W		
R23	110-5.11K-1	4	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R24	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R25	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R26	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R27	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R28	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R29	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R30	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-16.2-1	1	RESISTOR,FXD,MF,16.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R34	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R35	110-17.8K-1	2	RESISTOR,FXD,MF,17.8 KΩ,1%,0.25W		
R36	110-17.8K-1		RESISTOR,FXD,MF,17.8 KΩ,1%,0.25W		
R37	110-4.02K-1	2	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R38	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R39	110-4.02K-1		RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R40	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R41	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R42	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R43	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-10. A7 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
TP1	702-17	3	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-547	1	ECL,SP8680B,SINGLE	SP8680B	PLESSY
U2	54-328	1	TTL.74S02,QUAD,2 INPUT NOR	74S02	FSC
U3	54-329	3	TTL,74S112,DUAL	SN74S112N	T.I.
U4	54-329		TTL,74S112,DUAL	SN74S112N	T.I.
U5	54-74132	1	TTL,74132,QUAD,NAND SCHMITT	DM74132N	NSC
U6	54-329		TTL,74S112,DUAL	SN74S112N	T.I.
U7	54-376	1	OP-AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
VR1	54-MC7805CP	1	VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
J1-J5	513-34	5	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-11. A8 PCB Parts List (1 of 1)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C9	230-61	1	CAPACITOR,FXD,560pF,5%	200-100-NPO-561J	CENTRE ENG
C10	230-37	13	CAPACITOR,FXD,CER,0.1μF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1μF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-71	1	CAPACITOR,FIXED,CER,68pf,5%	150-100-NPO-680J	CENTR ENG
C13	230-37		CAPACITOR,FXD,CER,0.1μF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	250-105	1	CAPACITOR,FXD,ALUM,10μF	513D106M050JA4	SPRAGUE
C15	230-37		CAPACITOR,FXD,CER,0.1μF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1μF,20%,100V	RPE122104M100V	MURATA/ERIE
L1	310-53	1	INDUCTOR,FXD,47.0μH,5%	1537-60	
R1	110-1K-1	2	2 RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R2	110-499-1	1	RESISTOR,FXD,MF,499Ω,1%,0.25W		
R3	110-4.75K-1	1	RESISTOR,FXD,MF, 4.75KΩ,1%,0.25W		
R4	110-24.9-1	1	RESISTOR,MF24.9Ω,1%,0.25W		
R5	110-200-1	3	RESISTOR,FXD,MF,200Ω,1%,0.25W		
R6	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R7	110-511-1	2	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R8	110-200-1		RESISTOR,FXD,MF,200Ω,1%,0.25W		
R9	110-200-1		RESISTOR,FXD,MF,200Ω,1%,0.25W		
R10	110-51.1-1	2	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25Ω	SMA-4 OR C4	CORNING
R12	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
RN1	123-34	1	RESISTOR,NETWORK,MF,5 X 470Ω,2%	MSP10A03-471G	DALE
RN2	123-15	2	RESISTOR,NETWORK,MF,7 X 4.7 KΩ,2%		
RN3	123-15		RESISTOR,NETWORK,MF,7 X 4.7 KΩ,2%		
T1	320-88	4	TRANSFORMER,RF,FIX,200-500 KHZ		WEST COAST MAG
T2	320-88		TRANSFORMER,RF,FIX,200-500 KHZ		WEST COAST MAG
T3	320-88		TRANSFORMER,RF,FIX,200-500 KHZ		WEST COAST MAG
T4	320-88		TRANSFORMER,RF,FIX,200-500 KHZ		WEST COAST MAG
U1	54-528	1	CMOS,74HCT138	SN74HCT138N	T.I.
U2	54-512	1	CMOS,HEX,SN74HC14N		T.I.
U3	54-514	1	CMOS,QUAD,SN74HC125N	SN74HC125N	T.I.
U4	54-513	1	CMOS,74HC74,DUAL	SN74HC74N	T.I.
U5	54-523	1	CMOS,74HC374	SN74HC374N	T.I.
U6	54-458	2	ANALOG SWITCH	DG508CJ	SILICONIX
U7	54-365	1	CMOS,7555,,TIMER	ICM7555IPA	INTERSIL
U8	54-535	1	CMOS,74HC393,DUAL	SN74HC393N	TEXAS INST.
U9	54-532	1	CMOS,74HC299	CD74HC299E	RCA
U10	54-336	1	CMOS,509,4 CHANNEL	DG509 ACJ	SILICONIX
U11	54-519	1	CMOS,74HC165	SN74HC165N	T.I.
U12	54-458		ANALOG SWITCH	DG508CJ	SILICONIX

Table 5-12. A9 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C2	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C3	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C4	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C5	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C6	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C7	230-66	1	CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C8	250-42A	11	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C9	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C12	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C13	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C17	230-37	7	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	250-143	7	CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C19	230-60	2	CAPACITOR,FXD,470pF,5%	200-100-NPO-471J	CENTRE ENG
C20	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	230-70	2	CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C24	230-60		CAPACITOR,FXD,470pF,5%	200-100-NPO-471J	CENTRE ENG
C25	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C26	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C27	230-70		CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C28	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C29	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C30	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C31	230-77	1	CAPACITOR,FXD,CER,3300pF,5%	300-100-NPO-332J	CENTRE ENG
C32	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-FD300	8	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR3	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR4	10-1N823	1	DIODE,ZENER,1N823	1N823	MOTOROLA
CR5	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR6	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR7	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR8	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR9	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR10	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR11	10-72	2	DIODE,VARACTOR,ZC804B	ZC804	MSI ELECTORNICS

Table 5-12. A9 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR12	10-72		DIODE,VARACTOR,ZC804B	ZC804	MSI ELECTORNICS
CR14	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
J3	551-547	1	CONNECTOR HEADER	68001-103	BERG
L1	310-36	2	INDUCTOR,FXD,0.33µH,20%	1025-8	
L2	310-36		INDUCTOR,FXD,0.33µH,20%	1025-8	
L3	310-72	2	INDUCTOR,FXD,0.047µH,10%	551-5172-05-02-00	CAMBION
L4	310-72		INDUCTOR,FXD,0.047µH,10%	551-5172-05-02-00	CAMBION
P1	551-538	1	CONNECTOR,SOCKET	66947-011	BERG
Q1	20-56	1	TRANSISTOR,JFET,J310	J310	SILICONIX
Q2	20-2N5179	5	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q3	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q4	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q5	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q6	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
R1	109-33-5	6	RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R2	109-33-5		RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R3	109-33-5		RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R4	109-33-5		RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R5	109-33-5		RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R6	109-33-5		RESISTOR,FXD,MF,33Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R7	110-3.01K-1	6	RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R8	110-3.01K-1		RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R9	110-3.01K-1		RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R10	110-3.01K-1		RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R11	110-13.7K-1		RESISTOR,FXD,MF,13.7 KΩ,1%,0.25W		
R12	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R13	109-1K-5	6	RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R14	109-1K-5		RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R15	110-11.8K-1	2	RESISTOR,FXD,MF,11.8 KΩ,1%,0.25W		
R16	110-1.96K-1	1	RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R17	110-1.47K-1	1	RESISTOR,FXD,MF,1.47 KΩ,1%,0.25W		
R18	110-2.37K-1	1	RESISTOR,FXD,MF,2.37 KΩ,1%,0.25W		
R19	110-10K-1	1	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R20	110-5.11K-1	2	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R21	110-1.27K-1	1	RESISTOR,FXD,MF,1.27 KΩ,1%,0.25W		
R22	110-4.02K-1	2	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R23	110-90.9K-1	1	RESISTOR,FXD,MF,90.9 KΩ,1%,0.25W		
R24	110-6.04K-1	1	RESISTOR,FXD,MF,6.04 KΩ,1%,0.25W		
R25	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R26	110-13.7K-1	2	RESISTOR,FXD,MF,13.7 KΩ,1%,0.25W		

Table 5-12. A9 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R27	110-11.8K-1		RESISTOR,FXD,MF,11.8 KΩ,1%,0.25W		
R28	110-41.2K-1	1	RESISTOR,FXD,MF,41.2 KΩ,1%,0.25W		
R29	110-10.2K-1	1	RESISTOR,FXD,MF,10.2 KΩ,1%,0.25W		
R30	110-3.01K-1		RESISTOR,FXD,MF,3.01KΩ,1%,0.25W		
R31	110-10.5K-1	1	RESISTOR,FXD,MF,10.5 KΩ,1%,0.25W		
R32	110-3.01K-1		RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R34	110-316-1	1	RESISTOR,FXD,MF,316Ω,1%,0.25W		
R35	109-750-5	3	RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R36	109-16-5	1	RESISTOR,FXD,MF,16Ω,5%,0.12W	CCF-50	DALE RESISTOR
R37	109-5.1K-5	3	RESISTOR,FXD,MF,5.1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R38	109-3K-5	1	RESISTOR,FXD,MF,3 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R39	109-330-5	2	RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R40	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R41	109-110-5	2	RESISTOR,FXD,MF,110Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R42	109-91-5	2	RESISTOR,FXD,MF,91Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R43	109-5.1K-5		RESISTOR,FXD,MF,5.1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R44	109-750-5		RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R45	109-36-5	1	RESISTOR,FXD,MF,36Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R46	109-150-5	2	RESISTOR,FXD,MF,150Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R47	109-1K-5		RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R48	109-43-5	4	RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R49	109-1K-5		RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R50	109-43-5		RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R51	109-110-5		RESISTOR,FXD,MF,110Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R52	109-91-5		RESISTOR,FXD,MF,91Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R53	109-5.1K-5		RESISTOR,FXD,MF,5.1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R54	109-750-5		RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R55	109-150-5		RESISTOR,FXD,MF,150Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R56	109-1K-5		RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R57	109-43-5		RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R58	109-1K-5		RESISTOR,FXD,MF,1 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R59	109-43-5		RESISTOR,FXD,MF,43Ω,5%,0.12W	CFF-50	DALE RESISTOR
R60	109-1.8K-5		1 RESISTOR,FXD,MF,1.8 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R61	110-71.5K-1	1	RESISTOR,FXD,MF,71.5 KΩ,1%,0.25W		
R62	110-147K-1	1	RESISTOR,FXD,MF,147 KΩ,1%,0.25W		
R63	110-511-1	1	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R64	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R65	110-19.6K-1	1	RESISTOR,FXD,MF,19.6 KΩ,1%,0.25W		
R66	110-4.02K-1		RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R67	110-33.2K-1	1	RESISTOR,FXD,MF,33.2 KΩ,1%,0.25W		
TP1	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED

Table 5-12. A9 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17	7	TERMINAL,EYELET	20-2137D	VEROSPEED
TP6	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP8	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP9	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U2	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U3	54-376	1	OP AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U4	50-9	1	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
J1,J2	513-34	2	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-13. A10 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-19	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C2	230-66	1	CAPACITOR,FXD,CER,0.22µF,10%	CW30C224K	CENTRALAB
C3	250-42	2	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C4	230-47	10	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C5	230-39	8	CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C6	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C8	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C9	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C10	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C11	230-47		CAPACITOR,FXD,.01µF,+/-10%	200-100-X7R-103K	CENTRE ENG
C12	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C13	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C14	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C15	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C16	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C17	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C18	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C19	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C20	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C22	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
CR1	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR2	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR3	10-FD300	2	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR4	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
L1	310-43	1	INDUCTOR,FXD,10.0µH,10%	1537-36	
L2	310-61	3	INDUCTOR,FXD,10µH,10%	1025-44	
L3	310-61		INDUCTOR,FXD,10µH,10%	1025-44	
L4	310-61		INDUCTOR,FXD,10µH,10%	1025-44	
P1	551-539	1	CONNECTOR,SOCKET	66947-004	BERG
Q1	20-2N3563	5	TRANSISTOR,NPN,2N3563	PN3563	FSC
Q2	20-2N3563		TRANSISTOR,NPN,2N3563	PN3563	FSC
Q3	20-2N3563		TRANSISTOR,NPN,2N3563	PN3563	FSC
Q4	20-2N3563		TRANSISTOR,NPN,2N3563	PN3563	FSC
Q5	20-2N3563		TRANSISTOR,NPN,2N3563	PN3563	FSC
Q6	20-2N5179	3	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q7	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q8	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q9	20-2N3906	2	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q10	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA

Table 5-13. A10 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
Q11	20-2N3904	2	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q12	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
R1	110-5.11-1	1	RESISTOR,FXD,MF,5.11Ω,1%,0.25W		
R2	109-51-5	9	RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R3	109-1.8K-5	1	RESISTOR,FXD,MF,1.8 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R4	109-2.2K-5	1	RESISTOR,FXD,MF,2.2 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R5	109-36-5	1	RESISTOR,FXD,MF,36Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R6	109-330-5	8	RESISTOR,FXD,MF,330Ω,5%,0.125W,	CT3 SERIES+VALUE	CORNING
R7	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R8	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R9	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R10	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R11	109-20-5	3	RESISTOR,FXD,MF,20Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R12	109-82-5	3	RESISTOR,FXD,MF,82Ω,5%,0.12W	CCF-50	DALE RESISTOR
R13	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R14	109-750-5	3	RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R15	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R16	109-30-5	5	RESISTOR,FXD,MF,30Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R17	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R18	109-16-5	3	RESISTOR,FXD,MF,16Ω,5%,0.12W	CCF-50	DALE RESISTOR
R19	109-20-5		RESISTOR,FXD,MF,20,5%,0.12W	CT3 SERIES+VALUE	CORNING
R20	109-82-5		RESISTOR,FXD,MF,82Ω,5%,0.12W	CCF-50	DALE RESISTOR
R21	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R22	109-750-5		RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R23	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R24	109-30-5		RESISTOR,FXD,MF,30Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R25	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R26	109-16-5		RESISTOR,FXD,MF,16Ω,5%,0.12W	CCF-50	DALE RESISTOR
R27	109-20-5		RESISTOR,FXD,MF,20Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R28	109-82-5		RESISTOR,FXD,MF,82Ω,5%,0.12W	CCF-50	DALE RESISTOR
R29	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R30	109-750-5		RESISTOR,FXD,MF,750Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R31	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R32	109-30-5		RESISTOR,FXD,MF,30Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R33	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR
R34	109-16-5		RESISTOR,FXD,MF,16Ω,5%,0.12W	CCF-50	DALE RESISTOR
R35	109-330-5		RESISTOR,FXD,MF,330Ω,5%,0.125W	CT3 SERIES+VALUE	CORNING
R36	109-30-5		RESISTOR,FXD,MF,30Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R37	109-30-5		RESISTOR,FXD,MF,30Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R38	109-2K-5	1	RESISTOR,FXD,MF,2 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R39	109-51-5		RESISTOR,FXD,MF,51Ω,5%,0.12W	CMF-50	DALE RESISTOR

Table 5-13. A10 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
TP1	702-17	1	TERMINAL,EYELET	20-2137D	VEROSPEED
VR1	54-MC7805CP	1	VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
J1-J5	513-34	5	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-14. A11 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C2	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	250-42		5 CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C10	230-66	1	CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C11	230-37	19	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	230-64	4	CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C19	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C20	230-52	1	CAPACITOR,FDX,15pF,5%	150-100-NPO-150J	CENTRE ENG
C21	250-58	2	CAPACITOR,FXD,TANT,68µF,10%,6V	196D686X9006KE3	SPRAGUE
C22	250-58		CAPACITOR,FXD,TANT,68µF,10%,6V	196D686X9006KE3	SPRAGUE
C23	230-47	1	CAPACITOR,FXD,.01uF,10%	200-100-X7R-103K	CENTRE ENG
C24	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C26	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C27	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C28	230-78	20	CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C29	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C30	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C31	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C32	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C33	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C34	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C35	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C36	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C37	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C38	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C39	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C40	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C41	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG

Table 5-14. A11 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C42	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C43	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C44	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C45	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C46	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C47	230-78		CAPACITOR,FXD,CER,2200pF,1%	200-100-NPO-222F	CENTRE ENG
C48	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C49	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C50	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C51	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C52	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C53	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
L1	310-53	1	INDUCTOR,FXD,47.0µH,5%	1537-60	
L2	310-43	3	INDUCTOR,FXD,10.0µH,10%	1537-36	
L3	310-43		INDUCTOR,FXD,10.0µH,10%	1537-36	
L4	310-43		INDUCTOR,FXD,10.0µH,10%	1537-36	
P1	551-538	1	CONNECTOR,SOCKET	66947-011	BERG
P2	551-539	1	CONNECTOR,SOCKET	66947-004	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q2	20-2N3904	2	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q3	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
R1	110-16.2-1	1	RESISTOR,FXD,MF,16.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R2	110-54.9-1	1	RESISTOR,FXD,MF,54.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-1K-1	6	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R4	110-3.48K-1	1	RESISTOR,FXD,MF,3.48 KΩ,1%,0.25W		
R5	110-100-1	1	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R6	110-26.1-1	1	RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R7	110-464-1	2	RESISTOR,FXD,MF,464Ω,1%,0.25W		
R8	110-464-1		RESISTOR,FXD,MF,464Ω,1%,0.25W		
R9	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R10	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R11	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R12	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R13	110-5.36K-1	2	RESISTOR,FXD,MF,5.36 KΩ,1%,0.25W		
R14	110-5.36K-1		RESISTOR,FXD,MF,5.36 KΩ,1%,0.25W		
R15	110-3.16K-1	5	RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R16	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R17	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R18	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R19	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		

Table 5-14. A11 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R20	110-604K-1	1	RESISTOR,FXD,MF,604 KΩ,1%,0.25W		
R21	113-7.23K-0.5	4	RESISTOR,FXD,MF,7.23 KΩ,0.5%		
R22	113-7.23K-0.5		RESISTOR,FXD,MF,7.23 KΩ,0.5%		
R23	113-3.61K-0.5	4	RESISTOR,FXD,MF,3.61 KΩ,0.5%		
R24	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R25	110-9.53K-1	3	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R26	113-3.61K-0.5		RESISTOR,FXD,MF,3.61 KΩ,0.5%		
R27	113-3.61K-0.5		RESISTOR,FXD,MF,3.61 KΩ,0.5%		
R28	113-1.8K-0.5	3	RESISTOR,FXD,MF,1.8 KΩ,0.5%		
R29	110-1.96K-1	1	RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R30	110-7.87K-1	1	RESISTOR,FXD,MF,7.87 KΩ,1%,0.25W		
R31	113-2.4K-0.5	2	RESISTOR,FXD,MF,2.4 KΩ,0.5%,0.12W		
R32	113-2.4K-0.5		RESISTOR,FXD,MF,2.4 KΩ,0.5%,0.12W		
R33	113-1.21K-0.5	1	RESISTOR,FXD,MF,1.21 KΩ,0.5%		
R34	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R35	110-9.53K-1		RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R36	113-1.8K-0.5		RESISTOR,FXD,MF,1.8 KΩ,0.5%		
R37	113-1.8K-0.5		RESISTOR,FXD,MF,1.8 KΩ,0.5%		
R38	113-909-0.5	1	RESISTOR,FXD,MF,909Ω,0.5%		
R39	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R40	110-19.6K-1	1	RESISTOR,FXD,MF,19.6 KΩ,1%,0.25W		
R41	113-7.23K-0.5		RESISTOR,FXD,MF,7.23 KΩ,0.5%		
R42	113-7.23K-0.5		RESISTOR,FXD,MF,7.23 KΩ,0.5%		
R43	113-3.61K-0.5		RESISTOR,FXD,MF,3.61 KΩ,0.5%		
R44	110-511-1	6	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R45	110-9.53K-1		RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R46	110-4.02K-1	1	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R47	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R48	110-169-1	2	RESISTOR,FXD,MF,169Ω,1%,0.25W	SMA4 OR C4	CORNING
R49	110-169-1		RESISTOR,FXD,MF,169Ω,1%,0.25W	SMA4 OR C4	CORNING
R50	110-31.6-1	4	RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R51	110-31.6-1		RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R52	110-31.6-1		RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R53	110-31.6-1		RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R54	110-274-1		2 RESISTOR,FXD,MF,274Ω,1%,0.25W		DALE
R55	110-274-1		RESISTOR,FXD,MF,274Ω,1%,0.25W		DALE

Table 5-14. A11 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R56	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R57	110-2.37K-1	1	RESISTOR,FXD,MF,2.37 KΩ,1%,0.25W		
R58	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R59	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
TP1	702-17	5	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-512	1	CMOS,74HC14,HEX	SN74HC14N	T.I.
U2	54-518	2	CMOS,74HC164	SN74HC164N	T.I.
U3	54-361	3	TTL,74S196	SN74S196N	T.I.
U4	54-545	1	AS TTL,74AS11,TRIPLE	SN74AS11N	T.I.
U5	54-361		IC,TTL,74S196	SN74S196N	T.I.
U6	54-518		IC,CMOS,74HC164	SN74HC164N	T.I.
U7	54-74167	1	TTL,74167	SN74167N	T.I.
U8	54-361		IC,TTL,74S196	SN74S196N	T.I.
U9	54-329		IC,TTL,74S112,DUAL	SN74S112N	T.I.
U10	54-74LS132		1 IC,TTL,74LS132,QUAD,NAND	DM74LS132N	NSC
U11	54-349	1	TTL,74LS283,SINGLE	SN74LS283N	T.I.
U12	54-406	1	TTL,74S197,BINARY COUNTER	SN74S197N	T.I.
U13	54-329	2	TTL,74S112,DUAL,JK	SN74S112N	T.I.
U14	54-547	1	ECL,SP8680B,SINGLE	SP8680B	PLESSY
U15	54-544	1	AS TTL,74AS02,QUAD	SN74AS02N	T.I.
U19	54-172	1	TTL,74LS390,DUAL	DM74LS390N	NSC
U20	54-540	1	ALS TTL,74ALS112	74ALS112N	T.I.
U21	50-30	6	OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U22	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U23	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U24	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U25	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U26	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
VR1	54-MC7805CP	1	VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
J1,J2	513-34	2	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-15. A12 PCB Parts List (1 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-66	1	CAPACITOR,FXD,CER,0.22µF,10%	CW30C224K	CENTRALAB
C2	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C3	230-64	6	CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C4	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C5	230-37	7	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	250-77	1	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C7	230-52	1	CAPACITOR,FDX,15pF,5%	150-100-NPO-150J	CENTRE ENG
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C13	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C16	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C20	223-330	4	CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C21	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C22	223-43	2	CAPACITOR,FXD,MICA,43PF,5%,500V	DM 10E 430J05%300V	ELMENCO
C23	223-43		CAPACITOR,FXD,MICA,43PF,5%,500V	DM 10E 430J05%300V	ELMENCO
C24	250-42	2	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C26	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C27	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
L1	310-53	2	INDUCTOR,FXD,47.0µH,5%	1537-60	
L2	310-53		INDUCTOR,FXD,47.0µH,5%	1537-60	
P1	551-538	1	CONNECTOR,SOCKET	66947-011	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q4	20-2N2222A	2	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q6	20-45	1	TRANSISTOR,FET	VN10KM	SILICONIX
Q7	20-2N3563	2	TRANSISTOR,NPN,2N3563	PN3563	FSC
Q8	20-2N3563		TRANSISTOR,NPN,2N3563	PN3563	FSC
R1	109-56-5	1	RESISTOR,FXD,MF,56Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R2	110-1K-1	5	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R3	110-3.48K-1	1	RESISTOR,FXD,MF,3.48 KΩ,1%,0.25W		
R4	109-100-5	1	RESISTOR,FXD,MF,100Ω,1%,0.12W	CMF-50	DALE RESISTOR
R5	109-27-5	1	RESISTOR,FXD,MF,27Ω,5%,0.12W	CCF-50	DALE RESISTOR
R6	110-200-1	1	RESISTOR,FXD,MF,200Ω,1%,0.25W		
R7	110-56.2-1	1	RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R12	110-750-1	2	RESISTOR,FXD,MF,750Ω,1%,0.25W		

Table 5-15. A12 PCB Parts List (2 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R13	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R14	110-1.07K-1	1	RESISTOR,FXD,MF,1.07 KΩ,1%,0.25W		
R15	110-887-1	2	RESISTOR,FXD,MF,887Ω,1%,0.25W		
R16	110-301-1	2	RESISTOR,FXD,MF,301Ω,1%,0.25W		
R17	110-2.43K-1	1	RESISTOR,FXD,MF,2.43KΩ,1%,0.25W		
R18	110-301-1		RESISTOR,FXD,MF,301Ω,1%,0.25W		
R19	110-887-1		RESISTOR,FXD,MF,887Ω,1%,0.25W		
R20	110-383-1	1	RESISTOR,FXD,MF,383Ω,1%,0.25W		
R21	110-681-1	1	RESISTOR,FXD,MF,681Ω,1%,0.25W		
R22	110-750-1		RESISTOR,FXD,MF,750Ω,1%,0.25W		
R23	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R24	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R25	110-4.87K-1	4	RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R26	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R27	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R28	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R29	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R30	110-90.9K-1	2	RESISTOR,FXD,MF,90.9 KΩ,1%,0.25W		
R31	110-19.6K-1	2	RESISTOR,FXD,MF,19.6 KΩ,1%,0.25W		
R32	110-100-1	2	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-90.9K-1		RESISTOR,FXD,MF,90.9 KΩ,1%,0.25W		
R35	110-19.6K-1		RESISTOR,FXD,MF,19.6 KΩ,1%,0.25W		
R36	110-68.1-1	2	RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R37	110-16.2-1	1	RESISTOR,FXD,MF,16.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R38	110-2.74K-1	2	RESISTOR,FXD,MF,2.74 KΩ,1%,0.25W		
R39	110-2.74K-1		RESISTOR,FXD,MF,2.74 KΩ,1%,0.25W		
R40	110-22.6K-1	2	RESISTOR,FXD,MF,22.6 KΩ,1%,0.25W		
R41	110-22.6K-1		RESISTOR,FXD,MF,22.6 KΩ,1%,0.25W		
R42	110-169-1	1	RESISTOR,FXD,MF,169Ω,1%,0.25W	SMA4 OR C4	CORNING
R43	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R44	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R45	110-4.02K-1	1	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
U1	54-547	1	ECL,SP8680B,SINGLE	SP8680B	PLESSY
U2	54-361	2	TTL,74S196	SN74S196N	T.I.
U3	54-361		TTL,74S196	SN74S196N	T.I.
U4	54-540	1	TTL,74ALS112,DUAL	74ALS112N	T.I.
U5	54-390	1	TTL,74ALS00A,QUAD	SN74ALS00AN	T.I.
U6	50-9	1	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
VR1	54MC7805P	1	VOLTAGE REGULATOR,7805	340T-5	NATIONAL SEMI
J1-J4	513-34	4	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER+SUHNER

Table 5-16. A13 PCB Parts List (1 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C2	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CERR,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	250-58	1	CAPACITOR,FXD,TANT,68µF,10%,6V	196D686X9006KE3	SPRAGUE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-55	2	CAPACITOR,FXD,100pF,5%	150-100-NPO-101J	CENTRE ENG
C13	230-37	40	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-55		CAPACITOR,FXD,,100pF,5%	150-100-NPO-101J	CENTRE ENG
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C19	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C24	230-58	2	CAPACITOR,FXD,,270pF,5%	200-100-NPO-271J	CENTRE ENG
C25	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C30	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C31	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C32	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C33	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C35	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C36	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C37	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C38	230-64	8	CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C39	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C40	250-40	1	CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X002HE3	SPRAGUE
C41	250-42	2	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C42	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE

Table 5-16. A13 PCB Parts List (2 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C43	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C44	230-64		CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C46	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C47	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C48	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C49	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C50	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C51	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C53	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C54	230-64		CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C55	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C56	230-58		CAPACITOR,FXD,270pF,5%	200-100-NPO-271J	CENTRE ENG
C57	230-47	1	CAPACITOR,FXD,.01uF,10%	200-100-X7R-103K	CENTRE ENG
C58	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-1N4446	9	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR8	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR9	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR10	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR12	10-4	9	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR13	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR14	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR16	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR17	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR18	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR19	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
DS1	15-5	2	LED,RED	MV5774C	MONSANTO
DS2	15-5		LED,RED	MV5774C	MONSANTO
L1	310-89	1	INDUCTOR,FXED,1.9uH @ 50 MHZ	VK200 10/3B	FERROXCUBE
L2	310-45	1	INDUCTOR,FXD,100.0µH,5%	1315-12J	
L3	310-57	4	INDUCTOR,FXD,0.15µH,10%	1025-00	
L4	310-57		INDUCTOR,FXD,0.15µH,10%	1025-00	
L5	310-57		INDUCTOR,FXD,0.15µH,10%	1025-00	

Table 5-16. A13 PCB Parts List (3 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
L6	310-57		INDUCTOR,FXD,0.15µH,10%	1025-00	
P1	551-538	1	CONNECTOR,SOCKET	66947-011	BERG
Q1	20-2N4249	2	TRANSISTOR,PNP,2N4249	MPS4249-18	MOTOROLA
Q2	20-2N4249		TRANSISTOR,PNP,2N4249	MPS4249-18	MOTOROLA
Q3	20-2N4122	16	TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q4	20-2N4122		TRANSISTOR,PNP,2N4122,SI	PN4122	NATIONAL SEMI
Q5	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q6	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q7	20-2N5179	4	TRANSISTOR,NPN,2N5179	2N5179	RCA
Q8	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q9	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q10	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q11	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q12	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q14	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q15	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q16	0-2N4122	2	TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q17	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q18	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q19	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q20	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q21	20-2N4122		TRANSISTOR,PNP,2N4122	PN4122	NATIONAL SEMI
Q22	20-2N5179		TRANSISTOR,NPN,2N5179	2N5179	RCA
Q23	20-2N3904	3	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q24	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q25	0-2N3904	2	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
R1	110-2.05K-1	2	RESISTOR,FXD,MF,2.05 KΩ,1%,0.25W		
R2	110-4.02K-1	2	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R3	110-2.05K-1		RESISTOR,FXD,MF, 2.05 KΩ,1%,0.25W		
R4	110-4.02K-1		RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R5	110-200-1	1	RESISTOR,FXD,MF,200Ω,1%,0.25W		
R6	110-1K-1	2	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R7	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R9	110-511-1	2	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R10	110-100-1	4	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-10.5K-1	1	RESISTOR,FXD,MF,10.5 KΩ,1%,0.25W		
R12	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R14	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R15	110-383-1	2	RESISTOR,FXD,MF,383Ω,1%,0.25W		
R16	110-383-1		RESISTOR,FXD,MF,383Ω,1%,0.25W		

Table 5-16. A13 PCB Parts List (4 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R17	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R18	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-1.78K-1	4	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R20	110-261-1	4	RESISTOR,FXD,MF,261Ω,1%,0.25W		
R21	110-536-1	4	RESISTOR,FXD,MF,536,1%,0.25W		
R22	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R24	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R25	110-332-1	4	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R26	110-51.1-1	17	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R27	110-26.1-1	4	RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R28	110-536-1		RESISTOR,FXD,MF,536Ω,1%,0.25W		
R29	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R30	110-261-1		RESISTOR,FXD,MF,261Ω,1%,0.25W		
R31	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-332-1		RESISTOR,FXD,MF,332Ω,1%,0.25W		
R33	110-56.2-1	8	RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-26.1-1		RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R36	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R37	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R38	110-1.78K-1		RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R39	110-169-1	1	RESISTOR,FXD,MF,169Ω,1%,0.25W	SMA4 OR C4	CORNING
R40	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R41	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R42	110-1.78K-1		RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R43	110-536-1		RESISTOR,FXD,MF,536Ω,1%,0.25W		
R44	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R45	110-261-1		RESISTOR,FXD,MF,261Ω,1%,0.25W		
R46	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R47	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R48	110-332-1		RESISTOR,FXD,MF,332Ω,1%,0.25W		
R49	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-26.1-1		RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R51	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R52	110-536-1		RESISTOR,FXD,MF,536Ω,1%,0.25W		
R53	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R54	110-261-1		RESISTOR,FXD,MF,261Ω,1%,0.25W		
R55	110-332-1		RESISTOR,FXD,MF,332Ω,1%,0.25W		
R56	110-56.2-1		RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R57	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-16. A13 PCB Parts List (5 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R58	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R59	110-1.78K-1		RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R60	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R61	110-26.1-1		RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R62	110-2.37K-1	1	RESISTOR,FXD,MF,2.37 KΩ,1%,0.25W		
R63	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R65	110-6.49-1	1	RESISTOR,FXD,MF,6.49Ω,1%,0.25W		
R66	110-90.9-1	2	RESISTOR,FXD,MF,90.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-402-1	1	RESISTOR,FXD,MF,402Ω,1%,0.25W		
R68	110-90.9-1		RESISTOR,FXD,MF,90.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
TP1	702-17	9	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP6	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP7	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP8	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP9	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U2	54-539	1	ALS TTL,74ALS86,QUAD	SN74ALS86N	T.I.
U3	54-387	2	TTL,74ALS08,QUAD	SN74ALS08N	T.I.
U4	54-542		TTL,74ALS160	SN74ALS160N	T.I.
U5	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U6	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U8	54-541		ALS TTL,74ALS151	SN74ALS151N	T.I.
U9	54-512	1	CMOS,74HC14,HEX	SN74HC14N	T.I.
U10	54-518	7	CMOS,74HC164	SN74HC164N	T.I.
U11	54-542	9	ALS TTL,74ALS160	SN74ALS160N	T.I.
U12	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U13	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U14	54-387		TTL,74ALS08,QUAD	SN74ALS08N	T.I.
U15	54-541		ALS TTL,74ALS151	SN74ALS151N	T.I.
U16	54-518		CMOS,74HC164	SN74HC164N	T.I.
U17	54-518		CMOS,74HC164	SN74HC164N	T.I.
U18	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U19	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U20	54-542		ALS TTL,74ALS160	SN74ALS160N	T.I.
U21	54-518		CMOS,74HC164	SN74HC164N	T.I.
U22	54-518		CMOS,74HC164	SN74HC164N	T.I.
U24	54-552	3	ALS-TTL,74ALS153,DUAL	SN74ALS153N	TI

Table 5-16. A13 PCB Parts List (6 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U25	54-538	4	ALS TTL,74ALS74,DUAL	SN74ALS74N	T.I.
U26	54-537	1	ALS TTL,74ALS38,QUAD	SN74ALS38N	T.I.
U27	54-538		ALS TTL,74ALS74,DUAL	SN74ALS74N	T.I.
U28	54-538		ALS TTL,74ALS74,DUAL	SN74ALS74N	T.I.
U29	54-324	1	TTL,,DUAL,DIGITAL DELAY LINE	DDU-4-5125	DATA DELAY DEV
U30	54-552		ALS-TTL,74ALS153,DUAL	SN74ALS153N	TI
U31	54-552		ALS-TTL,74ALS153,DUAL	SN74ALS153N	TI
U32	54-391	2	TTL,74ALS02,QUAD	SN74ALS02N	T.I.
U33	54-518		CMOS,74HC164	SN74HC164N	T.I.
U34	54-518		CMOS,74HC164	SN74HC164N	T.I.
U35	54-391		TTL,74ALS02,QUAD	SN74ALS02N	T.I.
U36	54-233	2	OP AMP,CA3054	CA3054	RCA
U37	54-233		OP AMP,CA3054	CA3054	RCA
U38	54-538		ALS TTL,74ALS74,DUAL	SN74ALS74N	T.I.
VR1	54-184	1	VOLTAGE REGULATOR,7905	UA7905UC	FAIRCHILD
J1-J9	513-34	9	CONNECTOR, RF BULKHD, MICROMIN	22MCX-50-0-2/111	HUBER-SUHNER

Table 5-17. A15 PCB Parts List (1 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-39	13	CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C2	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C4	223-56	1	CAPACITOR,FXD,MICA,56PF,5%,500V	DM10E 560J0 500V	
C5	230-85	1	CAPACITOR,FXD,CER,0.33uF,10%		
C6	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C8	250-58A	1	CAPACITOR,FXD,TANT,68µF,10%,6V	196D686X9006KA1	SPRAGUE
C9	250-40A	1	CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C10	250-42A	34	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C11	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C12	230-53	4	CAPACITOR,FXD,39pF,5%	150-100-NPO-390J	CENTRE ENG
C13	230-53		CAPACITOR,FXD,39pF,5%	150-100-NPO-390J	CENTRE ENG
C14	230-63	1	CAPACITOR,FXD,820pF,5%	150-100-NPO-821J	CENTRE ENG
C16	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C17	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C18	230-66	2	CAPACITOR,FXD,CER,0.22µF,10%	CW30C224K	CENTRALAB
C19	230-66		CAPACITOR,FXD,CER,0.22µF,10%	CW30C224K	CENTRALAB
C20	210-30	2	CAPACITOR,FXD,PEST,0.10µF,10%	ECQ-E2104KZS	PANASONIC
C21	210-30		CAPACITOR,FXD,PEST,0.10µF,10%	ECQ-E2104KZS	PANASONIC
C22	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C23	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C24	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C26	230-53		CAPACITOR,FXD,,39pF,5%	150-100-NPO-390J	CENTRE ENG
C27	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C28	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C29	230-53		CAPACITOR,FXD,39pF,5%	150-100-NPO-390J	CENTRE ENG
C30	230-52	1	CAPACITOR,FDX,15pF,5%	150-100-NPO-150J	CENTRE ENG
C32	230-55	2	CAPACITOR,FXD,100pF,5%	150-100-NPO-101J	CENTRE ENG
C33	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C34	230-65	1	CAPACITOR,FXD,1500pF,5%	200-100-NPO-152J	CENTRE ENG
C35	230-77	1	CAPACITOR,FXD,CER,3300pF,5%	300-100-NPO-332J	CENTRE ENG
C36	250-39A	6	CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C37	250-39A		CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C38	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C39	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C40	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C41	230-47	7	CAPACITOR,FXD,.01µF,+/-10%	200-100-X7R-103K	CENTRE ENG
C42	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C43	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C44	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE

Table 5-17. A15 PCB Parts List (2 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C45	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C46	230-55		CAPACITOR,FXD„100pF,5%	150-100-NPO-101J	CENTRE ENG
C47	230-58	2	CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C48	250-39A		CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C49	250-39A		CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C50	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C51	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C52	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C53	230-47		CAPACITOR,FXD,.01µF,+/-10%	200-100-X7R-103K	CENTRE ENG
C54	230-47		CAPACITOR,FXD,.01µF,+/-10%	200-100-X7R-103K	CENTRE ENG
C55	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C56	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C57	230-62	1	CAPACITOR,FXD,680pF,5%	200-100-NPO-681J	CENTRE ENG
C58	230-81	2	CAPACITOR,FXD,CER,47PF,5%	150-100-NPO-470J	CENTRE ENG
C59	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C60	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C61	230-60	1	CAPACITOR,FXD,470pF,5%	200-100-NPO-471J	CENTRE ENG
C62	230-64	1	CAPACITOR,FXD,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C63	230-74	2	CAPACITOR,FIXED,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C64	230-57	1	CAPACITOR,FXD,220pF	200-100-NPO-221J	CENTRE ENG
C65	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C66	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C67	230-74		CAPACITOR,FIXED,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C68	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C69	230-58		CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C70	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C72	240-30	1	1 CAPACITOR,VAR,2-10PF,250V	2807C00210MJ02F	MEPCO
C73	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C74	230-39		CAPACITOR,FXD,CER,0.1µF,10%	50 8121-050-X7RO-104K	ERIE
C75	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C76	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C77	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C78	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C79	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C80	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C81	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C82	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C83	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C84	230-51	2	CAPACITOR,FDX,3.3pF,.025V	150-100-NPO-339C	CENTRE ENG
C85	230-51		CAPACITOR,FDX,3.3pF,.025V	150-100-NPO-339C	CENTRE ENG
C86	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE

Table 5-17. A15 PCB Parts List (3 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C87	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C88	230-47		CAPACITOR,FXD,.01uF,10%	200-100-X7R-103K	CENTRE ENG
C89	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C90	230-81		CAPACITOR,FXD,CER,47PF,5%	150-100-NPO-470J	CENTRE ENG
C91	250-39A		CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C92	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C93	250-39A		CAPACITOR,FXD,TANT,4.7µF,20%,3V	196D475X0035JA1	SPRAGUE
C95	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
C96	250-42A		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KA1	SPRAGUE
CR1	10-FD300	13	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR2	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR3	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR4	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR5	10-11	2	DIODE,ZENER,1N750A	IN750A	FSC
CR6	10-11		DIODE,ZENER,1N750A	IN750A	FSC
CR7	10-1N751A	2	DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR8	10-1N4446	15	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR9	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR10	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR11	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR12	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR13	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR16	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR17	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR18	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR19	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR20	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR21	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR22	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR23	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR24	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR25	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR26	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR27	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR28	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR29	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR30	10-1N758A	1	DIODE,ZENER,1N758A	1N758A	MOTOROLA
CR31	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR33	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD

Table 5-17. A15 PCB Parts List (4 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR34	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR35	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
J1	516-68	1	CONN,RF CABLE	85MCX-50-0-1	HUBER&SUHNER
J2	551-557	2	CONNECTOR,HEADER	68001-104	BERG
J3	551-557		CONNECTOR,HEADER	68001-104	BERG
K1	690-64	1	RELAY,DPDT	TF2E-5V	AROMAT
L1	310-43	2	INDUCTOR,FXD,10.0µH,10%	1537-36	
L2	310-43		INDUCTOR,FXD,10.0µH,10%	1537-36	
L3	310-89	3	INDUCTOR,FIXED,1.9µH @ 50mHz	VK200 10/3B	FERROXCUBE
L4	310-131	1	INDUCTOR,FXD,8.2µH,10%	1025-42	DELEVAN
L5	310-89		INDUCTOR,FIXED,1.9µH @ 50mHz	VK200 10/3B	FERROXCUBE
L6	310-89		INDUCTOR,FIXED,1.9µH @ 50mHz	VK200 10/3B	FERROXCUBE
Q1	20-56	4	TRANSISTOR,JFET,J310	J310	SILICONIX
Q2	20-2N3904	11	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q3	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q4	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q5	20-2N3906	7	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q6	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q7	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q8	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q9	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q10	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q11	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q12	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q13	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q14	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q15	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q16	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q17	20-45	7	TRANSISTOR,FET	VN10KM	SILICONIX
Q18	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
Q19	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
Q20	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q21	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q22	20-66	4	TRANSISTOR,JFET,2N4392	2N4392	SILICONIX
Q23	20-66		TRANSISTOR,JFET,2N4392	2N4392	SILICONIX
Q24	20-66		TRANSISTOR,JFET,2N4392	2N4392	SILICONIX
Q25	20-66		TRANSISTOR,JFET,2N4392	2N4392	SILICONIX
Q26	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q27	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q28	20-2N3904		TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
Q29	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA

Table 5-17. A15 PCB Parts List (5 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
Q31	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
Q32	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
Q33	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
Q34	20-45		TRANSISTOR,FET	VN10KM	SILICONIX
R1	110-1K-1	33	RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R2	110-604-1	2	RESISTOR,FXD,MF,604Ω,1%,0.25W		
R3	110-2K-1	5	RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R4	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R5	110-10K-1	21	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R6	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R7	110-100-1	10	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R8	110-100K-1	7	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R9	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R10	110-604-1		RESISTOR,FXD,MF,604Ω,1%,0.25W		
R11	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R12	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R13	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R14	110-3.16K-1	2	RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R15	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R16	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R17	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R18	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R19	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R20	110-51.1-1	14	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R21	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R22	110-196K-1	1	RESISTOR,FXD,MF,196 KΩ,1%,0.25W		
R23	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R24	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R25	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R26	110-20K-1	2	RESISTOR,FXD,MF,20 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R27	110-20K-1		RESISTOR,FXD,MF,20 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R28	110-14K-1	2	RESISTOR,FXD,MF,14 KΩ,1%,0.25W		
R29	110-14K-1		RESISTOR,FXD,MF,14 KΩ,1%,0.25W		
R30	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R31	110-1M-1	4	RESISTOR,FXD,MF,1 MΩ,1%,0.25W		
R32	110-1M-1		RESISTOR,FXD,MF,1 MΩ,1%,0.25W		
R33	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R34	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R35	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R36	110-953-1	1	RESISTOR,FXD,MF,953Ω,1%,0.25W		
R37	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		

Table 5-17. A15 PCB Parts List (6 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R38	110-4.02K-1	2	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R39	110-4.99K-1	3	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R40	110-4.22K-1	1	RESISTOR,FXD,MF,4.22 KΩ,1%,0.25W		
R41	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R42	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R43	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R44	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R45	110-31.6K-1	3	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R46	110-4.87K-1	8	RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R47	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R48	110-31.6K-1		RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R49	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R50	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R51	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R52	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R53	110-4.75K-1	4	RESISTOR,FXD,MF,4.75 KΩ,1%,0.25W		
R54	110-4.75K-1		RESISTOR,FXD,MF,4.75 KΩ,1%,0.25W		
R55	110-215-1	4	RESISTOR,FXD,MF,215Ω,1%,0.25W		
R56	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R57	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R58	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R59	110-90.9-1	1	RESISTOR,FXD,MF,90.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R60	110-7.15K-1	4	RESISTOR,FXD,MF,7.15 KΩ,1%,0.25W		
R61	110-1M-1		RESISTOR,FXD,MF,1MΩ,1%,0.25W		
R62	110-316-1	2	RESISTOR,FXD,MF,316Ω,1%,0.25W		
R63	110-7.15K-1		RESISTOR,FXD,MF,7.15 KΩ,1%,0.25W		
R64	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R65	110-4.87K-1		RESISTOR,FXD,MF, 4.87KΩ,1%,0.25W		
R66	110-7.87K-1	2	RESISTOR,FXD,MF,7.87 KΩ,1%,0.25W		
R67	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R68	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R69	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R70	110-750-1	4	RESISTOR,FXD,MF,750Ω,1%,0.25W		
R71	110-681-1	2	RESISTOR,FXD,MF,681Ω,1%,0.25W		
R72	110-1.21K-1	3	RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R73	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R74	110-1.69K-1	2	RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R75	110-6.81K-1	2	RESISTOR,FXD,MF,6.81 KΩ,1%,0.25W		
R76	110-48.7-1	4	RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R77	157-1K-B	2	RESISTOR,TRIM,CER,1 KΩ,10%	18T	
R78	110-48.7-1		RESISTOR,FXD,MF,, 48.7,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-17. A15 PCB Parts List (7 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R79	110-3.01K-1	2	RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R80	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R81	110-1K-1		RESISTOR,FXD,MF,1KΩ,1%,0.25W		
R82	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R83	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R84	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R85	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R86	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R87	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R88	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R89	110-40.2-1	1	RESISTOR,MF,40.2Ω,1%,0.25W		
R90	110-7.15K-1		RESISTOR,FXD,MF,7.15 KΩ,1%,0.25W		
R91	110-1M-1		RESISTOR,FXD,MF,1MΩ,1%,0.25W		
R92	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R93	110-7.15K-1		RESISTOR,FXD,MF,7.15 KΩ,1%,0.25W		
R94	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R95	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R96	110-7.87K-1		RESISTOR,FXD,MF,7.87 KΩ,1%,0.25W		
R97	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R98	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R99	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R100	110-750-1		RESISTOR,FXD,MF,750Ω,1%,0.25W		
R101	110-681-1		RESISTOR,FXD,MF,681Ω,1%,0.25W		
R102	110-1.21K-1		RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R103	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R104	110-1.69K-1		RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R105	110-6.81K-1		RESISTOR,FXD,MF,6.81 KΩ,1%,0.25W		
R106	110-48.7-1		RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R107	157-1K-B		RESISTOR,TRIM,CER,1 KΩ,10%,18T	18T	
R108	110-48.7-1		RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R109	110-3.01K-1		RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R110	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R111	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R112	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R113	110-4.87K-1		RESISTOR,FXD,MF,4.87 KΩ,1%,0.25W		
R114	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R115	110-4.75K-1		RESISTOR,FXD,MF,4.75 KΩ,1%,0.25W		
R116	110-4.75K-1		RESISTOR,FXD,MF,4.75 KΩ,1%,0.25W		
R129	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R130	110-499K-1	7	RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R131	110-383-1	2	RESISTOR,FXD,MF,383Ω,1%,0.25W		

Table 5-17. A15 PCB Parts List (8 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R132	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R134	110-301-1	1	RESISTOR,FXD,MF,301Ω,1%,0.25W		
R135	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R136	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R137	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R138	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R139	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R140	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R141	110-14.7K-1	2	RESISTOR,FXD,MF,14.7 KΩ,1%,0.25W		
R144	110-487-1	1	RESISTOR,FXD,MF,487Ω,1%,0.25W		
R145	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R146	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R147	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R148	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R149	110-75K-1	1	RESISTOR,FXD,MF,75 KΩ,1%,0.25W		
R150	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R151	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R152	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R153	110-56.2-1	1	RESISTOR,FXD,MF,56.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R154	110-13.3K-1	1	RESISTOR,FXD,MF,13.3 KΩ,1%,0.25W		
R155	110-1.87K-1	1	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R156	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R157	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R158	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R159	110-19.6K-1	1	RESISTOR,FXD,MF,19.6 KΩ,1%,0.25W		
R160	110-31.6K-1		RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R161	110-14.7K-1		RESISTOR,FXD,MF,14.7 KΩ,1%,0.25W		
R162	110-5.11K-1	2	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R163	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R164	110-9.09K-1	1	RESISTOR,FXD,MF,9.09 KΩ,1%,0.25W		
R165	110-750-1		RESISTOR,FXD,MF,750Ω,1%,0.25W		
R166	110-750-1		RESISTOR,FXD,MF,750Ω,1%,0.25W		
R167	110-12.1K-1	1	RESISTOR;FXD,MF,12.1 KΩ,1%,0.25W		
R168	110-274-1	1	RESISTOR,FXD,MF,274Ω,1%,0.25W		DALE
R169	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R170	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R171	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R172	110-4.02K-1		RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R173	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R174	110-274K-1	1	RESISTOR,FXD,MF,274 KΩ,1%,0.25W		
R175	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-17. A15 PCB Parts List (9 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R176	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R177	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R178	110-787-1	4	RESISTOR,FXD,MF,787Ω,1%,0.25W		
R179	110-383-1		RESISTOR,FXD,MF,383Ω,1%,0.25W		
R180	110-787-1		RESISTOR,FXD,MF,787Ω,1%,0.25W		
R181	110-787-1		RESISTOR,FXD,MF,787Ω,1%,0.25W		
R182	110-787-1		RESISTOR,FXD,MF,787Ω,1%,0.25W		
R183	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R184	110-301K-1	2	RESISTOR,FXD,MF,301 KΩ,1%,0.25W		
R185	110-332-1	1	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R186	110-301K-1		RESISTOR,FXD,MF,301 KΩ,1%,0.25W		
R189	110-511-1	2	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R190	110-9.53K-1	1	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R191	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R192	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R193	110-18.7K-1	1	RESISTOR,FXD,MF,18.7 KΩ,1%,0.25W		
R194	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R195	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R196	110-1.21K-1		RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R197	157-2K-B	1	RESISTOR,TRIM,CER,2 KΩ,10%	18T	
R198	110-3.57K-1	1	RESISTOR,FXD,MF,3.57 KΩ,1%,0.25W		
R199	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R200	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R201	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R202	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R203	157-50K-B	1	RESISTOR,TRIM,CER,50 KΩ,10%	18T	
R204	110-825K-1	1	RESISTOR,FXD,MF,825 KΩ,1%,0.25W		
R205	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R206	110-127K-1	1	RESISTOR,FXD,MF,127 KΩ,1%,0.25W		
R207	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R208	110-6.19K-1	2	RESISTOR,FXD,MF,6.19 KΩ,1%,0.25W		
R209	157-20K-B	1	RESISTOR,TRIM,CER,20 KΩ,10%	18T68XR-20K	BECKMAN
R210	110-6.19K-1		RESISTOR,FXD,MF,6.19 KΩ,1%,0.25W		
R211	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R212	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R213	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R214	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R215	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R216	110-499K-1		RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R217	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R218	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		

Table 5-17. A15 PCB Parts List (10 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R219	110-5.11-1	2	RESISTOR,FXD,MF,5.11Ω,1%,0.25W		
R220	110-26.1-1	2	RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R221	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R222	110-11K-1	1	RESISTOR,FXD,MF,11 KΩ,1%,0.25W		
R223	110-2.37K-1	2	RESISTOR,FXD,MF,2.37 KΩ,1%,0.25W		
R224	110-2.37K-1		RESISTOR,FXD,MF,2.37 KΩ,1%,0.25W		
R225	110-5.11-1		RESISTOR,FXD,MF,5.11Ω,1%,0.25W		
R226	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R227	110-26.1-1		RESISTOR,FXD,MF,26.1Ω,1%,0.25W	SMA-4ORC4	CORNING
R228	110-316-1		RESISTOR,FXD,MF,316Ω,1%,0.25W		
R229	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R230	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
TP1	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	54-530	1	CMOS,74HCT244	SN74HC244N	T.I.
U2	54-528	1	CMOS,74HCT138	SN74HCT138N	T.I.
U3	54-523	3	CMOS,74HC374	SN74HC374N	T.I.
U4	54-523		CMOS,74HC374	SN74HC374N	T.I.
U5	54-523		CMOS,74HC374	SN74HC374N	T.I.
U6	54-132	5	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U7	50-DG200BA	4	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U8	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U9	54-505	2	D/A,7528,8BIT,BINARY	AD7528JN	ANALOG DEV
U11	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U12	54-537	1	ALS TTL,74ALS38,QUAD	SN74ALS38N	T.I.
U13	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U14	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U15	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U16	54-503	6	OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U17	54-501	1	D/A,MP1232	MP1232HN	MICROPOWER
U18	54-53	2	OP AMP,TLO72,DUAL	TL072CP3	T.I.
U19	54-505		D/A,7528,8BIT,BINARY	AD7528JN	ANALOG DEV
U20	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U21	50-27	3	OP AMP,OP37,SINGLE	OP-37EP	PRECISION MONOLITHIC
U22	50-34	3	OP AMP,LT1056ACH,SINGLE	LT1056ACH	LINEAR TECH
U24	54-503		OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U25	50-27		OP AMP,OP37,SINGLE	OP-37EP	PRECISION MONOLITHIC
U26	54-503		OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U27	50-27		OP AMP,OP37,SINGLE	OP-37EP	PRECISION MONOLITHIC
U28	54-503		OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U29	54-503		OP AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH

Table 5-17. A15 PCB Parts List (11 of 11)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U30	20-73	1	TRANSISTOR,FET,U431	U431	SILICONIX
U31	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U32	50-34		OP-AMP,LT1056ACH,SINGLE	LT1056ACH	LINEAR TECH
U33	50-36	1	VIDEO AMP,NE5539N,SINGLE	NE5539N	SIGNETICS
U34	50-33	1	OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECH
U35	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U36	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U37	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U38	54-24	1	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U40	50-34		OP AMP,LT1056ACH,SINGLE	LT1056ACH	LINEAR TECH
U41	54-30	2	COMPARATOR,LM311,SINGLE	LM311N	RCA
U42	54-30		COMPARATOR,LM311,SINGLE	LM311N	RCA
U43	50-LM305AH	1	VOLTAGE REGULATOR,LM305	LM305AH	NSC
U44	50-LM304H	1	VOLTAGE REGULATOR,LM304	LM304H	NSC
VR1	54-502	1	VOLTAGE REGULATOR,LT1031	LT1031CCH	LINEAR TECH
W2	551-577	2	CONNECTOR,SOCKET	M7565-05	HARWIN ENG
W3	551-577		CONNECTOR,SOCKET	M7565-05	HARWIN ENG
	553-177	1	PCB EJECTOR	LP-36	BIVAR
	553-200	1	EJECTOR, PCB, A15	PER 6700-B-31550	

Table 5-18. A16 PCB Parts List (1 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
BL01	54-334	1	D/A,12BIT	DAC 1208 LCD	NATIONAL
BL02	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL03	553-201	1	PCB EJECTOR, A16	PER 6700-B-31550	
BL04	790-189	1	SPACER PLAIN,#6	88-093-N-1	ACCURATE SCREW
BL05	790-281	1	STANDOFF,PLAIN,#6-32	4057	SMITH
BL06	900-560	1	SCREW,RND,6-32		
C1	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	220-51	1	CAPACITOR,FXD,MICA,51PF,5%,500V	CD15ED510J03	CORNELL DUBILIER
C4	230-39	3	CAPACITOR,FXD,CER,0.1µF,10%,50V	050-X7RO-104K	ERIE
C5	230-49	1	CAPACITOR,FXD,0.022µF,100V	200-100-X7R-223K	CENTRE ENG
C6	230-41	1	CAPACITOR,FXD,CER,1.0µF,20%,10V	400-100-601-105M	CENTRE ENG
C7	230-37	3	3 CAPACITOR,FXD,CER,0.1µF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	250-42		22 CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C10	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C11	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C13	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C14	250-102	2	CAPACITOR,FXD,PCAR,0.01µF,1%,5V	RV2A103F	IMB
C15	250-102		CAPACITOR,FXD,PCAR,0.01µF,1%,5V	RV2A103F	IMB
C16	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C17	227-12	1	CAPACITOR,FXD,PEST,0.1055µF,2%	ZV2B10052G	IMB
C18	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C19	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C20	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C21	220-820	1	CAPACITOR,FXD,MICA,820PF,5%,30V	CD15FC821J03	CORNELL DUBILIER
C22	223-10	2	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C23	223-10		CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C24	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-50	1	CAPACITOR,FXD,0.047µF,+/-10%	300-200-X7R-473K	CENTRE ENG
C28	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C29	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C32	220-150	1	CAPACITOR,FXD,MICA,150PF,5%,50V	DM15F151J	ARCO/SOSHIN
C33	250-77	1	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C34	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C35	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C36	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C37	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE

Table 5-18. A16 PCB Parts List (2 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C38	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C39	250-39	1	CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C40	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C41	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C42	220-24	1	CAPACITOR,FXD,MICA,24PF,5%,500V	CD15ED240JO3	CORNELL DUBILIER
C43	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C44	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C46	230-76	8	CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C47	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C48	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C49	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C50	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C51	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C52	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C53	230-76		CAPACITOR,FXD,CER,1200PF,1%	200-100-NPO-122F	CENTRE ENG
C58	223-600	1	CAPACITOR,FXD,CER,1500PF,10%	200-100-X7R-152K	CENTRE ENG
CR1	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR2	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR3	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR4	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR5	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR6	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR7	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR8	0-FD300	1	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR9	10-11		DIODE,ZENER,1N750A	IN750A	FSC
CR10	10-11		DIODE,ZENER,1N750A	IN750A	FSC
CR11	10-1N751A	2	DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR12	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR13	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR16	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR17	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR18	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR19	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR20	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR22	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR23	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR24	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR25	10-1N754A	1	DIODE,ZENER,1N754A	1N754A	FSC
CR26	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV

Table 5-18. A16 PCB Parts List (3 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR27	10-1N4446	20	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR28	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR29	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR30	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR31	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR32	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR33	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR34	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR35	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR36	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR37	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR38	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR39	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR40	10-11	3	DIODE,ZENER,1N750A	IN750A	FSC
R1	110-604-1	2	RESISTOR,FXD,MF,604Ω,1%,0.25W		
R2	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R3	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R4	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R5	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R6	110-604-1		RESISTOR,FXD,MF,604Ω,1%,0.25W		
R7	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R8	110-1.96K-1	7	RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R9	110-10K-1	20	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R10	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R11	110-5.36K-1	1	RESISTOR,FXD,MF,5.36 KΩ,1%,0.25W		
R12	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-11K-1	2	RESISTOR,FXD,MF,11 KΩ,1%,0.25W		
R15	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R16	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R17	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R18	110-3.16K-1	2	RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R19	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R20	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R21	110-3.16K-1		RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R22	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-1.87K-1	2	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R24	110-12.1K-1	1	RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		
R25	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R26	110-13K-1	1	RESISTOR,FXD,MF,13 KΩ,1%,0.25W		
R27	110-1K-1	11	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		

Table 5-18. A16 PCB Parts List (4 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R28	110-80.6K-1	1	RESISTOR,FXD,MF,80.6 KΩ,1%,0.25W		
R29	110-7.5K-1	1	RESISTOR,FXD,MF,7.5 KΩ,1%,0.25W		
R30	110-316-1	1	RESISTOR,FXD,MF,316Ω,1%,0.25W		
R31	110-2.21K-1	1	RESISTOR,FXD,MF,2.21 KΩ,1%,0.25W		
R32	110-100K-1	2	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R33	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R34	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R35	110-5.9K-1	2	RESISTOR,FXD,MF,5.9 KΩ,1%,0.25W		
R37	110-2.26K-1	1	RESISTOR,FXD,MF,2.26VKΩ,1%,0.25W		
R38	110-95.3K-1	1	RESISTOR,FXD,MF,95.3 KΩ,1%,0.25W		
R39	110-3.83K-1	3	RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R40	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R41	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R42	110-28.7K-1	2	RESISTOR,FXD,MF,28.7 KΩ,1%,0.25W		
R43	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R44	110-5.9K-1		RESISTOR,FXD,MF,5.9 KΩ,1%,0.25W		
R45	110-28.7K-1		RESISTOR,FXD,MF,28.7 KΩ,1%,0.25W		
R46	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R47	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R48	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R49	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-8.06K-1	1	RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R51	110-1.87K-1		RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R52	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R53	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R54	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R55	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R56	110-18.2K-1	1	RESISTOR,FXD,MF,18.2 KΩ,1%,0.25W		
R57	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R58	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R59	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R60	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R61	110-25.5K-1	2	RESISTOR,FXD,MF,25.5 KΩ,1%,0.25W		
R62	110-31.6-1	2	RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-31.6-1		RESISTOR,FXD,MF,31.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R65	110-12.4K-1	1	RESISTOR,FXD,MF,12.4 KΩ,1%,0.25W		
R66	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R67	110-3.83K-1		RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R68	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R69	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		

Table 5-18. A16 PCB Parts List (5 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R70	110-8.45K-1	1	RESISTOR,FXD,MF,8.45 KΩ,1%,0.25W		
R71	110-3.83K-1		RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R72	110-4.02K-1	1	RESISTOR,FXD,MF,4.02 KΩ,1%,0.25W		
R73	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R74	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R75	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R76	110-44.2K-1	1	RESISTOR,FXD,MF,44.2 KΩ,1%,0.25W		
R77	110-12.7K-1	1	RESISTOR,FXD,MF,12.7 KΩ,1%,0.25W		
R78	110-40.2K-1	1	RESISTOR,FXD,MF,40.2 KΩ,1%,0.25W		
R79	110-21.5K-1	1	RESISTOR,FXD,MF,21.5 KΩ,1%,0.25W		
R80	110-2.15K-1	1	RESISTOR,FXD,MF,2.15 KΩ,1%,0.25W		
R81	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R82	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W		CORNING
R83	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R84	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R85	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R86	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R87	110-196K-1		RESISTOR,FXD,MF,196 KΩ,1%,0.25W		
R88	110-196K-1		RESISTOR,FXD,MF,196 KΩ,1%,0.25W		
R89	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R90	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R91	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R92	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R93	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R94	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R95	110-196K-1	4	RESISTOR,FXD,MF,196 KΩ,1%,0.25W		
R96	110-196K-1		RESISTOR,FXD,MF,196 KΩ,1%,0.25W		
R97	110-4.64K-1	1	RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		
R98	110-178K-1	1	RESISTOR,FXD,MF,178 KΩ,1%,0.25W		
R99	110-14.7K-1	1	RESISTOR,FXD,MF,14.7 KΩ,1%,0.25W		
R100	110-1.96K-1		RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R101	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R102	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R103	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R104	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R105	110-11K-1		RESISTOR,FXD,MF,11 KΩ,1%,0.25W		
R106	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R107	110-100-1	3	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R108	113-665-0.5	3	RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R109	113-665-0.5		RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R110	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		

Table 5-18. A16 PCB Parts List (6 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R111	113-332-0.5	1	RESISTOR,FXD,MF,332Ω,0.5%,0.125W		
R112	110-4.22K-1	1	RESISTOR,FXD,MF,4.22 KΩ,1%,0.25W		
R113	113-1.33K-0.5	2	RESISTOR,FXD,MF,1.33 KΩ,0.5%		
R114	113-1.33K-0.5		RESISTOR,FXD,MF,1.33 KΩ,0.5%		
R115	110-511-1	2	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R116	113-665-0.5		RESISTOR,FXD,MF,665Ω,0.5%,0.125W		
R117	110-9.53K-1	1	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R118	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R119	110-25.5K-1		RESISTOR,FXD,MF,25.5 KΩ,1%,0.25W		
TP1	551-539	3	CONNECTOR,SOCKET	66947-004	BERG
TP5	551-539		CONNECTOR,SOCKET	66947-004	BERG
TP9	551-539		CONNECTOR,SOCKET	66947-004	BERG
U1	50-30	4	OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U2	50-22	1	OP AMP,NE5534,SINGLE	NE5534FE	SIGNETICS
U3	50-DG200BA	4	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U4	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U5	54-528	1	CMOS,74HCT138	SN74HCT138N	T.I.
U6	54-523	3	CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	T.I.
U7	54-523		CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	T.I.
U8	54-510	1	CMOS,74HC04,HEX	SN74HC04N	T.I.
U9	54-523		CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	T.I.
U10	54-334		D/A,12 BIT	DAC 1208 LCD	NATIONAL SEMI
U11	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U12	54-24	2	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U13	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U14	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U15	50-7	2	IC,OP AMP,LF357,SINGLE	LF357N	NSC
U16	50-9	8	IC,OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U17	50-7		OP AMP,LF357,SINGLE	LF357N	NSC
U18	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U19	54-53	2	OP AMP,TLO72,DUAL	TL072CP3	T.I.
U20	54-505	1	D/A,7528,8 BIT,BINARY	AD7528JN	ANALOG DEV
U21	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U22	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U23	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U24	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U25	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U26	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U27	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U28	54-132	2	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.

Table 5-18. A16 PCB Parts List (7 of 7)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U29	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U30	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U32	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
U33	50-30		OP AMP,5532A,DUAL	NE5532N	SIGNETICS
W1	800-176	4	WIRE,JUMPER		SQUIRES
W2	800-176		WIRE,JUMPER		SQUIRES
W3	800-176		WIRE,JUMPER		SQUIRES
W4	800-176		WIRE,JUMPER		SQUIRES
W5	800-140	2	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W6	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W9	800-338		WIRE,HOOKUP		ADVANCE

Table 5-19. A17 PCB Parts List (1 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C2	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C4	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42	35	35 CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	227-51	1	1 CAPACITOR,FXD,PEST,0.0022µF,10V	ZA2B222K	IMB
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C10	250-19	2	2 CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C11	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C13	220-200	4	CAPACITOR,FXD,MICA,200PF,5%,50V		
C14	250-123	1	CAPACITOR,FXD,PPRO,1.0µF,10%	X363uw 1.0/10/100	TRW
C27	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C28	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V		
C29	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C30	250-19		CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C31	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C32	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V		
C33	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C34	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C35	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C36	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C37	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C38	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C39	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C40	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C41	227-50	4	4 CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C42	227-50		CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C43	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3,	SPRAGUE
C45	227-50		CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C46	227-50		CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C47	230-41	2	2 CAPACITOR,FXD,CER,1.0µF,20%,10V	400-100-601-105M	CENTRE ENG
C48	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V		
C49	230-37	13	13 CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C50	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C51	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C53	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C54	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE

Table 5-19. A17 PCB Parts List (2 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C55	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C56	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C57	230-41		CAPACITOR,FXD,CER,1.0µF,20%,10V	400-100-601-105M	CENTRE
C58	250-39	2	CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C59	250-39		CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C60	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C61	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C62	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C63	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C64	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3,	SPRAGUE
CR1	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR2	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR3	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR4	10-1N4446	2	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-1N751A	2	2 DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR7	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR10	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR11	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR12	10-FD300	11	11 DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR13	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR14	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR15	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR16	10-1N757A		DIODE,ZENER,1N757A	1N757A	MOTOROLA
CR17	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR18	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR19	10-1N757A	2	DIODE,ZENER,1N757A	1N757A	MOTOROLA
CR20	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR21	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
L1	310-45	1	INDUCTOR,FXD,100.0µH	1315-12J	
L2	310-43	1	INDUCTOR,FXD,10.0µH	1537-36	
Q1	20-2N3694	1	TRANSISTOR,NPN,2N3694	MPS3694-18	MOTOROLA
R1	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R2	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-49.9-1	2	RESISTOR,FXD,MF,49.9Ω,1%,0.25W		
R4	110-49.9-1		RESISTOR,FXD,MF,49.9Ω,1%,0.25W		
R5	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R6	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R7	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R8	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R9	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		

Table 5-19. A17 PCB Parts List (3 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R10	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R11	110-90.9K-1	1	RESISTOR,FXD,MF,90.9 KΩ,1%,0.25W		
R12	113-10.18K-0.1	1	RESISTOR,FXD,MF,10.18 KΩ,0.1%		
R13	110-100-1	20	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R15	110-80.6K-1	1	RESISTOR,FXD,MF,80.6 KΩ,1%,0.25W		
R16	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R17	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R18	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R19	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R20	110-17.8K-1	1	RESISTOR,FXD,MF,17.8 KΩ,1%,0.25W		
R21	110-825K-1	1	RESISTOR,FXD,MF,825 KΩ,1%,0.25W		
R22	110-1K-1	2	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R23	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R24	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R25	113-10K-0.1A	4	RESISTOR,FXD,MF,10 KΩ,0.1%		
R26	113-10K-0.1A		RESISTOR,FXD,MF,10 KΩ,0.1%		
R28	113-10K-0.1	15	RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R29	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R30	110-2K-1	2	RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R31	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-24.9-1	1	RESISTOR,MF,24.9Ω,1%,0.25W		
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R35	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R36	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R37	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R38	110-953-1	2	RESISTOR,FXD,MF,953Ω,1%,0.25W		
R39	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R40	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R41	110-953-1		RESISTOR,FXD,MF,953Ω,1%,0.25W		
R42	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R43	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R44	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R45	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R46	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R47	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R48	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-19. A17 PCB Parts List (4 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R51	113-30.1K-0.1	3	RESISTOR,FIXED,MF,30.1 KΩ,0.1%	CEA-T2-30.1K-0.1%	TRW
R52	113-10K-0.1A		RESISTOR,FXD,MF,10 KΩ,0.1%		
R53	113-30.1K-0.1		RESISTOR,FIXED,MF,30.1 KΩ,0.1%	CEA-T2-30.1K-0.1%	TRW
R54	113-10K-0.1A		RESISTOR,FXD,MF,10 KΩ,0.1%		
R55	113-30.1K-0.1		RESISTOR,FIXED,MF,30.1 KΩ,0.1%	CEA-T2-30.1K-0.1%	TRW
R56	110-215K-1	1	RESISTOR,FXD,MF,215 KΩ,1%,0.25W		
R57	110-511-1	1	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R58	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R59	110-9.53K-1	1	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R61	110-20K-1	1	RESISTOR,FXD,MF,20 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R62	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-10K-1	9	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R65	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R66	110-2.87K-1	1	RESISTOR,FXD,MF,2.87 KΩ,1%,0.25W		
R67	110-1M-1	4	RESISTOR,FXD,MF,1 MΩ,1%,0.25W		
R68	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R69	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R73	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R74	113-1.8K-0.1	4	RESISTOR,FXD,MF,1.8 KΩ,0.1%,0.12W		
R75	113-1.8K-0.1		RESISTOR,FXD,MF,1.8 KΩ,0.1%,0.12W		
R76	113-1.8K-0.1		RESISTOR,FXD,MF,1.8 KΩ,0.1%,0.12W		
R77	113-1.8K-0.1		RESISTOR,FXD,MF,1.8 KΩ,0.1%,0.12W		
R79	110-1M-1		RESISTOR,FXD,MF,1MΩ,1%,0.25W		
R80	113-1K-0.1	2	RESISTOR,FXD,MF,1 KΩ,0.1%,0.125W		
R81	113-110-0.1	2	RESISTOR FIXED,MF,110Ω		VERMONT PREC
R82	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R83	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R84	110-1M-1		RESISTOR,FXD,MF,1 MΩ,1%,0.25W		
R85	113-1K-0.1		RESISTOR,FXD,MF,1 KΩ,0.1%,0.125W		
R86	113-110-0.1		RESISTOR FIXED,MF,110Ω		VERMONT PREC
R87	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R88	110-33.2K-1	1	RESISTOR,FXD,MF,33.2 KΩ,1%,0.25W		
R89	110-1.69K-1	2	RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R90	110-1.69K-1		RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R91	110-1M-1		RESISTOR,FXD,MF,1 MΩ,1%,0.25W		
R92	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R93	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-19. A17 PCB Parts List (5 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R94	113-1M-0.1	6	RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W		
R95	113-1M-0.1		RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W		
R96	113-1M-0.1		RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W	PER DESC	
R97	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R98	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R99	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R100	113-1M-0.1		RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W		
R101	113-1M-0.1		RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W		
R102	113-1M-0.1		RESISTOR,FXD,MF,1 MΩ,0.1%,0.25W		
R103	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R108	113-19.6K-0.1	2	RESISTOR,FXD,MF,19.6 KΩ,0.1%,0.2W		
R109	113-19.6K-0.1		RESISTOR,FXD,MF,19.6 KΩ,0.1%,0.2W		
R110	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R111	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
RN1	123-6	1	RESISTOR,NETWORK,MF,7 X 10 KΩ,2%		
TP1	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	54-520	2	CMOS,74HC273	SN74HC273N	T.I.
U2	54-522	1	CMOS,74HC373	SN74HC373N	T.I.
U3	54-459	1	A/D,574,12 BIT,BINARY	AD574AJD	ANALOG DEVICES
U4	54-526	2	74HCT04,HEX INVERTERS	CE74HCT04E	RCA
U5	54-524	2	CMOS,74HCT00,QUAD	MC74HCT00N	MOTOROLA
U6	54-356	1	TTL,74LS136,QUAD	SN74LS136N	T.I.
U7	54-458	3	ANALOG SWITCH,DG 508	DG508CJ	SILICONIX
U8	54-523	3	CMOS,74HC374	SN74HC374N	T.I.
U9	54-458		ANALOG SWITCH,DG 508	DG508CJ	SILICONIX
U10	54-204	1	OP AMP,LF398,SINGLE	LF395N	NSC
U11	54-523		CMOS,74HC374	SN74HC374N	T.I.
U12	54-526		74HCT04,HEX INVERTERS	CE74HCT04E	RCA
U13	54-458		ANALOG SWITCH,DG 508	DG508CJ	SILICONIX
U14	54-528	2	CMOS,74HCT138	SN74HCT138N	T.I.
U15	50-DG200BA	3	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U16	54-520		CMOS,74HC273	SN74HC273N	T.I.
U17	54-528		CMOS,74HCT138	SN74HCT138N	T.I.
U18	54-334	2	D/A,12 BIT	DAC 1208 LCD	NATIONAL
U19	54-53	8	OP AMP,TLO72,DUAL	TL072CP3	T.I.
U20	54-24	5	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U21	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U22	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U23	54-524		CMOS,74HCT00,QUAD	MC74HCT00N	MOTOROLA
U24	54-334		D/A,12 BIT	DAC 1208 LCD	NATIONAL

Table 5-19. A17 PCB Parts List (6 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U25	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U26	54-503	7	OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U27	54-30	1	COMPARATOR,LM311,SINGLE	LM311N	RCA
U28	54-502	2	VOLTAGE REGULATOR,LT1031	LT1031CCH	LINEAR TECH
U29	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U30	54-502		VOLTAGE REGULATOR,LT1031	LT1031CCH	LINEAR TECH
U31	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U32	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U33	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U34	54-460	2	D/A,9331,16 BIT	MP9331-16-4	MICRO POWER SYS
U35	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U36	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U37	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U38	54-460		D/A,9331,16 BIT	MP9331-16-4	MICRO POWER SYS
U39	54-503		OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECH
U40	54-523		CMOS,74HC374	SN74HC374N	T.I.
U41	50-DG200BA		ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U42	54-505	1	D/A,7528,8BIT,BINARY	AD7528JN	ANALOG DEV
U45	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U46	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U47	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U48	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U49	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U50	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U51	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U52	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
BL04	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL05	553-202	1	EJECTOR, PCB, A17	PER 6700-B-31550	

Table 5-20. A18 PCB Parts List (1 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	227-45	2	CAPACITOR,FXD,MYLR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C2	230-3	1	CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C3	223-10	1	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C4	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C16	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C17	220-200	1	CAPACITOR,FXD,MICA,200PF,5%,50V		
C18	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C19	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	250-42	9	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C22	227-45		CAPACITOR,FXD,MYLAR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C23	230-47	1	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C24	230-53	1	CAPACITOR,FXD,39µF,5%	150-100-NPO-390J	CENTRE ENG
C25	220-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CD15FD131JO3	CORNELL DUBILIER
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-48	1	CAPACITOR,FXD,.018µF,10%	200-100-X7R-183K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	250-51	2	CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C30	223-100	1	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C31	250-51		CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C33	230-37	6	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C36	250-77	6	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C37	220-10	1	CAPACITOR,FXD,MICA,10PF,5%,500V		
C38	250-19	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C39	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C41	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C43	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C44	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N746A	2	DIODE,ZENER,1N746	1N746	MOTOROLA
CR5	10-1N4446	8	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD

Table 5-20. A18 PCB Parts List (2 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR6	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR8	10-1N746A		DIODE,ZENER,1N746	1N746	MOTOROLA
CR11	10-SI2	3	DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR12	10-1N5359A	1	DIODE,ZENER,1N5359	1N5359A	MOTOROLA
CR13	10-FD300	3	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR16	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR17	10-1N962B	1	DIODE,ZENER,1N962	1N962B	MOTOROLA
CR18	10-11	1	DIODE,ZENER,1N750A	IN750A	FSC
CR19	10-25	2	DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR20	10-25		DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR21	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR22	15-5	1	LED,RED	MV5774C	MONSANTO
CR26	10-4	3	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR27	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR28	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR29	10-STB568	4	DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR30	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR31	10-1N755A	1	DIODE,ZENER,1N755A	1N755A	MOTOROLA
CR32	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR33	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR34	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR35	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR36	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
PO1	551-517	1	CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
Q3	20-45	1	TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q4	20-MPSA92	1	TRANSISTOR,PNP	MPSA92	MOTOROLA
Q6	20-MPSA42	3	TRANSISTOR,NPN	MPSA42	MOTOROLA
Q7	20-MPSA42		TRANSISTOR,NPN	MPSA42	MOTOROLA
Q9	20-MPSA42		TRANSISTOR,NPN	MPSA42	MOTOROLA
R1	110-10K-1	7	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R2	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R3	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R6	110-12.7K-1	1	RESISTOR,FXD,MF,12.7 KΩ,1%,0.25W		
R7	130-47-3	1	RESISTOR,FXD,WW,47Ω,5%,3.25W		
R8	110-1.87K-1	1	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R9	110-12.4K-1	1	RESISTOR,FXD,MF,12.4 KΩ,1%,0.25W		

Table 5-20. A18 PCB Parts List (3 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R10	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-196-1	2	RESISTOR,FXD,MF,196Ω,1%,0.25W		
R12	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R14	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R15	130-15-3	4	RESISTOR,FXD,WW,15Ω,5%,3.25W		
R16	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R17	110-4.42K-1		RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R18	110-196-1		RESISTOR,FXD,MF,196Ω,1%,0.25W		
R19	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R22	110-8.06K-1	2	RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R23	110-16.2K-1	2	RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R24	110-8.06K-1		RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R25	110-16.2K-1		RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R26	110-51.1K-1	1	RESISTOR,FXD,MF,51.1 KΩ,1%,0.25W		
R27	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R28	113-3.01K-0.1	1	RESISTOR,FXD,MF,3.01 KΩ,0.1%,0.1W		
R29	131-35	1	RESISTOR,FIXED,WW,3Ω,3%	KW-25C3-3ROH	BANTRY
R30	110-30.1-1	1	RESISTOR,FXD,MF,30.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-511-1	4	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R32	110-31.6K-1	1	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-100-1	11	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R36	110-1.21K-1	1	RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R37	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		
R38	110-8.66K-1	1	RESISTOR,FXD,MF,8.66 KΩ,1%,0.25W		
R39	110-59K-1	1	RESISTOR,FXD,MF,59 KΩ,1%,0.25W		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10 KΩ		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R44	110-1K-1	3	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R45	113-105K-1	2	RESISTOR,FXD,MF,105 KΩ,1%		
R46	110-464K-1	1	RESISTOR,FXD,MF,464 KΩ,1%,0.25W		
R47	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R48	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R49	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W		CORNING
R50	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R51	102-.5-5	1	RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		

Table 5-20. A18 PCB Parts List (4 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R56	113-27.4K-1	1	RESISTOR,FIKED,METEL FILM,27.4Ω		
R57	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R58	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R59	110-1.54K-1	1	RESISTOR,FXD,MF,1.54 KΩ,1%,0.25W		
R60	110-38.3K-1	1	RESISTOR,FXD,MF,38.3 KΩ,1%,0.25W		
R61	110-332-1	1	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R62	113-10K-0.1	5	RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R63	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R64	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R65	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R66	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R68	110-100K-1	3	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R69	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	130-1-3	3	RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R71	110-4.99K-1	4	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R73	110-15K-1	1	RESISTOR,FXD,MF,15 KΩ,1%,0.25W		
R74	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R75	103-6.8-5	1	RESISTOR,FXD,CC,6.8Ω,5%,1W	RC32GF6.8J	ALLEN BRADLEY
R76	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R77	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R79	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R80	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R81	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R82	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R83	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R84	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R85	113-4.99K-0.1	1	RESISTOR,FXD,MF,4.99 KΩ,0.1%,0.W		
R86	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R87	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R88	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R89	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R90	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R91	113-105K-1		RESISTOR,FXD,MF,105 KΩ,1%		
TP01	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	50-9	3	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI

Table 5-20. A18 PCB Parts List (5 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U2	50-DG200BA	1	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U3	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U4	54-132	1	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U5	54-24	1	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U6	54-376	1	OP-AMP,OP27EJ,SINGLE	PRECISION MONOLITHIC	
U7	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U8	50-6		OP AMP,LM358,DUAL	MLM358	MOTOROLA
U9	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U10	50-6	2	OP AMP,LM358,DUAL	MLM358	MOTOROLA
W1	800-260	3	WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W2	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W3	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W05	800-140	1	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
BL01	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL02	553-203	1	EJECTOR, PCB, A18	PER 6700-B-31550	

Table 5-21. A19 PCB Parts List (1 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	227-45	2	CAPACITOR,FXD,MYLAR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C2	220-680	1	CAPACITOR,FXD,MICA,680PF,5%,30V	DM15-681J	ARCO/SOSHIN
C3	223-10	1	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C4	250-42	9	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	250-77	4	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C16	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C17	220-390	1	CAPACITOR,FXD,MICA,390PF,5%,50V	DM15-391T	ELMENCO
C18	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C19	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C22	227-45		CAPACITOR,FXD,MYLAR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C23	230-47	2	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C24	230-53	1	CAPACITOR,FXD,39pF,5%	150-100-NPO-390J	CENTRE ENG
C25	220-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CD15FD131JO3	CORNELL DUBILIER
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-47		CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	250-51	2	CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C30	223-100	1	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C31	250-51		CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C33	230-37	6	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C35			NOT USED		
C36			NOT USED		
C37			NOT USED		
C38			NOT USED		
C39	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C40			NOT USED		
C41			NOT USED		
C42			NOT USED		
C43	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C44	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD

Table 5-21. A19 PCB Parts List (2 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N746A	2	DIODE,ZENER,1N746	1N746	MOTOROLA
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR8	10-1N746A		DIODE,ZENER,1N746	1N746	MOTOROLA
CR11	10-SI2	3	DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR12	10-1N5359A	1	DIODE,ZENER,1N5359	1N5359A	MOTOROLA
CR13	10-FD300	3	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR16	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR17	10-1N962B	1	DIODE,ZENER,1N962	1N962B	MOTOROLA
CR18	10-11	1	DIODE,ZENER,1N750A	IN750A	FSC
CR19	10-25	2	DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR20	10-25		DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR21	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR22	15-5	1	LED,RED	MV5774C	MONSANTO
CR26	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR27	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR28			NOT USED		
CR29	10-STB568	2	DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR30			NOT USED		
CR31			NOT USED		
CR32	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR33			NOT USED		
CR34	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR35	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR36	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
P01	551-517	1	CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
Q3	20-45	1	TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q4	20-MPSA92	1	TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q6	20-MPSA42	3	TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q7	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q9	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
R1	110-10K-1	7	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R2	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R3	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R6	110-12.1K-1	1	RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		

Table 5-21. A19 PCB Parts List (3 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R7	130-47-3	1	RESISTOR,FXD,WW,47Ω,5%,3.25W		
R8	110-2.74K-1	1	RESISTOR,FXD,MF,2.74 KΩ,1%,0.25W		
R9	110-12.4K-1	1	RESISTOR,FXD,MF,12.4 KΩ,1%,0.25W		
R10	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-196-1	2	RESISTOR,FXD,MF,196Ω,1%,0.25W		
R12	130-15-3	4	RESISTOR,FXD,WW,154Ω,5%,3.25W		
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R14	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R15	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R16	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R17	110-4.42K-1		RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R18	110-196-1		RESISTOR,FXD,MF,196Ω,1%,0.25W		
R19	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R22	110-8.06K-1	2	RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R23	110-16.2K-1	2	RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R24	110-8.06K-1		RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R25	110-16.2K-1		RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R26	110-51.1K-1	1	RESISTOR,FXD,MF,51.1 KΩ,1%,0.25W		
R27	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R28	113-3.01K-0.1	1	RESISTOR,FXD,MF,3.01 KΩ,0.1%,0.1W		
R29	131-35	1	RESISTOR,FIXED,WW,3Ω,3%	KW-25C3-	BANTRY
R30	110-30.1-1	1	RESISTOR,FXD,MF,30.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-511-1	4	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R32	110-31.6K-1	1	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-100-1	9	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R36	110-1.21K-1	1	RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R37	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		
R38	110-8.66K-1	1	RESISTOR,FXD,MF,8.66 KΩ,1%,0.25W		
R39	110-59K-1	1	RESISTOR,FXD,MF,59 KΩ,1%,0.25W		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10 KΩ		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R44	110-1K-1	3	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R45	113-26.1K-1	1	RESISTOR,FIXED,METAL FILM,26.1 KΩ		
R46	110-499K-1	1	RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R47	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R48	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R49	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-21. A19 PCB Parts List (4 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R50	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R51	102-.5-5	1	RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R56	113-34.8K-1	1	RESISTOR,FIXED,METAL FILM,34.8 KΩ,		
R57	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R58	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R59	110-1.54K-1	1	RESISTOR,FXD,MF,1.54 KΩ,1%,0.25		
R60	110-38.3K-1	1	RESISTOR,FXD,MF,38.3 KΩ,1%,0.25W		
R61	110-332-1	1	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R62	113-10K-0.1	4	RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R63	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R64	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R65	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R66	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R68	110-100K-1	2	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R69	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	130-1-3	2	RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R71	110-4.99K-1	2	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R73			NOT USED		
R74			NOT USED		
R75			NOT USED		
R76			NOT USED		
R77	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R79	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R80	110-4.99K-1		RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R81	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R82			NOT USED		
R83			NOT USED		
R84			NOT USED		
R85			NOT USED		
R86			NOT USED		
R87	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R88	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R89			NOT USED		
R90	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		

Table 5-21. A19 PCB Parts List (5 of 5)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R91			NOT USED		
TP01	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	50-9	2	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U2	50-DG200BA	1	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U3	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U4	54-132	1	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U5	54-24	1	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U6	54-376	1	OP AMP,OP27EJ,SINGLE		PRECISION MONOLITHIC
U7	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U8	50-6	1	OP AMP,LM358,DUAL	MLM358	MOTOROLA
U9			NOT USED		
U10			NOT USED		
W2	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W3	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W4			NOT USED		
W01	800-260	3	WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W05	800-140	1	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
BL01	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL02	553-204	1	EJECTOR, PCB, A19	PER 6700-B-31550	

Table 5-22. A20 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C2	230-3	1	CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C3	223-15	1	CAPACITOR,FXD,MICA,15PF,5%,500V	CM04CD150JO3	ARCO/SOSHIN
C4	250-42	9	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	250-77	5	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C16	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C17	220-270	1	CAPACITOR,FXD,MICA,270PF,5%,50V	CD15FD271J03M	CORNELL DUBILIER
C18	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C19	230-37	6	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C23	230-47	1	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C24	230-53	1	CAPACITOR,FXD,39pF,5%	150-100-NPO-390J	CENTRE ENG
C25	220-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CD15FD131JO3	CORNELL DUBILIER
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-91	1	CAPACITOR,FXD,CER,47OOpF	150-100-72K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	250-51	2	CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C30	223-100	1	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C31	250-51		CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C33	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C35	R50-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C40	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C43	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C44	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N746A	2	DIODE,ZENER,1N746	1N746	MOTOROLA
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	0-1N44461		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR8	10-1N746A		DIODE,ZENER,1N746	1N746	MOTOROLA
CR11	10-SI2	3	DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR12	10-1N5359A	1	DIODE,ZENER,1N5359	1N5359A	MOTOROLA

Table 5-22. A20 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR13	10-FD300	3	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR16	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR17	10-1N962B	1	DIODE,ZENER,1N962	1N962B	MOTOROLA
CR18	10-11	1	DIODE,ZENER,1N750A	IN750A	FSC
CR19	10-25	2	DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR20	10-25		DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR21	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR22	15-5	1	LED,RED	MV5774C	MONSANTO
CR26	10-4	3	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR27	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR28	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR29	10-STB568	3	DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR32	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR33	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR34	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR35	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR36	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
P01	551-517	1	CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
Q3	20-45	1	TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q4	20-MPSA92	1	TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q6	20-MPSA42	3	TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q7	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q9	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
R1	110-10K-1	8	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R2	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R3	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R6	110-12.7K-1	1	RESISTOR,FXD,MF,12.7 KΩ,1%,0.25W		
R7	130-47-3	1	RESISTOR,FXD,WW,47Ω,5%,3.25W		
R8	110-1.87K-1	1	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R9	110-8.25K-1	1	RESISTOR,FXD,MF,8.25 KΩ,1%,0.25W		
R10	110-100-1	10	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-196-1	2	RESISTOR,FXD,MF,196Ω,1%,0.25W		
R12	130-15-3	4	RESISTOR,FXD,WW,15Ω,5%,3.25W		
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R14	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R15	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R16	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-22. A20 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R17	110-4.42K-1		RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R18	110-196-1		RESISTOR,FXD,MF,196Ω,1%,0.25W		
R19	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R22	110-8.06K-1	2	RESISTOR,FXD,MF,8.06KΩ,1%,0.25W		
R23	110-16.2K-1	2	RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R24	110-8.06K-1		RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R25	110-16.2K-1		RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R26	110-51.1K-1	1	RESISTOR,FXD,MF,51.1 KΩ,1%,0.25W		
R27	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R28	113-3.01K-0.1	1	RESISTOR,FXD,MF,3.01 KΩ,0.1%,0.1W		
R29	131-35	1	RESISTOR,FIXED,WW,3Ω,3%	KW-25C3-3ROH	BANTRY
R30	110-30.1-1	1	RESISTOR,FXD,MF,30.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-511-1	4	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R32	110-31.6K-1	1	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-5.11K-1	1	RESISTOR,FXD,MF,5.11KΩ,1%,0.25W		
R36	110-1.21K-1	1	RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R37	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		
R38	110-8.66K-1	1	RESISTOR,FXD,MF,8.66 KΩ,1%,0.25W		
R39	110-59K-1	1	RESISTOR,FXD,MF,59 KΩ,1%,0.25W		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10 KΩ		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R44	110-1K-1	3	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R45	113-14.3K-1	1	RESISTOR,FIXED,METAL FILM,14.3 KΩ		
R46	110-422K-1	1	RESISTOR,FXD,MF,422 KΩ,1%,0.25W		
R47	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R48	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R49	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R51	102-.5-5	1	RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10KΩ		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R56	113-17.8K-1	1	RESISTOR,FIXED,METAL FILM,17.8Ω		
R57	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R58	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R59	110-1.54K-1	1	RESISTOR,FXD,MF,1.54 KΩ,1%,0.25W		

Table 5-22. A20 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R60	110-38.3K-1	1	RESISTOR,FXD,MF,38.3 KΩ,1%,0.25W		
R61	110-332-1	1	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R62	113-10K-0.1	4	RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R63	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R64	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R65	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R66	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R68	110-100K-1	3	3 RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R69	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	130-1-3	3	RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R71	110-4.99K-1	1	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R77	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R79	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R80	110-2K-1	2	2 RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R81	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R82	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R83	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R84	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R85	110-2K-1		RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R86	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R87	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R88	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R90	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
TP01	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	50-9	2	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U2	50-DG200BA	1	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U3	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U4	54-132	1	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U5	54-24	1	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U6	54-376	1	OP AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U7	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U8	50-6	2	OP AMP,LM358,DUAL	MLM358	MOTOROLA
U10	50-6		OP AMP,LM358,DUAL	MLM358	MOTOROLA
W01	800-260	3	WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W02	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W03	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W05	800-140	1	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
BL04	553-205	1	EJECTOR, PCB, A20	PER 6700-B-31550	

Table 5-23. A21 PCB Parts List (1 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	227-45	2	CAPACITOR,FXD,MYLR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C2	230-3	1	CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C3	223-15	1	1 CAPACITOR,FXD,MICA,15PF,5%,500V	CM04CD150JO3	ARCO/SOSHIN
C4	250-42	9	9 CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	250-77	4	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C16	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C17	220-470	1	CAPACITOR,FXD,MICA,470PF,5%,50V		
C18	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C19	230-37	6	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C22	227-45		CAPACITOR,FXD,MYLAR,0.1µF,20%,1V	230B1B104M	ELECTROCUBE
C23	230-47	1	CAPACITOR,FXD,.01µF,10%	200-100-X7R-103K	CENTRE ENG
C24	230-71	1	CAPACITOR,FIXED,CER,68PF,5%	150-100-NPO-680J	CENTRE ENG
C25	220-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CD15FD131JO3	CORNELL DUBILIER
C26	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-91	1	CAPACITOR,FXD,CER,47OOPF	150-100-472K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	250-51	2	CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C30	223-100	1	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C31	250-51		CAPACITOR,FXD,ALUM,47µF	T3073FE470T063JPT	MEPCO
C33	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C39	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C43	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C44	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446	8	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N746A	2	DIODE,ZENER,1N746	1N746	MOTOROLA
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR7	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR8	10-1N746A		DIODE,ZENER,1N746	1N746	MOTOROLA
CR11	10-SI2	3	DIODE,RECTIFIER,IN4003	SS6253	SEMTECH

Table 5-23. A21 PCB Parts List (2 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR12	10-1N5359A	1	DIODE,ZENER,1N5359	1N5359A	MOTOROLA
CR13	10-FD300	3	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR16	10-FD300		DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR17	10-1N962B	1	DIODE,ZENER,1N962	1N962B	MOTOROLA
CR18	10-11	1	DIODE,ZENER,1N750A	IN750A	FSC
CR19	10-25	2	DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR20	10-25		DIODE,RECTIFIER,MR854	MR854	MOTOROLA
CR21	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR22	15-5	1	LED,RED	MV5774C	MONSANTO
CR26	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR27	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR29	10-STB568	2	DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR32	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
CR34	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR35	10-SI2		DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR36	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
P01	551-517	1	CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
Q3	20-45	1	TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q4	20-MPSA92	1	TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q6	20-MPSA42	3	TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q7	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q9	20-MPSA42		TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
R1	110-10K-1	7	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R2	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R3	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-1.78K-1	1	RESISTOR,FXD,MF,1.78 KΩ,1%,0.25W		
R6	110-12.7K-1	1	RESISTOR,FXD,MF,12.7 KΩ,1%,0.25W		
R7	130-47-3	1	RESISTOR,FXD,WW,47Ω,5%,3.25W		
R8	110-1.87K-1	1	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R9	110-10.2K-1	1	RESISTOR,FXD,MF,10.2 KΩ,1%,0.25W		
R10	110-100-1	9	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-196-1	2	RESISTOR,FXD,MF,196Ω,1%,0.25W		
R12	130-15-3	4	RESISTOR,FXD,WW,15Ω,5%,3.25W		
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R14	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R15	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R16	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R17	110-4.42K-1		RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		

Table 5-23. A21 PCB Parts List (3 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R18	110-196-1		RESISTOR,FXD,MF,196Ω,1%,0.25W		
R19	130-15-3		RESISTOR,FXD,WW,15Ω,5%,3.25W		
R22	110-8.06K-1	2	RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R23	110-16.2K-1	2	RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R24	110-8.06K-1		RESISTOR,FXD,MF,8.06 KΩ,1%,0.25W		
R25	110-16.2K-1		RESISTOR,FXD,MF,16.2 KΩ,1%,0.25W		
R26	110-51.1K-1	1	RESISTOR,FXD,MF,51.1 KΩ,1%,0.25W		
R27	110-30.1K-1	1	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R28	113-3.01K-0.1	1	RESISTOR,FXD,MF,3.01 KΩ,0.1%,0.1W		
R29	131-35	1	RESISTOR,FIXED,WW,3Ω,3%	KW-25C3-3ROH	BANTRY
R30	110-30.1-1	1	RESISTOR,FXD,MF,30.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-511-1	4	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R32	110-31.6K-1	1	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R33	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R35	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R36	110-1.21K-1	1	RESISTOR,FXD,MF,1.21 KΩ,1%,0.25W		
R37	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		
R38	110-8.66K-1	1	RESISTOR,FXD,MF,8.66 KΩ,1%,0.25W		
R39	110-59K-1	1	RESISTOR,FXD,MF,59 KΩ,1%,0.25W		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10 KΩ		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R44	110-1K-1	3	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R45	113-15K-1	1	RESISTOR,FIXED,METAL FILM,15 KΩ		
R46	110-499K-1	1	RESISTOR,FXD,MF,499 KΩ,1%,0.25W		
R47	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R48	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R49	110-51.1-1	1	RESISTOR,FXD.MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-348-1	1	RESISTOR,FXD,MF,348Ω,1%,0.25W		
R51	102-.5-5	1	RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10 KΩ		
R56	113-30.9K-1	1	RESISTOR,FIXED,METAL FILM		
R57	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
R58	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R59	110-1.54K-1	1	RESISTOR,FXD,MF,1.54 KΩ,1%,0.25W		
R60	110-38.3K-1	1	RESISTOR,FXD,MF,38.3 KΩ,1%,0.25W		

Table 5-23. A21 PCB Parts List (4 of 4)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R61	110-332-1	1	RESISTOR,FXD,MF,332Ω,1%,0.25W		
R62	113-10K-0.1	4	RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R63	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R64	113-10K-0.	1	RESISTOR, FXD,MF,10 K,0.1%,0.125W		
R65	113-10K-0.1		RESISTOR,FXD,MF,10 KΩ,0.1%,0.125W		
R66	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R68	110-100K-1	2	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R69	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	130-1-3	2	RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R71	110-4.99K-1	1	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R77	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R79	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R80	110-2K-1	1	RESISTOR,FXD,MF,2 KΩ,1%,0.25W		
R81	130-1-3		RESISTOR,FXD,WW,1Ω,5%,3.25W	UT-2C-20	ULTEX
R87	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R88	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R90	110-511-1		RESISTOR,FXD,MF,511Ω,1%,0.25W		
TP01	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	50-9	2	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U2	50-DG200BA	1	ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U3	50-9		OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U4	54-132	1	OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U5	54-24	1	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U6	54-376	1	OP AMP,OP27EJ,SINGLE	OP27EJ	PRECISION MONOLITHIC
U7	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U8	50-6	1	OP AMP,LM358,DUAL	MLM358	MOTOROLA
W2	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W3	800-260		WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W01	800-260	3	WIRE,JUMPER	J1.000X0.125T22	SQUIRES
W05	800-140	1	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
BL01	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL02	553-206	1	EJECTOR, PCB, A21	PER 6700-B-31550	

Table 5-24. A22 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-41	2	CAPACITOR,FXD,CER,1.0µF,20%,10V	400-100-601-105M	CENTRE ENG
C2	250-42	2	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-41		CAPACITOR,FXD,CER,1.0µF,20%,10V	400-100-601-105M	CENTRE ENG
C4	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-39	1	CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C6	230-30	2	CAPACITOR,FXD,CER,1000PF	BGP.001,500V,+80-20	RMC
C7	227-50	2	CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C8	227-50		CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C9	230-30		CAPACITOR,FXD,CER,1000PF	BGP.001,500V,+80-20	RMC
C10	250-34	2	CAPACITOR,FXD,ALUM,10µF	3070-CD100T063SF	MEPCO
C11	250-34		CAPACITOR,FXD,ALUM,10µF	3070-CD100T063SF	MEPCO
C12	250-136	16	CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C13	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C14	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C15	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C16	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C17	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C18	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C19	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C20	230-37	2	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C23	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C24	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C25	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C26	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C27	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C28	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C29	250-136		CAPACITOR,FXD,TANT,2.2µF	T354E225M050AS	KEMET
C30	250-19	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D105X9035HE3	SPRAGUE
C31	220-200	1	CAPACITOR,FXD,MICA,200PF,5%,50V		
CR1	10-1N752A	1	DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR2	10-1N4743A	1	DIODE,ZENER,1N4743	1N4743A	MOTOROLA
CR3	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR4	10-1N4446	2	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR5	10-1N4751	1	DIODE,ZENER,1N4751A	1N4751A	MOTOROLA
CR6	10-SI4	10	DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR7	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR8	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR9	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR10	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH

Table 5-24. A22 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR11	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR12	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR13	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR14	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR15	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
CR16	10-SI4		DIODE,RECTIFIER,1N4004	SS6253	SEMTECH
P1	551-517	2	CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
P3	551-517		CONNECTOR,SOCKET	100-083-30218-190	TEKA PRODUCTS
Q2	20-MPSA42	1	TRANSISTOR,NPN,MPSA42	MPSA42	MOTOROLA
Q3	20-MPSA92	4	TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q4	20-MPSU04	1	TRANSISTOR,NPN,MPSU04	MPSU04	MOTOROLA
Q6	20-MPSA92		TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q7	20-MPSA92		TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
Q8	20-MPSA92		TRANSISTOR,PNP,MPSA92	MPSA92	MOTOROLA
R1	110-316-1	1	RESISTOR,FXD,MF,316Ω,1%,0.25W		
R2	110-5.62K-1	1	RESISTOR,FXD,MF,5.62 KΩ,1%,0.25W		
R3	110-3.83K-1	1	RESISTOR,FXD,MF,3.83 KΩ,1%,0.25W		
R4	110-1.69K-1	2	RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R5	110-3.32K-1	2	RESISTOR,FXD,MF,3.32 KΩ,1%,0.25W		
R6	102-.5-5	3	RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R7	102-.5-5		RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R8	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R9	110-2.21K-1	1	RESISTOR,FXD,MF,2.21 KΩ,1%,0.25W		
R10	110-2.15K-1	3	RESISTOR,FXD,MF,2.15 KΩ,1%,0.25W		
R11	110-511-1	1	RESISTOR,FXD,MF,511Ω,1%,0.25W		
R12	110-5.11K-1	2	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R13	110-4.12K-1	1	RESISTOR,FXD,MF,4.12 KΩ,1%,0.25W		
R14	110-2.15K-1		RESISTOR,FXD,MF,2.15 KΩ,1%,0.25W		
R15	110-1.69K-1		RESISTOR,FXD,MF,1.69 KΩ,1%,0.25W		
R17	102-.5-5		RESISTOR,FXD,CC,0.5Ω,5%,0.5W	UT-1/2	
R18	110-3.32K-1		RESISTOR,FXD,MF,3.32 KΩ,1%,0.25W		
R19	110-1.47K-1	1	RESISTOR,FXD,MF,1.47 KΩ,1%,0.25W		
R20	110-7.87K-1	1	RESISTOR,FXD,MF,7.87 KΩ,1%,0.25W		
R21	110-2.15K-1		RESISTOR,FXD,MF,2.15 KΩ,1%,0.25W		
R22	110-1K-1	2	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R23	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R24	110-16.9K-1	1	RESISTOR,FXD,MF,16.9 KΩ,1%,0.25W		
R25	110-90.9K-1	1	RESISTOR,FXD,MF,90.9 KΩ,1%,0.25W		
R26	110-49.9K-1	2	RESISTOR,FXD,MF,49.9 KΩ,1%,0.25W		
R27	110-49.9K-1		RESISTOR,FXD,MF,49.9 K,1%,0.25W		
R28	110-215K-1	1	RESISTOR,FXD,MF,215 K,1%,0.25W		

Table 5-24. A22 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R29	110-162K-1	1	RESISTOR,FXD,MF,162 KΩ,1%,0.25W		
R30	110-115K-1	1	RESISTOR,FXD,MF,115 KΩ,1%,0.25W		
R31	110-10K-1	2	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R32	110-64.9K-1	2	RESISTOR,FXD,MF,64.9 KΩ,1%,0.25W		
R33	110-64.9K-1		RESISTOR,FXD,MF,64.9 KΩ,1%,0.25W		
R34	110-45.3K-1	2	RESISTOR,FXD,MF,45.3 KΩ,1%,0.25W		
R35	110-45.3K-1		RESISTOR,FXD,MF,45.3 KΩ,1%,0.25W		
R36	110-127K-1	2	RESISTOR,FXD,MF,127 KΩ,1%,0.25W		
R37	110-127K-1		RESISTOR,FXD,MF,127 KΩ,1%,0.25W		
R38	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R39	110-147K-1	1	RESISTOR,FXD,MF,147 KΩ,1%,0.25W		
R40	110-75K-1	1	RESISTOR,FXD,MF,75 KΩ,1%,0.25W		
TP1	551-608	1	CONNECTOR SOCKET	66947-013	BERG
U1	54-53	2	OP AMP,TLO72,DUAL	TL072CP3	T.I.
U2	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
VR2	54-502	1	VOLTAGE REGULATOR,LT1031	LT1031CCH	LINEAR TECH
BL01	553-177	1	PCB EJECTOR	LP-36	BIVAR
BL02	553-207	1	EJECTOR, PCB, A22	PER 6700--B-31550	

Table 5-25. A23 PCB Parts List (1 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-57	1	CAPACITOR,FXD,TANT,150µF,10%,6V	196D157X9006PE3	SPRAGUE
C2	230-37	33	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	PE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C19	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C24	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C30	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C31	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C32	230-70	1	CAPACITOR,FIXED,CER,27PF,5%	150-100-NPO-270J	CENTRE ENG.
C33	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C34	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C35	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR2	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
J1	551-148	1	CONNECTOR,DIP SOCKET,PCB MNT	CA-18S-10SD	CIRCUIT ASSEMBLY
L1	310-89	1	INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
P2	551-206	1	CONNECTOR,HEADER,PC MNT	65521-103	BERG
P3	551-236	1	CONNECTOR,DIP SOCKET,PC MNT	8136-475G9	AUGAT
R1	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		

Table 5-25. A23 PCB Parts List (2 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R2	110-10K-1	7	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R3	110-100-1	1	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R6	10-5.11K-11	2	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R7	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R8	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R9	110-10K-1		RESISTOR,FXD,MF,10KΩ,1%,0.25W		
R10	110-1K-1	1	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R11	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R12	109-510-5	2	RESISTOR,FXD,MF,510Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
R13	109-510-5		RESISTOR,FXD,MF,510Ω,5%,0.12W	CT3 SERIES+VALUE	CORNING
RN1	123-9	2	RESISTOR,NETWORK,MF,9 X 10 KΩ,2%	410A103	ALLEN-BRADLEY
RN2	123-9		RESISTOR,NETWORK,MF,9 X 10 KΩ,2%	410A103	ALLEN-BRADLEY
SW1	420-14	1	SWITCH,SLIDE	124-441-020	CHICAGO SWITCH
U1	54-317	1	MICROPROCESSOR,8284A	8284A	
U2	54-74LS73	1	TTL,74LS73,DUAL,JK FLIP FLOP	DM74LS73AN	NSC
U3	54-119	1	TTL,74LS151	SN74LS151P	MOTOROLA
U4	54-44	1	TTL,74LS74,DUAL,D FLIP FLOP	DM74LS74AN	NSC
U5	54-74LS04	1	TTL,74LS04,HEX,INVERTERS	74LS04PC	FSC
U6	54-113	1	TTL,74LS393,DUAL	DM74LS393N	NSC
U7	54-212	1	MICROPROCESSOR,8253-5	P8253-5	INTEL
U8	54-316	1	MICROPROCESSOR,8259A	P8259A	INTEL
U9	54-315	1	MICROPROCESSOR,8088	P8088	INTEL
U10	54-103	2	TTL,74LS373,OCTAL	DM74LS373N	NSC
U11	54-103		TTL,74LS373,OCTAL	DM74LS373N	NSC
U12	54-74LS01	1	TTL,74LS01,QUAD,2 INPUT NAND	N74LS01N	SIGNETICS
U13	54-57	1	TTL,74LS02,QUAD,2 INPUT NOR	DM74LS02N	NSC
U14	54-534	1	CMOS,74HCT374	MC74HCT374N	MOTOROLA
U15	54-530	2	CMOS,74HCT244	SN74HC244N	T.I.
U16	54-533	1	CMOS,74HCT373	MC74HCT373N	MOTOROLA
U17	54-530		CMOS,74HCT244	SN74HC244N	T.I.
U18	54-528	2	CMOS,74HCT138	SN74HCT138N	T.I.
U19	54-528		CMOS,74HCT138	SN74HCT138N	T.I.
U20	54-74LS139	2	TTL,74LS139,DUAL	DM74LS139N	NSC
U21	54-74LS139		TTL,74LS139,DUAL	DM74LS139N	NSC
U22	CALL FAC-TORY	2	EPROM	CALL FACTORY	
U23	CALL FAC-TORY		EPROM	CALL FACTORY	
U24	CALL FAC-TORY	1	EPROM	CALL FACTORY	
U25	54-402	1	MEMORY,DS1225/MK48Z08	DS1225Y	DALLAS SEMI

Table 5-25. A23 PCB Parts List (3 of 3)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U26	54-409	2	MEMORY,6264,RAM	HM6264P-15	HITACHI
U27	CALL FAC-TORY	2	EEPROM	CALL FACTORY	
U28	CALL FAC-TORY		EEPROM	CALL FACTORY	
U29	54-409		MEMORY,6264,RAM	HM6264P-15	HITACHI
U30	54-74LS138	1	TTL,74LS138	SN74LS138N	T.I.
U32	54-493	1	VOLTAGE COMPARATOR,TL7705A	TL7705ACP	T.I.
W1	800-140	7	WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W4	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W6	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W7	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W9	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W12	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
W13	800-140		WIRE,JUMPER	J0.400 X 0.125 T22	SQUIRES
Y1	630-27	1	CRYSTAL,15MHZ	CY15A	CRYSTEK
BL09	553-96	1	PCB EJECTOR	LP-36	BIVAR
BL12	B8116-23	1	EJECTOR, PCB, A23	PER 6700-B-31550	

Table 5-26. A24 PCB Parts List (1 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-41	1	CAPACITOR,FXD,TANT,6.8µF,10%,3V	196D685X9035KE3	SPRAGUE
C2	230-37	17	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
J1	551-236	1	CONNECTOR,DIP SOCKET,PC MNT	8136-475G9	AUGAT
L1	310-89	1	INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
P2	551-102	1	CONNECTOR,HDR,PC MNT	CA-D265P100-230-430	
P3	551-206	1	CONNECTOR,HDR,PC MNT	65521-103	BERG
R1	110-1K-1	4	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R2	110-75K-1	1	RESISTOR,FXD,MF,75 KΩ,1%,0.25W		
R3	110-10K-1	5	RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R4	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R5	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R6	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R7	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R8	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R9	110-10K-1		RESISTOR,FXD,MF,10 KΩ,1%,0.25W		
R10	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
RN1	123-9	1	RESISTOR,NETWORK,MF,9 X 10 KΩ,2%	410A103	ALLEN-BRADLEY
S1	420-14	1	SWITCH,SLIDE	124-441-020	CHICAGO SWITCH
U1	54-93	1	MICROPROCESSOR,8085A	P8085A	INTEL
U2	54-526	1	74HCT04,HEX INVERTERS	CE74HCT04E	RCA
U3	54-74LS01	1	TTL,74LS01,QUAD,2 INPUT NAND	N74LS01N	SIGNETICS
U4	54-529	1	CMOS,74HCT139,DUAL	74HCT139N	SUPERTEX INC.
U5	54-332	1	TTL,75161A,8 CHANNELS,GPIB	DN75161AN	NSC
U6	54-331	1	TTL,75160A,8 CHANNELS,GPIB	DN75160AN	NSC

Table 5-26. A24 PCB Parts List (2 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U7	54-330	1	TTL,7210,,GPIB TALKER/LIST	UPD7210C	NEC
U8	54-533	1	CMOS,74HCT373	MC74HCT373N	MOTOROLA
U9	54-527	1	CMOS,74HCT74,DUAL	CD74HCT74E	RCA
U10	CALL FAC-TORY	1	EPROM	CALL FACTORY	
U11	54-409	1	MEMORY,6264,RAM,8K/8	HM6264P-15	HITACHI
U12	54-314	1	MICROPROCESSOR,8255A-5	8255A-5	
U13	54-528	1	CMOS,74HCT138	SN74HCT138N	T.I.
U14			NOT USED		
U15	54-530	1	CMOS,74HCT244	SN74HC244N	T.I.
U16	54-531	1	CMOS,74HCT245	MC74HCT245N	MOTOROLA
U17	54-74LS00	1	TTL,74LS00,QUAD,2 INPUT NAND	SN74LS00P	MOT
Y1	630-17	1	CRYSTAL,6.000 MHZ	6.000MHZ	CRYSTEK
BL08	553-96	1	PCB EJECTOR	LP-36	BIVAR
BL09	B8116-24	1	EJECTOR, PCB, A24	PER 6700-B-31550	

Table 5-27. A25 PCB Parts List (1 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	223-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CM04ED131J03	ARCO
C2	230-33	1	CAPACITOR,FXD,CER,2000PF,20%,5V	BGP.002+-20%500VY5U	RMC
C3	230-37	11	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	250-121	2	CAPACITOR,FIXED,CER,0.01µF	30GAS10	SPRAGUE
C6	250-121		CAPACITOR,FIXED,CER,0.01µF	30GAS10	SPRAGUE
C8	250-183	2	CAPACITOR,FXD,ALUM,10µF	SM450VB10RM16X25LL	UNITED CHEMI-CON
C9	227-50	2	CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C10	250-183		CAPACITOR,FXD,ALUM,10µF	SM450VB10RM16X25LL	UNITED CHEMI-CON
C11	220-240	3	CAPACITOR,FXD,MICA,240PF,5%,50V		
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-52	1	CAPACITOR,FXD,,15pF,5%	150-100-NPO-150J	CENTRE ENG
C14	250-42	4	CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	227-13	1	CAPACITOR,FXD,MICA,1000PF,2%,1V		
C17	250-39	2	CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C18	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C19	220-470	1	CAPACITOR,FXD,MICA,470PF,5%,50V		
C20	230-3	6	CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C21	250-77	2	CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C22	250-77		CAPACITOR,FXD,CER,0.01µF,10%,1V	CK05BX103K	SPRAGUE
C23	250-74	1	CAPACITOR,FXD,TANT,47µF,10%,35V	196D476X9035TE4	SPRAGUE
C24	250-40	2	CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X002HE3	SPRAGUE
C25	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C26	250-39		CAPACITOR,FXD,TANT,4.7µF,20%,3V	199D475X9035CA1	SPRAGUE
C27	250-40		CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X002HE3	SPRAGUE
C28	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
C29	230-34	2	CAPACITOR,FXD,CER,2700PF,10%,1V	805-024-Z5F-272K	ERIE
C30	230-34		CAPACITOR,FXD,CER,2700PF,10%,1V	805-024-Z5F-272K	ERIE
C31	210-30	2	CAPACITOR,FXD,PEST,0.10µF,10%	ECQ-E2104KZS	PANASONIC
C32	250-133	2	CAPACITOR,FXD,ALUM,220µF	UPA-1E221M	NICHICON
C33	250-133		CAPACITOR,FXD,ALUM,220µF	UPA-1E221M	NICHICON
C34	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C35	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C36	220-240		CAPACITOR,FXD,MICA,240PF,5%,50V		
C37	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C38	250-134	6	CAPACITOR,FXD,ALUM,47µF	PAIH470MRH	NICHICON
C39	250-134		CAPACITOR,FXD,ALUM,47µF	UPAIH470MRH	NICHICON
C40	250-135	3	CAPACITOR,FXD,ALUM,10µF	UPA1J100MAH	NICHICON
C41	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C42	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C43	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB

Table 5-27. A25 PCB Parts List (2 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C44	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C45	250-162	2	CAPACITOR,FXD,ALUM,22µF,20%	UPA2C220M	NICHICON
C46	250-162		CAPACITOR,FXD,ALUM,22µF,20%	UPA2C220M	NICHICON
C47	250-134		CAPACITOR,FXD,ALUM,47µF	UPAIH470MRH	NICHICON
C48	250-134		CAPACITOR,FXD,ALUM,47µF	UPAIH470MRH	NICHICON
C49	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C50	250-19A		CAPACITOR,FXD,TANT,1µF,10%,35V	196D-105X9035HA1	SPRAGUE
C52	210-30		CAPACITOR,FXD,PEST,0.10µF,10%	E2104KZS	PANASONIC
C53	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C54	250-134		CAPACITOR,FXD,ALUM,47µF	UPAIH470MRH	NICHICON
C55	250-134		CAPACITOR,FXD,ALUM,47µF	UPAIH470MRH	NICHICON
C56	250-135		CAPACITOR,FXD,ALUM,10µF	UPA1J100MAH	NICHICON
C57	250-135		CAPACITOR,FXD,ALUM,10µF	UPA1J100MAH	NICHICON
C58	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C59	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C60	230-8	2	CAPACITOR,FXD,CER,0.02µF,20%,5V	DD16F10Z5U203M500V	MURATA/ERIE
C61	230-8		CAPACITOR,FXD,CER,0.02µF,20%,5V	DD16F10Z5U203M500V	MURATA/ERIE
C64	250-19A	2	CAPACITOR,FXD,TANT,1µF,10%,35V	196D-105X9035HA1	SPRAGUE
C65	220-240		CAPACITOR,FXD,MICA,240PF,5%,50V		
C66	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C67	230-64	1	CAPACITOR,FXD,,1000pF,5%	200-100-NPO-102J	CENTRE ENG
C68	210-38	1	CAP,FXD,PEST,0.022µF,10%,400V	ECQ-E4223KZ	PANASONIC
C69	227-50		CAPACITOR,FXD,PEST,0.01µF,2%,2V	ZA2C103G	IMB
C70	250-42		CAPACITOR,FXD,TANT,10µF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-1N4446	10	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR2	10-78	2	DIODE,ZENER,1N5351B	1N5351B	MOTOROLA
CR3	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR4	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR5	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR6	10-23	2	DIODE,RECTIFIER,IN493G	1N4936	MOTOROLA
CR7	10-23		DIODE,RECTIFIER,IN493G	1N4936	MOTOROLA
CR8	10-1N751A	1	DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR9	10-1N752A	1	DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR10	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR11	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR12	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR13	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR14	10-31	2	DIODE,RECTIFIER,1N4934	1N5416	SEMTECH
CR15	10-31		DIODE,RECTIFIER,1N4934	1N5416	SEMTECH
CR16	10-24	1	DIODE ZENER,IN5360A	1N5360A	MOTOROLA
CR19	10-78		DIODE,ZENER,1N5351B	1N5351B	MOTOROLA

Table 5-27. A25 PCB Parts List (3 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR22	10-40	8	DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR23	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR24	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR25	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR26	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR27	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR28	10-26	2	DIODE,RECTIFIER,MR852	MR852	MOTOROLA
CR29	10-26		DIODE,RECTIFIER,MR852	MR852	MOTOROLA
CR30	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR31	10-40		DIODE,RECTIFIER,MR822	MR822	MOTOROLA
CR32	15-18	1	INDICATOR,LED,RED	550-0406	DIALIGHT
CR33	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR34	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
L1	A30511	1	INDUCTOR,FXD,17.6µH/7.3A		WEST COAST MAG
L13	A32372	2	INDUCTOR FILTER,SWITCHER	SPEC-A-32372	WEST COAST MAG
L14	A32372		INDUCTOR FILTER,SWITCHER	SPEC-A-32372	WEST COAST MAG
L16	310-98	1	INDUCTOR,FXD,1MH,10%	1537-744	DELEVAN
L17	310-123	1	INDUCTOR,FXD,10MH,10%	MR10000	LENOX-FUGEL
Q1	20-9	1	TRANSISTOR,PNP,2N4249	2N4249	IDI
Q2	20-2N3694	1	TRANSISTOR,NPN,2N3694	MPS3694-18	MOTOROLA
Q3	20-2N2222A	2	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q4	20-2N2905	2	TRANSISTOR,PNP,2N2905	2N2905	MOTOROLA
Q5	20-2N2905		TRANSISTOR,PNP,2N2905	2N2905	MOTOROLA
Q8	20-2N2907A	1	TRANSISTOR,PNP,2N2907A	2N2907A	MOTOROLA
Q9	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q12	20-2N3904	1	TRANSISTOR,NPN,2N3904	2N3904	MOTOROLA
R1	110-6.19K-1	2	RESISTOR,FXD,MF,6.19 KΩ,1%,0.25W		
R2	110-6.19K-1		RESISTOR,FXD,MF,6.19 KΩ,1%,0.25W		
R3	130-0.5-5	2	RESISTOR,FXD,WW,0.5Ω,5%,2W	G3-80Z.5ohm+/-5%	DALE
R4	110-549-1	2	RESISTOR,FXD,MF,549Ω,1%,0.25W		
R5	102-100K-5	2	RESISTOR,FXD,CC,100 KΩ,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R6	102-100K-5		RESISTOR,FXD,CC,100 KΩ,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R7	110-549-1		RESISTOR,FXD,MF,549Ω,1%,0.25W		
R8	130-0.5-5		RESISTOR,FXD,WW,0.5Ω,5%,2W	G3-80Z.5ohm+/-5%	DALE
R9	113-4.84K-0.1	1	RESISTOR,FXD,MF,4.84 KΩ,0.1%,0.1W		
R10	110-1K-1	12	RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R11	113-4.99K-0.1	1	RESISTOR,FXD,MF,4.99 KΩ,0.1%,0.1W		
R12	110-22.1K-1	2	RESISTOR,FXD,MF,22.1 KΩ,1%,0.25W		
R13	110-28.7K-1	1	RESISTOR,FXD,MF,28.7 KΩ,1%,0.25W		
R14	110-20K-1	3	RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-27. A25 PCB Parts List (4 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R15	110-100-1	2	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R16	110-22.1K-1		RESISTOR,FXD,MF,22.1 KΩ,1%,0.25W		
R17	110-1.87K-1	1	RESISTOR,FXD,MF,1.87 KΩ,1%,0.25W		
R18	110-3.16K-1	1	RESISTOR,FXD,MF,3.16 KΩ,1%,0.25W		
R19	110-24.9K-1	1	RESISTOR,FXD,MF,24.9 KΩ,1%,0.25W		
R20	110-4.42K-1	1	RESISTOR,FXD,MF,4.42 KΩ,1%,0.25W		
R21	110-6.65K-1	1	RESISTOR,FXD,MF,6.65 KΩ,1%,0.25W		
R22	110-100K-1	2	RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R23	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R24	110-20K-1		RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R25	109-10K-5	1	RESISTOR,FXD,MF,10 KΩ,5%,0.12W	CT3 SERIES+VALUE	CORNING
R26	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R27	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R28	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R29	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R30	110-28.7-1	2	RESISTOR,FXD,MF,28.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-261-1	3	RESISTOR,FXD,MF,261Ω,1%,0.25W		
R32	110-28.7-1		RESISTOR,FXD,MF,28.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-261-1		RESISTOR,FXD,MF,261Ω,1%,0.25W		
R34	104-750-5	2	RESISTOR,FXD,CC,750Ω,5%,2W	RC42GF751J	ALLEN BRADLEY
R35	104-750-5		RESISTOR,FXD,CC,750Ω,5%,2W	RC42GF751J	ALLEN BRADLEY
R36	110-68.1-1	1	RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R37	110-19.6-1	1	RESISTOR,FXD,MF,19.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R38	110-249-1	1	RESISTOR,FXD,MF,249Ω,1%,0.25W		
R39	110-10K-1	7	RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R40	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R41	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R42	101-2.2M-5	1	RESISTOR,FXD,CC,2.2 MΩ,5%,0.25W	RC07GF225J	ALLEN BRADLEY
R43	110-48.7K-1	1	RESISTOR,FXD,MF,48.7 KΩ,1%,0.25W		
R44	110-100-1		RESISTOR,FXD,MF,, 100,1%,0.25	SMA-4 OR C4	CORNING
R45	110-1.47K-1	2	RESISTOR,FXD,MF,1.47 KΩ,1%,0.25W		
R46	110-14.7K-1	1	RESISTOR,FXD,MF,14.7 KΩ,1%,0.25W		
R47	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R48	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R49	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R50	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R51	110-147-1	1	RESISTOR,FXD,MF,147Ω,1%,0.25W	SMA-4 OR C4	CORNING
R52	110-750K-1	1	RESISTOR,FXD,MF,750 KΩ,1%,0.25W		
R53	110-499-1	2	RESISTOR,FXD,MF,499Ω,1%,0.25W		
R54	110-100K-1		RESISTOR,FXD,MF,100 KΩ,1%,0.25W		
R55	110-499-1		RESISTOR,FXD,MF,499Ω,1%,0.25W		

Table 5-27. A25 PCB Parts List (5 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R56	110-10-1	4	RESISTOR,FXD,10.0Ω,1%	SMA-4 OR C4	CORNING
R57	110-10-1		RESISTOR,FXD,10.0Ω,1%	SMA-4 OR C4	CORNING
R58	110-402-1	1	RESISTOR,FXD,MF,402Ω,1%,0.25W		
R59	110-24.9-1	1	RESISTOR,MF,24.9Ω,1%,0.25W		
R60	110-10-1		RESISTOR,FXD,10.0Ω,1%	SMA-4 OR C4	CORNING
R61	110-3.24-1	1	RESISTOR,FXD,MF,3.24Ω,1%		
R62	110-51.1-1	1	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-20K-1		RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-61.9-1	2	RESISTOR,FXD,MF,61.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R65	110-121-1	1	RESISTOR,FXD,MF,121Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	110-5.11K-1	1	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R71	110-61.9-1		RESISTOR,FXD,MF,61.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-31.6K-1	1	RESISTOR,FXD,MF,31.6 KΩ,1%,0.25W		
R73	110-10-1		RESISTOR,FXD,10.0Ω,1%	SMA-4 OR C4	CORNING
R74	110-15.0-1	1	RESISTOR,FXD,MF,15.0Ω,1%,0.25W		
R80	110-1.5K-1	1	RESISTOR,FXD,MF,1.50 KΩ,1%,0.25W		
R81	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R82	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R83	110-1.47K-1		RESISTOR,FXD,MF,1.47 KΩ,1%,0.25W		
R84	110-133-1	1	RESISTOR,FXD,MF,133Ω,1%,0.25W	SMA-4 OR C4	CORNING
R85	110-261-1		RESISTOR,FXD,MF,261Ω,1%,0.25W		
R86	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R87	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R88	110-2.32K-1	1	RESISTOR,FXD,MF,2.32 KΩ,1%,0.25W		
R89	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R90	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R91	110-590-1	1	RESISTOR,FXD,MF,590Ω,1%,0.25W		
R92	110-49.9K-1	1	RESISTOR,FXD,MF,49.9 KΩ,1%,0.25W		
R93	110-825-1	1	RESISTOR,FXD,MF,825Ω,1%,0.25W		
R94	110-165K-1	1	RESISTOR,FXD,MF,165KΩ,1%,0.25W		
RT1	35-1	1	THERMISTOR,NTC,1.0 MΩ,5%,0.1W	12C1004-5	WESTERN THERMISTOR
T3	320-123	1	TRANSFORMER,POWER,50 KHz	PER DWG B35662	TRANEX
TP1	551-674	2	CONNECTOR SOCKET	66947-003	BERG
TP2	551-674		CONNECTOR SOCKET	66947-003	BERG
TP3	551-674		CONNECTOR SOCKET	66947-003	BERG
TP4	551-674		CONNECTOR SOCKET	66947-003	BERG
TP5	551-674		CONNECTOR SOCKET	66947-003	BERG
TP6	551-674		CONNECTOR SOCKET	66947-003	BERG
U1	20-820	2	OPTOCOUPLER,NPN	MCT-2E	MONSANTO
U2	20-820		OPTOCOUPLER,NPN	MCT-2E	MONSANTO
U3	50-34	1	OP AMP,LT1056ACH,SINGLE	LT1056ACH	LINEAR TECH

Table 5-27. A25 PCB Parts List (6 of 6)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U4	54-765	1	PWM,TL494,SINGLE	TL494CN	MOTOROLA
U5	54-555	2	OP AMP,NE555,SINGLE	LM555CN	RCA SOLID STATE
U6	54-158	1	COMPARATOR,LM393,DUAL	LM393N	SIGNETICS
U7	54-205	1	DIGITAL INTERFACE,MC4044	MC4044P	MOTOROLA
U8	54-555		OP AMP,NE555,SINGLE	LM555CN	RCA SOLID STATE
VR1	54-LM340T	1	VOLTAGE REGULATOR,LM340T-12	LM340T-12	NATIONAL SEMI
VR2	54-502	1	VOLTAGE REGULATOR,LT1031	LT1031CCH	LINEAR TECH

Table 5-28. A27 PCB Parts List (1 of 1)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
J1	551-579	1	CONNECTOR,R&P	745114-1	AMP
J2	551-556	1	CONNECTOR,HEADER	67997-114	BERG
K1	690-38	1	RELAY,LATCHING	DS2ES-DC5V	AROMAT

Table 5-29. A28 PCB Parts List (1 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	230-40	2	CAPACITOR,FXD,CER,0.01µF,20%,1V	5GA-S10	SPRAGUE
C2	230-40		CAPACITOR,FXD,CER,0.01µF,20%,1V	5GA-S10	SPRAGUE
C5	250-144	1	CAPACITOR,FXD,ALUM,1500µF,20%	ULB1H152M	NICHICON
C6	250-19A	1	CAPACITOR,FXD,TANT,1µF,10%,35V	196D-105X9035HA1	SPRAGUE
C7	230-37	1	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	250-40A	1	CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
CR5	10-SI2	1	DIODE,RECTIFIER,IN4003	SS6253	SEMTECH
CR10	10-1N4446	3	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR11	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR12	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
FL1	260-7	1	EMI FILTER,BALANCED,SOLDER	3EZP	CORCOM
J1	551-561	1	CONNECTOR HEADER	65595-111	BERG
J2	551-560	1	CONNECTOR,HEADER	65595-104	BERG
J3	551-776	1	CONNECTOR,HEADER	68016-15	BERG
J4	551-552	1	CONNECTOR HEADER	68016-104	BERG
J5	551-551	5	CONNECTOR HEADER	68016-103	BERG
J6	551-551		CONNECTOR HEADER	68016-103	BERG
J7	551-551		CONNECTOR HEADER	68016-103	BERG
J8	551-551		CONNECTOR HEADER	68016-103	BERG
J9	551-553	1	CONNECTOR HEADER	68492-106	BERG
J10	551-775	1	CONNECTOR,HEADER	67997-16	BERG
J11	551-707	4	CONNECTOR,HEADER	69167-103	BERG
J12	551-725	2	CONNECTOR,HEADER	69167-104	DU PONT
J13	551-725		CONNECTOR,HEADER	69167-104	DU PONT
J14	551-554	1	CONNECTOR HEADER	68492-114	BERG
J19	551-603	2	CONNECTOR,HEADER	68492-126	BERG
J20	551-707		CONNECTOR,HEADER	69167-103	BERG
J21	551-707		CONNECTOR,HEADER	69167-103	BERG
J22	551-707		CONNECTOR,HEADER	69167-103	BERG
J23	551-603		CONNECTOR,HEADER	68492-126	BERG
J24	551-551		CONNECTOR HEADER	68016-103	BERG
J25	551-586	1	CONNECTOR,HEADER	68492-124	BERG
J26	551-600	1	CONNECTOR HEADER	10-63-1063	MOLEX
J27	551-607	1	CONNECTOR,HEADER	68492-130	BERG
K1	690-47	1	RELAY,CRADLE	LY30-US-DC24	OMRON
Q1	20-2N3906	1	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
Q2	20-2N4410	1	TRANSISTOR,NPN,2N4410	2N4410	MOTOROLA
Q3	20-2N6041	1	TRANSISTOR,PNP,2N6041	2N6041	MOTOROLA
Q4	20-2N3694	1	TRANSISTOR,NPN,2N3694	MPS3694-18	MOTOROLA
R1	102-100K-5	2	RESISTOR,FXD,CC,100 KΩ,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R2	102-100K-5		RESISTOR,FXD,CC,100 KΩ,5%,0.5W	RC20GF104J	ALLEN BRADLEY

Table 5-29. A28 PCB Parts List (2 of 2)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R3	110-487-1	1	RESISTOR,FXD,MF,487Ω,1%,0.25W		
R4	110-1.96K-1	1	RESISTOR,FXD,MF,1.96 KΩ,1%,0.25W		
R5	110-9.53K-1	1	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R6	110-1K-1	2	RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R7	110-15K-1	1	RESISTOR,FXD,MF,15 KΩ,1%,0.25W		
R8	110-1K-1		RESISTOR,FXD,MF,1 KΩ,1%,0.25W		
R9	110-2.0-1	1	RESISTOR,FXD,MF,2.0Ω,1%,0.25W		CORNING
W1	800-13		WIRE,BUSS,22AWG	8021	BELDEN
W2	800-13		WIRE,BUSS,22AWG	8021	BELDEN
XA8	551-503	5	CONNECTOR,CARD EDGE,PRESS FIT	NK20A-1-1-192	WINCHESTER
XA15	551-501	5	CONNECTOR,CARD EDGE,PRESS FIT	NK25A-1-1-192	WINCHESTER
XA16	551-501		CONNECTOR,CARD EDGE,PRESS FIT	NK25A-1-1-192	WINCHESTER
XA17	551-502	1	CONNECTOR,CARD EDGE,PRESS FIT	NK35A-1-1-192	WINCHESTER

Table 5-30. A29 PCB Parts List (1 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
C1	250-40A	6	CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C2	250-40A		CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C3	250-40A		CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C4	230-37	17	CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C9	230-11	1	CAPACITOR,FXD,CER,0.01µF	TCP-R01	ARCO/SOSHIN
C10	250-143	2	CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C11	230-64	1	CAPACITOR,FXD,,1000pF	200-100-NPO-102J	CENTRE ENG
C12	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C16	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C17	250-40A		CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C18	250-40A		CAPACITOR,FXD,TANT,2.2µF,20%,2	196D225X0025HA1	SPRAGUE
C19	250-40A		CAPACITOR,FXD,TANT,2.2µF,20%,2V	196D225X0025HA1	SPRAGUE
C22	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C23	250-42B	8	CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C24	230-71	1	CAPACITOR,FIXED,CER,68pf,5%	150-100-NPO-680J	CENTR ENG
C25	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C26	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C27	230-39	2	CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C28	230-39		CAPACITOR,FXD,CER,0.1µF,10%,50V	8121-050-X7RO-104K	ERIE
C29	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C30	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C31	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C33	230-61	1	CAPACITOR,FXD,560pF	200-100-NPO-561J	CENTRE ENG
C34	230-53		CAPACITOR,FXD,,39pF	150-100-NPO-390J	CENTRE ENG
C45	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1µF,20%,100V	RPE122104M100V	MURATA/ERIE
C53	230-53	2	CAPACITOR,FXD,,39pF,5%	150-100-NPO-390J	CENTRE ENG
C54	250-19A	2	CAPACITOR,FXD,TANT,1µF,10%,35V	196D-105X9035HA1	SPRAGUE
C55	250-19A		CAPACITOR,FXD,TANT,1µF,10%,35V	196D-105X9035HA1	SPRAGUE
C56	230-49	2	CAPACITOR,FXD,,.022µF,100V	200-100-X7R-223K	CENTRE ENG
C57	230-49		CAPACITOR,FXD,,.022µF,100V	200-100-X7R-223K	CENTRE ENG
C58	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
C59	250-42B		CAPACITOR,FXD,TANT,10µF,10%	T350E106K025AS	KEMET
CR1	10-1N751A	7	DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR2	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA

Table 5-30. A29 PCB Parts List (2 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
CR5	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR6	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR8	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR11	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR12	10-4	3	DIODE,SCHOTTKY MIXER	MBD501	MOTOROLA
CR13	10-1N759A	1	DIODE,ZENER,1N759A	1N759A	FSC
CR14	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15	10-1N4749A	1	DIODE,ZENER,1N4749	1N4749A	MOTOROLA
CR16	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR26	10-1N4446	23	DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR27	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR28	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR29	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR30	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR31	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR32	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR33	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR34	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR35	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR36	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR37	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR38	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR39	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR40	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR41	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR44	10-1N752A	4	DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR45	10-1N752A		DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR49	10-1N751A		DIODE,ZENER,1N751A	1N751A	MOTOROLA
CR50	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR51	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR52	10-1N755A	1	DIODE,ZENER,1N755A	1N755A	MOTOROLA
CR53	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR54	10-1N752A		DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR55	10-1N752A		DIODE,ZENER,1N752A	1N752A	MOTOROLA
CR56	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR57	10-FD300	1	DIODE RECTIFIER,IN3595	1N3595	SOLID STATE DEV
CR58	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR59	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
CR60	10-1N4446		DIODE,SWITCHING,1N4446	1N4446 T+R	FAIRCHILD
J1	551-707	6	CONNECTOR,HEADER	69167-103	BERG
J2	551-707		CONNECTOR,HEADER	69167-103	BERG

Table 5-30. A29 PCB Parts List (3 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
J3	551-707		CONNECTOR,HEADER	69167-103	BERG
J4	551-707		CONNECTOR,HEADER	69167-103	BERG
J5	551-707		CONNECTOR,HEADER	69167-103	BERG
J6	551-548	4	CONNECTOR HEADER	68001-106	BERG
J7	551-548		CONNECTOR HEADER	68001-106	BERG
J8	551-548		CONNECTOR HEADER	68001-106	BERG
J9	551-548		CONNECTOR HEADER	68001-106	BERG
J10	553-284	2	SOCKET	645831-6	AMP
J14	551-707		CONNECTOR,HEADER	69167-103	BERG
L1	310-89	2	INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
L2	310-89		INDUCTOR,FIXED,1.9µH @ 50 MHZ	VK200 10/3B	FERROXCUBE
L3	310-45	1	INDUCTOR,FXD,100.0µH,5%	1315-12J	
L4	310-53	1	INDUCTOR,FXD,47.0µH,5%	1537-60	
P1	551-542	1	CONNECOTR,PCB TRANSISTOR TYPE	FCN-754PO14-AU/O	FUJITSU
P2	551-362	2	CONNECTOR,INSULATION	15-38-0264	MOLEX
P3	551-362		CONNECTOR,INSULATION	15-38-0264	MOLEX
Q3	20-2N2222A	19	TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q4	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q6	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q7	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q8	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q9	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q10	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q11	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q12	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q18	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q19	20-2N4249	1	TRANSISTOR,PNP,2N4249	MPS4249-18	MOTOROLA
Q20	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q21	20-2N2907A	1	TRANSISTOR,PNP,2N2907A	2N2907A	MOTOROLA
Q22	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q23	20-2N2218	1	TRANSISTOR,NPN,2N2218	2N2218	NATIONAL
Q24	20-45	4	TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q25	20-45		TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q26	20-45		TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q27	20-45		TRANSISTOR,FET,N CHANNEL	VN10KM	SILICONIX
Q28	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q30	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q31	20-2N2222A		TRANSISTOR,NPN,2N2222A	2N2222A	MOTOROLA
Q32	20-22	1	TRANSISTOR,NPN,TIP110	TIP110	MOTOROLA
Q33	20-2N3906	2	TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA

Table 5-30. A29 PCB Parts List (4 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
Q34	20-2N3906		TRANSISTOR,PNP,2N3906	2N3906	MOTOROLA
R1	110-100-1	29	RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R2	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-34.8K-1	3	RESISTOR,FXD,MF,34.8 KΩ,1%,0.25W		
R4	110-30.1K-1	6	RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R7	110-34.8K-1		RESISTOR,FXD,MF,34.8 KΩ,1%,0.25W		
R8	110-30.1K-1		RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R11	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R12	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-34.8K-1		RESISTOR,FXD,MF,34.8 KΩ,1%,0.25W		
R14	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R15	110-30.1K-1		RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R16	110-30.1K-1		RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R17	110-30.1K-1		RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R18	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-12.4K-1	1	RESISTOR,FXD,MF,12.4 KΩ,1%,0.25W		
R20	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R21	110-16.2-1	1	RESISTOR,FXD,MF,16.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R22	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R24	110-5.11K-1	2	RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R25	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R26	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R27	110-10K-1	10	RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R28	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R29	110-42.2K-1	2	RESISTOR,FXD,MF,42.2 KΩ,1%,0.25W		
R30	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-20K-1	4	RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-20K-1		RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-42.2K-1		RESISTOR,FXD,MF,42.2 KΩ,1%,0.25W		
R34	110-215K-1	1	RESISTOR,FXD,MF,215 KΩ,1%,0.25W		
R37	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R38	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R39	110-48.7-1	4	RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R40	110-48.7-1		RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R41	110-48.7-1		RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R43	110-48.7-1		RESISTOR,FXD,MF,48.7Ω,1%,0.25W	SMA-4 OR C4	CORNING
R44	110-33.2-1	7	RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R45	110-33.2-1		RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R49	110-133-1	4	RESISTOR,FXD,MF,133Ω,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-133-1		RESISTOR,FXD,MF,133Ω,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-30. A29 PCB Parts List (5 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R51	110-215-1	6	RESISTOR,FXD,MF,215Ω,1%,0.25W		
R52	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R53	110-61.9-1	2	RESISTOR,FXD,MF,61.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R54	110-61.9-1		RESISTOR,FXD,MF,61.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R55	110-40.2-1	1	RESISTOR,MF,40.2Ω,1%,0.25W		
R56	110-33.2-1		RESISTOR;FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R57	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R58	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R59	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R60	110-215-1		RESISTOR,FXD,MF,215Ω,1%,0.25W		
R61	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R62	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-51.1-1	9	RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R65	110-68.1-1	6	RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R66	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R68	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R69	110-33.2-1		RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R70	110-33.2-1		RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R71	110-33.2-1		RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R72	110-33.2-1		RESISTOR,FXD,MF,33.2Ω,1%,0.25W	SMA-4 OR C4	CORNING
R73	110-4.64K-1	5	RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		
R74	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R75	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R76	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R77	110-68.1-1		RESISTOR,FXD,MF,68.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R78	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R79	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R80	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R85	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R86	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R87	110-1K-1	3	RESISTOR,FXD,MF,1.0 KΩ,1%,.025W		
R88	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R92	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,0.025W		
R93	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R94	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R95	110-9.53K-1	2	RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R96	110-499-1	2	RESISTOR,FXD,MF,499Ω,1%,0.25W		
R97	110-3.32K-1	1	RESISTOR,FXD,MF,3.32 KΩ,1%,0.25W		
R98	110-825-1	2	RESISTOR,FXD,MF,825Ω,1%,0.25W		

Table 5-30. A29 PCB Parts List (6 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R99	110-825-1		RESISTOR,FXD,MF,825Ω,1%,0.25W		
R100	110-1K-1		RESISTOR,FXD,MF,1.0 KΩ,1%,0.025W		
R101	110-2.26K-1	1	RESISTOR,FXD,MF,2.26 KΩ,1%,0.25W		
R102	110-3.01K-1	1	RESISTOR,FXD,MF,3.01 KΩ,1%,0.25W		
R103	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R104	110-9.53K-1		RESISTOR,FXD,MF,9.53 KΩ,1%,0.25W		
R105	110-499-1		RESISTOR,FXD,MF,499Ω,1%,0.25W		
R106	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R107	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R108	110-10-1	1	RESISTOR,FXD,10.0Ω,,1%	SMA-4 OR C4	CORNING
R109	110-2.87K-1	1	RESISTOR,FXD,MF,2.87 KΩ,1%,0.25W		
R110	103-240-5	1	RESISTOR,FXD,CC,240Ω,5%,1W	RC32GF241J	ALLEN BRADLEY
R112	110-464K-1	4	RESISTOR,FXD,MF,464 KΩ,1%,0.25W		
R113	110-464K-1		RESISTOR,FXD,MF,464 KΩ,1%,0.25W		
R114	110-464K-1		RESISTOR,FXD,MF,464 KΩ,1%,0.25W		
R115	110-464K-1		RESISTOR,FXD,MF,464 KΩ,1%,0.25W		
R116	110-20K-1		RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R117	110-20K-1		RESISTOR,FXD,MF,20.0 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R118	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R119	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R120	110-7.32K-1	2	RESISTOR,FXD,MF,7.32 KΩ,1%,0.25W		
R124	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R125	110-12.1K-1		RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		
R126	110-1.5K-1	4	RESISTOR,FXD,MF,1.50 KΩ,1%,0.25W		
R127	110-12.1K-1		RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		
R128	110-1.5K-1		RESISTOR,FXD,MF,1.50 KΩ,1%,0.25W		
R129	110-1.5K-1		RESISTOR,FXD,MF,1.50 KΩ,1%,0.25W		
R130	110-7.32K-1		RESISTOR,FXD,MF,7.32 KΩ,1%,0.25W		
R131	110-13.7K-1	2	RESISTOR,FXD,MF,13.7 KΩ,1%,0.25W		
R132	110-13.7K-1		RESISTOR,FXD,MF,13.7 KΩ,1%,0.25W		
R133	110-1.5K-1		RESISTOR,FXD,MF,1.50 KΩ,1%,0.25W		
R138	110-5.11K-1		RESISTOR,FXD,MF,5.11 KΩ,1%,0.25W		
R146	110-4.64K-1		RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		
R147	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R148	110-100-1		RESISTOR,FXD,MF,100Ω,1%,0.25W	SMA-4 OR C4	CORNING
R149	110-80.6-1	1	RESISTOR,FXD,MF,80.6Ω,1%,0.25W	SMA-4 OR C4	CORNING
R150	110-4.64K-1		RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		
R151	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R152	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R153	110-90.9-1	1	RESISTOR,FXD,MF,90.9Ω,1%,0.25W	SMA-4 OR C4	CORNING
R156	110-4.64K-1		RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		

Table 5-30. A29 PCB Parts List (7 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
R157	110-10K-1		RESISTOR,FXD,MF,10.0 KΩ,1%,0.25W		
R158	110-133-1		RESISTOR,FXD,MF,133Ω,1%,0.25W	SMA-4 OR C4	CORNING
R159	110-133-1		RESISTOR,FXD,MF,133Ω,1%,0.25W	SMA-4 OR C4	CORNING
R160	110-11.5K-1	2	RESISTOR,FXD,MF,11.5 KΩ,1%,0.25W		
R161	110-8.25K-1	1	RESISTOR,FXD,MF,8.25 KΩ,1%,0.25W		
R162	110-12.1K-1	4	RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		
R163	110-133K-1	1	RESISTOR,FXD,MF,133 KΩ,1%,0.25W	MR25	
R164	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R165	110-51.1-1		RESISTOR,FXD,MF,51.1Ω,1%,0.25W	SMA-4 OR C4	CORNING
R166	110-4.64K-1		RESISTOR,FXD,MF,4.64 KΩ,1%,0.25W		
R167	110-4.99K-1	1	RESISTOR,FXD,MF,4.99 KΩ,1%,0.25W	SMA-4 OR C4	CORNING
R168	103-20-5	1	RESISTOR,FXD,CC,20Ω,5%,1W	RC32200J	
R169	110-11.5K-1		RESISTOR,FXD,MF,11.5 KΩ,1%,0.25W		
R170	110-14.7K-1	1	RESISTOR,FXD,MF,14.7 KΩ,1%,0.25W		
R171	110-30.1K-1		RESISTOR,FXD,MF,30.1 KΩ,1%,0.25W		
R172	110-287K-1	1	RESISTOR,FXD,MF,287 KΩ,1%,0.25W		
R173	110-12.1K-1		RESISTOR,FXD,MF,12.1 KΩ,1%,0.25W		
RN1	123-6	3	RESISTOR,NETWORK,MF,7 X 10 KΩ,2%		
RN3	123-15	2	RESISTOR,NETWORK,MF,7 X 4.7 KΩ,2%		
RN4	123-15		RESISTOR,NETWORK,MF,7 X 4.7 KΩ,2%		
RN5	123-6		RESISTOR,NETWORK,MF,7 X 10 KΩ,2%		
RN6	123-6		RESISTOR,NETWORK,MF,7 X 10 KΩ,2%		
U1	54-530	1	CMOS,74HCT244	SN74HC244N	T.I.
U2	54-524	1	CMOS,74HCT00,QUAD	MC74HCT00N	MOTOROLA
U4	54-523	7	CMOS,74HC374	SN74HC374N	T.I.
U5	54-132	2	OP AMP,TL074CN3	TL074CN3	T.I.
U6	54-528	2	CMOS,74HCT138	SN74HCT138N	T.I.
U7	54-528		CMOS,74HCT138	SN74HCT138N	T.I.
U8	54-523		CMOS,74HC374	SN74HC374N	T.I.
U9	54-523		CMOS,74HC374	SN74HC374N	T.I.
U10	54-501	3	D/A,MP1232	MP1232HN	MICRO POWER SYSTEMS
U11	54-132		OP AMP,TL074CN3,QUAD	TL074CN3	T.I.
U12	54-24	6	ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U13	54-501		D/A,MP1232	MP1232HN	MICRO POWER SYSTEMS
U14	50-9	1	OP AMP,LF356,SINGLE	LF356N	NATIONAL SEMI
U15	54-501		D/A,MP1232	MP1232HN	MICRO POWER SYSTEMS
U16	54-53	2	OP AMP,TLO72,DUAL	TL072CP3	T.I.
U17	54-510	1	CMOS,74HC04	SN74HC04N	T.I.
U18	54-523		CMOS,74HC374	SN74HC374N	T.I.
U20	54-144	4	TTL,75451,DUAL	SN75451BP	T.I.

Table 5-30. A29 PCB Parts List (8 of 8)

REF DES	WPN	QTY	DESCRIPTION	VENDOR PART NUMBER	VENDOR NAME
U21	54-144		TTL,75451,DUAL	SN75451BP	T.I.
U22	54-144		TTL,75451,DUAL	SN75451BP	T.I.
U23	54-144		TTL,75451,DUAL	SN75451BP	T.I.
U24	54-523		CMOS,74HC374	SN74HC374N	T.I.
U25	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U26	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U27	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U28	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U29	20-46	4	TRANSISTOR,NPN	CA3183E	RCA
U30	20-46		TRANSISTOR,NPN	CA3183E	RCA
U31	54-523		CMOS,74HC374	SN74HC374N	T.I.
U32	54-24		ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U33	20-46		TRANSISTOR,NPN	CA3183E	RCA
U34	20-46		TRANSISTOR,NPN	CA3183E	RCA
U36	54-336	1	CMOS,509	DG509 ACJ	SILICONIX
U37	54-523		CMOS,74HC374	SN74HC374N	T.I.
U38	54-505	1	D/A,7528,8-BIT,BINARY	AD7528JN	ANALOG DEV
U39	54-53		OP AMP,TLO72,DUAL	TL072CP3	T.I.
U40	54-23	1	OP AMP,MC1495L,SINGLE	MC1495L	MOTOROLA
U41	50-33	3	OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECH
U42	50-33		OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECH
U43	50-33		OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECH
VR1	54-184	1	VOLTAGE REGULATOR,7905	UA7905UC	FAIRCHILD

Table 5-31. Option 1-Rack Mount Assembly

WPN	QTY	DESCRIPTION
783-79		ADHESIVE
790-106	2	EXTENSION BRACKET
790-292	2	SLIDE KIT,RACK
900-336	10	NUT,KEP
900-91	6	SCREW,FLAT HEAD
900-95	8	SCREW,FLAT HEAD
A31689	2	TRIM STRIP,OPTION HANDLE
C31667	2	OPTION HANDLE
D31678-1	1	LEFT ADAPTER PLATE
D31678-2	1	RIGHT ADAPTER PLATE

Table 5-32. Option 2A-110 dB Step Attenuator

WPN	QTY	DESCRIPTION
4422K	1	20 GHz STEP ATTENUATOR
720-12	3	CABLE ACCESSORY,CLAMP
900-142	2	SCREW,PAN HEAD
900-148	2	SCREW,PAN HEAD
900-168	2	SCREW,PAN HEAD
900-345	2	WASHER,#4
900-348	2	WASHER,#6
900-391	4	WASHER,#4
900-392	2	WASHER,#6
900-74	4	SCREW,FLAT HEAD
A31992	2	BRACKET,ATTENUATOR/COUPLER
A9201-189	1	CABLE ASSY
B31989	1	CARRIER PLATE, ATTENUATOR/COUPLER
K224	1	INSERTABLE,M-F K CONNECTOR

Table 5-33. Option 2B-110 dB Step Attenuator

WPN	QTY	DESCRIPTION
4522K	1	26.5 GHz STEP ATTENUATOR
720-12	3	CABLE ACCESSORY,CLAMP
900-142	2	SCREW,PAN HEAD
900-148	2	SCREW,PAN HEAD
900-168	2	SCREW,PAN HEAD
900-345	2	WASHER,#4
900-348	2	WASHER,#6
900-391	4	WASHER,#4
900-392	2	WASHER,#6
900-74	4	SCREW,FLAT HEAD
A31992	2	BRACKET,ATTENUATOR/COUPLER
A9201-189	1	CABLE ASSY
B31989	1	CARRIER PLATE, ATTENUATOR/COUPLER
K224	1	INSERTABLE,M-F K CONNECTOR

Table 5-34. Option 2C-110 dB Step Attenuator

WPN	QTY	DESCRIPTION
4622K	1	40 GHz STEP ATTENUATOR
720-12	3	CABLE ACCESSORY,CLAMP
900-142	2	SCREW,PAN HEAD
900-148	2	SCREW,PAN HEAD
900-168	2	SCREW,PAN HEAD
900-345	2	WASHER,#4
900-348	2	WASHER,#6
900-391	4	WASHER,#4
900-392	2	WASHER,#6
900-74	4	SCREW,FLAT HEAD
A31992	2	BRACKET,ATTENUATOR/COUPLER
A9210-12	1	CABLE ASSY
B31989	1	CARRIER PLATE, ATTENUATOR/COUPLER
K224	1	INSERTABLE,M-F K CONNECTOR

Table 5-35. Option 9K-Rear Panel K Connector

WPN	QTY	DESCRIPTION
513-31	1	RF BULKHEAD K CONNECTOR
680-645	1	LABEL
720-1/8	2	CABLE FASTENER,CLAMP
783-97		ADHESIVE,CONTACT CEMENT
900-148	4	SCREW,PAN HEAD
900-348	4	WASHER,#6
900-392	4	WASHER,#6
A13393	1	PLUG BUTTON,PAINTED
A31886	2	BRACKET,CABLE SUPPORT
A31887	1	PLUG,RF OUTPUT
A9210-13	1	CABLE ASSY
A9211-5	1	CABLE ASSY

INDEX NO.	WPN	QTY	DESCRIPTION
1	C8187-2	1	ON/STANDBY PUSHBUTTON
2	B32154-20	1	DECR PUSHBUTTON
3	B32154-19	1	INCR PUSHBUTTON
4	A12070	1	INCR/DECR KNOB
5	B32154-7	1	"." PUSHBUTTON
6	B32154-8	1	"1" PUSHBUTTON
7	B32154-9	1	"2" PUSHBUTTON
8	B32154-10	1	"3" PUSHBUTTON
9	B32154-11	1	"4" PUSHBUTTON
10	B32154-12	1	"5" PUSHBUTTON
11	B32154-13	1	"6" PUSHBUTTON
12	B32154-14	1	"7" PUSHBUTTON
13	B32154-15	1	"8" PUSHBUTTON
14	B32154-16	1	"9" PUSHBUTTON
15	B32154-17	1	"0" PUSHBUTTON
16	B32154-18	1	"-" PUSHBUTTON
17	C8187-1	36	ALL OTHER PUSHBUTTONS
18	C31648	2	HANDLE,FRONT
19	D36300	1	OVERLAY,FRONT PANEL
20	C8187-4	1	SHIFT KEY PUSHBUTTON
21	D31615	1	INSTRUMENT CASE
22	D13656	4	FOOT,REAR
23	B31636	4	HANDLE,END CAP
24	D13655	4	FOOT,BOTTOM
25	B31651	2	HANDLE STRAP,PLASTIC
26	B31634	2	INSERT,HANDLE STRAP

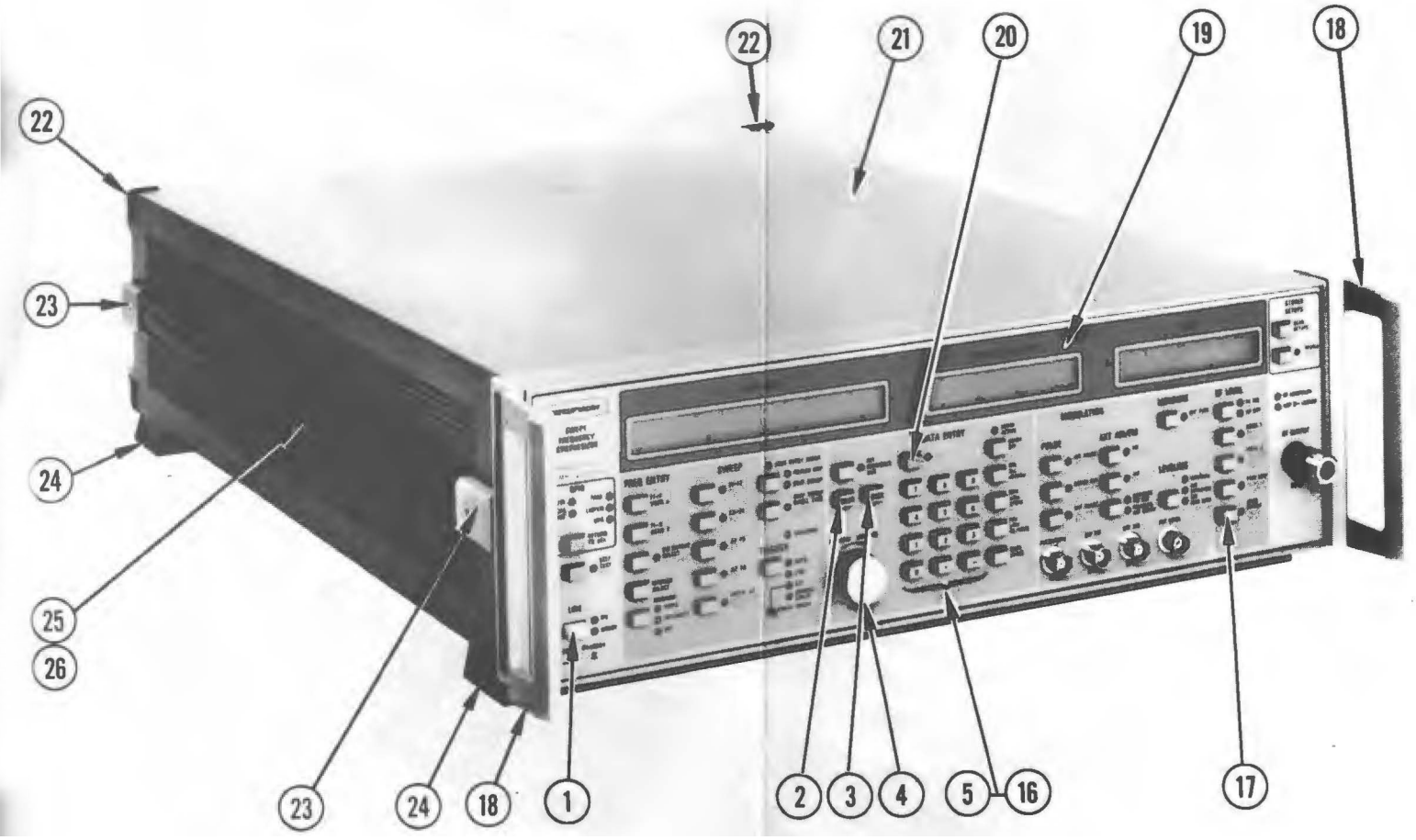
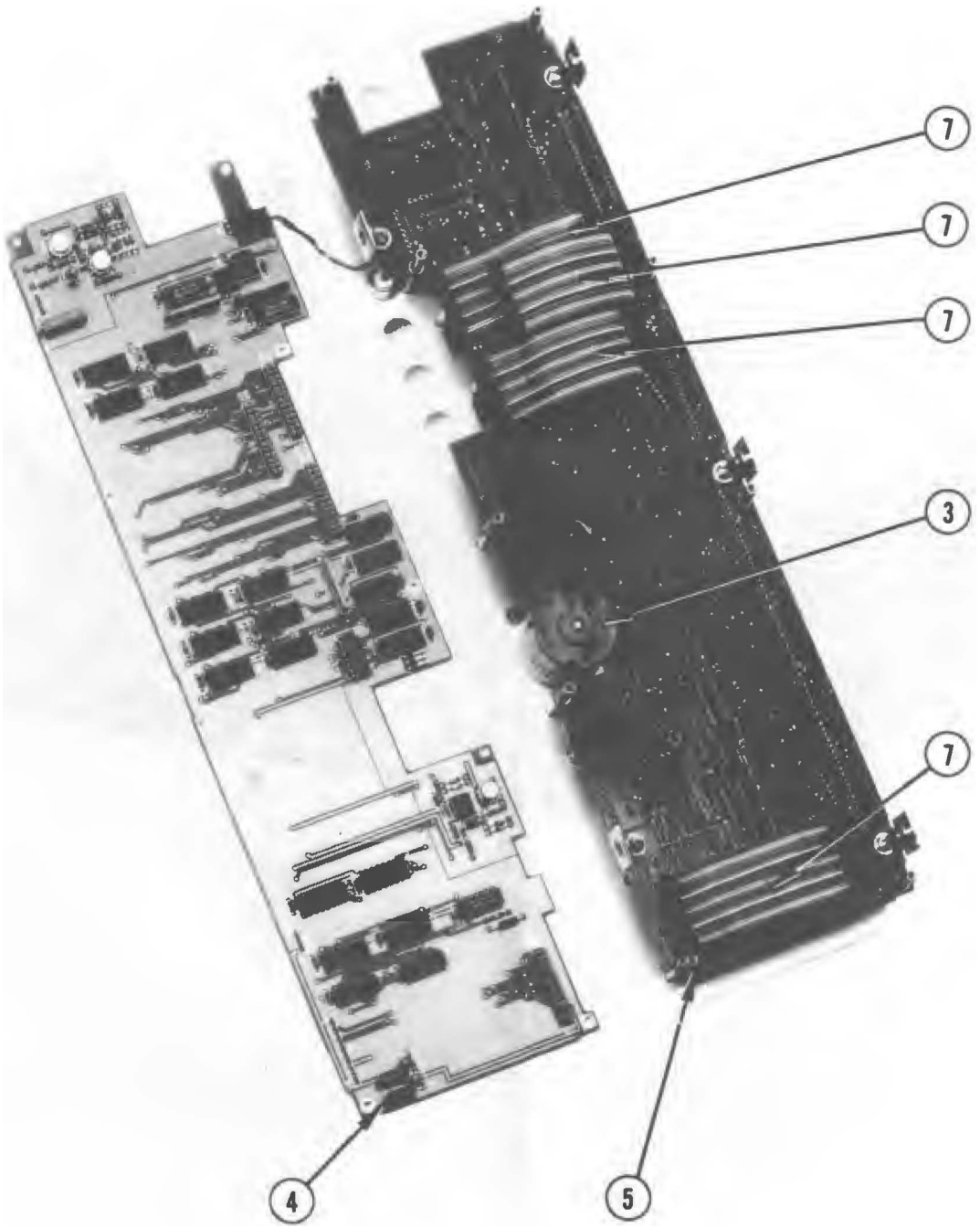


Figure 5-1. Top Assembly


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INDEX NO.	WPN	QTY	DESCRIPTION
1	790-265	9	STANDOFF,MALE/FEMALE
2	A31594	5	MOUNTING BRACKET
3	60-25	1	DC MOTOR
4	D31702-3	1	A2 PCB ASSY,FRONT PANEL
5	D31701-3	1	A1 PCB ASSY,FRONT PANEL
6	C31949	1	SUBPANEL PLATE ASSY
7	803-30	4	RIBBON CABLE

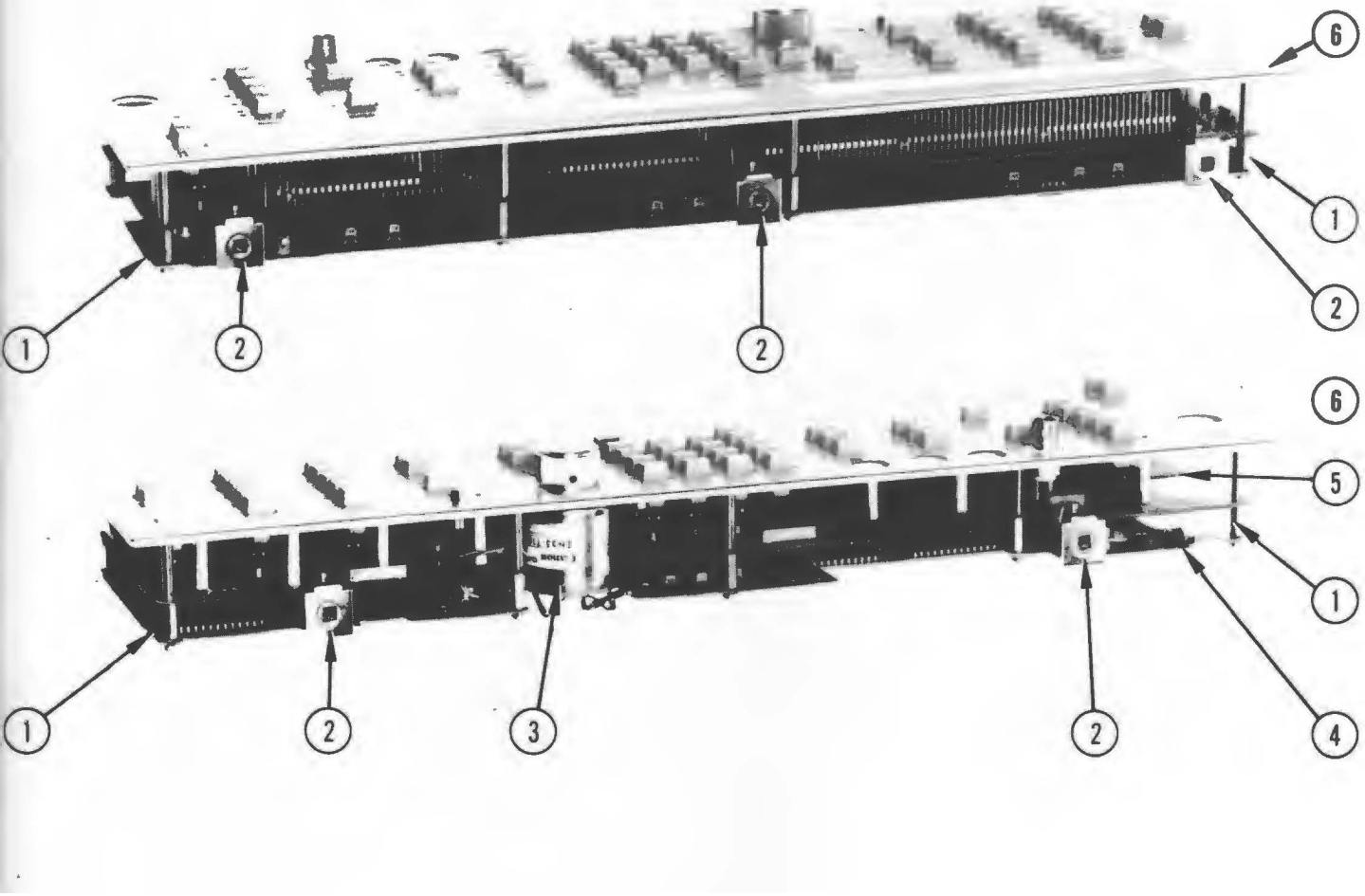


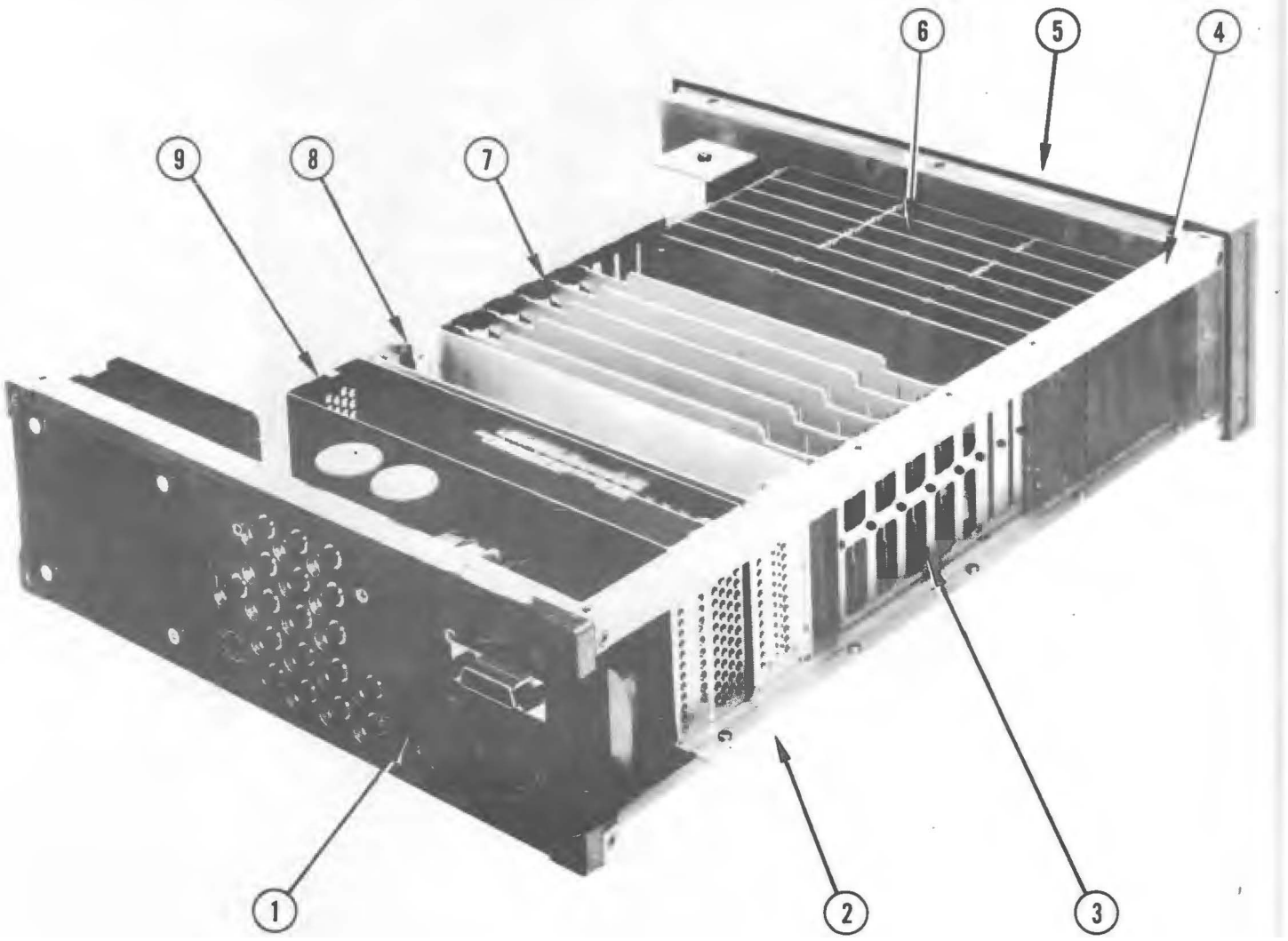
Figure 5-2. Front Panel Assembly

INDEX NO.	WPN	QTY	DESCRIPTION
1	D31849	1	REAR CASTING
2	B31600	1	EXTRUSION,LOWER LEFT
3	C31838	1	CARD CAGE BRACKET,LEFT
4	B31598	1	EXTRUSION,UPPER LEFT
5	D31938	1	FRONT CASTING
*	A31936	2	FILTERCON CABLE ASSY, 3-PIN
*	A31937	1	FILTERCON CABLE ASSY, 11-PIN
6	D31880	1	RF HOUSING
7	C31837	1	CARD CAGE BRACKET, RIGHT

INDEX NO.	WPN	QTY	DESCRIPTION
8	C31836	1	DIGITAL HOUSING
-	B31841	1	DIGITAL HOUSING COVER
9	C31835	1	POWER SUPPLY HOUSING
-	B31839	1	POWER SUPPLY HOUSING COVER
10	C31932	1	10 MHZ CRYSTAL OSC ASSY
11	B31641	1	CHASSIS MOUNT
12	D31549	1	6700 CHASSIS
**	260-14	4	FILTERCON ASSY, 3-PIN
**	260-15	9	FILTERCON ASSY, 11-PIN
13	A31834	1	PILLOW BLOCK ASSY

* The Filtercon Cable assemblies are attached to the Front Casting.

** The Filtercon assemblies are located between the A28 Motherboard connectors and the A3-A13 PCB connectors.



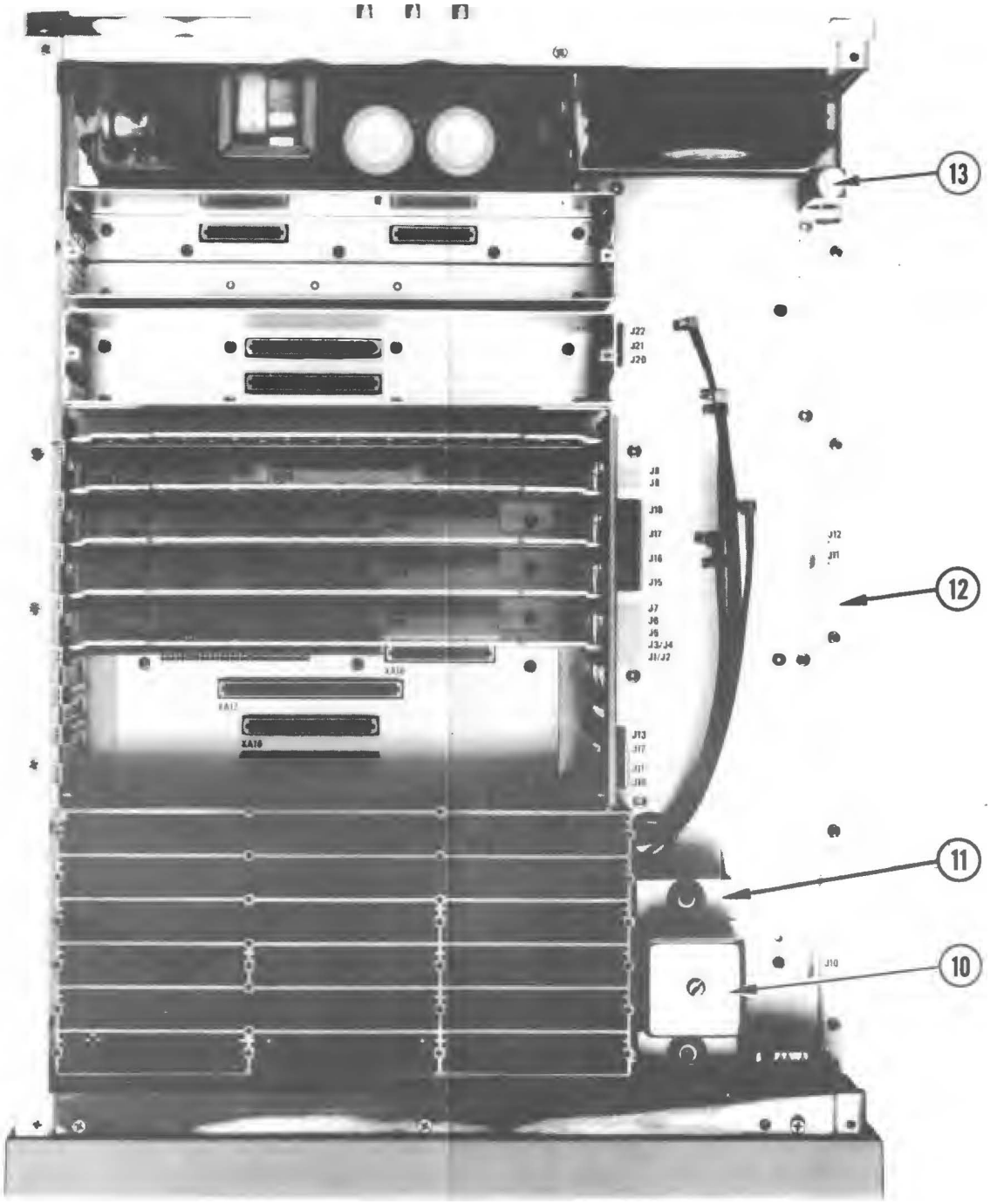


Figure 5-3. Basic Frame Assembly

INDEX NO.	WPN	QTY	DESCRIPTION
1	C31703-4	1	A3 PCB ASSY,COARSE LOOP MIXER
2	D31806-3	1	A6 PCB ASSY,COARSE LOOP DIVIDER
3	D31914-4	1	A4 PCB ASSY,COARSE LOOP OSC
4	C31709-3	1	A9 PCB ASSY,FINE LOOP OSC
5	D31805-3	1	A5 PCB ASSY,500 MHZ REF OSC
6	C31707-4	1	A7 PCB ASSY,REF DIVIDER
7	C31712-4	1	A12 PCB ASSY,YIG PHASE DETECTOR
8	D31925-3	1	A25 PCB ASSY,POWER SUPPLY
9	D31724-3	1	A24 PCB ASSY,GPIB
10	D31723-3	1	A23 PCB ASSY,MICROPROCESSOR
11	D31722-3	1	A22 PCB ASSY,REGULATOR
12	D31718-7	1	A21 PCB ASSY,YIG DRIVER,18-26.5 GHZ
13	D31718-6	1	A20 PCB ASSY,YIG DRIVER,13.25-20 GHZ
14	D31718-5	1	A19 PCB ASSY,YIG DRIVER,8-12.4 GHZ
15	D31718-9	1	A18 PCB ASSY,YIG DRIVER,2-8.4 GHZ
16	D31717-3	1	A17 PCB ASSY,ANALOG INSTRUCTION
17	D31716-5	1	A16 PCB ASSY,FM AMP
18	D31915-3	1	A15 PCB ASSY,ALC
19	B31585	1	COVER PLATE,A14,BLANK
20	D31913-3	1	A13 PCB ASSY
21	D31711-4	1	A11 PCB ASSY
22	D31708-3	1	A8 PCB ASSY

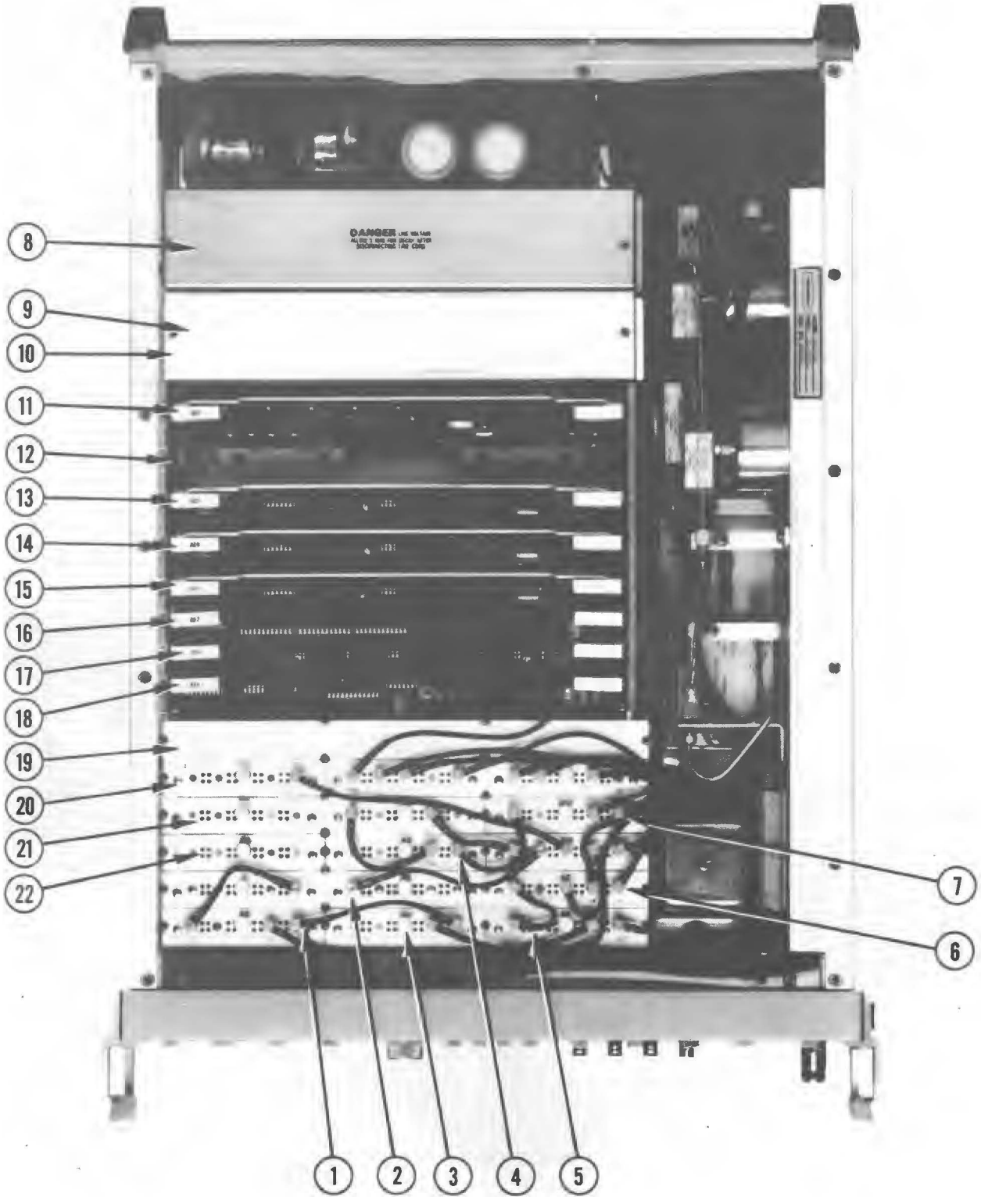


Figure 5-4. PCB Mechanical Assembly

NOTE: The A3 thru A13 PCBs are pull out assemblies with permanently attached cover plates and handles, as shown below. These PCBs reside in the RF housing.

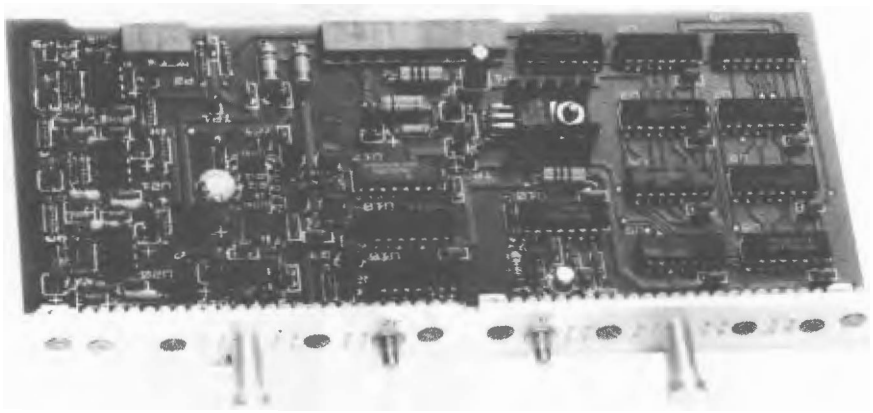


Figure 5-5. Pull Out PCBs

INDEX NO.	WPN	QTY	DESCRIPTION
1	A36026	18	CABLE ASSY,MCX TO MCX,SINGLE SHIELDED
-	A36026-27		SINGLE SHIELDED COAX,RG174,MCX TO MCX,A1372 TO A15J1
-	A36026-1		A3J1 TO A6J1,RG174,COAX
-	A36026-2		A3J2 TO A5J2
-	A36026-3		A3J3 TO A4J2
-	A36026-4		A4J1 TO POWER AMP IN
-	A36026-5		A5J1 TO A7J1
-	A36026-7		A6J2 TO A10J2
-	A36026-8		A7J3 TO A10J4
-	A36033		A7J5 TO CRYSTAL OSC
-	A36026-11		A9J1 TO A11J1
-	A36026-12		A9J2 TO A12J1
-	A36026-13		A10J1 TO A11J2
-	A36026-14		A10J3 TO A13J1
-	A36026-17		A12J4 TO SAMPLE I/F OUT
-	A36026-22		A13J6 TO 2-8 PULSE MOD
-	A36026-23		A13J7 TO 8-12 PULSE MOD
-	A36026-24		A13J8 TO 12-20 PULSE MOD
-	A36026-25		A13J9 TO 20-26 PULSE MOD
2	A36027	6	CABLE ASSY,BNC TO MCX,RG174,COAX,SINGLE SHIELDED
-	A36027-1		REAR PANEL 10 MHZ IN TO A7J4
-	A36027-2		REAR PANEL PULSE SYNC TO A13J5
-	A36027-3		REAR PANEL 10 MHZ OUT TO A10J5
-	A36027-4		REAR PANEL PULSE IN TO A13J4
-	A36027-5		REAR PANEL HIGH RES IN TO A12J2
-	A36027-6		FRONT PANEL PULSE IN TO A13J3
3	A36029	1	CABLE ASSY,SMA TO MCX,RG174,COAX,A5J3 TO DOWN CONVERTER IN

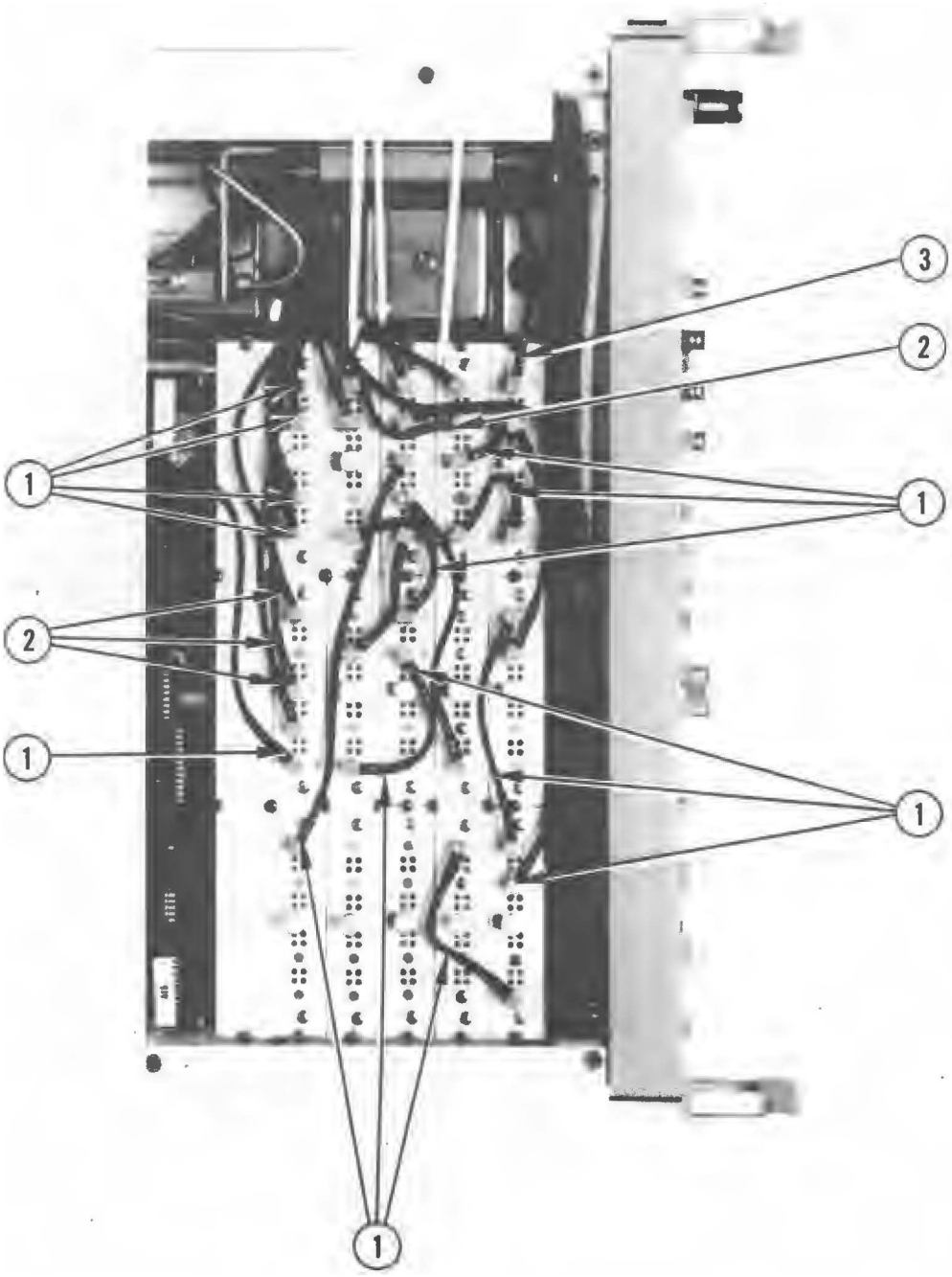


Figure 5-6. Cabling to Digital Housing

INDEX NO.	WPN	QTY	DESCRIPTION
1	D31828-3	1	A28 PCB,MOTHERBOARD
2	B31600	1	EXTRUSION,LOWER LEFT
3	B31584	1	SHIELD,HIGH VOLTAGE
4	A8138	2	LABEL,DANGER LINE VOLTAGE
5	B31646	1	SHIELD,CABLE
6	D31829-3	1	A29 PCB,REAR PANEL INTERFACE
7	B31601	1	EXTRUSION,LOWER RIGHT
8	A32075-1	1	CABLE ASSY, 2-CONDUCTOR,26 AWG

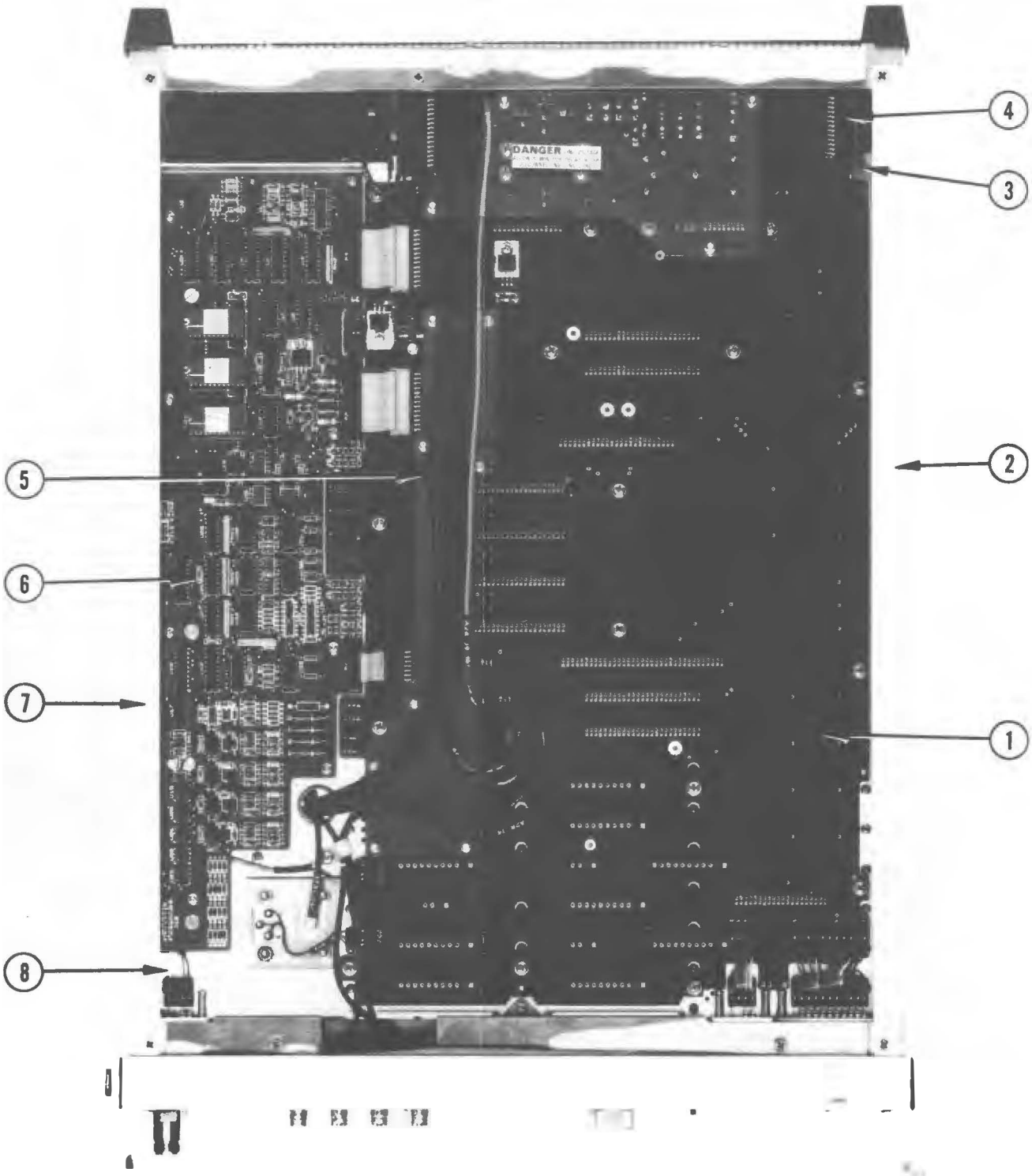
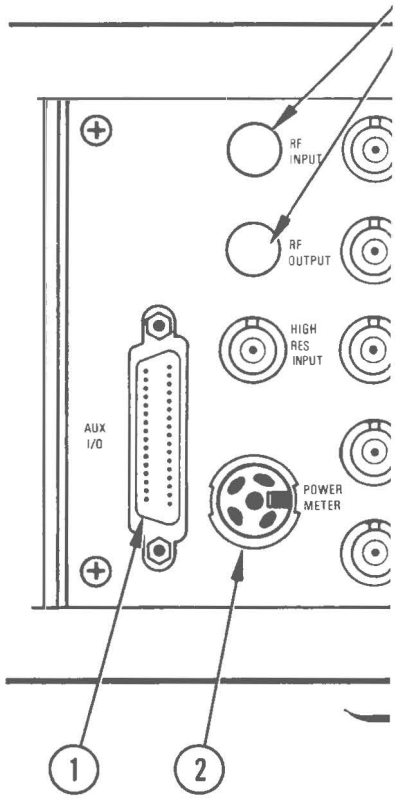


Figure 5-7. Basic Frame Assembly, Bottom View

INDEX NO.	WPN	QTY	DESCRIPTION
1	551-579	1	CONN,AUX I/O
2	B31926	1	CABLE ASSY,POWER METER
3	510-5	11	CONN,BNC FEMALE
4	D31849	1	REAR CASTING
5	A31928	1	CABLE ASSY,GPIB
6	553-248	2	FUSE HOLDER,3 AG
7	410-85	1	SWITCH,ROTARY,LINE SELECT
8	551-588	1	CONN ACCESSORY,MNTG HARDWARE
9	C31612	1	OVERLAY,REAR PANEL
10	790-193	4	NUT,THUMB
11	783-403	1	FILTER,FAN
12	785-882	4	STANDOFF,M/F
13	B31929	1	LINE TRANSFORMER
14	260-11	1	AC LINE CONN/EMI FILTER
15	B31597	1	BRACKET,CHASSIS SUP-PORT
16	B31571	1	HONEYCOMB,FAN
17	C31840-3	1	A27 PCB ASSY,AUX I/O
18	B31927	1	SUBASSEMBLY,FAN
19	A31931	1	CABLE ASSY,RIBBON,14-CONDUCTOR
20	785-610	1	STANDOFF,PLAIN
21	720-3/8	1	CABLE FASTENER,CLAMP
22	A36027-1	1	CABLE ASSY,BNC TO SMC
23	A36027-2	1	CABLE ASSY,BNC TO SMC
24	A36027-3	1	CABLE ASSY,BNC TO SMC
25	A36027-4	1	CABLE ASSY,BNC TO SMC
26	A36027-5	1	CABLE ASSY,BNC TO SMC
27	A32068-1	1	CABLE ASSY,BNC TO 3 PIN
28	A32068-2	1	CABLE ASSY,BNC TO 3 PIN
29	B31873	1	ASSY,SUPPORT,LINE FIL-TER (OR CAP)
30	D31726-2	1	A26 PCB ASSY,LINE FILTER
31	790-42	2	PLUGS,BUTTON



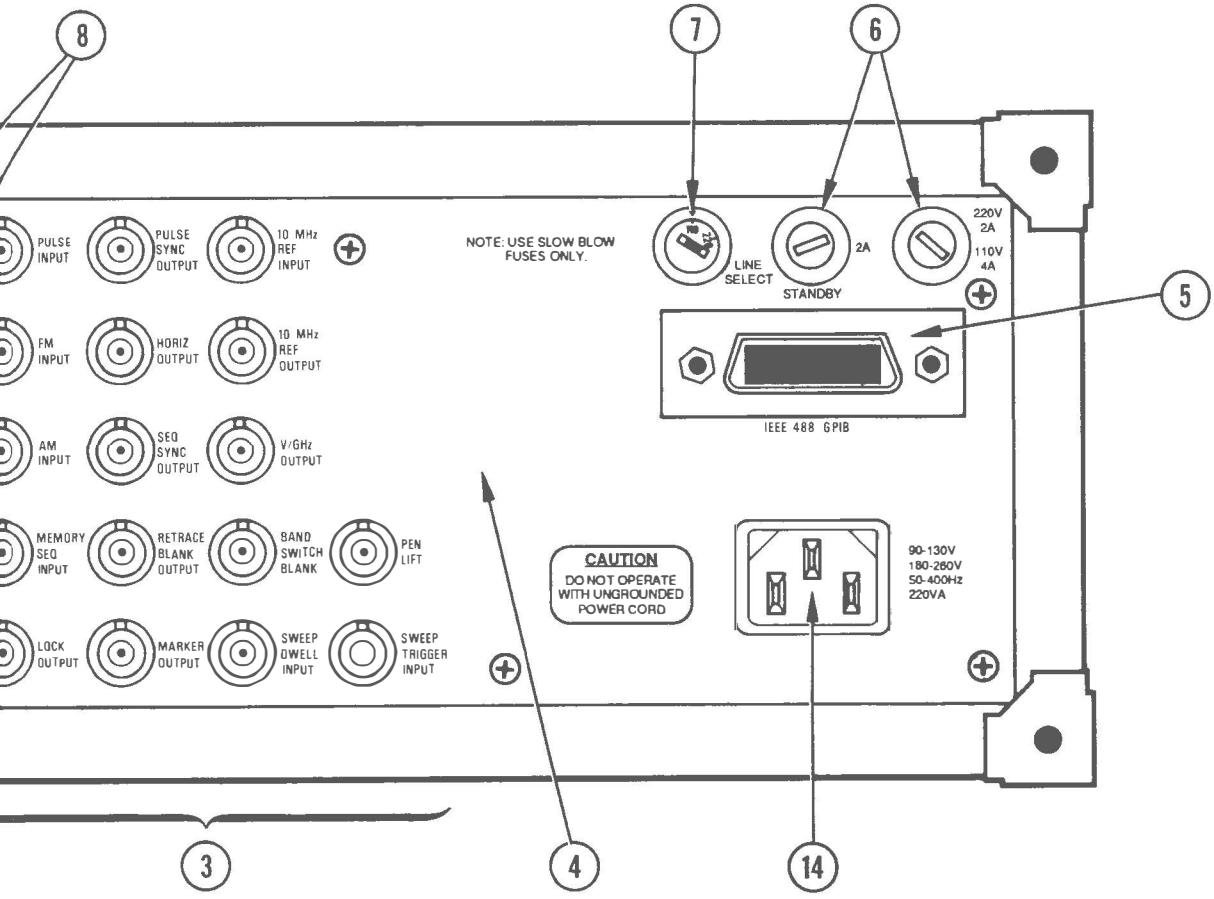
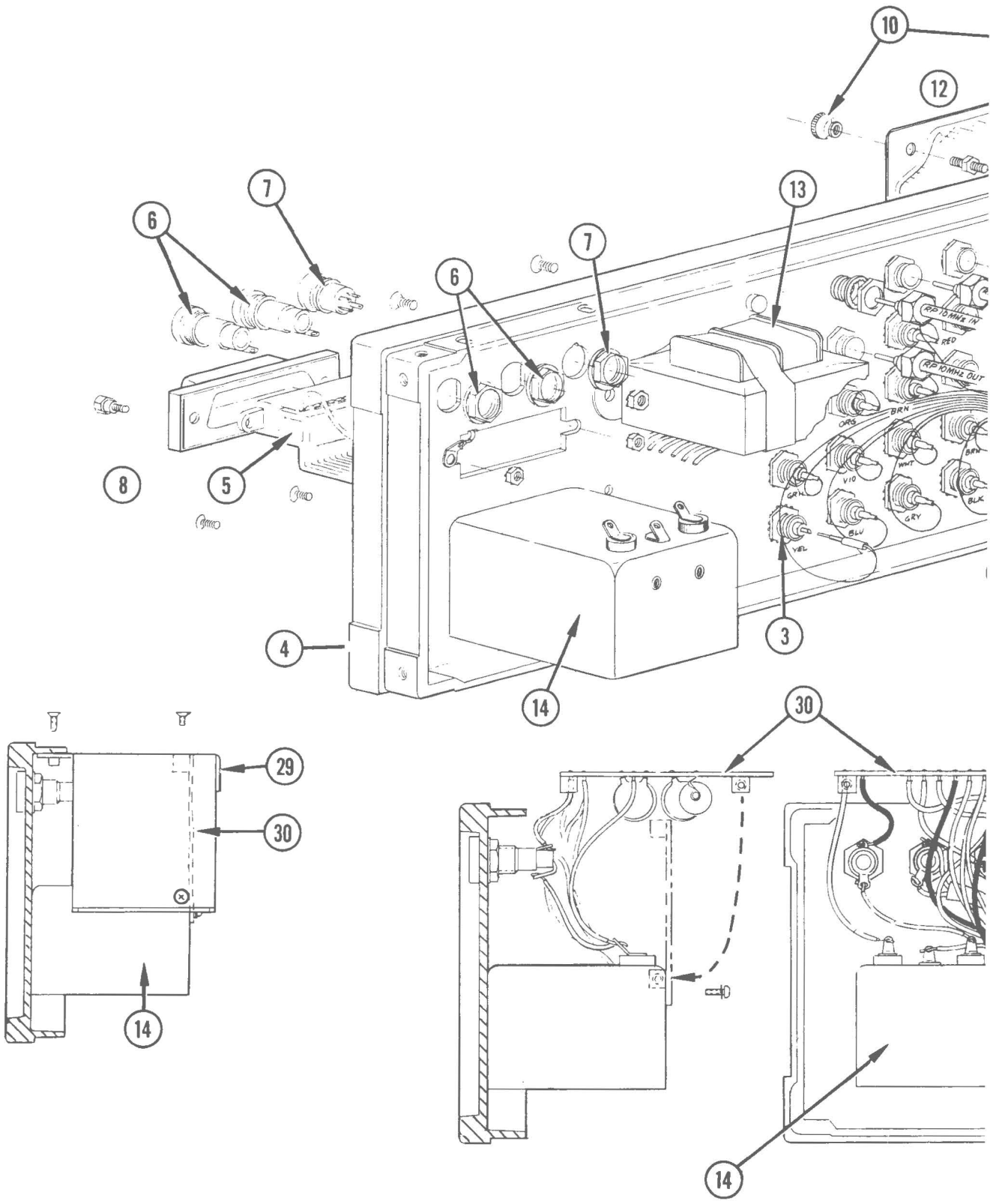


Figure 5-8. Rear Panel Assembly (1 of 2)


10
12
7
6
13
7
6
RP 10MHz IN
RED
RP 10MHz OUT
BRN
ORG
WHT
V10
GRN
BLK
GRY
BLU
YEL
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4
3
14
30
29
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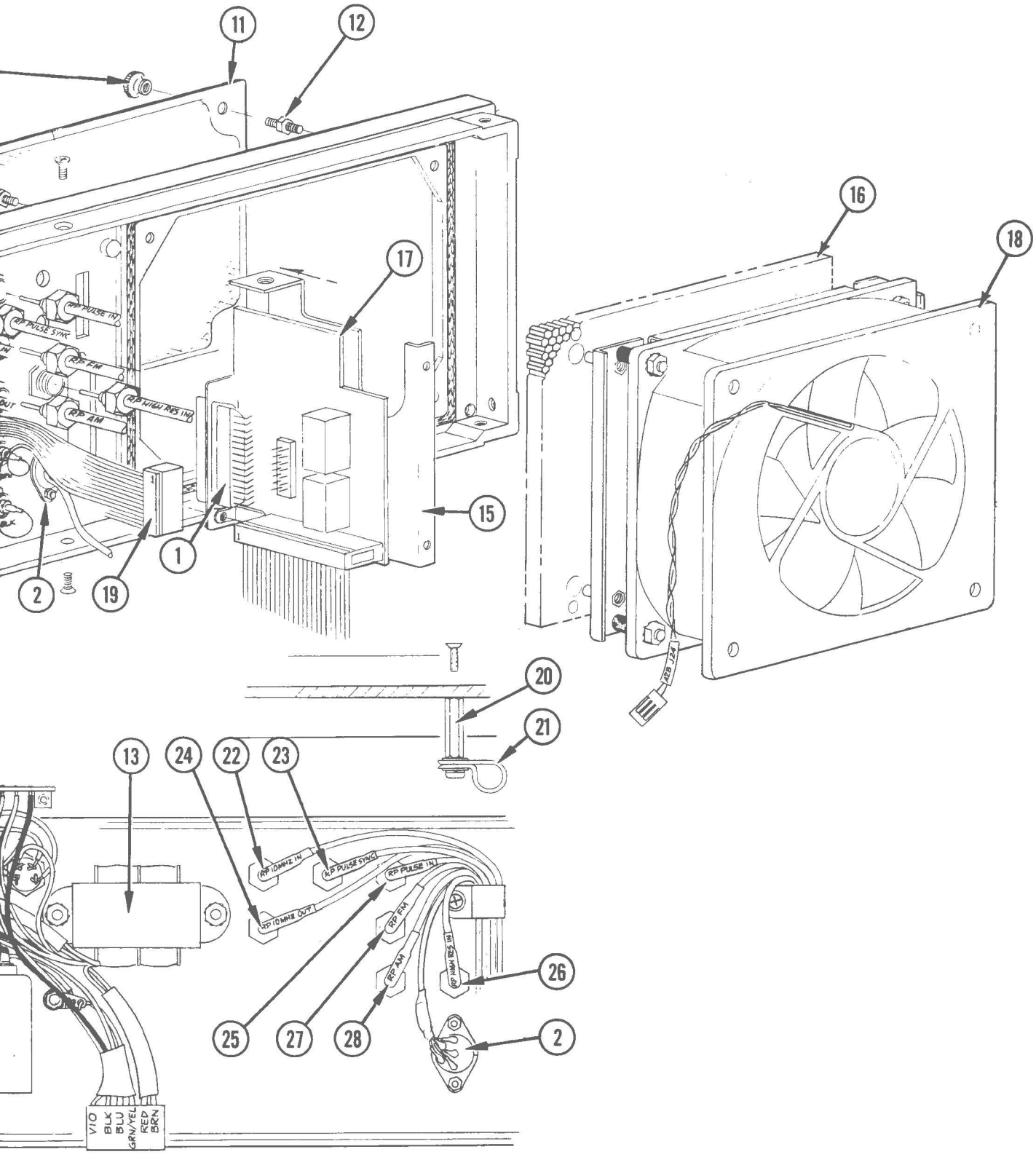
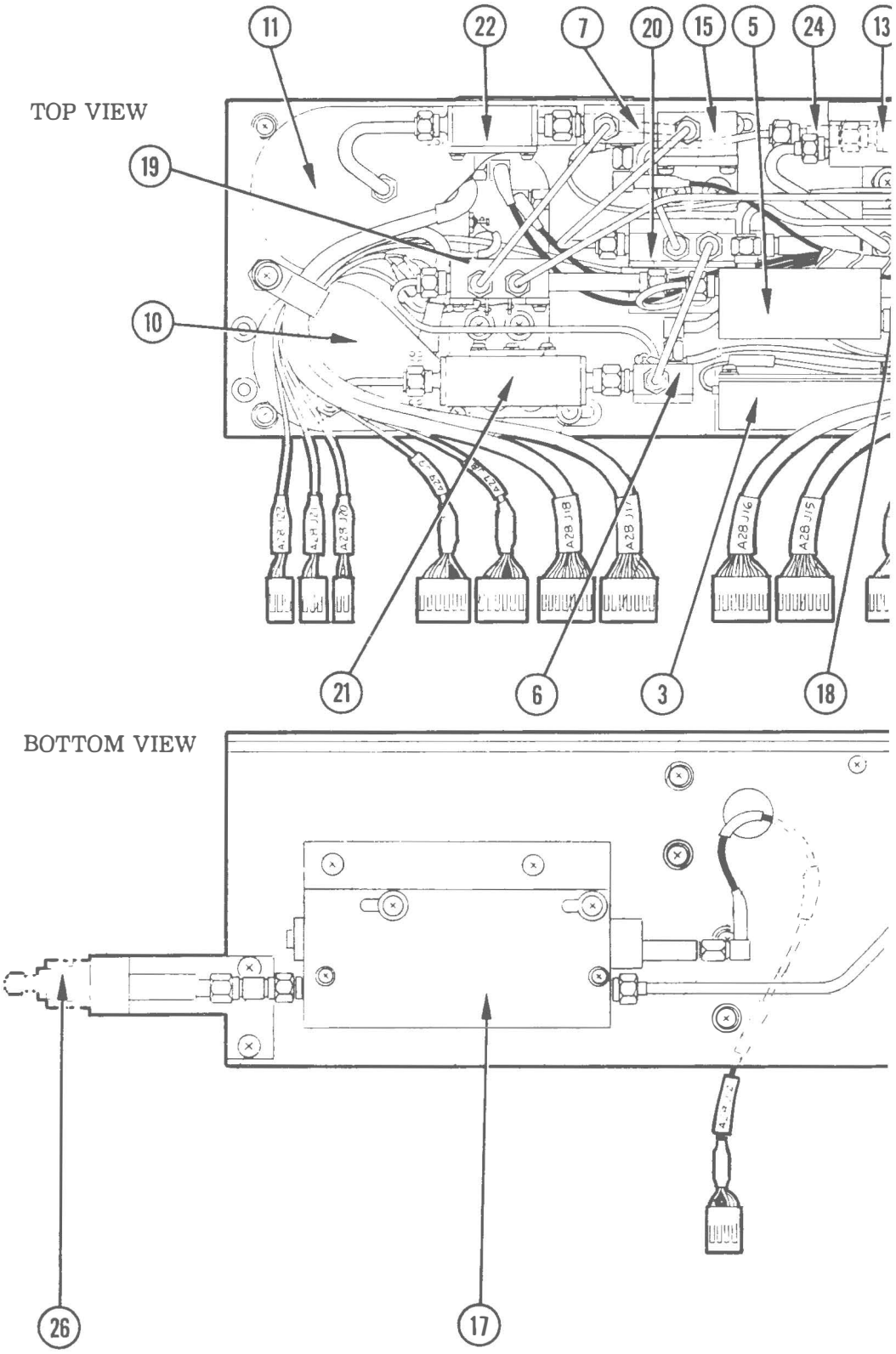


Figure 5-8. Rear Panel Assembly (2 of 2)

INDEX NO.	WPN	QTY	DESCRIPTION
1	C36025	1	A30 SAMPLER/IF AMP ASSY
2	B31867-1	1	A31 POWER AMP/MULT. ASSY
3	C31755-3	1	SWITCHING FILTER
4	B31996	1	LOW POWER DOWN CONVERTER ASSY
	ND36035	*	HIGH POWER DOWN CONVERTER ASSY
5	D19960	1	2 TO 8.4 GHz CONTROL MODULATOR
6	D19970	1	8 TO 12.4 GHz CONTROL MODULATOR
7	D19980	1	12.4 TO 20 GHz CONTROL MODULATOR
8	D19990	1	18 TO 26.5 GHz CONTROL MODULATOR
9	C31752-3	1	2 TO 8.4 GHz OSCILLATOR ASSY
10	C31751-3	1	8 TO 12.4 GHz OSCILLATOR ASSY
11	C31754-3	1	12.4 TO 20 GHz OSCILLATOR ASSY
12	C31753-3	1	18 TO 26.5 GHz OSCILLATOR ASSY
13	60-59	1	FREQUENCY DOUBLER/AMP/MOD
14	B21260	1	2 TO 8 GHz RF AMP
	C21270	*	2 TO 8.4 GHz RF AMP
	ND19072	*	8 TO 12.4 GHz RF AMP
15	B18730	1	12.4 TO 20 GHz RF AMP
16	C20552	1	18 TO 26.5 GHz RF AMP
	C18965	*	18 TO 26.5 GHz RF AMP
17	D21450	1	0.01 TO 20 GHz DIRECTIONAL COUPLER
	D21451	1	0.01 TO 26.5 GHz DIRECTIONAL COUPLER
	D21452	1	0.01 TO 40 GHz DIRECTIONAL COUPLER
18	D18630	1	SP4T,26.5 GHz,OUTPUT PIN SWITCH ASSY
	D19900	1	SP4T,40 GHz,OUTPUT PIN SWITCH ASSY
19	D18360	1	SP4T,26.5 GHz,SAMPLER PIN SWITCH ASSY
20	D22166	1	DPDT,PIN SWITCH ASSY
21	1000-39	1	8 TO 12.4 GHz DUAL ISOLATOR
22	1000-40	1	12.4 TO 20 GHz DUAL ISOLATOR
23	1000-41	1	18 TO 26.5 GHz DUAL ISOLATOR
24	43KA-6	1	ATTENUATOR,6 dB
25	43KA-10	1	ATTENUATOR,10 dB
26	ND34998	1	OUTPUT CONN ASSY, 20 GHz
	ND35898	1	OUTPUT CONN ASSY, 40 GHz
–	35WR28K	1	ADAPTER ASSY,MALE WAVEGUIDE
	250-39A	1	CAPACITOR,FXD,TANT, 4.7µF,20%
	K222	1	CONN,K FEMALE-K FEMALE
	B18476	**	LOW PASS FILTER,20 GHz
	B19614	**	LOW PASS FILTER,8.5 GHz
	B19623	**	LOW PASS FILTER,12.4 GHz
	B19626	**	LOW PASS FILTER,26.5 GHz
	B20257	**	LOW PASS FILTER W/DC,20 GHz
	B22646	**	LOW PASS FILTER,40 GHz
	C19130	**	VIDEO FILTER ASSY, 8 TO 26.5 GHz
	1040-15	**	FREQUENCY TRIPLER, 40 TO 60 GHz

* Used in models 67XXB-10, -20, and -40
** Used in singleband models

Figure 5-9. Microwave Deck Assembly, Top and Bottom View (1 of 2)


TOP VIEW
11
22
7
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15
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18
BOTTOM VIEW
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17

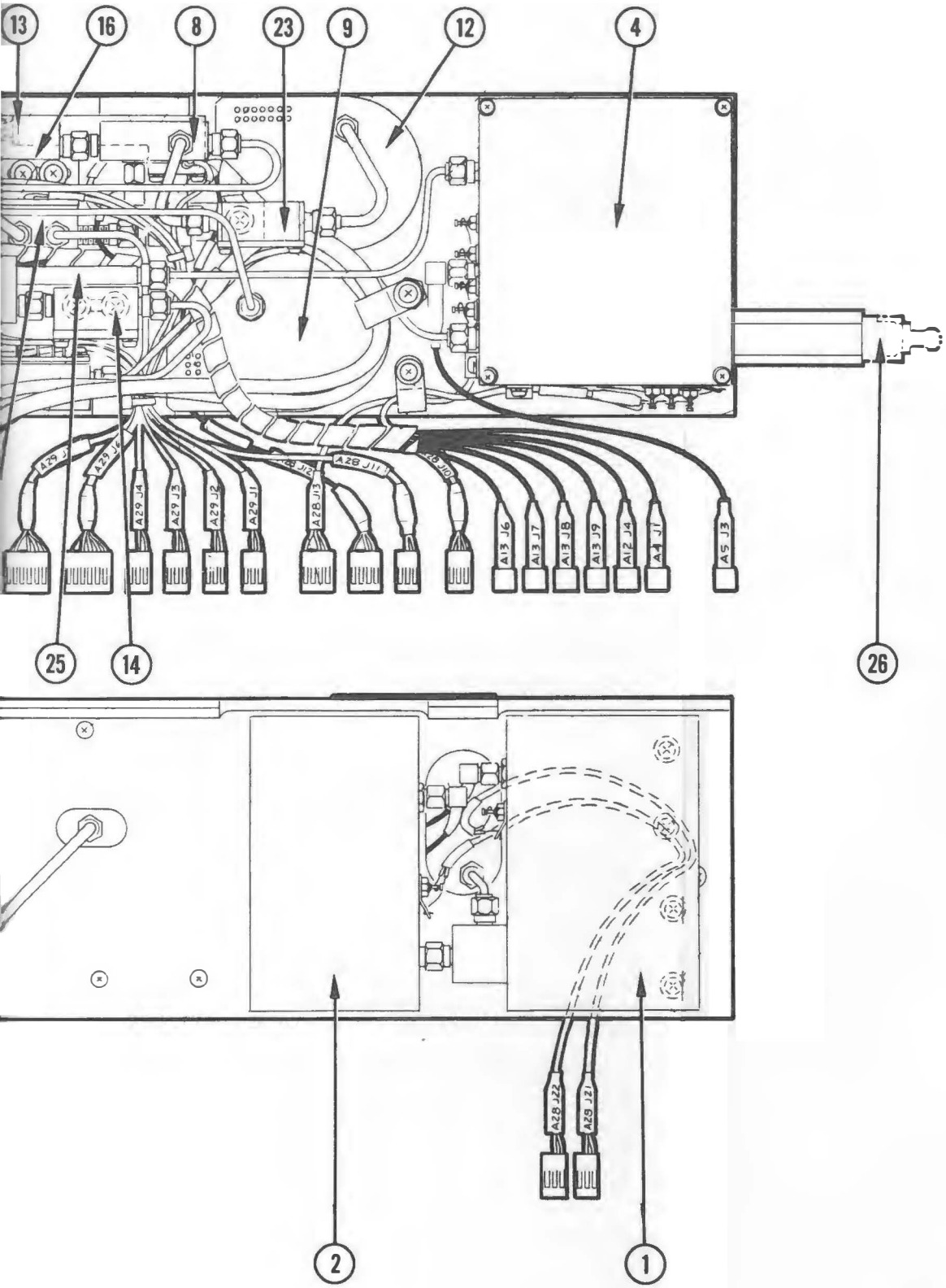


Figure 5-9. Microwave Deck Assembly, Top and Bottom View