SERVICE MANUAL

VIKING® VX
900 MHz LTR-Net®
75W-160W Repeater

Part No. 242-2009-632/634

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VIKING® VX
900 MHz LTR-Net REPEATER
PART NO. 242-2009-632/634

Transcrypt International, Inc. designs and manufactures two-way radio equipment to serve a wide variety of communications needs. Transcrypt International Inc. produces EFJohnson® brand equipment for the mobile telephone and land mobile radio services which include business, industrial, government, public safety, and personal users.

LAND MOBILE PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from your product supplier or from the Transcrypt International, Inc., 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. Phone (507) 835-6222.

WARNING

DO NOT allow the antenna to touch or come in very close proximity with the eyes, face, or any exposed body parts while the radio is transmitting.

DO NOT operate the transmitter of a mobile radio whena person outside the vehicle is within one (1) meter of the antenna.

DO NOT operate the transmitter of a stationary radio (base station, repeater or marine radio) when a person is within one (1) meter of the antenna.

DO NOT operate the radio in explosive or flammable atmospheres. The transmitted radio energy could trigger blasting caps or cause an explosion.

DO NOT operate the radio without the proper antenna installed.

DO NOT allow children to operate or play with this equipment.

NOTE: The above warning list is not intended to include all hazards that may be encountered when using this radio.

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by Transcrypt International, Inc. could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

SAFETY INFORMATION

Proper operation of this radio will result in user exposure below the Occupational Safety and Health Act and Federal Communication Commission limits.

The information in this document is subject to change without notice.

Transcrypt International Inc. will not be liable for any misunderstanding due to misinformation or errors found in this document.

TABLE OF CONTENTS (CONT'D)

1 INTRODUCTION AND OPERATION

1 INSTALLATION

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

10 SCHEMATICS AND COMPONENT LAYOUTS

TABLE OF CONTENTS (CONT'D)

LIST OF FIGURES

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

TABLE OF CONTENTS (CONT'D)

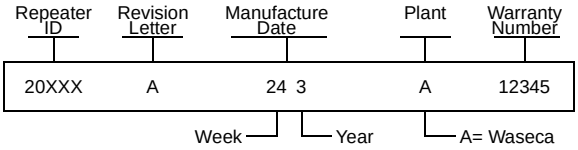
SECTION 1 INTRODUCTION AND OPERATION

1.1 SCOPE OF MANUAL

This service manual provides installation, operation, programming, service, and alignment information for the VIKING® VX LTR-Net® Repeater, Part No. 242-2009-632/634.

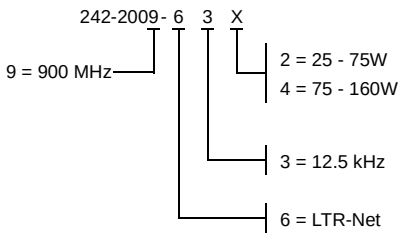
1.2 REPEATER IDENTIFICATION

The repeater identification number is printed on a label that is affixed to the inside of the repeater cabinet. The following information is contained in that number:



1.3 MODEL NUMBER BREAKDOWN

The following breakdown shows the part number scheme used for the Viking VX.



1.4 REPEATER DESCRIPTION

The VIKING VX 900 MHz repeater is designed for operation in a LTR-Net and LTR system. It operates on the 900 MHz channels from 935-940 MHz (repeater transmit). The repeater receive frequencies are 39 MHz below these frequencies (896-901 MHz). Channel spacing is 12.5 kHz and RF power output is adjustable from 25 to 75 watts (Part No. 242-2009-632) or 75-160W (Part No. 242-2009-634) with the high power amplifier.

This repeater is modular in design for ease of service. There are separate assemblies for the logic cards, receiver, exciter, power amplifier and power supply sections.

This repeater is programmed with a laptop or personal computer using the repeater software, Part No. 023-9998-459.

When the repeaters are installed in an environment that contains small airborne particles, e.g. grain dust or salt fog, the repeater cabinets need to be sealed. A heat exchanger, i.e. air conditioner, is then required to cool the cabinets. The air conditioners must be suited for the environment. Each low power repeater (75W) requires >1200 BTU/hr dissipation to maintain exterior cabinet temperature. Each high power (160W or 175W) requires >2100 BTU/hr dissipation to maintain exterior cabinet temperature.

1.4.1 TRUNKED SYSTEM

A trunked radio system, as defined by the FCC, is a "method of operation in which a number of radio frequency pairs are assigned to radios and base stations in the system for use as a trunk group". Trunking is the pooling of radio channels where all users have automatic access to all channels reducing waiting time and increasing channel capacity for a given quality of service.

Trunking concepts are based on the theory that individual subscribers use the system a small percentage of the time and that a large number of subscribers will not try to use the system at the exact same time.

1.4.2 LTR-NET TRUNKED SYSTEM

LTR-Net repeater operation is automatic and is similar to a LTR repeater in which a logic module performs the call functions and communicates over-the-air to subscriber units. There must be one repeater for each RF channel and each repeater contains a logic module responsible for signaling on its own channel. Logic modules then share information with all other repeaters in the system via inter-repeater communication.

System control is accomplished by the exchange of data messages between radio and repeater. The LTR-Net system trunks up to 20 channels by utilizing continuous subaudible digital data applied to the RF carrier simultaneously with voice modulation. Therefore, no dedicated control channel is required and all channels are used for voice communications for maximum system efficiency. Each radio is assigned a Home Channel which sends system commands to specified radios. There are normal words and special function words. The special function words are used to initiate special calls; Telephone, Unique ID, and Data by Unique ID. The special function words are also used for command calls: Interrogate, Kill, Reassign, Electronic Serial number Authentication, Registration, De-Registration, etc.

Since each repeater is responsible for signaling on its own channel, this approach lends itself well to a distributed processing logic controlled approach requiring only a small logic unit within each repeater. These processors share information over a communication path. This architecture permits each repeater to be autonomous. A failure in one repeater leaves the remainder of the system intact and operational.

The repeaters may be connected to a larger system. This allows the system to perform some of the previously mentioned calls. The Switch may communicate from one LTR-Net Locality to another. The system equipment may be centrally located or distributed at each Locality. A Locality is a set of repeaters that are interconnected to pool the channels in a trunked channel group.

1.5 LTR-Net SIGNALING

The repeater covered by this manual utilizes LTR-Net signaling. This signaling provides advanced features such as 65504 Unique ID codes, five levels of access priority, home channel backup, and over-the-air mobile reprogramming. LTR-Net signaling and repeater control is provided by the Main Processor Card. The repeater connects to the 3000 Series Switch using a phone line or some other type of link. The Switch provides overall system control (see Sections 1.14 and 5 for more information on LTR-Net equipment and features).

1.6 ACCESSORIES

The accessories available for the Viking VX LTR repeater are listed in Table 1-1. A brief description of some of these accessories follows.

Table 1-1 VIKING VX REPEATER ACCESSORIES

Accessory	Part No.
2000 Series Service Kit[1]	250-2000-230
Battery Back-Up Option[2]	023-2000-835
Reference Oscillator Splitter Shelf[3]	023-2000-924
Reference Oscillator Adapter Kit[4]	023-2000-923
Redundant OCXO	561-0006-012
Companding Module	023-2000-940
2’ RG-58 BNC M-M HSDB cable	023-4406-505
6’ RG-58 BNC M-M HSDB cable	597-3001-214
Custom Frequency Programming & Setup	023-2000-100
PC Programmer PGMR Software	023-9998-459
Service Microphone	589-0015-011
50 ohm Termination HSDB	023-4406-504
Telewave Combining Systems	
5-channel 115V AC[6]	585-1163-115
5-channel 230V AC[6]	585-1163-125
10-channel 115V AC[7]	585-1163-110
10-channel 230V AC[7]	585-1163-120
Duplexer (High Power Only)	585-1157-101
RF Lightning Protector	
Type-N Lightning Arrestor	585-0898-001
Polyphaser™	585-0898-005
Floor Mount 19” Open Rack***	
7’ with accessories[5], setup and test	023-2000-216
7’ 6” with accessories[5], setup and test	023-2000-217
8’ with accessories[5], setup and test	023-2000-218
AC Power Distribution	
AC Power Strip 115V AC (1 per 2 rptrs)	597-1004-010
AC Power Stirp 230V AC (1 per 2 rptrs)	023-2000-212

[1] Includes: extender card, extender cables, TIC bias cable and programming cable.
[2] +26V DC input with cable.
[3] Required for more than eight channels.
[4] Interface to existing systems.
[5] Accessories include all mounting hardware, rack ground bar and wire to repeaters.
[6] These systems use two antennas and one additional rack (combining rack is included).
[7] These systems use three antennas and two additional racks (combining rack is included).

2000 Series Service Kit- This kit includes an extender card, extender cables, TIC bias cable and programming cable. These items are used when tuning the repeater and while troubleshooting.

Battery Backup Option - It includes the +26V DC battery backup module that resides in the power supply and the necessary interconnect cabling to connect the repeater to the batteries (see Section 1.5).

1:8 Splitter Shelf - This increases the number of outputs from an OCXO drawer (see Figure 1.12).

Reference Oscillator Adapter Kit - The kit is installed in the 1:8 Splitter Shelf. The attenuator is used in 2009 repeater systems when only one OCXO drawer is available.

Redundant OCXO - The OCXO (Oven Controlled Crystal Oscillator) drawer produces a stable 1.25 MHz (±0.1 PPM) reference signal for the Receiver and Exciter synthesizers.

Companding Module - This enhances the receive and transmit audio when used in conjunction with the Telephone Interface Card (TIC).

Two Foot Cable - This is a 2' RG-58 coax cable with BNC male connectors for the HSDB (High Speed Data Bus).

Six Foot Cable - This is a 6' RG-58 coax cable with BNC male connectors for the HSDB (High Speed Data Bus).

Custom Frequency - This is a factory frequency programming and repeater setup.

PGMR 2000 Programming Software - 3.5" programming disk used to program the repeater.

Service Microphone - This is a speaker and microphone combination that plugs into the MAC connectors. The microphone provides local audio and push-to-talk, while the speaker provides local audio adjusted with the volume control.

1.7 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the

Warranty Department
Transcrypt International, Inc.
299 Johnson Avenue,
Box 1249,
Waseca, MN 56093- 0514

This information may also be requested by phone from the Warranty Department as described in Section 1.2. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6222.

1.8 FACTORY CUSTOMER SERVICE

The Customer Service Department of the E.F. Johnson Company provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular Customer Service hours are 7:30 a.m. - 5:30 p.m. Central Time, Monday - Friday. The Customer Service Department can be reached using one of the following telephone numbers:

Toll-Free: (800) 328-3911
(From within continental United States only)

International: (507) 835-6911

FAX: (507) 835-6969

E-Mail: First Initial/Last Name@transcrypt.com
(You need to know the name of the person you want to reach. Example: dthompson@transcrypt.com)

NOTE: Emergency 24-hour technical support is also available at the 800 and preceding numbers during off hours, holidays, and weekends.

When your call is answered at E.F. Johnson Company, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist

you. When you enter some numbers, another number is requested to further categorize the type of information you need.

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

Transcrypt International, Inc.
Customer Service Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.9 FACTORY RETURNS

Repair service is normally available through local authorized E.F. Johnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Customer Service Department before returning equipment because a service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary.

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling the repair lab (see Section 1.2) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Then include a form in the shipping container with each unit. Your telephone number and contact name are important because there are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order and it makes it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. RA numbers are required for exchange units or if the Field Service Department wants to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

1.10 REPLACEMENT PARTS

E.F. Johnson replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number as described in Section 1.2. When ordering, please supply the part number and quantity of each part ordered. E.F. Johnson dealers also need to give their account number. If there is uncertainty about the part number, include the designator (C112, for example) and the model number of the equipment the part is from.

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.2.

E.F. Johnson Company
Service Parts Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.11 INTERNET HOME PAGE

The E.F. Johnson Company has a home page on the World Wide Web that can be accessed for information on such things as products, systems, and regulations. The address is http://www.transcrypt.com.

1.12 SOFTWARE UPDATES/REVISIONS

All inquiries concerning updated software, its installation and revisions should be directed to the Customer Service Department (see Section 1.2).

1.13 REPEATER OPERATION

1.13.1 MAIN PROCESSOR CARD (MPC)

Refer to Figure 1-2.

- Programming Jack

J1 provides input connection from the computer and the "flash memory" in the MPC. The programming information in an IBM® PC programs the MPC directly from the serial card through an interconnect cable to the COM1 or COM2 port.

- Reset

S1 provides a manual reset of the Main Processor Card (MPC). A manual reset causes a complete power-up restart.

- Display and LEDs

Each combination of DS1 display read-out and CR4/CR3 indication refers to an active alarm. See Table 1-2 for alarms and definitions. LED indications: CR1 blinking; MPC is operational, CR2 on; high power, off is low power and CR5 on; indicates an LTR Repeater.

1.13.2 TEST MODE

When the Repeater is in Test mode the safety measures are disabled. Therefore, if the Repeater is keyed for an extended period and the power amplifier temperature increase, thermal shutdown will not occur. There are pop-up windows that appear in the Test mode screens to alert the user that there is an alarm and action should be taken.

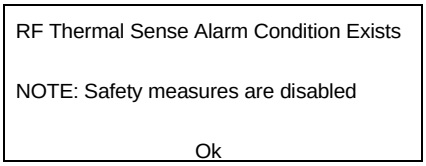


Figure 1-1 ALARM IN TEST MODE

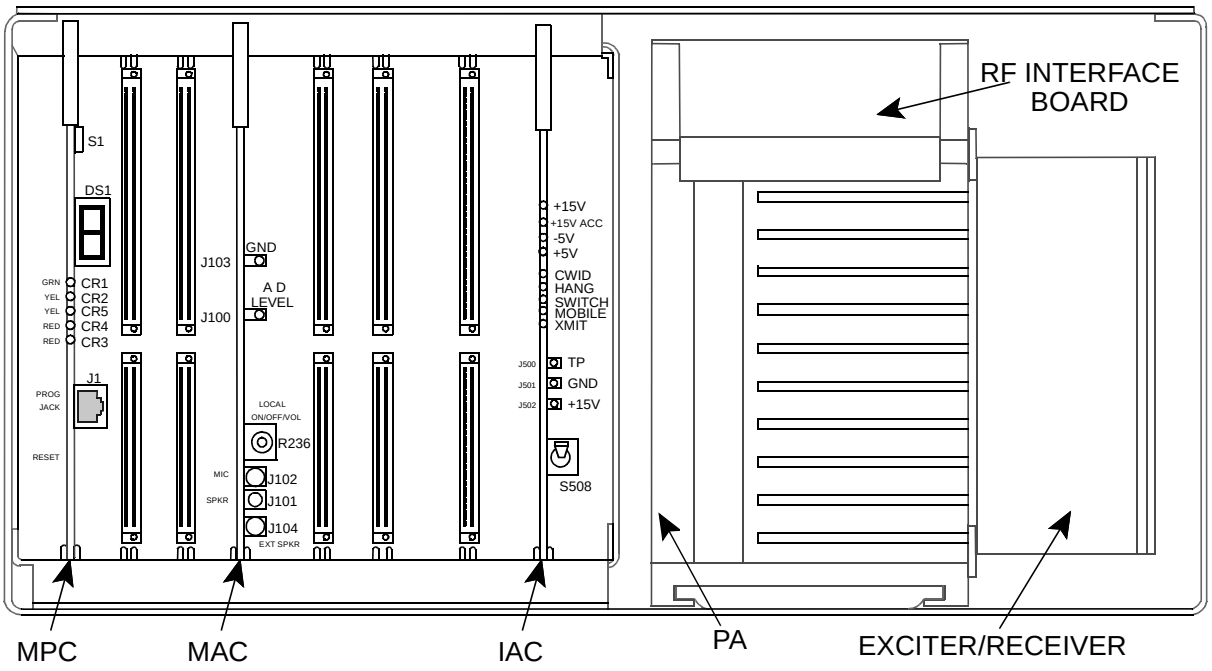


Figure 1-2 REPEATER CARDS

Table 1-2 ACTIVE REPEATER ALARMS

Alarm No.	DS1	CR3	CR4	Definition
0	0	Off	On	Test Mode
1	1	Off	On	IAC input 1 Active
2	2	Off	On	IAC input 2 Active
3	3	Off	On	IAC input 3 Active
4	4	Off	On	IAC input 4 Active
5	5	Off	On	IAC input 5 Active
6	6	Off	On	IAC input 6 Active
7	7	Off	On	IAC input 7 Active
8	8	Off	On	IAC input 8 Active
9	9	Off	On	MAC Processor Alarm
10	A	Off	On	HSDB Processor/Cable Alarm
11	B	Off	On	IRDB Cable Alarm
13	D	Off	On	TIC Processor Alarm
15	F	Off	On	VNC Alarm
16	0	On	Off	AC Power Failure
17	1	On	Off	Battery Power Failure
18	2	On	Off	Power supply thermal sense
19	3	On	Off	Fan 1 current out of specification
20	4	On	Off	Fan 2 current out of specification
21	5	On	Off	IAC mismatch
32	0	On	On	RF shutdown
33	1	On	On	RF Half Power Mode
34	2	On	On	Thermal sense in RF portion
35	3	On	On	RF Finals 1-2 power out failure
36	4	On	On	RF Finals 3-4 power out failure
37	5	On	On	RF VSWR Failure
38	6	On	On	Normal Synthesizer Tx Lock failure
39	7	On	On	Normal Synthesizer Rx Lock failure
40	8	On	On	HS Synthesizer Tx Lock failure
41	9	On	On	HS Synthesizer Rx Lock failure
42	A	On	On	RF Quarter Power Alarm

1.13.3 MAIN AUDIO CARD (MAC)

Refer to Figure 1-2.

- External Speaker Jack

J104 provides repeater audio output to an external speaker. The local volume control adjusts the volume level of this speaker.

- Speaker/Microphone Jacks

J102 provides audio input from a microphone. J101 provides the receive audio to the microphone.

- Local On/Off/Volume Control

R236 provides control of the receive audio output to J101 and J104. Turning this control clockwise past the detente applies voltage to the local audio amplifier.

- A D Level Test Point

J100 provides audio/data level output for test level checks.

- Ground

J103 is connected to ground for test equipment when monitoring test point J100.

1.13.4 INTERFACE ALARM CARD (IAC)

Refer to Figure 1-2.

- Voltage Test Output

J502 provides a +15V test point on the IAC.

- Ground

J501 is connected to ground for test equipment when monitoring voltage test point J502.

- A D Level Test Point

J500 provides a test point to monitor audio and data levels, AC fail and thermal sensor.

- Power Supply On/Off Switch

S508 turns the power supply DC voltages on and off from the IAC in the front of the repeater.

- Power Indicator

CR501 indicates the +5V supply is at normal level and applied to the IAC. CR524 indicates -5V supply is at normal level and applied to the IAC. CR523 indicates the +15V accessory supply is at normal level. CR525 indicates that the +15V supply is at normal level and applied to the IAC.

- CWID Indicator

This indicates that the CW Identification is being transmitted on the lowest-frequency repeater. The CWID is a continuous-wave (CW) transmission of the station call letters in Morse Code to satisfy the station identification requirement. The CWID is programmed into the repeater memory. This indicator also is used when an alarm is transmitted with Morse code.

- Hang Indicator

This indicates that the hang word is being transmitted by the repeater. This word is transmitted on calls in which the channel is held for the duration of the call and not just for the duration of the transmission. The hang word tells the mobiles to stay on the same channel and not re-access the system when responding to a call.

- Switch Call Indicator

The Switch Call Indicator on the IAC shows that a Switch-To-Mobile transmission is in progress (see Figure 7-30.)

- Mobile Call Indicator

Mobile-to-repeater transmission in progress is indicated by the Mobile Call Indicator.

- Xmit Indicator

This indicates that the repeater transmitter is keyed by the logic.

1.13.5 POWER SUPPLY

The 2000 Series Repeater Power Supply is a quad output 800W supply with power factor correction. A battery back-up module, PN 023-2000-830, can be added to the power supply to provide automatic battery revert in the event of AC power failure (see Section 1.4) The Battery Back-Up module charges the batteries when AC is present at the power supply (see Section 1.5 and 8.6).

1.14 LTR-Net SYSTEM COMPONENTS

1.14.1 INTRODUCTION

The main components in a LTR-Net system are shown in Figure 1-3. An LTR-Net system can be designed to meet the requirements of almost any user. The following are LTR-Net features.

- With LTR-Net signaling, advanced features such as up to 65504 Unique ID codes, automatic mobile identification, home channel backup, and five levels of access priority are available.

- Users of different types of radio equipment can talk to each other.
  Example: a Conventional mobile channel could talk to a mobile operating on a LTR-Net (trunked) 900 MHz channel.

- Wide area radio coverage can be provided so that a mobile could talk to another mobile that is using a repeater that may be hundreds of miles away. That repeater may be part of the same LTR-Net system or another LTR-Net system. Phone line or other types of links can be used to provide the communication path.

LTR-Net systems are not restricted to a specific type of signaling. Example: an entire LTR-Net system could be designed using Conventional channels which use tone- or digitally-controlled squelch. The various types of signaling can also be mixed in a system.

Example: There could be:

10-channels using LTR-Net signaling
5-channels using LTR® signaling
5-channels using Conventional signaling

Check with your Johnson representative for more information concerning the capabilities of LTR-Net systems.

The following sections provide a brief description of the LTR-Net components see Figure 1-3.

1.14.2 MOBILE TRANSCEIVERS

The mobile and handheld transceivers used in a LTR-Net system must be compatible with the type of signaling in use and also the frequency range.

LTR-Net transceivers can be programmed for LTR and Conventional operation. However, some LTR transceivers can only be programmed for LTR and Conventional operation. The main difference between LTR-Net and LTR only versions of the same model is the software in the microprocessor.

1.14.3 REPEATERS

NOTE: The Summit QX does not require a separate LTR-Net logic drawer.

The repeater model used in a LTR-Net system is determined by frequency range, 900 MHz use the Summit QX 2009 repeaters. There is one repeater for each RF channel.

Inter-Repeater Data Communication

Data communication between LTR-Net or LTR repeaters is via a high-speed data bus. This bus cable is installed in a daisy-chain manner between repeaters. If both LTR-Net and LTR repeaters are located at a Locality, only like types are connected together. Up to 20 LTR-Net or 20 LTR repeaters can be interconnected (see Section 1.9 for connecting the data bus).

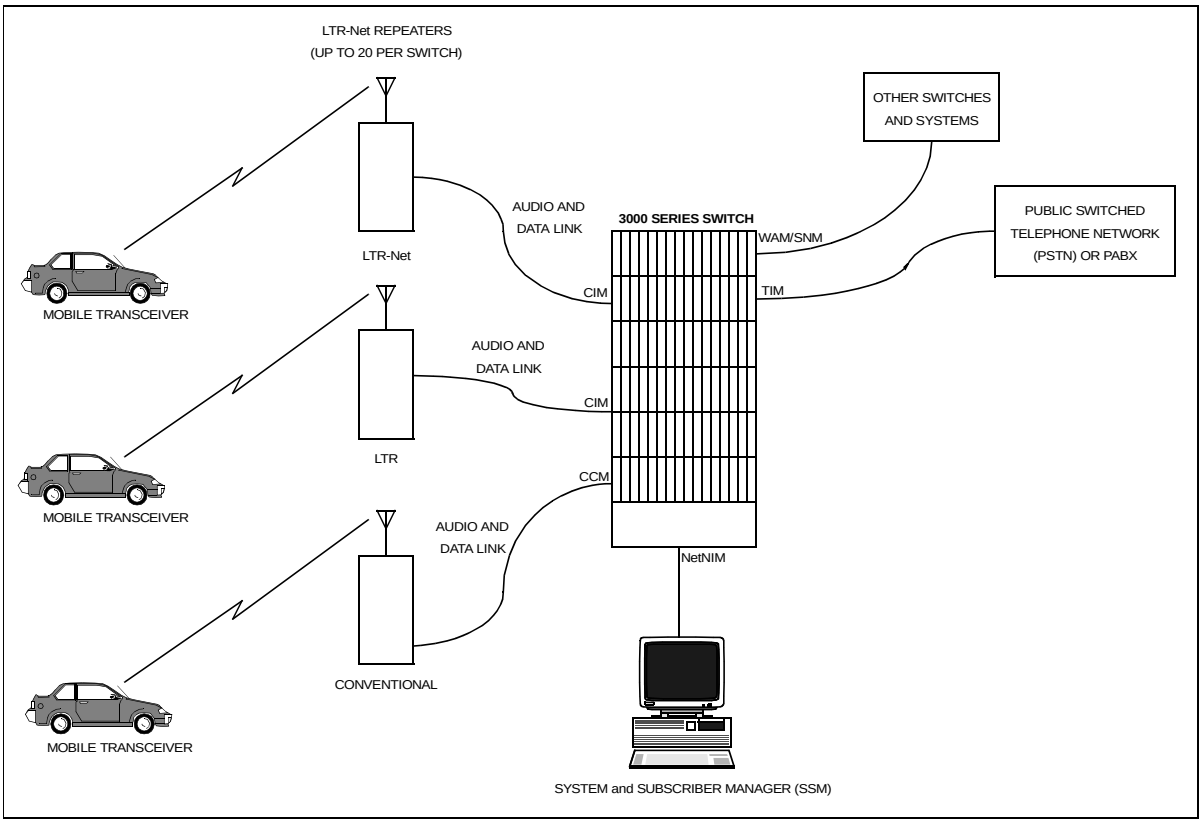


Figure 1-3 LTR-Net SYSTEM COMPONENTS

Repeater Connection To Switch

The repeaters can be located at the same Locality as the Switch or they may be located at a Locality that is many miles from the Switch. A voice and data link is required between the repeaters and Switch. This link can be a direct connection, phone lines, microwave, RF transceiver, fiber optic, or some other type of link. This link is connected to the repeater terminal block on the back of the repeater.

The voice link routes transceiver voice to and from the Switch. The voice must be routed to the Switch when a call involves a dispatcher, telephone interconnect, or another RF channel or LTR-Net system. If the call is a mobile-to-mobile call on the same RF channel, the voice is simply repeated by the repeater (it is also routed to the Switch but is not connected to anything). The voice path input/output port interfaces with a standard 4-wire, 600 ohm phone line.

The data link allows the Switch to control the repeater. With mobile-to-repeater calls, the data fed to the Switch is used to determine what routing is required for the call. On Switch-to-mobile calls, the data fed to the repeater allows the Switch to operate the repeater like a base station.

There are three different types of links that can be selected for the data path between each repeater and the Switch. The MPC is programmed for the type of link used (see Section 1.11).

- A 4-Wire voice-grade link can be used that is similar to the audio link. The data is then sent as tones using FSK modulation.
- RS-232 serial inputs and outputs are available for direct connection or connection to a link that accepts RS-232 data.
- Data can be modulated as in '1' and then sent over the voice path using a Blank and Burst technique. Only one 4-wire link is then needed between each repeater and the Switch.

1.14.4 SWITCH

The Switch can connect several different forms of communication together to form a communication network that requires the Call Processor. It has up to six shelves with 12 or 16 device slots each (72 or 96 slots available) and up to three racks (for 216 or 288 slots). Many different modules are available to complete the network. Some modules have specific device slot requirements.

1.14.5 CALL PROCESSOR AND SYSTEM AND SUBSCRIBER MANAGER

The Call Processor, along with the System and Subscriber Manager, controls the LTR-Net System. The Call Processor (CP) is an IBM® PC or compatible computer that is running the EFJohnson management program. The System and Subscriber Manager software is used by the System Administrator to program, control and continuously monitor Switch operation, and provides logging of information for billing purposes.

The System and Subscriber Manager (SSM) is a program that executes on an IBM PC or compatible computer. The function of the SSM is to manage the database information that the Call Processor uses in its operation. The SSM has the capability to generate reports from the logged information of the CP. The SSM also has the ability to setup and initiate such activities as Dynamic Reprogramming of certain mobile parameters (Group 11), disabling (Kill) of lost or stolen mobiles and many other functions.

1.14.6 LOCALITY

A Locality is the location where one or more repeaters are housed. Trunked system repeaters are connected to the same high-speed data bus and are required to be located close together. LTR-Net can have a maximum of 20 repeaters at a Locality. One CIM (Channel Interface Module) is required for each LTR-Net repeater. A CCM (Conventional Channel Module) is required for a conventional channel.

1.14.7 HOME REPEATER CHANNEL

All LTR-Net mobiles have one of the Locality repeaters assigned as their "Home Repeater". This repeater handles the data and audio unless a failure causes the Status Repeater to take over. The Group ID calls use the Home Repeater number in identifying the mobiles (see Section 1.15.3).

1.14.8 STATUS REPEATER CHANNEL

The Status Repeater Channel is one repeater at a Locality designated to transmit update information for all calls occurring at that Locality. The Status repeater is a "Home Repeater" backup usually not assigned voice traffic.

1.14.9 MONITOR REPEATER CHANNEL

This is the repeater channel that a mobile is currently monitoring for update messages. This repeater may be either the mobile's Home Repeater or the Locality Status Repeater. A special algorithm is used by the mobile to determine which is to be monitored. Generally, it is the last repeater that a valid data message was detected on.

1.14.10 HOME CHANNEL ALIASING

The LTR-Net Home Channel Aliasing feature increases the number of addresses available on a Locality for Group calls. It does this by allowing calls to be programmed on non-exisent Home repeaters.

Each Home repeater can be programmed with 1-239 Group ID codes. Assume a Locality has four active repeaters and one of these is the Status repeater (that is normally not assigned as a Home repeater). The number of calls that can be programmed are then as follows:

Without Aliasing - 3 x 239 or 717 calls
With Aliasing - 20 x 239 or 4780 calls

When a call is placed on a non-existent Home repeater, the subscriber unit automatically uses the next lower numbered active repeater.

NOTE: Since this feature does not increase system capacity, adding too many users may result in unsatisfactory operation due to frequency busy conditions.

1.14.11 TELEPHONE INTERCONNECT AND DATA TRANSMISSION

Mobile transceivers can be used to access the PSTN (Public Switched Telephone Network). However, this interconnect operation must be on a secondary basis to dispatch operation. An exception is when the trunked system or channel is assigned exclusively to one user.

Mobiles may place telephone calls through the PSTN (Public Switch Telephone Network) or a PABX (Private Automatic Branch Exchange) using the Interconnect special call. When the Call Processor detects a mobile placing an interconnect call, it checks to see if it is authorized that service determined by the System and Subscriber Manager and what type of call it is making. If it is authorized, the Switch completes the connection through the TIM (Telephone Interface Module) to the telephone network. The Call Processor performs the record keeping needed for billing.

Data transmission and paging are also allowed on these frequencies. It also must be secondary to voice communication. Refer to applicable FCC rules and regulations for more information.

1.14.12 PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

If interconnect calls are to be placed by mobiles or landside users to mobiles, the Switch is connected to the PSTN (Public Switched Telephone Network). The specific mobiles which can place calls and other interconnect parameters are determined by how the System Manager programs the System and Subscriber Manager/Call Processor and by the programming of each mobile transceiver.

1.14.13 PRIVATE AUTOMATIC BRANCH EXCHANGE (PABX)

The system has the ability to connect to a PABX or PBX. This allows mobile originated calls to use the dial access codes and the least cost routing facility of the PABX/PBX.

1.14.14 PULSE CODE MODULATION (PCM)

PCM typically runs on the voice buses at 2.048 MHz. The Switch provides 32-Time Slots for sending of audio.

1.15 LTR-Net FEATURES

1.15.1 STANDARD AND SPECIAL CALLS

There are two types of calls with LTR-Net signaling; Standard Calls and Special Calls. Group ID codes 1-239 are Standard (dispatch) calls, and Group ID codes 240-247 are Special Calls.

As previously stated, up to 239 Group ID codes are assignable on each Home repeater. When a transceiver monitors its Home or Status repeater, it receives data messages containing a Home repeater number, Group ID, and Unique ID code (refer to Section 1.15.2). When it detects its Home repeater and a Group ID from 1-239 that it is programmed to decode, it unsquelches and the call is received. The correct Unique ID code does not need to be detected to receive a Standard Call. Standard Calls are limited to other transceivers assigned to the same Home repeater. However, each selectable system of a transceiver can be programmed with a different Home repeater to allow calls to mobiles assigned to other Home repeaters if desired.

If a Group ID from 240-247 is received, a Special Call is indicated and the transceiver will respond according to the type of call. Special calls are used to perform many of the special LTR-Net features described in this section. Examples of Special Calls are calls to a specific transceiver (Unique ID), Group (Directed Group) or Telephone Interconnect. Others are Interrogate, Interconnect, and Transceiver Disable. Generally, a transceiver must decode its Unique ID code to respond to a Special Call.

1.15.2 UNIQUE ID CODES

Each transceiver is programmed with a Unique ID code in addition to Group ID codes. Unique ID codes are assigned on a system-wide basis, not on a repeater basis as with Group IDs. Up to 65504 Unique ID codes can be assigned per Switch.

Whenever a transceiver makes a call, it always transmits its Unique ID in addition to a Group ID. Any control point equipped with a decoder and display capable of listening to that transceiver can then display the ID of that unit. This provides automatic identification of transceivers making calls.

Unique IDs also permit individual mobile units to be called using the special calls described in the preceding section. Calls can also be made to individual transceivers using standard call Group IDs 1-239 if an ID is assigned to only one transceiver.

1.15.3 GROUP IDENTIFICATION CALLS

The Group ID (1-239) is assigned to each LTR-Net Home Repeater. A "standard" Group ID call is accepted by a mobile if its Home Repeater and Group ID are in the data message. A "special" calls are Telephone Interconnect calls, UID calls and Directed Group calls (Auxiliary calls). Telephone Interconnect Calls are assigned a Token Group ID (240-247) assigned by the repeater upon request from a mobile. Telephone Interconnect calls, Unique ID calls and Directed Group Calls all require the System and Subscriber Manager/Call Processor to provide authorization.

1.15.4 ALARM FORWARDING TO SWITCH

Repeater alarms are routed to the CIB (Channel Interface Bus) to be detected by the Call Processor and the System and Subscriber Manager.

SPECIFICATIONS

GENERAL[1]

Frequency Range	896-901 MHz Receive, 935-940 MHz Transmit
Dimensions	9.125 H x 17" W x 20.9" D
AC Voltage/Frequency	100-240V AC/50-60 Hz
AC Current (at 117V AC)	0.40A (Standby), 1.8A (25W), 3.3A (75W), 5.8A (160W)
AC Input Power	47W (Standby), 211W (25W), 390W (75W), 680W (160W)
DC Current at 26.5V DC	6A (25W), 11A (75W), 22.5A (160W)
Number of Channels	1 (Synthesized, programmable)
Channel Spacing	12.5 kHz
Channel Resolution	12.5 kHz
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Duty Cycle	Continuous
FCC Type Acceptance	ATH2422009, ATH2422009-1
FCC Compliance	Parts 15, 90

RECEIVER

12 dB SINAD	0.35 µV
20 dB Quieting	0.50 µV
Signal Displacement Bandwidth	±3 kHz
Adjacent Channel Rejection	-75 dB
Intermodulation Rejection	-75 dB
Spurious & Image Rejection	-90 dB
Audio Squelch Sensitivity	12 dB SINAD
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 3% at 0.5W/16 ohms
Local Audio Power	0.5W/16 ohms
Audio Sensitivity	±750 Hz
Hum & Noise Ratio	-45 dB
Frequency Spread	5 MHz
Frequency Stability	±0.1 PPM -30°C to +60°C (-22°F to +140°F)

TRANSMITTER

RF Power Output	Low Power = 75W min (default setting) 25W (variable set point) High Power = 160W min (default setting) 75W (variable set point)
Spurious Emissions	-90 dBc
Harmonic Emissions	-90 dBc
Audio Deviation	±1.6 kHz
LTR Data Deviation	±750 Hz
CWID Deviation	±1 kHz
Repeat Deviation	±800 Hz
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 2%
Hum & Noise (TIA)	-45 dB
Frequency Spread	5 MHz
Frequency Stability	±0.1 PPM -30°C to +60°C (-22°F to +140°F)
Emission Designators	11K0F3E, 11K0F1D

1. These general specifications are intended for reference and are subject to change without notice. Contact the Systems Applications consultants for guaranteed or additional specifications.

2000 OCXO DRAWER

Size	1.75” high, 17” wide, 14” deep (19” rack mount, 1 rack unit height)
Weight	8 pounds
Shipping Weight	9 pounds
Operational Temperature Range	-30°C to +60°C (-22°F to +140°F)
AC Voltage/Frequency	115V AC ±15% 50/60 Hz
DC Voltage (w/2 oscillators)	0.2A (115V AC) or 0.1A (230V AC)
DC Voltage (optiona external supply)	15V DC ±15%
DC Current (w/2 oscillators)	< 1A DC at initial turn on < 0.7A DC after warm-up
Frequency	10 MHz
Reference Signal Outputs	8 - 1.25 MHz outputs
External 10 MHz Signal Input Level	2V P-P minimum (high impendance input)
Output Amplitude	0 dBm ±1 dB (1.25 MHz outputs) 10 dBm ±1 dB (10 MHz output)
Overall Oscillator Output Stability	0.1 PPM
Oscillator Temperature Stability	0.03 PPM (-40°C to +70°C (-40°F to +158°F)
Oscillator Aging	1 E-9/Day
Oscillator Tuning Range (Mechanical)	Range for 10 years aging adjustable to 0.01 PPM nominal
Single Sideband Noise/Hz	-105 dBc at 10 Hz -135 dBc at 100 Hz -150 dBc at 10 kHz
Current handling capability of alarm relay outputs	2A

SECTION 2 INSTALLATION

2.1 INTRODUCTION

Information in this section tells how to set up the repeater for operation in an LTR-Net system. It is assumed that the repeater has been previously aligned at the factory or as described in the alignment procedure in Section 7.

Even though each repeater is thoroughly aligned and tested at the factory, it is good practice to check performance before it is placed in service. This ensures that no damage occurred during shipment and that the repeater is otherwise operating properly. Performance testing is described in Sections 7.2, 7.3, 7.4 and 7.5.

2.1.1 SITE PREPARATION AND ANTENNA INSTALLATION

Site preparation and antenna installation are not within the scope of this manual. Basic installation requirements are discussed in the "Dealer Guide To Site Preparation", Part No. 004-8000-100. Factory installation is also available. Contact your Johnson representative for more information.

2.2 ENVIRONMENT

The following conditions should be considered when selecting a site for the Repeater.

Operating Temperature

-30°C to +60°C (-22°F to +140°F).

Humidity

Less than 95% relative humidity at 50°C.

Air Quality

For equipment operating in a controlled environment with the Repeaters rack mounted, the airborne particles must not exceed 30 $\mu g/m^3$.

For equipment operating in an uncontrolled environment with the Repeaters rack mounted, the airborne particles must not exceed 100 $\mu g/m^3$.

NOTE: If the Repeater is installed in an area that exceeds these environmental conditions, the site should be equipped with air filters to remove dust and dirt that could cause the equipment to overheat.

2.3 VENTILATION

The RF modules and the power supply are equipped with fans, controlled by thermostats, that force air through the equipment for cooling. The air flow is from the front to the back of the equipment. This permits the Repeaters to be stacked or rack mounted (see Figure 2-3). There are a few considerations when installing Repeaters to provide adequate air circulation.

- The Repeaters should be mounted with a minimum of 6 inches clearance between the front or back of the cabinet for air flow. The power supply requires a minimum of 18 inches at the back of the Repeater for removal.

NOTE: Repeaters should not touch. Leave a minimum of one empty screw hole (approximately 1/2") between repeaters vertically, especially for bottom ventilation slots in high power repeaters.

- Cabinet enclosures must provide air vents for adequate air circulation.

- Temperature and humidity must be considered when several Repeaters are installed at a site. This might require air conditioning the site.

2.4 AC POWER

The AC power source to the Viking VX Repeater can be 120V AC or 240V AC. Nothing need be done to the power supply for 240V AC operation. However, a 240V AC outlet requires that the 120V AC power plug be replaced. A locking AC power cord is provided for the supply.

The 120V AC cord is a standard 3-wire grounded cord used with a standard AC wall outlet. The outlet must be capable of supplying a maximum of 328W (-632) or 680W (-634). With the nominal 120V AC input, the source must supply 3A for each 75W

repeater or 6A for each 160W repeater and should be protected by a circuit breaker. It is recommended that all of the repeaters in a rack should not be on the same breaker in order to provide one operational repeater in the event a breaker trips. An AC surge protector is recommended for all equipment.

Each Repeater requires an outlet, the receiver multicoupler and OCXO drawer require one each, so for a 5-channel system a minimum of 8 outlets are required. An additional three should be added for test equipment. The outlets must be within 3 feet of each Repeater cabinet. Future system expansion should be considered when electrical work is being planned for the initial system.

The Viking VX Repeater power supply can be equipped with an optional 24V DC back-up in the event of AC power failure. Since the transmitter remains on full power, if desired, the DC power source must have a current capability of about 15A per 75W repeater (25A per 160W repeater) or 75A for 5-75W repeaters (125A for 5-160W repeaters). The multicoupler requires 0.5A and the OCXO drawer requires 1A for a total system requirement at 24V DC of 76.5A for 75W repeaters (126.5A for 160W repeaters).

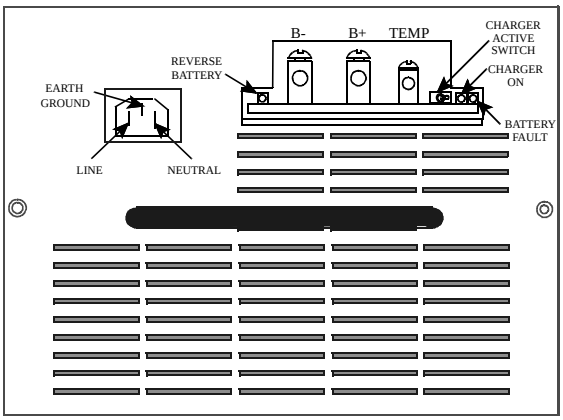


Figure 2-1 BATTERY BACKUP CONNECTOR

2.5 BATTERY BACKUP

If the power supply is equipped with battery backup, screw lugs are provided on the front of the power supply for battery connections (see Figure 2-2). A switch is provided for charging the battery or can be off if a separate battery charger is used. A battery temperature sensor connection is also provided. The temperature sensor cable is shown in Figure 2-2. LED indicators are provided to show Reverse Battery connection, Charger On/Off and Battery Fault.

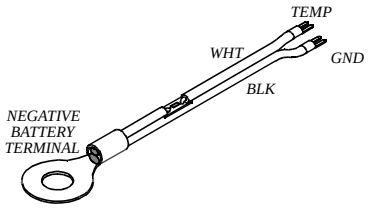


Figure 2-2 TEMPERATURE SENSOR CABLE

2.6 800W POWER SUPPLY

The power supply has four voltage output levels (see Table 2-1). Each voltage is set to ±1% at +25°C (+77°F). The output of this supply is capable or running any 2000 series repeater.

Each output is overload protected such that the power supply current limits and automatically resets when the overload is removed (see Table 2-1).

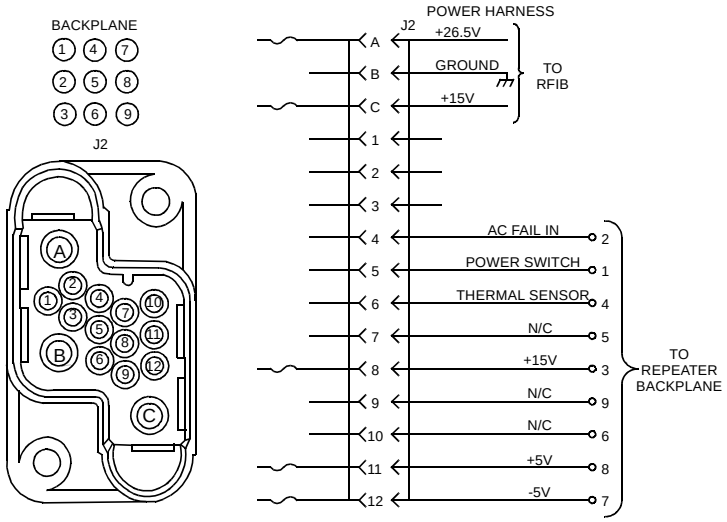
Each output is over voltage protected such that the power supply shuts down when an over voltage condition exists, usually when a component in the supply has failed (see Table 2-2). The power supply must be manually reset by toggling the Enable Line or removing AC power for more than 10 seconds.

Table 2-1 OUTPUT VOLTAGES

Voltage	Current	Wattage
+26.5V	22A	583W
+15V	5A	75W
+5.2V	5A	26W
-5V	1A	5W

Table 2-2 OVER VOLTAGE

Voltage	Range
+26.5V	+32V to +33V
+15V	+16V to +18V
+5.2V	+6V to +7V
-5V	-6V to -7V



POWER CABLE CONNECTOR AND SCHEMATIC

2.6.1 AC INPUT REQUIREMENTS

AC Input Voltage:	100-240V AC
Line Frequency:	50-60 Hz
AC In-rush:	60A maximum
Overall Efficiency:	>70% at 100V AC
	>80% at 240V AC
Lightning protection:	6kV for < 1ms
Power Factor:	>0.97 at full load
Brown Out Voltage:	80V AC
Temperature	-30°C - +60°C (full power)

Power factor correction per IEC555. The Power supply has the following safety agency approvals pending: UL1950, CSA22.2-950, TUV EN60950 (IEC950)

When the AC input voltage is below 90V AC, the maximum output power is decreased to keep the input current constant. If a battery back-up is installed, the batteries take over when the AC input voltage falls below 80V AC (dependent on power output).

The AC input connector is an IEC connector equipped with a locking mechanism.

The operating temperature range is -30°C to +60°C (-22°F to +140°F), i.e. the same as the repeater. The fan is thermostatically controlled by the internal temperature. When the internal heatsink temperature reaches +45°C (113°F) the fan turns on. When the heatsink temperature drops below +35°C (95°F) the fan turns off. If the internal heatsink temperature reaches +90°C (+194°F) the power supply turns off until the heatsink temperature drops below +85°C (+185°F). The over-temperature shutdown and restart are automatic.

2.7 GROUNDING

CAUTION

PROPER SITE GROUNDING AND LIGHTNING PROTECTION ARE VERY IMPORTANT TO PREVENT PERMANENT DAMAGE TO THE REPEATER.

As in any fixed radio installation, measures should be taken to reduce the possibility of lightning damage to the Viking VX equipment. Proper grounding eliminates shock hazard, protects against electromagnetic interference (EMI) and lightning.

Ground each piece of equipment separately. Do not ground one piece of equipment by connecting it to another grounded piece of equipment.

A good DC ground must be found or created at the site. Rooftop site grounds can be researched through the building management or architects. Tower site grounds must be made with grounding rods. The many techniques for providing adequate grounds for towers and poles and for installing building ground bus lines are beyond the scope of this manual. Refer to National Electrical Code article 250 "Grounding Techniques," article 800 "Communications Systems" and follow local codes.

The ground bus should be routed to the floor area within 5 feet of the system with a runner of 6 AWG or larger solid copper wire or 8 AWG stranded copper wire.

The outer conductor of each transmission line at the point where it enters the building should be grounded using 6 AWG or larger solid copper wire or 8 AWG stranded wire.

Secondary protection (other than grounding) provides the equipment protection against line transients that result from lightning. There are two types of secondary protection, RF and Telephone Line. Use the same wire sizes as specified for coaxial cables for any ground connections required by the secondary protectors.

RF

An RF protector keeps any lightning strike to the antenna feed line or tower from damaging the Repeaters. Install this protection in-line with the combiner and antenna feed line.

RF protectors are selected by calculating the maximum instantaneous voltage at the output of the combiner. Do this by using the following equation.

$V_P = 1.414 (X) (\sqrt{P(50)})$

Where:
V_P = Voltage at the output of the combiner.
P = repeater output in watts

X=	for	VSWR=
1.05		1.10 : 1
1.09		1.20 : 1
1.13		1.30 : 1
1.17		1.40 : 1
1.20		1.50 : 1
1.30		1.86 : 1

Example: Repeater power output of 60W with a VSWR of 1.3 : 1 (for this VSWR, X = 1.13):

$V_P = 1.414 (1.13) (\sqrt{60(50)})$
$V_P = 1.59782 (\sqrt{60(50)})$
$V_P = 1.59782 (54.772256)$
$V_P = 87.52V$

Telephone Line

There are four types of protection suppressors for telephone lines; Gas Tube, Silicon Avalanche Diode, Metal Oxide Varistor and Hybrid.

The hybrid protector is ideal for EF Johnson equipment, and is strongly recommended. A hybrid suppressor combines several forms of protection not available in just one type of device. For example, a high-speed diode reacts first clamping a voltage strike within 10 ns, a heavy duty heat coil reacts next to reduce the remainder of the current surge, and a high-powered three-element gas tube fires, grounding Tip and Ring.

2.7.1 PROTECTION GUIDELINES

Follow these guidelines for grounding and lightning protection. Each Repeater installation site is different; all of these may not apply.

- Ensure that ground connections make good metal-to-metal contact (e.g. grounding rod or tray, metal conduit) using #6 gauge solid or braided wire straps.
- With surge protectors, ensure that ground wires go directly to ground, not through other equipment.
- Run the ground wire for RF coax protectors directly to ground.
- With coax protectors, ensure maximum instantaneous voltage does not exceed the rated voltage.

- Do not run ground wires parallel to any other wiring (e.g. a ground wire parallel to a telephone line), except other ground wires.

- Double check all equipment for good ground and that all connections are clean and secure.

2.8 UNPACKING AND INSPECTION

The Repeater is shipped securely crated for transportation. When the Repeater arrives, ensure the crates remain upright, especially if storing the crates temporarily.

When unpacking the Repeater, check for any visible damage or problems caused by shipping. If there is obvious damage from shipping mishaps, file claims with the carrier. If there appears to be any damage caused before shipping, file a claim with Transcrypt International, Inc. Contact Customer Service for assistance (see Section 1.8).

If everything appears undamaged, remove the Repeater equipment from the crate, using normal precautions for unpacking.

NOTE: Do not discard the packing materials. If you must return an item, use the same packing materials and methods (including static protective bags for circuit cards) to repack the equipment. You are responsible for proper repacking. Transcrypt International, Inc. cannot be responsible for damage to equipment caused by negligence.

NOTE: Repeaters should not touch. Leave a minimum of one empty screw hole (approximately 1/2") between repeaters vertically, especially for bottom ventilation slots in high power repeaters.

NOTE: Each repeater should be grounded separately by connecting a ground bus from the ground lug on the back side of the RF module to the ground bar on the rack (see Figure 2-7).

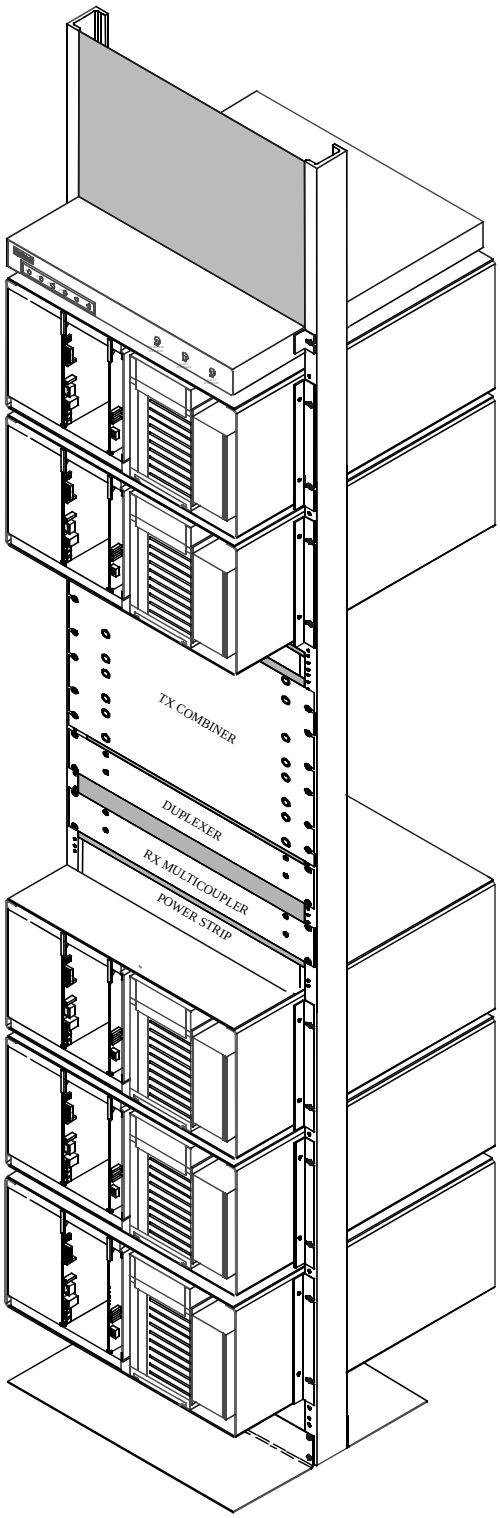


Figure 2-3 RACK MOUNTED REPEATERS

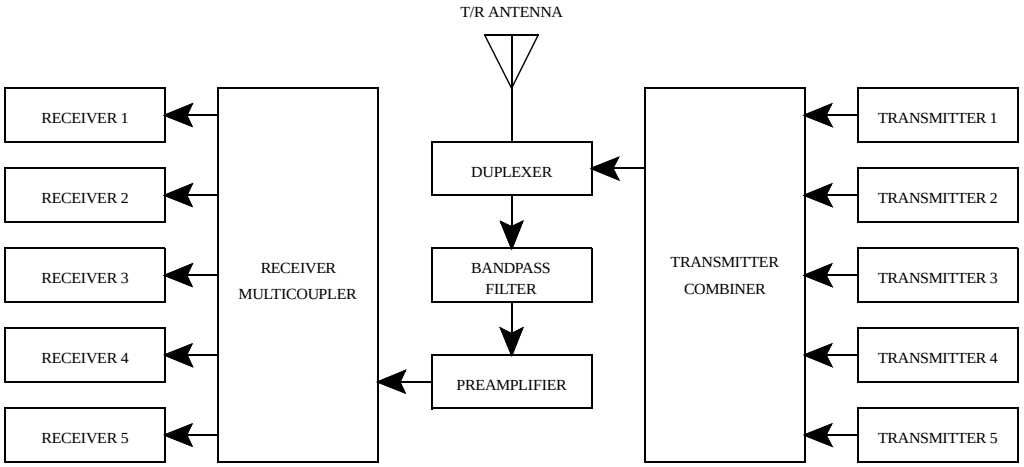


Figure 2-4 5-CHANNEL COMBINING SYSTEM

2.9 REPEATER DATA BUS INSTALLATION

The repeaters are interconnected by a balanced line High-Speed Data Bus (HSDB) consisting of a six conductor cable. The total length of the HSDB cannot exceed 500 feet. Connect the cables in daisy-chain fashion to modular connector A5 on the back of the repeater (see Figure 2-16). A 50 ohm termination is not required for VIKING VX repeaters.

2.9.1 MPC DATA BUS SWITCH SETTINGS

Switch settings on the MPC for the two types of installations require S2 and S3 sections to be switched as indicated in Figure 2-5.

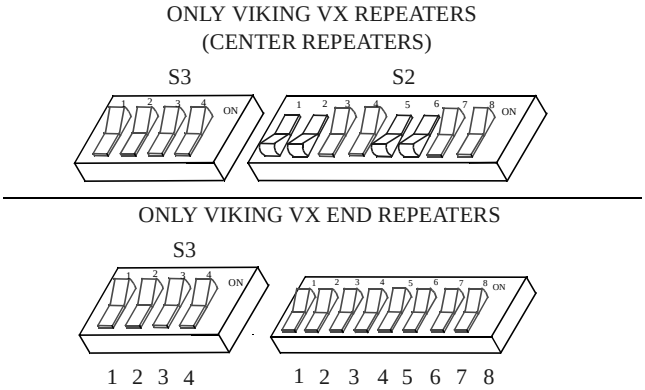


Figure 2-5 MPC DATA BUS SWITCHES

2.9.2 MPC DATA BUS JUMPER SETTINGS

Refer to Figure 2-6 for crystal selection and HSDB Code selections jumper placement. Jumper J5, pins 1-2 selects 11.059 MHz for LTR-Net (J5, pins 2-3 selects 12 MHz crystal for Standard LTR). The jumper on J4, pins 5-6 connects EPROM U14, pin 27 to ground for LTR-Net (J4, pins 3-4 connects EPROM U14, pin 27 (A14) to +5V for Standard LTR single-ended 5V data bus).

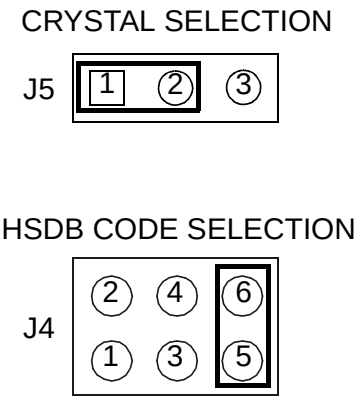


Figure 2-6 MPC JUMPERS

Jumper J4 must be placed with the following guidelines: J4, pins 5-6 for operation with the RJ-11 to RJ-11 cable 200X systems (see Section 4.5.6).

2.10 CONNECTING RECEIVE AND TRANSMIT ANTENNAS

Receive and Transmit antenna connector locations are shown in Figure 2-7. Although each transmitter and receiver could be connected to a separate antenna, this is usually not done because of the large number of antennas required by a multiple repeater installation. Therefore, an antenna combining system is usually used. An example of a combining system for a five-channel system is shown in Figure 2-4. The amount of power loss introduced by a combiner depends on the type of combiner used. If it has a loss of 3 dB, power output to the antenna is reduced by half.

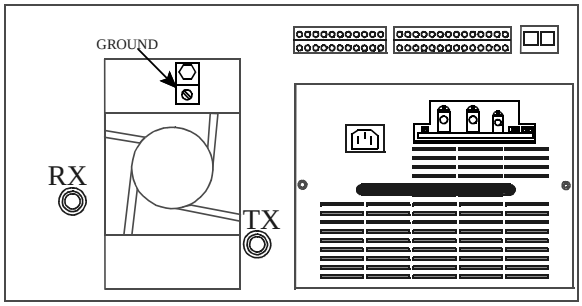


Figure 2-7 ANTENNA CONNECTIONS

2.11 CONNECTING AUDIO/DATA LINK TO SWITCH

A communication link of some type is required between the Switch and each repeater. This link allows the Switch to control the repeater and also routes audio between the Switch and repeater. Various types of links can be used, such as phone line, RF transceiver, microwave, or fiber optic Refer to Section 1.14.3 for more information. The repeater connection point is terminal block J2 on the back panel (see Figures 2-8, 2-12 and 2-13). The information which follows describes the installation of these links.

2.11.1 VOICE LINK

The voice link is always connected and it should be a standard 4-wire, 600 ohm balanced voice- grade link. It can be non-metallic, i.e. DC continuity is not required. If the repeaters and Switch are located at the same site, direct connection can be used as long as the line is less than approximately 300 feet.

Connect the voice link to terminals 1-2 and 3-4 (see Figure 2-8 and 2-12).

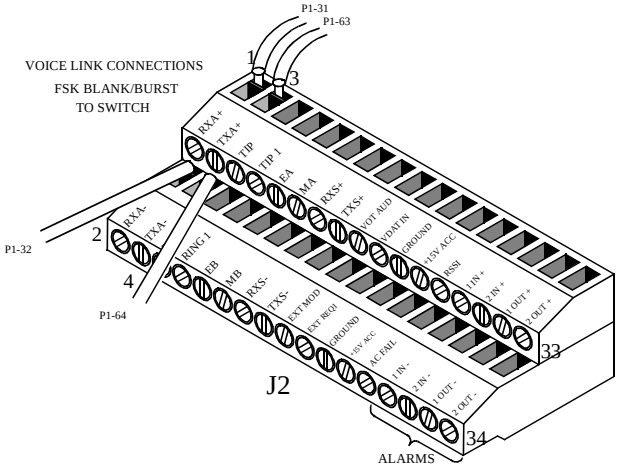


Figure 2-8 TERMINAL BLOCK J2

2.11.2 DATA LINK

One of these three methods can be used for installing the data link.

NOTE: See Section 7 for Link Alignment.

1. Separate 4-wire link can be used that is similar to that used for voice. The data is then encoded by FSK and sent as tones.

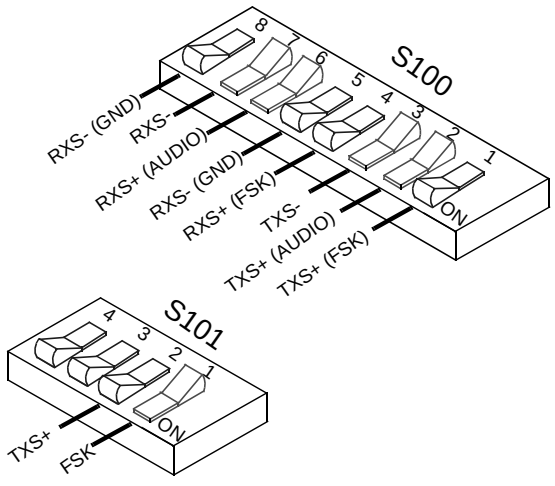


Figure 2-9 MAC DIP SWITCH SETTINGS FOR 4-WIRE LINK

2. A separate RS-232 serial link can be used.

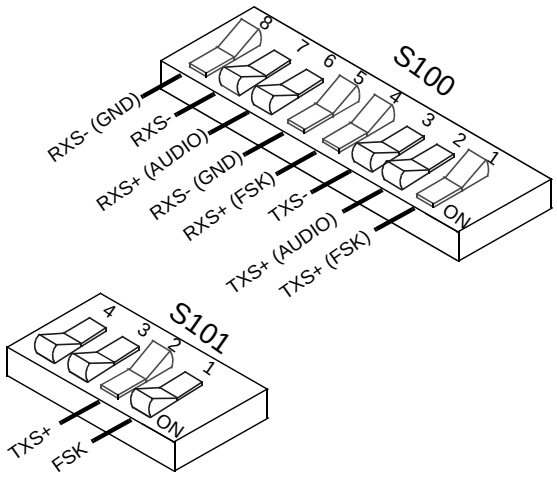


Figure 2-10 MAC DIP SWITCH SETTINGS FOR RS-232 LINK

3. The FSK data can be sent over the voice link using a Blank and Burst technique. No separate data link is then required.

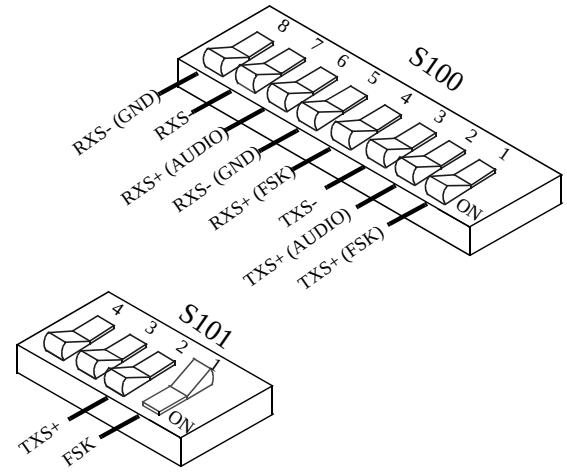


Figure 2-11 MAC DIP SWITCH SETTINGS FOR BLANK AND BURST LINK

Select the type of link being used, refer to Figure 2-8 and 2-12 and make the connections to terminals 1-2 and 3-4.

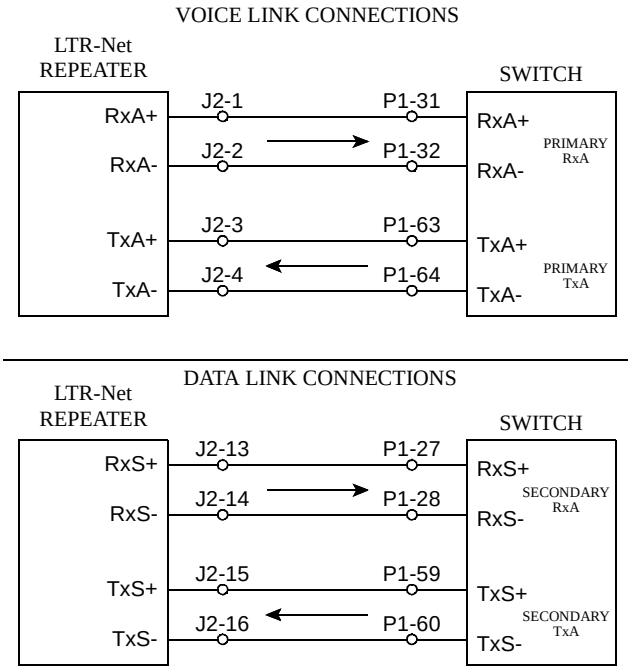


Figure 2-12 LTR-Net VOICE/DATA LINK

2.12 OCXO DRAWER CONNECTIONS

2.12.1 VIKING VX CONNECTION

These guidelines should be followed when using 2009 series repeaters with a 2000 OCXO drawer, Part No. 023-2000-925.

- One 1.25 MHz output on the 2000 OCXO drawer is connected to the 1.25 MHz Input on each 2009 Repeater. Up to eight 2009 series repeaters can be connected to the 1.25 MHz Output ports.

  This level is approximately 0 dBm.

- If connection to additional 2009 series repeaters is necessary, additional 8-Way Splitter Shelves, Part No. 023-2000-924, are added as required.

  All shelves are connected to the 1.25 MHz output ports of the 2000 OCXO drawer.

  The level at the splitter shelf output ports is approximately -10 dBm. See Figure 2-13.

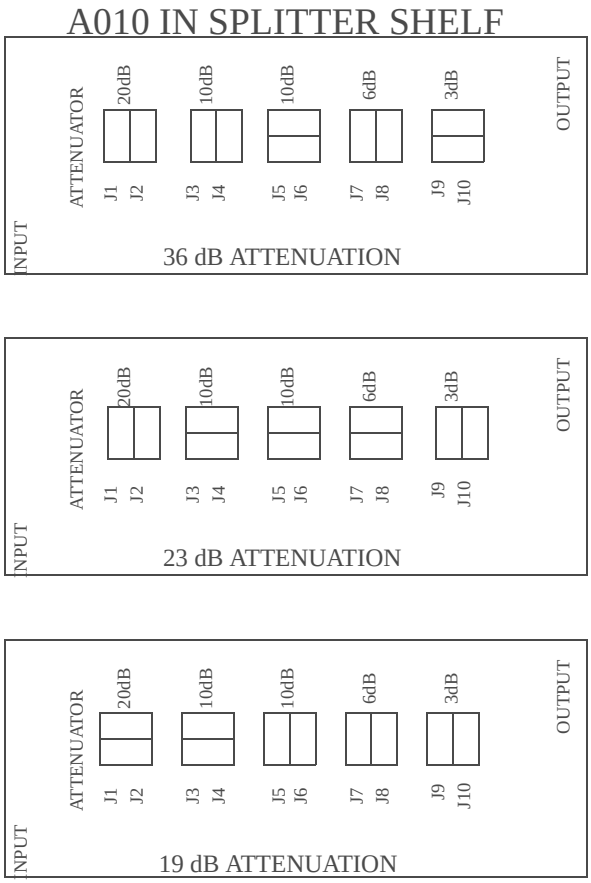


Figure 2-13 ATTENUATOR SETTINGS

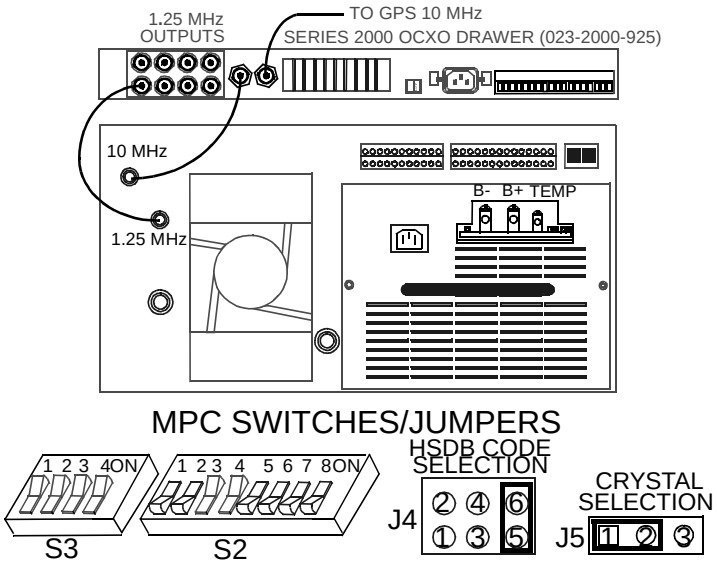


Figure 2-14 SINGLE REPEATER INSTALLATION

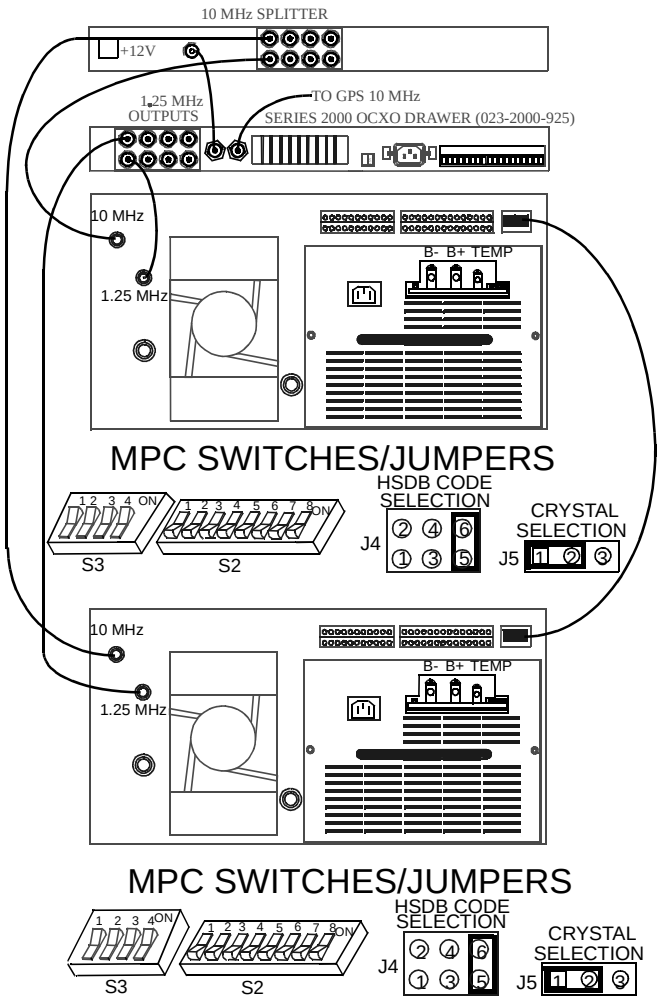


Figure 2-15 TWO REPEATER INSTALLATION

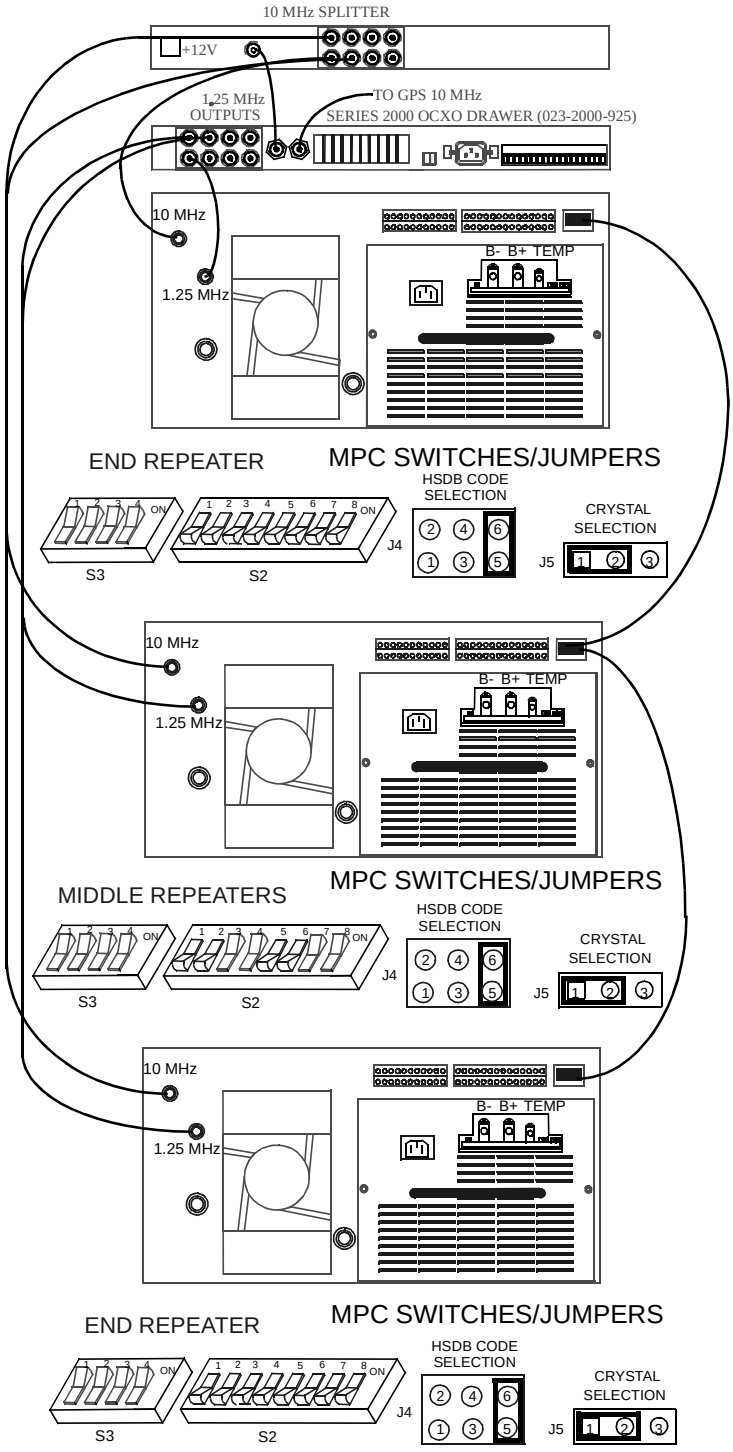


Figure 2-16 THREE OR MORE REPEATERS INSTALLATION

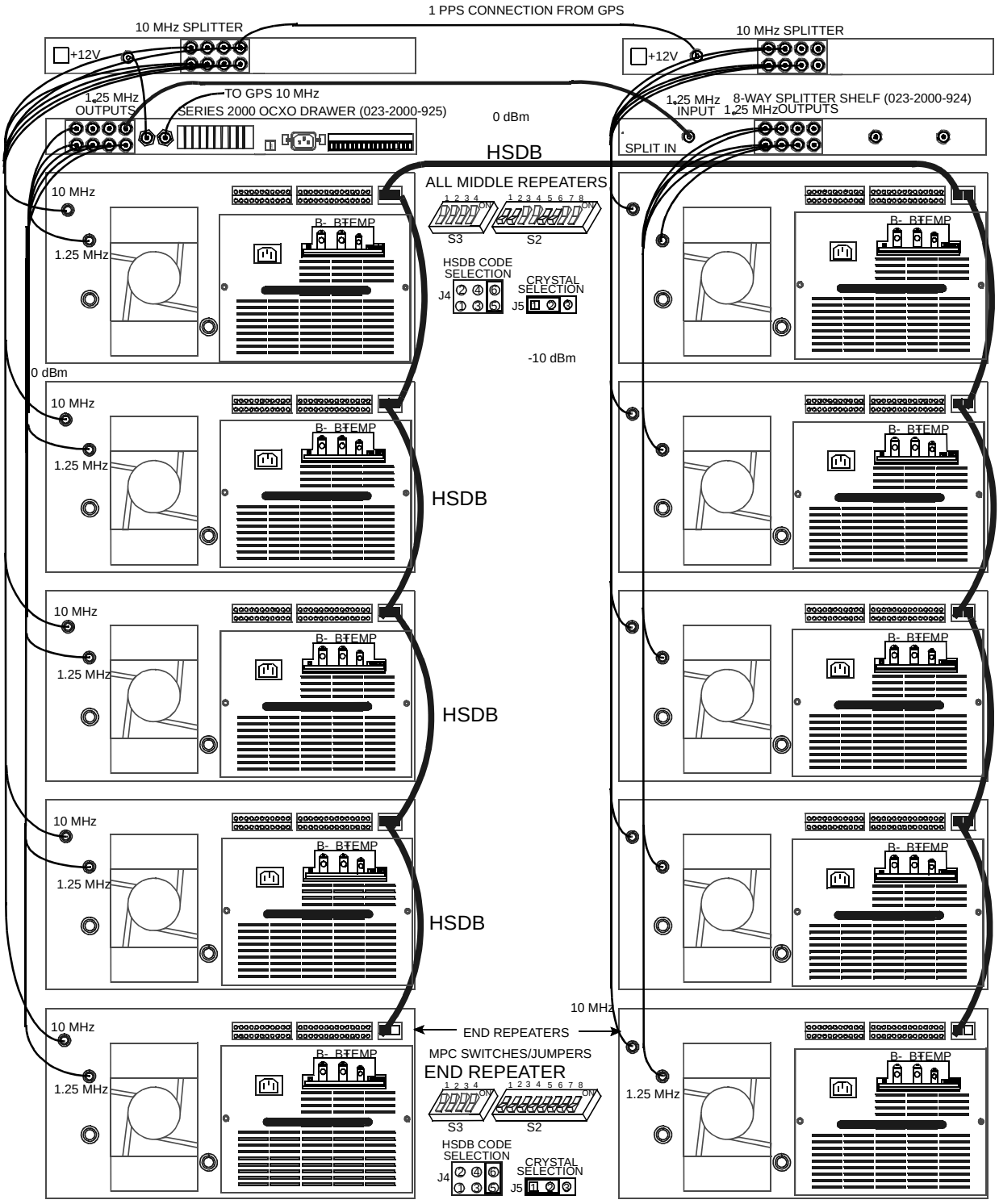


Figure 2-17 MORE THAN ONE RACK OF LTR-Net REPEATERS

SECTION 3 SOFTWARE

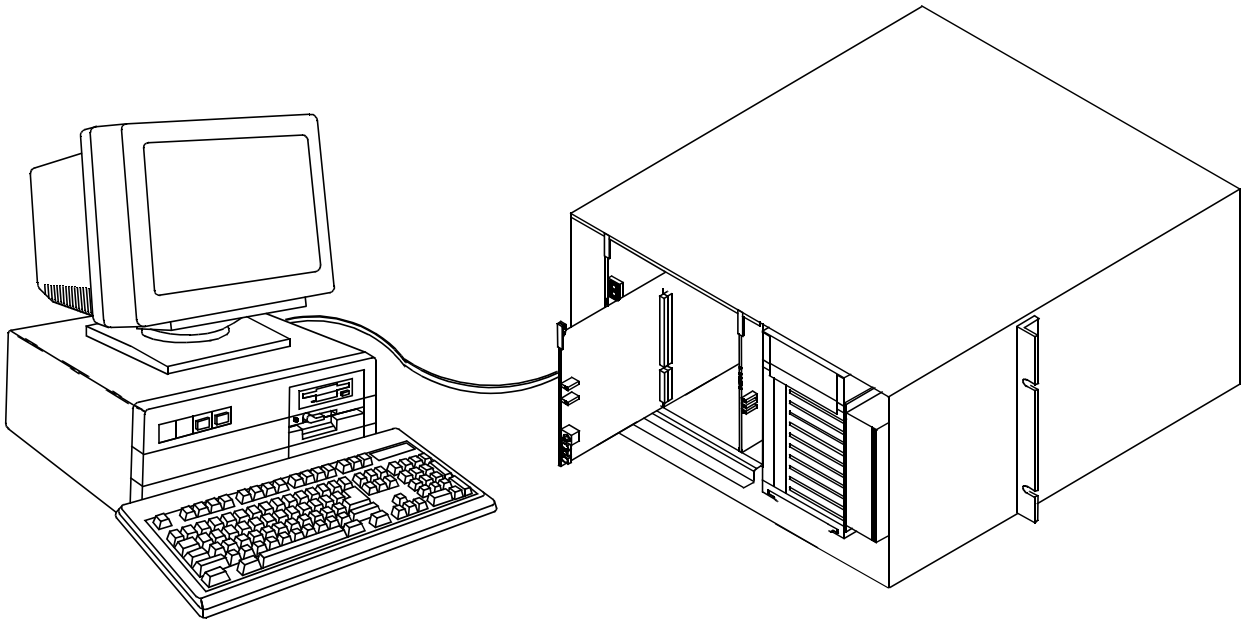


Figure 3-1 PROGRAMMING SETUP

3.1 INTRODUCTION

3.1.1 PROGRAMMING SETUP

The following items are required to program the repeater. The part numbers of this equipment are shown in Section 1, Table 1-1. A programming setup is shown above.

The LTR-Net Programmer on 3.5 inch disk, Part No. 023-9998-459, uses Windows NT 4.0 or later, or Windows 95 or later on a personal computer to program the EEPROM Memory in the Main Processor Card (MPC).

The computer is connected directly from the serial card to the MPC. The interconnect cables used are shown in Figure 3-2. The DB-9 to 8-pin modular adapter is connected to the serial port of the computer and an interconnect cable connects the adapter to the MPC.

NOTE: These connections are for the IBM computer and may differ from an IBM compatible. In which case, consult the manuals for your computer for serial card outputs and connections.

3.1.2 MINIMUM COMPUTER REQUIREMENTS

The LTR-Net Programmer requires Windows NT 4.0 or later, or Windows 95 or later that meets the following minimum requirements.

- 16M of memory
- 486 or faster microprocessor
- The personality program and help file are supplied on a 3.5", 1.44M diskette only. Therefore, a computer with a hard disk drive and 3.5" (1.44M) floppy drive is required.
- One unused serial port
- Color monitor

Although the program uses color to highlight certain areas on the screen, a monochrome (black and white) monitor or LCD laptop also provide satisfactory operation. Most video formats are supported. An unused serial port is required to connect the repeater to the computer. One or two serial ports are standard with most computers. One port may be used by the mouse.

3.1.3 PROGRAMMING CABLES

The cables from the repeater to the computer are not included.

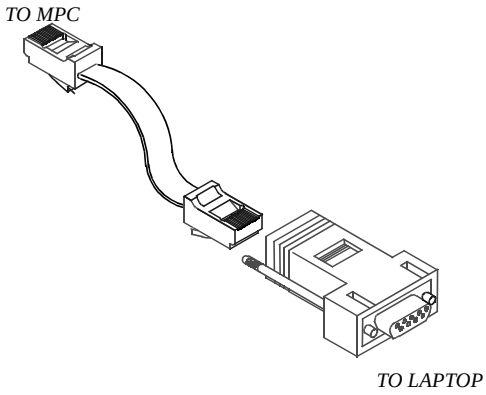


Figure 3-2 LAPTOP INTERCONNECT CABLE

3.1.4 EEPROM DATA STORAGE

The data programmed into the MPC is stored by an EEPROM memory. Since this type of device is nonvolatile, data is stored indefinitely without the need for a constant power supply. A repeater can be removed from the site or even stored indefinitely without affecting programming. Since EEPROM memory is also reprogrammable, a new device is not needed if programming is changed.

3.1.5 GETTING STARTED

NOTE: Before starting you should already know how to start Windows NT®, format and make backup copies of disks, copy and delete files, and run programs. If you are unfamiliar with any of these actions, refer to the Windows NT manual for your computer for more information (see Section 5).

Follow the computer instructions for loading the disk. The computer needs to have RS-232C capability, for example, the Serial Card in slot "COM1" or "COM2".

The LTR-Net Programmer is used to configure repeaters for proper operation with the LTR-Net protocol.

From the repeater standpoint, an LTR-Net system consists of one or more repeaters installed in a Locality, a 3000 Series Switch and the necessary interconnects and programming to provide LTR-Net operation (see Section 1).

The LTR-Net Programmer defaults to using COM1 at 9600 baud to communicate with a repeater, however this can be changed by selecting Utilities -> COM Port Setup from the menu, or by clicking on the COM toolbar button (see Section 4.7.1).

When you first start the programmer, you should create a Locality file with the information you wish to program into repeaters at that Locality. See "How Do I ... Create A New Locality File" for information on performing this function.

NOTE: All repeaters installed in a given Locality use the same Locality information, but each has its unique repeater information programmed.

3.1.6 LIMITATIONS

The LTR-Net Programmer requires Windows NT 4.0 or later, or Windows 95 or later.

In order to read data from a repeater, a Locality file must first be loaded from disk, or create and save a Locality file. Only one Locality file may be loaded at a time.

The LTR-Net Programmer supports COM1 through COM4, and all of the baud rates currently supported by the MPC. Since the number of data bits, stop bits, and the parity are fixed in the MPC, these cannot be changed in the programmer.

3.2 MISCELLANEOUS SOFTWARE INFORMATION

3.2.1 MINIMUM FREE MEMORY REQUIRED

Approximately 2MB of free memory is required to run this program. If not enough is available, there may be other programs that are also being loaded into conventional memory. These programs can be closed to make more space available.

3.2.2 SOFTWARE INSTALLATION

- Making a Backup Copy

When the programming software is received, make a backup copy and store the master in a safe place. To make a copy of the distribution disk with Windows NT or Windows 95 Explorer, right click the floppy drive icon and select Copy Disk.

- Creating a Windows Shortcut or Program Icon

To run the program from Windows NT or Windows 95, a shortcut icon can be created that can then be double clicked to start the program. To create this shortcut icon, select Start -> Settings -> Taskbar. Then select the Start Menu Programs tab and click the Add button. Information is then displayed to complete the process.

3.2.3 STARTING THE PROGRAM

There are several ways to start the LTR-Net Programmer. First, the program can be started by double clicking on the shortcut icon. This starts the program with an empty information file (Locality file). A Locality file contains all of the programming information for all repeaters installed at a Locality.

A second method of starting the program is to use the Explorer to change to the directory containing Locality files, then double click on one of those Locality files. This starts the programmer and automatically loads the selected file. This is normally the most convenient method to start the program, as it pre-loads all of the repeater data for a Locality.

Once files have been opened or saved from within the programmer, those filenames will show up in the taskbar Documents selection. allowing the program to be started by selecting the desired Locality file from the Start menu.

Refer to Section 4 for detailed information about the LTR-Net Programmer's contents and Section 5 for the parameters and their descriptions for the Locality and Repeater programming.

3.3 ALIGNMENT SOFTWARE

The software for the LTR-Net repeater programs the MPC to open and close the audio/data gates necessary for the alignment selected from the Test-Full Repeater menu.

Under the menu heading TEST, are the alignment procedures for the PA (see Section 7.4 or 7.5), Receiver (see Section 7.2), Exciter (see Section 7.3) and overall Full Repeater (see Section 7.6) including the MAC card (see Figure 3-3).

Figure 3-3 REPEATER TEST MENU

Refer to Section 7 for alignment procedures as shown in the program, alignment points diagrams and test setup diagrams.

3.4 HELP

Help screens are available for most parameters and options in this program. Whenever a parameter or options clarification is needed, press the Help button and a help screen will pop-up on the screen.

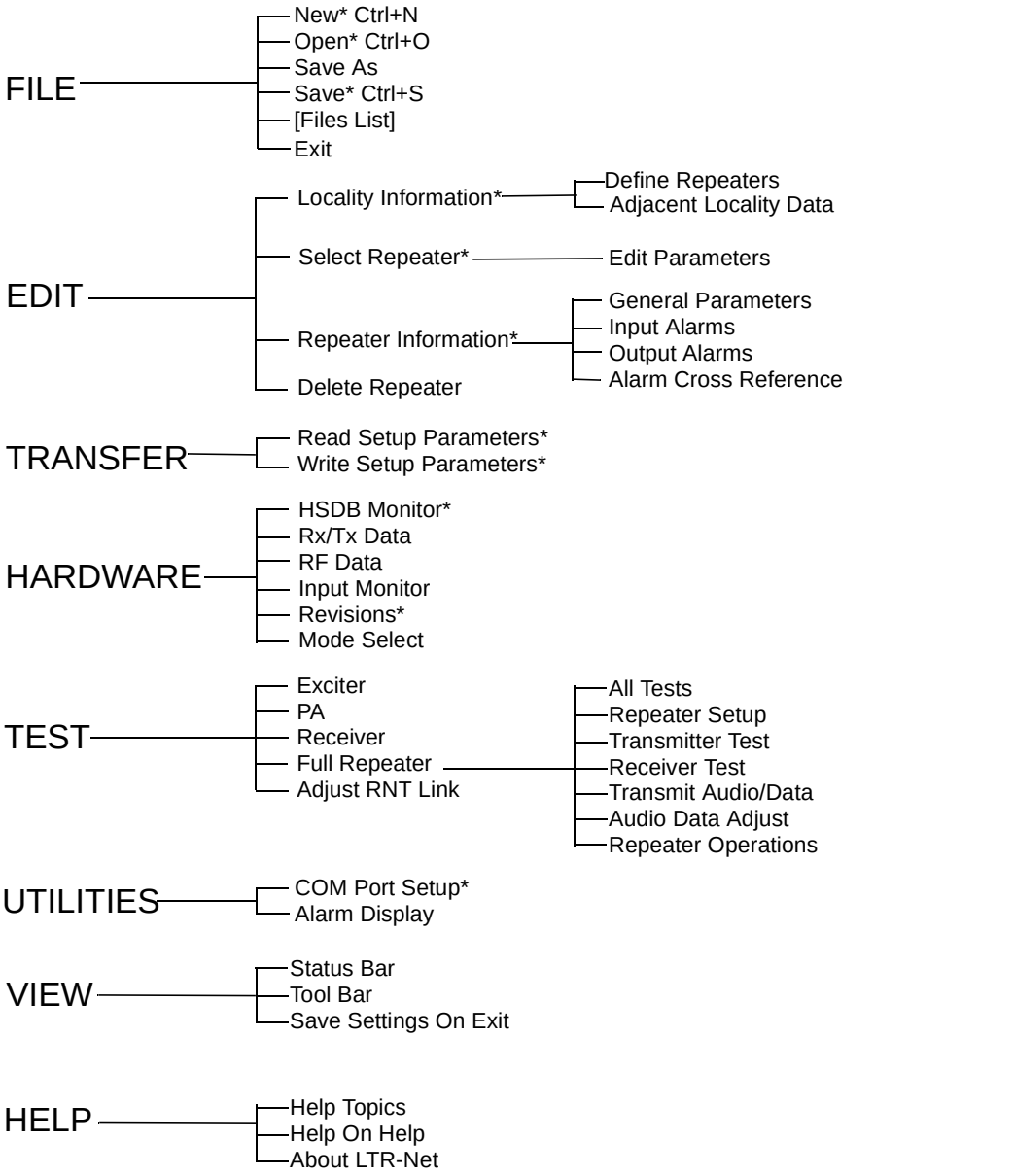


Figure 3-4 PROGRAMMING FLOWCHART

SECTION 4 LTR-Net PROGRAMMER

4.1 MENU DISPLAYS

The menus available are listed at the top of the screen (see Figure 4-1). Move the cursor with the mouse to highlight the menu name. Press the left mouse key to view the menu and the mouse to scroll through the menu. Call up the highlighted selection by pressing the left mouse button. The Toolbar provides one-click access to some of the most frequently used menu selections.

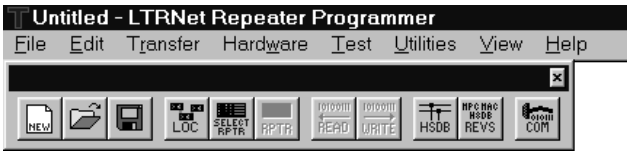


Figure 4-1 MAIN MENU

4.2 FILE MENU

This menu manipulates new or existing files into directories and saves files to be called up at another time.

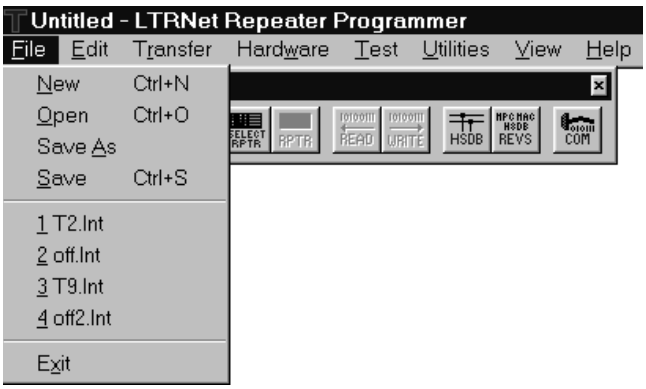


Figure 4-2 FILE MENU

4.2.1 NEW

This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+N. This menu selection or icon erases all Locality and Repeater information in the programmer and loads factory defaults. If the current data has been changed, selecting File -> New or the icon provides the opportunity to save the data before loading the defaults.

4.2.2 OPEN

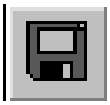
This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+O. This menu selection or icon opens a Locality file and loads its information into the programmer. It brings up a list of Locality data files to select from.

4.2.3 SAVE AS

This menu selection saves the edited version of an existing file loaded in the buffer under a new filename or gives a new file created in the Edit menu a filename.

Figure 4-3 OPEN / SAVE AS / SAVE FILE

4.2.4 SAVE



This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+S.

4.2.5 EXIT

Exits the repeater program and returns to Windows NT. See Section 4.8.3, View -> Save Setting On Exit to save the toolbar location (size and shape) as well as the main window location and size when the programmer is opened.

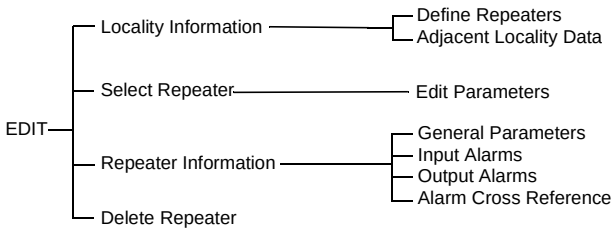


Figure 4-4 EDIT PROGRAMMING FLOWCHART

4.3 EDIT

This menu is used to create new files and set or change the repeater operating parameters. The file-name for the Locality and relevant data is shown in the Title Bar and Status Bar (see Section 4.8.1).

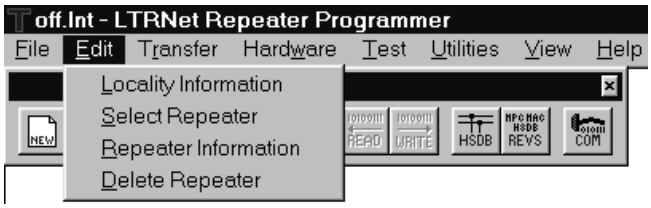


Figure 4-5 EDIT MENU

4.3.1 LOCALITY INFORMATION

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the Locality information screens to Define Repeaters and Adjacent Localities.

Figure 4-6 LOCALITY CONFIGURAITON

Table 4-1 DEFINE REPEATERS PARAMETERS

Delete Entry	Removes the selected Defined Repeater from the list.
Frequency Band	Selects the Locality frequency band, 800 MHz, 800 MHz with offset, (or 900 MHz).
Channel Number	Select a repeater number in the Defined Repeater pane and assign the channel number (1-920). See Appendix A for an 800 MHz Frequency Chart.
Area Bit	If the coverage area includes more than one Switch the area bit is used, this is normally 0.
Transmit Frequency	This is displayed for reference and is determined when the Channel Number is selected.
Receive Frequency	This is displayed for reference and is determined when the Channel Number is selected.
Active	Click on this box to activate the selected Defined Repeater.
Defined Repeaters	Click on a repeater number, then select the channel number and the data is displayed.
OK	Saves the current selections shown and closes the window.
Cancel	Disregards all changes and closes the window.
Help	Displays the Help screen for the parameters in this window.

Figure 4-7 ADJACENT LOCALITY DATA

- Select the Locality ID number for the Locality currently being defined.
- Select a Locality ID for each of the closest Adjacent Localities (0-15).
- Select a Preference number for each Adjacent Locality number as an alternative when leaving the range of this Locality.

4.3.2 SELECT REPEATER

This menu selection has an equivalent icon in the toolbar. This menu selection or icon selects a repeater from the currently defined repeaters within this Locality (see Figure 4-8). Move the cursor with the mouse to highlight the repeater filename and double-click the mouse to open the Edit Parameters window.

Figure 4-8 SELECT REPEATER

Table 4-2 ADJACENT LOCALITY PARAMETERS

This Locality ID	0-1023	This is the ID of the Locality currently being defined.
Locality	0-1023	The Locality ID number of a neighboring Locality.
Preference	1-15	A scale number for the best alternative Locality (1 = Highest, 15 = Lowest).
# (Number)	0-15	Choice of 16 neighboring Localities that can pick-up transmissions.

4.3.3 REPEATER INFORMATION

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the parameter pages for the selected repeater. It allows entry of information specific to this repeater.

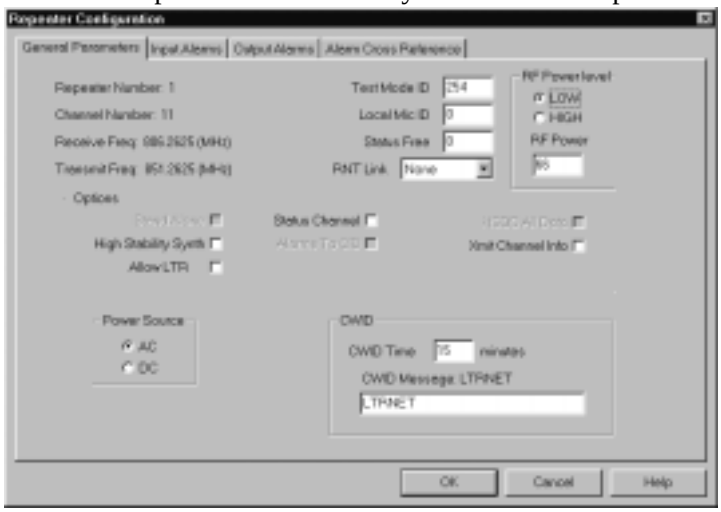


Figure 4-9 REPEATER CONFIGURATION

Table 4-3 GENERAL PARAMETERS

Repeater Number	1-20	Repeater number was established in Locality Configuration.
Channel Number	1-399	Channel number was established in Locality Configuration.
Receive Frequency		Frequency was determined by channel number in Locality Configuration.
Transmit Frequency		Frequency was determined by channel number in Locality Configuration.
Test Mode ID	1-239	Group ID transmitted when the Repeater is in the Test Mode.
Local Mic ID	1-239	Group ID transmitted when the local microphone PTT is active.
Status Free	0=never 20=always	When the number of free channels falls below this value, Status Channel can be used for voice.
RNT Link	None FSK Dig BnB	Data Signaling type for 3000 Series Switch. Frequency Shift Keying RS-232 Blank and Burst (FSK)
RF Power Level	Low, High	Low=25-75, High=75-160. Power level in watts for transmit power output.
Options	Stand Alone	Selected if the repeater is permitted to operate without a connection to the 3000 Series Switch.
	High Stability Synth	Selected if the Receiver and Transmitter use the High Stability Synthesizer.
	Allow LTR	Selected if standard LTR protocol is allowed.
	Status Channel	One repeater at a Locality is designated to transmit update information for all calls occurring at that Locality. Normally not assigned as a Home repeater.
	Alarm to CIB	Routes repeater alarms to the Channel Interface Bus to be detected by the Call Processor and the System and Subscriber Manager.
	HSDB All Data	Repeater receives all the data on the High Speed Data Bus.
	Xmit Channel Info	Repeater sends updates on all repeaters installed in this Locality.
Power Source	AC, DC	The type of primary power source for the Repeater.
CWID Time	0=disabled, 1-30 min	The time interval between CWID transmissions.
CWID Message	Station call letters	This is the FCC station call letters (15 characters/numbers).
OK		Saves the current selections shown and closes the window.
Cancel		Disregards all changes on any of these four screens and closes the window.
Help		Displays the Help screen for the parameters in this window.

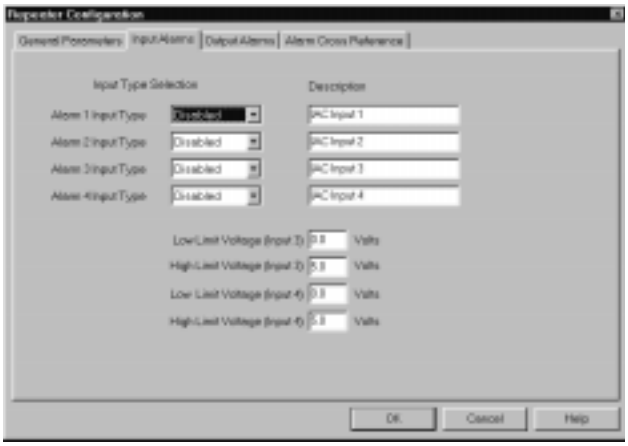


Figure 4-10 INPUT ALARMS

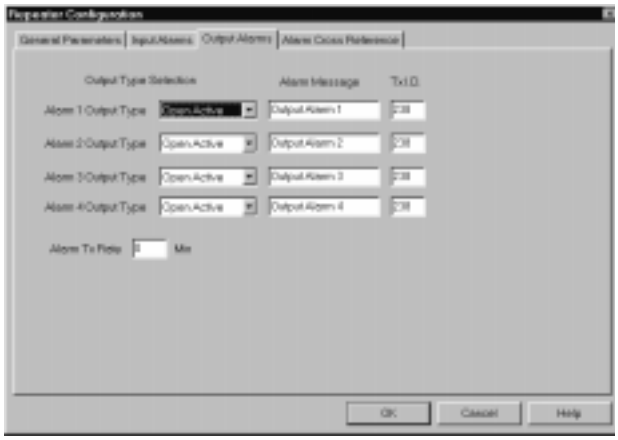


Figure 4-11 OUTPUT ALARMS

Input Alarms

There are four Input Alarms that can be activated by external devices (see Section 6.13). These inputs can be Disabled, Energized or De-Energized. Alarms 3 and 4 can also be Analog Inputs.

- Disabled - The input alarm line is inactive.
- Energized - An open circuit external to the repeater activates the alarm.
- De-energized - A closed circuit external to the repeater activates the alarm.
- Analog - Select the Low and High Limit pairs to trip an Analog Input Alarm. The High Limit must be greater in value than the Low Limit (0.0V-5.0V in 0.1V steps).
- Alarm Description - This is a text string (up to 15 characters) to describe the alarm. The description is automatically changed on the Cross Reference Window.

Output Alarms

Select the operation of the Output Alarm. The available types are:

- Open Active - An active alarm opens (no contact) the output lines.
- Closed Active - An active alarm closes (contact) the output lines.
- Alarm Message

This is a text string (up to 15 characters) to describe the alarm. This text string is sent via Morse code if the alarm input is programmed with a Tx ID and an output is selected in the Cross Reference menu (see Figure 4-13). The Alarm Message is automatically transferred to the Cross Reference window.

- Transmit ID

Each of the 4-alarm outputs can be assigned a Group ID from 1-239. The default setting is 238, 0 (zero) for disabled. This Group ID and the Repeater number identify an alarm that is active. This ID can be programmed into a transceiver so that when the alarm is active, the alarm description is received in Morse code.

- Alarm Transmit Rate

This sets the time interval for transmitting the alarm message in Morse code (0-30 min). If more than one alarm is active, this is the inter-alarm time.

Cross Reference

The cross reference screen selects the Output Alarm that is activated by each Input Alarm. There are up to:

- 48 alarms (0-47)
- 4 (hardware) External Input Alarms
- 18 (software) Internal Alarms (see Table 1-2).
- 26 unused

There are 4 Output Alarms. An alarm condition on any input can cause an Output Alarm. This window configures which Input Alarm activates an Output Alarm.

NOTE: More than one alarm condition can share the same output alarm (see Figure 4-13).

Show Alarm Map

This window displays an Alarm Map that displays those Alarm Outputs that have been mapped in bold type. Double-clicking on these outputs lists the Alarm Inputs that have been assigned to that output.

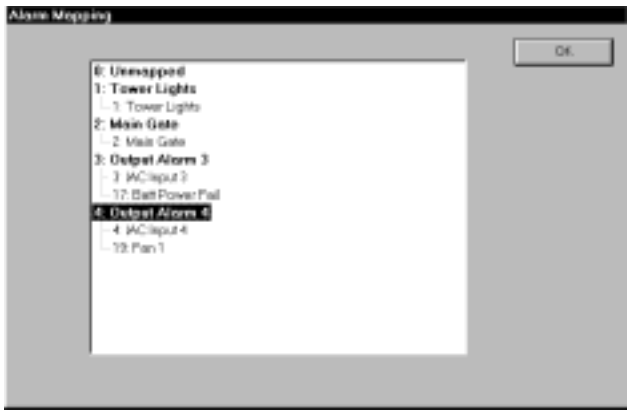


Figure 4-12 ALARM MAPPING

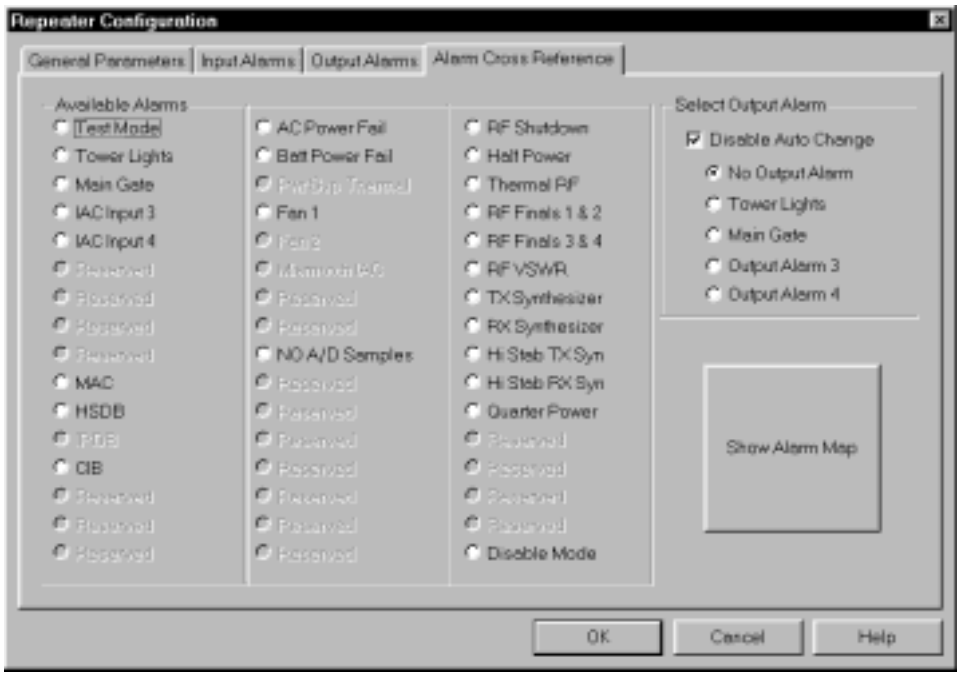


Figure 4-13 ALARM CROSS REFERENCE

4.3.4 DELETE REPEATER

Select the Repeater number to delete from this Locality and press the Delete button.

Figure 4-14 DELETE REPEATER

4.4 TRANSFER

Figure 4-15 TRANSFER MENU

4.4.1 READ SETUP PARAMETERS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon reads the contents of the EEPROM memory of a repeater and loads it into a buffer. The contents of the buffer may then be displayed to show the programming of the repeater.

NOTE: This button is only available if a Locality file is loaded and a repeater is connected.

4.4.2 WRITE SETUP PARAMETERS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon sends the contents of a Locality file to a connected repeater and programs the EEPROM memory in the Main Processor Card (MPC).

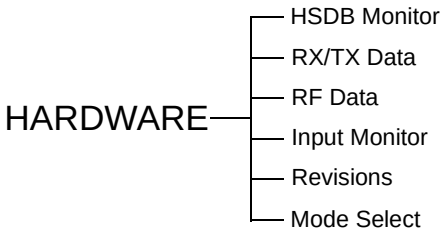


Figure 4-16 HARDWARE PROGRAMMING FLOWCHART

4.5 HARDWARE

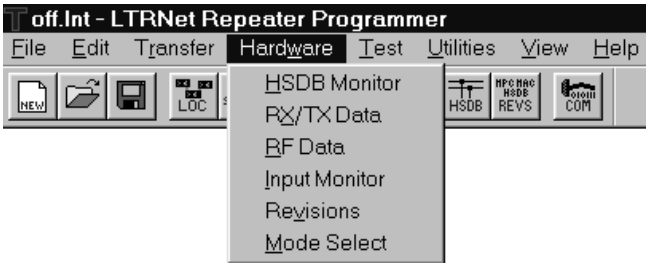


Figure 4-17 HARDWARE MENU

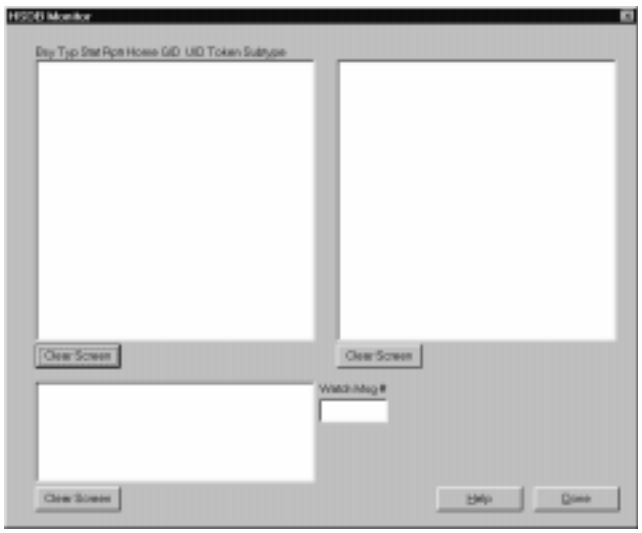


Figure 4-18 HSDB MONITOR

4.5.1 HSDB MONITOR

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the monitor window to view information from the High Speed Data Bus (HSDB). The HSDB connects all repeaters at a Locality and continually sends updates on the status of each repeater. This information window provides a list of all repeaters (1 to 20) at the Locality. If a repeater is not sending data, IDLE is next to the repeater number. The data sent by the repeater is used to determine the Home, GID and UID of destination (mobile) users to receive the call placed by the originator.

The Home column refers to the Home repeater number of the originator, therefore, the Repeater and Home numbers may not be the same number. The GID column refers to the Group ID of the talk group of the originator. The UID is the Unique ID used to identify the originator of Special Calls. Special Call information is listed in the Token and Subtype columns.

4.5.2 RECEIVE/TRANSMIT DATA

This is an information screen used at the repeater Locality while the computer (laptop) is connected to the MPC in the repeater being monitored (see Figure 4-19). This information is contained in the receive data stream exchanged between the repeater and the destination user (mobile/portable) and the data content of the repeater transmit data stream. The message contains data received from the destination and data sent to the mobile/portable by the repeater. The repeater receives the destination's: Unique ID, Home Repeater Number, Group ID, Priority and Status. The time stamp is included because messages are sent continually and this provides a reference for when a data exchange took place. The information sent to the destination in the update message from the repeater includes: Description/Group, Channel In Use, Home Repeater Number, Free Channel and Time Stamp.

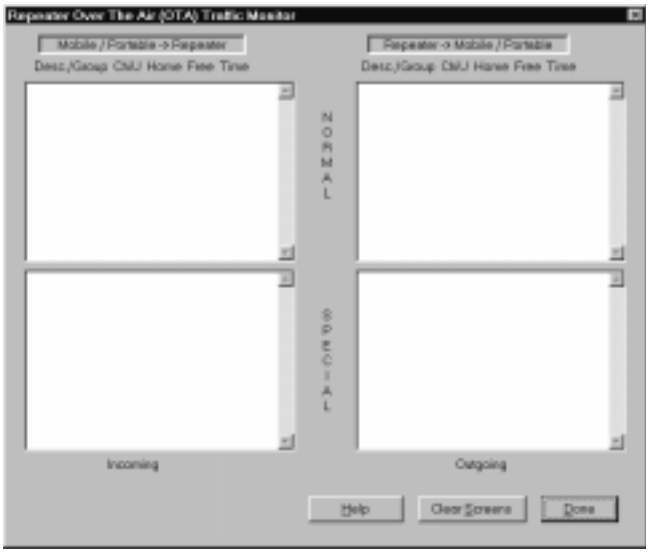


Figure 4-19 REPEATER TRAFFIC MONITOR

4.5.3 RF DATA

Figure 4-20 RF DATA

The RF Line Monitor window shows the state of the lines (see Figure 4-19). These lines are monitored by the A-D converter in the IAC. The normal values for each line are defined as follows.

Synthesizer Lock Lines:	
Exciter Synthesizer	Yes, No
Receive Synthesizer	Yes, No
Exciter High Stability	Yes, No
Receive High Stability	Yes, No
Wideband Audio Output	approx. 200
LO Injection	approx. 200
RSSI	20-150
Fan 1 Current	100-200, 0
Fan 2 Current	100-200, 0
Transmit Parameters:	
Forward Power (Low Power	25-75 Watts
Forward Power (High Power)	75-175 Watts
Reflected Power	0-6 Watts
Final Out 1-2 (ratio)	approx. equal
Final Out 3-4 (ratio)	approx. equal
Chassis Temp	27°C-55°C
Fan	On or Off
Power Supply Temp	22°C-45°C
Battery Voltage	21V-28V

Values with no label are the actual A-D reading. To calculate the voltage on the line, divide the value by 51. Example: Value ÷ 51 = Volts. Any variation from the above values may indicate a problem in that area. Values in this window are relative measurements only.

4.5.4 INPUT MONITOR

This window monitors the two Analog Input lines. It is only used with the 4-Alarm Type IAC, and only if Input 3, Input 4 or both are programmed for "Analog". In addition to the actual or measured value, the Low/High limit data are also displayed. These limits are programmed in the "Edit -> Repeater Information -> Input Alarms" screen (see Figure 4-13). If one of these inputs is not programmed "Analog", the data for that input is blanked.

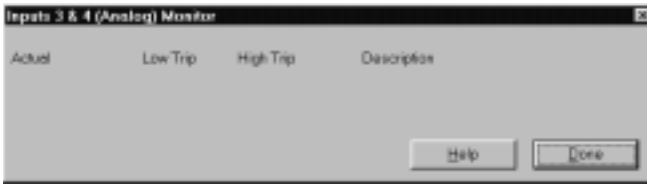


Figure 4-21 INPUT MONITOR

4.5.5 REVISIONS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon displays the current firmware revision information for the MPC, MAC and HSDB. The format is R.V (revision.version) for all modules. The MPC information also includes the release date of the software and the serial number of the repeater. The HSDB version in Figure 4-22 is for J4, pins 5-6 connected in the MPC for LTR-Net (J4, pins 3-4 connected in the MPC are for standard LTR).

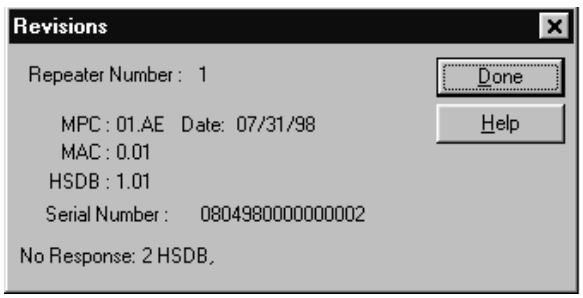


Figure 4-22 REVISIONS

4.5.6 MODE SELECT

The Mode Select window places the repeater either in the Normal mode, Test mode or Diagnostic mode. In the Normal mode, the repeater operates as a normal repeater. In the Test mode or Diagnostic Mode the repeater transmits a test word. This test word is the Test Mode ID setup in the Repeater Information (see Section 4.3.3).

C A U T I O N

*While in the test or diagnostics mode the repeater is "Busy", therefore it is important to place the repeater in **Normal mode** when the Test Mode is no longer required.*

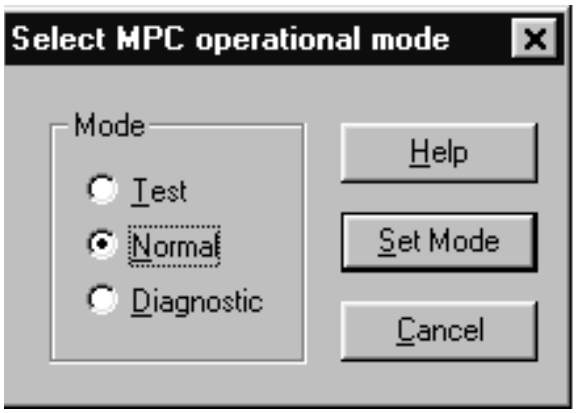


Figure 4-23 MODE SELECT

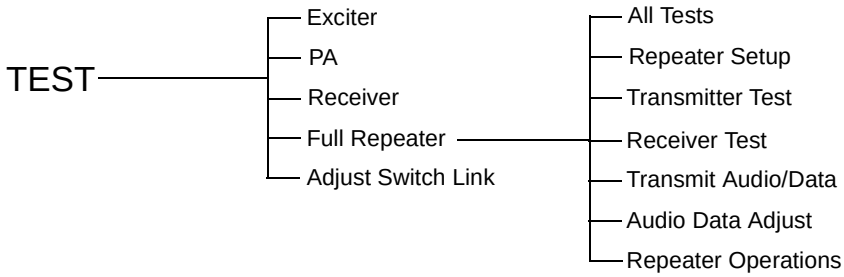


Figure 4-24 TEST PROGRAMMING FLOWCHART

4.6 TEST

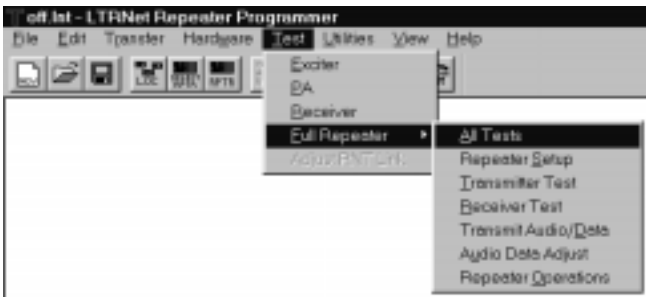
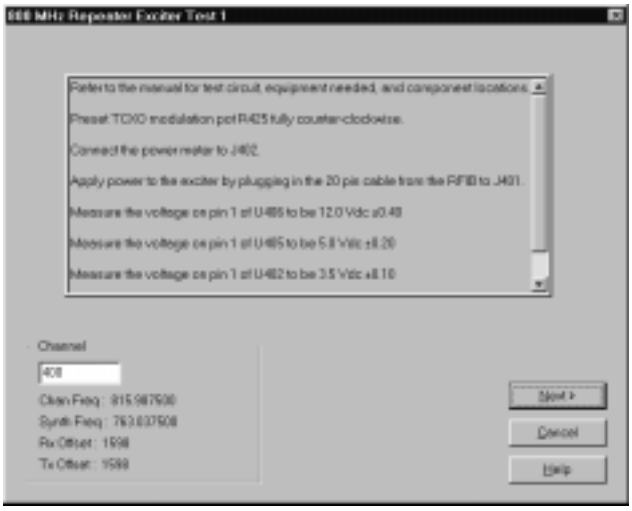


Figure 4-25 TEST MENU



NOTE: Some screens may require scrolling down to read the complete procedure.

4.6.1 EXCITER

This menu selection walks through the Exciter alignment windows. Refer to Section 7.3 for the Exciter alignment and Figure 7-2 for an alignment points diagram and Figure 7-10 for a test setup of the Exciter.

4.6.2 POWER AMPLIFIER

This menu selection walks through the Power Amplifier and RF Interface Board alignment windows. Refer to Sections 7.4 and 7.5 for the PA and RFIB alignment in this manual and Figures 7-3, 7-4, and 7-5 for alignment points diagrams and Figures 7-11 and 7-8 of the Power Amplifier.

4.6.3 RECEIVER

This menu selection walks through the Receiver alignment windows. Refer to Section 7.2 for the Receiver alignment in this manual and Figure 7-1 for an alignment points diagram and Figure 7-9 of the Receiver.

4.6.4 FULL REPEATER

This menu selection walks through the full repeater alignment windows. The Receiver and Exciter portions are performance tests and adjustments. The Audio and Data portions are level adjustments for the Main Audio Card (MAC). Refer to Figure 7-28 for an alignment points diagram for the MAC.

4.7 UTILITIES

Figure 4-26 UTILITIES MENU

4.7.1 COM PORT SETUP

This menu selection has an equivalent icon in the toolbar. This menu selection or icon allows changes to the COM port or baud rate used to send and receive data from the attached Repeater MPC. An interface cable connects the Repeater to the computer (see Figure 4-27).

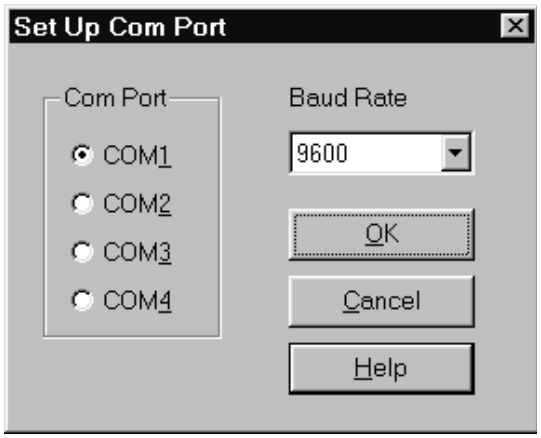


Figure 4-27 SETUP COM PORT

4.7.2 ALARM DISPLAY

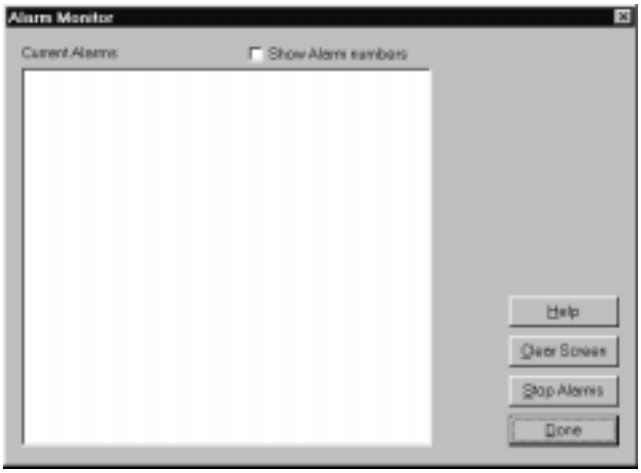


Figure 4-28 ALARM MONITOR

4.8 VIEW

4.8.1 STATUS BAR

The Status Bar is located at the bottom of the screen that displays information about the repeater.

4.8.2 TOOLBAR

The toolbar may be detached (floating) from the main window by dragging the toolbar to a new location with the mouse. It may also be resized (and reshaped) to suit individual preferences. The toolbar may also be moved to any edge of the programmer screen in this manner.

ICON Definitions (left to right)

ICON	Menu	see Section
	File -> New	4.2.1
	File -> Open	4.2.2
	File -> Save	4.2.4
	Edit -> Locality Information	4.3.1
	Edit -> Select Repeater	4.3.2
	Edit -> Repeater Information	4.3.3
	Transfer -> Read Setup Parameters	4.4.1
	Transfer -> Write Setup Parameters	4.4.2
	Hardware -> HSDB Monitor	4.5.1
	Hardware -> Revisions	4.5.5
	Utilities -> COM Port	4.7.1

4.8.3 SAVE SETTINGS ON EXIT

When the menu item View -> Save Settings on Exit is selected, the toolbar location (size and shape) as well as the main window location and size are saved and re-used when the programmer is opened.

4.9 HELP

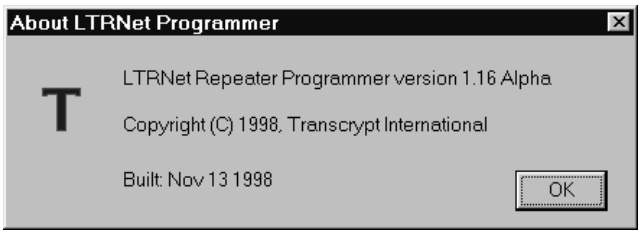
4.9.1 HELP TOPICS

This window contains the contents file of help topics, the index of help topics and a find topic screen.

4.9.2 HELP ON HELP

This window provides information on how to use help.

4.9.3 ABOUT LTR-NET



This menu selection provides information about the programmer software.

SECTION 4 LTR-Net PROGRAMMER

4.1 MENU DISPLAYS

The menus available are listed at the top of the screen (see Figure 4-1). Move the cursor with the mouse to highlight the menu name. Press the left mouse key to view the menu and the mouse to scroll through the menu. Call up the highlighted selection by pressing the left mouse button. The Toolbar provides one-click access to some of the most frequently used menu selections.

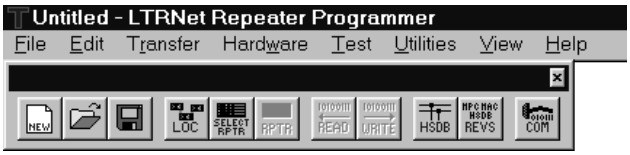


Figure 4-1 MAIN MENU

4.2 FILE MENU

This menu manipulates new or existing files into directories and saves files to be called up at another time.

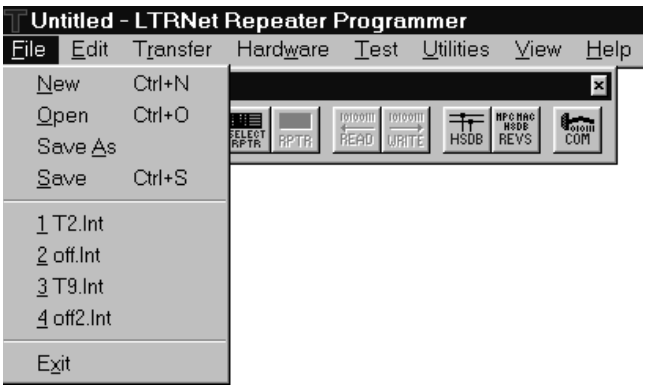


Figure 4-2 FILE MENU

4.2.1 NEW

This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+N. This menu selection or icon erases all Locality and Repeater information in the programmer and loads factory defaults. If the current data has been changed, selecting File -> New or the icon provides the opportunity to save the data before loading the defaults.

4.2.2 OPEN

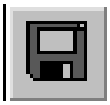
This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+O. This menu selection or icon opens a Locality file and loads its information into the programmer. It brings up a list of Locality data files to select from.

4.2.3 SAVE AS

This menu selection saves the edited version of an existing file loaded in the buffer under a new filename or gives a new file created in the Edit menu a filename.

Figure 4-3 OPEN / SAVE AS / SAVE FILE

4.2.4 SAVE



This menu selection has an equivalent icon in the toolbar and shortcut key Ctrl+S.

4.2.5 EXIT

Exits the repeater program and returns to Windows NT. See Section 4.8.3, View -> Save Setting On Exit to save the toolbar location (size and shape) as well as the main window location and size when the programmer is opened.

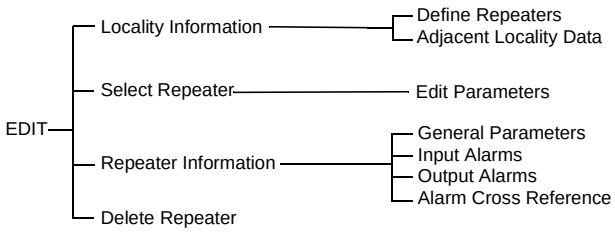


Figure 4-4 EDIT PROGRAMMING FLOWCHART

4.3 EDIT

This menu is used to create new files and set or change the repeater operating parameters. The file-name for the Locality and relevant data is shown in the Title Bar and Status Bar (see Section 4.8.1).

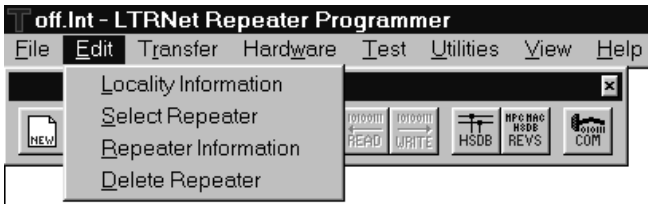


Figure 4-5 EDIT MENU

4.3.1 LOCALITY INFORMATION

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the Locality information screens to Define Repeaters and Adjacent Localities.

Figure 4-6 LOCALITY CONFIGURAITON

Table 4-1 DEFINE REPEATERS PARAMETERS

Delete Entry	Removes the selected Defined Repeater from the list.
Frequency Band	Selects the Locality frequency band, 800 MHz, 800 MHz with offset, (or 900 MHz).
Channel Number	Select a repeater number in the Defined Repeater pane and assign the channel number (1-920). See Appendix A for an 800 MHz Frequency Chart.
Area Bit	If the coverage area includes more than one Switch the area bit is used, this is normally 0.
Transmit Frequency	This is displayed for reference and is determined when the Channel Number is selected.
Receive Frequency	This is displayed for reference and is determined when the Channel Number is selected.
Active	Click on this box to activate the selected Defined Repeater.
Defined Repeaters	Click on a repeater number, then select the channel number and the data is displayed.
OK	Saves the current selections shown and closes the window.
Cancel	Disregards all changes and closes the window.
Help	Displays the Help screen for the parameters in this window.

Figure 4-7 ADJACENT LOCALITY DATA

- Select the Locality ID number for the Locality currently being defined.
- Select a Locality ID for each of the closest Adjacent Localities (0-15).
- Select a Preference number for each Adjacent Locality number as an alternative when leaving the range of this Locality.

4.3.2 SELECT REPEATER

This menu selection has an equivalent icon in the toolbar. This menu selection or icon selects a repeater from the currently defined repeaters within this Locality (see Figure 4-8). Move the cursor with the mouse to highlight the repeater filename and double-click the mouse to open the Edit Parameters window.

Figure 4-8 SELECT REPEATER

Table 4-2 ADJACENT LOCALITY PARAMETERS

This Locality ID	0-1023	This is the ID of the Locality currently being defined.
Locality	0-1023	The Locality ID number of a neighboring Locality.
Preference	1-15	A scale number for the best alternative Locality (1 = Highest, 15 = Lowest).
# (Number)	0-15	Choice of 16 neighboring Localities that can pick-up transmissions.

4.3.3 REPEATER INFORMATION

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the parameter pages for the selected repeater. It allows entry of information specific to this repeater.

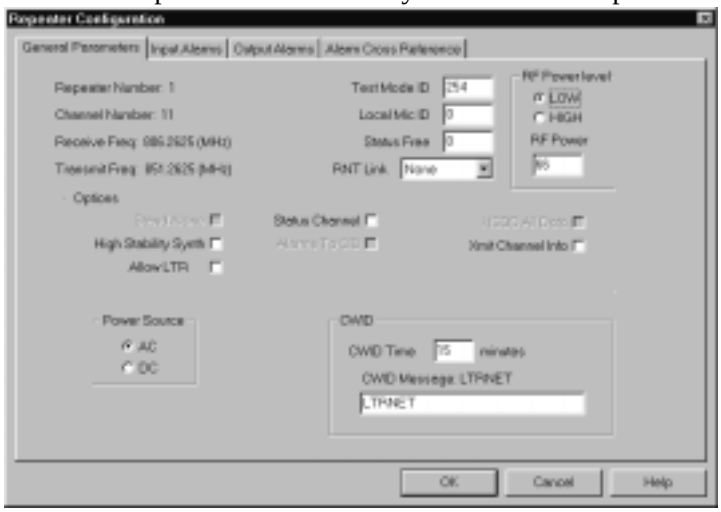


Figure 4-9 REPEATER CONFIGURATION

Table 4-3 GENERAL PARAMETERS

Repeater Number	1-20	Repeater number was established in Locality Configuration.
Channel Number	1-399	Channel number was established in Locality Configuration.
Receive Frequency		Frequency was determined by channel number in Locality Configuration.
Transmit Frequency		Frequency was determined by channel number in Locality Configuration.
Test Mode ID	1-239	Group ID transmitted when the Repeater is in the Test Mode.
Local Mic ID	1-239	Group ID transmitted when the local microphone PTT is active.
Status Free	0=never 20=always	When the number of free channels falls below this value, Status Channel can be used for voice.
RNT Link	None FSK Dig BnB	Data Signaling type for 3000 Series Switch. Frequency Shift Keying RS-232 Blank and Burst (FSK)
RF Power Level	Low, High	Low=25-75, High=75-160. Power level in watts for transmit power output.
Options	Stand Alone	Selected if the repeater is permitted to operate without a connection to the 3000 Series Switch.
	High Stability Synth	Selected if the Receiver and Transmitter use the High Stability Synthesizer.
	Allow LTR	Selected if standard LTR protocol is allowed.
	Status Channel	One repeater at a Locality is designated to transmit update information for all calls occurring at that Locality. Normally not assigned as a Home repeater.
	Alarm to CIB	Routes repeater alarms to the Channel Interface Bus to be detected by the Call Processor and the System and Subscriber Manager.
	HSDB All Data	Repeater receives all the data on the High Speed Data Bus.
	Xmit Channel Info	Repeater sends updates on all repeaters installed in this Locality.
Power Source	AC, DC	The type of primary power source for the Repeater.
CWID Time	0=disabled, 1-30 min	The time interval between CWID transmissions.
CWID Message	Station call letters	This is the FCC station call letters (15 characters/numbers).
OK		Saves the current selections shown and closes the window.
Cancel		Disregards all changes on any of these four screens and closes the window.
Help		Displays the Help screen for the parameters in this window.

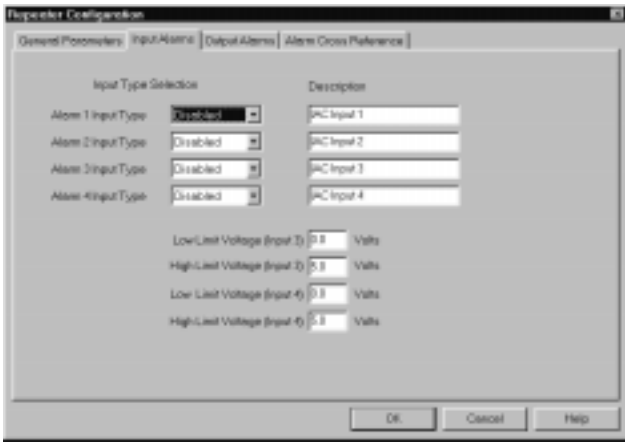


Figure 4-10 INPUT ALARMS

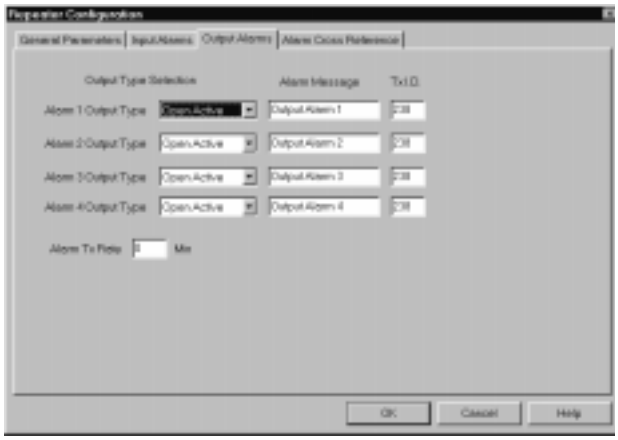


Figure 4-11 OUTPUT ALARMS

Input Alarms

There are four Input Alarms that can be activated by external devices (see Section 6.13). These inputs can be Disabled, Energized or De-Energized. Alarms 3 and 4 can also be Analog Inputs.

- Disabled - The input alarm line is inactive.
- Energized - An open circuit external to the repeater activates the alarm.
- De-energized - A closed circuit external to the repeater activates the alarm.
- Analog - Select the Low and High Limit pairs to trip an Analog Input Alarm. The High Limit must be greater in value than the Low Limit (0.0V-5.0V in 0.1V steps).
- Alarm Description - This is a text string (up to 15 characters) to describe the alarm. The description is automatically changed on the Cross Reference Window.

Output Alarms

Select the operation of the Output Alarm. The available types are:

- Open Active - An active alarm opens (no contact) the output lines.
- Closed Active - An active alarm closes (contact) the output lines.
- Alarm Message

This is a text string (up to 15 characters) to describe the alarm. This text string is sent via Morse code if the alarm input is programmed with a Tx ID and an output is selected in the Cross Reference menu (see Figure 4-13). The Alarm Message is automatically transferred to the Cross Reference window.

- Transmit ID

Each of the 4-alarm outputs can be assigned a Group ID from 1-239. The default setting is 238, 0 (zero) for disabled. This Group ID and the Repeater number identify an alarm that is active. This ID can be programmed into a transceiver so that when the alarm is active, the alarm description is received in Morse code.

- Alarm Transmit Rate

This sets the time interval for transmitting the alarm message in Morse code (0-30 min). If more than one alarm is active, this is the inter-alarm time.

Cross Reference

The cross reference screen selects the Output Alarm that is activated by each Input Alarm. There are up to:

- 48 alarms (0-47)
- 4 (hardware) External Input Alarms
- 18 (software) Internal Alarms (see Table 1-2).
- 26 unused

There are 4 Output Alarms. An alarm condition on any input can cause an Output Alarm. This window configures which Input Alarm activates an Output Alarm.

NOTE: More than one alarm condition can share the same output alarm (see Figure 4-13).

Show Alarm Map

This window displays an Alarm Map that displays those Alarm Outputs that have been mapped in bold type. Double-clicking on these outputs lists the Alarm Inputs that have been assigned to that output.

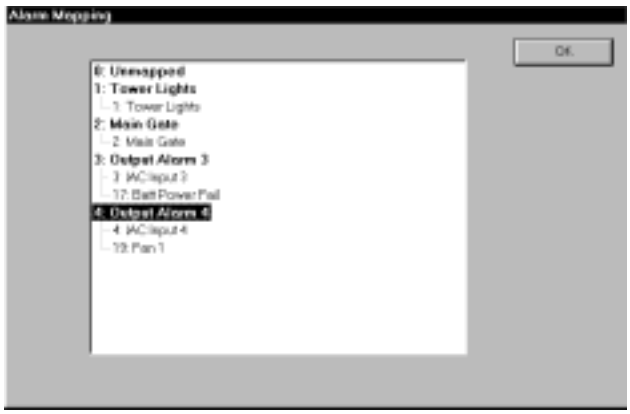


Figure 4-12 ALARM MAPPING

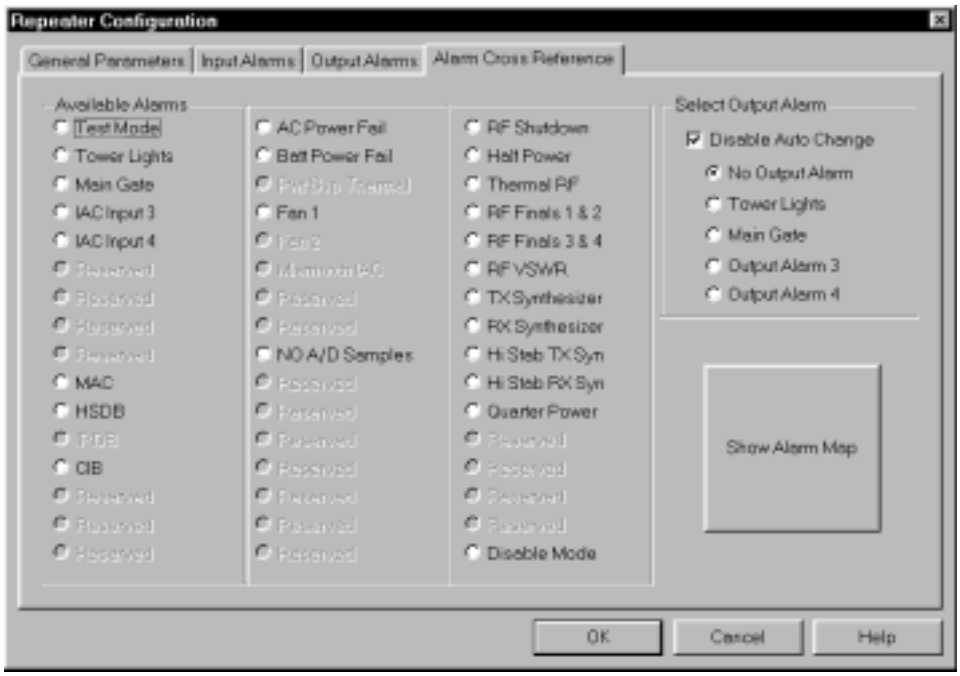


Figure 4-13 ALARM CROSS REFERENCE

4.3.4 DELETE REPEATER

Select the Repeater number to delete from this Locality and press the Delete button.

Figure 4-14 DELETE REPEATER

4.4 TRANSFER

Figure 4-15 TRANSFER MENU

4.4.1 READ SETUP PARAMETERS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon reads the contents of the EEPROM memory of a repeater and loads it into a buffer. The contents of the buffer may then be displayed to show the programming of the repeater.

NOTE: This button is only available if a Locality file is loaded and a repeater is connected.

4.4.2 WRITE SETUP PARAMETERS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon sends the contents of a Locality file to a connected repeater and programs the EEPROM memory in the Main Processor Card (MPC).

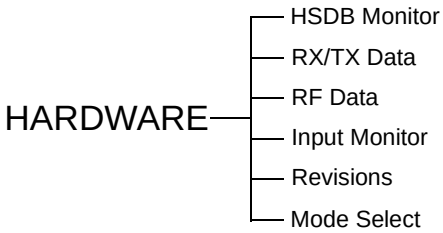


Figure 4-16 HARDWARE PROGRAMMING FLOWCHART

4.5 HARDWARE

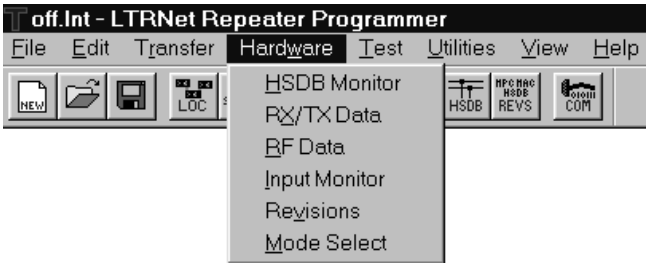


Figure 4-17 HARDWARE MENU

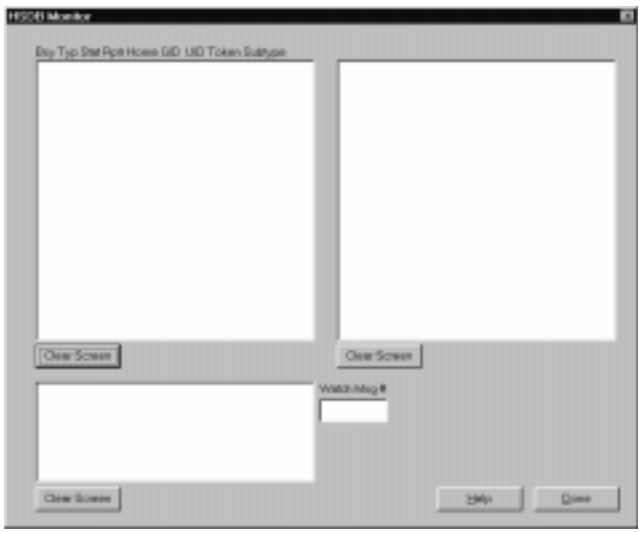


Figure 4-18 HSDB MONITOR

4.5.1 HSDB MONITOR

This menu selection has an equivalent icon in the toolbar. This menu selection or icon brings up the monitor window to view information from the High Speed Data Bus (HSDB). The HSDB connects all repeaters at a Locality and continually sends updates on the status of each repeater. This information window provides a list of all repeaters (1 to 20) at the Locality. If a repeater is not sending data, IDLE is next to the repeater number. The data sent by the repeater is used to determine the Home, GID and UID of destination (mobile) users to receive the call placed by the originator.

The Home column refers to the Home repeater number of the originator, therefore, the Repeater and Home numbers may not be the same number. The GID column refers to the Group ID of the talk group of the originator. The UID is the Unique ID used to identify the originator of Special Calls. Special Call information is listed in the Token and Subtype columns.

4.5.2 RECEIVE/TRANSMIT DATA

This is an information screen used at the repeater Locality while the computer (laptop) is connected to the MPC in the repeater being monitored (see Figure 4-19). This information is contained in the receive data stream exchanged between the repeater and the destination user (mobile/portable) and the data content of the repeater transmit data stream. The message contains data received from the destination and data sent to the mobile/portable by the repeater. The repeater receives the destination's: Unique ID, Home Repeater Number, Group ID, Priority and Status. The time stamp is included because messages are sent continually and this provides a reference for when a data exchange took place. The information sent to the destination in the update message from the repeater includes: Description/Group, Channel In Use, Home Repeater Number, Free Channel and Time Stamp.

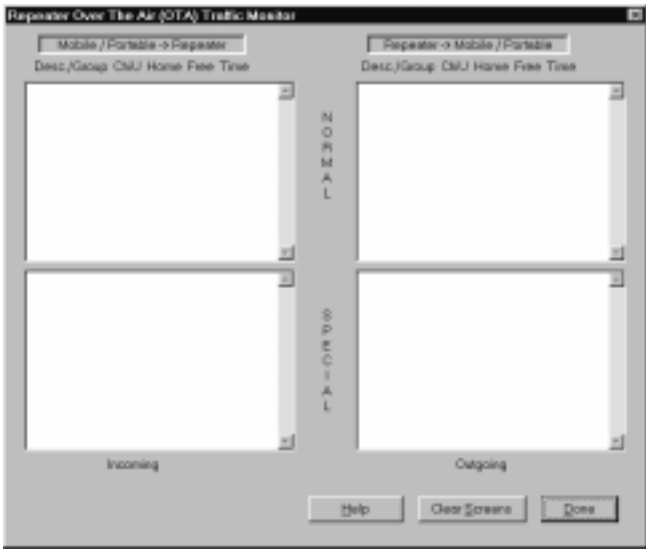


Figure 4-19 REPEATER TRAFFIC MONITOR

4.5.3 RF DATA

Figure 4-20 RF DATA

The RF Line Monitor window shows the state of the lines (see Figure 4-19). These lines are monitored by the A-D converter in the IAC. The normal values for each line are defined as follows.

Synthesizer Lock Lines:	
Exciter Synthesizer	Yes, No
Receive Synthesizer	Yes, No
Exciter High Stability	Yes, No
Receive High Stability	Yes, No
Wideband Audio Output	approx. 200
LO Injection	approx. 200
RSSI	20-150
Fan 1 Current	100-200, 0
Fan 2 Current	100-200, 0
Transmit Parameters:	
Forward Power (Low Power	25-75 Watts
Forward Power (High Power)	75-175 Watts
Reflected Power	0-6 Watts
Final Out 1-2 (ratio)	approx. equal
Final Out 3-4 (ratio)	approx. equal
Chassis Temp	27°C-55°C
Fan	On or Off
Power Supply Temp	22°C-45°C
Battery Voltage	21V-28V

Values with no label are the actual A-D reading. To calculate the voltage on the line, divide the value by 51. Example: Value ÷ 51 = Volts. Any variation from the above values may indicate a problem in that area. Values in this window are relative measurements only.

4.5.4 INPUT MONITOR

This window monitors the two Analog Input lines. It is only used with the 4-Alarm Type IAC, and only if Input 3, Input 4 or both are programmed for "Analog". In addition to the actual or measured value, the Low/High limit data are also displayed. These limits are programmed in the "Edit -> Repeater Information -> Input Alarms" screen (see Figure 4-13). If one of these inputs is not programmed "Analog", the data for that input is blanked.

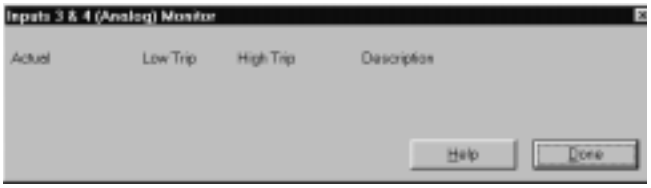


Figure 4-21 INPUT MONITOR

4.5.5 REVISIONS

This menu selection has an equivalent icon in the toolbar. This menu selection or icon displays the current firmware revision information for the MPC, MAC and HSDB. The format is R.V (revision.version) for all modules. The MPC information also includes the release date of the software and the serial number of the repeater. The HSDB version in Figure 4-22 is for J4, pins 5-6 connected in the MPC for LTR-Net (J4, pins 3-4 connected in the MPC are for standard LTR).

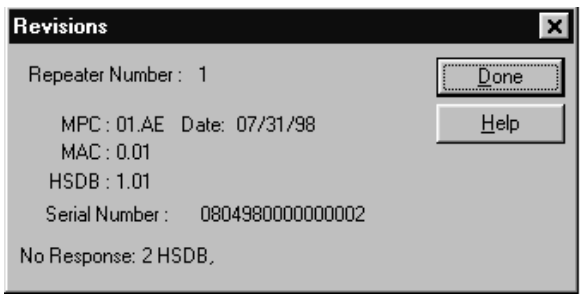


Figure 4-22 REVISIONS

4.5.6 MODE SELECT

The Mode Select window places the repeater either in the Normal mode, Test mode or Diagnostic mode. In the Normal mode, the repeater operates as a normal repeater. In the Test mode or Diagnostic Mode the repeater transmits a test word. This test word is the Test Mode ID setup in the Repeater Information (see Section 4.3.3).

C A U T I O N

*While in the test or diagnostics mode the repeater is "Busy", therefore it is important to place the repeater in **Normal mode** when the Test Mode is no longer required.*

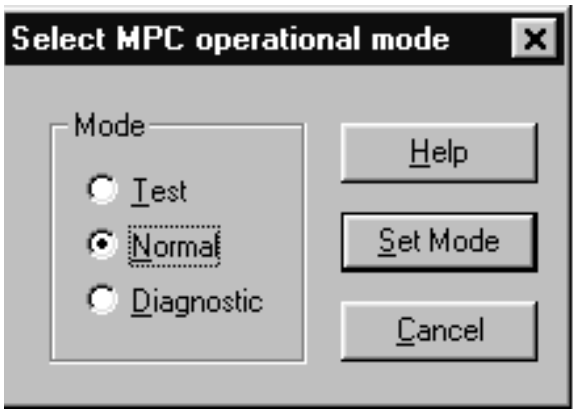


Figure 4-23 MODE SELECT

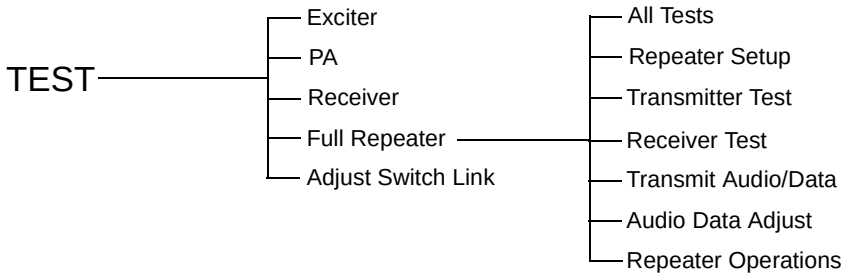


Figure 4-24 TEST PROGRAMMING FLOWCHART

4.6 TEST

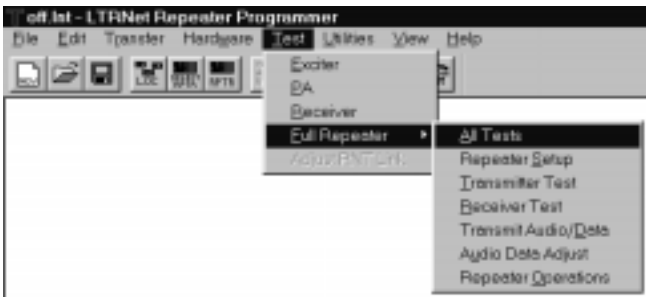
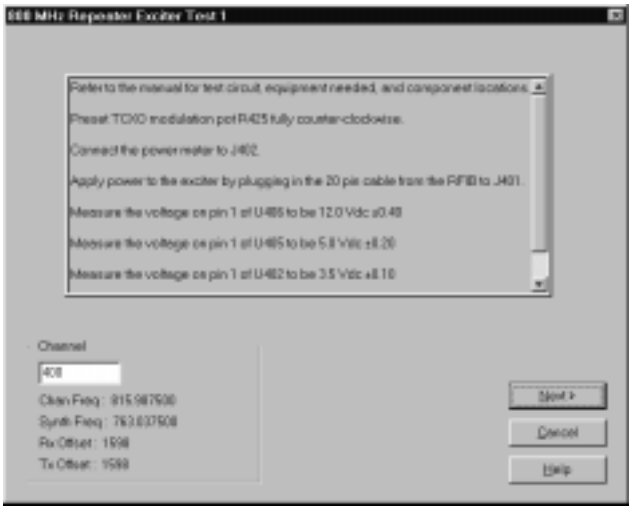


Figure 4-25 TEST MENU



NOTE: Some screens may require scrolling down to read the complete procedure.

4.6.1 EXCITER

This menu selection walks through the Exciter alignment windows. Refer to Section 7.3 for the Exciter alignment and Figure 7-2 for an alignment points diagram and Figure 7-10 for a test setup of the Exciter.

4.6.2 POWER AMPLIFIER

This menu selection walks through the Power Amplifier and RF Interface Board alignment windows. Refer to Sections 7.4 and 7.5 for the PA and RFIB alignment in this manual and Figures 7-3, 7-4, and 7-5 for alignment points diagrams and Figures 7-11 and 7-8 of the Power Amplifier.

4.6.3 RECEIVER

This menu selection walks through the Receiver alignment windows. Refer to Section 7.2 for the Receiver alignment in this manual and Figure 7-1 for an alignment points diagram and Figure 7-9 of the Receiver.

4.6.4 FULL REPEATER

This menu selection walks through the full repeater alignment windows. The Receiver and Exciter portions are performance tests and adjustments. The Audio and Data portions are level adjustments for the Main Audio Card (MAC). Refer to Figure 7-28 for an alignment points diagram for the MAC.

4.7 UTILITIES

Figure 4-26 UTILITIES MENU

4.7.1 COM PORT SETUP

This menu selection has an equivalent icon in the toolbar. This menu selection or icon allows changes to the COM port or baud rate used to send and receive data from the attached Repeater MPC. An interface cable connects the Repeater to the computer (see Figure 4-27).

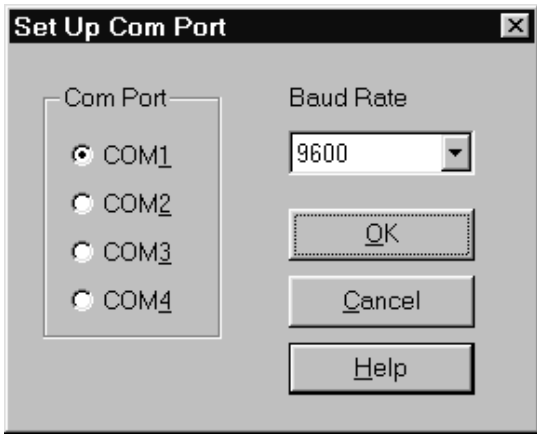


Figure 4-27 SETUP COM PORT

4.7.2 ALARM DISPLAY

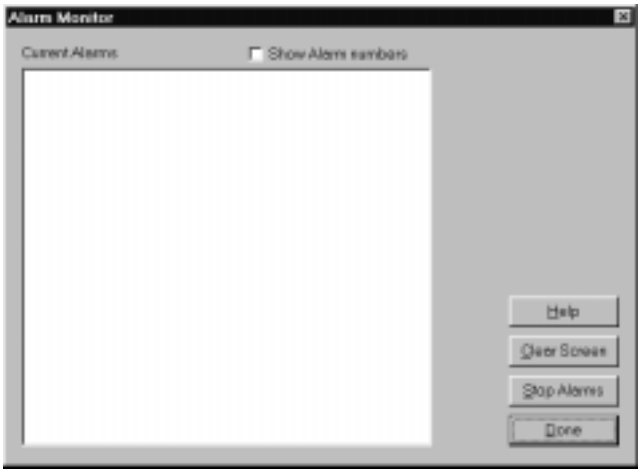


Figure 4-28 ALARM MONITOR

4.8 VIEW

4.8.1 STATUS BAR

The Status Bar is located at the bottom of the screen that displays information about the repeater.

4.8.2 TOOLBAR

The toolbar may be detached (floating) from the main window by dragging the toolbar to a new location with the mouse. It may also be resized (and reshaped) to suit individual preferences. The toolbar may also be moved to any edge of the programmer screen in this manner.

ICON Definitions (left to right)

ICON	Menu	see Section
	File -> New	4.2.1
	File -> Open	4.2.2
	File -> Save	4.2.4
	Edit -> Locality Information	4.3.1
	Edit -> Select Repeater	4.3.2
	Edit -> Repeater Information	4.3.3
	Transfer -> Read Setup Parameters	4.4.1
	Transfer -> Write Setup Parameters	4.4.2
	Hardware -> HSDB Monitor	4.5.1
	Hardware -> Revisions	4.5.5
	Utilities -> COM Port	4.7.1

4.8.3 SAVE SETTINGS ON EXIT

When the menu item View -> Save Settings on Exit is selected, the toolbar location (size and shape) as well as the main window location and size are saved and re-used when the programmer is opened.

4.9 HELP

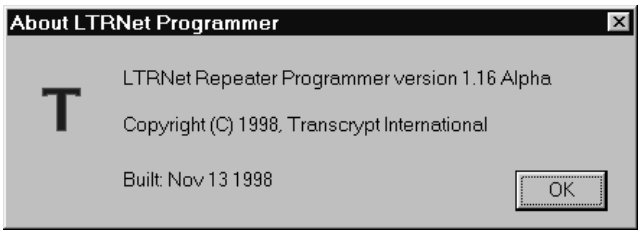
4.9.1 HELP TOPICS

This window contains the contents file of help topics, the index of help topics and a find topic screen.

4.9.2 HELP ON HELP

This window provides information on how to use help.

4.9.3 ABOUT LTR-NET



This menu selection provides information about the programmer software.

SECTION 5 REPEATER PROGRAMMING

5.1 OVERVIEW

The information in this section will assist the user in operating the programmer.

5.1.1 GETTING STARTED

The LTR-Net Programmer is used to configure repeaters for proper operation with the LTR-Net protocol.

From the repeater standpoint, an LTR-Net system consists of one or more repeaters installed in a Locality, a 3000 Series Switch and the necessary interconnects and programming to provide LTR-Net operation.

The LTR-Net Programmer defaults to using CIM1 at 9600 baud to communicate with a repeater. However, this can be changed by selecting Utilities -> COM Port Setup from the menu or by clicking on the  toolbar button.

When the programmer is first started, create a Locality file with the information to program into repeaters at that Locality (see How Do I ... Create a new Site File for information on performing this function, Section 5.3.1).

NOTE: All repeaters installed in a given Locality use the same Locality information, but each has its unique repeater information programmed.

5.1.2 STARTING THE PROGRAM

There are several ways to start the LTR-Net Programmer.

The most convenient method to start the program, pre-loads all the repeater data for a Locality. To do this, use the Explorer to change to the directory containing the Locality Files, then double-click on one of those Locality Files. This starts the programmer and automatically loads the selected file.

Another method of starting the program is by double-clicking on the shortcut  icon. This starts the program with an empty information file (Locality File). A Locality File contains all of the programming information for all repeaters installed at a Locality.

Once files are opened or saved from within the programmer, those filenames appear in the taskbar Documents selection. This allows starting the program by selecting the desired Locality File from the Start Menu.

5.1.3 USING THE TOOLBAR

The Toolbar provides one-click access to some of the most frequently used menu selections (see Section 4.8.2).

5.1.4 LIMITATIONS

The LTR-Net Programmer requires Windows NT 4.0 or later, or Windows 95 or later.

In order to read data from a repeater, first load a Locality File from disk, or create and save a Locality File. Only one LOcality File may be loaded at a time.

The LTR-Net Programmer supports COM1 through COM4, and all of the baud rates currently supported by the MPC. Since the number of data bits, stop bits, and parity are fixed in the MPC, these cannot be changed in the programmer.

5.2 LOCALITY SETUP

The Locality Setup window Defines Repeaters and Sets up Adjacent Locality Data.

5.2.1 GENERAL PARAMETERS

These repeater parameters select the frequency band for the repeater and the channel number. There are 920 channel numbers with transmit/receive frequencies assigned (see Appendix A). The area bit is used to identify a specific system if more than one is operating in a geographical area. Defined repeaters are designated active or inactive in the Locality from this window.

Also included in Locality Setup window are the Input Alarms, Output Alarms and Alarm Cross Reference (see Section 4.7.2).

5.3 HOW DO I

5.3.1 CREATING A NEW SITE FILE

NOTE: At any point in the programming sequence, if the Help button is pressed, a help screen appears.

- Select one of the following:
  File -> New pull down menu
  Ctrl+N

  icon.

  This erases all Locality and Repeater information in the programmer and load factory defaults.

- Select one of the following:
  File -> Locality Information pull down menu

  icon.

  This defines all repeaters in this Locality for frequency band, channel number and activates the unique parameters for each repeater. Define the Adjacent Locality Data for mobiles leaving this Locality area.

- Select one of the following:
  File -> Save pull down menu
  Ctrl+S

  
  icon.

  This assigns a filename to this Site File and the filename appears in the File pull-down menu and in the Open file window.

5.3.2 OPEN AN EXISTING SITE FILE

Select one of the following:
File -> Open pull down menu
Ctrl+O or  icon

Double-click on the filename or click on the filename and click on Open.

5.3.3 MODIFY AN EXIXTING SITE FILE

- Open the existing file to modify (see Section 5.3.2).
- Make the changes to the file.
- Save the file by selecting one of the following:
  File -> Save
  Ctrl+S or  icon.

5.3.4 ADD A REPEATER

- Open the Site File where the repeater is to be added.
  Select Edit -> Locality Information or 

  icon.

- Enter the repeater frequency band, channel number and activate the repeater.

- Select Edit -> Select Repeater or 

  icon.

- Enter the Repeater Setup information.

- Save the file by selecting one of the following:
  File -> Save
  Ctrl+S or  icon.

5.3.5 CHANGE A REPEATER NUMBER

- Open the Site File where the repeater is to be added.
  Select Edit -> Locality Information or 

  icon.

- In the Define Repeaters window, select the new repeater number and add the new information.

- Select the old repeater number and press delete entry.

- Select Edit -> Select Repeater or 

  icon.

- Enter the Repeater Setup information.

- Save the file by selecting one of the following:
  File -> Save
  Ctrl+S or  icon.

SECTION 6 CIRCUIT DESCRIPTION

6.1 RECEIVER

6.1.1 INTRODUCTION

The receiver provides high sensitivity and selectivity reception on any one of the 399 channels in the 896 to 901 MHz band.

The receiver is a double conversion type with intermediate frequencies of 52.95 MHz and 450 kHz. The first injection frequency is stabilized by a temperature compensated crystal oscillator (TCXO) with a frequency stability of ±0.1 PPM from -30°C to +60°C (-22°F to +140° F). Two 3-pole bandpass filters in the front-end reject signals outside the receive band. Two 4-pole crystal filters and one 6-pole ceramic filter establish receiver selectivity (see block diagram Figure 6-1).

6.1.2 REGULATED VOLTAGE SUPPLIES

The +15V DC power source is supplied by the repeater power supply. The +15V supply enters the receiver on J201, pin 1. U206 provides the +12V DC receive voltage to the RF and IF amplifiers. U210 supplies +12V DC to the first injection amplifiers. U207 supplies +12V DC to remaining +12V DC circuits. U208 supplies +6V DC to the remaining circuits.

6.1.3 HELICAL FILTER, RF AMPLIFIER

The receive signal enters the receiver on coaxial connector A201. A helical filter consisting of L201, L202 and L203 is a three-pole bandpass filter tuned to pass only a narrow band of frequencies (896-901 MHz) to the receiver. This filter also attenuates the image and other unwanted frequencies.

Impedance matching between the helical filter and RF amplifier Q201 is provided by C201, C202 and a section of microstrip. Q201 amplifies the receive signal to recover filter losses and increases receiver sensitivity. Biasing for Q201 is provided by R201/R202/R203/R204 and C204 provides RF bypass.

A 1.8 dB attenuator follows amplifier Q201. Additional filtering of the receive signal is provided by 3-pole helical filter L204-L206. A section of microstrip on the collector of Q201 and C205/C207 match the impedance from Q201 to the 3-pole helical filter L204-L206.

6.1.4 FIRST MIXER, CRYSTAL FILTER

First mixer U201 mixes the receive frequency with the first injection frequency to produce the 52.95 MHz first IF. Since low-side injection is used, the injection frequency is 52.95 MHz below the receive frequency. Matching between filter L204-L206 and the mixer is provided by L228, C208 and C372. The output of U201 is matched to Z201 at 52.95 MHz by L207, C209 and C267.

Z201 and Z202 form a two-section, four-pole filter with a center frequency of 52.95 MHz and a -3 dB bandwidth of 8 kHz. This filter attenuates adjacent channels and other signals close to the receive frequency. The filter sections are a matched pair and the dot on the case indicates which leads connect together. Matching with Q202 is provided by C210, L209 and C270.

6.1.5 IF AMPLIFIER, CRYSTAL FILTER

Q202 amplifies the 52.95 MHz IF signal to recover filter and mixer losses and improve receiver sensitivity. Biasing for Q202 is provided by R208/R209/R211/R313 and C211/C212/C213 provide RF bypass. The output of Q202 is matched to crystal filter Z203 at 52.95 MHz by C214, C293 and L211.

Z203 and Z204 form a two-section, four-pole filter with a center frequency of 52.95 MHz and a -3 dB bandwidth of 8 kHz. This filter establishes the selectivity of the receiver by further filtering the 52.95 MHz IF. The filter sections are a matched pair and the dot on the case indicates which leads connect together. Matching with U202 is provided by C215, C216, C301, L225 and R322.

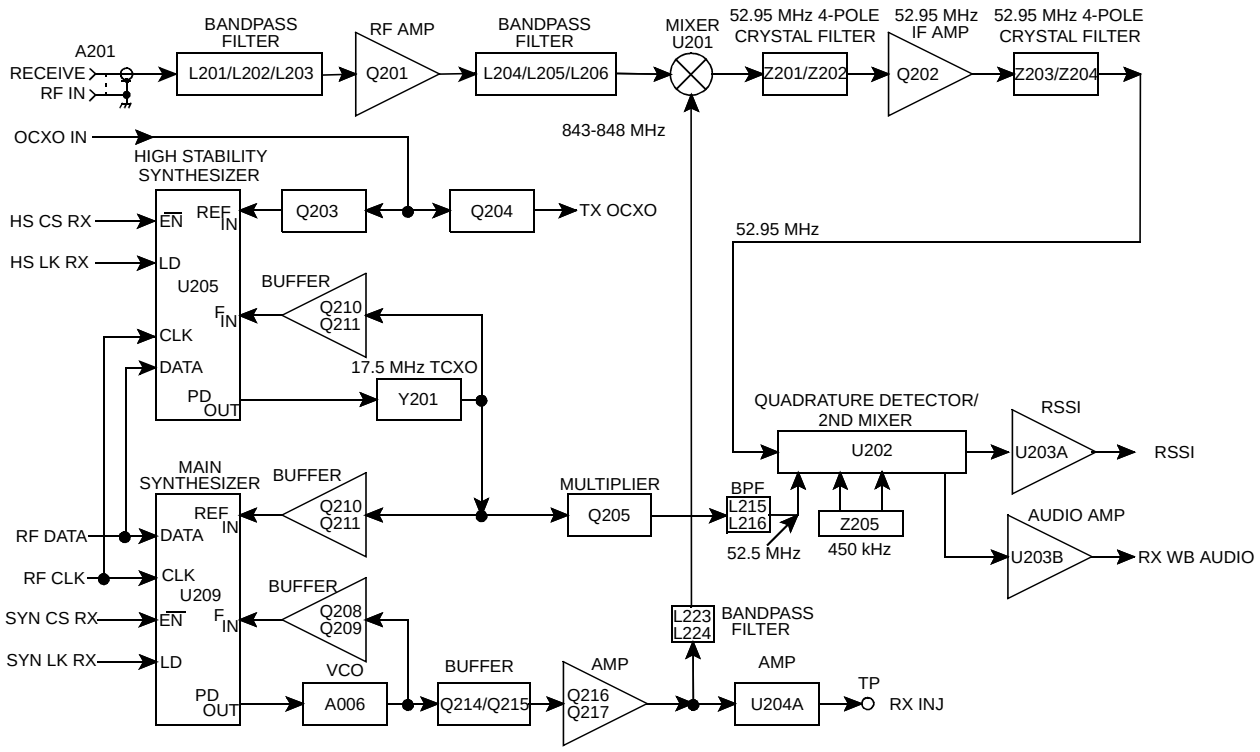


Figure 6-1 RECEIVER BLOCK DIAGRAM

6.1.6 SECOND MIXER/DETECTOR

As shown in Figure 6-2, U202 contains second oscillator, second mixer, limiter, detector and RSSI circuitry. The 52.95 MHz IF signal is mixed with a 52.5 MHz signal produced by TCXO Y201 and tripler Q205. The 17.5 MHz (±0.1 PPM) output of Y201 is fed through C231 to tripler Q205. The tripler passes the third harmonic at 52.5 MHz to the OSC B input of U202.

Biasing of Q205 is provided by R228, R227 and R229. RF choke L214 blocks the flow of RF through R229. An AC voltage divider formed by C236/C235 matches Q205 to the highpass filter. The third harmonic of the TCXO frequency is then used to drive the OSC B input at 52.5 MHz. L215, C237 and L216 form a high pass filter to attenuate frequencies below 52.95 MHz. C222 and C238 match the output of the filter to U202.

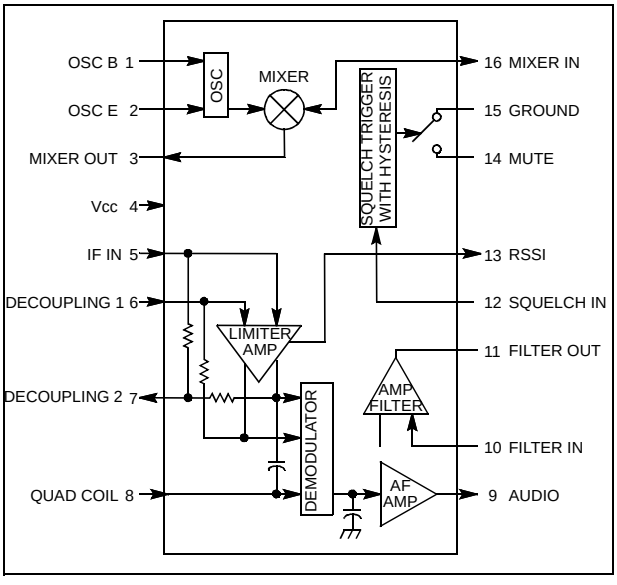


Figure 6-2 U202 BLOCK DIAGRAM

The 450 kHz second IF is then fed to ceramic filter Z205, then to the IF amplifier. The center frequency of Z205 is 450 kHz with a -6 dB bandwidth of 9 kHz used to attenuate wideband noise. The limiter amplifies the 450 kHz signal 92 dB which removes any amplitude fluctuations.

From the limiter, the signal is fed to the quadrature detector. An external phase-shift network connected to U202, pin 8, shifts the phase of one of the detector inputs 90° at 450 kHz (the other inputs are unshifted). When modulation occurs, the frequency of the IF signal changes at an audio rate as does the phase of the shifted signal. The detector, which has no output with a 90° phase shift, converts the phase shift into an audio signal. Z213 is adjusted to provide maximum undistorted output from the detector. The audio signal is then fed out on U202, pin 9.

6.1.7 WIDEBAND AUDIO AMPLIFIER

U203B amplifies the detected audio and data signal. R280/R263 set the gain of the amplifier and R256/R262/R284 provide a DC reference level. C220 bypasses the 450 kHz IF signal and C240 bypasses other frequencies. The output signal is adjusted by R264 and fed to J201, pin 9.

6.1.8 RSSI AMPLIFIER

U202, pin 13 is an output from an internal RSSI (receive signal strength indicator) circuit that provides a current proportional to the strength of the 450 kHz IF signal. The RSSI output is buffered through U203A and the level is adjusted by R261. The DC output signal is then fed to J201, pin 7.

6.1.9 HIGH STABILITY SYNTHESIZER

The high stability synthesizer inputs/outputs are shown in Figures 6-1 and 6-3. The synthesizer contains the R (reference), N, and A counters, phase and lock detectors and counter programming circuitry. The phase detector output of Synthesizer U205, pin 6 is a 10 kHz pulse waveform from 0 to 5V. This signal is integrated to provide a DC tuning voltage for the TCXO. The DC tuning voltage provides the TCXO with the ±0.1 PPM stability of the OCXO (Oven Controlled Crystal Oscillator) see Section 6.3.

The phase detector input signals are generated by counters in U205 that are programmed to divide by a certain number. This programming is provided through J201, pins 18, 19 and 20. The frequency stability of the High Stability synthesizer (TCXO output) is established by the ±0.1 PPM stability of the OCXO drawer. The output from the high stability loop is stable from -40°C to +70°C (-40°F to +158°F). The phase detector in U205 compares the phase and frequency of two input signals; fR and fV. The phase detector generates a 0 to 5V signal. The pulse width of this signal varies depending on the phase difference between fR and fV. This signal is filtered (integrated) by C245/C246/C247/R245/R246 to provide a DC tuning voltage for the TCXO. The voltage at Y201, pin 2 is set for 3.5V when the high stability loop is locked. This is done by adjusting the tuning screw in TCXO Y201.

One input signal to the phase detector in U205 is the reference frequency (fR). This frequency is 1.25 MHz divided by the R (reference) counter to 10 kHz. The 1.25 MHz signal comes from the OCXO drawer to J202. The signal is then fed to two buffer/amplifiers. Q203 provides the OCXO signal to the Receiver and Q204 provides the OCXO signal to the Exciter. The inputs to Q203/Q204 are matched to 50 ohms by R239/R321. DC blocking to Q203 is provided by C224. Bias for Q203 is provided by R219, R217, R218, R220 and R221. C313, C225 and C226 provide RF bypass. The output of Q203 is coupled to U205, pin 20 by C305.

DC blocking to Q204 is provided by C227. Bias for Q204 is provided by R224/R222/R223/R225/R226. C314, C228 and C229 provide RF bypass. The output of Q204 is coupled to the Exciter high stability synthesizer U401 by C230 (see Section 6.2.5).

The other input signal to the phase detector in U205 is from the TCXO frequency divided by the "N" counter and prescaler in U205. The "N" counter is programmed through the synthesizer data line on J201, pin 20. U205 is programmed so that the phase detector input (fV) is identical to the reference frequency (fR). The programming for the High Stability synthesizer does not change with channel selection.

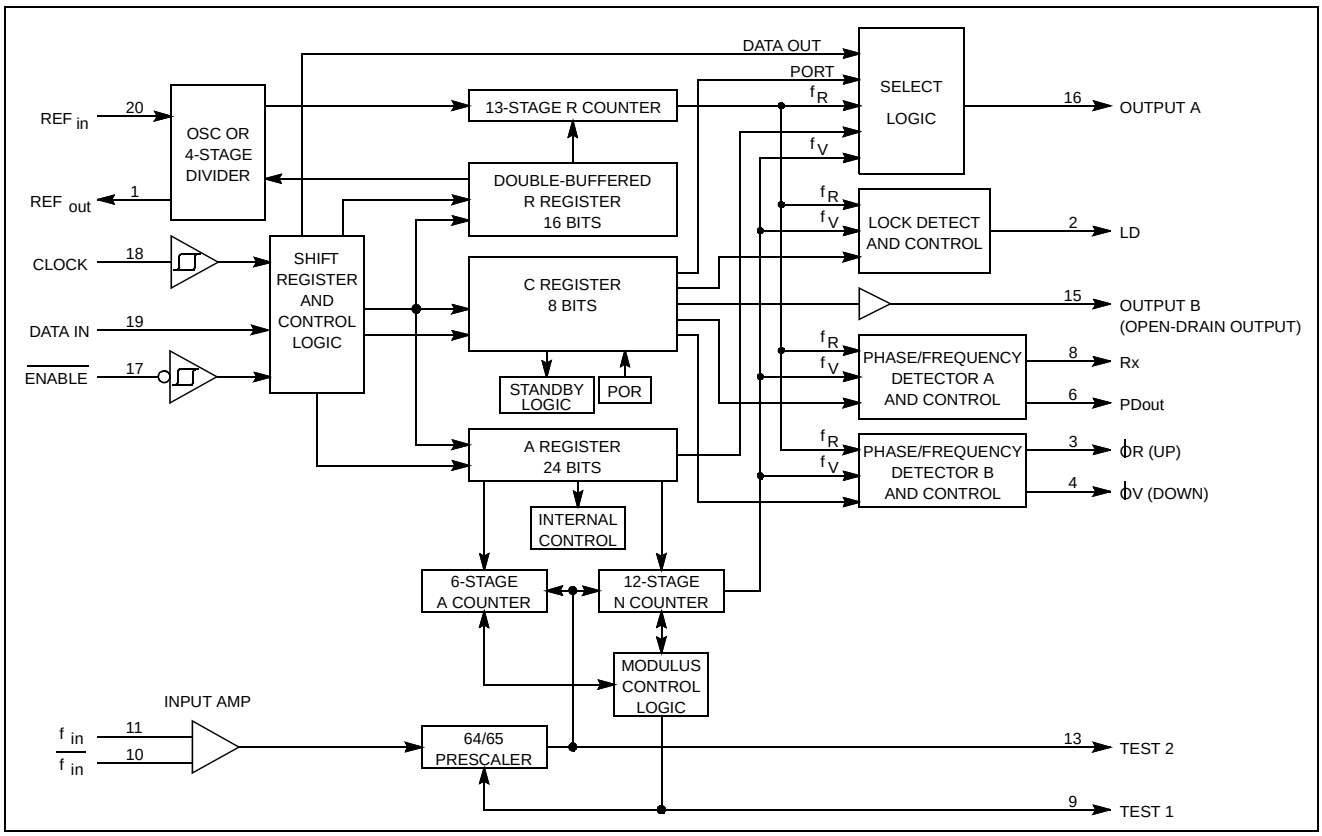


Figure 6-3 SYNTHESIZER BLOCK DIAGRAM

The programming of the counters in U205 is performed by circuitry in the Main Processor Card (MPC), buffered and latched through the Interface Alarm Card (IAC) and fed in to the synthesizer on J201, pin 20 to Data input port U205, pin 19.

Data is loaded into U205 serially on the Data input port U205, pin 19 when U205, pin 17 is low. Data is clocked into the shift registers a bit at a time by a low to high transition on the Clock input port U205, pin 18. The Clock pulses come from the MPC via the IAC to J201, pin 19.

The counter divide numbers are chosen so the TCXO-derived input to the phase detector (f_V) is the same frequency as the OCXO-derived input (f_R). The f_R input is produced by dividing the 1.25 MHz OCXO frequency by 125. This produces a reference frequency (f_R) of 10 kHz.

The f_V input is produced by dividing the TCXO frequency using the prescaler and N counter in U205. The prescaler divides by 64 or 65. The divide number of the prescaler is controlled by the N and A counters in U205.

Both the N and A counters begin counting down from their programmed number. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle repeats. The A counter is always programmed with a smaller number than the N counter. While the A counter is counting down, the prescaler divides by 65. Then when the A counter is halted, the prescaler divides by 64. As an example: To produce the frequency of 10 kHz, the N and A counters are programmed as follows:

N = 27 A = 22

To determine the overall divide number of the prescaler and N counter, the number of TCXO output pulses required to produce one N counter output pulse can be counted. The prescaler divides by 65 for 65 x 22 or 1430 input pulses. It then divides by 64 for 64 x (27 - 22) or 320 input pulses. The overall divide number K is therefore (320 + 1430) or 1750. The TCXO frequency of 17.5000 MHz divided by 1750 equals 10 kHz which is the fR input to the phase detector. The overall divide number K can also be determined by the formula:

K = 64N + A

Where, N = N counter divide number
A = A counter divide number.

6.1.10 LOCK DETECT

When the synthesizer is locked on frequency, the Lock Detect output on U205, pin 2 is a logic high voltage with narrow negative-going pulses. When the synthesizer is unlocked, the negative- going pulses are much wider, the width may vary at a rate determined by the frequency difference of fV and fR. The lock detect pulses are applied to J201, pin 19 and sent to the RF Interface on J102, pin 19 for detection and sampling in the IAC.

6.1.11 BUFFER AMPLIFIER

A cascode amplifier formed by Q206 and Q207 provides amplification and also isolation between the TCXO and Synthesizer U205. A cascode amplifier is used because it provides high reverse isolation. The input signal to this amplifier is from TCXO Y201. C250 provides DC blocking. Bias for the amplifier is provided by R241, R242, R243, R244 and R240. L217 is an RF choke. RF bypass is provided by C244, C249 and C248. The output of Q206/Q207 is coupled to U205 by C306

6.1.12 VCO (A006)

The VCO (Voltage-Controlled Oscillator) is formed by Q802 circuitry and a resonator consisting of L220 in the Receiver. The adjusting screw in L220 tunes the tank circuit to the desired frequency range. The VCO oscillates in a frequency range from 843-848 MHz. Biasing of Q802 is provided by R805, R806 and R807. AC voltage divider C812 and C813 initiates and maintains oscillation. C803 couples Q802 to resonator L220 that provides the shunt inductance of the tank circuit. The shunt capacitance of the tank circuit is made primarily by C804 in series with CR802.

The VCO frequency is controlled by a DC voltage across varactor diode CR802. As voltage across a reverse-biased varactor diode increases, its capacitance decreases. Therefore, VCO frequency increases as the control voltage increases. The control line is RF isolated from tank circuit by choke L804. The amount of frequency change produced by CR802 is controlled by series capacitor C804.

6.1.13 ACTIVE FILTER

Q801 functions as a capacitance multiplier to provide filtering of the 12V supply to Q802. R801 and R802 provide transistor bias, and C809 provides the capacitance that is effectively multiplied by the gain of Q801. If a noise pulse or other voltage change appears on the collector, the base voltage does not change because of C809. Therefore, the base current does not change and transistor current remains constant. R803 decouples the VCO output from AC ground. L803 is an RF choke and C807, C808, C810 and C811 provide RF bypass.

6.1.14 BUFFER

A cascode amplifier formed by Q208/Q209 provides amplification and isolation between the VCO and synthesizer. A cascode amplifier is used because it provides high gain, high isolation and consumes only a small amount of power. The input signal to this amplifier is coupled from the VCO RF output on pin 4. DC blocking to the VCO is provided by C268 and to the buffer by C261. Bias for the amplifier is provided by R275, R279, R278 and R277. Q209 is a common-emitter amplifier and Q208 is a common-base with C260 providing RF bypass. L219 provides some filtering of the cascode output. R273 lowers the Q of L219. The output of the amplifier is coupled by C309 to U209, pin 11.

6.1.15 SYNTHESIZER

The synthesizer inputs/outputs are shown in Figures 6-1 and 6-3. The synthesizer output signal is the receiver first injection frequency. This signal is produced by a VCO (voltage-controller oscillator). The frequency of this oscillator is controlled by a DC voltage. This DC voltage is generated by integrating the pulses from the phase detector in synthesizer chip U209. This integration is performed by the synthesizer loop filter which is made up of C805, C806 and R804 in the VCO circuitry.

Frequencies are selected by programming counters in U209 to divide by a certain number. This programming is provided through J201, pins 12, 18 and 20. The frequency stability of the synthesizer is established by the ±0.1 PPM stability of the high stability synthesizer loop consisting of OCXO, Synthesizer U205, Y201 and Q206/Q207. The output from the high stability loop is stable from -40°C to +70°C (-40°F to +158°F).

The VCO frequency of A006 is controlled by a DC voltage produced by integrating the phase detector output pulses of U209. The phase detector senses the phase and frequency of two input signals (fR and fV) and causes the VCO control voltage to increase or decrease if they are not the same. When the frequencies are the same the VCO is "locked" on frequency.

One input signal to the phase detector in U209 is the reference frequency (fR). This is the 17.5 MHz TCXO frequency divided by the R (reference) counter to the channel spacing or 12.5 kHz.

The other input signal to the phase detector in U209 is from the VCO frequency divided down by the "N" counter and prescaler in synthesizer U209 to 12.5 kHz. The "N" counter is programmed through the synthesizer data line on J201, pin 20. U209 is programmed so that the phase detector input (fV) is identical to the reference frequency (fR) (12.5 kHz) when the VCO is locked on the correct frequency.

The synthesizer contains the R (reference), N, and A counters, phase and lock detectors and counter programming circuitry. Frequencies are selected by programming the three counters in U209 to divide by assigned numbers. The programming of these counters is performed by circuitry in the Main Processor Card (MPC), which is buffered and latched through the Interface Alarm Card (IAC) and fed into the synthesizer on J201, pin 20 to Data input port U209, pin 19.

Data is loaded into U209 serially on the Data input port U209, pin 19. Data is clocked into the shift registers a bit at a time by a low to high transition on the Clock input port U209, pin 18. The Clock pulses come from the MPC via the IAC to J201, pin 18.

As previously stated, the counter divide numbers are chosen so that when the VCO is operating on the correct frequency, the VCO-derived input to the phase detector (fV) is the same frequency as the TCXO-derived input (fR) which is 12.5 kHz.

The fR input is produced by dividing the 17.5 MHz TCXO frequency by 1400. This division is done by the "R" counter in U209. The counter always divides by 1400 regardless of the channel number. This produces a reference frequency (fR) of 12.5 kHz. Since the VCO is on frequency (receive frequency minus 52.95 MHz) and no multiplication is used, the channel frequencies change in 12.5 kHz steps and the reference frequency (fR) is 12.5 kHz for all channels selected by this receiver.

The fV input is produced by dividing the VCO frequency using the prescaler and N counter in U209. The prescaler divides by 64 or 65. The divide number of the prescaler is controlled by the N and A counters in U209.

The N and A counters function as follows: both the N and A counters begin counting down from their programmed number. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle repeats. The A counter is always programmed with a smaller number than the N counter. While the A counter is counting down, the prescaler divides by 65. Then when the A counter is halted, the prescaler divides by 64.

Example: Assume a receive frequency of 898.5000 MHz (channel 200). Since the VCO is 52.95 MHz below the receive frequency it must be 845.5500 MHz for channel 200. To produce this frequency, the N and A counters are programmed as follows:

N = 1056 A = 60

NOTE: Section 8.2.5 describes how the N and A counter numbers are calculated for other channels.

To determine the overall divide number of the prescaler and N counter, the number of VCO output pulses required to produce one N counter output pulse can be counted. In this example, the prescaler divides by 65 for 65 x 60 or 3,900 input pulses. It then divides by 64 for 64 x (1056 - 60) or 63,744 input pulses.

The overall divide number K is therefore (3,900 + 63,744) or 67,644. The VCO frequency of 845.5500 MHz divided by 67,644 equals 12.5 kHz which is the fR input to the phase detector. The overall divide number K can also be determined by the following formula: **K = 64N + A**

Where,
N = N counter divide number and
A = A counter divide number.

6.1.16 BUFFER AMPLIFIER

A cascode amplifier formed by Q210 and Q211 provides amplification and also isolation between the TCXO and Synthesizer U209. A cascode amplifier is used because it provides high reverse isolation. The input signal to this amplifier is from TCXO Y201. C254 provides DC blocking. Bias for the amplifier is provided by R312, R248, R249, R251 and R250. L218 is an RF choke. RF bypass is provided by C251, C252 and C253. The output of Q210/Q211 is coupled to U209 by C307.

6.1.17 LOCK DETECT

When the synthesizer is locked on frequency, the Lock Detect on U209, pin 2 is a high voltage with very narrow negative-going pulses. Then when the synthesizer is unlocked, these pulses become much wider, the width may vary at a rate determined by the frequency difference of fV and fR.

The lock detect pulses are filtered by R270/C325 and applied to J201, pin 14 and the RF Interface on J103, pin 14 for detection and sampling in the IAC.

6.1.18 BUFFER AMPLIFIER

A cascode amplifier formed by Q214 and Q215 provides amplification and also isolation between the VCO and Receiver RF stages. A cascode amplifier is used because it provides high reverse isolation. The input signal to this amplifier is coupled from VCO A006 by C268. C268 also provides DC blocking. Bias for the amplifier is provided by R294, R311, R290, R291 and R292. L222 is an RF choke and R293 lowers the Q of the coil. RF bypass is provided by C274, C356, C310, C272, C273 and C335. The output of Q214/Q215 is matched to the Receiver RF stages by C275, C276 and two sections of microstrip.

6.1.19 RF AMPLIFIERS

U210 provides the +12V source for these amplifiers. RF amplifier Q216 is biased by R296 and R295. C278 provides RF bypass from the DC line and R297 provides supply voltage isolation. A section of microstrip on the collector acts as an RF inductor. Q216 is matched to Q217 by C277, C263, C288 and two sections of microstrip.

RF amplifier/buffer Q217 is similar in design to Q216. The output of Q217 is matched to the 3 dB attenuator made up of R285/R286/R287 by two sections of microstrip and C280 provides DC blocking. L223/L224 are tuned to the receive frequency minus 52.95 MHz and passed to Mixer U201. This injection frequency is also coupled through C284 to U204A. CR201, R255, R254 provide DC input to U204A, pin 3. The output of U204A, pin 1 is connected to J201, pin 13 for a receive injection test point and connected to the RF Interface Board on J103, pin 13.

6.2 EXCITER

6.2.1 VCO (A007)

The VCO (Voltage-Controlled Oscillator) is formed by Q802, associated circuitry and a resonator consisting of L404 in the Exciter. The screw in L404 tunes the tank circuit to the desired frequency range. The VCO oscillates in a frequency range from 935-940 MHz. Biasing of Q802 is provided by R805, R806 and R807. An AC voltage divider formed by C812 and C813 initiates and maintains oscillation.

C803 couples Q802 to resonator L404 in the Exciter. Resonator L404 provides the shunt inductance of the tank circuit. The shunt capacitance of the tank circuit is made primarily of C804 in series with CR802. RF choke L805 completes the DC bias path to ground.

The VCO frequency is controlled in part by DC voltage across varactor diode CR802. As voltage across a reverse-biased varactor diode increases, its capacitance decreases. Therefore, VCO frequency increases as the control voltage increases. The control line is RF isolated from tank circuit by choke L804. The amount of frequency change produced by CR802 is controlled by series capacitor C804.

The frequency is modulated in a similar manner. The transmit audio/data signal is applied across varactor diode CR801 to vary the VCO frequency at an audio rate. C802 in series with CR801 determine the amount of modulation produced by the audio signal.

6.2.2 EXCITER VCO AND TCXO FREQUENCY MODULATION

Both the VCO and TCXO are modulated in order to achieve the required frequency response. If only the VCO was modulated, the phase detector in U403 would sense the frequency change and increase or decrease the VCO control voltage to counteract the change (at the lower audio frequencies inside the closed loop bandwidth of the synthesizer). If only the TCXO frequency was modulated, the VCO would not track the higher audio frequencies (those beyond the closed loop bandwidth of the synthesizer). However, by modulating both the VCO and TCXO a flat audio response is achieved. Potentiometers R425 and R446 balance the modulating signals.

There are two 3.5V sources on the Exciter board; one is a reference for the modulation amplifier to the VCO, the other is for the modulation amplifier to the TCXO.

The reference voltage on U402B, pin 5 is sent to buffer U407B, J401, pin 9 to RFIB connector J102, pin 9 and out on J101, pin 14 to J2, pin 27 on the backplane, to the bottom connectors via pin 7 and finally to the MAC on P100, pin 7.

With reference to the ground on the Exciter, the 3.5V reference stability is maintained by U126B/C/D on the MAC. The 3.5V DC passes through summing amplifier U129B and transmit modulation gate U118D to P100, pin 29 (Tx MOD). P100, pin 29 is connected to backplane connector J2, pin 8 and RFIB connector J101, pin 22 to J102, pin 13. The transmit modulation and 3.5V reference enter the Exciter on J401, pin 13 and is routed to U402B,pin 6. R425 sets the TCXO modulation level. The modulation signal along with the 3.5V DC is applied to U402A, pin 2.

6.2.3 ACTIVE FILTER

Q801 functions as a capacitance multiplier to provide filtering of the 12V supply to Q802. R801 and R802 provide transistor bias, and C809 provides capacitance that is effectively multiplied by the gain of Q801. If a noise pulse or other quick voltage change appears on the collector, base voltage does not change significantly because of C809. Therefore, the base current does not change and transistor current remains constant. R803 decouples the VCO output from AC ground. L803 is an RF choke and C807/C808/C810/C811 provide RF bypass.

6.2.4 BUFFER

A cascode amplifier formed by Q406/Q407 provides amplification and isolation between the VCO and synthesizer. A cascode amplifier is used because it provides high reverse isolation. The input signal to this amplifier is tapped from the VCO RF output. DC blocking and coupling to the VCO is provided by C441 and to the buffer by C433. Bias for the amplifier is provided by R451, R453, R454 and R455. Q407 is a common-emitter amplifier and Q406 is a common-base with C432 providing RF bypass. L403 decouples the output from AC ground and R452 lowers the Q of L403. The amplifier is coupled by C429 and C499 to U403, pin 11.

6.2.5 HIGH STABILITY SYNTHESIZER

The High Stability synthesizer inputs/outputs are shown in Figures 6-3 and 6-4. The synthesizer contains the R (reference), N, and A counters, phase and lock detectors and counter programming circuitry. The phase detector output signal of Synthesizer U401, pin 6 is a 10 kHz pulse waveform from 0 to 5V.

This signal is integrated to provide a DC tuning voltage for the TCXO. The DC tuning voltage provides the TCXO with the ±0.1 PPM stability of the OCXO (see Section 6.3).

The phase detector output signal is generated by counters in U401 programmed to divide by a certain number. This programming is provided through J401, pins 18, 19 and 20. The frequency stability of the High Stability synthesizer is established by the ±0.1 PPM stability of the OCXO, stable from -40°C to +70°C (-40°F to +158°F).

The phase detector in U401 compares the phase and frequency of two input signals; fR and fV. The phase detector generates a 0 to 5V signal. The pulse width of this signal varies depending on the phase difference between fR and fV. This signal is filtered (integrated) by C406/C407/C408/R411/R412 to provide a DC tuning voltage for the TCXO. The voltage at U402A, pin 1 is set for 3.5V when the high stability loop is locked. This is done by adjusting the tuning screw in TCXO Y401.

One input signal is the reference frequency (fR). This frequency is the 1.25 MHz OCXO frequency divided by the reference counter to 10 kHz.

The other input signal to the phase detector in U401 is from the TCXO frequency divided by the "N" counter and prescaler in U401. The N counter is programmed through the synthesizer data line on J401, pin 20. U401 is programmed so the phase detector input (fV) is identical to the reference frequency (fR). High Stability synthesizer programming does not change with channel selection.

The programming of the counters in U401 is performed by circuitry in the Main Processor Card (MPC), buffered and latched through the Interface Alarm Card (IAC) and fed in to the synthesizer on J401, pin 20 to Data input port U401, pin 19.

Data is loaded into U401 serially on the Data input port U401, pin 19 when U401, pin 17 is low. Data is clocked into the shift registers a bit at a time by a low to high transition on the Clock input port U401, pin 18. The Clock pulses come from the MPC via the IAC to J401, pin 19.

The counter divide numbers are chosen so the TCXO derived input to the phase detector (fV) is the same frequency as the OCXO derived input (fR). The fR input is produced by dividing the 1.25 MHz OCXO frequency by 125 to produce a reference frequency (fR) of 10 kHz.

The fV input is produced by dividing the TCXO frequency using the prescaler and N counter in U401. The prescaler divides by 64 or 65. The prescaler divide number is controlled by the N and A counters in U401. The N and A counters function as follows:

Both the N and A counters begin counting down from their programmed number. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle repeats. The A counter is always programmed with a smaller number than the N counter. While the A counter is counting down, the prescaler divides by 65. Then when the A counter is halted, the prescaler divides by 64.

Example: To produce the 10 kHz frequency, the N and A counters are programmed as follows:

N = 27 A = 22

To determine the overall divide number of the prescaler and N counter, the number of TCXO output pulses required to produce one N counter output pulse can be counted. In this example, the prescaler divides by 65 for 65 x 22 or 1430 input pulses. It then divides by 64 for 64 x (27 - 22) or 320 input pulses. The overall divide number K is therefore (320 + 1430) or 1750. The TCXO frequency of 17.5000 MHz divided by 1750 equals 10 kHz which is the fR input to the phase detector. The overall divide number K can also be determined by the following formula:

K = 64N + A

Where,
N = N counter divide number and
A = A counter divide number.

6.2.6 LOCK DETECT

When the synthesizer is locked on frequency, the Lock Detect output on U401, pin 2 is a logic high voltage with narrow negative-going pulses. When the synthesizer is unlocked, the negative- going pulses are much wider, the width may vary at a rate determined by the frequency difference of f_V and f_R. The lock detect pulses of U401 are filtered by R407/C401 and applied to J401, pin 17, then sent to the RFIB on J102, pin 17 for detection.

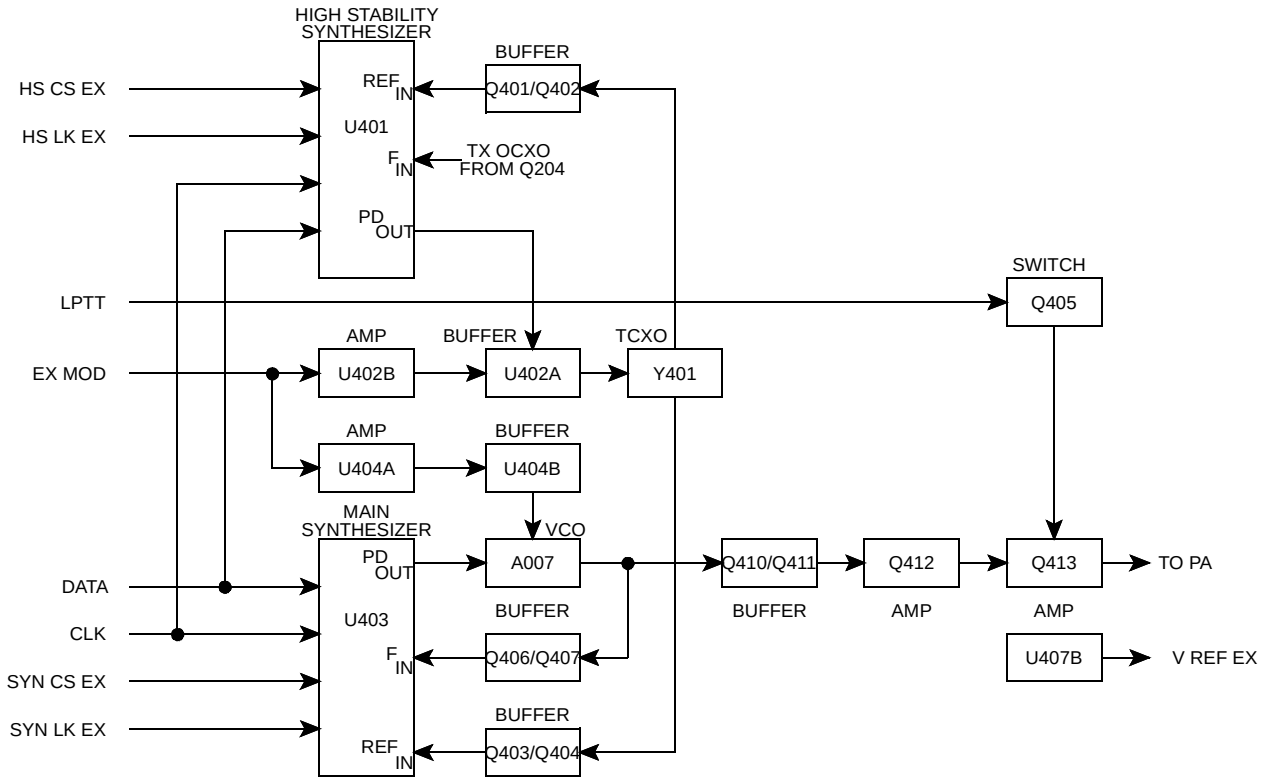


Figure 6-4 EXCITER BLOCK DIAGRAM

6.2.7 BUFFER AMPLIFIER

A cascode amplifier formed by Q401 and Q402 provides amplification and also isolation between the TCXO and Synthesizer U401. A cascode amplifier is used because it provides high gain, high isolation and consumes only a small amount of power. The input signal to this amplifier is coupled from TCXO Y401, pin 5 by C415. C415 also provides DC blocking. Bias for the amplifier is provided by R420, R421, R422, R423 and R418. L401 is an RF choke. RF bypass is provided by C411, C413 and C414. The output of Q401/Q402 is coupled to U401, pin 11 by C412.

6.2.8 EXCITER SYNTHESIZER

The synthesizer inputs/outputs are shown in Figures 6-3 and 6-4. The synthesizer output signal is the transmit frequency. This signal is produced by a VCO (voltage-controller oscillator) that is frequency controlled by a DC voltage produced by synthesizer chip U403. This DC voltage is filtered by a loop filter made up of C805, C806 and R804 in the VCO circuitry.

Frequencies are selected by programming counters in U403 to divide by a certain number. This programming is provided through J401, pins 12, 19 and 20. The frequency stability of the synthesizer is established by the ±0.1 PPM stability of the high stability loop that is stable from -40°C to +70°C (-40°F to +158°F).

The VCO frequency of A007 is controlled by a DC voltage produced by integrating the phase detector output pulses of U403. The phase detector senses the phase and frequency of two input signals and causes the VCO control voltage to increase or decrease if they are not the same. When the frequencies are the same, the VCO is then "locked" on frequency.

The synthesizer contains the R (reference), N, and A counters, phase and lock detectors and counter programming circuitry.

One input signal to the phase detector in U403 is the reference frequency (f_R). This frequency is the 17.5 MHz TCXO frequency divided by the reference counter to the channel spacing or 12.5 kHz. The other input signal (f_V) is the VCO frequency divided by the prescaler and the "N" counter in U403. The counters are programmed through the synthesizer data line on J401, pin 20. Each channel is programmed by a divide number so the phase detector input is identical to the reference frequency (f_R) when the VCO is locked on the correct frequency.

Frequencies are selected by programming the three counters in U403 to divide by assigned number. The programming of these counters is performed by circuitry in the Main Processor Card (MPC), buffered and latched through the Interface Alarm Card (IAC) and fed in to the synthesizer on J401, pin 20 to Data input port U403, pin 19.

Data is loaded into U403 serially on the Data input port U403, pin 19 when U403, pin 17 is low. Data is clocked into the shift registers a bit at a time by a low to high transition on the Clock input port U403, pin 18. The Clock pulses come from the MPC via the IAC to J401, pin 19.

As previously stated, the counter divide numbers are chosen so that when the VCO is operating on the correct frequency, the VCO-derived input to the phase detector (f_V) is the same frequency as the TCXO-derived input (f_R). The f_R input is produced by dividing the 17.5 MHz TCXO frequency by 1187. The R counter divides by 1187 regardless of the channel number. This produces a reference frequency (f_R) of 12.5 kHz. Since the VCO is on frequency and no multiplication is used, channel frequencies change in 12.5 kHz steps. The reference frequency is 12.5 kHz for all channels selected by this Exciter.

The f_V input is produced by dividing the VCO frequency using the prescaler and N counter in U403. The prescaler divides by 64 or 65. The divide number of the prescaler is controlled by the N and A counters in U403. The N and A counters function as follows:

Both the N and A counters begin counting down from their programmed number. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle repeats. The A counter is always programmed with a smaller number than the N counter. While the A counter is counting down, the prescaler divides by 65. Then when the A counter is halted, the prescaler divides by 64.

Example: To illustrate the operation of these counters, assume a transmit frequency of 937.5000 MHz (channel 200). Since the VCO is on the channel transmit frequency, this frequency is used. To produce this frequency, the N and A counters are programmed as follows:

N = 1171 A = 56

To determine the overall divide number of the prescaler and N counter, the number of VCO output pulses required to produce one N counter output pulse can be counted. In this example, the prescaler divides by 65 for 65 x 56 or 3640 input pulses. It then divides by 64 for 64 x (1171 - 56) or 71,360 input pulses. The overall divide number K is therefore (71,360 + 3640) or 75,000. The VCO frequency of 937.5000 MHz divided by 75,000 equals 12.5 kHz which is the f_R input to the phase detector. The overall divide number K can also be determined by the following formula:

K = 64N + A

Where,
N = N counter divide number and
A = A counter divide number.

NOTE: Section 8.2.5 describes how the N and A counter numbers can be calculated for other channels.

6.2.9 BUFFER AMPLIFIER

A cascode amplifier formed by Q403 and Q404 provides amplification and also isolation between the TCXO and Synthesizer U403. A cascode amplifier is used because it provides high gain, high reverse isolation and consumes only a small amount of power. The input signal to this amplifier is coupled from TCXO Y401, pin 5 by C420. C420 also provides DC blocking. Bias for the amplifier is provided by R430, R431, R432, R433 and R428. L402 is an RF choke.

RF bypass is provided by C416, C418 and C419. The output of Q403/Q404 is coupled to U403, pin 20 by C417.

6.2.10 BUFFER AMPLIFIER

A cascode amplifier formed by Q406 and Q407 provides amplification and also isolation between the VCO and Synthesizer U403. A cascode amplifier is used because it provides high gain, high isolation and consumes only a small amount of power. The input signal to this amplifier is coupled from VCO A007, pin 6 by C433. C433 also provides DC blocking. Bias for the amplifier is provided by R450, R451, R453, R454 and R455. L403 is an RF choke. RF bypass is provided by C430, C431 and C479. The output of Q406/Q407 is coupled to U403, pin 11 by a non-polarized capacitor formed by C429/C499.

6.2.11 LOCK DETECT

When the synthesizer is locked on frequency, the Lock Detect output on U403, pin 2 is a high voltage with narrow negative-going pulses. When the synthesizer is unlocked, the negative-going pulses are much wider, the width may vary at a rate determined by the frequency difference of fV and fR.

The locked or unlocked condition of the synthesizer is filtered by R440/C423 and applied to J401, pin 16, then sent to the RF Interface on J102, pin 16 for detection.

6.2.12 BUFFER AMPLIFIER

A cascode amplifier formed by Q410/Q411 provides amplification and also isolation between the VCO and exciter RF stages. A cascode amplifier is used because it provides high gain, high isolation and consumes only a small amount of power. The input signal to this amplifier is coupled from VCO A007, pin 4 by C441. C441 also provides DC blocking. Bias for the amplifier is provided by R464, R465, R466, R467 and R468. L406 is an RF choke and R463 lowers the Q of the coil. RF bypass is provided by C434, C442, C445, C443, C444 and C480. The output of Q410/Q411 is matched to the Exciter RF stages by C446, R450 and two sections of microstrip.

6.2.13 RF AMPLIFIERS

RF amplifier Q412 is biased by CR402, R469, R470 and R472. C448 provides RF bypass from the DC line and R471/R472 provide supply voltage isolation. A section of microstrip on the collector acts as an RF choke to the supply line. Q412 is matched to Q413 by C449, C451 and two sections of microstrip.

RF amplifier/buffer Q413 is similar in design to Q412. The collector voltage of Q413 is switched by Q405. The Logic Push-To-Talk (LPTT) on J401, pin 11 turns on Q405 and conducts the 15V supply to the collector of Q405 and to Q413. The output of Q413 is matched to 50 ohms by two sections of microstrip and C465 that also provides DC blocking. A 3 dB attenuator follows amplifier Q413. The RF output of the Exciter is on coaxial connector J402 to the Power Amplifier.

6.3 OCXO DRAWER

6.3.1 INTRODUCTION

The OCXO (Oven Controlled Crystal Oscillator) drawer produces the 1.25 MHz reference signal input for the high stability synthesizer loops of both the Receiver and Exciter. One OCXO drawer alone can drive eight repeaters. More repeaters can be driven with the use of external rack mounted 8-Way splitters. The signal level at each of the eight outputs is high enough to allow splitting the signal through an additional 8-Way splitter to drive additional repeaters.

The OCXOs generate a 10 MHz signal. The frequency stability of these oscillators is better than 0.1 PPM from -40°C to +70°C (-40°F to +158°F). One half hour after a cold start (at room temperature), the oscillators will be within 1E-8 of their stabilized frequency. Two OCXOs are used for redundancy. The drawer can be configured so that either oscillator is main and the remaining oscillator will be standby. If the main oscillator has an output failure, the drawer will automatically switch to the standby oscillator to drive the outputs. The oscillators can be switched between main and standby remotely. The drawer will not allow remote switching of oscillators if either oscillator has an output failure.

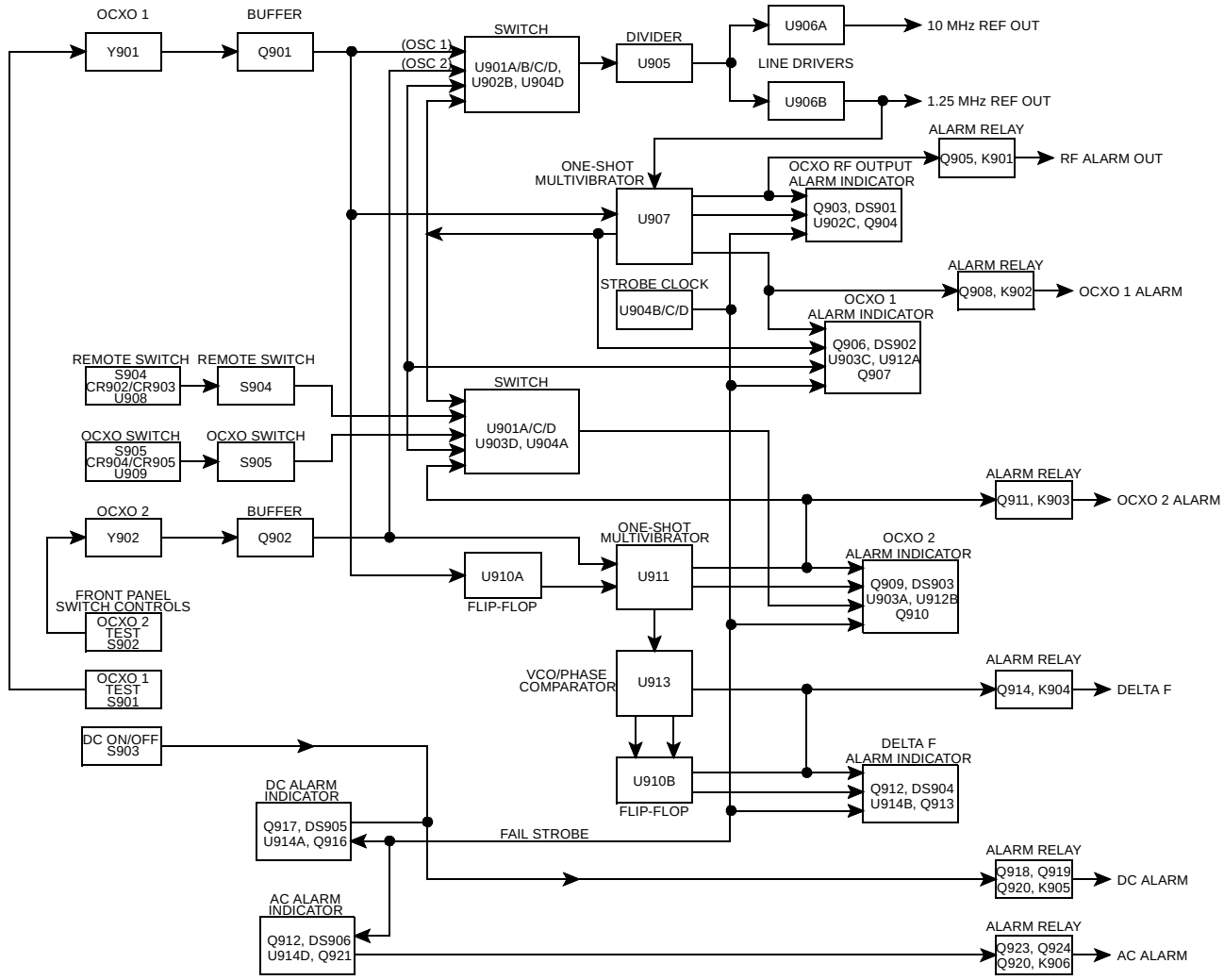


Figure 6-5 OCXO DRAWER BLOCK DIAGRAM

The OCXO drawer may be powered by the internal regulated 15V DC supply, or by an external 15V DC source. The internal 15V DC supply is powered from a 120V (±10%) or 240V (±10%) AC line. When both supplies are present, the internal 15V DC supply powers the drawer and the external 15V DC supply is a backup. If the internal supply should fail, the external 15V DC supply powers the drawer. The current requirement of the drawer is less than 1A upon initial turn on, and reduces to approximately 630 mA after the oscillators are stabilized.

The OCXO drawer contains several alarms. For all alarms, the following color scheme applies (see Figure 6-6):

Flashing Red	Failure
Yellow	Standby
Green	Active (OK)

If the main oscillator fails, its corresponding LED turns from green (active) to flashing red (failure). Consequently the LED for the remaining oscillator changes from yellow (standby) to green (active).

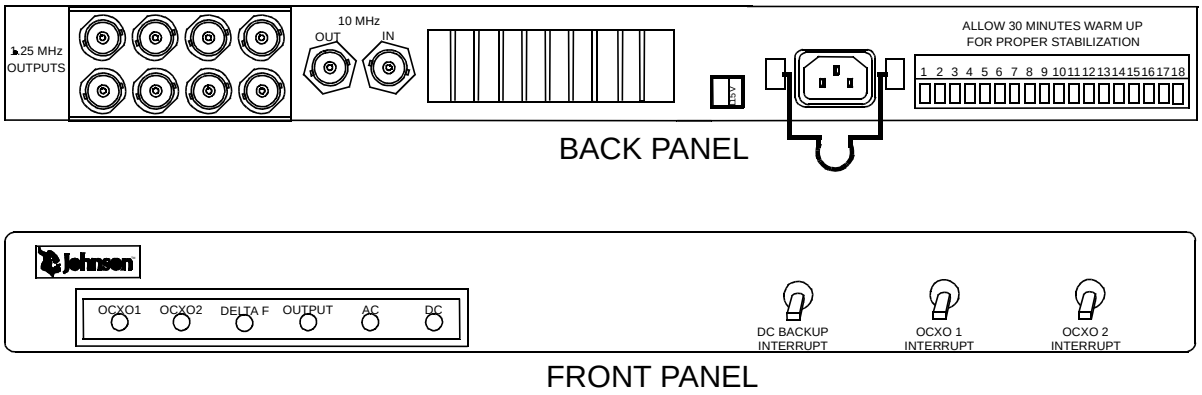


Figure 6-6 OCXO DRAWER FRONT/REAR PANELS

When there is no output from the drawer, the RF Output LED changes from green to flashing red indicating failure.

When there is a difference of more than 10 Hz between the two 10 MHz oscillators, the Delta F LED changes from green to flashing red (failure).

The Delta F alarm circuit has built in hysteresis and will not return to green until there is less than 5 Hz difference between the 10 MHz oscillators.

When both supplies are present, the AC LED is green (active), and the DC LED is yellow (standby). If the AC supply fails, the AC LED changes to flashing red (failure) and the DC LED changes to green (active) indicating that it is now powering the OCXO drawer. If the external DC supply fails, the DC LED changes from yellow (standby) to flashing red (failure).

All of these alarms are tied to relays that can be set to open or close contacts upon alarms. The relay contacts are connected to the 18-pin connector at the rear of the drawer. These relay contacts are capable of handling 1A DC current.

6.3.2 OCXOS, BUFFERS, DIVIDER AND LINE DRIVER

The OCXOs produce a signal level greater than 1V RMS. Q901 and Q902 serve as buffers and square up the signal from 0 to 5V (see Figure 6-5). Selection of the oscillators as described in Section 6.3.1 is accomplished by the logic gates U901-U904.

The 10 MHz signal is then applied to the counter chip U905. U905 is used to divide the 10 MHz signal by eight to create 1.25 MHz. The dual line driver chip U906 is used to drive the 8-Way 1.25 MHz outputs and the 10 MHz output. The signal is filtered to remove harmonics. The 1.25 MHz outputs have approximately 0 dBm of power into 50 ohms. The 10 MHz output delivers about 10 dBm into 50 ohms.

6.3.3 OCXO SWITCHING

Refer to the OCXO switching circuitry in Figure 6-7. The circuit is broken down into three levels where various tasks are performed. The bottom section is for remote control input and selecting which OCXO LED should indicate standby. U902A, pins 1-2 (OSC 1 - OSC 2) come from the OCXO pulse detector circuits. A logic high on U902A, pin 1 (OSC 1) indicates that OCXO 1 has output. Likewise, a logic high on U902A, pin 2 (OSC 2) indicates that OCXO 2 has output.

NOTE: U902C, pin 8 (S) cannot be high unless both OCXO pulse detectors indicate output. Therefore, no remote switching of OCXOs is allowed unless both OCXOs are running.

The top section of Figure 6-7 determines whether or not a switch is made to OCXO 2. In this section, an Exclusive OR logic decision is made between inputs (S) and (OSC 1). When U902B, pin 6 (X) is high, OCXO 1 is selected, when it is low, OCXO 2 is selected. If (OSC 1) is low, (X) goes low and OCXO 2 is selected.

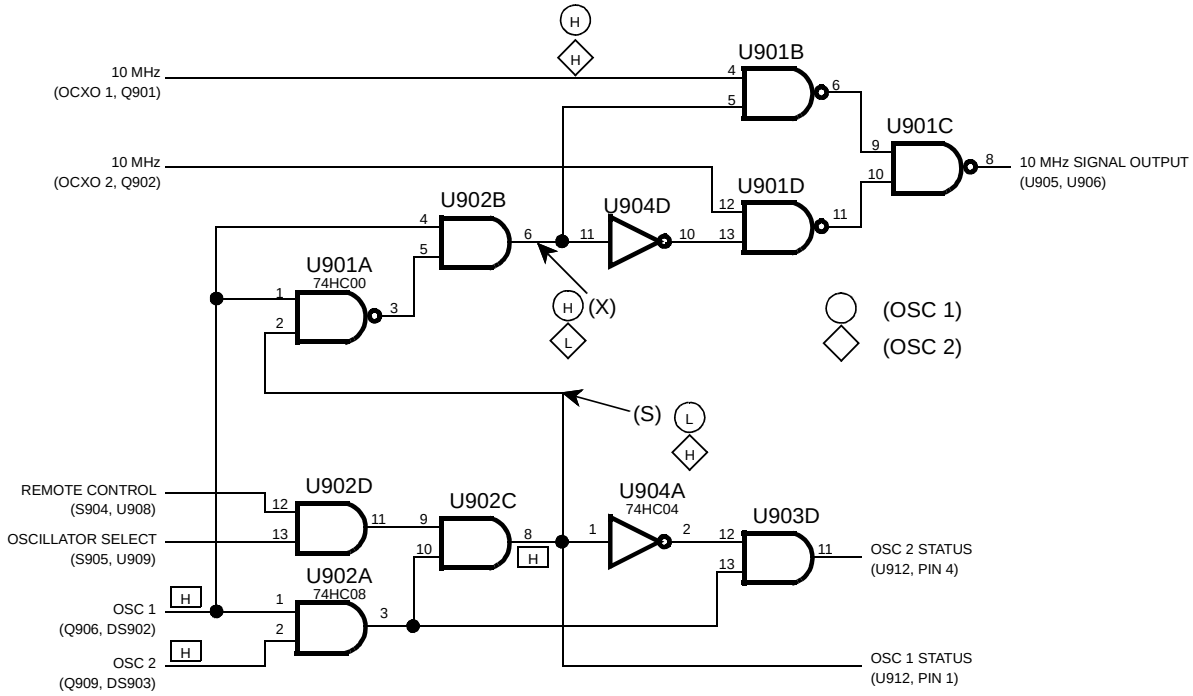


Figure 6-7 OCXO SWITCHING

NOTE: The bottom circuit does not allow (S) to be high and (OSC 1) to be low. If (OSC 1) is high and (S) is low, (X) stays high, and OCXO 1 is selected as the main oscillator. Finally, if (OSC 1) is high and (S) is high, (X) goes low and OCXO 2 is selected as the main oscillator.

6.3.4 OCXO PULSE DETECTION

The buffered OCXO 1 signal is sent to U907, pins 9-10. U907 is a retriggerable one-shot multivibrator that is used for pulse detection. If four or more 10 MHz pulses from OCXO 1 are missing, the output of one-shot multivibrator Q2 goes low. This turns off LED driver Q905 and the green half of LED DS902 turns off. Simultaneously, $\overline{Q2}$ goes high. This pulses on/off Q907 and strobes the red fail LED for OCXO 1. Relay driver Q908 can be driven by either Q2 or $\overline{Q2}$ depending on the desired normal state of the OCXO 1 alarm relay. U911, pins 1-2 also serve as a pulse detector for OCXO 2.

6.3.5 DELTA F DETECTION

The Delta F detection circuitry is made up of U910, U911 and U913. The buffered output of OCXO 2 is applied to the D-input of flip-flop U910 and the buffered output of OCXO 1 is applied to the CLK-input. The Q-output is the frequency difference between the two OCXOs.

The Q-output of U910, pin 5 is applied to the trigger input (B2) of the one-shot multivibrator in U911, pin 10. This device produces a 5 ms negative-going pulse when it is triggered. It is triggered twice by every output cycle from U910, pin 5. The second triggering is caused by the undetermined states produced when the signal goes low at the half-cycle point. Because of this double triggering, the frequency on the $\overline{Q2}$ output of U911, pin 12 is twice the frequency difference of the two OCXOs.

The $\overline{Q2}$ output of U911, pin 12 is applied to U913, pin 14, which is one input of an internal phase comparator. The other input of this phase comparator is from a voltage controlled oscillator (VCO) internal

to U913. The output of this phase comparator at U911, pin 13 is essentially low if the input from the VCO is higher in frequency than the input from U911, pin 12. Conversely, this output is essentially high if the input from the VCO is lower in frequency than the input from U911, pin 12. Clocking pulses are continually present on the PCP output of U913, pin 1.

The VCO oscillates at either the high or low end of its operating range, depending on the logic level present on the control input of U913, pin 9. If the control input is high, it oscillates at the high end of its range. If the control input is low, it oscillates at the low end of its range. The high frequency is approximately 20 Hz and the low frequency is approximately 10 Hz. During normal operation, the Q output of the flip-flop in U910, pin 8 is high and the VCO oscillates at 20 Hz.

When the frequency difference between OCXOs exceeds about 10 Hz (1 PPM), the frequency of the signal from U911, pin 12 exceeds the VCO frequency. Recall that the frequency difference is doubled by U911. The output from the phase comparator on U913, pin 13 goes high and the Q outputs of flip-flop U910B change state. This turns on red LED DS904. The Q output of U910, pin 9 now applies a logic low to the VCO control input of U913, pin 9 and the VCO goes to its low frequency limit (10 Hz). Therefore, the OCXO frequency difference must decrease to less than 5 Hz for the alarm to be canceled. This hysteresis prevents intermittent triggering when the frequency difference is near the triggering point.

6.4 75W POWER AMPLIFIER

6.4.1 AMPLIFIER/PRE-DRIVER

RF input to the PA from the Exciter is through a coaxial cable and connector to WO511. C501 couples the RF to 50 ohm microstrip that connects the input to U501. U501 is a 6W amplifier/pre- driver operating in the 935-940 MHz band.

Power control is connected to WO505 from the RF Interface board (RFIB). RF is filtered from the control voltage line by various capacitors and inductors to U501, pin 2. This control voltage regulates the RF output of the amplifier on U501, pin 4 to approximately 5W.

6.4.2 DRIVER

The output of U501 passes through several sections of 50 ohm microstrip and matching capacitors to the emitter of Q501. Driver Q501 is a common- base amplifier with a normal output of approximately 22W. Supply voltage is RF bypassed by various capacitors and microstrip. C525/C526/C536/ C537/C538/C589 match the output of the driver to the input impedance of the combiner to the final amplifiers.

6.4.3 FINAL AMPLIFIERS

Q502 and Q503 are combined 60W amplifiers. A 50 ohm microstrip connects the RF to a 70.7 ohm Wilkinson splitter and then to the emitter of each common-base amplifier. The 60W outputs on the collectors of the amplifiers are combined using a Wilkinson combiner. Q502 has a half-wave transmission line on the input and Q503 has a half-wave on the output. These transmission lines are used to drive the 60W amplifiers out of phase. The output of the combiner is fed from WO513 directly to the forward/reverse power detect board.

The Wilkinson splitter and combiner provide the capability to split the drive input and combine the final outputs while maintaining isolation between the two final amplifiers. The combiner consists of two quarter-wave transmission lines and a balancing resistor. During normal operation, signals of relatively equal phase and amplitude are present on both ends of the balancing resistor. Therefore, no current flows and no power is dissipated in the balance resistor. If one final fails, the other final of the pair continues to function.

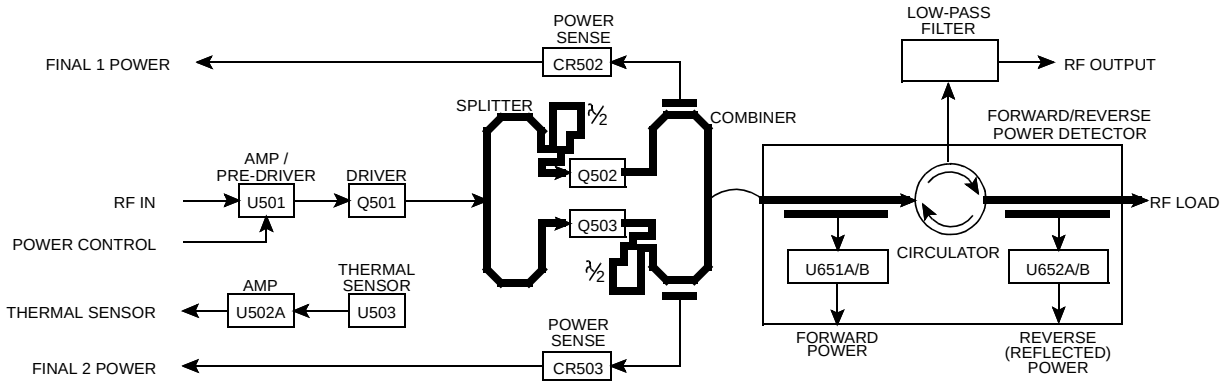


Figure 6-8 75W PA BLOCK DIAGRAM

6.4.4 POWER DETECTORS

Electromagnetic coupling is used to sample the output of each final amplifier. The RF is then fed to a rectifier to create a voltage indicative of the power output. The outputs of CR502 (W510) and CR503 (W508) are monitored by the repeater software through the RF Interface Board. If a final amplifier fails, the software reduces the output power to prevent overdriving the remaining final amplifier.

6.4.5 THERMAL SENSOR

Thermal protection is provided by temperature sensor U503. The operating range of the sensor is from -0° C to +100° C (+32° F to 212° F). Amplifier U502A sends the output of U503 through WO509 to the RF Interface Board. The RF Interface Board uses the temperature sensor signal to turn the fan on (50°C) and off (45°C). If the temperature of the heatsink exceeds 90°C power is reduced 3 dB. When the heatsink exceeds 95°C the RF is shut down.

6.4.6 FORWARD/REVERSE POWER DETECT, CIRCULATOR, LOW-PASS FILTER

The power amplifier output is directly coupled to the forward/reverse power detect board via a jumper. The output then enters the circulator and exits to the low-pass filter board and the antenna jack for a minimum power output of 75W at the default setting. If an antenna is not connected, the circulator connects the output power to R685.

Forward and reverse power is electromagnetically coupled from the input and reflected ports of the circulator. R663 and R680 are used to calibrate the forward and reflected power.

6.5 160W POWER AMPLIFIER

6.5.1 GAIN BLOCK

RF input to the PA from the Exciter is through a coaxial cable and connected to WO509. The signal coming through WO509 is amplified to approximately 0.25W using Q501 and associated matching components. This signal is then fed into U501. U501 is an 18W amplifier/pre-driver operating in the 935-940 MHz range.

Power control is connected to WO505 from the RF Interface board (RFIB). RF is filtered from the control voltage line by various capacitors and inductors to U501, pin 2. This control voltage regulates the RF output of the amplifier on U501, pin 5 to approximately 15W (see Figure 6-9).

6.5.2 DRIVER

The output of U501 passes through several sections of 50 ohm microstrip and matching capacitors to the emitter of Q502. Driver Q502 is a common base amplifier with an output of approximately 60W. Supply voltage is RF bypassed by various capacitors and microstrip. C568 matches the output of the driver to the input impedance of the splitter to the final amplifiers.

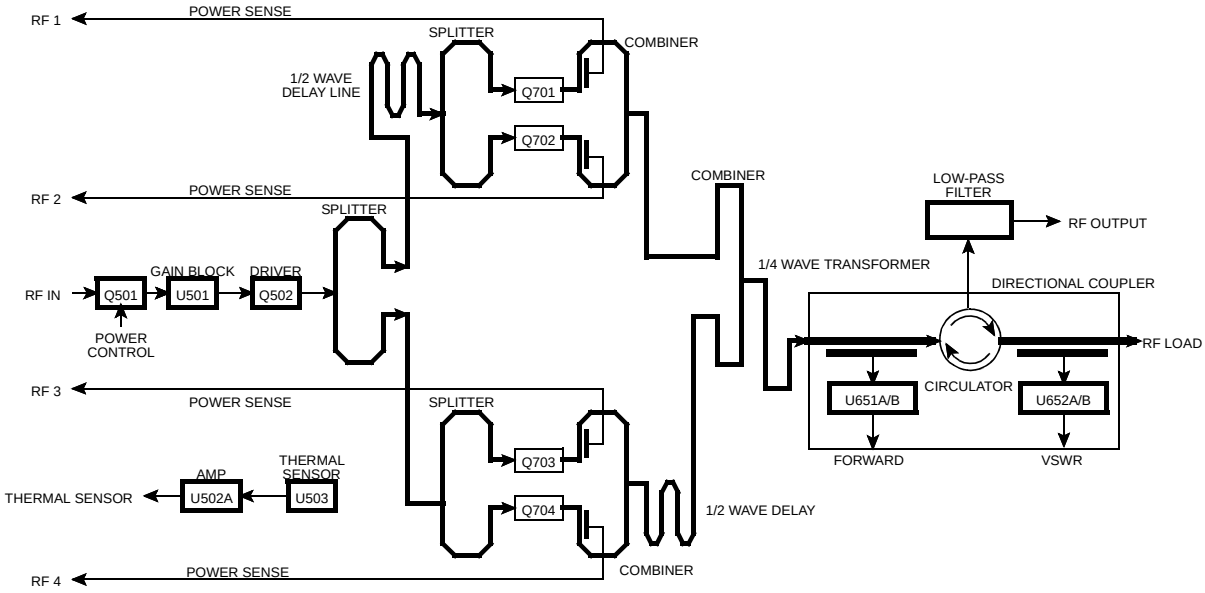


Figure 6-9 160W PA BLOCK DIAGRAM

6.5.3 FINAL AMPLIFIERS

The output of the driver is DC blocked by C552 and is connected to the first 70.7 ohm splitter with a 50 ohm microstrip. One output of the first splitter is sent directly to another 70.7 ohm splitter to feed Q703/Q704. The second output is connected to the splitter driving Q701/Q702 through a half-wave 50 ohm microstrip. The 60W output of Q701/Q702 is combined through a 70.7 ohm quarter-wave Wilkinson combiner and fed through a 50 ohm microstrip to the final 50 ohm combiner.

Outputs from amplifiers Q703/Q704 are fed to the final combiner through 50 ohm microstrip that is a half-wavelength longer than the other side. The 25 ohm output impedance of the final combiner is transformed to 50 ohms through a quarter-wave, 35.35 ohm microstrip. The output of the quarter-wave transformer is fed directly into the forward power detector via W510.

The Wilkinson combiners provide the capability to split the drive input and combine the final outputs while maintaining isolation between the final amplifiers. Each combiner consists of two quarter- wave transmission lines and a balancing resistor. During normal operation, a signal of relatively equal phase and amplitude is present on both ends of the balancing resistor. Therefore, no current flows and no power is dissipated in the resistor. If one final fails, the other final of the pair would continue to function.

6.5.4 POWER DETECTORS

Electromagnetic coupling is used to detect the output of each final amplifier. The detected RF is then fed to a rectifier to create a voltage output indication of the power output. The outputs are monitored by the RFIB and the station software. If any of the finals fails, the software will reduce the output power to prevent overdriving the remaining final amplifier.

6.5.5 FORWARD/REVERSE POWER DETECT, CIRCULATOR, LOW-PASS FILTER

The power amplifier output is directly coupled to the forward/reverse power detect board via a jumper. The output then enters the circulator and exits to the low-pass filter board and the antenna jack for a power output of 160W (±7W). If an antenna is not connected, the circulator connects the output to R685.

Forward and reverse power is electromagnetically coupled to the detectors on the input and reflected ports of the circulator. R663 and R680 are used to calibrate the forward and reverse sense levels. The sensed levels are connected to the RF Interface Board and software.

6.6 RF INTERFACE BOARD

The RF Interface Board connects the Receiver, Exciter and Power Amplifier to the backplane and power supply (see Figure 6-10).

The input and output connectors for the RF Interface Board are defined as follows.

6.6.1 POWER CONNECTOR

The power supply is connected to the RF Interface Board when the RF module is inserted into the station cabinet (see Figure 10-7). The jack portion of the connection is on the RF Interface Board, the plug portion is attached to the repeater cabinet.

P101/P102 +26.5V DC - Supply voltage to PA. +26.5V ±1%, 12A at 75W and 20A nominal (24A maximum) at 160W.

P103 +15V DC - Supply voltage to Exciter, Receiver and Power Control. 15V ±1%, 5.5A max.

P104/P105 GROUND - Ground return for the RF assembly.

6.6.2 SIGNAL CONNECTOR (J101)

This is the signal interface connector J101 (36 pin) that connects the RF Interface board to the backplane connector J2 (34 pin) through cable assembly A8.

Pin 1 GROUND

Pin 1 carries ground current between the RF Interface board and Backplane board.

Pin 2 PC STR

Pin 2 is the Power Control Strobe. This is normally low until after the power control data is shifted into the power control register. Then the strobe line goes high and back to low. The clock or data lines cannot be changed until after the strobe is set.

Pin 3 HS CS EX

Pin 3 is used in the 900 MHz repeater only. A low enables the high stability synthesizer loop.

Pin 4 GROUND

Pin 4 carries ground current between the RF Interface board and Backplane board.

Pins 5-6 UNUSED

Pin 7 RX WBAND

The wide band audio is from the receive audio demodulator U202 and goes to the MAC in the Controller card cage. The typical amplitude is 387 mV RMS (-6 dBm) and 2V DC with Standard TIA Test Modulation into the receiver. Little wave shaping is done on the receiver board other than a 31 kHz RC LPF which strips off the 450 kHz IF. Buffering is done with an op-amp.

Pin 8 RF DATA A

Data A (U105, pin 11) is the least significant bit (LSB) in the 3 multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 9 RF DATA C

Data C (U105, pin 9) is the most significant bit (MSB) in the 3 multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 10 RF MUX2 INH

The Multiplexer-2 Inhibit (U106, pin 6) is a CMOS input from the Controller that inhibits (disables) the output from the RF 2 Multiplexer with a logic high.

Pin 11 RF CLK

The clock will control the synthesizer chips and power control circuit when loading. This pin is a TTL input from the Controller.

Pin 12 HS CS RX

This input goes low to enable the loading of data into the receiver high stability synthesizer chip U205.

Pin 13 RF MUX1 INH

The Multiplexer-1 Inhibit (U105, pin 6) is a CMOS input from the Controller that inhibits (disables) the output from the RF 1 Multiplexer with a logic high.

Pin 14 V REF EX

This is the 3.5V reference to the Exciter TCXO. 3.5V from the Exciter is passed from J102, pin 9 to this pin and the backplane. The voltage then passes through the MAC and back to the backplane to J101, pin 22 with the TX MOD. These are connected to J102, pin 13 back to the Exciter.

Pins 15-18 UNUSED

Pin 19 RF MUX3 INH

The Multiplexer-3 Inhibit (U104, pin 6) is a CMOS input from the Controller that inhibits (disables) the output from the RF 3 Multiplexer with a logic high.

Pin 20 LPTT

The Logic Push-To-Talk is an open collector from the Controller. It has a sink capability of 20 mA and a maximum voltage rating of 18V. The transmitter should produce power when this pin is a logic low.

Pin 21 SYN CS EX

This input goes low to enable the loading of data into the exciter main synthesizer chip U403.

Pin 22 TX MOD

The audio from the MAC in the Controller processes a number of inputs to the station to produce the signals on this pin. This signal goes through the RFIB and then to the Exciter. A 707 mV RMS sine wave (2V P-P) at 1 kHz produces 60% of system deviation in the transmitter. The source impedance is low and the input impedance is less than 10k ohms.

Pin 23 GROUND

Pin 23 carries ground current between the RFIB and CBP board.

Pin 24 UNUSED

Pin 25 LOGIC CONTROL TO FANS

Pin 25 is in parallel with the temperature sensor.

Pin 26 RF DATA B

The Data B (U105, pin 10) is the middle significant bit in the three multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 27 A D LEVEL

20 lines (of the possible 24) of RF functions sampled are multiplexed to the Controller through this pin using three multiplex chips.

- RF Forward Power Sense
- RF Power Sense Device 1
- RF Power Sense Device 2
- RF Power Sense Device 3
- RF Power Sense Device 4
- RF Reflected Power Sense
- PA Temperature
- Transmit Audio Modulation
- High Stability Exciter Lock Detector
- Exciter Lock Detector
- Receiver Detector Audio
- Receive Signal Strength Indicator
- Receiver Injection Level
- High Stability Receive Lock Detector
- Receiver Lock Detector
- Fan Current 1
- Fan Current 2
- Fan 1 On Sense
- Power Supply Temp
- Battery Voltage

Pin 28 RF DATA

A data pin with TTL levels from the Controller which has the dual role of loading the synthesizer chips and adjusting the power control D/A lines for proper output power. Up to four synthesizer chips and a shift-register could be connected to this pin.

Pin 29 SYN CS RX

This input goes low to enable the loading of data into the receiver main synthesizer chip U209.

Pin 30 RSSI

This pin is the Receive Signal Strength Indication to the Controller. This RSSI is used for tune-up of the Receiver front-end during factory test mode. The dynamic range is 60 dB. It has an output from an op-amp with the voltage going from 0.5V to 4.5V. The level has an adjustment in the Receiver.

Pin 31 GROUND

Pin 31 carries ground current between the RFIB and Chassis Backplane.

Pins 32-36 UNUSED

6.6.3 FAN CONNECTOR (J104)

The outputs to the fan connectors are 4-pin plug-in terminals that supply DC voltage. The plug on the fan is a 2-pin connector. The plug-in terminals are located on the back of the RFIB.

Pin 1 FAN 1 LOW

Pin 1 is the ground return for Fan 1.

Pin 2 FAN HI

Pin 2 carries the voltage to Fan 1. The current is 1/4A nominal at 20V to 30V. This pin goes high when the PA heat sensor rises above 50°C and goes low below 45°C.

Pin 3 FAN2 LO

Pin 3 is the ground return for Fan 2 in 160W repeaters.

Pin 4 FAN HI

Pin 4 carries the voltage to Fan 2 in 160W repeaters. The Voltage is 20V-30V at 1/4A nominal. Pin 4 goes high when the PA heat sensor rises above 50°C and goes low below 45°C.

6.6.4 POWER AMPLIFIER CONNECTIONS

WO 115 POWER SENSE

This capacitive feedthrough pin is at +15V DC to the Power Detect Board.

WO 116 +26.5V DC

This capacitive feedthrough pin is at +26.5V DC and carries the PA current, 20A nominal at 160W from P102 to the Power Amplifier board.

WO 117 +26.5V DC GROUND

This capacitive feedthrough pin carries ground current from P105 to the Power Amplifier board. It must be capable of carrying up to 25A.

WO 118 +15V DC

This capacitive feedthrough pin connects +15V DC P103 to the PA, Exciter, and Forward/Reverse Power Detect boards. Maximum current handling is 6A (4A nominal at 160W).

WO 119 NOT USED

WO 120 CTRL OUT

This capacitive feedthrough pin carries the output of the power control driver on the RFIB to the power control pin of the power module on the Power Amplifier board. The voltage varies from 0V-15V with current as high as 0.5A.

WO 121 FWD PWR

This capacitive feedthrough pin is the forward power sense line. It is a voltage source that is a function of the output power of the Power Amplifier. The voltage level will be between 0V-5V and drive a 10k ohm load. A typical voltage of 3.9V correlates to 160W out of the PA. This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO 122 RF OUT 1

This capacitive feedthrough pin is a voltage source that is a function of the output power of Q701. The voltage level will be between 0V-5V and drive a 10k ohm load. This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO 123 RF OUT 2

This capacitive feedthrough pin is a voltage source that is a function of the output power of Q702. The voltage level will be between 0V-5V and drive a 10k ohm load. This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO 124 RF OUT 3

This capacitive feedthrough pin is a voltage source that is a function of the output power of Q703. The voltage level will be between 0V-5V and drive a 10k ohm load. This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO 125 RF OUT 4

This capacitive feedthrough pin is a voltage source that is a function of the output power of Q704. The voltage level will be between 0V-5V and drive a 10k ohm load. This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO 126 REFL PWR

This capacitive feedthrough pin is the reflected power sense line. It is a voltage indicative of the power reflected due to a mismatch. The voltage produced will typically be such that less than a 3:1 VSWR will not trigger alarms and when VSWR = 6:1 the controller will reduce power. The voltage level will be between 0V-5V and drive a 10k ohm load. This line goes through the multiplexers and A D LEVEL line to the Controller for processing. The time to sense and reduce the power takes several seconds.

WO 127 TEMP

This capacitive feedthrough pin is the temperature sense line of the Power Amplifier. It will be a linearly variable function of temperature ranging from 0V-5V output and 0°C to +100°C (+32°F to 212°F) input when driving a 10k ohm load. The primary functions of this line are for fan on/off and PA power reduction. The fan should be turned on at 50°C and off at 45°C. The PA should have power reduced when 90°C (194°F) is reached and with absolute turn-off at 95°C (203°F). This line goes through the multiplexers and A D LEVEL line to the Controller for processing.

WO147 RF DETECT PRE-DRIVER

This senses power out of the pre-driver. It is used to limit the power out of the pre-driver to 0.6 dB over 160W at room temperature. The 75W repeater limits to 0.6 dB over 75W.

W143 +26V DC

This is the +26.5V DC source to the RFIB from P101.

W144 +15V DC

This is the +15V DC source to the RFIB from P103.

W145 GROUND

W145 carries ground current from P104 to the RFIB.

6.6.5 EXCITER CONNECTOR (J102)

The connector from the Exciter (J401) to the RF Interface board (J102) links the Exciter to the MPC in the Controller Backplane.

Pin 1 VCC1

The voltage on this pin is a fused +15V ±1%, nominal current of 0.5A. It provides current to the Exciter from the RFIB.

Pins 2-8 GROUND

Pin 9 +3.5V DC

Pin 9 is the +3.5V DC TCXO reference voltage from the Exciter to the MAC.

Pin 10 GROUND

Pin 11 LPTT

The Logic Push-To-Talk (LPTT) is an open collector from the Controller. It has a sink capability of 20 mA nominal and a voltage rating of 18V maximum. The transmitter should produce power when this pin is a logic low.

Pin 12 SYN CS EX

Pin 12 is the Exciter main synthesizer chip select. It allows data input to the specific synthesizer chip when the line is pulled to a logic low.

Pin 13 TX MOD

The audio from the MAC in the Controller processes a number of inputs to the station per the TIA specifications to produce the signal on this pin. This signal goes through the RFIB and then to the Exciter. A 707 mV RMS (2V P-P) sine wave at 1 kHz provides 60% of system deviation in the transmitter. The DC voltage on the line is 3.5V ±0.1V. The source impedance should be low (output of an op-amp or analog switch < 200 ohms) and the input impedance will not be less than 10k ohms.

Pins 14-15 GROUND

These pins carry ground current between the RFIB and the Exciter board.

Pin 16 SYN LK EX

Pin 16 is the Exciter main synthesizer lock detector output. The synthesizer is locked with a TTL logic high state.

Pin 17 HS LK EX

Pin 17 is the high stability synthesizer lock detector output for the 900 MHz Exciter. The synthesizer is locked with a TTL logic high state.

Pin 18 HS CS EX

This input goes low to enable the loading of data into the exciter high stability synthesizer chip U401.

Pin 19 RF CLK

The clock controls the Exciter synthesizer when loading. The input source in the Controller is TTL with the speed determined by the synthesizer chip. There could be as many as four synthesizers and a shift register.

Pin 20 RF DATA

Pin 20 is a data pin from the Controller which has the dual role of loading the synthesizer chip and adjusting the power control D/A lines for proper output power. The data has TTL levels. Up to four synthesizer chips and a shift register could be connected to this pin.

6.6.6 RECEIVER CONNECTOR (J103)

The connector from the Receiver (J201) to the RF Interface board (J103) links the Receiver to the MPC in the Controller Backplane.

Pin 1 VCC1

Pin 1 is fused +15V ±1% with a nominal current of 1A provides current from the RFIB to the Receiver.

Pins 2-6 UNUSED

Pin 7 RSSI

This pin is the Receive Signal Strength Indicator (RSSI) to the Controller. The RSSI is used for tune-up of the Receiver front-end during test mode. The dynamic range is 60 dB. Output from an op-amp with the voltage going from 0.5V to 4.5V. The level has an adjustment in the Receiver.

Pin 8 UNUSED

Pin 9 RX WBAND

The receive wide band audio is from the demodulator and goes to the Main Audio Card (MAC) in the Controller card cage. The typical amplitude is 387 mV RMS (-6 dBm) and 2V DC with Standard TIA Test Modulation into the Receiver. Little wave shaping is done on the Receiver board other than a 31 kHz RC LPF which strips off the 450 kHz IF. Buffering is done with an op-amp which can drive a 10k ohm load.

Pin 10 UNUSED

Pin 11 GROUND

Pin 11 carries ground current between the RFIB and the Receiver board.

Pin 12 SYN CS RX

Pin 12 is the Receiver main synthesizer chip select. This chip is the same part as used in the Exciter. A low enables loading the Synthesizer.

Pin 13 RX INJ

This pin is the power sense for the Receiver injection. It is a linear voltage source that is a function of the injection power. The voltage level will be between 0V - 5V and be able to drive a 10k ohm load.

Pin 14 SYN LK RX

Pin 14 is the main synthesizer lock detector output for the Receiver. The synthesizer is locked with a TTL logic high state.

Pin 15 GROUND

Pin 15 carries ground current between the RFIB and the Receiver board.

Pin 16 HS CS RX

Pin 16 is the 900 MHz Receiver high stability synthesizer chip select. This synthesizer is the same circuit as used in the Exciter. A low enables loading the high stability synthesizer loop.

Pin 17 GROUND

Pin 17 carries ground current between the RFIB and the Receiver board.

Pin 18 RF CLK

The clock controls the Receiver synthesizers when loading. The input source in the Controller is TTL with the speed determined by the synthesizer chip. There could be as many as four synthesizers and a shift register.

Pin 19 HS LK RX

This is the high stability synthesizer lock detector output for the 900 MHz Receiver. The synthesizer is locked with a TTL logic high state.

Pin 20 RF DATA

Pin 20 is a data pin from the Controller which has the dual role of loading the synthesizer chips and adjusting the power control D/A lines for proper output power. The data has TTL levels. Up to four synthesizer chips and a shift register could be connected to this pin.

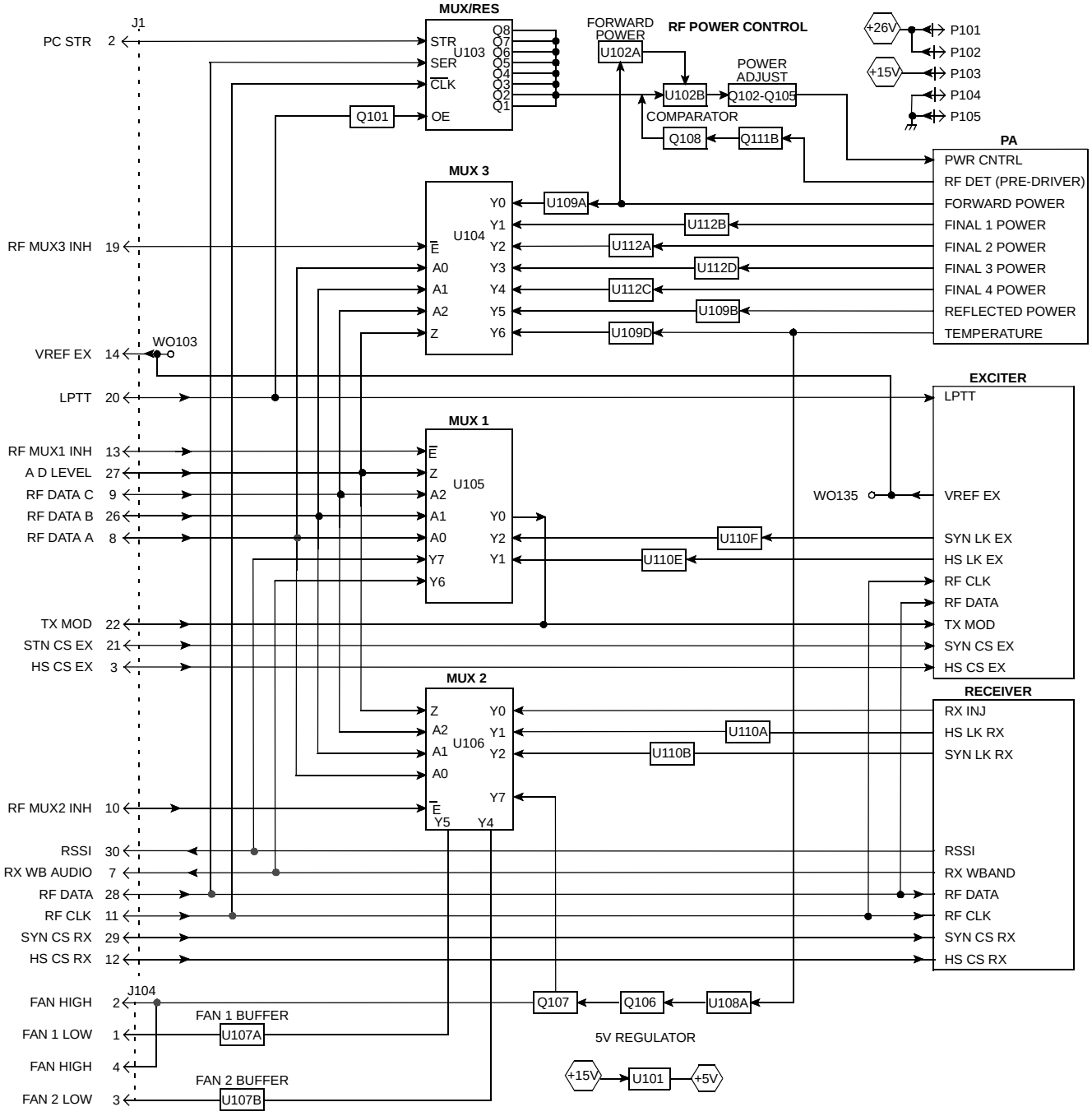


Figure 6-10 RF INTERFACE BOARD BLOCK DIAGRAM

6.7 800W POWER SUPPLY

WARNING

This power supply contains voltage potentials greater than 400V. Considering the dangerous voltages and the complexity of the switch-mode power supply, it is strongly recommended the power supply be returned to E.F. Johnson for repair (see Section 1.8).

6.7.1 FILTER BOARD

AC power is brought into the power supply through the IEC connector in the front of the power supply (see Figure 2-2). This connector is attached to the EMI filter assembly, Part No. 023-2000-820. The filter contains common mode and differential mode filtering such that the supply complies with FCC Class-A regulations. In addition to the filter components (C1, C2, L1, C3, C4, L2, C5) R1 is used to discharge the filter capacitors when AC is removed. Metal-oxide varistors (RV001/RV002) are placed across the line on the input and output of the EMI filter that clamp transients on the AC line to prevent damage to the power supply. The AC power is fused with F001 after the connector and before the filter. Replace fuse with a 15A/250V (314015) fuse.

At the output of the filter board is a bridge rectifier. The rectifier is heat sunk to the filter bracket through a Grafoil thermal interface pad. Filtered AC power is connected to the main board via wires W001 and W003. Filter and rectified current is brought to the main board via wires W004 and W005. The safety ground is connected from the filter board to a stud in the chassis through W002.

6.7.2 POWER FACTOR CORRECTION

The power factor switching frequency is set at 87.5 kHz, ±5 kHz. The average current mode boost converter is comprised of L107, Q101, CR145, C110, C111. Half of U102 is used for power factor correction. RT101/RT102 are negative temperature coefficient thermistors that limit the in-rush current to C110/C111. The resistor network connected to CR104 charges up C106/C107 to +18Voff the line. This provides the bias voltage required to start the controller IC U102. Once the IC turns on current is being switched on L107. A small tap winding on L107 provides sustaining current to the U102. When AC is first connected it could take several seconds for C106/C107 to charge to +14V before the unit starts.

U102 samples the input voltage through R105/R106/R107; the input current through T103/T104/CR146/CR108/R113/R114; and the output voltage through the divider at R127. U102 modulates the duty cycle to MOSFET Q101 such that the input current is shaped like and in phase with the input voltage. The controller has two feedback loops; a voltage loop to keep the 400V constant and a current loop to keep input current correct. Compensation for the current error amp is C120/R141/C121 on U102, pin 1. Compensation for the voltage error amp is provided by C127/C142/C126 on U102, pin 16. U102, pin 4 and associated circuitry automatically adjust the Power Factor Correction (PFC) for input voltage (100-240V AC), line frequency (50-60 Hz) and load on the power factor.

NOTE: The output voltage of the power factor section is at 400V DC. This voltage is bled off slowly. After turning off, it can take more than 5 minutes to discharge.

6.7.3 MAIN PULSE WIDTH MODULATOR

The +26.5V output is created from a two-transistor forward converter Q116/Q118. It uses the 400V output of the power factor correction on C110/C111 for an input voltage. The same controller IC (U102) drives the +26.5V stage. This stage runs at exactly twice the power factor correction frequency and uses trailing edge modulation. The pulse width modulator uses the PFC supplied current for modulation scheme that reduces ripple current in C110/C111.

The output of the IC, U102, pin 11 is fed to a level shifting gate drive network comprised of C139, C140, T106, C136, C197, C137 and C228. Each MOSFET (Q116, Q118) of the two-transistor forward converter has a gate protection zener diode CR117, CR120 respectively. In addition, each power MOSFET has a gate turnoff network.

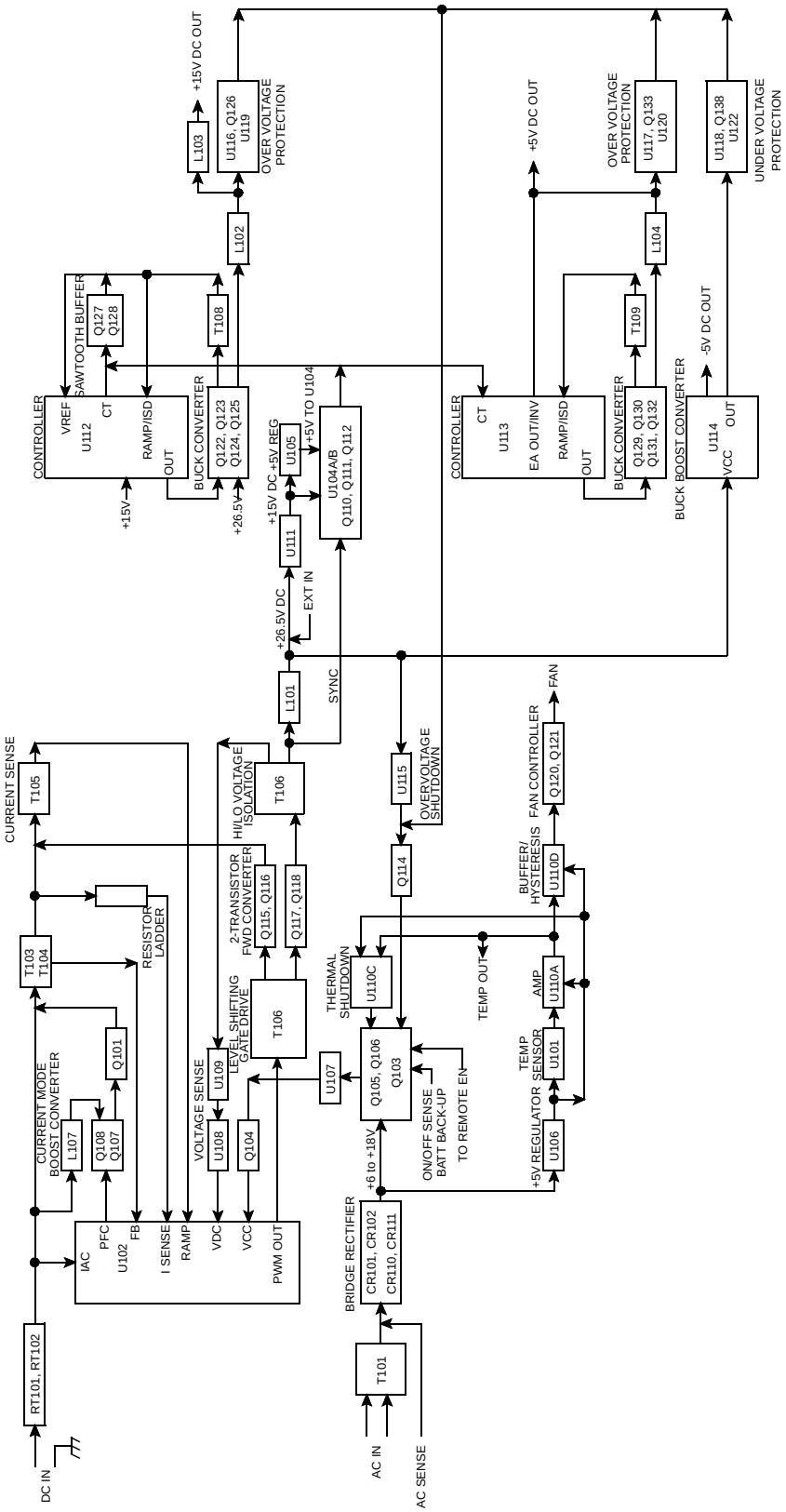


Figure 6-11 POWER SUPPLY BLOCK DIAGRAM

In operation, the power MOSFETs Q116, Q118 are on for approximately one-third of the period providing current to the primary side of T107. During that time CR121 is forward conducting and charging L101. When the MOSFETs are switched off, the magnetizing current of T107 continues to flow through CR118, CR119. These diodes place 400V across the transformer in opposite polarity that resets the transformer core. During the off period CR128 is free wheeling and L101 is discharging. Transformer T107 provides the isolation between the low voltage and high voltage sections.

The +26.5V pulse width modulator is peak current mode controlled. This type of converter requires current and voltage sense. T105, CR112, R125, R146 and C125 provide the current sense circuit. The voltage sense circuit is U109 and the associated circuitry on the isolated side of the supply.

An opto-isolator is used to cross the boundary from high to low voltage sections. In the event of an over-voltage condition (>+32V) U115 and associated components turn the power supply off. This shutdown mechanism latches the power supply Off. The enable line must be turned Off for 10 seconds for the power supply to reset. T106 has a tap to provide current to the optional battery back-up (Part No. 023-3-2000-830). The +26.5V is available at the high current output connector to the power supply and it also powers the +15V, +5V and -5V converters through F102.

6.7.4 SYNCHRONIZING CIRCUITS

The +15V and +5V sections run at the same frequency as the +26.5V pulse width modulator. In order for a beat note not to be produced, a sync circuit is used. If two converters are not synchronized, the difference frequency may show up at an undesired location in the repeater.

Divider R151/R152 samples the output of the main pulse width modulator. When Q116 and Q118 turn on, the output on U104A, pin 3 goes high. C138, R176, CR122 along with U104B creates a very narrow pulse on U104B, pin 6. Q110, Q111 and Q112 level shift and buffer this pulse. When the narrow pulse is presented to the timing capacitor of the +15V and +5V converters, the cycle terminates and a new one starts. This forces the +15V and +5V converters to run at the same frequency and is slightly delayed from the +26.5V converter.

6.7.5 FAN AND THERMAL SHUTDOWN

The voltage supply to the thermal measurement circuit is generated from transformer T101 and the associated bridge rectifier consisting of CR101, CR102, CR110 and CR111 and bulk storage capacitor C101. This voltage is approximately +9V when the AC voltage is at 120V AC.

NOTE: This DC voltage is dependent on the input AC voltage.

U106 provides a very accurate +5V required for proper operation of the temperature sense circuit. A precision temperature sensor (U101) is mounted to the +26.5V rectifier heatsink. The output of this sensor is 10 mV/°C with a ±1% accuracy. This voltage is amplified by U110A with precision resistors R183/R184 setting the gain.

The output of gain stage U110A is fed to the computer interface via WO116 to monitor power supply temperature with the programmer. The output of U110A, pin 3 is also connected to the thermal shutdown circuit U110C, R135, R136, R137, R138 and R139. If the heatsink temperature reaches 92°C (198°F) the output of U110C, pin 8 goes high and saturates Q103. When Q103 is turned on U107 is turned off and the power supply turns off. The remote voltage is always present so when the heatsink temperature drops to 80°C (176°F) the power supply restarts. The high temperature condition would only exist if the fan was blocked or faulty.

The output of U110A, pin 1 also connects to the fan controller. U110D with the associated resistors provides a means to turn the fan on/off. Transistors Q120/Q121 provide current gain and a voltage level shift to run the fan. The fan turns on when the heatsink reaches approximately 45°C (113°F) and turns off again when the temperature reaches 35°C (95°C). In normal operation the fan turns on and off.

6.7.6 +15V CONVERTER

The input voltage to this "Buck" DC/DC converter is the main +26.5V output fused through F102. The bias voltage for the controller IC U112, pin 15 is provided by a +15V regulator U111. The basic buck converter consists of MOSFET Q125, Schottky diode CR126 and storage inductor L102. C165, C166, C167, L103, C169 and C170 filter the output voltage and attenuate the ripple at the switching frequency (160 kHz). The capacitors are an integral part of the feedback loop. The duty cycle is approximately 60%.

The +15V buck converter is peak current mode controlled. T108 samples the inductor current while MOSFET Q125 is on. The sampled current is translated to a voltage via CR127, R209 and R210.

Because the MOSFET is a high-side switch, a charge pump is required to get the gate voltage above the input voltage. The charge pump operates as follows. When the output from IC U112, pin 14 is low, capacitor C162 is charged through CR124, R198, R199, R200 and Q122/Q123 are off. When U112, pin 14 goes high, the capacitor stays charged and CR124 is reverse biased. Q122/Q123 are turned on forward biasing CR125 and applying a gate-to-source voltage of approximately +12V. During this time Q124 is off. When U112, pin 14 goes low, Q124 turns on and rapidly discharges the gate capacitance.

Resistors R231/R208 coupled with C164 provide snubbing for Schottky diode CR126.

Because the +15V converter operates at greater than 50% duty cycle, slope compensation is required. Capacitor C176 is the time capacitor for this converter and R223 is the resistor that sets the charge current. A sawtooth wave is present on the high side of C176 that is buffered by Q127/Q128. The resistor divider network of R315, R227, R229 and R232 provide the correct amount of compensation for stable operation and current limiting.

The output voltage is sampled by R215, R216 and R217 and sent to the inverting side of the error amplifier internal to the controller IC on U112, pin 1. Voltage loop compensation is set by C174, C175 and R221.

Sync pulse is added into the low side of C176 via C172 and R225. The free running frequency of the 15V converter (approximately 145 kHz) is set about 10% lower than the 26.5V converter. This longer duty cycle allows the sync circuit to synchronize the converter.

Over voltage is sensed using U116 as a reference and amplifier, CR129 acts as a crowbar on the output. Once the crowbar is turned on, opto-isolator U119 is activated to shutdown the power supply. The enable line must be toggled or AC voltage removed for 10 seconds to reset the power supply.

6.7.7 +5V CONVERTER

Operation of the +5V "Buck" DC/DC converter is the same as the +15V, except slop compensation is not required. Some values are different to get the 5.2V DC and current limit to 6A. The duty cycle is approximately 20%.

6.7.8 -5V CONVERTER

The -5V "Buck-Boost" converter scales and inverts the voltage. This converter is free running at approximately 75 kHz. The output switch and controller are built into the 5-leg TO-220 IC U114. L105 is the storage inductor. C204, R270 and R271 close the voltage feedback loop and are set for optimum stable transient response. C208/C209 reduce output ripple. Under-voltage protection is required on this stage and works the same as the over-voltage protection of the +15V and +5V buck converters, but has opposite polarity.

6.7.9 POWER SUPPLY REPAIR AND ALIGNMENT

If a power supply fails it is typically a Power MOSFET or Power Diode. In some cases the MOSFET gate may short and cause some of the driver circuits to be damaged. When replacing heat sunk components it is advisable to replace the sil-pad thermal interface material at the same time. The mounting hardware must be replaced exactly as built in the factory. The mounting screws for the power semiconductors MUST BE torqued to 4-5 in/lbs. Under torque and over torque can shorten the life of the semiconductor.

The majority of the voltage and current limits are set with fixed value components in the power supply. However, the +26.5V, +15V and +5.2V supplies are adjustable. When certain components are replaced, the voltages must be adjusted. The voltages should be set at light load (i.e. repeater in the Receive mode).

1. The +26.5V supply can be adjusted with R174 when any of the following components are replaced: R173, R174, R175, U109, U108, U102, R143, R170 or R171.

2. The +15V supply can be adjusted with R216 when any of the following components are replaced: R215, R216, R217 or U112.

3. The +5.2V supply can be adjusted with R254 when any of the following components are replaced: R253, R254, R255 or U113.

6.8 BATTERY BACK-UP MODULE

6.8.1 OPERATION

When a battery back-up module is installed in a power supply it performs the function of running a repeater in the absence of AC voltage. When AC is present it can be used to charge a pair of lead-acid batteries in series. The charger is a temperature compensated constant voltage charger. The maximum output current from the charger is 2.2A. The charger works when AC is present and the repeater is enabled. The charger switch on the battery back-up module must be "On". The temperature compensation thermal sensor is part of 023-2000-223 battery back-up module cable assembly.

When AC is low or not applied to the 023-2000-800 power supply the battery input takes over if the voltage is within range. The input voltage to the battery back-up module acts as the 26.5V supply and the other voltages in the power supply also are present, +15, +5.2 and -5V. When AC is restored, the battery back-up module disengages automatically. The change over from battery to AC or AC to battery may cause the repeater to reset, depending on battery condition and load status.

NOTE: When using a generator, the DC voltage must be between 23-28.5V (26.5V DC is recommended) and ripple voltage less than 1% or approximately 0.25V P-P.

6.8.2 CHARGER

The charger charges the batteries when the repeater is on and switch S101 is "on". A tap off of the main transformer of the power supply through wire W104 and a +26.5V line via wire W102 are what supply the charger with the necessary voltage to charge the batteries. The tap off of the transformer is biased by the +26.5V and then filtered through L101, C105 and C119. Since the tap from the power supply is not a regulated voltage, bleeder resistors R136/R137 dissipate some power when the batteries are fully charged. No load situation, the peak voltage of the tap is approximately 63V, is not impressed across the 50V capacitors C105/C119. During a battery charging condition the line voltage to the charger on U107, pin 2 should be about 35V.

While charging batteries, if the charge voltage is varied with respect to the temperature of the batteries, the lifetime of the batteries is increased dramatically. Figure 6-12 shows the algorithm used in float charge applications for two 12V lead-acid batteries in series. Figure 6-12 shows that the charge voltage should be 27.3V DC ±0.15V at 25°C (77°F) with -55 mV/°C temperature compensation.

An LM317M linear voltage regulator (U107) is used to create the temperature compensated charge voltage. This device is capable of delivering 2.2A of continuous current to the batteries.

To create a temperature compensated voltage an op amp (U104) is used as a voltage gain device from a temperature probe attached to the batteries (part of 023-2000-223). This op amp with R148/R149 defines the slope for the algorithm of Figure 6-12. The output of the temperature compensation is attached to the adjust pin of U107. R138-R140 allow the output voltage to be set properly at a given ambient temperature. F101 is a 4A resettable fuse used to prevent thermal run away in the event of U107 failure. If the output current to the batteries exceeds 4A this fuse opens. Once the current drops below 100 mA, the fuse closes automatically.

NOTE: If any of the charging components are replaced, R140 needs to be adjusted to set the output (battery back-up battery terminals) voltage to 27.3V ±0.15V when temperature sensor is at 22°C (71.6°F).

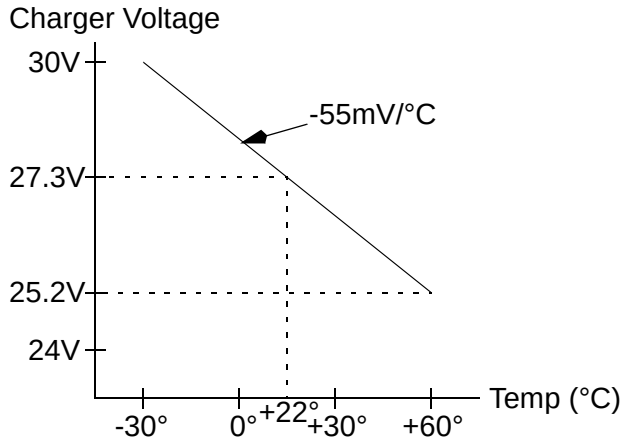


Figure 6-12 NO LOAD CHARGE VOLTAGE vs. TEMPERATURE

6.8.3 REVERSE BATTERY PROTECTION

To obtain reverse battery protection a number of techniques were implemented. Q108/Q110 are arranged in a Darlington configuration to isolate the output capacitors C109-C111 from conducting in the event the batteries are connected backwards. This circuit also provides a means to turn the battery charger off in case the user wants to run the repeater off of another DC source. S101 opens the base of Q105 which turns off Q104. CR111 is a green light emitting diode (LED) located on the right hand side of the battery back-up module when looking at the front of the power supply that tells the user the charger is in charge mode and is marked "On".

To notify the user that the batteries are connected improperly R101/CR101 are connected in series across the batteries. CR101 is a red LED that lights when the batteries are connected backwards and is located on the left hand side of the battery back-up module when looking at the front of the power supply. This LED is marked "Reverse Bat.". CR113 eliminates a path for the reverse battery current through the relay and over/under voltage protection circuitry.

NOTE: Exceeding -30V across the battery back-up terminals with the power supply on will destroy Q105.

6.8.4 ENGAGING THE RELAY

The main purpose of the Battery Back-Up Module (BBM) is that when the power supply loses AC line voltage, a pair of series connected 12V lead acid batteries (approximately 26.4V) or other 23-28.5V DC source will engage to the supply allowing the repeater to operate. To perform this function a voltage comparator (U101) is used to monitor the charge tap coming from the power supply.

A 2.5V reference voltage is supplied to the comparator from U102. The transformer tap voltage is smoothed and divided by CR114, C118, R116, R121 and R122. The values for these components were calculated so that when the AC line voltage is dropped to 70V AC, the output of the comparator turns Q103/Q102 on which in turn engages the relay K101. The relay is capable of 30A which delivers the battery energy to the power supply via W102 with the return line being W103.

NOTE: When AC is restored, the relay disengages and the charger automatically begins to charge the batteries.

6.8.5 OVER/UNDERVOLTAGE SHUTDOWN

U101 is a quad comparator IC used to create the overvoltage and undervoltage shutdown circuitry. If the batteries are drained sufficiently enough such that the voltage of the batteries drops below 20.3V DC the output of the comparator goes low and turns Q102 off. By turning Q102 off the batteries are switched out of the circuit. The batteries cannot be switched back into the repeater until the voltage rises to 22.6V DC. This operation is in place to protect the repeater and the batteries. In the event the batteries are over charged, or the repeater is driven by the generator that has the voltage set too high, the relay will disengage above 30.5V DC. In order to switch the batteries back to the repeater, the voltage must drop below 29V DC.

In an overvoltage or undervoltage situation, whether AC is present or not, the red LED (CR105) lights until the problem is rectified. This light is located on the right-hand side of the battery back-up module when looking at the front of the power supply and is marked BAT-BAD.

6.8.6 BBM FAN CONTROL

The voltage supply to the thermal measurement circuit is taken from the 26.5V DC line into the BBM. A precision temperature sensor U106 is mounted on the PC board near a screw into the BBM bracket which transfers heat to the sensor. The output of this sensor is 10 mV/°C with a ±1% accuracy. This voltage is amplified by U105 with resistors R153/R154 setting the gain.

The output of this gain stage (pin 1) is fed to another gain stage that performs as a comparator. The output (pin 7) will go high when the heatsink temperature reaches 45°C and will go low when the temperature goes below 35°C. This output is sent to the power supply through Q106 to turn the fan on and off.

6.9 CARD RACK

The card rack provides slots for up to eight logic cards; including Main Processor Card (MPC), Main Audio Card (MAC) and the Interface Alarm Card (IAC). The IAC has a notch in the card to accommodate a pin in Slot-8 so that no other card can be plugged into this slot.

On the back of the card rack is the Backplane with plug-in connectors to the cards and cables to the RF modules, Power Supply and External Connector Board.

Refer to the component layout and schematic diagram in Section 10 for more information on the repeater backplane.

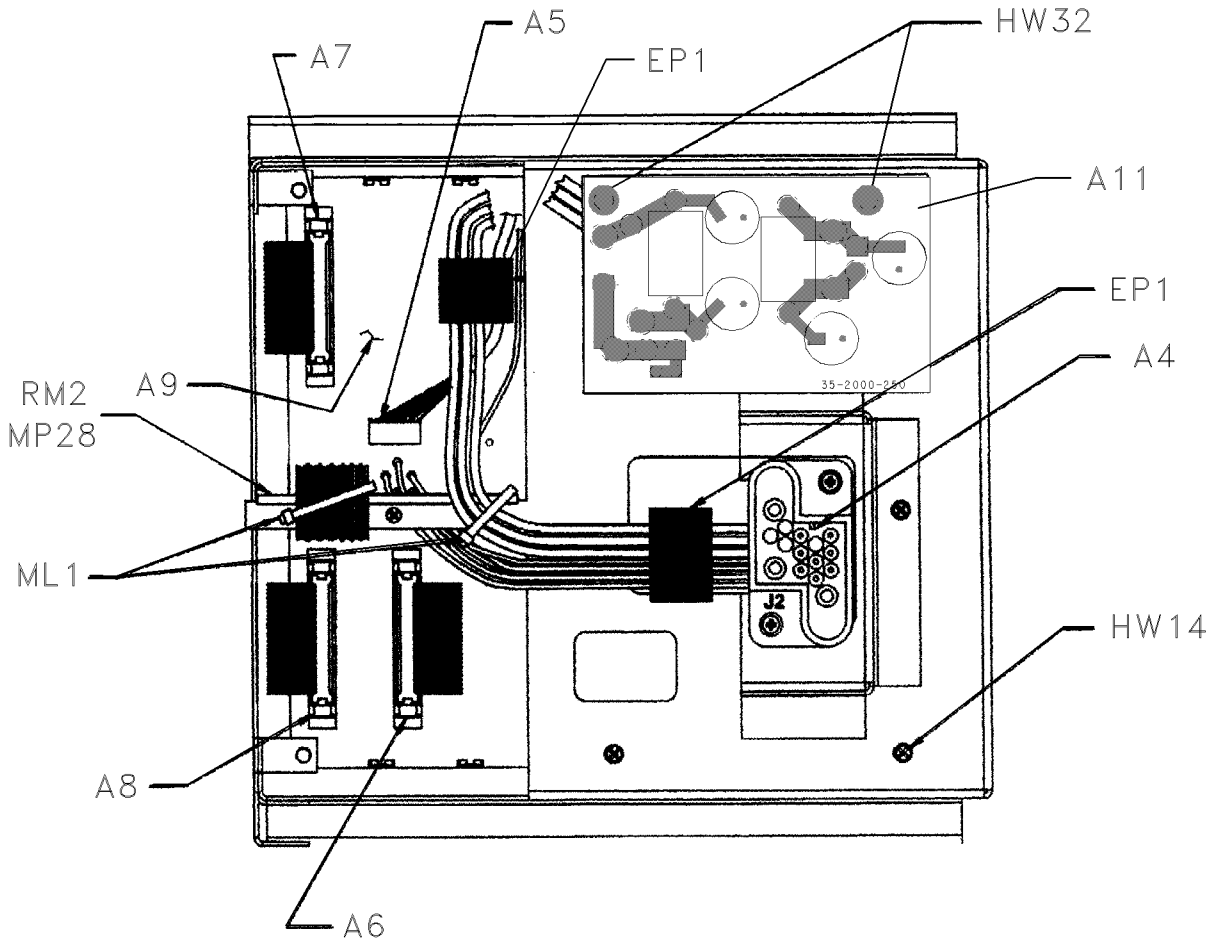


Figure 6-13 BACKPLANE CONNECTORS

6.10 ALARM EXTERNAL CONNECTOR BOARD

The alarm external connector board (A10) is the interface for the alarm outputs and connecting repeaters through the high speed data bus.

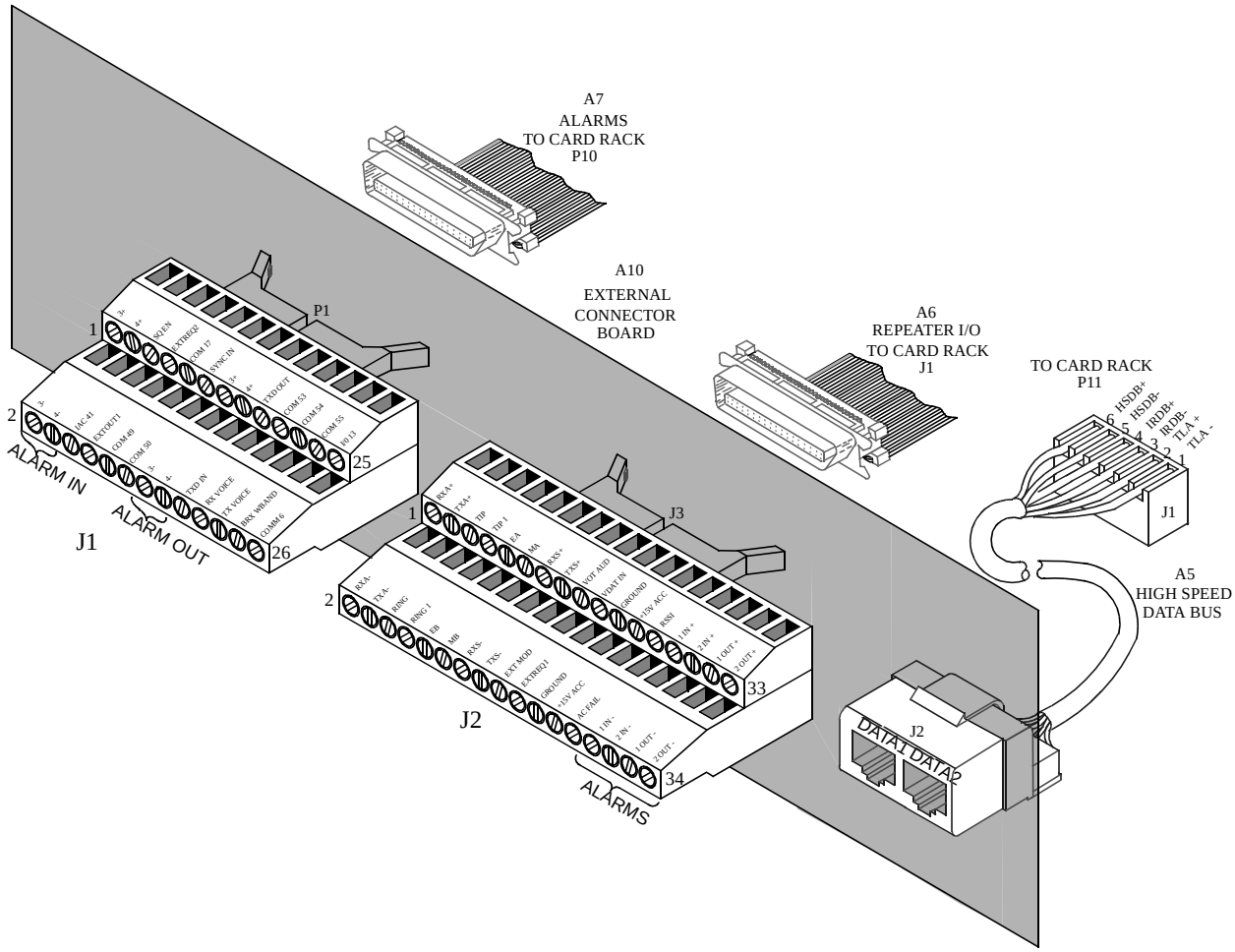


Figure 6-14 ALARM EXTERNAL CONNECTOR BOARD

6.11 MAIN PROCESSOR CARD

6.11.1 INTRODUCTION

The Main Processor Card (MPC) connects to the computer with repeater software to program the repeater parameters, sets and reads the alarms, handles communication between repeaters, maintains the audio gating for the MAC, handles initialization requests from cards and contains the repeater RF data for the Receiver, Exciter and CWID.

Control functions for each repeater are performed by the Main Processor in the MPC installed in each repeater. The MPC contains the main software and control over the repeater via microprocessor U27 (see Figure 6-23).

Information is exchanged between repeaters via a High-Speed Data Bus (HSDB) that interconnects all the MPCs. This control technique is called distributive processing and it eliminates the need for a separate system controller at each site. The HSDB processor (U13) on the MPC provides these control functions.

The MPC also contains:

- Flash Memory, RAM, non-volatile EEPROM.
- I/O chip select to allow the addressing of data latches for Input/Output.
- Read/Write selection to be sent and received on the Controller Backplane.
- Clock line, data line and chip select line from the IAC to load the Receiver and Exciter synthesizers.
- Serial communication circuitry and processes for the High Speed Data Bus (HSDB).
- Asynchronous parallel communication to the other cards, i.e. alarm input and output circuitry.
- AC Power Failure indication from the IAC.
- Provides an output from the IAC to the power amplifier to control the output power.
- Exciter Logic Push-To-Talk (PTT).
- Receiver synthesizer lock, Exciter synthesizer lock, thermal level from the power amplifier, VSWR level from the PA, forward power level, RSSI signal level, audio levels from the MAC, Receiver and Exciter from the IAC.

6.11.2 MAIN CONTROLLER MICROPROCESSOR

This contains the main software and control over the repeater (see Figure 6-15).

The main controller (U27) is a VLSI (Very Large Scale Integration) CMOS 16-bit single chip computer with an 8-bit external data bus. This processor has software compatibility with the V20 (8086/8088), faster memory access, superior interrupt processing ability, and enhanced control of internal peripherals. This ROMless processor has a variety of on-chip components including 256 bytes of RAM, serial and parallel inputs/outputs, comparator port lines and timers.

Eight banks of registers are mapped into internal RAM below an additional 256-byte special function register (SFR) area that is used to control on-chip peripherals. Internal RAM and the SFR area are together and can be relocated anywhere in the 1M-byte address space. This maintains compatibility with existing system memory maps.

The two microprocessors and UART (U22) are reset by integrated circuit U17. Reset occurs when power is turned on, when the 5V supply drops below a threshold level or the reset switch (S1) is active.

When a microprocessor is reset, several internal registers are cleared and the program is started over from the beginning. Low-voltage reset prevents improper operation resulting from low-voltage conditions.

When power is turned on, the RESET output U17, pin 6 is initially high and the inverted RESET output U17, pin 5 is initially low. Once the 5V

supply stabilizes, these outputs remain in these states for approximately 100 ms to ensure that reset occurs. This time delay is set by capacitor C14 connected to U17, pin 3. If the 5V supply drops below a nominal level, the RESET outputs change states and microprocessor operation is interrupted until the 5V supply returns to normal. C3 prevents fast transients on the 5V supply from causing reset.

Manual reset can be accomplished by pressing push-button switch S1. When U17, pin 2 goes low, U17 goes into the reset sequence described.

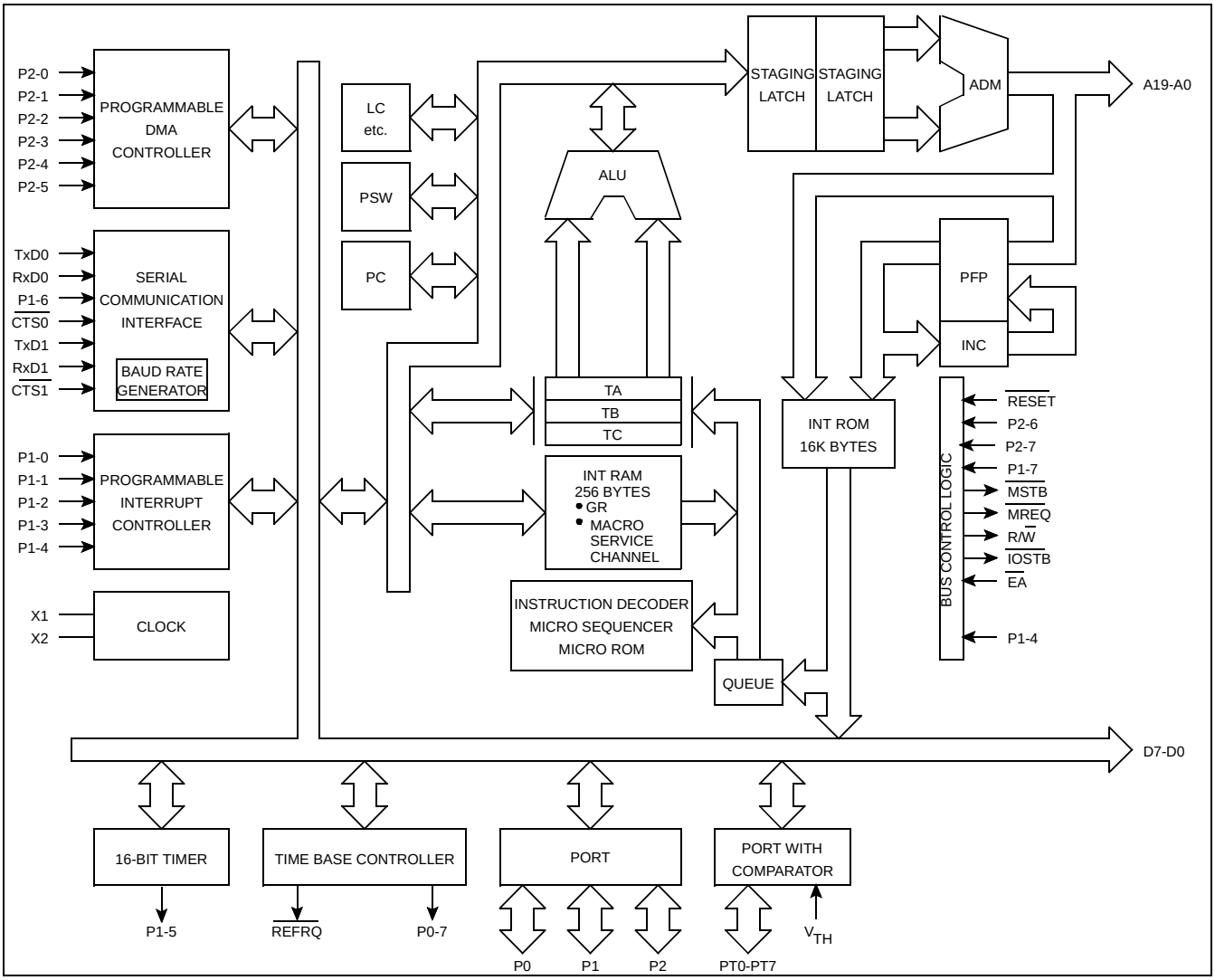


Figure 6-15 U27 BLOCK DIAGRAM

6.11.3 HIGH SPEED DATA BUS MICROPROCESSOR

The HSDB processor (U13) on the MPC provides the interface with the HSDB. It monitors data on this bus and also transmits data on to this bus when necessary. Information on this bus indicates which repeaters are in use and also which mobiles are using the system. This information is used by the repeater to encode data messages to the mobiles that are monitoring that channel. These messages also include information on which repeater is free and current system priority.

Microprocessor U13 is an 8052 that uses external EPROM (Erasable Programmable Read Only Memory) U14, an 8-bit device that stores the program. The microprocessor uses 2k x 8 EPROM and 64k x 8 RAM. The RAM (Random Access Memory) is used for temporary data storage. The HSDB processor is configured by the Main Processor.

The internal data bus of the microprocessor has four input/output ports. These ports have eight lines each, giving a total of 32 input/output lines that are designated P0, P1, P2, P3. P0 is used as a data bus. Ports P1 and P2 are always used as general purpose inputs/outputs. P3 is used for specialized functions, i.e. a serial port (RxD/TxD) and interrupt (INT).

The operating speed of the microprocessor is set by an 11.059 MHz clock generated by Y2. This clock frequency is divided down by an internal divider to provide a machine cycle time of 1.08 µs. Most program instructions are executed in one machine cycle and none require more than four machine cycles.

The microprocessor U13 communicates with the main processor (U27) through U9 and U10. U9 is a Transmit FIFO (First In First Out) and U10 is a Receive FIFO. This combination makes up an asynchronous parallel-to-parallel interface to the Main Processor.

Microprocessor U13 also calculates the current system priority for the channel. This priority is from the programming software responses and the current priority is sent to the main processor. U13 also reads repeater number and channel number information in memory. U13 also determines the current free repeater and includes that information in the data sent to the main processor.

6.11.4 CHIP SELECT DECODERS

These select the peripheral chip to read from or write to.

6.11.5 P1 SIGNAL CONNECTOR

This is the signal interface connector P1 (64 pin) that connects the Address and Data buses and control lines to the backplane connector.

Pins 1-10 Address Bus
Pins 33-42

This provides a path between the MPC main processor and the external memory on the MPC and the other cards in the Controller. This bus retrieves information programmed into memory for the operation of the repeater.

Pins 11-14 Data Bus
Pins 43-46

This provides a means of transferring data to and from the CPU on the MPC, memory storage on each card and peripheral devices in and out of the MAC and IAC.

Pin 15 MREQ

A memory request line operates in conjunction with the Read/Write lines. These provide the ability to read from or write to the main processor memory on the MPC.

Pin 16 $\overline{\text{MSTB}}$

A memory strobe line is used during MPC main processor Read/Write operations to external memory on the MPC and other cards plugged into the backplane.

Pins 17-20 UNUSED

Pin 21 LPTT

The Logic Push-To-Talk is an open collector from the Controller. It has a sink capability of 20 mA and a maximum voltage rating of 18V. The transmitter should produce power when this pin is a logic low. Transmit indicator is on the IAC and is controlled independently of the LPTT.

Pin 22 SWITCH TX DATA

This is the RS-232 data to the Switch. The CIM receives confirmation of all requests made to the repeater and sends information the repeater receives. The data rate is 1200 baud.

Pin 23 SWITCH RX DATA

This is the RS-232 data from the Switch. The CIM controls the repeater with restart, enable and disable, executes requests to read and write to the repeater's memory and tells the repeater transmit code, hang or send turn-off. The data rate is 1200 baud.

Pins 24/56 HSDB+/HSDB-

This interconnects all repeaters to provide an exchange of information. This control technique is called distributive processing and eliminates a separate system controller at each site. Information on this bus indicates which repeaters are in use and also which mobiles are using the system. This information is used by the repeater to encode data messages to mobiles that are monitoring that channel. These messages also include information on which repeater is free and current system priority.

Pins 25-26 UNUSED

Pins 27/59 -5V IN

This is the -5V input to the MPC from the power supply via the Controller backplane.

Pins 28-29 +5V IN
Pins 60-61

This is the +5V input to the MPC from the power supply via the Controller backplane.

Pins 30/62 +15V IN

This is the +15V input to the MPC from the power supply via the Controller backplane.

Pins 31-32 GROUND
Pins 63-64

This is the ground connection to the MPC from the power supply via the Controller backplane.

Pin 47 READ

Pin 47 is used with the MREQ line to read data from the main processor and external memory.

Pin 48 WRITE

Pin 48 is used with the MREQ line to write data to the main processor and external memory.

Pins 49-55 Unused
Pins 57-58

6.11.6 J1 COMPUTER CONNECTOR

J1 is the MPC connection to the computer or modem.

Pin 1	Ground
Pin 2	Computer Tx
Pin 3	Computer Rx
Pin 4	Modem DCD

6.11.7 J2 MEMORY SELECT

J2 is jumpered to select either the Flash memory or the EPROM memory. Flash memory is ultra-fast data storage. The normal setting is pin 1 to pin 2.

Pin 1	+12V
Pin 2	U25, pin 1 Vpp
Pin 3	+5V

6.11.8 J3 BAUD RATE

J3 is jumpered to select the baud rate from the computer to the MPC, these two baud rates must be the same (see Figure 6-23).
To change jumper J13:

Power off the station.
Move P3 to the proper rate.
Power on the station.

6.11.9 S2/S3 HSDB SETTINGS

These switches configure; the HSDB for RS-485 or single-ended 5V operation, indicate if the Summit repeaters are connected to existing repeaters or only Summit repeaters, and if the repeater is an end repeater termination. Refer to Sections 2.9 and 7.6.9.

6.11.10 J4 EPROM MEMORY LOADING

This jumper selects EPROM memory loading for LTR systems. The LTR setting is pin 3 to pin 4.

6.11.11 J5 HSDB SPEED

J5 is jumpered to select the data bus speed. J5, pins 2/3 select the LTR 12 MHz crystal.

6.11.12 J6 WATCHDOG

This jumper enables or disables the watchdog timer for reset. Normal operating mode is P6 jumpering J6, pins 2/3. This jumper should not be moved or removed.

6.12 MAIN AUDIO CARD

6.12.1 INTRODUCTION

This control card stores the information required to operate the routing of audio and data from the inputs of the repeater to the outputs. Data is received on the address bus from the MPC for the operations to perform. The Audio/Data microprocessor and the latches open and close gates to route a path for the audio or data.

Audio control functions for each repeater are performed by the main processor in the MPC. The MPC contains the software and maintains control over the repeater via microprocessor U27. The audio/data microprocessor passes received data to the main processor, and it is given the programmable parameters for the gates.

Information is exchanged between the cards in the Controller Backplane via a data bus and an address bus. The address bus provides the link between the main processor and the chip and the address latches on the MAC. These latches control the octal latches that select the audio and data gates. The data bus is the link between the main processor and the audio/data processor on the MAC. The main processor controls the data to the octal latches and opens and closes the gates required to route audio/data in and out of the repeater. The MAC also contains:

- The audio interface between the receiver and exciter and to the external connections.
- The receive audio filtering with de-emphasis.
- The squelch filter and detector.
- Slow decay timing circuit that controls a mute gate on the main receive audio.
- A filter, DC restoration and slicer circuitry for detecting the subaudible data.
- The fast squelch and data fed to the microprocessor that decodes the data and uses the squelch line as a data qualification signal.
- Transmit audio filter and limiter with pre-emphasis.

6.12.2 AUDIO/DATA MICROPROCESSOR

This Audio/Data microprocessor is on the MAC card and is used to decode LTR data received from the mobiles. The LTR data is applied to U111, pin 8 (P1.7 input). When a word is successfully decoded the data is then sent to U161 (Tx FIFO) and transmitted on the data bus in parallel to the main processor on the MPC.

When it is time to transmit the CW Identification, the main processor on the MPC sends the identification to U111 via the data bus and U160 (Rx FIFO). The CWID is sent to the Tx Data Amplifier and Filter. The output of the filter is summed with the transmit audio and sent to the Exciter.

U111 also uses six octal latches to provide additional input and output lines. Latch U107/U108 provide outputs which allow U111 to control various audio gates. These gates control the CWID, FSK data, and receive/transmit audio signals.

Latch U106 provides outputs which allow U111 to route signals to the Audio/Data Test Point by switching gates on and off. U106 also provides adjustment of the selected EEPOTs.

U155-U156 allow U111 to select the EEPOT to adjust with chip select lines. These latches also provide routing of some audio/data signals through gates.

U111 also decodes data from the Switch and transmits data to the Switch. In addition, it controls the FSK modem (U110), receive and transmit audio gates, receiver squelch, several front-panel indicators, and other functions.

U111 encodes the data messages transmitted to mobiles monitoring that channel, and controls transmitter keying. The MAC also contains circuitry which provides amplification and filtering of the receive and transmit audio and data signals. In addition, a modem integrated circuit (U110) provides FSK encoding and decoding of data transmitted and received from the Switch.

6.12.3 RECEIVE AUDIO

The Receive Wide Band Audio (RX WBAND) signal from the Receiver is fed into the MAC on P100, pin 27. This audio signal includes; audio, LTR-Net

data, and noise. The audio processing circuit provides filtering and amplification of the audio signal before it is routed to the outputs on the MAC card.

A low-pass filter consisting of U121A/B attenuates frequencies above 3 kHz. This removes high-frequency noise from the audio signal. From the filter the signal is fed to amplifier U122A to increase the level before the high-pass filter to preserve adequate hum and noise ratio.

From the audio amplifier the signal is fed to a high-pass filter consisting of U122B/C/D. This filter attenuates frequencies below 300 Hz which removes data present in the wide band audio signal. These filters are configured to act like large inductors. The signal is then fed to U163A which provides 6 dB per octave de-emphasis.

Audio gates U113B/C/D permit noise squelch circuit, control logic, and audio switch to control gating of the audio signal. The control signal from the noise squelch circuit is applied to U113B through U113D. When a carrier is detected, this input is high and U113B passes the signal. Programming determines the gating of audio. When audio is passed by U113B/C and U114A, the audio can be routed through other gates to various outputs (see Section 6.12.6).

6.12.4 RECEIVE SQUELCH CIRCUITRY

The receive wide band audio includes audio, data and noise. The squelch circuit detects this noise to determine receive signal strength. When no carrier or a weak carrier is received, there is a large amount of noise present. Conversely, when a strong carrier is present, there is very little noise present.

U135A is a high-pass filter which attenuates frequencies below approximately 30 kHz so that only high-frequency noise is passed. This noise is amplified by U135B and U123A. A level control adjusts the gain of amplifier U135B. The gain of U123A is partially set by a thermistor to compensate for circuit gain and noise level changes caused by temperature variations.

The amplified noise is then applied to a bridge rectifier. The difference between bridge rectifier outputs is applied to the inputs of U123B. The output of U123B is positive-going pulses. These pulses are applied to U123C which is a Schmitt trigger. When the input signal rises above the reference, the output goes low and causes the reference voltage to decrease slightly adding hysteresis to the triggering level. This hysteresis prevents intermittent squelching when the receive signal strength is near the threshold level.

The output of U123C is applied to U123D and Logic Squelch to Audio/Data Gate U159B and audio/data processor U111. Gate U159B routes the squelch output to the Audio/Data Test Point J100. U123D functions as a timing buffer. The output of U123D is applied to Receive Squelch Active Gate U113D. When this gate is closed, the squelch circuit controls Normal Receive Gate U113B to block receive audio if no signal is present.

6.12.5 RECEIVE DATA CIRCUITRY

The receive wide band audio signal is the unfiltered output of discriminator U202 in the Receiver. Therefore, this signal contains audio, LTR data, and noise. A low-pass filter formed by U124A/B attenuates frequencies above 150 Hz by 24 dB per octave so that only the data frequencies are passed. From the filter the signal is fed to amplifier U125A. The gain of U125A is adjusted by a level control. The output of U125A can be routed through Data To Audio/Date Gate U159C and the Audio/Data Test Point J100.

DC restoration circuit converts the data signal from AC floating near ground to a digital signal at levels of 0 and 4.5V. U125B/C provide the reference voltage on the inverting input of comparator U125D. Positive peak detector U125B handles the positive-going peaks of the data signal. Negative peak detector U125C handles the negative-going peaks of the data signal.

The voltage on non-inverting input to U125D is midway between the positive- and negative-going peaks. The data input is on the non-inverting input of U125D. When the data signal rises above the reference voltage, the output goes high. Conversely, when the input voltage drops below the reference voltage, the output goes low. The receive data is then passed to audio/data processor U111.

6.12.6 RECEIVE AUDIO PROCESSING

The receive audio signal from the receiver is fed into the MAC on P100, pin 27. When it is a call that does not need to be routed to the Switch (i.e. most mobile-to-mobile calls utilizing only that repeater), Repeat Gate U153C is enabled and the receive audio signal is routed through Transmit Option Gate U158C to the input of the transmit audio buffer U164B to be retransmitted. Repeat Gate U153C is controlled by processor U111 through latch U107. A logic 1 on the control input causes the signal to be passed, and a logic 0 causes the signal to be blocked.

Amplifier U166A provides amplification of the receive audio signal fed to the Switch. The gain of U166A is set so that if an RF signal is received that has a reference deviation level, the Switch receives a specified level also. No limiting occurs.

When the audio received from the mobile must be routed to the Switch (i.e. calls to a dispatcher or another system), receive audio gate U116B is enabled and passes the signal.

When the received audio must be routed to the backplane (i.e. for other cards), Receive Voice Gate U115B is enabled by processor U111/latch U108 and passes the audio signal to amplifier U120B. Receive To Backplane (RX TO BP) U115C is enabled and passes the amplified audio to the backplane.

When the audio received must be routed to the external speaker or speaker/microphone, Local Audio Mute Gate U114D is enabled by U111/latch U108. The audio is passed to local audio output amplifier U132. The gain of U132 is adjusted by the local audio volume control and the on/off switch.

6.12.7 VOTER AUDIO

This is not a Simulcast operation, however, when used the Receive audio from the voter receiver comes into the MAC on P100, pin 25. Amplifier U120A sets the gain of the signal and the output is routed to Voter Audio Mute Gate U115A. The gate is controlled by A/D processor U111/latch U108. If the gate is enabled, the audio goes to the Receive Mute Gate U113C and passes throughout the MAC Card.

6.12.8 COMPANDOR OPTION

The compandor option enhances the receive and transmit audio when used in conjunction with the Telephone Interface Card (TIC) in LTR-Net systems.

The filtered Receive Audio passes through the Receive Mute Gate U113C to the expander input on A301, pin 1. The expand output of A301, pin 2 is coupled to the audio outputs by U114C.

The transmit comes from TX-VOICE P100, pin 32, passes through the TX Voice Gate U158A to the expander input on A301, pin 5. The compressed output of A301, pin 4 is passed to the Transmit Audio Buffer.

6.12.9 TRANSMIT AUDIO

PTT switch (Q101/Q102) provides local microphone Push-To-Talk (PTT) indication to U105. U105 then tells U111 via the data bus that the local microphone PTT has been activated.

U164A amplifies the microphone audio signal to provide the correct input level to U164B. Local Microphone Mute Gate U117C is controlled by A/D processor U111/latch 106. The function of U117C is to mute the local microphone audio when the local microphone PTT switch is pressed. This prevents interference if the microphone remains live when the PTT switch is pressed.

Transmit Intercom Gate U117A is controlled by A/D processor U111/latch U157. When enabled, this gate passes local microphone audio to Main Audio Amplifier U166A and to the Main Audio To Switch output. This provides an intercom between the repeater site and Switch console operator.

Buffer U164B combines the microphone audio signal from U164A with the audio signal from the Repeat Gate U153C.

U127B/C form a high-pass filter that attenuates frequencies below 300 Hz to prevent interference with the Multi-Net data applied at U129B. 6 dB per octave pre-emphasis is provided by an RC combination before the signal is fed to U127D.

Limiter U127D and rectifiers form a precision limiter which prevents over modulation caused by high-level input signals. With normal input levels, the output of a bridge rectifier follows the input of the bridge. When a high-level signal is applied to the bridge, the bridge opens and the output of the bridge is limited to a specific level.

The output of the limiter passes to a composite 6-pole splatter filter formed by U127A, U128D and U128A separated by buffers U128B and U128C.

The output from U128A is fed to Normal Modulation Mute Gate U118B. This gate is controlled by A/D processor U111/latch U106. When enabled, the gate passes transmit audio to EEPOT U149. U149 is an electronically adjustable potentiometer that adjusts the gain of transmit audio amplifier U129C. The gain of U129C can only be adjusted through the software. Therefore, a computer must be attached to the MAC card when levels are set.

The output of U129C is fed to summing amplifier U129B where it is combined with Multi-Net transmit data and CWID when present. The gain of audio and data are the same so unity gain is produced. The output signal is fed to the TCXO where it frequency modulates the transmit signal.

6.12.10 TRANSMIT AUDIO PROCESSING

This is not a Simulcast operation. The balanced audio signal from the Switch is applied to U167A. This stage is a differential amplifier which converts the input signal to a single-ended output. The input impedance is set at 600 ohms. The output signal is applied to Transmit Audio amplifier U167B. The gain of U167B is adjusted by a level control. The output of the amplifier is connected to two gates. One is the Transmit Audio To FSK U116D. This gate is controlled by A/D processor U111/latch U107. When enabled, this gate passes the FSK blank and burst data from the Switch to the Secondary Audio from the Switch converter U131C.

When data and audio share the same path, U131D amplifies the signal and applies it to two gates. When enabled Transmit Secondary To FSK gate U153D passes the audio to FSK Modem U110. The other gate is Data Level Test Gate U133A. When enabled U153A passes the signal to Transmit Option Gate U158C and Level Detect Gate U159A to Audio/Data Test Point J100. The other gate is the Transmit Audio Gate U116C. This gate is also controlled by A/D processor U111/latch U107. When audio from the Switch is to be transmitted, Transmit Audio Gate U116C is enabled and passes the signal and Repeat Gate U153C is disabled interrupting the receive audio signal. When enabled, this gate passes the Main Audio from the Switch to Transmit Option Gate U158C and on to the transmit audio buffer U164B.

Transmit voice from the backplane comes into the MAC on P100, pin 32. When used, this signal passes to the transmit voice amplifier U130A. The amplifier output level is adjusted by a level control. The output of U130A is applied to another transmit voice amplifier U130B and Transmit Voice Gate U158A. U158A is controlled by A/D processor U111/latch U107. When enabled, the gate passes the voice to Transmit Option Gate U158C and on to the transmit audio buffer U164B. Transmit Voice amplifier U130B is adjusted by a level control. The output is fed to Transmit Net Gate U153B. Gate U153B is controlled by A/D processor U111/latch U155. When enabled, this gate passes transmit voice to FSK Modem U110.

6.12.11 TRANSMIT DATA AND CWID PROCESSING

This is not a Simulcast operation. The data signal is produced by A/D processor U111 on Transmit Data and Transmit Shape outputs. The transmit shape output is normally the opposite logic level of the transmit data output when data is transmitted. However, the bit before a logic transition occurs, the transmit shape output is the same logic level as the transmit data output. This results in a slightly higher logic 1 level and a logic 0 that is slightly lower. This pulse shaping minimizes interference between data bits when the data is filtered by the low-pass filter.

The data from U111 is fed to buffer U126A and Transmit Data Enable Gate U117B. Gate U117B is controlled by A/D processor U111 directly. When enabled this gate passes the data to EEPOT U151. U151 is an electronically adjustable potentiometer that adjusts the gain of transmit audio amplifier U126B. The gain of U126B can only be adjusted through the software. Therefore, a computer must be attached to the MAC card. U126B provides the required signal level at the output of the low-pass filter. A relatively

stable DC bias voltage for U126C/D is required because these stages are DC coupled to the transmit TCXO (see Section 6.2.2) and changes in bias voltage can cause fluctuations in the transmit frequency.

U126C/D form a low-pass filter that attenuates square-wave harmonics in the data signal above 150 Hz to prevent interference with the audio band. From this filter the signal is fed to summing amplifier U129B and combined with the transmit audio signal. The output of U129B is fed to Transmit Modulation Mute Gate U118D. This gate is controlled by A/D processor U111/latch U106. When enabled, transmit audio and data are passed to the Exciter modulation input and the transmit TCXO.

When needed, the External Modulation input on P100, pin 11 is fed to External Modulation Mute Gate U118C. Gate U118C is controlled by A/D processor U111/latch U106. When enabled, this gate passes the modulation on pin 11 to summing amplifier U129B and gate U118D to the modulation input of Exciter.

The repeater on the lowest frequency channel in each system must periodically transmit the station call letters as a continuous-wave identification encoded by Morse Code. This identification is programmed with the Edit Parameters software.

The CWID output is controlled by A/D processor U111/latch U107. This output is fed to CWID tone generator U100B/A and turns the tone generator on and off to create the Morse Code. From the tone generator the signal is fed to bandpass filter U129A. This filter passes the 800 Hz fundamental present in the signal. The output of the filter is jumpered by P106 on J106, pins 2/3 and P107 on J106, pins 4/5 to the summing amplifier and applied to gate U118D, and to the modulation input of the Exciter.

6.12.12 FSK MODEM

The function of the FSK Modem U109 is to convert digital data into tones that can be sent on a phone line or some other type of audio link. Modem U110 receives tones from the audio link and converts them back to digital data (see Figure 6-16). The FSK Modem is only used when connecting the repeater to an Switch.

This modem is programmed to operate in the Bell 202 Main Loopback mode by the M0-M1 pins. In this mode, a space (logic 0) is represented by a 2200 Hz tone, and a mark (logic 1) is represented by a 1200 Hz tone. The same tones are used for transmit and receive. Therefore, the transmit and receive filters in the modem are set for the same frequency. This form of frequency modulation in which data is encoded by shifting the frequency of tones is called Frequency Shift Keying (FSK). The modulation is phase-continuous which means that no interruption of the waveform occurs when the frequency changes.

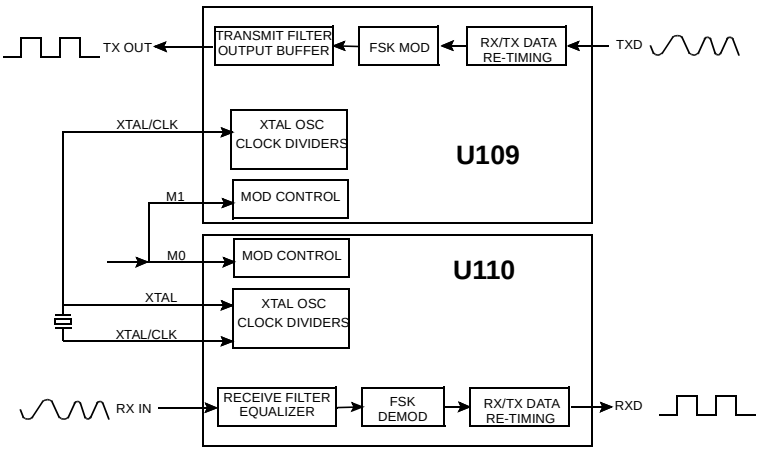


Figure 6-16 MODEM BLOCK DIAGRAM

This modem operates half-duplex, therefore two are used to provide full duplex operation which is the simultaneous transmission and reception of data. The data rate is 1200 baud (bits per second). Full duplex 1200 baud operation is possible because a 4-wire line is used which provides two separate audio paths. The path is selected by programming switches S100 and S101 as shown in Figure 6-17.

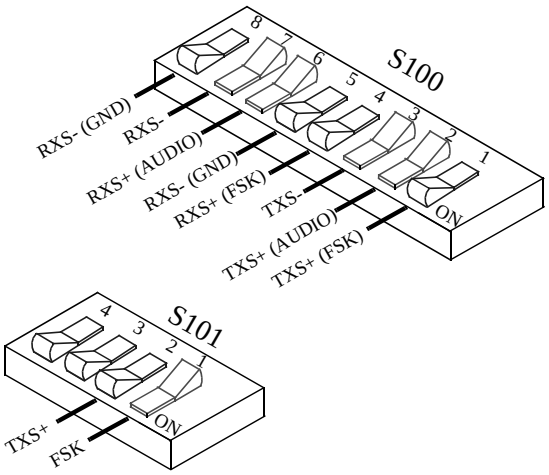


Figure 6-17 FSK MODEM SWITCH SETTINGS

If an RS-232 link is used for data communication with the Switch (on P100, pins 22-23), the modem is not used. This type of data path is selected by programming switches S100 and S101 as shown in Figure 6-18.

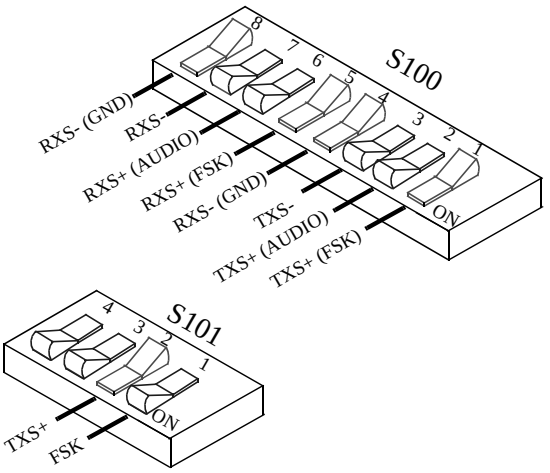


Figure 6-18 RS-232 SWITCH SETTINGS

The level of the transmit FSK signal from U109 to the Switch is set by amplifier U165A. The output of the amplifier is routed to main audio amplifier U166A by FSK To Audio Gate U116A. This gate is controlled by A/D processor U111/latch U108. Buffer amplifier U166B converts the single-ended input to a balanced 600 ohm output.

When the FSK data signal uses a different 4-wire link as the voice signal, the FSK output of U165A is applied to secondary audio amplifier U131A. Buffer amplifier U131B converts the single-ended input to a balanced 600 ohm output.

The FSK signal is also applied to FSK amplifier U165B and fed to gate U115D. Gate U115D is controlled by A/D processor U111/latch U155. When enabled the FSK signal is passed to voice amplifier U120B and Receive Voice To Backplane gate U115C to the Controller Backplane.

The FSK input from the Switch is applied to differential amplifier U131C. This stage converts the balanced input to a single-ended output. The FSK signal is then applied to U131D which sets the input level on the RC input of the modem. When enabled by A/D processor U111/latch U107 the transmit Secondary To FSK gate passes the FSK signal to U110 RC input. When the FSK data signal uses the same 4-wire link as the voice signal, the signal from U167A is applied to transmit audio amplifier U167B and passed by gate U116D to U131C.

If an RS-232 serial data path (1200 baud) is used instead of 600 ohm 4-wire lines, the data signal completely bypasses modem U110. In this case, RS-232 driver U162B converts data to the Switch to RS-232 logic levels of -5V and -7.5V. Conversely, when data is received from the Switch, RS-232 receiver U162C converts the RS-232 logic levels to TTL levels of 0V and +5V.

The 1200 Hz carrier is constantly transmitted by the Switch modem and received by the MAC modem. In turn, the MAC modem sends a constant carrier to the Switch modem. This is used as a constant check that a completed link is established between the two modems. If the carrier does not return from the MAC, it notifies the Switch system operator that the link has been broken.

The input and output connectors for the MAC are defined as follows.

6.12.13 P101 SIGNALING CONNECTOR

The signal interface connector P101 (64 pin) connects the Address and Data buses and control lines to the backplane connector. See Figures 6-24 and 6-25.

Pins 1-10 ADDRESS BUS
Pins 33-42

This provides a path between the MPC main processor and the processor and memory of the MAC. This bus retrieves information programmed into memory for the operation of the MAC.

Pins 11-14 DATA BUS
Pins 43-46

This data bus provides a means of transferring data to and from the processor on the MAC with peripheral devices in the MAC.

Pin 15 MREQ

A memory request line operates in conjunction with the Read/Write lines. These provide the ability to read from or write to the processor memory.

Pin 16 $\overline{\text{MSTB}}$

This is a memory strobe line used during MAC processor Read/Write operations to external memory.

Pins 17-20 UNUSED

Pin 21 LPTT

The Logic Push-To-Talk is not used on the MAC.

Pin 22 SWITCH TX DATA

This is the RS-232 data from the Switch. The CIM controls the repeater with restart, enable and disable, executes requests to read and write to the repeater's memory, and tells the repeater transmit code, hang or send turn-off.

Pin 23 SWITCH RX DATA

This is the RS-232 data to the Switch. The CIM receives confirmation of all requests made to the repeater and sends information the repeater receives.

Pins 24/56 HSDB+/-

The High Speed Data Bus interconnects the Viking VX repeaters. A 50 ohm termination is required if Viking VX repeaters are used with existing repeaters and the interface.

Pins 25/57 UNUSED

Pin 26 TLA DB

The Trunk Line Accounting Data Bus is used for telephone interconnect calls.

Pin 27/59 -5V IN

This is the -5V input to the MPC from the power supply via the Controller backplane.

Pins 28-29 +5V IN
Pins 60-61

This is the +5V input to the MPC from the power supply via the Controller backplane.

Pins 30/62 +15V IN

This is the +15V input to the MPC from the power supply via the Controller backplane.

Pins 31-32 GROUND
Pins 63-64

This is the ground connection to the MPC from the power supply via the Controller backplane.

Pin 47 READ

Read is used with the MREQ line to read data from the processor and external memory.

Pin 48 WRITE

Write is used with the MREQ line to write data to the processor and external memory.

Pins 49-55 UNUSED

Pin 58 VOTER DATA IN

This is used in a Voter system. Data from the voted site is injected at this pin.

6.12.14 P100 EXTERNAL OUTPUTS

Connector P100 contains the audio and data outputs to the terminal block on the back of the Repeater cabinet. These outputs are connected to other external devices. The input and output connectors for the connector are defined as follows.

Pins 1-6 UNUSED

Pin 7 3.5V

This is the 3.5V DC TCXO reference voltage from the Exciter to the MAC.

Pin 8 TX DATA OUT

This output contains trunking signaling data and CWID data when enabled at jumper J106 and used with external optional equipment.

Pin 9 TX DATA IN

This input would normally contain trunking signaling data, CWID data, and an externally summed in signal. This input is enabled at J106 and is used with external optional equipment.

Pin 10 EXT REQ1

This input provides for external requests from optional equipment.

Pin 11 EXT MOD

This input provides for external wide band modulation of the Exciter with out any filtering. This input is not used at this time.

Pins 13-26 UNUSED

Pin 27 RX WB AUDIO

The Receive Wide Band Audio from the Receiver audio demodulator through the RF Interface Board. The typical amplitude is 387 mV RMS (-6 dBm) and 2V DC with Standard TIA Test Modulation into the receiver.

Pin 28 A D LEVEL

This is the Audio/Data Level output.

Pin 29 TX MOD

The output of this pin is produced by audio and data inputs to the Repeater to produce the signals on this pin. This signal goes through the RFIB and then to the Exciter.

Pin 30 UNUSED

Pin 31 RX VOICE

This is receive audio output connected to the backplane.

Pin 32 TX VOICE

This is transmit audio input connected to the repeat gate.

6.12.15 J100 A D LEVEL TEST POINT

This test point located on the front card edge is used during alignment to monitor audio and data.

6.12.16 J101 SPEAKER/MICROPHONE

This jack is used in conjunction with J102 when a combination speaker/microphone is used during setup and testing of the repeater.

6.12.17 J102 LOCAL MICROPHONE

This jack is used for a microphone to key the Exciter and inject transmit audio.

6.12.18 J103 GROUND

This jack provides a ground connection for the MAC when monitoring the test points.

6.12.19 J104 EXTERNAL SPEAKER

J104 provides an external speaker connection at the repeater site for monitoring.

6.12.20 J105 WATCH DOG

J105 enables or disables the watchdog timer for reset. Normal operating mode is P105 jumpering J105, pins 2/3. This jumper should not be moved or removed.

6.12.21 J106 TX DATA PATH

Jumpers P106 and P107 connect J106, pins 1-2 and 3-4 for external options that require the Tx Data signal. Normal operation connects J106, pins 2-3 and 4-5.

6.12.22 A301 COMPANDOR CONNECTIONS

EP101	Expand In
EP102	Expand Out
EP103	Ground
EP104	Compress Out
EP105	Compress IN
EP106	+5V

6.13 INTERFACE ALARM CARD

This card stores the information required to operate the alarms designated in the programming of the repeater. Data is received on the address bus from the MPC for the; operation to perform, the processor and external memory, open and close relays on the outputs, and receive alarm indications on the inputs. This information is either routed to external devices or alarm outputs can be wired to alarm inputs.

The Interface Alarm Card (IAC) contains 4-input contacts and 4-output contacts. The 4- inputs can be disabled, energized or de-energized. The 4-output relays are dry contacts that have a 2A rating and can be either normally open or normally closed.

The electromechanical relay outputs are comprised of eight SPDT (normally open) relays. The relays are all open at power-on. Data to the relay is latched by a write to the base address.

The IAC activates relays when alarm trigger events occur. The IAC monitors for alarm activity in the system and can set the various output relays as defined by the user during programming. When an external alarm is set it can be monitored from a remote location. Refer to Section 4.7.2 for alarm programming.

6.13.1 ALARM FORWARDING TO SWITCH

Repeater alarms are routed to the CIB (Channel Interface Bus) to be detected by the Call Processor and the System and Subscriber Manager.

6.13.2 RELAY OUTPUTS

The alarm relay outputs are provided via a terminal block on the back of the repeater (see Figures 6-19 and 6-20).

The alarm outputs are on the terminal block at the rear of the repeater.

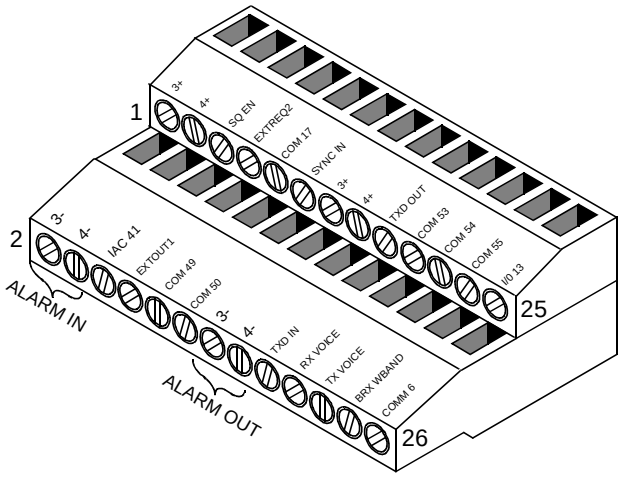


Figure 6-19 4 I/O J1 ALARM OUTPUTS

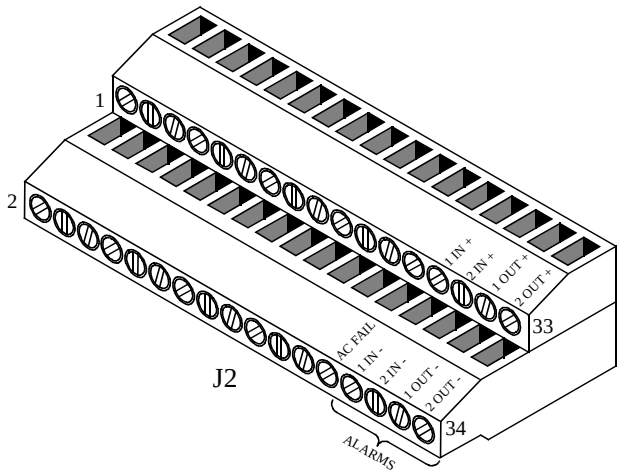


Figure 6-20 4 I/O J2 ALARM OUTPUTS

6.13.3 ISOLATED INPUTS

The isolated alarm inputs are provided via a terminal block on the back of the repeater (see Figures 6-19 and 6-20).

The isolated inputs are driven by either AC or DC signals. The active high inputs can be set by switches to be polarity sensitive, non-polarity sensitive or add a resistance in series to dissipate unused power (see Figure 6-21).

The active low inputs can also be set for either +5V or +15V operation when a ground closure is required to provide an active alarm.

Standard 12V/24V AC control transformer outputs can be accepted as well as DC voltages. This input voltage range is 5-24V RMS. External resistors connected in series may be used to extend the input voltage range.

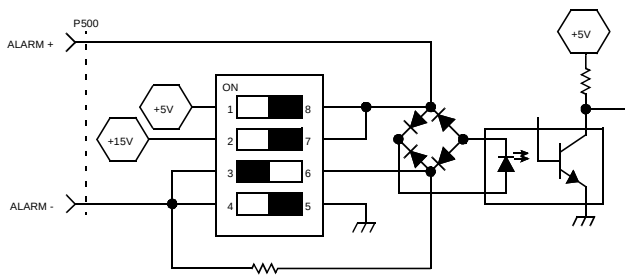


Figure 6-21 S500-S503

6.13.4 ALARM INDICATORS

There are three forms of alarm indicators from the repeater. One form is the two red LEDs and display combination on the MPC. Refer to Table 1-2 for the combinations and definitions of the active alarms.

Another form is the output relay to the terminal blocks at the rear of the repeater where outputs can be wired to external devices or to alarm inputs.

The third form is the output relay and to transmit a 15-character description of the alarm over-the-air to a remote location. The description is sent in Morse code with a transmit ID assigned during programming. A transceiver programmed with this ID can monitor the repeater and alert the system owner when an alarm occurs.

6.13.5 ALARM FUNCTIONS

The alarms can be configured in various modes to alert the system owner to conditions and hazards with the equipment and the repeater site facility. A few of the possibilities are shown in Figure 6-22. In this example the input alarm 2 of Repeater 1 is connected to the door of the building, input alarm 3 of Repeater 5 is connected to the fire alarm system, the AC fail alarm (#16 see Table 1-2) is mapped to alarm 2 output so it can be transmitted (see Figure 4-13) and the output alarm 1 of Repeater 1 is connected to the input alarm 1 of Repeater 2 and so on until the output alarm 1 is fed back to the input alarm 1 of Repeater 1. Then the RF Shutdown alarm (#32) is mapped for alarm 1 in each repeater. This configuration allows Repeater 2 to give an alarm when Repeater 1 has an RF Shutdown alarm output, etc.

The input alarms are given a 15-character description during programming and a Transmit ID. These are used when an input alarm is activated to send a Morse code message consisting of the description over the air to a monitoring transceiver programmed with this ID.

There are 40 internal alarms that can be included in the output alarm configuration (see Table 1-2). These alarms can also be programmed to send an output as shown in the cross reference screen of the alarm configuration menu (see Figure 4-13). Among these alarms are the thermal sense from the PA and the AC fail alarm output on the terminal block at the rear of the repeater to activate the battery backup.

6.13.6 P500 SIGNALING CONNECTOR

The input and output connectors for the IAC are defined as follows. The signal interface connector P500 (64 pin) connects the Address and Data buses and control lines to the backplane connector. See Figure 6-26.

Pins 1-4 ADDRESS BUS (A12-A19 Only)
Pins 33-36

This address bus provides a path between the MPC main processor and the latches and multiplexers of the IAC. This bus retrieves information programmed into the MPC memory for the operation of the IAC.

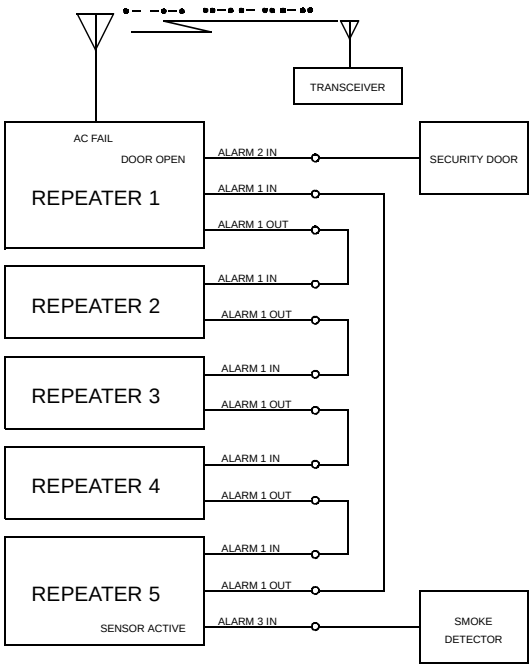


Figure 6-22 ALARM EXAMPLE

Pins 5/37 ALARM 1 IN +/ALARM 1 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pins 6/38 ALARM 2 IN +/ALARM 2 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pins 7/39 ALARM 3 IN +/ALARM 3 IN -

This is an input received from a connection to an external device as a specific condition.

Pins 8/40 ALARM 4 IN +/ALARM 4 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pin 9 SQUELCH ENABLE

This is an output to rear connector J1. It can be configured for inverted output, non-inverted output or logic controlled non-inverted output.

Pin 10 EXTERNAL REQ 2

This is an input received from a connection to an external device.

Pins 11-14 DATA BUS
Pins 43-46

This data bus provides a means of transferring data to and from the latches and multiplexers on the IAC with peripheral devices in the IAC.

Pin 15 MREQ

A memory request line operates in conjunction with the Read/Write lines. These lines read from or write to the MPC processor memory.

Pins 16/17 UNUSED

Pin 18 SYNC IN

This is an input received from a connection to an external device.

Pins 19/51 ALARM 1 OUT +/ALARM 1 OUT -

This is an output to an external device to perform a specific function.

Pins 20/52 ALARM 2 OUT +/ALARM 2 OUT -

This is an output to an external device to perform a specific function.

Pins 21-23 UNUSED

Pins 24/25 +15V ACCESSORY

This DC supply is an output to an external device through rear connector J1.

Pins 26/58 +15V FILTERED

This DC supply is an output to an external device through rear connector J1.

Pins 27/59 -5V IN

This is the -5V input from the power supply via the Controller backplane.

Pins 28-29 +5V IN
Pins 60-61

This is the +5V input to the MPC from the power supply via the Controller backplane.

Pins 30/62 +15V IN

This is the +15V input to the MPC from the power supply via the Controller backplane.

Pins 31-32 GROUND
Pins 63-64

This is the ground connection to the MPC from the power supply via the Controller backplane.

Pin 41-42 UNUSED

Pin 47 READ

Read is used with the MREQ line to read data from the MPC processor and external memory.

Pin 48 WRITE

Write is used with the MREQ line to write data to the MPC processor and external memory.

Pins 49-50 UNUSED

Pins 53-55 UNUSED

Pin 56 THERMAL SENSOR

The Thermal Sensor monitors the PA temperature and creates an alarm condition if the temperature exceeds the limit.

Pin 57 POWER SWITCH

Pin 57 turns the voltage from the power supply to the Repeater on and off. This pin is connected to the on/off toggle switch S508.

6.13.7 P501 EXTERNAL OUTPUTS

Connector P501 contains data and control outputs to the terminal block on the back of the Repeater cabinet. These outputs are connected to other external devices.

The input and output connectors for the connector are defined as follows.

Pins 1/17 ALARM 3 OUT +/ALARM 3 OUT -

Pins 2/18 ALARM 4 OUT +/ALARM 4 OUT -

These are outputs to external devices to perform a specific function.

Pin 3 RX WBAND

Receive Wide Band Audio from the Receiver audio demodulator through the RF Interface Board. The typical amplitude is 387 mV RMS (-6 dBm) and 2V DC with Standard TIA Test Modulation into the receiver.

Pins 4-6 UNUSED

Pin 7 EXT OUT 1

This is an external output to rear connector J1.

Pin 8 RF CLOCK

The clock will control the synthesizer chips and power control circuit when loading. This pin is a TTL input from the Controller.

Pin 9 AC FAIL IN

This input from the AC supply is used by the AC fail output to indicate that the AC has been interrupted.

Pin 10 SYN CS RX

This is the chip select pin for the main receiver synthesizer chip. This chip is the same part as used in the Exciter. A low loads the synthesizer.

Pin 11 UNUSED

Pin 12 RF MUX 1 INH

The Multiplexer-1 Inhibit (U105, pin 6) is a CMOS input from the Controller that inhibits (disables) the Multiplexer-1 output with a logic high.

Pin 13 RF MUX 2 INH

The Multiplexer-2 Inhibit (U106, pin 6) is a CMOS input from the Controller that inhibits (disables) the Multiplexer-2 output with a logic high.

Pin 14 RF MUX 3 INH

The Multiplexer-3 Inhibit (U104, pin 6) is a CMOS input from the Controller that inhibits (disables) the output from the RF 3 Multiplexer with a logic high.

Pin 15 PC STR

The Power Control Strobe is normally low until after the power control data is shifted into the power control register. Then the strobe line goes high and back to low. The clock or data lines cannot be changed until after the strobe is set.

Pin 16 HS CS EX

This is the 900 MHz Exciter high stability synthesizer chip select. A low enables loading the high stability synthesizer loop.

Pins 19-21 UNUSED

Pin 22 BUF RX WBAND

This is buffered Receive Wide Band Audio from the Receiver audio demodulator through the RF Interface Board. The typical amplitude is 387 mV RMS (-6 dBm) and 5V DC with Standard TIA Test Modulation into the receiver. This is an output to the rear connector J1.

Pin 23 AC FAIL OUT

This is an indication that the AC power has been interrupted.

Pin 24 UNUSED

Pin 25 HS CS RX

This is the 900 MHz Receiver high stability synthesizer chip select. A low enables loading the high stability synthesizer loop.

Pin 26 SYN CS EX

Pin 26 is the main Synthesizer Chip Select in the Exciter that allows input of data to the specific synthesizer chip when the line is pulled to logic low.

Pin 27 UNUSED

Pin 28 A D LEVEL

20 lines (of the possible 24) of RF functions sampled are multiplexed to the Controller through this pin using three multiplex chips.

Pin 29 RF DATA A

Data A (U105, pin 11) is the least significant bit (LSB) in the 3 multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 30 RF DATA B

Data B (U105, pin 10) is the middle significant bit in the 3 multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 31 RF DATA C

Data C (U105, pin 9) is the most significant bit (MSB) in the 3 multiplex chips located on the RFIB. This pin is a CMOS input from the Controller requiring a logic high for activation.

Pin 32 RF DATA

This is a data pin with TTL levels from the Controller which has the dual role of loading the synthesizer chips and adjusting the power control D/A lines for proper output power. Up to four synthesizer chips and a shift-register could be connected to this pin.

6.13.8 J500 A D LEVEL TEST POINT

20 lines (of the possible 24) of RF functions sampled are multiplexed to the Controller through this pin using three multiplex chips.

6.13.9 J501 GROUND

J501 is an IAC ground reference for test points.

6.13.10 J502 +15V

J502 is a voltage test point.

6.13.11 POWER SWITCH

S508 turns the power supply DC voltage on and off from the front of the IAC.

6.13.12 J505 SQUELCH ENABLE OUTPUT

P505 jumpers J505, pins 1/2 to configure the squelch enable output for an inverted output. If P505 jumpers J505, pins 2/3 the output is non-inverted. If P505 jumpers J505, pins 3/4 the output is non-inverted and under the control of U503.

Figure 6-23 MAIN PROCESSOR CARD BLOCK DIAGRAM

Figure 6-24 MAIN AUDIO CARD LOGIC BLOCK DIAGRAM

Figure 6-25 MAIN AUDIO CARD AUDIO BLOCK DIAGRAM

Figure 6-26 INTERFACE ALARM CARD BLOCK DIAGRAM

SECTION 7 ALIGNMENT AND TEST PROCEDURES

7.1 OCXO AND TEST EQUIPMENT FREQUENCY STABILITY

The receiver and transmitter frequencies are locked to the 1.250000 MHz reference frequency from the local oscillator drawer. This frequency is stable to within ±0.1 PPM from -30°C to +60°C as required by the FCC. To properly align the IF sections of the receiver, the signal generator must have similar stability. Since most test equipment is not this stable, a separate reference oscillator that is stable to ±0.05 or ±0.01 PPM may be needed to clock the signal generator and frequency counter.

Adjustment of the 1.250000 MHz reference frequency probably should not be attempted for the same reason. Unless the communications monitor has a stability of ±0.01 PPM or better, the repeater frequency may be more correct than that of the monitor. If it is certain that one or both oscillators in the local oscillator drawer are off frequency, there is an adjusting screw on the oscillators that is used to change the frequency slightly. Adjustment should only be performed when the ambient temperature is near the calibration reference of 25°C (77°F).

If power is removed from the local oscillator drawer, the oscillators require a minimum restabilization period of 30 minutes. No frequency-critical adjustments should be attempted until the oscillator frequency has stabilized.

7.2 RECEIVER ALIGNMENT

Refer to Figure 7-1 for component locations. Refer to Figure 7-9 for equipment needed and setup diagram.

7.2.1 PRE-TEST

1. Preset L201, L202, L203, L204, L206, L223 and L224 tuning screws about 1/4 inch above the top of the casting.

2. Preset L202 and L205 tuning screws so they are just barely above their tightening lock nuts.

7.2.2 VOLTAGE MEASUREMENTS

Apply power to the Receiver by plugging the 20-pin cable from the RF Interface Board into J201 (see Figure 7-1).

Measure the voltages at the following pins.

U206, pin 1	+12V DC ±0.4V
U207, pin 1	+12V DC ±0.4V
U208, pin 1	+6V DC ±0.2V
U210, pin 1	+12V DC ±0.4V

7.2.3 PROGRAM TUNE-UP CHANNEL

1. Using the PC and software, program the Synthesizer for the Receive channel number.

2. Tune the VCO helical L220 for +4.5V DC ±0.05V on U209, pin 6 or TP2.

3. Alternately tune L223 and L224 in 1/2-turn to 1-turn increments until a voltage is measured on J201, pin 13 or TP5. At that time, tune L223 for a peak, then L224 for a peak.

4. Retune L223 and L224 for a peak at J201, pin 13.

NOTE: The Channel Number, Channel Frequency and Synthesizer Frequency appear at the bottom of the screen.

7.2.4 TCXO FREQUENCY ADJUST

1. Set Y201 (TCXO) for 3.5V DC ±0.05V DC at TP1 (response time is very slow).

7.2.5 VCO TEST

2. The Synthesizer is programmed for 199 channels above the Receive Channel.

3. The voltage on U209, pin 6 (TP2) should be < 7.5V DC.

4. Record the voltage on J201, pin 13 (TP5) ____.

5. The Synthesizer is programmed for 199 channels below the Receive Channel.

6. The voltage on U209, pin 6 (TP2) should be > 2V DC.

7. Record the voltage on J201, pin 13 (TP5) ____.

8. If the voltages recorded in Steps 3 and 6 are not within ±0.2V, tune L224 as required to balance the voltage readings.

9. The Synthesizer is reprogrammed for the Receive Channel.

7.2.6 FRONT END ADJUSTMENTS

1. Set the signal generator to the Receive Channel at a level sufficient to produce an output voltage on J201, pin 7 (TP3) (RSSI Output).

2. Tune L204, L205, L206, L201, L202, L203 and L204 for a peak voltage on J201, pin 7 (TP3). Decrease the generator output level to maintain a 2-3V reading at J201, pin 7.

3. Set the generator to 1000 μV with a 1 kHz tone at ±1.5 kHz deviation (100 μV at the Rx antenna with 20 dB pad on the generator).

4. Tune the Quadrature detector coil Z213 for maximum AC voltage on J201, pin 9 (TP4).

5. Adjust R264 for 387 mV RMS, ±5 mV RMS, on J201, pin 9.

6. Adjust R284 for 2V DC ±0.05V DC on J201, pin 9 (TP4).

7. Measure the distortion on pin J201, pin 9 (TP4) (analog tuning meter is preferred).

8. Tune C207, L209, L211 and L225 for peak voltage on J201, pin 7 (TP3). Decrease the generator output level to maintain 2-3V.
   Distortion should be <5% (typically < 3%).

9. Repeat Steps 4, 5 and 6.

7.2.7 AUDIO DISTORTION

1. Plug a 16 ohm resistive load at J101 or J104 on the MAC (Main Audio Card).

2. Connect a distortion analyzer to the 16 ohm load.

3. Measure the distortion of the receive audio at J101 or J104 on the MAC with the local volume control set to 2.8V RMS.

4. The reading should be less than 3% (typically < 1%).

5. Measure receive sensitivity at J101 or J104 on the MAC.

6. The reading should be < 0.35 μV (typically < 0.25 μV).
   Optional: Adjust L207, L209, L211, and L225 for best distortion and recheck sensitivity.

7. The Synthesizer is programmed for 199 channels above the Receive Channel.

8. The receive sensitivity should be < 0.35 μV (typically < 0.3 μV).
   Optional: Adjust L204 to balance sensitivity at ±199 channels if needed.

9. The Synthesizer is programmed for 199 channels below the Receive Channel.
   Optional: Adjust L204 to balance sensitivity at ±199 channels if needed.

10. The receive sensitivity should < 0.35 μV (typically < 0.3 μV).

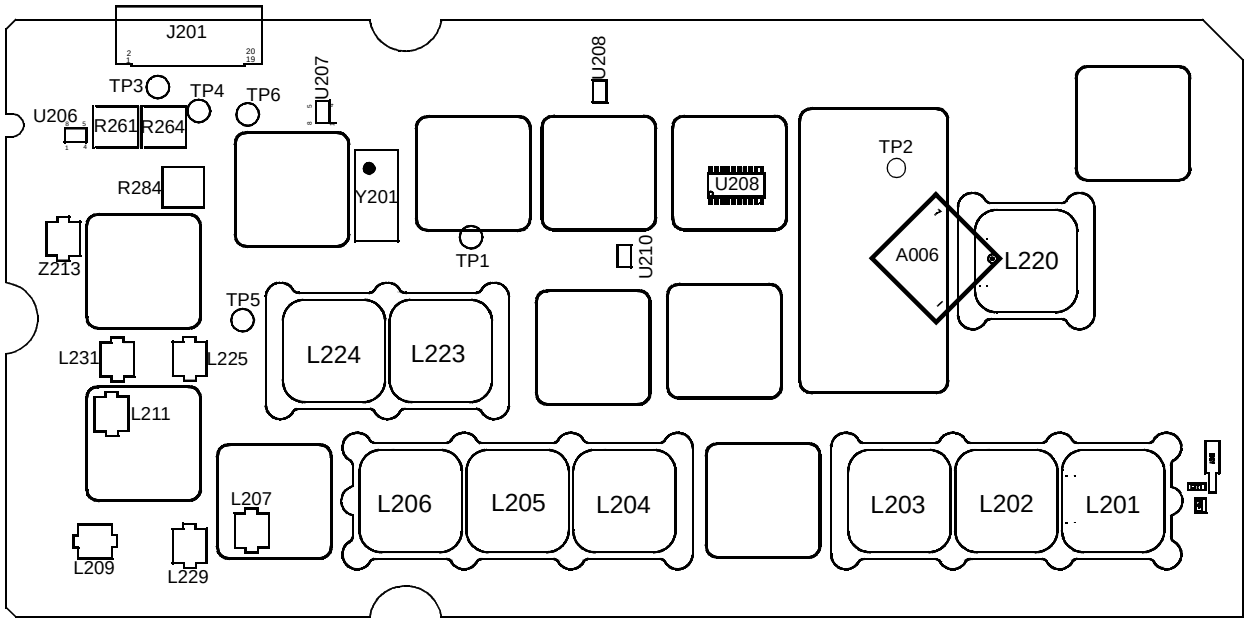


Figure 7-1 RECEIVER ALIGNMENT POINTS

7.3 EXCITER ALIGNMENT

Refer to Figure 7-2 for component locations. Refer to Figure 7-10 for equipment needed and setup diagram.

WARNING

SAFETY MEASURES ARE DISABLED IN TEST MODE. ALARMS ARE ACTIVE. HOWEVER, FEATURES SUCH AS THERMAL SHUTDOWN IN THE PA ARE DISABLED.

7.3.1 PRETEST

1. Set TCXO modulation adjust R425 fully counter-clockwise.

2. Connect the power meter to J402.

3. Connect OCXO to J403.

NOTE: 2000 Series OCXO must be powered up for 1/ 2 hour or longer to stabilize frequency.

7.3.2 VOLTAGE MEASUREMENTS

Apply power to the Exciter by plugging the 20-pin cable from the RF Interface Board into J401.

Measure the voltages at the following pins.

U406, pin 1	+12V DC ±0.4V
U405, pin 1	+5V DC ±0.2V
U404, pin 7	+3.5V DC ±0.1V

7.3.3 PROGRAM TUNE-UP CHANNEL

1. Program the Transmit Channel.

2. Use the "Turn on carrier" button to key the Exciter.

3. Tune VCO helical L404 for 4.5V ±0.05V on U403, pin 6 (TP1).

4. Measure the Power Output of the Exciter at J402. Reading should be +17.5 dBm ±0.5 dB.

5. Use the "Turn on carrier" button to unkey the Exciter.

7.3.4 TCXO FREQUENCY ADJUST

1. Tune TCXO Y401 for 3.5V DC ±0.05V DC at U402, pin 1 (response time is very slow).

7.3.5 VCO TEST

1. The Synthesizer is programmed for 199 channels above the transmit frequency.

2. Use the "Turn on carrier" button to key the Exciter.

3. Measure the voltage on U403, pin 6 (TP1). Voltage should be < 7V DC and the Power Output +17.5 dBm ±0.5 dB.

4. Use the "Turn on carrier" button to unkey the Exciter.

5. The Synthesizer is programmed for 199 channels below the transmit frequency.

6. Use the "Turn on carrier" button to key the Exciter.

7. Measure the voltage on U403, pin 6 (TP1). Voltage should be > 2.5V DC and the Power Output +17.5 dBm ±0.5 dB.

8. Use the "Turn on carrier" button to unkey the Exciter.

7.3.6 TRANSMIT MODULATION ADJUST

1. Connect a 10 dB pad and modulation analyzer to J402.

2. Press the "FM" and "3 kHz LPF" switches of the modulation analyzer.

3. Inject a 1 kHz sine wave with a level of 400 mV RMS into P100, pin 32 on the MAC.

   NOTE: This test changes the Audio Deviation Limit. Perform test in Section 7.6.6 to correct.

4. Adjust U149 for 707 mV RMS on P100, pin 29. This waveform should be a "clean" sine wave.

5. Use the "Turn on carrier" button to key the Exciter.

6. Set R446 for ±1.5 kHz deviation.

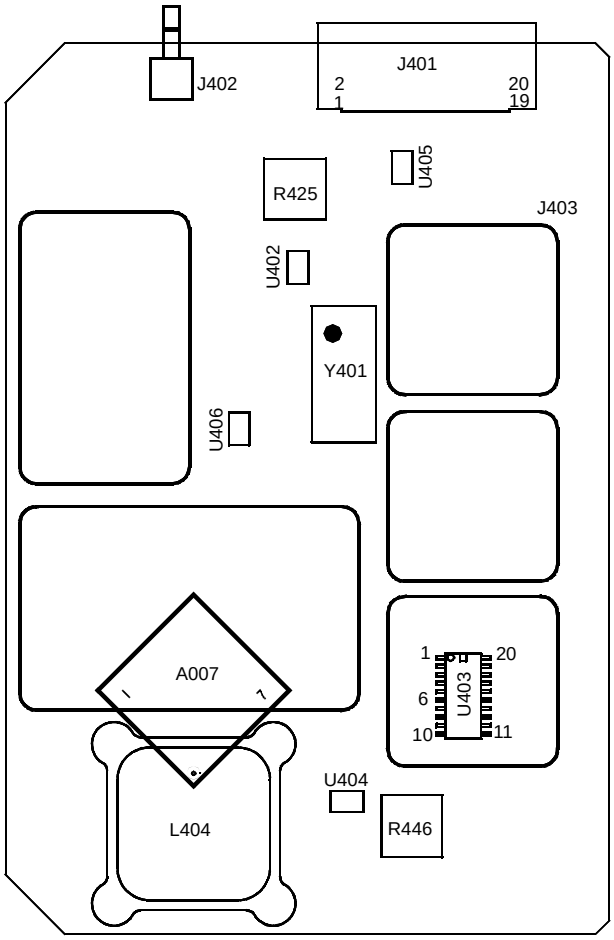


Figure 7-2 EXCITER ALIGNMENT POINTS

7. Use the "Turn on carrier" button to unkey the Exciter.

   NOTE: Ensure that the oscilloscope is "DC" coupled and the Modulation Analyzer has the 3 kHz LPF switch set but NOT the 300 Hz HPF and 50 Hz HPF switches set.

8. Adjust U151 for a 2V P-P square wave on P100, pin 29.

   NOTE: This test changes the TX Data Level. Perform test in Section 7.6.6 to correct.

9. Use the "Turn on carrier" button to key the Exciter.

10. Set R425 for "best" square wave as observed on the oscilloscope.

11. Use the "Turn on carrier" button to unkey the Exciter.

12. Repeat Steps 1-7. Very little adjustment of R446 should be needed.

7.4 75W POWER AMPLIFIER ALIGNMENT

7.4.1 INTRODUCTION

Refer to Figures 7-3 and 7-5 for component locations. Refer to Figure 7-11 for equipment needed and setup diagram.

Select "PA" from the "TEST" menu in the Repeater Programming Software.

IMPORTANT NOTE

No field alignment is required. Adjustments in Sections 7.4.2 and 7.4.4 are part of a new unit production test procedure. They should only be performed as required on "out-of-warranty" and "field-repaired" units. Broken seals on R76, R663 or R680 will void the warranty! Full power control range of 25-75W is controlled by the repeater configuration parameters under the Edit-Setup Parameters menu selection.

The adjustments in Section *7.4.2* provide for proper matching for the output of Q501 and set a protective limit on the drive to the final transistors. This limit is approached only under certain unusual operating or repair conditions. However, improper adjustment may impair normal operation of the PA, especially at temperature extremes.

If Q501 or U501 are replaced, only Section 7.4.2 adjustments should be performed. No other adjustments are necessary in this case. Replacement of RF components surrounding Q501 and U501 does not justify performance of Section 7.4.2 adjustments. Replacement of active components within the power control circuitry of the RF Interface Board would require Section 7.4.2 adjustments.

Section **7.4.2** adjustments are necessary **only** if repairs are made and such repairs are likely to affect the sensitivity/calibration of the forward or reverse power detectors (e.g. replacement of detector diodes CR651/CR652 or of the entire forward/reverse power detector assembly). Replacement of components within the power control circuitry of the RF Interface Board are unlikely to affect the calibration of the power control.

NOTE: Replacement of Q501, Q502, Q503 or U501 does <u>not</u> require the adjustments in Section 7.4.2.

7.4.2 FORWARD POWER OUTPUT CALIBRATION

1. Connect the:
   power supply ground lead to P105,
   +15V DC lead to P103,
   +26.5V DC lead to P101 and
   the 36-pin cable to J101 on the RFIB.

2. Connect attenuator and power meter to A8.

3. Set R663 fully counterclockwise.

4. Set R76 on the RFIB fully counterclockwise.

5. Set the signal generator to +16 dBm ±0.1 dB at 937.5 MHz.

NOTE: All cable and attenuator losses must be measured and incorporated into this measurement.

CRITICAL ADJUSTMENTS

6. Use the "Turn on carrier" button to key the PA.

7. Adjust R663 for 85W ±2W (±0.1 dB).

8. Verify that Output 1 is within 20% of Output 2.

9. Use the "Turn on carrier" button to unkey the PA.

7.4.3 PRE-DRIVER POWER LIMIT ADJUSTMENT

1. Set a power reference of 0 dB at 85W.

2. Monitor the Transmit current and RF output level. Use the Up Arrow key to increase the power level until 0.6 dB above 85W (97W) is reached or peak PA output.

NOTE: If the Transmit current begins to increase rapidly and is not constant with time, then unkey the PA immediately and troubleshoot.

3. Adjust power limit control R76 clockwise until power is limited to 0.55 dB above 85W (95W). If the maximum PA power is < 95W, adjust R76 until power begins to decrease.

7.4.4 REFLECTED POWER ADJUST

1. Remove the load cable from A8.

2. Use the "Turn on carrier" button to key the PA.

   NOTE: This will not harm the PA.

3. Adjust Reverse Power Calibration Pot R680 for equal voltages on W126 and W121 on the RFIB or for equal Forward and Reverse Power.

4. Use the "Turn on carrier" button to unkey the PA.

5. Apply "Glyptol" to R663, R680 and R76.

6. Use the “Turn fan on” button to turn on/off fans. Both PA fans should turn ON.

7. Measure temperature detector voltage at W127 on the RFIB. Normal output at 25°C ambient is approximately +1.0V DC.

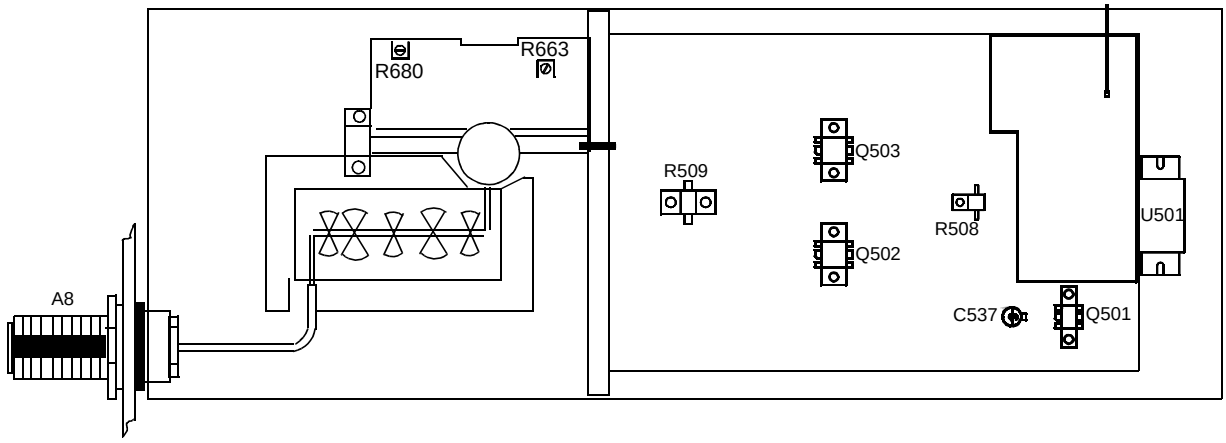


Figure 7-3 POWER AMPLIFIER ALIGNMENT POINTS

7.5 160W POWER AMPLIFIER ALIGNMENT

Refer to Figures 7-4 and 7-5 for component locations. Refer to Figure 7-8 for equipment needed and setup diagram.

NOTE: No alignment is required unless the driver transistor Q502 or driver matching caps have been replaced or critical components on the power detector board have been replaced.

WARNING

Breaking the glyptol on R663, R680 or R76 will void the warranty on the PA.

7.5.1 POWER OUTPUT ADJUSTMENTS

Refer to Figure 7-8 for test circuit and equipment needed.

1. Connect the:
   power supply ground lead to P105,
   +15V DC lead to P103,
   +26.5V DC lead to P101 and
   the 36-pin cable to J101 on the RFIB.

2. Connect attenuator and power meter to A8, the Transmit Antenna Connector.

3. Set R663 on the Forward/Reverse Power Detect board fully counterclockwise.

4. Set R76 on the RFIB fully counterclockwise.

5. Set the generator to +15 dBm ±0.1 dB at 937.5 MHz.

NOTE: All cable and attenuator losses must be measured and incorporated into this measurement.

CRITICAL ADJUSTMENT

6. Use the "Turn on carrier" button to key the PA.

7. Adjust Forward Power Calibration Pot R663 for 160W ±0.1 dB (±3.5W).

8. Verify Output 1 is within 20% of Output 2 and Output 3 is within 20% of Output 4.

7.5.2 PRE-DRIVER POWER LIMIT ADJUSTMENT

1. Set a power reference of 0 dB at 160W.

2. Monitor the Transmit current and RF output level. Use the Up Arrow key to increase the power level until 0.8 dB above 160W is reached (192W).

CAUTION

If TX current begins to increase rapidly and is not constant with time, then unkey the PA immediately and troubleshoot.

3. Adjust power limit control R76 clockwise until power is limited to 0.75 dB above 175W (192W).

4. Use the "Turn on carrier" button to unkey the PA.

7.5.3 REFLECTED POWER ADJUST

1. Remove the load cable from A8.

2. Use the "Turn on carrier" button to key the PA. This will not harm the PA.

3. Adjust Reverse Power Calibration Pot R680 for equal voltages on W126 and W121 on the RFIB or for equal Forward and Reverse Power.

4. Use the "Turn on carrier" button to unkey the PA.

5. Apply 'glyptol' to R663, R680 and R76.

6. Use the “Turn on fan” button to turn on/off fans. Both PA fans should turn ON.

7. Measure temperature detector voltage at W127 on the RFIB. Normal output at 25°C ambient is approximately +1V DC.

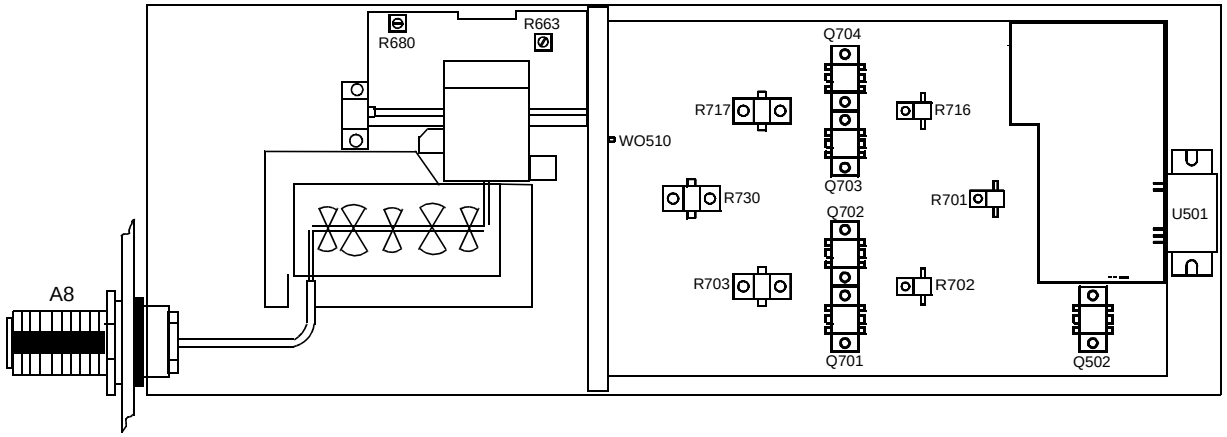


Figure 7-4 160W POWER AMPLIFIER ALIGNMENT POINTS

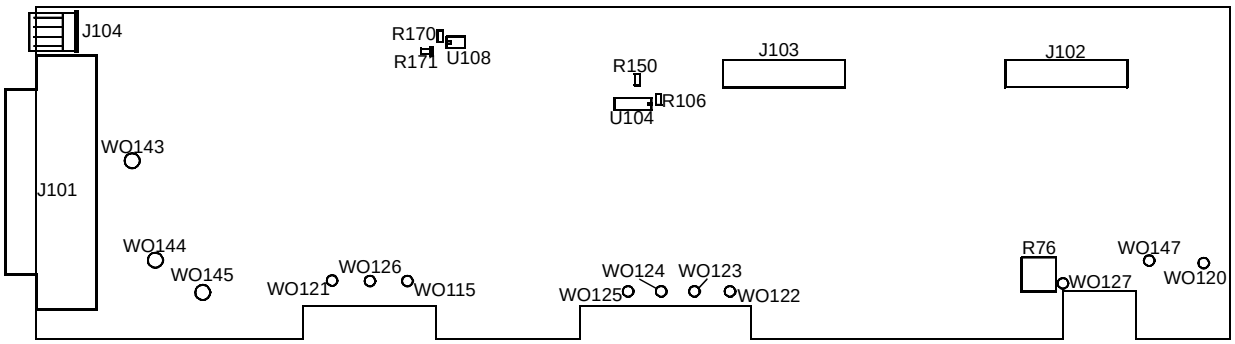
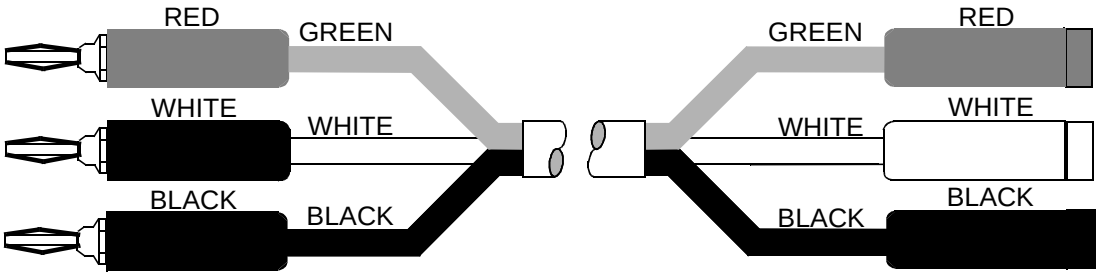


Figure 7-5 RF INTERFACE BOARD ALIGNMENT POINTS



(INCLUDED IN 2000 SERIES SERVICE KIT 250-2000-230)

Figure 7-6 POWER EXTENDER CABLES

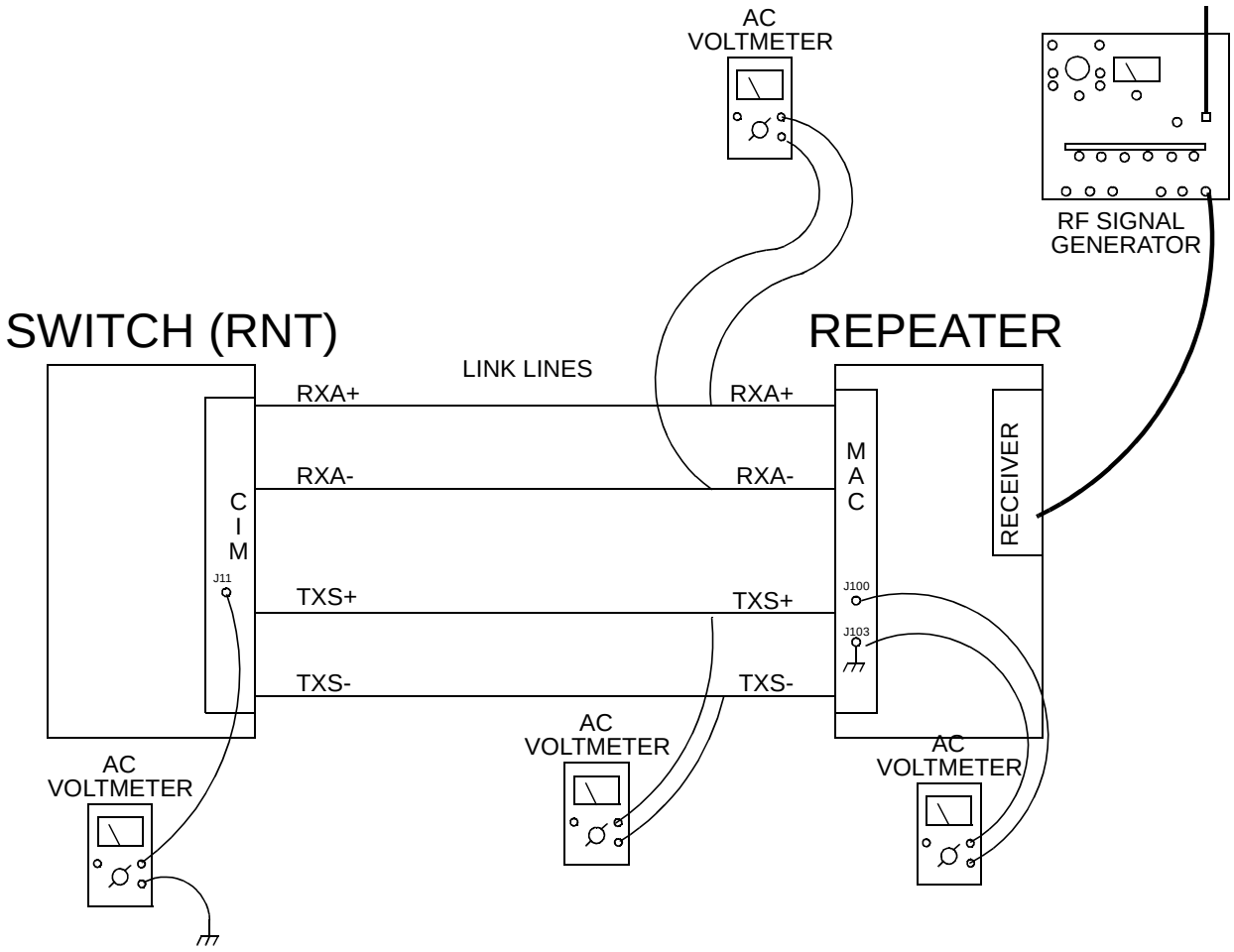


Figure 7-7 REPEATER TO CIM TEST SETUP

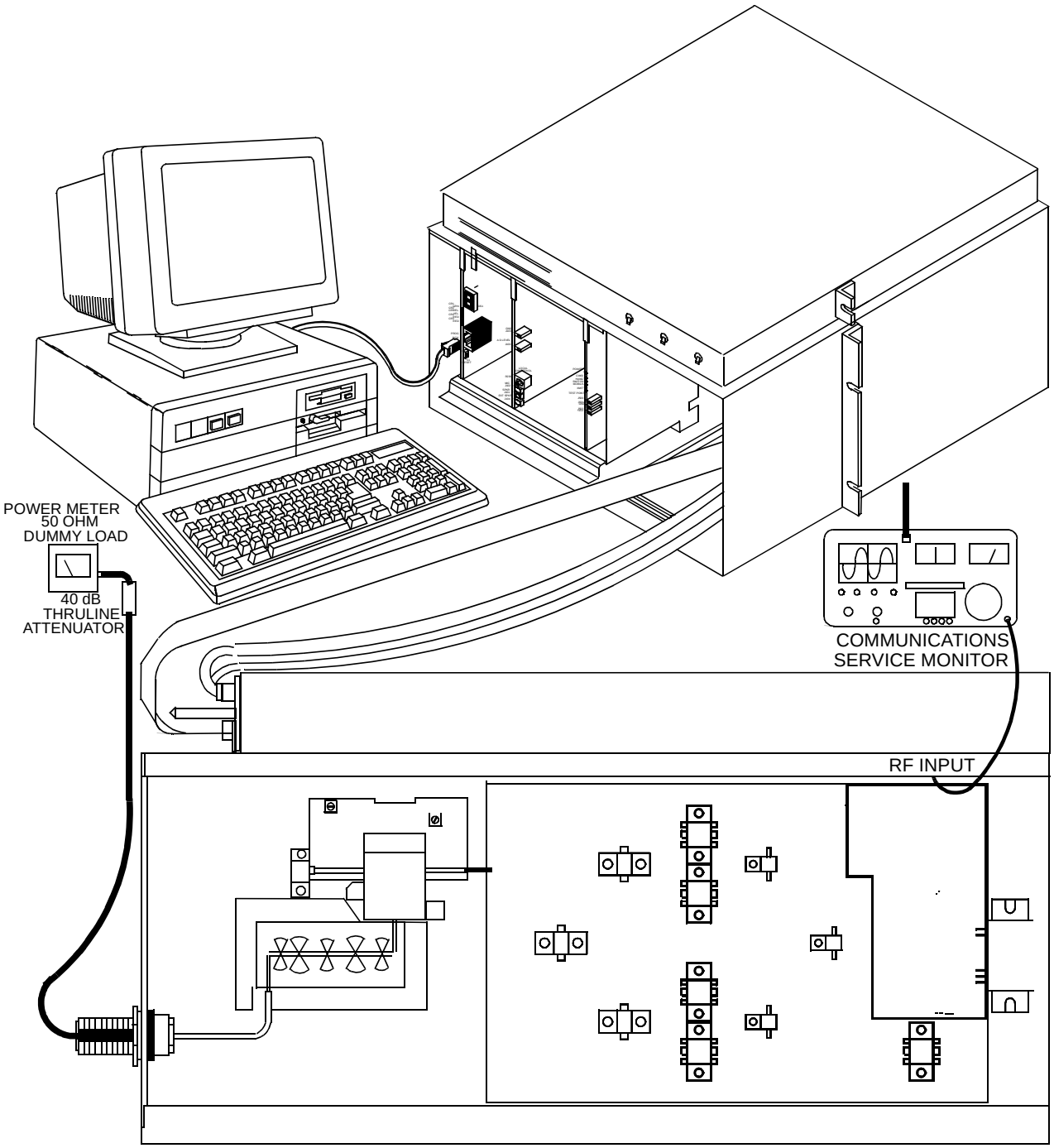


Figure 7-8 160W PA TEST SETUP

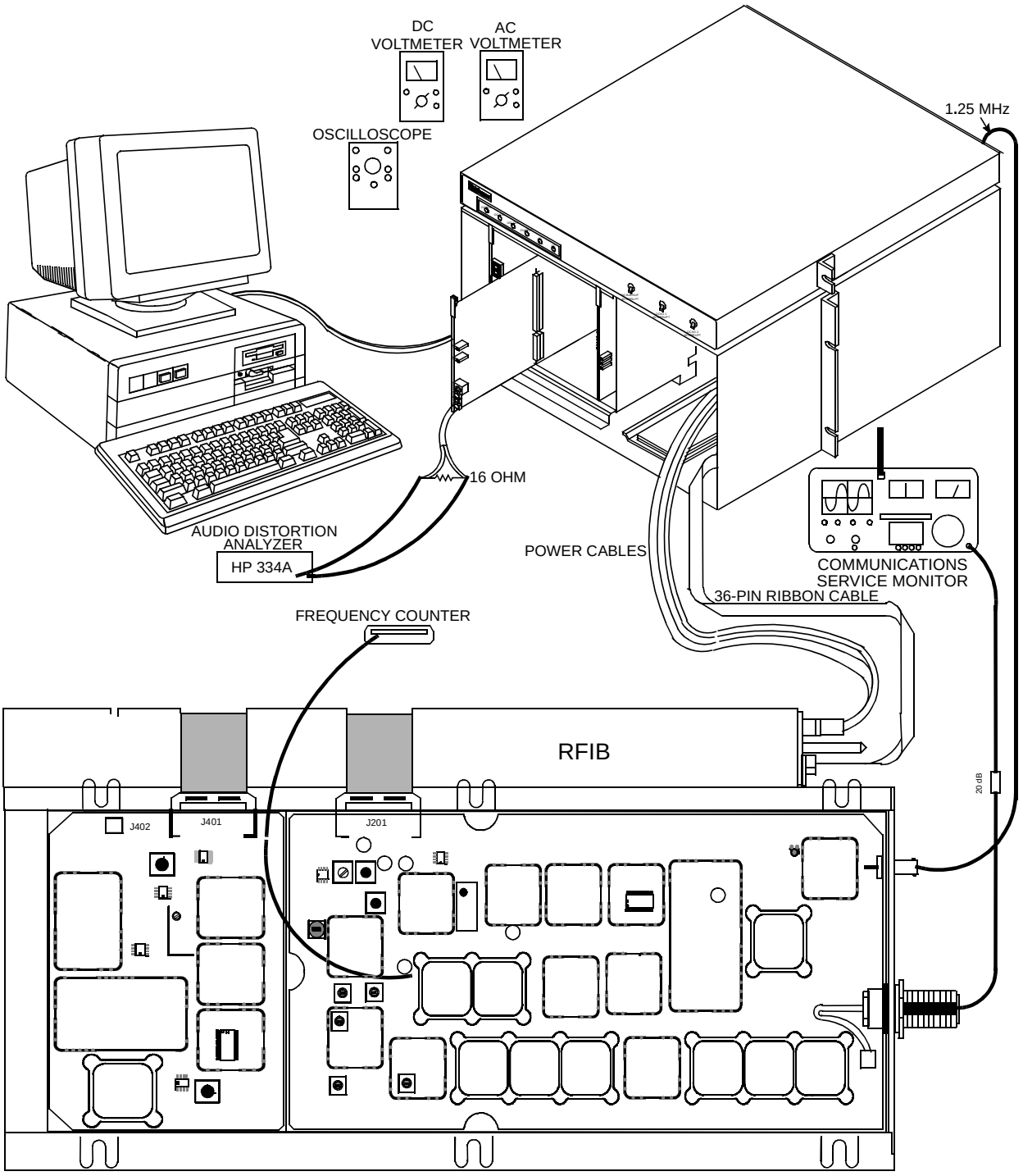


Figure 7-9 RECEIVER TEST SETUP

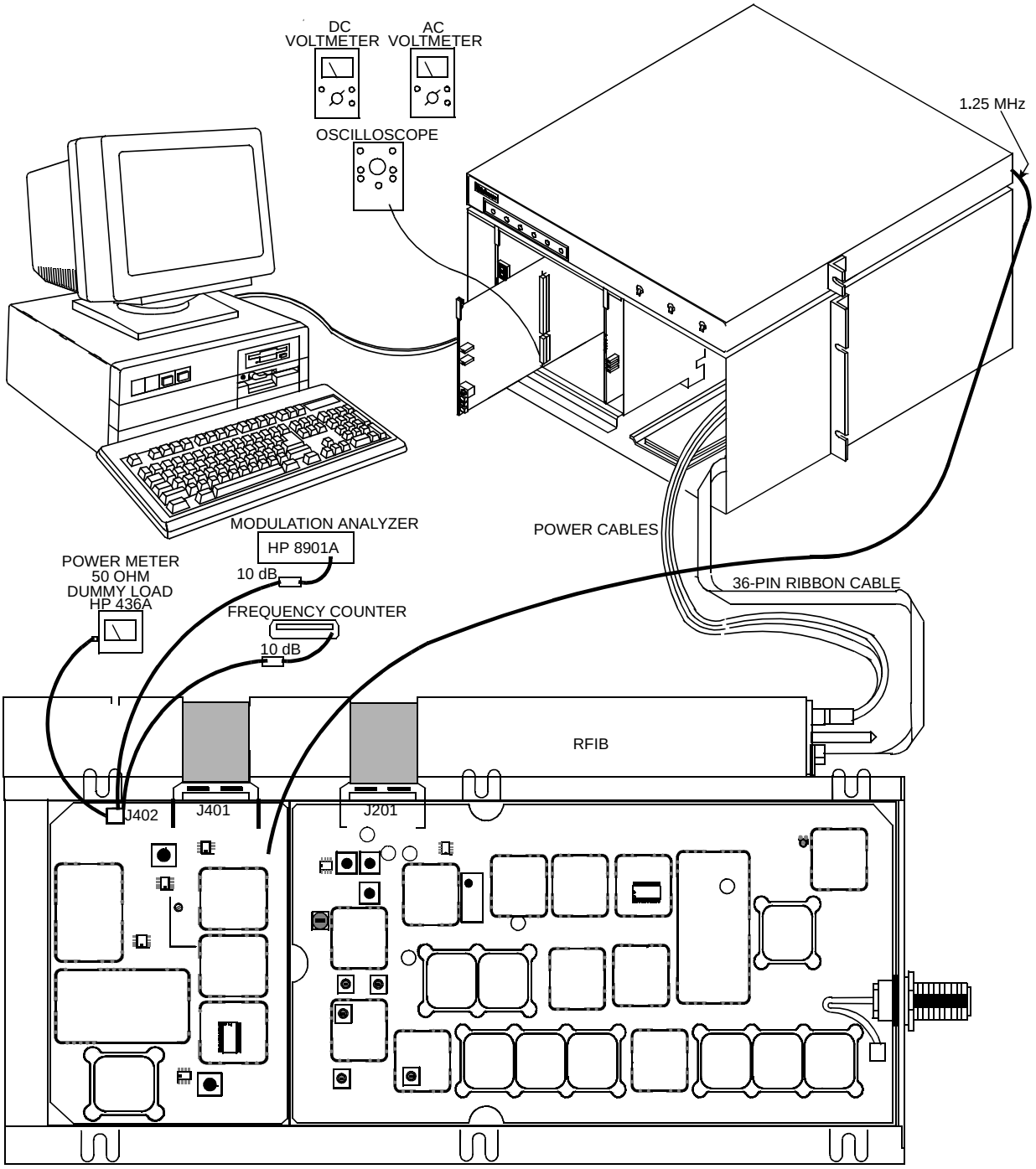


Figure 7-10 EXCITER TEST SETUP

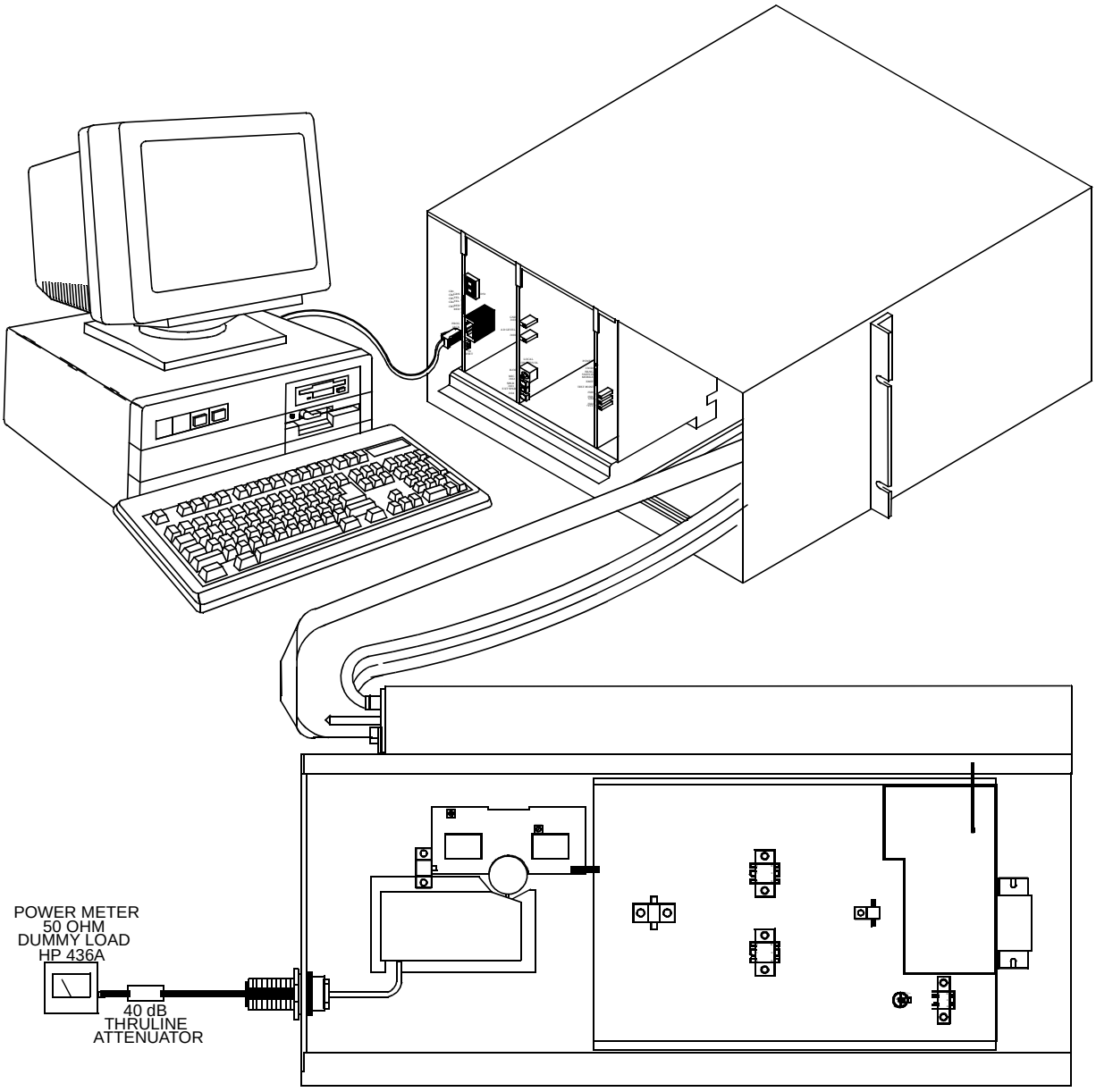


Figure 7-11 75W POWER AMPLIFIER TEST SETUP

7.6 FULL REPEATER ALIGNMENT

7.6.1 PERFORMANCE TEST PROGRAM

1. Select the TEST - FULL REPEATER - ALL TEST and press Enter.

7.6.2 REPEATER SETUP

The Viking VX repeater has been pretested at the factory, therefore only performance tests are required to check the repeater. Refer to test setup diagrams for equipment and cabling diagram.

1. Pretest the MPC, IAC, MAC and RFIB per their individual board level test procedures.

2. Pretest the Power Amplifier, Exciter, Receiver and Chassis per their individual test procedures. The RF modules should be tuned for the customer specified T/R frequency pair. If not, retune per individual test procedures.

3. Assemble the Transceiver to the Power Amplifier and insert into the chassis along with the Power Supply, MPC and MAC. Slide the IAC partially into the card rack but do not engage the locking level. Connect the OCXO input to the high stability 1.25 MHz source.

4. Engage the locking lever of the IAC and turn on the repeater power supply switch (S508) in the IAC or engage the locking lever (see Figure 7-30).

The operating code has been programmed at the factory. The parameters are programmed into the MPC. If these parameters have changed or are incorrect, exit this test and reprogram the repeater.

It may be necessary to remove the RF assembly from the chassis and connect via extension cables for some of the tests or adjustments.

NOTE: Unless specifically stated otherwise, all measurements are to be done per the latest TIA documented procedures. All audio generators and audio voltmeters are unbalanced unless specifically stated otherwise.

7.6.3 TRANSMITTER TEST/ADJUSTMENTS

NOTE: 2000 Series OCXO must be powered up for 1/2 hour or longer to stabilize frequency.

Transmit Mode

1. Use the "Turn on carrier" button to key the repeater.

2. The Transmit LED on the IAC should turn on to indicate the repeater is transmitting.

3. Use the "Turn on carrier" button to unkey the repeater.

Transmitter Output Power Test

1. Use the "Turn on carrier" button to key the repeater.

2. Check the transmit output power. The power can be adjusted from the computer using the Power Control button. Calibrate test equipment for ±2W.

3. Use the "Turn on carrier" button to unkey the repeater.

NOTE: This adjustment will alter the repeater's stored default value.

7.6.4 RECEIVER TESTS/ADJUSTMENT

Receiver TCXO Frequency Test

1. Check the receiver injection frequency by using a "sniffer" pickup loop, or RF probe connected to a suitable frequency counter placed near L210 in the Receiver (see Section 7.2.4). The frequency should be the Channel Frequency minus 52.95 MHz (±90 Hz).

2. Tune Y201 (TCXO) on the Receiver at TP1 for 3.5V DC ±0.05V (response time is very slow).

Receiver Audio Distortion Measurement

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Insert test cables into J100/J103 on the MAC and connect to an AC voltmeter.

3. Adjust R237 for 0 dBm (775 mV RMS).

4. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

5. Adjust R236 for 2.8V RMS and measure the distortion. Distortion should be < 3%.

Receiver Hum and Noise Measurement

NOTE: Receiver cover must be on for this measurement.

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Remove modulation from the RF generator. The measured level shall be ≤ -45 dB.

Receiver SINAD Measurement

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. 12 dB SINAD reading shall be ≤ 0.35 µV.

Receiver Squelch Adjustment

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Set the RF generator output for 5 dB SINAD.

5. Adjust R234 on the MAC so the Receiver just squelches.

6. Increase the RF generator output until the Receiver unsquelches. Reading shall be ≤ 10 dB SINAD.

Receiver Data Level Adjustment

1. Adjust the RF generator for 100 µV output with a 100 Hz tone at ±800 Hz deviation.

2. Insert test cables into J100/J103 on the MAC and connect to an AC voltmeter.

3. Adjust R235 to achieve 340 mV RMS

Local Speaker/Microphone Check

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Plug a Speaker/Microphone into J101/J102 of the MAC.

3. Adjust R236 until the 1 kHz tone is heard.

Receiver Desense Check

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±1.5 kHz deviation.

2. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the MAC.

3. Adjust R236 for 2.8V RMS.

4. Adjust the RF generator output for 12 dB SINAD.

5. Use the "Turn on carrier" button to key the transmitter.

6. SINAD shall not degrade more than 1 dB; i.e. no less than 11 dB SINAD.

7. Use the "Turn on carrier" button to unkey the transmitter.

Receiver Miscellaneous Tests (Optional)

Several additional tests may be performed on the Repeater Receiver as listed below:

1. Signal Displacement Bandwidth

2. Adjacent Channel Rejection

3. Offset Channel Selectivity

4. Intermodulation Rejection

5. Spurious Rejection

6. Audio Response

7. Audio Sensitivity

Perform the Test desired using the appropriate RF Generators, modulation frequencies and levels, R236 levels and test probes.

7.6.5 RECEIVER EXPANDER MEASUREMENT

NOTE: This test is valid only with compandor option installed.

1. Adjust the RF generator for 100 µV into the receiver with a modulation tone of 1 kHz at ±1.5 kHz deviation.

2. Insert AC voltmeter probes into J100/J103 on the MAC. AC voltage shall be between 1.1 and 1.25V RMS.

3. Adjust RF generator for ±800 Hz deviation. AC voltage shall be between 325 and 450 mV RMS.

4. Adjust RF generator for ±500 Hz deviation. Voltage level shall be between 150 and 250 mV RMS.

7.6.6 TRANSMIT AUDIO/DATA LEVEL ADJUSTMENTS

NOTE: All audio generators and audio voltmeters are unbalanced unless specifically stated otherwise.

Audio Deviation Limit Adjustment

1. Remove VNC cards if present.

2. Apply a 1 kHz tone at -3 dBm (548 mV RMS) to P100, pin 32 of the MAC.

3. Insert test cables into J100/J103 and connect to an AC voltmeter.

4. Use the "Turn on carrier" button to key the transmitter.

5. Adjust R305 for 0 dBm (775 mV RMS).

6. Use the "Turn on carrier" button to unkey the transmitter.

7. Press F2 to advance to the next screen.

8. Final adjustment must be performed on the customer channel. Apply a 1 kHz tone at +7 dBm (1.73V RMS) to P100, pin 32 of the MAC. (Set modulation analyzer LPF switch to 3 kHz.)

9. Use the "Turn on carrier" button to key the transmitter.

10. Adjust U149 with the Level Control buttons to set the maximum allowed deviation at ±1.6 kHz ±50.

11. Use the "Turn on carrier" button to unkey the transmitter.

12. Remove the signal from P100, pin 32.

Repeat Audio Level Adjustment

NOTE: Audio Deviation Limit Adjustment must be completed before this test.

1. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±800 Hz deviation. Set modulation analyzer LPF switch to 3 kHz.

2. Use the "Turn on carrier" button to key the transmitter.

3. Final adjustment must be performed on the customer channel. Adjust R237 on the MAC to achieve ±800 Hz (±50 Hz) transmit deviation.

4. Use the "Turn on carrier" button to unkey the transmitter.

5. Press F2 to advance to the next screen.

6. Connect an AC voltmeter to J103 and P100, pin 31 (RX_VOICE).

7. Adjust R238 for -3 dBm (548 mV RMS).

8. Remove the RF generator from the Receiver.

Data Level Adjustment

1. Remove VNC cards if present. (Set modulation analyzer LPF switch to 3 kHz.) Final adjustment must be performed on the customer channel.

2. Use the "Turn on carrier" button to key the transmitter.

3. Adjust U151 with the Level Control buttons to achieve ±750 Hz ±50 Hz transmit deviation.

4. Use the "Turn on carrier" button to unkey the transmitter.

Audio/Data Deviation Check

1. Remove VNC cards if present.

2. Apply a 1 kHz tone at +7 dBm (1.73V RMS) to P100, pin 32 of the MAC. (Set modulation analyzer LPF to 3 kHz.)

3. Use the "Turn on carrier" button to key the transmitter.

4. Check for measured deviation out of the modulation analyzer to be ±2.4 kHz +100/-200 Hz.

5. Use the "Turn on carrier" button to unkey the transmitter.

6. Disconnect all cables.

CWID Level Check

1. Set modulation analyzer LPF switch to 3 kHz. Use the "Turn on carrier" button to key the transmitter.

2. Deviation should measure between 750 Hz and 1250 Hz.

3. Use the "Turn on carrier" button to unkey the transmitter.

Local Speaker/Microphone Check

1. Plug a Speaker/Microphone into J101/J102 of the MAC. Set modulation analyzer LPF switch to 3 kHz.

2. Press the microphone PTT and say "four" loudly into the microphone.

3. Deviation should measure ±1.4-1.6 kHz.

4. Release the microphone PTT.

Transmitter Hum and Noise Ratio (Optional)

NOTE: An HP8901A modulation analyzer is required for this test.

1. On the modulation analyzer press:
   300 Hz HPF
   3000 Hz LPF
   FM
   Pre-Display
   750 µS
   Avg RMS Cal
   0.22
   dB

2. Use the "Turn on carrier" button to key the transmitter and measure the Hum and Noise Ratio. The reading shall be < -45 dB.

3. Use the "Turn on carrier" button to unkey the transmitter.

Transmit Audio Distortion

1. Remove VNC cards if present. On the modulation analyzer select:
   FM
   50 Hz
   15 kHz

2. Apply 200 mV RMS at 1 kHz to P100, pin 32 of the MAC.

3. Use the "Turn on carrier" button to key the transmitter.

4. Adjust audio level to produce ±1 kHz deviation.

5. On the modulation analyzer select:
   300 Hz
   3 kHz
   750 µs de-emphasis

6. Distortion should be < 2%.

7.6.7 TRANSMITTER COMPRESSOR MEASUREMENT

NOTE: This test is valid only with compandor option installed.

1. Set the modulation analyzer LPF to 3 kHz.

2. Apply +7 dBm (1.73V RMS) at 1 kHz to P100, pin 32 on the MAC.

3. Use the "Turn on carrier" button to key the transmitter.

4. Deviation shall be between 1.35 and 1.5 kHz.

5. Adjust 1 kHz signal to -8.2 dBm (300 mV RMS). Deviation shall be between 750 and 850 kHz.

6. Adjust 1 kHz signal to -17.8 dBm (100 mV RMS). Deviation shall be between 450 and 500 kHz.

7. Use the "Turn on carrier" button to unkey the transmitter.

7.6.8 AUDIO/DATA LEVEL ADJUSTMENTS

NOTE: Section 7.6.6 must be completed before any of the following adjustments can be made.

NOTE: All audio generators and audio voltmeters are unbalanced unless specifically stated otherwise.

Voice Audio From Repeater

1. Set MAC S100 and S101, all Sections OFF.

2. Adjust the RF generator for 100 µV modulated with a 1 kHz tone at ±1.5 kHz deviation.

3. Connect a balanced AC voltmeter with a 600 ohm input impedance between balanced lines RXA+ and RXA- on J2, located on the back of the Repeater.

4. Adjust R239 on the MAC for the type of line.

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

Voice Audio To Repeater

1. Set MAC S100 and S101, all Sections OFF (see Figure 7-12).

2. Inject a 1 kHz tone from a balanced 600 ohm source, at the level determined by the type of line used, into TXA+ and TXA- of J2 located on the back of the Repeater (see Figure 7-12).
   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

3. Adjust R243 on the MAC to obtain -6 dBm (387 mV RMS) measured at J100/J103.

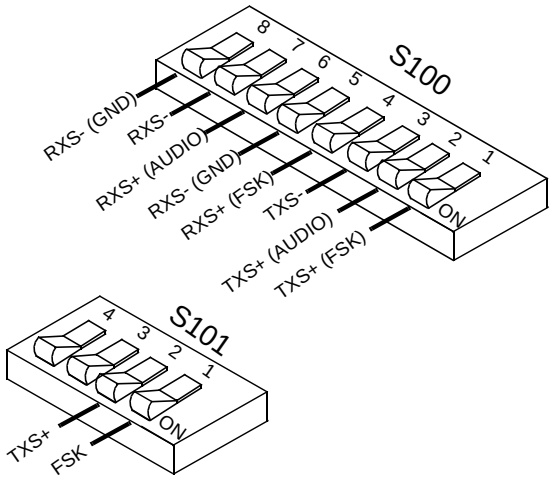


Figure 7-12 S100 SETTING

FSK Data Level Adjustment To Repeater
Separate Data Path (4-Wire) Optional Setting.

1. Set MAC S100 Sections 1, 4, 5, 8 OFF; 2, 3, 6, 7 ON; S101 Sections 2, 3, 4 OFF; 1 ON (see Figure 7-13).

2. Inject a 1.2 kHz tone from a **balanced** 600 ohm source, at the level determined by the type of line used, into TXS+ and TXS- of J2 located on the back of the Repeater (see Figure 7-14).

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

3. Adjust R242 on the MAC to obtain -10 dBm (245 mV RMS) measured at J100/J103.

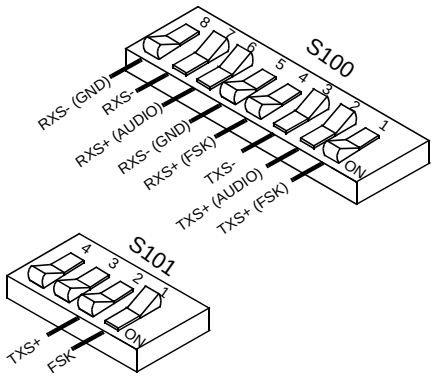


Figure 7-13 S100/S101 SWITCH SETTINGS

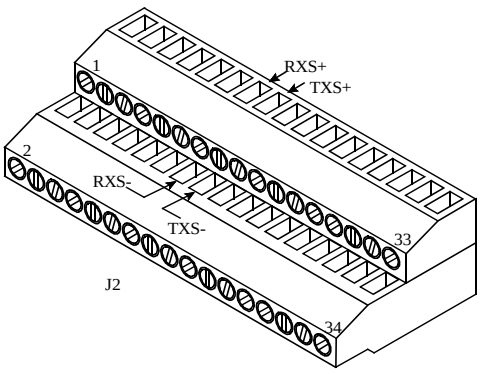


Figure 7-14 J2 TERMINAL BLOCK (SECONDARY)

FSK Data Level Adjustment To Repeater
Data over Voice (2-Wire) Default Setting.

1. Set MAC S100, all Sections OFF; S101 Sections 2, 3, 4 OFF; 1 ON (see Figure 7-15).

2. Inject a 1.2 kHz tone from a **balanced** 600 ohm source, at the level determined by the type of line used, into TXA+ and TXA- of J2 located on the back of the Repeater (see Figure 7-18).

   Leased Line/Direct Connect (default)
   -22 dBm (62 mV RMS)

   Microwave/T1 (optional)
   -38 dBm (10 mV RMS)

3. Adjust R242 on the MAC to obtain -10 dBm (245 mV RMS) measured at J100/J103.

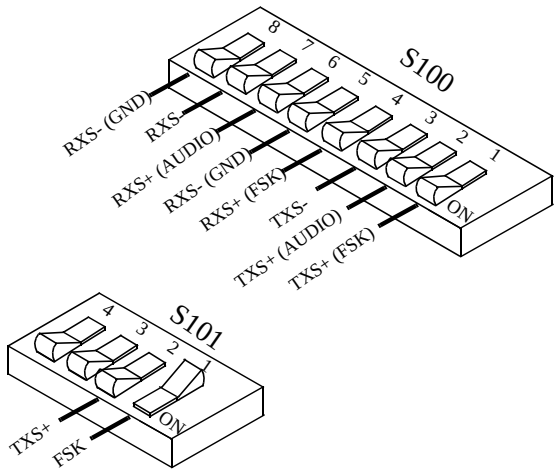


Figure 7-15 SWITCH SETTINGS

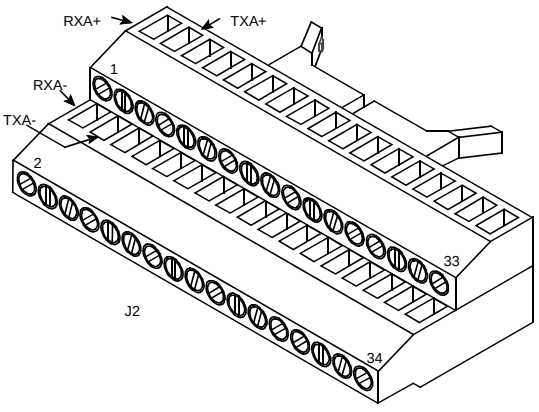


Figure 7-16 J2 TERMINAL BLOCK

FSK Data Level Adjustment From Repeater
Separate Data Path (4-Wire) Optional Setting.

1. Set MAC S100 Sections 1, 4, 5, 8 OFF; 2, 3, 6, 7 ON; S101 Sections 2, 3, 4 OFF; 1 ON (see Figure 7-15).

2. Adjust R240 on the MAC to obtain -16 dBm (123 mV RMS) measured at J100/J103.

3. Press F2 to advance to the next screen.

4. Connect a **balanced** AC Voltmeter with a 600 ohm input impedance between balanced lines RXS+ and RXS- of J2 located on the back of the Repeater (see Figure 7-14).

5. Adjust R241 on the MAC for the type of line used.

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

FSK Data Level Adjustment From Repeater
Data over Voice (2-Wire) Default Setting.

NOTE: This adjustment can only be done after Voice Audio To Switch is completed.

1. Set MAC S100, all Sections OFF; S101 Sections 2, 3, 4 OFF; 1 ON (see Figure 7-15).

2. Connect a **balanced** AC Voltmeter with a 600 ohm input impedance between balanced lines RXA+ and RXA- of J2 located on the back of the Repeater (see Figure 7-18).

3. Adjust R240 on the MAC for the type of line used.

   Leased Line/Direct Connect (default)
   -22 dBm (62 mV RMS)

   Microwave/T1 (optional)
   -38 dBm (10 mV RMS)

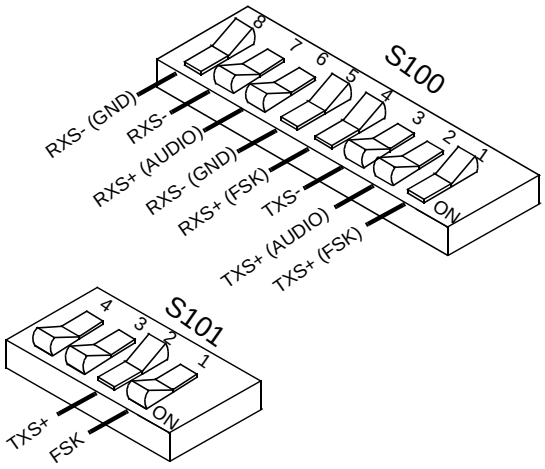


Figure 7-17 S100/S101 RS-232

RS-232 Data To And From Switch (RNT) (Optional)

These are the switch settings only.

1. Set MAC S100, Sections 2, 3, 6, 7 OFF; 1, 4, 5, 8 ON (see Figure 7-17).

2. Set MAC S101, Sections 1, 3, 4 OFF; 2 ON (see Figure 7-17).

7.6.9 REPEATER OPERATION

New HSDB Test

1. Switch settings on the MPC for RS-485 (new style) operation are shown in Figure 7-18. S002 all Section On. S003 all Section Off.

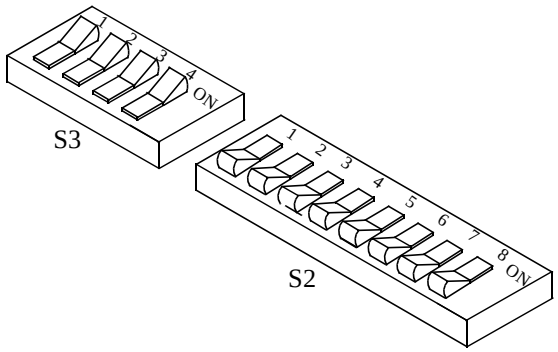


Figure 7-18 NEW HSDB SWITCH SETTINGS

2. Verify that the repeater is programmed for "Stand Alone" mode in Setup Parameters-F4 (see Section 4.3.3).

3. The repeater is now in Normal Operation mode. Verify by the MPC front panel indicators that no HSDB alarms have occurred (Alarm Number 10) see Table 1-2.

Old HSDB Test

1. Switch settings on the MPC for single-ended 5V (old style) operation are shown in Figure 7-19. S002 Sections 1-8 Off. S003 all sections On.

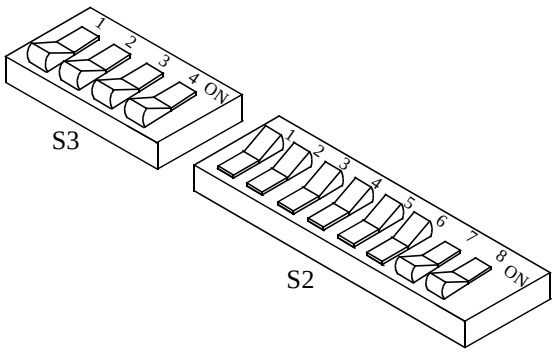


Figure 7-19 OLD HSDB SWITCH SETTINGS

2. Verify that the repeater is programmed for "Stand Alone" mode in Setup Parameters-F4 (see Section 4.3.3).

3. The repeater is now in Normal Operation mode. Verify by the MPC front panel indicators that no HSDB alarms have occurred (Alarm Number 10) see Table 1-2.

Handshake Test

1. Program an LTR, portable or mobile, for the following parameters.

   Home Repeater - Same as repeater number.
   Home Channel - Same as repeater channel.
   Area - Same as repeater's area bit.
   Encode ID - 1
   Decode ID - 1

2. The repeater is now in Normal Operation mode.

3. Key the radio several times on the programmed System/Group. Access should occur every time. (Proper Tx/Rx antenna connections are assumed.)

Alarm Test

1. The repeater is now in Normal Operation mode.

2. Verify by the MPC front panel indicators that no alarms have occurred (see Table 1-2).

7.7 SWITCH (RNT) INTERFACE

7.7.1 REPEATER SETUP

1. Connect the repeater as shown in Figures 7-7, 7-20 and 7-21.

2. Adjust the repeater for the type of link used for communication back to the CIM in the Switch. The types of links used are:
   Leased Lines (LL)
   Direct Connection (DC)
   Microwave (MW)
   T1 Interfaces (T1)

3. Program the repeater for the specified parameters using the Programmer.

*NOTE: Assume all audio generators and voltmeters to be **unbalanced** unless stated otherwise.*

7.7.2 CIM SETUP

1. Adjust the CIM for the type of link used for communication back to the repeater. The types of links used are:
   Leased Lines (LL)
   Direct Connection (DC)
   Microwave (MW)
   T1 Interfaces (T1)
   Refer to the LTR-Net Switch, Setup and Alignment manual, PN 001-3239-001, for more information on the CIM alignment (see Figure 7-31).

2. Connect the link lines to the Switch and its associated CIM (see Figure 7-21).

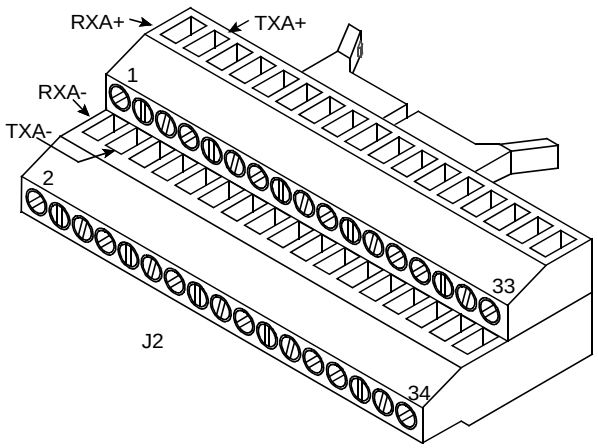


Figure 7-20 J2 CONNECTOR

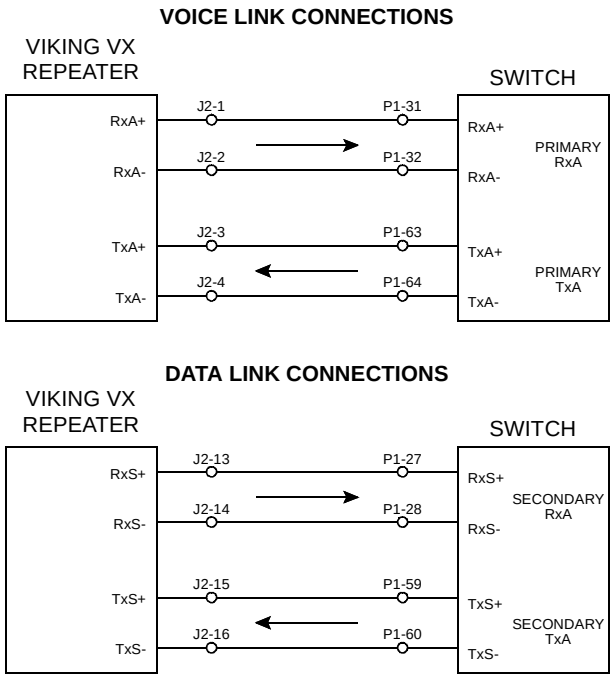


Figure 7-21 VIKING VX VOICE/DATA LINK

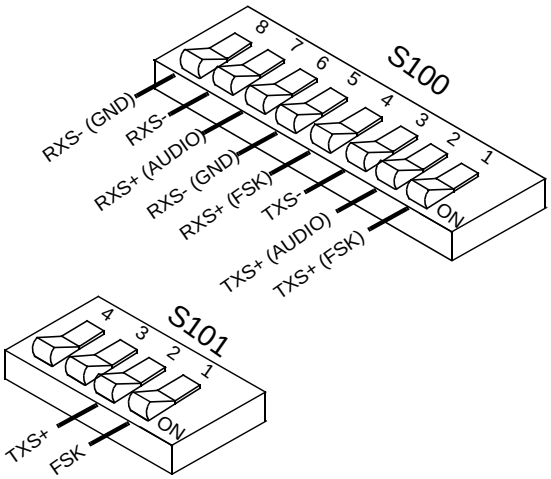


Figure 7-22 S100/S101 SWITCH SETTING

7.7.3 VOICE AUDIO TO SWITCH

1. **On the MAC**, set S100 and S101, all Sections OFF (see Figure 7-22).

2. Connect an RF generator to the receiver.

3. Adjust the RF generator for 100 µV modulated with a 1 kHz tone at ±1.5 kHz deviation.

4. Connect a **balanced** AC Voltmeter with a 600 ohm input impedance between balanced lines RXA+ and RXA- of J2 located on the back of the Repeater (see Figure 7-18).

5. **On the MAC**, adjust R239 for the type of line used.

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

7.7.4 VOICE AUDIO FROM SWITCH

1. **On the MAC**, set S100 and S101, all Sections OFF (see Figure 7-22).

2. **On the CIM** (in the Switch) generate an alignment tone (set S5 to "1") (see Figure 7-31).

3. **On the CIM**, connect a balanced AC voltmeter at J12.

4. **On the CIM**, adjust R44 for the type of line used.

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

5. **On the MAC**, adjust R243 for -6 dBm (387 mV RMS) measured at J100/J103.

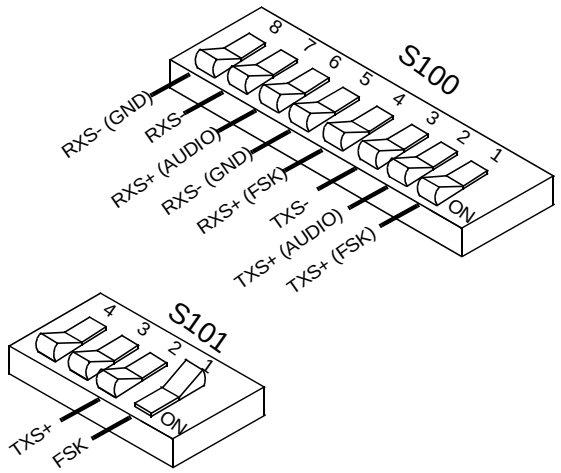


Figure 7-23 MAC SWITCH SETTINGS

7.7.5 BLANK AND BURST - FSK DATA FROM SWITCH

1. On the MAC,
   set S100 all Sections OFF
   set S101, sections 2, 3, 4 OFF
   set S101, section 1 ON (see Figure 7-23).

2. **On the CIM**, (in the Switch) generate an alignment tone (set S5 to a value of "8").

3. **On the CIM**, adjust R86 at TP4 for the type of line used.

   Leased Line/Direct Connect (default)
   -12 dBm (194 mV RMS)

   Microwave/T1 (optional)
   -28 dBm (31 mV RMS)

4. **On the CIM**, verify at J12 (see Figure 7-31).

   Leased Line/Direct Connect (default)
   -21 dBm (69 mV RMS)

   Microwave/T1 (optional)
   -37 dBm (11 mV RMS)

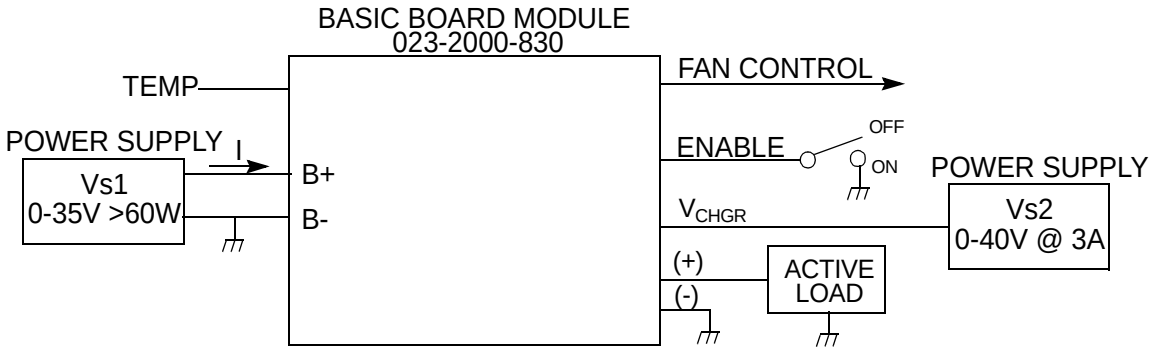


Figure 7-24 BATTERY REVERT TEST SETUP

7.7.6 FSK LINK - FSK DATA LEVEL TO SWITCH

1. On the MAC,
   set S100 all Sections OFF
   set S101, sections 2, 3, 4 OFF
   set S101, section 1 ON (see Figure 7-23).

2. Connect a **balanced** AC voltmeter with 600 ohm input impedance between balanced lines RXA+ and RXA- of J2 located on the back of the Repeater (see Figure 7-20).

3. On the MAC, adjust R240 for the type of line used.

   Leased Line/Direct Connect (default)
   -22 dBm (62 mV RMS)

   Microwave/T1 (optional)
   -38 dBm (10 mV RMS)

7.8 VISUAL CHECK

1. Make sure the heat sunk parts are not shorted to the heat-sink.

2. Verify all electrolytic capacitors are installed correctly.

3. Connect 023-2000-830 Battery Back-Up as shown in Figure 7-24.

7.9 BATTERY REVERT TEST

1. Connect the circuit as shown in Figure 7-24.

2. Turn the active load to current mode at 1A.

3. Turn enable to On, battery fault LED should be on.

4. Increase Vs1 until:
   the relay engages
   the voltage is present on the active load
   the battery fault LED is off.

   This voltage will be 22V DC ±0.5V.

5. Increase Vs1 until:
   the relay disengages
   the LED lights
   no voltage is present at the active load.

   This voltage will be 31V DC ±0.5V.

6. Decrease VS1 until:
   the relay engages
   the LED goes out
   voltage is present at the active load.

   This voltage will be 28V DC ±0.5V.

7. Set Vs1 to 26.5V DC and turn the enable line to OFF. No voltage will be present at the active load.

8. Decrease Vs1 until:
   the relay disengages
   the LED lights
   no voltage is present at the active load.

   This voltage will be 19V DC ±0.5V.

9. With the enable line OFF measure current Is, it should be less than 20 mA.

10. Reverse the polarity of Vs1
    Set to 26.5V DC
    BBM Enable ON

    Reverse Battery LED will light and Is should be less than 50 mA.

11. Disconnect the test setup.

7.10 BATTERY CHARGER SECTION

1. Connect Battery Backup Module as shown in Figure 7-25.

2. Set the active load to 0A and set Vs2 to 40V at 3A.

3. Adjust R140 so the voltage at the active load reads 27.55V DC ±0.1V.

NOTE: The temperature sensor LM335 has to be at 22°C (room temperature).

4. Increase the active load current to 1.8A and verify voltage at the load is greater than 26V.

NOTE: The fan control line will stay at 0V until the heat sink is above 50°C.

5. Set the active load current to zero, shut off Vs2 and disconnect the BBM. Glyptol R140.

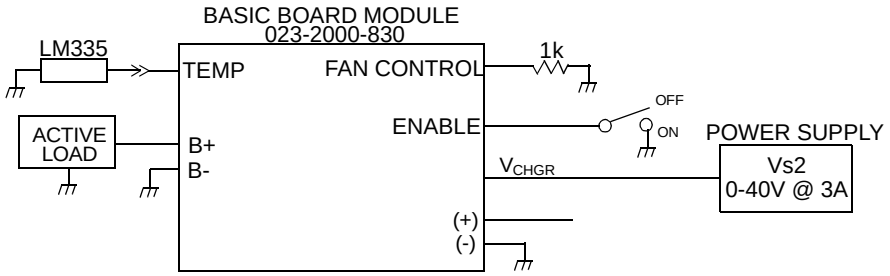


Figure 7-25 BATTERY CHARGER TEST SETUP

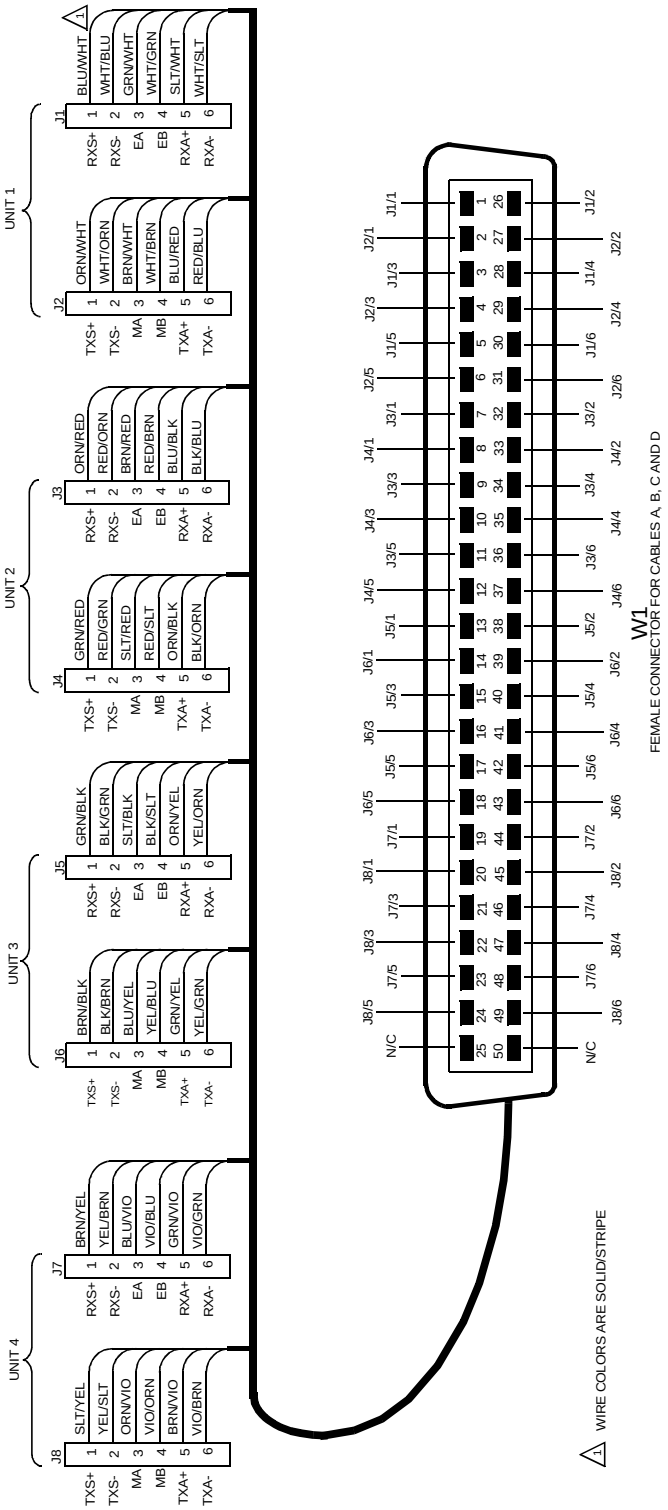


Figure 7-26 SWITCH (RNT) BACKPLANE WIREHARNESS

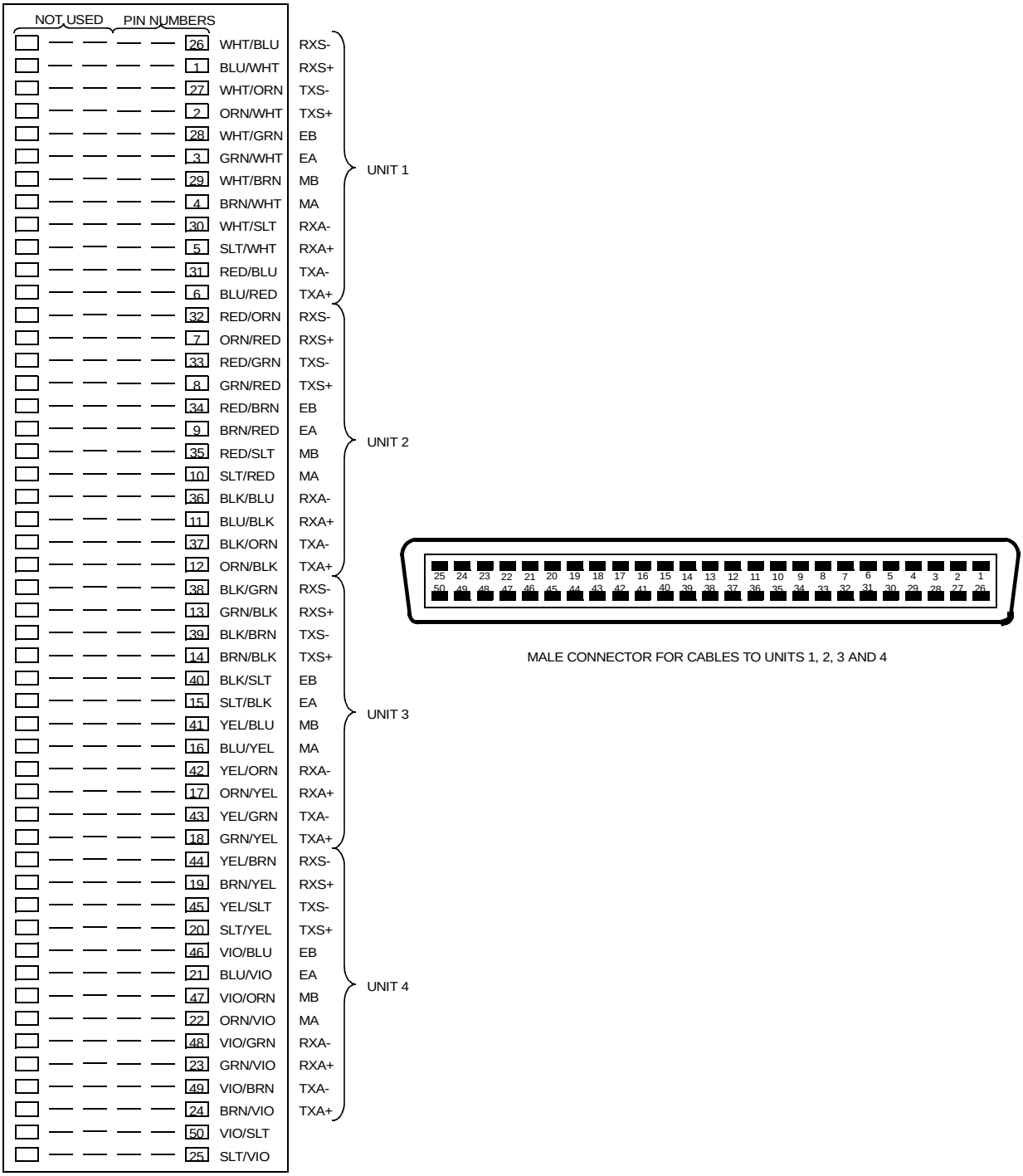


Figure 7-27 SWITCH (RNT) PUNCH BLOCK

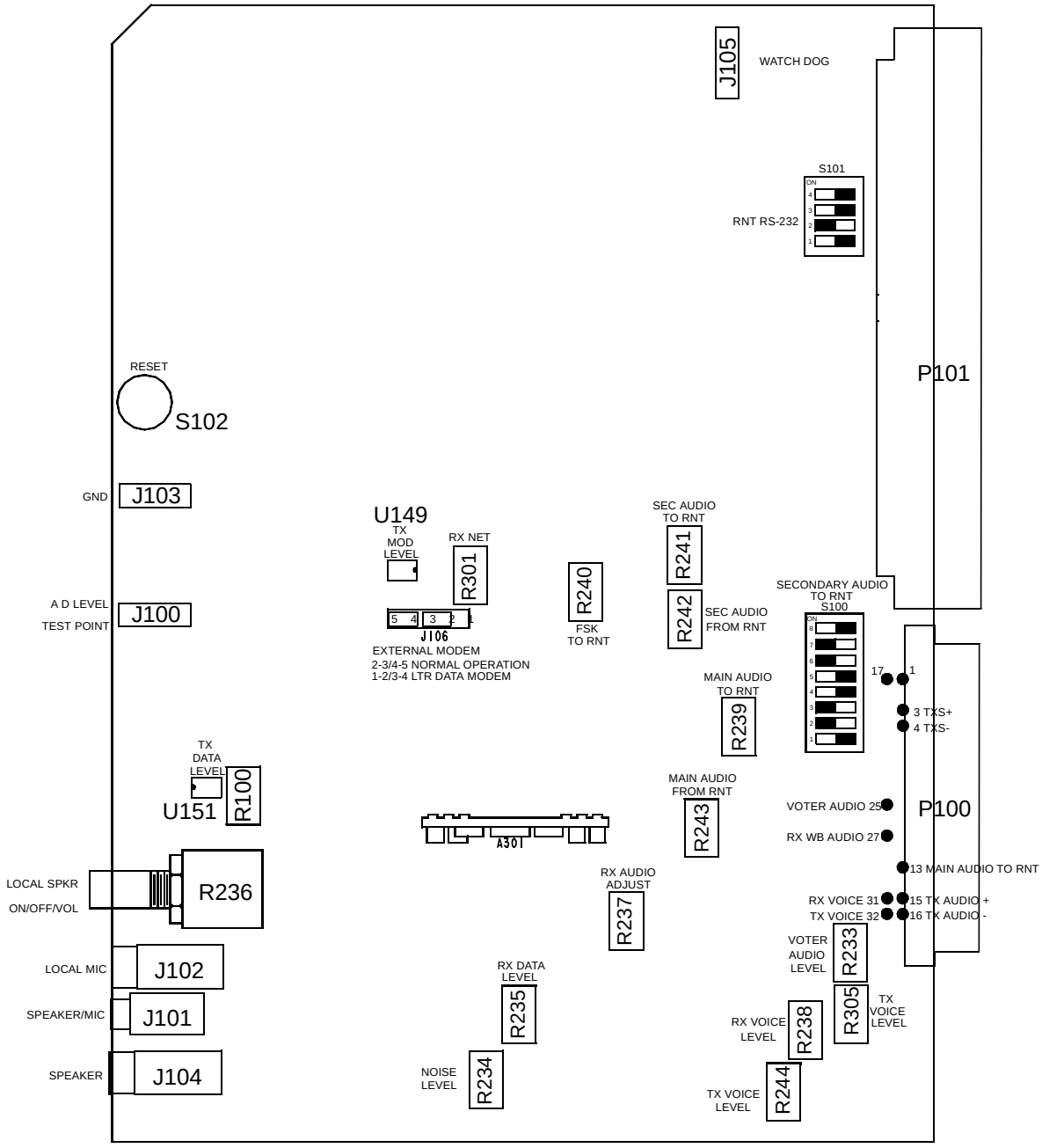


Figure 7-28 MAC ALIGNMENT POINTS

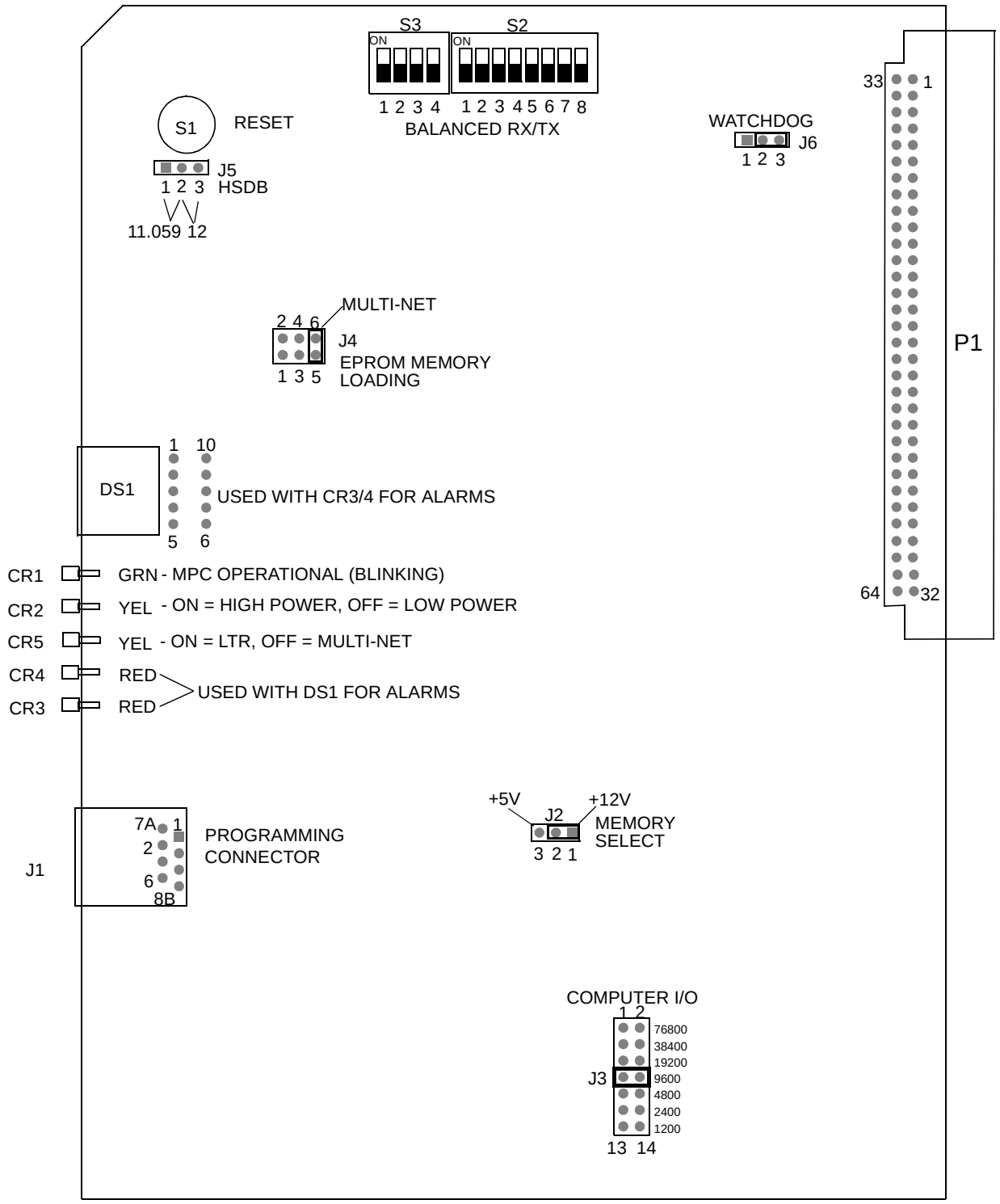


Figure 7-29 MAIN PROCESSOR CARD ALIGNMENT POINTS

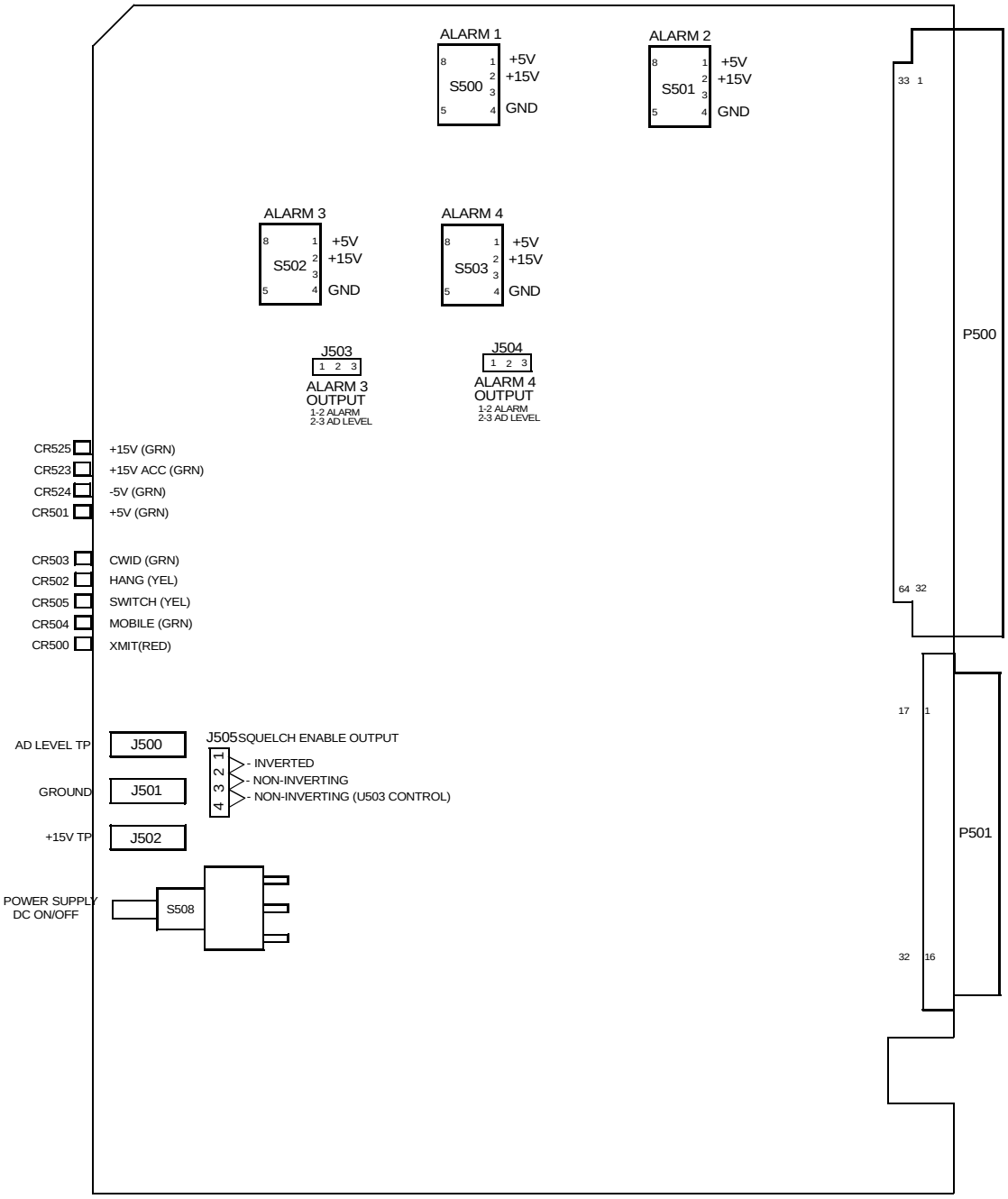


Figure 7-30 INTERFACE ALARM CARD ALIGNMENT POINTS

SECTION 8 SERVICING

8.1 INTRODUCTION

8.1.1 PERIODIC CHECKS

This repeater should be put on a regular maintenance schedule and an accurate performance record maintained. Important checks are receiver sensitivity and transmitter frequency, modulation, and power output. It is recommended that repeater performance be checked regularly even though periodic checks are not specifically required by the FCC.

8.1.2 SURFACE-MOUNTED COMPONENTS

A large number of the components used in this repeater are the surface-mounted type. Since these components are relatively small in size and are soldered directly to the PC board, care must be used when they are replaced to prevent damage to the component or PC board. Surface-mounted components should not be reused since they may be damaged by the unsoldering process. For more information on replacing surface-mounted components, refer to the Surface-Mounted Device Handbook, Part No. 001-0576-002.

8.1.3 SCHEMATIC DIAGRAMS AND COMPONENT LAYOUTS

Schematic diagrams and component layouts of the PC boards used in this repeater are located in Section 10. A component locator guide is also provided for both the schematic and board layouts to aid in component location.

8.1.4 REPLACEMENT PARTS LIST

A replacement parts list containing all the parts used in this repeater is located in Section 9. Parts are listed alpha numerically according to designator. For information on ordering parts, refer to Section 1.10.

8.1.5 TCXO MODULES NOT SERVICEABLE

Transmit or Receive TCXOs are not field serviceable because if a part is changed, a factory recalibration must be performed to ensure that it stays within its ±1 PPM tolerance.

8.2 SYNTHESIZER SERVICING

8.2.1 INTRODUCTION

Synthesizer malfunctions can be caused by no VCO output, or the VCO is unlocked. The VCO can be unlocked due to a bad synthesizer chip, an incomplete synthesizer phase-lock loop, or because the synthesizer chip is programmed incorrectly.

To make certain that the synthesizer chip is receiving programming data, pins 17, 18 and 19 of the chip should be monitored during programming. Pin 17 ($\overline{\text{Enable}}$) will go from a high to a low level. Pin 18 (Clock) will go from low to high in narrow pulses. Pin 19 (Data) goes from high to low with wider data pulses.

When the VCO is locked, the lock detect line of the synthesizer pin 2 is high with very narrow negative-going pulses. These pulses become wider when the VCO is out of lock. When this unlock condition exists either in the Exciter VCO or the Receiver VCO it is relayed by the RF Interface board and is detected by the MPC via the RF Data lines. The MPC then does not allow the transmitter to key and the receiver cannot unsquelch.

When the VCO is unlocked, the f_R and f_V inputs to the phase detector are not in phase (refer to Sections 6.1.15 and 6.2.8). The phase detector in the synthesizer then causes the VCO control voltage to go to the high or low end of its operating range (0 or 9V). This in turn causes the VCO to oscillate at the high or low end of its frequency range.

As shown in Figures 6-1 and 6-4, a loop is formed by the VCO, buffer, frequency input (F_{IN}) and the phase detector output (PD OUT). Therefore, if any of these components begin to malfunction, improper signals appear throughout the loop. However, correct operation of the counters can still be verified by measuring the input and output frequencies to check the divide number.

Proceed as follows to check the input and output signal of the synthesizer modules to determine if they are operating properly.

8.2.2 TCXO MODULE

Check the signal at TCXO, pin 5. It should be 17.5 MHz for Y201 and Y401 at a level of approximately 3V P-P. If the TCXO is defective, it is not serviceable and must be replaced with a new unit as described in Section 8.1.5.

Measure the signal at pin 20 (Ref In) of the synthesizer chip. It will be approximately 1V P-P. If the signal is low here, the TCXO buffer circuit may be defective.

8.2.3 VOLTAGE CONTROLLED OSCILLATOR (VCO)

Check for VCO output signal with a high impedance RF voltmeter. If there is no output signal, or if the frequency is greatly off, the VCO is defective.

Next, monitor the signal level at pin 11 (F In) of the synthesizer chip. If the signal is less than 100 mV P-P, the VCO buffer is defective.

Lock Detector

When the VCO is locked on frequency, the waveform at pin 2 (Lock Det) should be as follows. When the VCO is unlocked, the negative-going pulses should be much wider than those shown in Figure 8-1. If the lock detect circuit is operating properly, check prescaler input pin 11 (F In).

The operation of the N and A counters can be observed by monitoring pins 16 and 19. Pin 16 (f_V) equals fin ÷ (64N+A) = 12.5 kHz if the synthesizer is locked. Pin 9 is the modulus control signal.

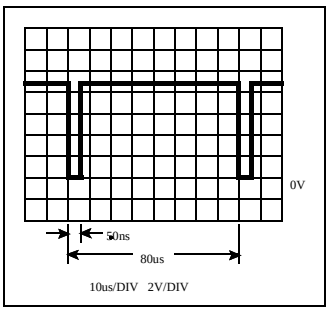


Figure 8-1 LOCK DETECT WAVEFORM

Modulus Control Signal

- The frequency of the modulus control signal on TEST 1, pin 9 should be equal to the N counter output frequency (either in or out of lock). When the VCO is in lock, this frequency should be 12.5 kHz.

- The duty cycle of the modulus control signal determines the divide number of the prescaler. The duty cycle (T1 ÷ T2) should be as follows:

  T1 ÷ T2 = A Cntr Div No ÷ N Cntr Div No
  T2 = 80 µs when locked.

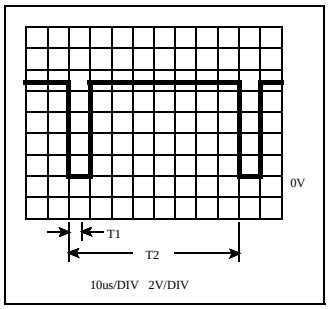


Figure 8-2 MODULUS CONTROL WAVEFORM

If the modulus control signal is not correct, the synthesizer may be defective or the logic may not be programming the correct divide number.

8.2.4 INTERNAL PRESCALER

Checking Prescaler Divide Number

The prescaler divide number can be checked by measuring the input and output frequencies. The prescaler divide number can be calculated as follows. (A and N counter divide numbers are calculated as described in Section 8.2.5.)

Prescaler Divide Number =
64 + (A Cntr Div No ÷ N Cntr Div No)

Example: Channel 200 (receive)

Prescaler Div No = 64 + (60 ÷ 1056) = 64.0568

Measure the prescaler input frequency at f_{in}, pin 11. Then measure the output frequency at TEST 2, pin 13 and calculate the divide number. If the VCO is not locked on frequency, the divide number should still be correct. The measured frequencies may not be exactly as calculated due to counter accuracy and resolution limitations.

NOTE: The counter should be connected to a high stability reference oscillator.

Example: Channel 300, VCO locked on frequency

845.550 MHz (pin 11) ÷ 13.200 (pin 13) = 64.0568

8.2.5 CALCULATING "N " AND "A " COUNTER DIVIDE NUMBERS

"N" Counter

N Counter Divide Number =
Integer (VCO Freq. (MHz) ÷ 0.8)

Example: Channel 200 (receive)

VCO freq = 898.500 - 52.95 = 845.550 MHz

N Cntr Div No = 845.550 ÷ 0.8 = 1056.9375

Integer (whole no.) of 1056.9375 = **1056**

Example: Channel 200 (transmit)
N Cntr Div No = 937.500 ÷ 0.8 = 1171.8750

Integer (whole no.) of 1171.8750 = **1171**

"A" Counter

A Counter Divide Number =
(VCO freq (MHz) ÷ .0125) - (N Cntr Div No x 64)

Example: Channel 200 (receive)

A Cntr Div No = (845.550 ÷ .0125) - (1056 x 64)
= 67,644 - 67,584
= **60**

Example: Channel 200 (transmit)

A Cntr Div No = (937.500 ÷ .0125) - (1171 x 64)
= 75,000 - 74,944
= **56**

8.3 RECEIVER SERVICING

To isolate a receiver problem to a defective section, start by checking the DC voltages shown in Section 6.6.6 and on the schematic diagram (Section 10). If that does not indicate the problem, perform the performance tests in Section 7.2 to isolate the problem. If the synthesizer is out of lock, the receiver is also nonfunctional because the first injection and IF signals will be incorrect.

8.4 TRANSMITTER SERVICING

To isolate a transmitter problem to a defective section, start by checking the DC voltages shown in Sections 6.6.4 and 6.6.6 and on the schematic diagram (Section 10). If that does not indicate the problem, perform the Performance Tests in Section 7.3, 7.4 and 7.5 to isolate the problem. If the synthesizer is out of lock, the Exciter is also nonfunctional because the software will not allow the repeater to transmit.

8.5 POWER SUPPLY SERVICING

The power supply is a switch mode type with very high voltages. It is highly recommended that the power supply be returned to the factory for servicing (see Section 1.8). A parts list, schematic and compo-

nent layout are provided for those customers that desire to do their own repairs (see Sections 9 and 10).

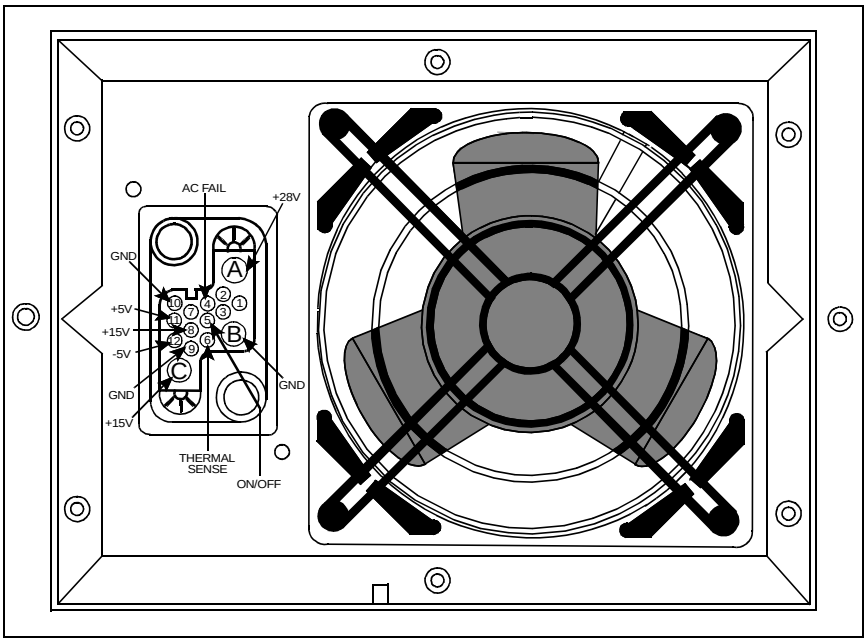


Figure 8-3 POWER SUPPLY REAR VIEW

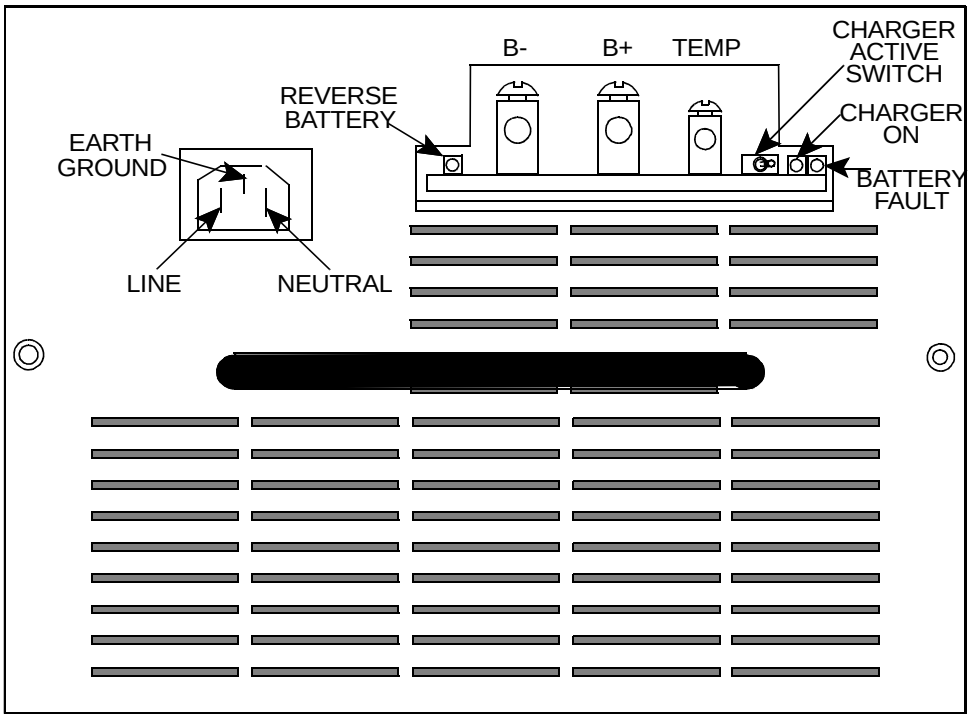


Figure 8-4 POWER SUPPLY FRONT VIEW

Standby Battery Jack

This provides a connection point for a +24V DC standby battery. Current is drawn from the battery only when the repeater enable line is on and AC has failed, or no AC is connected. A trickle charger can be jumpered in to charge the battery when AC returns. The charger jumper is removed when a separate battery charger is used (see Figure 8-4). The standby battery connection to the power supply must be ordered installed from the factory.

NOTE: A small amount (<30 mA) of current is drawn from the batteries with the repeater off. If the repeater is going to be turned off for more than one week (with good batteries connected) the fuse should be removed from the DC cable harness.

8.5.1 VOLTAGE CHECKS

Secondary voltages can be checked at the power supply connector with the power supply removed from the Repeater. First the on/off line must be grounded, jumper pin 5 to ground, then check the supply voltages as shown (see Figure 8-2). If voltages are absent the supply must be sent to the E.F. Johnson Company.

8.6 CHIP COMPONENT IDENTIFICATION

8.6.1 CERAMIC CHIP CAPS (510-36XX-XXX)

Ceramic chip capacitors are identified using either an American or Japanese EIA standard. The values for both standards are shown in Table 8-2.

American EIA Standard

This uses a single letter or number to indicate the value, and the color of this letter or number to indicate the multiplier.

Japanese EIA Standard

This uses a letter to indicate the value followed by a number to indicate the multiplier.

Example: 15 pF capacitor

American - Single Black "E"
Japanese -"E1"

The Japanese EIA Standard may also utilize a bar to indicate the temperature coefficient.

Example: $\overline{A2}$ - 100 pF NPO

XX = NPO $\overline{X}$X = N150 X$\overline{X}$ = N220

$\underline{XX}$ = N330 $\underline{X}$X = N470 X$\underline{X}$ = N750

|XX = X7R

8.6.2 TANTALUM CHIP CAPS (510-26XX-XXX)

Tantalum chip capacitor identification varies with vendor and physical size. The positive (+) end is usually indicated by a colored board or beveled edge. The value and voltage may be indicated by printing on the capacitor or by using a special code.

8.6.3 CHIP INDUCTORS (542-9000-XXX)

Three colored dots are used to indicate the value of chip inductors. The two dots on the left side indicate the first and second digits of the value in nano-Henries, and the single dot on the right side indicates the multiplier (see Table 8-1).

Example: Dots - Brown-Black-Red

10 nH x 100 = 1000 nH (1.0 μH)

The last three digits of the part number are also the value and multiplier. The multiplier digits are shown in Table 8-1.

8.6.4 CHIP RESISTORS

The value of chip resistors is indicated by a number printed on the resistor. A 3-digit number is used to identify ±5% and ±10% resistors, and a 4-digit number is used to identify ±1% resistors.

The 3-digit number used to identify ±5% and ±10% resistors corresponds to the last 3-digits of the E.F. Johnson part number. This number is derived as shown.
Example:

273	27k ohm
339	3.3 ohm

Some resistors with a ±1% tolerance are identified by a 4-digit number and others may not have a marking. When identified with a 4-digit number, the first three digits are the value and the fourth is the multiplier.

Example: 5761 5.76k ohm

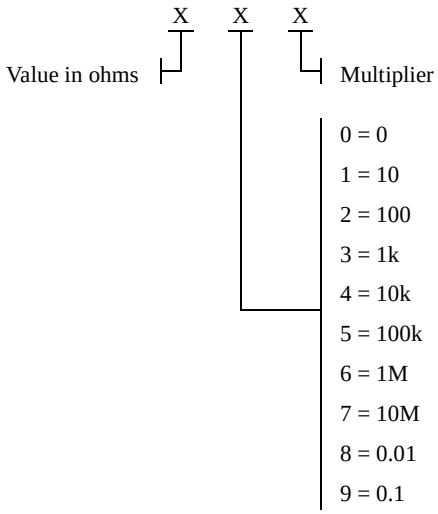
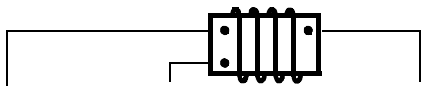


Figure 8-5 3-DIGIT RESISTOR

Table 8-1 CHIP INDUCTOR IDENTIFICATION



Color	1st Digit	2nd Digit	Multiplier (Last PN Digit)
Black	0	0	1 (7)
Brown	1	1	10 (8)
Red	2	2	100 (9)
Orange	3	3	1000 (0)
Yellow	4	4	10,000 (1)
Green	5	5	100,000 (2)
Blue	6	6	---
Violet	7	7	---
Gray	8	8	---
White	9	9	0.1 (6)

Table 8-2 CERAMIC CHIP CAP IDENTIFICATION

American EIA Standard		Japanese EIA Standard	
First Letter/ Number	Value (pF)	First Letter/ Number	Value (pF)
A	10	A	1.0
B	11	B	1.1
C	12	C	1.2
D	13	D	1.3
E	15	E	1.5
H	16	F	1.6
I	18	G	1.8
J	20	H	2.0
K	22	J	2.2
L	24	K	2.4
N	27	L	2.7
O	30	M	3.0
R	33	N	3.3
S	36	P	3.6
T	39	Q	3.9
V	43	R	4.3
W	47	S	4.7
X	51	T	5.1
Y	56	U	5.6
Z	62	V	6.2
3	68	W	6.8
4	75	X	7.5
7	82	Y	8.2
9	91	Z	9.1
Color	**Multiplier**	**Second Number**	**Multiplier**
Orange	0.1	0	1
Black	1	1	10
Green	10	2	100
Blue	100	3	1000
Violet	1000	4	10,000
Red	10,000	5	100,000

8.6.5 CHIP TRANSISTORS AND DIODES

Surface mounted transistors and diodes are identified by a special number that is shown in a table on Page 10-1.

8.7 BERYLLIUM PRODUCT WARNING

Q501, Q502, Q503, R504, R505 in the 75W power amplifier and R685 R701, R702, R703, R716, R717, R730, Q502, Q701, Q702, Q703, Q704 in the 160W Power Amplifier contain Beryllium (BeO). Inhalation of dust or fumes may cause serious chronic lung disease. Refer to the Material Safety Data Sheets for further details.

8.8 GRAFOIL REPLACEMENT PROCEDURE

When replacing a device that uses Grafoil for the thermal interface, the Grafoil must be replaced. The old Grafoil must be completely removed from the heatsink. To avoid scuffing the heatsink a plastic scraper (e.g. tuning tool) should be used to remove the old Grafoil.

SECTION 9 PARTS LIST

900 MHz LTR-Net 75W REPEATER
PART NO. 242-2009-632

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 003	900 MHz 75W repeater assem	023-2009-932
A 006	Tx/Rx module assembly	023-2009-832
A 010	2000 series power supply	023-2000-800
HW001	6-32 machine panhead philips	575-1606-012
MP001	PA hold down bracket	017-2210-032
PA001	Main Processor Card assem**	023-2000-310
PA002	Main Audio Card assem**	023-2000-320
PA003	Interface Alarm Card assem**	023-2000-350
PA004	Repeater enclosure assembly	023-2000-200
U 014	HSDB LTR-Net software	023-9998-456
W 013	AC power cord 6’7" 16 AWG	597-1001-013

900 MHz LTR-Net 160W REPEATER
PART NO. 242-2009-634

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 003	900 MHz 175W repeater assem	023-2009-934
A 006	Tx/Rx module assembly	023-2009-832
A 010	2000 series power supply	023-2000-800
HW001	6-32 machine panhead philips	575-1606-012
MP033	PA hold down bracket	017-2210-032
PA001	Main Processor Card assem**	023-2000-310
PA002	Main Audio Card assem**	023-2000-320
PA003	Interface Alarm Card assem**	023-2000-350
PA004	Repeater enclosure assembly	023-2000-200
U 014	HSDB LTR-Net software	023-9998-456
W 013	AC power cord 6’7" 16 AWG	597-1001-013

**Requires Application Engineering authorization to purchase.

900 MHz 75W REPEATER ASSEMBLY
PART NO. 023-2009-932

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 002	895 MHz drop-in circulator	585-0590-005
A 004	PA - Rx/Tx 20-cond ribbon	023-2000-190
A 005	PA - Rx/Tx 20-cond ribbon	023-2000-190
A 008	N ST BK cable assembly	416-0614-001
A 009	PA RF input coax SMB	597-3002-031
A 010	Forward/Reverse Power	023-2008-680
A 011	800 MHz LPF assembly	023-2008-630
PA001	75W PA mechanical assem	023-2009-732
PA008	RF Interface board assembly	023-2008-110
PA009	900 MHz 75W PA assembly	023-2009-500
C 001	1000 pF ±20% 1kV feedthru	510-3149-102
C 002	1000 pF ±20% 1kV feedthru	510-3149-102
C 003	1000 pF ±20% 1kV feedthru	510-3149-102
C 004	1000 pF ±20% 1kV feedthru	510-3149-102
C 005	1000 pF ±20% 1kV feedthru	510-3149-102
C 006	1000 pF ±20% 1kV feedthru	510-3149-102
C 007	1000 pF ±20% 1kV feedthru	510-3149-102
C 008	1000 pF ±20% 1kV feedthru	510-3149-102
C 009	1000 pF ±20% 1kV feedthru	510-3149-102
C 010	1000 pF ±20% 1kV feedthru	510-3149-102
C 011	1000 pF ±20% 1kV feedthru	510-3149-102
C 012	1000 pF ±20% 1kV feedthru	510-3149-102
C 013	1000 pF ±20% 1kV feedthru	510-3149-102
C 523	12 pF 250V mini mica	510-0019-120
C 524	12 pF 250V mini mica	510-0019-120
C 525	22 pF 250V mini mica	510-0019-220
C 526	22 pF 250V mini mica	510-0019-220
C 586	6.2 pF 250V mini mica	510-0219-629
C 587	6.2 pF 250V mini mica	510-0219-629
EP500	Jumper/RF Power Detector	016-2228-015
HW003	5/8-24 x 0.094 hex nut NPB	560-9079-028
HW004	5/8 x 0.02 lockwasher int CPS	596-9119-028
J 001	2-pin lock receptacle #22	515-9032-232

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 501*	30W 900 MHz 24V MRF894	576-0004-821
Q 502*	60W 800 MHz 24V MRF898	576-0004-820
Q 503*	60W 800 MHz 24V MRF898	576-0004-820
R 508*	100 ohm 20W flange mount	569-5001-001
R 509*	100 ohm 100W flange mount	569-5001-002
R 685*	50 ohm 250W flange mount	569-5001-003
U 501	6W 870-950 MHz power mod	544-4001-051

900 MHz 160W REPEATER ASSEMBLY
PART NO. 023-2009-934

A 002	895 MHz drop-in circulator	585-0590-005
A 004	PA - Rx/Tx 20-cond ribbon	023-2000-190
A 005	PA - Rx/Tx 20-cond ribbon	023-2000-190
A 008	N ST BK cable assembly	416-0614-001
A 009	PA RF input coax SMB	597-3002-031
A 010	Forward/Reverse Power	023-2008-680
A 011	800 MHz LPF assembly	023-2008-630
PA001	160W PA mechanical assem	023-2009-734
PA008	RF Interface board assembly	023-2008-110
PA009	160W PA assembly	023-2009-520
C 001	1000 pF ±20% 1kV feedthru	510-3149-102
C 002	1000 pF ±20% 1kV feedthru	510-3149-102
C 003	1000 pF ±20% 1kV feedthru	510-3149-102
C 004	1000 pF ±20% 1kV feedthru	510-3149-102
C 005	1000 pF ±20% 1kV feedthru	510-3149-102
C 006	1000 pF ±20% 1kV feedthru	510-3149-102
C 007	1000 pF ±20% 1kV feedthru	510-3149-102
C 008	1000 pF ±20% 1kV feedthru	510-3149-102
C 009	1000 pF ±20% 1kV feedthru	510-3149-102
C 010	1000 pF ±20% 1kV feedthru	510-3149-102
C 011	1000 pF ±20% 1kV feedthru	510-3149-102
C 012	1000 pF ±20% 1kV feedthru	510-3149-102
C 013	1000 pF ±20% 1kV feedthru	510-3149-102
EP500	Jumper, RF Power Detector	016-2228-015
HW003	5/8-24 x 0.094 hex nut NPB	560-9079-028
HW004	5/8 x 0.02 lockwasher int CPS	596-9119-028
J 001	2-pin lock receptacle #22	515-9032-232
J 002	2-pin lock receptacle #22	515-9032-232
Q 502*	60W 800 MHz 24V MRF898	576-0004-820
Q 701*	60W 800 MHz 24V MRF898	576-0004-820
Q 702*	60W 800 MHz 24V MRF898	576-0004-820
Q 703*	60W 800 MHz 24V MRF898	576-0004-820
Q 704*	60W 800 MHz 24V MRF898	576-0004-820
R 685*	50 ohm 250W flange mount	569-5001-003
R 701*	100 ohm 20W flange mount	569-5001-001
R 702*	100 ohm 20W flange mount	569-5001-001
R 703*	100 ohm 100W flange mount	569-5001-002
R 716*	100 ohm 20W flange mount	569-5001-001
R 717*	100 ohm 100W flange mount	569-5001-002
R 730*	100 ohm 100W flange mount	569-5001-002
U 501	18W 870-950 MHz power mod	544-4001-029

TRANSMIT/RECEIVE MODULE
PART NO. 023-2009-832

HW001	5/8-24 X 0.094 hex nut NPB	560-9079-028
HW002	5/8 x 0.02 lockwasher int. CPS	596-9119-028
HW249	10-32 mach panhead phil ZPS	575-1610-020
HW250	#10 flat washer ZPS	596-1410-016
J 202	BNC panel mount	515-3005-002
MP200	Transceiver pad	017-2210-105
PA002	Transceiver	023-2000-205
PA004	900 MHz Receiver	023-2009-200
PA005	900 MHz Exciter	023-2009-400

REPEATER ENCLOSURE ASSEMBLY
PART NO. 023-2000-200

A 004	Shelf power harness assembly	023-2000-165
A 005	High speed data bus harness	023-2000-170
A 006	Input/Output harness assem	023-2000-175
A 007	Alarm harness assembly	023-2000-180
A 008	RF input harness assembly	023-2000-185
A 009	Controller backplane card	023-2000-210
A 010	External connector board	023-2000-220
A 011	Power supply filter board	023-2000-250
CH017	Chassis	017-2210-080

***DANGER** Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for details.

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
EP001	Ferrite bead	517-2002-008
EP002	Ferrite bead	517-2002-009
EP010	3/8" heat shrink tubing	042-0241-556
EP011	1/2" tubing	042-0241-557
HW013	6-32 machine panhead philips	575-1606-014
HW014	6-32 panhead philips ZPS	575-1606-012
HW016	8-32 panhead philips ZPS	575-1608-012
HW017	10-32 machine panhead phil	575-1610-016
HW018	6-19 panhead philips ZPS	575-5606-008
HW019	6-32 machine flathead philips	575-8206-012
HW020	6-32 x 0.094 nut	560-1106-010
HW021	8-32 socket head shield screw	575-9078-106
HW022	8 x 0.032 flat washer NPB	596-2408-012
HW023	#10 flat washer NPB	596-1410-016
HW024	1/2" cable clamp	572-0001-007
HW025	Ratcheting flat wire	572-0011-005
HW026	Floating connector shield	018-1007-028
HW027	Floating connector cushion	018-1132-150
HW029	Speed nut 0.093 stud	537-0002-004
HW030	4-40 shield screw	575-9078-105
HW031	Lens, adhesive	574-3002-115
HW032	6-32 machine panhead philips	575-1606-024
HW033	6 x 0.018 lockwasher	596-1106-009
HW036	High vinyl foot	574-1004-003
J 010	Banana jack assembly .166	108-2302-621
J 011	Banana jack assembly .166	108-2303-621
J 012	Banana jack assembly .166	108-2301-621
MP001	PA floating connector bracket	017-2210-099
MP012	8-32 x 1.15 spacer 0.375	013-1723-221
MP013	Guide pin shield	013-1723-220
MP015	Chassis top cover	017-2210-070
MP017	Door lock rod	013-1723-225
MP018	Mounting ears	017-2210-085
MP019	Door lock cam	017-2210-110
MP020	Front door lens	032-0758-025
MP021	PA slide	032-0758-015
MP022	Front door	032-0758-020
MP024	Slide lock cam	537-9007-012
MP025	Card guide 4.5"	574-9015-006
MP026	PA conn floating plate	017-2226-020
MP028	Flexible grommet	574-0001-030
MP029	Flexible grommet	574-0001-030
MP030	Spacer	013-1723-228
MP031	Spacer	013-1723-229
MP032	Dowel pin guide	013-1723-230
NP001	Nameplate E.F. Johnson	559-5861-163

TRANSCEIVER MECHANICAL
PART NO. 023-2000-205

CH252	Transceiver housing	015-0902-010
EP252	0.093 OD RF shield gasket	574-3002-036
HW272	6-32 pan torx ZPS	575-0006-010
HW273	6-32 machine panhead philips	575-1606-016
MP253	Transceiver deck cover	015-0902-015

CONTROLLER BACKPLANE CARD
PART NO. 023-2000-210

F 001	4 Amp 250V submin fuse	534-0017-020
F 002	4 Amp 250V submin fuse	534-0017-020
F 003	1 Amp 250V submin fuse	534-0017-014
FH001	Fuse holder	534-0017-001
FH002	Fuse holder	534-0017-001
FH003	Fuse holder	534-0017-001
HW012	Polarizing key box cont	515-7109-010
J 001	34-pos latch ejection header	515-9031-400
J 002	34-pos latch ejection header	515-9031-400
MP001	Round swage spacer 0.5"	312-2483-216
MP002	Round swage spacer 0.75"	312-2483-224
P 001	64-pin DIN female straight	515-7082-201
P 002	32-pin DIN female straight	515-7082-200
P 003	64-pin DIN female straight	515-7082-201
P 004	32-pin DIN female straight	515-7082-200
P 005	64-pin DIN female straight	515-7082-201
P 006	32-pin DIN female straight	515-7082-200
P 007	64-pin DIN female straight	515-7082-201
P 008	32-pin DIN female straight	515-7082-200
P 009	32-pin DIN female straight	515-7082-200
P 010	26-pin locking straight header	515-9031-397
P 011	6-pin friction lock conn	515-9031-205
P 012	64-pin DIN female straight	515-7082-201

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
P 013	32-pin DIN female straight	515-7082-200
P 014	64-pin DIN female straight	515-7082-201
P 015	32-pin DIN female straight	515-7082-200
P 016	64-pin DIN female straight	515-7082-201
P 017	32-pin DIN female straight	515-7082-200
P 018	64-pin DIN female straight	515-7082-201
PC001	PC board	035-2000-210
	EXTERNAL CONNECTOR BOARD PART NO. 023-2000-220	
HW001	6-32 ss pem fastener	560-9106-010
HW002	Polarizing key box cnt	515-7109-010
J 001	26-pos terminal block PC mt	515-7110-426
J 002	34-pos terminal block PC mt	515-7110-434
J 003	34-pos latch ejection header	515-9031-400
J 004	8-pos modular jack	515-2006-046
J 005	8-pos modular jack	515-2006-046
MP001	Insulator	018-1132-018
NP001	External connector label	559-0069-060
P 001	26-pin locking straight header	515-9031-397
P 002	8-pin friction lock header	515-9031-207
PC001	PC board	035-2000-220
	POWER SUPPLY FILTER BOARD PART NO. 023-2000-250	
EP020	Ferrite bead	517-2002-009
EP021	Ferrite bead	517-2002-009
MP001	Round tapped swage spacer	312-2493-212
MP002	Round tapped swage spacer	312-2493-212
PC001	PC board	035-2000-250
	RF INTERFACE BOARD PART NO. 023-2008-110	
C 101	.1 µF ±10% X7R chip	510-3606-104
C 102	2.2 µF 20V tantalum SMD	510-2626-229
C 103	4.7 µF 16V tantalum SMD	510-2625-479
C 104	.1 µF ±10% X7R 1206 chip	510-3606-104
C 105	39 pF ±5% NPO 1206 chip	510-3602-390
C 107	2.2 µF 20V tantalum SMD	510-2626-229
C 108	.018 µF ±10% X7R 0805 chip	510-3605-183
C 109	.001 µF ±5% NPO 1206 chip	510-3602-102
C 110	.1 µF ±10% X7R 1206 chip	510-3606-104
C 111	.047 µF ±10% X7R 1206 chip	510-3606-473
C 112	1 µF 35V tantalum SMD	510-2628-109
C 113	.047 µF ±10% X7R 1206 chip	510-3606-473
C 114	1 µF 35V tantalum SMD	510-2628-109
C 115	.047 µF ±10% X7R 1206 chip	510-3606-473
C 116	.01 µF ±10% X7R 1206 chip	510-3606-103
C 117	1000 µF 50V	510-4076-102
C 119	.1 µF ±10% X7R 1206 chip	510-3606-104
C 120	.1 µF ±10% X7R 1206 chip	510-3606-104
C 125	.01 µF ±10% X7R 1206 chip	510-3606-103
C 126	.018 µF ±10% X7R 0805 chip	510-3605-183
C 130	.1 µF ±10% X7R 1206 chip	510-3606-104
C 132	.001 µF ±5% NPO 1206 chip	510-3602-102
C 135	.001 µF ±5% NPO 1206 chip	510-3602-102
C 138	.001 µF ±5% NPO 1206 chip	510-3602-102
C 141	.001 µF ±5% NPO 1206 chip	510-3602-102
C 143	.1 µF ±10% X7R 1206 chip	510-3606-104
C 149	.1 µF ±10% X7R 1206 chip	510-3606-104
C 150	.001 µF ±5% NPO 1206 chip	510-3602-102
CR101	Switching SOT-23	523-1504-002
CR103	3.9V zener SOT-23	523-2016-399
CR104	5.1V zener SOT-23	523-2016-519
CR107	5.1V zener SOT-23	523-2016-519
CR108	5.1V zener SOT-23	523-2016-519
CR109	5.1V zener SOT-23	523-2016-519
CR110	5.1V zener SOT-23	523-2016-519
CR111	Dual switching common-cath	523-1504-022
EP101	Terminal lug 2104-06	586-0005-106
EP102	Terminal lug 2104-06	586-0005-106
EP103	Terminal lug 2104-06	586-0005-106
EP104	Terminal lug 2104-06	586-0005-106
EP105	Terminal lug 2104-06	586-0005-106
F 101	2A 250V AC sub-min	534-0017-017
F 102	2A 250V AC sub-min	534-0017-017
FH101	Fuse holder PC mount	534-1017-001
FH102	Fuse holder PC mount	534-1017-001

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
HW105	Polarizing key box cnt	515-7109-010
HW106	Polarizing key box cnt	515-7109-010
HW240	#6 plit lock washer ZPS	596-1306-008
HW247	6-32 machine pan head philips	575-1606-012
J 101	36-pin right angle radial	515-0511-001
J 102	20-pin straight low profile	515-9031-376
J 103	20-pin straight low profile	515-9031-376
J 104	4-pin right angle header	515-9035-004
L 101	3 µH filter choke PC mount	542-5007-031
MP101	PA connector mounting shield	032-0758-028
P 101	Banana plug panel mount	108-0753-001
P 102	Banana plug panel mount	108-0753-001
P 103	Banana plug panel mount	108-0753-001
P 104	Banana plug panel mount	108-0753-001
P 105	Banana plug panel mount	108-0753-001
PC100	PC board	035-2008-110
Q 101	Si PNP low noise SOT-23	576-0003-657
Q 102	Si NPN SOT-23	576-0003-600
Q 103	PNP D-pak power	576-0002-603
Q 104	Si NPN low noise SOT-23	576-0003-657
Q 105	Si NPN amp SOT-23	576-0003-658
Q 106	Si NPN SOT-23	576-0003-600
Q 107	PNP D-pak power	576-0002-603
Q 108	Si NPN gen purp sw/amp	576-0001-300
R 045	100 ohm ±5% 1206 SMD	569-0115-101
R 046	100 ohm ±5% 1206 SMD	569-0115-101
R 048	1k ohm ±5% 1206 SMD	569-0115-102
R 049	Zero ohm ±5% 1206 SMD	569-0115-001
R 050	4.99k ohm ±1% 1206 SMD	569-0111-368
R 051	100 ohm ±5% 1206 SMD	569-0115-101
R 052	10k ohm ±5% 1206 SMD	569-0115-103
R 053	10k ohm ±5% 1206 SMD	569-0115-103
R 054	10k ohm ±5% 1206 SMD	569-0115-103
R 055	2.7k ohm ±5% 1206 SMD	569-0115-272
R 056	470k ohm ±5% 1206 SMD	569-0115-474
R 057	10k ohm ±5% 1206 SMD	569-0115-103
R 059	10k ohm ±5% 1206 SMD	569-0115-103
R 061	43k ohm ±5% 1206 SMD	569-0115-433
R 063	10k ohm ±5% 1206 SMD	569-0115-103
R 064	43k ohm ±5% 1206 SMD	569-0115-433
R 065	10k ohm ±5% 1206 SMD	569-0115-103
R 066	43k ohm ±5% 1206 SMD	569-0115-433
R 073	10k ohm ±5% 1206 SMD	569-0115-103
R 074	1k ohm ±5% 1206 SMD	569-0115-102
R 075	1k ohm ±5% 1206 SMD	569-0115-102
R 076	5k ohm single turn trimmer	562-1112-502
R 078	270k ohm ±5% 1206 SMD	569-0115-274
R 079	1k ohm ±1% 1206 SMD	569-0111-301
R 080	1k ohm ±1% 1206 SMD	569-0111-301
R 081	470 ohm ±5% 1206 SMD	569-0115-471
R 082	270k ohm ±5% 1206 SMD	569-0115-274
R 083	1k ohm ±1% 1206 SMD	569-0111-301
R 084	1k ohm ±1% 1206 SMD	569-0111-301
R 085	470 ohm ±5% 1206 SMD	569-0115-471
R 086	270k ohm ±5% 1206 SMD	569-0115-274
R 087	1k ohm ±1% 1206 SMD	569-0111-301
R 088	1k ohm ±1% 1206 SMD	569-0111-301
R 089	470 ohm ±5% 1206 SMD	569-0115-471
R 090	270k ohm ±5% 1206 SMD	569-0115-274
R 091	1k ohm ±1% 1206 SMD	569-0111-301
R 092	1k ohm ±1% 1206 SMD	569-0111-301
R 093	470 ohm ±5% 1206 SMD	569-0115-471
R 094	5.1k ohm ±5% 1206 SMD	569-0115-512
R 095	1k ohm ±5% 1206 SMD	569-0115-102
R 100	100 ohm ±5% 1206 SMD	569-0115-101
R 101	1k ohm ±5% 1206 SMD	569-0115-102
R 102	2.7k ohm ±5% 1206 SMD	569-0115-272
R 103	270k ohm ±5% 1206 SMD	569-0115-274
R 104	270k ohm ±5% 1206 SMD	569-0115-274
R 105	2.7k ohm ±5% 1206 SMD	569-0115-272
R 106	10k ohm ±5% 1206 SMD	569-0115-103
R 107	560 ohm ±5% 1206 SMD	569-0115-561
R 108	2.7k ohm ±5% 1206 SMD	569-0115-272
R 109	1k ohm ±5% 1206 SMD	569-0115-102
R 110	5.1k ohm ±5% 1206 SMD	569-0115-512
R 111	330 ohm ±5% 1206 SMD	569-0115-331
R 112	1k ohm ±5% 1206 SMD	569-0115-102
R 113	1.8k ohm ±5% 1206 SMD	569-0115-182
R 114	1.8k ohm ±5% 1206 SMD	569-0115-182
R 115	470 ohm ±5% 1206 SMD	569-0115-471
R 116	470 ohm ±5% 1206 SMD	569-0115-471
R 117	270 ohm ±5% 1206 SMD	569-0115-271
R 118	20k ohm ±1% 1206 SMD	569-0111-430
R 119	20k ohm ±1% 1206 SMD	569-0111-430
R 120	10k ohm ±1% 1206 SMD	569-0111-401
R 121	20k ohm ±1% 1206 SMD	569-0111-430
R 122	10k ohm ±1% 1206 SMD	569-0111-401

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 123	20k ohm ±1% 1206 SMD	569-0111-430
R 124	10k ohm ±1% 1206 SMD	569-0111-401
R 125	20k ohm ±1% 1206 SMD	569-0111-430
R 126	10k ohm ±1% 1206 SMD	569-0111-401
R 127	20k ohm ±1% 1206 SMD	569-0111-430
R 128	10k ohm ±1% 1206 SMD	569-0111-401
R 129	20k ohm ±1% 1206 SMD	569-0111-430
R 130	10k ohm ±1% 1206 SMD	569-0111-401
R 131	20k ohm ±1% 1206 SMD	569-0111-430
R 132	10k ohm ±1% 1206 SMD	569-0111-401
R 133	20k ohm ±1% 1206 SMD	569-0111-430
R 134	20k ohm ±1% 1206 SMD	569-0111-430
R 135	22k ohm ±5% 1206 SMD	569-0115-223
R 136	22k ohm ±5% 1206 SMD	569-0115-223
R 137	22k ohm ±5% 1206 SMD	569-0115-223
R 138	22k ohm ±5% 1206 SMD	569-0115-223
R 139	10k ohm ±5% 1206 SMD	569-0115-103
R 140	10k ohm ±5% 1206 SMD	569-0115-103
R 141	10k ohm ±5% 1206 SMD	569-0115-103
R 142	10k ohm ±5% 1206 SMD	569-0115-103
R 143	22k ohm ±5% 1206 SMD	569-0115-223
R 144	22k ohm ±5% 1206 SMD	569-0115-223
R 145	22k ohm ±5% 1206 SMD	569-0115-223
R 146	22k ohm ±5% 1206 SMD	569-0115-223
R 147	22k ohm ±5% 1206 SMD	569-0115-223
R 148	22k ohm ±5% 1206 SMD	569-0115-223
R 149	22k ohm ±5% 1206 SMD	569-0115-223
R 150	10k ohm ±5% 1206 SMD	569-0115-103
R 151	10k ohm ±5% 1206 SMD	569-0115-103
R 152	10k ohm ±5% 1206 SMD	569-0115-103
R 153	22k ohm ±5% 1206 SMD	569-0115-223
R 154	22k ohm ±5% 1206 SMD	569-0115-223
R 155	22k ohm ±5% 1206 SMD	569-0115-223
R 156	22k ohm ±5% 1206 SMD	569-0115-223
R 157	10k ohm ±5% 1206 SMD	569-0115-103
R 158	10k ohm ±5% 1206 SMD	569-0115-103
R 159	10k ohm ±5% 1206 SMD	569-0115-103
R 160	22k ohm ±5% 1206 SMD	569-0115-223
R 161	22k ohm ±5% 1206 SMD	569-0115-223
R 162	22k ohm ±5% 1206 SMD	569-0115-223
R 163	22k ohm ±5% 1206 SMD	569-0115-223
R 164	22k ohm ±5% 1206 SMD	569-0115-223
R 165	22k ohm ±5% 1206 SMD	569-0115-223
R 166	22k ohm ±5% 1206 SMD	569-0115-223
R 167	1k ohm ±1% 1206 SMD	569-0111-301
R 168	10k ohm ±5% 1206 SMD	569-0115-103
R 169	270k ohm ±5% 1206 SMD	569-0115-274
R 170	1k ohm ±1% 1206 SMD	569-0111-301
R 171	511 ohm ±1% 1206 SMD	569-0111-269
R 172	1k ohm ±5% 1206 SMD	569-0115-102
R 173	3.3k ohm ±5% 1206 SMD	569-0115-332
R 174	8.2k ohm ±5% 1206 SMD	569-0115-822
R 175	8.2k ohm ±5% 1206 SMD	569-0115-822
R 176	8.2k ohm ±5% 1206 SMD	569-0115-822
R 177	8.2k ohm ±5% 1206 SMD	569-0115-822
R 178	8.2k ohm ±5% 1206 SMD	569-0115-822
R 179	10k ohm ±5% 1206 SMD	569-0115-103
R 180	10k ohm ±5% 1206 SMD	569-0115-103
R 181	22 ohm ±5% 1206 SMD	569-0115-220
R 182	22 ohm ±5% 1206 SMD	569-0115-220
R 183	22 ohm ±5% 1206 SMD	569-0115-220
R 184	22 ohm ±5% 1206 SMD	569-0115-220
R 185	22k ohm ±5% 1206 SMD	569-0115-223
R 186	10k ohm ±5% 1206 SMD	569-0115-103
R 187	15k ohm ±5% 1206 SMD	569-0115-153
R 188	22 ohm ±5% 1206 SMD	569-0115-220
R 189	22 ohm ±5% 1206 SMD	569-0115-220
R 190	22 ohm ±5% 1206 SMD	569-0115-220
R 191	22 ohm ±5% 1206 SMD	569-0115-220
R 192	22k ohm ±5% 1206 SMD	569-0115-223
R 193	10k ohm ±5% 1206 SMD	569-0115-103
R 194	15k ohm ±5% 1206 SMD	569-0115-153
R 197	10k ohm ±5% 1206 SMD	569-0115-103
R 198	10k ohm ±5% 1206 SMD	569-0115-103
R 199	10k ohm ±5% 1206 SMD	569-0115-103
U 101	+5V regulator 78L05	544-2603-039
U 102	Dual op amp SOIC LM2904	544-2019-004
U 103	8-bit shift register MC14094	544-3016-094
U 104	8-chan mux 4051	544-3016-051
U 105	8-chan mux 4051	544-3016-051
U 106	8-chan mux 4051	544-3016-051
U 107	Dual op amp SOIC LM2904	544-2019-004
U 108	Dual op amp SOIC LM2904	544-2019-004
U 109	Quad op amp SOIC LM224	544-2020-014
U 110	Hex non-inv buffer 4050B	544-3016-050
U 111	Dual op amp SO-8 LM2904	544-2019-004
U 112	Quad op amp SOIC LM224	544-2020-014

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	RECEIVE VCO PART NO. 023-2009-800	
C 803	1 pF ±0.1 pF 150V chip	510-3356-109
C 804	2.7 pF ±0.1 pF 150V chip	510-3656-279
C 805	.47 µF 16V tantalum SMD	510-2625-478
C 806	4.7 µF 10V tantalum SMD	510-2624-479
C 807	27 pF ±5% NPO 0805 chip	510-3601-270
C 808	27 pF ±5% NPO 0805 chip	510-3601-270
C 809	15 µF 20V tantalum SMD	510-2626-150
C 810	27 pF ±5% NPO 0805 chip	510-3601-270
C 811	27 pF ±5% NPO 0805 chip	510-3601-270
C 812	3.9 pF 150V chip	510-3656-399
C 813	5.6 pF 150V chip	510-3656-569
CR802	Varactor 105G SOT-23	523-1504-015
L 803	.039 µH inductor SMD	542-9001-397
L 804	.039 µH inductor SMD	542-9001-397
L 805	.039 µH inductor SMD	542-9001-397
PC801	PC board	035-2009-800
Q 801	Si NPN gen purp switch/amp	576-0001-300
Q 802	NPN UHF low noise SOT-23	576-0003-636
R 801	10 ohm ±5% 0805 chip	569-0105-100
R 802	3.6k ohm ±5% 0805 chip	569-0105-362
R 803	100 ohm ±5% 0805 chip	569-0105-101
R 804	4.7k ohm ±5% 0805 chip	569-0105-472
R 805	5.1k ohm ±5% 0805 chip	569-0105-512
R 806	6.2k ohm ±5% 0805 chip	569-0105-622
R 807	180 ohm ±5% 1206 SMD	569-0115-181
	900 MHz RECEIVER PART NO. 023-2009-200	
A 006	900 MHz VCO assembly	023-2009-800
A 201	RF input coax assembly	023-2000-161
A 202	OCXO coax cable assembly	597-3001-215
A 203	Top shield assembly	023-2000-199
C 201	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 202	4.3 pF ±5% NPO 1206 chip	510-3602-439
C 203	4.7 µF 16V tantalum SMD	510-2625-479
C 204	33 pF ±5% NPO 1206 chip	510-3602-330
C 205	10 pF ±5% NPO 1206 chip	510-3602-100
C 207	3 pF ±5% NPO 1206 chip	510-3602-309
C 208	33 pF ±5% NPO 1206 chip	510-3602-330
C 209	8.2 pF ±5% NPO 1206 chip	510-3602-829
C 210	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 211	.01 µF ±10% X7R chip	510-3606-103
C 212	.01 µF ±10% X7R chip	510-3606-103
C 213	4.7 µF 16V tantalum SMD	510-2625-479
C 214	7.5 pF ±5% NPO 1206 chip	510-3602-759
C 215	5.6 pF ±5% NPO 1206 chip	510-3602-759
C 216	5.6 pF ±5% NPO 1206 chip	510-3602-759
C 217	.1 µF ±10% X7R 1210	510-3607-104
C 218	.001 µF ±5% NPO 1206 chip	510-3602-102
C 219	.1 µF ±10% X7R 1210	510-3607-104
C 220	.001 µF ±5% NPO 1206 chip	510-3602-102
C 221	.1 µF ±10% X7R 1210	510-3607-104
C 222	120 pF ±5% NPO 1206 chip	510-3602-121
C 224	.01 µF ±10% X7R chip	510-3606-103
C 225	.01 µF ±10% X7R chip	510-3606-103
C 226	.01 µF ±10% X7R chip	510-3606-103
C 227	.01 µF ±10% X7R chip	510-3606-103
C 228	.01 µF ±10% X7R chip	510-3606-103
C 229	.01 µF ±10% X7R chip	510-3606-103
C 230	.01 µF ±10% X7R chip	510-3606-103
C 231	100 pF ±5% NPO 1206 chip	510-3602-101
C 232	4.7 µF 16V tantalum SMD	510-2625-479
C 233	.01 µF ±10% X7R chip	510-3606-103
C 234	.01 µF ±10% X7R chip	510-3606-103
C 235	220 pF ±5% NPO 1206 chip	510-3602-221
C 236	220 pF ±5% NPO 1206 chip	510-3602-221
C 237	5.6 pF ±5% NPO 1206	510-3602-569
C 238	390 pF ±5% NPO 1206	510-3602-391
C 240	4.7 µF 16V tantalum SMD	510-2625-479
C 241	.1 µF ±10% X7R 1210	510-3607-104
C 242	.1 µF ±10% X7R 1210	510-3607-104
C 243	.1 µF ±10% X7R 1210	510-3607-104
C 244	.01 µF ±10% X7R chip	510-3606-103
C 245	33 µF 10V tantalum SMD	510-2524-330
C 246	1 µF 16V tantalum SMD	510-2625-109
C 247	56 pF ±5% NPO 1206 chip	510-3602-560
C 248	.001 µF ±5% NPO 1206 chip	510-3602-102
C 249	.01 µF ±10% X7R 1206 chip	510-3606-103
C 250	100 pF ±5% NPO 1206 chip	510-3602-101
C 251	.01 µF ±10% X7R 1206 chip	510-3606-103
C 252	.001 µF ±5% NPO 1206 chip	510-3602-102
C 253	.01 µF ±10% X7R 1206 chip	510-3606-103
C 254	100 pF ±5% NPO 1206 chip	510-3602-101
C 255	.1 µF ±10% X7R 1210	510-3607-104

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 256	.1 µF ±10% X7R 1210	510-3607-104
C 257	.1 µF ±10% X7R 1210	510-3607-104
C 258	27 pF ±5% NPO 1206 chip	510-3602-270
C 259	27 pF ±5% NPO 1206 chip	510-3602-270
C 260	27 pF ±5% NPO 1206 chip	510-3602-270
C 261	3.3 pF ±5% NPO 1206 chip	510-3602-339
C 262	7.5 pF ±5% NPO 1206 chip	510-3602-759
C 264	7.5 pF ±5% NPO 1206 chip	510-3602-759
C 266	4.7 µF 16V tantalum SMD	510-2625-479
C 267	39 pF ±5% NPO 1206 chip	510-3602-390
C 268	1.5 pF ±5% NPO 1206 chip	510-3602-159
C 269	27 pF ±5% NPO 1206 chip	510-3602-270
C 270	100 pF ±5% NPO 1206 chip	510-3602-101
C 271	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 272	18 pF ±5% NPO 1206 chip	510-3602-180
C 273	27 pF ±5% NPO 1206 chip	510-3602-270
C 274	27 pF ±5% NPO 1206 chip	510-3602-270
C 275	3.3 pF ±5% NPO 1206 chip	510-3602-339
C 277	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 278	27 pF ±5% NPO 1206 chip	510-3602-270
C 279	4.7 µF 16V tantalum SMD	510-2625-479
C 280	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 281	4.7 µF 16V tantalum SMD	510-2625-479
C 282	27 pF ±5% NPO 1206 chip	510-3602-270
C 284	1 pF ±5% NPO 1206 chip	510-3602-109
C 285	.001 µF ±5% NPO 1206 chip	510-3602-102
C 286	.001 µF ±5% NPO 1206 chip	510-3602-102
C 287	1.5 µF 25V tantalum SMD	510-2627-159
C 288	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 289	4.7 µF 16V tantalum SMD	510-2625-479
C 290	.001 µF ±5% NPO 1206 chip	510-3602-102
C 291	.001 µF ±5% NPO 1206 chip	510-3602-102
C 292	1.5 µF 25V tantalum SMD	510-2627-159
C 293	.01 µF ±10% X7R 1206	510-3606-103
C 294	4.7 µF 16V tantalum SMD	510-2625-479
C 295	.001 µF ±5% NPO 1206 chip	510-3602-102
C 296	.001 µF ±5% NPO 1206 chip	510-3602-102
C 297	1.5 µF 25V tantalum SMD	510-2627-159
C 298	4.7 µF 16V tantalum SMD	510-2625-479
C 299	4.7 µF 16V tantalum SMD	510-2625-479
C 300	.001 µF ±5% NPO 1206 chip	510-3602-102
C 301	39 pF ±5% NPO 1206 chip	510-3602-390
C 303	.1 µF ±10% X7R 1206	510-3606-104
C 304	27 pF ±5% NPO 1206 chip	510-3602-270
C 305	.01 µF ±10% X7R 1206	510-3606-103
C 306	18 pF ±5% NPO 1206	510-3602-180
C 307	100 pF ±5% NPO 1206	510-3602-101
C 308	4.7 µF 16V tantalum SMD	510-2625-479
C 309	1 pF ±5% NPO 1206 chip	510-3602-109
C 310	27 pF ±5% NPO 1206 chip	510-3602-270
C 311	.001 µF ±5% NPO 1206 chip	510-3602-102
C 312	.001 µF ±5% NPO 1206 chip	510-3602-102
C 313	.01 µF ±10% X7R 1206	510-3606-103
C 314	.01 µF ±10% X7R 1206	510-3606-103
C 315	.001 µF ±5% NPO 1206 chip	510-3602-102
C 316	.01 µF ±10% X7R 1206	510-3606-103
C 317	.001 µF ±5% NPO 1206 chip	510-3602-102
C 318	.001 µF ±10% X7R 1206	510-3606-102
C 319	.001 µF ±5% NPO 1206 chip	510-3602-102
C 320	.001 µF ±5% NPO 1206 chip	510-3602-102
C 321	.001 µF ±5% NPO 1206 chip	510-3602-102
C 322	.001 µF ±5% NPO 1206 chip	510-3602-102
C 323	.001 µF ±5% NPO 1206 chip	510-3602-102
C 324	100 pF ±5% NPO 1206	510-3602-101
C 325	100 pF ±5% NPO 1206	510-3602-101
C 326	3 pF ±5% NPO 1206 chip	510-3602-309
C 328	820 pF ±5% NPO 1206 chip	510-3602-821
C 329	.1 µF ±10% X7R 1210	510-3607-104
C 330	27 pF ±5% NPO 1206 chip	510-3602-270
C 331	27 pF ±5% NPO 1206 chip	510-3602-270
C 332	27 pF ±5% NPO 1206 chip	510-3602-270
C 333	27 pF ±5% NPO 1206 chip	510-3602-270
C 334	27 pF ±5% NPO 1206 chip	510-3602-270
C 335	27 pF ±5% NPO 1206 chip	510-3602-270
C 336	4.7 µF 16V tantalum SMD	510-2625-479
C 337	33 pF ±5% NPO 1206 chip	510-3602-330
C 338	.01 µF ±10% X7R 1206	510-3606-103
C 356	2 pF ±5% NPO 1206 chip	510-3602-209
C 358	3.9 pF ±5% NPO 1206 chip	510-3602-399
C 360	120 pF ±5% NPO 1206 chip	510-3602-121
C 363	.001 µF ±10% X7R 1206	510-3606-102
C 364	1.5 pF ±5% NPO 1206 chip	510-3602-159
C 365	4.7 µF 16V tantalum SMD	510-2625-479
C 366	.001 µF ±10% X7R 1206	510-3606-102
C 367	27 pF ±5% NPO 1206 chip	510-3602-270
C 368	27 pF ±5% NPO 1206 chip	510-3602-270
C 369	27 pF ±5% NPO 1206 chip	510-3602-270
C 370	27 pF ±5% NPO 1206 chip	510-3602-270
C 371	1.3 pF ±5% NPO 1206 chip	510-3602-139
C 372	1.3 pF ±5% NPO 1206 chip	510-3602-139
C 373	3.9 pF ±5% NPO 1206 chip	510-3602-399
CH200	3-cavity helical front end	015-0901-038
CH201	3-cavity helical front end	015-0901-038

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CH202	2-cavity helical front end	015-0901-028
CH203	1-cavity helical front end	015-0901-010
CR201	Hot carrier diode SOT-23	523-1504-016
CR204	Si 9.1V zener SOT-23	523-2016-919
CR205	5.6V zener SOT-23	623-2016-569
CR206	5.6V zener SOT-23	623-2016-569
EP200	Mini ceramic crystal pin insul	010-0345-280
EP202	Ferrite bead SMD 1206	517-2503-010
EP204	Ferrite bead SMD 1206	517-2503-010
EP206	Ferrite bead SMD 1206	517-2503-002
HW200	10-32 hex set screw NPB	575-9059-032
HW201	10-32 hex set screw NPB	575-9059-024
HW202	Tension lock nut CPS	560-1810-022
HW203	6-32 panhead torx	575-0006-008
HW204	4-40 panhead slot nylon screw	575-4504-008
HW205	Polarizing key box cnt	515-7109-010
HW206	6-32 pan torx ZPS	575-0006-008
J 201	20-pin right angle header	515-9031-375
L 201	Helical coil 2 1/16 turns	016-2186-208
L 202	Helical coil 2 1/16 turns	016-2186-209
L 203	Helical coil 2 1/16 turns	016-2186-208
L 204	Helical coil 2 1/16 turns	016-2186-208
L 205	Helical coil 2 1/16 turns	016-2186-209
L 206	Helical coil 2 1/16 turns	016-2186-208
L 207	0.9 µH variable inductor 7mm	542-1012-008
L 209	0.9 µH variable inductor 7mm	542-1012-008
L 210	2.5T coil 22 AWG	542-0010-025
L 211	0.9 µH variable inductor 7mm	542-1012-008
L 212	1.5T coil 22 AWG	542-0010-015
L 213	0.82 µH inductor SMD	542-9001-828
L 214	.1 µH inductor SMD	542-9001-108
L 215	.1 µH inductor SMD	542-9001-108
L 216	.1 µH inductor SMD	542-9001-108
L 217	10 µH inductor SMD	542-9001-100
L 218	.1 µH inductor SMD	542-9001-108
L 219	.018 µH inductor SMD	542-9001-187
L 220	2 1/4 turn helical coil	016-2186-252
L 221	4T 22 AWG 0.05 ID SMD air	542-0015-004
L 222	2T 22 AWG 0.05 ID SMD air	542-0015-002
L 223	Helical coil	016-2186-204
L 224	Helical coil	016-2186-204
L 225	0.9 µH variable inductor 7mm	542-1012-008
L 226	3T 22 AWG 0.05 ID SMD air	542-0015-003
L 227	3T 22 AWG 0.05 ID SMD air	542-0015-003
L 228	4T 22 AWG 0.05 ID SMD air	542-0015-004
L 230	0.82 µH inductor SMD	542-9001-828
MP200	Helical coil form	013-1627-102
MP201	Helical core	013-1627-105
MP203	Damped washer 0.125	018-1132-152
MP204	Bottom shield	017-2210-101
MP206	Grounding clip	537-5001-002
MP210	Receive shield	017-2210-019
PC201	PC board	035-2009-200
Q 201	NPN RF amp low noise	576-0003-610
Q 202	Si NPN RF amp SOT-23	576-0003-602
Q 203	Si NPN amp SOT-23	576-0003-658
Q 204	Si NPN amp SOT-23	576-0003-658
Q 205	Si NPN amp	576-0003-658
Q 206	Si NPN amp SOT-23	576-0003-658
Q 207	Si NPN amp SOT-23	576-0003-658
Q 208	NPN UHF low noise SOT-23	576-0003-636
Q 209	NPN UHF low noise SOT-23	576-0003-636
Q 210	Si NPN amp SOT-23	576-0003-658
Q 211	Si NPN amp SOT-23	576-0003-658
Q 214	NPN UHF low noise SOT-23	576-0003-636
Q 215	NPN UHF low noise SOT-23	576-0003-636
Q 216	NPN .2-2 GHz SO-8 amp	576-0003-604
Q 217	NPN 750 mW UHF/800 MHz	576-0004-098
R 201	2.7k ohm ±5% 1206 SMD	569-0115-272
R 202	200 ohm ±5% 1206 SMD	569-0115-201
R 203	200 ohm ±5% 1206 SMD	569-0115-201
R 204	270 ohm ±5% 1206 SMD	569-0115-271
R 205	510 ohm ±5% 1206 SMD	569-0115-511
R 206	10 ohm ±5% 1206 SMD	569-0115-100
R 207	510 ohm ±5% 1206 SMD	569-0115-511
R 208	1.8k ohm ±5% 1206 SMD	569-0115-182
R 209	680 ohm ±5% 1206 SMD	569-0115-681
R 211	51 ohm ±5% 1206 SMD	569-0115-510
R 212	100k ohm ±5% 1206 SMD	569-0115-104
R 213	5.1k ohm ±5% 1206 SMD	569-0115-512
R 214	51k ohm ±5% 1206 SMD	569-0115-513
R 215	1.8k ohm ±5% 1206 SMD	569-0115-182
R 217	3.3k ohm ±5% 1206 SMD	569-0115-332
R 218	2.7k ohm ±5% 1206 SMD	569-0115-272
R 219	100 ohm ±5% 1206 SMD	569-0115-101

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 220	100 ohm ±5% 1206 SMD	569-0115-101
R 221	180 ohm ±5% 1206 SMD	569-0115-181
R 222	3.3k ohm ±5% 1206 SMD	569-0115-332
R 223	2.7k ohm ±5% 1206 SMD	569-0115-272
R 224	100 ohm ±5% 1206 SMD	569-0115-101
R 225	100 ohm ±5% 1206 SMD	569-0115-101
R 226	180 ohm ±5% 1206 SMD	569-0115-181
R 227	10k ohm ±5% 1206 SMD	569-0115-103
R 228	1k ohm ±5% 1206 SMD	569-0115-102
R 229	10 ohm ±5% 1206 SMD	569-0115-100
R 230	270 ohm ±5% 1206 SMD	569-0115-271
R 231	10k ohm ±5% 1206 SMD	569-0115-103
R 232	10k ohm ±5% 1206 SMD	569-0115-103
R 233	1k ohm ±5% 1206 SMD	569-0115-102
R 234	1k ohm ±5% 1206 SMD	569-0115-102
R 235	20k ohm ±5% 1206 SMD	569-0115-203
R 236	100 ohm ±5% 1206 SMD	569-0115-101
R 237	3.9k ohm ±5% 1206 SMD	569-0115-392
R 238	240 ohm ±5% 1206 SMD	569-0115-241
R 239	51 ohm ±5% 1206 SMD	569-0115-510
R 240	270 ohm ±5% 1206 SMD	569-0115-271
R 241	10 ohm ±5% 1206 SMD	569-0115-100
R 242	2.7k ohm ±5% 1206 SMD	569-0115-272
R 243	3.3k ohm ±5% 1206 SMD	569-0115-332
R 244	3.3k ohm ±5% 1206 SMD	569-0115-332
R 245	16k ohm ±5% 1206 SMD	569-0115-163
R 246	1k ohm ±5% 1206 SMD	569-0115-102
R 248	2.7k ohm ±5% 1206 SMD	569-0115-272
R 249	3.3k ohm ±5% 1206 SMD	569-0115-332
R 250	270 ohm ±5% 1206 SMD	569-0115-271
R 251	3.3k ohm ±5% 1206 SMD	569-0115-332
R 252	36k ohm ±5% 1206 SMD	569-0115-363
R 253	10k ohm ±5% 1206 SMD	569-0115-103
R 254	240k ohm ±5% 1206 SMD	569-0115-244
R 255	27k ohm ±5% 1206 SMD	569-0115-273
R 256	20k ohm ±5% 1206 SMD	569-0115-203
R 257	100 ohm ±5% 1206 SMD	569-0115-101
R 258	100 ohm ±5% 1206 SMD	569-0115-101
R 260	Zero ohm ±10% 1206 SMD	569-0115-001
R 261	5k ohm single turn trimmer	562-0112-502
R 262	10k ohm ±5% 1206 SMD	569-0115-103
R 263	240k ohm ±5% 1206 SMD	569-0115-244
R 264	5k ohm single turn trimmer	562-0112-502
R 265	1k ohm ±5% 1206 SMD	569-0115-102
R 266	220 ohm ±5% 1206 SMD	569-0115-221
R 267	294 ohm ±1% 1206 SMD	569-0111-246
R 268	1k ohm ±1% 1206 SMD	569-0111-301
R 269	1k ohm ±5% 1206 SMD	569-0115-102
R 270	1k ohm ±5% 1206 SMD	569-0115-102
R 271	910 ohm ±5% 1206 SMD	569-0115-911
R 272	240 ohm ±5% 1206 SMD	569-0115-241
R 273	100 ohm ±5% 1206 SMD	569-0115-101
R 274	10 ohm ±5% 1206 SMD	569-0115-100
R 275	6.8k ohm ±5% 1206 SMD	569-0115-682
R 276	47k ohm ±5% 1206 SMD	569-0115-473
R 277	150 ohm ±5% 1206 SMD	569-0115-151
R 278	1.6k ohm ±5% 1206 SMD	569-0115-162
R 279	1.6k ohm ±5% 1206 SMD	569-0115-162
R 280	100k ohm ±5% 1206 SMD	569-0115-104
R 281	1k ohm ±5% 1206 SMD	569-0115-102
R 283	100 ohm ±5% 1206 SMD	569-0115-101
R 284	5k ohm single turn trimmer	562-0112-502
R 285	300 ohm ±5% 1206 SMD	569-0115-301
R 286	18 ohm ±5% 1206 SMD	569-0115-180
R 287	300 ohm ±5% 1206 SMD	569-0115-301
R 290	1.5k ohm ±5% 1206 SMD	569-0115-152
R 291	1.3k ohm ±5% 1206 SMD	569-0115-132
R 292	75 ohm ±5% 1206 SMD	569-0115-750
R 293	51 ohm ±5% 1206 SMD	569-0115-510
R 294	10 ohm ±5% 1206 SMD	569-0115-100
R 295	390 ohm ±5% 1206 SMD	569-0115-391
R 296	1k ohm ±5% 1206 SMD	569-0115-102
R 297	220 ohm ±5% 1206 SMD	569-0115-221
R 298	100 ohm ±5% 1206 SMD	569-0115-101
R 299	36 ohm ±5% 1206 SMD	569-0115-360
R 300	36 ohm ±5% 1206 SMD	569-0115-360
R 301	220 ohm ±5% 1206 SMD	569-0115-221
R 302	220 ohm ±5% 1206 SMD	569-0115-221
R 303	43 ohm ±5% 1206 SMD	569-0115-430
R 304	240 ohm ±5% 1206 SMD	569-0115-241
R 311	4.3k ohm ±5% 1206 SMD	569-0115-432
R 312	10 ohm ±5% 1206 SMD	569-0115-100
R 313	220 ohm ±5% 1206 SMD	569-0115-221
R 314	220 ohm ±5% 1206 SMD	569-0115-221
R 315	270 ohm ±5% 1206 SMD	569-0115-271
R 316	10k ohm ±5% 1206 SMD	569-0115-103
R 319	10k ohm ±5% 1206 SMD	569-0115-103
R 321	510 ohm ±5% 1206 SMD	569-0115-511
R 322	560 ohm ±5% 1206 SMD	569-0115-561
R 323	Zero ohm ±10% 1206 SMD	569-0115-001
R 324	10k ohm ±5% 1206 SMD	569-0115-103
RT101	1k ohm ±5% thermistor chip	569-3013-002

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
TP001	Red tip jack, vert. 0.08	105-2002-211
TP003	Red tip jack, vert. 0.08	105-2002-211
TP004	Red tip jack, vert. 0.08	105-2002-211
TP005	Red tip jack, vert. 0.08	105-2002-211
TP006	Red tip jack, vert. 0.08	105-2002-211
U 201	Mixer LRMS-2H	544-0007-013
U 202	FM IF MC3371D SO-16	544-2002-031
U 203	Dual op amp SO-8	544-2019-004
U 204	Op amp SO-8 MC33172D	544-2019-017
U 206	+12V regulator 78L12 SO-8	544-2603-032
U 207	+12V regulator 78L12 SO-8	544-2603-032
U 208	+5V regulator 78L05 SO-8	544-2603-039
U 209	Synthesizer MC145190F SOIC	544-3954-026
U 210	+12V regulator SOIC 78L12	544-2603-032
U 211	Single op amp LMC7101	544-2016-001
W 201	Cable assembly	597-3003-290
Y 201	17.5 MHz crystal 1 PPM	518-7117-500
Z 201	52.95 MHz 4-pole 8 kHz BW	532-0009-011
Z 203	52.95 MHz 4-pole 8 kHz BW	532-0009-011
Z 205	450 kHz cer filter 9 kHz BW	532-2006-034
Z 213	455 kHz var inductor w/cap	542-1012-010
	TRANSMIT VCO PART NO. 023-2009-850	
C 802	.3 pF ±0.1 pF 150V chip	510-3356-039
C 803	1.1 pF ±0.1 pF 150V chip	510-3356-119
C 804	1.8 pF ±0.1 pF 150V chip	510-3356-189
C 805	.1 µF ±10% X7R chip	510-3606-104
C 806	1 µF 16V tantalum SMD	510-2625-109
C 807	27 pF ±5% NPO 0805 chip	510-3601-270
C 808	27 pF ±5% NPO 0805 chip	510-3601-270
C 809	15 µF 20V tantalum SMD	510-2626-150
C 810	27 pF ±5% NPO 0805 chip	510-3601-270
C 811	27 pF ±5% NPO 0805 chip	510-3601-270
C 812	3.3 pF ±10% 50V chip	510-3352-339
C 813	4.7 pF ±10% 50V chip	510-3352-479
CR801	Varacap 26-32 pF 30V SOT	523-1504-014
CR802	Varactor SOT-23 hyper	523-5004-002
L 803	.039 µH inductor SMD	542-9001-397
L 804	.039 µH inductor SMD	542-9001-397
L 805	.022 µH inductor SMD	542-9001-227
PC801	PC board	035-2009-800
Q 801	Si NPN gen purp switch/amp	576-0001-300
Q 802	NPN low noise SOT-23	576-0003-636
R 801	10 ohm ±5% 0805 chip	569-0105-100
R 802	3.6k ohm ±5% 0805 chip	569-0105-362
R 803	100 ohm ±5% 0805 chip	569-0105-101
R 804	12k ohm ±5% 0805 chip	569-0105-123
R 805	5.1k ohm ±5% 0805 chip	569-0105-512
R 806	6.2k ohm ±5% 0805 chip	569-0105-622
R 807	180 ohm ±5% 0805 chip	569-0105-181
R 814	10k ohm ±5% 1206 SMD	569-0115-103
	900 MHz EXCITER PART NO. 023-2009-400	
A 007	900 MHz VCO	023-2009-850
C 400	27 pF ±5% NPO 1206 chip	510-3602-270
C 401	.01 µF ±10% X7R	510-3606-103
C 402	.1 µF ±10% X7R	510-3606-104
C 405	.001 µF ±5% NPO 1206 chip	510-3602-102
C 406	1 µF 16V tantalum SMD	510-2625-109
C 407	33 µF 10V tantalum SMD	510-2624-330
C 408	56 pF ±5% NPO 1206 chip	510-3602-560
C 409	.01 µF ±10% X7R chip	510-3606-103
C 410	.01 µF ±10% X7R chip	510-3606-103
C 411	.1 µF ±10% X7R	510-3606-104
C 412	27 pF ±5% NPO 1206 chip	510-3602-270
C 413	.001 µF ±5% NPO 1206 chip	510-3602-102
C 414	.01 µF ±10% X7R chip	510-3606-103
C 415	100 pF ±5% NPO 1206 chip	510-3602-101
C 416	.1 µF ±10% X7R 1210	510-3607-104
C 417	.01 µF ±10% X7R 1206 chip	510-3606-103
C 418	.001 µF ±5% NPO 1206 chip	510-3602-102
C 419	.01 µF ±10% X7R chip	510-3606-103
C 420	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 421	4.7 µF 16V tantalum SMD	510-2625-479
C 422	.1 µF ±10% X7R 1210	510-3607-104
C 423	100 pF ±5% NPO 1206 chip	510-3602-101
C 424	.1 µF ±10% X7R 1210	510-3607-104
C 425	.1 µF ±10% X7R 1210	510-3607-104
C 426	4.7 µF 16V tantalum SMD	510-2625-479
C 428	4.7 µF 16V tantalum SMD	510-2625-479

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 429	27 pF ±5% NPO 1206 chip	510-3602-270
C 430	27 pF ±5% NPO 1206 chip	510-3602-270
C 431	27 pF ±5% NPO 1206 chip	510-3602-270
C 432	27 pF ±5% NPO 1206 chip	510-3602-270
C 433	2 pF ±5% NPO 1206 chip	510-3602-209
C 434	27 pF ±5% NPO 1206 chip	510-3602-270
C 441	1 pF ±5% NPO 1206 chip	510-3602-109
C 442	27 pF ±5% NPO 1206 chip	510-3602-270
C 443	27 pF ±5% NPO 1206 chip	510-3602-270
C 444	10 pF ±5% NPO 1206 chip	510-3602-100
C 445	27 pF ±5% NPO 1206 chip	510-3602-270
C 446	27 pF ±5% NPO 1206 chip	510-3602-270
C 447	4.7 µF 16V tantalum SMD	510-2625-479
C 448	27 pF ±5% NPO 1206 chip	510-3602-270
C 449	2.7 pF ±5% NPO 1206 chip	510-3602-279
C 450	4.3 pF ±5% NPO 1206 chip	510-3602-439
C 451	5.1 pF ±5% NPO 1206 chip	510-3602-519
C 453	820 pF ±5% NPO 1206 chip	510-3602-821
C 460	4.7 µF 16V tantalum SMD	510-2625-479
C 461	27 pF ±5% NPO 1206 chip	510-3602-270
C 462	.001 µF ±5% NPO 1206 chip	510-3602-102
C 463	15 µF 20V tantalum SMD	510-2626-150
C 464	.01 µF ±10% X7R chip	510-3606-103
C 465	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 466	.001 µF ±5% NPO 1206 chip	510-3602-102
C 467	1.5 µF 25V tantalum SMD	510-2627-159
C 469	4.7 µF 16V tantalum SMD	510-2625-479
C 470	.001 µF ±5% NPO 1206 chip	510-3602-102
C 471	.001 µF ±5% NPO 1206 chip	510-3602-102
C 472	1.5 µF 25V tantalum SMD	510-2627-159
C 474	4.7 µF 16V tantalum SMD	510-2625-479
C 475	.001 µF ±5% NPO 1206 chip	510-3602-102
C 476	4.7 µF 16V tantalum SMD	510-2625-479
C 477	27 pF ±5% NPO 1206 chip	510-3602-270
C 479	27 pF ±5% NPO 1206 chip	510-3602-270
C 480	39 pF ±5% NPO 1206 chip	510-3602-390
C 481	1 µF 16V tantalum SMD	510-2625-109
C 482	27 pF ±5% NPO 1206 chip	510-3602-270
C 483	27 pF ±5% NPO 1206 chip	510-3602-270
C 484	27 pF ±5% NPO 1206 chip	510-3602-270
C 485	27 pF ±5% NPO 1206 chip	510-3602-270
C 488	.1 µF ±10% X7R 1210	510-3607-104
C 496	15 µF 20V tantalum SMD	510-2626-150
C 497	100 pF ±5% NPO 1206 chip	510-3602-101
C 498	2.7 pF ±5% NPO 1206 chip	510-3602-279
C 499	27 pF ±5% NPO 1206 chip	510-3602-270
C 814	27pF ±5% NPO 1206 chip	510-3602-270

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CH400	Single helical cavity front end	015-0901-010
CR401	Si 9.1V zener SOT-23	523-2016-919
CR402	5.6V zener SOT-23	523-2016-569
CR403	5.6V zener SOT-23	523-2016-569
EP400	Helical core form	013-1627-103
HW400	10-32 hex set screw NPB	575-9059-032
HW401	Tension lock nut CPS	560-1810-022
HW402	6-32 pan torx ZPS	575-0006-008
HW403	4-40 panhead slot nylon screw	575-4504-008
HW404	Polarized key box connector	515-7109-010
J 401	20-pin right angle header	515-9031-375
J 402	Right angle PC JCM-B	131-3701-301
J 403	Jack assembly	131-1701-206
L 401	10 µH inductor SMD	542-9001-100
L 402	.1 µH inductor SMD	542-9001-108
L 403	.018 ceramic inductor SMD	542-9001-187
L 404	2T 45° helical coil	016-2186-251
L 406	.039 µH inductor SMD	542-9001-397
MP402	Damped washer 0.125	018-1132-152
PC400	PC board	035-2009-400
Q 401	Si NPN amp	576-0003-658
Q 402	Si NPN amp	576-0003-658
Q 403	Si NPN amp	576-0003-658
Q 404	Si NPN amp	576-0003-658
Q 405	Si PNP switching	576-0003-612
Q 406	Si NPN low noise SOT-23	576-0003-636
Q 407	Si NPN low noise SOT-23	576-0003-636
Q 410	Si NPN low noise SOT-23	576-0003-636
Q 411	Si NPN low noise SOT-23	576-0003-636
Q 412	NPN .2-2 GHz SO-8	576-0003-604
Q 413	NPN 750 mW UHF/800 MHz	576-0004-098
R 401	10k ohm ±5% SMD 1206	569-0115-103
R 404	100 ohm ±5% SMD 1206	569-0115-101
R 405	1k ohm ±5% SMD 1206	569-0115-102
R 406	1k ohm ±5% SMD 1206	569-0115-102
R 407	1k ohm ±5% SMD 1206	569-0115-102
R 408	100 ohm ±5% SMD 1206	569-0115-101
R 409	910 ohm ±5% SMD 1206	569-0115-911

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 410	100 ohm ±5% SMD 1206	569-0115-101
R 411	1k ohm ±5% SMD 1206	569-0115-102
R 412	8.2k ohm ±5% SMD 1206	569-0115-822
R 416	270 ohm ±5% SMD 1206	569-0115-271
R 417	10k ohm ±5% SMD 1206	569-0115-103
R 418	10 ohm ±5% SMD 1206	569-0115-100
R 419	12.1k ohm ±1% SMD 1206	569-0111-409
R 420	2.7k ohm ±5% SMD 1206	569-0115-272
R 421	3.3k ohm ±5% SMD 1206	569-0115-332
R 422	3.3k ohm ±5% SMD 1206	569-0115-332
R 423	270 ohm ±5% SMD 1206	569-0115-271
R 424	10k ohm ±5% SMD 1206	569-0115-103
R 425	50k ohm single turn trimmer	562-0112-503
R 426	Zero ohm ±5% SMD 1206	569-0115-001
R 427	62k ohm ±5% SMD 1206	569-0115-623
R 428	10 ohm ±5% SMD 1206	569-0115-100
R 429	4.99k ohm ±1% SMD 1206	569-0111-368
R 430	2.7k ohm ±5% SMD 1206	569-0115-272
R 431	3.3k ohm ±5% SMD 1206	569-0115-332
R 432	3.3k ohm ±5% SMD 1206	569-0115-332
R 433	270 ohm ±5% SMD 1206	569-0115-271
R 434	294 ohm ±1% SMD 1206	569-0111-246
R 435	1k ohm ±1% SMD 1206	569-0111-301
R 436	100 ohm ±5% SMD 1206	569-0115-101
R 437	100 ohm ±5% SMD 1206	569-0115-101
R 438	10k ohm ±5% SMD 1206	569-0115-103
R 439	1k ohm ±5% SMD 1206	569-0115-102
R 440	1k ohm ±5% SMD 1206	569-0115-102
R 441	47k ohm ±5% SMD 1206	569-0115-473
R 443	36 ohm ±5% SMD 1206	569-0115-360
R 444	10k ohm ±5% SMD 1206	569-0115-103
R 445	120k ohm ±5% SMD 1206	569-0115-124
R 446	50k ohm single turn trimmer	562-0112-503
R 447	1k ohm ±5% SMD 1206	569-0115-102
R 448	10k ohm ±5% SMD 1206	569-0115-103
R 449	10k ohm ±5% SMD 1206	569-0115-103
R 450	10 ohm ±5% SMD 1206	569-0115-100
R 451	6.8k ohm ±5% SMD 1206	569-0115-682
R 452	100 ohm ±5% SMD 1206	569-0115-101
R 453	1.6k ohm ±5% SMD 1206	569-0115-162
R 454	1.6k ohm ±5% SMD 1206	569-0115-162
R 455	150 ohm ±5% SMD 1206	569-0115-151
R 456	680 ohm ±5% SMD 1206	569-0115-681
R 457	36 ohm ±5% SMD 1206	569-0115-360
R 458	130 ohm ±5% SMD 1206	569-0115-131
R 459	130 ohm ±5% SMD 1206	569-0115-131
R 461	8.2k ohm ±5% SMD 1206	569-0115-822
R 462	10 ohm ±5% SMD 1206	569-0115-100
R 463	100 ohm ±5% SMD 1206	569-0115-101
R 464	5.6k ohm ±5% SMD 1206	569-0115-562
R 465	1.2k ohm ±5% SMD 1206	569-0115-122
R 466	1.6k ohm ±5% SMD 1206	569-0115-162
R 467	1.6k ohm ±5% SMD 1206	569-0115-162
R 468	150 ohm ±5% SMD 1206	569-0115-151
R 469	2.4k ohm ±5% SMD 1206	569-0115-242
R 470	330 ohm ±5% SMD 1206	569-0115-331
R 471	180 ohm ±5% SMD 1206	569-0115-181
R 472	180 ohm ±5% SMD 1206	569-0115-181
R 473	100 ohm ±5% SMD 1206	569-0115-101
R 474	2k ohm ±5% SMD 1206	569-0115-202
R 476	270 ohm ±5% SMD 1206	569-0115-271
R 480	7.5k ohm ±5% SMD 1206	569-0115-752
R 481	1.3k ohm ±5% SMD 1206	569-0115-132
R 482	Zero ohm ±5% SMD 1206	569-0115-001
R 485	1k ohm ±5% SMD 1206	569-0115-102
R 486	12.1k ohm ±1% SMD 1206	569-0111-409
R 487	4.99k ohm ±1% SMD 1206	569-0111-368
R 488	10k ohm ±5% SMD 1206	569-0115-103
R 489	300 ohm ±5% SMD 1206	569-0115-301
R 490	18 ohm ±5% SMD 1206	569-0115-180
R 491	300 ohm ±5% SMD 1206	569-0115-301
U 401	Parallel load phase lock loop	544-2024-005
U 402	Dual op amp SO-8 2904	544-2019-004
U 403	Synthesizer SOIC MC145190	544-3954-026
U 404	Dual op amp SO-8	544-2019-004
U 405	+5V regulator 78L05 SO-8	544-2603-039
U 406	+12V regulator 78L12 SO-8	544-2603-032
U 407	Dual op amp SO-8	544-2019-004
Y 401	17.5 MHz 1 PPM	518-7117-500

75 WATT POWER AMPLIFIER
PART NO. 023-2009-500

C 501	27 pF ±5% NPO 1206 chip	510-3602-270
C 502	1 µF 35V tantalum SMD	510-2628-109
C 503	.1 µF 35V tantalum SMD	510-2628-108
C 504	.018 µF ±10% X7R 0805 chip	510-3605-183
C 505	1 µF 35V tantalum SMD	510-2628-109
C 506	.018 µF ±10% X7R 0805 chip	510-3605-183
C 507	56 pF high Q .110 cube	510-3663-560
C 508	56 pF high Q .110 cube	510-3663-560
C 509	27 pF ±5% NPO 1206 chip	510-3602-270

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 510	1 µF 35V tantalum SMD	510-2628-109
C 511	56 pF high Q .110 cube	510-3663-560
C 512	.1 µF 35V tantalum SMD	510-2628-108
C 513	1 µF 35V tantalum SMD	510-2628-109
C 514	.018 µF ±10% X7R 0805 chip	510-3605-183
C 515	56 pF high Q .110 cube	510-3663-560
C 516	1 µF 35V tantalum SMD	510-2628-109
C 517	.018 µF ±10% X7R 0805 chip	510-3605-183
C 518	56 pF high Q .110 cube	510-3663-560
C 519	10 pF ±5% NPO 1206 chip	510-3602-100
C 520	.001 µF ±5% NPO 1206 chip	510-3602-102
C 521	.001 µF ±5% NPO 1206 chip	510-3602-102
C 527	56 pF high Q .110 cube	510-3663-560
C 528	.018 µF ±10% X7R 0805 chip	510-3605-183
C 529	.01 µF ±10% X7R chip	510-3606-103
C 530	.001 µF ±5% NPO 1206 chip	510-3602-102
C 531	6.8 µF 35V tantalum SMD	510-2628-689
C 532	27 pF high Q .110 cube	510-3663-270
C 533	56 pF high Q .110 cube	510-3663-560
C 534	6.8 µF 35V tantalum SMD	510-2628-689
C 535	.018 µF ±10% X7R 0805 chip	510-3605-183
C 536	3.9 pF high Q .110 cube	510-3663-399
C 537	1.56 - 4.86 pF T-cap vert mt	187-0103-175
C 538	15 pF high Q .110 cube	510-3663-150
C 541	6.2 pF ±10% high Q SMD	510-3653-629
C 542	56 pF high Q .110 cube	510-3663-560
C 543	27 pF high Q .110 cube	510-3663-270
C 544	.018 µF ±10% X7R chip	510-3605-183
C 545	6.8 µF 35V tantalum SMD	510-2635-689
C 546	.001 µF ±5% NPO 1206 chip	510-3602-102
C 547	56 pF high Q .110 cube	510-3663-560
C 548	.018 µF ±10% X7R chip	510-3605-183
C 549	6.8 µF 35V tantalum SMD	510-2635-689
C 550	56 pF high Q .110 cube	510-3663-560
C 553	56 pF high Q .110 cube	510-3663-560
C 555	6.2 pF ±10% high Q SMD	510-3653-629
C 556	56 pF high Q .110 cube	510-3663-560
C 557	27 pF high Q .110 cube	510-3663-270
C 558	.018 µF ±10% X7R chip	510-3605-183
C 559	6.8 µF 35V tantalum SMD	510-2635-689
C 560	.001 µF ±5% NPO 1206 chip	510-3602-102
C 561	56 pF high Q .110 cube	510-3663-560
C 562	.018 µF ±10% X7R 0805 chip	510-3605-183
C 563	6.8 µF 35V tantalum SMD	510-2635-689
C 564	56 pF high Q .110 cube	510-3663-560
C 567	56 pF high Q .110 cube	510-3663-560
C 569	39 pF ±5% NPO 1206 chip	510-3602-390
C 570	.018 µF ±10% X7R 0805 chip	510-3605-183
C 571	.018 µF ±10% X7R 0805 chip	510-3605-183
C 572	39 pF ±5% NPO 1206 chip	510-3602-390
C 573	.018 µF ±10% X7R 0805 chip	510-3605-183
C 574	.018 µF ±10% X7R 0805 chip	510-3605-183
C 575	56 pF high Q .110 cube	510-3663-560
C 576	1 µF 35V tantalum SMD	510-2628-109
C 577	4.7 µF 16V tantalum SMD	510-2625-479
C 578	.018 µF ±10% X7R 0805 chip	510-3605-183
C 579	.001 µF ±5% NPO 1206 chip	510-3602-102
C 580	4.7 µF 16V tantalum SMD	510-2625-479
C 581	.018 µF ±10% X7R 0805 chip	510-3605-183
C 582	1 µF 16V tantalum SMD	510-2625-109
C 583	39 pF ±5% NPO 1206 chip	510-3602-390
C 584	.001 µF ±5% NPO 1206 chip	510-3602-102
C 585	.018 µF ±10% X7R 0805 chip	510-3605-183
C 588	1.5 pF high Q .110 cube	510-3663-159
C 589	1.5 pF high Q .110 cube	510-3663-159
CR501	Dual Schottky SOT-14	523-1504-033
CR502	Dual Schottky SOT-14	523-1504-033
CR503	Dual Schottky SOT-14	523-1504-033
EP501	Ferrite bead SMD 1233	517-2503-010
EP502	Ferrite bead SMD 1233	517-2503-010
EP503	Ferrite bead SMD 1233	517-2503-010
EP504	Ferrite bead SMD 1233	517-2503-010
EP505	Ferrite bead SMD 1233	517-2503-010
EP506	Ferrite bead SMD 1233	517-2503-010
EP507	Ferrite bead SMD 1233	517-2503-010
EP508	Ferrite bead SMD 1233	517-2503-010
EP510	Ferrite bead SMD 1233	517-2503-010
EP511	Ferrite bead SMD 1233	517-2503-010
EP512	Ferrite bead SMD 1233	517-2503-010
EP513	Ferrite bead SMD 1233	517-2503-010
EP514	Ferrite bead SMD 1233	517-2503-010
EP515	Ferrite bead SMD 1233	517-2503-010
EP516	Ferrite bead SMD 1233	517-2503-010
EP517	Ferrite bead SMD 1233	517-2503-010
EP518	Ferrite bead SMD 1233	517-2503-010
EP520	Ferrite bead SMD 1233	517-2503-010
L 501	5T 22 AWG 0.05 ID SMD air	542-0015-005
L 502	.01 µH inductor SMD	542-9001-107
L 503	.01 µH inductor SMD	542-9001-107
PC500	PC board	035-2009-500

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 501*	30W 24V 900 MHz MRF-894	576-0004-821
Q 502*	60W 24V 800 MHz MRF-898	576-0004-820
Q 503*	60W 24V 800 MHz MRF-898	576-0004-820
R 501	820 ohm ±5% 1206 SMD	569-0115-821
R 502	12 ohm ±5% 1206 SMD	569-0115-120
R 503	820 ohm ±5% 1206 SMD	569-0115-821
R 504	110 ohm ±5% 1206 SMD	569-0115-111
R 505	1k ohm ±5% 1206 SMD	569-0115-102
R 506	200 ohm ±5% 1206 SMD	569-0115-201
R 507	2k ohm ±5% 1206 SMD	569-0115-202
R 508*	100 ohm 100W flange mount	569-5001-002
R 509*	100 ohm 20W flange mount	569-5001-001
R 510	100 ohm ±5% 1206 SMD	569-0115-101
R 511	200 ohm ±5% 1206 SMD	569-0115-201
R 512	100 ohm ±5% 1206 SMD	569-0115-101
R 513	1k ohm ±1% 1206 SMD	569-0111-301
R 514	1k ohm ±1% 1206 SMD	569-0111-301
R 515	3.4k ohm ±1% 1206 SMD	569-0111-352
R 516	200 ohm ±5% 1206 SMD	569-0115-201
R 517	100 ohm ±5% 1206 SMD	569-0115-101
R 518	100 ohm ±5% 1206 SMD	569-0115-101
R 519	1k ohm ±1% 1206 SMD	569-0111-301
R 520	1k ohm ±1% 1206 SMD	569-0111-301
R 521	3.4k ohm ±1% 1206 SMD	569-0111-352
R 522	240 ohm ±5% 1206 SMD	569-0115-241
R 523	56 ohm ±5% 1206 SMD	569-0115-560
R 524	75 ohm ±5% 1206 SMD	569-0115-750
R 525	100k ohm ±1% 1206 SMD	569-0111-501
R 526	301k ohm ±1% 1206 SMD	569-0111-547
R 527	470 ohm ±5% 1206 SMD	569-0115-471
R 528	12 ohm ±5% 1206 SMD	569-0115-120
R 685*	50 ohm 250W flange mount	569-5001-003
U 501	6W pwr module 870-950 MHz	544-4001-051
U 502	Dual op amp 532 SO-8	544-2019-004
U 503	Temp sensor LM35 SO-8	544-2032-003
U 504	+5V regulator SO-8 78L05	544-2603-039

160 WATT POWER AMPLIFIER
PART NO. 023-2009-520

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 501	.018 µF ±10% X7R chip	510-3605-183
C 502	43 pF ±5% NPO 1206 chip	510-3602-430
C 503	4.7 pF ±5% NPO 1206 chip	510-3602-479
C 504	39 pF ±5% NPO 1206 chip	510-3602-390
C 505	270 pF ±5% NPO 1206 chip	510-3602-271
C 506	390 pF ±5% NPO 1206 chip	510-3602-391
C 507	.018 µF ±10% X7R chip	510-3605-183
C 508	39 pF ±5% NPO 1206 chip	510-3602-390
C 509	270 pF ±5% NPO 1206 chip	510-3602-271
C 510	390 pF ±5% NPO 1206 chip	510-3602-391
C 511	.018 µF ±10% X7R chip	510-3605-183
C 512	2.2 µF 20V tantalum SMD	510-2626-229
C 513	.018 µF ±10% X7R chip	510-3605-183
C 514	.1 µF 35V tantalum SMD	510-2628-108
C 515	56 pF ±10% high Q cube	510-3663-560
C 516	.018 µF ±10% X7R chip	510-3605-183
C 517	56 pF ±10% high Q cube	510-3663-560
C 518	.018 µF ±10% X7R chip	510-3605-183
C 519	1 µF 35V tantalum SMD	510-2628-109
C 520	.1 µF 35V tantalum SMD	510-2628-108
C 521	2.7 pF ±5% NPO 1206 chip	510-3602-279
C 523	.018 µF ±10% X7R chip	510-3605-183
C 524	.1 µF 35V tantalum SMD	510-2628-108
C 525	56 pF ±10% high Q cube	510-3663-560
C 526	.018 µF ±10% X7R chip	510-3605-183
C 527	1 µF 35V tantalum SMD	510-2628-109
C 528	56 pF ±10% high Q cube	510-3663-560
C 529	56 pF ±10% high Q cube	510-3663-560
C 530	56 pF ±10% high Q cube	510-3663-560
C 531	.1 µF 35V tantalum SMD	510-2628-108
C 532	1 µF 35V tantalum SMD	510-2628-109
C 533	.018 µF ±10% X7R chip	510-3605-183
C 534	56 pF ±10% high Q cube	510-3663-560
C 535	1 µF 35V tantalum SMD	510-2628-109
C 536	.018 µF ±10% X7R chip	510-3605-183
C 537	56 pF ±10% high Q cube	510-3663-560
C 538	.1 µF 35V tantalum SMD	510-2628-108
C 539	1 µF 35V tantalum SMD	510-2628-109
C 540	.018 µF ±10% X7R chip	510-3605-183
C 542	6.2 pF high Q SMD	510-3653-629
C 543	56 pF ±10% high Q cube	510-3663-560
C 544	56 pF ±10% high Q cube	510-3663-560
C 545	.018 µF ±10% X7R chip	510-3605-183
C 546	.001 µF ±5% NPO 1206 chip	510-3602-102
C 547	6.8 µF 35V tantalum SMD	510-2635-689
C 548	27 pF ±10% high Q cube	510-3663-270
C 549	6.8 µF 35V tantalum SMD	510-2635-689
C 550	.018 µF ±10% X7R chip	510-3605-183
C 551	56 pF ±10% high Q cube	510-3663-560
C 552	56 pF ±10% high Q cube	510-3663-560
C 553	56 pF ±10% high Q cube	510-3663-560
C 554	1 µF 35V tantalum SMD	510-2628-109

***DANGER** Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for further details. (Parts are from 023-2009-932.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 555	4.7 µF 16V tantalum SMD	510-2625-479
C 556	4.7 µF 16V tantalum SMD	510-2625-479
C 557	.018 µF ±10% X7R chip	510-3605-183
C 558	.001 µF ±5% NPO 1206 chip	510-3602-102
C 559	.018 µF ±10% X7R chip	510-3605-183
C 560	1 µF 16V tantalum SMD	510-2625-109
C 561	39 pF ±5% NPO 1206 chip	510-3602-390
C 562	.001 µF ±5% NPO 1206 chip	510-3602-102
C 563	.018 µF ±10% X7R chip	510-3605-183
C 565	10 pF ±5% NPO 1206 chip	510-3602-100
C 566	.001 µF ±5% NPO 1206 chip	510-3602-102
C 567	.001 µF ±5% NPO 1206 chip	510-3602-102
C 568	6.2 pF 250V mini-mica SMD	510-0019-629
C 702	6.2 pF high Q SMD	510-3653-629
C 703	6.2 pF 250V mini-mica SMD	510-0019-629
C 704	56 pF ±10% high Q cube	510-3663-560
C 705	56 pF ±10% high Q cube	510-3663-560
C 706	6.8 µF 35V tantalum SMD	510-2635-689
C 707	.018 µF ±10% X7R chip	510-3605-183
C 708	56 pF ±10% high Q cube	510-3663-560
C 709	27 pF ±10% high Q cube	510-3663-270
C 710	.001 µF ±5% NPO 1206 chip	510-3602-102
C 711	6.8 µF 35V tantalum SMD	510-2635-689
C 712	.018 µF ±10% X7R chip	510-3605-183
C 714	6.2 pF high Q SMD	510-3653-629
C 715	6.2 pF 250V mini-mica SMD	510-0019-629
C 716	56 pF ±10% high Q cube	510-3663-560
C 717	56 pF ±10% high Q cube	510-3663-560
C 718	6.8 µF 35V tantalum SMD	510-2635-689
C 719	.018 µF ±10% X7R chip	510-3605-183
C 720	56 pF ±10% high Q cube	510-3663-560
C 721	27 pF ±10% high Q cube	510-3663-270
C 722	.001 µF ±5% NPO 1206 chip	510-3602-102
C 723	6.8 µF 35V tantalum SMD	510-2635-689
C 724	.018 µF ±10% X7R chip	510-3605-183
C 725	39 pF ±5% NPO 1206 chip	510-3602-390
C 726	.018 µF ±10% X7R chip	510-3605-183
C 727	.018 µF ±10% X7R chip	510-3605-183
C 728	39 pF ±5% NPO 1206 chip	510-3602-390
C 729	.018 µF ±10% X7R chip	510-3605-183
C 730	.018 µF ±10% X7R chip	510-3605-183
C 732	6.2 pF high Q SMD	510-3653-629
C 733	6.2 pF 250V mini-mica SMD	510-0019-629
C 734	56 pF ±10% high Q cube	510-3663-560
C 735	56 pF ±10% high Q cube	510-3663-560
C 736	6.8 µF 35V tantalum SMD	510-2635-689
C 737	.018 µF ±10% X7R chip	510-3605-183
C 738	56 pF ±10% high Q cube	510-3663-560
C 739	27 pF ±10% high Q cube	510-3663-270
C 740	.001 µF ±5% NPO 1206 chip	510-3602-102
C 741	6.8 µF 35V tantalum SMD	510-2635-689
C 742	.018 µF ±10% X7R chip	510-3605-183
C 744	6.2 pF high Q SMD	510-3653-629
C 745	6.2 pF 250V mini-mica SMD	510-0190-629
C 746	56 pF ±10% high Q cube	510-3663-560
C 747	56 pF ±10% high Q cube	510-3663-560
C 748	6.8 µF 35V tantalum SMD	510-2635-689
C 749	.018 µF ±10% X7R chip	510-3605-183
C 750	56 pF ±10% high Q cube	510-3663-560
C 751	27 pF ±10% high Q cube	510-3663-270
C 752	.001 µF ±5% NPO 1206 chip	510-3602-102
C 753	6.8 µF 35V tantalum SMD	510-2635-689
C 754	.018 µF ±10% X7R chip	510-3605-183
C 755	39 pF ±5% NPO 1206 chip	510-3602-390
C 756	.018 µF ±10% X7R chip	510-3605-183
C 757	.018 µF ±10% X7R chip	510-3605-183
C 758	39 pF ±5% NPO 1206 chip	510-3602-390
C 759	.018 µF ±10% X7R chip	510-3605-183
C 760	.018 µF ±10% X7R chip	510-3605-183
C 761	1.5 pF ±10% high Q cube	510-3663-159
C 762	1.5 pF ±10% high Q cube	510-3663-159
C 766	1.5 pF ±10% high Q cube	510-3663-159
C 771	56 pF ±10% high Q cube	510-3663-560
C 772	56 pF ±10% high Q cube	510-3663-560
C 773	56 pF ±10% high Q cube	510-3663-560
C 774	56 pF ±10% high Q cube	510-3663-560
CR501	Dual Schottky SOT-143	523-1504-033
CR701	Dual Schottky SOT-143	523-1504-033
CR702	Dual Schottky SOT-143	523-1504-033
CR703	Dual Schottky SOT-143	523-1504-033
CR704	Dual Schottky SOT-143	523-1504-033
EP502	Ferrite bead SMD 1233	517-2503-010
EP503	Ferrite bead SMD 1233	517-2503-010
EP504	Ferrite bead SMD 1233	517-2503-010
EP505	Ferrite bead SMD 1233	517-2503-010
EP506	Ferrite bead SMD 1233	517-2503-010
EP507	Ferrite bead SMD 1233	517-2503-010
EP508	Ferrite bead SMD 1233	517-2503-010
EP509	Ferrite bead SMD 1233	517-2503-010
EP510	Ferrite bead SMD 1233	517-2503-010
EP511	Ferrite bead SMD 1233	517-2503-010
EP513	Ferrite bead SMD 1233	517-2503-010

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
EP701	Ferrite bead SMD 1233	517-2503-010
EP702	Ferrite bead SMD 1233	517-2503-010
EP703	Ferrite bead SMD 1233	517-2503-010
EP704	Ferrite bead SMD 1233	517-2503-010
EP705	Ferrite bead SMD 1233	517-2503-010
EP706	Ferrite bead SMD 1233	517-2503-010
EP707	Ferrite bead SMD 1233	517-2503-010
EP708	Ferrite bead SMD 1233	517-2503-010
EP709	Ferrite bead SMD 1233	517-2503-010
EP710	Ferrite bead SMD 1233	517-2503-010
EP711	Ferrite bead SMD 1233	517-2503-010
EP712	Ferrite bead SMD 1233	517-2503-010
EP713	Ferrite bead SMD 1233	517-2503-010
EP714	Ferrite bead SMD 1233	517-2503-010
EP715	Ferrite bead SMD 1233	517-2503-010
EP716	Ferrite bead SMD 1233	517-2503-010
L 501	6T 22 AWG 0.05 ID SMD air	542-0015-006
L 502	4T 22 AWG 0.05 ID SMD air	542-0015-004
L 503	.01 µH SMD	542-9001-107
L 504	.01 µH SMD	542-9001-107
PC501	PC board	035-2009-520
Q 501	NPN 750 mW UHF/800 MHz	576-0004-098
Q 502*	60W 800 MHz 24V MRF898	576-0004-820
Q 701*	60W 800 MHz 24V MRF898	576-0004-820
Q 702*	60W 800 MHz 24V MRF898	576-0004-820
Q 703*	60W 800 MHz 24V MRF898	576-0004-820
Q 704*	60W 800 MHz 24V MRF898	576-0004-820
R 502	Zero ohm ±5% 1206 SMD	569-0115-001
R 504	150 ohm ±5% 1206 SMD	569-0115-151
R 505	750 ohm ±5% 1206 SMD	569-0115-751
R 507	360 ohm ±5% 1206 SMD	569-0115-361
R 508	120 ohm ±5% 1206 SMD	569-0115-121
R 509	120 ohm ±5% 1206 SMD	569-0115-121
R 510	240 ohm ±5% 1206 SMD	569-0115-241
R 511	56 ohm ±5% 1206 SMD	569-0115-560
R 512	75 ohm ±5% 1206 SMD	569-0115-750
R 513	100k ohm ±1% 1206 SMD	569-0111-501
R 514	301k ohm ±1% 1206 SMD	569-0111-547
R 515	470 ohm ±5% 1206 SMD	569-0115-471
R 517	110 ohm ±5% 1206 SMD	569-0115-111
R 519	1k ohm ±5% 1206 SMD	569-0115-102
R 520	200 ohm ±5% 1206 SMD	569-0115-201
R 521	3.9k ohm ±5% 1206 SMD	569-0115-392
R 685*	50 ohm 250W flange mt load	569-5001-003
R 701*	100 ohm 20W flange mount	569-5001-001
R 702*	100 ohm 20W flange mount	569-5001-001
R 703*	100 ohm 100W flange mount	569-5001-002
R 704	100 ohm ±5% 1206 SMD	569-0115-101
R 705	200 ohm ±5% 1206 SMD	569-0115-201
R 706	100 ohm ±5% 1206 SMD	569-0115-101
R 707	1k ohm ±1% 1206 SMD	569-0111-301
R 708	1k ohm ±1% 1206 SMD	569-0111-301
R 709	3.4k ohm ±1% 1206 SMD	569-0111-352
R 710	100 ohm ±5% 1206 SMD	569-0115-101
R 711	200 ohm ±5% 1206 SMD	569-0115-201
R 712	100 ohm ±5% 1206 SMD	569-0115-101
R 713	1k ohm ±1% 1206 SMD	569-0111-301
R 714	1k ohm ±1% 1206 SMD	569-0111-301
R 715	3.4k ohm ±1% 1206 SMD	569-0111-352
R 716*	100 ohm 20W flange mount	569-5001-001
R 717*	100 ohm 100W flange mount	569-5001-002
R 718	100 ohm ±5% 1206 SMD	569-0115-101
R 719	200 ohm ±5% 1206 SMD	569-0115-201
R 720	100 ohm ±5% 1206 SMD	569-0115-101
R 721	1k ohm ±1% 1206 SMD	569-0115-301
R 722	1k ohm ±1% 1206 SMD	569-0115-301
R 723	3.4k ohm ±1% 1206 SMD	569-0115-352
R 724	100 ohm ±5% 1206 SMD	569-0115-101
R 725	200 ohm ±5% 1206 SMD	569-0115-201
R 726	100 ohm ±5% 1206 SMD	569-0115-201
R 727	1k ohm ±1% 1206 SMD	569-0111-301
R 728	1k ohm ±1% 1206 SMD	569-0111-301
R 729	3.4k ohm ±1% 1206 SMD	569-0111-352
R 730*	100 ohm 100W flange mount	569-5001-002
U501	18W RF power module	544-4001-079
U 502	Dual op amp 532 SO-8	544-2019-004
U 503	Temp sensor LM35 SO-8	544-2032-003
U 504	+5V regulator 78L05 SO-8	544-2603-039

FORWARD/REVERSE POWER DETECTOR
PART NO. 023-2008-680

C 653	27 pF ±5% NPO 1206 chip	510-3602-270
C 654	12 pF ±5% NPO 1206 chip	510-3602-120
C 658	27 pF ±5% NPO 1206 chip	510-3602-270
C 659	.001 µF ±5% NPO 1206 chip	510-3602-102
C 660	2.2 µF 20V tantalum SMD	510-2626-229
C 661	4.7 µF 10V tantalum SMD	510-2624-479

***DANGER** Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for further details. (Parts are from 023-2009-934.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 662	4.7 µF 10V tantalum SMD	510-2624-479
C 663	.001 µF ±5% NPO 1206 chip	510-3602-102
C 664	27 pF ±5% NPO 0805 chip	510-3601-270
C 665	27 pF ±5% NPO 0805 chip	510-3601-270
C 667	27 pF ±5% NPO 0805 chip	510-3601-270
C 668	27 pF ±5% NPO 0805 chip	510-3601-270
C 669	27 pF ±5% NPO 0805 chip	510-3601-270
C 670	27 pF ±5% NPO 0805 chip	510-3601-270
C 671	27 pF ±5% NPO 0805 chip	510-3601-270
C 672	27 pF ±5% NPO 0805 chip	510-3601-270
C 673	.001 µF ±10% NPO 0805 chip	510-3605-102
C 674	27 pF ±5% NPO 0805 chip	510-3601-270
C 675	27 pF ±5% NPO 0805 chip	510-3601-270
C 676	27 pF ±5% NPO 0805 chip	510-3601-270
C 677	27 pF ±5% NPO 0805 chip	510-3601-270
C 678	27 pF ±5% NPO 0805 chip	510-3601-270
C 679	.001 µF ±5% NPO 0805 chip	510-3605-102
C 681	.001 µF ±5% NPO 0805 chip	510-3605-102
C 682	.001 µF ±5% NPO 0805 chip	510-3605-102
C 683	4.7 µF 10V SMD tantalum	510-2624-479
C 684	.001 µF ±5% NPO 0805 chip	510-3605-102
CR651	Dual Schottky SOT-143	523-1504-033
CR652	Dual Schottky SOT-143	523-1504-033
L 652	12.5 nH air core inductor	542-0030-004
L 653	.039 µH inductor SMD	542-9001-397
L 655	12.5 nH air core inductor	542-0030-004
L 656	.039 µH inductor SMD	542-9001-397
L 657	12.5 nH air core inductor	542-0030-004
MP651	PA PC board shield	017-2210-086
MP652	PA PC board shield	017-2210-086
MP653	PC board	017-2210-096
R 653	160 ohm ±5% 1206 SMD	569-0115-161
R 654	Zero ohm ±5% 1206 SMD	569-0115-001
R 655	Zero ohm ±5% 1206 SMD	569-0115-001
R 656	20k ohm ±1% 1206 SMD	569-0111-430
R 658	10k ohm ±1% 1206 SMD	569-0111-401
R 659	10k ohm ±1% 1206 SMD	569-0111-018
R 660	10k ohm ±1% 1206 SMD	569-0111-401
R 662	10k ohm ±1% 1206 SMD	569-0111-401
R 663	5k ohm top adjust SMD pot	562-0135-502
R 664	160 ohm ±5% 1206 SMD	569-0115-161
R 665	10k ohm ±1% 1206 SMD	569-0111-401
R 666	10k ohm ±1% 1206 SMD	569-0111-401
R 667	470 ohm ±5% 1206 SMD	569-0115-471
R 670	160 ohm ±5% 1206 SMD	569-0115-161
R 671	Zero ohm ±5% 1206 SMD	569-0115-001
R 672	Zero ohm ±5% 1206 SMD	569-0115-001
R 673	20k ohm ±1% 1206 SMD	569-0111-430
R 675	10k ohm ±1% 1206 SMD	569-0111-401
R 676	10k ohm ±1% 1206 SMD	569-0111-401
R 677	10k ohm ±1% 1206 SMD	569-0111-401
R 678	10k ohm ±1% 1206 SMD	569-0111-401
R 680	5k ohm top adjust SMD pot	562-0135-502
R 681	150 ohm ±5% 0805 SMD	569-0105-151
R 682	7.5k ohm ±5% 0805 SMD	569-0105-752
R 683	10k ohm ±5% 0805 SMD	569-0105-103
R 684	470 ohm ±5% 0805 SMD	569-0105-471
R 686	47 ohm ±5% 1206 SMD	569-0115-470
R 687	240 ohm ±5% 1206 SMD	569-0115-241
R 688	10k ohm ±1% 1206 SMD	569-0111-401
R 689	10k ohm ±5% 0805 SMD	569-0105-103
U 651	Dual op amp SO-8	544-2019-004
U 652	Dual op amp SO-8	544-2019-004
U 653	+5V regulator LM78L05 SO-8	544-2603-039

900 MHz 75W PA MECHANICAL
PART NO. 023-2009-732

B 252	24V DC fan 3.14" sq x 1.26"	529-2002-027
EP200	Ground lug 6-14 wire	586-0007-070
HW251	6-32 panhead philips ZPS	575-1606-008
HW253	6-32 panhead philips ZPS	575-1606-012
HW254	1/8" cable clamp	572-0001-001
HW255	6-32 pan torx ZPS	575-0006-010
HW256	4-40 panhead philips ZPS	575-1604-010
HW257	6-32 panhead philips ZPS	575-1606-010
HW258	6-32 panhead philips ZPS	575-1606-016
HW259	6-19 panhead philips ZPS	575-5606-008
HW260	6 x 32 lock washer ext ZPS	596-1206-010
HW261	0.26 x 0.54 grafoil flgres	018-1007-030
HW262	0.42 x 0.995 grafoil mrf	018-1007-032
HW263	894.25 x 0.995 grafoil mrf	018-1007-034
HW264	0.385 x 0.88 grafoil flgres	018-1007-036
HW265	Multi-module grafoil	018-1007-046
HW266	Grafoil circulator	018-1007-042
HW268	10-32 HHSL Sems screw ZPS	575-9810-012
HW269	0.062 x 0.85 x 5.65 poron stp	574-3002-110

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
MP254	M PA plate align dowel pin	013-1723-216
MP255	PA heat sink	014-0771-124
MP256	PA shield, left	017-2210-026
MP257	PA shield, top	017-2210-022
MP258	Low power PA shield, 1 fan	017-2210-025
MP261	1/4 hex brass M/F spacer	312-7483-024
MP262	High power LPF PA shield	017-2210-097
MP268	M PA stop	013-1723-222
MP270	PA shield	017-2210-095

900 MHz 75W PA MECHANICAL
PART NO. 023-2009-734

B 252	24V DC fan 3.14" sq x 1.26"	529-2002-027
EP100	Balanced finger gasket	537-5001-006
EP200	Ground lug 6-14 wire	586-0007-070
HW251	3/16 #2 panhead phil sheetmtl	575-3602-006
HW253	6-32 panhead philips ZPS	575-1606-012
HW254	1/8" cable clamp	572-0001-001
HW255	6-32 pan torx ZPS	575-0006-010
HW256	4-40 panhead philips ZPS	575-1604-010
HW257	6-32 panhead philips ZPS	575-1606-010
HW258	6-32 panhead philips ZPS	575-1606-016
HW259	6-19 panhead philips ZPS	575-5606-008
HW260	6 x 32 lockwasher ext ZPS	596-1206-010
HW261	0.26 x 0.54 grafoil flgres	018-1007-030
HW262	0.42 x 0.995 grafoil mrf	018-1007-032
HW264	0.385 x 0.88 grafoil flgres	018-1007-036
HW265	Multi-module grafoil	018-1007-046
HW266	Grafoil circulator	018-1007-042
HW267	MRF898 dbl length grafoil	018-1007-033
HW268	10-32 HHSL Sems screw ZPS	575-9810-012
HW269	0.062 x 0.85 x 5.65 poron stp	574-3002-110
HW270	8-32 panhead phil CPS	575-0608-008
MP240	PA coax ground tab	017-2210-038
MP254	M PA plate align dowel pin	013-1723-216
MP255	PA heat sink	014-0771-124
MP256	PA shield, left	017-2210-026
MP257	PA shield, top	017-2210-022
MP258	Right high power PA shield	017-2210-023
MP261	1/4 hex brass M/F spacer	312-7483-024
MP262	High power LPF PA shield	017-2210-097
MP265	High pwr RF PA PC bd shield	017-2210-034
MP266	High pwr RF PA bd shield	017-2210-035
MP268	M PA stop	013-1723-222
MP269	Predriver cover shield	017-2210-037
MP270	PA shield	017-2210-095

2000 SERIES REPEATER POWER SUPPLY
PART NO. 023-2000-800

A 801	Main board assembly	023-2000-810
A 803	AC filter board assembly	023-2000-820
B 800	24V DC fan 3.14” square	529-2002-012
HW800	Speed nut	537-0001-002
HW801	10-32 x 0.375 CPS nut	560-1110-012
HW802	6-32 x 0.094 nut	560-1106-010
HW803	4-40 machine panhead ZPS	575-1604-010
HW804	6-32 machine panhead ZPS	575-1606-010
HW805	6-32 machine panhead ZPS	575-1606-016
HW806	Washer	596-2406-012
HW809	6 x 0.018 lockwasher int.	596-1106-009
HW810	3/8” cable clamp	572-0001-005
HW811	#10 split lock washer	596-1310-010
HW812	Snap rivet 0.157 dia. x 0.29	574-9015-052
HW813	Connector mounting screw	515-7141-215
J 800	2-pos lock receptacle #22 wire	515-9032-262
MP801	Main enclosure	017-2210-165
MP802	Top cover	017-2210-166
MP803	Handle	017-2139-202
MP804	Strain relief	016-2187-270
MP805	Fan finger guard	578-1000-001
NP800	Nameplate holder	015-0900-406
NP801	Nameplate label	559-5861-161

WIREHARNESS
PART NO. 023-2000-803

EP001	Power socket	515-9012-284
EP002	Signal socket	515-9012-291
MP001	15-pos plug	515-9012-272

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	800W POWER SUPPLY MAIN BOARD PART NO. 023-2000-810	
A 002	Pin feed EPROM blank label	559-1154-004
A 802	Wireharness	023-2000-803
A 803	Thermal sensor board assem	023-2000-840
C 101	220 µF 25V aluminum radial	510-4225-221
C 102	.01 µF ±5% X7R 1206	510-3609-103
C 103	220 nF ±10% X7R 1210	510-3606-224
C 104	1 µF 35V tantalum SMD	510-2628-109
C 105	1 µF 35V tantalum SMD	510-2628-109
C 106	1500 µF 35Valuminum elect	510-4075-152
C 107	1500 µF 35Valuminum elect	510-4075-152
C 108	470 pF ±5% NPO 1206	510-3602-471
C 109	.1 µF ±10% X7R 1206	510-3609-104
C 110	330 µF 450V aluminum	510-4574-331
C 111	330 µF 450V aluminum	510-4574-331
C 113	.0047 µF ±10% X7R 1206	510-3609-472
C 114	.1 µF ±10% X7R 1206	510-3609-104
C 115	.1 µF ±10% X7R 1206	510-3609-104
C 116	.1 µF ±10% X7R 1206	510-3609-104
C 117	.47 µF 16V tantalum SMD	510-2625-478
C 118	270 pF ±5% NPO 1206	510-3602-271
C 119	1 µF 35V tantalum SMD	510-2628-109
C 120	270 pF ±5% NPO 1206	510-3602-271
C 121	.0027 µF ±5% X7R 1206	510-3609-272
C 122	470 pF ±5% NPO 1206	510-3602-471
C 123	1 µF 35V tantalum SMD	510-2628-109
C 124	.1 µF ±10% X7R 1206	510-3609-104
C 125	.0022 µF ±5% X7R 1206	510-3609-222
C 126	.1 µF ±5% X7R 1206	510-3609-104
C 127	.01 µF ±10% X7R 1206	510-3609-103
C 128	6.8 µF 35V tantalum SMD	510-2635-689
C 129	.1 µF ±10% X7R 1206	510-3609-104
C 131	.1 µF ±10% X7R 1206	510-3609-104
C 132	1 µF 35V tantalum SMD	510-2628-109
C 133	1 µF 35V tantalum SMD	510-2628-109
C 134	.1 µF ±5% X7R 1206	510-3609-104
C 135	.1 µF ±5% X7R 1206	510-3609-104
C 136	2.2 µF 16V tantalum SMD	510-2625-229
C 137	2.2 µF 16V tantalum SMD	510-2625-229
C 138	.001 µF ±5% NPO 1206	510-3602-102
C 139	6.8 µF 35V tantalum SMD	510-2635-689
C 140	6.8 µF 35V tantalum SMD	510-2635-689
C 141	.1 µF ±5% X7R 1206	510-3609-104
C 142	1 nF 600V AC double m	510-1023-102
C 143	2700 µF 35V aluminum	510-4075-272
C 144	2700 µF 35V aluminum	510-4075-272
C 145	2700 µF 35V aluminum	510-4075-272
C 146	.1 µF ±5% X7R 1206	510-3609-104
C 147	.1 µF ±5% X7R 1206	510-3609-104
C 148	.1 µF ±5% X7R 1206	510-3609-104
C 149	.1 µF ±5% X7R 1206	510-3609-104
C 150	.01 µF ±5% X7R 1206	510-3609-103
C 152	.1 µF ±5% X7R 1206	510-3609-104
C 153	1 µF 35V tantalum SMD	510-2628-109
C 154	.1 µF ±5% X7R chip	510-3609-104
C 156	.01 µF ±5% X7R 1206	510-3609-103
C 159	6.8 µF 35V tantalum SMD	510-2635-689
C 160	15 µF 20V tantalum SMD	510-2633-150
C 161	.01 µF ±5% X7R 1206	510-3609-103
C 162	.1 µF ±5% X7R 1206	510-3609-104
C 163	2700 µF 35V aluminum	510-4075-272
C 164	.001 µF ±5% NPO 1206	510-3602-102
C 165	1500 µF 35V aluminum	510-4075-152
C 166	1500 µF 35V aluminum	510-4075-152
C 167	.01 µF ±5% X7R 1206	510-3609-103
C 168	.01 µF ±5% X7R 1206	510-3609-103
C 169	1500 µF 35V aluminum	510-4075-152
C 170	.01 µF ±5% X7R 1206	510-3609-103
C 172	.01 µF ±5% X7R 1206	510-3609-103
C 173	.1 µF ±5% X7R 1206	510-3609-104
C 174	2200 pF ±5% NPO 1206	510-3602-222
C 175	.22 µF ±10% X7R 1210	510-3606-224
C 176	.001 µF ±5% NPO 1206	510-3602-102
C 178	1 µF 35V tantalum SMD	510-2628-109
C 180	6.8 µF 35V tantalum SMD	510-2635-689
C 181	.01 µF ±5% X7R 1206	510-3609-103
C 182	470 pF ±5% NPO 1206	510-3602-471
C 183	270 pF ±5% NPO 1206	510-3602-271
C 184	.1 µF ±5% X7R 1206	510-3609-104
C 185	.001 µF ±5% NPO 1206	510-3602-102
C 186	1500 µF 35V aluminum	510-4075-152
C 187	1500 µF 35V aluminum	510-4075-152
C 188	1500 µF 35V aluminum	510-4075-152
C 189	.01 µF ±5% X7R 1206	510-3609-103
C 190	.01 µF ±5% X7R 1206	510-3609-103
C 192	.1 µF ±5% X7R 1206	510-3609-104
C 193	2200 pF ±5% NPO 1206	510-3602-222
C 194	.22 µF ±10% X7R 1210	510-3606-224
C 195	.01 µF ±5% X7R 1206	510-3609-103
C 196	.001 µF ±5% NPO 1206	510-3602-102
C 197	2.2 µF 16V tantalum SMD	510-2625-229

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 198	1 µF 35V tantalum SMD	510-2628-109
C 199	6.8 µF 35V tantalum SMD	510-2635-689
C 200	6.8 µF 35V tantalum SMD	510-2635-689
C 201	.01 µF ±5% X7R 1206	510-3609-103
C 202	470 pF ±5% NPO 1206	510-3602-471
C 203	470 pF ±5% NPO 1206	510-3602-471
C 204	.047 µF ±5% X7R 1206	510-3609-473
C 205	1500 µF 35V aluminum	510-4075-152
C 207	2200 pF ±5% NPO 1206	510-3602-222
C 208	.1 µF ±5% X7R 1206	510-3609-104
C 209	1500 µF 35V aluminum	510-4075-152
C 210	2200 pF ±5% NPO 1206	510-3602-222
C 211	.01 µF ±5% X7R 1206	510-3609-103
C 212	.01 µF ±5% X7R 1206	510-3609-103
C 213	.1 µF ±5% X7R 1206	510-3609-104
C 214	.01 µF ±5% X7R 1206	510-3609-103
C 215	.1 µF ±5% X7R 1206	510-3609-104
C 216	.01 µF ±5% X7R 1206	510-3609-103
C 217	.1 µF ±5% X7R 1206	510-3609-104
C 218	.01 µF ±5% X7R 1206	510-3609-103
C 219	.1 µF ±5% X7R 1206	510-3609-104
C 220	.1 µF ±5% X7R 1206	510-3609-104
C 221	.01 µF ±5% X7R 1206	510-3609-103
C 222	.1 µF ±5% X7R 1206	510-3609-104
C 223	.1 µF ±5% X7R 1206	510-3609-104
C 224	.01 µF ±5% X7R 1206	510-3609-103
C 225	.01 µF ±5% X7R 1206	510-3609-103
C 227	.1 µF ±5% X7R 1206	510-3609-104
C 228	2.2 µF 16V tantalum SMD	510-2625-229
C 229	.1 µF ±5% X7R 1206	510-3609-104
C 230	1 µF 35V tantalum SMD	510-2628-109
C 232	6.8 µF 35V tantalum SMD	510-2635-689
C 233	.1 µF ±5% X7R 1206	510-3609-104
C 234	.001 µF ±5% NPO 1206	510-3602-102
C 235	.1 µF ±5% X7R 1206	510-3609-104
C 236	.1 µF ±5% X7R 1206	510-3609-104
CR101	Switching diode SOT-23	523-1504-002
CR102	Switching diode SOT-23	523-1504-002
CR103	3A ultra-fast diode	523-1507-004
CR104	18V zener ±5% SMD	523-2026-180
CR105	1A Schottky diode	523-0519-031
CR106	1A Schottky diode	523-0519-031
CR107	Switching diode SOT-23	523-1504-017
CR108	Switching diode SOT-23	523-1504-017
CR110	Switching diode SOT-23	523-1504-002
CR111	Switching diode SOT-23	523-1504-002
CR112	Switch diode SOT-23	523-1504-017
CR113	5.1V zener SOT-23	523-2016-519
CR114	1A Schottky diode	523-0519-031
CR115	1A Schottky diode	523-0519-031
CR116	1A Schottky diode	523-0519-031
CR117	18V zener SOT-23	523-2016-180
CR118	3A ultra-fast diode	523-1507-004
CR119	3A ultra-fast diode	523-1507-004
CR120	18V zener SOT-23	523-2016-180
CR121	Ultra-fast rectifier	523-0019-024
CR122	Switch diode SOT-23	523-1504-017
CR123	1A Schottky diode	523-0519-031
CR124	1A Schottky diode	523-0519-031
CR125	1A Schottky diode	523-0519-031
CR126	Schottkey diode 20A	523-0519-030
CR127	Switch diode SOT-23	523-1504-017
CR128	Ultra-fast rectifier	523-0019-024
CR129	25A 400V SCR TO-220	523-3021-001
CR130	1A Schottky diode	523-0519-031
CR131	1A Schottky diode	523-0519-031
CR132	Schottkey diode 20A	523-0519-030
CR133	Switch diode SOT-23	523-1504-017
CR134	1A Schottky diode	523-0519-031
CR135	25A 400V SCR TO-220	523-3021-001
CR136	3A ultra-fast diode	523-1507-004
CR137	Switching diode SOT-23	523-1504-002
CR138	Switching diode SOT-23	523-1504-002
CR139	Dual switching common cath	523-1504-022
CR140	4.7V zener SOT-23	523-2016-479
CR141	25A 400V SCR TO-220	523-3021-001
CR142	Switch diode SOT-23	523-1504-017
CR143	Switch diode SOT-23	523-1504-017
CR145	8A 600V ultrafast diode	523-0019-026
CR148	13V 1W zener SMT	523-2026-130
EP100	Ferrite bead	517-2002-008
EP101	0.25” spade lug	586-3502-021
EP103	0.25” spade lug	586-3502-021
EP104	0.25” spade lug	586-3502-021
EP105	0.25” spade lug	586-3502-021
EP106	0.25” spade lug	586-3502-021
EP110	0.25” spade lug	586-3502-021
EP111	0.25” spade lug	586-3502-021
EP112	0.25” spade lug	586-3502-021

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
F 102	10A 250V fastblow AGC fuse	534-0003-036
FH102	Fuse clip	534-1007-001
HW100	Cam5 x 3.795 sil-pad	018-1007-051
HW101	0.89 x 1.37 sil-pad	018-1007-052
HW102	1.06 x 4.73 sil-pad	018-1007-053
HW104	0.83 x 5 Teflon spacer	018-1007-056
HW105	0.83” Teflon spacer	018-1007-057
HW106	1.28” Teflon spacer	018-1007-058
HW107	4-40 3/8” hex socket CPS	575-9076-122
HW108	6-32 3/8” socket hoodcap	575-9076-112
HW109	6-32 machine panhead ZPS	575-1606-012
HW110	#4 x 0.046 shoulder washer	596-4504-008
HW111	#4 x 0.040 flat washer NPB	596-2404-008
HW112	#6 x 0.028 flat washer NPB	596-2406-010
HW113	#4 shakeproof washer	596-1104-008
HW114	#6 x 0.018 int lockwasher	596-1106-009
HW115	#4 spring washer	596-9604-009
HW120	TO-220 clamp	537-9055-051
J 101	2-pin friction header	515-9031-201
J 102	2-pin friction header	515-9031-201
L 101	15 µH 30A DC inductor	542-5010-005
L 102	20 µH 8A DC inductor	542-5010-006
L 103	7.5 µH 8A DC inductor	542-5010-008
L 104	10 µH 5A DC inductor	542-5010-007
L 105	100 µH 1A DC inductor	542-5010-012
L 107	300 µH 17A DC inductor	542-5010-004
MP100	5.7” heat sink	014-0771-130
MP101	2.9” heat sink	014-0771-131
MP102	5.7” heat sink	014-0771-133
MP105	TO-202 spacer	017-2210-162
PC001	PC board	035-2000-810
Q 101	30A 500V N-chnl pwr module	576-0006-354
Q 102	PNP switching	576-0003-612
Q 103	Si NPN amp/sw SOT-23	576-0003-600
Q 104	PNP high current SOT-223	576-0006-026
Q 105	PNP switching	576-0003-612
Q 106	Si NPN amp/sw SOT-23	576-0003-600
Q 107	PNP high current SOT-223	576-0006-026
Q 108	NPN high current SOT-223	576-0006-027
Q 110	Si NPN amp/sw SOT-23	576-0003-600
Q 111	Si NPN amp/sw SOT-23	576-0003-600
Q 112	Si NPN amp/sw SOT-23	576-0003-600
Q 114	PNP switching	576-0003-612
Q 115	PNP high current SOT-223	576-0006-026
Q 116	14A 500V N-MOSFET	576-0006-351
Q 117	PNP high current SOT-223	576-0006-026
Q 118	14A 500V N-MOSFET	576-0006-351
Q 120	Si NPN amp/sw SOT-23	576-0003-600
Q 121	PNP 6A SMD MJD42C	576-0002-603
Q 122	PNP high current SOT-223	576-0006-026
Q 123	N-Chnl E-MOSFET SOT-23	576-0006-110
Q 124	PNP high current SOT-223	576-0006-026
Q 125	20A 200V N-MOSFET	576-0006-352
Q 126	PNP switching	576-0003-612
Q 127	Si NPN amp/sw SOT-23	576-0003-600
Q 128	PNP switching	576-0003-612
Q 129	PNP high current SOT-223	576-0006-026
Q 130	N-Chnl E-MOSFET SOT-23	576-0006-110
Q 131	PNP high current SOT-223	576-0006-026
Q 132	20A 200V N-MOSFET	576-0006-352
Q 133	PNP switching	576-0003-612
Q 138	PNP switching	576-0003-612
R 101	330k ohm ±5% 1206 SMD	569-0115-334
R 102	330k ohm ±5% 1206 SMD	569-0115-334
R 103	240k ohm ±5% 1206 SMD	569-0115-244
R 104	100k ohm ±5% 1206 SMD	569-0115-104
R 105	330k ohm ±5% 1206 SMD	569-0115-334
R 106	330k ohm ±5% 1206 SMD	569-0115-334
R 107	330k ohm ±5% 1206 SMD	569-0115-334
R 108	20k ohm ±5% 2512 SMD	569-0175-203
R 109	20k ohm ±5% 2512 SMD	569-0175-203
R 110	20k ohm ±5% 2512 SMD	569-0175-203
R 111	220 ohm ±5% 1206 SMD	569-0115-221
R 112	10 ohm ±5% 1206 SMD	569-0115-100
R 113	0.03 ohm 55W low ind wire	569-4151-307
R 114	0.03 ohm 55W low ind wire	569-4151-307
R 115	4.7k ohm ±5% 1206 SMD	569-0115-472
R 116	36k ohm ±5% 1206 SMD	569-0115-363
R 117	330 ohm ±5% 1206 SMD	569-0115-331
R 118	18.2k ohm ±1% 1206 SMD	569-0111-426
R 119	24.3k ohm ±1% 1206 SMD	569-0111-438
R 120	20k ohm ±5% 2512 SMD	569-0175-203
R 121	100k ohm ±1% 1206 SMD	569-0111-501
R 122	100k ohm ±1% 1206 SMD	569-0111-501
R 123	100k ohm ±1% 1206 SMD	569-0111-501
R 124	100k ohm ±1% 1206 SMD	569-0111-501
R 125	13 ohm ±5% 1206 SMD	569-0115-130

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 126	10 ohm ±5% 1206 SMD	562-0115-100
R 127	1.27k ohm ±1% 1206 SMD	569-0111-311
R 128	51 ohm ±5% 2512 SMD	569-0175-510
R 129	36k ohm ±5% 1206 SMD	569-0115-363
R 130	100k ohm ±5% 1206 SMD	569-0115-104
R 131	36k ohm ±5% 1206 SMD	569-0115-363
R 132	10k ohm ±5% 1206 SMD	569-0115-103
R 133	100k ohm ±5% 1206 SMD	569-0115-104
R 134	20k ohm ±5% 1206 SMD	569-0115-203
R 135	13k ohm ±1% 1206 SMD	569-0111-412
R 136	100k ohm ±5% 1206 SMD	569-0115-104
R 137	1M ohm ±5% 1206 SMD	569-0115-105
R 138	2.26k ohm ±1% 1206 SMD	569-0111-335
R 139	2.26k ohm ±1% 1206 SMD	569-0111-335
R 140	15k ohm ±1% 1206 SMD	569-0111-418
R 141	10k ohm ±5% 1206 SMD	569-0115-103
R 142	560k ohm ±5% 1206 SMD	569-0115-564
R 143	3k ohm ±5% 1206 SMD	569-0115-302
R 144	25.5k ohm ±1% 1206 SMD	569-0111-440
R 146	100 ohm ±5% 1206 SMD	569-0115-101
R 148	4.7k ohm ±5% 1206 SMD	569-0115-472
R 149	1k ohm ±5% 1206 SMD	569-0115-102
R 150	2k ohm ±5% 1206 SMD	569-0115-202
R 151	20k ohm ±5% 2512 SMD	569-0175-203
R 152	4.7k ohm ±5% 1206 SMD	569-0115-472
R 153	100 ohm ±5% 1206 SMD	569-0115-101
R 154	10k ohm ±5% 1206 SMD	569-0115-103
R 155	36k ohm ±5% 1206 SMD	569-0115-363
R 156	1k ohm ±5% 1206 SMD	569-0115-102
R 157	20k ohm ±5% 1206 SMD	569-0115-203
R 158	15k ohm ±5% 1206 SMD	569-0115-153
R 159	20 ohm ±5% 1206 SMD	569-0115-200
R 160	470 ohm ±5% 1206 SMD	569-0115-471
R 161	20 ohm ±5% 1206 SMD	569-0115-200
R 162	Zero ohm ±5% 1206 SMD	569-0115-001
R 163	20 ohm ±5% 1206 SMD	569-0115-200
R 164	470 ohm ±5% 1206 SMD	569-0115-471
R 165	20 ohm ±5% 1206 SMD	569-0115-200
R 166	10 ohm ±5% 2512 SMD	569-0175-100
R 167	10 ohm ±5% 2512 SMD	569-0175-100
R 168	10 ohm ±5% 2512 SMD	569-0175-100
R 169	1k ohm ±5% 1206 SMD	569-0115-102
R 170	820 ohm ±5% 1206 SMD	569-0115-821
R 171	820 ohm ±5% 1206 SMD	569-0115-821
R 172	100k ohm ±5% 1206 SMD	569-0115-104
R 173	16.9k ohm ±1% 1206 SMD	569-0111-423
R 174	1k ohm trim pot	562-0110-102
R 175	1.8k ohm ±5% 1206 SMD	569-0115-182
R 176	100 ohm ±5% 1206 SMD	569-0115-101
R 178	2k ohm ±5% 1206 SMD	569-0115-202
R 179	4.7k ohm ±5% 1206 SMD	569-0115-472
R 180	7.5k ohm ±5% 1206 SMD	569-0115-752
R 181	1k ohm ±5% 1206 SMD	569-0115-102
R 182	75 ohm ±5% 1206 SMD	569-0115-750
R 183	95.3k ohm ±1% 1206 SMD	569-0111-495
R 184	357k ohm ±1% 1206 SMD	569-0111-554
R 185	1k ohm ±5% 1206 SMD	569-0115-102
R 186	10k ohm ±5% 1206 SMD	569-0115-103
R 187	95.3k ohm ±1% 1206 SMD	569-0111-495
R 188	10k ohm ±1% 1206 SMD	569-0111-401
R 189	6.81k ohm ±1% 1206 SMD	569-0111-381
R 190	1k ohm ±5% 1206 SMD	569-0115-102
R 191	3.3k ohm ±5% 1206 SMD	569-0115-332
R 192	8.2k ohm ±5% 1206 SMD	569-0115-822
R 193	8.2k ohm ±5% 1206 SMD	569-0115-822
R 194	8.2k ohm ±5% 1206 SMD	569-0115-822
R 195	8.2k ohm ±5% 1206 SMD	569-0115-822
R 196	8.2k ohm ±5% 1206 SMD	569-0115-822
R 197	10k ohm ±5% 1206 SMD	569-0115-103
R 198	18 ohm ±5% 1206 SMD	569-0115-180
R 199	18 ohm ±5% 1206 SMD	569-0115-180
R 200	18 ohm ±5% 1206 SMD	569-0115-180
R 201	180 ohm ±5% 1206 SMD	569-0115-181
R 202	20k ohm ±5% 1206 SMD	569-0115-203
R 203	2k ohm ±5% 1206 SMD	569-0115-202
R 204	2k ohm ±5% 2512 SMD	569-0175-202
R 205	10 ohm ±5% 1206 SMD	569-0115-100
R 206	10 ohm ±5% 1206 SMD	569-0115-100
R 207	180 ohm ±5% 1206 SMD	569-0115-181
R 208	51 ohm ±5% 1206 SMD	569-0115-510
R 209	820 ohm ±5% 1206 SMD	569-0115-821
R 210	820 ohm ±5% 1206 SMD	569-0115-821
R 211	12.4k ohm ±1% 1206 SMD	569-0111-410
R 212	2.26k ohm ±1% 1206 SMD	569-0111-335
R 213	200 ohm ±5% 1206 SMD	569-0115-201
R 214	1k ohm ±5% 1206 SMD	569-0115-102
R 215	6.2k ohm ±5% 1206 SMD	569-0115-622
R 216	1k ohm single turn trimmer	562-0112-102
R 217	1.2k ohm ±5% 1206 SMD	569-0115-122
R 218	4.7k ohm ±5% 1206 SMD	569-0115-472
R 219	470 ohm ±5% 1206 SMD	569-0115-471
R 220	2k ohm ±1% 1206 SMD	569-0111-330
R 221	36k ohm ±5% 1206 SMD	569-0115-363
R 222	Zero ohm ±5% 1206 SMD	569-0115-001

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 223	13k ohm ±5% 1206 SMD	569-0115-133
R 224	Zero ohm ±5% 1206 SMD	569-0115-001
R 225	68 ohm ±5% 1206 SMD	569-0115-680
R 226	24 ohm ±5% 1206 SMD	569-0115-240
R 227	180 ohm ±5% 1206 SMD	569-0115-181
R 228	2k ohm ±1% 1206 SMD	569-0111-330
R 229	820 ohm ±5% 1206 SMD	569-0115-821
R 230	100 ohm ±5% 1206 SMD	569-0115-101
R 231	51 ohm ±5% 2512 SMD	569-0175-510
R 232	820 ohm ±5% 1206 SMD	569-0115-821
R 233	3.3k ohm ±5% 1206 SMD	569-0115-332
R 234	1k ohm ±5% 1206 SMD	569-0115-102
R 235	18 ohm ±5% 1206 SMD	569-0115-180
R 236	18 ohm ±5% 1206 SMD	569-0115-180
R 237	18 ohm ±5% 1206 SMD	569-0115-180
R 238	180 ohm ±5% 1206 SMD	569-0115-181
R 240	2k ohm ±5% 1206 SMD	569-0115-202
R 241	2k ohm ±5% 2512 SMD	569-0175-202
R 242	10 ohm ±5% 1206 SMD	569-0115-100
R 243	10 ohm ±5% 1206 SMD	569-0115-100
R 244	180 ohm ±5% 1206 SMD	569-0115-181
R 245	51 ohm ±5% 1206 SMD	569-0115-510
R 246	200 ohm ±5% 1206 SMD	569-0115-201
R 247	36 ohm ±5% 1206 SMD	569-0115-360
R 249	3.4k ohm ±1% 1206 SMD	569-0111-352
R 250	2.49k ohm ±1% 1206 SMD	569-0111-339
R 251	200 ohm ±5% 1206 SMD	569-0115-201
R 252	1k ohm ±5% 1206 SMD	569-0115-102
R 253	4.7k ohm ±5% 1206 SMD	569-0115-472
R 254	1k ohm single turn trimmer	562-0112-102
R 255	4.3k ohm ±5% 1206 SMD	569-0115-432
R 256	2k ohm ±1% 1206 SMD	569-0111-330
R 257	10k ohm ±5% 1206 SMD	569-0115-103
R 258	36k ohm ±5% 1206 SMD	569-0115-363
R 259	13k ohm ±5% 1206 SMD	569-0115-133
R 260	68 ohm ±5% 1206 SMD	569-0115-680
R 261	24 ohm ±5% 1206 SMD	569-0115-240
R 262	29.4k ohm ±1% 1206 SMD	569-0111-446
R 263	2.49k ohm ±1% 1206 SMD	569-0111-339
R 264	2k ohm ±1% 1206 SMD	569-0111-330
R 265	3.3k ohm ±5% 1206 SMD	569-0115-332
R 266	1k ohm ±5% 1206 SMD	569-0115-102
R 267	430 ohm ±5% 1206 SMD	569-0115-431
R 268	4.7k ohm ±5% 1206 SMD	569-0115-472
R 269	360 ohm ±5% 1206 SMD	569-0115-361
R 270	33k ohm ±5% 1206 SMD	569-0115-333
R 271	3.3k ohm ±5% 1206 SMD	569-0115-332
R 272	51 ohm ±5% 2512 SMD	569-0175-510
R 273	1k ohm ±5% 1206 SMD	569-0115-102
R 274	1k ohm ±5% 1206 SMD	569-0115-102
R 275	20k ohm ±5% 1206 SMD	569-0115-203
R 276	10k ohm ±5% 1206 SMD	569-0115-103
R 277	10k ohm ±5% 1206 SMD	569-0115-103
R 278	10k ohm ±5% 1206 SMD	569-0115-103
R 279	10k ohm ±5% 1206 SMD	569-0115-103
R 280	75 ohm ±5% 1206 SMD	569-0115-750
R 281	470 ohm ±5% 1206 SMD	569-0115-471
R 284	3.4k ohm ±1% 1206 SMD	569-0111-352
R 285	2.49k ohm ±1% 1206 SMD	569-0111-339
R 286	1k ohm ±5% 1206 SMD	569-0115-102
R 287	200 ohm ±5% 1206 SMD	569-0115-201
R 302	20k ohm ±5% 1206 SMD	569-0115-203
R 303	200 ohm ±5% 1206 SMD	569-0115-201
R 306	20k ohm ±5% 1206 SMD	569-0115-203
R 307	Zero ohm ±5% 1206 SMD	569-0115-001
R 308	Zero ohm ±5% 1206 SMD	569-0115-001
R 309	Zero ohm ±5% 1206 SMD	569-0115-001
R 311	100k ohm ±1% 1206 SMD	569-0111-501
R 312	100k ohm ±1% 1206 SMD	569-0111-501
R 313	100k ohm ±1% 1206 SMD	569-0111-501
R 314	100k ohm ±1% 1206 SMD	569-0111-501
R 315	820 ohm ±5% 1206 SMD	569-0115-821
RT101	8A 2.5 ohm NTC thermistor	569-3014-001
RT102	8A 2.5 ohm NTC thermistor	569-3014-001
T 101	0.5 line freq. bias transformer	592-3041-004
T 103	1:200 current transformer	592-3041-002
T 104	1:200 current transformer	592-3041-002
T 105	100:1 current transformer	592-3041-005
T 106	1:1 transformer	592-3041-003
T 107	4.5:1 switch mode transformer	592-3041-001
U 102	PFC/PWN combo SOIC	544-2002-035
U 104	Quad 2-in AND SOIC HC08	544-3766-008
U 105	5V regulator LM78L05ABD	544-2603-039
U 106	5V regulator LM78L05ABD	544-2603-039
U 107	Opto-isolator surface mt	544-9022-001
U 108	Opto-isolator	544-2010-005
U 109	Programmable TL431AID	544-2003-097
U 110	Quad op amp LMC660 SOIC	544-2020-020
U 111	Adj volt reg full temp LM317T	544-2003-094

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
U 112	PWM current mode ML4823	544-2002-034
U 113	PWM current mode ML4823	544-2002-034
U 114	5V 3A regulator power supply	544-2003-098
U 115	Programmable TL431AID	544-2003-097
U 116	Programmable TL431AID	544-2003-097
U 117	Programmable TL431AID	544-2003-097
U 118	Programmable TL431AID	544-2003-097
U 119	Opto-isolator SOIC-8	544-2010-006
U 120	Opto-isolator SOIC-8	544-2010-006
U 121	Programmable volt TL431AID	544-2003-097
U 122	Opto-isolator SOIC-8	544-2010-006

AC FILTER BOARD
PART NO. 023-2000-820

C 001	.22 µF 275V AC ±2%	510-1024-224
C 003	.0022 µF ±2% Y2	510-1022-222
C 004	.0022 µF ±2% Y2	510-1022-222
C 005	1 µF 275V X2 class capacitor	510-1024-105
CR001	600V 35A rectifier bridge	523-4004-025
EP006	1/2” tubing	042-0241-557
F 001	15A 250V ceramic body	534-0003-045
FH001	Fuse clip	534-1007-001
HW001	#10 shakeproof washer	596-1110-012
HW002	4-40 machine panhead ZPS	575-1604-016
HW003	9/16” ID rubber grommet	574-0002-004
HW004	10-32 machine panhead ZPS	575-1610-016
HW005	#4 shakeproof washer	596-1104-008
HW007	Heatsink Grafoil TO-15	018-1007-055
J 001	AC power cord connector	515-0028-008
L 001	1 µH 10A coil	542-5010-010
L 002	4.2 µH 10A coil	542-5010-009
MP001	Filter bracket	017-2210-167
PC001	PC board	035-2000-820
R 001	1M ohm ±5% 1/4W CF	569-0513-105
RV001	Metal oxide varistor	569-3503-001
RV002	Metal oxide varistor	569-3503-001
W 001	Wire 1 assembly	023-2000-825
W 002	Wire 2 assembly	023-2000-826
W 003	Wire 3 assembly	023-2000-827
W 004	Wire 4 assembly	023-2000-828
W 005	Wire 5 assembly	023-2000-829

BATTERY BACK-UP
PART NO. 023-2000-830

C 101	.01 µF ±10% X7R chip	510-3606-103
C 103	6.8 µF 35V tantalum SMD	510-2635-689
C 104	.1 µF ±5% X7R 1206	510-3609-104
C 105	1000 µF 50Valuminum elect	510-4076-102
C 106	.1 µF ±5% X7R 1206	510-3609-104
C 107	.1 µF ±5% X7R 1206	510-3609-104
C 109	.1 µF ±5% X7R 1206	510-3609-104
C 110	6.8 µF 35V tantalum SMD	510-2635-689
C 111	1000 µF 50Valuminum elect	510-4076-102
C 112	.1 µF ±5% X7R 1206	510-3609-104
C 113	1 µF 35V tantalum SMD	510-2628-109
C 114	.1 µF ±5% X7R 1206	510-3609-104
C 115	.1 µF ±5% X7R 1206	510-3609-104
C 118	1 µF ±10% 100V polyester	510-1031-105
C 119	220 µF 25V aluminum radial	510-4225-221
C 124	1 µF 35V tantalum SMD	510-2628-109
C 125	.1 µF ±5% X7R 1206	510-3609-104
C 126	.1 µF ±5% X7R 1206	510-3609-104
C 127	.1 µF ±5% X7R 1206	510-3606-104
C 128	.01 µF ±10% X7R 1206	510-3606-103
C 129	.1 µF ±10% X7R 1206	510-3606-104
C 130	.01 µF ±10% X7R 1206	510-3606-103
C 131	.1 µF ±10% X7R 1206	510-3606-104
C 132	.01 µF ±10% X7R 1206	510-3606-103
C 133	.1 µF ±10% X7R 1206	510-3606-104
C 134	.01 µF ±10% X7R 1206	510-3606-103
CR101	Red LED right angle PC mt	549-4001-035
CR102	3A ultra-fast diode	523-1507-004
CR103	12V zener diode	523-2016-120
CR104	18V ±5% zener SMT	523-2026-180
CR105	Red LED right angle PC mt	549-4001-035
CR109	8A 600V ultra-fast diode	523-0019-026
CR111	Green LED rt angle PC mt	549-4001-037
CR113	Switching diode SOT-23	523-1504-002
CR114	3A ultra-fast diode	523-1507-004

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CR115	Switching diode SOT-23	523-1504-002
CR116	3A ultra-fast diode	523-1507-004
CR117	13V 1W zener SMT	523-2026-130
CR118	18V ±5% zener SMT	523-2026-180
EP100	Heat sink insulator TO-220	574-5005-060
EP101	Copper terminal lug	586-0007-072
EP102	Copper terminal lug	586-0007-072
EP103	Copper terminal lug	586-0007-071
F 101	4A resettable polyfuse	534-0020-001
HW100	4-40 machine panhead ZPS	575-1604-012
HW101	6-32 machine panhead ZPS	575-1606-008
HW102	4 x 0.04 flat washer	596-2404-008
HW103	6 x 0.018 int lockwasher	596-1106-009
HW104	#4 shakeproof washer	596-1104-008
HW105	10-32 machine panhead ZPS	575-1610-012
HW106	#10 shakeproof washer	596-1110-012
HW107	4 x 0.46 shoulder washer	596-4504-008
HW108	10-32 x 0.375 CPS	560-1110-012
HW800	Speed nut	537-0001-002
J 100	2-pin lock receptacle	515-9032-232
K 101	Single pole 24V relay	567-0031-001
L 101	70 µH 3A Toroid inductor	542-5010-014
MP100	Bracket	017-2210-169
MP101	Terminal cover	032-0758-050
NP100	Max input 28.5V Bat/Backup	559-5861-166
NP800	Nameplate holder	015-0900-406
NP801	Nameplate	559-5861-161
PC001	PC board	035-2000-830
Q 101	PNP high current SOT-223	576-0006-026
Q 102	PNP high current SOT-223	576-0006-026
Q 103	N-channel E-MOSFET	576-0006-110
Q 104	PNP TO-220 ISO	576-0002-057
Q 105	PNP high current SOT-223	576-0006-026
R 101	4.7k ohm ±5% 1206 SMD	569-0115-472
R 102	330 ohm ±5% 1206 SMD	569-0115-331
R 103	2k ohm ±5% 1206 SMD	569-0115-202
R 104	2k ohm ±5% 1206 SMD	569-0115-202
R 105	2k ohm ±5% 1206 SMD	569-0115-202
R 106	2k ohm ±5% 2512 SMD	569-0175-202
R 107	1k ohm ±5% 1206 SMD	569-0115-102
R 108	2k ohm ±5% 1206 SMD	569-0115-202
R 109	2k ohm ±5% 1206 SMD	569-0115-202
R 110	2k ohm ±5% 1206 SMD	569-0115-202
R 111	51 ohm ±5% 1W 2512 SMD	569-0175-510
R 112	7.5k ohm ±1% 1206 SMD	569-0111-385
R 112	1k ohm ±1% 1206 SMD	569-0111-301
R 115	470 ohm ±5% 1W 2512 SMD	569-0175-471
R 116	47 ohm ±5% 1206 SMD	569-0115-470
R 117	3.3k ohm ±5% 1206 SMD	569-0115-332
R 118	10.5k ohm ±1% 1206 SMD	569-0111-403
R 119	1k ohm ±1% 1206 SMD	569-0111-301
R 120	1k ohm ±1% 1206 SMD	569-0111-301
R 121	62k ohm ±5% 1206 SMD	569-0115-623
R 122	4.7k ohm ±5% 1206 SMD	569-0115-472
R 123	10k ohm ±5% 1206 SMD	569-0115-103
R 124	10k ohm ±5% 1206 SMD	569-0115-103
R 125	1k ohm ±1% 1206 SMD	569-0111-301
R 126	42.2k ohm ±1% 1206 SMD	569-0111-461
R 127	82.5k ohm ±1% 1206 SMD	569-0111-489
R 128	10k ohm ±5% 1206 SMD	569-0115-103
R 129	20k ohm ±5% 1206 SMD	569-0115-203
R 130	33k ohm ±5% 1206 SMD	569-0115-333
R 136	3.3k ohm ±5% 2512 SMD	569-0175-332
R 137	3.3k ohm ±5% 2512 SMD	569-0175-332
R 138	240 ohm ±5% 2512 SMD	569-0115-241
R 139	3.3k ohm ±5% 2512 SMD	569-0175-332
R 140	1k ohm single turn trimmer	562-0112-102
R 141	Zero ohm ±5% 1206 SMD	569-0115-001
R 142	10k ohm ±5% 1206 SMD	569-0115-103
R 143	2k ohm ±5% 2512 SMD	569-0175-202
R 144	15k ohm ±5% 1206 SMD	569-0115-153
R 145	15k ohm ±5% 1206 SMD	569-0115-153
R 146	3.9k ohm ±5% 1206 SMD	569-0115-392
R 147	10k ohm ±5% 1206 SMD	569-0115-103
R 148	15k ohm ±5% 1206 SMD	569-0115-153
R 149	82k ohm ±5% 1206 SMD	569-0115-823
R 150	10k ohm ±5% 1206 SMD	569-0115-103
R 151	100 ohm ±5% 1206 SMD	569-0115-101
R 152	75 ohm ±5% 1206 SMD	569-0115-750
R 153	100k ohm ±5% 1206 SMD	569-0115-104
R 154	300k ohm ±5% 1206 SMD	569-0115-304
R 155	1k ohm ±5% 1206 SMD	569-0115-102
R 156	10k ohm ±5% 1206 SMD	569-0115-103
R 157	15k ohm ±1% 1206 SMD	569-0111-301
R 158	1k ohm ±1% 1206 SMD	569-0111-301

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 159	180k ohm ±5% 1206 SMD	569-0115-184
R 160	10k ohm ±5% 1206 SMD	569-0115-103
R 165	2k ohm ±5% 2512 SMD	569-0175-202
S 101	Toggle switch on/on rt angle	583-0006-014
U 101	Quad comparator 2901	544-2025-011
U 102	Programmable voltage reg	544-2003-097
U 103	Programmable voltage reg	544-2003-097
U 104	Dual op amp SO-8	544-2019-004
U 105	Dual op amp SO-8	544-2019-004
U 106	Temp sensor LM-35 SO-8	544-2032-003
U 107	Full temp adjustable LM317T	544-2003-094
W 101	Green wire assembly	023-2000-836
W 102	Red wire assembly	023-2000-837
W 103	Black wire assembly	023-2000-838
W 104	Orange wire assembly	023-2000-839

THERMAL SENSOR BOARD
PART NO. 023-2000-840

A 001	Thermal sensor board assem	023-2000-841
C 001	.1 µF 10% X7R chip	510-3606-104
J 001	48 mil edge clip, short	515-9034-004
J 002	48 mil edge clip, short	515-9034-004
J 003	48 mil edge clip, short	515-9034-004
PC001	Thermal sensor board	035-2000-840
U 001	Temp sensor LM-35 SO-8	544-2032-003

OCXO DRAWER
PART NO. 023-2000-921 (w/1 OCXO)
023-2000-922 (w/2 OCXOs)

A 001	Main board OCXO drawer	023-2000-920
A 002	Power supply board OCXO	023-2000-930
A 003	8-Way BNC RF splitter	585-0647-027
C 901	150 pF ±5% NPO 1206 chip	510-3602-151
C 902	.01 µF ±10% X7R chip	510-3606-103
C 903	.0039 µF ±5% X7R 1206	510-3609-392
C 904	.0039 µF ±5% X7R 1206	510-3609-392
C 905	.001 µF ±10% X7R chip	510-3606-102
C 906	150 pF ±5% NPO 1206 chip	510-3602-151
C 907	150 pF ±5% NPO 1206 chip	510-3602-151
C 908	.01 µF ±10% X7R chip	510-3606-103
C 909	22 µF 16V SMD tant SMD	510-2625-220
C 910	22 µF 16V SMD tant SMD	510-2625-220
C 911	150 pF ±5% NPO 1206 chip	510-3602-151
C 912	.047 µF ±10% X7R chip	510-3606-473
C 913	.01 µF ±10% X7R chip	510-3606-103
C 914	.01 µF ±10% X7R chip	510-3606-103
C 915	.01 µF ±10% X7R chip	510-3606-103
C 916	.01 µF ±10% X7R chip	510-3606-103
C 917	.1 µF ±10% X7R 1210 chip	510-3607-104
C 921	2.2 µF 16V tantalum SMD	510-2625-229
C 922	2.2 µF 16V tantalum SMD	510-2625-229
C 923	470 pF ±5% NPO 1206 chip	510-3602-471
C 924	470 pF ±5% NPO 1206 chip	510-3602-471
C 925	.01 µF ±10% X7R chip	510-3606-103
C 926	.01 µF ±10% X7R chip	510-3606-103
C 927	.01 µF ±10% X7R chip	510-3606-103
C 928	.01 µF ±10% X7R chip	510-3606-103
C 929	.01 µF ±10% X7R chip	510-3606-103
C 930	.01 µF ±10% X7R chip	510-3606-103
C 931	.01 µF ±10% X7R chip	510-3606-103
C 932	.01 µF ±10% X7R chip	510-3606-103
C 933	.01 µF ±10% X7R chip	510-3606-103
C 934	.01 µF ±10% X7R chip	510-3606-103
C 935	.01 µF ±10% X7R chip	510-3606-103
C 936	.01 µF ±10% X7R chip	510-3606-103
C 937	.01 µF ±10% X7R chip	510-3606-103
C 938	.01 µF ±10% X7R chip	510-3606-103
C 939	.01 µF ±10% X7R chip	510-3606-103
C 940	.01 µF ±10% X7R chip	510-3606-103
C 941	.01 µF ±10% X7R chip	510-3606-103
C 942	.01 µF ±10% X7R chip	510-3606-103
C 943	.01 µF ±10% X7R chip	510-3606-103
C 944	.01 µF ±10% X7R chip	510-3606-103
C 945	.01 µF ±10% X7R chip	510-3606-103
C 946	.01 µF ±10% X7R chip	510-3606-103
C 947	.01 µF ±10% X7R chip	510-3606-103
C 948	.01 µF ±10% X7R chip	510-3606-103
CR901	Switching diode SOT-23	523-1504-002
CR902	Dual switch diode SOT-23	523-1504-023
CR903	Dual switch diode SOT-23	523-1504-023

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CR904	Dual switch diode SOT-23	523-1504-023
CR905	Dual switch diode SOT-23	523-1504-023
CR906	Switching diode SOT-23	523-1504-002
CR907	200V 1.5A rectifier 1N4818	523-0013-201
CR908	200V 1A rectifier 1N4003	523-0501-002
DS901	Red/Green LED right angle	549-4006-001
DS902	Red/Green LED right angle	549-4006-001
DS903	Red/Green LED right angle	549-4006-001
DS904	Red/Green LED right angle	549-4006-001
DS905	Red/Green LED right angle	549-4006-001
DS906	Red/Green LED right angle	549-4006-001
EP001	8 ft AC cord 3-18	597-1001-011
F 901	2A 250V subminiature	534-0017-017
FH901	Fuse holder PC bd mount	534-1017-001
HW001	6-32 x 0.078 nut NPB	560-2106-008
HW002	6-32 machine panhead ZPS	575-1610-008
HW003	10-32 machine panhead ZPS	575-1610-016
HW004	6-32 flathead philips BZPS	575-8206-306
HW005	6 x 0.018 lockwasher int	596-1106-009
HW006	#10 flat washer ZPS	596-1410-016
HW007	6-32 flathead 82 philips	575-9086-012
HW008	Power supply board insulator	018-1007-048
HW009	LED lens cover	018-1007-049
HW010	Lens adhesive	574-3002-117
HW011	LED lens cover adhesive	574-3002-118
HW012	5/16" cable clamp	572-0001-004
HW013	Washer	596-2406-012
HW014	6-32 mach panhead phil ZPS	575-1606-012
HW015	Fishpaper 0.005	018-1007-050
HW901	0.025 x 0.037 pin receptacle	515-5006-255
HW902	Rubber feet	574-1008-002
J 901	18-pin block header	586-2006-010
J 902	3-pin single inline header	515-7100-003
J 903	3-pin single inline header	515-7100-003
J 904	3-pin single inline header	515-7100-003
J 905	3-pin single inline header	515-7100-003
J 906	3-pin single inline header	515-7100-003
J 907	3-pin single inline header	515-7100-003
J 908	3-pin single inline header	515-7100-003
J 909	3-pin single inline header	515-7100-003
J 910	3-pin single inline header	515-7100-003
J 911	3-pin single inline header	515-7100-003
J 912	Rear connector housing	515-9031-234
J 920	18-terminal block connector	586-2006-005
K 901	12V SPDT reed DIP	567-2002-021
K 902	12V SPDT reed DIP	567-2002-021
K 903	12V SPDT reed DIP	567-2002-021
K 904	12V SPDT reed DIP	567-2002-021
K 905	12V SPDT reed DIP	567-2002-021
K 906	12V SPDT reed DIP	567-2002-021
L 901	3.9 µH inductor SMD	542-9001-399
L 902	10 µH inductor SMD	542-9001-100
L 903	3.9 µH inductor SMD	542-9001-399
L 904	.39 µH inductor SMD	542-9001-398
L 905	1.2 µH inductor SMD	542-9001-129
L 906	.39 µH inductor SMD	542-9001-398
MP001	Power cord strain relief	016-2187-270
MP002	Front panel	017-2210-125
MP003	Lens	032-0758-035
MP004	Drawer	017-2210-127
MP005	Top cover	017-2210-129
MP006	Mounting ear	017-2210-132
MP007	Foam pad 0.312 thick	574-3001-016
NP001	Nameplate	559-5861-163
P 902	2-pos shorting socket	515-5010-001
P 903	2-pos shorting socket	515-5010-001
P 904	2-pos shorting socket	515-5010-001
P 905	2-pos shorting socket	515-5010-001
P 906	2-pos shorting socket	515-5010-001
P 907	2-pos shorting socket	515-5010-001
P 908	2-pos shorting socket	515-5010-001
P 909	2-pos shorting socket	515-5010-001
P 910	2-pos shorting socket	515-5010-001
P 911	2-pos shorting socket	515-5010-001
P 912	2-pos shorting socket	515-5010-001
P 913	2-pos shorting socket	515-5010-001
PC900	PC board	035-2000-900
Q 901	Si NPN SOT-23	576-0003-658
Q 902	Si NPN SOT-23	576-0003-658
Q 903	Si NPN SOT-23	576-0003-658
Q 904	Si NPN SOT-23	576-0003-658

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 905	Si NPN SOT-23	576-0003-658
Q 906	Si NPN SOT-23	576-0003-658
Q 907	Si NPN SOT-23	576-0003-658
Q 908	Si NPN SOT-23	576-0003-658
Q 909	Si NPN SOT-23	576-0003-658
Q 910	Si NPN SOT-23	576-0003-658
Q 911	Si NPN SOT-23	576-0003-658
Q 912	Si NPN SOT-23	576-0003-658
Q 913	Si NPN SOT-23	576-0003-658
Q 914	Si NPN SOT-23	576-0003-658
Q 915	Si NPN SOT-23	576-0003-658
Q 916	Si PNP SOT-23	576-0003-657
Q 917	Si NPN SOT-23	576-0003-658
Q 918	Si PNP SOT-23	576-0003-657
Q 919	Si NPN SOT-23	576-0003-658
Q 920	Si NPN SOT-23	576-0003-658
Q 921	Si PNP SOT-23	576-0003-657
Q 922	Si NPN SOT-23	576-0003-658
Q 923	Si PNP SOT-23	576-0003-657
Q 924	Si NPN SOT-23	576-0003-658
Q 925	Si NPN SOT-23	576-0003-658
R 901	1k ohm ±5% 1206 SMD	569-0115-102
R 902	10k ohm ±5% 1206 SMD	569-0115-103
R 903	270 ohm ±5% 1206 SMD	569-0115-271
R 904	51 ohm ±5% 1206 SMD	569-0115-510
R 905	430 ohm ±5% 1206 SMD	569-0115-431
R 906	200 ohm ±5% 1206 SMD	569-0115-201
R 907	2.4k ohm ±5% 1206 SMD	569-0115-242
R 908	10k ohm ±5% 1206 SMD	569-0115-103
R 909	430 ohm ±5% 1206 SMD	569-0115-431
R 910	200 ohm ±5% 1206 SMD	569-0115-201
R 911	2.4k ohm ±5% 1206 SMD	569-0115-242
R 912	10k ohm ±5% 1206 SMD	569-0115-103
R 913	10k ohm ±5% 1206 SMD	569-0115-103
R 914	3.3k ohm ±5% 1206 SMD	569-0115-332
R 915	10k ohm ±5% 1206 SMD	569-0115-103
R 916	4.7k ohm ±5% 1206 SMD	569-0115-472
R 917	1k ohm ±5% 1206 SMD	569-0115-102
R 918	10k ohm ±5% 1206 SMD	569-0115-103
R 919	270 ohm ±5% 1206 SMD	569-0115-271
R 920	1M ohm ±5% 1206 SMD	569-0115-105
R 921	30k ohm ±5% 1206 SMD	569-0115-303
R 922	10k ohm ±5% 1206 SMD	569-0115-103
R 923	5.1k ohm ±5% 1206 SMD	569-0115-512
R 924	10k ohm ±5% 1206 SMD	569-0115-103
R 925	270k ohm ±5% 1206 SMD	569-0115-274
R 926	Zero ohm ±5% 1206 SMD	569-0115-001
R 927	100 ohm ±5% 1206 SMD	569-0115-101
R 928	150 ohm ±5% 1206 SMD	569-0115-151
R 929	Zero ohm ±5% 1206 SMD	569-0115-001
R 930	27k ohm ±5% 1206 SMD	569-0115-273
R 931	Zero ohm ±5% 1206 SMD	569-0115-001
R 932	100 ohm ±5% 1206 SMD	569-0115-101
R 933	150 ohm ±5% 1206 SMD	569-0115-151
R 934	Zero ohm ±5% 1206 SMD	569-0115-001
R 935	27k ohm ±5% 1206 SMD	569-0115-273
R 936	Zero ohm ±5% 1206 SMD	569-0115-001
R 937	100 ohm ±5% 1206 SMD	569-0115-101
R 938	150 ohm ±5% 1206 SMD	569-0115-151
R 939	Zero ohm ±5% 1206 SMD	569-0115-001
R 940	27k ohm ±5% 1206 SMD	569-0115-273
R 941	Zero ohm ±5% 1206 SMD	569-0115-001
R 942	100 ohm ±5% 1206 SMD	569-0115-101
R 943	150 ohm ±5% 1206 SMD	569-0115-151
R 944	Zero ohm ±5% 1206 SMD	569-0115-001
R 945	27k ohm ±5% 1206 SMD	569-0115-273
R 946	15k ohm ±5% 1206 SMD	569-0115-153
R 948	30k ohm ±5% 1206 SMD	569-0115-303
R 949	30k ohm ±5% 1206 SMD	569-0115-303
R 950	15k ohm ±5% 1206 SMD	569-0115-153
R 951	Zero ohm ±5% 1206 SMD	569-0115-001
R 952	Zero ohm ±5% 1206 SMD	569-0115-001
R 953	1k ohm ±5% 1206 SMD	569-0115-102
R 954	150 ohm ±5% 1206 SMD	569-0115-151
R 955	1.3k ohm ±5% 1206 SMD	569-0115-132
R 956	1.3k ohm ±5% 1206 SMD	569-0115-132
R 957	30k ohm ±5% 1206 SMD	569-0115-303
R 958	15k ohm ±5% 1206 SMD	569-0115-153
R 959	10k ohm ±5% 1206 SMD	569-0115-103
R 960	36k ohm ±5% 1206 SMD	569-0115-363
R 961	30k ohm ±5% 1206 SMD	569-0115-303
R 962	36k ohm ±5% 1206 SMD	569-0115-363
R 963	Zero ohm ±5% 1206 SMD	569-0115-001
R 964	1k ohm ±5% 1206 SMD	569-0115-102
R 965	150 ohm ±5% 1206 SMD	569-0115-151
R 966	1.3k ohm ±5% 1206 SMD	569-0115-132
R 967	1.3k ohm ±5% 1206 SMD	569-0115-132
R 968	30k ohm ±5% 1206 SMD	569-0115-303
R 969	15k ohm ±5% 1206 SMD	569-0115-153
R 970	10k ohm ±5% 1206 SMD	569-0115-103
R 971	36k ohm ±5% 1206 SMD	569-0115-363
R 972	30k ohm ±5% 1206 SMD	569-0115-303
R 973	470k ohm ±5% 1206 SMD	569-0115-474

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 974	39k ohm ±5% 1206 SMD	569-0115-393
R 975	51 ohm ±5% 1206 SMD	569-0115-510
R 976	15k ohm ±5% 1206 SMD	569-0115-153
R 977	15k ohm ±5% 1206 SMD	569-0115-153
S 901	Toggle switch on-none-mom	583-0006-010
S 902	Toggle switch on-none-mom	583-0006-010
S 903	Toggle switch on-none-mom	583-0006-010
S 904	4-pos recessed DIP switch	583-5002-104
S 905	4-pos recessed DIP switch	583-5002-104
U 901	Quad 2-in NAND 74HC00	544-3766-000
U 902	Quad 2-in AND 74HC08	544-3766-008
U 903	Quad 2-in AND 74HC08	544-3766-008
U 904	Hex inverter SOIC 74HC04	544-3766-004
U 905	Dual 4-bit bi ripple counter	544-3766-393
U 906	Dual differential line driver	544-2023-026
U 907	Dual monostable multivibrator	544-3766-123
U 908	Opto isolation NPN out	544-2010-001
U 909	Opto isolation NPN out	544-2010-001
U 910	Dual D-flip-flop 74HC74	544-3766-074
U 911	Dual monostable multivibrator	544-3766-123
U 912	Quad 2-in OR gate 74HC32	544-3766-032
U 913	Phase locked loop 4046 SOIC	544-3016-046
U 914	Quad 2-in AND 74HC08	544-3766-008
W 902	Coax BNC panel 14.5"	597-3003-250
W 903	Coax BNC	597-3003-252
W 904	Coax BNC panel 14.5"	597-3003-250
Y 901	10 MHz OCXO ±0.03 PPM	561-0006-012
Y 902	10 MHz OCXO ±0.03 PPM	561-0006-012

OCXO DRAWER POWER SUPPLY
PART NO. 023-2000-930

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 101	1000 µF 50V	510-4076-102
C 102	6.8 µF 35V SMD tantalum	510-2635-689
C 103	.001 µF ±5% NPO 1206 chip	510-3602-102
C 104	220 µF 25V aluminum radial	510-4225-221
C 105	15 µF 20V SMD tantalum	510-2626-150
C 106	15 µF 20V SMD tantalum	510-2633-150
C 107	.001 µF ±5% NPO 1206	510-3602-102
C 108	2200 µF 25V aluminum axial	510-4325-222
C 109	15 µF 20V tantalum SMD	510-2633-150
C 110	.001 µF ±5% NPO 1206	510-3602-102
C 111	.001 µF ±5% NPO 1206	510-3602-102
C 112	4.7 µF 16V SMD tantalum	510-2625-479
CR101	200V 1.5A 1N4818	523-0013-201
CR102	200V 1.5A 1N4818	523-0013-201
CR103	200V 1.5A 1N4818	523-0013-201
CR104	200V 1.5A 1N4818	523-0013-201
CR105	200V 1.5A 1N4818	523-0013-201
EP101	Therma-film washer TO-3	574-5005-001
F 101	0.25A 250V subminiature	534-0017-008
FH101	Fuse holder PC board mount	534-1017-001
HW101	4-40 machine panhead ZPS	575-1604-012
HW102	#4 shakeproof washer	596-1104-008
HW103	4-40 x 0.094 nut NPB	560-2104-008
HW104	4-40 x 0.25 panhead taptite	575-0604-008
HW105	6-32 panhead taptite 5/16	575-0606-010
HW106	#4 x 0.046 shoulder washer	596-4504-008
HW107	Grafoil TO-220	018-1007-043
HW108	Grafoil pad	018-1007-044
HW109	6-32 panhead philips	575-0606-012
J 101	PC board mt AC power cord	515-0028-008
J 102	4-cond #22 conn housing	515-9031-233
MP101	OCXO drawer heat sink	017-2210-130
MP102	OCXO drwr finned heat sink	014-0771-126
PC100	Power supply board	035-2000-930
R 101	2.49k ohm ±1% 1206 SMD	569-0111-339
R 102	220 ohm ±1% 1206 SMD	569-0111-234
S 101	115/230V select switch	583-3008-002
T 101	Low profile PC bd mt xfmr	592-3001-030
U 101	Voltage reg TO-3 LM117	544-2003-092
U 102	5V regulator LM2940T-5	544-2003-091

MAIN PROCESSOR CARD
PART NO. 023-2000-310

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 001	10 pF ±5% NPO 1206 chip	510-3602-100
C 002	20 pF ±5% NPO 1206 chip	510-3602-200
C 004	.01 µF ±10% X7R chip	510-3606-103
C 005	.01 µF ±10% X7R chip	510-3606-103
C 006	.01 µF ±10% X7R chip	510-3606-103
C 007	.01 µF ±10% X7R chip	510-3606-103
C 008	10 pF ±5% NPO 1206 chip	510-3602-100
C 009	.01 µF ±10% X7R chip	510-3606-103
C 010	.01 µF ±10% X7R chip	510-3606-103
C 011	.01 µF ±10% X7R chip	510-3606-103
C 012	.01 µF ±10% X7R chip	510-3606-103
C 013	20 pF ±5% NPO 1206 chip	510-3602-200
C 015	.01 µF ±10% X7R chip	510-3606-103
C 016	.01 µF ±10% X7R chip	510-3606-103
C 017	47 µF 25V electrolytic radial	510-4425-470
C 018	47 µF 25V electrolytic radial	510-4425-470
C 019	62 pF ±5% NPO 1206 chip	510-3602-620
C 020	.1 µF ±10% X7R chip	510-3606-104
C 021	.1 µF ±10% X7R chip	510-3606-104
C 022	.1 µF ±10% X7R chip	510-3606-104
C 023	.1 µF ±10% X7R chip	510-3606-104
C 024	10 µF 16V tantalum SMD	510-2625-100
C 025	10 µF 16V tantalum SMD	510-2625-100
C 026	.01 µF ±10% X7R chip	510-3606-103
C 027	10 µF 16V tantalum SMD	510-2625-100
C 028	10 µF 16V tantalum SMD	510-2625-100
C 029	62 pF ±5% NPO 1206 chip	510-3602-620
C 030	.01 µF ±10% X7R chip	510-3606-103
C 031	.01 µF ±10% X7R chip	510-3606-103
C 032	.01 µF ±10% X7R chip	510-3606-103
CR001	Green LED submin radial	549-4001-122
CR002	Yellow LED submin radial	549-4001-121
CR003	Red LED subminiature radial	549-4001-120
CR004	Red LED subminiature radial	549-4001-120
CR005	Yellow LED submin radial	549-4001-121
DS001	7-segment display .3" green	549-4002-020
EP001	Crystal pin insulator	018-1080-001
EP002	Crystal pin insulator	018-1080-001
EP003	Crystal pin insulator	018-1080-001
EP004	Crystal pin insulator	018-1080-001
HW001	Panel fastener	537-0011-031
HW001	Card injector/extractor nylon	537-9057-020
J 001	8-cond modular jack PC mt	515-2006-040
J 002	3-pin single inline header	515-7100-003
J 003	14-pin double row header	515-7101-407
J 004	6-pin double row header	515-7101-403
J 005	3-pin single inline header	515-7100-003
J 006	3-pin single inline header	515-7100-003
P 001	64-pin DIN male right angle	515-7082-101
P 002	2-pos shorting socket	515-5010-001
P 003	2-pos shorting socket	515-5010-001
P 004	2-pos shorting socket	515-5010-001
P 005	2-pos shorting socket	515-5010-001
P 006	2-pos shorting socket	515-5010-001
PC310	PC board	035-2000-310
Q 002	PNP switching SOT-23	576-0003-612
Q 003	NPN gen purp SOT-23	576-0001-300
R 001	10M ohm ±5% 1206 SMD	569-0115-106
R 002	2.2k ohm ±5% 1206 SMD	569-0115-222
R 003	Zero ohm ±5% 1206 SMD	569-0115-001
R 004	2k ohm ±5% 1206 SMD	569-0115-202
R 005	150 ohm ±5% 1206 SMD	569-0115-151
R 006	200 ohm ±5% 1206 SMD	569-0115-201
R 007	1.2k ohm ±5% 1/4W CF	569-0115-122
R 008	1.2k ohm ±5% 1/4W CF	569-0115-122
R 009	1.2k ohm ±5% 1/4W CF	569-0115-122
R 010	200 ohm ±5% 1206 SMD	569-0115-201
R 011	1.2k ohm ±5% 1/4W CF	569-0115-122
R 012	10k ohm ±5% 1206 SMD	569-0115-103
R 013	150 ohm ±5% 1206 SMD	569-0115-151
R 014	10k ohm ±5% 1206 SMD	569-0115-103
R 015	10k ohm ±5% 1206 SMD	569-0115-103
R 016	10k ohm ±5% 1206 SMD	569-0115-103
R 017	2.2k ohm ±5% 1206 SMD	569-0115-222
R 018	2.2k ohm ±5% 1206 SMD	569-0115-222
R 019	2.2k ohm ±5% 1206 SMD	569-0115-222
R 020	2.2k ohm ±5% 1206 SMD	569-0115-222
R 021	100k ohm ±5% 1206 SMD	569-0115-104
R 022	10k ohm ±5% 1206 SMD	569-0115-103
R 023	4.7k ohm ±5% 1206 SMD	569-0115-472
R 024	4.7k ohm ±5% 1206 SMD	569-0115-472
R 025	10k ohm ±5% 1206 SMD	569-0115-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 026	10k ohm ±5% 1206 SMD	569-0115-103
R 027	10k ohm ±5% 1206 SMD	569-0115-103
R 028	4.7k ohm ±5% 1206 SMD	569-0115-472
R 029	10k ohm ±5% 1206 SMD	569-0115-103
R 030	10k ohm ±5% 1206 SMD	569-0115-103
R 031	10k ohm ±5% 1206 SMD	569-0115-103
R 032	1k ohm ±5% 1206 SMD	569-0115-102
R 033	1k ohm ±5% 1206 SMD	569-0115-102
R 034	10k ohm ±5% 1206 SMD	569-0115-103
R 035	3.9k ohm ±5% 1206 SMD	569-0115-392
R 038	20k ohm ±5% 1206 SMD	569-0115-203
R 039	270k ohm ±5% 1206 SMD	569-0115-274
R 040	15 ohm 1W SMD	569-0175-150
S 001	SPST momentary sw	583-4005-002
S 002	8-pos DIP switch	583-5002-008
S 003	4-pos DIP switch	583-5002-004
U 001	8k x 8 CMOS static RAM	544-5001-109
U 002	Hex inverter SOIC 74HC04	544-3766-004
U 003	1 of 8 demux 74HC138	544-3766-138
U 004	1 of 8 demux 74HC138	544-3766-138
U 005	1 of 16 demux SOIC 74HC154	544-3766-154
U 006	Quad 2-input OR 74HC32	544-3766-032
U 007	Quad 2-input OR 74HC32	544-3766-032
U 008	D-latch non-inv 74HC573	544-3766-573
U 009	9 bit x 64 word FIFO DIP-28	544-3764-703
U 010	9 bit x 64 word FIFO DIP-28	544-3764-703
U 011	12V regulator TO-92 78L12	544-2003-032
U 012	12V regulator TO-92 78L12	544-2003-032
U 013	CMOS 87C52	544-5011-948
U 014	HSDB LTR-Net software	023-9998-456
U 015	Hex open drain buffer SO-14	544-3716-906
U 016	Driver/receiver RS232C/v28	544-2023-014
U 017	Micro monitor SO-8 DS1232	544-2003-085
U 018	32 x 8 SCRAM SO-28 CMOS	544-5001-412
U 020	Quad 2-input NAND 74HC00	544-3766-000
U 021	7-stage binary cntr SOIC 4024	544-3016-024
U 022	Prog comm intfc 82C51	544-5001-319
U 023	Differential bus xcvr SN65176	544-2023-025
U 024	Differential bus xcvr SN65176	544-2023-025
U 025	MPC boot code	023-9998-277
U 026	BCD 7 latch DIP-16 MC14495	544-3014-495
U 027	CPU v25 PLCC-84 MPD7032	544-5002-016
U 028	EEPROM PLCC32R 28C64	544-5002-412
U 030	HEX inverting Schmitt trigger	544-3014-092
U 031	Quad 2-input NOR gate	544-3014-002
U 032	Octal buffer/line driver	544-3542-243
X 001	10-pos right angle IC socket	515-5008-270
X 014	28-pin IC socket	515-5008-018
X 013	40-pin IC socket	515-5008-019
X 024	8-pin DIP socket	515-5008-011
X 025	32-pin IC socket	515-5008-108
X 027	84-pos PLCC socket	515-5020-100
Y 001	10 MHz crystal HC-18	521-0010-000
Y 002	11.059 MHz crystal	521-0011-059
Y 003	2.4576 MHz HC-18U	521-0002-458
Y 004	12 MHz µP crystal	521-0012-000
Z 001	EMI suppression filter	532-3003-002
Z 002	EMI suppression filter	532-3003-002

MAIN AUDIO CARD
PART NO. 023-2000-320

A 301	Compandor option	023-2000-940
C 100	470 pF ±5% NPO 1206 chip	510-3602-471
C 101	.0022 µF ±10% X7R 1206 chip	510-3606-222
C 102	.001 µF ±2% NPO 1206	510-3616-102
C 103	.1 µF ±10% X7R chip	510-3606-104
C 104	100 pF ±2% NPO 1206	510-3616-101
C 105	.033 µF ±5% X7R 1210	510-3610-333
C 106	.068 µF ±5% X7R 1206	510-3609-683
C 107	.022 µF ±5% X7R 1206	510-3609-223
C 108	.1 µF ±5% X7R 1206	510-3609-104
C 109	.1 µF ±5% X7R 1206	510-3609-104
C 110	.022 µF ±5% X7R 1206	510-3609-223
C 111	.022 µF ±5% X7R 1206	510-3609-223
C 112	.01 µF ±5% X7R 1206	510-3609-103
C 113	100 pF ±5% NPO 1206 chip	510-3602-101
C 114	100 pF ±5% NPO 1206 chip	510-3602-101
C 115	100 pF ±5% NPO 1206 chip	510-3602-101
C 116	.001 µF ±5% NPO 1206	510-3602-102
C 117	.01 µF ±5% X7R 1206	510-3609-103
C 118	.01 µF ±5% X7R 1206	510-3609-103
C 119	.1 µF ±5% X7R 1206	510-3609-104
C 120	.1 µF ±5% X7R 1206	510-3609-104
C 121	.01 µF ±5% X7R 1206	510-3609-103
C 122	.022 µF ±5% X7R 1206	510-3609-223
C 123	.047 µF ±5% X7R 1206	510-3609-473
C 124	.0068 µF ±10% X7R chip	510-3606-682
C 125	680 pF ±2% NPO 1206	510-3616-681
C 126	.01 µF ±2% NPO 1206	510-3617-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 127	680 pF ±2% NPO 1206	510-3616-681
C 128	.0033 µF ±2% NPO 1206	510-3616-332
C 129	470 pF ±2% NPO 1206	510-3616-471
C 130	470 pF ±2% NPO 1206	510-3616-471
C 131	.0047 µF ±5% X7R 1206	510-3609-472
C 132	.0056 µF ±2% NPO 1206	510-3617-562
C 133	.0047 µF ±2% NPO 1206	510-3616-472
C 134	20 pF ±5% NPO 1206 chip	510-3602-200
C 136	100 pF ±5% NPO 1206	510-3602-101
C 137	100 pF ±5% NPO 1206	510-3602-101
C 138	.1 µF ±10% X7R chip	510-3606-104
C 139	.1 µF ±10% X7R chip	510-3606-104
C 140	.1 µF ±10% X7R chip	510-3606-104
C 141	.1 µF ±10% X7R chip	510-3606-104
C 142	.01 µF ±5% X7R 1206	510-3609-103
C 143	.022 µF ±5% X7R 1206	510-3609-223
C 144	.047 µF ±10% X7R 1206	510-3606-473
C 145	.0068 µF ±5% X7R 1206	510-3609-682
C 146	390 pF ±5% NPO 1206	510-3602-391
C 147	4700 pF ±2% NPO 1206	510-3616-681
C 148	.01 µF ±2% NPO 1206	510-3617-103
C 149	4700 pF ±2% NPO 1206	510-3616-472
C 150	.022 µF ±5% X7R 1206	510-3609-223
C 151	.1 µF ±10% X7R chip	510-3606-104
C 152	.1 µF ±10% X7R chip	510-3606-104
C 153	.1 µF ±10% X7R chip	510-3606-104
C 154	.1 µF ±10% X7R chip	510-3606-104
C 155	15 pF ±5% NPO 1206 chip	510-3602-150
C 156	.1 µF ±10% X7R chip	510-3606-104
C 157	.1 µF ±10% X7R chip	510-3606-104
C 158	10 µF 16V tantalum SMD	510-2625-100
C 159	.1 µF ±10% X7R chip	510-3606-104
C 160	.1 µF ±10% X7R chip	510-3606-104
C 161	.1 µF ±10% X7R chip	510-3606-104
C 162	20 pF ±5% NPO 1206 chip	510-3602-200
C 163	20 pF ±5% NPO 1206 chip	510-3602-200
C 164	.001 µF ±2% NPO 1206	510-3616-102
C 165	360 pF ±5% NPO 1206	510-3602-361
C 166	15 pF ±5% NPO 1206 chip	510-3602-150
C 169	.1 µF ±10% X7R chip	510-3606-104
C 170	.01 µF ±10% X7R chip	510-3606-103
C 171	.01 µF ±10% X7R chip	510-3606-103
C 172	.01 µF ±10% X7R chip	510-3606-103
C 173	.01 µF ±10% X7R chip	510-3606-103
C 174	.01 µF ±10% X7R chip	510-3606-103
C 175	.01 µF ±10% X7R chip	510-3606-103
C 176	.01 µF ±10% X7R chip	510-3606-103
C 177	.01 µF ±10% X7R chip	510-3606-103
C 178	.01 µF ±10% X7R chip	510-3606-103
C 179	.01 µF ±10% X7R chip	510-3606-103
C 180	.01 µF ±10% X7R chip	510-3606-103
C 181	.01 µF ±10% X7R chip	510-3606-103
C 182	.01 µF ±10% X7R chip	510-3606-103
C 183	.01 µF ±10% X7R chip	510-3606-103
C 184	.01 µF ±10% X7R chip	510-3606-103
C 185	.01 µF ±10% X7R chip	510-3606-103
C 186	.01 µF ±10% X7R chip	510-3606-103
C 187	.01 µF ±10% X7R chip	510-3606-103
C 188	.01 µF ±10% X7R chip	510-3606-103
C 189	.01 µF ±10% X7R chip	510-3606-103
C 190	.01 µF ±10% X7R chip	510-3606-103
C 191	.01 µF ±10% X7R chip	510-3606-103
C 192	.01 µF ±10% X7R chip	510-3606-103
C 193	.01 µF ±10% X7R chip	510-3606-103
C 194	.01 µF ±10% X7R chip	510-3606-103
C 195	.01 µF ±10% X7R chip	510-3606-103
C 196	.01 µF ±10% X7R chip	510-3606-103
C 197	.01 µF ±10% X7R chip	510-3606-103
C 198	.01 µF ±10% X7R chip	510-3606-103
C 199	.01 µF ±10% X7R chip	510-3606-103
C 200	.01 µF ±10% X7R chip	510-3606-103
C 201	.01 µF ±10% X7R chip	510-3606-103
C 202	.01 µF ±10% X7R chip	510-3606-103
C 203	.01 µF ±10% X7R chip	510-3606-103
C 204	.01 µF ±10% X7R chip	510-3606-103
C 205	.01 µF ±10% X7R chip	510-3606-103
C 206	.01 µF ±10% X7R chip	510-3606-103
C 207	1 µF tantalum SMD	510-2625-109
C 208	.01 µF ±10% X7R chip	510-3606-103
C 209	.01 µF ±10% X7R chip	510-3606-103
C 210	.01 µF ±10% X7R chip	510-3606-103
C 211	.01 µF ±10% X7R chip	510-3606-103
C 212	.01 µF ±10% X7R chip	510-3606-103
C 213	.01 µF ±10% X7R chip	510-3606-103
C 214	.01 µF ±10% X7R chip	510-3606-103
C 215	.01 µF ±10% X7R chip	510-3606-103
C 216	.01 µF ±10% X7R chip	510-3606-103
C 217	.01 µF ±10% X7R chip	510-3606-103
C 218	.01 µF ±10% X7R chip	510-3606-103
C 219	.01 µF ±10% X7R chip	510-3606-103
C 220	.01 µF ±10% X7R chip	510-3606-103
C 221	.01 µF ±10% X7R chip	510-3606-103
C 222	.01 µF ±10% X7R chip	510-3606-103
C 223	.01 µF ±10% X7R chip	510-3606-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 224	.01 µF ±10% X7R chip	510-3606-103
C 225	.01 µF ±10% X7R chip	510-3606-103
C 226	.01 µF ±10% X7R chip	510-3606-103
C 227	.01 µF ±10% X7R chip	510-3606-103
C 228	.01 µF ±10% X7R chip	510-3606-103
C 229	.01 µF ±10% X7R chip	510-3606-103
C 230	.01 µF ±10% X7R chip	510-3606-103
C 231	.01 µF ±10% X7R chip	510-3606-103
C 232	.01 µF ±10% X7R chip	510-3606-103
C 233	.01 µF ±10% X7R chip	510-3606-103
C 234	.01 µF ±10% X7R chip	510-3606-103
C 235	1 µF 16V tantalum SMD	510-2625-109
C 236	.001 pF ±2% NPO 1206	510-3616-102
C 237	.033 µF ±5% X7R 1210	510-3610-333
C 238	.047 µF ±5% X7R 1206	510-3609-473
C 239	.068 µF ±5% X7R 1206	510-3609-683
C 240	1 µF 16V tantalum SMD	510-2625-109
C 241	15 µF 20V tantalum SMD	510-2626-150
C 242	15 µF 20V tantalum SMD	510-2626-150
C 247	.1 µF ±10% X7R chip	510-3606-104
C 249	.1 µF ±10% X7R chip	510-3606-104
C 251	15 µF 20V tantalum SMD	510-2626-150
C 254	.1 µF ±10% X7R 1206	510-3606-104
C 255	47 µF 10V tantalum SMD	510-2624-470
C 256	15 µF 20V tantalum SMD	510-2626-150
C 257	47 µF 10V tantalum SMD	510-2624-470
C 258	47 µF 10V tantalum SMD	510-2624-470
C 262	.01 µF ±10% X7R chip	510-3606-103
C 263	.01 µF ±10% X7R chip	510-3606-103
C 264	.01 µF ±10% X7R chip	510-3606-103
C 265	.01 µF ±10% X7R chip	510-3606-103
C 266	.01 µF ±10% X7R chip	510-3606-103
C 267	47 µF 10V tantalum SMD	510-2624-470
C 268	47 µF 10V tantalum SMD	510-2624-470
C 269	47 µF 10V tantalum SMD	510-2624-470
C 270	47 µF 10V tantalum SMD	510-2624-470
C 271	.01 µF ±10% X7R chip	510-3606-103
C 272	.01 µF ±10% X7R chip	510-3606-103
C 273	.01 µF ±10% X7R chip	510-3606-103
C 276	.0022 µF ±2% NPO 1206	510-3616-222
C 277	.0047 µF ±2% NPO 1206	510-3616-472
C 278	.0068 µF ±2% NPO 1206	510-3617-682
C 279	.22 µF ±5% X7R 1210	510-3610-224
C 280	.022 µF ±5% X7R 1206	510-3609-223
C 281	820 pF ±2% NPO 1206	510-3616-821
C 282	.1 µF ±10% X7R 1206	510-3606-104
C 283	.1 µF ±10% X7R 1206	510-3606-104
C 285	470 µF 25V radial low temp	510-4064-471
C 286	10 µF tantalum SMD	510-2625-100
C 287	300 pF ±5% NPO 1206	510-3602-301
C 288	300 pF ±5% NPO 1206	510-3602-301
C 289	300 pF ±5% NPO 1206	510-3602-301
C 290	300 pF ±5% NPO 1206	510-3602-301
C 291	.1 µF ±5% X7R 1206	510-3609-104
C 292	360 pF ±5% NPO 1206	510-3602-361
C 293	68 pF ±5% NPO 1206	510-3602-680
C 294	.1 µF ±5% X7R 1206	510-3609-104
C 296	10 µF 16V tantalum SMD	510-2625-100
C 297	.0039 µF ±2% NPO 1206	510-3616-392
C 298	.0033 µF ±2% NPO 1206	510-3616-332
C 299	.01 µF ±10% X7R chip	510-3606-103
C 300	.0056 µF ±2% NPO 1210	510-3617-562
C 301	.0047 µF ±2% NPO 1206	510-3616-472
C 302	.0033 µF ±2% NPO 1206	510-3616-332
C 303	.0039 µF ±2% NPO 1206	510-3616-392
C 304	.1 µF ±10% X7R 1206 chip	510-3606-104
C 305	10 µF tantalum SMD	510-2625-100
C 306	.1 µF ±10% X7R chip	510-3606-104
C 307	100 pF ±5% NPO 1206	510-3602-101
CR100	Switching diode SOT-23	523-1504-002
CR101	Dual switching diode SOT-23	523-1504-023
CR102	Dual switching diode SOT-23	523-1504-023
CR103	Dual switching diode SOT-23	523-1504-023
CR104	Dual switching diode SOT-23	523-1504-023
CR105	Dual switching diode SOT-23	523-1504-023
CR106	Switching diode SOT-23	523-1504-002
CR107	4.3V zener SOT-23	523-2016-439
CR108	UHF/VHF band switch SOT	523-1504-012
CR109	UHF/VHF band switch SOT	523-1504-012
CR110	UHF/VHF band switch SOT	523-1504-012
CR111	2.4V 1W zener	523-2505-249
CR112	2.4V 1W zener	523-2505-249
CR113	15V zener SOT-23	523-2016-150
CR114	15V zener SOT-23	523-2016-150
CR117	15V zener SOT-23	523-2016-150
CR118	15V zener SOT-23	523-2016-150
CR119	5.1V zener SOT-23	523-2016-519
CR120	5.1V zener SOT-23	523-2016-519
EP100	Crystal pin insulator	018-1080-001
HW001	Panel fastener	537-0011-031
HW101	Card inj/ext nylon pull	537-9057-020

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
HW102	Rivet snap 0.142 dia	574-9015-050
J 100	Green horizontal tip jack .080	105-2204-105
J 101	Speaker jack 0.1 enclosed	515-2002-011
J 102	3.6mm jack enclosed	515-2001-011
J 103	Black horiz tip jack .080	105-2203-101
J 104	3.6mm jack enclosed	515-2001-011
J 105	3-pin single inline header	515-7100-003
J 106	5-pin single inline header	515-7100-005
J 301	Minisert cl bottom socket	515-5006-041
MP101	Control knob	032-0792-010
P 100	32-pin DIN male right angle	515-7082-102
P 101	64-pin DIN male right angle	515-7082-101
P 102	2-pos shorting socket	515-5010-001
P 106	2-pos shorting socket	515-5010-001
P 107	2-pos shorting socket	515-5010-001
PC200	PC board	035-2000-320
Q 101	Si PNP SOT-23 2N3906	576-0003-657
Q 102	Si NPN SOT-23 2N3904	576-0003-658
R 101	29.4k ohm ±1% 1206 SMD	569-0111-446
R 102	147k ohm ±1% 1206 SMD	569-0111-517
R 103	69.8k ohm ±1% 1206 SMD	569-0111-482
R 104	15k ohm ±1% 1206 SMD	569-0111-418
R 105	100 ohm ±1% 1206 SMD	569-0111-201
R 106	1.07M ohm ±1% 1206 SMD	569-0111-604
R 107	1.07M ohm ±1% 1206 SMD	569-0111-604
R 108	110 ohm ±1% 1206 SMD	569-0111-205
R 109	1.07M ohm ±1% 1206 SMD	569-0111-604
R 110	110 ohm ±1% 1206 SMD	569-0111-205
R 111	18.2k ohm ±1% 1206 SMD	569-0111-426
R 112	47k ohm ±5% 1206 SMD	569-0115-473
R 113	150k ohm ±5% 1206 SMD	569-0115-154
R 114	18k ohm ±5% 1206 SMD	569-0115-183
R 115	47k ohm ±5% 1206 SMD	569-0115-473
R 116	1.5k ohm ±5% 1206 SMD	569-0115-152
R 117	6.2k ohm ±5% 1206 SMD	569-0115-622
R 118	12k ohm ±5% 1206 SMD	569-0115-123
R 119	47k ohm ±5% 1206 SMD	569-0115-473
R 120	10k ohm ±5% 1206 SMD	569-0115-103
R 121	47k ohm ±5% 1206 SMD	569-0115-473
R 122	10k ohm ±5% 1206 SMD	569-0115-103
R 123	330k ohm ±5% 1206 SMD	569-0115-334
R 124	1M ohm ±5% 1206 SMD	569-0115-105
R 125	100k ohm ±5% 1206 SMD	569-0115-104
R 126	100k ohm ±5% 1206 SMD	569-0115-104
R 127	470k ohm ±5% 1206 SMD	569-0115-474
R 128	100k ohm ±5% 1206 SMD	569-0115-104
R 129	47k ohm ±5% 1206 SMD	569-0115-473
R 130	100k ohm ±5% 1206 SMD	569-0115-104
R 131	56k ohm ±5% 1206 SMD	569-0115-563
R 132	56k ohm ±5% 1206 SMD	569-0115-563
R 133	100k ohm ±5% 1206 SMD	569-0115-104
R 134	100k ohm ±5% 1206 SMD	569-0115-104
R 135	47k ohm ±5% 1206 SMD	569-0115-473
R 136	10k ohm ±5% 1206 SMD	569-0115-103
R 137	121k ohm ±1% 1206 SMD	569-0111-509
R 138	121k ohm ±1% 1206 SMD	569-0111-509
R 139	35.7k ohm ±1% 1206 SMD	569-0111-454
R 140	27.4k ohm ±1% 1206 SMD	569-0111-443
R 141	22.6k ohm ±1% 1206 SMD	569-0111-435
R 142	17.4k ohm ±1% 1206 SMD	569-0111-424
R 143	3.3k ohm ±5% 1206 SMD	569-0115-332
R 144	1k ohm ±5% 1206 SMD	569-0115-102
R 145	150k ohm ±5% 1206 SMD	569-0115-154
R 150	86.6k ohm ±1% 1206 SMD	569-0111-491
R 151	43.2k ohm ±1% 1206 SMD	569-0111-462
R 152	22k ohm ±5% 1206 SMD	569-0115-223
R 153	43k ohm ±5% 1206 SMD	569-0115-433
R 154	43k ohm ±5% 1206 SMD	569-0115-433
R 155	82k ohm ±5% 1206 SMD	569-0115-823
R 156	82k ohm ±5% 1206 SMD	569-0115-823
R 157	82k ohm ±5% 1206 SMD	569-0115-823
R 158	82k ohm ±5% 1206 SMD	569-0115-823
R 159	2.74k ohm ±1% 1206 SMD	569-0111-343
R 160	1.1k ohm ±1% 1206 SMD	569-0111-305
R 161	3.01k ohm ±1% 1206 SMD	569-0111-347
R 162	18.2k ohm ±1% 1206 SMD	569-0111-426
R 163	100k ohm ±5% 1206 SMD	569-0115-104
R 164	100k ohm ±5% 1206 SMD	569-0115-104
R 165	47k ohm ±5% 1206 SMD	569-0115-473
R 166	56k ohm ±5% 1206 SMD	569-0115-563
R 167	56k ohm ±5% 1206 SMD	569-0115-563
R 168	2.2k ohm ±5% 1206 SMD	569-0115-222
R 169	54.9k ohm ±1% 1206 SMD	569-0111-472
R 170	1M ohm ±5% 1206 SMD	569-0115-105
R 171	10k ohm ±5% 1206 SMD	569-0115-103
R 172	10k ohm ±5% 1206 SMD	569-0115-103
R 173	430k ohm ±5% 1206 SMD	569-0115-434
R 174	160k ohm ±5% 1206 SMD	569-0115-164

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 175	4.3k ohm ±5% 1206 SMD	569-0115-432
R 176	6.8k ohm ±5% 1206 SMD	569-0115-682
R 177	100k ohm ±5% 1206 SMD	569-0115-104
R 178	100k ohm ±5% 1206 SMD	569-0115-104
R 179	300 ohm ±5% 1206 SMD	569-0115-301
R 180	300 ohm ±5% 1206 SMD	569-0115-301
R 181	100k ohm ±5% 1206 SMD	569-0115-104
R 182	100k ohm ±5% 1206 SMD	569-0115-104
R 183	300 ohm ±5% 1206 SMD	569-0115-301
R 184	300 ohm ±5% 1206 SMD	569-0115-301
R 185	75k ohm ±1% 1206 SMD	569-0111-485
R 186	75k ohm ±1% 1206 SMD	569-0111-485
R 187	75k ohm ±1% 1206 SMD	569-0111-485
R 188	75k ohm ±1% 1206 SMD	569-0111-485
R 189	300 ohm ±5% 1206 SMD	569-0115-301
R 190	300 ohm ±5% 1206 SMD	569-0115-301
R 191	75k ohm ±1% 1206 SMD	569-0111-485
R 192	75k ohm ±1% 1206 SMD	569-0111-485
R 193	75k ohm ±1% 1206 SMD	569-0111-485
R 194	75k ohm ±1% 1206 SMD	569-0111-485
R 195	300 ohm ±5% 1206 SMD	569-0115-301
R 196	300 ohm ±5% 1206 SMD	569-0115-301
R 197	1M ohm ±5% 1206 SMD	569-0115-105
R 198	10k ohm ±5% 1206 SMD	569-0115-103
R 199	100k ohm ±5% 1206 SMD	569-0115-104
R 200	2.2k ohm ±5% 1206 SMD	569-0115-222
R 201	270k ohm ±5% 1206 SMD	569-0115-274
R 202	1M ohm ±5% 1206 SMD	569-0115-105
R 203	10k ohm ±5% 1206 SMD	569-0115-103
R 204	47k ohm ±5% 1206 SMD	569-0115-473
R 205	7.5k ohm ±5% 1206 SMD	569-0115-752
R 206	10k ohm ±5% 1206 SMD	569-0115-103
R 207	10k ohm ±5% 1206 SMD	569-0115-103
R 208	10k ohm ±5% 1206 SMD	569-0115-103
R 209	10k ohm ±5% 1206 SMD	569-0115-103
R 210	10k ohm ±5% 1206 SMD	569-0115-103
R 211	100 ohm ±5% 1206 SMD	569-0115-101
R 212	1k ohm ±5% 1206 SMD	569-0115-102
R 213	5.1k ohm ±5% 1206 SMD	569-0115-512
R 214	3.9k ohm ±5% 1206 SMD	569-0115-392
R 215	1k ohm ±5% 1206 SMD	569-0115-102
R 216	10k ohm ±5% 1206 SMD	569-0115-103
R 217	100 ohm ±5% 1206 SMD	569-0115-101
R 218	82k ohm ±5% 1206 SMD	569-0115-823
R 219	180k ohm ±5% 1206 SMD	569-0115-184
R 220	16k ohm ±5% 1206 SMD	569-0115-163
R 222	100k ohm ±5% 1206 SMD	569-0115-104
R 223	6.8k ohm ±5% 1206 SMD	569-0115-682
R 225	10k ohm ±5% 1206 SMD	569-0115-103
R 226	10k ohm ±5% 1206 SMD	569-0115-103
R 227	10k ohm ±5% 1206 SMD	569-0115-103
R 228	5.1k ohm ±1% 1206 SMD	569-0111-512
R 229	1k ohm ±5% 1206 SMD	569-0115-102
R 230	7.5k ohm ±5% 1206 SMD	569-0115-752
R 231	10k ohm ±5% 1206 SMD	569-0115-103
R 232	51 ohm ±5% 2512 SMD	569-0175-510
R 233	100k ohm multi-turn pot	562-0110-104
R 234	100k ohm multi-turn pot	562-0110-104
R 235	100k ohm multi-turn pot	562-0110-104
R 236	10k ohm Vol/Audio switch	562-0018-044
R 237	100k ohm multi-turn pot	562-0110-104
R 238	100k ohm multi-turn pot	562-0110-104
R 239	100k ohm multi-turn pot	562-0110-104
R 240	100k ohm multi-turn pot	562-0110-104
R 241	100k ohm multi-turn pot	562-0110-104
R 242	100k ohm multi-turn pot	562-0110-104
R 243	100k ohm multi-turn pot	562-0110-104
R 244	100k ohm multi-turn pot	562-0110-104
R 247	54.9k ohm ±1% 1206 SMD	569-0111-472
R 248	120k ohm ±5% 1206 SMD	569-0115-124
R 249	36k ohm ±5% 1206 SMD	569-0115-363
R 250	150k ohm ±5% 1206 SMD	569-0115-154
R 251	51k ohm ±5% 1206 SMD	569-0115-513
R 252	43k ohm ±5% 1206 SMD	569-0115-433
R 253	390k ohm ±5% 1206 SMD	569-0115-394
R 254	47k ohm ±5% 1206 SMD	569-0115-473
R 256	36k ohm ±5% 1206 SMD	569-0115-363
R 257	36k ohm ±5% 1206 SMD	569-0115-363
R 258	2.2k ohm ±5% 1206 SMD	569-0115-222
R 259	10k ohm ±5% 1206 SMD	569-0115-103
R 260	47k ohm ±5% 1206 SMD	569-0115-473
R 261	270k ohm ±5% 1206 SMD	569-0115-274
R 262	2.2k ohm ±5% 1206 SMD	569-0115-222
R 263	10k ohm ±5% 1206 SMD	569-0115-103
R 264	10k ohm ±5% 1206 SMD	569-0115-103
R 265	2.2k ohm ±5% 1206 SMD	569-0115-222
R 266	10k ohm ±5% 1206 SMD	569-0115-103
R 267	2.2k ohm ±5% 1206 SMD	569-0115-222
R 268	36k ohm ±5% 1206 SMD	569-0115-363
R 269	36k ohm ±5% 1206 SMD	569-0115-363
R 270	39k ohm ±5% 1206 SMD	569-0115-393
R 271	180k ohm ±5% 1206 SMD	569-0115-184
R 274	36k ohm ±5% 1206 SMD	569-0115-363
R 275	36k ohm ±5% 1206 SMD	569-0115-363

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 276	18k ohm ±5% 1206 SMD	569-0115-183
R 277	5.1k ohm ±5% 1206 SMD	569-0115-512
R 279	150k ohm ±5% 1206 SMD	569-0115-154
R 280	150k ohm ±5% 1206 SMD	569-0115-154
R 281	1M ohm ±5% 1206 SMD	569-0115-105
R 282	10k ohm ±5% 1206 SMD	569-0115-103
R 283	Zero ohm ±5% 1206 SMD	569-0115-001
R 284	10k ohm ±5% 1206 SMD	569-0115-103
R 285	2.2k ohm ±5% 1206 SMD	569-0115-222
R 286	75k ohm ±5% 1206 SMD	569-0115-753
R 288	220 ohm ±5% 1206 SMD	569-0115-221
R 289	2.2 ohm ±10% 1206 SMD	569-0115-229
R 290	1 ohm ±10% 1206 SMD	569-0115-109
R 291	1k ohm ±5% 1206 SMD	569-0115-102
R 292	39 ohm ±5% 1206 SMD	569-0115-390
R 293	6.2k ohm ±5% 1206 SMD	569-0115-622
R 294	1k ohm ±5% 1206 SMD	569-0115-102
R 295	10k ohm ±5% 1206 SMD	569-0115-103
R 296	10k ohm ±5% 1206 SMD	569-0115-103
R 297	10k ohm ±5% 1206 SMD	569-0115-103
R 298	10k ohm ±5% 1206 SMD	569-0115-103
R 299	10k ohm ±5% 1206 SMD	569-0115-103
R 300	36k ohm ±5% 1206 SMD	569-0115-363
R 301	100k ohm multi-turn pot	562-0110-104
R 302	36k ohm ±5% 1206 SMD	569-0115-363
R 303	240 ohm ±5% 1206 SMD	569-0115-241
R 304	27 ohm ±5% 1206 SMD	569-0115-270
R 305	100k ohm multi-turn pot	562-0110-104
R 306	36k ohm ±5% 1206 SMD	569-0115-363
R 307	36k ohm ±5% 1206 SMD	569-0115-363
R 308	909k ohm ±1% 1206 SMD	569-0111-593
R 309	25.5k ohm ±1% 1206 SMD	569-0111-440
R 310	Zero ohm ±10% 1206 SMD	569-0115-001
R 311	Zero ohm ±10% 1206 SMD	569-0115-001
R 312	Zero ohm ±10% 1206 SMD	569-0115-001
R 313	Zero ohm ±10% 1206 SMD	569-0115-001
R 314	43.2k ohm ±1% 1206 SMD	569-0111-462
R 315	86.6k ohm ±1% 1206 SMD	569-0111-491
R 316	25.5k ohm ±1% 1206 SMD	569-0111-440
R 317	909k ohm ±1% 1206 SMD	569-0111-593
R 318	10k ohm ±5% 1206 SMD	569-0115-103
R 319	10k ohm ±5% 1206 SMD	569-0115-103
R 320	180k ohm ±5% 1206 SMD	569-0115-184
R 321	100 ohm ±5% 1206 SMD	569-0115-101
R 322	Zero ohm ±5% 1206 SMD	569-0115-001
R 323	Zero ohm ±5% 1206 SMD	569-0115-001

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
RT100	10k ohm chip thermistor	569-3013-007
S 100	8-pos DIP switch	583-5002-008
S 101	4-pos DIP switch	583-5002-004
U 100	Quad 2-input NOR	544-3766-002
U 101	Hex inverter SOIC 74HC04	544-3766-004
U 102	1 of 8 demux 74HC138	544-3766-138
U 103	1 of 16 demux SOIC 74HC154	544-3766-154
U 104	D-latch non-inverting SOIC	544-3766-573
U 105	D-latch non-inverting SOIC	544-3766-573
U 106	D flip flop SOIC 74HC574	544-3766-574
U 107	D flip flop SOIC 74HC574	544-3766-574
U 108	D flip flop SOIC 74HC574	544-3766-574
U 109	Compatible modem Bell-202	544-3988-014
U 110	Compatible modem Bell-202	544-3988-014
U 111	CMOS 87C52	544-5011-948
U 112	Main Audio Card/LTR-Net	023-9998-455
U 113	Quad analog sw SPST SO-16	544-3003-001
U 114	Quad analog sw SPST SO-16	544-3003-001
U 115	Quad analog sw SPST SO-16	544-3003-001
U 116	Quad analog sw SPST SO-16	544-3003-001
U 117	Quad analog sw SPST SO-16	544-3003-001
U 118	Quad analog sw SPST SO-16	544-3003-001
U 119	Micro monitor SO-8 DS1232	544-2003-085
U 120	Dual op amp SOIC LM2904	544-2019-004
U 121	Dual op amp SOIC LM2904	544-2019-004
U 122	Quad op amp SOIC MC3403	544-2020-008
U 123	Quad op amp SOIC MC3403	544-2020-008
U 124	Dual op amp SOIC LM2904	544-2019-004
U 125	Quad op amp SOIC MC3404	544-2020-008
U 126	Quad op amp SOIC MC3404	544-2020-008
U 127	Quad op amp SOIC MC3404	544-2020-008
U 128	Quad op amp SOIC MC3404	544-2020-008
U 129	Quad op amp SOIC MC3404	544-2020-008
U 130	Dual op amp SOIC LM2904	544-2019-004
U 131	Quad op amp SOIC MC3404	544-2020-008
U 132	Audio amp 10W TO-220	544-2006-013
U 133	1 of 16 demux SOIC 74HC154	544-3766-154
U 135	Dual op amp SO-8 MC33178	544-2019-018
U 136	+8V regulator SOIC 78L08	544-2603-042
U 149	EEPOT 100k SOIC 9C104	544-0004-209
U 151	EEPOT 100k SOIC 9C104	544-0004-209
U 153	Quad analog sw SPST SO-16	544-3003-001
U 154	Quad 2-in OR SOIC 74HC32	544-3766-032
U 155	D flip flop SOIC 74HC574	544-3766-574
U 156	D flip flop SOIC 74HC574	544-3766-574

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
U 157	D flip flop SOIC 74HC574	544-3766-574
U 158	Quad analog sw SOIC DG202	544-3003-001
U 159	Quad analog sw SOIC DG202	544-3003-001
U 160	9 bit x 64 word FIFO DIP-28	544-3764-703
U 161	9 bit x 64 word FIFO DIP-28	544-3764-703
U 162	Dr/Rcvr RS232C V.28 145406	544-2023-014
U 163	Dual op amp SOIC LM2904	544-2019-004
U 164	Dual op amp SOIC LM2904	544-2019-004
U 165	Dual op amp SOIC LM2904	544-2019-004
U 166	Dual op amp SO-8 MC33178	544-2019-018
U 167	Quad op amp SOIC MC3404	544-2020-008
X 110	28-pin IC socket	515-5008-018
X 111	40-pin IC socket	515-5008-019
X 112	28-pin IC socket	515-5008-018
Y 100	3.5795 MHz crystal	521-0003-579
Y 101	11.059 MHz crystal	521-0011-059
Z 100	EMI suppression filter	532-3003-002
Z 101	EMI suppression filter	532-3003-002
Z 102	EMI suppression filter	532-3003-002

INTERFACE ALARM CARD
PART NO. 023-2000-350

C 500	.01 µF ±10% X7R chip	510-3606-103
C 502	.1 µF ±10% X7R 1210	510-3607-104
C 503	150 pF ±5% NPO 1206 chip	510-3602-151
C 511	.01 µF ±10% X7R chip	510-3606-103
C 512	.01 µF ±10% X7R chip	510-3606-103
C 513	.01 µF ±10% X7R chip	510-3606-103
C 514	.01 µF ±10% X7R chip	510-3606-103
C 515	.01 µF ±10% X7R chip	510-3606-103
C 516	.01 µF ±10% X7R chip	510-3606-103
C 517	.01 µF ±10% X7R chip	510-3606-103
C 518	.01 µF ±10% X7R chip	510-3606-103
C 519	.01 µF ±10% X7R chip	510-3606-103
C 521	.01 µF ±10% X7R chip	510-3606-103
C 522	47 µF 25V electrolytic radial	510-4425-470
C 523	47 µF 25V electrolytic radial	510-4425-470
C 525	10 µFD 16V tantalum SMD	510-2625-100
C 526	1 µF 16V tantalum SMD	510-2625-109
C 527	.1 µF 35V tantalum SMD	510-2628-108
C 528	.01 µF ±10% X7R chip	510-3606-103
C 529	.01 µF ±10% X7R chip	510-3606-103
C 530	220 µF 25V aluminum radial	510-4225-221
C 531	.01 µF ±10% X7R chip	510-3606-103
C 532	1000 µF 25V aluminum radial	510-4225-102
C 533	.01 µF ±10% X7R chip	510-3606-103
C 534	100 pF ±5% NPO 1206	510-3602-101
C 535	100 pF ±5% NPO 1206	510-3602-101
C 536	.1 µF ±10% X7R 1210	510-3607-104
C 537	.1 µF ±10% X7R 1210	510-3607-104
C 538	.01 µF ±10% X7R chip	510-3606-103
C 539	.01 µF ±10% X7R chip	510-3606-103
CR500	Red LED submin radial	549-4001-120
CR501	Green LED submin radial	549-4001-122
CR502	Yellow LED submin radial	549-4001-121
CR503	Green LED submin radial	549-4001-122
CR504	Green LED submin radial	549-4001-122
CR505	Yellow LED submin radial	549-4001-121
CR506	Dual switch diode SOT-23	523-1504-023
CR507	Dual switch diode SOT-23	523-1504-023
CR508	Dual switch diode SOT-23	523-1504-023
CR509	Dual switch diode SOT-23	523-1504-023
CR510	Dual switch diode SOT-23	523-1504-023
CR511	Dual switch diode SOT-23	523-1504-023
CR512	Dual switch diode SOT-23	523-1504-023
CR513	Dual switch diode SOT-23	523-1504-023
CR523	Green LED submin radial	549-4001-122
CR524	Green LED submin radial	549-4001-122
CR525	Green LED submin radial	549-4001-122
CR526	200V 1.5A rectifier 1N4818	523-0013-201
CR527	5.1V zener SOT-23	523-2016-519
CR528	5.1V zener SOT-23	523-2016-519
CR529	15V zener SOT-23 BZXC15	523-2016-150
CR530	15V zener SOT-23 BZXC15	523-2016-150
CR531	15V zener SOT-23 BZXC15	523-2016-150
CR532	15V zener SOT-23 BZXC15	523-2016-150
CR533	15V zener SOT-23 BZXC15	523-2016-150
F 501	1A 250V submin fuse	534-0017-014
FH501	Fuse holder	534-1017-001
HW001	Panel fastener 0.475 long	537-0011-031
HW500	Card inj/ext nylon pull	537-9057-020
J 500	Horizontal green tip jack .080	105-2204-105
J 501	Horizontal black tip jack .080	105-2203-101
J 502	Horizontal red tip jack .080	105-2202-101
J 503	3-pin single inline header	515-7100-003

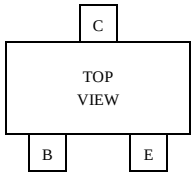
SYMBOL NUMBER	DESCRIPTION	PART NUMBER
J 504	3-pin single inline header	515-7100-003
J 505	4-pin single inline header	515-7100-004
K 500	12V SPDT 1A relay submin	567-2002-021
K 501	12V SPDT 1A relay submin	567-2002-021
K 502	12V SPDT 1A relay submin	567-2002-021
K 503	12V SPDT 1A relay submin	567-2002-021
L 501	3 µH filter choke PC mount	542-5007-031
P 500	64-pin DIN male right angle	515-7082-101
P 501	32-pin DIN male right angle	515-7082-102
P 503	2-pos shorting socket	515-5010-001
P 504	2-pos shorting socket	515-5010-001
P 505	2-pos shorting socket	515-5010-001
PC350	PC board	035-2000-350
Q 500	Si NPN SOT-23 2N3904	576-0003-658
Q 501	Si NPN SOT-23 2N3904	576-0003-658
Q 502	Si NPN SOT-23 2N3904	576-0003-658
Q 503	Si NPN SOT-23 2N3904	576-0003-658
Q 504	NPN dig SOT-23F RN1404	576-0003-616
Q 505	NPN dig SOT-23F RN1404	576-0003-616
R 500	4.7k ohm ±5% 1206 SMD	569-0115-472
R 501	4.7k ohm ±5% 1206 SMD	569-0115-472
R 502	430 ohm ±5% 1/4W CF	569-0513-431
R 504	1k ohm ±5% 1206 SMD	569-0115-102
R 506	1k ohm ±5% 1206 SMD	569-0115-102
R 507	100k ohm ±5% 1206 SMD	569-0115-104
R 508	10k ohm ±1% 1206 SMD	569-0111-401
R 509	10k ohm ±1% 1206 SMD	569-0111-401
R 510	10k ohm ±5% 1206 SMD	569-0115-103
R 511	20k ohm ±5% 1206 SMD	569-0115-203
R 512	10k ohm ±5% 1206 SMD	569-0115-103
R 513	10k ohm ±5% 1206 SMD	569-0115-103
R 514	10k ohm ±5% 1206 SMD	569-0115-103
R 515	1k ohm ±5% 1206 SMD	569-0115-102
R 516	2.7k ohm ±5% 1/4W CF	569-0115-272
R 517	2.7k ohm ±5% 1/4W CF	569-0115-272
R 518	2.7k ohm ±5% 1/4W CF	569-0115-272
R 519	2.7k ohm ±5% 1/4W CF	569-0115-272
R 520	2.7k ohm ±5% 1/4W CF	569-0115-272
R 521	4.7k ohm ±5% 1206 SMD	569-0115-472
R 522	10k ohm ±1% 1206 SMD	569-0111-401
R 523	10k ohm ±1% 1206 SMD	569-0111-401
R 524	4.7k ohm ±5% 1206 SMD	569-0115-472
R 525	10k ohm ±1% 1206 SMD	569-0111-401
R 526	10k ohm ±1% 1206 SMD	569-0111-401
R 527	4.7k ohm ±5% 1206 SMD	569-0115-472
R 528	1.2k ohm ±5% 1206 SMD	569-0115-122
R 529	4.7k ohm ±5% 1206 SMD	569-0115-472
R 530	10k ohm ±1% 1206 SMD	569-0111-401
R 531	4.32k ohm ±1% 1206 SMD	569-0111-362
R 532	4.7k ohm ±5% 1206 SMD	569-0115-472
R 533	1k ohm ±5% 1206 SMD	569-0115-102
R 534	1M ohm ±5% 1206 SMD	569-0115-105
R 535	4.7k ohm ±5% 1206 SMD	569-0115-472
R 536	10k ohm ±5% 1206 SMD	569-0115-103
R 537	1k ohm ±5% 1206 SMD	569-0115-102
R 538	100k ohm ±5% 1206 SMD	569-0115-104
R 539	100k ohm ±5% 1206 SMD	569-0115-104
R 541	200 ohm ±5% 1206 SMD	569-0115-201
R 543	10k ohm ±5% 1206 SMD	569-0115-103
R 544	1k ohm ±5% 1206 SMD	569-0115-102
R 545	10k ohm ±5% 1206 SMD	569-0115-103
R 546	430 ohm ±5% 1/4W CF	569-0513-431
R 547	430 ohm ±5% 1/4W CF	569-0513-431
R 548	430 ohm ±5% 1/4W CF	569-0513-431
R 549	10k ohm ±5% 1206 SMD	569-0115-103
R 550	10k ohm ±5% 1206 SMD	569-0115-103
R 551	10k ohm ±5% 1206 SMD	569-0115-103
R 552	10k ohm ±5% 1206 SMD	569-0115-103
R 553	1.2k ohm ±5% 1206 SMD	569-0115-122
R 554	1.2k ohm ±5% 1206 SMD	569-0115-122
R 555	1.2k ohm ±5% 1206 SMD	569-0115-122
R 556	10k ohm ±5% 1206 SMD	569-0115-103
R 557	10k ohm ±5% 1206 SMD	569-0115-103
R 558	10k ohm ±5% 1206 SMD	569-0115-103
R 559	10k ohm ±5% 1206 SMD	569-0115-103
R 560	10k ohm ±5% 1206 SMD	569-0115-103
R 561	10k ohm ±5% 1206 SMD	569-0115-103
R 562	10k ohm ±5% 1206 SMD	569-0115-103
R 563	3.9k ohm ±5% 1206 SMD	569-0115-392
R 564	1k ohm ±5% 1206 SMD	569-0115-102
R 567	200 ohm ±5% 1206 SMD	569-0115-201
R 568	200 ohm ±5% 1206 SMD	569-0115-201
R 569	200 ohm ±5% 1206 SMD	569-0115-201
R 576	2.7k ohm ±5% 1/4W CF	569-0115-272
R 577	1k ohm ±5% 1206 SMD	569-0115-102
R 578	2.7k ohm ±5% 1/4W CF	569-0115-272

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
S 500	4-pos recessed DIP switch	583-5002-104
S 501	4-pos recessed DIP switch	583-5002-104
S 502	4-pos recessed DIP switch	583-5002-104
S 503	4-pos recessed DIP switch	583-5002-104
S 508	Toggle switch on/on rt angle	583-0006-014
U 500	1 of 16 demux SOIC 74HC154	544-3766-154
U 501	1 of 16 demux SOIC 74HC154	544-3766-154
U 503	D flip flop SOIC 74HC574	544-3766-574
U 504	D flip flop SOIC 74HC574	544-3766-574
U 505	D flip flop SOIC 74HC574	544-3766-574
U 506	8-bit A/D converter	544-2031-001
U 507	Bilateral switch SOIC 4066B	544-3016-066
U 508	Hex open drain buffer SO-14	544-3716-906
U 509	Quad op amp SOIC	544-2020-008
U 510	NPN out opto isolator 4N35	544-2010-001
U 511	NPN out opto isolator 4N35	544-2010-001
U 512	NPN out opto isolator 4N35	544-2010-001
U 513	Bilateral switch SOIC 4066B	544-3016-066
U 514	Dual op amp SOIC LM2904	544-2019-004
U 517	Transparent latch SOIC	544-3766-573
U 518	D flip flop SOIC 74HC574	544-3766-574
U 520	NPN out opto isolator 4N35	544-2010-001
U 521	Transparent latch SOIC	544-3766-573
U 523	+8V regulator 78M08	544-2003-081
Z 500	EMI suppression filter	532-3003-002
Z 501	EMI suppression filter	532-3003-002

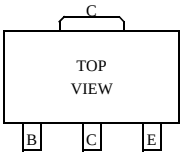
SECTION 10 SCHEMATICS AND COMPONENT LAYOUTS

TRANSISTORS

TRANSISTORS		
Part Number	Basing Diagram	Identification
576-0001-300	1	1R
576-0002-603	2	
576-0003-600	1	2X
576-0003-602	1	R2/R3
576-0003-604	3	3604
576-0003-612	1	2T
576-0003-636	1	R25
576-0003-657	1	2A
576-0003-658	1	1A
576-0004-098	3	
576-0004-820	4	
576-0004-821	4	
576-0006-109	5	
DIODES		
523-1504-002	6	5A
523-1504-012	6	2A
523-1504-015	6	4E
523-1504-016	6	5H
523-1504-023	-	A7
523-2016-180	6	Y7
523-2016-479	6	8E/Z1
523-2016-519	6	8F/Z2
523-2016-629	6	8J/Z4
523-2016-919	6	8P/Z8
523-5004-002		



1



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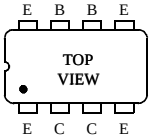

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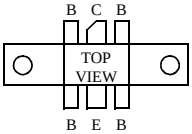

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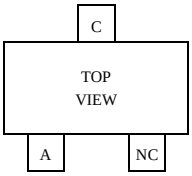
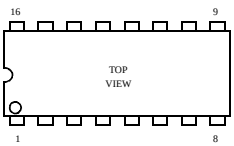
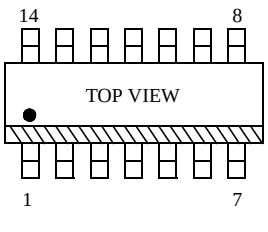
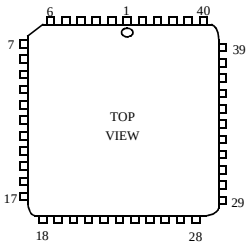


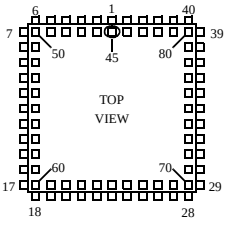
6

INTEGRATED CIRCUITS









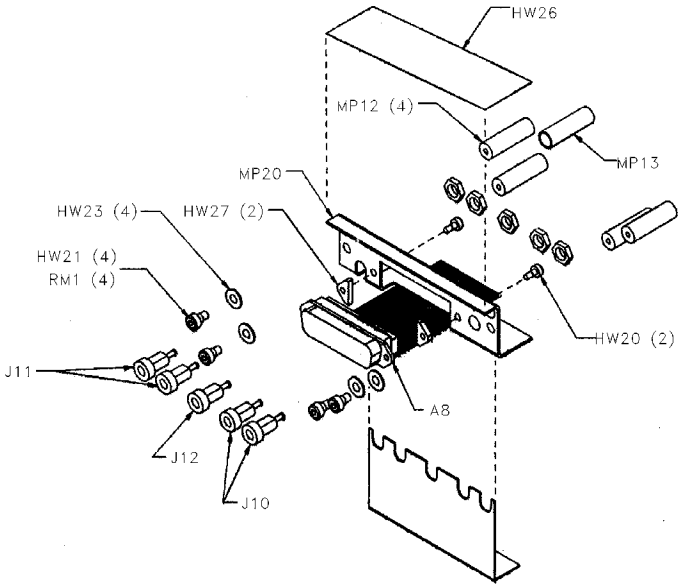


Figure 10-1 RF MODULE INTERFACE CONNECTOR

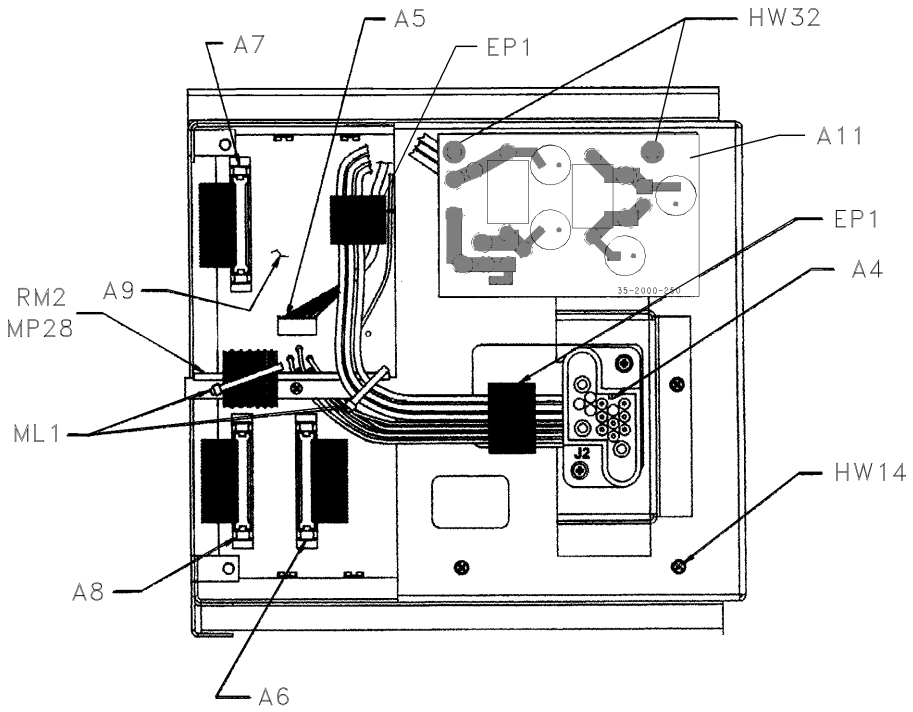
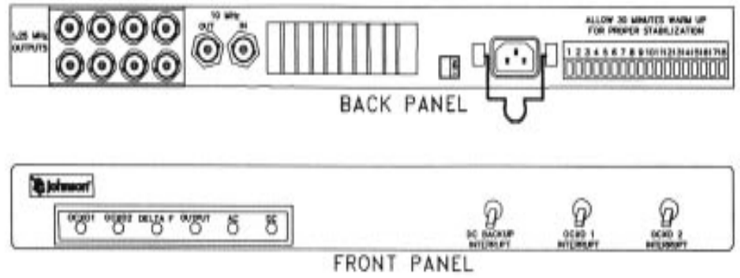
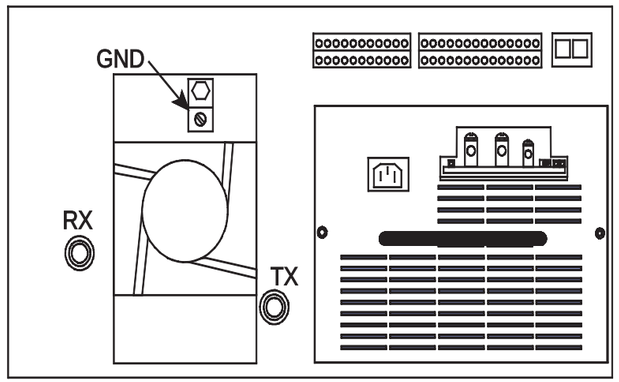


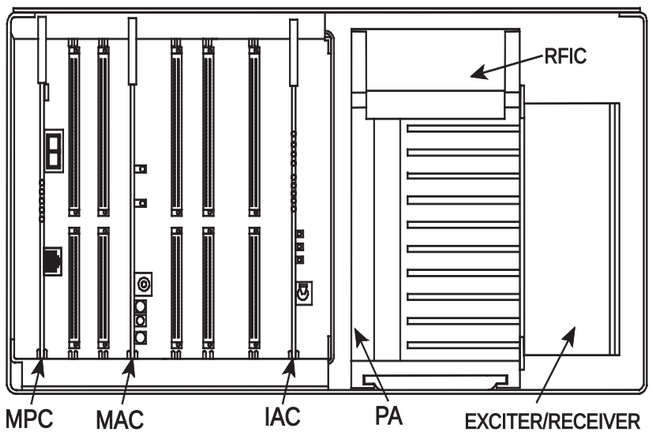
Figure 10-2 BACKPLANE CABLE CONNECTIONS



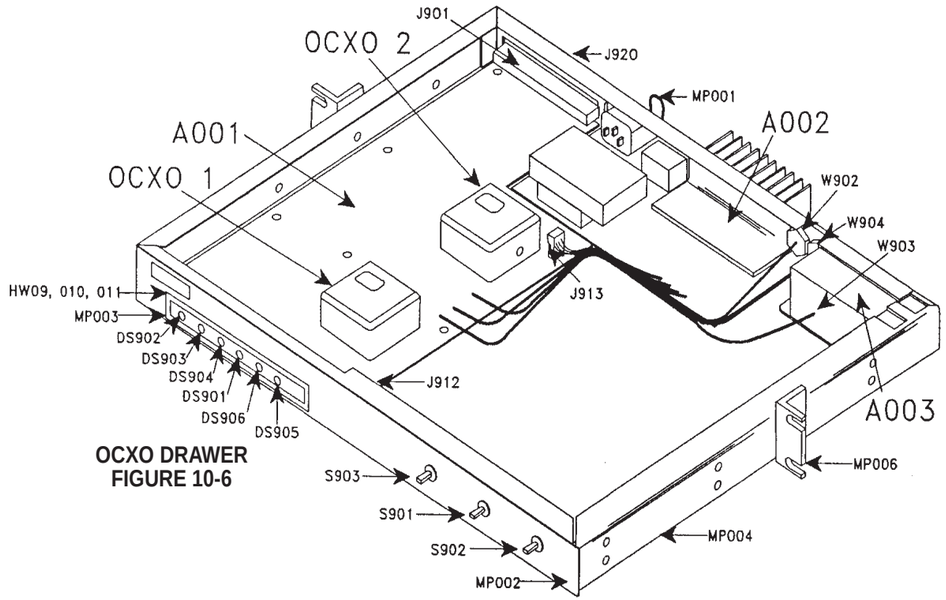
OCXO DRAWER FRONT/REAR PANEL
FIGURE 10-3



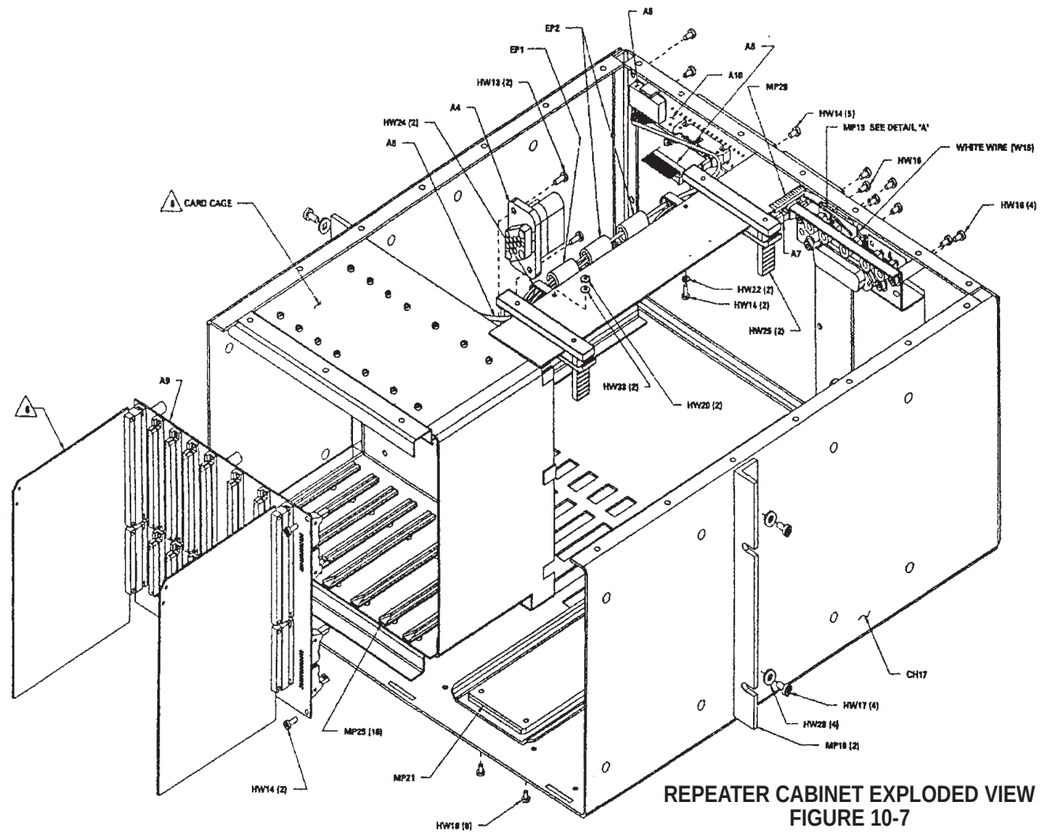
REPEATER REAR VIEW
FIGURE 10-4



REPEATER FRONT VIEW
FIGURE 10-5

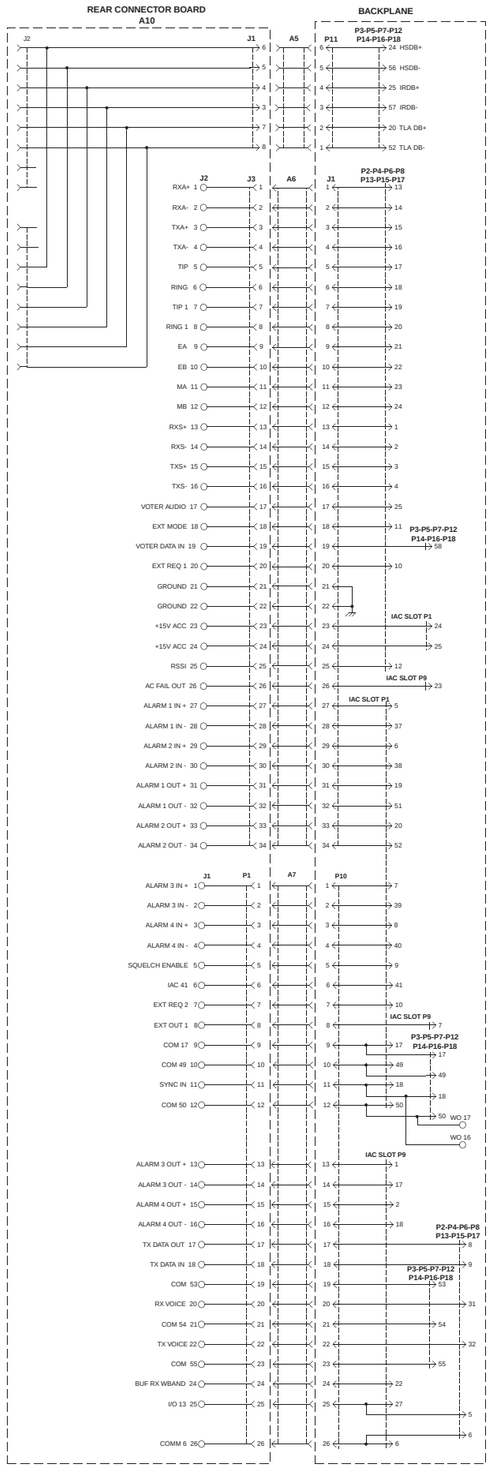


OCXO DRAWER
FIGURE 10-6



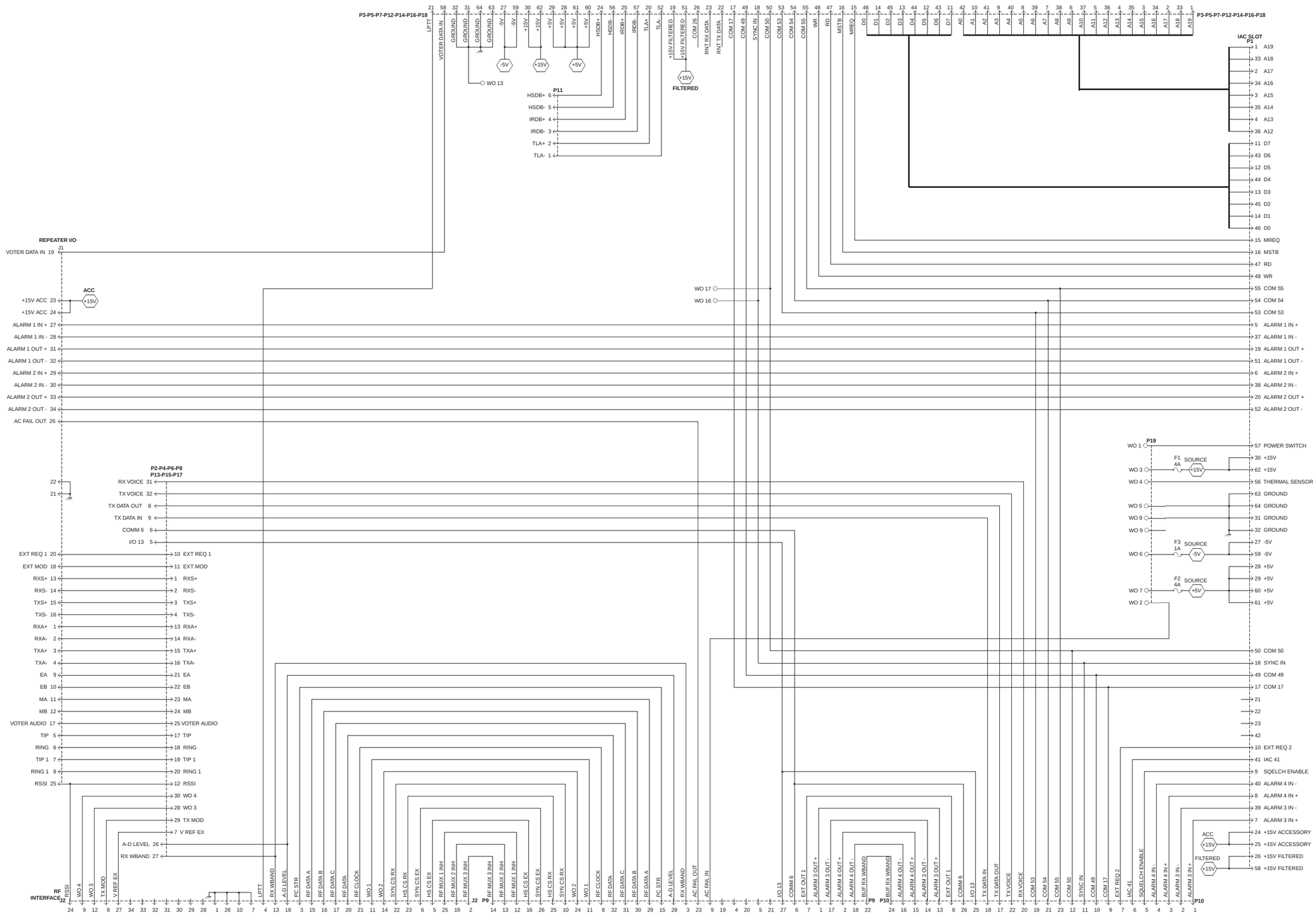
REPEATER CABINET EXPLODED VIEW
FIGURE 10-7

March 1999
Part No. 001-2009-600



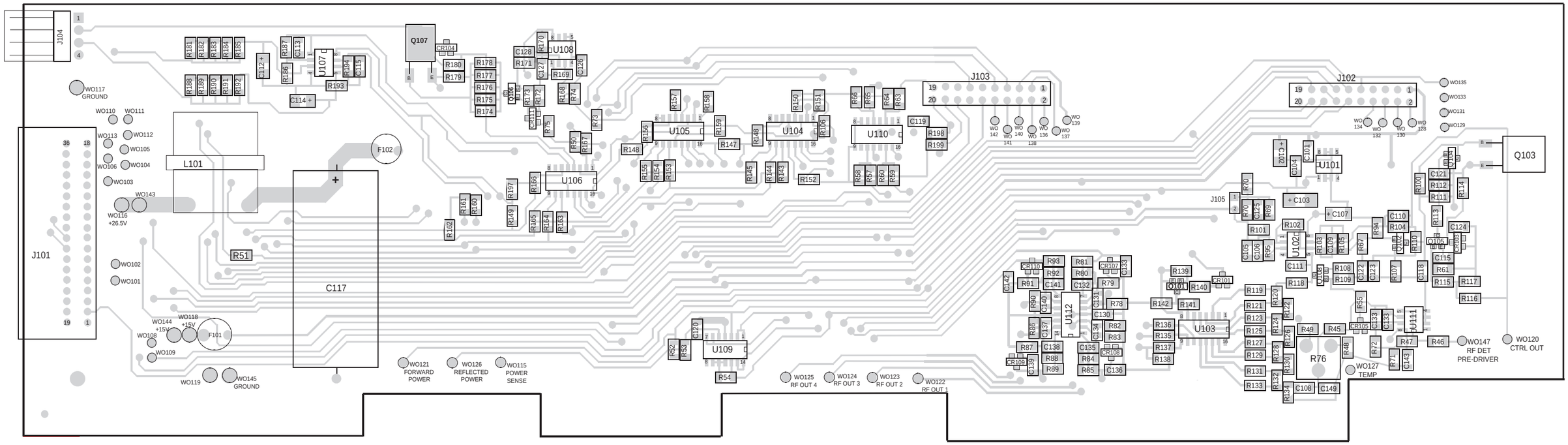
INPUT/OUTPUT ALARM INTERFACE
FIGURE 10-8

RF INTERFACE
FIGURE 10-9



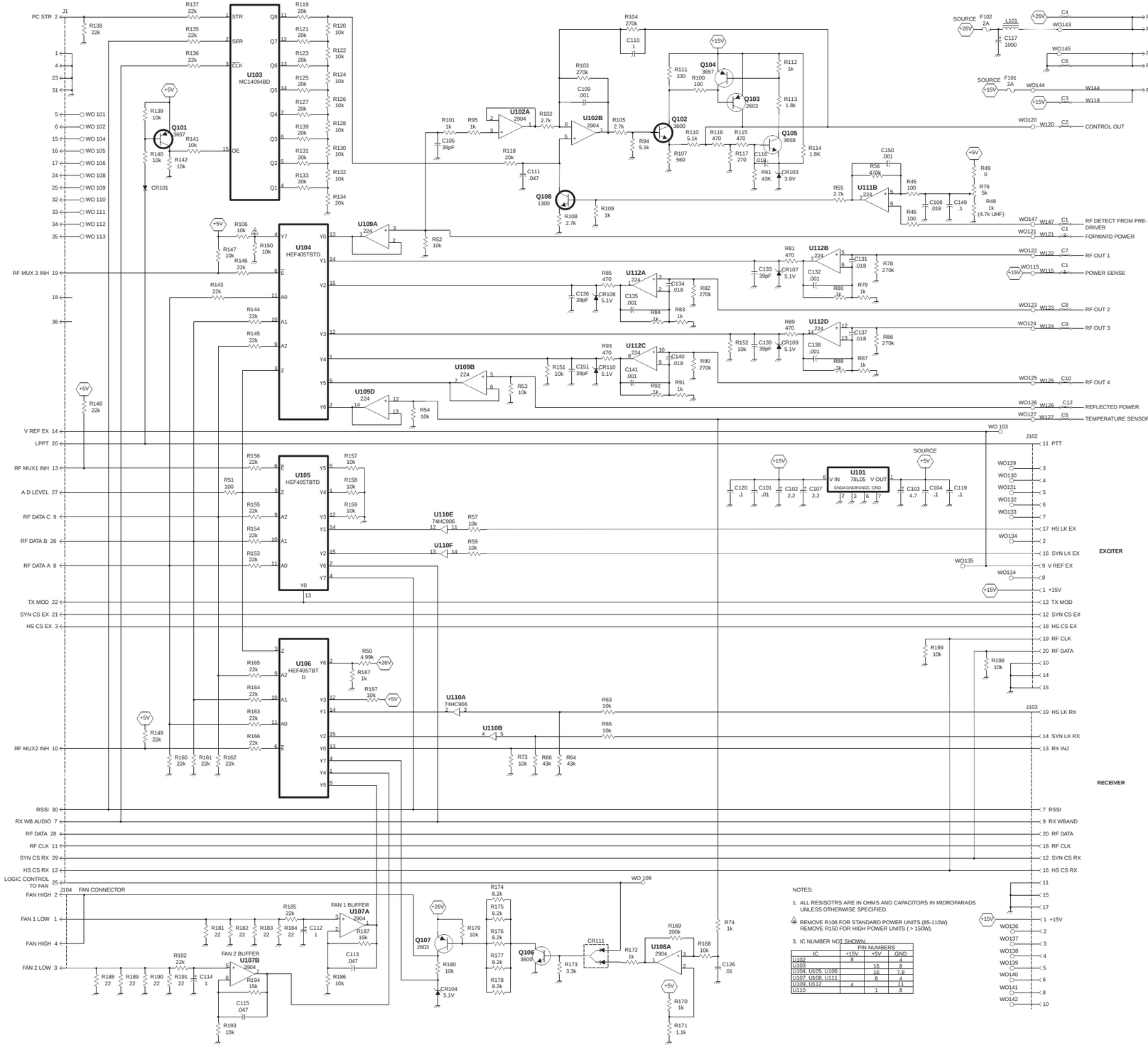
March 1999
Part No. 001-2009-600

BACKPLANE INTERCONNECT
FIGURE 10-10



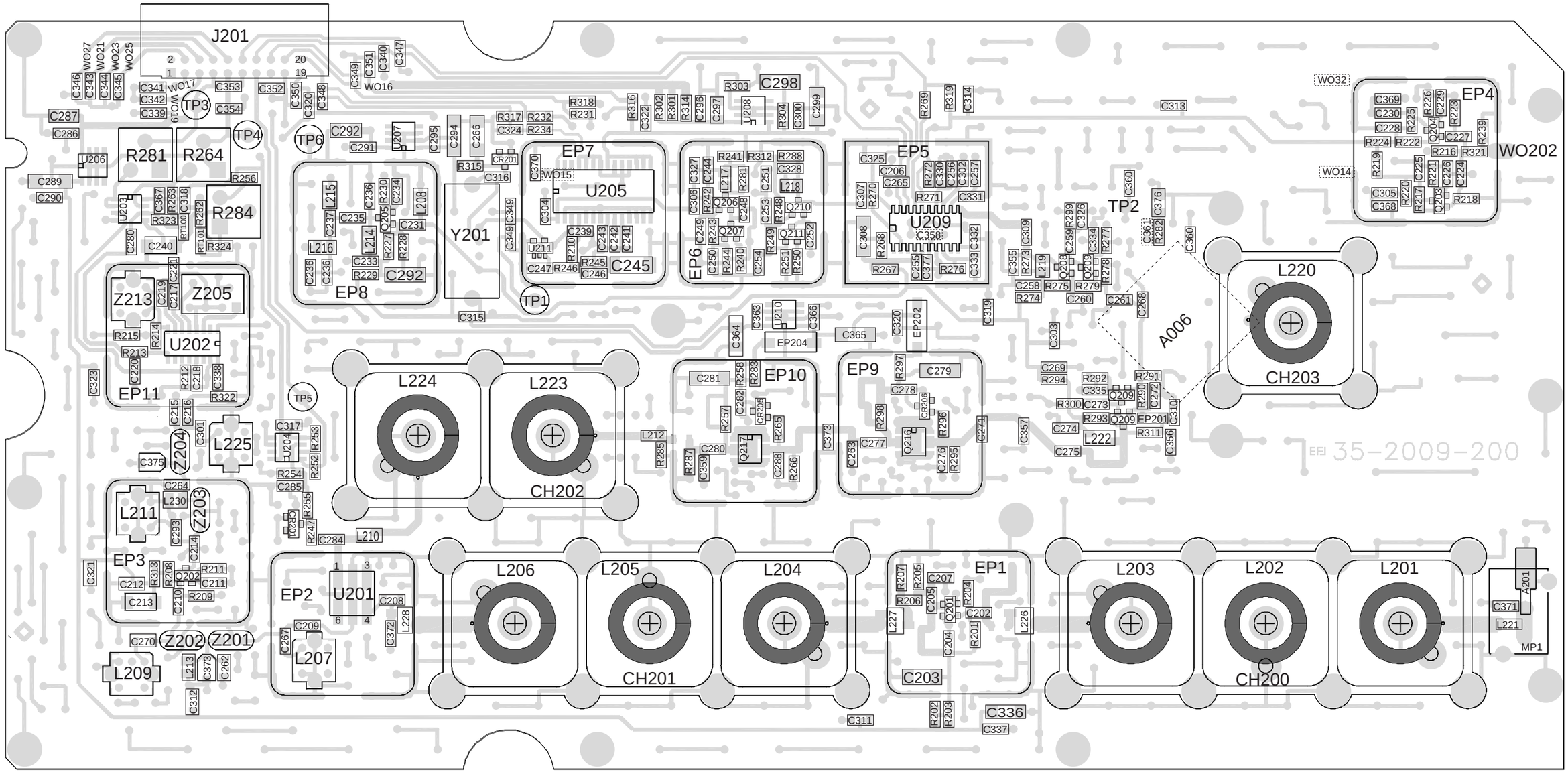
March 1999
Part No. 001-2009-600

RF INTERFACE BOARD COMPONENT LAYOUT
FIGURE 10-11



March 1999
Part No. 001-2009-600

RF INTERFACE BOARD SCHEMATIC
FIGURE 10-12



RECEIVER COMPONENT LAYOUT
FIGURE 10-13

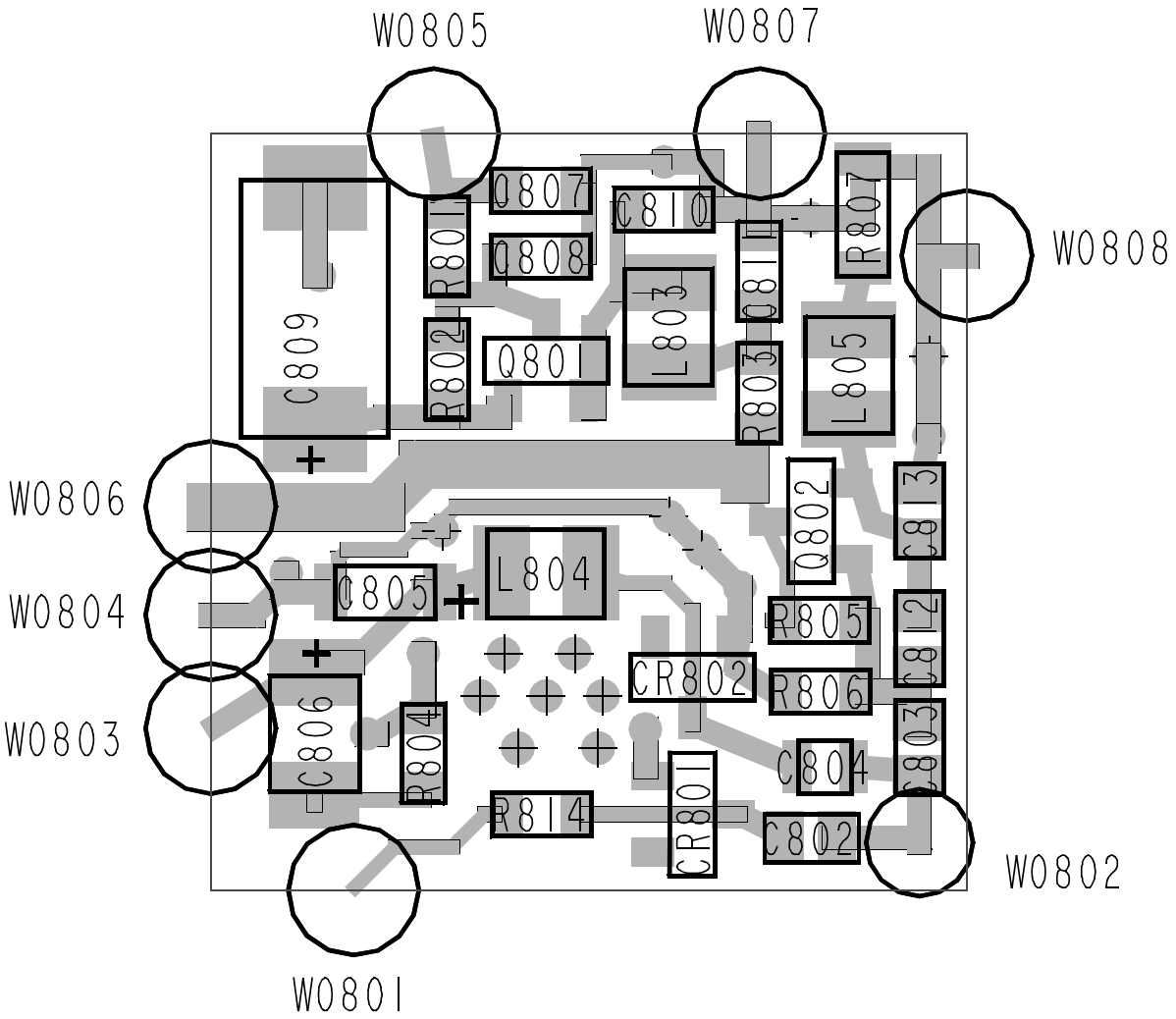


Figure 10-14 RECEIVE VCO COMPONENT LAYOUT

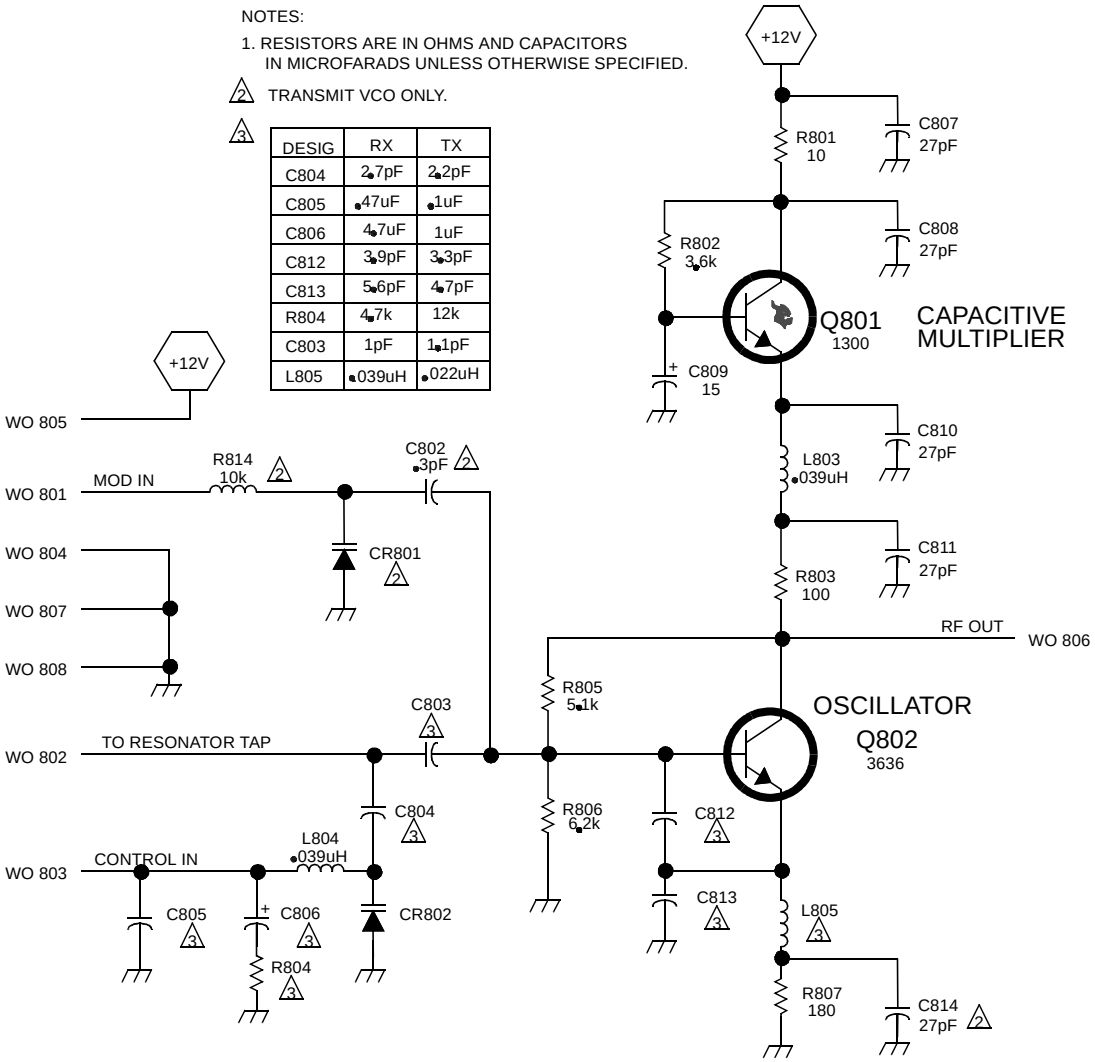
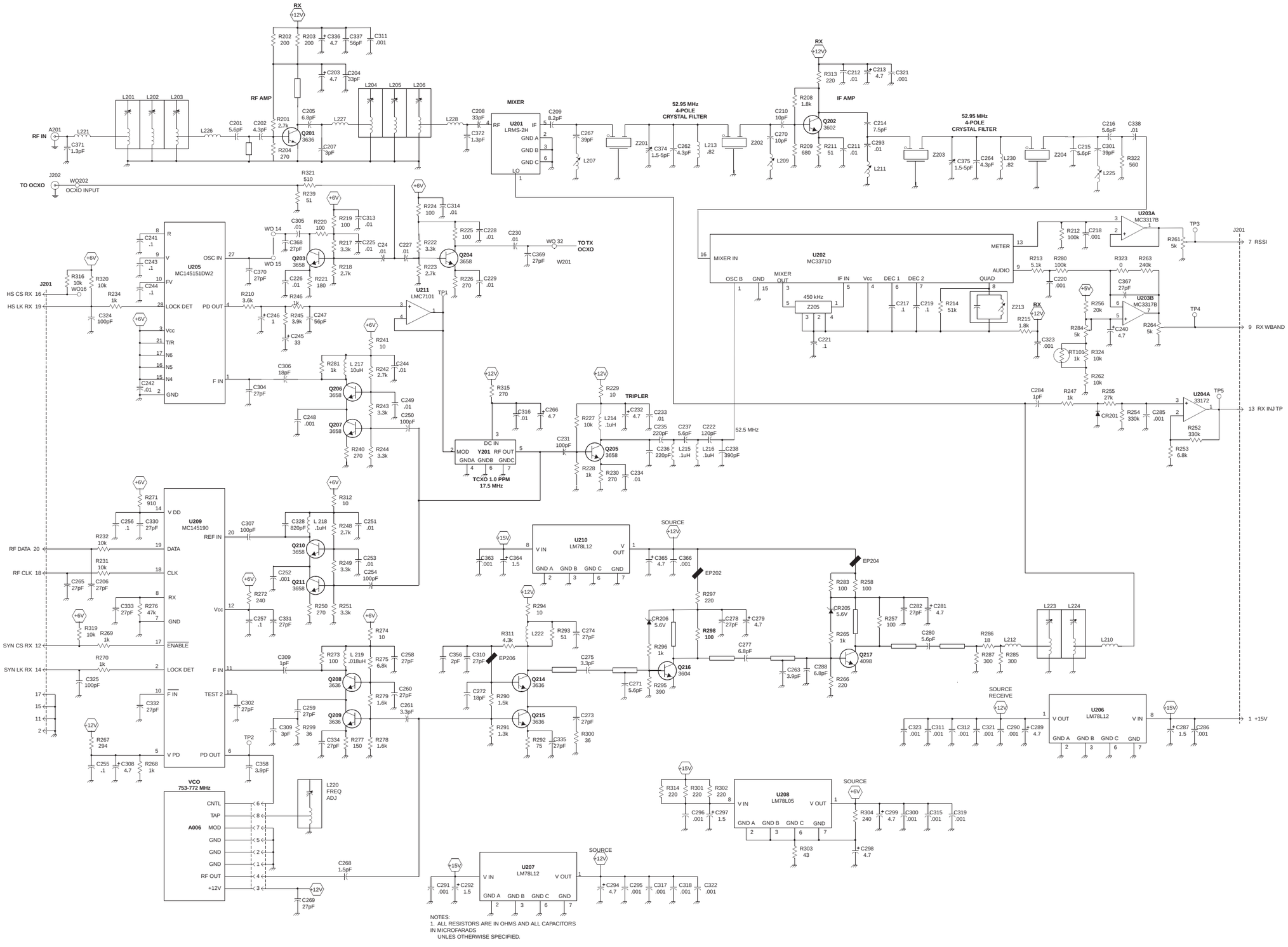


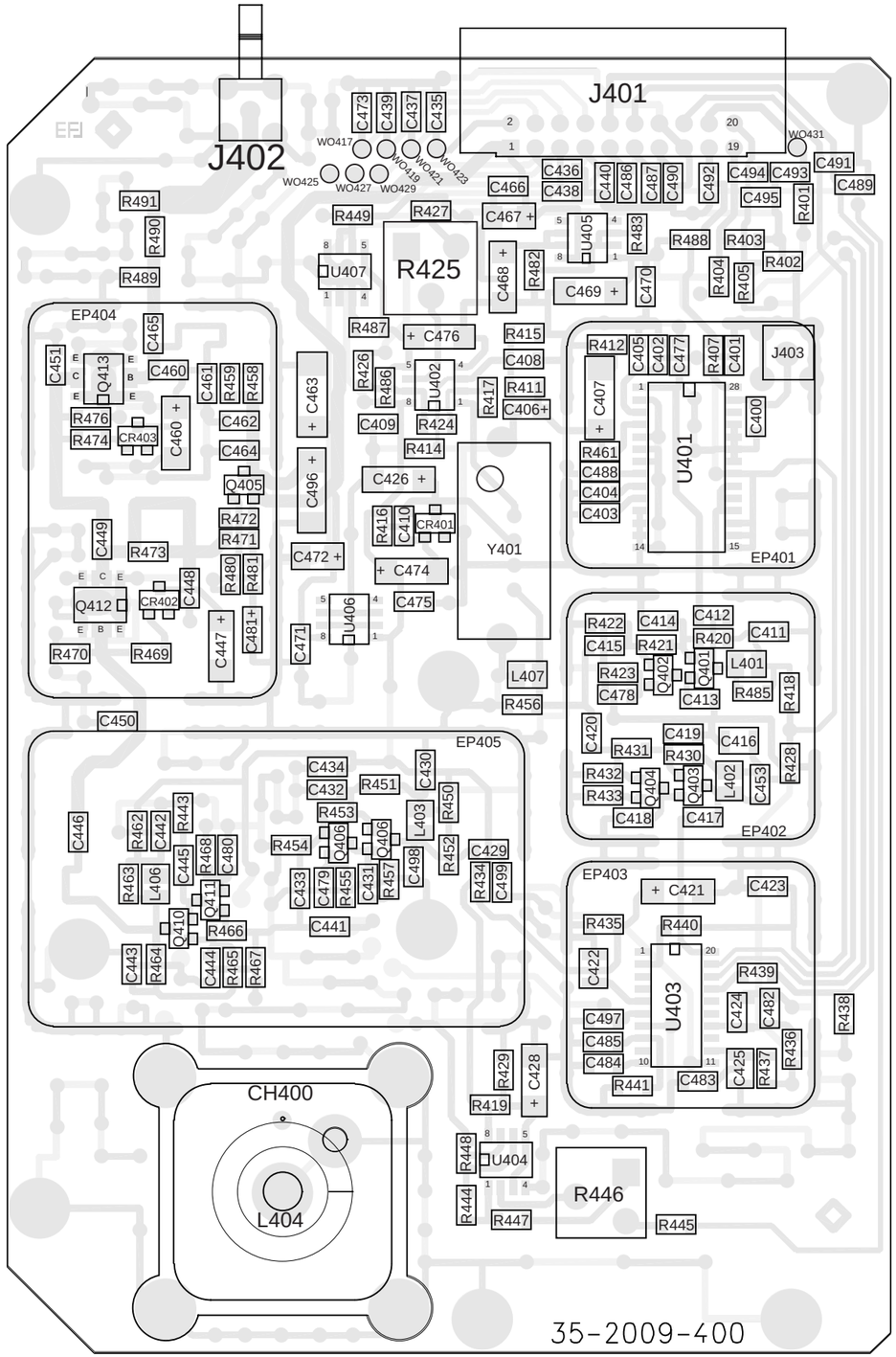
Figure 10-15 RECEIVE VCO SCHEMATIC



NOTES:
1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLES OTHERWISE SPECIFIED.

March 1999
Part No. 001-2009-600

RECEIVER SCHEMATIC
FIGURE 10-16



EXCITER COMPONENT LAYOUT
FIGURE 10-17

*C814 IS PLACED ON TOP OF R807

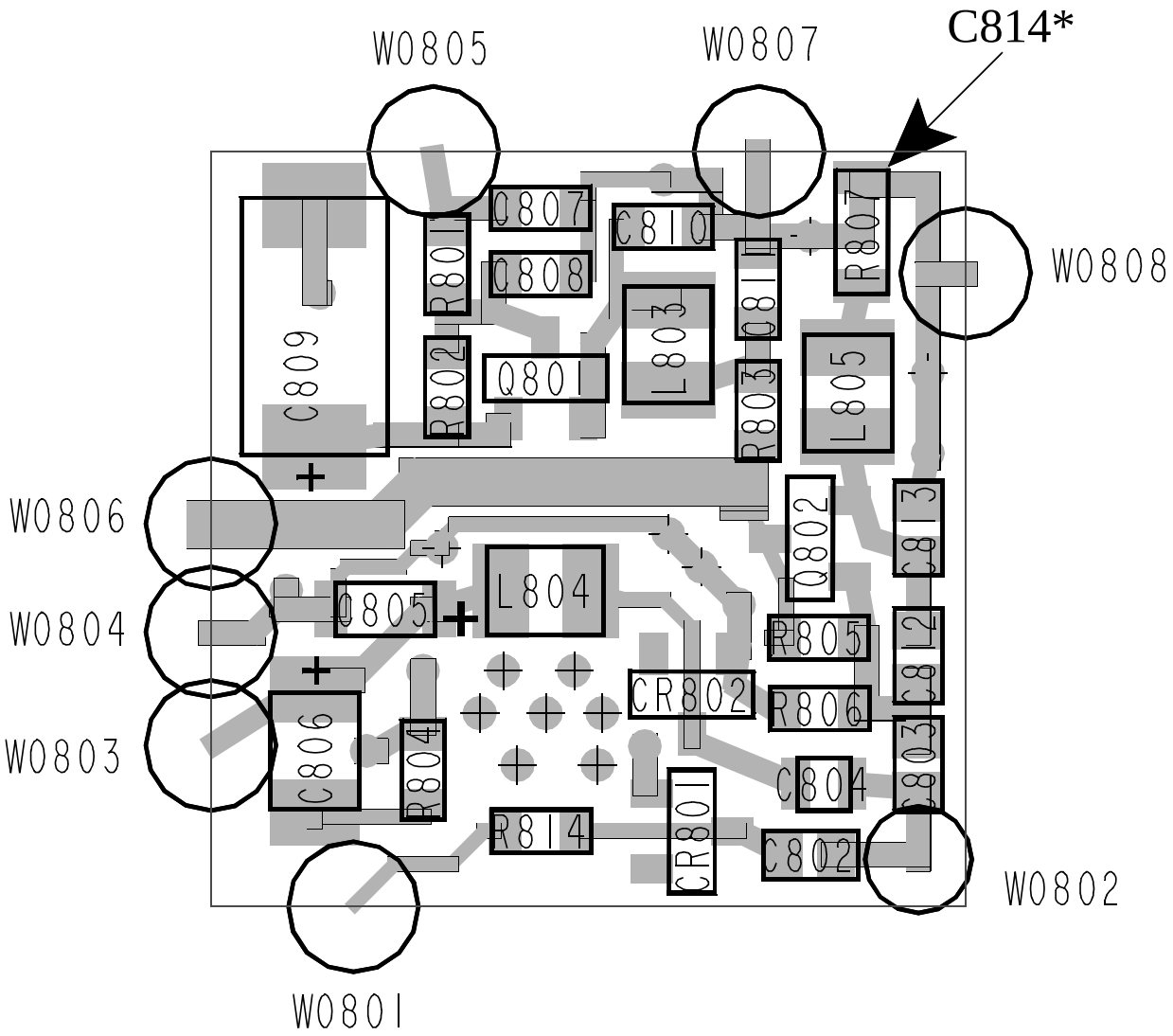


Figure 10-18 TRANSMIT VCO COMPONENT LAYOUT

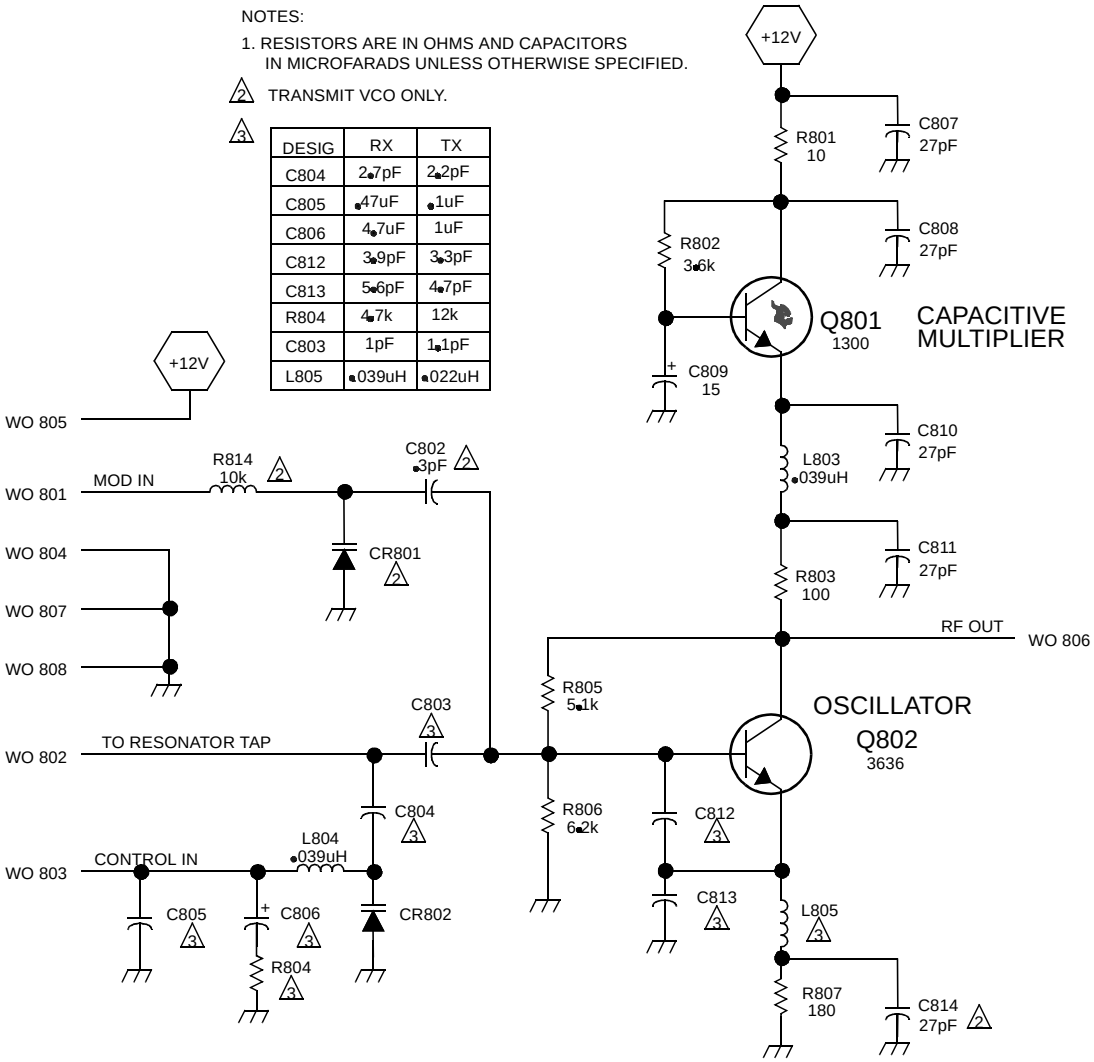
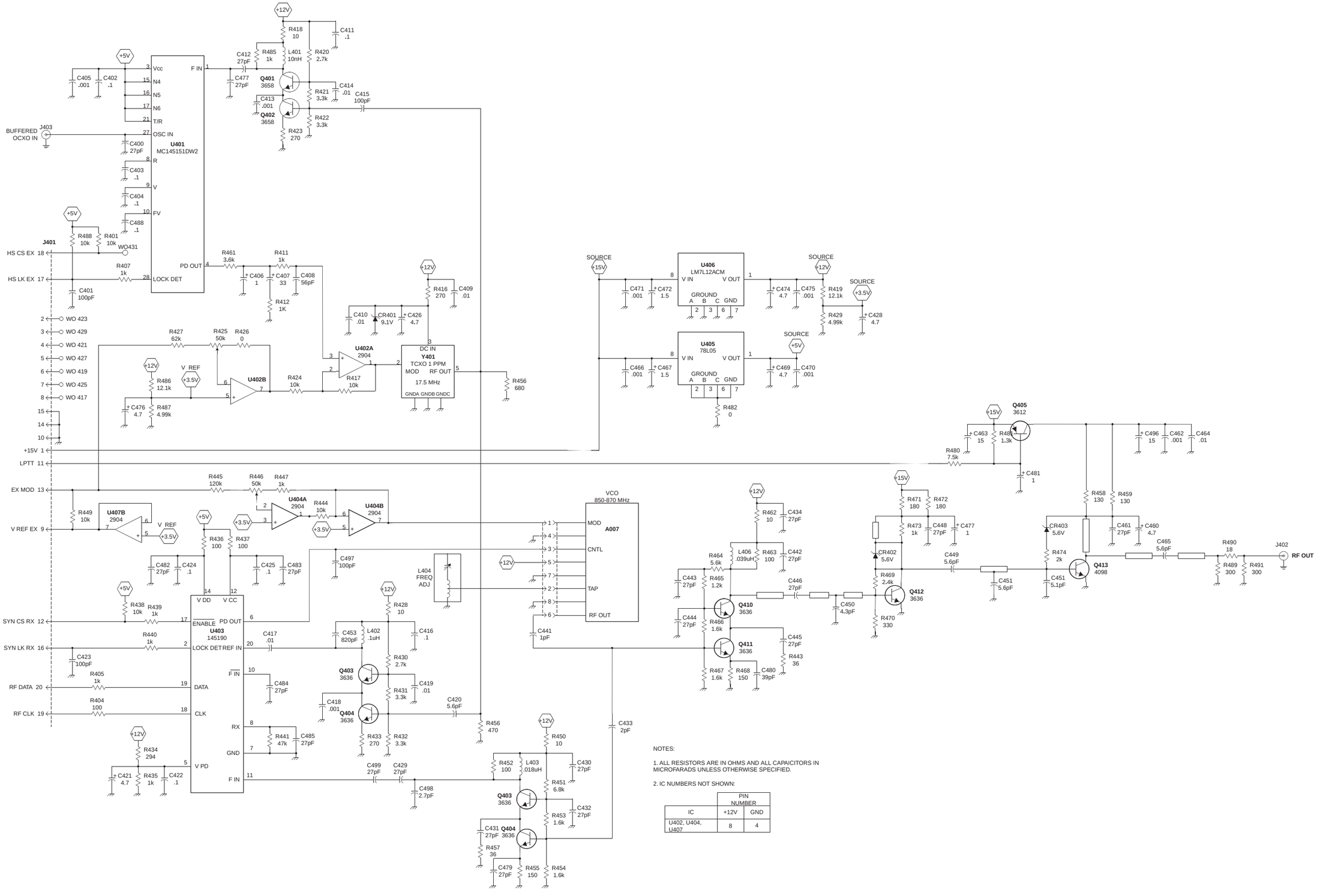


Figure 10-19 TRANSMIT VCO SCHEMATIC



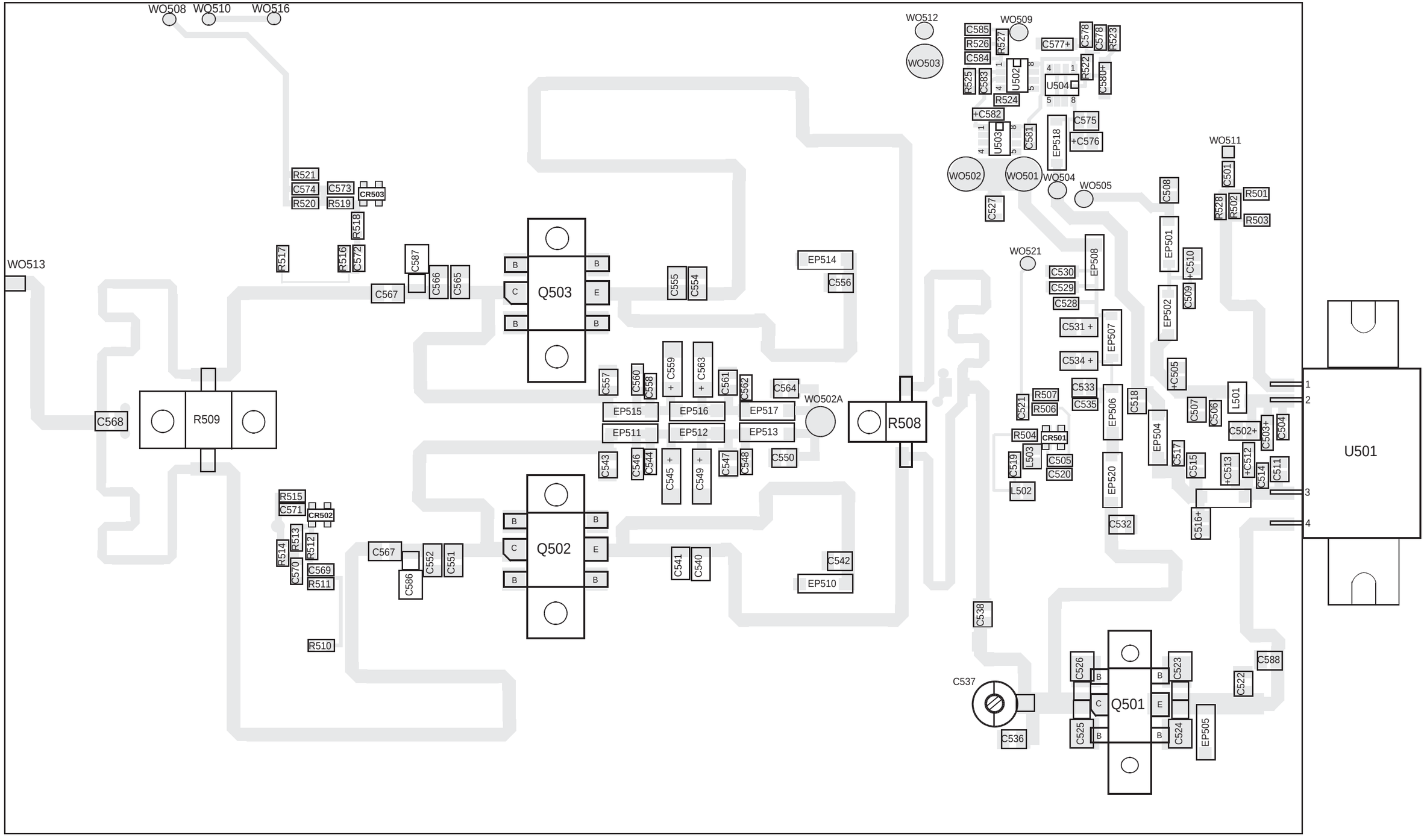
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPAICITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

2. IC NUMBERS NOT SHOWN:

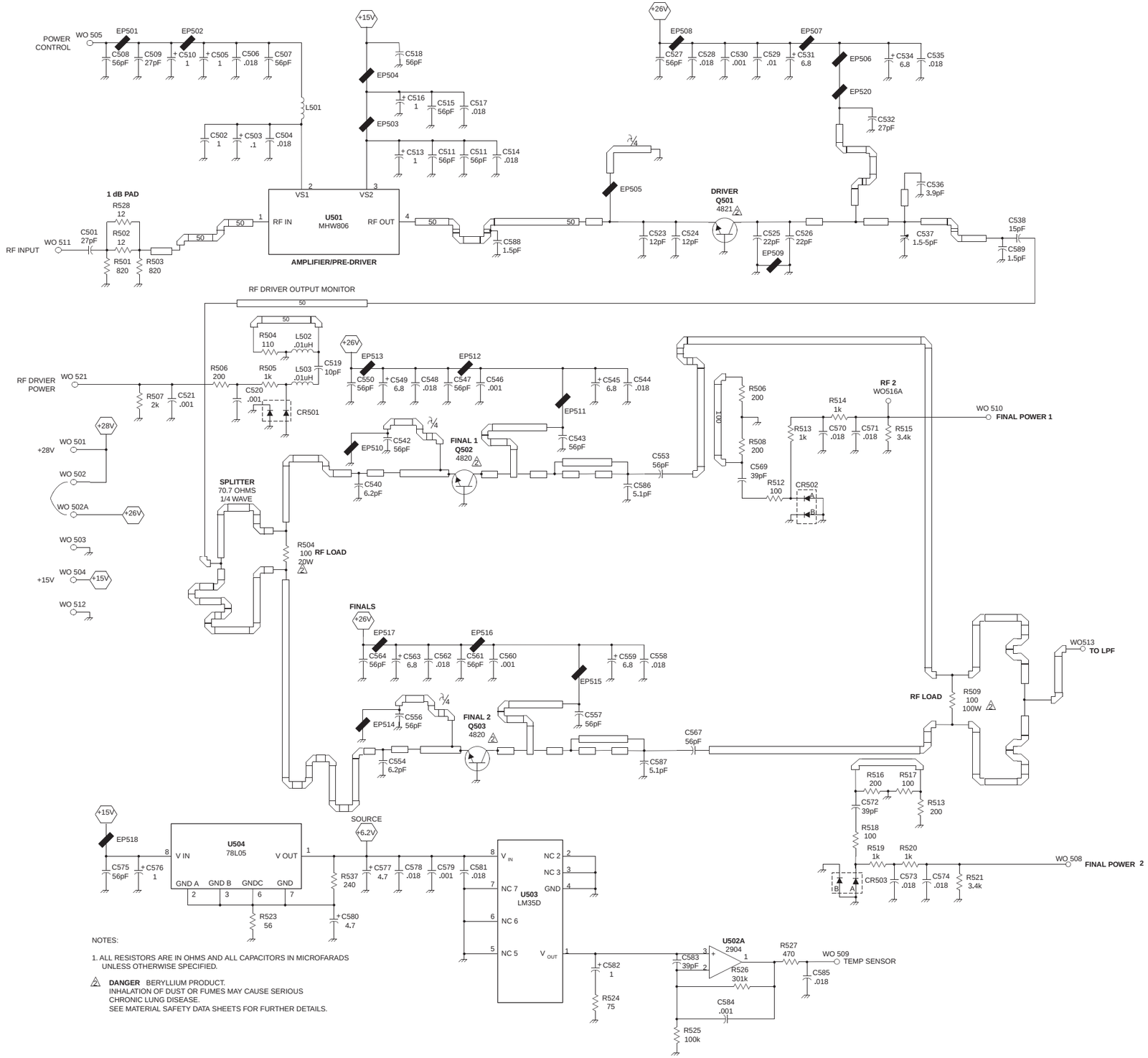
IC	PIN NUMBER +12V	PIN NUMBER GND
U402, U404, U407	8	4

EXCITER SCHEMATIC
FIGURE 10-20



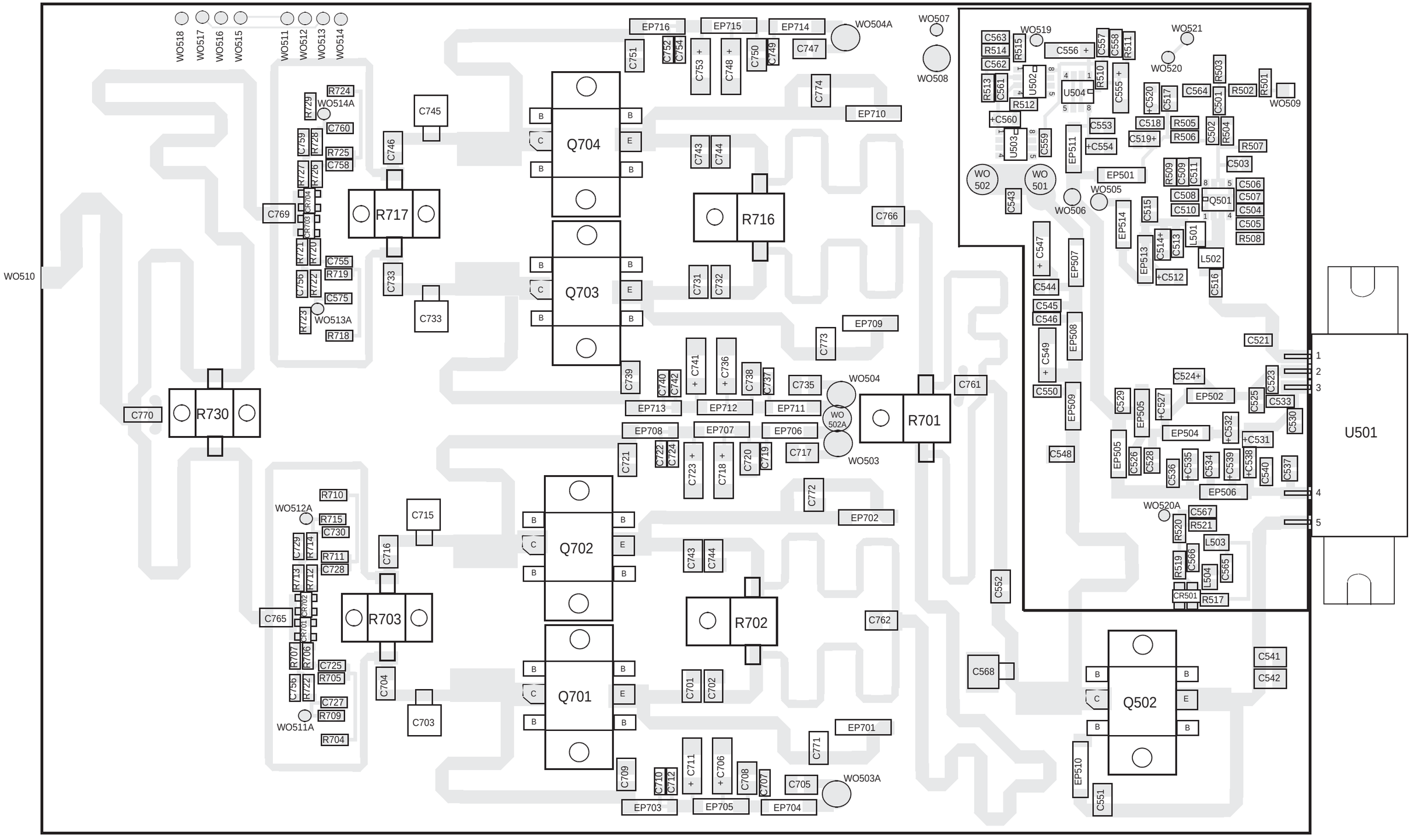
March 1999
Part No. 001-2009-600

75W POWER AMPLIFIER COMPONENT LAYOUT
FIGURE 10-21



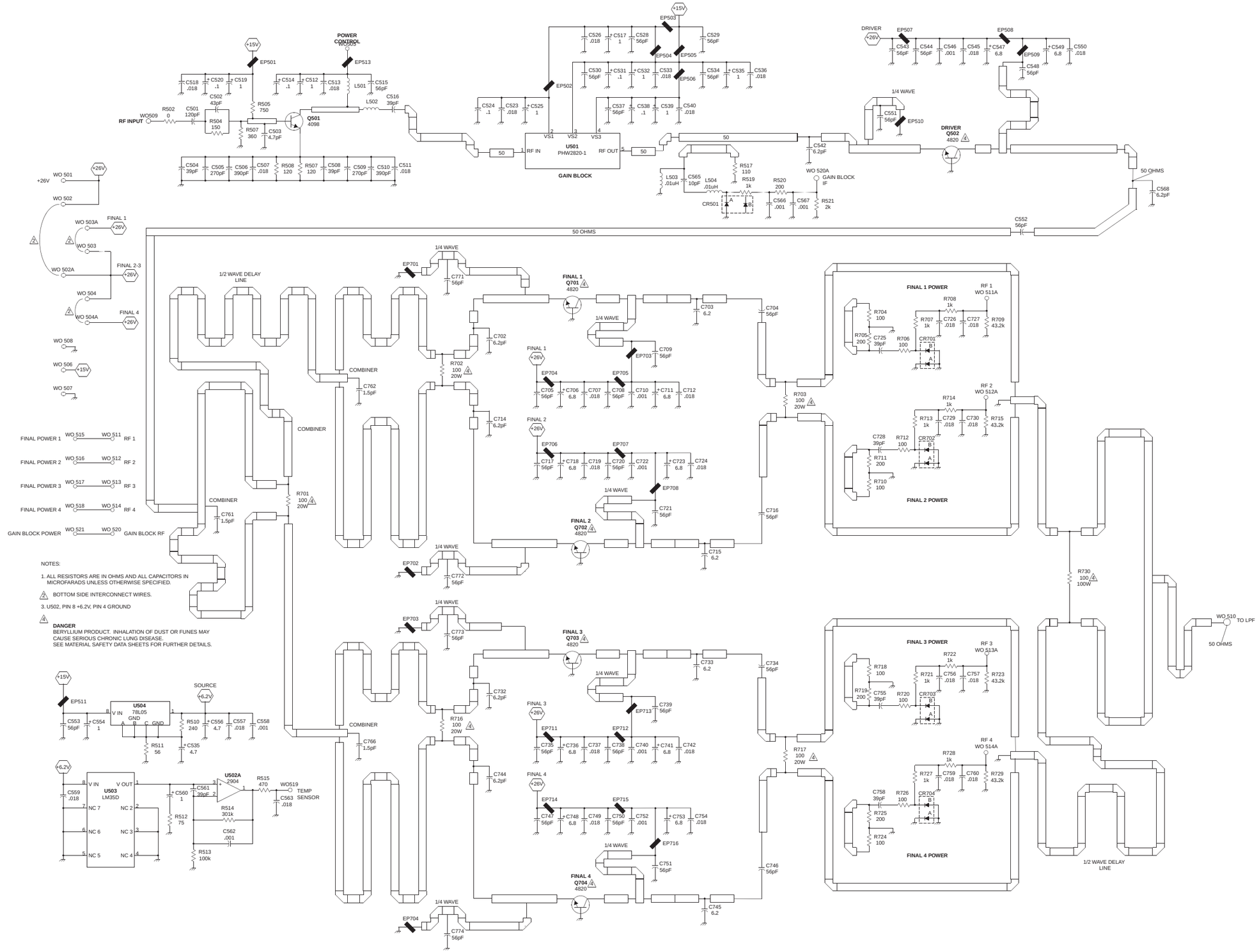
March 1999
Part No. 001-2009-600

75W POWER AMPLIFIER SCHEMATIC
FIGURE 10-22



March 1999
Part No. 001-2009-600

160W POWER AMPLIFIER COMPONENT LAYOUT
FIGURE 10-23



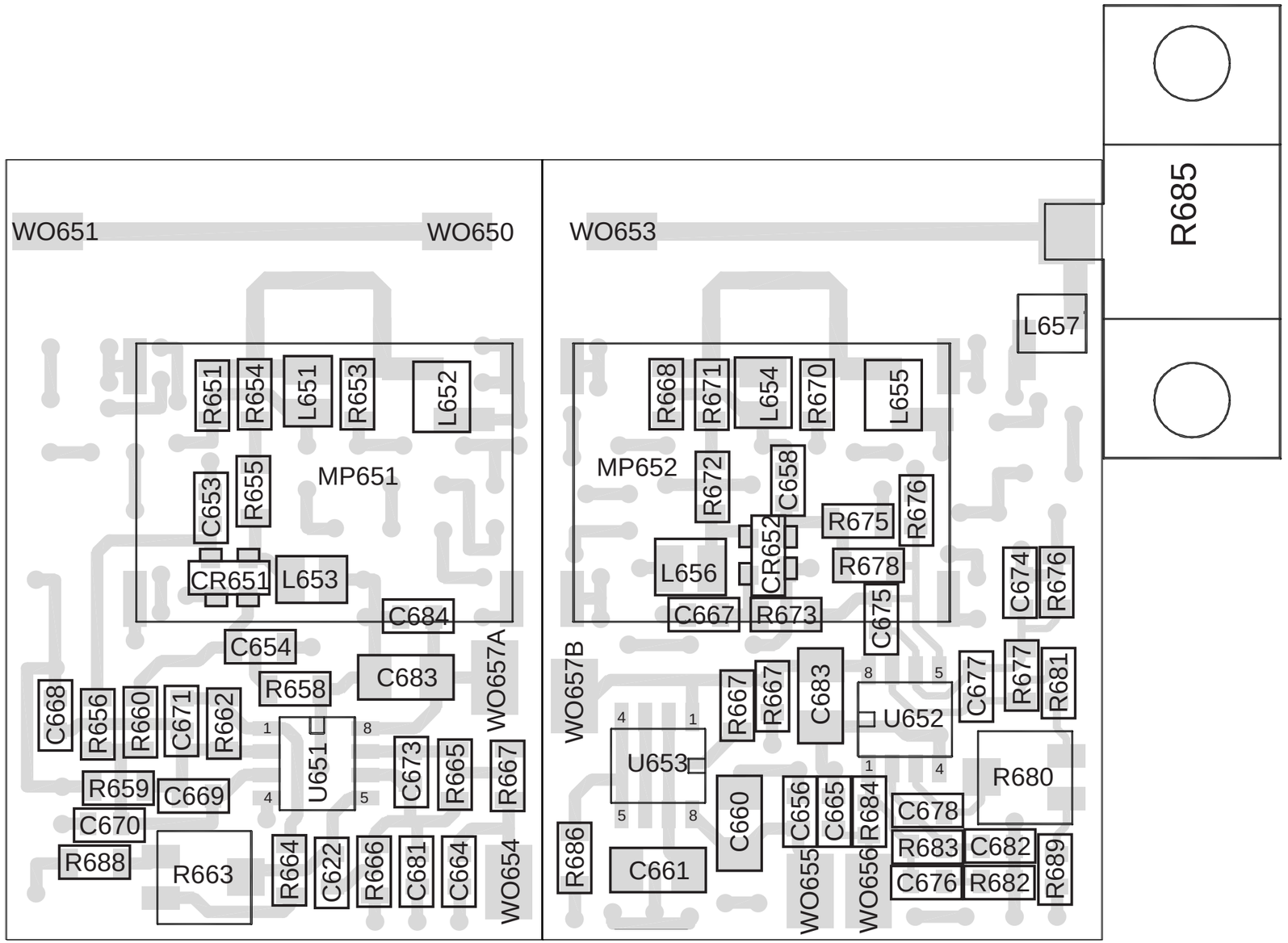
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

2. BOTTOM SIDE INTERCONNECT WIRES.

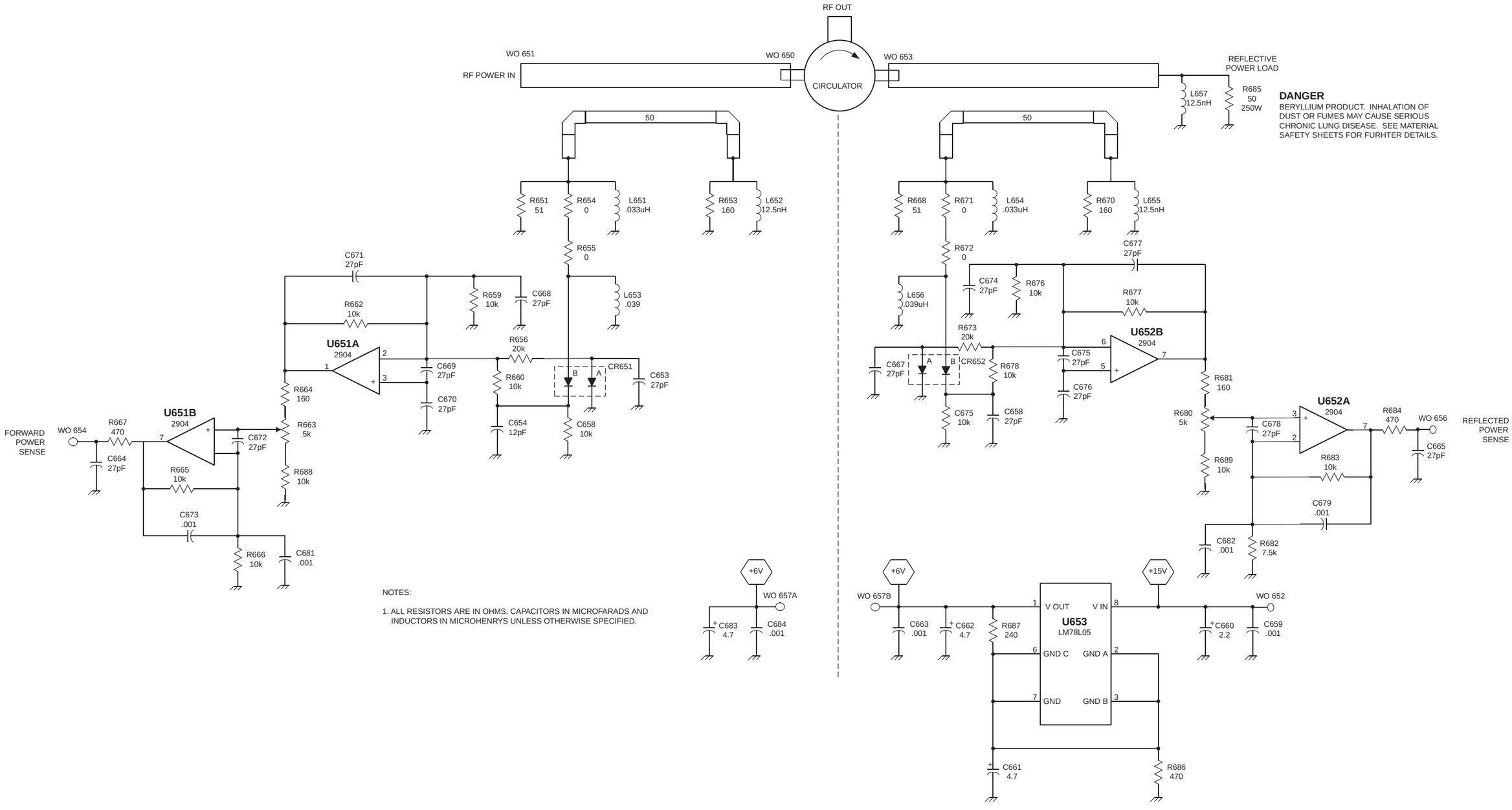
3. U502, PIN 8 +6.2V, PIN 4 GROUND

4. **DANGER**
BERYLLIUM PRODUCT. INHALATION OF DUST OR FUNES MAY CAUSE SERIOUS CHRONIC LUNG DISEASE.
SEE MATERIAL SAFETY DATA SHEETS FOR FURTHER DETAILS.



March 1999
Part No. 001-2009-600

FORWARD/REVERSE POWER BOARD
COMPONENT LAYOUT
FIGURE 10-25

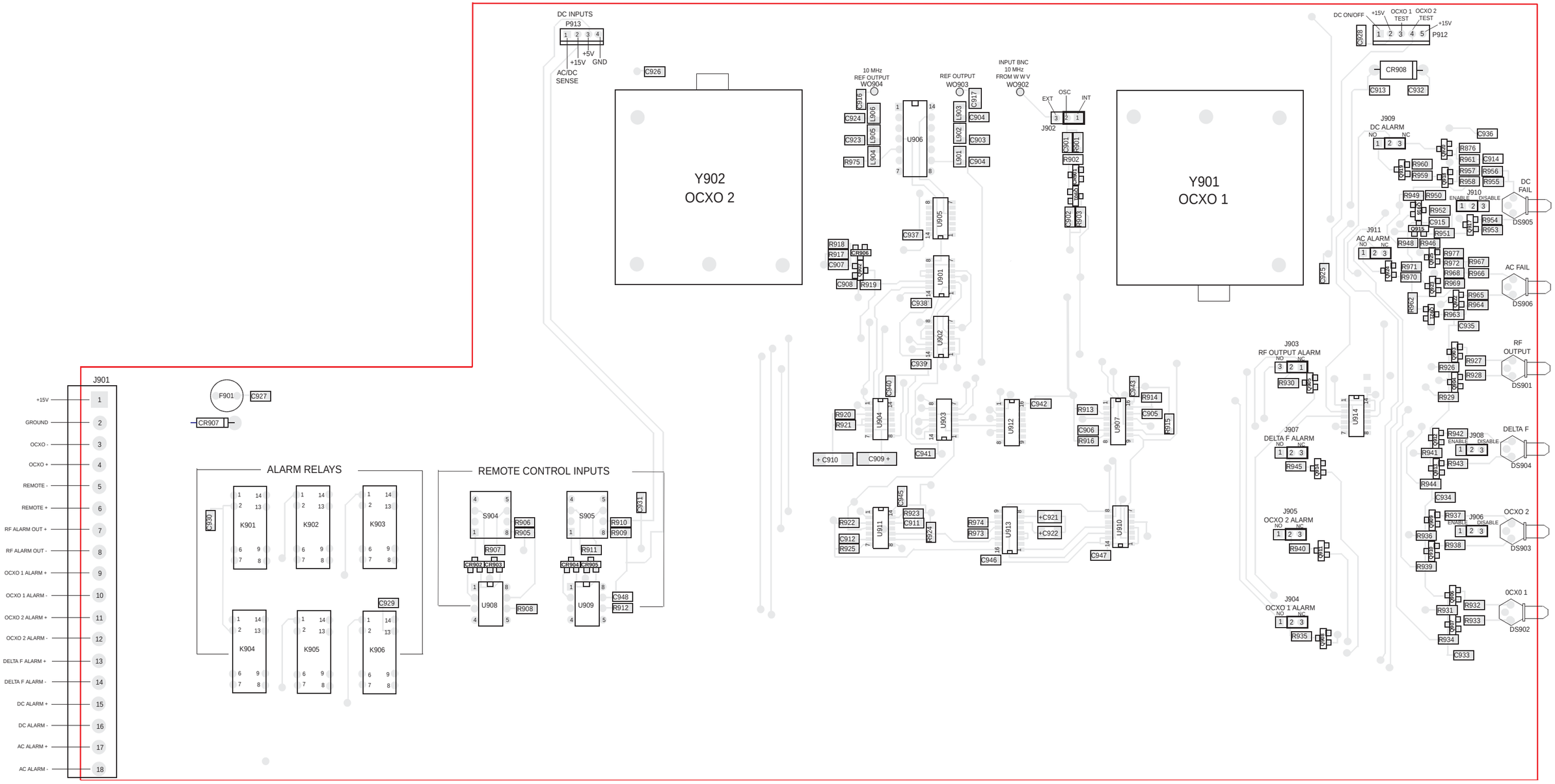


NOTES:

1. ALL RESISTORS ARE IN OHMS, CAPACITORS IN MICROFARADS AND INDUCTORS IN MICROHENRYS UNLESS OTHERWISE SPECIFIED.

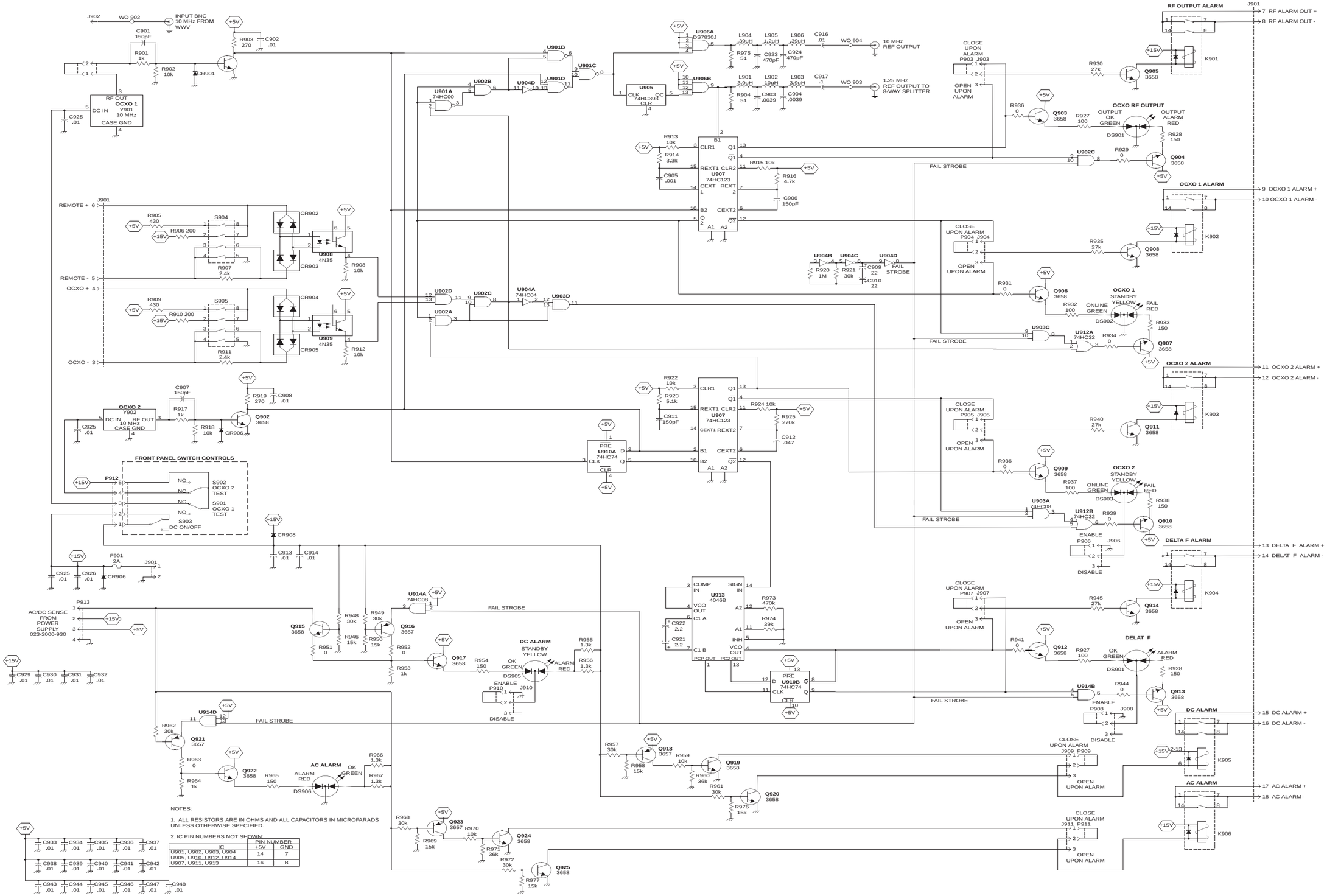
March 1999
Part No. 001-2009-600

FORWARD/REVERSE POWER SCHEMATIC
FIGURE10-26



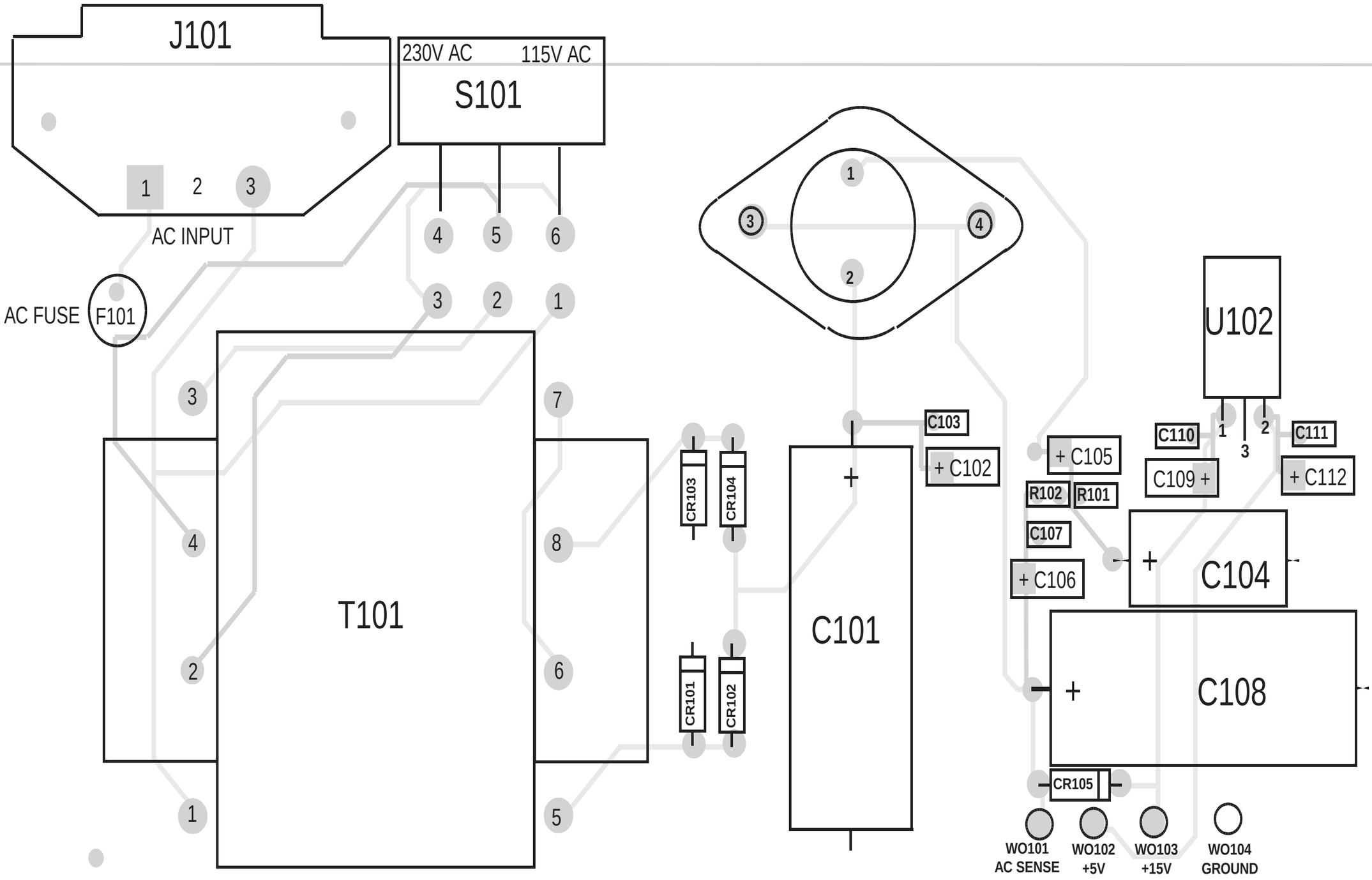
OCXO COMPONENT LAYOUT
FIGURE 10-27

March 1999
Part No. 001-2009-600

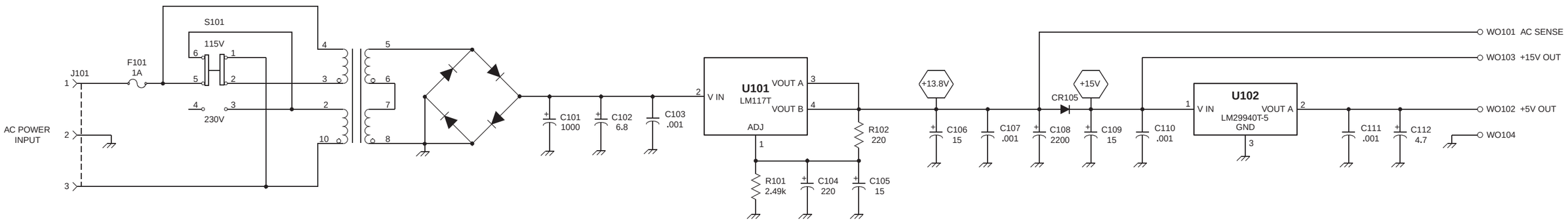


March 1999
Part No. 001-2009-600

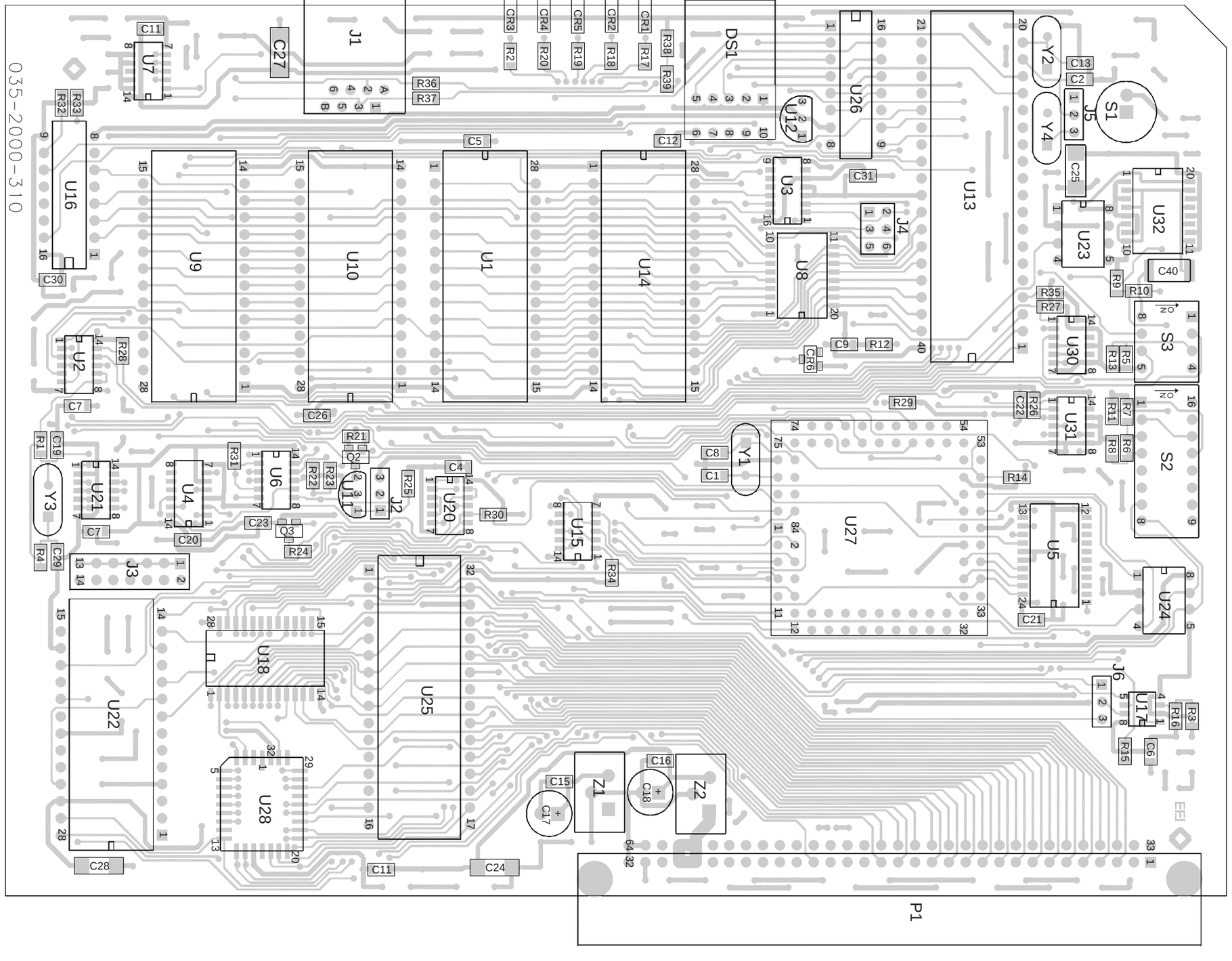
OCXO SCHEMATIC
FIGURE10-28



OCXO POWER SUPPLY COMPONENT LAYOUT
FIGURE 10-29

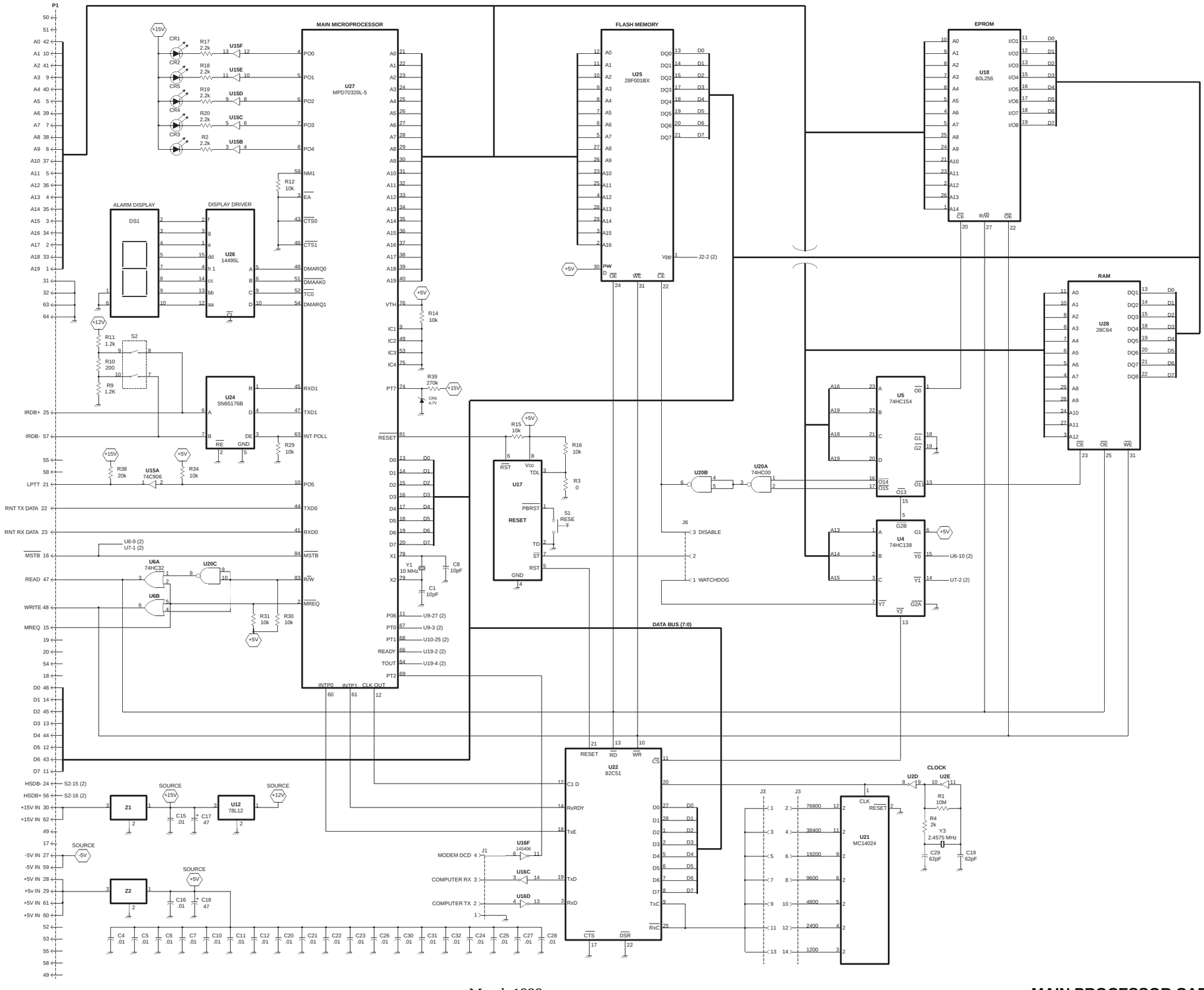


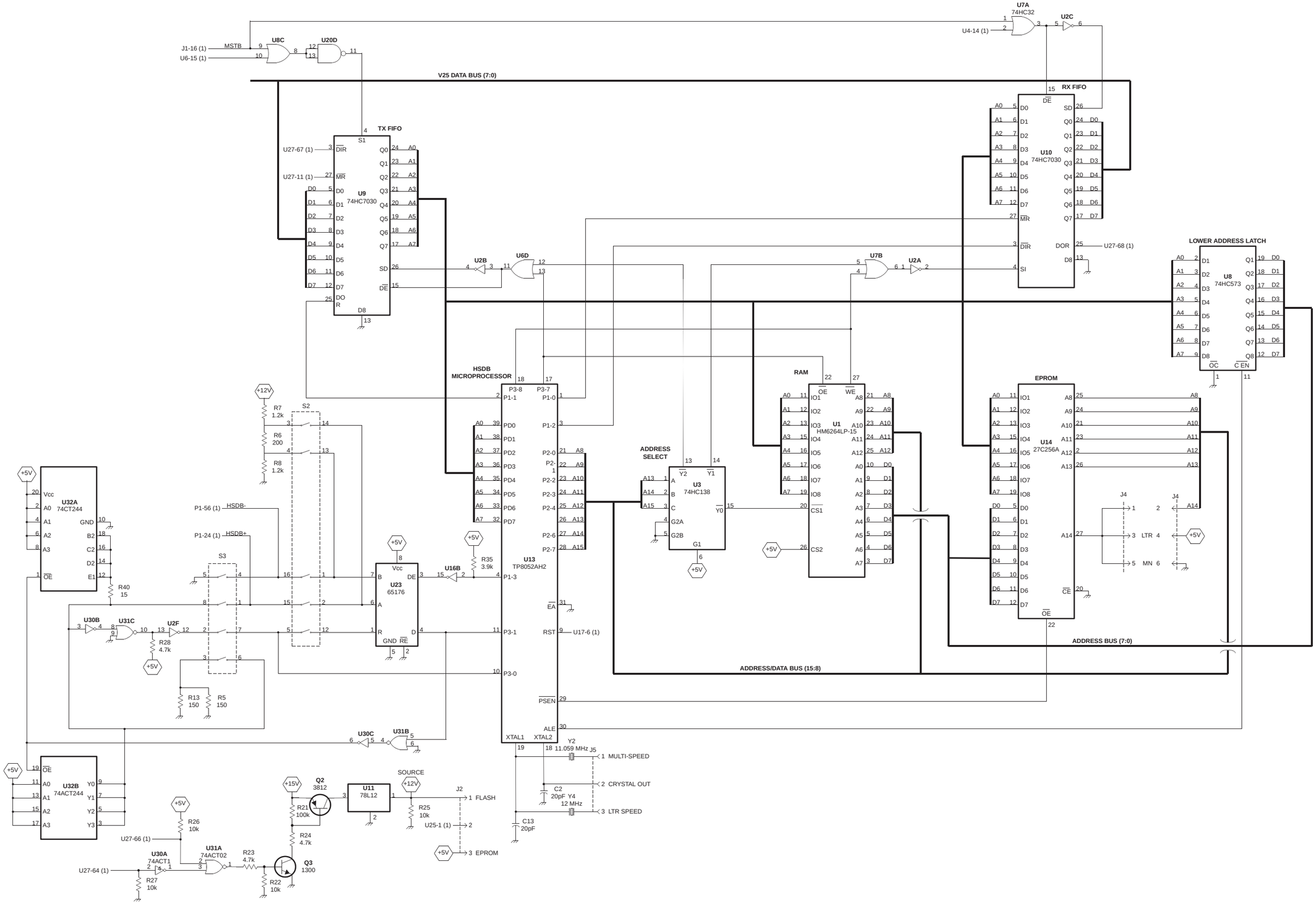
160W POWER AMPLIFIER SCHEMATIC
FIGURE10-30



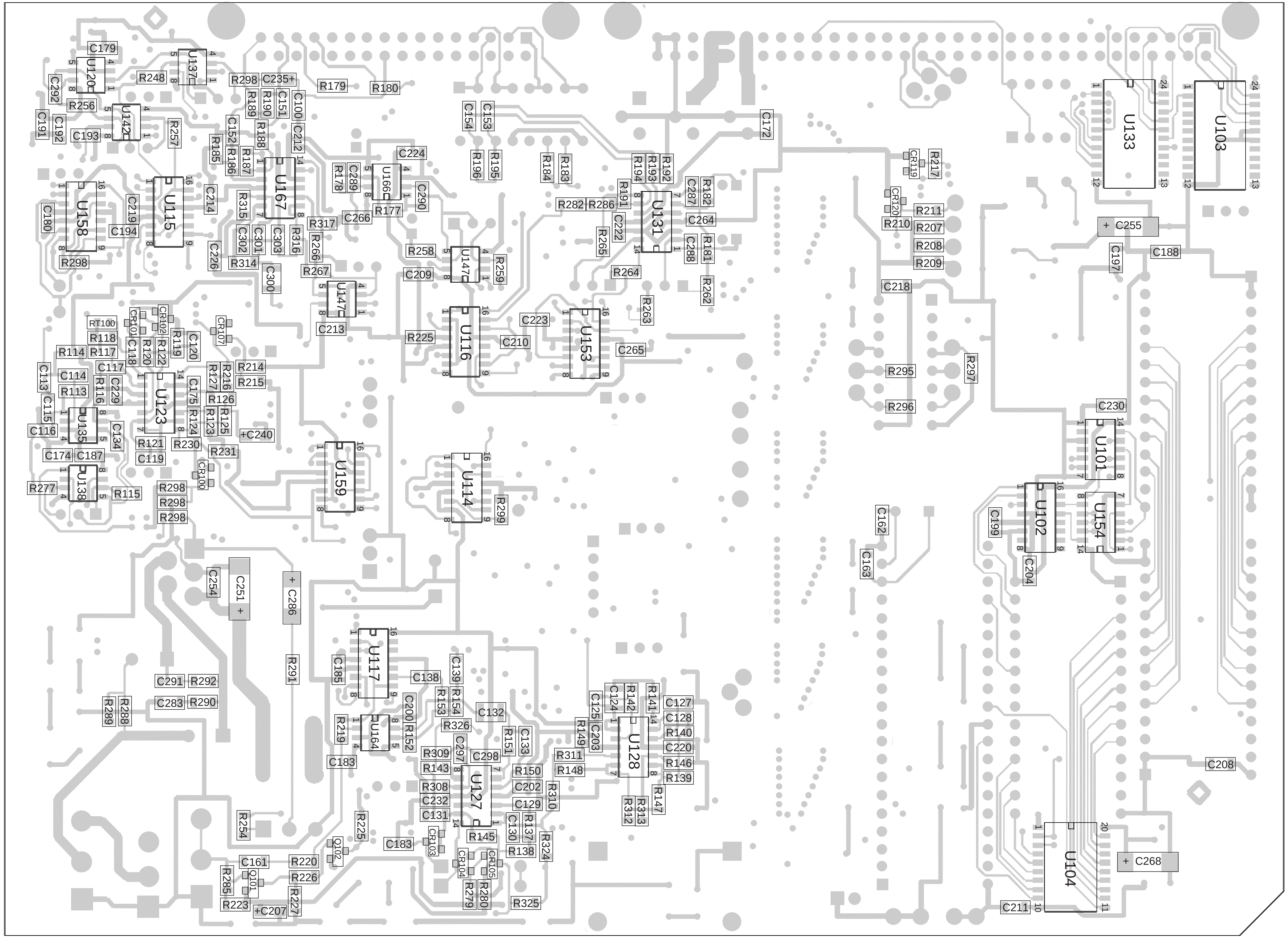
March 1999
Part No. 001-2009-600

MAIN PROCESSOR CARD COMPONENT LAYOUT
FIGURE 10-31

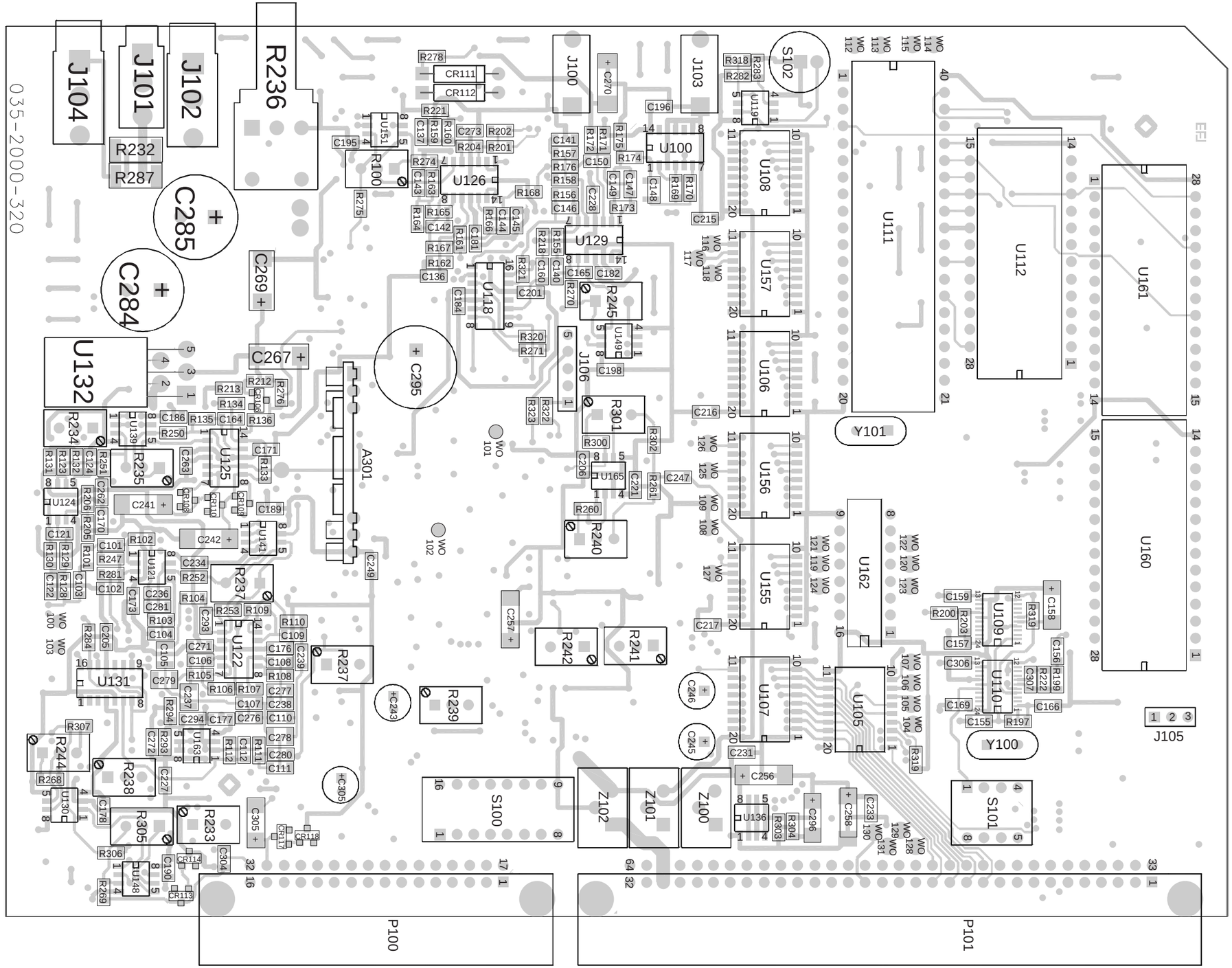

P1
MAIN MICROPROCESSOR
U27
MPD70320L-5
FLASH MEMORY
U25
28F001BX
EPROM
U18
60L256
RAM
U28
28C64
ALARM DISPLAY
DS1
DISPLAY DRIVER
U26
14495L
U24
SN65176B
U15A
74C906
U15B
U15C
U15D
U15E
U15F
U6A
74HC32
U6B
U20C
U20A
74HC00
U20B
U5
74HC154
U4
74HC138
U17
RESET
U22
82C51
U16A
U16B
U16C
U16D
U16E
U16F
14506
U12
78L12
Z1
Z2
U21
MC14024
CLOCK
DATA BUS (7:0)
MARCH 1999
Part No. 001-2009-600
10-27
MAIN PROCESSOR CARD SCHEMATIC (1 OF 2)
FIGURE10-32



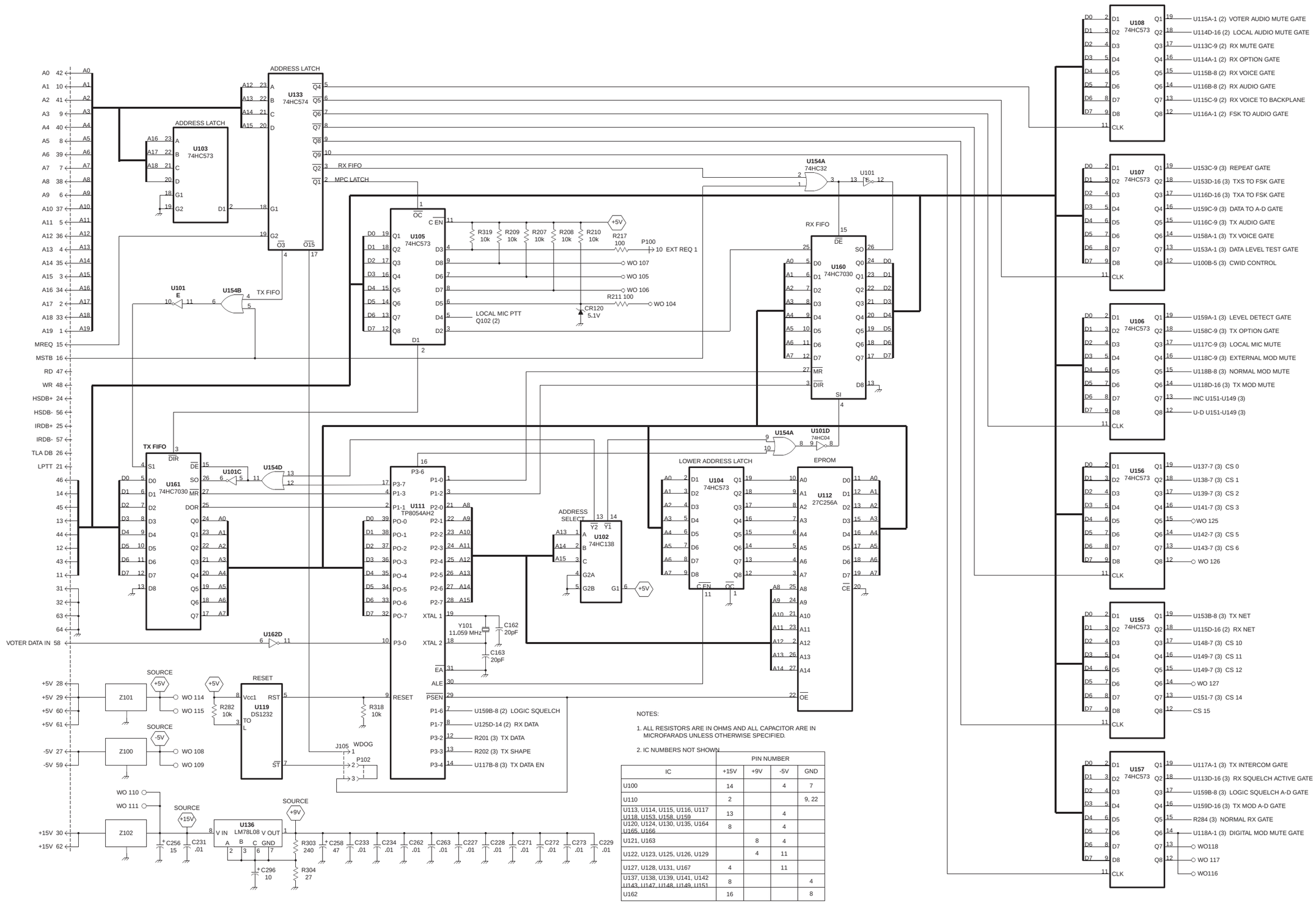
MAIN PROCESSOR CARD SCHEMATIC (2 OF 2)
FIGURE 10-33



MAIN AUDIO CARD COMPONENT LAYOUT
(OPPOSITE COMPONENT SIDE VIEW)
FIGURE10-34



MAIN AUDIO CARD COMPONENT LAYOUT
(COMPONENT SIDE VIEW)
FIGURE 10-35



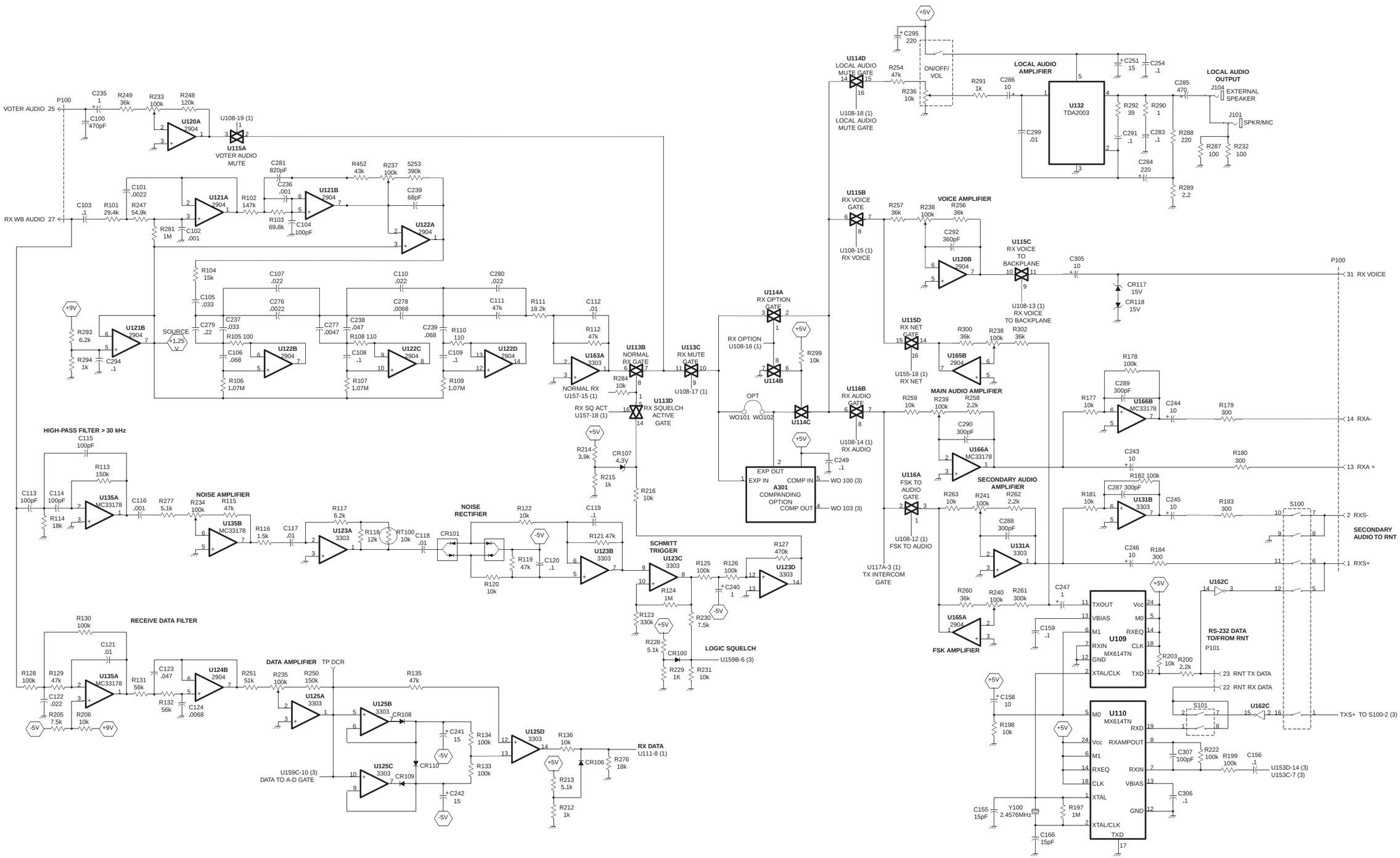
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITOR ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

2. IC NUMBERS NOT SHOWN

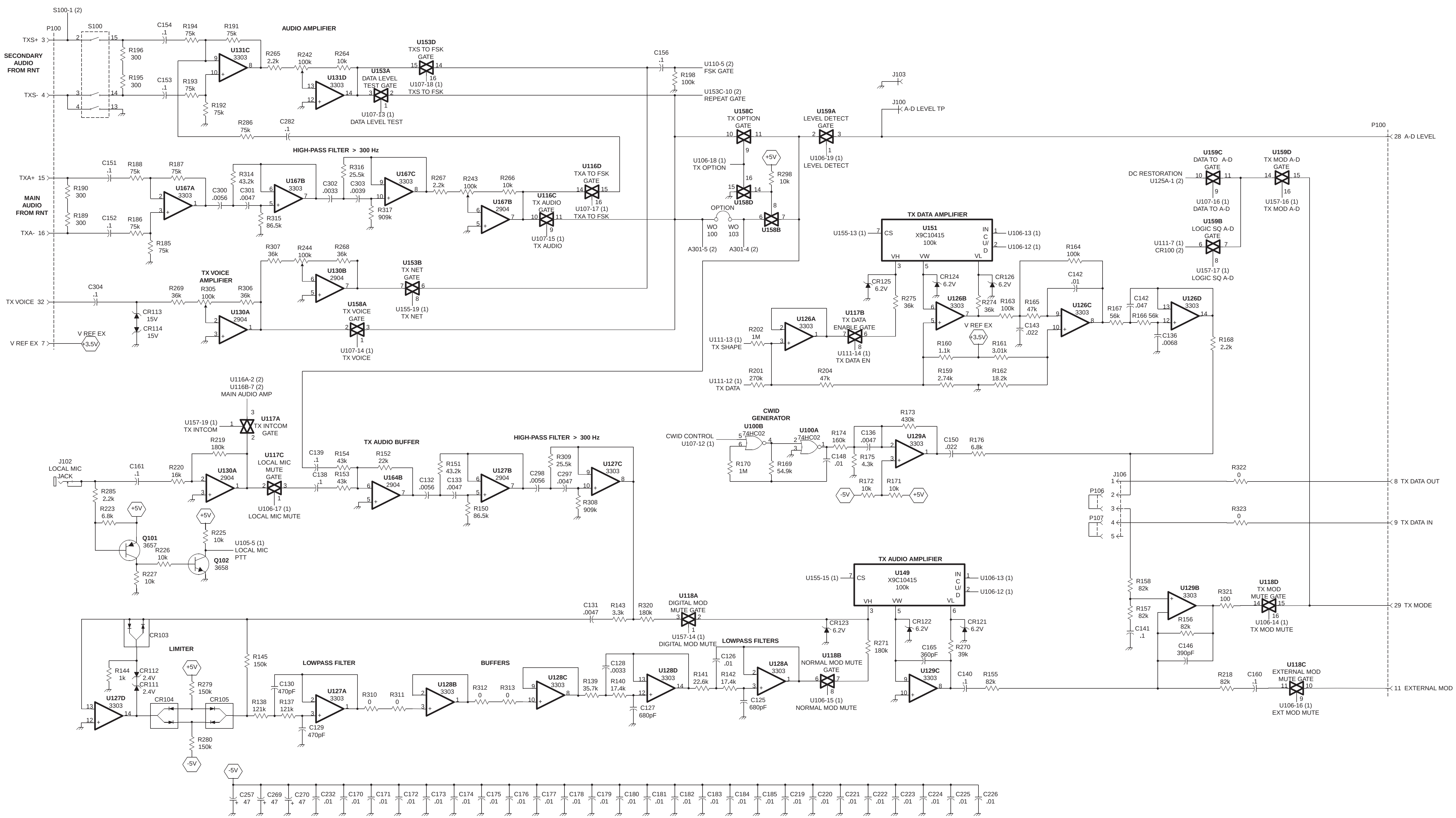
IC	PIN NUMBER +15V	+9V	-5V	GND
U100	14		4	7
U110	2			9, 22
U113, U114, U115, U116, U117 U118, U153, U158, U159	13		4	
U120, U124, U130, U135, U164 U165, U166	8		4	
U121, U163		8	4	
U122, U123, U125, U126, U129		4	11	
U127, U128, U131, U167	4		11	
U137, U138, U139, U141, U142 U143, U147, U148, U149, U151	8			4
U162	16			8

MAIN AUDIO CARD SCHEMATIC (1 OF 3)
FIGURE10-36



MAIN AUDIO CARD SCHMEATIC (2 OF 3)
FIGURE 10-37

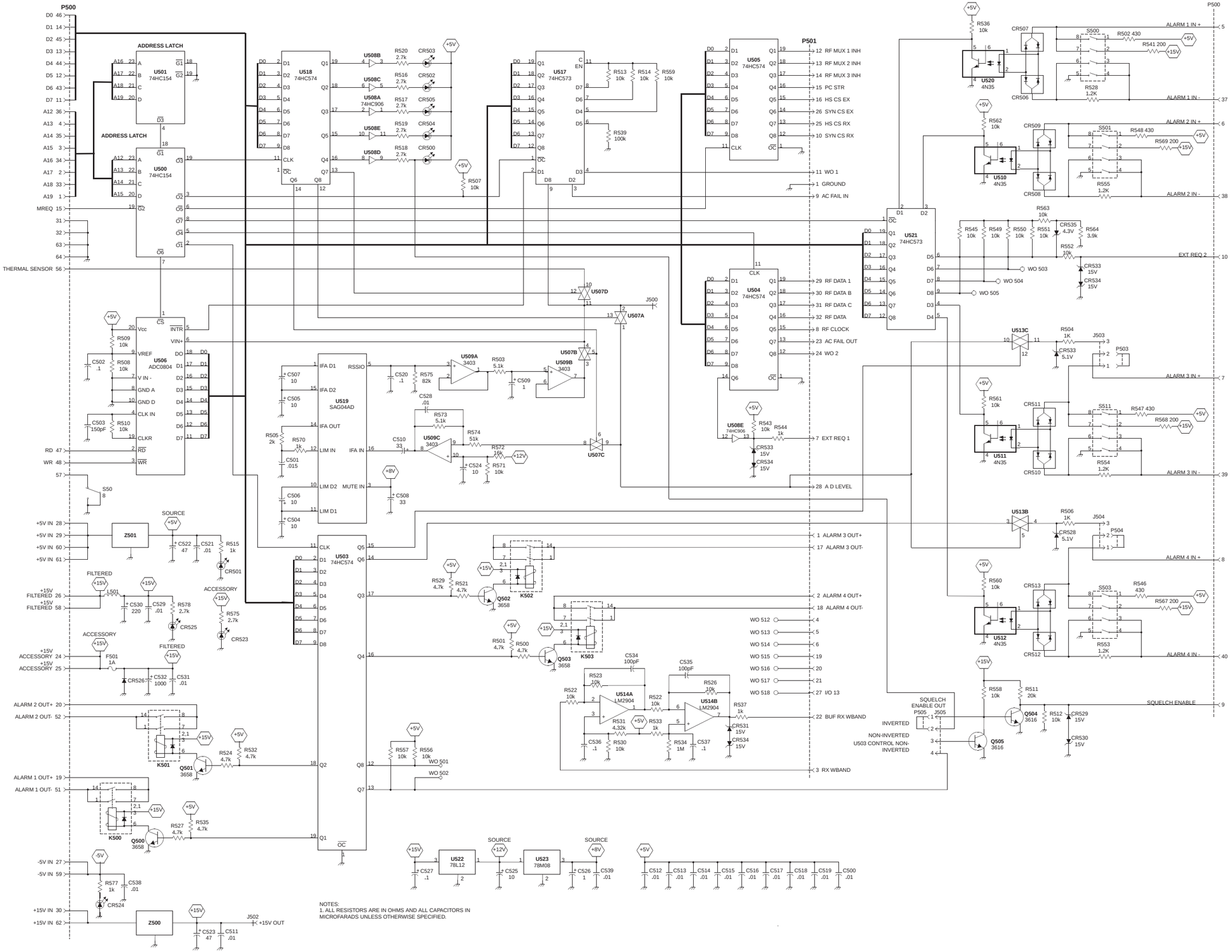
March 1999
Part No. 001-2009-600



MAIN AUDIO CARD SCHEMATIC (3 OF 3)
FIGURE10-38

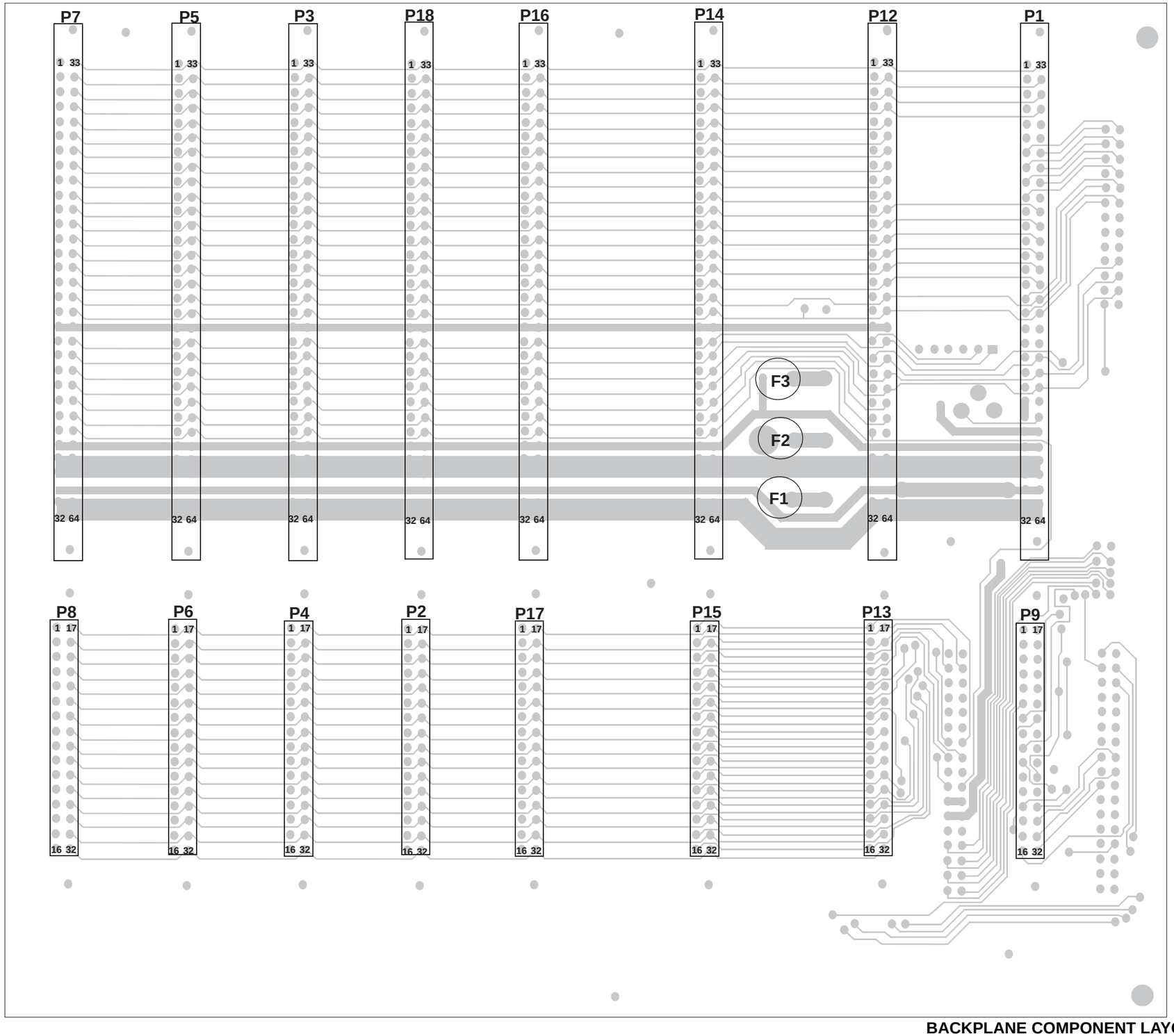
035-2000-350

INTERFACE ALARM CARD COMPONENT LAYOUT
FIGURE10-39

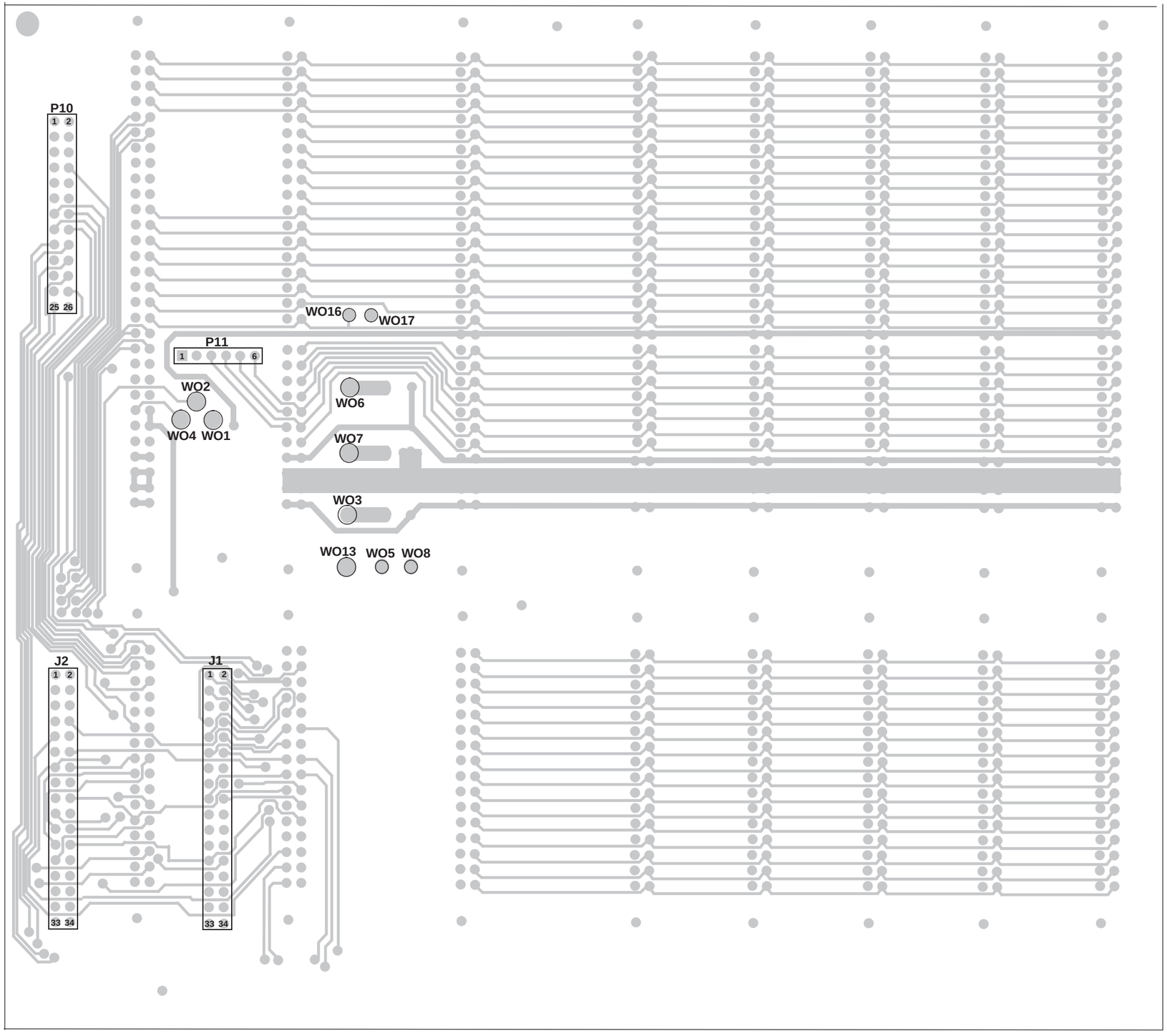


March 1999
Part No. 001-2009-600

INTERFACE ALARM CARD SCHEMATIC
FIGURE10-40

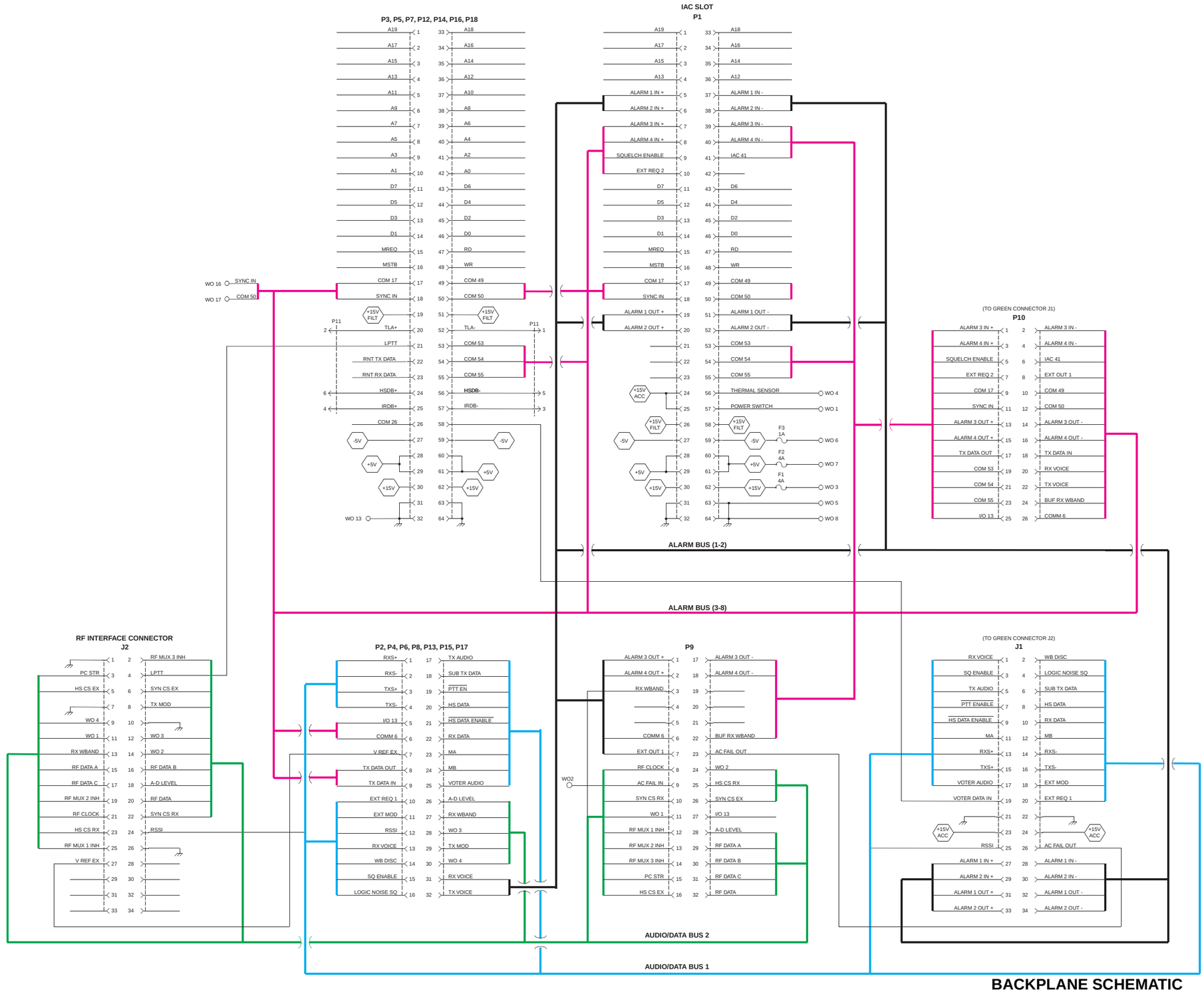


BACKPLANE COMPONENT LAYOUT
FIGURE 10-41

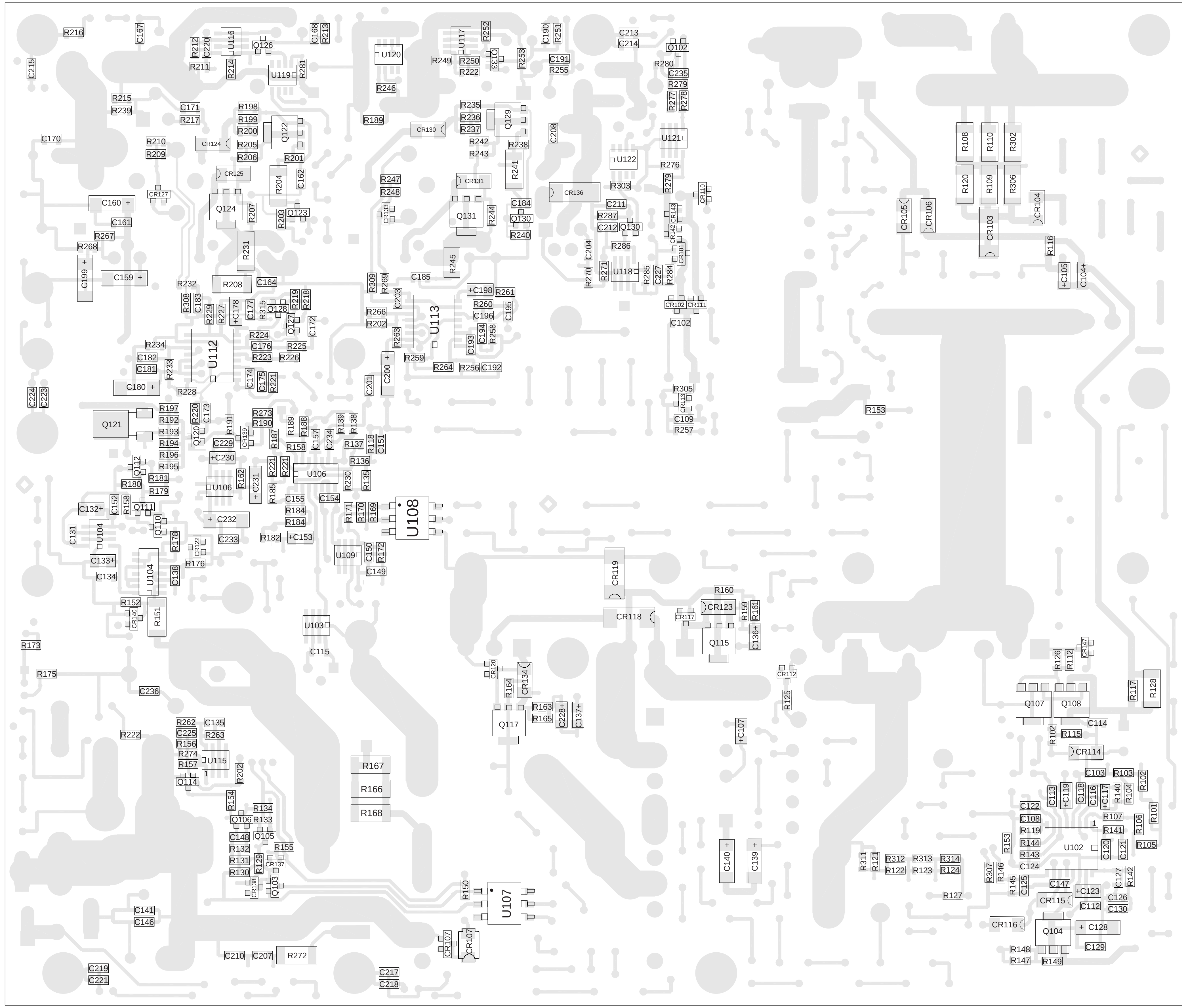


March 1999
Part No. 001-2009-600

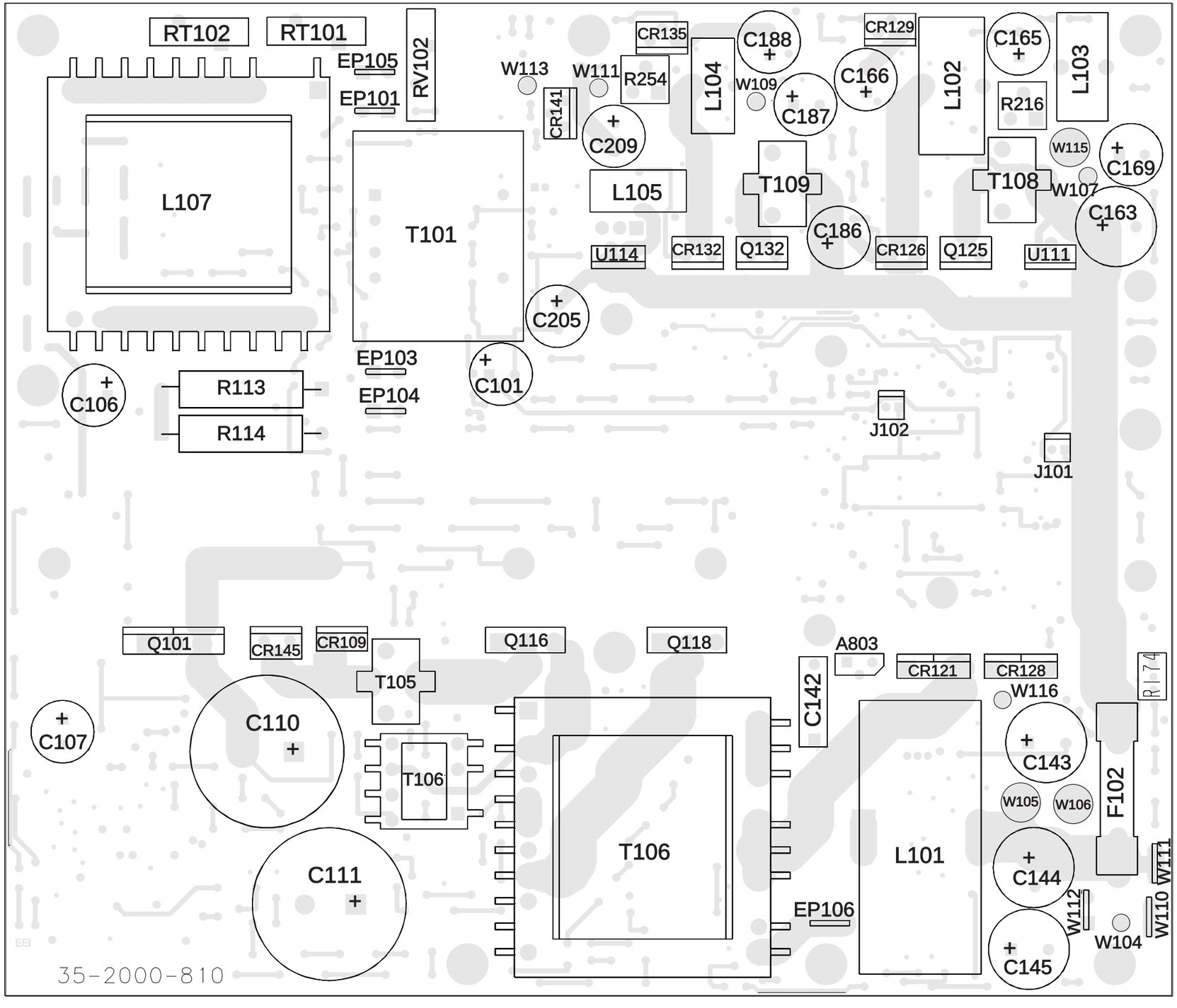
BACKPLANE COMPONENT LAYOUT (CABLE SIDE)
FIGURE10-42



BACKPLANE SCHEMATIC
FIGURE 10-43

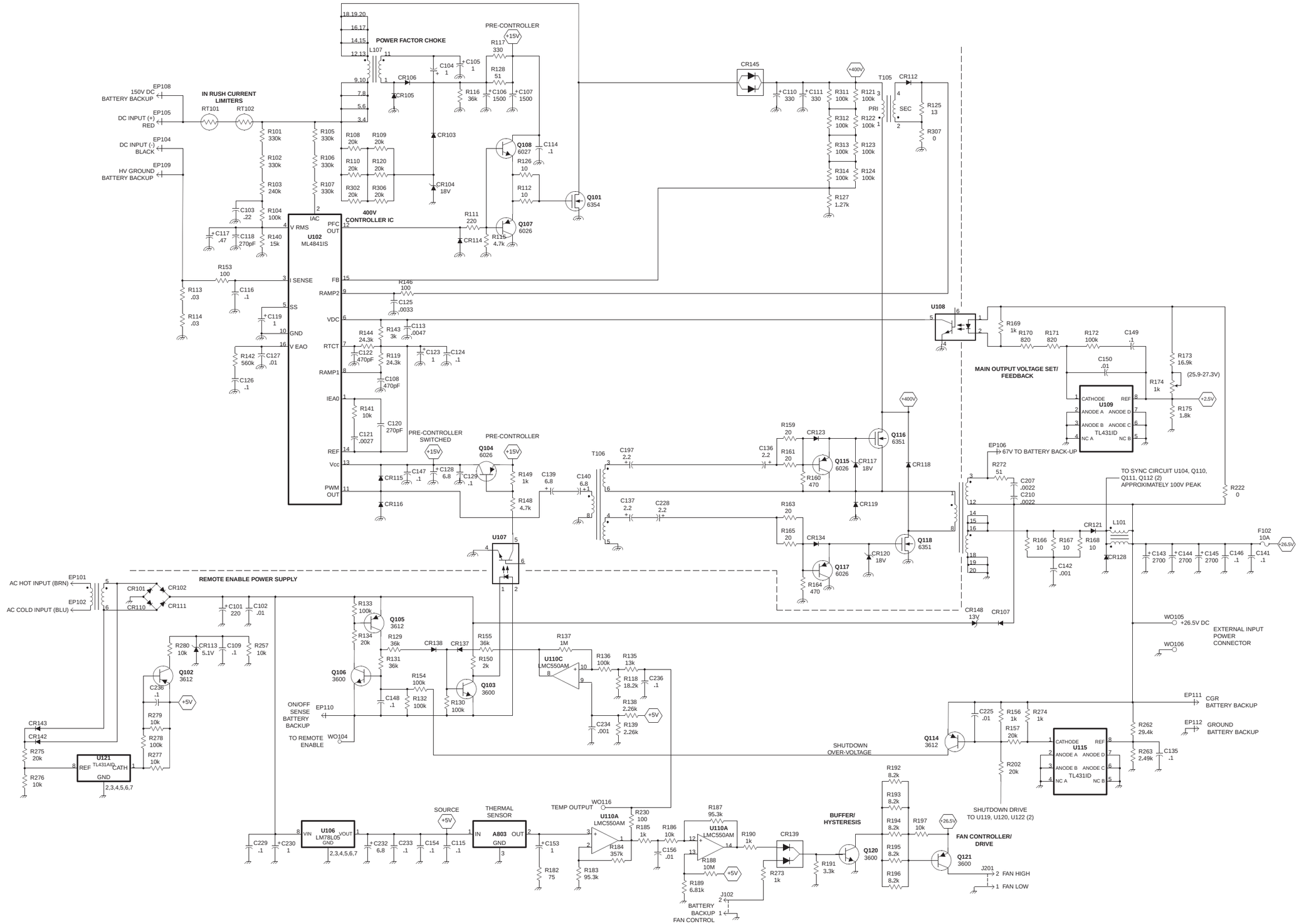


800W POWER SUPPLY COMPONENT LAYOUT
(OPPOSITE COMPONENT SIDE VIEW)
FIGURE10-44



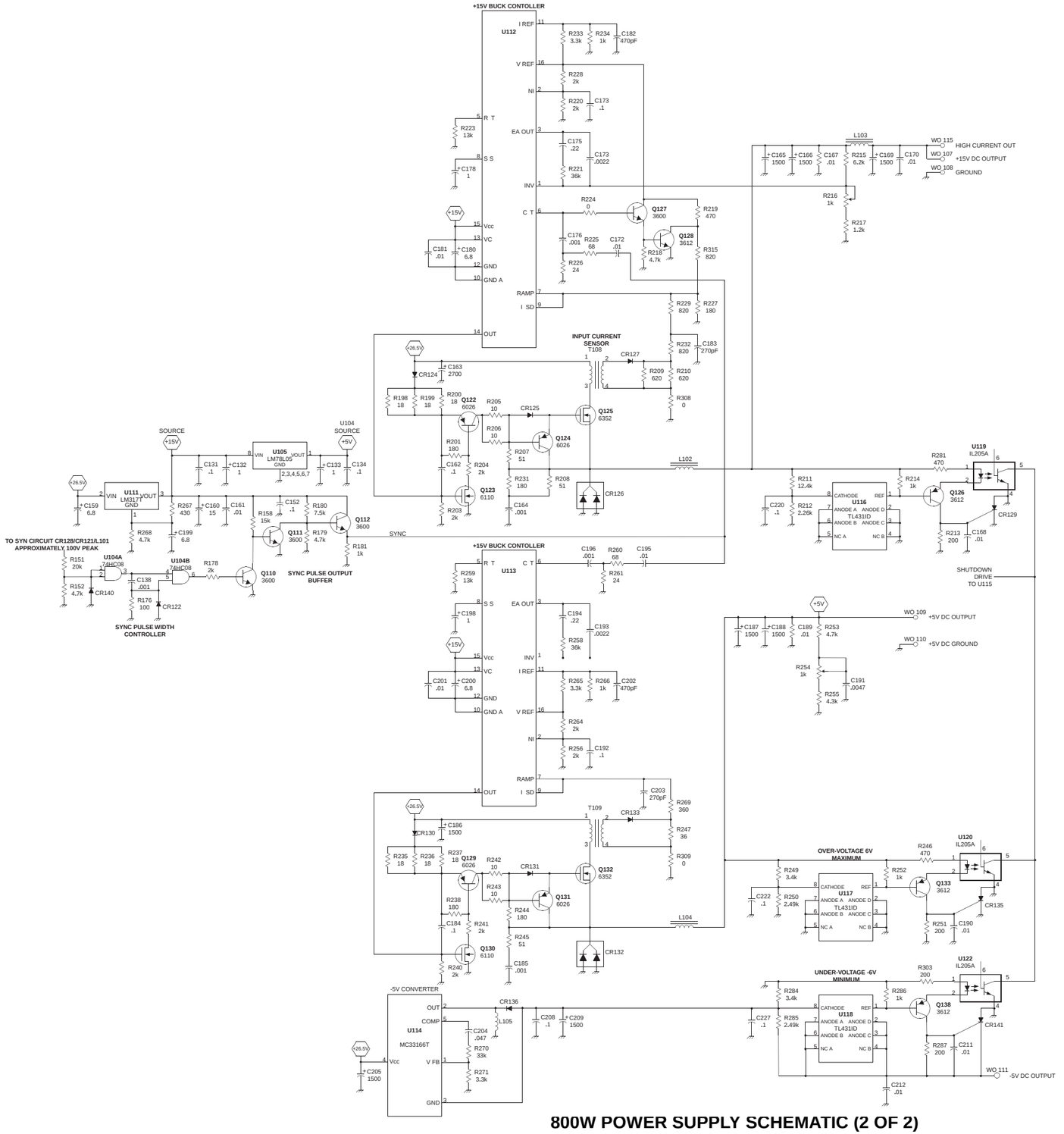
T

(COMPONENT SIDE VIEW)
FIGURE 10-45

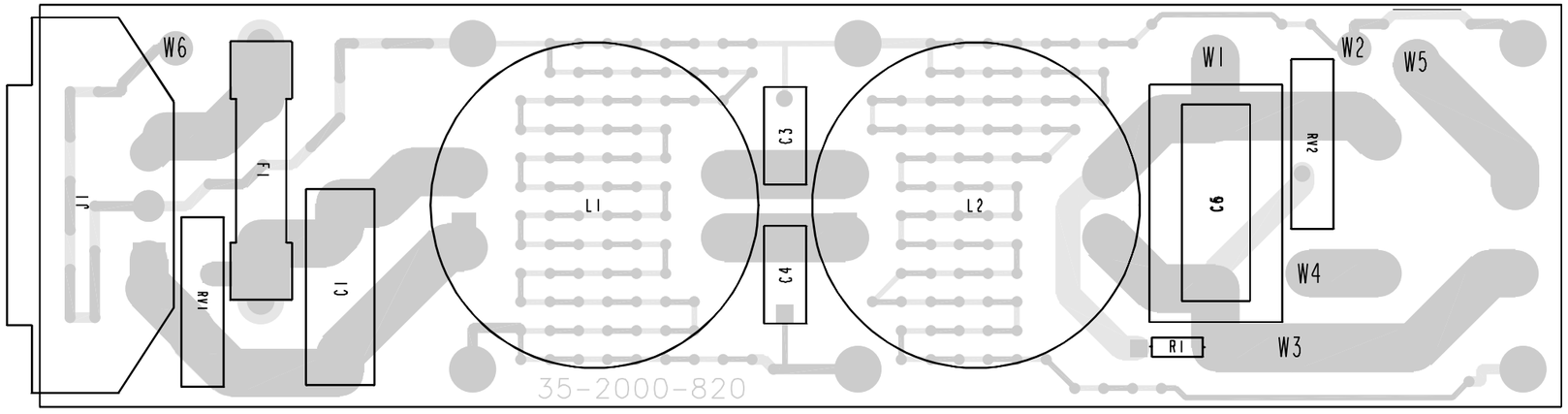


March 1999
Part No. 001-2009-600

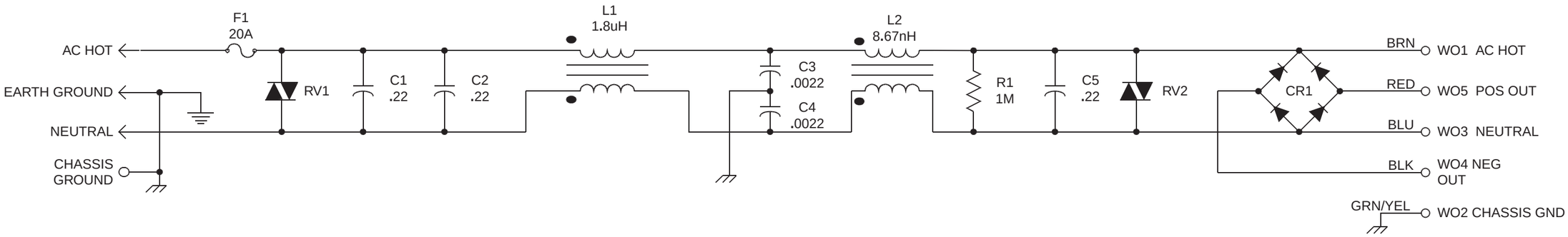
800W POWER SUPPLY SCHEMATIC (1 OF 2)
FIGURE10-46



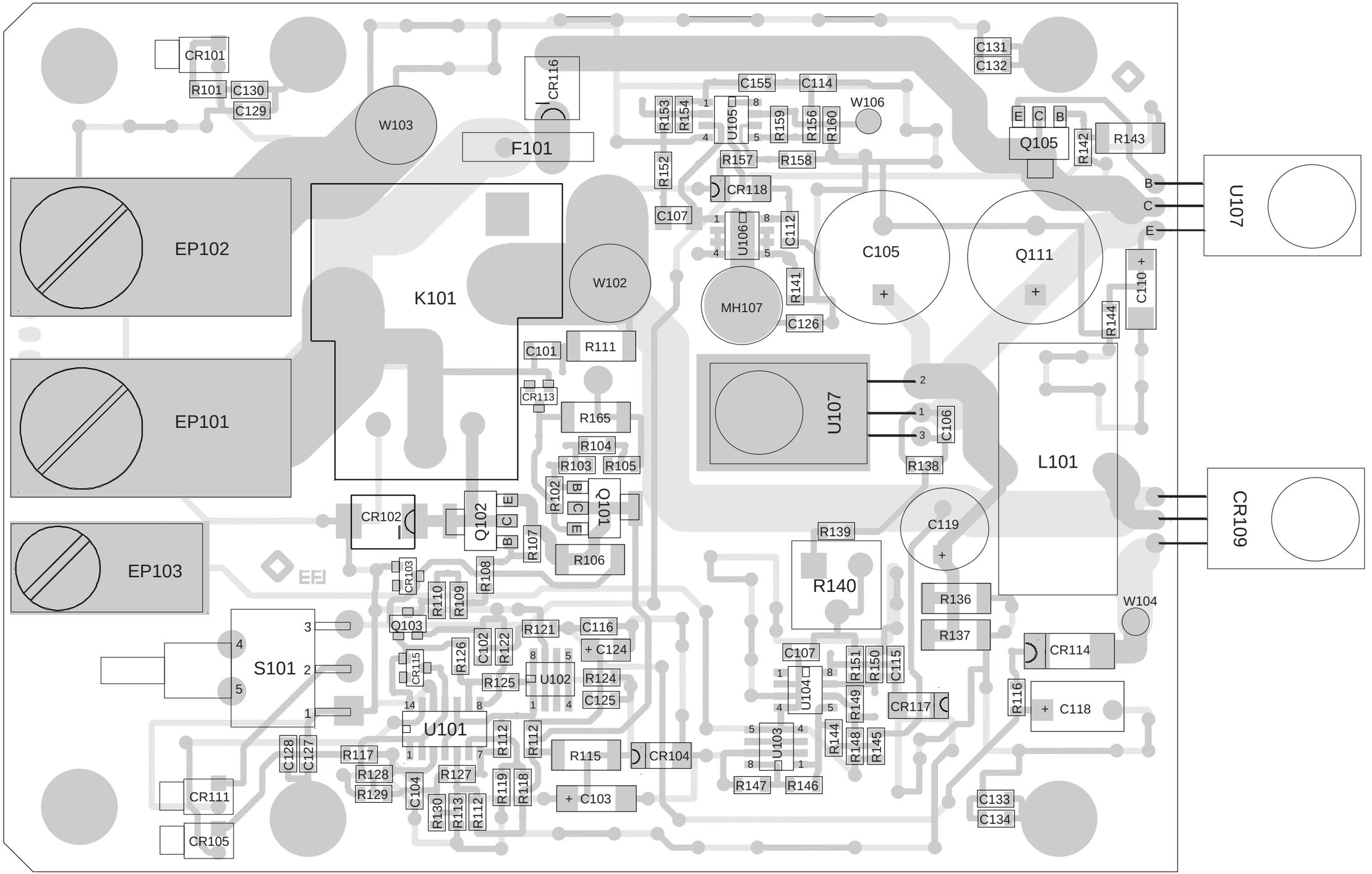
800W POWER SUPPLY SCHEMATIC (2 OF 2)
FIGURE 10-47



POWER SUPPLY FILTER BOARD COMPONENT LAYOUT
FIGURE 10-48

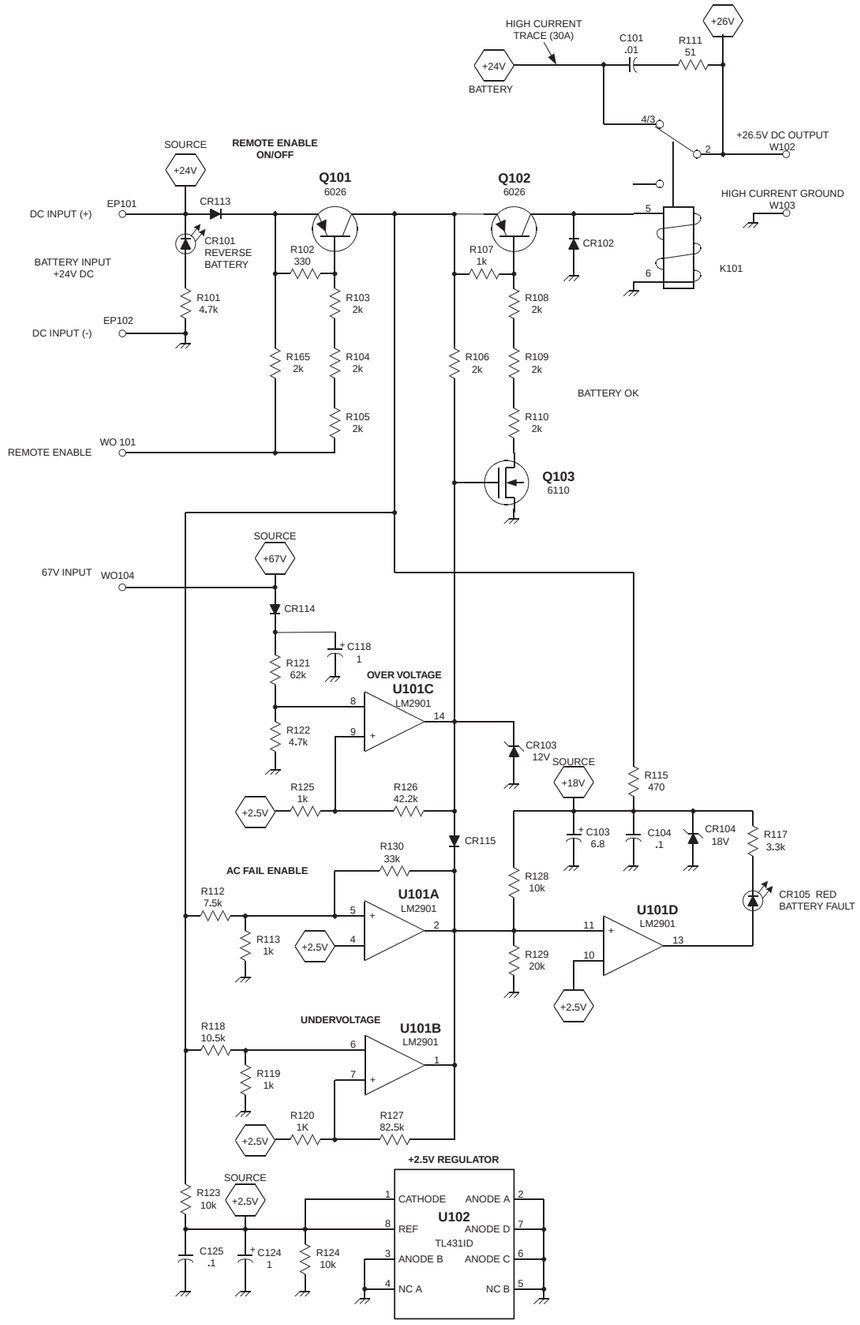


POWER SUPPLY FILTER BOARD SCHEMATIC
FIGURE 10-49

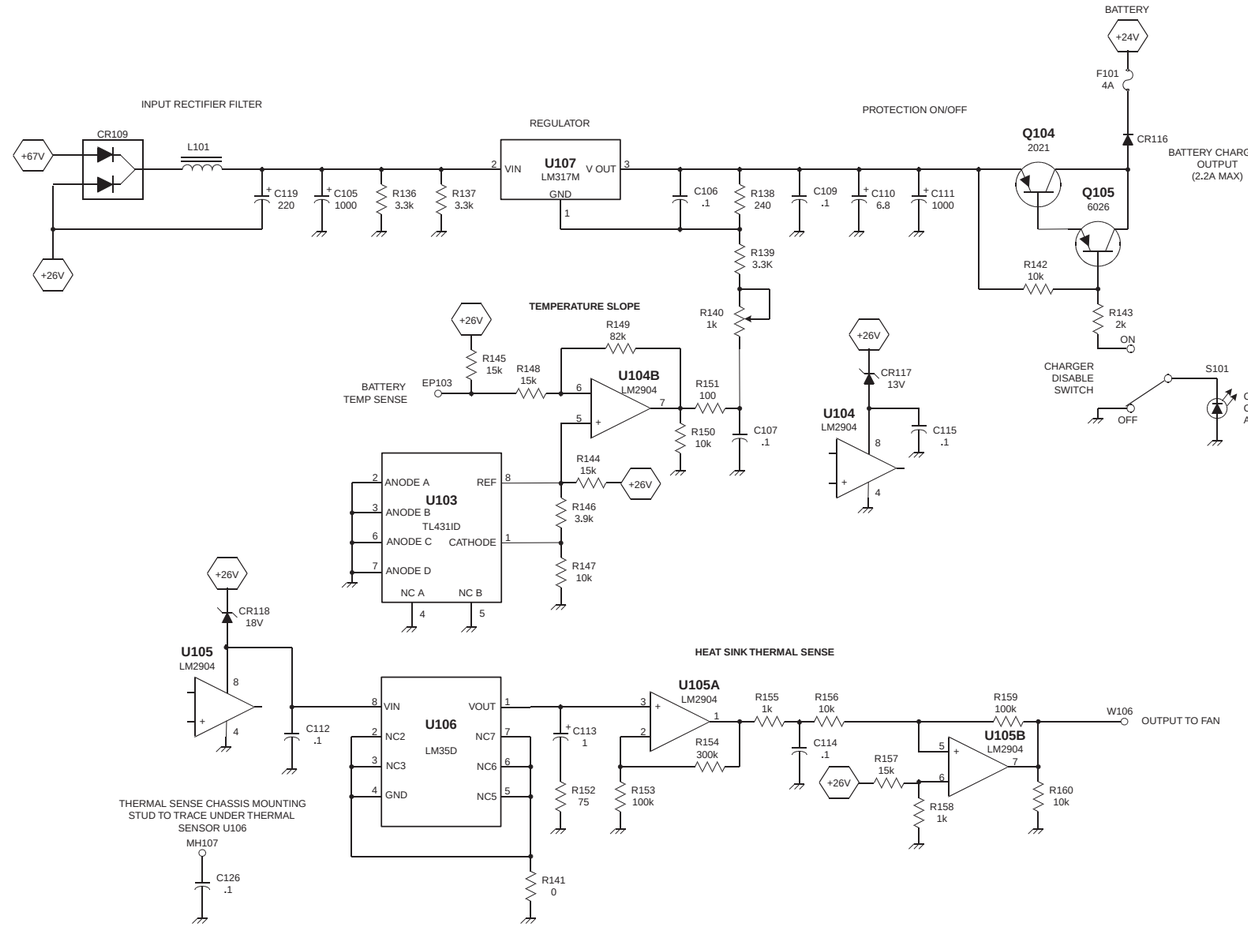


March 1999
Part No. 001-2009-600

BATTERY BACK-UP COMPONENT LAYOUT
FIGURE 10-50



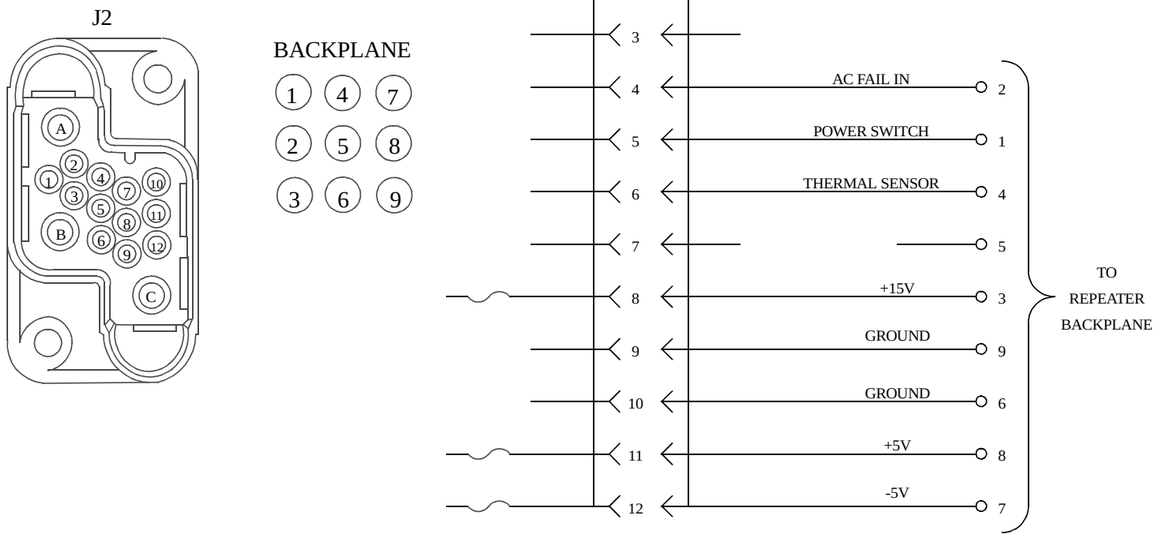
REVERT SECTION



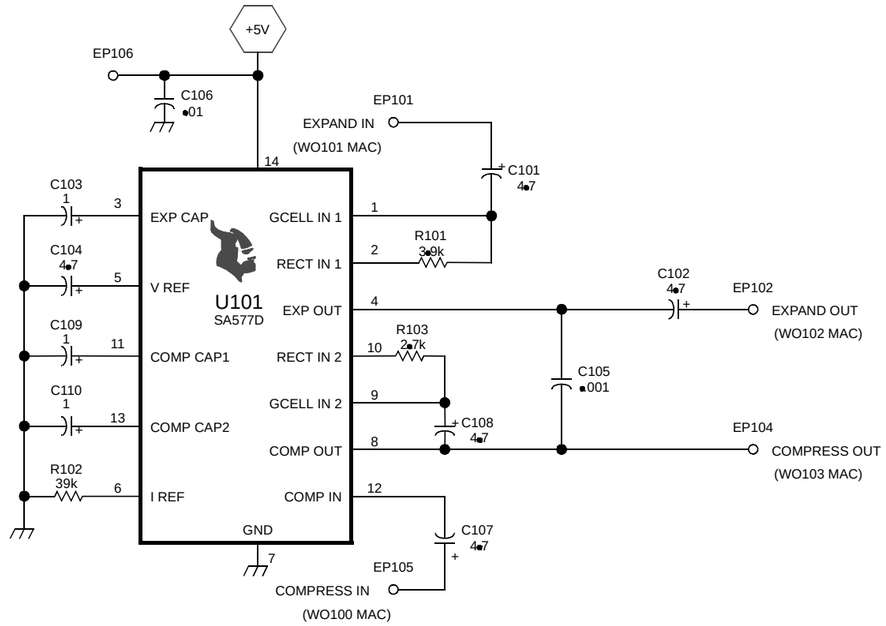
CHARGER SECTION

March 1999
Part No. 001-2009-600

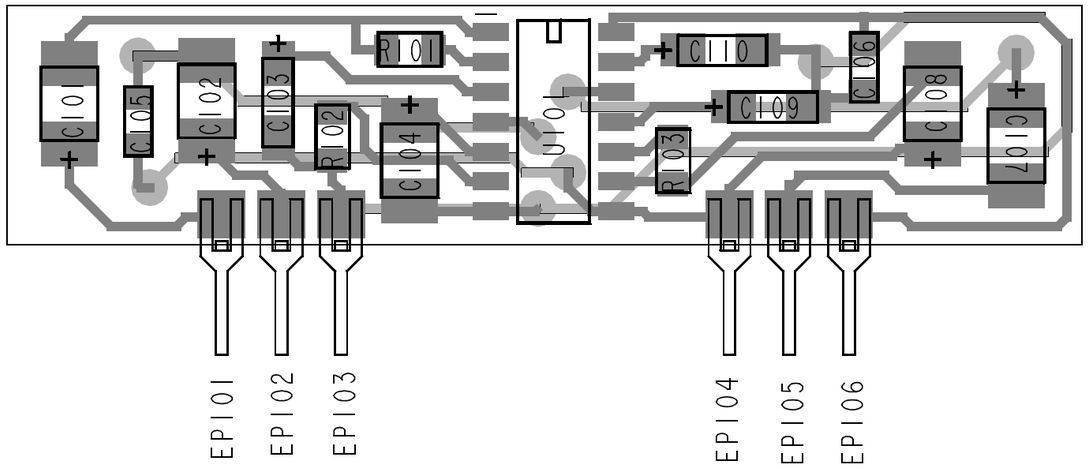
BATTERY BACK-UP SCHEMATIC
FIGURE10-51



POWER CABLE CONNECTOR AND SCHEMATIC
FIGURE 10-52



COMPANDOR SCHEMATIC
FIGURE 10-53



COMPANDOR COMPONENT LAYOUT
FIGURE 10-54

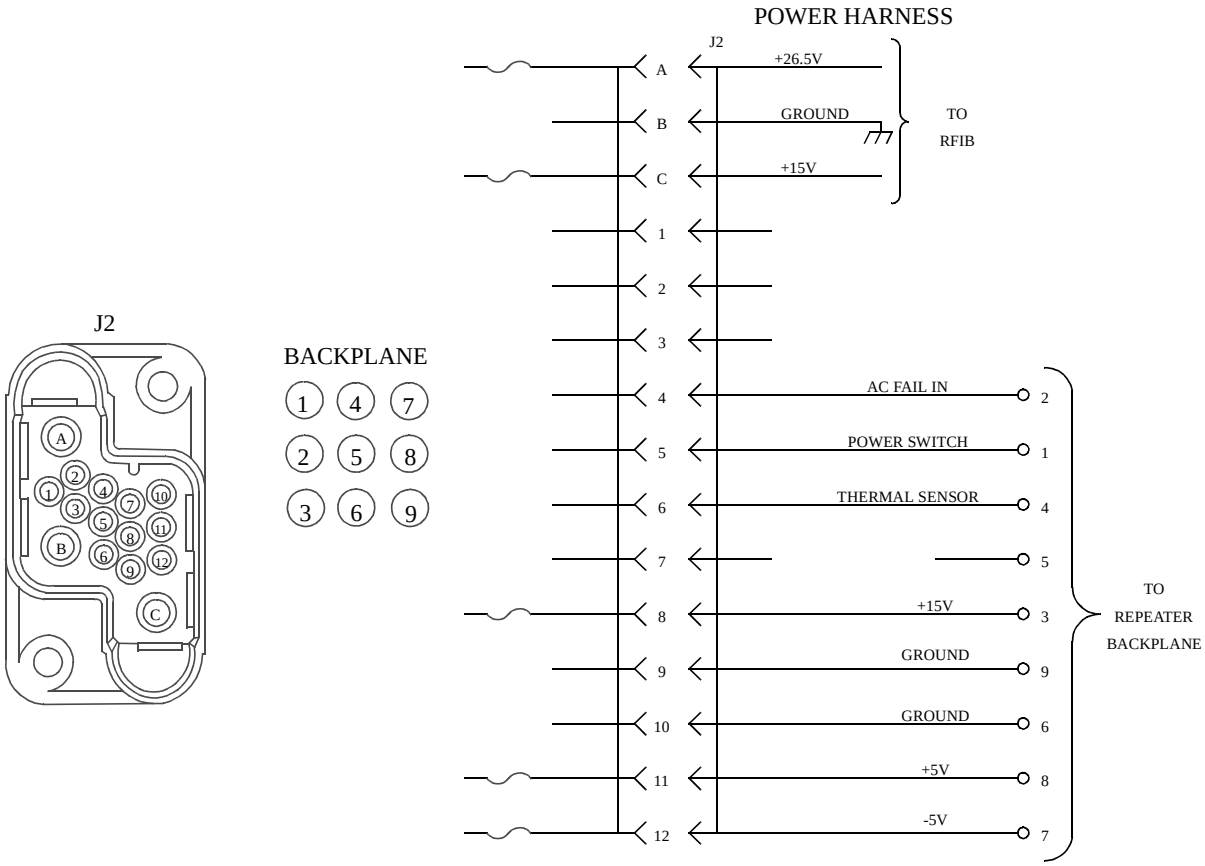


Figure 10-54 POWER CABLE CONNECTOR AND SCHEMATIC

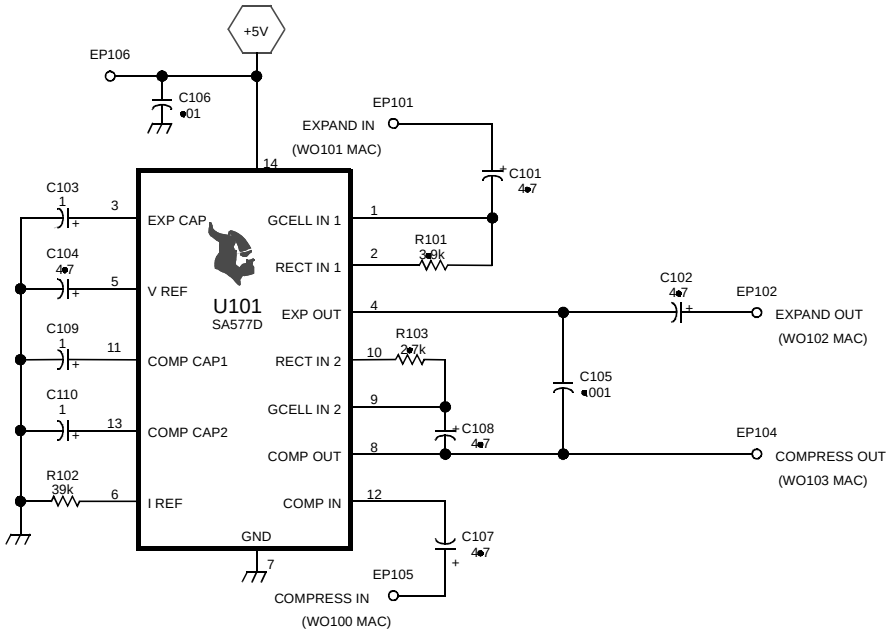


Figure 10-55 COMPANDOR SCHEMATIC

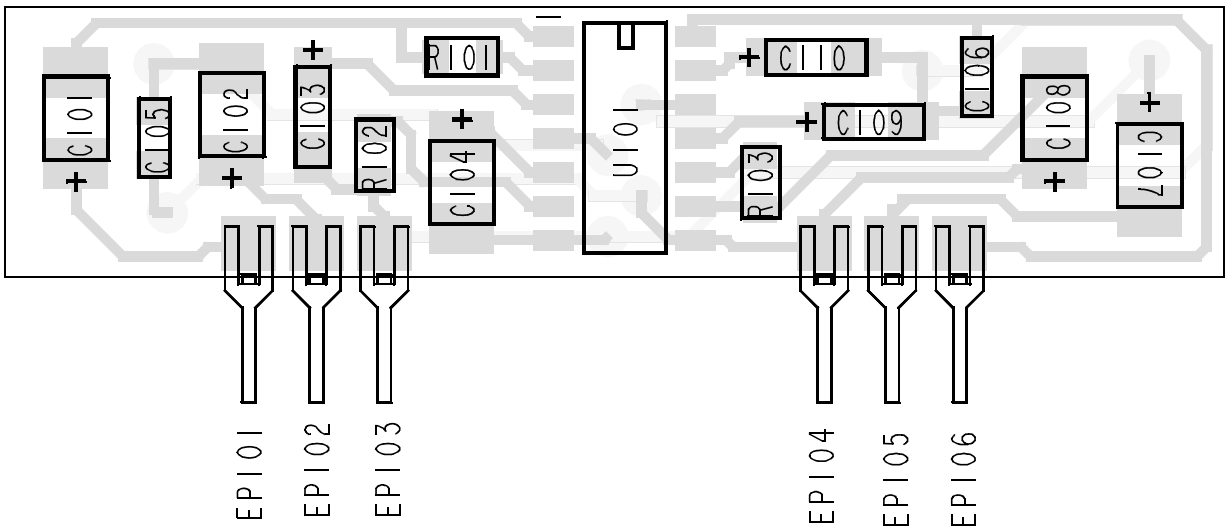


Figure 10-56 COMPANDOR COMPONENT LAYOUT

APPENDIX A 900 MHz CHANNEL FREQUENCY CHART

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
1	1	935.0125	896.0125	45	45	935.5625	896.5625
2	2	935.0250	896.0250	46	46	935.5750	896.5750
3	3	935.0375	896.0375	47	47	935.5875	896.5875
4	4	935.0500	896.0500	48	48	935.6000	896.6000
5	5	935.0625	896.0625	49	49	935.6125	896.6125
6	6	935.0750	896.0750	50	50	935.6250	896.6250
7	7	935.0875	896.0875	51	51	935.6375	896.6375
8	8	935.1000	896.1000	52	52	935.6500	896.6500
9	9	935.1125	896.1125	53	53	935.6625	896.6625
10	10	935.1250	896.1250	54	54	935.6750	896.6750
11	11	935.1375	896.1375	55	55	935.6875	896.6875
12	12	935.1500	896.1500	56	56	935.7000	896.7000
13	13	935.1625	896.1625	57	57	935.7125	896.7125
14	14	935.1750	896.1750	58	58	935.7250	896.7250
15	15	935.1875	896.1875	59	59	935.7375	896.7375
16	16	935.2000	896.2000	60	60	935.7500	896.7500
17	17	935.2125	896.2125	61	61	935.7625	896.7625
18	18	935.2250	896.2250	62	62	935.7750	896.7750
19	19	935.2375	896.2375	63	63	935.7875	896.7875
20	20	935.2500	896.2500	64	64	935.8000	896.8000
21	21	935.2625	896.2625	65	65	935.8125	896.8125
22	22	935.2750	896.2750	66	66	935.8250	896.8250
23	23	935.2875	896.2875	67	67	935.8375	896.8375
24	24	935.3000	896.3000	68	68	935.8500	896.8500
25	25	935.3125	896.3125	69	69	935.8625	896.8625
26	26	935.3250	896.3250	70	70	935.8750	896.8750
27	27	935.3375	896.3375	71	71	935.8875	896.8875
28	28	935.3500	896.3500	72	72	935.9000	896.9000
29	29	935.3625	896.3625	73	73	935.9125	896.9125
30	30	935.3750	896.3750	74	74	935.9250	896.9250
31	31	935.3875	896.3875	75	75	935.9375	896.9375
32	32	935.4000	896.4000	76	76	935.9500	896.9500
33	33	935.4125	896.4125	77	77	935.9625	896.9625
34	34	935.4250	896.4250	78	78	935.9750	896.9750
35	35	935.4375	896.4375	79	79	935.9875	896.9875
36	36	935.4500	896.4500	80	80	936.0000	897.0000
37	37	935.4625	896.4625	81	81	936.0125	897.0125
38	38	935.4750	896.4750	82	82	936.0250	897.0250
39	39	935.4875	896.4875	83	83	936.0375	897.0375
40	40	935.5000	896.5000	84	84	936.0500	897.0500
41	41	935.5125	896.5125	85	85	936.0625	897.0625
42	42	935.5250	896.5250	86	86	936.0750	897.0750
43	43	935.5375	896.5375	87	87	936.0875	897.0875
44	44	935.5500	896.5500	88	88	936.1000	897.1000

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
89	89	936.1125	897.1125	137	137	936.7125	897.7125
90	90	936.1250	897.1250	138	138	936.7250	897.7250
91	91	936.1375	897.1375	139	139	936.7375	897.7375
92	92	936.1500	897.1500	140	140	936.7500	897.7500
93	93	936.1625	897.1625	141	141	936.7625	897.7625
94	94	936.1750	897.1750	142	142	936.7750	897.7750
95	95	936.1875	897.1875	143	143	936.7875	897.7875
96	96	936.2000	897.2000	144	144	936.8000	897.8000
97	97	936.2125	897.2125	145	145	936.8125	897.8125
98	98	936.2250	897.2250	146	146	936.8250	897.8250
99	99	936.2375	897.2375	147	147	936.8375	897.8375
100	100	936.2500	897.2500	148	148	936.8500	897.8500
101	101	936.2625	897.2625	149	149	936.8625	897.8625
102	102	936.2750	897.2750	150	150	936.8750	897.8750
103	103	936.2875	897.2875	151	151	936.8875	897.8875
104	104	936.3000	897.3000	152	152	936.9000	897.9000
105	105	936.3125	897.3125	153	153	936.9125	897.9125
106	106	936.3250	897.3250	154	154	936.9250	897.9250
107	107	936.3375	897.3375	155	155	936.9375	897.9375
108	108	936.3500	897.3500	156	156	936.9500	897.9500
109	109	936.3625	897.3625	157	157	936.9625	897.9625
110	110	936.3750	897.3750	158	158	936.9750	897.9750
111	111	936.3875	897.3875	159	159	936.9875	897.9875
112	112	936.4000	897.4000	160	160	937.0000	898.0000
113	113	936.4125	897.4125	161	161	937.0125	898.0125
114	114	936.4250	897.4250	162	162	937.0250	898.0250
115	115	936.4375	897.4375	163	163	937.0375	898.0375
116	116	936.4500	897.4500	164	164	937.0500	898.0500
117	117	936.4625	897.4625	165	165	937.0625	898.0625
118	118	936.4750	897.4750	166	166	937.0750	898.0750
119	119	936.4875	897.4875	167	167	937.0875	898.0875
120	120	936.5000	897.5000	168	168	937.1000	898.1000
121	121	936.5125	897.5125	169	169	937.1125	898.1125
122	122	936.5250	897.5250	170	170	937.1250	898.1250
123	123	936.5375	897.5375	171	171	937.1375	898.1375
124	124	936.5500	897.5500	172	172	937.1500	898.1500
125	125	936.5625	897.5625	173	173	937.1625	898.1625
126	126	936.5750	897.5750	174	174	937.1750	898.1750
127	127	936.5875	897.5875	175	175	937.1875	898.1875
128	128	936.6000	897.6000	176	176	937.2000	898.2000
129	129	936.6125	897.6125	177	177	937.2125	898.2125
130	130	936.6250	897.6250	178	178	937.2250	898.2250
131	131	936.6375	897.6375	179	179	937.2375	898.2375
132	132	936.6500	897.6500	180	180	937.2500	898.2500
133	133	936.6625	897.6625	181	181	937.2625	898.2625
134	134	936.6750	897.6750	182	182	937.2750	898.2750
135	135	936.6875	897.6875	183	183	937.2875	898.2875
136	136	936.7000	897.7000	184	184	937.3000	898.3000

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
185	185	937.3125	898.3125	233	233	937.9125	898.9125
186	186	937.3250	898.3250	234	234	937.9250	898.9250
187	187	937.3375	898.3375	235	235	937.9375	898.9375
188	188	937.3500	898.3500	236	236	937.9500	898.9500
189	189	937.3625	898.3625	237	237	937.9625	898.9625
190	190	937.3750	898.3750	238	238	937.9750	898.9750
191	191	937.3875	898.3875	239	239	937.9875	898.9875
192	192	937.4000	898.4000	240	240	938.0000	899.0000
193	193	937.4125	898.4125	241	241	938.0125	899.0125
194	194	937.4250	898.4250	242	242	938.0250	899.0250
195	195	937.4375	898.4375	243	243	938.0375	899.0375
196	196	937.4500	898.4500	244	244	938.0500	899.0500
197	197	937.4625	898.4625	245	245	938.0625	899.0625
198	198	937.4750	898.4750	246	246	938.0750	899.0750
199	199	937.4875	898.4875	247	247	938.0875	899.0875
200	200	937.5000	898.5000	248	248	938.1000	899.1000
201	201	937.5125	898.5125	249	249	938.1125	899.1125
202	202	937.5250	898.5250	250	250	938.1250	899.1250
203	203	937.5375	898.5375	251	251	938.1375	899.1375
204	204	937.5500	898.5500	252	252	938.1500	899.1500
205	205	937.5625	898.5625	253	253	938.1625	899.1625
206	206	937.5750	898.5750	254	254	938.1750	899.1750
207	207	937.5875	898.5875	255	255	938.1875	899.1875
208	208	937.6000	898.6000	256	256	938.2000	899.2000
209	209	937.6125	898.6125	257	257	938.2125	899.2125
210	210	937.6250	898.6250	258	258	938.2250	899.2250
211	211	937.6375	898.6375	259	259	938.2375	899.2375
212	212	937.6500	898.6500	260	260	938.2500	899.2500
213	213	937.6625	898.6625	261	261	938.2625	899.2625
214	214	937.6750	898.6750	262	262	938.2750	899.2750
215	215	937.6875	898.6875	263	263	938.2875	899.2875
216	216	937.7000	898.7000	264	264	938.3000	899.3000
217	217	937.7125	898.7125	265	265	938.3125	899.3125
218	218	937.7250	898.7250	266	266	938.3250	899.3250
219	219	937.7375	898.7375	267	267	938.3375	899.3375
220	220	937.7500	898.7500	268	268	938.3500	899.3500
221	221	937.7625	898.7625	269	269	938.3625	899.3625
222	222	937.7750	898.7750	270	270	938.3750	899.3750
223	223	937.7875	898.7875	271	271	938.3875	899.3875
224	224	937.8000	898.8000	272	272	938.4000	899.4000
225	225	937.8125	898.8125	273	273	938.4125	899.4125
226	226	937.8250	898.8250	274	274	938.4250	899.4250
227	227	937.8375	898.8375	275	275	938.4375	899.4375
228	228	937.8500	898.8500	276	276	938.4500	899.4500
229	229	937.8625	898.8625	277	277	938.4625	899.4625
230	230	937.8750	898.8750	278	278	938.4750	899.4750
231	231	937.8875	898.8875	279	279	938.4875	899.4875
232	232	937.9000	898.9000	280	280	938.5000	899.5000

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
281	281	938.5125	899.5125	329	329	939.1125	900.1125
282	282	938.5250	899.5250	330	330	939.1250	900.1250
283	283	938.5375	899.5375	331	331	939.1375	900.1375
284	284	938.5500	899.5500	332	332	939.1500	900.1500
285	285	938.5625	899.5625	333	333	939.1625	900.1625
286	286	938.5750	899.5750	334	334	939.1750	900.1750
287	287	938.5875	899.5875	335	335	939.1875	900.1875
288	288	938.6000	899.6000	336	336	939.2000	900.2000
289	289	938.6125	899.6125	337	337	939.2125	900.2125
290	290	938.6250	899.6250	338	338	939.2250	900.2250
291	291	938.6375	899.6375	339	339	939.2375	900.2375
292	292	938.6500	899.6500	340	340	939.2500	900.2500
293	293	938.6625	899.6625	341	341	939.2625	900.2625
294	294	938.6750	899.6750	342	342	939.2750	900.2750
295	295	938.6875	899.6875	343	343	939.2875	900.2875
296	296	938.7000	899.7000	344	344	939.3000	900.3000
297	297	938.7125	899.7125	345	345	939.3125	900.3125
298	298	938.7250	899.7250	346	346	939.3250	900.3250
299	299	938.7375	899.7375	347	347	939.3375	900.3375
300	300	938.7500	899.7500	348	348	939.3500	900.3500
301	301	938.7625	899.7625	349	349	939.3625	900.3625
302	302	938.7750	899.7750	350	350	939.3750	900.3750
303	303	938.7875	899.7875	351	351	939.3875	900.3875
304	304	938.8000	899.8000	352	352	939.4000	900.4000
305	305	938.8125	899.8125	353	353	939.4125	900.4125
306	306	938.8250	899.8250	354	354	939.4250	900.4250
307	307	938.8375	899.8375	355	355	939.4375	900.4375
308	308	938.8500	899.8500	356	356	939.4500	900.4500
309	309	938.8625	899.8625	357	357	939.4625	900.4625
310	310	938.8750	899.8750	358	358	939.4750	900.4750
311	311	938.8875	899.8875	359	359	939.4875	900.4875
312	312	938.9000	899.9000	360	360	939.5000	900.5000
313	313	938.9125	899.9125	361	361	939.5125	900.5125
314	314	938.9250	899.9250	362	362	939.5250	900.5250
315	315	938.9375	899.9375	363	363	939.5375	900.5375
316	316	938.9500	899.9500	364	364	939.5500	900.5500
317	317	938.9625	899.9625	365	365	939.5625	900.5625
318	318	938.9750	899.9750	366	366	939.5750	900.5750
319	319	938.9875	899.9875	367	367	939.5875	900.5875
320	320	939.0000	900.0000	368	368	939.6000	900.6000
321	321	939.0125	900.0125	369	369	939.6125	900.6125
322	322	939.0250	900.0250	370	370	939.6250	900.6250
323	323	939.0375	900.0375	371	371	939.6375	900.6375
324	324	939.0500	900.0500	372	372	939.6500	900.6500
325	325	939.0625	900.0625	373	373	939.6625	900.6625
326	326	939.0750	900.0750	374	374	939.6750	900.6750
327	327	939.0875	900.0875	375	375	939.6875	900.6875
328	328	939.1000	900.1000	376	376	939.7000	900.7000

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
377	377	939.7125	900.7125
378	378	939.7250	900.7250
379	379	939.7375	900.7375
380	380	939.7500	900.7500
381	381	939.7625	900.7625
382	382	939.7750	900.7750
383	383	939.7875	900.7875
384	384	939.8000	900.8000
385	385	939.8125	900.8125
386	386	939.8250	900.8250
387	387	939.8375	900.8375
388	388	939.8500	900.8500
389	389	939.8625	900.8625
390	390	939.8750	900.8750
391	391	939.8875	900.8875
392	392	939.9000	900.9000
393	393	939.9125	900.9125
394	394	939.9250	900.9250
395	395	939.9375	900.9375
396	396	939.9500	900.9500
397	397	939.9625	900.9625
398	398	939.9750	900.9750
399	399	939.9875	900.9875

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